NDA & NA

Solved Papers eBook

(2013 – 2018)

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10 NDA SOLVED PREVIOUS PAPERS

NDA 1 2018 SOLVED PAPER

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SSBCrack

NDA CUT OFF MARKS

National Defence Academy & Naval Academy Examination (II), 2017

Minimum qualifying standard/marks at the written stage and marks secured by the last candidate in the Merit order at final stage of the examination.

Minimum qualifying standard/marks at the written stage (out of 900 marks)	Marks secured by the last candidate in the Merit order (out of 1800 marks)
258 (With at least 25% marks in each subject)	624

National Defence Academy and Naval Academy Examination (I), 2017

Minimum Qualifying standard approved at the written stage and marks secured by the last recommended candidate at final stage of the Examination:

Minimum qualifying standard approved at the written stage (Out of 900 marks)	Marks secured by the last finally recommended candidate (Out of 1800 marks)
342 (With at least 25 % marks in each Subject)	708

NDA CUT OFF MARKS

National Defence Academy and Naval Academy Examination (I), 2016

Minimum Qualifying standard approved at the written stage and marks secured by the last recommended candidate at final stage of the examination:

Minimum qualifying standard approved at the written stage (Out of 900 marks)	Marks secured by the last finally recommended candidate (Out of 1800 marks)
288 (With at least 25 % marks in each Subject)	656

National Defence Academy & Naval Academy Examination (II), 2016

Minimum qualifying standard/marks at the written stage and marks secured by the last candidate in the merit order at final stage of the examination

Minimum qualifying standard/marks at the written stage (out of 900 marks)	Marks secured by the last candidate in the merit order (out of 1800 marks)
229 (With at least 20% marks in each subject)	602

NDA EXAM QUESTION PAPER DETAILS

Code	Subject	Marks	Duration
01	Mathematics	300	2 and ½ hour.
02	General Ability	600	2 and ½ hour.
	SSB Interview	900	4-5 days.
Total		**1800**	

NDA EXAM SYLLABUS

NDA exam has two papers – **Mathematics** and **General Ability Test**.
The Paper – 1 i,e. Mathematics comprises topics including (1) Algebra, (2) Matrics and Determinants, (3) Trigonometry, (4) Analytical Geometry of Two and Three Dimensions, (5) Differential Calculus. (6) Integral Calculus and Differential Equations, (7) Victor Algebra and (8) Statistics and Probability.

The Paper – 2 i,e. General Ability Test comprises topics including (Part A) English and (Part B) General Knowledge. The syllabus for English covers several aspects such as comprehension, cohesion, grammar and usage and vocabulary. The syllabus for General Knowledge is broadly divided into Social Studies, Current Events, Chemistry, Physics, Geography and General Science.

HOW TO USE THIS eBOOK

1. DOWNLOAD THE BOOK AND KEEP IT IN YOUR SMARTPHONE.

2. EVERYDAY AFTER YOU WAKEUP, TAKE 10 QUESTIONS EACH FROM MATHS AND GENERAL ABILITY TEST PAPERS.

3. TRY TO SOLVE THEM ON A PAPER AND CROSS CHECK THE ANSWERS.

4. IF YOU ARE NOT ABLE TO FIND THE SOLUTION, REFER THE eBOOK AGAIN AND SOLVE IT.

5. REPEAT THE SAME IN THE EVENING AND AT NIGHT BEFORE YOU SLEEP.

6. SLOWLY INCREASE THE NUMBER OF QUESTIONS YOU SOLVE.

7. IF YOU SOLVE 50 QUESTIONS IN A DAY, YOU CAN SOLVE AROUND 1500 QUESTIONS IN A MONTH AND MAY BE MORE.

8. REMEMBER THESE ARE ACTUAL QUESTIONS, WHAT YOU WILL FACE IN THE NDA EXAM WILL BE SIMILAR TO THESE QUESTIONS.

9. SOLVING THESE QUESTIONS WILL HELP YOU TO BOOST YOUR PREPARTING IN NO TIME.

Mathematics NDA 1 2018 Question Paper

1. If $n \in N$, then $121^n - 21^n + 1900^n - (-4)^n$ is divisible by which of the following?
   - **a.** 1904
   - **b.** 2000
   - **c.** 2002
   - **d.** 2006

2. If $n = (2017)!$, then, what is $\frac{1}{log_2 n} + \frac{1}{log_3 n} + \frac{1}{log_4 n} + \ldots + \frac{1}{log_{2017} n}$ equal to?
   - **a.** 0
   - **b.** 1
   - **c.** $\frac{n}{2}$
   - **d.** n

3. In the expansion of $(1+x)^{43}$, if the coefficients of $(2r+1)^{th}$ and $(r+2)^{th}$ terms are equal, then what is the value of $r(r \neq 1)$?
   - **a.** 5
   - **b.** 14
   - **c.** 21
   - **d.** 22

4. What is the principal argument of $(-1-i)$, where $i = \sqrt{-1}$?
   - **a.** $\frac{\pi}{4}$
   - **b.** $\frac{-\pi}{4}$
   - **c.** $\frac{-3\pi}{4}$
   - **d.** $\frac{3\pi}{4}$

5. Let α and β be real numbers and z be a complex number. If $z^2 + \alpha z + \beta = 0$ has two distinct non-real roots with real roots $Re(z) = 1$, then it is necessary that
   - **a.** $\beta \in (-1,0)$
   - **b.** $\beta \in (1,\infty)$
   - **c.** $|\beta| = 1$
   - **d.** $\beta \in (0,1)$

6. Let A and B be subsets of *X* and $C = (A \cap B') \cup (A' \cap B)$, where A’ and B’ are complements of A and B respectively in *X*. What is *C* equal to?
   - **a.** $(A \cup B') - (A \cap B')$
   - **b.** $(A' \cup B) - (A' \cap B)$
   - **c.** $(A \cup B) - (A \cap B)$
   - **d.** $(A' \cup B') - (A' \cap B')$

7. How many numbers between 100 and 1000 can be formed with the digits 5, 6, 7, 8, 9 if the repetition of digits is not allowed?
   - **a.** 3^5
   - **b.** 5^3
   - **c.** 120
   - **d.** 60

8. The number of non-zero integral solutions of the equation $|1-2i|^x - 5^x$ is
   - **a.** Zero (no solution)
   - **b.** One
   - **c.** Two
   - **d.** Three

9. If the ratio of AM to GM of two positive numbers *a* and *b* is 5:3, then a:b is equal to
   - **a.** 3:5
   - **b.** 2:9
   - **c.** 9:1
   - **d.** 5:3

10. If coefficients of a^m and a^n in the expansion of $(1+a)^{m+n}$ are α and β, then which one of the following is correct?
    - **a.** α = 2β
    - **b.** α = β
    - **c.** 2α = β
    - **d.** $\alpha = (m+n)^{\beta}$

11. If $x + log_{15}(1+3^x) = x\, log_{15}5 + log_{15}12$, where *x* is an integer, then what is *x* equal to?
    - **a.** -3
    - **b.** 2
    - **c.** 1
    - **d.** 3

12. How many four-digit numbers divisible by 10 can be formed using 1, 5, 0, 6, 7 without repetition of digits?
    - **a.** 24
    - **b.** 36
    - **c.** 44
    - **d.** 64

Consider the information given below and answer the two (02) items that follow:

In a class, 54 students are good in Hindi only, 63 students are good in Mathematics only, and 41 students are good in English only. There are 18 students who are good in both Hindi and Mathematics. 10 students are good in all three subjects.

13. What is the number of students who are good in either Hindi or Mathematics but not in English?
 - **a.** 99
 - **b.** 107
 - **c.** 125
 - **d.** 130

14. What is the number of students who are good in Hindi and Mathematics but not in English?
 - **a.** 18
 - **b.** 12
 - **c.** 10
 - **d.** 8

15. If α and β are different complex numbers with $|\alpha| = 1$, then what is $\left|\frac{\alpha-\beta}{1-\alpha\beta}\right|$ equal to?
 - **a.** $|\beta|$
 - **b.** 2
 - **c.** 1
 - **d.** 0

16. The equation $|1 - x| + x^2 = 5$ has
 - **a.** a rational root and an irrational root
 - **b.** two rational roots
 - **c.** two irrational roots
 - **d.** no real roots

17. The binary number expression of the decimal number 31 is
 - **a.** 1111
 - **b.** 10111
 - **c.** 11011
 - **d.** 11111

18. What is $i^{1000} + i^{1001} + i^{1002} + i^{1003}$ equal to (where $i = \sqrt{-1}$)?
 - **a.** 0
 - **b.** i
 - **c.** $-i$
 - **d.** 1

19. What is $\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + \frac{1}{\log_4 n} + \ldots + \frac{1}{\log_{100} n}$ equal to $(n \neq 1)$?
 - **a.** $\frac{1}{\log_{100!} n}$
 - **b.** $\frac{1}{\log_{99!} n}$
 - **c.** $\frac{99}{\log_{100!} n}$
 - **d.** $\frac{99}{\log_{99!} n}$

20. The modulus-amplitude form of $\sqrt{3} + i$, where $i = \sqrt{-1}$ is
 - **a.** $2\left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right)$
 - **b.** $2\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)$
 - **c.** $4\left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right)$
 - **d.** $4\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)$

21. What is the number of non-zero terms in the expansion of $(1 + 2\sqrt{3x})^{11} + (1 - 2\sqrt{3x})^{11}$ (after simplification)?
 - **a.** 4
 - **b.** 5
 - **c.** 6
 - **d.** 11

22. What is the greatest integer among the following by which the number $5^5 + 7^5$ is divisible?
 - **a.** 6
 - **b.** 8
 - **c.** 11
 - **d.** 12

23. If $x = 1 - y + y^2 - y^3 + \ldots$ up to infinite terms, where $|y| < 1$, then which one of the following is correct?
 - **a.** $x = \frac{1}{1+y}$

b. $x = \frac{1}{1-y}$

c. $x = \frac{y}{1+y}$

d. $x = \frac{y}{1-y}$

24. What is the inverse of the matrix $A = \begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$?

a. $\begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$

b. $\begin{pmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{pmatrix}$

c. $\begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{pmatrix}$

d. $\begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$

25. If A is a 2×3 matrix and AB is a 2×5 matrix, then B must be a

a. 3×5 matrix

b. 5×3 matrix

c. 3×2 matrix

d. 5×2 matrix

26. If $A = \begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix}$ and $A^2 - kA - I2 = O$, where I2 is the 2×2 identity matrix, then what is the value of k?

a. 4

b. -4

c. 8

d. -8

27. What is the number of triangles that can be formed by choosing the vertices from a set of 12 points in a plane, seven of which lie on the same straight line?

a. 185

b. 175

c. 115

d. 105

28. What is $C(n,r) + 2C(n,r-1) + C(n,r)$ equal to?

a. $C(n+1,r)$

b. $C(n-1,r+1)$

c. $C(n,r+1)$

d. $C(n+2,r)$

29. Let $[x]$ denote the greatest integer function. What is the number of solutions of the equation $x^2 + 4x + [x] = 0$ in the interval $[0,2]$?

a. Zero (no solution)

b. One

c. Two

d. Three

30. A survey of 850 students in a University yields that 680 students like music and 215 like dance. What is the least number of students who like both music and dance?

a. 40

b. 45

c. 50

d. 55

31. What is the sum of all two-digit numbers which when divided by 3 leave 2 as the remainder?

a. 1565

b. 1585

c. 1635

d. 1655

32. If $0 < a < 1$, the value of log_{10a} is negative. This is justified by

a. Negative power of 10 is less than 1

b. Negative power of 10 is between 0 and 1

c. Negative power of 10 is positive

d. Negative power of 10 is negative

33. The third term of a GP is 3. What is the product of the first 5 terms?

a. 216

b. 226

c. 243

d. Cannot be determined due to insufficient data

34. If $x, \frac{3}{2}, z$ are in AP; $x, 3, z$ are in GP; then which one of the following will be

in HP?

- **a.** x, 6, z
- **b.** x, 4, z
- **c.** z, 2, z
- **d.** x, 1, z

35. What is the value of the sum $\sum_{n-2}^{11}(i^n + i^{n+1})$ where $i = \sqrt{-1}$

- **a.** I
- **b.** 2i
- **c.** -2i
- **d.** 1 + i

36. If $\sin x = \frac{1}{\sqrt{5}}$, $\sin y = \frac{1}{\sqrt{10}}$, where $0 < x < \frac{\pi}{2}$, then what is $(x + y)$ equal to?

- **a.** π
- **b.** $\frac{\pi}{2}$
- **c.** $\frac{\pi}{4}$
- **d.** 0

37. What is $\frac{\sin 5x - \sin 3x}{\cos 5x + \cos 3x}$ equal to?

- **a.** $\sin x$
- **b.** $\cos x$
- **c.** $\tan x$
- **d.** $\cot x$

38. What is $\sin 105° + \cos 105°$ equal to?

- **a.** $\sin 50°$
- **b.** $\cos 50°$
- **c.** $\frac{1}{\sqrt{2}}$
- **d.** 0

39. In a triangle ABC if $a = 2, b = 3$ and $\sin A = 2/3$, then what is angle B equal to?

- **a.** $\pi/4$
- **b.** $\pi/2$
- **c.** $\pi/3$
- **d.** $\pi/6$

40. What is the principal value of $\sin^{-1}\left(\sin\frac{2\pi}{3}\right)$?

- **a.** $\pi/4$
- **b.** $\pi/2$
- **c.** $\pi/3$
- **d.** $2\pi/3$

41. If $x, x - y$ and $x + y$ are the angles of a triangle (not an equilateral triangle) such that $\tan(x - y)$, $\tan x$, and $\tan(x + y)$ are in GP, what is x equal to?

- **a.** $\pi/4$
- **b.** $\pi/3$
- **c.** $\pi/6$
- **d.** $\pi/2$

42. ABC is a triangle inscribed in a circle with centre O. Let $\alpha = \angle BAC$, where $45° < \alpha < 90°$. Let $\beta = \angle BOC$. Which one of the following is correct?

- **a.** $\cos\beta = \frac{1 - \tan^2\alpha}{1 + \tan^2\alpha}$
- **b.** $\cos\beta = \frac{1 + \tan^2\alpha}{1 - \tan^2\alpha}$
- **c.** $\cos\beta = \frac{2\tan\alpha}{1 + \tan^2\alpha}$
- **d.** $\sin\beta = 2\sin^2\alpha$

43. If a flag-staff 6 m height placed on the top of a tower throws a shadow of $2\sqrt{3}$ m along the ground, then what is the angle that the sun makes with the ground?

- **a.** 60°
- **b.** 45°
- **c.** 30°
- **d.** 15°

44. What is $\tan^{-1}\left(\frac{1}{4}\right) + \tan^{-1}\left(\frac{3}{5}\right)$ equal to?

- **a.** 0
- **b.** $\pi/4$
- **c.** $\pi/3$
- **d.** $\pi/2$

45. A spherical balloon of radius *r* subtends an angle α at the eye of an observer, while the angle of elevation of its centre is β. What is the height of the centre of the balloon (neglecting the height of the observer)?

a. $\frac{r \sin\beta}{\sin\left(\frac{\alpha}{2}\right)}$

b. $\frac{r \sin\beta}{\sin\left(\frac{\alpha}{4}\right)}$

c. $\frac{r \sin\left(\frac{\beta}{2}\right)}{\sin\alpha}$

d. $\frac{r \sin\alpha}{\sin\left(\frac{\beta}{2}\right)}$

46. If $\frac{\sin(x+y)}{\sin(x-y)} = \frac{a+b}{a-b}$, then what is $\frac{\tan x}{\tan y}$ equal to?

a. $\frac{a}{b}$

b. $\frac{b}{a}$

c. $\frac{a+b}{a-a}$

d. $\frac{a-b}{a+a}$

47. If $\sin\alpha + \sin\beta = 0 = \cos\alpha + \cos\beta$, where $0 < \beta < \alpha < 2\pi$, then which one of the following is correct?

a. $\alpha = \pi - \beta$

b. $\alpha = \pi + \beta$

c. $\alpha = 2\pi - \beta$

d. $2\alpha = \pi + 2\beta$

48. Suppose $\cos A$ is given. If only one value of $\cos\left(\frac{A}{2}\right)$ is possible, then A must be

a. An odd multiple of 90°

b. A multiple of 90°

c. An odd multiple of 180°

d. A multiple of 180°

49. If $\cos\alpha + \cos\beta + \cos\gamma = 0$, where $0 < \alpha \le \frac{\pi}{2}$, $0 < \beta \le \frac{\pi}{2}$, $0 < \gamma \le \frac{\pi}{2}$, then what is the value of $\sin\alpha + \sin\beta + \sin\gamma$?

a. 0

b. 3

c. $\frac{5\sqrt{2}}{2}$

d. $\frac{3\sqrt{2}}{2}$

50. The maximum value of $\sin\left(x + \frac{\pi}{5}\right) + \cos\left(x \frac{\pi}{5}\right)$, where $x \in \left(0, \frac{\pi}{2}\right)$, is attained at

a. $\frac{\pi}{20}$

b. $\frac{\pi}{15}$

c. $\frac{\pi}{10}$

d. $\frac{\pi}{2}$

51. What is the distance between the points which divide the line segment joining (4, 3) and (5, 7) internally and externally in the ratio 2:3?

a. $\frac{12\sqrt{17}}{5}$

b. $\frac{13\sqrt{17}}{5}$

c. $\frac{\sqrt{17}}{5}$

d. $\frac{6\sqrt{17}}{5}$

52. What is the angle between the straight lines $(m^2 - mn)\, y = (mn + n^2)\, x + n^3$ and $(mn + m^2) y = (mn - n^2) x + m^3$, where $m > n$?

a. $\tan^{-1}\left(\frac{2mn}{m^2+n^2}\right)$

b. $\tan^{-1}\left(\frac{4m^2n^2}{m^4-n^4}\right)$

c. $\tan^{-1}\left(\frac{4m^2n^2}{m^4+n^4}\right)$

d. 45°

53. What is the equation of the straight line cutting off an intercept 2 from the negative direction of y-axis and inclined at 30° with the positive direction of x-axis?

a. $x - 2\sqrt{3}\, y - 3\sqrt{2} = 0$

b. $x + 2\sqrt{3}\, y - 3\sqrt{2} = 0$

c. $x + \sqrt{3}\, y - 2\sqrt{3} = 0$

d. $x-\sqrt{3}\,y-2\sqrt{3}=0$

54. What is the equation of the line passing through the point of intersection of the lines
$x+2y-3=0$ and $2x-y+5=0$ and parallel to the line
$y-x+10=0$?

a. $7x-7y+18=0$
b. $5x-7y+18=0$
c. $5x-5y+18=0$
d. $x-y+5=0$

55. Consider the following statements:

1. The length p of the perpendicular from the origin to the line $ax+by=c$ satisfies the relation $p^2=\frac{c^2}{a^2+b^2}$.
2. The length p of the perpendicular from the origin to the line $\frac{x}{a}+\frac{y}{b}=1$ satisfies the relation $\frac{1}{p^2}=\frac{1}{a^2}+\frac{1}{b^2}$.
3. The length of the perpendicular from the origin to the line $y=mx+c$ satisfies the relation $\frac{1}{p^2}=\frac{1+m^2+c^2}{c^2}$.

Which of the above is/are correct?

a. 1, 2, and 3
b. 1 only
c. 1 and 2 only
d. 2 only

56. What is the equation of the ellipse whose vertices are $(\pm 5,0)$ and foci are at $(\pm 4,0)$?

a. $\frac{x^2}{25}+\frac{y^2}{9}=1$

b. $\frac{x^2}{16}+\frac{y^2}{9}=1$

c. $\frac{x^2}{25}+\frac{y^2}{16}=1$

d. $\frac{x^2}{9}+\frac{y^2}{25}=1$

57. What is the equation of the straight line passing through the point (2, 3) and making an intercept on the positive y-axis equal to twice its intercept on the positive x-axis?

a. $2x+y=5$
b. $2x+y=7$
c. $x+2y=7$
d. $2x-y=1$

58. Let the coordinates of the points A, B, C be (1, 8, 4), (0, -11, 4) and (2, -3, 1) respectively. What are the coordinates of the point D which is the foot of the perpendicular from A on BC?

a. (3, 4. -2)
b. (4, -2, 5)
c. (4, 5, -2)
d. (2, 4, 5)

59. What is the equation of the plane passing through the points (-2, 6, -6), (-3, 10, -9) and (-5, 0, -6)?

a. $2x-y-2z=2$
b. $2x+y+3z=3$
c. $x+y+z=6$
d. $x-y-z=3$

60. A sphere of constant radius r through the origin intersects the coordinate axes in A, B, and C. What is the locus of the centroid of the triangle ABC?

a. $x^2+y^2+z^2=r^2$
b. $x^2+y^2+z^2=4r^2$
c. $9(x^2+y^2+z^2)=4r^2$
d. $3(x^2+y^2+z^2)=2r^2$

61. The coordinates of the vertices P, Q, and R of a triangle PQR are (1, -1, 1), (3, -2, 2) and (0, 2, 6) respectively. If ∠RQP = θ, then what is ∠PRQ equal to?

a. $30°+\theta$
b. $45°-\theta$
c. $60°-\theta$
d. $90°-\theta$

62. The perpendiculars that fall from any point of the straight line $2x+11y=5$ upon the two straight lines
$24x+7y=20$ and $4x-3y=2$ are

a. 12 and 4 respectively
b. 11 and 5 respectively
c. Equal to each other
d. Not equal to each other

63. The equation of the line, when the portion of it intercepted between the axes is divided by the point (2,3) in the ratio of 3:2, is

a. Either $x+y=4$ or $9x+y=12$
b. Either $x+y=5$ or $4x+$

$9y = 30$

c. Either $x + y = 4$ or $x + 9y = 30$

d. Either $x + y = 5$ or $9x + 4y = 30$

64. What is the distance between the straight lines $3x + 4y = 9$ and $6x + 8y = 15$?

a. 3/2

b. 3/10

c. 6

d. 5

65. What is the equation to the sphere whose centre is at (-2, 3, 4) and radius is 6 units?

a. $x^2 + y^2 + z^2 + 4x - 6y - 8z = 7$

b. $x^2 + y^2 + z^2 + 6x - 4y - 8z = 7$

c. $x^2 + y^2 + z^2 + 4x - 6y - 8z = 4$

d. $x^2 + y^2 + z^2 + 4x + 6y + 8z = 4$

66. If $\vec{a}$ and $\vec{b}$ are vectors such that $|\vec{a}| = 2$, $|\vec{b}| = 7$ and $\vec{a} \times \vec{b} = 3\hat{i} + 2\hat{j} + 6\hat{k}$, then what is the acute angle between $\vec{a}$ and $\vec{b}$?

a. 30°

b. 45°

c. 60°

d. 90°

67. Let $\vec{p}$ and $\vec{q}$ be the position vectors of the points P and Q respectively with respect to origin O. The points R and S divide PQ internally and externally respectively in the ratio 2:3. If $\overrightarrow{OR}$ and $\overrightarrow{OS}$ are perpendicular, then which one of the following is correct?

a. $9p^2 = 4q^2$

b. $4p^2 = 9q^2$

c. $9p = 4q$

d. $4p = 9q$

68. What is the moment about the point $\hat{i} + 2\hat{j} - \hat{k}$ of a force represented by $3\hat{i} + \hat{k}$ acting through the point $2\hat{i} - \hat{j} + 3\hat{k}$?

a. $-3\hat{i} + 11\hat{j} + 9\hat{k}$

b. $3\hat{i} + 2\hat{j} + 9\hat{k}$

c. $3\hat{i} + 4\hat{j} + 9\hat{k}$

d. $\hat{i} + \hat{j} + \hat{k}$

69. If $\vec{a} + 2\vec{b} + 3\vec{c} = 0$ and $\vec{a} \times \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = \lambda(\vec{b} \times \vec{c})$ then what is the value of λ?

a. 2

b. 3

c. 4

d. 6

70. If the vectors $\vec{k}$ and $\vec{A}$ are parallel to each other, then what is $k\vec{k} \times \vec{A}$ equal to?

a. $k^2\vec{A}$

b. 0

c. $-k^2\vec{A}$

d. $\vec{A}$

71. Which one of the following is correct in respect of the function $f: R \to R^+$ defined as $f(x) = |x + 1|$?

a. $f(x)^{\,2} = [f(x)]^{\,2}$

b. $f|(x)| = |f(x)|$

c. $f(x + y) = f(x) + |f(y)$

d. None of the above

72. Suppose $f: R \to R^+$ is defined by $f(x) = \frac{x^2}{1+x^2}$. What is the range of the function?

a. $[0, 1)$

b. [0, 1]

c. (0, 1]

d. (0, 1)

73. If $f(x) = |x| + |x + 1|$, then which one of the following is correct?

a. $f(x)$ is continuous at $x = 0$ and $x = 1$

b. $f(x)$ is continuous at $x = 0$ but not at $x = 1$

c. $f(x)$ is continuous at $x = 1$ but not at $x = 0$

d. $f(x)$ is neither continuous at $x = 0$ nor at $x = 1$

74. Consider the function $f(x) = \begin{cases} x^2 \ \ell n|x| & x \neq 0 \\ 0 & x = 0 \end{cases}$ What is $f'(0)$ equal to?

a. 0

b. -1

c. 1
d. It does not exist

75. What is the area of the region bounded by the parabola $y^2 = 6(x-1)$ and $y^2 = 3x$?
a. $\frac{\sqrt{6}}{3}$
b. $\frac{2\sqrt{6}}{3}$
c. $\frac{4\sqrt{6}}{3}$
d. $\frac{5\sqrt{6}}{3}$

Consider the following information for the next three (03) items that follow:
Three sides of a trapezium be the angle between a pair of adjacent sides.

76. If the area of the trapezium is maximum, what is the length of the fourth side?
a. $\frac{\pi}{6}$
b. $\frac{\pi}{4}$
c. $\frac{\pi}{3}$
d. $\frac{2\pi}{5}$

77. If the area of the trapezium is maximum, what is the length of the fourth side?
a. 8 cm
b. 9 cm
c. 10 cm
d. 12 cm

78. What is the maximum area of the trapezium?
a. $36\sqrt{3}\,cm^2$
b. $30\sqrt{3}\,cm^2$
c. $27\sqrt{3}\,cm^2$
d. $24\sqrt{3}\,cm^2$

79. What is
$$\int_0^{\pi} e^x$$
equal to?
a. $\frac{e^{\pi}+1}{2}$
b. $\frac{e^{\pi}-1}{2}$
c. $e^{\pi}+1$
d. $\frac{e^{\pi}+1}{4}$

80. If $f(x) = \frac{x^2-9}{x^2-2x-3}$, $x \neq 3$ is continuous at $x = 3$, then which one of the following is correct?
a. $f(3) = 0$
b. $f(3) = 1.5$
c. $f(3) = 3$
d. $f(3) = -1.5$

81. What is
$$\int_1^{e} x \ell n\, x\, dx$$
equal to?
a. $\frac{e+1}{4}$
b. $\frac{e^2+1}{4}$
c. $\frac{e-1}{4}$
d. $\frac{e^2-1}{4}$

82. What is
$$\int_0^{\sqrt{2}} [x^2]$$
equal to (where [.] is the greatest integer function)?
a. $\sqrt{2}-1$
b. $1-\sqrt{2}$
c. $2(\sqrt{2}-1)$
d. $\sqrt{3}-1$

83. What is the maximum value of $16\sin\theta - 12\sin^2\theta$?
a. 3/4
b. 4/3

- **c.** 16/3
- **d.** 4

84. If f: R → S defined by $f(x) = 4\sin x - 3\cos x + 1$ is onto, then what is S equal to?
    - **a.** $[-5, 5]$
    - **b.** $(-5, 5)$
    - **c.** $(-4, 6)$
    - **d.** $[-4, 6]$

85. For f to be a function, what is the domain of f, if $f(x) = \frac{1}{\sqrt{|x|-x}}$?
    - **a.** $(-\infty, 0)$
    - **b.** $(0, \infty)$
    - **c.** $(-\infty, \infty)$
    - **d.** $(-\infty, 0]$

86. What is the solution of the differential equation $x\,dy - y\,dx = 0$?
    - **a.** $xy = c$
    - **b.** $y = cx$
    - **c.** $x + y = c$
    - **d.** $x - y = c$

87. What is the derivative of the function $f(x) = e^{\tan x} + \ell n(\sec x) - e^{\ell n\, x}$ at $x = \frac{\pi}{4}$?
    - **a.** e/2
    - **b.** e
    - **c.** 2e
    - **d.** 4e

88. Which one of the following differential equations has a periodic solution?
    - **a.** $\frac{d^2x}{dt^2} + \mu x = 0$
    - **b.** $\frac{d^2x}{dt^2} - \mu x = 0$
    - **c.** $x\frac{dx}{dt} + \mu t = 0$
    - **d.** $\frac{dx}{dt} + \mu xt = 0$

89. What is the period of the function $f(x) = \sin x$?
    - **a.** $\pi/4$
    - **b.** $\pi/2$
    - **c.** π
    - **d.** 2π

90. What is $\int \frac{dx}{2^x - 1}$ equal to?
    - **a.** $\ell n(2^x - 1) + c$
    - **b.** $\frac{\ell n(1-2^{-x})}{\ell n\, 2} + c$
    - **c.** $\frac{\ell n(2^{-x}-1)}{2\,\ell n\, 2} + c$
    - **d.** $\frac{\ell n(1+2^{-x})}{\ell n\, 2} + c$

91. The order and degree of the differential equation $y^2 = 4a(x - a)$, where ‘a’ is an arbitrary constant, are respectively
    - **a.** 1,2
    - **b.** 2,1
    - **c.** 2,2
    - **d.** 1,1

92. What is the value of

$$\int_{-\pi/4}^{\pi/4} (\sin x - \tan x)\, dx$$

    - **a.** $-\frac{1}{\sqrt{2}} + \ell n\left(\frac{1}{\sqrt{2}}\right)$
    - **b.** $\frac{1}{\sqrt{2}}$
    - **c.** 0
    - **d.** $\sqrt{2}$

93. If

$$\int_a^b x^3 dx = 0$$

and

$$\int_a^b x^2\, dx = \frac{2}{3}$$

then what are the values of a and b respectively?
    - **a.** -1,1
    - **b.** 1,1
    - **c.** 0,0
    - **d.** 2, -2

94. What is

$$\int_0^1 x(1-x)^9\, dx$$

equal to?
    - **a.** 1/110
    - **b.** 1/132

c. 1/148
d. 1/240

95. What is $\lim_{x\to 0} \frac{\tan x}{\sin 2x}$ equal to?

a. 1/2
b. 1
c. 2
d. Limit does not exist

96. What is $\lim_{h\to 0} \frac{\sqrt{2x+3h}-\sqrt{2x}}{2h}$ equal to?

a. $\frac{1}{2\sqrt{2x}}$
b. $\frac{3}{\sqrt{2x}}$
c. $\frac{3}{2\sqrt{2x}}$
d. $\frac{3}{4\sqrt{2x}}$

97. If $f(x)$ is an even function, where $f(x) \neq 0$, then which one of the following is correct?
a. $f'(x)$ is even function
b. $f'(x)$ is odd function
c. $f'(x)$ may be an even or odd function depending on the type of function
d. $f'(x)$ is a constant function

98. If $y = e^{x^2} \sin 2x$, then what is $\frac{dy}{dx}$ at $x = \pi$ equal to?
a. $(1+\pi)e^{x^2}$
b. $2\pi\, e^{\pi^2}$
c. $2e^{\pi^2}$
d. e^{x^2}

99. What is the solution of $(1 + 2x)\, dy\, (1 - 2y)\, dx = 0$?
a. $x - y - 2xy = c$
b. $y - x - 2xy = c$
c. $y + x - 2xy = c$
d. $x + y + 2xy = c$

100. What are the order and degree, respectively, of the differential equation $\left(\frac{d^3y}{dx^3}\right)^2 = y^4 + \left(\frac{dy}{dx}\right)^5$?
a. 4, 5
b. 2, 3
c. 3, 2
d. 5, 4

101. In a Binomial Distribution, the mean is three times its variance. What is the probability of exactly 3 successes out of 5 trials?
a. 80/243
b. 40/243
c. 20/243
d. 10/243

102. Consider the following statements:
1. $P(\bar{A} \cup B) = P(\bar{A}) + P(B) - P(\bar{A} \cap B)$
2. $P(A \cap \bar{B}) = P(B) - P(A \cap B)$
3. $P(A \cap B) = P(B)\, P(A \mid B)$

Which of the above statements are correct?
a. 1 and 2 only
b. 1 and 3 only
c. 2 and 3 only
d. 1, 2, and 3

103. If the correlation coefficient between x and y is 0.6, covariance is 27 and variance of y is 25, then what is the variance of x?
a. 9/5
b. 81/25
c. 9
d. 81

104. The probabilities that a student will solve Question A and Question B are 0.4 and 0.5 respectively. What is the probability that he solves at least one of the two questions?
a. 0.6
b. 0.7
c. 0.8
d. 0.9

105. Let $\bar{x}$ be the mean of $x_1, x_2, x_3, \ldots, x_n$. If $x_i = a + cy_i$, for some constants a and c, then what will be the mean of $y_1, y_2, y_3, \ldots, y_n$?
a. $a + \overline{cx}$
b. $a - \frac{1}{e}\,\bar{x}$

c. $\frac{1}{e}\bar{x} - a$

d. $\frac{\bar{x}-a}{c}$

106. Consider the following statements:
1. If the correlation coefficient $r_{xy} = 0$, then the two lines of regression are parallel to each other.
2. If the correlation coefficient $r_{xy} = +1$, then the two lines of regression are perpendicular to each other.

Which of the above statements is/are correct?

a. 1 only
b. 2 only
c. Both 1 and 2
d. Neither 1 nor 2

107. If $4x - 5y + 33 = 0$ and $20x - 9y = 107$ are two lines of regression, then what are the values of $\bar{x}$ and $\bar{y}$ respectively?

a. 12 and 18
b. 18 and 12
c. 13 and 17
d. 17 and 13

108. Consider the following statements:
1. Mean is independent of change in scale and changes in origin.
2. Variance is independent of change in scale but not in origin.

Which of the above statements is / are correct?

a. 1 only
b. 2 only
c. Both 1 and 2
d. Neither 1 nor 2

109. Consider the following statements:
1. The sum of deviations from mean is always zero.
2. The sum of absolute deviations is minimum when taken around median.

Which of the above statements is/ are correct?

a. 1 only
b. 2 only
c. Both 1 and 2
d. Neither 1 and 2

110. What is the median of the numbers 4.6, 0, 9.3, -4.8, 7.6, 2.3, 12.7, 3.5, 8.2, 6.1, 3.9, 5.2?

a. 3.8
b. 4.9
c. 5.7
d. 6.0

111. In a test in Mathematics, 20% of the students obtained "first class". If the data are represented by a Pie-Chart, what is the central angle corresponding to "first class"?

a. 20°
b. 36°
c. 72°
d. 144°

112. The mean and standard deviation of a set of values are 5 and 2 respectively. If 5 is added to each value, then what is the coefficient of variation for the new set of values?

a. 10
b. 20
c. 40
d. 70

113. A train covers the first 5 km of its journey at a speed of 30 km/hr and the next 15km at speed of 45 km/hr. What is the average speed of the train?

a. 35 km/hr
b. 37.5 km/hr
c. 39.5 km/hr
d. 40 km/hr

114. Two fair dice are rolled. What is the probability of getting a sum of 7?

a. 1/36
b. 1/6
c. 7/12
d. 5/12

115. If A and B are two events such that 2P(A) = 3P(B), where $0 < P(A) < P(B) < 1$, then which one of the following is correct?

a. $P(A \mid B) < P(B \mid A) <$

$P(A \cap B)$

b. $P(A \cap B) < P(B|A) < P(A|B)$

c. $P(B|A) < P(A|B) < P(A \cap B)$

d. $P(A \cap B) < P(A|B) < P(B|A)$

116. A box has ten chits numbered 0, 1, 2, 3, …., 9. First, one chit is drawn at random and kept aside. From the remaining, a second chit is drawn at random. What is the probability that the second chit drawn is "9"?

a. 1/10

b. 1/9

c. 1/90

d. None of the above

117. One bag contains 3 white and 2 black balls, another bag contains 5 white and 3 black balls. If a bag is chosen at random and a ball is drawn from it, what is the chance that it is white?

a. 3/8

b. 49/80

c. 8/13

d. 1/2

118. Consider the following in respect of two events A and B:

1. P (A occurs but not B) = $P(A) - P(B)$ if $B \subset A$
2. P (A alone or B alone occurs) = $P(A) + P(B) - P(A \cap B)$
3. $P(A \cup B) = P(A) + P(B)$ if A and B are mutually exclusive

Which of the above is/ are correct?

a. 1 only

b. 1 and 3 only

c. 2 and 3 only

d. 1 and 2 only

119. A committee of three has to be chosen from a group of 4 men and 5 women. If the selection is made at random, what is the probability that exactly two members are men?

a. 5/14

b. 1/21

c. 3/14

d. 8/21

120. The standard deviation σ of the first N natural numbers can be obtained using which one of the following formulae?

a. $\sigma = \frac{N^2-1}{12}$

b. $\sigma = \sqrt{\frac{N^2-1}{12}}$

c. $\sigma = \sqrt{\frac{N-1}{12}}$

d. $\sigma = \sqrt{\frac{N^2-1}{6N}}$

Mathematics NDA 1 2018 Solution

1. (b)
Putting $n = 1, 121^n - 25^n + 1900^n - (-4)^n = 121 - 25 + 1900 + 4 = 2000$
Which is divisible by 2000.

2. (b)
$\frac{1}{\log_2^n} + \frac{1}{\log_3^n} + \frac{1}{\log_4^n} + \ldots.. + \frac{1}{\log_{2017}^n}$
$= \log_n^2 + \log_n^3 + \log_n^4 + \ldots.. + \log_n^{2017}$
$= \log_n^{2017!} = \log_{2017!}^{2017!} = 1$

3. (b)
${}^{43}C_{2r+1} = {}^{43}C_{43-r-2} \Rightarrow 3r + 1 = 41$
$\Rightarrow r = 14$

4. (c)
$\text{Arg}(-1 - i) = \pi + \frac{\pi}{4} = -\frac{3\pi}{4}$

5. (c)
Let $z = x + iy$
$(x + iy)^2 + \alpha(x + iy) + \beta = 0$
$\Longrightarrow x^2 - y^2 + 2ixy + \alpha x + i\alpha y + \beta = 0$
Equating real and imaginary parts separately, we get
$x^2 - y^2 + \alpha x + \beta = 0 , (2x + \alpha)y = 0$
Now, $2x + \alpha = 0 \quad (\because y = 0)$
$\Longrightarrow \alpha = -2 \quad (\because x = \text{Re } z = 1)$
Now, $1 - y^2 - 2 + \beta = 0$
$\Longrightarrow \beta = 1 + y^2 > 1 \ (\because y \in R, y \neq 0)$
$\Longrightarrow \beta \in (1, \infty)$

6. (c)
$C = (A \cap B') \cup (A' \cap B)$
$= (A - B) \cup (B - A) = (A \cup B) - (A \cap B)$

7. (d)
No. of ways $= 5 \times 4 \times 3 = 60$

8. (a)
$|1 - 2i|^x = 5^x$
$\Rightarrow 5^{x/2} = 5^x$
$\Rightarrow x = 0$
There is no non-zero integral solution.

9. (c)
$\frac{(a+b)/2}{\sqrt{ab}} = \frac{5}{3} \Rightarrow \frac{a^2 + b^2 + 2b}{ab} = \frac{100}{9}$

$\Rightarrow 9t^2 - 82t + 9 = 0 \quad$ [where $t = a/b$]
$\Rightarrow t = 9, 1/9$
$\Rightarrow a : b = 9 : 1$ OR $a : b = 1 : 9$

10. (b)

$\alpha = {}^{m+n}C_n , \beta = {}^{m+n}C_m$

$\therefore \alpha = \beta$

11. (c)
$x + \log_{15}(1 + 3^x) = x\log_{15}5 + \log_{15}12$
$\Longrightarrow \log_{15}15^x + \log_{15}(1 + 3^x) = \log_{15}5^x + \log_{15}12$
$\Longrightarrow \log_{15}15^x(1 + 3^x) = \log_{15}(5^x \times 12)$
$\Longrightarrow 15^x(1 + 3^x) = 5^x \times 12$
$\Longrightarrow 3^x + 3^{2x} = 12 \Longrightarrow x = 1$

12. (a)
The last digit is fixed as '0'.
$\therefore$ No. of ways $= 4 \times 3 \times 2 = 24$

13. (c)
Required No.
$= (54 + 63) + (18 - 10) = 125$

14. (d)
Required No. $= 18 - 10 = 8$

15. (c)
$\left|\frac{\alpha - \beta}{\alpha.\bar{\alpha} - \alpha\bar{\beta}}\right| = \frac{|\alpha - \beta|}{|\alpha||\bar{\alpha} - \bar{\beta}|} = \frac{|\alpha - \beta|}{|\alpha - \beta|} = 1$

16. (a)
$|1 - x| + x^2 = 5$
$\Longrightarrow 1 - x + x^2 = 5, x < 1$
Or $-1 + x + x^2 = 5, x \geq 1$
$\Longrightarrow x^2 - x - 4 = 0 , x < 1$ or
$x^2 + x - 6 = 0 , x \geq 1$
$\Longrightarrow x = \frac{-1-\sqrt{17}}{2}$ or $x = 2$
Equation has a rational root and an irrational root.

17. (d)
$31 = 16 + 8 + 4 + 2 + 1$

$\therefore$ Binary expression of decimal number
$31 = 11111$

18. (a)
$i^{1000} + i^{1001} + i^{1002} + i^{1003} = 1 + i + i^2 + i^3$
$\Longrightarrow 1 + i - 1 - i = 0$

19. (a)
$$\frac{1}{\log_2 N} + \frac{1}{\log_3 N} + \frac{1}{\log_4 N} + \ldots\ldots + \frac{1}{\log_{100} N}$$
$$= log_N^2 + log_N^3 + \ldots\ldots + log_N^{100} = log_N^{100!} = \frac{1}{log_{100!}^N}$$

20. (b)
$z = \sqrt{3} + i$
$r = \sqrt{3 + 1} = 2$
argument $= \frac{\pi}{6}$
So, $z = 2\left(\cos\frac{\pi}{6} + i \sin\frac{\pi}{6}\right)$

21. (c)
Let $y = 2\sqrt{3}\,x$
Now, $(1 + y)^{11} + (1 - y)^{11}$ has no. of terms
$$= \frac{11 + 1}{2} = 6$$

22. (d)
$5^5 + 7^5$ is divisible by $5 + 7 = 12$

23. (a)
Using formula for sum of infinite terms of GP
$$x = \frac{1}{1 - (-y)} = \frac{1}{1 + y}$$

24. (a)
In this case,
$A^{-1} = \text{adj } A = (\text{co} - \text{factor } A)^T$
$$= \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

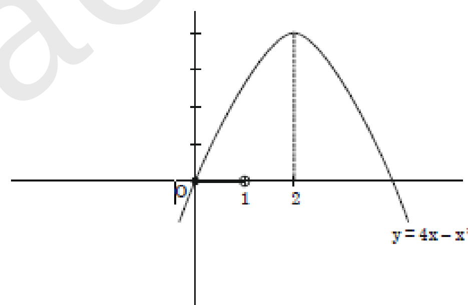
25. (a)
$$(A)_{(2\times 3)} \times (B)_{(3\times 5)} = (AB)_{(2\times 5)}$$
$\therefore$ B must be 3×5 matrix

26. (a)
$A^2 - I_2 = kA$
$$\Rightarrow \begin{bmatrix} 5 & 8 \\ 8 & 13 \end{bmatrix} - \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} k & 2k \\ 2k & 3k \end{bmatrix}$$
$$\Rightarrow \begin{bmatrix} 4 & 8 \\ 8 & 12 \end{bmatrix} - \begin{bmatrix} k & 2k \\ 2k & 3k \end{bmatrix} \Rightarrow k = 4$$

27. (a)
No. of triangle
$= {}^{12}C_3 - {}^{7}C_3 = 220 - 35 = 185$

28. (d)
${}^{n}_{r}C + {}^{n}_{r-1}C + {}^{n}_{r-1}C + {}^{n}_{r-2}C$
$= {}^{n+1}_{r}C + {}^{n+1}_{r-1}C = {}^{n+2}_{r}C$

29. (a)
No. of solution = one



30. (b)
Required No.
$= 680 + 215 - 850 = 45$

31. (c)
Sum $= 11 + 14 + \ldots\ldots + 98$
$$= \left(\frac{11 + 98}{2}\right) \times 30 = 109 \times 15 = 1635$$

32. (b)
Negative power of 10 will always be between 0 & 1.

33. (c)
Product $= \frac{3}{r^2} \times \frac{3}{r} \times 3 \times 3r \times 3r^2 = 243$

34. (a)
$x + z = 3$, $xz = 9$
$$\frac{2xz}{x + z} = \frac{18}{3} = 6 \Longrightarrow x, 6, z \in H.P$$

35. (c)
Sum $= i^2 + 2i^3 + 2i^4 + \ldots + 2i^{10} + 2i^{11} + i^{12}$
$= 2i^{11} = 2i^3 = -2i$

36. (c)
$\sin x = \frac{1}{\sqrt{5}}, \sin y = \frac{1}{\sqrt{10}}$
$\sin(x+y) = \sin x . \cos y + \cos x \sin y$
$\cos x = \sqrt{1 - \frac{1}{5}} = \frac{2}{\sqrt{5}},$
$\cos y = \sqrt{1 - \frac{1}{10}} = \sqrt{\frac{9}{10}} = \frac{3}{\sqrt{10}}$
$\sin(x+y) = \frac{1}{\sqrt{5}} \times \frac{3}{\sqrt{10}} + \frac{2}{\sqrt{5}} \times \frac{1}{\sqrt{10}} = \frac{5}{\sqrt{50}} = \frac{1}{\sqrt{2}}$
$\Rightarrow x + y = 45°$

37. (c)
$$\frac{\sin 5x - \sin 3x}{\cos 5x + \cos 3x} = \frac{2\cos 4x. \sin x}{2\cos 4x. \cos x} = \tan x$$

38. (c)
$\sin(90° + 15°) + \cos 105° = \cos 15° + \cos 105°$
$= 2\cos 60° . \cos 45° = 2 \times \frac{1}{2} \times \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}}$

39. (b)
$$\frac{a}{\sin A} = \frac{b}{\sin B}$$
$$\frac{2}{2/3} = \frac{3}{\sin B}$$
$\sin B = 1, B = \frac{\pi}{2}$

40. (c)
$$\sin^{-1}\left(\sin\frac{2\pi}{3}\right) = \sin^{-1}\sin\left(\pi - \frac{\pi}{3}\right) = \sin^{-1}\sin\frac{\pi}{3} = \frac{\pi}{3}$$

41. (b)
Sum of angles of a triangle $= \pi$
$\Rightarrow x - y + x + x + y = \pi \Rightarrow x = \pi/3$

42. (a)
$$\cos\beta = \cos 2\alpha = \frac{1 - \tan^2\alpha}{1 + \tan^2\alpha}$$

43. (a)
$$\tan\theta = \frac{6}{2\sqrt{3}} = \sqrt{3} \Rightarrow \theta = 60°$$

44. (b)
$$\tan^{-1}\left(\frac{\frac{1}{4} + \frac{3}{5}}{1 - \left(\frac{1}{4}\right) \times \left(\frac{3}{5}\right)}\right) = \tan^{-1}(1) = \frac{\pi}{4}$$

45. (a)
Let H be the height and R be the distance of centre of balloon from the observer.
$$R = \frac{r}{\sin\alpha/2}$$
$$H = R\sin\beta = \frac{r\sin\beta}{\sin\alpha/2}$$

46. (a)
$$\frac{\sin(x+y) + \sin(x-y)}{\sin(x+y) - \sin(x-y)} = \frac{a}{b}$$
$$\Rightarrow \frac{2\sin x\cos y}{2\sin y\cos x} = \frac{a}{b} \Rightarrow \frac{\tan x}{\tan y} = \frac{a}{b}$$

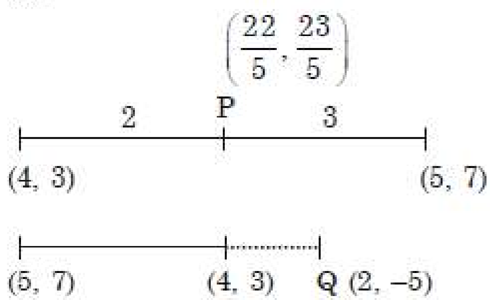
47. (b)
$(\sin\alpha + \sin\beta)^2 + (\cos\alpha + \cos\beta)^2 = 0$
$\Rightarrow 2 + 2\cos(\alpha - \beta) = 0$
$\Rightarrow \cos(\alpha - \beta) = -1 = \cos\pi$
$\Rightarrow \alpha = \pi + \beta$

48. (c)
A must be odd multiple of 180°

49. (b)
$\cos\alpha + \cos\beta + \cos\gamma = 0, 0 < \alpha \le \frac{\pi}{2},$
$0 < \beta \le \frac{\pi}{2}, 0 < \gamma < \frac{\pi}{2}$
$\Rightarrow \alpha = \beta = \gamma = \frac{\pi}{2}$
$\Rightarrow \sin\alpha + \sin\beta + \sin\gamma = 3$

50. (a)
$f(x) = \sin\left(x + \frac{\pi}{5}\right) + \cos\left(x + \frac{\pi}{5}\right)$
$= \sqrt{2}\sin\left(x + \frac{\pi}{5} + \frac{\pi}{4}\right)$
$f(x)$ is maximum when $x + \frac{\pi}{5} + \frac{\pi}{4} = \frac{\pi}{2}$
$\Rightarrow x = \frac{\pi}{20}$

51. (a)



$\therefore PQ = \sqrt{\left(2-\frac{22}{5}\right)^2 + \left(-5-\frac{23}{5}\right)^2} = \frac{12}{5}\sqrt{17}$

52. (b)

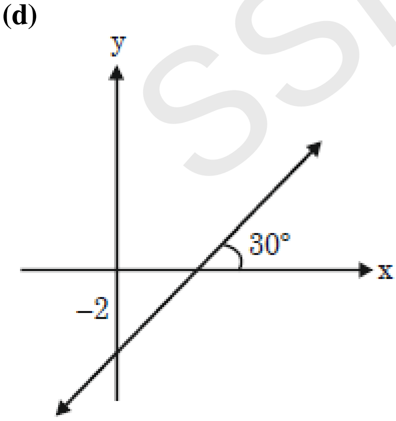
Slope $S_1 = \frac{mn+n^2}{m^2-mn}$, Slope $S_2 = \frac{mn-n^2}{mn+m^2}$

$$\text{Angle} = \tan^{-1}\left(\frac{\frac{mn+n^2}{m^2-mn} - \frac{mn-n^2}{mn+m^2}}{1+\frac{mn+n^2}{m^2+mn} \times \frac{mn-n^2}{mn+m^2}}\right)$$

After solving

$$\text{Angle} = \tan^{-1}\left(\frac{4m^2n^2}{m^4-n^4}\right)$$

53. (d)



Equation of line is

$y = \frac{1}{\sqrt{3}}x - 2$

$\Rightarrow \sqrt{3y} = x - 2\sqrt{3}$

$\Rightarrow x - \sqrt{3y} - 2\sqrt{3} = 0$

54. (c)

Equation of line is

$x + 2y - 3 + \lambda(2x - y + 5) = 0$

$\Rightarrow (1+2\lambda)x + (2-\lambda)y + 5\lambda - 3 = 0$

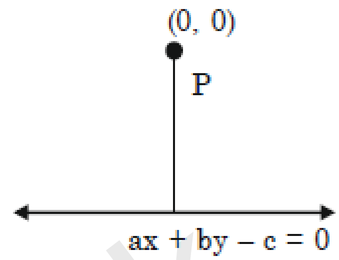
Now, $\frac{1+2\lambda}{\lambda-2} = 1 \Rightarrow \lambda = -3$

$\therefore$ Equation is $-5x + 5y - 18 = 0$

$\Rightarrow 5x - 5y + 18 = 0$

55. (c)

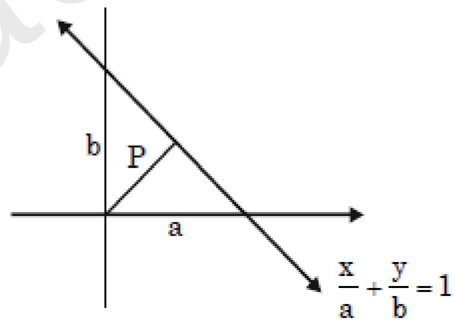
Statement 1



$P = \frac{|-c|}{\sqrt{a^2+b^2}} \Rightarrow P^2 = \frac{c^2}{a^2+b^2}$

It is true.

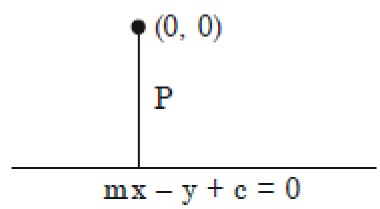
Statement 2



$\frac{1}{P^2} = \frac{1}{a^2} + \frac{1}{b^2}$

It is true.

Statement 3



$\Rightarrow P^2 = \frac{c^2}{m^2+1} \Rightarrow \frac{1}{P^2} = \frac{m^2+1}{c^2}$

It is false.

56. (a)

$c = 4, a = 5$

$b^2 = 25 - 16 = 9$

$\therefore$ Equation of ellipse is

$$\frac{x^2}{25} + \frac{y^2}{9} = 1$$

57. (b)

Equation of line is $\frac{x}{a} + \frac{y}{2a} = 1$

$\Rightarrow 2x + y = 2a$ ...(1)

Putting (2, 3), we get $2a = 7$

$\therefore$ Equation of line is $2x + y = 7$

58. (c)

Equation of BC is

$$\frac{x-0}{2} = \frac{y+11}{8} = \frac{z-4}{-3} = \lambda \text{ (say)}$$

$\Rightarrow x = 2\lambda, y = 8\lambda - 11, z = -3\lambda + 4$

Now, $2(x-1) + 8(y-8) - 3(z-4) = 0$

$\Rightarrow 2x + 8y - 3z = 54$

$\Rightarrow 4\lambda + 64\lambda - 88 + 9\lambda - 12 = 54$

$\Rightarrow \lambda = 2$

$\therefore$ foot $= (4, 5, -2)$

59. (a)

Equation of plane is

$$\begin{vmatrix} x+2 & y-6 & z+6 \\ -1 & 4 & -3 \\ -3 & -6 & 0 \end{vmatrix} = 0$$

$\Rightarrow (z+6)(18) + 3[-6(x+2) + 3(y-6)] = 0$

$\Rightarrow 18z + 108 + 3(-6x - 12 + 3y - 18) = 0$

$\Rightarrow 2x - y - 2z = 2$

60. (c)

Let A (a, 0, 0), B (0, b, 0), C (0, 0, c)

Equation sphere is

$x^2 + y^2 + z^2 - ax - by - cz = 0$

$r = \frac{1}{2}\sqrt{a^2 + b^2 + c^2} \Rightarrow a^2 + b^2 + c^2 = 4r^2$

Let, (α, β, γ) be the centroid of triangle.

$\Rightarrow \alpha = \frac{a}{3}, \beta = \frac{b}{3}, \gamma = \frac{c}{3}$

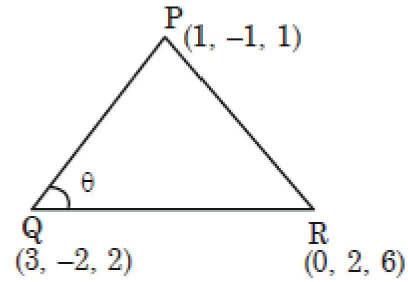
Now, $\alpha^2 + \beta^2 + \gamma^2 = \frac{a^2}{9} + \frac{b^2}{9} + \frac{c^2}{9} = \frac{4r^2}{9}$

$\Rightarrow 9(\alpha^2 + \beta^2 + \gamma^2) = 4r^2$

$\Rightarrow$ Locus is given by, $9(x^2 + y^2 + z^2) = 4r^2$

61. (d)

$\overrightarrow{PQ} . \overrightarrow{PR} = 0$



$\Rightarrow \angle QPR = 90°$

We have, $\angle RQP = \theta$

$\Rightarrow \angle PRQ = 90° - \theta$

62. (c)

Let, $\left(\frac{5}{2}, 0\right)$ be a point on $2x + 11y = 5$.

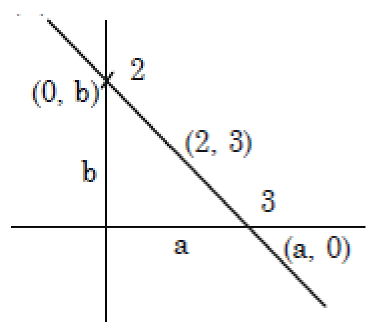
Now, perpendicular from $\left(\frac{5}{2}, 0\right)$ to

$24x + 7y = 20$ is $\frac{8}{5}$

Perpendicular from $\left(\frac{5}{2}, 0\right)$ to

$4x - 3y = 2$ is $\frac{8}{5}$

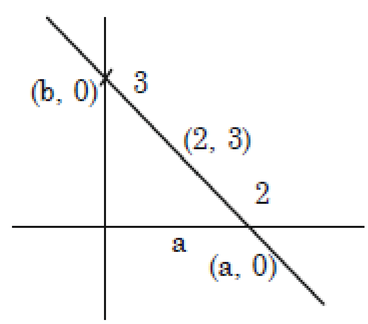
63. (d)



Now $\frac{2a}{5} = 2 \Rightarrow a = 5$

$\frac{3b}{5} = 3 \Rightarrow b = 5$

Equation of line is $x + y = 5$.



$\frac{3a}{5} = 2 \Rightarrow a = \frac{10}{3}$

$$\frac{2b}{5} = 3 \Rightarrow b = \frac{15}{2}$$

Equation of line is

$$\frac{3x}{10} + \frac{2y}{15} = 1$$

$$\Rightarrow 9x + 4y = 30$$

64. (b)

$$\text{Distance} = \frac{\left|9 - \frac{15}{2}\right|}{5} = \frac{3}{10}$$

65. (a)

$$(x+2)^2 + (y-3)^2 + (z-4)^2 = 6^2$$

$$\Rightarrow x^2 + y^2 + z^2 + 4x - 6y - 8z = 6^2 - 2^2 - 3^2 - 4^2$$

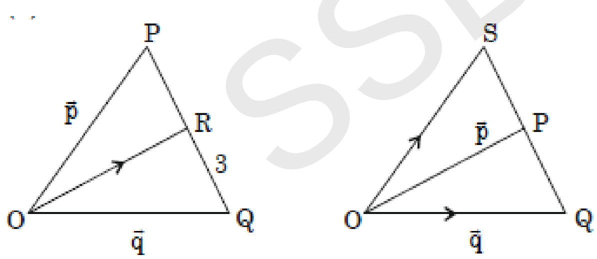
$$\Rightarrow x^2 + y^2 + z^2 + 4x - 6y - 8z = 7$$

66. (a)

$$\sin\theta = \frac{|\vec{a} \times \vec{b}|}{|\vec{a}||\vec{b}|} = \frac{7}{2 \times 7} = \frac{1}{2}$$

$$\Rightarrow \theta = 30°$$

67. (a)



$$\overrightarrow{OR} = \frac{3\vec{p} + 2\vec{q}}{5}, \qquad \overrightarrow{OS} = 3\vec{p} - 2\vec{q}$$

$$\overrightarrow{OR} \cdot \overrightarrow{OS} = 0$$

$$\Rightarrow \frac{1}{5}(3\vec{p} + 2\vec{q}) \cdot (3\vec{p} - 2\vec{q}) = 0$$

$$\Rightarrow 9|\vec{p}|^2 - 4|\vec{q}|^2 = 0 \Rightarrow 9p^2 = 4q^2$$

68. (a)

$$\vec{r} = (2\hat{i} - \hat{j} + 3\hat{k}) - (\hat{i} + 2\hat{j} - \hat{k})$$

$$= \hat{i} - 3\hat{j} + 4\hat{k}$$

$$\vec{\pi} = \vec{r} \times \vec{F} = (\hat{i} - 3\hat{j} + 4\hat{k}) \times (3\hat{i} + \hat{k})$$

$$= -3\hat{i} + 11\hat{j} + 9\hat{k}$$

69. (d)

$$(\vec{a} + 2\vec{b}) = -3\vec{c} \Rightarrow \vec{a} \times \vec{b} + 2\vec{b} \times \vec{b} = -3\vec{c} \times \vec{b}$$

$$\Rightarrow \vec{a} \times \vec{b} = 3(\vec{b} \times \vec{c})$$

$$3\vec{c} + \vec{a} = -2\vec{b} \Rightarrow 3(\vec{c} \times \vec{a}) + (\vec{a} \times \vec{a}) = -2\vec{b} \times \vec{a}$$

$$\Rightarrow 3(\vec{c} \times \vec{a}) = 2(\vec{a} \times \vec{b}) = 6(\vec{b} \times \vec{c})$$

$$\Rightarrow \vec{c} \times \vec{a} = 2(\vec{b} \times \vec{c})$$

Now,

$$\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = 6(\vec{b} \times \vec{c}) \Rightarrow \lambda = 6$$

70. (b)

Cross product of parallel vectors $= \vec{0}$

71. (d)

$f(x) = |x + 1|$

going through options

(a) $f(x^2) = |x^2 + 1|$

$\{f(x)\}^2 = (x+1)^2$

Which implies $f(x^2) \neq \{f(x)\}^2$

(b) $f(|x|) = \big||x| + 1\big|$

$|f(x)| = \big||x + 1|\big| = |x + 1|$

Which implies $f(|x|) \neq |f(x)|$

(c) $f(x + y) = |x + y + 1|$

$f(x) + f(y) = |x + 1| + |y + 1|$

Which implies

$f(x + y) \neq f(x) + f(y)$

Option d is correct.

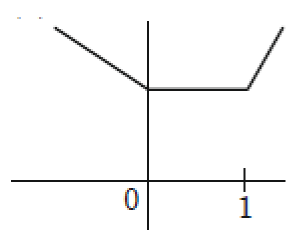
72. (a)

$y = f(x) = \frac{x^2}{1+x^2}$

Clearly $y \geq 0$, Again $x^2 < 1 + x^2$

So, Range is [0, 1)

73. (a)



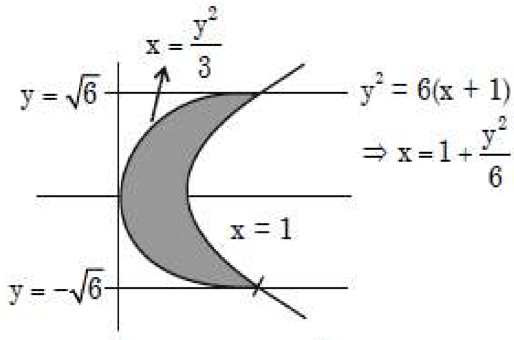
Clearly f(x) is continuous at x=0 and 1.

74. (a)

$$f'(0) = \lim_{h \to 0} \frac{f(h) - f(0)}{h}$$

$$= \lim_{h\to 0} \frac{h^2 \log h}{h} = 0$$

75. (c)



Solving $y^2 = 6(x-1)$ and $y^2 = 3x$

We get $6x - 6 = 3x \Rightarrow x = 2$

$\Rightarrow y = \pm\sqrt{6}$

$$\text{Area} = \int_{-\sqrt{6}}^{\sqrt{6}} \left(1 + \frac{y^2}{6} - \frac{y^2}{3}\right) dy$$

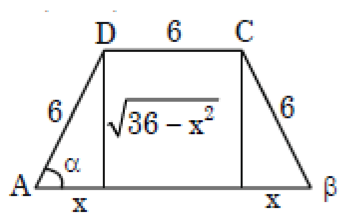
$$= 2\int_0^{\sqrt{6}} \left(y - \frac{y^2}{6}\right) dy$$

$$= 2\left[y - \frac{y^3}{18}\right]_0^{\sqrt{6}} = 2 \times \frac{2\sqrt{6}}{3} = \frac{4\sqrt{6}}{3}$$

76. (c)

$$A = \text{Area} = \frac{1}{2}(6 + 6 + 2x)\sqrt{36 - x^2}$$

$$= (6 + x)\sqrt{36 - x^2}$$



$$\frac{dA}{dx} = (6 + x)\left(\frac{-2x}{2\sqrt{36 - x^2}}\right) + \sqrt{36 - x^2}$$

$$= \sqrt{36 - x^2} - \frac{x(6 + x)}{\sqrt{36 - x^2}} = \frac{36 - 6x - 2x^2}{\sqrt{36 - x^2}}$$

$$\frac{dA}{dx} = 0 \Rightarrow 36 - 6x - 2x^2 = 0 \Rightarrow x = 3$$

$$\frac{d^2A}{dx^2} < 0$$

Now, $\cos\alpha = \frac{x}{6} = \frac{3}{6} = \frac{1}{2} \Rightarrow \alpha = 3$

77. (d)

Fourth side $= 6 + 6 = 12$

78. (c)

Maximum area $= 9 \times 3\sqrt{3} = 27\sqrt{3}$

79. (a)

$$I = \int_0^{\pi} e^x \sin x \, dx$$

$$= [\sin x \cdot e^x]_0^{\pi} - \int_0^{\pi} -\sin x \cdot e^x \, dx$$

$$= 0 - \left\{[\cos x \cdot e^x]_0^{\pi} - \int_0^{\pi} -\sin x \cdot e^x \, dx\right\}$$

$$= -[-e^{\pi} - 1] - I$$

$$\Rightarrow 2I = e^{\pi} + 1 \Rightarrow I = \frac{e^{\pi} + 1}{2}$$

80. (b)

$$f(3) = \lim_{x\to 3} \frac{2x}{2x - 2}$$

(L. Hospital rule)

$$= \frac{6}{4} = 1.5$$

81. (b)

$$\int_1^e x \log x \, dx = \left[\log x \cdot \frac{x^2}{2}\right]_1^e - \int_1^e \frac{1}{x} \cdot \frac{x^2}{2} dx$$

$$= \frac{e^2}{2} - \frac{1}{2} \times \frac{1}{2}[x^2]_1^e = \frac{e^2}{2} - \frac{e^2 - 1}{4} = \frac{e^2 + 1}{4}$$

82. (a)

$$\int_0^{\sqrt{2}} [x^2] \, dx = \int_0^1 0 \, dx + \int_1^{\sqrt{2}} 1 \, dx = \sqrt{2} - 1$$

83. (c)

Let, $\sin\theta = x$, clearly $x \in [-1, 1]$

84. (d)

$\because f(x) = 4\sec x - 3\cos x + 1$

Minimum $f = \sqrt{4^2 + (-3)^2} + 1 = -4$

Maximum $f = \sqrt{4^2 + (-3)^2} + 1 = 6$

$S =$ Range of f

$= [\text{Minimum f, maximum f}] = [-4, 6]$

85. (a)

f(x) is defined if

$|x| - x > 0 \Rightarrow |x| > x$

For $x > 0$, $x > x$, (not possible)

For $x < 0, -x > x \Rightarrow 2x < 0 \Rightarrow x < 0$ (possible)

So, domain of $f = (-\infty, 0)$

86. (b)

$xdy - ydx = 0$

$\Rightarrow \frac{xdy - ydx}{x^2} = 0 \Rightarrow d\left(\frac{y}{x}\right) = 0$

Integrating, we get $\frac{y}{x} = c \Rightarrow y = cx$

87. (c)

$f(x) = e^{\tan x} + \ell n(\sec x) - x$

$f'(x) = e^{\tan x}.\sec^2 x + \frac{\sec x \tan x}{\sec x} - 1$

$f'(\pi/4) = 2e + 1 - 1 = 2e$

88. (a)

It is obvious.

89. (d)

Period of $f(x) = \sin x$ is 2π

90. (b)

$$\int \frac{dx}{2^x - 1} = \frac{1}{\log 2}\int \frac{2^{-x}\log 2}{1 - 2^{-x}}dx$$

$$= \frac{1}{\log 2}\log(1 - 2^{-x}) + c$$

91. (a)

$y^2 = 4a(x - a)$ ......(1)

Order = 1.

Differentiating, both sides, we get

$2y\frac{dy}{dx} = 4a \Rightarrow \left(\frac{y}{2}\right)\frac{dy}{dx} = a$

Putting in (1), we get

$$y^2 = 4\left(\frac{y}{2}\right)\left(\frac{dy}{dx}\right)\left(x - \frac{y}{2}\frac{dy}{dx}\right)$$

$$\Rightarrow y^2 = 2y\frac{dy}{dx}\left(x - \frac{y}{2}\frac{dy}{dx}\right)$$

$$\Rightarrow y^2 = 2xy\frac{dy}{dx} - y^2\left(\frac{dy}{dx}\right)^2$$

Degree 2.

92. (c)

$f(x) = \sin x - \tan x$

$\Rightarrow f(-x) = -\sin x + \tan x = -f(x)$

$\Rightarrow$ f(x) is odd function.

$$\Rightarrow \int_{\frac{\pi}{4}}^{\pi/4} (\sin x - \tan x)dx = 0$$

93. (a)

$$\int_a^b x^3 dx = 0 \Rightarrow a = -b$$

($\because x^3$ is an odd function)

Now,

$$\int_{-b}^{b} x^2 dx = \frac{2}{3} \Rightarrow 2\int_0^b x^2 dx = \frac{2}{3}$$

$$\Rightarrow \left[\frac{x^3}{3}\right]_0^b = \frac{1}{3} \Rightarrow b^3 = 1 \Rightarrow b = 1$$

94. (a)

$$\int_0^1 x(1 - x)^9\, dx = \int_0^1 (1 - x)x^9 dx$$

$$= \int_0^1 (x^9 - x^{10})\, dx = \left[\frac{x^{10}}{10} - \frac{x^{11}}{11}\right]_0^1$$

$$= \frac{1}{10} - \frac{1}{11} = \frac{1}{100}$$

95. (a)

$$\lim_{x\to 0} \frac{\tan x}{\sin 2x} = \frac{1}{2}$$

96. (d)

$$\lim_{x\to 0} \frac{\frac{1}{2\sqrt{2x + 3h}} \times 3}{2} = \frac{3}{4\sqrt{2x}}$$

97. **(b)**

f(x) is even function $\Rightarrow f'(x)$ is odd function.

98. **(c)**

$$\frac{dy}{dx} = 2e^{x^2}\cos 2x + 2xe^{x^2}\sin 2x$$
$$= 2e^{x^2}(\cos 2x + x\sin 2x)$$
$$= 2e^{\pi^2}\{\cos\pi + \pi\sin 2\pi\} = 2e^{\pi^2}$$

99. **(a)**

$$(1+2x)dy = (1-2y)dx$$
$$\Rightarrow \int\frac{dx}{1+2x} = \int\frac{dx}{1-2y}$$
$$\Rightarrow \frac{1}{2}\log(1+2x) = -\frac{1}{2}\log(1-2y) + \frac{1}{2}\log c$$
$$\Rightarrow \log(1+2x)(1-2y) = c \Rightarrow x - y - 2xy = c$$

100. **(c)**

Order = 3, Degree = 2

101. **(a)**

np= 3 npq, where n= no. of trials

$$\Rightarrow q = \frac{1}{3} \Rightarrow p = \frac{2}{3}$$
$$P(x=3) = {}^5C_3\left(\frac{2}{3}\right)^3 \times \left(\frac{1}{3}\right)^2 = \frac{80}{243}$$

102. **(b)**

Statement 1

$P(\overline{A}\cup\ \overline{B}) = P(\overline{A}) + P(B) - P(\overline{A}\cap B)$ is true.

Statement 2

$P(A\cap\ \overline{B}) = P(B) - P(A\cap B)$ is false.

Statement 3

$P(A\cap B) = P(B)\times P(A/B)$ is true.

103. **(d)**

$\sigma(x) = ?$

$\sigma^2(y) = 25 \Rightarrow \sigma(y) = 5$

$$CoV(x,y) = \frac{CoV(x,y)}{\sigma(x)\sigma(y)}$$
$$\Rightarrow \sigma(x) = \frac{CoV(x,y)}{r(x,y)\sigma(y)} = \frac{27\times 5}{3\times 5} = 9$$

$\Rightarrow$ Variance of $x = \sigma^2(x) = 81$

104. **(b)**

$$P = (A\cup B) = 1 - P(A'\cap B')$$
$$= 1 - [(1-0.4)\times(1-0.5)]$$
$$= 1 - 0.3 = 0.7$$

105. **(d)**

Mean of $x_i = \overline{x}$

Mean of $a + cy_i = \overline{x}$

Mean of $cy_i = \overline{x} - a$

Mean of $y_i = \frac{\overline{x}-a}{c}$

106. **(d)**

If r = 0, lines of regression are perpendicular and when r = 1, lines of regression are so, both statements are wrong.

107. **(c)**

Solving $4\overline{x} - 5\overline{y} + 33 = 0$ and $20\overline{x} + 9\overline{y} - 107 = 0$

We get $\overline{x} = 13, y = 17$

108. **(d)**

Mean changes with changes in origin. Variance is independent to the choice of origin.

109. **(c)**

By the properties of deviation

110. **(b)**

On arranging these 12 numbers in ascending order, the sixth and seventh terms are 4.6 and 5.2.

$$\therefore \text{Median} = \frac{4.6+5.2}{2} = 4.9$$

111. **(c)**

20% of $360° = 72°$

112. **(b)**

New mean $= 5 + 5 = 10$

New σ = Old $\sigma = 2$

Coefficient of variation $= \frac{\sigma}{\text{mean}} \times 100$

$$= \frac{2}{10}\times 100 = 20$$

113. **(d)**

$$\text{Average speed} = \frac{5+15}{\frac{5}{30}+\frac{15}{45}} = \frac{20\times 90}{15+30}$$
$$= 40 \text{ km/hr}$$

114. **(b)**

$$E = \{(1,6),(2,5),(3,4),(4,3),(5,2),(6,1)\}$$

$$n(E) = 6\,, n(S) = 36 \Rightarrow P(E) = \frac{6}{36} = \frac{1}{6}$$

115. **(b)**

$$2P(A) = 3P(B)$$
$$\Rightarrow \frac{2P(A)}{P(A\cap B)} = \frac{3P(B)}{P(A\cap B)}$$
$$\Rightarrow \frac{1}{2}\times\frac{P(A\cap B)}{P(A)} = \frac{1}{3}\frac{P(A\cap B)}{P(B)}$$
$$\Rightarrow \frac{1}{2}P\left(\frac{B}{A}\right) = \frac{1}{3}P(A/B)$$
$$\Rightarrow P(B/A) < P(A/B)$$

116. **(c)**

$n(E) = 1, n(S) = 10\times 9 = 90$

$P(E) = 1/90$

117. **(b)**

$$P = \frac{1}{2}\left[\frac{3}{5}+\frac{5}{8}\right] = \frac{1}{2}\times\frac{49}{40} = \frac{49}{80}$$

118. **(b)**

It $B \subset A$, then $P(A - B) = P(A) -$ $P(A\cap B) = P(A) + P(B) - 2P(A\cap B)$

Statement 1 is correct

P (A alone or B alone)

$= P(A) - P(A\cap B) + P(B) - P(A\cap B)$

$= P(A) + P(B) - 2P(A\cap B)$

Statement 2 is false.

It A and B are mutually exclusive, then $P(A\cap B) = 0$

$\Rightarrow - P(A\cup B) = P(A) + P(B)$

Statement 3 is correct.

119. **(a)**

$n(E) = C(4,2)\times C(5,1) = 6\times 5 = 30$

$n(S) = C(9,3) = 84$

$$P(E) = \frac{30}{84} = \frac{5}{14}$$

120. **(b)**

$$\sigma^2 = \frac{1}{n}\sum_{i-1}^{n} x_i^2 - \left(\frac{1}{n}\sum_{i-1}^{n} x_i\right)^2$$
$$= \frac{1}{n}(1^2+2^2+\cdots..n^2) - \left(\frac{1}{n}(1+2+3+\cdots.n)\right)^2$$
$$= \frac{1}{n}\times\frac{n(n+1)(2n+1)}{6} - \frac{(n+1)}{2} = \frac{n^2-1}{12}$$
$$= \sigma = \sqrt{\frac{n^2}{12}}$$

General Ability Test NDA 1 2018 Question Paper

PART-A

SYNONYMS

Directions: Each item in this section consists of a sentence with an underlined word/words followed by four words. Select the option that is nearest in meaning to the underlined word/words and mark your response in your Answer Sheet accordingly.

1. I do not want you to lead a life of sycophancy as you did during the foreign rule.
a. admiration **b.** love
c. appreciation **d.** flattery

2. In India, It has become easy to attack cultural artefacts these days.
a. beckon **b.** assault
c. belch **d.** appreciate

3. A local court granted bail to the criminal on Thursday.
a. confessed **b.** donated
c. allowed **d.** yielded

4. The judge told that he would analyze the evidence and then deliver the verdict.
a. liberate **b.** surrender
c. transfer **d.** pronounce

5. The growth and development of the peasant movement was indissolubly linked with the national struggle for freedom.
a. firmly **b.** vaguely
c. individually **d.** steadily

6. Weather conditions have been improving over the past few days.
a. mending **b.** amending
c. becoming better **d.** advancing

7. The confusion on the interlocutor's face was gratifying.
a. government officer **b.** party worker
c. dialogist **d.** revolutionary

8. He spends his money lavishly.
a. hesitatingly **b.** generously
c. foolishly **d.** carefully

9. The government's new policies will come into force from the next fiscal year.
a. calendar **b.** academic
c. financial **d.** leap

10. Abundant food was available for the soldiers in the mess.
a. little **b.** plentiful
c. delicious **d.** wholesome

ANTONYMS

Directions: Each item in this section consists of a sentence with an underlined word/words followed by four words. Select the option that is **opposite in meaning** to the underlined word/words and mark your response in your Answer Sheet accordingly.

11. The country's economy must be geared to wartime requirements.
a. subordinated to **b.** related to
c. adjusted to **d.** unlinked to

12. Why does fire attract insects?
a. discharge **b.** destroy
c. repel **d.** remove

13. The party was excellent, and I would like to thank all the people concerned.
a. cared **b.** attentive
c. dependable **d.** uninvolved

14. He is very serious by temperament.
a. grave **b.** trivial
c. sober **d.** stupid

15. There are a few miscellaneous items to discuss in this meeting.
a. pure **b.** mixed
c. homogenous **d.** discordant

16. Due to the postal, strike, the outgoing mail got delayed.
a. urgent **b.** incoming
c. ordinary **d.** speedy

17. He had a fine ear for music.
a. small **b.** close
c. coarse **d.** smooth

18. There is no likeness between him and his brother.
a. unlikeliness **b.** unlikelihood
c. dissimilarity **d.** disaffinity

19. Cultural diversity in the working place is good for business.
a. uniformity **b.** conformity
c. identity **d.** similarity

20. The company was liquidated within five years.
a. bankrupt **b.** closed down
c. flourishing **d.** privatised

SPOTTING ERRORS

Directions: Each item in this section has a sentence with three underlined parts labelled (a), (b) and (c). Read each sentence to find out whether there is any error in any underlined part and indicate your response in the Answer Sheet against the corresponding letter i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d).

21. The politician lost face in his constituency
a.
when he broke the pre-election promises
b.
he made to his people. No error.
c. **d.**

22. At the request of the Defence Attorney,
a.
the jury were called
b.
and their individual verdicts were recorded.
c.
No error.
d.

23. Frank Lloyd Wright has been acclaimed
a.
by colleagues
b.
as the greater of all modem architects.
c.
No error.
b.

24. In my younger days I could run four miles
a. **b.**
at a stretch. No error.
c. **d.**

25. The owner as well as his servants
a. **b.**
is honest. No error.
c. **d.**

IDIOMS AND PHRASES

Directions: Given below are some idioms/phrases followed by four alternative meanings to each. Choose the response (a), (b), (c) or (d) which is the most appropriate expression.

26. Cry over spilt milk
- **a.** Complaining about a loss in the past
- **b.** Too much inquisitive about something
- **c.** When something is done badly to save money
- **d.** Dealing with a problem only in an emergency situation

27. Cut the mustard
- **a.** Prepare spices out of mustard seeds
- **b.** To come up to expectations
- **c.** Making absurd expectations
- **d.** Very enthusiastic

28. Devil's advocate
- **a.** A dangerous person
- **b.** To present a counter argument
- **c.** Very argumentative person
- **d.** Creating an unpleasant situation

29. Don't count your chickens before the eggs have hatched
- **a.** If you are not good at something, better to avoid that
- **b.** Don't make plans for something that might not happen
- **c.** Not to come up to expectations
- **d.** Don't put all your resources in one possibility

30. Give the benefit of doubt
- **a.** To be partial to someone
- **b.** To be judgmental
- **c.** Regard someone as innocent until
- **d.** Say something exactly right

ORDERING OF SENTENCES

Directions: In this section each item consists of six sentences of a passage. The first and sixth sentences are given in the beginning as SI and S6. The middle four sentences in each have been jumbled up and labelled P, Q, R and S. You are required to find the proper sequence of the four sentences and mark your response accordingly on the Answer Sheet.

31. S1 : The Subsidiary Alliance system was extremely advantageous to the British.
S6 : They controlled the defence and the foreign relations of the protected ally.
P : They could now maintain a large army at the cost of Indian states
Q : if any war occurred in the territories
R : either of the-British ally or of the Britishers
S : This enabled them to fight wars far away from their own territories
The proper sequence should be
a. P Q R S **b.** P S Q R
c. Q R P S **d.** S R P Q

32. S1 : In reality, by signing a Subsidiary Alliance, an Indian state virtually signed away its independence.
S6 : In fact, the Indian ruler lost all vestiges of sovereignty in external matters.
P : of maintaining diplomatic relations Q
: It lost the right of self defence
R : with its neighbours
S : and of settling its disputes

The proper sequence should be

a. P Q R S b. R S P Q
c. Q P S R d. Q S R P

33. S1 : A mighty popular Revolt broke out in Northern and Central India in 1857.
S6 : Millions of peasants, artisans and soldiers fought heroically and wrote a glorious chapter.
P : Sepoys, or the Indian soldiers of the Company's army
Q : but soon engulfed wide regions and involved the masses
R : and nearly swept away the British rule
S : It began with a mutiny of the
The proper sequence should be

a. R S P Q b. P Q R S
c. S R P Q d. Q R P S

34. SI : The Indian Civil Service gradually developed into one of the most efficient and powerful civil services in the world.
S6 : though these qualities obviously served British, and not Indian interests.
P : and often participated in the making of policy independence, integrity and hard work
R : They developed certain traditions of S
: Its members exercised vast power The proper sequence should be

a. P Q R S b. Q R S P
c. R S Q P d. S P R Q

35. SI : The ruin of Indian handicrafts was reflected in the ruin of the towns and cities which were famous for their manufactures.
S6 : Centres were developed and laid waste.
P : Dacca, Surat, Murshidabad and many other rising industrial
Q : ravages of war and plunder, failed to
R : survive British conquest
S : Cities which had withstood the The proper sequence should be

a. P Q R S b. S Q R P
c. S R P Q d. Q R S P

COMPREHENSION

Directions: In this section you have few short passages. After each passage, you will find some items based on the passage. First, read a passage and answer the items based on it. You are required to select your answers based on the contents of the passage and opinion of the author only.

Passage

The rule of the road means that in order that the liberties of all may be preserved, the liberties of everybody must be curtailed. When the policeman, say, at a road-crossing steps into the middle of the road and puts out his hand, he is the symbol not of tyranny but of liberty. You have submitted to a curtailment of private liberty in order that you may enjoy a social order which makes your liberty a reality. We have both liberties to preserve — our individual liberty and our social liberty. That is, we must have a judicious mixture of both. I shall not permit any authority to say that my child must go to this. school or that, shall specialize in science or arts. These things are personal. But if I say that my child shall have no education at all, then society will thinly tell me that my child must have education whether I like it or not.

36. According to the author, the "rule of the road" implies
a. the rule regulating the traffic on the road
b. the principle on which a road is constructed to ensure safe traffic
c. unrestricted freedom for all to lead a happy life
d. restricted individual freedom to ensure freedom for all

37. The author thinks that when a policeman signals you to stop on a road-crossing, he is
a. behaving in a whimsical manner
b. interfering with your freedom to use the road
c. protecting the liberty of all to use the road
d. mischievously creating hurdles in your way from some personal motive

38. The author is of the view that we should
a. have absolute individual liberty without any restrictions imposed by the society
b. have everything controlled by the society without any kind of individual liberty
c. try to strike a sensible balance between our individual liberty and our social liberty
d. have more of social liberty than individual liberty

39. The author holds that
a. educating or not educating his child is a matter of personal liberty
b. educating or not educating his child is also a matter of social liberty
c. choosing the school for his child is a matter of social liberty
d. choosing the subject of study for his child is a matter of social liberty

40. The most suitable title of the passage would be
a. The Policeman at a Road Crossing
b. The Laws of the Road
c. Importance of Liberty
d. Education of Children

Passage

My most interesting visitor comes at night, when the lights are still burning — a tiny bat who prefers to fly in through the open door and will use the window only if there is no alternative. His object in entering the house is to snap up the moths that cluster around the lamps. All the bats I have seen fly fairly high, keeping near the ceiling; but this particular bat flies in low, like a dive-bomber, zooming in and out of chair legs and under tables. Once, he passed straight between my legs. Has his radar gone wrong, I wondered, or is he just plain crazy?

41. Consider the following statements:
1. The tiny bat flew in low like a dive-bomber.
2. The tiny bat like) all bats keeps near the ceiling.
3. It has lost direction because its radar has gone wrong.
4. It wants to entertain the author with its skill in flying.

Which of the above statements may be assumed to be true from the information given in the passage?

a. 1 only **b.** 1 and 3
c. 2 and 4 **d.** 3 and 4

42. The bat entered the room
a. because there was no alternative
b. to eat the moths round the lamps
c. as it had gone mad
d. as it preferred to fly in through the open door

43. After comparing the habits of the tiny bat with those of other bats, the author was
a. sure, that this bat had lost its direction
b. notsure of its preferences
c. surprised to find that it was an expert flier
d. unable to give the correct explanation for its behaviour

44. The author calls the tiny bat an "interesting visitor". This means
a. the bat visits him at night
b. the bat is interested in the moths
c. this bat has peculiar qualities
d. this bat surprises him by zooming in and out like a dive-bomber

45. What, according to you, can be the most suitable title for the passage?
a. Someone visits me
b. Night of Mysteries
c. My Nocturnal Visitor
d. A Funny Visitor

FILL IN THE BLANK

Directions: Each of the following sentences in this section has a blank space and four words or group of words given after the sentence. Select the word or group of words you consider most appropriate for the blank space and indicate your response on the Answer Sheet accordingly

46. The tired traveller____________on in the hope of finding some resting place.
a. strolled **b.** scurried
c. paraded **d.** plodded

47. The car was damaged beyond repair in the ____________accident.
a. outrageous **b.** ghastly
c. nasty **d.** heinous

48. They gave a____________dinner to celebrate the occasion, which impressed every guest.
a. austere **b.** public
c. sumptuous **d.** summary

49. Once the____________manuscript is received by the publishers, it is typed in double space.
a. total **b.** full
c. complete **d.** filled

50. I am used to____________in queues.
a. stand **b.** standing
c. stand up **d.** standing still

PART-B

51. Which one of the following statements is correct?
a. Any energy transfer that does not involve temperature difference in some way is not heat
b. Any energy transfer always requires a temperature difference
c. On heating the length and volume of the object remain exactly the same
d. Whenever there is a temperature difference, heat is the only way of energy transfer

52. If T is the time period of an oscillating pendulum, which one of the following statements is NOT correct?
a. The motion repeats after time T only once
b. T is the least time after which motion repeats itself
c. The motion repeats itself after nT, where n is a positive integer
d. T remains the same only for small angular displacements

53. If an object moves with constant velocity then which one of the following statements is NOT correct?
a. Its motion is along a straight line
b. Its speed changes with time
c. Its acceleration is zero
d. Its displacement increases linearly with time

54. An object, is moving with uniform acceleration a. Its initial velocity is it and after time t its velocity is v. The equation of its motion is $v = u + at$. The velocity (along y-axis) time (along x-axis) graph shall be a straight line
a. passing through origin
b. with x-interceptu
c. with y-interceptu
d. with slope u

55. What is the net force experienced by a bar magnet placed in a uniform magnetic field?
a. Zero
b. Depends upon length of the magnet
c. Never zero
d. Depends upon temperature

56. Which one of the following has maximum inertia
a. An atom
b. A molecule
c. A one-rupee coin
d. A cricket ball

57. Which one of the following is the value of 1 kWh of energy converted into joules?
a. 1.8×10^6 J
b. 3.6×10^6 J
c. 6.0×10^6 J
d. 7.2×10^6 J

58. Which one of the following statements about gravitational force is NOT correct?
a. It is experienced by all bodies in the universe
b. It is a dominant force between celestial bodies
c. It is a negligible force for atoms
d. It is same for all pairs of bodies in our universe

59. Whether an object will float or sink in a liquid, depends on
a. mass of the object only
b. mass of the object and density of liquid only
c. difference in the densities of the object and liquid
d. mass and shape of the object only

60. Which one of the following devices is non-ohmic
a. Conducting copper coil
b. Electric heating coil
c. Semi conductor diode
d. Rheostat

61. Which one of the following is the natural phenomenon based on which a simple periscope works?
a. Reflection of light
b. Refraction of light
c. Dispersion of light
d. Total internal reflection of light

62. Which one of the following frequency ranges is sensitive to human ears?
a. 0 – 200 Hz
b. 20 – 20,000 Hz
c. 200 – 20,000 Hz only
d. 2,000 – 20, 000 Hz only

63. The accidental touch of Nettle leaves creates a burning sensation, which is due to inject of
a. Hydrochloric acid
b. Methanoic acid
c. Citric acid
d. Sulphuric acid

64. Which of the following properties is true for a tooth paste?
a. It is acidic
b. It is neutral
c. It is basic
d. It is made up of calcium phosphate, the material of tooth enamel

65. Which one of the following gives the highest amount of hydrogen ions (H^+)?
a. Sodium hydroxide solution
b. Milk of magnesia
c. Lemon juice
d. Gastric juice

66. Brine is an aqueous solution of
a. NaCl
b. NaOH
c. $NaHCO_3$
d. Na_2CO_3

67. Which one of the following is the chemical formula of Washing Soda?
a. $NaHCO_3$
b. $Na_2CO_3 . 10H_2O$
c. $Na_2CO_3 . 5H_2O$
d. NaOH

68. Which one of the following is NOT true for bleaching powder?
a. It is used as a reducing agent in chemical industries
b. It is used for bleaching wood pulp in paper factories
c. It is used for disinfecting drinking water
d. It is used for bleaching linen in textile industry

69. AIDS is caused by a virus whose genetic material is
a. single stranded circular DNA
b. double stranded DNA
c. single stranded RNA
d. double stranded RNA

70. Which one of the following is an organelle that is NOT found in prokaryotic cells?
a. Cell wall
b. Mitochondria
c. Plasma membrane
d. Ribosome

71. Which one of the following parts of body does NOT take part in the process of breathing?
a. Bronchi
b. Bowman's capsule
c. Diaphragm
d. Trachea

72. Which one of the following statements about classification of plants is correct?
a. Thallophytes have well differentiated body design
b. Funaria is a fungus
c. All Pteridophytes are Phanerogams
d. Vascular system is not found among Bryophytes

73. Which one of the following is the correct sequence of levels of hierarchy of classification of organisms from higher to lower?
a. Phylum – Class – Order – Family – Genus
b. Phylum – Class – Family – Order – Genus
c. Family – Order – Class – Species – Genus
d. Class – Family – Order – Species – Genus

74. Which one of the following statements about meristematic tissues in plants is correct?
a. These are dead tissues and form wood
b. They provide flexibility to plant due to their thickened walls
c. These are present in the bark of a tree only
d. Growth occurs in plants due to division of cells of these tissues

75. Which one of the following Union Territories has the highest female literacy rate?
a. Chandigarh
b. Ladshadweep
c. Andaman and Nicobar Islands
d. Puducherry

76. Consider the following statements about Roaring Forties :
1. They are strong Westerly winds found in the oceans of Southern Hemisphere.
2. The strong east to west air currents are caused by the combination of air being displaced from the Equator towards the South Pole and the earth's rotation and abundance of landmasses to serve as wind breaks.

Which of the statements given above is / are correct?
a. 1 only　　b. 2 only
c. Both 1 and 2　　d. Neither 1 nor 2

77. Consider the following statements:
1. The doldrums is a low pressure area around Equator where the prevailing winds are calm.
2. Chinook is a hot and dry wind that blows in winter and therefore raises the temperature in a short time.

Which of the statements given above is / are correct?
a. 1 only　　b. 2 only
c. Both 1 and 2　　d. Neither 1 not 2

78. Which one of the following is the driest desert of the world?
a. Atacama　　b. Gobi
c. Sahara　　d. Kalahari

79. Which of the following statements about latent heat for a given substance is/ are correct?
1. It is fixed at a given temperature.
2. It depends upon the temperature and volume.
3. It is independent of temperature and volume.
4. it depends on the temperature but independent of volume.

Select the correct answer using the code given below:
a. 2　　b. 1 and 3
c. 4 only　　d. 1 and 4

80. Which one of the following statements about the mass of a body is correct?
a. It changes from one place to another
b. It is same everywhere
c. It depends on its shape
d. It does not depend on its temperature

81. A ball balanced on the vertical rod is an example of
a. stable equilibrium
b. unstable equilibrium
c. neutral equilibrium
d. perfect equilibrium

82. Which of the following statements about a fluid at rest in cup is / are correct?
1. Pressure is same at all the points in the fluid.
2. Pressure is exerted on the walls.
3. Pressure exists everywhere in the fluid.

Select the correct answer using the code given below
a. 1 only　　b. 2 only
c. 2 and 3 only　　d. 1, 2 and 3

83. Which one of the following devices is used to measure atmospheric pressure?
a. Ammeter　　b. Barometer
c. Potentiometer　　d. Lactometer

84. Which one of the following is the number of water molecules that share with two formula unit $CaSO_4$ in plaster of Paris?
a. One　　b. Two
c. Five　　d. Ten

85. How is carbon black obtained?
a. By heating wood at high temperature in absence of air
b. By heating coal at high temperature in absence of air
c. By burning hydrocarbons in a limited supply of air
d. By heating coal at high temperature in presence of air

86. Which one of the following properties is NOT true for graphite?
a. Hybridisation of each carbon atom is sp^3
b. Hybridisation of each carbon atom is sp2
c. Electrons are delocalized over the whole sheet of atoms
d. Each layer is composed of hexagonal rings

87. Which one of the following is the purest forms of Carbon?
a. Charcoal　　b. Coke
c. Fullerene　　d. Carbon black

88. The Poisonous nature of Carbon monoxide (CO) is due to its
a. Insolubility in water
b. Ability to form a complex with haemoglobin
c. Ability to reduce some metal oxides
d. Property of having one sigma bond

89. Which one of the following elements is needed in the human body to transfer electrical signals by nerve cells?
a. Lithium **b.** Sodium
c. Rubidium **d.** Caesium

90. Who among the following first discovered cell?
a. Robert Brown **b.** Robert Hooke
c. Leeuwenhoek **d.** Rudolf Virchow

91. Which one of the following group of organisms forms a foodchain?
a. Grass, human and fish
b. Grass, goat and human
c. Tree, tree cutter and tiger
d. Goat, cow and human

92. Which one of the following types of tissues will have contractile proteins?
a. Nervous tissue **b.** Muscle tissue
c. Bone tissue **d.** Blood tissue

93. If by an unknown accident the acid secreting cells of the stomach wall of an individual are damaged, digestion of which of the following biomolecule will be affected to a greater extent?
a. Protein only
b. Lipid
c. Carbohydrate only
d. Protein and Carbohydrate

94. In which one of the following places, Headquarters of a Railway Zone is located?
a. Kanpur **b.** Lucknow
c. Hajipur **d.** New Jalpaiguri

95. Which of the following statements about Indian Academy of Highway Engineers is/are correct?
1. It is a registered society.
2. It is a collaborative body of both Central Government and State Governments.
Select the correct answer using the code given below:
a. 1 only **b.** 2 only
c. Both 1 and 2 **d.** Neither 1 nor 2

96. Which one of the following is NOT a tributary of Indus River ?
a. Beas **b.** Ravi
c. Chenab **d.** Tawi

97. Which one among the following is the largest tiger reserve of India in terms of area of the core / critical tiger habitat?
a. Manas
b. Pakke
c. Nagarjunasagar Srisailam
d. Periyar

98. Which one of the following is NOT A coastal depositional feature?
a. Tombolo **b.** Sand bar
c. Stack **d.** Spit

99. Which of the following is / are coastal erosional feature (s)?
1. Notch **2.** Sea Arch
3. Cliff **4.** Hook
Select the correct answer using the code given below:
a. 1, 2 and 3 **b.** 2, 3 and 4
c. 2 and 3 only **d.** 1 only

100. Chemical weathering of rocks is much greater in a place with
a. cold and dry climate **b.** hot and humid climate
c. hot and dry **d.** cold and humid climate

101. Which of the following statements about specific heat of the body is / are correct?
1. It depends upon mass and shape of the body
2. It is independent of mass and shape of the body
3. It depends only upon the temperature of the body
Select the correct answer using the code given below:
a. 1 only **b.** 2 and 3
c. 1 and 3 **d.** 2 only

102. Which one of the following is an example of the force of gravity of the earth acting on a vibrating pendulum bob?
a. Applied force **b.** Frictional force
c. Restoring force **d.** Virtual force

103. Which one of the following statements about the refractive index of a material medium with respect to air is correct?
a. It can be either positive or negative
b. It can have zero value
c. It is unity for all materials
d. It is always greater than one

104. Which one of the following statements about magnetic field lines is NOT correct?
a. They can emanate from a point
b. They do not cross each other
c. Field lines between two poles cannot be precisely straight lines at the ends
d. There are no field lines within a bar magnet

105. Two convex lenses with power 2 dioptre are kept in contact with each other. The focal length of the combined lens system is
a. 0.10 m **b.** 2 m
c. 4 m **d.** 0.25 m

106. Which one of the following alkali metals has lowest melting point?
a. Sodium **b.** Potassium
c. Rubidium **d.** Caesium

107. Which one of the following metals is alloyed with sodium to transfer heat in a nuclear reactor?
a. Potassium **b.** Calcium
c. Magnesium **d.** Strontium

108. Which one of the following metals is used in the filaments of photo-electric cells that convert light energy into electric energy?
a. Tungsten **b.** Copper
c. Rubidium **d.** Aluminium

109. Which of the following statements about Ring of Fire is / are correct?
1. It is a zone of convergence plate boundaries
2. It is an active seismic and volcanic zone
3. It is associated with deep trench
Select the correct answer using the code given below :
a. 1 and 2 only **b.** 2 and 3 only
c. 1 only **d.** 1, 2 and 3

110. Which one of the following Himalayan vegetation species is found between the altitudes of 1800 to 2600 metres?
a. Saal **b.** Chir
c. Spruce **d.** Deodar

111. Which one of the following rivers is NOT a tributary of river Cauvery?
a. Hemavati **b.** Arkavati
c. Indravati **d.** Amravati

112. Which of the following conditions is/are essential for tea cultivation?
1. Tropical and sub-tropical climate
2. Heavy rainfall ranging from 150 cm to 250 cm
3. Soil should contain good amount of lime
Select the correct answer using the code given below:
a. 1, 2 and 3 **b.** 1 and 2 only
c. 2 and 3 only **d.** 1 only

113. Bharatmala Project is related to
a. Improving road connectivity
b. Interlinking ports and railways
c. Interlinking of rivers
d. Interlinking major cities with gas pipelines

114. Which one of the following is a local wind that blows out from Siberia?
a. Bora **b.** Purga
c. Mistral **d.** Blizzard

115. Which one of the following centres in NOT known for iron and steel industry?
a. Bhadravati **b.** Salem
c. Vishakhapatnam **d.** Renukoot

116. Which of the following are essential pre-requisites for establishment of a thermal power station?
1. Availability of fossil fuels
2. Proximity to a river, lake or sea
3. Good transport network
4. Proximity to an urban centre
Select the correct answer using the code given below:
a. 1, 2 and 3 **b.** 2 and 4
c. 2 and 3 only **d.** 1 and 3 only

117. Which of the following statements about 'Aadi Mahotsav' held recently in New Delhi is/are correct?
1. The theme of the festival was 'A Celebration of the Spirit of Tribal Culture, Cuisine and Commerce'
2. The festival was organized by the Ministry of Tourism, Government of India
Select the correct answer using the code given below :
a. 1 only **b.** 2 only
c. Both 1 and 2 **d.** Neither 1 nor 2

118. Light year is a unit for measurement of
a. age of universe
b. very small time intervals
c. very high temperature
d. very large distance

119. Which of the following statements about electromagnetic waves, sound waves and water waves is/are correct?
1. They exhibit reflection
2. They carry energy
3. They exert pressure
4. They can travel in vacuum
Select the correct answer using the code given below :
a. 1, 2 and 3 **b.** 2 and 4
c. 1 and 3 only **d.** 1 only

120. Thermal capacity of a body depends on the
a. mass of the body only
b. mass and shape of the body only
c. density of the body
d. mass, shape and temperature of the body

121. Who among the following first used the term 'Industrial Revolution' in English to describe the changes that occurred in British industrial development between 1760 and 1820 ?
a. Karl Marx **b.** Georges Michelet
c. Arnold Toynbee **d.** Friedrich Engels

122. Which one of the following statements about the Olympe de Gouges (1748-1793) is correct ?
a. She declared that although citizens should have equal rights, they are not entitled to the same honours by the State
b. She was a supporter of the Jacobin government
c. She was jailed for treason by the National Assembly
d. She declared that the nation is the union of woman and man.

123. Who among the following built a model steam engine in 1698 called "Miner's Friend" to drain mines ?

a. Thomas Savery **b.** Thomas Newcomen
c. James Watt **d.** Richard Arkwright

124. Which one of the following statements about Renaissance" Humanist culture is NOT true ?

a. It slackened the control of religion over human life
b. It believed that human nature .was many-sided
c. It was concerned with good manners
d. It criticized material wealth, power and glory

125. Who gifted the Badshah Nama to King George in 1799?

a. Abul Fazl **b.** Abdul Hamid Lahori
c. Nawab of Awadh **d.** William Jones

126. What is the name of the award given to meritorious men in the Mughal Court in the form of a robe of honour that was once worn by the Emperor ?

a. Sarapa **b.** Patka
c. Padma murassa **d.** Khilat

127. Who among the following social reformer started a society for the encouragement of widow remarriage in 1866 in Maharashtra?

a. Bal Gangadhar Tilak
b. Jyotirao Phule
c. Vishnushastri Pandit
d. Pandita Ramabai

128. Name the first major voluntary associa-tion representing primarily Indian land-lord interests that was set up in Calcutta in 1851?

a. British Indian Association
b. Landholder's Society
c. Madras Native Association
d. Bombay Association

129. Who among the following introduced the Permanent Settlement of Bengal in 1793?

a. Lord Cornwallis **b.** Lord Ripon
c. Robert Clive **d.** John Adam

130. Name the rebel who fought against the British in the battle of Chinhat in the course of the 1857 Revolt?

a. Ahmadullah Shah **b.** Shah Mal
c. Mangal Pandey **d.** Kunwar Singh

131. Who among the following are the two civil servants who civil servants who assisted the constituent Assembly in framing the constitution of India?

a. B.N. Rau and K.M. Munshi
b. S.N. Mukherjee and Alladi Krishna swamy Aiyar
c. B.N. Rau and S.N. Mukherjeet
d. K.M. Munshi and Alladi Krishna swamy Aiyar

132. Which member of the constituent Assembly proposed the resolution that the National Flag of India be a "horizontal tricolour of saffron, which and dark green in equal proportion", with a wheel in navy blue at the centre?

a. Jawaharlal Nehru
b. B. R. Ambedkar
c. Rajendra Prasad
d. Sardar Valabhbhai Patel

133. Which of the following is / are NOT historical biography / biographies ?

1. Dipavamsa
2. Harshacharita
3. Vikramankadevacharita
4. Prithvirajavijaya

Select the correct answer from the code given below:

a. 1 only **b.** 2 and 3 only
c. 2, 3 and 4 only **d.** 1, 2, 3 and 4

134. Which of the following pairs are correctly matched?

Traveller	Country from
1. Marco Polo	Italy
2. Ibn Battutu	Morocco
3. Nikitin	Russia
4. Seydi Ali Reis	Turkey

Select the correct answer using the code given below:

a. 1, 2 and 3 only **b.** 2 and 3 only
c. 1, 2, 3 and 4 **d.** 1, and 4 only

135. Which of the following clans are included in the Agnikula Rajputs?

1. Pratiharas 2. Chaulukyas
3. Paramaras 4. Chahamanas

Select the correct answer using the code given below

a. 1 and 3 only **b.** 1, 3 and 4 only
c. 1, 2, 3 and 4 **d.** 2, and 4 only

136. Who among the following was the author of Humayun Nama?

a. Roshanara Begum
b. Ruquaiya Sultan Begum
c. Gulbadan Begum
d. Gauhara Begum

137. Which one of the following about the Parliament of India is NOT correct?

a. The Parliament consists of the President, the Lok Sabha and the Rajya Sabha
b. There are no nominated members in the Lok Sabha
c. The Rajya Sabha cannot be dissolved
d. Some members of the Rajya Sabha are nominated by the President

138. Which one of the following statements with regard to the comptroller and Auditor General (CAG) of India is NOT correct?
- **a.** He is appointed by the President of India
- **b.** He can be removed from office in the same way as the judge of the Supreme Court of India
- **c.** The CAG is eligible for further office under the Government of India after he has ceased the hold his office
- **d.** The salary of the CAG is charged upon the Consolidated fund of India

139. The Superintendence, direction and control of elections in India is vested in
- **a.** The Supreme Court of India
- **b.** The Parliament of India
- **c.** The Election Commission of India
- **d.** The Chief Election Commissioner

140. Which of the following provision (s) of the Constitution of India became effective from 26th November 1949?
1. Elections
2. Citizenship
3. Emergency provisions
4. Appointment of the Judges

Select the correct answer using the code given below

a. 1 only **b.** 1 and 2 only
c. 1, 2 and 3 **d.** 2 and 4

141. Which of the following statements regarding construction of Rohtang tunnel is NOT correct ?
- **a.** It is located at an altitude of 5,000 feet
- **b.** It will provide all-year connectivity to Lahaul and Spiti Valley
- **c.** The tunnel is being built by the border Roads organization
- **d.** It will reduce the length of the Leh Manali highway by approximately 50 km

142. Who among the following recently became the first woman pilot in Indian Navy?

a. Astha Segal **b.** Roopa A
c. Sakthi Maya **d.** Shubhangi Swaroop

143. Who among the following Indians did NOT hold the title of Miss World?

a. Reita Faria **b.** Sushmita Sen
c. Diana Hayden **d.** Yukta Mookhey

144. Which one of the following countries has failed to qualify for the first time in 60 years for the FIFA world cup to be held in Russia in the year 2018?

a. Mexico **b.** Iran
c. Saudi Arabia **d.** Italy

145. The Defence Technology and Trade Initiative (DTTI) is a forum for dialogue on defence partnership between India and
- **a.** Russia
- **b.** United State of America
- **c.** Israel
- **d.** France

146. As per the policy applicable in 2017, how much Foreign Direct Investment (FDI) is permitted in the defence sector in India?
- **a.** 49 per cent through the automatic route
- **b.** 26 per cent through the government route
- **c.** 26 per cent through the automatic route and beyond that up to 499 per cent through the government route
- **d.** 75 per cent through the automatic route

147. Which one of the following countries did NOT participate in the 21st edition of Exercise Malabar?
- **a.** United State of America
- **b.** Japan
- **c.** India
- **d.** Australia

148. Justice Dalveer Bhandari of India was recently re-elected to the International Court of Justic after Christopher Greenwood pulled out before 12th round of voting. Christopher Greenwood was a nominee of

a. Canada **b.** Russia
c. Britain **d.** USA

149. In order of review the Income Tax Act, 1961 and to draft a new Direct Tax Law in consonance with economic needs of the country, the Government of India in November 2017 has constituted a Task Force. Who the following is made the convenor of it?
- **a.** Shri Arvind Subramanian
- **b.** Shri Arvind Modi
- **c.** Shri Amitabh Kant
- **d.** Dr. Bibek Debroy

150. The 5th Global Conference on Cyber Space (GCCS) was held in New Delhi in November, 2017. Which of the following statements about GCCS is / are correct?
1. The 4th version of GCCS was held in London.
2. The main them of GCCS 2017 is 'Cyber4All: A Secure and Inclusive Cyberspace for Sustainable Development'.
3. 'Bindu' is the logo GCCS 2017.

Select the correct answer using the code given below:

a. 1 only **b.** 2 only
c. 2 and 3 only **d.** 1, 2 and 3

General Ability Test NDA 1 2018 Answer Keys

PART-A				PART-B							
Q No.	**Ans.**	**Q No.**	**Ans.**	**Q No.**	**Ans.**	**Q No.**	**Ans.**	**Q No.**	**Ans.**	**Q No.**	**Ans.**
1	D	26	A	51	A	76	A	101	B	126	A
2	B	27	B	52	A	77	C	102	C	127	C
3	C	28	C	53	B	78	A	103	D	128	A
4	D	29	B	54	C	79	C	104	D	129	A
5	A	30	C	55	A	80	B	105	D	130	A
6	C	31	B	56	D	81	B	106	D	131	C
7	C	32	C	57	B	82	B	107	A	132	A
8	C	33	A	58	D	83	B	108	C	133	A
9	C	34	D	59	C	84	A	109	D	134	C
10	B	35	B	60	C	85	C	110	B	135	C
11	D	36	D	61	A	86	A	111	C	136	C
12	C	37	C	62	B	87	D	112	A	137	B
13	D	38	C	63	B	88	B	113	A	138	C
14	B	39	B	64	D	89	B	114	B	139	C
15	C	40	C	65	D	90	B	115	D	140	B
16	B	41	A	66	A	91	B	116	A	141	C
17	C	42	B	67	B	92	B	117	A	142	C
18	A	43	D	68	A	93	A	118	D	143	B
19	A	44	D	69	C	94	C	119	A	144	D
20	C	45	C	70	B	95	C	120	A	145	B
21	C	46	D	71	B	96	D	121	C	146	A
22	D	47	A	72	D	97	C	122	D	147	D
23	C	48	C	73	A	98	C	123	A	148	C
24	B	49	C	74	D	99	A	124	D	149	B
25	D	50	B	75	B	100	B	125	C	150	B

Mathematics NDA 2 2017 Question Paper

1. If $x + \log_{10}(1 + 2^x) = x\log_{10} + \log_{10} 6$ then x is equal to
(a) 2, -3
(b) 2 only
(c) 1
(d) 3

2. The remainder and the quotient of the binary division
$(101110)_2 \div (110)_2$ are respectively
(a) $(111)_2$ and $(100)_2$
(b) $(100)_2$ and $(111)_2$
(c) $(101)_2$ and $(111)_2$
(d) $(100)_2$ and $(100)_2$

3. The matrix A has x rows and $x + 5$ columns. The matrix B has y rows and $11 - y$ columns. Both AB and BA exist. What are the values x and y respectively?
(a) 8 and 3
(b) 3 and 4
(c) 3 and 8
(d) 8 and 8

4. If $S_n = nP + \frac{n(n-1)Q}{2}$, where S_n denotes the sum of the first *n* terms of an AP, then the common difference is
(a) P + Q
(b) 2P + 3Q
(c) 2Q
(d) Q

5. The roots of the equation
$(q - r)x^2 + (r - p)x + (p - q) = 0$ are
(a) $(r - p) / (q - r)$, 1/2
(b) $(p - q) / (q - r)$, 1
(c) $(q - r) / (p - q)$, 1
(d) $(r - p) / (p - q)$, 1/2

6. If E is the universal set and $A = B \cup C$, then the set
$E - \Big(E - \big(E - (E - (E - A))\big)\Big)$ is same as the set
(a) $B' \cup C'$
(b) $B \cup C$
(c) $B' \cap C'$
(d) $B \cap C$

7. If A = {x: x is a multiple of 2}, B= {x: x is a multiple of 10}, then $A \cap (B \cap C)$ is equal to
(a) A
(b) B
(c) C
(d) {x: x is a multiple of 100}

8. If α and β are the roots of the equation $1 + x + x^2 = 0$, then the matrix product
$\begin{bmatrix} 1 & \beta \\ \alpha & \alpha \end{bmatrix} \begin{bmatrix} \alpha & \beta \\ 1 & \beta \end{bmatrix}$ is equal to?
(a) $\begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$
(b) $\begin{bmatrix} -1 & -1 \\ -1 & 2 \end{bmatrix}$
(c) $\begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$
(d) $\begin{bmatrix} -1 & -1 \\ -1 & -2 \end{bmatrix}$

9. If |a| denotes the absolute value of an integer, then which of the following are correct?
I. $|ab| = |a||b|$
II. $|a + b| \leq |a| + |b|$
III. $|a - b| \geq |a| - |b|$

Select the correct answer using the code given below.

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2, and 3

10. How many different permutations can be made out of the letters of the word "PERMUTATION"?
(a) 19958400
(b) 19954800
(c) 19952400
(d) 39916800

11. If $A = \begin{bmatrix} 4i-6 & 10i \\ 14i & 6+4i \end{bmatrix}$ and $k = \frac{1}{2i}$, where $i = \sqrt{-1}$, then kA is equal to
(a) $\begin{bmatrix} 2+3i & 5 \\ 7 & 2-3i \end{bmatrix}$
(b) $\begin{bmatrix} 2-3i & 5 \\ 7 & 2+3i \end{bmatrix}$
(c) $\begin{bmatrix} 2-3i & 7 \\ 5 & 2+3i \end{bmatrix}$
(d) $\begin{bmatrix} 2+3i & 5 \\ 7 & 2+3i \end{bmatrix}$

12. The sum of all real roots of the equation $|x-3|^2 + |x-3| - 2 = 0$ is
(a) 2
(b) 3
(c) 4
(d) 6

13. If is given that the roots of the equation $x^2 - 4x - \log_3 P = 0$ are real. For this, the minimum value of P is
(a) $\frac{1}{27}$
(b) $\frac{1}{64}$
(c) $\frac{1}{81}$
(d) 1

14. If A is a square matrix, then the value of adj $A^T - (\text{adj } A)^T$ is equal to
(a) A
(b) $2|A|I$, where I is the identity matrix
(c) Null matrix whose order is same as that of A
(d) Unit matrix whose order is same as that of A

15. The value of the product $6^{\frac{1}{2}} \times 6^{\frac{1}{4}} \times 6^{\frac{1}{8}} \times 6^{\frac{1}{16}} \times \ldots$ up to infinite terms is
(a) 6
(b) 36
(c) 216
(d) 512

16. The value of the determinant $\begin{vmatrix} \cos^2\frac{\theta}{2} & \sin^2\frac{\theta}{2} \\ \sin^2\frac{\theta}{2} & \cos^2\frac{\theta}{2} \end{vmatrix}$ for all values of θ, is
(a) 1
(b) $\cos\theta$
(c) $\sin\theta$
(d) $\cos\theta$

17. The number of terms in the expansion of $(x+a)^{100} + (x-a)^{100}$ after simplification is
(a) 202
(b) 101
(c) 51
(d) 50

18. In the expansion of $(1+)^{50}$, the sum of the coefficients of odd powers of *x* is
(a) 2^{26}
(b) 2^{49}
(c) 2^{50}
(d) 2^{51}

19. If a, b, c are non-zero real numbers, then the inverse of the matrix
$$A = \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$$
(a) $\begin{bmatrix} a^{-1} & 0 & 0 \\ 0 & b^{-1} & 0 \\ 0 & 0 & c^{-1} \end{bmatrix}$
(b) $\frac{1}{abc}\begin{bmatrix} a^{-1} & 0 & 0 \\ 0 & b^{-1} & 0 \\ 0 & 0 & c^{-1} \end{bmatrix}$
(c) $\frac{1}{abc}\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
(d) $\frac{1}{abc}\begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$

20. A person is to count 4500 notes. Let a_n denote the number of notes he counts in the *n*th minute.
If $a_1 = a_2 = a_3 = .. = a_{10} = 150$, and a_{10}, a_{11}, a_{12} ... are in AP with the common difference -2 , then the time taken by him to count all the notes is
(a) 24 minutes
(b) 34 minutes
(c) 125 minutes
(d) 135 minutes

21. The smallest positive integer *n* for which $\left(\frac{1+i}{1-i}\right)^n = 1$, is
(a) 1
(b) 4
(c) 8
(d) 16

22. If we define a relation R on the set $N \times N$ as (a, b) R (c, d) $\Leftrightarrow$ $a + d = b + c$ for all (a, b), (c, d) $\in$ $N \times N$, then the
(a) Symmetric only
(b) Symmetric and transitive only
(c) Equivalence relation
(d) Reflexive only

23. If $y = x + x^2 + x^3 + \cdots$ up to infinite terms, where $x < 1$, then which of the following is correct?
(a) $x = \frac{y}{1+y}$
(b) $x = \frac{y}{1-y}$
(c) $x = \frac{1+y}{y}$
(d) $x = \frac{1-y}{y}$

24. If α and β are the roots of the equation $3x^2 + 2x + 1 = 0$, then equation whose roots are $\alpha + \beta^{-1}$ and $\beta + \alpha^{-1}$ is
(a) $3x^2 + 8x + 16 = 0$
(b) $3x^2 - 8x - 16 = 0$
(c) $3x^2 + 8x - 16 = 0$
(d) $x^2 + 8x + 16 = 0$

25. The value of
$$\frac{1}{\log_3 e} + \frac{1}{\log_3 e^2} + \frac{1}{\log_3 e^4} + \cdots$$
Up to infinite terms is
(a) $\log_e 9$
(b) 0
(c) 1
(d) $\log_e 3$

26. A tea party is arranged for 16 people along two sides of a long table with eight chairs on each side. Four particular men wish to sit on one particular side and two particular men on the other side. The number of ways they can be seated is
(a) $24 \times 8! \times 8!$
(b) $(8!)^3$
(c) $210 \times 8! \times 8!$
(d) $16!$

27. The system of equation $kx + y + z = 1$, $x + ky + z = k$ and $x = y + kz = k^2$ has no solution if *k* equals
(a) 0
(b) 1
(c) -1
(d) -2

28. If $1.3 + 2.3^2 + 3.3^3 + \cdots + n.3^n = \frac{(2n-1)3^a + b}{4}$
Then *a* and *b* are respectively
(a) n, 2
(b) n, 3
(c) n + 1, 2
(d) n + 1, 3

29. In $\triangle$ PQR, $\angle R = \frac{\pi}{2}$, If $\tan\left(\frac{P}{2}\right)$ and $\tan\left(\frac{Q}{2}\right)$ are the roots of the equation $ax^2 + bx + c = 0$, then which one of the following is correct?
(a) $a = b + c$
(b) $b = c + a$
(c) $c = a + b$
(d) $b = c$

30. If $\left|z - \frac{4}{2}\right| = 2$, then the maximum value of $|z|$ is equal to
(a) $1 + \sqrt{3}$
(b) $1 + \sqrt{5}$
(c) $1 - \sqrt{5}$
(d) $\sqrt{3} - 1$

31. The angle of elevation of a stationary cloud from a point 25 m above a lake is $15°$ and the angle of depression of its image in the lake $45°$. The height of the cloud above the lake level is
(a) 25 m
(b) $25\sqrt{3}$ m
(c) 50 m
(d) $50\sqrt{3}$ m

32. The value of
$\tan 9° - \tan 27° - \tan 63° + \tan 81°$ is equal to
(a) -1
(b) 0
(c) 1
(d) 4

33. The value of $\sqrt{3}\,\text{cosec}\,20° - \sec 20°$ is equal to
(a) 4
(b) 2
(c) 1
(d) -4

34. Angle α is divided into two parts A and B such that $A - B = x$ and
$\tan A : \tan B = p : q$. The value $\sin x$ is equal to
(a) $\frac{(p+q)\sin\alpha}{p-q}$
(b) $\frac{p\sin\alpha}{p-q}$
(c) $\frac{p\sin\alpha}{p+q}$
(d) $\frac{(p-q)\sin\alpha}{p+q}$

35. The value of
$\sin^{-1}\left(\frac{3}{5}\right) + \tan^{-1}\left(\frac{1}{7}\right)$
is equal to
(a) 0
(b) $\frac{\pi}{4}$
(c) $\frac{\pi}{3}$
(d) $\frac{\pi}{2}$

36. The angles of elevation of the top of a tower from the top and foot of a pole are respectively $30°$ and $45°$. If h_T is the height of the tower and h_P is the height of the pole, then which of the following are correct?
1. $\frac{2h_P h_T}{3+\sqrt{3}} = h_P^2$
2. $\frac{h_T - h_P}{\sqrt{3}+1} = \frac{h_P}{2}$
3. $\frac{2(h_P+h_T)}{h_P} = 4 + \sqrt{3}$

Select the correct answer using the code given below.
(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

37. In a triangle ABC, $a - 2b + c = 0$. The value of $\cot\left(\frac{A}{2}\right)\cot\left(\frac{C}{2}\right)$ is
(a) $\frac{9}{2}$
(b) 3
(c) $\frac{3}{2}$
(d) 1

38. $\sqrt{1 + \sin A} = -\left(\sin\frac{A}{2} + \cos\frac{A}{2}\right)$ is true if
(a) $\frac{3\pi}{2} < A < \frac{5\pi}{2}$ only
(b) $\frac{\pi}{2} < A < \frac{3\pi}{2}$ only
(c) $\frac{3\pi}{2} < A < \frac{7\pi}{2}$

(d) $0 < A < \frac{3\pi}{2}$

39. In triangle ABC, if
$\frac{\sin^2 A + \sin^2 B + \sin^2 C}{\cos^2 A + \cos^2 B + \cos^2 C} = 2$
Then the triangle is
(a) Right-angled
(b) Equilateral
(c) Isosceles
(d) Obtuse-angled

40. The principal value of $\sin^{-1} x$ lies in the interval
(a) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$
(b) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$
(c) $\left[0, \frac{\pi}{2}\right]$
(d) $[0, \pi]$

41. The points (a, b), (0,0), (-a,-b) and (ab, b^2) are
(a) The vertices of a parallelogram
(b) The vertices of a rectangle
(c) The vertices of a square
(d) Collinear

42. The length of the normal from origin to the plane $x = 2y - 2z = 9$ is equal to
(a) 2 units
(b) 3 units
(c) 4 units
(d) 5 units

43. If α, β and γ are the angles which the vector $\overrightarrow{OP}$ (O being the origin) makes with positive direction of the coordinate axes, then which of the following are correct?
1. $\cos^2\alpha + \cos^2\beta = \sin^2\gamma$
2. $\sin^2\alpha + \sin^2\beta = \cos^2\gamma$
3. $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2$

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

44. The angle between the lines $x + y - 3 = 0$ and $x - y + 3 = 0$ is α and the acute angle between the lines $x - \sqrt{3}y + 2\sqrt{3} = 0$ is β. Which one of the following is correct?
(a) $\alpha = \beta$
(b) $\alpha > \beta$
(c) $\alpha < \beta$
(d) $\alpha = 2\beta$

45. Let $\vec{\alpha} = \hat{i} + 2\hat{j} - \hat{k}$, $\vec{\beta} = 2\hat{i} - \hat{j} + 3\hat{k}$ be three vectors. If $\vec{\alpha}$ and $\vec{\beta}$ are both perpendicular to the vector $\vec{\delta}$ and $\vec{\delta}\,.\vec{\gamma} = 10$, then what is the magnitude of $\vec{\delta}$?
(a) $\sqrt{3}$ units
(b) $2\sqrt{3}$ units
(c) $\frac{\sqrt{3}}{2}$ unit
(d) $\frac{1}{\sqrt{3}}$ unit

46. If $\hat{a}$ and $\hat{b}$ are two unit vectors, then the vector $(\hat{a} + \hat{b}) \times (\hat{a} \times \hat{b})$ is parallel to
(a) $(\hat{a} - \hat{b})$
(b) $(\hat{a} + \hat{b})$
(c) $(2\hat{a} - \hat{b})$
(d) $(2\hat{a} + \hat{b})$

47. $\vec{F} = \hat{i} + 3\hat{j} + 2\hat{k}$ acts on a particle to displace it from the point $A(\hat{i} + 2\hat{j} - 3\hat{k})$ to the point $B(3\hat{i} - \hat{j} + 5\hat{k})$. The work done by the force will be
(a) 5 units
(b) 7 units
(c) 9 units

(d) 10 units

48. For any vector $\vec{a}|\vec{a}\times\hat{x}|^2+|\vec{a}\times\hat{j}|^2+|\vec{a}\times\hat{k}|^2$ is equal to
(a) $|\vec{a}|^2$
(b) $2|\vec{a}|^2$
(c) $3|\vec{a}|^2$
(d) $4|\vec{a}|^2$

49. A man running round a racecourse notes that the sum of the distances of two flag-posts from him is always 10 m and the distance between the flag-posts is 8 m. The area of the path he encloses is
(a) 18π square metres
(b) 15π square metres
(c) 12π square metres
(d) 8π square metres

50. The distance of the point (1, 3) from the line $2x+3y=6$, measured parallel to the line $4x+y=4$, is
(a) $\frac{5}{\sqrt{13}}$ units
(b) $\frac{3}{\sqrt{17}}$ units
(c) $\sqrt{17}$ units
(d) $\frac{\sqrt{17}}{2}$ units

51. If the vector $a\hat{\imath}+\hat{\jmath}+\hat{k}, \hat{\imath}+b\hat{\jmath}+\hat{k}$ and $\hat{\imath}+\hat{\jmath}=c\hat{k}$ $(a, b, c \neq 1)$ are coplanar, then the value of
$$\frac{1}{1-a}+\frac{1}{1-b}+\frac{1}{1-c}$$
is equal to
(a) 0
(b) 1
(c) $a+b+c$
(d) abc

52. The point of intersection of the line joining the points $(-3, 4, -8)$ and $(5, -6, 4)$ with the XY-plane is
(a) $\left(\frac{7}{3}, -\frac{8}{3}, 0\right)$
(b) $\left(-\frac{7}{3}, -\frac{8}{3}, 0\right)$
(c) $\left(-\frac{7}{3}, \frac{8}{3}, 0\right)$
(d) $\left(\frac{7}{3}, \frac{8}{3}, 0\right)$

53. If the angle between the lines whose direction ratios are $(2, -1, 2)$ and $(x, 3, 5)$ is $\frac{\pi}{4}$, then the smaller value of *x* is
(a) 52
(b) 4
(c) 2
(d) 1

54. The position of the point (1, 2) relative to the ellipse $2x^2+7y^2=20$ is
(a) Outside the ellipse
(b) Inside the ellipse but not at the focus
(c) On the ellipse
(d) At the focus

55. The equation of a straight line which cuts off an intercept of 5 units on negative direction of y-axis and makes an angle $120°$ with positive direction of x-axis is
(a) $y+\sqrt{3x}+5=0$
(b) $y-\sqrt{3x}+5=0$
(c) $y+\sqrt{3x}-5=0$
(d) $y-\sqrt{3x}-5=0$

56. The equation of the line passing through the point (2, 3) and the point of intersection of lines $2x-3y+7=0$ and $7x+4y+2=0$ is
(a) $21+46y-180=0$
(b) $21x-46y+96=0$
(c) $46x+21y-155=0$
(d) $46x-21y-29=0$

57. The equation of the ellipse whose centre is at origin, major axis is along x-axis with eccentricity $\frac{3}{4}$ and latus rectum 4 units is

(a) $\frac{x^2}{1024}+\frac{7y^2}{64}=1$

(b) $\frac{49x^2}{1024}+\frac{7y^2}{64}=1$

(c) $\frac{7x^2}{1024}+\frac{49y^2}{64}=1$

(d) $\frac{x^2}{1024}+\frac{y^2}{64}=1$

58. The equation of the circle which passes through the points (1, 0), (0, 6), and (3, 4) is
(a) $4x^2+4y^2+142x+47y+140=0$
(b) $4x^2+4y^2-142x+47y+138=0$
(c) $4x^2+4y^2-142x+47y+138=0$
(d) $4x^2+4y^2+150x-49y+138=0$

59. A variable plane passes through a fixed point (a, b, c) and cuts the axes in A, B, and C respectively. The locus of the centre of the sphere OABC, O being the origin is
(a) $\frac{x}{2}+\frac{y}{b}+\frac{z}{c}=1$

(b) $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=1$

(c) $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=2$

(d) $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=2$

60. The equation of the plane passing through the line of intersection of the planes $x+y+z=1$, $2x+3y+4z=7$ and perpendicular to the plane
$x-5y+3z=5$ is given by
(a) $x+2y+3z-6=0$
(b) $x+2y+3z+6=0$
(c) $3x+4y+5z-8=0$
(d) $3x+4y+5z+8=0$

61. The inverse of the function $y=5^{\ln x}$ is
(a) $x=y^{\frac{1}{\ln 5}}, \quad y>0$
(b) $x=y^{\ln 5}, \quad y>0$
(c) $x=y^{\frac{1}{\ln 5}}, \quad y<0$
(d) $x=5\ln y, y>0$

62. A function is defined as follows:
$$f(x)=\begin{cases}-\frac{x}{\sqrt{x^2}}, & x\neq 0\\ 0, & x=0\end{cases}$$
Which one of the following is correct in respect of the above function?
(a) f(x) is continuous at x = 0 but not differentiable at x = 0
(b) f(x) is continuous as well as differentiable at x = 0
(c) f(x) is discontinuous at x = 0
(d) None of the above

63. If $y=(\cos x)^{(\cos x)^{\cos x}}$, then $\frac{dy}{dx}$ is equal to

(a) $-\frac{y^2\tan x}{1-y\ln(\cos x)}$

(b) $\frac{y^2\tan x}{1+y\ln(\cos x)}$

(c) $\frac{y^2\tan x}{1-y\ln(\sin x)}$

(d) $\frac{y^2\tan x}{1+y\ln(\sin x)}$

64. Consider the following:
1. $x+x^2$ is continuous at x = 0
2. $x+\cos\frac{1}{x}$ is discontinuous at x = 0
3. $x^2+\cos\frac{1}{x}$ is continuous at x = 0

Which of the following are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

65. Consider the following statements:
    1. $\frac{dy}{dx}$ at a point on the curve gives slope of the tangent at that point.
    2. If a(t) denotes acceleration of a particle, then
    $$\int a(t)dt + c$$
    gives velocity of the particle.
    3. If s(t) gives displacement of a particle at time t, then $\frac{ds}{dt}$ gives its acceleration at that instant.

    Which of the above statements is/are correct?
    (a) 1 and 2 only
    (b) 2 only
    (c) 1 only
    (d) 1, 2 and 3

66. If $y = \sec^{-1}\left(\frac{x+1}{x-1}\right) + \sin^{-1}\left(\frac{x-1}{x+1}\right)$, then $\frac{dy}{dx}$ is equal to
    (a) 0
    (b) 1
    (c) $\frac{x-1}{x+1}$
    (d) $\frac{x+1}{x-1}$

67. What is
    $$\int \tan^{-1}(\sec x + \tan x)\, dx$$
    equal to?
    (a) $\frac{\pi x}{4} + \frac{x^2}{4} + c$
    (b) $\frac{\pi x}{2} + \frac{x^2}{4} + c$
    (c) $\frac{\pi x}{4} + \frac{\pi x^2}{4} + c$
    (d) $\frac{\pi x}{4} + \frac{x^2}{4} + c$

68. A function defined by $(0, \infty)$ by
    $$f(x) = \begin{cases} 1 - x^2 & \text{for} \quad 0 < x \le 1 \\ \ln x & \text{for} \quad 1 < x \le 2 \\ \ln 2 - 1 + 0.5\, x & \text{for} \quad 2 < x < \infty \end{cases}$$
    Which one of the following is correct in respect of the derivative of the function, i.e., f′(x)?
    (a) $f'(x) = 2x \quad \text{for} \quad 0 < x \le 1$
    (b) $f'(x) = -2x \quad \text{for} \quad 0 < x \le 1$
    (c) $f'(x) = -2x \quad \text{for} \quad 0 < x < 1$
    (d) $f'(x) = 0 \quad \text{for} \quad 0 < x < \infty$

69. Which one of the following is correct in respect of the function
    $$f(x) = x(x-1)(x+1)\ ?$$
    (a) The local maximum value is larger than local minimum value.
    (b) The local maximum value is smaller than local minimum value.
    (c) The function has no local maximum.
    (d) The function has no local minimum.

70. Consider the following statements:
    1. Derivative of f(x) may not exist at some point.
    2. Derivative of f(x) may exist finitely at some point.
    3. Derivative of f(x) may be infinite (geometrically) at some point.

    Which of the above statements are correct?
    (a) 1 and 2 only
    (b) 2 and 3 only
    (c) 1 and 3 only
    (d) 1, 2 and 3

71. The maximum value of $\frac{\ln x}{x}$ is
    (a) e
    (b) $\frac{1}{e}$
    (c) $\frac{2}{e}$
    (d) 1

72. The function $f(x) = |x| = |x| - x^3$ is
    (a) Odd

(b) Even
(c) Both even and odd
(d) Neither even nor odd

73. If

$$l_1 = \frac{d}{dx}\left(e^{\sin x}\right)$$
$$l_2 = \lim_{h \to 0} \frac{e^{\sin(x+h)} - e^{\sin x}}{h}$$
$$l_3 = \int e^{\sin x} \cos x \, dx$$

Then which one of the following is correct?
(a) $l_1 \neq l_2$
(b) $\frac{d}{dx}(l_3) = l_2$
(c) $\int l_3 \, dx = l_2$
(d) $l_2 = l_3$

74. The general solution of

$$\frac{dy}{dx} = \frac{ax + h}{by + k}$$

represents a circle only when
(a) $a = b = 0$
(b) $a = -b \neq 0$
(c) $a = b \neq 0, h = k$
(d) $a = b \neq 0$

75. if

$$\lim_{x \to \frac{\pi}{2}} \frac{\sin x}{x} = l$$

And

$$\lim_{x \to \infty} \frac{\cos x}{x} = m$$

Then which one of the following is correct?
(a) $l = 1, m = 1$
(b) $l = \frac{2}{\pi}, m = \infty$
(c) $l = \frac{2}{\pi}, m = 0$
(d) $l = 1, m = \infty$

76. What is $\int_0^{2\pi} \sqrt{1 + \sin\frac{x}{2} dx}$ equal to?
(a) 8
(b) 4
(c) 2
(d) 0

77. The area bounded by the curve $|x| + |y| = 1$ is
(a) 1 square unit
(b) $2\sqrt{2}$ square units
(c) 2 square units
(d) $2\sqrt{3}$ square units

78. If x is any real number, then $\frac{x^2}{1+x^4}$ belongs to which one of the following intervals?
(a) (0, 1)
(b) $\left(0, \frac{1}{2}\right]$
(c) $\left(0, \frac{1}{2}\right]$
(d) $[0, 1]$

79. The left-hand derivative of

$$f(x) = [x] \sin(\pi x) \text{ at } x = k$$

where k is an integer and $[x]$ is the greatest integer function, is
(a) $(-1)^k (k - 1)\pi$
(b) $(-1)^{k-1} (k - 1)\pi$
(c) $(-1)^k k\pi$
(d) $(-1)^{k-1} k\pi$

80. If $f(x) = \frac{x}{2} - 1$, then on the interval $[0, \pi]$ which one of the following is correct?
(a) $\tan[f(x)]$, where [.] is the greatest integer function, and $\frac{1}{f(x)}$ are both continuous
(b) $\tan[f(x)]$, where [.] is the greatest integer function, and $f^{-1}(x)$ are both continuous
(c) $\tan[f(x)]$, where [.] is the greatest integer function, and $\frac{1}{f(x)}$ are both discontinuous
(d) $\tan[f(x)]$, where [.] is the greatest integer function, is discontinuous but $\frac{1}{f(x)}$ is continuous

81. The order and degree of the differential equation

$$\left[1+\left(\frac{dy}{dx}\right)^2\right]^3 = \rho^2\left[\frac{d^2y}{dx^2}\right]^2$$

are respectively
(a) 3 and 2
(b) 2 and 2
(c) 2 and 3
(d) 1 and 3

82. If

$$y = \cos^{-1}\left(\frac{2x}{1+x^2}\right)$$

then $\frac{dy}{dx}$ is equal to
(a) $-\frac{2}{1+x^2}$ for all $|x| < 1$
(b) $-\frac{2}{1+x^2}$ for all $|x| > 1$
(c) $\frac{2}{1+x^2}$ for all $|x| < 1$
(d) None of the above.

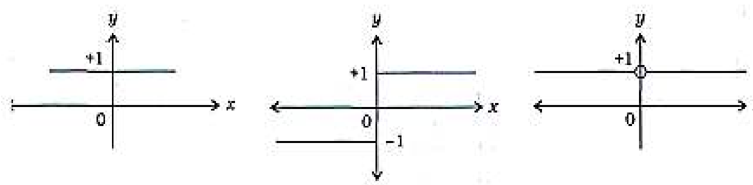
83. The set of all points, where the function $f(x) = \sqrt{1-e^{-x^2}}$ is differentiable, is
(a) $(0,\infty)$
(b) $(-\infty, 0) \cup (0,\infty)$
(c) $(-\infty,\infty)$
(d) $(-1,\infty)$

84. Match List-I with List-II and select the correct answer using the code given below the lists.

List -I (Function		List- II (Maximum value)	
A.	$\sin x + \cos x$	1.	$\sqrt{10}$
B.	$3\sin x + 4\cos x$	2.	$\sqrt{2}$
C.	$2\sin x + \cos x$	3.	5
D.	$\sin x + 3\cos x$	4.	$\sqrt{5}$

Code:
(a) (A-2), (B-3), (C-1), (D-4)
(b) (A-2), (B-3), (C-4), (D-1)
(c) (A-3), (B-2), (C-1), (D-4)
(d) (A-3), (B-2), (C-4), (D-1)

85. If $f(x) = x\left(\sqrt{x}-\sqrt{x+1}\right)$, then f(x) is
(a) Continuous but not differentiable at x = 0
(b) Differentiable at x = 0
(c) Not continuous at x = 0



(a) (b) (c)

(d) None of the above

86. Which one of the following graphs represents the function $f(x) = \frac{x}{x}, x \neq 0$

87. Let $f(n) = \left[\frac{1}{4}+\frac{n}{1000}\right]$, where [x] denotes the integral part of x. then the value of

$$\sum_{n=1}^{1000} f(n) \quad \text{is}$$

(a) 251
(b) 250
(c) 1
(d) 0

88. $\int(\ln x)^{-1}\,dx - \int(\ln x)^{-2}\,dx$ is equal to
(a) $x(\ln x)^{-1} + c$
(b) $x(\ln x)^{-2} + c$
(c) $x(\ln x) + c$
(d) $x(\ln x)^2 + c$

89. A cylindrical jar without a lid has to be constructed using a given surface area of a metal sheet. If the capacity of the jar is to be maximum then the diameter of the jar must be *k* times the height of the jar. The value of *k* is
(a) 1
(b) 2
(c) 3
(d) 4

90. The value of

$$\int_0^{\frac{\pi}{4}}\sqrt{\tan x}\,dx + \int_0^{\frac{\pi}{4}}\sqrt{\cot x}\,dx$$

is equal to
(a) $\frac{\pi}{4}$

(b) $\frac{\pi}{2}$
(c) $\frac{\pi}{2\sqrt{2}}$
(d) $\frac{\pi}{2}$

91. Let g be the greatest integer function. Then the function $f(x) = \left(g(x)\right)^2 - g(x^2)$ is discontinuous at
(a) All integers
(b) All integers except 0 and 1
(c) All integers except 1

92. The differential equation of minimum order by eliminating the arbitrary constants A and C in the equation $y = A[\sin(x + C) + \cos(x + C)]$ is
(a) $y'' + (\sin x + \cos y)\, y' = 1$
(b) $y'' = (\sin x + \cos x)\, y'$
(c) $y'' = (y')^2 + \sin x \cos x$
(d) $y'' + y = 0$

93. Consider the following statements:
Statement I: $x > \sin x$ for all $x > 0$
Statement II: $f(x) = x - \sin x$ is an increasing function for $x > 0$
Which one of the following is correct in respect of the above statements?
(a) Both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.
(b) Both Statement I and II are true and Statement II is not the correct explanation of Statement I.
(c) Statement I is true but Statement II is false.
(d) Statement I is false but Statement II is true.

94. The solution of the differential equation
$$\frac{dy}{dx} = \frac{y\phi(x) - y^2}{\phi(x)}$$
is
(a) $y = \frac{x}{\phi(x)+c}$
(b) $y = \frac{\phi(x)}{xc} + c$
(c) $y = \frac{\phi(x)+c}{x}$
(d) $y = \frac{\phi(x)}{x+c}$

95. If
$$f(x) = \frac{4x + x^2}{1 + x^3} \text{ and } g(x) = \ln\left(\frac{1 + x}{1 - x}\right)$$
then what is the value of $f \circ g\left(\frac{e-1}{e+1}\right)$ equal to?
(a) 2
(b) 1
(c) 0
(d) $\frac{1}{2}$

96. The value of the determinant $\begin{vmatrix} 1-\alpha & \alpha-\alpha^2 & \alpha^2 \\ 1-\beta & \beta-\beta^2 & \beta^2 \\ 1-\gamma & \gamma-\gamma^2 & \gamma^2 \end{vmatrix}$ is equal to
(a) $(\alpha - \beta)(\beta - \gamma)(\alpha - \gamma)$
(b) $(\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)$
(c) $(\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)(\alpha + \beta + \gamma)$
(d) 0

97. The adjoint of the matrix $A = \begin{bmatrix} 1 & 0 & 2 \\ 2 & 1 & 0 \\ 0 & 3 & 1 \end{bmatrix}$ is
(a) $\begin{bmatrix} -1 & 6 & 2 \\ -2 & 1 & -4 \\ 6 & 3 & 1 \end{bmatrix}$
(b) $\begin{bmatrix} 1 & 6 & -2 \\ -2 & 1 & 4 \\ 6 & -3 & 1 \end{bmatrix}$
(c) $\begin{bmatrix} 6 & 1 & 2 \\ 4 & -1 & 2 \\ 6 & 3 & -1 \end{bmatrix}$
(d) $\begin{bmatrix} -6 & 2 & 1 \\ 4 & -2 & 1 \\ 3 & 1 & -6 \end{bmatrix}$

98. If $A = \begin{pmatrix} -2 & 2 \\ -2 & 2 \end{pmatrix}$, then which one of the following is correct?
(a) $A^2 = -2A$
(b) $A^2 = -4A$
(c) $A^2 = -3A$

(d) $A^2 = 4A$

99. Geometrically $\mathrm{Re}(z^2 - i) = 2$, where $i = \sqrt{-1}$ and Re is the real part, represents
(a) Circle
(b) Ellipse
(c) Rectangular hyperbola
(d) Parabola

100. If $p + q + r = a + b + c = 0$, then the determinant $\begin{vmatrix} pa & qb & rc \\ qc & ra & pb \\ rb & pc & qa \end{vmatrix}$ equals
(a) 0
(b) $pa + qb + rc$
(c) 1
(d) $pq + qb + rc + a + b + c$

101. A committee of two persons is selected from two men and two women. The probability that the committee will have exactly one woman is
(a) $\frac{1}{6}$
(b) $\frac{2}{3}$
(c) $\frac{4}{9}$
(d) $\frac{5}{9}$

102. Let a dice be loaded in such a way that even faces are twice likely to occur as the odd faces. What is the probability that a prime number will show up when the dice is tossed.
(a) $\frac{1}{3}$
(b) $\frac{2}{3}$
(c) $\frac{4}{9}$
(d) $\frac{5}{9}$

103. Let the sample space consist of non-negative integers up to 50, denote the numbers which are multipliers of 3 and Y denote the odd numbers. Which of the following is/are correct?
1. $P(X) = \frac{8}{25}$
2. $P(Y) = \frac{1}{2}$

Select the correct answer using the code given below.
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

104. For two events A and B, let $P(A) = \frac{1}{2}$, $P(A \cup B) = \frac{2}{3}$ and $P(A \cap B) = \frac{1}{6}$. What $P(\bar{A} \cap B)$ equal to?
(a) $\frac{1}{6}$
(b) $\frac{1}{4}$
(c) $\frac{1}{3}$
(d) $\frac{1}{2}$

105. Consider the following statements:
1. Coefficient of variation depends on the unit of measurement of the variable.
2. Range is a measure of dispersion
3. Mean deviation is least when measured about median.

Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

106. Given that the arithmetic mean and standard deviation of a sample of 15 observations are 24 and 0 respectively. Then which one of the following is the arithmetic mean of the smallest five observations in the data?
(a) 0

(b) 8
(c) 16
(d) 24

107. Which one of the following can be considered as appropriate pair of values of regression coefficient of *y* on *x* and regression of *x* on *y*?
(a) (1, 1)
(b) (-1, 1)
(c) $\left(-\frac{1}{2}, 2\right)$
(d) $\left(\frac{1}{3}, \frac{10}{3}\right)$

108. Let A and B be two events with $\mathrm{P(A)} = \frac{1}{3}$, $\mathrm{P(B)} = \frac{1}{6}$ and $\mathrm{P(A \cap B)} = \frac{1}{12}$. What is $\mathrm{P(B|\overline{A})}$ equal to?
(a) $\frac{1}{5}$
(b) $\frac{1}{7}$
(c) $\frac{1}{8}$
(d) $\frac{1}{10}$

109. In a binomial distribution, the mean is $\frac{2}{3}$ and the variance is $\frac{5}{9}$. What is the probability that x = 2?
(a) $\frac{5}{36}$
(b) $\frac{25}{36}$
(c) $\frac{25}{216}$
(d) $\frac{25}{54}$

110. The probability that a ship safely reaches a port is $\frac{1}{3}$. The probability that out of 5 ships, at least 4 ships would arrive safely is
(a) $\frac{1}{243}$
(b) $\frac{10}{243}$
(c) $\frac{11}{243}$
(d) $\frac{13}{243}$

111. What is the probability that at least two persons out of a group of three persons were born in the same month (disregard year)?
(a) $\frac{33}{144}$
(b) $\frac{17}{72}$
(c) $\frac{1}{144}$
(d) $\frac{2}{9}$

112. It is given that $\overline{\mathrm{X}} = 10$, $\overline{\mathrm{Y}} = 90$, $\sigma_{\mathrm{x}} = 3$ $\sigma_{\mathrm{Y}} = 12$ and $\mathrm{r_{xy}} = 0.8$. The regression equation of X on Y is
(a) $\mathrm{Y} = 3.2\,\mathrm{X} + 58$
(b) $\mathrm{X} = 3.2\,\mathrm{Y} + 58$
(c) $\mathrm{X} = -8 + 0.2\,\mathrm{Y}$
(d) $\mathrm{Y} = -8 + 0.2\,\mathrm{X}$

113. If $\mathrm{P(B)} = \frac{3}{4}$, $\mathrm{P(A \cap B \cap \overline{C})} = \frac{1}{3}$ and $\mathrm{P(\overline{A} \cap B \cap \overline{C})} = \frac{1}{3}$, then what is $\mathrm{P(B \cap C)}$ equal to?
(a) $\frac{1}{12}$
(b) $\frac{3}{4}$
(c) $\frac{1}{15}$
(d) $\frac{1}{9}$

114. The following table gives the monthly expenditure of two families:

	Expenditures (in Rs.)	
Items	**Family A**	**Family B**
Food	3,500	2, 700

Clothing	500	800
Rent	1,500	1, 000
Education	2,000	1, 800
Miscellaneous	2,500	1, 800

In constructing a pie diagram to the above data, the radii of the circles are to be chosen by which one of the following ratios?

(a) 1: 1
(b) 10: 9
(c) 100: 91
(d) 5: 4

115. If a variable takes values 0, 1, 2, 3, …, n with frequencies 1, C(n, 1), C(n, 2), C(n, 3), … , C(n,n) respectively, then the arithmetic mean is

(a) 2n
(b) n + 1
(c) n
(d) $\frac{n}{2}$

116. In a multiple-choice test, an examinee either knows the correct answer with probability p, or guesses with probability $1 - p$. The probability of answering a question correctly is $\frac{1}{m}$, if he or she merely guesses. If the examinee answers a question correctly, the probability that he or she really knows the answer is

(a) $\frac{mp}{1+mp}$

(b) $\frac{mp}{1+(m-1)p}$

(c) $\frac{(m-1)p}{1+(m-1)p}$

(d) $\frac{(m-1)p}{1+mp}$

117. If x_1 and x_2 are positive quantities, then the condition for the difference between the arithmetic mean and the geometric mean to be greater than 1 is

(a) $x_1 + x_2 > 2\sqrt{x_1x_2}$
(b) $\sqrt{x_1} + \sqrt{x_2} > \sqrt{2}$
(c) $|\sqrt{x_1} + \sqrt{x_2}| > \sqrt{2}$
(d) $x_1 + x_2 < 2(\sqrt{x_1x_2} + 1)$

118. Consider the following statements:

1. Variance is unaffected by change of origin and change of scale.
2. Coefficient of variance is independent of the unit of observations.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

119. Five sticks of length 1, 3, 5, 7 and 9 feet are given. Three of these sticks are selected at random. What is the probability that the selected sticks can form a triangle?

(a) 0.5
(b) 0.4
(c) 0.3
(d) 0

120. The coefficient of correlation when coefficients of regression are 0.2 and 1.8 is

(a) 0.36
(b) 0.2
(c) 0.6
(d) 0.9

Mathematics NDA 2 2017 Solution

1. $x + \log_{10}(1 + 2^x) = x\log_{10}5 + \log_{10}6$
$\Rightarrow x(1 - \log_{10}5) = \log_{10}6 - \log_{10}(1 + 2^x)$
$\Rightarrow x(\log_{10}10 - \log_{10}5) = \log_{10}\left(\frac{6}{1+2^x}\right)$
$\Rightarrow x\log_{10}2 = \log_{10}\left(\frac{6}{1+2^x}\right) \Rightarrow x = 1$

2. $(101110)_2 = (46)_{10}$ and $(110)_2 = (6)_{10}$
Quotient = $(7)_{10} = (111)_2$
Remainder = $(4)_{10} = (100)_2$

3. For AB and BA to be exist
$x + 5 = y$ and $11 - y = x$
Solving these, x = 8 and y = 3

4. $S_n = nP + \frac{n(n-1)Q}{2}$
$\therefore$ common difference $(d) = 2 \times \frac{Q}{2} = Q$

5. Sum of coefficients
$= q - r + r - p + p - q = 0 \Rightarrow 1$ is a root.
Another root $= \frac{p-q}{q-r}$

6. $E - \Big(E - \big(E - (E - (E - A))\big)\Big)$
$= E - \Big(E - \big(E - (E - A')\big)\Big)$
$= E - \big(E - (E - A)\big)$
$= E - (E - A') = E - A = A$
$= (B \cup C)' = B' \cap C'$

7. Here, $C \subset A$ and $C \subset B$
$C = A \cap B = A \cap (B \cap C)$
$= A \cap C = C$

8. α and β are roots of $x^2 + x + 1 = 0$
$\Rightarrow \alpha = \omega, \beta = \omega^2$
$\begin{bmatrix} 1 & \beta \\ \alpha & \alpha \end{bmatrix}\begin{bmatrix} \alpha & \beta \\ 1 & \beta \end{bmatrix} = \begin{bmatrix} \alpha + \beta & \beta + \beta^2 \\ \alpha^2 + \alpha & \alpha\beta + \alpha\beta \end{bmatrix}$
$= \begin{bmatrix} \omega + \omega^2 & \omega^2 + \omega \\ \omega^2 + \omega & 2\omega^2 \end{bmatrix} = \begin{bmatrix} -1 & -1 \\ -1 & 2 \end{bmatrix}$

9. All are true.

10. "T" is repeated twice. So, Number of permutations
$= \frac{(11)!}{2!} = 19958400$

11. $k = \frac{1}{2i} = \frac{-i}{2}$
$kA = \begin{bmatrix} (4i - 6)\left(\frac{-1}{2}\right) & 10i\left(\frac{-i}{2}\right) \\ 14i\left(\frac{-i}{2}\right) & \left(6 + 4i\left(\frac{-i}{2}\right)\right) \end{bmatrix}$
$= \begin{bmatrix} 2 + 3i & 5 \\ 7 & 2 - 3i \end{bmatrix}$

12. $|x - 3|^2 + |x - 3| - 2 = 0$
Let $|x - 3| = y$
$\Rightarrow y = \frac{-1 \pm \sqrt{1+8}}{2} = \frac{-1 \pm 3}{2}$
$\Rightarrow y = 1$ or -2 (-2 Rejected as y is +ve)
$\Rightarrow y = 1$
$\Rightarrow |x - 3| = 1 \Rightarrow x - 3 = 1$ or $x - 3 = 1$
$\Rightarrow x = 4$ or 2
$\therefore$ Sum of roots = 6

13. $x^2 - 4x - \log_3^P = 0$
$D = 16 + 4\log_3^P \geq 0$
$\Rightarrow \log_3^P \geq \frac{-16}{4} \geq -4$
$\Rightarrow P \geq 3^{-4} \geq \frac{1}{81}$
$\therefore$ Minimum value $= \frac{1}{81}$

14. $\text{Adj } A^T = (\text{adj}A)^T \Rightarrow \text{Adj } A^T - (\text{adj}A)^T = 0$

15. $6^{\frac{1}{2}} \times 6^{\frac{1}{4}} \times 6^{\frac{1}{8}} \times 6^{\frac{1}{16}} \ldots\ldots\ldots\infty$
$6^{\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\cdots\infty} = 6^{\frac{\frac{1}{2}}{1-\frac{1}{2}}} = 6^1 = 6$

16. $\begin{vmatrix} \cos^2\frac{\theta}{2} & \sin^2\frac{\theta}{2} \\ \sin^2\frac{\theta}{2} & \cos^2\frac{\theta}{2} \end{vmatrix} = \left(\cos^4\frac{\theta}{2} - \sin^4\frac{\theta}{2}\right)$
$= \left(\cos^2\frac{\theta}{2} + \sin^2\frac{\theta}{2}\right)\left(\cos^2\frac{\theta}{2} - \sin^2\frac{\theta}{2}\right) = \cos\theta$

17. $(x + a)^{100} + (x - a)^{100}$
Number of terms = 101-50 = 51

18. In $(1 + x)^{50}$
$C_1 + C_3 + C_5 + \cdots = \frac{1}{2} \times 2^{50} = 2^{49}$
$[\because\ C_0 + C_1 + C_2 + \cdots C_n = 2^n$

19. $A = \begin{bmatrix}1 & 0 & 0\\0 & b & 0\\0 & 0 & c\end{bmatrix} a = \text{diag}\,[a, b, c]$

$A^{-1} = \text{diag}^{-1}[a, b, c] = \frac{1}{|A|}\ \text{diag}[a^{-1}, b^{-1}, c^{-1}]$

$= \frac{1}{abc}\begin{bmatrix}a^{-1} & 0 & 0\\0 & b^{-1} & 0\\0 & 0 & c^{-1}\end{bmatrix}$

20. Let us assume that total minutes = x

For first nine minutes $= 150 \times 9$

Let the remaining minutes $= y = x - 9$

Now,

$(150 \times 9) + \frac{y}{2}[2 \times 150 + (y-1)(-2)] = 4500$

$\frac{y}{2}(302 - 2y) = 3150 \Rightarrow y^2 - 151y + 3150 = 0$

$\Rightarrow (y-126)(y-25) = 0 \Rightarrow y = 25$ or 126

(Rejected)

So, $x = y + 9 = 25 + 9 = 34$ minutes

21. $\left(\frac{1+i}{1-i}\right)^n = i^n = 1 \Rightarrow n = 4$

22. $(a, b)\ R\ (c, d) \Leftrightarrow a + b = b + c$

$a + a = a + a$

$\Rightarrow (a, a)\ R\ (a, a) \Rightarrow$ R is reflexive.

Next, Let $(a, b)\ R\ (c, d) \Rightarrow a + b = b + c$

$\Rightarrow c + b = d + a \Rightarrow (c, d)\ R(a, b)$

$\Rightarrow$ R is symmetric.

Next, $(a, b)\ R\ (c, d)$ and $(c, d)\ R\ (e, f)$

$\Rightarrow a + b = b + c$ and $c + f = d + e$

$\Rightarrow a + d + c + f = b + c + d + e$

$\Rightarrow a + f = b + e \Rightarrow (a, b)R\ (e, f)$

$\Rightarrow$ R is transitive $\Rightarrow$ R is an equivalence relation.

23. $y = \frac{x}{1-x} \Rightarrow x = \frac{y}{1+y}$

24. $3x^2 + 2x + 1 = 0 \Rightarrow \alpha + \beta = -\frac{2}{3}, \alpha\beta = \frac{1}{3}$

$S = \alpha + \beta + \frac{1}{\alpha} + \frac{1}{\beta} = -\frac{2}{3} - 2 = \frac{-8}{3}$

$P = (\alpha + \beta^{-1})(\beta + \alpha^{-1}) = \alpha\beta + 2 + \frac{1}{\alpha\beta} = \frac{16}{3}$

Required equation is $x^2 - Sx + P = 0$

$x^2 + \frac{8}{3}x + \frac{16}{3} = 0 \Rightarrow 3x^2 + 8x + 16 = 0$

25. $\log_e + \frac{1}{2}\log_e 3 + \frac{1}{4}\log_e 3 + \cdots$

$= (\log_e 3)\left[1 + \frac{1}{2} + \frac{1}{4} + \cdots\infty\right] = (\log_e 3)\frac{1}{1-\frac{1}{2}}$

$= 2\log_e 3 = \log_e 9$

26. $\frac{8!}{4!}\frac{8}{6!} = 8! \times 8! \times \frac{10\times9\times8\times7}{4!} = 210 \times (8!)^2$

27. $\begin{vmatrix}k & 1 & 1\\1 & k & 1\\1 & 1 & k\end{vmatrix} = 0$

$\Rightarrow k(k^2-1) - (k-1) + (1-k) = 0$

$\Rightarrow k(k+1) - 1 - 1\,] = 0 \Rightarrow k^2 + k - 2 = 0$

$\Rightarrow 1, -2$

For k =1, first two equations will become same.

$\Rightarrow k = -2$

28. $S_n = \frac{ab}{1-r} + \frac{dbr(1-r^{n-1})}{(1-r)^2}$

$1.3 + 2.3^2 + \cdots\ n.3^n$

$= \frac{\{(2n-1)3^{n+1} + 3\}}{4}$

$= \frac{(2n-1)3^a + b}{4} = \frac{(2n-1)3^{n+1} + 3}{4}$

$a = n + 1, b = 3$

29. $\frac{P}{2} + \frac{Q}{2} = 45°$

$\tan\left(\frac{P}{2} + \frac{Q}{2}\right) = \frac{\tan\frac{P}{2} + \frac{Q}{2}}{1 - \tan\frac{P}{2}\tan\frac{Q}{2}} = 1$

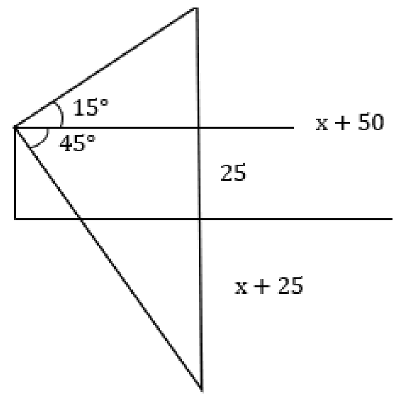
$\frac{-b}{a} = 1 - \frac{c}{a} = \frac{a-c}{a} \Rightarrow a + b = c$

30. $\left|z - \frac{4}{2}\right| \geq |z| - \left|\frac{4}{2}\right| \Rightarrow 2 \geq |z| - \frac{4}{|z|}$

$\Rightarrow |z|^2 - 2|z| - 4 \leq 0$

$\Rightarrow |z| = \frac{2+2\sqrt{5}}{2} = 1 + \sqrt{5}$ (neglecting -ve value)

31. $\tan 15° = 2 - \sqrt{3} = \frac{x}{x+50}$



$$\Rightarrow \left(2-\sqrt{3}-1\right)x = -50\left(2-\sqrt{3}\right)$$

$$\Rightarrow x = \frac{-50\left(2-\sqrt{3}\right)}{\left(1-\sqrt{3}\right)}$$

$$\Rightarrow x+25 = \frac{-50\left(2-\sqrt{3}\right)+25\left(1-\sqrt{3}\right)}{1-\sqrt{3}}$$

$$= \frac{-100+50\sqrt{3}+25-25\sqrt{3}}{1-\sqrt{3}}$$

$$= \frac{-75+25\sqrt{3}}{1-\sqrt{3}} = \frac{25\left(3-\sqrt{3}\right)}{\left(\sqrt{3}-1\right)} = 25\sqrt{3}$$

32. $\tan 9° - \tan 27° - \tan 63° + \tan 81°$

$$= (\tan 9° + \cot 9°) - (\tan 27° + \cot 27°)$$

$$= \frac{\cos(9°-9°)}{\sin 9° \cos 9°} - \frac{\cos(27°-27°)}{\sin 27° \cos 27°}$$

$$= \frac{2}{\sin 18°} - \frac{2}{\sin 54°} = \frac{2(\sin 54° - \sin 18°)}{\sin 18° \cdot \sin 54°}$$

$$= \frac{2 \cdot 2\cos 36° \cdot \sin 18°}{\sin 18° \cdot \sin 54°} = 4$$

33. $\sqrt{3}\,\mathrm{cosec}\,20° - \sec 20°$

$$= \frac{\sqrt{3}}{\sin 20°} - \frac{1}{\cos 20°}$$

$$= 2\left(\frac{\sqrt{3}\cos 20° - \sin 20°}{2\sin 20° \cdot \cos 20°}\right)$$

$$= 2\times 2\left(\frac{\sin 60° \cdot \cos 20° - \cos 60° \cdot \sin 20°}{\sin 40°}\right)$$

$$= 2\times 2\,\frac{\sin(60°-20°)}{\sin 40°} = 4$$

34. $\alpha = A + B$ and $x = A - B$

$$\Rightarrow A = \frac{x+\alpha}{2}, B = \frac{\alpha - x}{2}$$

$$\frac{\tan A}{\tan B} = \frac{\tan\left(\frac{x+\alpha}{2}\right)}{\tan\left(\frac{\alpha-x}{2}\right)} = \frac{p}{q}$$

$$\Rightarrow \frac{2\sin\left(\frac{\alpha+x}{2}\right)\cos\left(\frac{\alpha-x}{2}\right)}{2\cos\left(\frac{\alpha+x}{2}\right)\sin\left(\frac{\alpha-x}{2}\right)} = \frac{p}{q}$$

$$\Rightarrow \frac{\sin\alpha + \sin x}{\sin\alpha - \sin x} = \frac{p}{q}$$

$$\Rightarrow \frac{\sin\alpha + \sin x + \sin\alpha - \sin x}{\sin\alpha + \sin x - \sin\alpha + \sin x} = \frac{p+q}{p-q}$$

$$\Rightarrow \frac{2\sin\alpha}{2\sin x} = \frac{p+q}{p-q}$$

$$\Rightarrow \sin x = \frac{(p-q)\sin\alpha}{p+q}$$

35. $\sin^{-1}\frac{3}{5} + \tan^{-1}\frac{1}{7} = \tan^{-1}\frac{3}{4} + \tan^{-1}\frac{1}{7}$

$$= \tan^{-1}\frac{\frac{3}{4}+\frac{1}{7}}{1-\frac{3}{4}\cdot\frac{1}{7}} = \tan^{-1}\frac{21+4}{28-3}$$

$$= \tan^{-1}\frac{25}{25} = \tan^{-1} 1 = \frac{\pi}{4}$$

36. Let the distance between pole & tower is ‘b’.

Now, $\frac{h_T}{b} = \tan 45° = 1 \Rightarrow h_T = b$

$$\frac{h_T - h_P}{b} = \tan 45° = \frac{1}{\sqrt{3}} \Rightarrow \frac{h_T - h_P}{h_T} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \frac{h_T - h_P}{h_T - (h_T - h_P)} = \frac{1}{\sqrt{3}-1} \Rightarrow \frac{h_T - h_P}{h_P} = \frac{\sqrt{3}+1}{2}$$

$\Rightarrow$ Statement ′2′is correct,

$$\frac{h_T - h_P + 2h_P}{h_P} = \frac{\sqrt{3}+1+4}{2} \Rightarrow \frac{h_T + h_P}{h_P} = \frac{5+\sqrt{3}}{2}$$

$\Rightarrow$ Statement′3′is incorrect.

∴ Option ‘c’ right choice.

37. $a + b = 2b$

$$\cot\frac{A}{2}\cdot\cot\frac{C}{2}$$

$$= \sqrt{\frac{s(s-a)}{(s-b)(s-c)} \times \frac{s(s-c)}{(s-a)(s-b)}}$$

$$= \frac{s}{s-b} = \frac{2s}{2s-2b} = \frac{a+b+c}{a+b+c-2b} = \frac{3b}{b} = 3$$

38. $\sqrt{1+\sin A} = \left|\sin\frac{A}{2} + \cos\frac{A}{2}\right|$

$$= \begin{cases} \sin\frac{A}{2} + \cos\frac{A}{2}, & 2n\pi - \frac{\pi}{4} \le 2n\pi + \frac{3\pi}{4} \\ -\left(\sin\frac{A}{2} + \cos\frac{A}{2}\right), & \text{otherwise} \end{cases}$$

So, $\sqrt{1+\sin A} = -\left(\sin\frac{A}{2} + \cos\frac{A}{2}\right)$

When $\frac{3\pi}{4} < \frac{A}{2} < \frac{5\pi}{4}$

$\Rightarrow \frac{3\pi}{2} < A < \frac{5\pi}{2}$

39. $\sin^2 A + \sin^2 B + \sin^2 C$

$= 2\cos^2 A + 2\cos^2 B + 2\cos^2 C$

$\Rightarrow \cos^2 A + \cos^2 B + \cos^2 C = 1$

$\Rightarrow \frac{3}{2} + \frac{1}{2}(\cos 2A + \cos 2B + \cos 2C) = 1$

$\Rightarrow \cos 2A + \cos 2B + \cos 2C = -1$

$\Rightarrow 2\cos(A+B)\cos(A-B) = -(1+\cos 2C)$

$\Rightarrow -2\cos C\cos(A-B) = -2\cos^2 C$

$\Rightarrow \cos(A-B) = \cos C$

$\Rightarrow A - B = C$

Again, $A + B + C = \pi$

$\Rightarrow A + B + A - B = \pi$

$\Rightarrow A = \frac{\pi}{2}$

$\Rightarrow \Delta$ is right angle.

40. Range of $\sin^{-1} x$ is $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

$\Rightarrow \sin^{-1} x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

41. All given points lie on the line of equation

$ay = bx$

All points are collinear

42. $x + 2y - 2z = 9$

$\Rightarrow$ Length of normal $= \frac{9}{\sqrt{1^2 + 2^2 + (-2)^2}} = 3$

43. $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

$\cos^2\alpha + \cos^2\beta = 1 - \cos^2\gamma = \sin^2\gamma$

$\Rightarrow$ Statement 1 is correct

$\cos^2\alpha + \cos^2\beta + \cos^2 = 1$

$\Rightarrow 1 - \sin^2\alpha + 1 - \sin^2\beta + 1 - \sin^2\gamma = 1$

$\Rightarrow \sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2$

$\Rightarrow$ Statement 3 is correct

44. $\angle$ between $x + y - 3 = 0$ & $x - y + 3 = 0$ is $90° \Rightarrow \alpha = 90°$

As β is acute, therefore $\alpha > \beta$

45. Let $\vec{\delta} = a\hat{i} + b\hat{j} + c\hat{k}$

$\vec{\alpha}\cdot\vec{\delta} = 0 \Rightarrow a + 2b - c = 0$ ...(i)

$\vec{\beta}\cdot\vec{\delta} = 0 \Rightarrow 2a + b + 3c = 0$ ...(ii)

from (i) and (ii)

$\frac{a}{5} = \frac{b}{-5} = \frac{c}{-5}$

$\Rightarrow \frac{a}{1} = \frac{b}{-1} = \frac{c}{-1} = -\lambda$ (say)

$\Rightarrow a = \lambda, b = -\lambda, c = -\lambda$

Again, $\vec{\delta}\cdot\vec{\gamma} = 10$

$\Rightarrow 2a + b + 6c = 2\lambda - \lambda - 6\lambda = -5\lambda = 10$

$\Rightarrow \lambda = -2$

$\therefore \vec{\delta} = -2\hat{i} + 2\hat{j} + 2\hat{k} \Rightarrow |\vec{\delta}| = \sqrt{12} = 2\sqrt{3}$

46. $(\hat{a} + \hat{b}) \times (\hat{a} \times \hat{b})$

$= \hat{a} \times (\hat{a} \times \hat{b}) + \hat{b} \times (\hat{a} \times \hat{b})$

$= (\hat{a}\cdot\hat{b})\hat{a} - (\hat{a}\cdot\hat{a})\hat{b} + (\hat{b}\cdot\hat{b})\hat{a} - (\hat{b}\cdot\hat{a})\hat{b}$

$= k\hat{a} - \hat{b} + \hat{a} - k\hat{b}$

$= (k+1)(\hat{a} - \hat{b})$

47. $\overrightarrow{AB} = 2\hat{c} - 3\hat{j} + 8\hat{k}$

work done $= \vec{F}\cdot\overrightarrow{AB} = 1 \times 2 + 3(-3) + 2(8)$

$= 2 - 9 + 16 = 9$ units

48. Let $\vec{a} = x\hat{i} + y\hat{j} + 3\hat{k}$

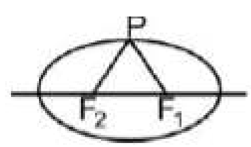
$|\vec{a} \times \hat{i}|^2 = z^2 + y^2$

$|\vec{a} \times \hat{j}|^2 = x^2 + z^2$

$|\vec{a} \times \hat{k}|^2 = x^2 + y^2$

$\therefore 2(x^2 + y^2 + z^2) = 2|\vec{a}|^2$

49.



$PF_1 + PF_2 = 10$

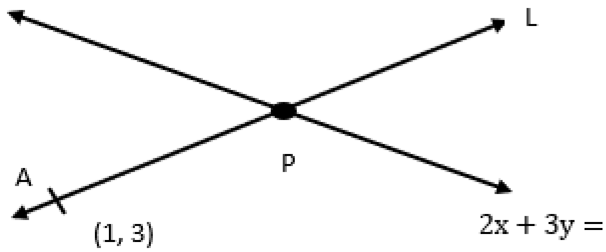
$\Rightarrow 2a = 10 \Rightarrow a = 5$

$F_1F_2 = 8 \Rightarrow 2c = 8 \Rightarrow c = 4$

$a^2 = b^2 + c^2 \Rightarrow b^2 = 3^2 \Rightarrow b = 3$

Area $= {}^{\pi}ab = \pi \times 3 \times 5 = 15\pi$

50.



Equation of line L is

$y-3=-4(x-1) \Rightarrow y-3=-4x+4$

$\Rightarrow 4x+y=7$

Solving equations, $x=\frac{3}{2}, y=1$

$$\therefore AP=\sqrt{\left(\frac{3}{2}-1\right)^2 (1-3)^2}=\sqrt{\frac{1}{4}+4}=\frac{\sqrt{17}}{2}$$

51. $\begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix}=0$

$\Rightarrow C_2 \rightarrow C_2-C_1, C_3 \rightarrow C_3-C_1$

$\begin{vmatrix} a & 1-a & 1-a \\ 1 & b-1 & 0 \\ 1 & 0 & c-1 \end{vmatrix}=0$

$\Rightarrow a(b-1)(c-1)-(1-a)(c-1)-(1-a)(b-1)=0$

Dividing by $(1-a)(1-b)(1-c)$, we get

$$\frac{a}{1-a}+\frac{1}{1-b}+\frac{1}{1-c}=0$$

$$\Rightarrow \frac{1}{1-b}+\frac{1}{1-c}=-\frac{a}{1-a}$$

Adding $\frac{1}{1-a}$ on both sides

$$\frac{1}{1-a}+\frac{1}{1-b}+\frac{1}{1-c}=1$$

52.

Equation of line is

$$\frac{x+3}{8}=\frac{y-4}{-10}=\frac{z+8}{12}=\lambda \text{ (say)}$$

$\Rightarrow x=8\lambda-3, y=-10\lambda+4, z=12\lambda-8,$

since line intersects XY plane, so, $z=0$

$$\Rightarrow \lambda=\frac{9}{3} \therefore x=\frac{7}{3}, y=\frac{-8}{3}$$

$$\Rightarrow \text{Point } \left(\frac{7}{3}, \frac{-8}{3}, 0\right)$$

53. $2x-3+10=3\sqrt{\frac{34+x^2}{2}}$

$$4x^2+49+28x=\frac{9(34+x^2)}{2}$$

$8x^2+98+56x=306+9x^2$

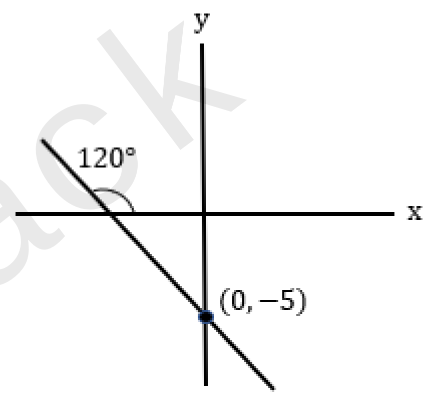
$x^2-56x+208=0$

$$x=\frac{+56 \pm \sqrt{3136-832}}{2}=28 \pm 24=4, 52$$

54. $2(1)^2+7(2)^2-20=2+28-20>0$

$\therefore$ point lies outside the ellipse.

55.



$m=\tan 120°=-\sqrt{3}$

$y+5=-\sqrt{3}\,x \Rightarrow y+\sqrt{3}\,x+5=0$

56. Required Line

$(2x-3y+7)+\lambda(-42y-4y)(98-2)=0$ ...(1)

Putting (2, 3)

$\Rightarrow (4-9+7)+\lambda(14+12+2)=0$

$$\Rightarrow \lambda=-\frac{1}{14}$$

$(28x-7x)+(-42y-4y)(98-2)=0$

$21x-46y+96=0$

57. $b^2=2a, c^2=\frac{9}{16}a^2$

We know, $a^2=b^2+c^2$ So,

$$a^2=2a+\frac{9}{16}a^2 \Rightarrow a=\frac{32}{7}$$

$$b^2=\frac{64}{7}$$

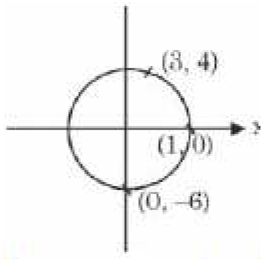
Equation of ellipse

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

Putting values of a and b

$$\frac{49x^2}{1024}+\frac{7y^2}{64}=1$$

58.



Let equation of circle is

$x^2 - x + y^2 + 6y + \lambda(-y - 6 + 6x) = 0$

Putting (3, 4), we get

$9 - 3 + 16 + 24 + \lambda(-4 - 6 + 18) = 0$

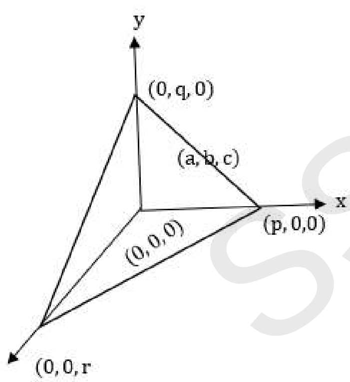
$\Rightarrow 46 + 8\lambda = 0 \Rightarrow \lambda = \dfrac{-23}{4}$

$\therefore x^2 - x + y^2 + 6y - \dfrac{23}{4}(-y - 6 + 6x) = 0$

$\Rightarrow 4x^2 + 4y^2 - 4x + 24y + 23y + 138 - 138x = 0$

$\Rightarrow 4x^2 + 4y^2 - 142x + 47y + 138 = 0$

59.



Equation of plane is

$\dfrac{x}{p} + \dfrac{y}{q} + \dfrac{z}{r} = 1$

It passes through

$(a, b, c) \Rightarrow \dfrac{a}{p} + \dfrac{b}{q} + \dfrac{c}{r} = 1$

Equation of sphere is given by

$x^2 + y^2 + z^2 - pz - qy - rz = 0$ with its centre at (x_c, y_c, z_c) such that

$x_c = \dfrac{p}{2}, y_c = \dfrac{q}{2}, z_c = \dfrac{r}{2}$

$\Rightarrow p = 2x_c, q = 2y_c, r = 2z_c$

$\therefore$ locus of centre

$\Rightarrow \dfrac{a}{x} + \dfrac{b}{y} + \dfrac{c}{z} = 2$

60. Let $P_1 = x + y + z - 1 = 0$

$P_2 = 2x + 3y + 4z - 7 = 0$

Equation of plane passing through the line of intersection of P_1 and P_2 is given by

$x + y + z - 1 + \lambda(2x + 3y + 4z - 7) = 0$

$\Rightarrow x(1 + 2\lambda) + y(1 + 3\lambda) + z(1 + 4\lambda) - 1 - 7\lambda = 0$

This is perpendicular to $x - 5y - 3z - 5 = 0$

$\Rightarrow 1(1 + 2\lambda) - 5(1 + 3\lambda) + 3(1 + 4\lambda) = 0$

$\Rightarrow 1 + 2\lambda - 5 - 15\lambda + 3 + 12\lambda = 0$

$\Rightarrow -\lambda - 1 = 0 \Rightarrow \lambda = -1$

$\therefore$ Equation of plane is

$-x - 2y - 3z - 1 + 7 = 0 \Rightarrow x + 2y + 3z = 0$

61. $y = 5^{\log x}$

$\Rightarrow \log y = (\log x)(\log 5)$

$\Rightarrow \log x = \dfrac{\log y}{\log 5} = \log y^{\frac{1}{\log 5}} \Rightarrow y^{\frac{1}{\log 5}}, y > 0$

62.

$f(x) = \begin{cases} -\dfrac{x}{|x|}, & x \neq 0 \\ 0, & x = 0 \end{cases}$

$= \begin{cases} -1, & x > 0 \\ 1 & x < 0 \\ 0 & x = 0 \end{cases}$

f(x) is discontinuous at x = 0

63. $y = (\cos x)^y$

$\Rightarrow \log y = y \log \cos x$

Differentiating both sides,

$\dfrac{1}{y}\dfrac{dy}{dx} = y.(-\tan x) + \log \cos x . \dfrac{dy}{dx}$

$\Rightarrow \left(\dfrac{1}{y} - \log \cos x\right)\dfrac{dy}{dx} = -y \tan x$

$\Rightarrow \dfrac{dy}{dx} = \dfrac{-y^2 \tan x}{1 - y \log \cos x}$

64. Both statements are correct.
65. Statements I and II are correct.

66. $\cos^{-1}\frac{x-1}{x+1} + \sin^{-1}\frac{x-1}{x+1} = \frac{\pi}{2}$

$\Rightarrow \dfrac{dy}{dx} = 0$

67.

$$\int \tan^{-1}(\sec x + \tan x)dx = \int \tan^{-1}\left\{\tan\left(\frac{\pi}{2}\right) - \frac{x}{2}\right\}dx$$

$$= \int \left(\frac{\pi}{4} - \frac{x}{2}\right)dx = \frac{\pi x}{4} - \frac{x^2}{4} + c$$

68. $f(x) = \begin{cases} 1 - x^2, & 0 < x \le 1 \\ \log x, & 1 < x \le 2 \\ \log 2 - 1 + 0.5x, & 2 < x < \infty \end{cases}$

$f'(x) = -2x, 0 < x \le 1$

69. $f(x) = x(x^2 - 1)$

$f'(x) = x(2x) + (x^2 - 1) = 3x^2 - 1$

$f''(x) = 6x$

At $f'(x) = 0 \Rightarrow x = \pm\frac{1}{\sqrt{3}}$

$f(x)_{max} = f\left(\frac{-1}{\sqrt{3}}\right) = \frac{-1}{\sqrt{3}}\left(\frac{1}{3} - 1\right) = \frac{2}{3\sqrt{3}}$

$f(x)_{min} = f\left(\frac{1}{\sqrt{3}}\right) = \frac{1}{\sqrt{3}}\left(\frac{1}{3} - 1\right) = \frac{-2}{3\sqrt{3}}$

70. All statements are correct.

71. $f(x) = \frac{\ln x}{x}$

$f'(x) = \frac{\left(\frac{1}{x}\right)x - \ln x}{x^2} = \frac{1 - \ln x}{x^2}$

$f''(x) = \frac{-\frac{1}{x}\cdot x^2 - 2x(1 - \ln x)}{x^4}$

$= \frac{-x - 2x(1 - \ln x)}{x^4} = \frac{-[1 + 2 - 2\ln x]}{x^3}$

$= \frac{-(3 - 2\ln x)}{x^3}$

At $f'(x) = 0 \Rightarrow \ln x = 1 \Rightarrow x = e$

$f''(e) = \frac{-(3-2)}{e^3} = -\frac{1}{e^3} < 0$

$f(x)_{max} = f(e) = \frac{\ln e}{e} = \frac{1}{e}$

72. $f(x) = \begin{cases} x - x^3, & x \ge 0 \\ -x - x^3, & x < 0 \end{cases}$

$f(-x) \begin{cases} x + x^3, & x \ge 0 = f(x) \\ x + x^3, & x < 0 = -f(x) \end{cases}$

Neither even nor odd

73. $\ell_1 = \frac{d}{dx}e^{\sin x}$

$\ell_2 = \lim_{n\to 0}\frac{e^{\sin(x+n)} - e^{\sin x}}{n} = \frac{d}{dx}e^{\sin x} = \ell_1$

$\ell_3 = \int e^{\sin x}\cos x\, dx = \int e^t\, dt = e^t + c$

$= e^{\sin x} + c$

$\frac{d}{dx}(\ell_3) = \frac{d}{dx}e^{\sin x} = \ell_2$

74.

$\frac{dy}{dx} = \frac{ax + h}{by + k}$

$\int (by + k)dy = \int (ax + h)dx$

$\frac{by^2}{2} + ky = \frac{ax^2}{2} + hx + c$

$\frac{ax^2}{2} - \frac{by^2}{2} + hx - ky + c = 0$

$a = -b \ne 0$

75.

$\lim_{x\to\pi/2}\frac{\sin x}{x} = L \Rightarrow L = 2/\pi$

$m = 0$

76.

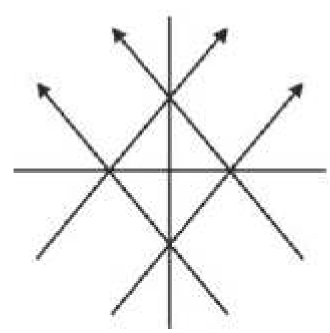
$\int_0^{2\pi}\sqrt{1 + \sin\frac{x}{2}}\, dx$

$= \int_0^{2\pi}\left|\sin\frac{x}{4} + \cos\frac{x}{4}\right|\, dx$

$= 4\left[\sin\frac{x}{4} - \cos\frac{x}{4}\right]_0^{2\pi}$

$= 8$

77.



Area $= 4 \times \frac{1}{2} \times 1 = 2$ sq. unit

78.

$y = \frac{x^2}{1 + x^4}$

$\Rightarrow y \ge 0$ Also,

$y = \frac{x^2}{1 + x^4} = \frac{1}{x^2 + \frac{1}{x^2}} \Rightarrow y \le \frac{1}{2}$

$\Longrightarrow y \in \left[0, \frac{1}{2}\right]$

79. L. H. D.

$= \lim\limits_{h\to 0} \dfrac{(k-1)\sin\pi(k-h) - [k]\sin k\pi}{-h}$

$= \lim\limits_{h\to 0} \dfrac{(k-1)\sin(k\pi - \pi h)}{-h}$

$= \lim\limits_{h\to 0} \dfrac{\pm(k-1)\sin(\pi h)}{-h}$

$= \mp(k-1)\pi$

$= (-1)^k(k-1)\pi$

80. $f(x) = \frac{x}{2} - 1, [0, \pi]$

$\tan[f(x)] = \tan[[\dfrac{x}{2} - 1]$

$\dfrac{1}{f(x)} = \dfrac{1}{\frac{x}{2} - 1}$ is discontinues at $x = 2$

Also, $\tan[f(x)]$ is discontinuous for $x = 2$ in $[0, \pi]$

81.

$$\left[1 + \left(\frac{dy}{dx}\right)^2\right]^3 = p^2\left[\frac{d^2y}{dx^2}\right]^2$$

Order = 2, Degree = 2

82.

$y = \cos^{-1}\left(\dfrac{2x}{1+x^2}\right)$

$= \dfrac{\pi}{2} - \sin^{-1},\left(\dfrac{2x}{1+x^2}\right)$

$= \dfrac{\pi}{2} - 2\tan^{-1}x, |x| < 1$

83.

$f'(x) = \dfrac{-2x(-e^{-x2})}{2\sqrt{1-e^{-x2}}} = \dfrac{xe^{-x2}}{\sqrt{1-e^{-x2}}}$

Which is defined $\forall\ x \in R$, except x = 0

$\Longrightarrow f(x)$ is differentiable on $(-\infty, 0) \cup (0, \infty)$

84. $f(x) = \sin x + \cos x$

$\Longrightarrow$ maximum value $= \sqrt{2}$

$(A) \to (2)$

$f(x) 3\sin x + 4\cos x$

$\Longrightarrow$ maximum value $= \sqrt{3^2 + 4^2} = 5$

$(B) \to (3)$

$f(x) = 2\sin + \cos x$

$\Longrightarrow$ maximum value $= \sqrt{4+1} = \sqrt{2}$

$(C) \to (4)$

$f(x) = \sin + 3\cos x$

maximum value $= \sqrt{1+9} = \sqrt{10}$

$(D) \to (1)$

85. $L.H.Lt = R.H.Lt = f(0) = 0$

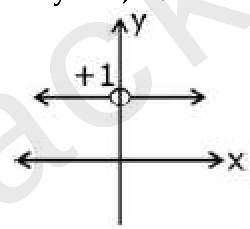
$\Longrightarrow f(x)$ is continuous at $x = 0$

$L.H.D = R.H.D = -1$

$\Longrightarrow f(x)$ is differentiable at $x = 0$

86. $f(x) = \frac{x}{x}, \neq 0$

$\Longrightarrow y = 1, x \neq 0$



87. $f(n) = \left[\frac{1}{4} + \frac{n}{1000}\right]$

$\therefore \sum\limits_{n-1}^{1000} + (n)$

$= \left[\dfrac{1}{4} + \dfrac{1}{1000}\right] + \left[\dfrac{1}{4} + \dfrac{2}{1000}\right] + \left[\dfrac{1}{4} + \dfrac{1}{1000}\right] + \ldots$

$\ldots. + \left[\dfrac{1}{4} + \dfrac{1000}{1000}\right]$

$= 0 + 0 + 0 + \cdots \left[\dfrac{1}{4} + \dfrac{750}{1000}\right] + \left[\dfrac{1}{4} + \dfrac{750}{1000}\right] + \ldots$

$\ldots + \left[\dfrac{1}{4} + \dfrac{1000}{1000}\right]$

$= 1 + 1 + 1 + \cdots \ldots.. + 1$ (251 times)

$= 251$

88.

$\displaystyle\int \left[\frac{1}{\log x} - \frac{1}{(\log x)^2}\right] dx$

Putting $\log x = t$

$\Longrightarrow x = e^t \Longrightarrow dx = e^t\, dt$

$\displaystyle\int e^t\left[\frac{1}{t} - \frac{1}{t^2}\right] dt = \frac{e^t}{t} + c = \frac{x}{\log x} + c$

89. The height and the radius of the base of an open cylinder of given surface area and maximum volume are equal i.e., radius=height.

$\Longrightarrow$ Diameter $= 2 \times$ height.

$\Rightarrow k = 2$

90.

$$\int_0^{\pi/4} \sqrt{\tan x} + \int_0^{\pi/4} \sqrt{\cot x}\ dx$$

$$= \int_0^{\pi/4} \left(\sqrt{\tan x} + \sqrt{\cot x}\right)\ dx$$

$$= \int_0^{\pi/4} \frac{\sin x + \cos x}{\sqrt{\sin x \cos x}} dx$$

$$= \sqrt{2}\int_0^{\pi/4} \frac{(\sin x + \cos x)}{\sqrt{1 - (\sin x \cos x)^2}} dx$$

Putting $\sin x - \cos x = t$
$\Rightarrow dt = (\sin x + \cos x)\ dx$
when $x = 0,\ t = -1$

and $x = \frac{\pi}{4}$, $t = 0$

$$= \sqrt{2}\int_{-1}^{0} \frac{1}{\sqrt{1 - t^2}}\ dt = \sqrt{2}\int_{-1}^{0} [\sin^{-1} t]_{-1}^{0}$$

$$= \sqrt{2}[0 - (-\pi/2)] = \frac{\pi}{\sqrt{2}}$$

91. $g(x) = [x]$
$f(x) = [x]^2 - [x]$
$f(x)$ is discontinuous at every integers except $x = 1$.

92. $y = A[\sin(x + c) + \cos(x + c)]$

$$\frac{dy}{dx} = A[\cos(x + c) - \sin(x + c)]$$

$$\frac{d^2y}{dx^2} = -A[\sin(x + c) + \cos(x + c)] = -y$$

$$\Rightarrow \frac{d^2y}{dx^2} + y = 0$$

93. Both statements are correct but statement 2 is not the correct explanation of statement 1.

94.

$$\frac{dy}{dx} - \frac{y\phi'(x)}{\phi(x)} = \frac{-y^2}{\phi(x)}$$

$$\Rightarrow \frac{1}{y^2}\cdot\left(\frac{dy}{dx}\right) - \frac{1}{y}\cdot\frac{\phi'(x)}{\phi(x)} = \frac{1}{\phi(x)}$$

we get

$$\frac{dt}{dx} = \frac{1}{y^2}\left(\frac{dy}{dx}\right)$$

$$\Rightarrow \frac{dt}{dx} + \frac{\phi'(x)}{\phi(x)}t = -\frac{1}{\phi(x)}$$

$$I.F = e^{\int \frac{\phi'(x)}{\phi(x)} dx} = e^{\log \phi(x)} = \phi(x)$$

Solution of differential equation is

$$t \cdot \phi(x) = \int -\frac{1}{\phi(x)} \times \phi(x)\ dx$$

$$\Rightarrow -\frac{1}{y}\phi(x) = -x \Rightarrow \frac{\phi(x)}{y} = x$$

$$\Rightarrow y = \frac{\phi(x)}{x} + c$$

95.

$$f(x) = \frac{4x + x^4}{1 + x^3}$$

$$g(x) = \ln\left(\frac{1 + x}{1 - x}\right)$$

$$g\left(\frac{e - 1}{e + 1}\right) = \ln\left[\frac{e + 1 + e - 1}{e + 1 - e + 1}\right] = \ln\left(\frac{2e}{2}\right) = 1$$

$$f\ o\ g\left(\frac{e - 1}{e + 1}\right) = f(1) = \frac{4 + 1}{1 + 4} = 1$$

96. $\begin{vmatrix} 1-\alpha & \alpha-\alpha^2 & \alpha^2 \\ 1-\beta & \beta-\beta^2 & \beta^2 \\ 1-\gamma & \gamma-\gamma^2 & \gamma^2 \end{vmatrix}$

$C_1 \to C_1 + C_2 + C_3$

$$= \begin{vmatrix} 1 & \alpha-\alpha^2 & \alpha^2 \\ 1 & \beta-\beta^2 & \beta^2 \\ 1 & \gamma-\gamma^2 & \gamma^2 \end{vmatrix}$$

$C_2 \to C_2 + C_3$

$$= \begin{vmatrix} 1 & \alpha & \alpha^2 \\ 1 & \beta & \beta^2 \\ 1 & \gamma & \gamma^2 \end{vmatrix} = (\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)$$

97. $A = \begin{bmatrix} 1 & 0 & 2 \\ 2 & 1 & 0 \\ 0 & 3 & 1 \end{bmatrix}$

$C_{11} = 1 \quad C_{12} = -2 \quad C_{13} = 6$
$C_{21} = 6 \quad C_{22} = 1 \quad C_{23} = -3$
$C_{31} = -2 \quad C_{32} = 4 \quad C_{33} = 1$

$$\therefore \text{Adj } A = \begin{bmatrix} 1 & 6 & -2 \\ -2 & 1 & 4 \\ 6 & -3 & 1 \end{bmatrix}$$

98. $A^2 = \begin{bmatrix} -2 & 2 \\ 2 & 2 \end{bmatrix}\begin{bmatrix} -2 & 2 \\ 2 & -2 \end{bmatrix}\begin{bmatrix} 8 & -8 \\ -8 & 8 \end{bmatrix}$
$= -4\begin{bmatrix} -2 & 2 \\ 2 & -2 \end{bmatrix} = -4A$

99. Let $z = x + iy$
$z^2 - 1 = x^2 - y^2 + 2xyi - i$
$= x^2 - y^2 + (2xy - 1)i$
$Re(z^2 - i) = 2$
$\Longrightarrow x^2 - y^2 = 2$
This equation represents rectangular hyperbola.

100. $p + q + r = a + b + c = 0$
$\begin{vmatrix} pa & qb & rc \\ qc & ra & pb \\ rb & pc & qa \end{vmatrix}$
$= pqr(a^3 + b^3 + c^3) - abc(p^3 + q^3 + r^3)$
$= pqr\ (3abc) - abc\ (3pqr)$
$= 0(\because\ a^3 + b^3 + c^3 = 3abc\ p^3 + q^3 + r^3 = 3pqr)$

101.
$n(s) = {}^4C_2 = \frac{4 \times 3}{2} = 6$
$n(E) = {}^2C_1 \times {}^2C_1 = 2 \times 2 = 4$
$P(E) = \frac{4}{6} = \frac{2}{3}$

102. Possible primes are 2, 3, 5.
$\frac{2}{3} \times \frac{1}{3} + \frac{1}{3} \times \frac{2}{3} = \frac{4}{9}$

103. $n(X) = 16, n(Y) = 25$ and $S = 51$
$\Longrightarrow P(X) = \frac{16}{51}, P(Y) = \frac{25}{51}$

104. $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$P(B) = \frac{2}{3} - \frac{1}{2} + \frac{1}{6} = \frac{1}{3}$
$\therefore P(\bar{A} \cap B) = \frac{1}{3} - \frac{1}{6} = \frac{1}{6}$

105. Statement 1 and statement 2 are correct. Mean derivation is least when measured about mean, therefore statement 3 is wrong.

106. As standard deviation is '0', therefore all observations will be equal to 24.
$\Longrightarrow$ Average of any five observations = 24.

107. Regression coefficient of y on x
= regression coefficient of x on y
$\Longrightarrow$ (x, y) lies on (y = x) line.

108. $P(A) = \frac{1}{3}, P(B) = \frac{1}{6}, P(A \cap B) = \frac{1}{12}$
$P(B|\bar{A}) = \frac{P(B \cap \bar{A})}{P(\bar{A})}$
$P(B \cap \bar{A}) = P(B) - P(A \cap B) = \frac{1}{12}$
$P(\bar{A}) = \frac{2}{3}$
$\therefore P\left(\frac{B}{\bar{A}}\right) = \frac{1/12}{2/3} = \frac{1}{8}$

109. $np = \frac{2}{3}, npq = \frac{5}{9}$
$\Longrightarrow q = \frac{5}{9} \times \frac{3}{2} = \frac{5}{6}$
$\Longrightarrow p = \frac{1}{6}, n = 4$
$p(x = 2) = {}^4C_2 \left(\frac{1}{6}\right)^2 \times \left(\frac{5}{6}\right)^2$
$= 6 \times \frac{1}{36} \times \frac{25}{36} = \frac{25}{216}$

110. $p(\text{all reach safely}) = \left(\frac{1}{3}\right)^5$
$p(\text{4 reach safely}) = 5 \times \left(\frac{1}{3}\right)^2 \frac{2}{3}$
$p(\text{at least 4 reach safely}) = \frac{11}{243}$

111.
$p(\text{none born in same month}) = \frac{12 \times 11 \times 10}{12 \times 12 \times 12}$
$p(\text{at least two born in same month})$
$= 1 - \frac{12 \times 11 \times 10}{12 \times 12 \times 12} = \frac{144 - 110}{144} = \frac{17}{72}$

112. $\bar{x} = 10, \bar{y} = 90$
$\sigma x = 3, \sigma y = 10$
$r_{xy} = 0.8$
Regression equation x on y is
$\Longrightarrow x - 10 = r\frac{\sigma x}{\sigma y}(y - 90)$
$\Longrightarrow x - 10 = 0.8 \times \frac{3}{12}(y - 90)$

$\Rightarrow x - 10 = 0.2(y - 90)$
$\Rightarrow x = -8 + 0.2y$

113.
$P(B \cap \bar{C}) = P(A \cap B \cap \bar{C}) + P(\bar{A} \cap B \cap \bar{C})$
$= \frac{1}{3} + \frac{1}{3} = \frac{2}{3}$
$P(B) = P(B \cap C) + P(B \cap \bar{C})$
$\Rightarrow P(B \cap C) = P(B) - P(B \cap \bar{C})$
$= \frac{3}{4} - \frac{2}{3} = \frac{1}{12}$

114. Total expenditure of A = 10,000
Total expenditure of B = 8,100
So, area of A: area of B= 10,000: 8,100 = 100:81
$\Rightarrow$ radii of A: radii of B $= \sqrt{100} : \sqrt{81} = 10 : 9$

115. The arithmetic mean will always be between minimum and maximum value so out of the given option 'n/2' is possible value.

116. P (to know correct answer) = p
P (to guess correct answer) = $(1 - p) \times (1/m)$
P (to answer correctly) = $p + \frac{1-p}{m}$
So, required probability
$$= \frac{p}{p + \frac{1-p}{m}} = \frac{mp}{1 + p(m-1)}$$

117.
$\frac{x_1 + x_2}{2} - \sqrt{x_1 x_2} > 1$
$\Rightarrow \frac{x_1 + x_2}{2} > \sqrt{x_1 x_2} + 1$
$\Rightarrow x_1 + x_2 > 2\sqrt{x_1 x_2} + 2$
$\Rightarrow x_1 + x_2 - 2\sqrt{x_1 x_2} > 2$
$\Rightarrow \left(\sqrt{x_1} - \sqrt{x_2}\right)^2 > 2$
$\Rightarrow \left|\sqrt{x_1} - \sqrt{x_2}\right| > \sqrt{2}$

118. Variance is independent of change of origin but not scale. So, Statement 1 is incorrect, Statement 2 is correct.

119. $n(S) = {}^5C_3 = 10$
$n(E) = {}^4C_3 - 1 = 3$

$P(E) = \frac{3}{10} = 0.3$

120. Coefficient of correlation
$= \sqrt{0 \cdot 2 \times 1 \cdot 8} = 0 \cdot 6$

General Ability Test NDA 2 2017 Question Paper

PART-A

Synonyms

Directions: Each item in this section consists of a sentence with an underlined word/words followed by four options. Select the option that is nearest in meaning to the underlined word/words and mark your response in your Answer Sheet accordingly.

1. The discussion was wound up after a long and fruitful exchange of views.
   (a) postponed
   (b) cut short
   (c) interrupted
   (d) concluded
2. He was fully alive to the need for making adjustments.
   (a) concerned about
   (b) worried about
   (c) aware of
   (d) indifferent about
3. The police officer tried to intimidate the witness but in vain.
   (a) inform
   (b) reward
   (c) frighten
   (d) persuade
4. We must adopt drastic measures to control population growth.
   (a) simple
   (b) dramatic
   (c) realistic
   (d) severe
5. He is extremely meticulous in his approach.
   (a) simple
   (b) careful
   (c) fair
   (d) reasonable
6. The experts' minute examination brought light to some important clues.
   (a) quick
   (b) detailed
   (c) superficial
   (d) prolonged
7. The decision of the Union Government to repeal the Urban Ceiling Act has been welcomed by all.
   (a) suppress
   (b) amend
   (c) cancel
   (d) withhold
8. This is his maiden appearance on the screen.
   (a) first
   (b) last
   (c) girlish
   (d) shy
9. At the end of the marathon everybody was exhausted.
   (a) weakened
   (b) honoured
   (c) satisfied
   (d) tired
10. He gave me a counterfeit coin.
   (a) rare
   (b) fake
   (c) unmatured
   (d) inferior

Antonyms

Directions: Each item in this section consists of a sentence with an underlined word/words followed by four options. Select the option that is opposite in meaning to the underlined word/words and mark your response in your Answer Sheet accordingly.

11. My mother has been working hard for the last two weeks and she feels run down.
   (a) morbid
   (b) energetic
   (c) exhausted
   (d) emotional
12. The President condemned the act of violence during the celebration of the festival.
   (a) reason
   (b) instigation
   (c) restraint
   (d) sobriety
13. The students made a generous contribution to the flood relief fund.
   (a) niggard
   (b) selfish
   (c) spendthrift
   (d) indecent
14. He was just idle by temperament.
   (a) employed

(b) occupied
(c) industrious
(d) happy

15. Most of the decisions taken by the officer were unjust.
(a) serious
(b) lenient
(c) correct
(d) imbecile

16. He is a loving father and takes great delight in his children.
(a) revolt
(b) dissatisfaction
(c) enjoyment
(d) disgust

17. He was quite concerned about his son's career.
(a) unrelated
(b) indifferent
(c) dispassionate
(d) carefree

18. They are confident of success.
(a) imprudent
(b) impatient
(c) diffident
(d) reluctant

19. We carried on the search for the missing person.
(a) delayed
(b) reconsidered
(c) broke up
(d) called off

20. This T.V. has may indigenous components.
(a) Indian
(b) foreign
(c) unnatural
(d) genuine

Selecting Words

Directions: In the following passage, at certain points you are given a choice of four words marked (a), (b), (c), and (d), one of which fits the meaning of the passage. Choose the best word out of the four. Mark the letter, viz., (a), (b), (c), or (d), relating to this word on your Answer Sheet. Examples K and L have been solved for you.

K	L
The	
(a) boy was in the school in Shimla	(a) She was homesick.
(b) horse	(b) It
(c) dog	(c) He
(d) cow	(d) Her

Explanation: Out of the list given in item K, only, 'boy' is the correct answer because usually, a boy, and not a horse, a dog or a cow, attends school. So '(a)' is to be marked on the Answer Sheet for item K. A boy usually referred to as 'he', so for item L, '(c)' is the correct answer. Notice that to solve the first item K you have to read the rest of the sentence and then see what fits best.

Passage

After this incident I went to Nainital and returned after nearly a month. I had

21. (a) hardly
(b) barely
(c) merely
(d) rarely

taken 22. (a) out my clothes when I saw Gangu standing
(b) away
(c) off
(d) on

23. (a) by a new baby. He was 24. (a) jumping
(b) near | (b) bursting
(c) with | (c) dancing
(d) at | (d) singing

with joy. Even Nanda 25. (a) could not have
(b) would
(c) should
(d) ought

26. (a) experimented such joy 27. (a) at
(b) show | (b) bursting
(c) should | (c) on
(d) heard | (d) into

getting Krishna. His face had the same

28. (a) light
(b) glow
(c) sense
(d) hope

that 29. (a) comes on the face of a 30. (a) starved
(b) appears | (b) starving
(c) rises | (c) hungry
(d) shows | (d) shows

man after a full meal.

Ordering of words in a sentence

Directions: Each of the following items in this section consists of a sentence, the parts of which have been jumbled. These parts have been labelled P, Q, R, and S. Given below each sentence are four sequences namely (a), (b), (c) and (d). You are required to re-arrange the jumbled parts of the sentence and mark your response accordingly.

31. The spirit of man
    (P) has slowly and painfully surmounted
    (Q) and his growing intelligence
    (R) all the obstacles that have come in his way
    (S) has faced all kinds of dangers
    (a) Q P S R (b) S Q P R
    (c) R P Q S (d) P R Q S

32. After our school boys had won a well-contested hockey match
    (P) so that they might communicate the news of their victory to the headmaster
    (Q) who is a keen sportsman
    (R) they came to school in high spirits
    (S) and takes a very lively interest in school games
    (a) Q P S R (b) S Q P R
    (c) R P Q S (d) P R Q S

33. Even a leisurely game like cricket
    (P) demanding grace rather than strength
    (Q) and over the rough tactics of the Australian team that visited England in 1921.
    (R) as we saw in the controversy over body-line bowling
    (S) can cause much ill-will
    (a) P S R Q (b) R S P Q
    (c) S R Q P (d) Q P R S

34. Scientists point out
    (P) of sunspot activity
    (Q) that it is an aftermath that
    (R) has now reached its peak
    (S) of the eleven-year cycle
    (a) R S P Q (b) P Q S R
    (c) Q R P S (d) Q S P R

35. As the ship streams from San Diego
    (P) as walls of gray water from a distant storm in the North Pacific
    (Q) making the greener among us miserable with sea sickness
    (R) rock and toss the ship
    (s) those of us aboard have a personal demonstration of powerful ocean movement
    (a) P Q R S (b) S R P Q
    (c) S P R Q (d) Q S R P

Spotting Errors

Directions: Each item in this section has a sentence with three underlined parts labelled (a), (b), and (c). Read each sentence to find out whether there is any error in any underlined part and indicate your response in the Answer Sheet against the corresponding letter i.e., (a), (b) or (c). If you find no error, your response should be indicated as (d).

36. An electrical circuit (a) is the complete path (b) traversed by electric current. (c) No error. (d)

37. He waved us a by-by (a) as he boarded the train (b) which disappeared into the tunnel. (c) No error (d)

38. There was great deal that had to be scrapped that must be scrapped: (a) but surely India could not have been what she undoubtedly was (b) and could not have continued a cultured existence for thousands of years. (c) No error. (d)

39. With regard to interior decoration, it is the attention given to the less overt aspects of using space (a) that give it life, an identity, a quality (b)

that makes it exciting and unusual. (c) No error. (d)

40. A small parcel (a) of novel is (b) better than none. (c) No error. (d)

Fill in the blanks

Directions: Each of the following sentences in this section has a blank space and four words or group of words given after the sentence. Select the word or group of words you consider most appropriate for the blank space and indicate your response on the Answer Sheer accordingly.

41. He looks as if he _______ weary.
    (a) is
    (b) was
    (c) would be
    (d) were
42. My house is insured __________ theft and fire.
    (a) for
    (b) against
    (c) in
    (d) towards
43. The result of the prolonged discussion was _______.
    (a) disappointment
    (b) disappointing
    (c) disappointed
    (d) to disappoint
44. You are lucky _________ in the 20th century.
    (a) by being born
    (b) to have been born
    (c) for being born
    (d) to have born
45. Sita is true to _________.
    (a) word
    (b) her words
    (c) the words
    (d) words
46. Years _________ since I saw her last.
    (a) have passed
    (b) had passed
    (c) had been passing
    (d) have been passing
47. When he heard the terrible noise, he asked me what was _____ on.
    (a) happening
    (b) being
    (c) getting
    (d) going
48. Could you lend me some money? I am very ____ of cash at the moment.
    (a) down
    (b) low
    (c) short
    (d) scarce
49. I saw her when she was standing ______the side of the statue.
    (a) by
    (b) at
    (c) in
    (d) beyond
50. True friends never _____ their loved ones in adversity.
    (a) abuse
    (b) criticize
    (c) befool
    (d) desert

PART-B

51. Which one of the following was set as a target of average growth of GDP of India over the plan period 2012-2017 by the Approach Paper to the Twelfth Five Year Plan?
    (a) 7 percent
    (b) 8 percent
    (c) 9 percent
    (d) 10 percent
52. Which one of the following is not a subject that has been devolved to the Panchayati Raj Institutions by the II^{1} Schedule of the Constitution of India?
    (a) Non-conventional energy sources
    (b) Roads
    (c) Higher education
    (d) Libraries
53. Who among the following used the term Industrial Revolution for the first time in English to describe the changes that occurred in the

British industrial development between 1760 and 1820?
(a) Friedrich Engles
(b) Eric Hobsbawm
(c) Arnold Toynbee
(d) Georges Michelet

54. Who among the following is the author of the book 'The Indian Struggle, 1920-1934'?
(a) Maulana Abul Kalam
(b) Jayprakash Narayan
(c) Subhash Chandra Bose
(d) Manabendra Nath Roy

55. Which one of the following about the Swadeshi Campaign in 1896 is not correct?
(a) Its centre was Maharashtra
(b) Its main participants were students
(c) It opposed the levy of tariff on imports
(d) It publicly burnt foreign clothes

56. Which one of the following associations was founded in London by Dadabhai Naoroji in 1866?
(a) The Bengal British India Society
(b) The East India Association
(c) The British Indian Association
(d) The Madras Native Association

57. Mariana Trench is located in the ocean floor of
(a) Southern Atlantic Ocean
(b) Western Pacific Ocean
(c) Eastern Pacific Ocean
(d) Northern Atlantic Ocean

58. Taklamakan Desert is situated in
(a) Western Asia
(b) Southern fringe of Sahara in Africa
(c) South America
(d) Central Asia

59. Rudraprayag is situated at the confluence of rivers Alaknanda and
(a) Bhagirathi
(b) Mandakini
(c) Nandakini
(d) Dhauliganga

60. Arrange the following Indian cities according to their locations from west to east:
1. Bilaspur
2. Jodhpur
3. Bhopal
4. Ranchi

Select the correct answer using the code given below:
(a) 3-2-1-4
(b) 2-3-1-4
(c) 4-1-2-3
(d) 2-1-3-4

61. The Kashmir region receives additional amount of precipitation during the winter brought by,
(a) South-west Monsoon
(b) Western Disturbances
(c) Retreating Monsoon
(d) Temperate Cyclone

62. Which part of India has the Kalakot tertiary coal field?
(a) Brahmaputra river basin of Assam
(b) Damodar river basin of Jharkhand and West Bengal
(c) Himalayan mountain region
(d) Cardamon hills in Kerala

63. Tendons through which muscles are connected to bones are tightly compacted bundles of which one of the following fibrous protein?
(a) fibrin
(b) collagen
(c) elastin
(d) cellulose

64. Which one of the following is the scientific name of the causal organism of elephantiasis?
(a) Ascaris lumbricoides
(b) Culex pipiens
(c) Wuchereria bancrofti
(d) Fasciola hepatica

65. Melanin is the natural pigment that gives color to human skin, hair, and the iris. It provides protection against
(a) Ultraviolet radiation
(b) Infrared radiation
(c) X-ray radiation
(d) Short wave radio radiation

66. Intake of which one of the following food components should be minimized by patients having Gouty Arthritis due to elevated serum uric acid level?
(a) Food fibers
(b) Nucleic acids
(c) Lipids

(d) Carbohydrates

67. Which one of the following statements about microbes is not correct?
    (a) They are used in sewage treatment plants.
    (b) They are used in industrial fermenters for the production of beverages.
    (c) No antibiotic has been obtained from any microbe.
    (d) They are used to get many bioactive molecules for the treatment of diseases.

68. Golden rice is a genetically-modified crop plant where the incorporated gene is meant for biosynthesis of
    (a) Omega-3 fatty acids
    (b) Vitamin A
    (c) Vitamin B
    (d) Vitamin C

69. An object moves in a circular path with a constant speed. Which one of the following statements is correct?
    (a) The centripetal acceleration of the object is smaller for a gentle curve (i.e., curve of larger radius) than that for a sharp curve (i.e., curve of smaller radius).
    (b) The centripetal acceleration is greater for a gentle curve than that for a sharp curve.
    (c) The centripetal acceleration is the same for both the gentle and sharp curves.
    (d) The centripetal acceleration causes the object to slow down.

70. The force acting on a particle of mass m moving along the x-axis is given by $f(x) = Ax^2 - Bx$. Which one of the following is the potential energy of the particle?
    (a) $2Ax - B$
    (b) $-\frac{x^2}{6}(2Ax - 3B)$
    (c) $Ax^2 - Bx^2$
    (d) Zero

71. The symbol of SI unit of inductance is H. It stands for
    (a) Holm
    (b) Halogen
    (c) Henry
    (d) Hertz

72. In a vacuum, a five-rupee coin, a feather of a sparrow bird and a mango are dropped simultaneously from the same height. The time taken by them to reach the bottom is t_1 , t_2 , and t_3. respectively. In this situation, we will observe that
    (a) $t_1 > t_2 > t_3$
    (b) $t_1 > t_3 > t_2$
    (c) $t_3 > t_1 > t_2$
    (d) $t_1 = t_2 = t_3$

73. Electron emission from a metallic surface by application of light is known as
    (a) Thermionic emission
    (b) Photoelectric emission
    (c) High field emission
    (d) Auto electronic emission

74. How does light take to reach the Earth from the Sun?
    (a) about 4 minutes
    (b) about 8 minutes
    (c) about 24 minutes
    (d) about 24 hours

75. Radioactivity is measured by
    (a) GM Counter
    (b) Polarimeter
    (c) Calorimeter
    (d) Colorimeter

76. The mirrors used as rear-view mirrors in vehicles are
    (a) concave
    (b) convex
    (c) cylindrical
    (d) plane

77. Which one of the following waves is used for detecting forgery in currency notes?
    (a) Ultraviolet waves
    (b) Infrared waves
    (c) Radio waves
    (d) Microwaves

78. The majority charge carriers in a p-type semiconductor are
    (a) free electrons
    (b) conduction electrons
    (c) ions
    (d) holes

79. The ionization energy of hydrogen atom in the ground state is
    (a) 13.6 MeV
    (b) 13.6 eV
    (c) 13.6 Joule
    (d) Zero

80. When pure water boils vigorously, the bubbles that rise to the surface are composed primarily of
    (a) air
    (b) hydrogen
    (c) hydrogen and oxygen
    (d) water vapour
81. Which compound when dissolved in water conducts electricity and forms a basic solution?
    (a) HCl
    (b) CH_3COOH
    (c) CH_3OH
    (d) $NaOH$
82. The principal use of hydrofluoric acid is
    (a) in etching glass
    (b) as a bleaching agent
    (c) as an extremely strong oxidizing agent
    (d) in the preparation of strong fluorine compounds
83. The species that has the same number of electrons as ${}^{32}_{16}S\ Cl$ is
    (a) ${}^{32}_{16}S$
    (b) ${}^{34}_{16}S^{+}$
    (c) ${}^{40}_{18}Ar^{+}$
    (d) ${}^{35}_{16}S^{2}$
84. The compound $CgH_{12}O_4$ contains
    (a) 22 atoms per mole
    (b) twice the mass percent of H as compared to the mass percent of C
    (c) six times the mass percent of C as compared to the mass percent of H
    (d) thrice the mass percent of H as compared to the mass percent of O
85. The proposition 'equal volumes of different gases contain equal numbers of molecules at the same temperature and pressure' is known as
    (a) Avogadro's hypothesis
    (b) Gay-Lussac's hypothesis
    (c) Planck's hypothesis
    (d) Kirchhoff's theory
86. Which one of the following statements about the Ilbert Bill is correct?
    (a) It proposed that the Indian magistrates would try Europeans in criminal cases.
    (b) It allowed Indians to file criminal cases against Europeans.
    (c) It authorized Indian ICS officers to try Europeans in courts.
    (d) It was an agitation led by Ilbert in support of the nationalists.
87. Who among the following can attend the meetings of both Houses of Parliament while not being member of either House?
    (a) The Solicitor General of India
    (b) The Vice-President of India
    (c) The Comptroller and Auditor General of India
    (d) The attorney General of India
88. Who among the following was believed to be a leader of the Sanyasis and Fakirs conspiring against the British in 1857?
    (a) Mangal Pandey
    (b) Bahadur Shah II
    (c) Queen Zeenat Mahal
    (d) Nana Sahib
89. Who among the following was the founder of the Avadh Kingdom in the 18^{th} century?
    (a) Murshid Quli Khan
    (b) Saadat Khan
    (c) Alivardi Khan
    (d) Sarfaraz Khan
90. Who among the following was the founder of the Young Bengal Movement?
    (a) Henry Vivian Derozio
    (b) David Hare
    (c) Dwarkanath Tagore
    (d) Prasanna Kumar Tagore
91. Which one of the following statements about the Quit India Movement is correct?
    (a) It broke out in August 1942.
    (b) Ahmedabad Textile Mills went on strike for more than 3 months.
    (c) Muslim League and Hindu Mahasabha actively participated in the movement.
    (d) Communist Party did not support the movement.
92. Who among the following is the winner of the Singapore Open Superseries Badminton Men's Singles title 2017?
    (a) Kidambi Srikanth
    (b) Lin Dan
    (c) B. Sai Praneeth
    (d) Kento Momota
93. Koradi Thermal Power Station is located in
    (a) Nagpur

(b) Raipur
(c) Mumbai
(d) Secunderabad

94. Which one of the following is the theme of the International Day for Monuments and Sites (World Heritage Day) 2017?
(a) The Heritage of Sport
(b) Cultural Heritage and Sustainable Tourism
(c) Past and Present Heritage
(d) Heritage and Science

95. In April 2017, USA dropped MOAB (Massive Ordinance Air Blast popularly known as the Mother of All Bombs) in the suspected hideouts of militants in which one of the following countries?
(a) Iran
(b) Syria
(c) Afghanistan
(d) Somalia

96. Who among the following is the Chairman of the Interdisciplinary Committee constituted recently by the Government of India to examine framework for virtual currencies?
(a) Secretary, Department of Financial Services
(b) Special Secretary, Department of Revenue
(c) Special Secretary, Department of Economic Affairs
(d) Deputy Governor, Reserve Bank of India

97. SAMPADA scheme is being implemented by the Ministry of
(a) Finance
(b) Housing and Urban Affairs
(c) Food Processing Industries
(d) Earth Sciences

98. The shortest day length that occurs in the hemisphere is on
(a) 21st March
(b) 23rd September
(c) 22nd November
(d) 22nd December

99. The Indian Railways have gone in for qualitative improvements since independence. Which of the following have taken place in recent years?
1. gauge conversion
2. track electrification
3. automatic signals

Select the correct answer using the codes given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2, and 3

100. In India, maximum amount of rainfall is received from
(a) Western Disturbances
(b) Northeast Monsoon
(c) Southwest Monsoon
(d) Retreating Monsoon

101. Which set of the following biosphere reserves in India is included in the World Network of Biosphere Reserves?
(a) Gulf of Mannar, Nokrek, Panchmarhi and Simlipal
(b) Gulf of Mannar, Kanchanjunga, Nokrerk, and Seshachalam
(c) Nilgai, Nokrek, Panchmarhi, and Panna
(d) Nilgiri, Nokrek, Panchmarhi, and Seshachalam

102. Which of the following statements about magnetite ore of iron is/are correct?
1. It is known as black ore.
2. It contains 60% to 70% of pure iron
3. It possesses magnetic properties

Select the correct answer using the code given below:
(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2, and 3

103. Which one of the following vitamins has a role in blood clotting?
(a) Vitamin A
(b) Vitamin D
(c) Vitamin E
(d) Vitamin K

104. The term ‘Probiotic’ is applied to
(a) organic food
(b) antacid
(c) antibiotic
(d) live microbial food supplement

105. Which one of the following microbes causes acidification and curding of milk?
(a) lactic acid bacillus
(b) Clostridium botulinum
(c) Vibrio choleras
(d) Saccharomyces cerevisiae

106. Who among the following shared Nobel Prize in 1962 along with Francis Crick and James

Watson for their discoveries concerning the molecular structure of nucleic acids?
(a) Erwin Chargaff
(b) Maurice Hugh Frederick Wilkins
(c) Rosalind Franklin
(d) Phoebus Levene

107. Water boils at a lower temperature at high altitudes because
(a) the air pressure is less
(b) outside temperature is less
(c) latent heat is less
(d) none of the above

108. Concave mirror is used in headlights of vehicles because it
(a) focuses light from the bulb onto nearby vehicles
(b) sends parallel rays
(c) fits well into the shape of the headlight
(d) is cheaper than other mirrors

109. If some object is weighed when submerged in water, what will happen to its weight compared to its weight in air?
(a) increase
(b) decrease
(c) remain exactly the same
(d) increase or decrease, cannot be specified

110. Light year is a measure of
(a) time
(b) distance
(c) total amount of light falling on the Earth in a year
(d) average intensity of light falling on the Earth in a year

111. Which one of the following statements about a satellite orbiting around the Earth is correct?
(a) Satellite is kept in orbit by remote control from the ground station.
(b) Satellite is kept in orbit by retro-rocket and solar energy keeps it moving around the Earth.
(c) Satellite requires energy from solar panels and solid fuels for orbiting.
(d) Satellite does not require any energy for orbiting.

112. Which one of the following statements about energy is correct?
(a) Energy can be created as well as destroyed.
(b) Energy can be created but not destroyed.
(c) Energy can neither be created nor destroyed.
(d) Energy cannot be created but can be destroyed.

113. Step-up transformers are used for
(a) increasing electrical power
(b) decreasing electrical power
(c) decreasing voltage
(d) increasing voltage

114. Which among the following waves carries the maximum energy per photon?
(a) X-rays
(b) Radio waves
(c) Light waves
(d) Microwave

115. How much CO_2 is produced on heating 1 kg of carbon?
(a) 11/3 kg
(b) 3/11 kg
(c) 4/3 kg
(d) ¾ kg

116. Zinc is used to protect iron from corrosion because zinc is
(a) more electropositive than iron
(b) cheaper than iron
(c) a bluish white metal
(d) a good conductor of heat and electricity

117. Which one of the following gases is placed second in respect of abundance in the Earth's atmosphere?
(a) oxygen
(b) hydrogen
(c) nitrogen
(d) carbon dioxide

118. Which one of the following is a chemical change?
(a) cutting of hair
(b) graying of hair naturally
(c) swelling of resin in water
(d) cutting of fruit

119. Which one of the following chemicals is used as washing soda?
(a) calcium carbonate
(b) calcium bicarbonate
(c) sodium carbonate
(d) sodium bicarbonate

120. Why is potassium permanganate used for purifying drinking water?
(a) it kills germs

(b) it dissolves the impurities
(c) it is a reducing agent
(d) it is an oxidizing agent

121. Consider the following movements:
1. Moplah Rebellion
2. Bardoli Satyagraha
3. Champaran Satyagraha
4. Salt Satyagraha

Which one of the following is the correct chronological order of the above in ascending order?
(a) 1-3-4-2
(b) 3-1-2-4
(c) 2-3-1-4
(d) 4-2-1-3

122. Which one of the following travelogues has given an insight on the reign of Muhammad Bin Tughlaq?
(a) Ibn Battuta's Rihla
(b) Francois Bernier's Travels in the Mogul Empire
(c) Niccolao Manucci's Storia do Mogor
(d) Tavernier's Travels in India

123. Which one of the following was not a Chishti Sufi saint?
(a) Khwaja Moinnudin
(b) Baba Fariduddin Ganj-i-Shakar
(c) Nizamuddin Auliya
(d) Shaikh Bahauddin Zakariya

124. In April 2017, India celebrated 100 years of Mahatma Gandhi's
(a) Satyagraha in Kheda
(b) Dandi March
(c) Satyagraha in Champaran
(d) Return from South Africa

125. A rainbow is produced due to which one of the following phenomena?
(a) Dispersion of light
(b) Interference of light
(c) Diffraction of light
(d) Scattering of light by atmospheric dust

126. Bats detect obstacles in their path by receiving the reflected
(a) infrasonic waves
(b) ultrasonic waves
(c) radio waves
(d) microwaves

127. The statement that 'heat cannot flow by itself from a body at a lower temperature to a body at a higher temperature' is known as
(a) Zeroth law of thermodynamics
(b) First law of thermodynamics
(c) Second law of thermodynamics
(d) Third law of thermodynamics

128. Which one of the following waves does not belong to the category of the other three?
(a) X-rays
(b) microwaves
(c) radio waves
(d) soundwaves

129. Which of the following statements is not correct?
(a) Human eye is a refracting system containing a diverging lens.
(b) The retina of the human eye contains millions of light sensitive cells called rods and cones which concert the light into electrical messages.
(c) Every image that is focused on the retina is upside down.
(d) We need both eyes to judge the relative positions of objects accurately.

130. Which one of the following statements is not correct?
(a) Ultrasonic waves cannot get reflected, refracted, or absorbed.
(b) Ultrasonic waves are used to detect the presence of defects like cracks, porosity, etc. in the internal structure of common structure materials.
(c) Ultrasonic waves can be used for making holes in very hard materials like diamond.
(d) Ultrasonic waves cannot travel through vacuum.

131. According to the Travel and Tourism Competitiveness Index (TTCI) 2017 released by the World Economic Forum, among the 136 economies across the world, India ranked
(a) 50^{th}
(b) 40^{th}
(c) 30^{th}
(d) 20^{th}

132. Which one of the following is the theme of the World Health Day 2017 celebrated by the World Health Organization?
(a) diabetes

(b) food safety
(c) Depression: Let's Talk
(d) Ageing and Health

133. Which one of the following ministries has launched a new programme on Interdisciplinary Cyber Physical Systems (ICPS) foster and promote R&D?
(a) Ministry of Earth Sciences
(b) Ministry of Science and Technology
(c) Ministry of Information and Broadcasting
(d) Ministry of New and Renewable Energy

134. Consider the following statements about the Nagara style of temple architecture:
1. This style of temples is commonly found in the areas between Himalayas and Vindhyas.
2. The most striking feature of this style is its pyramidal shikhara.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) both 1 and 2
(d) neither 1 nor 2

135. Ashoka's connection with Buddhism is evident from which one of the following edicts?
(a) Major Rock Edict 13
(b) Rock Edict 6
(c) Minor Rock Edict 1
(d) Pillar Edict 4

136. The Cabinet Mission Plan for India envisaged a
(a) federation
(b) confederation
(c) unitary form of government
(d) union of states

137. The creation of the institution or Lokpal was first recommended by
(a) Law Commission
(b) Santhanam Committee
(c) Shah Commission
(d) Administrative Reforms Commission

138. Which one of the following is a cause of acid rains?
(a) ozone
(b) ammonia
(c) sulfur dioxide
(d) carbon monoxide

139. The desirable pH for drinking water is
(a) 6.5 to 8.5
(b) 5.0 to 6.5
(c) 6.5 to 7.0
(d) 7.0 to 8.5

140. Consider the following reaction:

$$\mathrm{CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O}$$

Which of the following about the reaction given above is/are correct?
1. Carbon is oxidized.
2. Hydrogen is oxidized.
3. Hydrogen is reduced.
4. Carbon is reduced.

Select the correct answer using the code given below:
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 2 and 4 only

141. Sunrise in eastern Arunachal Pradesh would be about how many hours before the sunrise in western Gujarat?
(a) one hour
(b) two hours
(c) three hours
(d) four hours

142. Consider the following states of India in terms of percentage of forest area in relation to the total area of the state:
1. Karnataka
2. Odisha
3. Kerala
4. Andhra Pradesh

Which of the following is the correct descending order?
(a) 1-2-4-3
(b) 3-1-2-4
(c) 3-2-1-4
(d) 2-3-1-4

143. Which one of the following states in India has the longest coastline?
(a) Odisha
(b) Tamil Nadu
(c) Karnataka
(d) West Bengal

144. Which one of the following states in India has the largest area under forest cover?
(a) Maharashtra
(b) Chhattishgarh
(c) Madhya Pradesh
(d) Andhra Pradesh

145. Which one of the following is not an igneous rock?
(a) gabbro
(b) granite
(c) dolomite
(d) basalt

146. The Coriolis effect is the result of
(a) pressure gradient
(b) earth's axis of inclination
(c) earth's rotation
(d) earth's revolution

147. Where is Mekong Delta located?
(a) Thailand
(b) Cambodia
(c) Myanmar
(d) Vietnam

148. Which one of the following pairs of rivers and tributaries is not correctly matched?
(a) Godavari: Indravati
(b) Ganga: Penganga
(c) Krishna: Bhima
(d) Luni: Sukri

149. Consider the following characteristics of a tropical cyclone:
1. A warm sea temperature of $> 26℃$
2. High relative humidity of atmosphere at a height of $> 700\text{ m}$
3. Atmospheric instability

The above-mentioned characteristics are associated with which one of the following cycles of its development?
(a) formulation and initial stage
(b) modification stage
(c) full maturity
(d) decay

150. In the Mesopotamian records, which one of the following terms was used for the Indus Valley (Harappans)?
(a) Dilmun
(b) Meluha
(c) Magan
(d) Failaka

General Ability Test NDA 2 2017 Answer Keys

ENGLISH:

1	D	2	C	3	C	4	D	5	B	6	B	7	C	8	A	9	D	10	B
11	B	12	D	13	A	14	C	15	C	16	D	17	B	18	C	19	D	20	B
21	B	22	C	23	C	24	A	25	B	26	C	27	A	28	B	29	B	30	B
31	B	32	C	33	C	34	C	35	C	36	C	37	A	38	D	39	B	40	D
41	A	42	B	43	B	44	B	45	B	46	A	47	D	48	C	49	B	50	D

GENERAL STUDIES:

51	C	52	C	53	C	54	C	55	C	56	B	57	B	58	D	59	B	60	B
61	B	62	C	63	B	64	C	65	A	66	B	67	C	68	B	69	A	70	B
71	C	72	D	73	B	74	B	75	A	76	B	77	A	78	D	79	B	80	C
81	D	82	A	83	C	84	C	85	A	86	A	87	D	88	A	89	B	90	A
91	C	92	C	93	A	94	A	95	C	96	C	97	C	98	D	99	A	100	C
101	A	102	C	103	D	104	D	105	A	106	B	107	A	108	B	109	B	110	B
111	D	112	C	113	D	114	D	115	A	116	A	117	A	118	B	119	C	120	D
121	B	122	A	123	D	124	C	125	A	126	B	127	C	128	D	129	A	130	D
131	B	132	C	133	B	134	C	135	A	136	D	137	D	138	C	139	C	140	A
141	B	142	A	143	C	144	B	145	C	146	C	147	D	148	B	149	A	150	B

Mathematics NDA 1 2017 Question Paper

1. The sum of the roots of the equation $x^2 + bx + c = 0$ (where b and c are non-zero) is equal to the sum of the recipients of their squares. Then, $\frac{1}{c}, b, \frac{c}{b}$ are in
   (a) AP
   (b) GP
   (c) HP
   (d) None of the above

2. The sum of the roots of the equation $ax^2 + x + c = 0$ (where a and c are non-zero) is equal to the sum of the reciprocals of their squares. Then a, ca^2, c^2 are in
   (a) AP
   (b) GP
   (c) HP
   (d) None of the above

3. The value of $[C(7,0) + C(7,1)] + [C(7,1) + C(7,2)] + \cdots + [C(7,6) + C(7,7)]$ is
   (a) 254
   (b) 255
   (c) 256
   (d) 257

4. The number of different words (eight-letter words) ending and beginning with a consonant which can be made out of the letters of the word 'EQUATION' is
   (a) 5200
   (b) 4320
   (c) 3000
   (d) 2160

5. The fifth term of an AP of n terms, whose sum is $n^2 + n$, is
   (a) 5
   (b) 7
   (c) 8
   (d) 15

6. The sum of all the two-digit odd numbers is
   (a) 2475
   (b) 2530
   (c) 4905
   (d) 5049

7. The sum of the first n terms of the series $\frac{1}{2} + \frac{3}{4} + \frac{7}{8} + \frac{15}{16} + \cdots$ is equal to
   (a) $2^n - n - 1$
   (b) $1 - 2^{-n}$
   (c) $2^{-n} + n - 1$
   (d) $2^n - 1$

8. Consider the following in respect of sets A and B:
   1. $(A - B) \cup B = A$
   2. $(A - B) \cup A = A$
   3. $(A - B) \cap B = \emptyset$
   4. $A \subseteq B \Rightarrow A \cup B = B$

   Which of the above are correct?
   (a) 1, 2 and 3
   (b) 2, 3 and 4
   (c) 1, 3 and 4
   (d) 1, 2 and 4

9. In the binary equation $(1p101)_2 + (10q1)_2 = (100r00)_2$
   Where p, q and r are binary digits, what are the possible values of p, q and r respectively?
   (a) 0, 1, 0
   (b) 1, 1, 0
   (c) 0, 0, 1
   (d) 1, 0, 1

10. If $S = \{x : x^2 + 1 = 0, x \text{ is real}\}$, then S is
    (a) {-1}
    (b) {0}
    (c) {1}
    (d) An empty set

11. The expansion $(x - y)^2$, $n \geq 5$ is done in the descending powers of x. If the sum of the fifth and sixth terms is zero, then $\frac{x}{y}$ is equal to
    (a) $\frac{n-5}{6}$
    (b) $\frac{n-4}{5}$
    (c) $\frac{5}{n-4}$

(d) $\frac{6}{n-5}$

12. If $A = \begin{bmatrix} \alpha & 2 \\ 2 & \alpha \end{bmatrix}$ and $\det(A^3) = 125$, then α is equal to
(a) ± 1
(b) ± 2
(c) ± 3
(d) ± 5

13. If B is a non-singular matrix and A is a square matrix, then the value of $\det(B^{-1}AB)$ is equal to
(a) $\det(B)$
(b) $\det(A)$
(c) $\det(B^{-1})$
(d) $\det(A^{-1})$

14. If $a \neq b \neq c$, then one value of x which satisfies the equation

$$\begin{vmatrix} 0 & x-a & x-b \\ x+a & 0 & x-c \\ x+b & x+c & 0 \end{vmatrix} = 0$$

Is given by
(a) a
(b) b
(c) c
(d) 0

15. If $A = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$ then what is AA^T equal to (where A^T is the transpose of A)?
(a) Null matrix
(b) Identity matrix
(c) A
(d) -A

16. What is the value of $\tan 18°$?
(a) $\frac{\sqrt{5}-1}{\sqrt{10+2\sqrt{5}}}$
(b) $\frac{\sqrt{5}-1}{\sqrt{10+\sqrt{5}}}$
(c) $\frac{\sqrt{10+2\sqrt{5}}}{\sqrt{5}-1}$
(d) $\frac{\sqrt{10+\sqrt{5}}}{\sqrt{5}-1}$

17. Let x, y, z be positive real numbers such that x, y, z are in GP and $\tan^{-1} x$, $\tan^{-1} y$ and $\tan^{-1} z$ are in AP. Then which one of the following is correct?
(a) $x = y = z$
(b) $xz = 1$
(c) $x \neq y$ and $y = z$
(d) $x = y$ and $y \neq z$

18. If $\tan(\alpha + \beta) = 2$ and $\tan(\alpha - \beta) = 1$, then $\tan(2\alpha)$ is equal to
(a) -3
(b) -2
(c) $-\frac{1}{3}$
(d) 1

19. Consider the following for triangle ABC:
1. $\sin\left(\frac{B+C}{2}\right) = \cos\left(\frac{A}{2}\right)$
2. $\tan\left(\frac{B+C}{2}\right) = \cot\left(\frac{A}{2}\right)$
3. $\sin(B+C) = \cos A$
4. $\tan(B-C) = -\cot A$
Which of the above are correct?
(a) 1 and 3
(b) 1 and 2
(c) 1 and 4
(d) 2 and 3

20. If $\sec\theta - \operatorname{cosec}\theta = \frac{4}{3}$, then what is $(\sin\theta - \cos\theta)$ equal to?
(a) -2 only
(b) $\frac{1}{2}$ only
(c) Both -2 and $\frac{1}{2}$
(d) Neither $\frac{1}{2}$ nor -2

21. If a vertex of a triangle is (1, 1) and the midpoints of two sides of the triangle through this vertex are (-1, 2) and (3, 2), then the centroid of the triangle is
(a) $\left(-\frac{1}{3}, \frac{7}{3}\right)$
(b) $\left(-1, \frac{7}{3}\right)$
(c) $\left(\frac{1}{3}, \frac{7}{3}\right)$

(d) $\left(1, \frac{7}{3}\right)$

22. The incentre of the triangle with vertices $A(1, \sqrt{3}), B(0,0)$ and $C(2,0)$ is

(a) $\left(1, \frac{\sqrt{3}}{2}\right)$

(b) $\left(\frac{2}{3}, \frac{1}{\sqrt{3}}\right)$

(c) $\left(\frac{2}{3}\right), \frac{\sqrt{3}}{2}$

(d) $\left(1, \frac{1}{\sqrt{3}}\right)$

23. If the three consecutive vertices of a parallelogram are (-2, -1), (1,0) and (4, 3), then what are the coordinates of the fourth vertex?
(a) (1, 2)
(b) (1, 0)
(c) (0, 0)
(d) (1, -1)

24. The two circles $x^2 + y^2 = r^2$ and $x^2 + y^2 - 10x + 16 = 0$ intersect at two distinct points. Then which one of the following is correct?
(a) $2 < r < 8$
(b) $r = 2$ or $r = 8$
(c) $r < 2$
(d) $r > 2$

25. What is the equation of the circle which passes through the points (3, -2) and (-2, 0) and having its centre on the line $2x - y - 3 = 0$?
(a) $x^2 + y^2 + 3x + 2 = 0$
(b) $x^2 + y^2 + 3x + 12y + 2 = 0$
(c) $x^2 + y^2 + 2x = 0$
(d) $x^2 + y^2 = 5$

26. What is the ratio in which the point $C = \left(-\frac{2}{7}, -\frac{20}{7}\right)$ divides the line joining the points $A(-2,-2)$ and $B(2,-4)$?
(a) 1: 3
(b) 3: 4
(c) 1: 2
(d) 2: 3

27. What is the equation of the ellipse having foci $(\pm 2, 0)$ and the eccentricity $\frac{1}{4}$?

(a) $\frac{x^2}{64} + \frac{y^2}{60} = 1$

(b) $\frac{x^2}{60} + \frac{y^2}{64} = 1$

(c) $\frac{x^2}{20} + \frac{y^2}{24} = 1$

(d) $\frac{x^2}{24} + \frac{y^2}{20} = 1$

28. What is the equation of the straight line parallel to $2x + 3y + 1 = 0$ and passes through the point (-1, 2)?
(a) $2x + 3y - 4 = 0$
(b) $2x + 3y - 5 = 0$
(c) $x + y - 1 = 0$
(d) $3x - 2y + 7 = 0$

29. What is the acute angle between the pair of straight lines $\sqrt{2}x + \sqrt{3}y = 1$ and $\sqrt{3}x + 2y = 2$?

(a) $\tan^{-1}\left(\frac{1}{2\sqrt{6}}\right)$

(b) $\tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$

(c) $\tan^{-1}(3)$

(d) $\tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$

30. If the centroid of a triangle formed by $(7, x), (y, -6)$ and $(9, 10)$ is $(6, 3)$, then the values of x and y are respectively
(a) 5, 2
(b) 2, 5
(c) 1, 0
(d) 0, 0

31. Let *S* be the set of all persons living in Delhi. We say that *x, y* in *S* are related if they were born in Delhi on the same day. Which one of the following is correct?

(a) The relation is an equivalent relation.
(b) The relation is not reflexive but it is symmetric and transitive.
(c) The relation is not symmetric but is reflexive and transitive.
(d) The relation is not transitive but it is reflexive and symmetric.

32. Let $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. Then the number of subsets of A containing two or three elements is
(a) 45
(b) 120
(c) 165
(d) 330

33. The value of
$i^{2n} + i^{2n+1} + i^{2n+2} + i^{2n+3}$, where $i = \sqrt{-1}$, is
(a) 0
(b) 1
(c) i
(d) $-i$

34. If the difference between the roots of the equation $x^2 + kx + 1 = 0$ is strictly less than $\sqrt{5}$, where $|k| \geq 2$, then k can be any element of the interval
(a) $(-3, -2] \cup [2, 3)$
(b) $(-3, 3)$
(c) $[-3, -2] \cup [2, 3]$
(d) None of the above

35. If the roots of the equation $x^2 + px + q = 0$ are in the same ratio as those of the equation $x^2 + lx + m = 0$, then which one of the following is correct?
(a) $p^2m = l^2q$
(b) $m^2p = l^2q$
(c) $m^2p = q^2l$
(d) $m^2p^2 = l^2q$

36. The value of

$$\left(\frac{-1 + i\sqrt{3}}{2}\right)^n + \left(\frac{-1 - i\sqrt{3}}{2}\right)^n$$

Where n is not a multiple of 3 and $i = \sqrt{-1}$, is
(a) 1
(b) -1
(c) i
(e) $-i$

37. Three-digit numbers are formed from the digits 1, 2, and 3 in such a way that the digits are not repeated. What is the sum of such three-digit numbers?
(a) 1233
(b) 1322
(c) 1323
(d) 1332

38. What is the sum of the series
$0.3 + 0.33 + 0.333 + \cdots n$ terms?
(a) $\frac{1}{3}\left[n - \frac{1}{9}\left(1 - \frac{1}{10^n}\right)\right]$
(b) $\frac{1}{3}\left[n - \frac{2}{9}\left(1 - \frac{1}{10^n}\right)\right]$
(c) $\frac{1}{3}\left[n - \frac{1}{3}\left(1 - \frac{1}{10^n}\right)\right]$
(d) $\frac{1}{3}\left[n - \frac{1}{9}\left(1 + \frac{1}{10^n}\right)\right]$

39. If ω, ω^2 are the cube roots of unity, then $(1 + \omega)(1 + \omega^2)(1 + \omega^3)(1 + \omega + \omega^2)$ is equal to
(a) -2
(b) -1
(c) 0
(d) 2

40. If the sum of m terms of an AP is n and the sum of n terms is m, then the sum of $(m + n)$ terms is
(a) mn
(b) $m + n$
(c) $2(m + n)$
(d) $-(m + 2)$

41. The modulus and principal argument of the complex number

$$\frac{1 + 2i}{1 - (1 - i)^2}$$

are respectively
(a) 1, 0
(b) 1, 1

(c) 2, 0
(d) 2, 1

42. If the graph of a quadratic polynomial lies entirely above the x-axis, then which one of the following is correct?
(a) Both the roots are real
(b) One root is real and the other is complex
(c) Both the roots are complex
(d) Cannot say

43. If $|z+4| \leq 3$, then the maximum value of $|z+1|$ is
(a) 0
(b) 4
(c) 6
(d) 10

44. The number of roots of the equation $z^2 = 2\bar{z}$ is
(a) 2
(b) 3
(c) 4
(d) Zero

45. If $\cot\alpha$ and $\cot\beta$ are the roots of the equation $x^2 + bx + c = 0$ with $b \neq 0$, then the value of $\cot(\alpha+\beta)$ is
(a) $\frac{c-1}{b}$
(b) $\frac{1-c}{b}$
(c) $\frac{b}{c-1}$
(d) $\frac{b}{1-c}$

46. The equations
$$x + 2y + 3z = 1$$
$$2x + y + 3z = 2$$
$$5x + 5y + 9z = 4$$
(a) Have the unique solution
(b) Have infinitely many solutions
(c) Are inconsistent
(d) None of the above

47. $A = \begin{bmatrix} x+y & y \\ x & x-y \end{bmatrix}, B = \begin{bmatrix} 3 \\ -2 \end{bmatrix}$, and $C = \begin{bmatrix} 4 \\ -2 \end{bmatrix}$
If $AB = C$, then what is A^2 equal to?
(a) $\begin{bmatrix} 4 & 8 \\ -4 & -16 \end{bmatrix}$
(b) $\begin{bmatrix} 4 & -4 \\ 8 & -16 \end{bmatrix}$
(c) $\begin{bmatrix} -4 & -8 \\ 4 & 12 \end{bmatrix}$
(d) $\begin{bmatrix} -4 & -8 \\ 8 & 12 \end{bmatrix}$

48. What is the value of the determinant
$$\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+xyz & 1 \\ 1 & 1 & 1+xyz \end{vmatrix}?$$
(a) $1+x+y+z$
(b) $2xyz$
(c) $x^2y^2z^2$
(d) $2x^2y^2z^2$

49. If $\begin{vmatrix} x & y & 0 \\ 0 & x & y \\ y & 0 & x \end{vmatrix} = 0$, then which one of the following is correct?
(a) $\frac{x}{y}$ is one of the cube roots of unity
(b) x is one of the cube roots of unity
(c) y is one of the cube roots of unity
(d) $\frac{x}{y}$ is one of the cube roots of -1

50. Consider the set A of all matrices of order 3×3 with entries 0 or 1 only. Let B be the subset of A consisting of all matrices whose determinant is 1. Let C be the subset of A consisting of all matrices whose determinant is -1. Then which one of the following is correct?
(a) C is empty
(b) B has as many elements as C
(c) $A = B \cup C$
(d) D has thrice as many elements as C

51. If $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$, then what is A^3 equal to?
(a) $\begin{bmatrix} \cos 3\theta & \sin 3\theta \\ -\sin 3\theta & \cos 3\theta \end{bmatrix}$

(b) $\begin{bmatrix} \cos^3\theta & \sin^3\theta \\ -\sin^3\theta & \cos^3\theta \end{bmatrix}$

(c) $\begin{bmatrix} \cos 3\theta & -\sin 3\theta \\ \sin 3\theta & \cos 3\theta \end{bmatrix}$

(d) $\begin{bmatrix} \cos^3\theta & -\sin^3\theta \\ \sin^3\theta & \cos^3\theta \end{bmatrix}$

52. What is the order of

$$[x\ y\ z]\begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}?$$

(a) 3×1
(b) 1×1
(c) 1×3
(d) 3×3

53. If $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, then the value of A^2 is

(a) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
(b) $\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$
(c) $\begin{bmatrix} 0 & 0 \\ 1 & 1 \end{bmatrix}$
(d) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

54. If $A = \frac{3}{5}$, where $450° < 540°$, then $\cos\frac{A}{2}$ is equal to

(a) $\frac{1}{\sqrt{10}}$

(b) $-\sqrt{\frac{3}{10}}$

(c) $\frac{\sqrt{3}}{\sqrt{10}}$

(d) None of the above

55. What is $\frac{1}{\sin 10°} - \frac{\sqrt{3}}{\cos 10°}$ equal to?

(a) 0
(b) 1
(c) 2
(d) 4

56. From the top of a lighthouse, 100 m high, the angle of depression of a boat is $\tan^{-1}\left(\frac{5}{12}\right)$. What is the distance between the boat and the lighthouse?

(a) 120 m
(b) 180 m
(c) 240 m
(d) 360 m

57. The maximum value of

$$\sin\left(x + \frac{\pi}{6}\right) + \cos\left(x + \frac{\pi}{6}\right)$$

in the interval $\left(0, \frac{\pi}{2}\right)$ is attained at

(a) $\frac{\pi}{12}$

(b) $\frac{\pi}{6}$

(c) $\frac{\pi}{3}$

(d) $\frac{\pi}{2}$

58. If $K = \sin\left(\frac{\pi}{18}\right)\sin\left(\frac{5\pi}{18}\right)\sin\left(\frac{7\pi}{18}\right)$, then what is the value of K?

(a) $\frac{1}{2}$

(b) $\frac{1}{4}$

(c) $\frac{1}{8}$

(d) $\frac{1}{16}$

59. The expression $\frac{\sin\alpha + \sin\beta}{\cos\alpha + \cos\beta}$ is equal to

(a) $\tan\left(\frac{\alpha+\beta}{2}\right)$
(b) $\cot\left(\frac{\alpha+\beta}{2}\right)$
(c) $\sin\left(\frac{\alpha+\beta}{2}\right)$
(d) $\cos\left(\frac{\alpha+\beta}{2}\right)$

60. If $\sin\theta = 3\sin(\theta + 2\alpha)$, then the value of $\tan(\theta + \alpha) + 2\tan\alpha$ is equal to

(a) -1
(b) 0

(c) 1
(d) 2

61. What is
$$\int \frac{x^{e-1}+e^{x-1}}{x^e+e^x}$$
equal to?
(a) $\frac{x^2}{2}+c$
(b) $\ln(x+e)+c$
(c) $\ln(x^e+e^x)+c$
(d) $\frac{1}{e}\ln(x^e+e^x)+c$

62. Let $f: [-6, 6] \to R$ be defined by $f(x) = x^2 - 3$.
Consider the following:
1. $(f \circ f \circ f)(-1) = (f \circ f \circ f)(1)$
2. $(f \circ f \circ f)(-1) - 4(f \circ f \circ f)(1) = (f \circ f)(0)$

Which of the above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

63. Let $f(x) = px + q$ and $g(x) = mx + n$. Then $f(g(x)) = g(f(x))$ is equivalent to
(a) $f(p) = g(m)$
(b) $f(q) = g(n)$
(c) $f(n) = g(q)$
(d) $f(m) = g(p)$

64. If $F(x) = \sqrt{9 - x^2}$, then what is
$$\lim_{x\to 1}\frac{F(x)-F(1)}{x-1}$$
equal to?
(a) $-\frac{1}{4\sqrt{2}}$
(b) $\frac{1}{8}$
(c) $-\frac{1}{2\sqrt{2}}$
(d) $\frac{1}{2\sqrt{2}}$

65. What is $\frac{d^2x}{dy^2}$ equal to?
(a) $-\left(\frac{d^2y}{dx^2}\right)^{-1}\left(\frac{dy}{dx}\right)^{-3}$
(b) $\left(\frac{d^2y}{dx^2}\right)^{-1}\left(\frac{dy}{dx}\right)^{-2}$
(c) $-\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-3}$
(d) $\left(\frac{d^2y}{dx^2}\right)^{-1}$

66. Let
$$f(x): \begin{cases} x, & x \text{ is rational} \\ 0, & x \text{ is irrational} \end{cases}$$
and
$$g(x): \begin{cases} 0, & x \text{ is rational} \\ x, & x \text{ is irrational} \end{cases}$$

If $f: R \to R$ and $g: R \to R$, then $(f - g)$ is
(a) One-one and into
(b) Neither one-one not onto
(c) Many-one and onto
(d) One-one and onto

67. What is the length of the longest interval in which the function $f(x) = 3\sin x - 4\sin^3 x$ is increasing?
(a) $\frac{\pi}{3}$
(b) $\frac{\pi}{2}$
(c) $\frac{3\pi}{2}$
(d) π

68. If $xdy = y(dx + ydy)$: $y(1) = 1$ and $y(x) > 0$, then what is $y(-3)$ equal to?
(a) 3
(b) 2
(c) 1
(d) 0

69. What is the maximum value of the function $f(x) = 4\sin^2 x + 1$?
(a) 5
(b) 3
(c) 2
(d) 1

70. Let $f(x)$ be an indefinite integral of $\sin^2 x$. Consider the following statements:

Statement 1:
The function $f(x)$ satisfies $f(x+\pi) = f(x)$ for all real x.

Statement 2:
$\sin^2(x+\pi) = \sin^2 x$ for all real x.

Which one of the following is correct in respect of the above statements?
(a) Both statements are true and Statement 2 is the correct explanation of Statement 1
(b) Both statements are true but Statement 2 is not the correct explanation of Statement 1
(c) Statement 1 is true but Statement 2 is false
(d) Statement 1 is false but Statement 2 is true

71. What are the degree and order respectively of the differential equation

$$y = x\left(\frac{dy}{dx}\right)^2 + \left(\frac{dx}{dy}\right)^2 ?$$

(a) 1, 2
(b) 2, 1
(c) 1, 4
(d) 4, 1

72. What is the differential equation corresponding to $y^2 - 2ay + x^2 = a^2$ by eliminating a?
(a) $(x^2 - y^2)p^2 - 4pxy - 2x^2 = 0$
(b) $(x^2 - 2y^2)p^2 + 4pxy - x^2 = 0$
(c) $(x^2 + 2y^2)p^2 - 4pxy - x^2 = 0$
(d) $(x^2 + y^2)p^2 - 4pxy + x^2 = 0$

73. What is the general solution of the differential equation
$ydx - (x + 2y^2)dy = 0$?
(a) $x = y^2 + cy$
(b) $x = 2cy^2$
(c) $x = 2cy^2 + cy$
(d) None of the above

74. Let $f(x+y) = f(x)f(y)$ for all x and y. Then what is $f'(5)$ equal to where $f'(x)$ is the derivative of $f(x)$]?
(a) $f(5)f'(0)$
(b) $f(5) - f'(0)$
(c) $f(5)f(0)$
(d) $f(5) + f'(0)$

75. If $f(x)$ and $g(x)$ are continuous functions satisfying $f(x) = f(a-x)$ and $g(x) + g(a-x) = 2$, then what is $\int_0^a f(x)g(x)dx$ equal to?
(a) $\int_0^a g(x)dx$
(b) $\int_0^a f(x)dx$
(c) $\int_0^a f(x)dx$
(d) $\int_0^a 0$

76. For two department events A and B, it is given that $P(A) = 0\cdot 2$ and $P(B) = 0\cdot 5$. If $A \subseteq B$, then the values of conditional probabilities $P(A|B)$ and $P(B|A)$ are respectively.
(a) $\frac{2}{5}, \frac{3}{5}$
(b) $\frac{2}{5}, 1$
(c) $1, \frac{2}{5}$
(d) Information is insufficient

77. A point is chosen at random inside a circle. What is the probability that the point is closer to the centre of the circle than to its boundary?
(a) $\frac{1}{5}$
(b) $\frac{1}{4}$
(c) $\frac{1}{3}$
(d) $\frac{1}{2}$

78. If two regression lines between height (x) and weight (y) are $4y - 15x + 410 = 0$ and $30x - 2y - 825 = 0$, then what will be the correlation coefficient between height and weight?

(a) $\frac{1}{3}$
(b) $\frac{1}{2}$
(c) $\frac{2}{3}$
(d) $\frac{3}{4}$

79. In an examination, 40% of candidates got second class. When the data are represented by a pie chart, what is the angle corresponding to second class?
(a) $40°$
(b) $90°$
(c) $144°$
(d) $320°$

80. Consider the following statements:
Statement 1:
Range is not a good measure of dispersion.

Statement 2:
Range is highly affected by the existence of extreme values.

Which of the following is correct in respect of the above statements?
(a) Both Statement 1 and Statement 2 are correct and Statement 2 is the correct explanation of Statement 1.
(b) Both Statement 1 and Statement 2 are correct but Statement 2 is not the correct explanation of Statement 1.
(c) Statement 1 is correct but Statement 2 is not correct.
(d) Statement 2 is correct but Statement 1 is not correct.

81. A card is drawn from a well-shuffled ordinary deck of 52 cards. What is the probability that it is an ace?
(a) $\frac{1}{13}$
(b) $\frac{2}{13}$
(c) $\frac{3}{13}$
(d) $\frac{1}{52}$

82. If the data are moderately non-symmetrical, then which one of the following empirical relationships is correct?
(a) 2 x Standard deviation = 5 x Mean deviation
(b) 5 x Standard deviation = 2 x Mean deviation
(c) 4 x Standard deviation = 5 x Mean deviation
(d) 5 x Standard deviation = 4 x Mean deviation

83. Data can be represented in which of the following forms?
1. Textual form
2. Tabular form
3. Graphical form

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

84. For given statistical data, the graphs for less than ogive and more than ogive are drawn. If the point at which the two curves intersect is *P,* then abscissa of point *P* gives the value of which one of the following measures of central tendency?
(a) Median
(b) Mean
(c) Mode
(d) Geometric mean

85. Consider the following statements:
1. Two events are mutually exclusive if the occurrence of one event prevents the occurrence of the other.
2. The probability of the union of two mutually exclusive events is the sum of their individual probabilities.

Which of the above statements is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

86. If the regression coefficient of *x* and *y* and *y* on *x* are $-\frac{1}{2}$ and $-\frac{1}{8}$ respectively, then what is the correlation coefficient between *x* and *y*?
    (a) $-\frac{1}{4}$
    (b) $-\frac{1}{16}$
    (c) $\frac{1}{16}$
    (d) $\frac{1}{4}$

87. A sample of 5 observations has mean 32 and median 33. Later it is found that an observation was recorded incorrectly as 40 instead of 35. If we correct the data, then which one of the following is correct?
    (a) The mean and median remain the same
    (b) The median remains the same but the mean will decrease
    (c) The mean and median both will decrease
    (d) The mean remains the same but median will decrease

88. If two fair dice are thrown, then what is the probability that the sum is neither 8 nor 9?
    (a) $\frac{1}{6}$
    (b) $\frac{1}{4}$
    (c) $\frac{3}{4}$
    (d) $\frac{5}{6}$

89. Let A and B are two mutually exclusive events with $P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{4}$. What is the value of $P(\bar{A} \cap \bar{B})$?
    (a) $\frac{1}{6}$
    (b) $\frac{1}{4}$
    (c) $\frac{1}{3}$
    (d) $\frac{5}{12}$

90. The mean and standard deviation of a binomial distribution are 12 and 2 respectively. What is the number of trials?
    (a) 2
    (b) 12
    (c) 18
    (d) 24

91. A straight line with direction cosines $\langle 0, 1, 0 \rangle$ is
    (a) Parallel to x-axis
    (b) Parallel to y-axis
    (c) Parallel to z-axis
    (d) Equally inclined to all the axes

92. $(0, 0, 0), (a, 0, 0), (0, b, 0)$ and $(0, 0, c)$ are four distinct points. What are the coordinates of the point which is equidistant from the four points?
    (a) $\left(\frac{a+b+c}{3}, \frac{a+b+c}{3}, \frac{a+b+c}{3}\right)$
    (b) (a, b, c)
    (c) $\left(\frac{a}{2}, \frac{b}{2}, \frac{c}{2}\right)$
    (d) $\left(\frac{a}{3}, \frac{b}{3}, \frac{c}{3}\right)$

93. The points $P(3, 2, 4), Q(4, 5, 2), R(5, 8, 0)$ and $S(2, -1, 6)$ are
    (a) Vertices of a rhombus which is not a square
    (b) Non-coplanar
    (c) Collinear
    (d) Coplanar but not collinear

94. The line passing through the points $(1, 2, -1)$ and $(3, -1, 2)$ meets the yz plane at which one of the following points?
    (a) $\left(0, -\frac{7}{2}, \frac{5}{2}\right)$
    (b) $\left(0, \frac{7}{2}, \frac{1}{2}\right)$
    (c) $\left(0, -\frac{7}{2}, -\frac{5}{2}\right)$
    (d) $\left(0, \frac{7}{2} -\frac{5}{2}\right)$

95. Under which one of the following conditions are the lines $x = ay + b;\ z = cy + d$ and $x = ey + f;\ z = gy + h$ perpendicular?
    (a) $ae + cg - 1 = 0$
    (b) $ae + bf - 1 = 0$
    (c) $ae + cg + 1 = 0$
    (d) $ag + ce + 1 = 0$

96. If $\vec{a} = \hat{\imath} - \hat{\jmath} + \hat{k},\ \vec{b} = 2\hat{\imath} + 3\hat{\jmath} + 2\hat{k}$ and $\vec{c} = \hat{\imath} + m\hat{\jmath} + n\hat{k}$ are three coplanar vectors and $|\vec{c}| = \sqrt{6}$, then which one of the following is correct?

(a) $m = 2$ and $n = \pm 1$
(b) $m = \pm 2$ and $n = -1$
(c) $m = 2$ and $n = -1$
(d) $m = \pm 2$ and $n = 1$

97. Let $ABCD$ be a parallelogram whose diagonals intersect at *P* and let *O* be the origin. What is $\overrightarrow{OA} + \overrightarrow{OB} + \overrightarrow{OC} + \overrightarrow{OD}$ equal to?
(a) $2\overrightarrow{OP}$
(b) $4\overrightarrow{OP}$
(c) $6\overrightarrow{OP}$
(d) $8\overrightarrow{OP}$

98. $ABCD$ is a quadrilateral whose diagonals are AC and BD. Which one of the following is correct?
(a) $\overrightarrow{BA} + \overrightarrow{CD} = \overrightarrow{AC} + \overrightarrow{DB}$
(b) $\overrightarrow{BA} + \overrightarrow{CD} = \overrightarrow{BD} + \overrightarrow{CA}$
(c) $\overrightarrow{BA} + \overrightarrow{CD} = \overrightarrow{AC} + \overrightarrow{BD}$
(d) $\overrightarrow{BA} + \overrightarrow{CD} = \overrightarrow{BC} + \overrightarrow{AD}$

99. If $\vec{a} \times \vec{b} = \vec{c}$ and $\vec{b} \times \vec{c} = \vec{a}$ then which one of the following is correct?
(a) $\vec{a}, \vec{b}, \vec{c}$ are orthogonal in pairs and $|\vec{a}| = |\vec{c}|$ and $|\vec{b}| = 1$
(b) $\vec{a}, \vec{b}, \vec{c}$ are non-orthogonal to each other
(c) $\vec{a}, \vec{b}, \vec{c}$ are orthogonal in pairs but $|\vec{a}| \neq |\vec{c}|$
(d) $\vec{a}, \vec{b}, \vec{c}$ are orthogonal in pairs but $|\vec{b}| \neq 1$

100. If $\vec{a} = 2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}$, and $\vec{b} = 3\hat{\imath} + 2\hat{\jmath} - \lambda\hat{k}$ are perpendicular, then what is the value of λ?
(a) 2
(b) 3
(c) 4
(d) 5

101. What is $\lim_{x\to 0} \frac{e^x - (1+x)}{x^2}$ equal to?
(a) 0
(b) $\frac{1}{2}$
(c) 1
(d) 2

102. What is $\int_0^{\frac{\pi}{2}} \frac{d\theta}{1+\cos\theta}$ equal to?
(a) $\frac{1}{2}$
(b) 1
(c) $\sqrt{3}$
(d) None of the above

103. What is $\int \frac{dx}{x(x^7+1)}$ equal to?
(a) $\frac{1}{2}\ln\left|\frac{x^7-1}{x^7+1}\right| = c$
(b) $\frac{1}{7}\ln\left|\frac{x^7+1}{x^7}\right| + c$
(c) $\ln\left|\frac{x^7-1}{7x}\right| + c$
(d) $\frac{1}{7}\ln\left|\frac{x^7}{x^7+1}\right| + c$

104. The function $f : X \to Y$ defined by $f(x) = \cos x$, where $x \in X$, is one-one and onto if X and Y are respectively equal to
(a) $[0, \pi]$ and $[-1, 1]$
(b) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ and $[-1, 1]$
(c) $[0, \pi]$ and $[-1, 1]$
(d) $[0, \pi]$ and $[0, 1]$

105. If $f(x) = \frac{x}{x-1}$, then what is $\frac{f(a)}{f(a+1)}$ equal to?
(a) $f\left(-\frac{a}{a+1}\right)$
(b) $f(a^2)$
(c) $f\left(\frac{1}{a}\right)$
(d) $f(-a)$

106.
107.
108.
109.
110. What is the derivative of $\log_{10}(5x^2 + 3)$ with respect to x?
(a) $\frac{x\log_{10}e}{5x^2+3}$
(b) $\frac{2x\log_{10}e}{5x^2+3}$
(c) $\frac{10x\log_{10}e}{5x^2+3}$

(d) $\frac{10x \log_e 10}{5x^2+3}$

111. Let $f(a) = \frac{a-1}{a+1}$

Consider the following:

1. $f(2a) = f(a) + 1$
2. $f\left(\frac{1}{a}\right) = -f(a)$

Which of the above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

112. What is the maximum area of a triangle that can be inscribed in a circle of radius a?

(a) $\frac{3a^2}{4}$

(b) $\frac{a^2}{2}$

(c) $\frac{3\sqrt{3}a^2}{4}$

(d) $\frac{\sqrt{3}a^2}{4}$

113. Let $f(x) = x + \frac{1}{x}$, where $x \in (0, 1)$. Then which one of the following is correct?

(a) $f(x)$ fluctuates in the interval
(b) $f(x)$ increases in the interval
(c) $f(x)$ decreases in the interval
(d) None of the above

114. Suppose the function $f(x) = x^n, n \neq 0$ is differentiable for all x. Then n can be any element of the interval

(a) $[1, \infty)$
(b) $(0, \infty)$
(c) $\left(\frac{1}{2}, \infty\right)$
(d) None of the above

115. What is $\int_{e^{-1}}^{e^2} \left|\frac{\ln x}{x}\right| dx$ equal to?

(a) $\frac{3}{2}$
(b) $\frac{5}{2}$
(c) 3
(d) 4

116. The variance of 20 observations is 5. If each observation is multiplied by 3, then what is the new variance of the resulting observations?

(a) 5
(b) 10
(c) 15
(d) 45

117. The mean of a group of 100 observations was found to be 20. Later it was found that four observations were incorrect, which were recorded 21, 21, 18 and 20. What is the mean if the incorrect observations are omitted?

(a) 18
(b) 20
(c) 21
(d) 22

118. A committee of two persons is constituted from two men and two women. What is the probability that the committee will have only women?

(a) $\frac{1}{6}$
(b) $\frac{1}{3}$
(c) $\frac{1}{2}$
(d) $\frac{2}{3}$

119. A question is given to three students A, B and C whose chances of solving it are $\frac{1}{2}, \frac{1}{3}$ and $\frac{1}{4}$ respectively. What is the probability that the question will be solved?

(a) $\frac{1}{24}$
(b) $\frac{1}{4}$
(c) $\frac{3}{4}$
(d) $\frac{23}{24}$

120. The mean weight of 150 students in a certain class is 60 kg. The mean weight of boys in the class is 70 kg and that of girls is 55 kg. What is the number of boys in the class?

(a) 50
(b) 55
(c) 60
(d) 100

Mathematics NDA 1 2017 Solution

1. $-b = \frac{b^2-2c}{c^2}$
$\Longrightarrow bc^2 = b^2 - 2c \Longrightarrow b^2 + bc^2$
$\Longrightarrow \dfrac{2c}{b} = b + c^2 \Longrightarrow \dfrac{2}{b} = \dfrac{b}{c} + c$
$\Longrightarrow c, \dfrac{1}{b}, \dfrac{b}{c} \in AP \Longrightarrow \dfrac{1}{c}, b, \dfrac{c}{b} \in H.P$

2.
$-\dfrac{1}{a} = \dfrac{\frac{1}{a^2} - \frac{2c}{a}}{\frac{c^2}{c^2}}$
$\Longrightarrow -\dfrac{1}{a} = \dfrac{1-2ca}{c^2}$
$\Longrightarrow a - 2ca^2 = -c^2$
$\Longrightarrow 2ca^2 = a + c^2$
$\Longrightarrow a, ca^2, c^2 \in A.P$

3. ${}^8C_1 + {}^8C_2 + \cdots {}^8C_7$
$= 2^8 - 2 = 254$

4. ${}^3P_2 \times 6! = 6 \times 720 = 4320$

5. $a_n = 2n - 3$
$\Longrightarrow a_5 = 7$

6. $11 + 13 + \cdots + 99$
$= \dfrac{45}{2}(11 + 99) = 45 \times 55 = 2475$

7.
$\dfrac{1}{2} + \dfrac{3}{4} + \dfrac{7}{8} + \dfrac{15}{16} + \cdots$
$= \left(1 - \dfrac{1}{2}\right) + \left(1 - \dfrac{1}{4}\right) + \left(1 - \dfrac{1}{8}\right) + \cdots$
$= n - \left(\dfrac{1}{2} + \dfrac{1}{4} + \dfrac{1}{8} + \cdots\right)$
$= n - \dfrac{\frac{1}{2}\left(1 - \frac{1}{2^n}\right)}{\frac{1}{2}} = n - 1 + 2^{-n}$

8. By property,
$(A - B) \cup A = A, (A - B) \cap B = \phi$ and
$A \subseteq B \Rightarrow A \cup B = B$ are true.

9. $(1p101)^2 + (10q1)_2 = (100r00)_2$
Equating, $P = 0, q = 1, r = 0$

10. $S = \{x : x^2 + 1 = 0, x \in R\}$
$\Longrightarrow S = \phi$

11. ${}^nC_4 x^{n-4} y^4 - {}^nC_5 x^{n-5} y^5 = 0$
$\Longrightarrow {}^nC_4 x^{n-4} y^4 = {}^nC_5 x^{n-5} y^5$

$\Longrightarrow \dfrac{x}{y} = \dfrac{{}^nC_5}{{}^nC_4} = \dfrac{n-4}{5}$

12. $A = \begin{bmatrix} \alpha & 2 \\ 2 & \alpha \end{bmatrix} \Longrightarrow A^2 = \begin{bmatrix} \alpha^2 + 4 & 4\alpha \\ 4\alpha & \alpha^2 + 4 \end{bmatrix}$
$\Longrightarrow A^3 = \begin{bmatrix} \alpha^3 + 12\alpha & 6\alpha^2 + 8 \\ 6\alpha^2 + 8 & \alpha^3 + 12\alpha \end{bmatrix}$
$\Longrightarrow |A^3| = 125$
$\Longrightarrow (\alpha^3 + 12\alpha)^2 - (6\alpha^2 + 8)^2 = 125$
putting $\alpha = \pm 3, (63)^2 - (62)^2 = 125$ satisfied.

13. $|B^{-1}AB| = |B^{-1}|\,|A|\,|B|$
$= \dfrac{1}{|B|}\,|A|\,|B| = |A|$

14. Putting $x = 0$
$\begin{vmatrix} 0 & -a & -b \\ a & 0 & -c \\ b & c & 0 \end{vmatrix}$ is a skew-symmetric matrix of odd order whose determinant value is zero.

15. $A = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$
$AA^T = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$
$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ = Identity matrix

16.
$\tan 18^\circ = \dfrac{\sqrt{5} - 1}{\sqrt{10 + 2\sqrt{5}}}$ (Result)

17. $2\tan^{-1} y = \tan^{-1} x + \tan^{-1} z$
$\Longrightarrow \tan^{-1}\dfrac{2y}{1 - y^2} = \tan^{-1}\dfrac{x + z}{1 - xz}$
$\Longrightarrow \dfrac{2y}{1 - y^2} = \dfrac{x + z}{1 - xz} = \dfrac{x + z}{1 - y^2}$ $(\because y^2 = xz)$
$\Longrightarrow 2y = x + z$
$\Longrightarrow x, y, z \in A.P$
But $x, y, z \in G.P$ (given)
$\Longrightarrow x = y = z$

18. $\tan 2\alpha = \tan(\alpha + \beta + \alpha - \beta)$
$= \dfrac{\tan(\alpha + \beta) + \tan(\alpha - \beta)}{1 - \tan(\alpha + \beta)\tan(\alpha - \beta)} = \dfrac{2 + 1}{1 - 2 \times 1} = \dfrac{3}{-1} = -3$

19. $A + B + C = \pi$

$\sin\left(\frac{B+C}{2}\right) = \sin\left(\frac{\pi}{2} - \frac{A}{2}\right) = \cos\frac{A}{2}\ (True)$

$\tan\left(\frac{B+C}{2}\right) = \tan\left(\frac{\pi}{2} - \frac{A}{2}\right) = \cot\frac{A}{2}\ (True)$

Statement 1 and 2 are true.

20. $\sin\theta \operatorname{cosec}\theta = \frac{4}{3}$

$\Rightarrow \frac{\sin\theta - \cos\theta}{\sin\theta\cos\theta} = \frac{4}{3}$

$\Rightarrow \frac{(\sin\theta - \cos\theta)^2}{(\sin\theta\cos\theta)^2} = \frac{16}{9}$

$\Rightarrow \frac{1 - 2\sin\theta\cos\theta}{\sin^2\theta\cos^2\theta} = \frac{16}{9}$

Let $\sin\theta\cos\theta = x$

$\Rightarrow \frac{1-2x}{x^2} = \frac{16}{9}$

$\Rightarrow 16x^2 + 18x - 9 = 0$

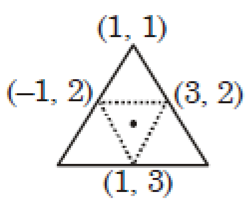
$\Rightarrow (8x-3)(2x+3) = 0$

$\Rightarrow x = \frac{3}{8}, x = \frac{3}{2}$

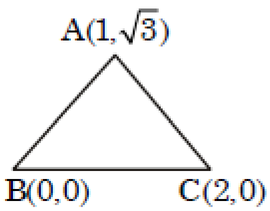
$\Rightarrow \sin\theta\cos\theta = \frac{3}{8}$

$\Rightarrow \sin\theta - \cos\theta = \frac{4}{3} \times \frac{3}{8} = \frac{1}{2}$

21. Centroid $= \left(1, \frac{7}{3}\right)$

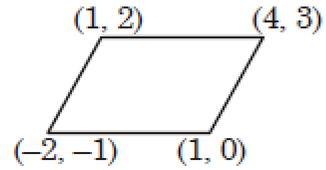


22. $\triangle ABC$ is equilateral



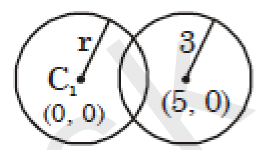
$\Rightarrow$ Incentre = Centroid $= \left(1, \frac{1}{\sqrt{3}}\right)$

23.



4th vertex $= (4 - 2 - 1, 3 - 1 - 0) = (1, 2)$

24.



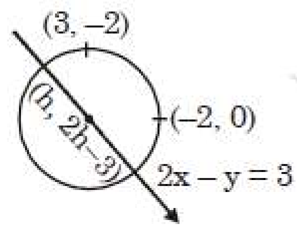
$r - 3 < C_1C_2 < r + 3$

$\Rightarrow r - 3 < 5 < r + 3$

$\Rightarrow r > 2, r < 8$

$\Rightarrow 2 < r < 8$

25. $(h-3)^2 + (2h-1)^2 = (h+2)^2 + (2h-3)^2$



$\Rightarrow h = -\frac{3}{2} \Rightarrow 2h - 3 = -6$

$\therefore r^2 = \frac{1}{4} + 36$

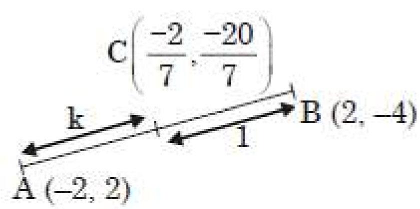
Equation of circle is

$\left(x + \frac{3}{2}\right)^2 + (y+6)^2 = \frac{1}{4} + 36$

$\Rightarrow x^2 + y^2 + 3x + 12y + 2 = 0$

26.

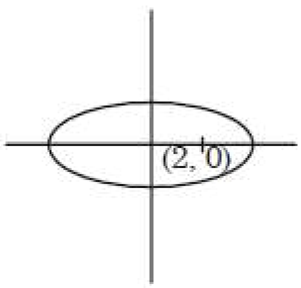
$\frac{2k-2}{k+1} = -\frac{2}{7}$



$\Rightarrow 7(k-1) = -k - 1$

$\Rightarrow 8k = 6 \Rightarrow k = \dfrac{3}{4}$ ratio $= 3:4$

27. $2 = \frac{a}{4} \Rightarrow a = 8$



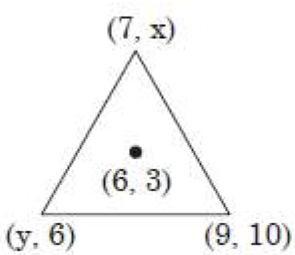
$b^2 = 64 - 4 = 60$

Equation of ellipse is $\dfrac{x^2}{64} + \dfrac{y^2}{60} = 1$

28. Let equation of line is $2x + 3y + \lambda = 0$
putting $(-1, 2)$, we get $\lambda = -4$
$\Rightarrow$ equation of line is $2x + 3y - 4 = 0$

29.
$$\theta = \tan^{-1}\left(\frac{\frac{-\sqrt{2}}{\sqrt{3}} + \frac{\sqrt{3}}{\sqrt{2}}}{1 + \left(\frac{-\sqrt{2}}{\sqrt{3}}\right)\left(\frac{-\sqrt{3}}{\sqrt{2}}\right)}\right) = \tan^{-1}\left(\frac{1}{2\sqrt{6}}\right)$$

30.



$16 + y = 18 \Rightarrow y = 2$
Next, $x + 4 = 9 \Rightarrow x = 5$
$\therefore (x, y) = (5, 2)$

31.
$R = \{(x, y): x$ and y were born in Delhi on same day$\}$
R is an equivalence relation

32. Required no. of subsets
$= {}^{10}C_2 + {}^{10}C_3 = 45 + 120 = 165$

33. $1^{2n} + 1^{2n+1} + 1^{2n+2} + 1^{2n+3} = 0$

34. $(\alpha - \beta)^2 < 5$
$\Rightarrow k^2 - 4 < 5 \Rightarrow k^2 < 9$
$\Rightarrow -3 < k < 3$ .....(1)
Next, $|k| \geq 2 \Rightarrow k \leq -2$ or $k \geq 2$ ......(2)
from both, $k \in (-3, -2] \cup [2, 3)$

35. Let $\alpha, k\alpha$ be roots of $x^2 + px + q = 0$
and $\beta, k\beta$ be roots of $x^2 + \ell x + m = 0$
Clearly,
$\dfrac{\alpha^2}{\beta^2} = \dfrac{p^2}{\ell^2} = \dfrac{q}{m} \Rightarrow p^2 m = \ell^2 q$

36.
$$\left(\frac{-1 + i\sqrt{3}}{2}\right)^2 + \left(\frac{-1 - i\sqrt{3}}{2}\right)^2 = \omega^2 + \omega^{2n} = -1$$
n is not multiple of 3

37. Sum $= 12(10^\circ + 10^1 + 10^2)$
$= 111 \times 12 = 1332$

38. $0.3 + 0.33 + 0.333 + \ldots..$
$= \dfrac{3}{10} + \dfrac{33}{100} + \dfrac{333}{1000} + \cdots$
$= \dfrac{3}{9}\left[\dfrac{9}{10} + \dfrac{99}{100} + \dfrac{999}{1000} + \cdots\right]$
$$= \frac{1}{3}\left[\left(1 - \frac{1}{10}\right) + \left(1 - \frac{1}{100}\right) + \left(1 - \frac{1}{1000}\right) + \cdots\right]$$
$$= \frac{1}{3}\left[n - \frac{\frac{1}{10}\left(1 - \frac{1}{10^n}\right)}{\frac{9}{10}}\right] = \frac{1}{3}\left[n - \frac{1}{9}\right]\left(1 - \frac{1}{10^n}\right)$$

39. $(1 + \omega)(1 + \omega^2)(1 + \omega^3)(1 + \omega + \omega^2) = 0$

40. In an $A.P$
If $S_m = n$ and $S_n = m$ then $S_{m+n} = -(m + n)$

41.
$$\frac{1 + 2i}{1 - (1 - i)^2} = \frac{1 + 2i}{1 - (-2i)} = \frac{1 + 2i}{1 + 2i} = 1$$
Modulus = 1, Argument = 0

42. If graph of quadratic lies entirely above x-axis then $D > 0$. So, both roots are complex.

43. $|z + 1| = |z + 4 - 3|$

$\leq |z+4| + |-3|$
maximum value of $|z+1| = 6$

44. $z^2 = 2\bar{z}$
Let $z = x + iy$
Now, $x^2 - y^2 + 2xyi = 2x - 2yi$
$\Rightarrow x = -1$ and $y = \pm\sqrt{3}$
So, $z = -1 + \sqrt{3i}$ and $z = -1 - \sqrt{3i}$ are two roots

45.
$$\cot(\alpha+\beta) = \frac{\cot\alpha - \cot\beta - 1}{\cot\beta + \cot\alpha}$$
$$= \frac{c-1}{-b} = \frac{1-c}{b}$$

46.
$$\begin{vmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \\ 5 & 5 & 9 \end{vmatrix} = 1(9-15) - 2(18-15) + 3(10-5)$$
$= -6 - 6 + 15 = 3 \neq 0$
$\Rightarrow$ system has unique solution.

47. $\begin{bmatrix} x+y & y \\ x & x-y \end{bmatrix}\begin{bmatrix} 3 \\ -2 \end{bmatrix} = \begin{bmatrix} 4 \\ -2 \end{bmatrix}$
$\Rightarrow \begin{bmatrix} 3x+y \\ x+2y \end{bmatrix} = \begin{bmatrix} 4 \\ -2 \end{bmatrix}$
solving we get, $x = 2, y = -2$
$A = \begin{bmatrix} x+y & y \\ x & x-y \end{bmatrix} = \begin{bmatrix} 0 & -2 \\ 2 & 4 \end{bmatrix}$
$\Rightarrow A^2 = \begin{bmatrix} 0 & -2 \\ 2 & 4 \end{bmatrix}\begin{bmatrix} 0 & -2 \\ 2 & 4 \end{bmatrix} = \begin{bmatrix} -4 & -8 \\ 8 & 12 \end{bmatrix}$

48. $R_2 \to R_2 - R_1, R_3 \to R_3 - R_1$
$\begin{vmatrix} 1 & 1 & 1 \\ 0 & xyz & 0 \\ 0 & 0 & xyz \end{vmatrix} = x^2y^2z^2$

49. $x^3 + y^3 = 0 \Rightarrow x^2 - xy + y^2 = 0$
$\Rightarrow \left(\frac{x}{y}\right)^2 - \frac{x}{y} + 10 = 0, \frac{x}{y} = -1$
$\Rightarrow \frac{x}{y}$ is one of the cube roots of -1

50. By symmetry B has as many elements as C.

51. $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$
$\Rightarrow A^2 = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$
$= \begin{bmatrix} \cos 2\theta & \sin 2\theta \\ -\sin 2\theta & \cos 2\theta \end{bmatrix}$
$\Rightarrow A^3 = \begin{bmatrix} \cos 3\theta & \sin 3\theta \\ -\sin 2\theta & \cos 3\theta \end{bmatrix}$

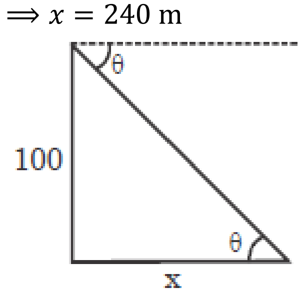
52. $(1\times 3)(3\times 3)(3\times 1)$
$= (1\times 1)$

53. $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$
$\Rightarrow A^2 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
$\Rightarrow A^4 = I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

54. $\sin A = \frac{3}{5}$
$\Rightarrow \cos A = -\frac{4}{5}$ ($\because A$ lies in 2nd quadrant)
$\therefore \cos^2\frac{A}{2} = \frac{1+\cos A}{2} = \frac{1}{10}$
$\Rightarrow \cos\frac{A}{2} = \frac{1}{\sqrt{10}}\left(\frac{A}{2} \text{ lies in 1st quadrant}\right)$

55.
$$\frac{1}{\sin 10°} - \frac{\sqrt{3}}{\cos 10°}$$
$$= \frac{2\times 2\left[\frac{1}{2}\cos 10° - \frac{\sqrt{3}}{2}\sin 10°\right]}{2\sin 10°\cos 10°}$$
$$= 4\frac{\cos(60°+18)}{\sin 20°} = 4\frac{\cos 70°}{\sin 20°} = 4$$

56. $\tan\theta = \frac{5}{12}$
$\Rightarrow \frac{100}{x} = \frac{5}{12}$
$\Rightarrow x = 240$ m



57.
$$f(x) = \sin\left(x+\frac{\pi}{6}\right) + \cos\left(x+\frac{\pi}{6}\right) = \sqrt{2}\sin\left(x+\frac{\pi}{6}+\frac{\pi}{4}\right)$$
$f(x)$ is maximum when

$$x+\frac{\pi}{6}+\frac{\pi}{4}=\frac{\pi}{2}\Longrightarrow x=\frac{\pi}{12}$$

58. $K=\sin 10°\cdot\sin 50°\cdot\sin\ \ 70°$

$$=\frac{1}{4}\sin 30°=\frac{1}{4}\times\frac{1}{2}=\frac{1}{8}$$

59.

$$\frac{\sin\alpha+\sin\beta}{\cos\alpha+\cos\beta}$$
$$=\frac{2\sin\left(\frac{\alpha+\beta}{2}\right)\cos\left(\frac{\alpha-\beta}{2}\right)}{2\cos\left(\frac{\alpha+\beta}{2}\right)\cos\left(\frac{\alpha-\beta}{2}\right)}$$
$$=\tan\left(\frac{\alpha+\beta}{2}\right)$$

60.

$$\frac{\sin(\theta+2\alpha)}{\sin\theta}=\frac{1}{3}$$
$$\Longrightarrow\frac{\sin(\theta+2\alpha)+\sin\theta}{\sin(\theta+2\alpha)-\sin\theta}=\frac{4}{-2}=-2$$
$$\Longrightarrow\frac{2\sin(\theta+\alpha)\cos\alpha}{2\cos(\theta+\alpha)\sin\alpha}=-2$$
$$\Longrightarrow\frac{\tan(\theta+\alpha)}{\tan\alpha}=-2$$
$$\Longrightarrow\tan(\theta+\alpha)+2\tan\alpha=0$$

61.

$$\int\frac{x^{e-1}+e^{x-1}}{x^e+e^x}dx$$
$$=\frac{1}{e}\int\frac{ex^{e-1}+e^x}{x^e+e^x}\,dx$$
$$=\frac{1}{e}\log(x^e+e^x)+c$$

62. $f(x)=x^2-3$

$f\ o\ f(x)=(x^2-3)^2-3=x^4-6x^2+6$

$f\ o\ f\ o\ f(x)=(x^4-6x^2+6)^2-3$

$f\ o\ f\ o\ f(x)$ is even function

$\Longrightarrow(f\ o\ f\ o\ f)(-1)=(f\ o\ f\ o\ f)(1)$

Next $(f\ o\ f\ o\ f)(-1)-4\,(f\ o\ f\ o\ f)(1)$

$-3\{(f\ o\ f\ o\ f)(1)\}=(-3)(-2)=6$

$f\ o\ f(0)=6$

Both 1 and 2 are correct.

63. $p(mx+n)+q=m(px+q)+n$

$\Longrightarrow pn+q=qm+n$

$\Longrightarrow f(n)=g(q)$

64.

$$\underset{x\to 1}{\text{µm}}\frac{F(x)-F(-1)}{x-1}$$
$$=\{F'(x)\}_{x=1}=\left(\frac{-2x}{2\sqrt{9-x^2}}\right)_{x=1}=\frac{-1}{2\sqrt{2}}$$

65.

$$\frac{d^2x}{dy^2}=\frac{d}{dy}\left(\frac{1}{\left(\frac{dy}{dx}\right)}\right)$$
$$=\frac{-\frac{d}{dy}\left(\frac{dy}{dx}\right)}{\left(\frac{dy}{dx}\right)^2}=\frac{-\frac{d}{dx}\left(\frac{dy}{dx}\right)\times\frac{dx}{dy}}{\left(\frac{dy}{dx}\right)^2}$$
$$=\frac{d^2y}{dx^2}\left(\frac{dy}{dx}\right)^{-3}$$

66. $(f-g)(x)=\begin{cases}x, & x\in Q\\ -x, & x\in R-Q\end{cases}$

Clearly $f-g$ is one-one and onto

67. $f(x)=\sin 3x$

$\sin 3x$ is increasing in

$\left[-\frac{\pi}{6},\frac{\pi}{6}\right]$

Interval length $=\frac{\pi}{3}$

68. $x\,dy=ydx+y^2dy$

$$\Longrightarrow\int\frac{ydx+xdy}{y^2}=-\int dy\Longrightarrow -y=\frac{x}{y}+C$$

$y(1)=1\Longrightarrow C=-2\Longrightarrow -y=\dfrac{x}{y}-2$

$\therefore y(-3)=3\ (\because y(x)>0)$

69. Maximum value $=4+1=5$

70.

$$f(x)=\int\sin^2 xdx=\int\left(\frac{1-\cos 2x}{2}\right)dx$$
$$=\frac{1}{2}\left[x-\frac{1}{2}\sin 2x\right]+C$$

$f(x+\pi)\neq f(x)$ ($\because f(x)$ is not periodic)

Statement 1 false

Next, $\sin^2(\pi+x)=\sin^2 x$

Statement 2 true

71.

$$y = x\left(\frac{dy}{dx}\right)^2 + \left(\frac{dy}{dx}\right)^{-2}$$
$$\Rightarrow y\left(\frac{dy}{dx}\right)^2 = x\left(\frac{dy}{dx}\right)^4 + 1$$
$$\text{order} = 1, \text{degree} = 4$$

72. $y^2 - 2ay + x^2 = a^2$

$$\Rightarrow 2y\frac{dy}{dx} - 2a\frac{dy}{dx} + 2x = 0 \Rightarrow \frac{y\frac{dy}{dx} + x}{\frac{dy}{dx}} = a$$
$$\Rightarrow \frac{py + x}{p} = a \Rightarrow y^2 \frac{-2y(py + x)}{p} + x^2 = \left(\frac{py + x}{p}\right)^2$$
$$\Rightarrow p^2y^2 - 2p^2y^2 - 2xyp + p^2x^2 = p^2y^2 + x^2 + 2xyp$$
$$\Rightarrow -2p^2y^2 + p^2x^2 - 4xyp - x^2 = 0$$
$$\Rightarrow p^2(x^2 - 2y^2) - 4xyp - x^2 = 0$$

73. $ydx = (x + 2y^2)dy$

$$\Rightarrow \frac{dx}{xy} - \frac{x}{y} - 2y$$
$$I.F = \int_{e} -\frac{1}{y}dy = -\frac{1}{y}$$
$$\Rightarrow \frac{x}{y} = 2y + c \Rightarrow x = 2y^2 + cy$$

74. $f(x + y) = f(x).f(y)\ \forall\ x, y \in R$

$$\Rightarrow f(0 + 0) = f(0).f(0) \Rightarrow \{f(0)\}^2 - f(0) = 0$$
$$\Rightarrow f(0) = 1$$

Next,

$$f'(x) = \lim_{h \to 0}\frac{f(x + h) - f(x)}{h}$$
$$= f(x).\lim_{h \to 0}\frac{f(h) - 1}{h}$$
$$= f(x)\lim_{h \to 0}\frac{f(h) - f(0)}{h} = f(x).f'(o)$$
$$\therefore f'(5) = f(5).f'(o)$$

75.

$$I = \int_0^a f(x)\,g(x)\,dx$$
$$= \int_0^a f(a - x).g(a - x)\,dx$$
$$= \int_0^a f(x)\{2 - g(x)\}\,dx$$
$$= \int_0^a 2f(x)dx - \int_0^a f(x).g(x)\,dx$$
$$\Rightarrow 2I = 2\int_0^a f(x)dx$$
$$\Rightarrow I = \int_0^a f(x)\,dx$$

76. $A \subseteq B \Rightarrow A \cap B = A$

$$P(A/B) = \frac{P(A \cap B)}{P(B)} = \frac{P(A)}{P(B)} = \frac{0.2}{0.5} = \frac{2}{5}$$
$$P(A/B) = \frac{P(A \cap B)}{P(A)} = \frac{P(A)}{P(A)} = 1$$

77. Required probability

$$= \frac{\pi\left(\frac{r}{2}\right)^2}{\pi r^2} = \frac{1}{4}$$

78.

$$r = \sqrt{\frac{15}{4} \times \frac{2}{30}} = \frac{1}{2}$$

79. Angle $= \frac{2}{5} \times 360° = 144°$

80. It is a fundamental concept. So, options ‘a’ is correct.

81. $P(ace) = \frac{4}{52} = \frac{1}{13}$

82. $S.D = \frac{5}{4}\ M.D.$ (formula)

83. Data can be represented in tabular and graphical form.

84. The abscissa of the point of intersection of less than and more than ogive is median.

85. Both statements are correct.

86. Result

$= \sqrt{\left(\frac{1}{2}\right) \times \left(-\frac{1}{8}\right)} = -\frac{1}{4}$

87. Median remains same but the mean will decrease.

88. Required probability
$= 1 - \frac{9}{36} = 1 - \frac{1}{4} = \frac{3}{4}$

89. $P(\bar{A} \cap \bar{B}) = 1 - P(A \cup B)$
$= 1 - \left(\frac{1}{3} + \frac{1}{4}\right) = \frac{5}{12}$

90. $np = 12$ and $npq = 4$
$\Rightarrow q = \frac{4}{12} = \frac{1}{3} \Rightarrow p = \frac{2}{3}$
so,
$n \times \frac{2}{3} = 12 \Rightarrow n = 18$

91. Parallel to y-axis.

92. Let
$O(0,0,0)$ $A(a,0,0), B(0,b,0)$ and $C(0,0,c)$.
$P\left(\frac{a}{2}, \frac{b}{2}, \frac{c}{2}\right)$ is equidistant from O, A, B and C.

93. P, Q, R, S are collinear.

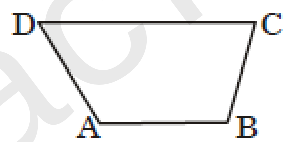
94. Let
$\frac{x-1}{2} = \frac{y-2}{-3} = \frac{z+1}{3} = \lambda$
$\Rightarrow x = 2\lambda + 1, y = -3\lambda + 2, z = 3\lambda - 1$
putting $x = 0, \lambda = -\frac{1}{2}$
$\therefore y = \frac{7}{2}, z = \frac{5}{2}$ so, point
$\left(0, \frac{7}{2}, -\frac{5}{2}\right)$

95.
$\frac{x-b}{a} = \frac{y-0}{1} = \frac{z-d}{c}$ ... (i)
$\frac{x-f}{e} = \frac{y-0}{1} = \frac{z-h}{g}$ ... (ii)
$(i)$and $(ii)$are perpendicular
$\Rightarrow ae + 1 + cg = 0$

96. $\begin{vmatrix} 1 & -1 & 1 \\ 2 & 3 & 2 \\ 1 & m & n \end{vmatrix} = 0$
$\Rightarrow 3n - 2m + 2n - 2 + 2m - 3 = 0$
$\Rightarrow n = 1$
Next, $1 + m^2 + n^2 = 6 \Rightarrow m = \pm 2$

97. $\overrightarrow{OA} + \overrightarrow{OC} = 2(\overrightarrow{OP})$ ... (1)
$\overrightarrow{OB} + \overrightarrow{OD} = 2(\overrightarrow{OP})$ ... (2)
adding (1) and (2) we get,
$\overrightarrow{OA} + \overrightarrow{OB} + \overrightarrow{OC} + \overrightarrow{OD} = 4\overrightarrow{OP}$

98.



$\overrightarrow{BA} + \overrightarrow{AD} = \overrightarrow{BD}$ .... (i)
$\overrightarrow{CD} + \overrightarrow{DA} + \overrightarrow{CA}$ .... (ii)
adding (i) and (ii)
$\overrightarrow{BA} + \overrightarrow{CD} = \overrightarrow{BD} + \overrightarrow{CA}$

99. $\vec{a} \times \vec{b} = \vec{c} \Rightarrow \vec{c}$ is perpendicular to both $\vec{a}$ and $\vec{b}$
$\vec{b} \times \vec{c} = \vec{a} \Rightarrow \vec{a}$ is perpendicular to both $\vec{b}$ and $\vec{c}$
$\Rightarrow \vec{a}, \vec{b}, \vec{c}$ form an orthogonal system.
Next,
$|\vec{a} \times \vec{b}| = |\vec{c}| \Rightarrow |\vec{a}||\vec{b}| \sin 90° \;.1 = |\vec{c}|$
and $|\vec{b} \times \vec{c}| = \vec{a} \Rightarrow |\vec{b}||\vec{c}| = \sin 90° \;.1 = |\vec{a}|$
putting for $|\vec{c}|$, we get $|\vec{b}||\vec{a}||\vec{b}| = |\vec{a}| \Rightarrow |\vec{b}| = 1$
and $|\vec{a}| = |\vec{c}|$

100. $(2)(3) + (3)(2) - 4\lambda = 0 \Rightarrow \lambda = 3$

101.

$\lim_{x \to 0} \frac{e^x - (1+x)}{x^2}$

$= \lim_{x \to 0} \frac{\left(1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \;.....\right) - (1+x)}{x^2} = \frac{1}{2!} = \frac{1}{2}$

102.

$$\int_0^{\pi/2} \frac{1}{1+\cos\theta}\, d\theta$$
$$= \int_0^{\pi/2} \frac{1}{2\cos^2\frac{\theta}{2}}\, d\theta = \frac{1}{2}\int_0^{\pi/2} \sec^2\frac{\theta}{2}\, d\theta$$
$$= \frac{1}{2} \times 2\left[\tan\frac{\theta}{2}\right]_0^{\pi/2} = 1$$

103.
$$\int \frac{1}{x(x^7+1)}\, dx$$
$$= \frac{1}{7}\int \frac{7x^6}{x^7(x^7+1)}\, dx$$
putting $x^7 = t$
$$= \frac{1}{7}\int \frac{7x^6}{t(t+1)}\, dt = \frac{1}{7}\int \left(\frac{1}{t} - \frac{1}{t+1}\right) dt$$
$$= \frac{1}{7}[\log t - \log(t+1)] + c$$
$$= \frac{1}{7}\log\left(\frac{t}{t+1}\right) + c = \frac{1}{7}\log\left(\frac{x^7}{x^7+1}\right) + c$$

104. $f(x) = \cos x$ is bijective for domain $X = [0, \pi]$ and co-domain $Y = [-1, 1]$.

105.
$$\frac{f(a)}{f(a+1)} = \frac{\frac{a}{a-1}}{\frac{a+1}{a}} = \frac{a}{a-1} \times \frac{a}{a+1} = \frac{a^2}{a^2-1}$$
$$= f(a^2)$$

106.
$$\log\left(\frac{dy}{dx}\right) = a \Rightarrow \frac{dy}{dx} = e^a \Rightarrow \int dy = \int e^a\, dx$$
$$\Rightarrow y = x\, e^a + c$$

107.
$$f(x) = \begin{cases} 2x+1, -3 < x < -2 \\ x-1, -2 \le x < 0 \\ x+2, 0 \le x < 1 \end{cases}$$
Here, $f(0^-) = -1$ and $f(0^+) = 2$ clearly $f(x)$ is discontinuous at $x = 0$ and continuous at all other points.

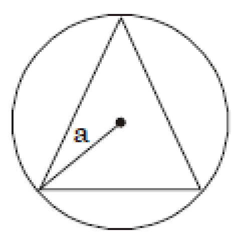
108. If $\lim\limits_{x\to a} f(x)$ and $\lim\limits_{x\to a} g(x)$ both exists, then $\lim\limits_{x\to a} f(x) . g(x)$ exists. But if $\lim\limits_{x\to a} f(x) . g(x)$ exists, then it is not necessary that $\lim\limits_{x\to a} f(x)$ and $\lim\limits_{x\to a} g(x)$ both exists.

109. If $f(x) = x^2(x-3)$ then
$f(-x) = x^2(-x-3) \neq f(x)$ or $-f(x)$
$\Rightarrow f(x)$ is neither even nor odd.

110.
$$\frac{d}{dx}\log_{10}^{(5x^2+3)}$$
$$= \frac{1}{5x^2+3} \times \log_{10}^{e} \times 10x = \frac{10x\log_{10}^{e}}{5x^2+3}$$

111.
$$f(a) = \frac{a-1}{a+1}$$
$$f(2a) = \frac{2a-1}{2a+1}$$
$$f(a) + 1 = \frac{a-1}{a+1} + 1 = \frac{2a}{a+1}$$
So, $f(2a) \neq f(a) + 1$
Next,
$$f\left(\frac{1}{a}\right) = \frac{\frac{1}{a}-1}{\frac{1}{a}+1} = \frac{1-a}{a+1} = -\left(\frac{a-1}{a+1}\right) = -f(a)$$

112. For area of Δ to be maximum, triangle should be an equilateral triangle.



ℓ = length of side of equilateral triangle $= \sqrt{3}a$
$$\therefore \text{Area} = \frac{\sqrt{3}}{4}\left(\sqrt{3}\, a\right)^2 = \frac{3\sqrt{3}}{4}a^2$$

113.
$$f(x) = x + \frac{1}{x} \Rightarrow f'(x) = \frac{x^2-1}{x^2}$$
$$\Rightarrow f'(x) = \frac{(x-1)(x+1)}{x^2}$$
for $x \in (0,1), f'(x) < 0$
$\Rightarrow f(x)$ decreases

114. $f(x) = x^n, n \neq 0.$

$\Longrightarrow f'(x) = nx^{n-1}$

$f(x)$ to be differentiable, $n - 1 \geq 0 \Longrightarrow n \geq 1$

$\Longrightarrow n \in [1, \infty]$

115.

$$\int_{e^{-1}}^{e^2} \left|\frac{\log x}{x}\right| dx = \int_{e^{-1}}^{e^0} -\frac{\log x}{x}\, dx + \int_{e^0}^{e^2} \frac{\log x}{x}\, dx$$

$$= -\frac{1}{2}[(\log x)^2]_{e^{-1}}^{e^0} + \frac{1}{2}[(\log x)^2]_{e^0}^{e^2} = \frac{1}{2} + 2 = \frac{5}{2}$$

116. New variance $= 5 \times (3)^2 = 45$

117. Required mean

$$= \frac{20 \times 100 - (21 + 21 + 18 + 20)}{96} = \frac{1920}{96} = 20$$

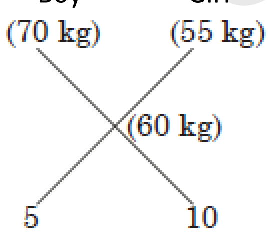
118. Required probability

$$= \frac{{}^2C_0 \times {}^2C_2}{{}^4C_2} = \frac{1}{6}$$

119. Required probability

$$= 1 - \left(\frac{1}{2} \times \frac{2}{3} \times \frac{3}{4}\right) = 1 - \frac{1}{4} = \frac{3}{4}$$

120. Boy Girl



By aligation, ratio $= 1:2$

$\therefore$ no. of boys $= \frac{1}{3} \times 150 = 50$

General Ability Test NDA 1 2017 Question Paper

PART – A
SPOTTING ERRORS

Directions for the following 5 (five) items:

Each item in this section has a sentence with three underlined parts labelled (a), (b), and (c). Read each sentence to find out whether there is any error in any underlined part and indicate your response in the Answer Sheet against the corresponding letter i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d).

1. I can fly (a) if I will be (b) a bird. (c) No error (d)
2. As soon as (a) the train arrived (b) the passengers entered the compartments. (c) No error. (d)
3. Never (a) I have (b) seen such a town (c). No error. (d)
4. He goes to his office (a) by bicycle (b) every day. (c) No error. (d)
5. Far from being appreciated, (a) his conduct was discussed (b) and sharply commented. (c) No error. (d)

COMPREHENSION

Directions for the following 6 (six) items:

In this section, you have **two** short passages. Read the passages and answer the items that follow. You are required to select your answers based on the contents of the passage and opinion of the author only.

Passage – 1

We had just passed Tenali, where I roused myself in order to hear the name of the station. As I was falling asleep again, a violent jolt shot me into the arms of somebody in the seat opposite. The engine with one wheel broken was lying across the track and beside it was the luggage van, likewise, derailed. Groaning, wheezing, gasping, sputtering in its death agony, the engine was like a fallen horse which, snorting, trembling in every limb, its flanks heaving, its chest laboring, seems incapable of making the smallest effort to struggle on its legs again.

6. The author had roused himself as he wanted to
   (a) get off
   (b) meet someone
   (c) know the name of the station
   (d) keep himself awake
7. The engine stopped because
   (a) the driver had stopped it
   (b) one of the wheels was broken
   (c) there was a halting place
   (d) there was no fuel
8. The engine is compared to a fallen horse because
   (a) it was groaning like a horse
   (b) it was lying across the track
   (c) it could make no effort to stand upright
   (d) it had a broken wheel

Passage – 2

I was beginning to tire a little now. I had been cutting steps continuously for two hours, and Tenzing, too, was moving very slowly. As I chipped steps around still another corner, I wondered rather dully just how long we could keep it up. Our original zest had now quite gone and it was turning more into a grim struggle. I then realized that the ridge ahead, instead of still monotonously rising, now dropped sharply away, and far below I could see the North Col and Rongbuk glacier. I looked upwards to see a narrow ridge running up to a snowy summit. A few more whacks of the ice-axe in the firm snow and we stood on top.

9. Which of the following is the most appropriate description of the area in which the narrator had been moving?
   (a) a steep rocky slope
   (b) a peak with a flight of steps
   (c) a high peak covered with snow

(d) a long ridge

10. 'I had been cutting steps continuously for two hours' suggests that
    (a) the climber was unskilled in the art of making steps
    (b) he had to cut the steps out of snow before climbing up which was necessarily a slow process
    (c) the slowness was caused by the fact that as soon as he cut the steps they were again covered with snow
    (d) he had to work suspended form a ledge
11. 'It was turning more into a grim struggle' would mean
    (a) that after the long exertion he was feeling so weak that any further climbing meant a hard struggle with the forces of nature
    (b) that Tenzing was making the task more difficult
    (c) that strong cold wind was pushing him down from above and that he had to struggle with the forces of nature
    (d) that he was in a mood to give up ultimately

SELECTING WORDS

Directions for the following 10 (ten) items:

Each of the following items in this section has a sentence with a blank space and four words or group of words given after the sentence. Select whichever word or group of words you consider most appropriate for the blank space and indicate your response on the Answer Sheet accordingly.

12. I ______ you to be at the party this evening.
    (a) look forward to
    (b) hope
    (c) expect
    (d) think
13. When I met John yesterday, it was the first time I ______ him since Christmas.
    (a) saw
    (b) have seen
    (c) had seen
    (d) have been seeing
14. He _____to listen to my arguments and walked away.
    (a) denied
    (b) disliked
    (c) prevented
    (d) refused
15. The flow of blood was so ______ that the patient died.
    (a) intense
    (b) adequate
    (c) profuse
    (d) extensive
16. You have never _______ me about your experiences in America.
    (a) said
    (b) told
    (c) explained
    (d) spoken
17. I always felt hungry __________ I heard the dinner bell.
    (a) as much as
    (b) as well as
    (c) as soon as
    (d) as close as
18. Although they took every precaution, they could not __________ the accident.
    (a) defer
    (b) allow
    (c) avoid
    (d) block
19. The ambitious nobleman ______ to marry the king's daughter.
    (a) transpired
    (b) perspired
    (c) aspired
    (d) expired
20. The dictator of that country was a monster of wickedness, insatiable in his __________ for blood and plunder.
    (a) idea
    (b) vision
    (c) lust
    (d) intention
21. Please don't give me anymore, I have had _______.
    (a) few

(b) too little
(c) little
(d) enough

ORDERING OF WORDS IN A SENTENCE

Directions for the following 9 (nine) items:

Each of the following items in this section consists of a sentence the parts of which have been jumbled. These parts have been labelled P, Q, R, and S. Given below each sentence are four sequences namely (a), (b), (c), and (d). You are required to rearrange the jumbled parts of the sentence and mark your response accordingly.

22. <u>Farm workers</u> <u>spend</u> <u>outdoors</u>
P Q R
<u>most of their time.</u>
S
The proper sequence should be
(a) P Q R S
(b) P R Q S
(c) P Q S R
(d) R P Q S

23. <u>He</u> <u>shuffled the papers</u> <u>in a drawer</u> <u>together.</u>
P Q R S
The proper sequence should be
(a) P Q S R
(b) P Q R S
(c) P S Q R
(d) R S P Q

24. <u>Do you think</u> <u>will</u> <u>this soap</u>
P Q R
<u>shrink woolen clothes?</u>
S
The proper sequence should be
(a) P Q R S
(b) P R Q S
(c) Q R P S
(d) Q P R S

25. <u>We advised</u> <u>the hijackers to surrender</u>
P Q
<u>to the police</u> <u>themselves.</u>
R S
The proper sequence should be
(a) P Q R S
(b) P R Q S
(c) P Q S R
(d) R P Q S

26. <u>Sports cars</u> <u>appeal</u> <u>to some motorists only</u>
P Q R
<u>with noisy exhausts.</u>
S
The proper sequence should be
(a) R Q S P
(b) P S Q R
(c) R S P Q
(d) P Q S R

27. <u>He</u> <u>almost</u>
P Q
<u>planned the entire strategy of operation</u>
R
<u>single-handed.</u>
S
The proper sequence should be
(a) R S P Q
(b) P R Q S
(c) S Q R P
(d) Q P S R

28. <u>She has</u> <u>more</u> <u>intelligence</u>
P Q R
<u>than what we suspected her to possess.</u>
S
The proper sequence should be
(a) P Q S R
(b) P R Q S
(c) P S Q R
(d) P Q R S

29. <u>They</u> <u>should implant</u>
P Q
<u>in the minds of young children</u> <u>sound principles.</u>
R S
The proper sequence should be
(a) P Q R S
(b) P Q S R
(c) R P Q S
(d) P R Q S

30. <u>When I was a student</u>
P

I learnt swimming at the age of 15
Q
of class X in a government school.
R S

The proper sequence should be

(a) P Q R S
(b) P R Q S
(c) Q P R S
(d) Q S P R

SENTENCE IMPROVEMENT

Directions for the following 10 (ten) items:

In this section, look at the underlined part of each sentence. Below each sentence are given three possible substitutions for the underlined part. If one of them (a), (b) or (c) is better than the underlined part, indicate your response on the Answer Sheet against the corresponding letter (a), (b) or (c). If none of the substitutions improves the sentence, indicate (d) as your response on the Answer Sheet. Thus a 'No improvement' response will be signified by the letter (d).

31. I disliked him not so much for his meanness but for his dishonesty.
(a) as for
(b) but because
(c) but due to
(d) No improvement

32. He preferred death rather than imprisonment.
(a) for
(b) to
(c) than
(d) No improvement

33. They kept the idea secretly.
(a) secretive
(b) secret
(c) secretively
(d) No improvement

34. He ought not to tell me your secret, but he did.
(a) telling
(b) have told
(c) having told
(d) No improvement

35. If I don't know the meaning of a word, I look it after in the dictionary.
(a) look it out
(b) look it for
(c) look it up
(d) No improvement

36. Mr. and Mrs. Rao stay in their home every evening.
(a) at home
(b) inside home
(c) within their home
(d) No improvement

37. When we saw him last, he ran to catch a bus.
(a) has run
(b) had run
(c) was running
(d) No improvement

38. She cut a sad figure in her first performance on the stage.
(a) made a sorry figure
(b) cut a sorry face
(c) cut a sorry figure
(d) No improvement

39. Last evening, I went to the optician and bought spectacles.
(a) a spectacle
(b) two spectacles
(c) a pair of spectacles
(d) No improvement

40. I would like to avail a fifteen days holiday this summer.
(a) to avail of
(b) to avail myself of
(c) to avail myself
(d) No improvement

ANTONYMS

Directions for the following 5 (five) items:

In this section, each item consists of a sentence with a word underlined and is followed by four words. Select the word that is most opposite in meaning to the underlined word and indicate your response in the Answer Sheet accordingly.

41. My first lecture in the classroom was a fiasco.
(a) success
(b) joy

(c) fun
(d) disaster

42. It was indeed arduous to cross streets in New York.
(a) pleasant
(b) effortless
(c) interesting
(d) risky

43. Unlike his brother, he is affable.
(a) reserved
(b) gullible
(c) irritable
(d) lovable

44. The birth of his child decidedly proved to be an auspicious event in his life.
(a) precious
(b) ominous
(c) useless
(d) unforgettable

45. The witness corroborated word for word the statement of the victim.
(a) accepted
(b) confirmed
(c) denied
(d) repeated

SYNONYMS

Directions for the following 5 (five) items:

In this section, each item consists of a sentence with a word underlined and is followed by four words or group of words. Select the word or group of words that is most similar in meaning to the underlined word and indicate your response in the Answer Sheet accordingly.

46. It is unwise to sever diplomatic relations with a neighbouring country over small matters.
(a) engage
(b) estrange
(c) cut off
(d) twist

47. Bad tendencies are to be countered by good ones until all that is evil disappears.
(a) opposed
(b) balanced
(c) reduced
(d) bypassed

48. The police fired indiscriminately at the crowd, killing many innocent women and children.
(a) continuously
(b) without distinguishing
(c) foolishly
(d) rapidly

49. Businessmen who lack acumen cannot be expected to be very successful.
(a) fairness
(b) sharpness
(c) boldness
(d) righteousness

50. His candid opinions have won him many friends.
(a) kind
(b) courteous
(c) generous
(d) frank

PART – B

51. Which one of the following statements regarding King Krishnadevaraya is NOT correct?
(a) He was a great scholar of Telugu and Sanskrit.
(b) Foreign travelers Paes and Nuniz visited his court.
(c) Barbosa praised him for the great justice and equity prevailing in his empire.
(d) He wrote his magnum opus *Amuktamalyada* in Sanskrit.

52. Match List I with List II and select the correct answer using the given code below the Lists:

List I *(Amendment to the Constitution of India)*	**List II** *(Subject)*
A. 52^{nd} Amendment Act, 1985	1. Reduction of voting age from 21 to 18
B. 73^{rd} Amendment Act, 1992	2. Right to Education
C. 61^{st} Amendment Act, 1988	3. Panchayati Raj

D. 86^{th} Amendment Act, 2006	4. Disqualification on grounds of defection

Code:

	A	B	C	D
(a)	4	1	3	2
(b)	4	3	1	2
(c)	2	3	1	4
(d)	2	1	3	4

53. Which one of the following was NOT a cause of the Revolt of 1857?
    (a) The rumour that the British had mixed the bone dust of cows and pigs into the flour being sold in the market.
    (b) The prophecy that British rule would come to an end on the centenary of the Battle of Plassey on 23^{rd} June, 1857.
    (c) Popular discontent with British rule.
    (d) The prophecy that the end of British rule would lead to the end of the Kali Yuga and the return of Ram Rajya
54. Which one of the following was NOT a feature of the Subsidiary Alliance of Lord Wellesley?
    (a) The British were responsible for protecting the ally from any external threats.
    (b) All internal threats were to be handled by the ally alone, with no help from the British.
    (c) The ally was to provide resources for maintaining a British armed contingent stationed in its territory.
    (d) The ally could not enter into any agreement with other rulers without the permission of the British.
55. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Place)*	List II *(Mineral)*
A. Lakwa	1. Copper
B. Malanjkhand	2. Petroleum
C. Kalakot	3. Zinc
D. Zawar	4. Coal

Code:

	A	B	C	D
(a)	3	4	1	2
(b)	3	1	4	2
(c)	2	1	4	3
(d)	2	4	1	3

56. Which one of the following are the major coral reef areas of India?
    1. Gulf of Kachchh
    2. Gulf of Mannar
    3. Lakshadweep
    4. Andaman and Nicobar Islands

    Select the correct answer using the code given below:
    (a) 1 and 3 only
    (b) 2 and 4 only
    (c) 1, 2 and 3 only
    (d) 1, 2, 3 and 4
57. Which of the following regions is/are NOT known for cotton-textile industry?
    1. Mumbai – Pune region
    2. Madurai – Coimbatore region
    3. Dhanbad – Jamshedpur region
    4. Indore – Ujjain region

    Select the correct answer using the code given below:
    (a) 1 and 3
    (b) 2 and 3
    (c) 1, 2 and 4
    (d) 3 only
58. Which one of the following States does NOT have the Headquarters of any Railway Zone?
    (a) Jharkhand
    (b) Chhattisgarh
    (c) Odisha
    (d) Bihar
59. Suppose a rod is given a negative charge by rubbing it with wool. Which one of the following statements is correct in this case?
    (a) The positive charges are transferred from rod to wool.

(b) The positive charges are transferred from wool to rod.
(c) The negative charges are transferred from rod to wool.
(d) The negative charges are transferred from wool to rod.

60. Which one of the following is the correct relation between frequency f and angular frequency ω?
(a) $f = \pi\omega$
(b) $\omega = 2\pi f$
(c) $f = 2\omega/\pi$
(d) $f = 2\pi\omega$

61. A Kelvin thermometer and a Fahrenheit thermometer both give the same reading for a certain sample. What would be the corresponding reading in a Celsius thermometer?
(a) 574
(b) 301
(c) 273
(d) 232

62. If the potential difference applied to an X-ray tube is doubled while keeping the separation between the filament and the target as same, what will happen to the cutoff wavelength?
(a) will remain same
(b) will be doubled
(c) will be halved
(d) will be four times of the original wavelength

63. Which one of the following statements is true for the relation $F = \frac{Gm_1m_2}{r^2}$? (All symbols have their usual meanings.)
(a) The quantity G depends on the local value of g, acceleration due to gravity.
(b) The quantity G is the greatest at the surface of the Earth.
(c) The quantity G is used only when Earth is one of the two masses.

64. Why is it difficult to measure the coefficient of expansion of a liquid than solid?
(a) Liquids tend to evaporate at all temperatures
(b) Liquids conduct more heat
(c) Liquids expand too much when heated
(d) Their containers also expand when heated

65. Radon is
(a) an inert gas
(b) an artificial fiber
(c) an explosive
(d) a metal

66. The chemical name for baking soda is
(a) Na_2CO_3
(b) $NaHCO_3$
(c) $CaCO_3$
(d) $NaOH$

67. Which one of the following elements is used in pencil-lead?
(a) zinc
(b) lead
(c) carbon (graphite)
(d) tin

68. Who among the following is one of the authors of the book "Philosophy of the Bomb"?
(a) Bhagat Singh
(b) Jawaharlal Nehru
(c) Surya Sen
(d) Yashpal

69. Which one of the following statements about Chittagong group is NOT correct?
(a) Its membership included a large number of youth including Ganesh Ghosh, Lokenath Baul, and Anant Singh.
(b) Its leader Surya Sen had been a lawyer in Dhaka before joining the group.
(c) Surya Sen and his group were closely associated with Congress work in Chittagong.
(d) This group had prepared an action plan to occupy the armouries in Chittagong.

70. Which one of the following was a significant feature of the Quit India Movement?
(a) Women did not play an important role in the movement.
(b) Nasik in Maharashtra was an important regional base during the movement.
(c) It was marked by anti-zamindar violence.
(d) It was marked by the emergence of parallel governments in different parts of India.

71. Which one of the following devices changes low voltage alternating current to high voltage alternating current and vice versa?
(a) generator

(b) motor
(c) transformer
(d) vibrator

72. An optical illusion which occurs mainly in deserts during hot summer is based on the principle of
(a) reflection
(b) interference
(c) dispersion
(d) total internal reflection

73. At which place Earth's magnetic field becomes horizontal?
(a) magnetic meridian
(b) magnetic equator
(c) geographical pole
(d) Tropic of Cancer

74. The speed of a car traveling on a straight road is listed below at successive intervals of 1 s:

Time (s)	0	1	2	3	4
Speed (m/s)	0	2	4	6	8

Which of the following is/are correct?
The car travels
1. with a uniform acceleration of $2/\text{ms}^2$.
2. 16 m in 4 s.
3. with an average speed of 4 m/s/

Select the correct answer using the code given below:
(a) 1, 2 and 3
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1 only

75. The speed of a body that has Mach number more than 1 is
(a) supersonic
(b) subsonic
(c) 300 m/s
(d) about 10 m/s

76. Molecules of which of the following has cage like structure?
1. Diamond
2. Graphite
3. Fullerenes

Select the correct answer using the code given below:
(a) 1, 2, and 3
(b) 2 and 3 only
(c) 2 only
(d) 3 only

77. Temporary hardness in water is due to which one of the followings of Calcium and Magnesium?
(a) hydrogen carbonates
(b) carbonates
(c) chlorides
(d) sulphates

78. Stung by hairs of nettle leaves causes burning pain. This is due to the injection of
(a) acetic acid
(b) methanoic acid
(c) sulphuric acid
(d) hydrochloric acid

79. Which one of the following elements is least reactive with water?
(a) lithium
(b) sodium
(c) potassium
(d) cesium

80. Rutherford's alpha-particle scattering experiment was responsible for the discovery of
(a) electron
(b) proton
(c) nucleus
(d) helium

81. Glass is a
(a) liquid
(b) colloid
(c) non-crystalline amorphous solid
(d) crystalline solid

82. Cell wall of any fungus is different from plants in having
(a) cellulose
(b) chitin
(c) cholesterol
(d) glycogen

83. Sleeping sickness is a parasitic disease of humans and other animals. It is caused by
(a) Histomonas
(b) Trypanosoma
(c) Angomonae
(d) Naegleria

84. Which one of the following agencies enforces the laws on food security in India?
(a) FDA

(b) WHO
(c) FSSAI
(d) FAO

85. Dengue virus causes high fever, rashes and reduces the number of a particular type of blood cells. Those blood cells are
(a) monocytes
(b) platelets
(c) eosinophils
(d) neutrophils

86. Which one of the following statements is NOT correct?
(a) all proteins are enzymes
(b) mostly enzymes are proteins
(c) all fats are energy rich compounds
(d) glucose is a common carbohydrate

87. Sugarcane is one of the important cash crops in India. It is grown to obtain
(a) starch
(b) glucose
(c) fructose
(d) sucrose

88. The colorful part of the Sunflower or Marigold plant is
(a) flower
(b) inflorescence
(c) fruit
(d) seed

89. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Mineral)*	**List II** *(Leading State)*
A. Manganese	1. Uttarakhand
B. Gypsum	2. Kamataka
C. Limestone	3. Rajasthan
D. Magnesite	4. Odisha

Code:

	A	**B**	**C**	**D**
(a)	1	3	2	4
(b)	1	2	3	4
(c)	4	2	3	1
(d)	4	3	2	1

90. Which one among the following is the correct order of tiger reserves situated from North to South in India?
(a) Corbett – Simlipal – Sariska – Periyar
(b) Periyar – Sariska – Simlipal – Corbett
(c) Corbett – Sariska – Simlipal – Periyar
(d) Periyar – Simlipal – Sariska – Corbett

91. Which of the following are correct with regard to Indian Monsoonal Rainfall?
1. largely governed by the topographical features
2. regional and seasonal variation in the distribution of rainfall
3. heavy downpour resulting considerable runoff
4. beginning and end of rain is regular and on time.

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 1, 2 and 3
(c) 3 and 4 only
(d) 2, 3 and 4

92. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Type of climate)*	**List II** *(State)*
A. Monsoon with Short Dry Season (Amw)	1. Uttar Pradesh and Bihar
B. Cold Humid Winter with Short Summer (Dfc)	2. Tamil Nadu Coast
C. Monsoon with Dry Winter (Cwg)	3. Arunachal Pradesh
D. Monsoon with Dry Summer (As)	4. Kerala and Karnataka Coast

Code:

	A	**B**	**C**	**D**
(a)	4	3	1	2
(b)	4	1	3	2
(c)	2	1	3	4
(d)	2	3	1	4

93. Which one of the following Himalayan rivers does NOT originate from across the Himalayas?
   (a) Indus
   (b) Satluj
   (c) Ganga
   (d) Brahmaputra
94. The Headquarters of Eastern Railway Zone of Indian Railway is located at
   (a) Bhubaneswar
   (b) Kolkata
   (c) Hajipur
   (d) Guwahati
95. Which one among of the following countries is the largest trading partner of India in external trade for the year 2015-2016?
   (a) United States of America
   (b) United Kingdom
   (c) United Arab Emirates
   (d) China
96. The radii of curvature of the faces of a double convex lens are 10 cm and 20 cm. The refractive index of the glass is $1 \cdot 5$. What is the power of this lens (in units of dioptre)?
   (a) $+7 \cdot 5\ \mathrm{D}$
   (b) $-7 \cdot 5\ \mathrm{D}$
   (c) $+2 \cdot 5\ \mathrm{D}$
   (d) $+5 \cdot 0\ \mathrm{D}$
97. The time period of a simple pendulum made using a thin copper wire of the length L is T. Suppose the temperature of the room in which this simple pendulum is placed increases by 30°C, what will be the effect on the time period of the pendulum?
   (a) T will increase slightly
   (b) T will remain the same
   (c) T will decrease slightly
   (d) T will become more than 2 times
98. Which one of the following physical quantity has the same unit as that of pressure?
   (a) angular momentum
   (b) stress
   (c) strain
   (d) work
99. Which one of the following statements is correct with regard to the material of electrical insulators?
   (a) they contain no electrons
   (b) electrons do not flow easily through them
   (c) they are crystals
   (d) they have more number of electrons than the protons on their surface
100. Which one of the following physical quantities does NOT affect the resistance of a cylinder resistor?
   (a) the current through it
   (b) its length
   (c) the resistivity of the material used in the resistor
   (d) the area of cross-section of the cylinder
101. Kidney secretes an enzyme, which changes plasma protein angiotensinogen into angiotensin. The enzyme is
   (a) renin
   (b) nitrogenase
   (c) hydrolase
   (d) mono-oxygenase
102. Red blood cells (RBCs) have
   (a) no nucleus, no mitochondria and no endoplasmic reticulum
   (b) nucleus, mitochondria and endoplasmic reticulum
   (c) nucleus, mitochondria but no endoplasmic reticulum
   (d) no mitochondria but endoplasmic reticulum is present
103. According to the Census 2011, the density of population in which one among the following States is the lowest?
   (a) Sikkim
   (b) Nagaland
   (c) Manipur
   (d) Mizoram
104. Headquarters of the World Meteorological Organizations located in
   (a) Washington
   (b) Geneva
   (c) Moscow
   (d) London
105. Match List I with List II and select the correct answer using the code given below the Lists:

List I **List II**

(Industry)	*(Place)*
A. Petrochemical	1. Coimbatore
B. Aircraft	2. Pinjore
C. Machine tools	3. Bengaluru
D. Cotton textiles	4. Bongaigaon

Code:

	A	**B**	**C**	**D**
(a)	4	3	2	1
(b)	4	2	3	1
(c)	1	2	3	4
(d)	1	3	2	4

106. Consider the following statements pertaining to Coffee plantation in India:
1. Need warm and moist climate with a spell of dry weather during the ripening period.
2. Rolling fields having good drainage.
3. Strong sunshine over hilly slopes exceeding temperature 35°C.
4. Kamataka is the leading producer in India.

Which of the statements given above are correct?
(a) 1 and 4 only
(b) 1, 2 and 3
(c) 3 and 4
(d) 1, 2 and 4

107. Dr. Urjit Patel, who has been appointed recently as Governor of Reserve Bank of India, was holding which position immediately prior to this appointment?
(a) Chief Economist, IMF
(b) Deputy Governor, Reserve Bank of India
(c) Chief Economic Advisor to the Government of India
(d) Professor of Economics at Harvard University

108. Who among the following personalities is NOT a Governor of any Indian State?
(a) Najma Heptulla
(b) Ram Nath Kovind
(c) Acharya Dev Vrat
(d) Arvind Subramaniam

109. Which of the following cricket teams was defeated by India to lift the Women's Twenty 20 Asia Cup 2016?
(a) Bangladesh
(b) Sri Lanka
(c) Pakistan
(d) Afghanistan

110. Which one of the following was the venue of 2nd BRICS Youth Summit of the Ministers, Officials and Youth Delegations?
(a) New Delhi
(b) Mumbai
(c) Shillong
(d) Guwahati

111. Which one among the following States of India has recently proposed to frame the first Internal Security Act to deal with the challenges of terrorism, insurgency, communalism and caste violence?
(a) Maharashtra
(b) Gujarat
(c) Uttar Pradesh
(d) Chhattisgarh

112. The World Humanitarian Day is being observed every year on which date?
(a) 24 October
(b) 19 August
(c) 10 December
(d) 8 March

113. Surge pricing takes place when a service provider
(a) raises the price of its product or service as demand outstrips supply
(b) follow preset prices immune to demand and supply dynamics
(c) fixes a minimum price for its services
(d) fixes an average price on the basis of transactions carried over a day

114. By fulfilling which of the following conditions can a political party claim the status of a national party?
1. It secures at least six per cent (6%) of the valid votes polled in any four or more states, at a general election to the House of the People or, to the State Legislative Assembly.

2. It wins at least four seats in the House of the People from any State or States or wins at least two per cent (2%) seats in the House of the People (i.e., 11 seats in the existing House having 543 members), and these members are elected from at least three different States.
3. The party in question has got recognition as a state party in at least two states.
4. It must have its headquarters in New Delhi.

Select the correct answer using the code given below:

(a) 1, 2 and 3
(b) 2 and 4
(c) 1 and 2 only
(d) 1, 3 and 4

115. In its emphasis on enhancing human capabilities, which one among the following does NOT figure in the Twelfth Five-Year Plan?

(a) life and longevity
(b) education
(c) delivery of public service
(d) skill development

116. Which one of the following is NOT a target of the 12^{th} Five-Year Plan?

(a) Real GDP Growth Rate of 8 per cent
(b) Agriculture Growth Rate of 5 per cent
(c) Manufacturing Growth Rate of 10 per cent
(d) Increase in green cover by 1 million hectare every year during the Plan period

117. Which one of the following was following characteristics does NOT describe the Khilafat movement?

(a) Mahatma Gandhi sought to link it to the Non-Cooperation movement
(b) It was not supported by the Congress
(c) It demanded that the Turkish Sultan must retain control over Muslim sacred spaces in the erstwhile Ottoman empire
(d) It was led by Muhammad Ali and Shaukat Ali

118. Which one of the following was NOT a feature of railways in colonial India?

(a) The main purpose of the setting up of railways in India was to serve the interest of the empire.
(b) British capital investments were invited with 15% guaranteed interest to be paid if necessary from Indian revenues.
(c) The construction works disturbed ecology.
(d) The construction of the railways was planned in such a way that it connected the internal markets with the ports but provided no interconnection between internal market cities.

119. Which colonial administrator made the following declaration about the partition of Bengal in 1904? "Bengal united is a power. Bengal divided will pull in different ways. That is perfectly true and one of the merits of the scheme."

(a) Lord Curzon
(b) H. H. Risley
(c) Lord Minto
(d) Sir Lancelot Hare

120. Who launched the Bardoli Satyagraha on 4^{th} February, 1928?

(a) Mahatma Gandhi
(b) Vallabhbhai Patel
(c) Rajendra Prasad
(d) Kalyanji Mehta

121. Which one of the following Princely States did NOT support the Congress during the course of the Civil Disobedience Movement?

(a) Bhavnagar
(b) Mysore
(c) Junagadh
(d) Kathiawar

122. Which one of the following is a feature of thought and philosophy of the Kandukuri Viresalingam?

(a) He believed that science and morality were unconnected to truth
(b) He believed in universal education
(c) He believed that language had no role in inculcating morality in students
(d) He did not attempt to build a national consciousness on a cultural base

123. Name the calligrapher in Akbar's court who was honoured with the title "Zarrin Kalam" or Golden Pen

(a) Abdul Fazl

(b) Tansen
(c) Muhammad Husayn
(d) Muhammad Kasim

124. Which one of the following sections of the Golden Quadrilateral Highway in India is the longest in terms of route distance?
(a) Delhi – Kolkata
(b) Kolkata – Chennai
(c) Chennai – Mumbai
(d) Mumbai – Delhi

125. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Classification of resources)*	**List II** *(Example)*
A. Basic inexhaustible resource	1. Hydel power
B. Conventional non-renewable resource	2. Coal
C. Non-conventional renewable resource	3. Solar energy
D. Non-conventional non-renewable resource	4. Natural gas

Code:

	A	**B**	**C**	**D**
(a)	3	2	1	4
(b)	3	1	2	4
(c)	4	1	2	3
(d	4	2	1	3

126. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Mineral Deposit)*	**List II** *(State)*
A. Gypsum	1. Odisha
B. Graphite	2. Gujarat
C. Fluorspar	3.Arunachal Pradesh
D. Nickel	4. Rajasthan

Code:

	A	**B**	**C**	**D**
(a)	1	3	2	4
(b)	1	2	3	4
(c)	4	3	2	1
(d)	4	2	3	1

127. Which one of the following pairs of Tribe and State is NOT correctly matched?
(a) Tharu: Madhya Pradesh
(b) Adi: Arunachal Pradesh
(c) Irula: Kerala
(d) Shaharia: Rajasthan

128. If the absolute refractive indices of glass and water are 3/2 and 4/3 respectively, what will be the ratio of velocity of light in glass and water?
(a) 3: 4
(b) 4: 3
(c) 8: 7
(d) 8: 9

129. A positive charge $+q$ is placed at the centre of a hollow metallic sphere of inner radius a and outer radius b. The electric field at a distance r from the centre is denoted by E. In this regard, which one of the following statements is correct?
(a) $E = 0 \text{ for } a < r < b$
(b) $E = 0 \text{ for } r < a$
(c) $E = q/4\pi\varepsilon_0 r \text{ for } a < r < b$
(d) $E = q/4\pi\varepsilon_0 a \text{ for } r < a$

130. Consider the following Indian States:
1. Bihar
2. Rajasthan
3. Jammu and Kashmir
4. Haryana

Which one of the following is the correct ascending order of the above States on the basis of percentage of State's population of India (based on census 2011)?
(a) 3 – 4 – 1 – 2

(b) 4 – 2 – 1 – 3
(c) 3 – 4 – 2 – 1
(d) 2 – 3 – 4 – 1

131. Who among the following was the author of the Badshah Nama?
(a) Abdul Hamid Lahori
(b) Abul Fazl
(c) Shah Jahan
(d) Sadullah Khan

132. Which one of the following statements about Fatehpur Sikri is NOT correct?
(a) It was located on the direct road to Ajmer.
(b) Akbar commissioned the building of a marble tomb for Sheikh Salim Chisti next to the Friday mosque at Fatehpur Sikri.
(c) The arched gateway or Bulund Darwaza was meant to remind visitors of the Mughal victory in Gujarat.
(d) In 1585, the capita of the Mughal emperor shifted from Fatehpur Sikri to Delhi.

133. Which one of the following cities hosted the 3rd World Trauma Congress recently?
(a) New Delhi
(b) Dacca
(c) Singapore
(d) Bangkok

134. Which one of the following is NOT one of the objectives of Act East Policy?
(a) To promote economic cooperation, cultural ties and develop strategic relationship with countries in the Asia-Pacific region
(b) To promote peace and amity with the neighbouring countries of Asia
(c) To place emphasis on India-ASEAN cooperation in India’s domestic agenda
(d) To provide enhanced connectivity to the North East of India

135. Arrange the following countries in ascending order on the basis of the total medals earned by them in Rio Olympics 2016:
1. United States
2. China
3. Great Britain
4. Russia

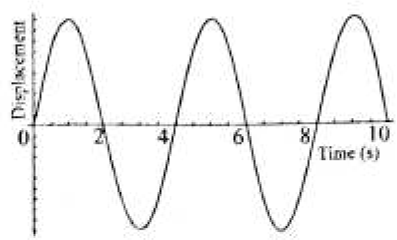
Select the correct answer using the code given below:
(a) 1, 2, 3, 4
(b) 1, 3, 2, 4
(c) 4, 3, 2, 1
(d) 4, 3, 1, 2

136. Which one of the following is NOT an objective of the National Civil Aviation Policy 2016?
(a) Establish an integrated ecosystem which will lead to significant growth of civil aviation sector
(b) To promote tourism, increase employment and lead to a balanced regional growth
(c) Ensure safety, security and sustainability of all sectors through the use of technology
(d) Enhance regional connectivity through fiscal support and infrastructure development

137. Which one of the following statements is NOT correct?
(a) In the conduction mode of transference of heat, the molecules of solid pass heat from one molecule to another without moving from their positions
(b) The amount of heat required to raise the temperature of a substance is called its specific heat capacity
(c) The process of heat transfer in liquids and gases is through convection mode
(d) The process of heat transfer from a body at higher temperature to a body at lower temperature without heating the space between them is known as radiation

138. The amount of heat required to change a liquid to gaseous state without any change in temperature is known as
(a) specific heat capacity
(b) mechanical equivalent of heat
(c) latent heat of evaporation
(d) quenching

139. The following figure shows displacement versus time curve for a particle executing simple harmonic motion:



Which one of the following statements is correct?

(a) phase of the oscillating particle is same at $t = 1s$ and $t = 3s$
(b) phase of the oscillating particle is same at $t = 2s$ and $t = 8s$
(c) phase of the oscillating particle is same at $t = 3s$ and $t = 7s$
(d) phase of the oscillating particle is same at $t = 4s$ and $t = 10s$

140. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Disease)*	**List II** *(Remedy)*
A. Hypermetropia	1. Concave lens
B. Presbyopia	2. Bifocal lens
C. Myopia	3. Surgery
D. Cataract	4. Convex lens

Code:

	A	**B**	**C**	**D**
(a)	4	2	1	3
(b)	4	1	2	3
(c)	3	1	2	4
(d)	3	2	1	4

141. A circular coil of single turn has a resistance of 20Ω. Which one of the following is the correct value for the resistance between the ends of any diameter of the coil?

(a) 5Ω
(b) 10Ω
(c) 20Ω
(d) 40Ω

142. In a solenoid, the current flowing through the wire I and number of turns per unit length is n. This gives a magnetic field B inside the solenoid. If number of turn per unit length is increased to $2n$, what will be the value of magnetic field in the solenoid?

(a) B
(b) $2B$
(c) $B/2$
(d) $B/4$

143. Which one of the following statements is correct about the magnification of an optical microscope?

(a) Magnification increases with the increase in focal length of eyepiece
(b) Magnification increases with the increase in focal length of eyepiece
(c) Magnification decreases with the increase in focal length of eyepiece

144. A homogeneous mixture contains two liquids. How are they separated?

(a) by filtration
(b) by evaporation
(c) by distillation
(d) by condensation

145. Which one of the following elements forms highest number of compounds?

(a) oxygen
(b) hydrogen
(c) chlorine
(d) carbon

146. Which one of the following elements corrodes rapidly?

(a) aluminum
(b) iron
(c) zinc
(d) silver

147. 20 g of common salt is dissolved in 180 g of water. What is the mass percentage of the salt in the solution?

(a) 5%
(b) 9%
(c) 10%
(d) 15%

148. The valency of an element depends upon the

(a) total number of protons in an atom
(b) mass number of an atom
(c) total number of neutrons in an atom
(d) total number of electrons in the outer most shell of an atom

149. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Noble gas)*	**List II** *(Use)*
A. Argon	1. In lights for advertising display
B. Neon	2. Airport landing lights and in light houses
C. Krypton	3. Light in photographer's flash gun
D. Xenon	4. In tungsten filament to last longer

Code:

	A	**B**	**C**	**D**
(a)	3	1	2	4
(b)	3	2	1	4
(c)	4	2	1	3
(d)	4	1	2	3

150. Colour vision in human eyes is the function of photoreceptor cells named
(a) rods
(b) cones
(c) blind spot
(d) fovea

General Ability Test NDA 1 2017 Answer Keys

Question No.	Answer	Question No.	Answer	Question No.	Answer	Question No.	Answer	Question No.	Answer
1	B	31	A	61	B	91	B	121	B
2	D	32	B	62	C	92	A	122	D
3	B	33	B	63	D	93	C	123	C
4	B	34	D	64	D	94	B	124	B
5	C	35	C	65	A	95	D	125	A
6	C	36	A	66	B	96	A	126	A
7	B	37	C	67	C	97	A	127	A
8	B	38	C	68	A	98	B	128	D
9	D	39	D	69	B	99	B	129	A
10	B	40	B	70	D	100	A	130	C
11	A	41	A	71	C	101	A	131	A
12	C	42	B	72	D	102	A	132	A
13	A	43	A	73	B	103	D	133	A
14	D	44	C	74	A	104	B	134	C
15	C	45	C	75	A	105	A	135	B
16	B	46	C	76	A	106	D	136	C
17	C	47	A	77	A	107	B	137	B
18	C	48	B	78	B	108	D	138	C
19	C	49	B	79	A	109	C	139	C
20	C	50	D	80	C	110	D	140	B
21	D	51	C	81	C	111	A	141	A
22	C	52	B	82	B	112	B	142	B
23	A	53	D	83	B	113	A	143	D
24	B	54	B	84	C	114	A	144	C
25	C	55	C	85	B	115	D	145	D
26	B	56	D	86	A	116	B	146	B
27	B	57	D	87	D	117	B	147	C
28	D	58	A	88	B	118	B	148	D
29	B	59	D	89	D	119	B	149	C
30	C	60	B	90	C	120	B	150	B

NDA 2 2016 Question Paper

MATHEMATICS

1. Let S be a set of all distinct numbers of the form $\frac{P}{Q}$, where $p, q \in \{1, 2, 3, 4, 5, 6\}$. What is the cardinality of the set S?

(a) 21 (b) 23
(c) 32 (d) 36

2. If $c > 0$ and $4a + c < 2b$, then $ax^2 - bx + c = 0$ has a root in which one of the following intervals?

(a) (0, 2) (b) (2, 3)
(c) (3, 4) (d) (–2, 0)

3. If $A = \{x \in R : x^2 + 6x - 7 < 0\}$ and $B = \{x \in R : x^2 + 9x + 14 > 0\}$, then which of the following is/are correct?

1. $A \cap B = \{X \in R : -2 < x < 1\}$
2. $A \setminus B = \{x \in R : -7 < x < -2\}$

Select the correct answer using the code given below:

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

4. If A is semy square matrix of order 3 and det A = 5, then what is $\det[(2A)^{-1}]$ equal to?

(a) 1/10 (b) 2/5
(c) 8/5 (d) 1/40

5. What is $\omega^{100} + \omega^{200} + \omega^{300}$ equal to, where ω is the cube root of unity?

(a) 1 (b) 3ω
(c) $3\omega^2$ (d) 0

6. If $\text{Re}\left(\frac{z-1}{z+1}\right) = 0$, where $2 = x + iy$ is a complex number, then which one of the following is correct?

(a) $z = 1 + i$ (b) $|z| = 2$
(c) $z = 1 - i$ (d) $|z| = 1$

7. What is $[x\ y\ z]\begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix}$ equal to ?

(a) $[ax + hy + gz \quad h + b + f \quad g + f + c]$

(b) $\begin{bmatrix} a & h & g \\ hx & by & fz \\ g & f & c \end{bmatrix}$

(c) $\begin{bmatrix} ax + hy + gz \\ hx + by + fz \\ gx + fy + cz \end{bmatrix}$

(d) $[ax + hy + gz \quad hx + by + fz \quad gx + fy + cz]$

8. Out of 15 points in a plane, n points are in the same straight line. 445 triangles can be formed by joining these points. What is the value of n?

(a) 3 (b) 4
(c) 5 (d) 6

9. If $z = \left(\frac{\sqrt{3}}{2} + \frac{i}{2}\right)^{107} + \left(\frac{\sqrt{3}}{2} - \frac{i}{2}\right)^{107}$, then what is the imaginary part of z equal to?

(a) 0 (b) $\frac{1}{2}$
(c) $\frac{\sqrt{3}}{2}$ (d) 1

10. If both the roots of the equation $x^2 - 2kx + k^2 - 4 = 0$ lie between –3 and 5, then which one of the following is correct?

(a) $-2 < k < 2$ (b) $-5 < k < 3$
(c) $-3 < k < 5$ (d) $-1 < k < 3$

11. What is the number of distinct solutions of the equation $z^2 + |z| = 0$ (where z is a complex number)?

(a) One (b) Two
(c) Three (d) Five

12. How many geometric progressions is/are possible containing 27, 8 and 12 as three of its/their terms?

(a) One (b) Two
(c) Four (d) Infinitely many

13. Let R be a relation from $A = \{1, 2, 3, 4\}$ to $B = \{1, 3, 5\}$ such that $R = [(a, b) : a < b$, where $a \in A$ and $b \in B]$. What is RoR^{-1} equal to?

(a) $\{(1, 3), (1, 5), (2, 3), (2, 5), (3, 5), (4, 5)\}$
(b) $\{(3, 1), (5, 1), (3, 2), (5, 2), (5, 3), (5, 4)\}$
(c) $\{(3, 3), (3, 5), (5, 3), (5, 5)\}$
(d) $\{(3, 3), (3, 4), (4, 5)\}$

14. A five-digit number divisible by 3 is to be formed using the digits 0, 1, 2, 3 and 4 without repetition of digits. What is the number of ways this can be done?

(a) 96 (b) 48
(c) 32 (d) No number can be formed

15. What is ${}^{47}C_4 + {}^{51}C_3 + \sum_{j=2}^{5} {}^{52-j}C_3$ equal to?

(a) ${}^{52}C_4$ (b) ${}^{51}C_5$
(c) ${}^{53}C_4$ (d) ${}^{52}C_5$

Consider the following for the next three (03) items that follow:

Let a, x, y, z, b be in AP, where $x + y + z = 15$. Let a, p, q, r, b be in HP, where $p^{-1} + q^{-1} + r^{-1} = \frac{5}{3}$

16. What is the value of ab?

(a) 10 (b) 9
(c) 8 (d) 6

17. What is the value of xyz?

(a) 120 (b) 105
(c) 90 (d) Cannot be determined

18. What is the value of pqr?

(a) 35/243 (b) 81/35
(c) 243/35 (d) Cannot be determined

Consider the following for the next two (02) items that follow:

The sixth term of an AP is 2 and its common difference is greater than 1.

19. What is the common difference of the AP so that the product of the first, fourth and fifth terms is greatest?

(a) 8/5 (b) 9/5
(c) 2 (d) 11/5

20. What is the first term of the AP so that the product of the first, fourth and fifth terms is greatest?

(a) -4 (b) -6
(c) -8 (d) -10

Consider the following for the next two (02) items that follow:

Let $ax^3 + bx^2 + cx + d = \begin{vmatrix} x+1 & 2x & 3x \\ 2x+3 & x+1 & x \\ 2-x & 3x+4 & 5x-1 \end{vmatrix}$ then

21. What is the value of c?

(a) -1 (b) 34
(c) 35 (d) 50

22. What is the value of $a + b + c + d$?

(a) 62 (b) 63
(c) 65 (d) 68

Consider the following for the next two (02) items that follow:

The interior angles of a polygon of n sides are in AP. The smallest angle is 120° and the common difference is 5°.

23. How many possible values can n have?

(a) One (b) Two
(c) Three (d) Infinitely many

24. What is the largest interior angle of the polygon?

(a) 160° only (b) 195° only
(c) Either 160° or 195° (d) Nither 160 nor 195°

25. If $m=\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $n = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$, then what is the value of the determinant of $m \cos\theta - n \sin\theta$?

(a) -1 (b) 0
(c) 1 (d) 2

26. If $f\{x\}=\begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then which of the following are correct ?

1. $f(\theta) \times f(\phi) = f(\theta + \phi)$
2. The value of the determinant of the matrix $f(\theta) \times f(\phi)$ is 1.
3. The determinant of f(x) is an even function.

Select the correct answer using the code given below:

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

27. Which of the following are correct in respect of the system of equations $x + y + z = 8$, $x - y + 2z = 6$ and $3x - y + 5z = k$?

1. They have no solution. if $k = 15$.
2. They have infinitely many solutions, if $k = 20$.
3. They have unique solution, if $k = 25$

Select the correct answer using the code given below:

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

28. $A = \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$ and $B= \begin{bmatrix} 2 & 3 \\ -1 & -2 \end{bmatrix}$, then which of the following is/are correct?

1. $AB(A^{-1}B^{-1})$ is a unit matrix.
2. $(AB)^{-1} = A^{-1}B^{-1}$

Select the correct answer using the code given below:

(a) 1 only (b) 2 only
(c) Both 1 only 2 (d) Neither 1 nor 2

29. If $x^{\ell n\left(\frac{y}{z}\right)} . y^{\ell n(xz)^2} . z^{\ell n\left(\frac{x}{y}\right)} = y^{4\ell n y}$ for any $x > 1$, $y > 1$ and $z > 1$, then which one of the following is correct?

(a) $\ell n\, y$ is the GM of $\ell n\, x$, $\ell n\, x$, $\ell n\, x$ and $\ell n\, z$
(b) $\ell n\, y$ is the AM of $\ell n\, x$, $\ell n\, x$, $\ell n\, x$ and $\ell n\, z$
(c) $\ell n\, y$ is the HM of $\ell n\, x$, $\ell n\, x$ and $\ell n\, z$
(d) $\ell n\, y$ is the AM of ℓn, In x, $\ell n\, z$ and $\ell n\, z$

30. If the number 235 in decimal system is converted into binary system, then what is the resulting number ?

(a) $(11110011)_2$ (b) $(11101011)_2$
(c) $(11110101)_2$ (d) $(11011011)_2$

Consider the following for the next two (O2) items that follow:

Let α and β be the roots of the equation

$x^2 - (1 - 2a^2)x + (1 - 2a^2) = 0$

31. Under what condition does the above equation have real roots ?

(a) $a^2 < \frac{1}{2}$ (b) $a^2 > \frac{1}{2}$
(c) $a^2 \le \frac{1}{2}$ (d) $a^2 \ge \frac{1}{2}$

32. Under what condition is $\frac{1}{\alpha^2}+\frac{1}{\beta^2}<1$?

(a) $a^2<\frac{1}{2}$ (b) $a^2>\frac{1}{2}$

(c) $a^2>1$ (d) $a^2 \in \left(\frac{1}{3},\frac{1}{2}\right)$ only

33. What is $\sqrt{\frac{1+\omega^2}{1+\omega}}$ equal to, where ω is the cube root of unity?

(a) 1 (b) ω

(c) ω^2 (d) $i\omega$, where $i=\sqrt{-1}$

34. In an examination, 70% students passed in Physics, 80% students passed in Chemistry, 75% students passed in Mathematics and 85% students passed in Biology, and x% students failed in all the four subjects. What is the minimum value of x ?

(a) 10 (b) 12

(c) 15 (d) None of the above

Consider the following for the next two (02) items that follow:

For the system of linear equations $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$ and $2x + 3y + \lambda z = \mu$

35. Under what condition does the above system of equations have infinitely many solutions ?

(a) $\lambda = 5$ and $\mu \neq 9$ (b) $\lambda = 5$ and $\mu = 9$

(c) $\lambda = 9$ and $\mu = 5$ (d) $\lambda = 9$ and $\mu \neq 5$

36. Under what condition does the above system of equations have unique solutions?

(a) $\lambda = 5$ and $\mu = 9$

(b) $\lambda \neq 9$ and $\mu = 7$ only

(c) $\lambda \neq 5$ and μ has any real value

(d) λ has any real value and $\mu \neq 9$

37. What is the number of odd integers between 1000 and 9999 with no digit repeated?

(a) 2100 (b) 2120

(c) 2240 (d) 3331

38. What is the greatest value of the positive integer n satisfying the condition

$$1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+......+\frac{1}{2^{n-1}}<2-\frac{1}{1000}?$$

(a) 8 (b) 9

(c) 10 (d) 11

Consider the following for the next two (02) items that follow:

$2x^2 + 3x - \alpha - 0$ has roots -2 and β while the equation $x^2 - 3mx + 2m^2 = 0$ has both roots positive, where $\alpha > 0$ and $\beta > 0$.

39. What is the value of α ?

(a) 1/2 (b) 1

(c) 2 (d) 4

40. If β, 2, 2m are in GP, then what is the value of $\beta\sqrt{m}$?

(a) 1 (b) 2

(c) 4 (d) 6

41. $\sin A + 2 \sin 2A + \sin 3A$ is equal to which of the following?

1. $4 \sin 2A \cos^2\left(\frac{A}{2}\right)$

2. $2 \sin 2A\left(\sin\frac{A}{2}+\cos\frac{A}{2}\right)^2$

3. $8 \sin A \cos A \cos^2\left(\frac{A}{2}\right)$

Select the correct answer using the code given below:

(a) 1 and 2 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1, 2 and 3

42. If $x = \sin 70^0 . \sin 50^0$ and $y = \cos 60^0 . \cos 80^0$, then what is xy equal to ?

(a) 1/16 (b) 1/8

(c) 1/4 (d) 1/2

43. If $\sin\theta_1 + \sin\theta_2 + \sin\theta_3 + \sin\theta_4 = 4$, then what is the value of $\cos\theta_1 + \cos\theta_2 + \cos\theta_3 + \cos\theta_4 = ?$

(a) 0 (b) 1

(c) 2 (d) 4

44. What is the value of

$$\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right)?$$

(a) $\frac{1}{2}$ (b) $\frac{1}{2}+\frac{1}{2\sqrt{2}}$

(c) $\frac{1}{2}-\frac{1}{2\sqrt{2}}$ (d) $\frac{1}{8}$

45. If $x\cos\theta + y\sin\theta = z$, then what is the value of $(x \sin\theta - y \cos\theta)^2$?

(a) $x^2+y^2-z^2$ (b) $x^2-y^2-z^2$

(c) $x^2-y^2+z^2$ (d) $x^2+y^2+z^2$

46. What is the value of $\cos(2 \cos^{-1}10.8)$?

(a) 0.81 (b) 0.56

(c) 0.48 (d) 0.28

47. The top of a hill when observed from the top and bottom of a building of height h is at angles of elevation p and q respectively. What is the height of the hill?

(a) $\frac{h\cot q}{\cot q-\cot p}$ (b) $\frac{h\cot p}{\cot p-\cot q}$

(c) $\frac{2h\tan p}{\tan p-\tan q}$ (d) $\frac{2h\tan q}{\tan q-\tan p}$

48. If $\sin 18^0 = \frac{\sqrt{5}-1}{4}$, then what is the value of $\sin 81°$?

(a) $\frac{\sqrt{3+\sqrt{5}}+\sqrt{5-\sqrt{5}}}{4}$ (b) $\frac{\sqrt{3+\sqrt{5}}+\sqrt{5+\sqrt{5}}}{4}$

(c) $\frac{\sqrt{3-\sqrt{5}}+\sqrt{5-\sqrt{5}}}{4}$ (d) $\frac{\sqrt{3+\sqrt{5}}-\sqrt{5-\sqrt{5}}}{4}$

49. A moving boat is observed from the top of a cliff of 150 m height. The angle of depression of the boat changes from 60° to 45° in 2 minutes. What is the speed of the boat in metres per hour?

(a) $\frac{4500}{\sqrt{3}}$ (b) $\frac{4500(\sqrt{3}-1)}{\sqrt{3}}$

(c) $4500\sqrt{3}$ (d) $\frac{4500(\sqrt{3}+1)}{\sqrt{3}}$

50. What is $\frac{1-\tan 2^0 \cot 62^0}{\tan 152^0 - \cot 88^0}$ equal to?

(a) $\sqrt{3}$ (b) $-\sqrt{3}$

(c) $\sqrt{2}-1$ (d) $1-\sqrt{2}$

51. An equilateral triangle has one vertex at (0,0) and another at $(3, \sqrt{3})$. What are the coordinates of the third vertex?

(a) $(0, 2\sqrt{3})$ only

(b) $(3, -\sqrt{3})$ only

(c) $(0, 2\sqrt{3})$ or $(3, -\sqrt{3})$

(d) Neither $(0, 2\sqrt{3})$ nor $(3, -\sqrt{3})$

52. What is the equation of the right bisector of the line segment joining (1, 1) and (2, 3)?

(a) $2x + 4y - 11 = 0$ (b) $2x - 4y - 5 = 0$

(c) $2x - 4y - 11 = 0$ (d) $x - y + 1 = 0$

53. What is the radius of the circle passing through the point (2, 4) and having centre at the intersection of the lines $x - y = 4$ and $2x + 3y + 7 = 0$?

(a) 3 units (b) 5 units

(c) $3\sqrt{3}$ units (d) $5\sqrt{2}$ units

54. What is the equation of the hyperbola having latus rectum and eccentrieity 8 and $\frac{3}{\sqrt{5}}$ respectively?

(a) $\frac{x^2}{25} - \frac{y^2}{20} = 1$ (b) $\frac{x^2}{40} - \frac{y^2}{20} = 1$

(c) $\frac{x^2}{40} - \frac{y^2}{30} = 1$ (d) $\frac{x^2}{30} - \frac{y^2}{25} = 1$

55. If the point (a, a) lies between the lines $|x + y| = 2$, then which one of the following is correct?

(a) $|a| < 2$ (b) $|a| < \sqrt{2}$

(c) $|a| < 1$ (d) $|a| < \frac{1}{\sqrt{2}}$

56. What is the equation of the straight line which passes through the point of intersection of the straight lines $x + 2y = 5$ and $3x + 7y = 17$ and is perpendicular to the straight line $3x + 4y = 10$?

(a) $4x + 3y + 2 = 0$ (b) $4x - y + 2 = 0$

(c) $4x - 3y - 2 = 0$ (d) $4x - 3y + 2 = 0$

57. If (a, b) is at unit distance from the line $8x + 6y + 1 = 0$, then which of the following conditions are correct?

1. $3a - 4b - 4 = 0$
2. $8a + 6b + 11 = 0$
3. $8a + 6b - 9 = 0$

Select the correct answer using the code given below:

(a) 1 and 2 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1, 2 and 3

58. If the ellipse $9x^2 + 16y^2 = 144$ intercepts the line $3x + 4y = 12$, then what is the length of the chord so formed?

(a) 5 units (b) 6 units

(c) 8 units (d) 10 units

59. A straight line cuts off an intercept of 2 units on the positive direction of x-axis and passes through the point (–3, 5). What is the foot of the perpendicular drawn from the point (3, 3) on this line?

(a) (1, 3) (b) (2, 0)

(c) (0, 2) (d) (1, 1)

60. What is the eccentricity of rectangular hyperbola?

(a) $\sqrt{2}$ (b) $\sqrt{3}$

(c) $\sqrt{5}$ (d) $\sqrt{6}$

Consider the following for the next two (02) items that follow:

Let Q be the image of the point P (–2, 1, –5) in the plane $3x - 2y + 2z + 1 = 0$.

61. Consider the following:

1. The coordinates of Q are (4, –3, –1).
2. PQ is of length more than 8 units.
3. The point (1, –1, –3) is the mid-point of the line segment PQ and lies on the given plane.

Which of the above statements are correct?

(a) 1 and 2 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1, 2 and 3

62. Consider the following:

1. The direction ratios of the line segment PQ are <3, –2, 2>.
2. The sum of the squares of direction cosines of the line segment PQ is unity.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

Consider the following for the next two (02) items that follow:

A line L passes through the point P(5, – 6, 7) and is parallel to the planes $x + y + z = 1$ and $2x - y - 2z = 3$.

63. What are the direction ratios of the line of intersection of the given planes?

(a) <1, 4, 3> (b) <–1, – 4, 3>

(c) <1, –4, 3> (d) <1, – 4, – 3>

64. What is the equation of the line L ?

(a) $\frac{x-5}{-1} = \frac{y+6}{4} = \frac{z-7}{-3}$

(b) $\frac{x+5}{-1} = \frac{y-6}{4} = \frac{z+7}{-3}$

(c) $\frac{x-5}{-1} = \frac{y+6}{-4} = \frac{z-7}{3}$

(d) $\frac{x-5}{-1} = \frac{y+6}{-4} = \frac{z-7}{-3}$

Consider the following for the next two (02) items that follow:

Let $\vec{a} = \hat{i} + \hat{j}$, $\vec{b} = 3\hat{i} + 4\hat{k}$ and $\vec{b} = \vec{c} + \vec{d}$, where $\vec{c}$ is parallel to $\vec{a}$ and $\vec{d}$ is perpendicular to $\vec{a}$.

65. What is $\vec{c}$ equal to?

(a) $\frac{3(\hat{i}+\hat{j})}{2}$ (b) $\frac{2(\hat{i}+\hat{j})}{3}$

(c) $\frac{(\hat{i}+\hat{j})}{2}$ (d) $\frac{(\hat{i}+\hat{j})}{3}$

66. If $\vec{d} = x\hat{i} + y\hat{j} + z\hat{k}$, then which of the following equations is/are correct?

1. $y - x = 4$
2. $2z - 3 = 0$

Select the correct answer using the code given below:

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

Consider the following for the next two (02) items that follow:

Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three vectors such that $\vec{a} + \vec{b} + \vec{c} = 0$ and $|\vec{a}| = 10$, $|\vec{b}| = 6$ and $|\vec{c}| = 14$.

67. What is $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$ equal to?

(a) –332 (b) –166

(c) 0 (d) 166

68. What is the angle between $\vec{a}$ and $\vec{b}$?

(a) 30° (b) 45°

(c) 60° (d) 75°

69. In a right-angled triangle ABC, if the hypotenuse AB = p, then what is $\overrightarrow{AB}.\overrightarrow{AC} + \overrightarrow{BC}.\overrightarrow{BA} + \overrightarrow{CA}.\overrightarrow{CB}$ equal to?

(a) p (b) p^2

(c) $2p^2$ (d) $\frac{p^2}{2}$

70. A force $\vec{F} = 3\hat{i} + 2\hat{j} - 4\hat{k}$ is applied at the point (1, –1, 2). What is the moment of the force about the point (2, –1, 3)?

(a) $\hat{i} + 4\hat{j} + 4\hat{k}$ (b) $2\hat{i} + \hat{j} + 2\hat{k}$

(c) $2\hat{i} - 7\hat{j} - 2\hat{k}$ (d) $2\hat{i} + 4\hat{j} - \hat{k}$

71. What is the domain of the function $f(x) = \frac{1}{\sqrt{|x| - x}}$?

(a) $(-\infty, 0)$ (b) $(0, \infty)$

(c) $0 < x < 1$ (d) $x > 1$

72. Consider the following in respect of the function

$$f(x) = \begin{cases} 2 + x, & x \geq 0 \\ 2 - x, & x < 0 \end{cases}$$

1. $\lim_{x \to 1} f(x)$ does not exist.
2. f(x) is differentiable at x = 0
3. f(x) is continuous at x = 0

Which of the above statements is/are correct?

(a) 1 only (b) 3 only

(c) 2 and 3 only (d) 1 and 3 only

73. Let $f : A \to R$, where $A = R \setminus \{0\}$ is such that $f(x) = \frac{x + |x|}{x}$.

On which one of the following sets is f(x) continuous?

(a) A (b) $B = \{x \in R : x \geq 0\}$

(c) $C = \{x \in R : x \leq 0\}$ (d) D = R

74. Which one of the following statements is correct in respect of the function $f(x) = x^3 \sin x$?

(a) It has local maximum at x = 0.

(b) It has local minimum at x = 0.

(c) It has neither maximum nor minimum at x = 0.

(d) It has maximum value 1.

75. What is the area bounded by the curves $|y| = 1 - x^2$?

(a) $\frac{4}{3}$ square units (b) $\frac{8}{3}$ square units

(c) 4 square units (d) $\frac{16}{3}$ square units

Consider the following function for the next two (02) items that follow:

$$f(x) = \begin{cases} 3x^2 + 12x - 1 & -1 \leq x \leq 2 \\ 37 - x, & 2 < x \leq 3 \end{cases}$$

76. Which of the following statements is/are correct?

1. f(x) is increasing in the interval [–1, 2].
2. f(x) is decreasing in the interval (2, 3].

Select the correct answer using the code given below:

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

77. Which of the following statements are correct?

1. f(x) is continuous at x = 2.
2. f(x) attains greatest value at x = 2.
3. f(x) is differentiable at x = 2.

Select the correct answer using the code given below:

(a) 1 and 2 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1, 2 and 3

Consider the following for the next three (03) items that follow:

Let $f(x) = [|x| - |x - 1|]^2$

78. What is f'(x) equal to when x>1?

(a) 0 (b) 2x–1

(c) 4x–2 (d) 8x –4

79. What is f'(x) equal to when 0< x <1?

(a) 0 (b) 2x–1

(c) 4x–2 (d) 8x–4

80. Which of the following equations is/are correct?

1. f(–2) = f(5)
2. f"(–2) + f"(0.5) + f"(3) = 4

Select the correct answer using the code given below:

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

Consider the following for the next three (03) items that follow:

Let $f(x) = [x]$, where [.] is the greatest integer function and $g(x) = \sin x$ be two real valued functions over R.

81. Which of the following statements is correct?
(a) Both f(x) and g(x) are continuous at $x = 0$.
(b) f(x) is continuous at $x = 0$, but g(x) is not continuous at $x = 0$.
(c) g(x) is continuous at $x = 0$, but f(x) is not continuous at $x = 0$.
(d) Both f(x) and g(x) are discontinuous at $x = 0$.

82. Which one of the following statements is correct?
(a) $\lim_{x\to 0}(fog)(x)$ exists
(b) $\lim_{x\to 0}(gof)(x)$ exists
(c) $\lim_{x\to 0+}(fog)(x) = \lim_{x\to 0-}(gof)(x)$
(d) $\lim_{x\to 0+}(fog)(x) = \lim_{x\to 0+}(gof)(x)$

83. Which of the following statements are correct?
1. $(fof)(x) = f(x)$.
2. $(gog)(x) = g(x)$ only when $x = 0$.
3. $(go(fog))(x)$ can take only three values.

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Consider the following for the next two (02) items that follow:

Let $f(x) = \begin{cases} \dfrac{e^x - 1}{x}, & x > 0 \\ 0, & x = 0 \end{cases}$ be a real valued function.

84. Which one of the following statements is correct?
(a) f(x) is a strictly decreasing function in (0, x),
(b) f(x) is a strictly increasing function in (0, x),
(c) f(x) is neither increasing nor decreasing in (0, x)
(d) f(x) is not decreasing in (0, x).

85. Which of the following statements is/are correct?
1. f(x) is right continuous at $x = 0$.
2. f(x) is discontinuous at $x = 1$.

Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Consider the following for the next two (02) items that follow:

Consider the parabola $y = x^2 + 7x + 2$ and the straight line $y = 3x - 3$.

86. What are the coordinates of the point on the parabola which is closest to the straight line?
(a) (0, 2) (b) (–2, –8)
(c) (–7, 2) (d) (1, 10)

87. What is the shortest distance from the above point on the parabola to the line?
(a) $\frac{\sqrt{10}}{2}$ (b) $\frac{\sqrt{10}}{5}$
(c) $\frac{1}{\sqrt{10}}$ (d) $\frac{\sqrt{5}}{4}$

Consider the following for the next three (03) items that follow:

Let $f(x) = \begin{cases} -2, & -3 \le x \le 0 \\ x - 2, & 0 < x \le 3 \end{cases}$ and $g(x) = f(|x|) + |f(x)|$

88. Which of the following statements is/are correct?
1. g(x) is differentiable at $x = 0$.
2. g(x) is differentiable at $x = 2$.

Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

89. What is the value of the differential coefficient of g(x) at $x = -2$?
(a) –1 (b) 0
(c) 1 (d) 2

90. Which of the following statements are correct?
1. g(x) is continuous at $x = 0$.
2. g(x) is continuous at $x = 2$.
3. g(x) is continuous at $x = -1$.

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

91. Let f(x) be a function such that $f'\left(\frac{1}{x}\right) + x^3 f'(x) = 0$, What is $\int_{-1}^{1} f(x)dx$ equal to?
(a) $2f(1)$ (b) 0
(c) $2f(-1)$ (d) $4f(1)$

92. What is $\int \frac{x^4 - 1}{x^2\sqrt{x^4 + x^2 + 1}}dx$ equal to?
(a) $\sqrt{\frac{x^4 + x^2 + 1}{x}} + c$ (b) $\sqrt{x^4 + 2 - \frac{1}{x^2}} + c$
(c) $\sqrt{x^2 + \frac{1}{x^2} + 1} + c$ (d) $\sqrt{\frac{x^4 - x^2 + 1}{x}} + c$

93. What are the degree and order respectively of the differential equation satisfying $e^{y\sqrt{1-x^2} + x\sqrt{1-y^2}} = ce^x$, (where $c > 0, |x| < 1, |y| < 1$)?
(a) 1, 1 (b) 1, 2
(c) 2, 1 (d) 2, 2

94. What is the curve which passes through the point (1, 1) and whose slope is $\frac{2y}{x}$?
(a) Circle (b) Parabola
(c) Ellipse (d) Hyperbola

95. If $x\,dy = y\,dx + y^2 dy, y > 0$ and $y(1) = 1$, then what is $y(-3)$ equal to?
(a) 3 only (b) –1 only
(c) Both –1 and 3 (d) Neither –1 nor 3

96. What is the order of the differential equation $\frac{dx}{dy}+\int y\,dx=x^3$?

(a) 1 (b) 2
(c) 3 (d) Cannot be determined

97. Which one of the following differential equations represents the family of straight lines which are at unit distance from the origin?

(a) $\left(y-x\frac{dy}{dx}\right)^2=1-\left(\frac{dy}{dx}\right)^2$

(b) $\left(y+x\frac{dy}{dx}\right)^2=1+\left(\frac{dy}{dx}\right)^2$

(c) $\left(y-x\frac{dy}{dx}\right)^2=1+\left(\frac{dy}{dx}\right)^2$

(d) $\left(y+x\frac{dy}{dx}\right)^2=1-\left(\frac{dy}{dx}\right)^2$

98. What is $\int e^{\sin x}\frac{x\cos^3 x-\sin x}{\cos^2 x}dx$ equal to?

(a) $(x+\sec x)e^{\sin x}+c$ (b) $(x-\sec x)e^{\sin x}+c$
(c) $(x+\tan x)e^{\sin x}+c$ (d) $(x-\tan x)e^{\sin x}+c$

99. If $\int_0^{\pi/2}\frac{dx}{3\cos x+5}=k\cot^{-1}2$, then what is the value of K ?

(a) 1/4 (b) 1/2
(c) 1 (d) 2

100. What is $\int_1^3\left|1-x^4\right|dx$ equal to?

(a) $-232/5$ (b) $-116/5$
(c) $116/5$ (d) $232/5$

101. A special dice with numbers 1, –1, 2, –2, 0 and 3 is thrown thrice. What is the probability that the sum of the numbers occurring on the upper face is zero?

(a) $1/72$ (b) $1/8$
(c) $7/72$ (d) $25/216$

102. There is 25% chance that it rains on any particular day. What is the probability that there is at least one rainy day within a period of 7 days?

(a) $1-\left(\frac{1}{4}\right)^7$ (b) $\left(\frac{1}{4}\right)^7$
(c) $\left(\frac{3}{4}\right)^7$ (d) $1-\left(\frac{3}{4}\right)^7$

103. A salesman has a 70% chance to sell a product to any customer. The behaviour of successive customers is independent. If two customers A and B enter, what is the probability that the salesman will sell the product to customer A or B?

(a) 0.98 (b) 0.91
(c) 0.70 (d) 0.49

104. A student appears for tests I, II and III. The student is considered successful if he passes in tests I, II or III or all the three. The probabilities of the student passing in tests I, II and III are m, n and 1/2 respectively. If the probability of the student to be successful is 1/2, then which one of the following is correct?

(a) $m(1+n)=1$ (b) $n(1+m)=1$
(c) $m=1$ (d) $mn=1$

105. Three candidates solve a question. Odds in favour of the correct answer are 5:2, 4:3 and 3:4 respectively for the three candidates. What is the probability that at least two of them solve the question correctly?

(a) 209/343 (b) 134/343
(c) 149/343 (d) 60/343

106. Consider the following statements:

1. The mean and median are equal in symmetric distribution.
2. The range is the difference between the maximum value and the minimum value in the data.
3. The sum of the areas of the rectangles in the histogra is equal to the total area bounded by the frequency polygon and the horizontal axis.

Which of the above statements are correct?

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

107. The scores of 15 students in an examination were recorded as 10, 5, 8, 16, 18, 20, 8, 10, 16, 20, 18, 11, 16, 14 and 12. After calculating the mean, median and mode, an error is found. One of the values is wrongly written as 16 instead of 18. Which of the following measures of central tendency will change?

(a) Mean and median (b) Median and mode
(c) Mode only (d) Mean and mode

108. For 10 observations on price (x) and supply (y), the following data was obtained :

$\sum x=130, \sum y=220,$

$\sum x^2=2288, \sum y^2=5506$ and $\sum xy=3467$.

What is line of regression of y on x?

(a) $y=0.91x+8.74$ (b) $y=1.02x+8.74$
(c) $y=1.02x-7.02$ (d) $y=0.91x-7.02$

109. In a study of two groups, the following results were obtained:

	Group A	Group B
Sample Size	20	25
Sample mean	22	23
Sample standard deviation	10	12

Which of the following statements is correct?

(a) Group A is less variable than Group B because Group A's standard deviation is smaller.
(b) Group A is less variable than Group B because Group A's sample size is smaller.
(c) Group A is less variable than Group B because Group A's sample mean is smaller.
(d) Group A is less variable than group B because Group A's coefficient of variation is smaller.

110. Consider the following statements in respect of class intervals of grouped frequency distribution:

1. Class intervals need not be mutually exclusive.
2. Class intervals should be exhaustive.
3. Class intervals need not be of equal width.

Which of the above statements are correct?

(a) 1 only 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

111. A medicine is known to be 75% effective to cure a patient. If the medicine is given to 5 patients, what is the probability that at least one patient is cured by this medicine?

(a) $\frac{1}{1024}$ (b) $\frac{243}{1024}$
(c) $\frac{1023}{1024}$ (d) $\frac{781}{1024}$

112. For two events, A and B, it is given that $P(A) = \frac{3}{5}$, $P(B) = \frac{3}{10}$, and $P(A \mid B) = \frac{2}{3}$. If $\overline{A}$ and $\overline{B}$ are the complementary events of A and B, then $P(\overline{A} \mid \overline{B})$ equal to?

(a) $\frac{3}{7}$ (b) $\frac{3}{4}$
(c) $\frac{1}{3}$ (d) $\frac{4}{7}$

113. A machine has three parts, A, B and C, whose chances of being defective are 0.02, 0.10 and 0.05 respectively. The machine stops working if any one of the parts becomes defective. What is the probability that the machine will not stop working?

(a) 0.06 (b) 0.16
(c) 0.84 (d) 0.94

114. Three independent events, A_1, A_2 and A_3 occur with probabilities $P(A_i) = \frac{1}{1+i}, i = 1, 2, 3$. What is the probability that at least one of the three events occurs?

(a) $\frac{1}{4}$ (b) $\frac{2}{3}$
(c) $\frac{3}{4}$ (d) $\frac{1}{24}$

115. Two variates, x and y, are uncorrelated and have standard deviations σ_x and σ_y respectively. What is the correlation coefficient between $x+y$ and $x-y$?

(a) $\frac{\sigma_x \sigma_y}{\sigma_x^2 + \sigma_y^2}$ (b) $\frac{\sigma_x + \sigma_y}{2\sigma_x \sigma_y}$
(c) $\frac{\sigma_x^2 - \sigma_y^2}{\sigma_x^2 + \sigma_y^2}$ (d) $\frac{\sigma_y - \sigma_x}{\sigma_x \sigma_y}$

116. A random sample of 20 people is classified in the following table according to their ages:

Age	Frequency
15 – 25	2
25 – 35	4
35 – 45	6
45 – 55	5
55 – 65	3

What is the mean age of this group of people?

(a) 41.0 (b) 41.5
(c) 42.0 (d) 42.5

117. If the covariance between x and y is 30, variance of x is 25 and variance of y is 144, then what is the correlation coefficient?

(a) 0.4 (b) 0.5
(c) 0.6 (d) 0.7

118. A coin is tossed three times. Consider the following events:

A: No head appears
B: Exactly one head appears
C: At least two heads appear

Which one of the following is correct?

(a) $(A \cup B) \cap (A \cup C) = B \cup C$
(b) $(A \cap B') \cup (A \cap C') = B' \cup C'$
(c) $A \cap (B' \cup C') = A \cup B \cup C$
(d) $A \cap (B' \cup C') = B' \cap C'$

119. In a series of 3 one-day cricket matches between teams A and B of a college, the probability of team A winning or drawing are 1/3 and 1/6 respectively. If a win, loss or draw gives 2, 0 and 1 point respectively, then what is the probability that team A will score 5 points in the series?

(a) $\frac{17}{18}$ (b) $\frac{11}{12}$
(c) $\frac{1}{12}$ (d) $\frac{1}{18}$

120. Let the random variable X follow B (6, p). If 16 P(X=4)= P(X=2), then what is the value of p?

(a) $\frac{1}{3}$ (b) $\frac{1}{4}$
(c) $\frac{1}{5}$ (d) $\frac{1}{6}$

GENERAL ABILITY

PART-A : ENGLISH

Directions for the following 10 (ten) items:

Each question in this section has a sentence with three underlined parts labelled (a), (b) and (c). Read each sentence to find out whether there is any error in any underlined part and indicate your response in the Answer Sheet against the corresponding letter i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d).

1. My friend was (a) habitual to drive a car (b) at very high speed. (c) No error. (d)
2. Being a day of national mourning (a) the offices were closed (b) and the national flag flew half mast. (c) No error. (d)
3. If you are wanting to watch (a) the birds nesting (b) you must not let them see you. (c) No error. (d)
4. He does not listen to (a) what I say, (b) although I am (c) advising him for a long time. No error. (d)
5. It is most essential for us (a) to reach the station before noon (b) lest we should miss the train. (c) No error. (d)
6. I asked him (a) what had brought (b) him there. (c) No error. (d)
7. The guards (a) dare not (b) to harm him. (c) No error. (d)
8. The principal looks very worried (a) because students are on (b) strike for the last fifteen days as a protest against his disciplinary action against some miscreants. (c) No error. (d)
9. The king was embarrassed (a) to find evidences (b) against his own queen. (c) No error. (d)
10. As I prefer coffee than tea (a) my friends always take the trouble (b) to get me a cup of coffee whenever I visit them. (c) No error (d)

Directions for the following 5 (five) items:

Each item in this section consists of a sentence with an underlined word or words followed by four words or groups of words. Select the word or groups of words that is most *similar* in meaning to the underlined word.

11. Hospitality is a virtue for which the natives of the East in general are highly admired.
    (a) Duty of a doctor
    (b) Generosity shown to guests
    (c) Cleanliness in hospitals
    (d) Kindness
12. House rent in cities like Mumbai or Delhi has risen to astronomical figures beyond the reach of even high-salaried people.
    (a) exorbitant (b) commercial
    (c) planetary (d) illogical
13. Appropriate technology holds the key to a nation's development.
    (a) Modern (b) Suitable
    (c) Effective (d) Growing
14. He was enamoured of his own golden voice.
    (a) very fond of (b) concerned with
    (c) obsessed with (d) imbued with
15. Some journalists are guilty of indulging in yellow journalism.
    (a) misrepresentation (b) vulgarization
    (c) sensational reporting (d) loud gestures

Directions for the following 5 (five) items:

Each item in this section consists of a sentence with an underlined word or words followed by four words or groups of words. Select the word or group of words that is most nearly *opposite* in meaning to the underlined word.

16. The culprit was sentenced by the Court.
    (a) acquitted (b) punished
    (c) relieved (d) pardoned
17. Thrifty as he is, he can well afford to live within his means.
    (a) careless (b) instinctive
    (c) sentimental (d) extravagant
18. Do not give him a responsible job, he is immature.
    (a) thoughtful (b) cautious
    (c) calculating (d) seasoned
19. I was prepared to show my hand provided he agreed to do the same.
    (a) to yield (b) to shake hands
    (c) to conceal my plan (d) to lose my ground
20. Akbar the great was a sagacious ruler.
    (a) haughty (b) cunning
    (c) rude (d) unwise

Directions for the following 10 (ten) items:

Each of the following sentences has a blank space and four words given after the sentence. Select whichever word you consider most appropriate for the blank space and indicate your response on the Answer Sheet.

21. She has been lying in bed for the last fortnight. I hope she will__________.
    (a) come out (b) pull out
    (c) pull through (d) go out
22. The path of progress is beset____________difficulties.
    (a) with (b) by
    (c) through (d) along
23. I feel __________ for those who are cruel to their children.
    (a) sympathy (b) contempt
    (c) admiration (d) craving
24. Both the parties were keen to have an________settlement of the dispute.
    (a) enviable (b) inimical
    (c) worthy (d) amicable
25. I have come to know that the two brothers have ________.
    (a) fallen through (b) fallen out
    (c) fallen for (d) fallen short
26. Everybody finds his own work _____whereas he feels that others have delightful jobs.
    (a) tedious (b) fabulous
    (c) unprofitable (d) indecent

27. The accident took place because of the criminal _____of the driver.
(a) performance (b) disregard
(c) negligence (d) slackness

28. The belief in the_______of vaccination is gaining ground.
(a) immunity (b) prevalence
(c) efficacy (d) workability

29. Our new leader is a_________young man and will take us forward.
(a) haughty (b) intoxicated
(c) fanciful (d) dynamic

30. They found a world of _______ between what he said and what he did.
(a) chaos (b) bitterness
(c) difference (d) hope

Directions for the following 7(seven) items:

Each of the following items in this section consists of a sentence the parts of which have been jumbled. These parts have been labelled P, Q, R and S. Given below each sentence are four sequences namely (a), (b), (c) and (d). You are required to rearrange the jumbled parts of the sentence and mark your response accordingly.

31. The statement therefore you must listen carefully (P) what the speaker has said (Q) in order to understand (R) will be made just once (S)
The proper sequence should be
(a) S P R Q (b) S R Q P
(c) R S P Q (d) S P Q R

32. The small boy who broke his leg (P) fell down (Q) and (R) climbed the wall (S)
The proper sequence should be
(a) P S R Q (b) S Q R P
(c) Q S R P (d) S P R Q

33. According to an engineer might hit the market next year (P) a newly developed air-cooler system (Q) that employed in conventional room coolers (R) which is based on a principle radically different from (S)
The proper sequence should be
(a) S Q R P (b) R S Q P
(c) Q S R P (d) P Q R S

34. The clerk on the desk (P) left the money (Q) in the safe (R) which he should have locked up (S)
The proper sequence should be
(a) S R Q P (b) Q R S P
(c) P Q R S (d) Q P S R

35. Hardly had my brother descended from the plane when the people (P) waved and cheered (Q) Who had come to receive him (R) from the lounge (S)
The proper sequence should be
(a) P Q R S (b) R S P Q
(c) R P Q S (d) P R S Q

36. The essay like that of the human face (P) because its (Q) variety is infinite (R) is a literary form Which is not easy to define (S)
The proper sequence should be
(a) P Q R S (b) P Q S R
(c) R S Q P (d) R S P Q

37. The exhibition committee attractive and useful (P) to make (Q) exhibition making efforts (R) has been (S)
The proper sequence should be
(a) Q S R P (b) S R Q P
(c) Q P S R (d) S P Q R

Directions for the following 13 (thirteen) items:

Look at the underlined part of each sentence. Below each sentence are given three possible substitutions for the underlined part. If one of them (a), (b) or (c) is better than the underlined part, indicate your response on the Answer Sheet against the corresponding letter (a), (b) or (c). If none of the substitutions improves the sentence, indicate (d) as your response on the Answer Sheet Thus a "No improvement" response will be signified by the letter (d).

38. My old teacher gave many poor students money in spite of he was poor.
(a) even though (b) as if
(c) however (d) NO IMPROVEMENT

39. You should to read the newspapers regularly if you want to be well informed.
(a) ought (b) have to
(c) should be (d) NO IMPROVEMENT

40. If he had listening to me he would not have got lost.
(a) listened me (b) listened to me
(c) listen me (d) NO IMPROVEMENT

41. He asked for a bank loan also he didn't have sufficient resources.
(a) because (b) even if
(c) requiring (d) NO IMPROVEMENT

42. I went to the shop to buy some stationeries.
(a) Stationery (b) stationary
(c) stationarics (d) NO IMPROVEMENT

43. I have been waiting here for the last two hours.
(a) from (b) since
(c) by (d) NO IMPROVEMENT

44. The table needs to be painted.
(a) paint (b) painting
(c) having paint (d) NO IMPROVEMENT

45. It began to rain heavily just when I prepare to go out.
(a) prepared (b) was preparing
(c) have prepared (d) NO IMPROVEMENT

46. The couple seemed to love one another very much.
(a) every other (b) each
(c) each other (d) NO IMPROVEMENT

47. It is high time that we did something.
(a) had done (b) would do
(c) have done (d) NO IMPROVEMENT

48. If I were a millionaire, I would have helped the poor.
(a) am capable of helping
(b) could have helped
(c) would help
(d) NO IMPROVEMENT

49. The training programme was extended for a month.
(a) from (b) until
(c) since (d) NO IMPROVEMENT

50. The painting which they were looking at was done by my sister.
(a) what (b) that
(c) whom (d) NO IMPROVEMENT

PART- B : GENERAL KNOWLEDGE

The following *6 (Six)* items consist of two statements, Statement I and Statement II. Examine these two statements carefully and select the correct answer using the code given below:

Code :

(a) Both the statement are individually true and Statement II is the correct explanation of Statement I
(b) Both the statements are individually true but Statement II is ***not*** the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

51. **Statement I :** Variability of annual rainfall is very high in western part of Rajasthan.
Statement II : Average annual rainfall is extremely low in western Rajasthan.

52. **Statement I :** Ozone is a tri-atomic molecule of oxygen.
Statement II : Ozone is concentrated mainly in stratosphere.

53. **Statement I :** The laterite soils develop in areas with high temperature and high rainfall.
Statement II : Laterite soils are the result of intense leaching process.

54. **Statement I :** Too much salt content in diet could be one of the reasons for kidney failure.
Statement II : High salt may cause high blood pressure.

55. **Statement I :** The city of Rome revived in a spectacular way in the 15th century.
Statement II : From the 15th century onwards, artists were known individually by name, not as member of a group or a guild, in Roman society.

56. **Statement I :** Chartism was the political reform campaign for democratic rights which swept over Britain between 1838 and 1848.
Statement II : The trade union movement declined by the 1830s as it failed to fulfill the aspirations of the working class.

57. 'Sahel' region of Sahara desert is associated with
(a) core area of Sahara desert
(b) southern moving edge of Sahara desert
(c) northern fringe of Sahara desert bordering Mediterranean sea
(d) another name of Sahara desert

58. Which one of the following pairs of a river and its tributary is ***not*** correctly matched?
(a) Godavari : Wainganga (b) Cauvery : Bhavani
(c) Narmada : Amaravati (d) Krishna : Bhima

59. In which one of the following countries, the Mediterranean type of Biome is found?
(a) Chile (b) Kenya
(c) Argentina (d) Bolivia

60. Arrange the following states in order of their decreasing population size as per the census 2011:
1. West Bengal 2. Bihar
3. Maharashtra 4. Andhra Pradesh
Select the correct answer using the code given below :
(a) 2 - 3 - 1 - 4 (b) 3 - 2 - 1 - 4
(c) 1 - 4 - 3 - 2 (d) 3 - 1 - 4 - 2

61. Match List I with List II and select the correct answer using the code given below the Lists:

List I (River)	List II (Mouth of the river)
A. Danube	1. North sea
B. Rhine	2. Black sea
C. Rhone	3. Bay of Biscay
D. Loire	4. Mediterranean sea

Code :

	A	B	C	D
(a)	2	1	4	3
(b)	3	4	1	2
(c)	2	4	1	3
(d)	3	1	4	2

62. Match List I with List II and select the correct answer using the code given below the Lists:

List I (Process)	List II (Type of Change)
A. Heating Camphor	1. Chemical
B. Cooling of water vapour up to room temperature	2. Evaporation
C. Cooking an egg	3. Condensation
D. Formation of water vapour at room temperature	4. Sublimation

Code :

	A	B	C	D
(a)	4	3	1	2
(b)	4	1	3	2
(c)	2	1	3	4
(d)	2	3	1	4

63. Identify the element having zero valency
(a) Sulphur (b) Phosphorous
(c) Lead (d) Radon

64. There are six electrons, six protons and six neutrons in an atom of an element. What is the atomic number of the element?
(a) 6 (b) 12
(c) 18 (d) 24

65. Which one of the following has different number of molecules? (All are kept at normal temperature and pressure)
(a) 3 gram of Hydrogen (b) 48 gram of Oxygen
(c) 42 gram of Nitrogen (d) 2 gram of Carbon

66. Combination of one volume of nitrogen with three volumes of hydrogen produces
(a) one volume of ammonia
(b) two volumes of ammonia
(c) three volumes of ammonia
(d) one and a half volumes of ammonia

67. Consider the following statements about cactus:
1. The leaves are reduced to spines.
2. The stem does the photosynthesis.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

68. In which one of the following, methanogens, i.e., methene producing bacteria are ***not*** present?
(a) Rumen of cattle (b) Aerobic environment
(c) Anaerobic sludge (d) Excreta of cattle

69. Malarial parasite is a
(a) bacteria (b) protozoa
(c) virus (d) fungus

70. With reference to biodiversity, which of the following statements is/are correct?
1. Species richness and high degree of endernism are important criteria for identifying biodiversity hot spots.
2. Species diversity is highest in the tropics and decreases down the poles.
3. Biodiversity conservation may be *in situ* as well as *ex situ*.

Select the correct answer using the code given below:
(a) 1 only (b) 2 and 3 only
(c) 1, 2 and 3 (d) 1 and 3 only

71. It is difficult to kill viruses because they
(a) consist of tough protein coat
(b) are very small in size
(c) lack cellular structure
(d) spend a lot of time inside the host's cells

72. When a ray of light enters a glass slab, then
(a) only the frequency changes
(b) frequency and velocity change
(c) frequency does not change
(d) frequency and wavelength change

73. A ball is thrown vertically upward from the ground with a speed of 25.2 m/s. The ball will reach the highest point of its journey in
(a) 5.14 s (b) 3.57 s
(c) 2.57 s (d) 1.29 s

74. One kilowatt hour is equal to
(a) 36×10^3 joule (b) 36×10^5 joule
(c) 10^3 joule (d) 10^5 joule

75. When sound waves are propagated through a medium, the physical quantity/quantities transmitted is/are
(a) matter only
(b) energy only
(c) energy and matter only
(d) energy, momentum and matter

76. Pressure is a scalar quantity because
(a) it is the ratio of force to area and both force and area are vectors
(b) it is the ratio of magnitude of force to area
(c) it is the ratio of component of force (normal to area) to area
(d) none of the above

77. A person is unable to read a newspaper without his glasses. He is most probably suffering from
(a) myopia (b) presbyopia
(c) astigmatism (d) hypermetropia

78. The free fall acceleration g increases as one proceeds, at sea level, from the equator toward either pole. The reason is
(a) Earth is a sphare with same density everywhere
(b) Earth is a sphere with different density at the polar regions than in the equatorial regions
(c) Earth is approximately an ellipsoid having its equatorial radius greater than its polar radius by 21 km
(d) Earth is apporximately an ellipsoid having its equatorial radius smaller than its polar by 21 km

79. Which one of the following statements is correct?
(a) The measurment of mass taken by a spring weighing balance is correct at the place where the spring balance is calibrated for
(b) The measurment of mass taken by a spring weighing balance is correct at all places
(c) The measurment of mass taken by a spring weighing balance is correct at the places where the acceleration due to gravity is same with the place where the spring balance is calibrated for
(d) A spring balance cannot be used to measure mass at any place

80. Which one of the following is ***not*** a contact force?
(a) Push force (b) Gravitational force
(c) Frictional force (d) Strain force

81. When a force of 1 newton acts on a mass of 1 kg which is able to move freely, the object moves in the direction of force with a/an
(a) speed of 1 km/s (b) acceleration of 1 m/s^2
(c) speed of 1 m/s (d) acceleration of 1 km/s^2

82. Which of the following items is used in the household wirings to prevent accidental fire in case of short circuit?
(a) Insulated wire
(b) Plastic switches
(c) Non-metallic coatings on conducting wires
(d) Electric fuse

83. Which of the following are the features of the ideology of utilitarianism?
1. Utilitarians believed that all value derives from land
2. The most celebrated spokesmen of utilitarianism were jeremy Bentham and John Stuart Mill
3. Utilitarians were advocates of the idea that India could be ruled through indigenous laws and customs
4. Utilitarians were advocates of the idea of the 'greatest good for the greatest number of people'

Select the correct answer using the code given below:
(a) 1 and 4 only (b) 2 and 4 only
(c) 1, 2 and 4 (d) 2 and 3

84. Who among the following invented the powerloom that revolutionized the cotton textile industry?
(a) Edmund Cartwright (b) Samuel Crompton
(c) Richard Arkwright (d) james Hargreaves

85. Subsidiary Alliance was a system devised by
(a) Lord Wellesley (b) Lord Dalhousie
(c) Lord Canning (d) Lord Ripon

86. Consider the following statements:
1. Periplus is a Greek word meaning sailting around.
2. Erythraean was the Greek name for the Mediterranean Sea.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

87. Who among the following was defeated by Saina Nehwal to win the women's title of the Australian Open Super Series Badminton Tournament, 2016?
(a) Sun Yu (b) Caroline Marin
(c) Wang Yihan (d) Sung Ji Hyun

88. Consider the following statements:
He was an Indian journalist, editor and author. He was associated with the Statesman, the Guardian, the Times of India etc. He received the Ramnath Goenka Lifetime Achievement Award in 2013. He died in june 2016.
The person referred to above is
(a) B K Karanjia (b) K M Mathew
(c) Inder Malhotra (d) Nanasaheb Parulckar

89. Achyut Lahkar, who died recently, was a
(a) sports administrator (b) wildlife photographar
(c) mobile theatre personality (d) bureaucrat

90. Recently Microsoft announced its 26.2 billion dollar acquisition of which one of the following professional networking sites?
(a) Partner Up (b) Perfect Business
(c) Startup Nation (d) Linked In

91. Which of the following statements concerning Mediterranean climatic region are correct ?
1. It is found in the latitude range 30^0 to 45^0 northern and southern hemisphere
2. Mediterranean climate experiences extreme temperature conditions.
3. In Mediterranean climate, rainfall occurs mainly during summer season
4. Mediterranean climate, rainfall is mainly due to westerlies.
Select the correct answer using the code given below:
(a) 1, 2 and 4 (b) 1 and 4 only
(c) 1, 2 and 3 (d) 3 and 4

92. Arrange the following states in decreasing order of their total area under forest cover :
1. Jharkhand 2. Chhattisgarh
3. Arunachal Pradesh 4. Madhya Pradesh
Select the correct answer using the code given below :
(a) 4 - 3 - 2 - 1 (b) 4 - 2 - 3 - 1
(c) 3 - 4 - 1 - 2 (d) 2 - 1 - 3 - 4

93. Which of the following statements concerning Scheduled Castes (SC) population in India are correct ?
1. The highest percentage of SC population out of the total population of the state is found in Punjab.
2. Bihar is the second largest state in respect of total SC population in India
3. Uttar Pradesh has the highest number of SC population in India
4. Among the Indian states, the lowest percentage of SC population out of the total population of the state is found in Goa
Select the correct answer using the code given below :
(a) 1, 2 and 3 (b) 1 and 3 only
(c) 2 and 4 only (d) 1, 2 and 4

94. Match List I with List II and select the correct answer using code given below the Lists :

List I (Elements)	List II (Highest Valency)
A. Sulfur	1. Five
B. Phosphorous	2. Six
C. Lead	3. Two
D. Silver	4. Four

Code :

	A	B	C	D
(a)	2	4	1	3
(b)	2	1	4	3
(c)	3	1	4	2
(d)	3	4	1	2

95. Which one of the following species is not capable of showing disproportionation reaction ?
(a) ClO^- (b) ClO_2^-
(c) $ClO_3^{!}$ (d) $ClO_4^{!}$

96. Which one of the following statements is correct ?
(a) Covalent bonds are directional
(b) Ionic bonds are directional
(c) Both covalent and ionic bonds are directional
(d) Both covalent and ionic bonds are non-directional

97. When one strikes a safety mat, the first step is
(a) burning of sulfur
(b) decomposition of potassium chlorate into potassium chloride and oxygen
(c) conversion of a small amount of red phosphorus into white phosphorus
(d) burning of glue and starch

98. The LPG cooking gas contains propane and butane as the constituents, A sulfur containing compound is added to the LPG, because
(a) it lowers the cost of production
(b) it enhances the efficiency of LPG
(c) it facilitates easy detection of leakage of the gas
(d) it assists in liquefying hydrocarbons

99. The genetic material of bacteria is found in
(a) nucleus (b) cytoplasm
(c) cell membrane (d) ribosome

100. A horse and a donkey can breed to produce mule which is an infertile animal. The infertility is because horse an donkey belong to different.
(a) class (b) order
(c) species (d) genus

101. A plan having yellow leaves with dead spots has the deficiency of
(a) Potassium (b) Magnesium
(c) Nitrate (d) Phosphate

102. Fluoride toothpaste is sometimes recommended because fluoride
(a) prevents plaque formation
(b) hardents the enamel of the tooth
(c) kills pathogenic bacteria
(d) prevents tooth ache

103. Along a streamline flow of fluid
(a) the velocity of all fluid particles at a given instant is constant
(b) the speed of fluid particle remains constant
(c) the velocity of all fluid particles crossing a given position is constant
(d) the velocity of a fluid particle remains constant

104. How is the kinetic energy of a moving object affected if the net work done on it is positive ?
(a) Decrease (b) Increases
(c) Remains constant (d) Becomes zero

105. A particle is executing simple harmonic motion. Which one of the following statements about the acceleration of the oscillating particle is true ?
(a) It is always in the opposite direction to velocity
(b) It is proportional to the frequency of oscillation
(c) It is minimum when the speed is maximum
(d) It decreases as the potential energy increases

106. Which one of the following four particles, whose displacement x and acceleration a_x are related as follows, is executing simple harmonic motion ?
(a) $a_x = +3x$ (b) $a_x = +3x^2$
(c) $a_x = -3x^2$ (d) $a_x = -3x$

107. If we plot a graph between volume V and inverse of pressure P (i.e. $\frac{1}{p}$) for an ideal gas at constant temperature T, the curve so obtained is
(a) straight line (b) circle
(c) parabola (d) hyperbola

108. Which one of the following statements is correct?
(a) The speed of sound waves in a medium depends opon the elastic property of the medium but not on inertia property.
(b) The speed of sound waves in a medium depends upon the inertia property of the medium but not on elastic property
(c) The speed of sound waves in a medium depends neither on its elastic property nor on its inertia property
(d) The speed of sound waves in a medium depends both on elastic and inertia properties of the medium.

109. Which one of the following statements is not correct ?
(a) Pitch of a sound is its characteristic by which we can generally differentiate between a male voice and a female voice
(b) The loudness of sound is related to its frequency
(c) A musical sound has certain well defined frequencies which are generally harmonics of a fundamental frequency
(d) The timbre of a particular musical sound is related to the waveform of the sound wave

110. A particle executes linear simple harmonic motion with amplitude of 2 cm. when the particle is at 1 cm from the mean position, the magnitudes of the velocity and the acceleration are equal. Then its time period (in second) is
(a) $\frac{2\pi}{\sqrt{3}}$ (b) $\frac{\sqrt{3}}{2\pi}$
(c) $\frac{\sqrt{3}}{\pi}$ (d) $\frac{1}{2\pi\sqrt{3}}$

111. Which one of the following statements is ***not*** correct ?
(a) The longest wavelength of light visible human eye is about 700 mm
(b) The shortest wavelength of light visible to human eye is about 400 mm
(c) The wavelength of gamma rays is longer than that of X-rays
(d) The ability of a telescope to form separable image of close objects is called its resolving power

112. If the image of an object, formed by a concave mirror is virtual, erect and magnified, then the objcet is placed
(a) at the principal focus
(b) at the center of curvature
(c) beyond the centre of curvature
(d) between the pole of the mirror and the principal focus

113. When three resistors each having resistancer, are connected in parallel, their resultant resistance is x. If these three resistances are connected in series, the total resistance will be
(a) 3x (b) 3rx
(c) 9x (d) 3/x

114. Which of the following was/were the feature(s) of Lenin's New Economic policy (NEP) for the Soviet Union ?
1. Private retail trading was strictly forebidden
2. Private enterprise was strictly forbidden
3. Peasants were not allowed to sell their surplus
4. To secure liquid capital, concessions were allowed to foreign capitalists, but the state retained the option of purchasing the products of such concerns

Select the correct answer using the code given below:
(a) 1 only (b) 2 and 3
(c) 1, 2 and 4 (d) 4 only

115. Which of the following was/were the reasons for the defeat of British during the American War of Independence ?
1. The remoteness of the American continent and the lack of good roads
2. The British authorities failed to rally the loyalist Americans
3. The Americans benefited from the extraordinary military leadership of George Washington
4. The Americans had access to superior arms and ammunition

Select the correct answer using the code given below:
(a) 1, 2 and 4 (b) 3 only
(c) 2 and 3 only (d) 1, 2 and 3

116. The industrial revolution in England had a profound impact on the lives of people. Which of the following statements are correct about that ?
1. Women were the main workers in the silk, lace-making and knitting insustries
2. Factory managers were well aware of the health risks of industrial work on children
3. Children were often employed in textile factories
4. The novel 'Hard Times' by Charles Dickens was a severe critique of the horrors of industrialization

Select the correct answer using the code given below :
(a) 1 and 3 only (b) 1 and 2
(c) 1, 3 and 4 (d) 3 and 4 only

117. Consider the following statements:
1. British colonialism continued to grow steadily in the 18th and 19th centuries
2. Raw cotton for the textile industry in Britain during the industrial revolution needed to be imported

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

118. Who among the following was the author of '*Neel Darpan*' published in 1860 ?
(a) Reverend James Long
(b) Michael Madhusudan Dutta
(c) Raja Ram Mohan Roy
(d) Dinbandhu Mitra

119. Which one of the following organizations was started by Jyotirao Phule in 1873 ?
(a) Prarthna Samaj (b) Bahujan Samaj
(c) Justice Party (d) Satyashodhak Samaj

120. Although used earlier by French and German writers, the term industrial Revolution in English was first popularized by
(a) Adam Smith (b) Amonld Toynbee
(c) James Mill (d) Bertned Russell

121. In the 19th century, the majority of the workers in Japan's modern industries were mainly
(a) Japanese men and children
(b) Japanese women and Chinese men
(c) Women
(d) Japanese and Chinese men

122. Which of the following statements regarding recent developments in international affairs is/are correct ?
1. NATO's defence ministers agree to boost support for Ukraine with a comprehensive package of assistance which will help it strengthen defence and to modernize its armed forces.
2. Israel announces plans for construction of dwelling units for Jewish settlers in a palestinian neighbourhood of East Jerusalem.

Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

123. As per the RBI guidelines, which one of the following is the minimum tenure of Masala Bonds that an Indian Company can issue offshore ?
(a) Five years (b) Four years
(c) Three years (d) Two years

124. Which of the following statements about Krishi Kalyan Cess (KKC) is/are correct ?
1. KKC is calculated in the same way as Service Tax is calculated.
2. The current rate of KKC is 0.50%
3. KKC is similar to the KKS (Krishi Kalyan Surcharge).

Select the correct answer using the code given below :
(a) 1, 2 and 3 (b) 1 and 2 only
(c) 2 and 3 only (d) 1 only

125. Which country won the Thomas cup Badminton Championship, 2016 ?
(a) Indonesia (b) Denmark
(c) China (d) Malaysia

126. Match List I with List II and select the correct answer using the code given below the Lists :

List I (Ultra mega power project at different stages of development)	**List II (State)**
A. Sasan	1. Gujarat
B. Munda	2. Madhya pradesh
C. Tilaiya	3. Andhra pradesh
D. Krishnapattam	4. Jharkhand

Code :

	A	B	C	D
(a)	2	4	1	3
(b)	3	4	1	2
(c)	2	1	4	3
(d)	3	1	4	2

127. The world's largest biomass cookstove system for cooking in community kitchen has been installed at
(a) Tirupati (b) Amritsar
(c) Shirdi (d) Udupi

128. Which one of the following sectors is the largest contributor to carbon dioxide emmisions from fuel consumption in India?
(a) Electricity and heat production
(b) Transport
(c) Manufacturing industries and constructions
(d) Others

129. As per census 2011, which one of the following states has the highest number of inhabitated villages ?
(a) Uttar pradesh (b) Odisha
(c) Rajasthan (d) Maharashtra

130. The property of electric current which is applicable in the fuse wire is :
(a) chemical effect of current
(b) megnetic effect of current
(c) heating effect of current
(d) optical property of current

131. Which one of the following statements is *not* correct ?
(a) The SI unit charge is ampere-second
(b) Debye is the unit of dipole moment
(c) Resistivity of a wire of length / and area of cross-section a depends upon both *l* and a
(d) The kinetic energy of an length of mass in kg and charge / coulomb when accelerated through a potential difference of V volt, is ev jacle.

132. Two balls, *A* and *B* are thrown simultaneously, *A* vertically upward with a speed of 20 m/s from the ground and *B* vertically downward from a height of 40 m with the same speed and along the same line of motion. At what points do the two balls collide by taking acceleration due to gravity as 9.8 m/s^2 ?
(a) The balls will collide after 3s at a height of 30.2 m from the ground
(b) The balls will collide after 2s at a height of 20.1 m from the ground.
(c) The balls will collide after 1s at a height of 15.1 m from the ground
(d) The balls will collide after 5s at a height of 20m from the ground

133. The setting time of cement is lowered by adding
(a) oxides of aluminium (b) gypsum
(c) oxides of magnesium (d) silica

134. Emulsion is known as a
(a) colloidal solution of substances having different physical states
(b) true solution
(c) distillation mixture for making alcohols
(d) colloidal solution of two liquids

135. If one mixes up ashes with animal fat, the substance received in the crude form is called
(a) Phenomone (b) Soap
(c) Cement (d) Concrete

136. Which of the following statements with regard to coverage rate of Aadhar cards during 2015 is/are correct ?
1. The coverage rate of Aadhar cards in western India is quite high and it is above 90 percent in Gujarat.

2. The coverage rate of Aadhar cards is the highest in southern India and it is almost 100 percent in the states of Telangana and Andhra Pradesh
3. The penctration of Aadhar cards has been very low in north-eastern part of India and it is the lowest in Assam and Meghalay.

Select the correct answer using the code given below :
(a) 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

137. Which one of the following is the correct descending order of countries in terms of per capita availability of arable land?
(a) India- China - Brazil (b) China - Brazil - India
(c) Brazil - China - India (d) Brazil - India - China

138. Match List I with List II and select the correct answer using the code given below the Lists :

List I (Geomorphic Agent)	List II (Feature)
A. Ground water	1. Plunge pool
B. Running water	2. Horns
C. Glacier	3. Playas
D. Wind	4. Lapies

Code :

	A	B	C	D
(a)	4	1	2	3
(b)	3	2	1	4
(c)	3	1	2	4
(d)	4	2	1	3

139. Which of the following statements concerning temperature is/are correct ?
1. In winter season isotherms in Northern Hemisphere are more or less circular on continents.
2. Isotherms are parallel to latitude in Southern Hemisphere in oceans
3. Minimum temperature during winter is recorded in Northern Canada

Select the correct answer using the code given below :
(a) 1 and 2 only (b) 1 and 3 only
(c) 1, 2 and 3 (d) 2 only

140. Which of the following statement(s) concerning natural regions of the world is/are correct ?
1. Equatorial climate regions have less urbanization
2. Meditarranean climatic reigon have high level of urbanization
3. Equatorial limatic regions have high concentration of human population
4. Mediterranean climate regions practice plantation farming

select the correct answer using the code given below :
(a) 1 and 2 only (b) 1, 2 and 3
(c) 2 and 4 (d) 1 only

141. Which one of the following gases gives acidic solution on dissolving in water ?
(a) Hydrogen (b) Carbondioxide
(c) Nitrogen (d) Oxygen

142. How many moles of hydrogen atom are present in one mole of Aluminium hydroxide ?
(a) one mole (b) Two moles
(c) Three moles (d) Four moles

143. The United Nations proclaimed 21 june as
(a) International Mother Language Day
(b) International widow's Day
(c) International Day of yoga
(d) International Day against Drug Abuse and illicit Trafficking

144. Who are Bhawana kanth, Avani Chaturvedi and Mohana Singh ?
(a) Sprinters (b) Rock climbers
(c) Fighter Pilots (d) Mountainers

145. Consider the following statements about the Constitution of India :
1. A Member of Parliament enjoys freedom of speech in the Parliament as a Parliamentary privilege protected by the Constitution of India .
2. The Constitution has vested the power to armed the Constitution in the Parliament

Which of the statements given above is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

146. Which one of the following statements about the Union Executive in India is correct ?
(a) According to the Constitution of India, the total number of member of the Council of Ministers cannot exceed 20% of the total number of Members of the house of the People
(b) The rank of different Ministers is determined by the president
(c) The Ministers is appointed by the president on the advice of the Prime Minister
(d) Only a member of either House of Paliament can be appointed as a Minister.

147. Which one of the following statements about Money Bill is correct ?
(a) A Bill shall be deemed to be a Money Bill only if it Provides for imposition of fines or penalties
(b) A Money Bill shall be introduced in the Rajya Sabha
(c) The Rajya Sabha can reject the Money Bill.
(d) The Speaker of the Lok Sabha finally decides if it is a Money Bill, should any dispute about it arise

148. Which one of the following powers of the Prime Minister of India is codified in the Constitution of India itself?
(a) The power of advising the president as regards the appointment of other Ministers
(b) The power to allocate business amonst the Ministers
(c) The power of summon the meeting of the cabinet
(d) The power of transfer of Minister from one Department to another department

149. The cylindrical stone seals were used in which civilization?
(a) Harappan (b) Egyptian
(c) Roman (d) Mesopotamian

150. Which of the following statements with regards to the Civil Disobedience movement is/are correct ?
1. The movement received massive response from business groups and peasantry
2. The movement coincided with large scale labour upsurge in Maharashtra
3. The movement was marked by the mass participation of lawyers and students

Select the correct answer using the code given below :
(a) 1 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1, 2 and 3

NDA 2 2016 Solutions

MATHEMATICS

1. (d) No. of elements given = 6
No. of elements taken at a time = 2 i.e. (p & q)
$\Rightarrow$ Cardinality of the set $(s) = 6^2 = 36$.
(because numbers are repeated).

2. (a) Let $f(x) = ax^2 - bx + c$
$f(2) = 4a - 2b + c < 0$ (given)
$f(0) = c > 0$ (given)
So, we can see that sign of f(x) changes, when x changes from 0 to 2, so it has a root in the interval (0, 2).

3. (c) We have :
$x^2 + 6x - 7 < 0$ & $x^2 + 9x + 14 > 0$
$\Rightarrow (x-1)(x+7) < 0$ & $\Rightarrow (x+2)(x+7) > 0$
$\Rightarrow x \in (-7, 1)$ & $\Rightarrow x \in (-\infty, -7) \cup (-2, \infty)$
$\therefore A \cap B = \{x \in R : -2 < x < 1\} \rightarrow$ It is true.
$A \setminus B = A - B = \{x \in R : -7 < x < -2\} \rightarrow$ It is also true.

4. (d) $|A| = 5 \Rightarrow |2A| = 2^3 \times 5 = 40$
$$\Rightarrow |A^{-1}| = \frac{1}{|A|} \Rightarrow |(2A)^{-1}| = \frac{1}{|2A|} = \frac{1}{40}$$

5. (d) $$\omega^{100} + \omega^{200} + \omega^{300} = (\omega^{99} \cdot \omega) + (\omega^{100})^2 + (\omega^3)^{100}$$
$$= (\omega^{99} \cdot \omega) + (\omega^{99} \cdot \omega)^2 + (\omega^3)^{100}$$
$\because \omega^3 = 1 \quad \omega^{99} = (\omega^3)^{33} = 1^{33} = 1$
$$\Rightarrow \omega^{100} + \omega^{200} + \omega^{300} = (1 \cdot \omega) + (1 \cdot \omega)^2 + 1^{100}$$
$$= \omega + \omega^2 + 1 = 1 + \omega + \omega^2 = 0$$

6. (d) $$\frac{z-1}{z+1} = \frac{x+iy-1}{x+iy+1}$$
$$\frac{z-1}{z+1} = \frac{x^2+y^2-1+2iy}{x^2+y^2+2x+1}$$
$$\Rightarrow \text{Re}\left(\frac{z-1}{z+1}\right) = \frac{x^2+y^2-1}{x^2+y^2+2x+1} = 0$$
$\Rightarrow x^2 + y^2 - 1 = 0$
$\Rightarrow x^2 + y^2 = 1$
Also, $z\bar{z} = x^2 + y^2 = 1$
and $z\bar{z} = |z|^2$
$\Rightarrow |z|^2 = 1$
$\Rightarrow |z| = 1$

7. (d) $$\begin{bmatrix} x & y & z \end{bmatrix} \begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix}$$
$$= \begin{bmatrix} ax+hy+gz & hx+by+fz & gx+fy+cz \end{bmatrix}$$

8. (c) Here, ${}^{15}C_3 - {}^{n}C_3 = 445$
$$\Rightarrow {}^{n}C_3 = \frac{15!}{3!\,12!} - 445$$
$\Rightarrow {}^{n}C_3 = 10$
${}^{3}C_3 = 1$; ${}^{4}C_3 = 4$; ${}^{5}C_3 = 10$
$\Rightarrow \boxed{n = 5}$

9. (a) $$z = \left[\frac{\sqrt{3}}{2} + \frac{i}{2}\right]^{107} + \left[\frac{\sqrt{3}}{2} - \frac{i}{2}\right]^{107}.$$
$$\because \cos\frac{\pi}{6} = \frac{\sqrt{3}}{2} \text{ \& } \sin\frac{\pi}{6} = \frac{1}{2}$$
$$\Rightarrow z = \left[\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right]^{107} + \left[\cos\frac{\pi}{6} - i\sin\frac{\pi}{6}\right]^{107}$$
Also, $(\cos\theta + i\sin\theta)^n = \cos n\theta + i\sin n\theta$
$$\Rightarrow z = \cos\frac{107\pi}{6} + \cancel{i\sin\frac{107\pi}{6}} + \cos\frac{107\pi}{6} - \cancel{i\sin\frac{107\pi}{6}}.$$
$\Rightarrow \text{Im}(z) = 0.$

10. (d) $x^2 - 2kx + k^2 - 4 = 0$
$\Rightarrow (x-k)^2 - 2^2 = 0$
$\Rightarrow (x-k-2)(x-k+2) = 0$
$\Rightarrow x = k+2, k-2.$
$\Rightarrow k+2 < 5$ & $k-2 > -3$
$\Rightarrow k < 3$ & $k > -1$
$\Rightarrow -1 < k < 3$

11. (c) Let $z = x + iy$
$z^2 + |z| = 0$
$$\Rightarrow x^2 - y^2 + 2ixy + \sqrt{x^2+y^2} = 0$$
$$\Rightarrow x^2 - y^2 + \sqrt{x^2+y^2} + i2xy = 0 + i0$$
$$\Rightarrow x^2 - y^2 + \sqrt{x^2+y^2} = 0 \quad \text{...(1)}$$
and $2xy = 0 \Rightarrow xy = 0 \Rightarrow x = 0$ or $y = 0$
Now : For $y = 0$ in eq. (1) we get :
$$x^2 + \sqrt{x^2} = 0$$
$$\Rightarrow x^2 + |x| = 0$$

Clearly $x^2+|x|$ will always be greater than 0 for all $x>0$.

Let, $x \le 0$

$x^2+|x|=0$

$\Rightarrow x^2-x=0 \Rightarrow x(x-1)=0$

$\Rightarrow x=0$ or $(x-1)=0$

$\Rightarrow x=0 \qquad (\because x \le 0)$

$\therefore \boxed{z=0}$

For $x=0$ in eq. (1) we get,

$-y^2+\sqrt{y^2}=0$

$-y^2+|y|=0$

If $y>0$, then

$-y^2+|y|=0$

$\Rightarrow -y^2+y=0$

$\Rightarrow y=0, y=1$

$\Rightarrow y=1 \qquad (\because y>0)$

$\therefore \boxed{z=i}$

If $y<0$, then

$-y^2+|y|=0$

$\Rightarrow -y^2-y=0$

$\Rightarrow y=0, y=-1$

$\Rightarrow y=-1 \qquad (\because y<0)$

$\therefore \boxed{z=-i}$

$\therefore$ There are only 3 distinct solutions.

12. (d) Let 'a' be the first term & 'x' be the common ratio. Also, suppose 27, 8 & 12 be the p^{th}, q^{th} & r^{th} term of the G.P.

$\therefore \quad ax^{p-1}=27$

$ax^{q-1}=8$

& $ax^{r-1}=12$

Now, $27 \times 8^2 = 12^3$

$\Rightarrow \quad ax^{p-1} \times (ax^{q-1})^2=(ax^{r-1})^3$

$\Rightarrow \quad x^{p-1} . x^{2q-2}=x^{2r-3}$

$\Rightarrow \quad p-1+2q-2=3r-3$

$\Rightarrow \quad p+2q-3r=0 \qquad ...(1)$

There are infinitely many solutions for the eq. (1).

13. (c) $R=\{(1,3),(1,5),(2,3),(2,5),(3,5),(4,5)\}$.

$\Rightarrow \quad R^{-1}=\{(3,1),(5,1),(3,2),(5,2),(5,3),(5,4)\}$.

$\Rightarrow \quad RoR^{-1}=\{(3,3),(3,5),(5,3),(5,5)\}$.

14. (d) Since sum of digits = 10 (which is not divisible by 3)

$\therefore$ No numbers can be formed.

15. (a) ${}^{47}C_4+{}^{51}C_3+{}^{50}C_3+{}^{49}C_3+{}^{48}C_3+{}^{47}C_3$

$=\underline{{}^{47}C_3+{}^{47}C_4}+{}^{48}C_3+{}^{49}C_3+{}^{50}C_3+{}^{51}C_3$

$\underline{{}^{48}C_4+{}^{48}C_3}+{}^{49}C_3+{}^{50}C_3+{}^{51}C_3$

$\left(\because {}^nC_r+{}^nC_{r+1}={}^{n+1}C_{r+1}\right)$

$=\underline{{}^{49}C_4+{}^{49}C_3}+{}^{50}C_3+{}^{51}C_3$

$=\underline{{}^{50}C_4+{}^{50}C_3}+{}^{51}C_3$

$={}^{51}C_4+{}^{51}C_3$

$={}^{52}C_4$

16. (b) $S_n=\frac{n}{2}(a+l)$

$\Rightarrow \quad a+x+y+z+b=\frac{5}{2}(a+b)$

$a+b+15=\frac{5}{2}(a+b)$

$\Rightarrow \quad a+b=10 \qquad ...(1)$

$\& \ \frac{1}{a}+\frac{1}{p}+\frac{1}{q}+\frac{1}{r}+\frac{1}{b}=\frac{5}{2}\left(\frac{1}{a}+\frac{1}{b}\right)$

$\Rightarrow \quad \frac{1}{a}+\frac{1}{b}+\frac{5}{3}=\frac{5}{2}\left(\frac{1}{a}+\frac{1}{b}\right)$

$\Rightarrow \quad \frac{3(a+b)}{ab}=\frac{10}{3}. \qquad ...(2)$

$\Rightarrow \quad \frac{3\times 10}{ab}=\frac{10}{3}.$

$\Rightarrow \quad ab=9$

17. (b) On solving eq (1) & (2), we get

(i) $a=1$ & $b=9 \Rightarrow a+4d=9 \Rightarrow d=2$

(ii) $a=9$ & $b=1 \Rightarrow a+4d=1 \Rightarrow d=-2$.

For $a=1$ & $d=2$,

$x=3$, $y=5$ & $z=7$

For $a=9$ & $d=-2$,

$x=7$, $y=5$ & $z=3$

$\Rightarrow \quad xyz=7\times5\times3=105$

18. (c) Since a, p, q, r, b or 1, p, q, r, 9 are in H.P.

$\Rightarrow \quad \frac{1}{1+4d}=9 \Rightarrow d=-\frac{2}{9}.$

$\frac{1}{p}=1-\frac{2}{9}=\frac{7}{9} \Rightarrow p=\frac{9}{7}$

$\frac{1}{q}=\frac{7}{9}-\frac{2}{9}=\frac{5}{9} \Rightarrow q=\frac{9}{5}$

$\& \ \frac{1}{r}=\frac{5}{9}-\frac{2}{9}=\frac{3}{9} \Rightarrow r=\frac{9}{3}$

$\Rightarrow \quad p\times q\times r=\frac{243}{35}$

19. (a) Let first term = a & common difference = x

$\therefore$ $a + 5x = 2 \Rightarrow a = 2 - 5x.$

Let $P = T_1 \times T_4 \times T_5$

$\Rightarrow$ $P = a(a+3x)(a+4x)$

$\Rightarrow$ $P = (2-5x)(2-5x+3x)(2-5x+4x)$

$\Rightarrow$ $P = -10x^3 + 34x^2 - 32x + 8.$

$$\frac{dp}{dx} = 0 \Rightarrow 15x^2 - 34x + 16 = 0$$

$$\Rightarrow (5x-8)(3x-2) = 0$$

$$\Rightarrow x = \frac{8}{5}, \left[\because x = \frac{2}{3} < 1\right]$$

20. (b) Since, $a = 2 - 5x$

$$\Rightarrow a = 2 - 5\left(\frac{8}{5}\right)$$

$$\Rightarrow a = -6$$

21. (c) $ax^3 + bx^2 + cx + d$

$= (x+1)[(x+1)(5x-1) - x(3x+4)] - 2x[(2x+3)(5x-1) - x(2-x)] + 3x[(2x+3)(3x+4) - (2-x)(x+1)]$

$\Rightarrow$ $ax^3 + bx^2 + cx + d = x^3 + 28x^2 + 35x - 1$

$\Rightarrow$ $c = 35$

22. (b) $a + b + c + d = 63$

23. (a) Here, $a = 120°$ and $d = 5$.

Sum of angles of polygon $= (n-2)\,180°$

$$\Rightarrow \frac{n}{2}[2a + (n-1)d] = (n-2)180$$

$$\Rightarrow \frac{n}{2}[2 \times 120 + (n-1)5] = (n-2)180$$

$$\Rightarrow n^2 - 25n + 144 = 0$$

$$\Rightarrow (n-9)(n-16) = 0$$

$\therefore n = 9, 16$

For $n = 9$, $T_9 = 120 + (9-1)5 = 160$

For $n = 16$, $T_{16} = 120 + (16-1)5 = 195$ [not possible]

24. (a) For $n = 9$

Largest angle $= T_9 = 120 + (9-1)5 = 160$

For $n = 16$

Largest angle $= T_{16} = 120 + (16-1)5 = 195$

(Not possible).

25. (c) $m\cos\theta - n\sin\theta = \begin{bmatrix} \cos\theta & 0 \\ 0 & \cos\theta \end{bmatrix} - \begin{bmatrix} 0 & \sin\theta \\ -\sin\theta & 0 \end{bmatrix}$

$$= \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

det. $(m\cos\theta - n\sin\theta) = \cos^2\theta - (-\sin^2\theta)$

$$= \cos^2\theta + \sin^2\theta = 1.$$

26. (a) $f(\theta) = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ & $f(\phi)\begin{bmatrix} \cos\phi & -\sin\phi & 0 \\ \sin\phi & \cos\phi & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$$f(\theta) \times f(\phi) = \begin{bmatrix} \cos\theta\cos\phi - \sin\theta\sin\phi & -\cos\theta\sin\phi - \sin\theta\cos\phi & 0 \\ \sin\theta\cos\phi - \cos\theta\sin\phi & -\sin\theta\sin\phi + \cos\theta\cos\phi & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

(using Trigonometric Identities)

$\Rightarrow$ $f(\theta) \times f(\phi) = f(\theta + \phi)$.

Also, det, $[f(\theta) \times f(\phi)] = 1\left[\cos^2(\theta+\phi) - (-\sin^2(\theta+\phi))\right]$

$= \cos^2(\theta+\phi) + \sin^2(\theta+\phi) = 1.$

& det.$(f(x)) = (\cos^2 x - (-\sin^2 x) = \cos^2 x + \sin^2 x = 1.$

27. (a) Here $\begin{bmatrix} 1 & 1 & 1 \\ 1 & -1 & 2 \\ 3 & -1 & 5 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 8 \\ 6 \\ k \end{bmatrix}$ or $AX = B$.

$|A| = 0$ ($\because$ the system does not have a unique solution)

Now, $(\text{Adj } A) = \begin{bmatrix} -3 & -6 & 3 \\ 1 & 2 & -1 \\ 2 & 4 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 8 \\ 6 \\ k \end{bmatrix}$

For $k = 15$, $(\text{Adj } A)B = \begin{bmatrix} -24-36+15 \\ 8+12-15 \\ 16+24-30 \end{bmatrix} = \begin{bmatrix} -45 \\ 5 \\ 10 \end{bmatrix} \neq 0$

($\because$ system is inconsistent i.e., it has no solution)

For $k = 20$, $(\text{Adj } A)B = \begin{bmatrix} -24-36+60 \\ 8+12-20 \\ 16+24-40 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} = 0$

($\because$ system has infinitely many solutions)

28. (d) Here, $A = \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 3 \\ -1 & -2 \end{bmatrix}$

$|A| = 3 - (-2) = 5$ and $|B| = -4 - (-3) = -1$

$\Rightarrow A^{-1} = \frac{1}{5}\begin{bmatrix} 3 & 1 \\ -2 & 1 \end{bmatrix}$ and $B^{-1} = -1\begin{bmatrix} -2 & -3 \\ 1 & 2 \end{bmatrix}$

$AB = \begin{bmatrix} 3 & 5 \\ 1 & 0 \end{bmatrix}$ and $A^{-1}B^{-1} = \frac{1}{5}\begin{bmatrix} 5 & 7 \\ -5 & 8 \end{bmatrix}$

$\Rightarrow AB(A^{-1}B^{-1}) = \frac{1}{5}\begin{bmatrix} -10 & -12 \\ 5 & 7 \end{bmatrix} \neq 1.$

$|AB| = 0 - 5 = -5$

$\therefore (AB)^{-1} = \frac{-1}{5}\begin{bmatrix} 0 & -5 \\ -1 & 3 \end{bmatrix} \neq A^{-1}B^{-1}$

29. (b) $x^{\ln\left(\frac{y}{z}\right)} \cdot y^{\ln(xz)^2} \cdot z^{\ln\left(\frac{x}{y}\right)} = y^{4\ln y}$

$$\Rightarrow \ln\left[x^{\ln\left(\frac{y}{z}\right)}\right] + \ln\left[y^{\ln(xz)^2}\right] + \ln\left[z^{\ln\left(\frac{x}{y}\right)}\right] = \ln\left[y^{4\ln y}\right]$$

$$\Rightarrow \left[\ln\left(\frac{y}{z}\right)\ln x\right] + [2\ln(xz)\ln y] + \left[\ln\left(\frac{x}{y}\right)\ln z\right] = 4[\ln y]^2$$

$$\Rightarrow \ln x[\ln y - \ln z] + 2\ln y[\ln x + \ln z] + \ln z[\ln x - \ln y] = 4[\ln y]^2$$

$$\Rightarrow 3\ln x + \ln z = 4\ln y$$

$$\Rightarrow \frac{\ln x + \ln x + \ln x + \ln z}{4} = \ln y$$

$\therefore$ lny is the AM of lnx, lnx, lnx, lnx & lnz.

30. (b)

2	235	1
2	117	1
2	58	0
2	29	1
2	14	0
2	7	1
2	3	1
	1	

So, $(235)_{10} = (11101011)_2$

31. (d) Using $ax^2 + bx + c = 0$

$a = 1, b = -(1-2a^2)$ & $c = (1-2a^2)$

For roots to be real,

$b^2 - 4ac \geq 0$

$\Rightarrow [-(1-2a^2)]^2 - 4(1)(1-2a^2) \geq 0$

$\Rightarrow 4a^4 + 4a^2 - 3 \geq 0$

$\Rightarrow (2a^2-1)(2a^2+3) \geq 0$

$\Rightarrow a^2 \geq \frac{1}{2}$ or $a^2 \leq -\frac{3}{2}$

32. (a) $\frac{1}{\alpha^2} + \frac{1}{\beta^2} < 1 \Rightarrow \frac{\alpha^2+\beta^2}{(\alpha\beta)^2} < 1$

$$\Rightarrow \frac{(\alpha+\beta)^2 - 2\alpha\beta}{(\alpha\beta)^2} < 1$$

$\alpha + \beta = \frac{-b}{a} = (1-2a^2)$ & $\alpha\beta = \frac{c}{a} = (1-2a^2)$

On solving: $\frac{4a^4 - 1}{4a^4 - 4a^2 + 1} < 1$

$\Rightarrow 4a^4 - 1 < 4a^4 - 4a^2 + 1$

$4a^2 < 2 \Rightarrow a^2 < \frac{1}{2}$

33. (b) $X = \sqrt{\frac{1+\omega^2}{1+\omega}}$ $\quad (\because 1 + \omega + \omega^2 = 0$ and $\omega^3 = 1)$

$$\Rightarrow X = \sqrt{\frac{-\omega}{-\omega^2}} = \sqrt{\frac{1}{\omega}} = \sqrt{\frac{\omega^3}{\omega}} = \sqrt{\omega^2} = \omega$$

34. (c)

35. (b) $A = \begin{bmatrix} 2 & 3 & 5 \\ 7 & 3 & -2 \\ 2 & 3 & \lambda \end{bmatrix}$ and $B = \begin{bmatrix} 9 \\ 8 \\ \mu \end{bmatrix}$

$$(\text{Adj } A) = \begin{bmatrix} 3\lambda+6 & 15-3\lambda & -21 \\ -(7\lambda+4) & 2\lambda-10 & 39 \\ 15 & 0 & -15 \end{bmatrix}$$

For infinitely many solutions :

$$(\text{Adj } A)B = 0 \Rightarrow \begin{bmatrix} 27\lambda + 54 + 120 - 24\lambda - 21\mu \\ -63\lambda - 36 + 16\lambda - 80 + 39\mu \\ 135 + 0 - 15\mu \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Hence, $\mu = 9$ and $\lambda = 5$.

36. (c) For unique solution :

$|A| \neq 0 \Rightarrow 2(3\lambda+6) - 3(7\lambda+4) + 5(21-6) \neq 0$

$\Rightarrow \lambda \neq 5$.

and μ can have any real value.

37. (c) **Case I**

When unit digit can be 1, 3, 5 or 7 & digit at thousand's place can be 1, 2, 3, 4, 5, 6, 7 or 8.

No. of ways digits can be filled are:

$\boxed{7}\boxed{8}\boxed{7}\boxed{4}$

Total no's $= 7 \times 8 \times 7 \times 4 = 1568$.

Case II

When unit digit can be 9 & digit at thousand's place can be 1, 2, 3, 4, 5, 6, 7 or 8.

No. of ways digits can be filled are:

$\boxed{8}\boxed{8}\boxed{7}\boxed{1}$

Total no's $= 8 \times 8 \times 7 \times 1 = 448$.

Case III

When unit digit can be 1, 3, 5 or 7 & digit at thousand's place can be 9.

No. of ways digits can be filled are:

$\boxed{1}\boxed{8}\boxed{7}\boxed{4}$

Total no's $= 1 \times 8 \times 7 \times 4 = 224$.

$\therefore$ Number of odd digits between 1000 & 9999 with no digit repeated $= 1568 + 448 + 224$
$= 2240$.

38. (c) $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots\ldots\ldots\ldots + \frac{1}{2^{n-1}} < 2 - \frac{1}{1000}$

LHS of given inequality is in G.P.

$$\therefore \frac{1 - \frac{1}{2^n}}{1 - \frac{1}{2}} < 2 - \frac{1}{1000}$$

$\Rightarrow \quad 2-\frac{1}{2^{n-1}}<2-\frac{1}{100}$

$\Rightarrow \quad 2^{n-1}<1000$

Now, $(2)^9=512$ & $(2)^{10}=1024$

$\therefore \quad n-1=9$

$\Rightarrow \quad n=10.$

39. (c) $2x^2+3x-\alpha=0$

Its roots are: -2 & β.

i.e., $\frac{-3}{2}=\beta-2 \Rightarrow \beta=2-\frac{3}{2}=\frac{1}{2} \Rightarrow \beta=\frac{1}{2}$

$\frac{\alpha}{2}=2\beta \Rightarrow \alpha=4\times\frac{1}{2} \Rightarrow \alpha=2$

40. (a) $\beta=\frac{1}{2}$

$\beta, 2, 2m$ are in GP.

$\Rightarrow \frac{2}{\beta}=\frac{2m}{2}$

$\Rightarrow m=\frac{2}{\beta}=2\times\frac{2}{1}$

$\Rightarrow m=4$

$\Rightarrow \beta\sqrt{m}=\frac{1}{2}\times\sqrt{4}=1$

41. (c) Let $A=30°$

$\Rightarrow \sin A+2\sin 2A+\sin 3A=\sin 30°+2\sin 60°+\sin 90°$

$=\frac{1}{2}+\frac{2\sqrt{3}}{2}+1=\frac{2\sqrt{3}+3}{2}$

$(\because 2\cos^2 A=1+\cos 2A)$

Now, $4\sin 2A\cos^2\left(\frac{A}{2}\right)=2\sin 2A\,[1+\cos A]$

$=2\sin 60°\,[1+\cos 30°]=\frac{2\sqrt{3}+3}{2}$

Also, $\sin 2A=2\sin A\cos A$ & $\sin^2 A+\cos^2 A=1$

$2\sin 2A\left[\sin\frac{A}{2}+\cos\frac{A}{2}\right]^2$

$=2\sin 2A\left[\sin^2\frac{A}{2}+\cos^2\frac{A}{2}+2\sin\frac{A}{2}\cos\frac{A}{2}\right]$

$=2\sin 2A[1+\sin A]=2\sin 60°[1+\sin 30°]$

$=\frac{3\sqrt{3}}{2}$

& $8\sin A\cos A\cos^2\left(\frac{A}{2}\right)$

$=4\sin A\cos A\,[1+\cos A]$

$=4\sin 30°\cos 30°\,[1+\cos 30°]$

$=\frac{2\sqrt{3}+3}{2}$

42. (a) $x=\sin 70°.\sin 50°$ and $y=\cos 60°\,.\,\cos 80°$

$\Rightarrow xy=\cos 60°\,.\,\sin 70°\,.\,\sin 50°\,.\,\cos 80°$

$xy=\frac{1}{2}\cdot\sin(90-20)\cdot\sin(90-40)\cdot\cos 80$

$\Rightarrow xy=\frac{1}{2}\cdot\cos 20\cdot\cos 40\cdot\cos 80$

$(\because \sin(90-x)=\cos x)$

$\Rightarrow xy=\frac{1}{2}\cdot\cos 20°\cdot\cos(60-20)°\cdot\cos(60+20)°$

$\Rightarrow xy=\frac{1}{2}\left[\frac{1}{4}\cos 3(20°)\right]=\frac{1}{2}\times\frac{1}{4}\times\cos 60°=\frac{1}{16}.$

$\left[\because \cos\theta\cdot\cos(60-\theta)\cdot\cos(60+\theta)=\frac{1}{4}\cos 3\theta\right]$

43. (a) $\sin\theta_1+\sin\theta_2+\sin\theta_3+\sin\theta_4=4$ ...(1)

Since max. value of $\sin\theta=1$

We have four terms in LHS of eq. (1).

$\Rightarrow$ Every term should be $=1$

$\Rightarrow \sin\theta_1=\sin\theta_2=\sin\theta_3=\sin\theta_4=1$

$\Rightarrow \theta_1=\theta_2=\theta_3=\theta_4=90°$

Now,

$\cos\theta_1+\cos\theta_2+\cos\theta_3+\cos\theta_4=(\cos 90°)\times 4=0.$

44. (d) $\left[1+\cos\frac{\pi}{8}\right]\left[1+\cos\frac{3\pi}{8}\right]\left[1+\cos\frac{5\pi}{8}\right]\left[1+\frac{\cos 7\pi}{8}\right]$

We have,

$\cos\frac{7\pi}{8}=\cos\left[\pi-\frac{\pi}{8}\right]=-\cos\frac{\pi}{8}$

and $\cos\frac{5\pi}{8}=\cos\left[\pi-\frac{3\pi}{8}\right]=-\cos\frac{3\pi}{8}$

$\therefore=\left[1+\cos\frac{\pi}{8}\right]\left[1+\cos\frac{3\pi}{8}\right]\left[1-\cos\frac{\pi}{8}\right]\left[1-\cos\frac{3\pi}{8}\right]$

$=\left[1-\cos^2\frac{\pi}{8}\right]\left[1-\cos^2\frac{3\pi}{8}\right]=\sin^2\frac{\pi}{8}\cdot\sin^2\frac{3\pi}{8}$

$=\frac{1}{4}\left[2\sin^2\frac{\pi}{8}\cdot 2\sin^2\frac{3\pi}{8}\right]$

$=\frac{1}{4}\left[\left(1-\cos\frac{\pi}{4}\right)\left(1-\cos\frac{3\pi}{4}\right)\right]$

$\left(\because 1-\cos\theta=2\sin^2\frac{\theta}{2}\right)$

$=\frac{1}{4}\left[\left(1-\frac{1}{\sqrt{2}}\right)\left(1+\frac{1}{\sqrt{2}}\right)\right]=\frac{1}{8}$

45. (a) Here, $z=x\cos\theta+y\sin\theta$

$z^2=x^2\cos^2\theta+y^2\sin^2\theta+2xy\sin\theta\cos\theta$

$\Rightarrow 2xy\sin\theta\cos\theta=z^2-x^2\cos^2\theta-y^2\sin^2\theta$

Let, $L=(x\sin\theta-y\cos\theta)^2$

$\Rightarrow L=x^2\sin^2\theta+y^2\cos^2\theta-2xy\sin\theta\cos\theta$

$\Rightarrow L=x^2\sin^2\theta+y^2\cos^2\theta-[z^2-x^2\cos^2\theta-y^2\sin^2\theta]$

$\Rightarrow L=x^2[\sin^2\theta+\cos^2\theta]+y^2[\sin^2\theta+\cos^2\theta]-z^2$

$\Rightarrow L=x^2+y^2-z^2$

46. (d) $\cos(2\cos^{-1}(0.8))$

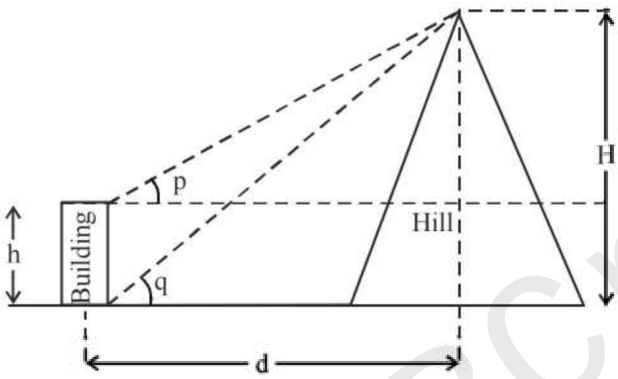
$=2\cos^2(\cos^{-1}(0.8))-1\quad[\because \cos 2A=2\cos^2 A-1]$

$=2[\cos(\cos^{-1}(0.8))]^2-1$

$=2(0.8)^2-1$

$=0.28$

47. (b)



Let height of hill = H

& horizontal distance between building & hill = d

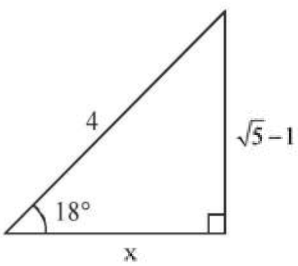
$\tan q=\dfrac{H}{d}\Rightarrow d=\dfrac{H}{\tan q}=H\cot q$

$\tan p=\dfrac{(H-h)}{d}\Rightarrow d=(H-h)\cot p$

$\Rightarrow\ H\cot q=(H-h)\cot p$

$H=\dfrac{h\cot p}{\cot p-\cot q}$

48. (a)



$\because\ \sin 18°=\dfrac{\sqrt{5}-1}{4}$

$x^2=4^2-\left(\sqrt{5}-1\right)^2$

$\Rightarrow\ x=\sqrt{10+2\sqrt{5}}$

$\Rightarrow\ \cos 18°=\dfrac{\sqrt{10+2\sqrt{5}}}{4}$

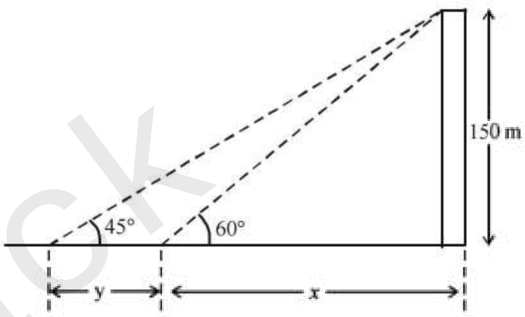
$\Rightarrow\ 2\cos^2 9-1=\dfrac{\sqrt{10+2\sqrt{5}}}{4}$

$\cos^2 9=\dfrac{\sqrt{10+2\sqrt{5}}+4}{8}$

$\Rightarrow\ \sin^2 81=\dfrac{4+\sqrt{10+2\sqrt{5}}}{8}$

After squaring all the options available, we come to a conclusion that option (a) is correct.

49. (b)



$\tan 60°=\dfrac{150}{x}\Rightarrow x=\dfrac{150}{\sqrt{3}}$

Also, $\tan 45°=\dfrac{150}{x+y}$

$\Rightarrow\ x+y=150$

$\Rightarrow\ y=150-x=150-\dfrac{150}{\sqrt{3}}$

$\Rightarrow\ y=150\left(\dfrac{\sqrt{3}-1}{\sqrt{3}}\right)$ = distance travelled

Speed in (m/hr) $=\dfrac{150(\sqrt{3}-1)}{\sqrt{3}}\times\dfrac{60}{2}=4500\dfrac{(\sqrt{3}-1)}{\sqrt{3}}$

50. (b) $L=\dfrac{1-\tan 2°\cot 62°}{\tan 152°-\cot 88°}=\dfrac{1-\tan 2°\cot(90-28)°}{\tan(180-28)°-\cot(90-2)°}$

$\Rightarrow L=\dfrac{1-\tan 2°\tan 28°}{-\tan 28°-\tan 2°}=-\left[\dfrac{1-\tan 2°\tan 28°}{\tan 2°+\tan 28°}\right]$

$\Rightarrow L=-\dfrac{1}{\tan(2+28)°}=-\dfrac{1}{\tan 30°}=-\sqrt{3}$

$\left[\because \tan(A+B)=\dfrac{\tan A+\tan B}{1-\tan A\tan B}\right]$

51. (c) Let ABC is equilateral triangle with $A(0,\ 0)$ and $B(3,\sqrt{3})$ and C to be known.

$\therefore AB=\sqrt{(3-0)^2+(\sqrt{3}-0)^2}=\sqrt{9+3}=\sqrt{12}$

Take option (a) i.e. $C\ (0,2\sqrt{3})$

$CA=\sqrt{0^2+(2\sqrt{3})^2}=\sqrt{12}$

$$CB = \sqrt{(3)^2 + (\sqrt{3})^2} = \sqrt{12}$$

Take option (b) i.e. $C\ (3, -\sqrt{3})$

$$CA = \sqrt{3^2 + (\sqrt{3})^2} = \sqrt{12}$$

$$CB = \sqrt{(0)^2 + (2\sqrt{3})^2} = \sqrt{12}$$

$\therefore$ Both option (a) and (b) are correct.

52. (a) Equation of given line is

$$(y-3) = \left(\frac{3-1}{2-1}\right)(x-2)$$

$\Rightarrow y = 2x - 1$

Slope $m_1 = 2$

and slope of perpendicular $= -\frac{1}{2}$

The perpendicular is also bisector, therefore it will pass through its mid-point.

$\Rightarrow$ Coordinates of mid-point of given line are :

$$\left(\frac{2+1}{2}, \frac{3+1}{2}\right) \text{ or } \left(\frac{3}{2}, 2\right).$$

So, equation of perpendicular bisector is :

$$(y-2) = -\frac{1}{2}\left(x - \frac{3}{2}\right)$$

$\Rightarrow 2x + 4y - 11 = 0$

53. (d) We have

$x - y = 4$ & $2x + 3y + 7 = 0$

On solving, we get,

$x = 1$ & $y = -3$

(these are coordinates of centre of the circle)

$\Rightarrow$ radius $= \sqrt{(2-1)^2 + (4+3)^2} = 5\sqrt{2}$

54. (a) Let the equation of hyperbola be $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

Latus rectum $= 8 = \frac{2b^2}{a} \Rightarrow b^2 = 4a$ ...... (i)

Also, $b^2 = a^2(e^2 - 1)$

$\Rightarrow$ $4a = a^2(e^2 - 1)$ [From (i)]

$$\Rightarrow 4a = a^2\left[\left(\frac{3}{\sqrt{5}}\right)^2 - 1\right]$$

$\Rightarrow$ $a = 5$ & $b^2 = 20$

$\therefore$ Equation is $\frac{x^2}{25} - \frac{y^2}{20} = 1$

55. (c) $|x + y| = 2 \Rightarrow x + y = \pm 2$

$\Rightarrow$ $x + y + 2 = 0$ and $x + y - 2 = 0$

$\Rightarrow$ $-2 < 2a < 0$ and $-1 < a < 0$

$\Rightarrow$ $|a| < 1$

56. (d) Intersecting lines are : $x + 2y = 5$ & $3x + 7y = 17$

On solving these we get : $x = 1$ & $y = 2$

Equation of perpendicular line is

$$3x + 4y = 10 \text{ or } y = \frac{-3}{4}x + 10$$

So, slope $= \frac{-3}{4}$

$\Rightarrow$ Slope of required line $= \frac{4}{3}$

$\therefore$ Equation of given line is

$$(y-2) = \frac{4}{3}(n-1) \text{ or } 4x - 3y + 2 = 0$$

57. (b) Here $\frac{|8a + 6b + 1|}{\sqrt{8^2 + 6^2}} = 1 \Rightarrow |8a + 6b + 1| = 10$

$\Rightarrow$ $8a + 6b + 1 = \pm 10$

$\Rightarrow$ $8a + 6b + 1 = 10$ & $8a + 6b + 1 = -10$

$\Rightarrow$ $8a + 6b - 9 = 0$ & $8a + 6b + 11 = 0$

58. (a) Here,

$9x^2 + 16y^2 = 144$ and $3x + 4y = 12$

$$\Rightarrow x = \frac{12 - 4y}{3}$$

So, $9\left(\frac{12-4y}{3}\right)^2 + 16y^2 = 144$

On solving we get, $y = 0, 3$

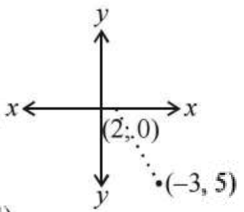
For $y = 0; x = 4$

For $y = 3; x = 0$

$\Rightarrow$ Length of chord $= \sqrt{(0-3)^2 + (4-0)^2} = \sqrt{9+16}$

$= \sqrt{25} = 5$ units

59. (d) The given line passes through (–3, 5) and (2, 0). Its equation is



$$y - y_1 = \left(\frac{y_2 - y_1}{x_2 - x_1}\right)(x - x_1)$$

$$\Rightarrow (y-5) = \left(\frac{0-5}{2+3}\right)(x+3)$$

$\Rightarrow y = -x + 2$ ...(1)

Slope $= m = -1$

and slope of perpendicular line $= -\frac{1}{m} = 1$

Equation of this line passing through (3, 3) is :

$(y - 3) = 1\ (n - 3)$

$\Rightarrow$ $y = x$.

From eq. (1) we get,

$x = -x + 2$

$\Rightarrow$ **$x = 1$ and $y = 1$.**

60. (a) Here, $b^2 = a^2(e^2 - 1)$

For rectangular hyperbola : $a = b$

$\Rightarrow b^2 = b^2(e^2 - 1)$

$\Rightarrow e^2 - 1 = 1$

$\Rightarrow e^2 = 2 \Rightarrow e = \pm\sqrt{2}$

61. (d) Let $Q(x_1, y_1, z_1)$ be the image of the point P.
The direction ratios of PQ are $3, -2, 2$. ...(i)

The Equation of line PQ is $\frac{x+2}{3}=\frac{y-1}{-2}=\frac{z+5}{2}=r$

Coordinates of any point on the line PQ is $3r-2, -2r+1$ and $2r-5$.
Let $Q(3r-2, -2r+1, 2r-5)$ be such a point.

Let L be the mid point of PQ, $L=\left(\frac{3r}{2}-2, 1-r, r-5\right)$

Since L lies on the plane $3x-2y+2z+1=0$

So, $3\left(\frac{3r}{2}-2\right)-2(1-r)+2(r-5)+1=0$

$\Rightarrow \frac{17}{2}r-17=0 \Rightarrow r=2$

So, coordinates of Q are $(3\times 2-2, -2\times 2+1, 2\times 2-5)$
$=(4,-3,-1)$ ...(ii)

Also the mid point of PQ is $L=\left(\frac{3\times 2}{2}-2, 1-2, 2-5\right)$
$=(1,-1,-3)$ ...(iii)

$\therefore PQ=\sqrt{(-2-4)^2+(1+3)^2+(-5+1)^2}=\sqrt{68}$

$\Rightarrow PQ=2\sqrt{17}>8$

$\therefore$ Option (d) is correct.

62. (c) From (i) above, 1 is correct.
We know that,
Sum of direction cosines of the line segment PQ = 1.

63. (c) Let a, b, c be the direction ratios of the line.
Then its equation is

$\frac{x-5}{a}=\frac{y+6}{b}=\frac{z-7}{c}$ ...(i)

Since (i) is parallel to the planes $x+y+z=1$ and $2x-y-2z=3$ then

$a(1)+b(1)+c(1)=0$ and $a(z)+b(-1)+c(-2)=0$

By cross multiplication

$\frac{a}{-1}=\frac{b}{4}=\frac{c}{-3}=\lambda$

$\Rightarrow a=-\lambda,\ b=4\lambda,\ c=-3\lambda$
$\Rightarrow$ Direction ratios of the line are
<–1, 4, –3> = <1, –4, 3>
Substituting a, b, c in (i), we get

$\frac{x-5}{-1}=\frac{y+6}{4}=\frac{z-7}{-3}$ ...(ii)

64. (a) From (ii) equation of the line is

$\frac{x-5}{-1}=\frac{y+6}{4}=\frac{z-7}{-3}$

65. (a) Since $\vec{c}$ is parallel to $\vec{a}$

$\vec{c}=\lambda\vec{a}$

Now $\vec{b}=\vec{c}+\vec{d}=\lambda\vec{a}+\vec{d}$

$=\lambda(\hat{i}+\hat{j})+x\hat{i}+y\hat{j}+z\hat{k}$

$3\hat{i}+4\hat{k}=(\lambda+x)\hat{i}+(\lambda+y)\hat{j}+z\hat{k}$

Comparing we get
$z=4,\ \lambda+y=0,\ \lambda+x=3 \Rightarrow -y+x=3$ (From (1))
$\Rightarrow \lambda=-y$ ...(1) $\Rightarrow x-y=3$ ...(2)

Now $\vec{d}$ is $\perp$r to $\vec{a}$
So, $\cos\theta=0$
$\Rightarrow x+y=0$ ...(3)
Solving (2) and (3) we get
$2x=3$

$\Rightarrow x=\frac{3}{2},\ y=-\frac{3}{2}$

$\Rightarrow \vec{c}=\lambda(\vec{a})=\frac{3}{2}(\hat{i}+\hat{j})$

66. (d) Since $z=4$ and $x=\frac{3}{2},\ y=-\frac{3}{2}$.

So, neither 1 nor 2 is correct.

67. (b) We have $\vec{a}+\vec{b}+\vec{c}=\vec{0}$

So $|\vec{a}+\vec{b}+\vec{c}|=0$

$\Rightarrow |\vec{a}+\vec{b}+\vec{c}|^2=|\vec{a}|^2+|\vec{b}|^2+|\vec{c}|^2+2(\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a})$

$\Rightarrow 0=(10)^2+(6)^2+(14)^2+2(\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a})$

$\Rightarrow 0=100+36+196+2(\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a})$

$\Rightarrow -\frac{332}{2}=\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}$

$\Rightarrow -166=\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}$

68. (c) Since $\vec{a}+\vec{b}+\vec{c}=0$

$\Rightarrow \vec{a}+\vec{b}=-\vec{c}$

$\Rightarrow |\vec{a}+\vec{b}|=|-\vec{c}|=|\vec{c}|$

$\Rightarrow |\vec{a}+\vec{b}|^2=|\vec{c}|^2$

$\Rightarrow |\vec{a}|^2+|\vec{b}|^2+2(\vec{a}\cdot\vec{b})=|\vec{c}|^2$

$\Rightarrow (10)^2+(6)^2+2(\vec{a}\cdot\vec{b})=(14)^2$

$\Rightarrow 2(\vec{a}\cdot\vec{b})=60$

$\Rightarrow \vec{a}\cdot\vec{b}=30$

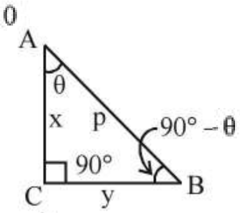
$\Rightarrow \cos\theta=\frac{\vec{a}\cdot\vec{b}}{|\vec{a}||\vec{b}|}=\frac{30}{10\times 6}=\frac{1}{2}$

$\Rightarrow \theta=\cos^{-1}\left(\frac{1}{2}\right) \Rightarrow \theta=60^\circ$

69. (b) $\overrightarrow{AB}\cdot\overrightarrow{AC}+\overrightarrow{BC}\cdot\overrightarrow{BA}+\overrightarrow{CA}\cdot\overrightarrow{CB}$
$=(AB\cdot AC\cdot\cos\theta)+(BC\cdot BA\cdot\cos(90-\theta))$
$+(CA\cdot CB\cdot\cos 90)$

$=(p\cdot x\cdot\cos\theta)+(y\cdot p\cdot\sin\theta)+0$

$=p[x\cos\theta+y\sin\theta]$



By projection formula :

$p=x\cos\theta+y\cos(90-\theta)$

$=x\cos\theta+y\sin\theta$

$\therefore\ p[x\cos\theta+y\sin\theta]=p\times p=p^2$.

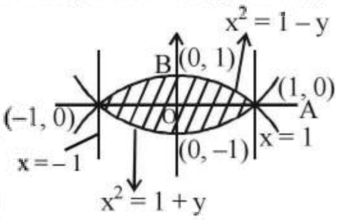
70. (c) Let point P is $(1, -1, 2)$
and point Q is $(2, -1, 3)$
$\Rightarrow$ Position vector of P w.r.t. Q is
$$\vec{r} = (1-2)\hat{i} + (-1+1)\hat{j} + (2-3)\hat{k}$$
$$\Rightarrow \vec{r} = -\hat{i} + 0\hat{j} - \hat{k} \text{ and } \vec{F} = 3\hat{i} + 2\hat{j} - 4\hat{k}$$
$$\Rightarrow \text{Moment} = \vec{r} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & 0 & -1 \\ 3 & 2 & -4 \end{vmatrix}$$
$$= \hat{i}(0+2) - \hat{j}(4+3) + \hat{k}(-2+0) = 2\hat{i} - 7\hat{j} - 2\hat{k}$$

71. (a) We know that
$$|x| = \begin{cases} x, & x \ge 0 \\ -x, & x < 0 \end{cases}$$
For domain, $|x| - x > 0$
Case 2: x Case 1: $x > 0 \Rightarrow x - x = 0$ (not possible)
$-x - x > 0$
$\Rightarrow -2x > 0$
$\Rightarrow x < 0$
So, $x \in (-\infty, 0)$

72. (d) For $x \ge 0$
$$\lim_{x\to1} f(x) = \lim_{x\to1} 2 + x = 2 + 1 = 3$$
For $x < 0$
$$\lim_{x\to1} f(x) = \lim_{x\to1} 2 - x = 2 - 1 = 1$$
So, $\lim_{x\to1} f(x)$ does not exist.
At $x = 0$
RHL: $\lim_{h\to0^+} f(0+h) = \lim_{h\to0} 2 + h = 2$
LHL $\lim_{h\to0^-} f(0-h) = \lim_{h\to0} 2 - h = 2$
$f(0) = 2 + 0 = 2.$
So, RHL = LHL = $f(0)$
$\Rightarrow f(x)$ is continuous at $x = 0$
Differentiability at $x = 0$
$$\text{LHD: } \lim_{h\to0^-} \frac{f(0-h) - f(0)}{-h} = \lim_{h\to0^-} \frac{2+h-2}{-h}$$
$$= \frac{-h}{h} = -1$$
$$\text{RHD: } \lim_{h\to0^+} \frac{f(0+h) - f(0)}{h} = \lim_{h\to0^+} \frac{2+h-2}{h} = 1$$
Since LHD $\ne$ RHD
So, $f(x)$ is not differentiable at $x = 0$.

73. (a) For $x \ge 0$
$$f(x) = \frac{x+x}{x} = 2$$
For $x < 0$
$$f(x) = \frac{x-x}{x} = 0$$
$$\lim_{x\to0^+} f(x) = 2$$
$$\lim_{x\to0^-} f(x) = 0$$
$f(0) = 2$
$\Rightarrow$ It is discontinuous at $x = 0$.
Option (a) is correct.

74. (c) $f(x) = x^3 \sin x$
$$f'(x) = 3x^2 \sin x + x^3 \cos x$$
$$f'(x) = 0$$
$$\Rightarrow 3x^2 \sin x + x^3 \cos x = 0$$
$$\Rightarrow x^2(3\sin x + x\cos x) = 0$$
$$\Rightarrow x = 0,\ 3\sin x + x\cos x = 0 \quad ...(1)$$
Put $x = 0$ in (1)
$3\sin x = 0 \Rightarrow \sin x = 0$
$$f''(x) = 6x\sin x + 3x^2\cos x + 3x^2\cos x + x^3(-\sin x)$$
$$f''(0) = 0$$
So, neither maximum nor min. at $x = 0$.

75. (b) Since $|y| = \begin{cases} y & y > 0 \\ -y & y < 0 \\ 0 & y = 0 \end{cases}$
For $y > 0 \Rightarrow y = 1 - x^2$
For $y < 0 \Rightarrow y = x^2 - 1$
For $y = 0 \Rightarrow x = \pm 1$
So area under the curve
= 4 × Area under the region OABO (symmetry)
$$= 4 \times \int_0^1 1 - x^2 dx$$
$$= 4 \times \left[x - \frac{x^3}{3}\right]_0^1$$


$$= 4\left(1 - \frac{1}{3}\right) = 4 \times \frac{2}{3} = \frac{8}{3} \text{ sq. units}$$

76. (c) For $-1 \le x \le 2$
$$f(x) = 3x^2 + 12x - 1$$
$$f'(x) = 6x + 12$$
If we take any point in the interval $[-1, 2]$ then
$$f'(1) = 6 \times 1 + 12 = 18 > 0$$
$\Rightarrow f(x)$ is increasing in the interval $[-1, 2]$.
For $2 < x \le 3$
$$f(x) = 37 - x$$
$$f'(x) = -1 < 0$$
$\Rightarrow f(x)$ is decreasing in the interval $(2, 3]$

77. (a) For continuity at $x = 2$.
RHL
$$\lim_{x\to2^+} f(x) = \lim_{x\to2^+} 37 - x = 37 - 2 = 3\sigma$$

LHL

$\lim_{x\to 2^-} f(x) = \lim_{x\to 2^-} 3x^2 + 12x - 1$

$= 3(2)^2 + 12 \times 2 - 1 = 12 + 24 - 1 = 35.$

$f(2) = 3 \times 4 + 12 \times 2 - 1 = 12 + 24 - 1 = 35$

So, RHL = LHL

$\Rightarrow f(x)$ is continuous at $x = 2$.

For differentiability at $x = 2$.

$$\text{LHD} = \lim_{x\to 2^-} \frac{f(x)-f(2)}{x-2} = \lim_{h\to 0} \frac{f(2-h)-f(2)}{2-h-2}$$

$$= \lim_{h\to 0} \frac{3(2-h)^2 + 12(2-h) - (12+24-1)}{-h}$$

$$= \lim_{h\to 0} \frac{3h^2 - 24h}{-h} = \lim_{h\to 0} 24 - 3h = 24$$

$$\text{RHD} = \lim_{x\to 2^+} \frac{f(x)-f(2)}{x-2} = \lim_{h\to 0} \frac{f(2+h)-f(2)}{2+h-2}$$

$$= \lim_{h\to 0} \frac{37-2-h-35}{h} = -1$$

LHD $\neq$ RHD

$\Rightarrow f(x)$ is not differentiable at $x = 2$.

To check 2.

For $x = 2$.

$f(x) = 3x^2 + 12x - 1$

$$= 3\left(x^2 + 4x - \frac{1}{3}\right) = 3\left((x+2)^2 - \frac{13}{3}\right)$$

On putting $x = 2$

$$f(x) = 3\left(16 - \frac{13}{3}\right) = 35$$

On putting $x = 1$

$$f(1) = 3\left((1+2)^2 - \frac{13}{3}\right) = 3\left(9 - \frac{13}{3}\right) = 14$$

So $f(x)$ attains greatest value at $x = 2$.

For (Qs. 78 to 80)

Given $f(x) = (|x| - |x+1|)^2$

$$f(x) = \begin{cases} 1 & x \le 0 \\ (2x-1)^2 & 0 < x < 1 \\ 1 & x \ge 1 \end{cases}$$

78. (a) When $x > 1$

$f(x) = 1$

$f'(x) = 0$

79. (d) When $0 < x < 1$

$f(x) = (2x-1)^2$

$f'(x) = 2(2x-1)\cdot 2 = 4(2x-1)$

$f'(x) = 8x - 4$

80. (a) For $x = -2$

$f(x) = 1$ so $f(-2) = 1$

For $x = 5$

$f(x) = 1 \Rightarrow f(5) = 1$

Hence $f(-2) = f(5)$

Now, for $x = -1$

$f''(x) = 0$

$f''(-2) = 0$

For $x = 0.5$

$f''(x) = 8 \Rightarrow f''(0.5) = 8$

For $x = 3$

$f''(x) = 0 \Rightarrow f''(3) = 0$

$\Rightarrow f''(-2) + f''(0.5) + f''(3) = 8 \neq 4$

Only statement 1 is correct.

81. (c) $f(x) = [x]$ and $g(x) = \sin x$

$\lim_{x\to 0^+} f(x) = [0+h] = 0$

$\lim_{x\to 0^-} f(x) = [0-h] = -1$

$f(0) = 0$

$\Rightarrow f(x)$ is not continuous at $x = 0$ and also $g(x)$ is continuous at $x = 0$. (every trignometric function is continuous).

82. (d) $(fog)(x) = [\sin x]$

$\lim_{x\to 0^+} (fog)(x) = \lim_{x\to 0^+} [\sin x] = [h]$ where $h > 0$

$\Rightarrow \lim_{x\to 0^+} (fog)(x) = 0$

$\lim_{x\to 0^-} (fog)(x) = \lim_{x\to 0^-} [\sin x] = [h]$ where $h < 0$

$\Rightarrow \lim_{x\to 0^-} (fog)(x) = -1$

$\Rightarrow \lim_{x\to 0} (fog)(x)$ does not exist.

Now, $(gof)(x) = \sin[x]$

$\lim_{x\to 0^+} (gof)(x) = \lim_{x\to 0^+} \sin[x] = \sin 0 = 0$

$\lim_{x\to 0^-} (gof)(x) = \lim_{x\to 0^-} \sin[x] = \sin(-1) = -0.01745$

$\Rightarrow \lim_{x\to 0} (gof)(x)$ does not exist.

$\Rightarrow \lim_{x\to 0^+} (fog)(x) = \lim_{x\to 0^+} (gof)(x)$

83. (d) $(fof)(x) = [[x]]$ and $f(x) = [x]$

Suppose $x = 0.2$

$\Rightarrow (fof)(x) = [[0.2]] = [0] = 0$

$f(x) = [0.2] = 0$

$\Rightarrow fof(x) = f(x)$

Now, $(gog)(x) = \sin\sin x$ and $g(x) = \sin x$

At $x = 0$

$(gog)(x) = \sin\sin 0 = \sin 0 = 0$

$g(x) = \sin 0 = 0$

$\Rightarrow (gog)(x) = g(x)$ at $x = 0$

$\because (fog)(x) = [\sin x]$

$(go(fog))(x) = \sin[\sin x]$

$\because \sin x$ has value from -1 to 1

If $-1 \le \sin x < 0$.

$(go(fog))(x) = \sin(-1) - \sin(-1)$

If $0 \le \sin x < 1$

$\therefore (go(fog))(x) = \sin(0) = \sin 0$ and

If $\sin x = 1$

$\therefore (go(fog))(x) = \sin(1) = \sin 1$

84. (a) $f(x) = \dfrac{e^x - 1}{x} > 0$

$\Rightarrow \quad f'(x) = \dfrac{x e^x - (e^x - 1)}{x^2} = \dfrac{(x+1) - e^x}{x^2}$

$= \left(\dfrac{1}{x} + \dfrac{1}{x^2}\right) - e^x$, which is a strictly decreasing function.

85. (b) For right hand continuity at $x = 0$

RHL $= \lim\limits_{x \to 0^+} f(x) = \lim\limits_{h \to 0} f(0+h)$

$$= \lim_{h \to 0} \frac{e^h - 1}{h} = \lim_{h \to 0} \frac{\left(1 + h + \frac{h^2}{2!} + \ldots\right) - 1}{h}$$

$$= \lim_{h \to 0} \frac{h + \frac{h^2}{2!} + \frac{h^3}{3!} + \ldots}{h}$$

$$= \lim_{h \to 0} 1 + \frac{h}{2!} + \frac{h^2}{3!} + \ldots = 1$$

$f(0) = 0$

$\Rightarrow f(x)$ is not right continuous at $x = 0$.

For discontinuity at $x = 1$

RHL $= \lim\limits_{x \to 1^+} f(x) = \lim\limits_{h \to 0} f(1+h)$

$$= \lim_{h \to 0} \frac{e^{1+h} - 1}{1+h}$$

$$= \lim_{h \to 0} \frac{\left(1 + (1+h) + \frac{(1+h)^2}{2} + \ldots\right) - 1}{1+h}$$

$$= \lim_{h \to 0} \frac{(1+h) + \frac{(1+h)^2}{2!} + \frac{(1+h)^3}{3!} + \ldots}{(1+h)}$$

$$= \lim_{h \to 0} 1 + \frac{(1+h)}{2!} + \frac{(1+h)^2}{3!} + \ldots$$

$$= 1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \ldots$$

LHL $= \lim\limits_{x \to 1^-} f(x) = \lim\limits_{h \to 0} f(1-h)$

$$= \lim_{h \to 0} \frac{e^{(1-h)} - 1}{1-h}$$

$$= \lim_{h \to 0} \frac{\left(1 + (1-h) + \frac{(1-h)^2}{2!} + \ldots\right) - 1}{(1-h)}$$

$$= \lim_{h \to 0} 1 + \frac{(1-h)}{2!} + \frac{(1-h)^2}{3!} + \ldots$$

$$= 1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \ldots$$

$$f(1) = \frac{e^1 - 1}{1} = \left(1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \ldots\right) - 1$$

$$= \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \ldots$$

$\Rightarrow$ RHL $\ne f(1)$, LHL $\ne f(1)$

So f is discontinuous.

86. (b) Parabola Eq : $y = x^2 + 7x + 2$

Line eq. : $y = 3x - 3$

Since all the points given in the options lie on the parabola.

Thus we will calculate the distance from the given line to these points :

for $(0, 2)$: distance $= \dfrac{|3(0) - (2) - 3|}{\sqrt{(3)^2 + (-1)^2}} = \dfrac{5}{\sqrt{10}}$

for $(-2, -8)$: distance $= \dfrac{|3(-2) - (-8) - 3|}{\sqrt{10}} = \dfrac{1}{\sqrt{10}}$

for $(-7, 2)$: distance $= \dfrac{|3(-7) - 2 - 3|}{\sqrt{10}} = \dfrac{26}{\sqrt{10}}$

for $(1, 10)$: distance $= \dfrac{|3(1) - 10 - 3|}{\sqrt{10}} = \dfrac{10}{\sqrt{10}}$

$\therefore (-2, -8)$ is the given point.

87. (c)

88. (a) $f(x) = \begin{cases} -2, & -3 \le x \le 0 \\ x - 2, & 0 < x \le 3 \end{cases}$ and

$g(x) = f(|x|) + |f(x)|$

At $x = 0$

For LHD : $g(x) = -2 + |-2| = -2 + 2 = 0 \Rightarrow g(x) = 0$

LHD $= \lim\limits_{x \to 0^-} \dfrac{g(x) - g(0)}{x - 0} = \lim\limits_{h \to 0} \dfrac{g(-h) - g(0)}{-h}$

$= \lim\limits_{h \to 0} \dfrac{0 - 0}{-h} = \lim\limits_{h \to 0} 0$

LHD $= 0$

For RHD : $g(x) = |x| - 2 + |x - 2|$

$g(x) = x - 2 - (x - 2) \qquad x > 0$ (and just greater than zero)

$g(x) = x - 2 - x + 2 = 0$

$\Rightarrow$ RHD $= \lim\limits_{x \to 0^+} \dfrac{g(x) - g(0)}{x - 0} = \lim\limits_{h \to 0} \dfrac{g(h) - g(0)}{h}$

$= \lim\limits_{h \to 0} 0 = 0$

$\Rightarrow$ LHD = RHD $\Rightarrow$ so $g(x)$ is differentiable at $x=0$.
At $x=2$
For LHD :

$$g(x)=|x|-2+|x-2|=x-2-(x-2)$$
$$=x-2-x+2=0$$

$$\therefore \text{LHD} = \lim_{x\to 2^-}\frac{g(x)-g(2)}{x-2}=\lim_{x\to 2}\frac{0}{x-2}=0$$

For RHD :

$$g(x)=|x|-2+|x-2|=x-2+x-2=2x-4$$

$$\Rightarrow \text{RHD} = \lim_{x\to 2^+}\frac{g(x)-g(2)}{x-2}=\lim_{x\to 2}\frac{2x-4-2(2)+4}{x-2}$$

$$=\lim_{x\to 2}\frac{2(x-2)}{x-2}=2$$

$\Rightarrow$ LHD $\neq$ RHD
Thus $g(x)$ is not differentiable at $x=2$.

89. (b) For $x=-2$
$g(x)=-2+|-2|=-2+2$
$\Rightarrow g(x)=0$
$\Rightarrow$ differential coefficient at $x=-2$ is given as :

$$g'(x)=\lim_{h\to 0}\frac{g(x+h)-g(x)}{h}=\lim_{h\to 0}\frac{0-0}{4}=0.$$

90. (d) At $x=0$

For LHL : $g(x)=-2+|-2|=0$

For RHL : $g(x)=|x|-2+|x-2|$

$g(x)=x-2-(x-2)=0$

$g(x)=0$

For $(x=0)$: $g(x)=-2+|-2|=0$

$$\text{LHL} = \lim_{x\to 0^-} g(x)=0$$

$$\text{RHL} = \lim_{x\to 0^+} g(x)=0$$

$g(0)=0$
$\Rightarrow g(x)$ is continuous at $x=0$
At $x=2$

For LHL : $g(x)=|x|-2+|x-2|$

$g(x)=x-2-(x-2)$

$g(x)=0$

For RHL : $g(x)=|x|-2+|x-2|$

$g(x)=x-2+x-2$

$2(x)=2x-4$

For $(x=2)$: $g(x)=|x|-2+|x-2|$

$$\text{LHL} = \lim_{x\to 2^-} g(x)=0$$

$$\text{RHL} = \lim_{x\to 2^+} g(x)=\lim_{x\to 2} 2x-4=2(2)-4=0$$

$g(2)=|2|-2+|2-2|$
$g(2)=2-2+2-2=0$
$\Rightarrow g(x)$ is continuous at $x=2$.
At $x=-1$

For LHL : $g(x)=-2+|-2|=0$

For RHL : $g(x)=-2+|-2|=0$

For $(x=-1)$: $g(x)=-2+|-2|=0$

$$\therefore \text{LHL} = \lim_{x\to -1^-} g(x)=0$$

$$\text{RHL} = \lim_{x\to -1^+} g(x)=0$$

$g(-1)=0$
$\Rightarrow g(x)$ is differentiable at $x=-1$.

91. (a)

92. (c) Take option (a)

$$I_1=\sqrt{\frac{x^4+x^3+1}{x}}+C$$

$$\frac{dI_1}{dx}=\frac{d}{dx}\left[(x^3+x^2+x^{-1})^{1/2}+C\right]$$

$$\frac{dI_2}{dx}=\frac{1}{2}(x^4+x^2+x^{-1})^{-1/2}(4x^3+2x-x^{-2})$$

$$=\frac{1}{2}\left[\frac{4x^3+2x-\frac{1}{x^2}}{\sqrt{x^3+x^2+\frac{1}{x}}}\right]$$

$$\frac{dI_2}{dx}=\frac{1}{2}\left[\frac{4x^5+2x^3-1}{\frac{x}{\sqrt{x}}\sqrt{x^4+x^3+1}}\right]$$

Take option (b) :

$$I_2=\sqrt{x^4+2-\frac{1}{x^2}}+C$$

$$\frac{dI_2}{dx}=\frac{1}{2}[x^4+2-x^{-2}]^{-1/2}[4x^3+0+2x^{-3}]$$

$$=\frac{1}{2}\left[\frac{4x^3+\frac{2}{x^3}}{\sqrt{x^4+2-\frac{1}{x^2}}}\right]=\frac{2x^6+1}{\frac{x^3}{x^2}\sqrt{x^6+2x^2+1}}$$

$$\frac{dI_2}{dx}=\frac{2x^6+1}{x\sqrt{x^6+2x+1}}$$

Take option (c) :

$$I_3=\sqrt{x^2+x^{-2}+1}+C$$

$$\frac{dI_3}{dx}=\frac{1}{2}[x^2+x^{-2}+1]^{-1/2}[2x-2x^{-3}+0]$$

$$=\frac{1}{2}\left[\frac{2x-\frac{2}{x^3}}{\sqrt{x^2+\frac{1}{x^2}+1}}\right]=\frac{1}{2}\left[\frac{2(x^4-1)}{x^3\sqrt{\frac{x^4+1+x^2}{x^2}}}\right]$$

$$\frac{dI_3}{dx}=\frac{x^4-1}{x^2\sqrt{x^4+x^2+1}}$$

$\therefore$ Option (c) is correct answer.

93. (a) $e^{y\sqrt{1-x^2}+x\sqrt{1-y^2}-x}=c$

$\Rightarrow \quad y\sqrt{1-x^2}+x\sqrt{1-y^2}-x=\log c$

$$\Rightarrow \quad \frac{dy}{dx}\sqrt{1-x^2}+y.\frac{1}{\cancel{2}\sqrt{1-x^2}}(-\cancel{2}x)+\sqrt{1-y^2}$$

$$+x.\frac{1}{\cancel{2}\sqrt{1-y^2}}(-\cancel{2}y).\frac{dy}{dx}-1=0$$

$$\Rightarrow \quad \frac{dy}{dx}\sqrt{1-x^2}-\frac{xy}{\sqrt{1-x^2}}+\sqrt{1-y^2}-\frac{xy}{\sqrt{1-y^2}}.\frac{dy}{dx}=1$$

Degree $=1$, order $=1$

94. (b) $\frac{dy}{dx}=\frac{2y}{x}$

$\Rightarrow x\frac{dy}{y}=2\frac{dx}{x}$

On integration

$\int\frac{dy}{y}=2\int\frac{dx}{x}$

$\Rightarrow \log y=2\log x+\log a$

$\Rightarrow \log y=\log x^2+\log a$

$\Rightarrow \log y=\log(x^2\cdot a)$

$\Rightarrow y=x^2a$

at $(1, 1)$; $a=1$

$\Rightarrow x^2=y=4\left(\frac{1}{4}\right)y$

$\Rightarrow$ the curve is parabola.

95. (a) Given, $xdy=ydx+y^2dy$

$\Rightarrow 1=\frac{4}{x}\frac{dx}{dy}+\frac{y^2}{x}$

$\Rightarrow \frac{dx}{dy}+y=\frac{x}{y}$

$\Rightarrow \frac{dx}{dy}-\frac{x}{y}=-y \qquad ...(1)$

$P=-\frac{1}{y}, Q=-y$

$\text{IF}=e^{\int Pdy}=e^{\int -\frac{1}{y}dy}=e^{-\log y}=\frac{1}{y}$

Multiplying Eqn. (1) by IF

$\Rightarrow \frac{1}{y}\frac{dx}{dy}-\frac{x}{y^2}=-1$

$\frac{x}{y}=\int\frac{1}{y}(-y)dy+C$

$\Rightarrow \frac{x}{y}=\int -1\,dy+C$

$\Rightarrow \frac{x}{y}=-y+C$

$y(1)=1$

$\frac{1}{1}=-1+C\Rightarrow C=2$

$\Rightarrow \frac{x}{y}=-y+2\Rightarrow x=-y^2+2y$

$\Rightarrow y(-3)\Rightarrow -3=-y^2+2y$

$\Rightarrow y^2-2y-3=0$

$\Rightarrow y=\frac{+2\pm\sqrt{4+12}}{2}=\frac{2\pm 4}{2}$

$\Rightarrow y=3,-1$

Since $y>0$ so $y=3$.

96. (b) $\frac{dx}{dy}+\int y\cdot dx=x^3\Rightarrow\int y\cdot dx=x^3-\frac{dx}{dy}$

$\Rightarrow 1+\frac{dy}{dx}\left(\int y\cdot dx\right)=x^3\cdot\frac{dy}{dx}$

Differentiate both sides w.e.t. x

$$\Rightarrow 0+\frac{dy}{dx}(y)+\left(\int y\cdot dx\right)\left(\frac{d^2y}{dx^2}\right)=x^3\cdot\frac{d^2y}{dx^2}+\frac{dy}{dx}(2x^2)$$

$$\Rightarrow y\cdot\frac{dy}{dx}+\frac{d^2y}{dx^2}\left[x^3-\frac{dx}{dy}\right]=x^3\cdot\frac{d^2y}{dx^2}+2x^2\frac{dy}{dx}$$

$$\Rightarrow y\frac{dy}{dx}+x^3\frac{d^2y}{dx^2}-\left(\frac{dx}{dy}\right)\left(\frac{d^2y}{dx^2}\right)=x^3\frac{d^2y}{dx^2}+2x^2\frac{dy}{dx}$$

$$\Rightarrow y\frac{dy}{dx}-\frac{dx}{dy}\cdot\frac{d^2y}{dx^2}=2x^2\bullet\frac{dy}{dx}$$

Multiplying both side by $\frac{dy}{dx}$

$$y\left(\frac{dy}{dx}\right)^2-\frac{d^2y}{dx^2}=2x^2\left(\frac{dy}{dx}\right)^2$$

$$\Rightarrow\frac{d^2y}{dx^2}+(2x^2-y)\left(\frac{dy}{dx}\right)^2=0$$

Order $=2$, degree $=1$.

97. (c) $y=mx+c$ (Equation of straight line)

$\frac{dy}{dx}=m$ and $mx-y+c=0$ is at unit distance from origin.

$\therefore\frac{|m(0)-(0)+c|}{\sqrt{m^2+(-1)^2}}=1\Rightarrow c=\sqrt{1+m^2}$

Now:

$$\left[y-x\frac{dy}{dx}\right]^2=[mx+c-xm]^2=c^2=1+m^2$$

also,

$$\left[y+x\frac{dy}{dx}\right]^2=[mx+c+mx]^2=[2mx+\sqrt{1+m^2}]^2$$

also, $1-\left(\frac{dy}{dx}\right)^2=1-m^2$ and $1+\left(\frac{dy}{dx}\right)^2=1+m^2$

$$\Rightarrow\left[y-x\frac{dy}{dx}\right]^2=1+\left(\frac{dy}{dx}\right)^2$$

98. (b) Let us differentiate all the options one by one to get the expression in the question whose integral is to be found.

Here $xe^{\sin x}$ is the common term in all the options. So, let us differentiate it first.

Let $I=xe^{\sin x}$

$$\Rightarrow\frac{dI}{dx}=e^{\sin x}[x\cos x+1]$$

$$\Rightarrow\frac{dI}{dx}=\frac{e^{\sin x}}{\cos^2 x}[x\cos^3 x+\cos^2 x]$$

Let $m=\sec xe^{\sin x}$

$$\Rightarrow\frac{dm}{dx}=\sec xe^{\sin x}\cdot\cos x+e^{\sin x}\sec x\tan x$$

$$\Rightarrow\frac{dm}{dx}=e^{\sin x}\left[1+\frac{\sin x}{\cos^2 x}\right]$$

$$\Rightarrow\frac{dm}{dx}=\frac{e^{\sin x}}{\cos^2 x}[\cos^2 x+\sin x]$$

Differentiation of option (a) is

$$=\frac{e^{\sin x}}{\cos^2 x}[x\cos^3 x+\cos^2 x+\cos^2 x+\sin x]$$

$$=\frac{e^{\sin x}}{\cos^2 x}[x\cos^3 x+2\cos^2 x+\sin x]$$

Differentiation of option (b) is

$$=\frac{e^{\sin x}}{\cos^2 x}[x\cos^3 x+\cos^2 x-\cos^2 x-\sin x]$$

$$=\frac{e^{\sin x}}{\cos^2 x}[x\cos^3 x-\sin x]$$

$\therefore$ Option (b) is correct.

99. (b) $I=\int_0^{\pi/2}\frac{dx}{3\cos x+5}$

$$I=\int_0^{\pi/2}\frac{dx}{3\left[\frac{1-\tan^2\frac{x}{2}}{1+\tan^2\frac{x}{2}}\right]+5}$$

$$I=\int_0^{\pi/2}\frac{\left(1+\tan^2\frac{x}{2}\right)dx}{3-3\tan^2\frac{x}{2}+5+5\tan^2\frac{x}{2}}$$

$$I=\int_0^{\pi/2}\frac{\sec^2\frac{x}{2}dx}{2\tan^2\frac{x}{2}+8}$$

$$I=\frac{1}{2}\int_0^{\pi/2}\frac{\sec^2\frac{x}{2}dx}{\tan^2\frac{x}{2}+2^2}$$

Put $\tan\frac{x}{2}=y$

$$\Rightarrow\frac{1}{2}\sec^2\frac{x}{2}dx=dy$$

$$\Rightarrow I=\int_0^1\frac{dy}{y^2+2^2}$$

$$\Rightarrow I=\frac{1}{2}\tan^{-1}\left(\frac{y}{2}\right)$$

$$\Rightarrow I=\frac{1}{2}\tan^{-1}\left(\frac{1}{2}\right)-0$$

Also $I=\frac{1}{2}\tan^{-1}\frac{1}{2}=k\cot^{-1}(2)$

$$\left(\because\tan^{-1}(x)=\cot^{-1}\left(\frac{1}{x}\right)\right)$$

$$\Rightarrow\frac{1}{2}\tan^{-1}\left(\frac{1}{2}\right)=k\tan^{-1}\left(\frac{1}{2}\right)$$

$$\therefore k=\frac{1}{2}$$

100. (d) $I=\int_1^3|1-x^4|\,dx$

$$I=\int_1^3-(1-x^4)dx\qquad\left(\because|x|=\begin{cases}x, & x\ge 0\\ -x, & x<0\end{cases}\right)$$

$$I=\int_1^3(x^4-1)dx\Rightarrow I=\left[\frac{x^5}{5}-x\right]_1^3$$

$$I=\left(\frac{3^5}{5}-3\right)-\left(\frac{1^5}{5}-1\right)\Rightarrow I=\frac{232}{5}$$

101. (d) Total no. of elementary events $=6^3$.

Favourable no. of elementary events

$=$ coefficient of x^0 in $[x+x^{-1}+x^0+x^{-2}+x^2+x^3]^3$

$$= \text{coeff. of } x^0 \text{ in } \left[\frac{1+x+x^2+x^3+x^4+x^5}{x^2}\right]^3$$

$$= \text{coeff. of } x^6 \text{ in } [1+x+x^2+x^3+x^4+x^5]^3$$

$$= \text{coeff. of } x^6 \text{ in } \left[\frac{1-x^6}{1-x}\right]^3$$

$$= \text{coeff. of } x^6 \text{ in } [1-x^6]^3[1-x]$$

$$= \text{coeff. of } x^6 \text{ in } [1-{}^3C_1x^6+\ldots][1-x]^{-3}$$

$$= \text{coeff. of } x^6 \text{ in } (1-x)^{-3}\cdot{}^3C_1 \text{ coeff. of } x^0 \text{ in } (1-x)^{-3}$$

$$= {}^{6+3-1}C_{3-1} - {}^3C_1$$

$$= {}^8C_2 - {}^3C_1 = \frac{8!}{6!2!} - \frac{3!}{2!}$$

$$= \frac{8\times 7}{2} - 3 = 25.$$

Required probability $= \dfrac{25}{216}$

102. (d) The probability of rain in one day

$$= \frac{25}{100} = \frac{1}{4}$$

Probability of getting at least one rainy day within a period of 7 days

$$= 1 - \left[1-\frac{1}{4}\right]^7 = 1 - \left[\frac{3}{4}\right]^7$$

103. (b) $P(A) = \dfrac{70}{100} = \dfrac{7}{10} = P(B)$

A and B are independent.

$\Rightarrow P(A \cap B) = P(A)P(B)$

$\Rightarrow P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$$= \frac{7}{10} + \frac{7}{10} - \frac{7}{10}\times\frac{7}{10} = 0.91$$

104. (a) $\dfrac{1}{2} = \mathrm{m}\times\mathrm{n}\times\dfrac{1}{2} + \mathrm{m}\times\mathrm{n}\times(1-\mathrm{n}) + \mathrm{m}\times\mathrm{n}\times\dfrac{1}{2}$

$\Rightarrow \quad 1 = \mathrm{m}(\mathrm{n}+1)$

105. (a) Odd in fav. for student $(A) = \dfrac{2}{5} = \dfrac{P(A)}{P(A')}$

Odd in fav. for student $(B) = \dfrac{4}{3} = \dfrac{P(B)}{P(B')}$

Odd in fav. for student $(C) = \dfrac{3}{4} = \dfrac{P(C)}{P(C')}$

$$\Rightarrow \quad P(A') = \frac{2}{5}P(A),\ P(B') = \frac{3}{4}P(B),\ P(C') = \frac{4}{3}P(C)$$

Now $P(A) + P(A') = 1 \Rightarrow P(A) + \dfrac{2}{5}P(A) = 1 \Rightarrow P(A) = \dfrac{5}{7}$

Also $P(B) + P(B') = 1 \Rightarrow P(B) + \dfrac{3}{4}P(B) = 1 \Rightarrow P(B) = \dfrac{4}{7}$

And $P(C) + P(C') = 1 \Rightarrow P(C) + \dfrac{4}{3}P(C) = 1 \Rightarrow P(C) = \dfrac{3}{7}$

$\therefore \quad P(A') = \dfrac{2}{5}\times\dfrac{5}{7} = \dfrac{2}{7}, \qquad P(B') = \dfrac{3}{4}\times\dfrac{4}{7} = \dfrac{3}{7},$

$P(C') = \dfrac{4}{3}\times\dfrac{3}{7} = \dfrac{4}{7}$

Req. Prob. $= P(A)\times P(B)\times P(C') + P(A)\times P(B')\times P(C')$
$\quad + P(A')\times P(B)\times P(C) + P(A)\times P(B)\times P(C)$

$$= \frac{5}{7}\times\frac{4}{7}\times\frac{4}{7} + \frac{5}{7}\times\frac{3}{7}\times\frac{3}{7} + \frac{2}{7}\times\frac{4}{7}\times\frac{3}{7} + \frac{5}{7}\times\frac{4}{7}\times\frac{3}{7}$$

$$= \frac{209}{343}$$

106. (d) Mean = Median (in symmetric distribution)
Range = (Max. value – Min. value)
And sum of areas of rectangles in the histogram is always equal to the total area bounded by frequency polygon and the horizontal axis.

107. (d) Mean of the scores $= \dfrac{202}{15}$

Mean of the correct scores $= \dfrac{200}{15}$

i.e., Mean changes.
Median is same for both cases i.e., 14.
Mode is proportional to mean.

108. (b) Line of regression of y on x is :

$$y - \bar{y} = b_{yx}(x - \bar{x})$$

$$\bar{y} = \frac{\Sigma y}{n};\ \bar{x} = \frac{\Sigma x}{n} \Rightarrow \bar{y} = \frac{220}{10} = 22;\ \bar{x} = \frac{130}{10} = 13$$

$$b_{yx} = \mathrm{r}\cdot\frac{\sigma_y}{\sigma_x}$$

$$\mathrm{r} = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

$$= \frac{10(3467) - (130)(220)}{\sqrt{[(10\times 2288) - 130^2][(10\times 5506) - (220^2)]}}$$

r = 0.962

$$\sigma_y = \sqrt{\frac{\Sigma y^2}{n} - \left(\frac{\Sigma y}{n}\right)^2} \Rightarrow \sigma_y = 8.2;\ \sigma_x = 7.73.$$

$$\Rightarrow b_{xy} = 0.962\times\frac{8.2}{7.73} = 1.02$$

$\Rightarrow$ Line of regression of y on x is :
$y - 22 = 1.02\,(x - 13)$
$\Rightarrow y = 1.02x + 8.74$

109. (d) For Group A :
Coefficient of variation

$$CV_A = \frac{\text{S.D.}}{\text{Mean}} = \frac{10}{22} = 0.4545.$$

For Group B :

$$CV_B = \frac{12}{23} = 0.522$$

$\Rightarrow$ Group A is less variable.

110. (b)

111. (c) Probabilty of medicine to cure a patient $= \frac{75}{100} = \frac{3}{4}$

Probability of curing at least one patient

$$= 1 - \left[1 - \frac{3}{4}\right]^5 = 1 - \left(\frac{1}{4}\right)^5 = 1 - \frac{1}{1024} = \frac{1023}{1024}$$

112. (a) $P(A) = \frac{3}{5}$; $P(B) = \frac{3}{10}$

$$\Rightarrow P(\overline{B}) = 1 - P(B) = \frac{7}{10}$$

$$P\left(\frac{A}{B}\right) = \frac{2}{3}$$

$$\Rightarrow P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)} = \frac{2}{3}$$

$$\Rightarrow P(A \cap B) = \frac{2}{3} \times \frac{3}{10} = \frac{1}{5}$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$\Rightarrow P(A \cup B) = \frac{3}{5} + \frac{3}{10} - \frac{1}{5} = \frac{7}{10}$$

$$\Rightarrow P(\overline{A \cup B}) = 1 - \frac{7}{10} = \frac{3}{10}$$

$$\Rightarrow P(\overline{A} \cap \overline{B}) = P(\overline{A \cup B}) = \frac{3}{10}$$

$$\Rightarrow P\left(\frac{\overline{A}}{\overline{B}}\right) = \frac{P(\overline{A} \cap \overline{B})}{P(\overline{B})} = \frac{\frac{3}{10}}{\frac{7}{10}} = \frac{3}{10} \times \frac{10}{7}$$

$$\Rightarrow P\left(\frac{\overline{A}}{\overline{B}}\right) = \frac{3}{7}.$$

113. (c) Probability that machine stops working

$$= P(A \cup B \cup C)$$

$$\Rightarrow P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C)$$

$$\Rightarrow P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A)P(B) - P(A)P(C) - P(B)P(C) + P(A)P(B)P(C)$$

($\because$ A, B & C are independent events)

$$\Rightarrow P(A \cup B \cup C) = 0.02 + 0.1 + 0.05 - (0.02 \times 0.1) - (0.02 \times 0.05) - (0.1 \times 0.05) + (0.02 \times 0.05 \times 0.1)$$

$$\Rightarrow P(A \cup B \cup C) = 0.16$$

$\therefore$ Probability that the machine will not stop working

$$= 1 - P(A \cup B \cup C) = 1 - 0.16 = 0.84$$

114. (c) $P(A_1) = \frac{1}{1+1} = \frac{1}{2}$

$$P(A_2) = \frac{1}{3}$$

$$P(A_3) = \frac{1}{4}$$

$\therefore$ Probability that at least one of these events occur is $P(A_1 \cup A_2 \cup A_3)$. Also A_1, A_2 & A_3 are independent events.

$$P(A_1 \cup A_2 \cup A_3) = P(A_1) + P(A_2) + P(A_3) - P(A_1 \cap A_2) - P(A_1 \cap A_3) - P(A_2 \cap A_3) + P(A_1 \cap A_2 \cap A_3)$$

$$= \frac{1}{2} + \frac{1}{3} + \frac{1}{4} - \left(\frac{1}{2} \times \frac{1}{3}\right) - \left(\frac{1}{2} \times \frac{1}{4}\right) - \left(\frac{1}{3} \times \frac{1}{4}\right) + \left(\frac{1}{2} \times \frac{1}{3} \times \frac{1}{4}\right)$$

$$= \frac{3}{4}.$$

115. (c) Let $u = (x+y)$; $v = (x-y)$

$$\therefore \overline{u} = (\overline{x} + \overline{y}); \ \overline{v} = (\overline{x} - \overline{y})$$

$$\text{cov}(u, v) = E\{(u - \overline{u})(v - \overline{v})\}$$

$$= E\{(x - \overline{x}) + (y - \overline{y})\} \cdot \{(x - \overline{x}) - (y - \overline{y})\}$$

$$= E\{(x - \overline{x})^2 - (y - \overline{y})^2\} = \sigma_x^2 - \sigma_y^2$$

$$\text{var}(u) = E(u - \overline{u})^2 = E\{(x - \overline{x}) + (y - \overline{y})\}^2 = \sigma_x^2 + \sigma_y^2$$

Therefore x and y are uncorrelated.

$$E(x - \overline{x})(y - \overline{y}) = 0$$

Similarly, $\text{var}(v) = \sigma_x^2 + \sigma_y^2$

Thus, $r(u, v) = \frac{\text{cov}(u, v)}{\sqrt{\text{var}(u) \cdot \text{var}(v)}} = \frac{\sigma_x^2 - \sigma_y^2}{\sigma_x^2 + \sigma_y^2}$

116. (b)

Age	Mid value x_i	Frequency f_i	$f_i x_i$
15 – 25	20	2	40
25 – 35	30	4	120
35 – 45	40	5	240
45 – 55	50	6	250
55 – 65	60	3	180
		$\Sigma f_i = 20$	$\Sigma x_i f_i = 836$

$$\Rightarrow \text{Mean age} = \frac{\Sigma x_i f_i}{\Sigma f_i} = \frac{836}{20} = 41.5$$

117. (b) $\text{cov}(x, y) = 30$

$\text{var}(x) = 25;\ \text{var}(y) = 144$

$$\Rightarrow r(x, y) = \frac{\text{cov}(x, y)}{\sqrt{\text{var}(x) \cdot \text{var}(y)}}$$

$$\Rightarrow r(x, y) = \frac{30}{\sqrt{25 \times 144}} = \frac{30}{5 \times 12} = 0.5$$

118. (d) $U = \{(HHH)(HHT)(HTH)(HTT)(THH)(THT)(TTH)(TTT)\}$

$A = \{(TTT)\}$

$B = \{(HTT)(THT)(TTH)\}$

$C = \{(HHH)(HHT)(HTH)(THH)\}$

By checking the options

(d) $A \cap (B' \cup C') = B' \cap C'$ is correct.

119. (d) Req. Prob. = P(5 points) = P(two wins and one draw)

= P(WWD) + P(WDW) + P(DWW)

$$= \frac{1}{3} \times \frac{1}{3} \times \frac{1}{6} + \frac{1}{3} \times \frac{1}{6} \times \frac{1}{3} + \frac{1}{6} \times \frac{1}{3} \times \frac{1}{3}$$

$$= \frac{1}{18}$$

120. (c) X follows $B(6, p) = 16P(x = 4) = P(x = 2)$

$$\Rightarrow 16\ {}^6C_4 \cdot p^4 (1-p)^{6-4} = {}^6C_2 \cdot p^2 (1-p)^{6-2}$$

$$\Rightarrow 16 \times \frac{6!}{4!\,2!} p^4 (1-p)^2 = \frac{6!}{2!\,4!} p^2 (1-p)^4$$

$$\Rightarrow 16p^2 = (1-p)^2 \Rightarrow 16p^2 = 1 + p^2 - 2p$$

$$\Rightarrow 15p^2 + 2p - 1 = 0 \Rightarrow 15p^2 + 5p - 3p - 1 = 0$$

$$\Rightarrow p = \frac{1}{5}, -\frac{1}{3}$$

GENERAL ABILITY

PART-A: ENGLISH

1.	(b)	**2.**	(a)	**3.**	(a)	**4.**	(c)	**5.**	(a)
6.	(d)	**7.**	(c)	**8.**	(b)	**9.**	(b)	**10.**	(a)

11. (b) Hospitality here refers to the friendly and generous reception and entertainment of guests, visitors, or strangers.

12. (a) Astronomical here refers to enormously or inconceivably large or great. Exorbitant means exceeding the bounds of custom, propriety, or reason, especially in amount or extent. Therefore, exorbitant is the synonym of astronomical.

13. (b) Appropriate means suitable or proper in the circumstances.

14. (c) Enamoured means impressed with or enthusiastic about something.

15. (c) Yellow journalism is a type of journalism that presents little or no legitimate well-researched news and instead uses eye-catching headlines to sell more newspapers. Techniques may include exaggerations of news events, scandal-mongering or sensationalism.

16. (a) Sentence here refers to declare the punishment decided for (an offender) whereas acquitted means free (someone) from a criminal charge by a verdict of not guilty. Therefore, acquitted is the antonym of sentenced.

17. (d) Thrifty means using money and other resources carefully and not wastefully whereas extravagant means lacking restraint in spending money or using resources. Therefore, extravagant is the antonym of thrifty.

18. (d) Immature means lacking the expected type of responsible behaviour for one's age whereas seasoned means having a lot of experience of doing something and therefore knowing how to do it well. Therefore, seasoned is the antonym of immature.

19. (c) 'To show my hand' here refers to allow people to know about intentions that you had previously kept secret. Therefore, 'to conceal my plan' is its most opposite in meaning.

20. (d) Sagacious means having or showing keen mental discernment and good judgement. Therefore, unwise is the antonym of sagacious.

21. (c) Pull through refers to get through an illness or other dangerous or difficult situation.

22. (a)

23. (b) Contempt means a strong feeling of disliking and having no respect for someone or something.

24. (d) Amicable means relating to behaviour between people that is pleasant and friendly, often despite a difficult situation.

25. (b) Falling out is defined as a disagreement or something that causes two people to no longer be friendly with one another.

26. (a) Tedious means tiresome because of length or dullness.

27. (c) Negligence means failure to exercise the care that a reasonably prudent person would exercise in like circumstances.

28. (c) Efficacy means the power to produce a desired result or effect.

29. (d) Dynamic here refers to a person positive in attitude and full of energy and new ideas.

30.	(c)	**31.**	(d)	**32.**	(b)	**33.**	(c)	**34.**	(d)
35.	(d)	**36.**	(c)	**37.**	(b)	**38.**	(a)	**39.**	(b)
40.	(b)	**41.**	(a)	**42.**	(a)	**43.**	(d)	**44.**	(d)
45.	(a)	**46.**	(c)	**47.**	(d)	**48.**	(c)	**49.**	(d)
50.	(d)								

PART-B : GENERAL KNOWLEDGE

51.	(d)	**52.**	(b)	**53.**	(a)	**54.**	(a)	**55.**	(a)
56.	(a)	**57.**	(a)						

58. (c) Amaravati river is the longest tributary of Kaveri river.

59. (a) Chile hae mediterranean type of Climate.

60. (b) **61.** (c)

62. (a) Heating Camphor-Sublimation

Cooling of water vapor up to room temperature-condensation

Cooking an egg-Chemical change

Formation of water vapor at room temperature-Evaporation

63. (d) Radon belongs to the noble gas family so it has zero valancy.

64. (a) Atomic number of any element is same as electron number or proton number.

65. (b) 48 gram of O_2 × (1 mole of O_2 ÷ 32 gm of O_2) × (6.022 × 10^{23} molecules O_2 ÷ 1 mole of O_2) = 9.033 × 10^{23} molecules of O_2

66. (b)

67. (c) In case of xerophytic plants leaves are reduced to spines and stem does the process of photosynthesis.

68. (b)

69. (b) Malarial parasite is plasmodium which is a protozoan.

70. (d) Biodiversity hot spot region.

71. (c)

72. (c) As the light enters from rarer medium to the denser medium the speed of light decreases but the frequency remains the same.

73. (c)

74. (b) One kilowatt hour is 3600000 joules.
1 KWh = 300000 joules = 36 × 10^6 joules.

75. (d)

76. (c) Pressure is magnitude of force normal to the area.

77. (d) Long sightedness or hypermetropia is eye related problem in which image is formed behind the retina. This may be due to short eye or cornea or crystalline lens does not refract the light enough.

78. (c) **79.** (d)

80. (b) Gravitational force is an imaginary force pulling everything towards the earth surface without any contact to the object.

81. (b) Force (F) = Mass (m) × acceleration (a)
acceleration (a) = Force (F)/Mass (m)
= 1 newton/1 kg = 1 m/s^2

82. (d) Electric fuse in electric circuit is a device which is used to interrupt any type of accidental fire due to short circuit.

83. (b)

84. (a) A power loom is a mechanised loom powered by a line shaft, and was one of the key developments in the Industrial Revolution. Edmund Cartwright the powerloom which revolutionaries the textile industry.

85. (a) **86.** (a) **87.** (a) **88.** (c) **89.** (c)

90. (c) **91.** (a) **92.** (a) **93.** (b)

94. (b) Sulphur - have six valance electron
Phosphorus - have five valence electron
Lead- have four valence electron
Silver - have two valence electron

95. (d) In ClO_4^-, Cl is in its maximum oxidation state that is +7 so it cannot go disproportionation reaction because it cannot further oxidised.

96. (a) Covalent bonds being directional is that atoms bonded covalently prefer specific orientations in space relative to one another. As a result, molecules in which atoms are bonded covalently have definite shapes.

97. (c) If we rub the match stick against the striking surface, the friction generated causes some of the red phosphorus present to turn into white phosphorus. White phosphorus is highly sensitive and volatile, it ignites spontaneously in the air, making a flame.

98. (c) The chemical ethyl mercaptan having sulphur added to the LPG otherwise odourless LPG cooking gas for imparting a detectable smell to the gas is a compound of Sulfur.

99. (b) Bacterial genetic material is present in the cytoplasm only in the form of nucleotide.

100. (c) Horse and donkey belong to the different species, with different number of chromosomes.

101. (b) The Mg-deficient leaves show advanced interveinal chlorosis, with necrosis developing in the highly chlorotic tissue.

102. (b) Fluoride is effective in preventing and reversing the early signs of dental caries (tooth decay) by hardening the enamel of the tooth.

103.	(c)	**104.**	(b)	**105.**	(c)	**106.**	(d)	**107.**	(a)
108.	(a)	**109.**	(b)	**110.**	(a)	**111.**	(c)	**112.**	(d)
113.	(c)	**114.**	(d)	**115.**	(c)	**116.**	(c)	**117.**	(a)
118.	(d)	**119.**	(d)	**120.**	(b)	**121.**	(c)	**122.**	(c)
123.	(c)	**124.**	(b)	**125.**	(b)	**126.**	(c)	**127.**	(c)
128.	(a)	**129.**	(a)	**130.**	(c)	**131.**	(c)	**132.**	(c)
133.	(b)	**134.**	(d)	**135.**	(b)	**136.**	(b)	**137.**	(d)
138.	(b)	**139.**	(c)	**140.**	(c)	**141.**	(c)	**142.**	(c)
143.	(c)	**144.**	(c)	**145.**	(c)	**146.**	(c)	**147.**	(d)
148.	(a)	**149.**	(d)	**150.**	(d)				

NDA 1 2016 Question Paper

MATHEMATICS

1. Suppose ω is a cube root of unity with $\omega \neq 1$. Suppose P and Q are the points on the complex plane defined by ω and ω^2. If O is the origin, then what is the angle between OP and OQ?
(a) $60°$ (b) $90°$
(c) $120°$ (d) $150°$

2. Suppose there is a relation $*$ between the positive numbers x and y given by $x * y$ if and only if $x \leq y^2$. Then which one of the following is correct?
(a) $*$ is reflexive but not transitive and symmetric
(b) $*$ is transitive but not reflexive and symmetric
(c) $*$ is symmetric and reflexive but not transitive
(d) $*$ is symmetric and but not reflexive and transitive

3. If $x^2 + px + 4 > 0$ for all real values of x, then which one of the following is correct?
(a) $|p|<4$ (b) $|p|\leq 4$
(c) $|p|>4$ (d) $|p|\geq 4$

4. If $z = x + iy = \left(\frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}\right)^{-25}$, where $i = \sqrt{-1}$, then what is the fundamental amplitude of $\frac{z-\sqrt{2}}{z-i\sqrt{2}}$?
(a) π (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{4}$

5. If $f(x_1) - f(x_2) = f\left(\frac{x_1 - x_2}{1 - x_1 x_2}\right)$ for $x_1, x_2 \in (-1, 1)$, then what is f(x) equal to?
(a) $\ln\left(\frac{1-x}{1+x}\right)$ (b) $\ln\left(\frac{2+x}{1-x}\right)$
(c) $\tan^{-1}\left(\frac{1-x}{1+x}\right)$ (d) $\tan^{-1}\left(\frac{1+x}{1-x}\right)$

6. What is the range of the function $y = \frac{x^2}{1+x^2}$, where $x \in \mathbf{R}$?
(a) $[0, 1)$ (b) $[0, 1]$
(c) $(0, 1)$ (d) $(0, 1]$

7. A straight line intersects x and y axes at P and Q respectively. If (3, 5) is the middle point of PQ, then what is the area of the triangle OPQ?
(a) 12 square units (b) 15 square units
(c) 20 square units (d) 30 square units

8. If a circle of radius b units with centre at (0, b) touches the line $y = x - \sqrt{2}$, then what is the value of b?
(a) $2+\sqrt{2}$ (b) $2-\sqrt{2}$
(c) $2\sqrt{2}$ (d) $\sqrt{2}$

For the next three (3) items that follow:

Consider the function $f(\theta) = 4(\sin^2\theta + \cos^4\theta)$

9. What is the maximum value of the function $f(\theta)$?
(a) 1 (b) 2
(c) 2 (d) 4

10. What is the minimum value of the function $f(\theta)$?
(a) 0 (b) 1
(c) 2 (d) 3

11. Consider the following statements:
1. $f(\theta) = 2$ has no solution.
2. $f(\theta) = \frac{7}{2}$ has a solution.

Which of the above statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

For the next two(2) items that follow:

Consider the curves

$$f(x) = x|x| - 1 \text{ and } g(x) = \begin{cases} \frac{3x}{2}, & x > 0 \\ 2x, & x \leq 0 \end{cases}$$

12. Where do the curves intersect?
(a) At (2, 3) only
(b) At (–1, –2) only
(c) At (2, 3) and (–1, –2)
(d) Neither at (2, 3) nor at (–1, –2)

13. What is the area bounded by the curves?
(a) $\frac{17}{6}$ square units (b) $\frac{8}{3}$ square units
(c) 2 square units (d) $\frac{1}{3}$ square unit

For the next two (2) items that follow:

Consider the function $f(x) = \frac{27(x^{2/3} - x)}{4}$

14. How many solutions does the function f(x) = 1 have?
(a) One (b) Two
(c) Three (d) Four

15. How many solutions does the function f(x) = –1 have?
(a) One (b) Two
(c) Three (d) Four

For the next two (2) items that follow:

Consider the functions

$$f(x) = xg(x) \text{ and } g(x) = \left[\frac{1}{x}\right]$$

Where $[\cdot]$ is the greatest integer function.

16. What is $\int_{\frac{1}{3}}^{\frac{1}{2}} g(x)\,dx$ equal to?

(a) $\frac{1}{6}$ (b) $\frac{1}{3}$

(c) $\frac{5}{18}$ (d) $\frac{5}{36}$

17. What is $\int_{\frac{1}{3}}^{1} f(x)\,dx$ equal to ?

(a) $\frac{37}{72}$ (b) $\frac{2}{3}$

(c) $\frac{17}{72}$ (d) $\frac{37}{144}$

For the next five (5) items that follow:

Consider the function $f(x) = |x-1| + x^2$, where $x \in \mathbf{R}$.

18. Which one of the following statements is correct?
(a) f(x) is continuous but not differentiable at $x = 0$
(b) f(x) is continuous but not differentiable at $x = 1$
(c) f(x) is differentiable at $x = 1$
(d) f(x) is not differentiable at $x = 0$ and $x = 1$

19. Which one of the following statements is correct?

(a) f(x) is increasing in $\left(-\infty, \frac{1}{2}\right)$ and decreasing in $\left(\frac{1}{2}, \infty\right)$

(b) f(x) is decreasing in $\left(-\infty, \frac{1}{2}\right)$ and increasing in $\left(\frac{1}{2}, \infty\right)$

(c) f(x) is increasing in $(-\infty, 1)$ and decreasing in $(1, \infty)$

(d) f(x) is decreasing in $(-\infty, 1)$ and increasing in $(1, \infty)$

20. Which one of the following statements is correct?

(a) f(x) has local minima at more than one point in $(-\infty, \infty)$

(b) f(x) has local maxima at more than one point in $(-\infty, \infty)$

(c) f(x) has local minimum at one point only in $(-\infty, \infty)$

(d) f(x) has neither maxima nor minima in $(-\infty, \infty)$

21. What is the area of the region bounded by x-axis, the curve $y = f(x)$ and the two ordinates $x = \frac{1}{2}$ and $x = 1$?

(a) $\frac{5}{12}$ square unit (b) $\frac{5}{6}$ square unit

(c) $\frac{7}{6}$ square units (d) 2 square units

22. What is the area of the region bounded by x-axis, the curve $y = f(x)$ and the two ordinates $x = 1$ and $x = \frac{3}{2}$?

(a) $\frac{5}{12}$ square unit (b) $\frac{7}{12}$ square unit

(c) $\frac{2}{3}$ square unit (d) $\frac{11}{12}$ square unit

For the next two (2) items that follow:

Given that $a_n = \int_0^{\pi} \frac{\sin^2\{(n+1)x\}}{\sin 2x}\,dx$

23. Consider the following statements:
1. The sequence $\{a_{2n}\}$ is in AP with common difference zero.
2. The sequence $\{a_{2n+1}\}$ is in AP with common difference zero.

Which of the above statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

24. What is $a_{n-1} - a_{n-4}$ equal to ?
(a) -1 (b) 0
(c) 1 (d) 2

For the next two (2) items that follow:

Consider the equation $x + |y| = 2y$.

25. Which of the following statements are ***not*** correct?
1. y as a function of x is not defined for all real x.
2. y as a function of x is not continuous at $x = 0$.
3. y as a function of x is differentiable for all x.

Select the correct answer using the code given below.
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

26. What is the derivative of y as a function of x with respect to x for $x < 0$?
(a) 2 (b) 1
(c) $\frac{1}{2}$ (d) $\frac{1}{3}$

For the next two (2) items that follow:

Consider the lines $y = 3x$, $y = 6x$ and $y = 9$

27. What is the area of the triangle formed by these lines?

(a) $\frac{27}{4}$ square units (b) $\frac{27}{2}$ square units

(c) $\frac{19}{4}$ square units (d) $\frac{19}{2}$ square units

28. The centroid of the triangle is at which one of the following points?

(a) (3,6) (b) $\left(\frac{3}{2}, 6\right)$

(c) (3,3) (d) $\left(\frac{3}{2}, 9\right)$

For the next two (2) items that follow:

Consider the function $f(x) = (x-1)^2(x+1)(x-2)^3$

29. What is the number of points of local minima of the function f(x)?
(a) None (b) One
(c) Two (d) Three

30. What is the number of points of local maxima of the function f(x)?
(a) None (b) One
(c) Two (d) Three

31. Let f(x) and g(x) be twice differentiable functions on [0, 2] satisfying $f''(x) = g''(x)$, $f'(1) = 4$, $g'(1) = 6$, $f(2) = 3$ and $g(2) = 9$. Then what is $f(x) - g(x)$ at $x = 4$ equal to?
(a) –10 (b) –6
(c) –4 (d) 2

For the next two (2) items that follow:

Consider the curves $y = |x - 1|$ and $|x| = 2$

32. What is/are the point(s) of intersection of the curves?
(a) (–2, 3) only (b) (2, 1) only
(c) (–2, 3) and (2, 1) (d) Neither (–2, 3) nor (2, 1)

33. What is the area of the region bounded by the curves and x-axis?
(a) 3 square units (b) 4 square units
(c) 5 square units (d) 6 square units

For the next two (2) items that follow:

Consider the function

$$f(x) = \begin{vmatrix} x^3 & \sin x & \cos x \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix},$$ where p is a constant.

34. What is the value of $f'(0)$?
(a) p^3 (b) $3p^3$
(c) $6p^3$ (d) $-6p^3$

35. What is the value of p for which $f''(0) = 0$?
(a) $-\frac{1}{6}$ or 0 (b) –1 or 0
(c) $-\frac{1}{6}$ or 1 (d) –1 or 1

For the next two (2) items that follow:

Consider a tiangle ABC in which

$$\cos A + \cos B + \cos C = \sqrt{3} \sin \frac{\pi}{3}$$

36. What is the value of $\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$?
(a) $\frac{1}{2}$ (b) $\frac{1}{4}$
(c) $\frac{1}{8}$ (d) $\frac{1}{16}$

37. What is the value of

$$\cos\left(\frac{A+B}{2}\right)\cos\left(\frac{B+C}{2}\right)\cos\left(\frac{C+A}{2}\right)?$$

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) $\frac{1}{16}$ (d) None of the above

For the next two (2) items that follow:

Given that $\tan\alpha$ and $\tan\beta$ are the roots of the equation $x^2 + bx + c = 0$ with $b \neq 0$.

38. What is $\tan(\alpha + \beta)$ equal to?
(a) $b(c - 1)$ (b) $c(b - 1)$
(c) $c(b - 1)^{-1}$ (d) $b(c - 1)^{-1}$

39. What is $\sin(\alpha + \beta)\sec\alpha\sec\beta$ equal to?
(a) b (b) – b
(c) c (d) – c

For the next two (2) items that follow:

Consider the two circles $(x - 1)^2 + (y - 3)^2 = r^2$ and $x^2 + y^2 - 8x + 2y + 8 = 0$

40. What is the distance between the centres of the two circles?
(a) 5 units (b) 6 units
(c) 8 units (d) 10 units

41. If the circles intersect at two distinct points, then which one of the following is correct?
(a) $r = 1$ (b) $1 < r < 2$
(c) $r = 2$ (d) $2 < r < 8$

For the next two (2) items that follow:

Consider the two lines $x + y + 1 = 0$ and $3x + 2y + 1 = 0$

42. What is the equation of the line passing through the point of intersection of the given lines and parallel to x-axis?
(a) $y + 1 = 0$ (b) $y - 1 = 0$
(c) $y - 2 = 0$ (d) $y + 2 = 0$

43. What is the equation of the line passing through the point of intersection of the given lines and parallel to y-axis?
(a) $x + 1 = 0$ (b) $x - 1 = 0$
(c) $x - 2 = 0$ (d) $x + 2 = 0$

For the next two (2) items that follow:

Consider the equation

$$k \sin x + \cos 2x = 2k - 7$$

44. If the equation possesses solution, then what is the minimum value of k?
(a) 1 (b) 2
(c) 4 (d) 6

45. If the equation possesses solution, then what is the maximum value of k?
(a) 1 (b) 2
(c) 4 (d) 6

For the next two (2) items that follow:

Consider the function $f(x) = \frac{a^{[x]+x} - 1}{[x] + x}$ where [·] denotes the greatest integer function.

46. What is $\lim_{x \to 0^+} f(x)$ equal to?
(a) 1 (b) ln a
(c) $1 - a^{-1}$ (d) Limit does not exist

47. What is $\lim_{x \to 0^-} f(x)$ equal to?
(a) 0 (b) ln a
(c) $1 - a^{-1}$ (d) Limit does not exist

For the next two (2) items that follow:

Let z_1, z_2 and z_3 be non-zero complex numbers satisfying $z^2 = i\bar{z}$, where $i = \sqrt{-1}$.

48. What is $z_1 + z_2 + z_3$ equal to?

(a) i (b) –i
(c) 0 (d) 1

49. Consider the following statements:

1. $z_1 z_2 z_3$ is purely imaginary.
2. $z_1 z_2 + z_2 z_3 + z_3 z_1$ is purely real.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

For the next two (2) items that follow:

Given that $\log_x y$, $\log_z x$, $\log_y z$ are in GP, $xyz = 64$ and x^3, y^3, z^3 are in A.P.

50. Which one of the following is correct?
x, y and z are

(a) in AP only (b) in GP only
(c) in both AP and GP (d) neither in AP nor in GP

51. Which one of the following is correct?
xy, yz and zx are

(a) in AP only (b) in GP only
(c) in both AP and GP (d) neither in AP nor in GP

For the next two (2) items that follow:

Let z be a complex number satisfying

$$\left|\frac{z-4}{z-8}\right| = 1 \text{ and } \left|\frac{z}{z-2}\right| = \frac{3}{2}$$

52. What is |z| equal to?

(a) 6 (b) 12
(c) 18 (d) 36

53. What is $\left|\frac{z-6}{z+6}\right|$ equal to?

(a) 3 (b) 2
(c) 1 (d) 0

For the next two (2) items that follow:

A function f(x) is defined as follows:

$$f(x) = \begin{cases} x + \pi & \text{for } x \in [-\pi, 0) \\ \pi \cos x & \text{for } x \in \left[0, \frac{\pi}{2}\right] \\ \left(x - \frac{\pi}{2}\right)^2 & \text{for } x \in \left(\frac{\pi}{2}, \pi\right] \end{cases}$$

54. Consider the following statements:

1. The function f(x) is continuous at $x = 0$.
2. The function f(x) is continuous at $x = \frac{\pi}{2}$.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

55. Consider the following statements:

1. The function f(x) is differentiable at $x = 0$.
2. The function f(x) is differentiable at $x = \frac{\pi}{2}$.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

For the next two (2) items that follow:

Let α and β $(\alpha < \beta)$ be the roots of the equation $x^2 + bx + c = 0$, where $b > 0$ and $c < 0$.

56. Consider the following:

1. $\beta < -\alpha$
2. $\beta < |\alpha|$

Which of the above is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

57. Consider the following:

1. $\alpha + \beta + \alpha\beta > 0$
2. $\alpha^2\beta + \beta^2\alpha > 0$

Which of the above is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

For the next three (3) items that follow:

Consider a parallelogram whose vertices are A (1, 2), B (4, y), C (x, 6) and D (3, 5) taken in order.

58. What is the value of $AC^2 - BD^2$?

(a) 25 (b) 30
(c) 36 (d) 40

59. What is the point of intersection of the diagonals?

(a) $\left(\frac{7}{2}, 4\right)$ (b) $(3, 4)$
(c) $\left(\frac{7}{2}, 5\right)$ (d) $(3, 5)$

60. What is the area of the parallelogram?

(a) $\frac{7}{2}$ square units (b) 4 square units
(c) $\frac{11}{2}$ square units (d) 7 square units

For the next four (4) items that follow:

Let $f : \mathbf{R} \to \mathbf{R}$ be a function such that

$$f(x) = x^3 + x^2 f'(1) + xf''(2) + f'''(3)$$

for $x \in \mathbf{R}$

61. What is f(1) equal to?

(a) –2 (b) –1
(c) 0 (d) 4

62. What is $f'(1)$ equal to?

(a) –6 (b) –5
(c) 1 (d) 0

63. What is $f'''(10)$ equal to?

(a) 1 (b) 5
(c) 6 (d) 8

64. Consider the following:

1. $f(2) = f(1) - f(0)$
2. $f''(2) - 2f'(1) = 12$

Which of the above is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

For the next three (3) items that follow:

A plane P passes through the line of intersection of the planes $2x - y + 3z = 2$, $x + y - z = 1$ and the point $(1, 0, 1)$.

65. What are the direction ratios of the line of intersection of the given planes?

(a) $\langle 2, -5, -3 \rangle$ (b) $\langle 1, -5, -3 \rangle$
(c) $\langle 2, 5, 3 \rangle$ (d) $\langle 1, 3, 5 \rangle$

66. What is the equation of the plane P?

(a) $2x + 5y - 2 = 0$ (b) $5x + 2y - 5 = 0$
(c) $x + z - 2 = 0$ (d) $2x - y - 2z = 0$

67. If the plane P touches the sphere $x^2 + y^2 + z^2 = r^2$, then what is *r* equal to?

(a) $\frac{2}{\sqrt{29}}$ (b) $\frac{4}{\sqrt{29}}$
(c) $\frac{5}{\sqrt{29}}$ (d) 1

For the next two (2) items that follow:

Consider the function $f(x) = |x^2 - 5x + 6|$

68. What is $f'(4)$ equal to?

(a) –4 (b) –3
(c) 3 (d) 2

69. What is $f''(2.5)$ equal to?

(a) –3 (b) –2
(c) 0 (d) 2

For the next two (2) items that follow:

Let f(x) be the greatest integer function and g(x) be the modulus function.

70. What is $(g \circ f)\left(-\frac{5}{3}\right) - (f \circ g)\left(-\frac{5}{3}\right)$ equal to?

(a) –1 (b) 0
(c) 1 (d) 2

71. What is $(f \circ f)\left(-\frac{9}{5}\right) + (g \circ g)(-2)$ equal to?

(a) –1 (b) 0
(c) 1 (d) 2

For the next two (2) items that follow:

Consider a circle passing through the origin and the points (a, b) and (–b, –a).

72. On which line does the centre of the circle lie?

(a) $x + y = 0$ (b) $x - y = 0$
(c) $x + y = a + b$ (d) $x - y = a^2 - b^2$

73. What is the sum of the squares of the intercepts cut off by the circle on the axes?

(a) $\left(\frac{a^2 + b^2}{a^2 - b^2}\right)^2$ (b) $2\left(\frac{a^2 + b^2}{a - b}\right)^2$
(c) $4\left(\frac{a^2 + b^2}{a - b}\right)^2$ (d) None of the above

For the next two (2) items that follow:

Let $\hat{a}, \hat{b}$ be two unit vectors and θ be the angle between them.

74. What is $\cos\left(\frac{\theta}{2}\right)$ equal to?

(a) $\frac{|\hat{a} - \hat{b}|}{2}$ (b) $\frac{|\hat{a} + \hat{b}|}{2}$
(c) $\frac{|\hat{a} - \hat{b}|}{4}$ (d) $\frac{|\hat{a} + \hat{b}|}{4}$

75. What is $\sin\left(\frac{\theta}{2}\right)$ equal to?

(a) $\frac{|\hat{a} - \hat{b}|}{2}$ (b) $\frac{|\hat{a} + \hat{b}|}{2}$
(c) $\frac{|\hat{a} - \hat{b}|}{4}$ (d) $\frac{|\hat{a} + \hat{b}|}{4}$

76. Consider the following statements:

1. There exists $\theta \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ for which $\tan^{-1}(\tan\theta) \neq \theta$.
2. $\sin^{-1}\left(\frac{1}{3}\right) - \sin^{-1}\left(\frac{1}{5}\right) = \sin^{-1}\left(\frac{2\sqrt{2}(\sqrt{3} - 1)}{15}\right)$

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

77. Consider the following statements:

1. $\tan^{-1} x + \tan^{-1}\left(\frac{1}{x}\right) = \pi$
2. There exist $x, y \in [-1, 1]$, where $x \neq y$ such that $\sin^{-1} x + \cos^{-1} y = \frac{\pi}{2}$.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

78. What are the order and degree respectively of the differential equation whose solution is $y = cx + c^2 - 3c^{3/2} + 2$, where c is a parameter?

(a) 1, 2 (b) 2, 2
(c) 1, 3 (d) 1, 4

79. What is

$$\int_{-2}^{2} x\,dx - \int_{-2}^{2} [x]\,dx$$

equal to, where $[\cdot]$ is the greatest integer function?

(a) 0 (b) 1
(c) 2 (d) 4

80. If $\int_{-2}^{5} f(x)dx = 4$ and $\int_{0}^{5} \{1 + f(x)\}dx = 7$, then what is $\int_{-2}^{0} f(x)dx$ equal to?

(a) –3 (b) 2
(c) 3 (d) 5

81. If $\lim_{x\to 0}\phi(x)=a^2$, where $a\neq 0$, then what is $\lim_{x\to 0}\phi\left(\frac{x}{a}\right)$ equal to?
(a) a^2 (b) a^{-2}
(c) $-a^2$ (d) $-a$

82. What is $\lim_{x\to 0} e^{-\frac{1}{x^2}}$ equal to?
(a) 0 (b) 1
(c) –1 (d) Limit does not exist

83. If A is a square matrix, then what is $\text{adj}(A^{-1}) - (\text{adj } A)^{-1}$ equal to?
(a) $2|A|$ (b) Null matrix
(c) Unit matrix (d) None of the above

84. What is the binary equivalent of the decimal number 0.3125?
(a) 0.0111 (b) 0.1010
(c) 0.0101 (d) 0.1101

85. Let R be a relation on the set N of natural numbers defined by 'nRM $\Leftrightarrow$ n is a factor of m'. Then which one of the following is correct?
(a) R is reflexive, symmetric but not transitive
(b) R is transitive, symmetric but not reflexive
(c) R is reflexive, transitive but not symmetric
(d) R is an equivalence relation

86. What is $\int_0^{4\pi} |\cos x|\,dx$ equal to?
(a) 0 (b) 2
(c) 4 (d) 8

87. What is the number of natural numbers less than or equal to 1000 which are neither divisible by 10 nor 15 nor 25?
(a) 860 (b) 854
(c) 840 (d) 824

88. (a, 2b) is the mid-point of the line segment joining the points (10, –6) and (k, 4). If a – 2b = 7, then what is the value of k?
(a) 2 (b) 3
(c) 4 (d) 5

89. Consider the following statements:
1. If ABC is an equilateral triangle, then $3\tan(A+B)\tan C = 1$.
2. If ABC is a triangle in which A = 78°, B = 66°, then
$\tan\left(\frac{A}{2}+C\right) < \tan A$
3. If ABC is any triangle, then
$\tan\left(\frac{A+B}{2}\right)\sin\left(\frac{C}{2}\right) < \cos\left(\frac{C}{2}\right)$

Which of the above statements is/are correct?
(a) 1 only (b) 2 only
(c) 1 and 2 (d) 2 and 3

90. If $A = (\cos 12° - \cos 36°)(\sin 96° + \sin 24°)$ and $B = (\sin 60° - \sin 12°)(\cos 48° - \cos 72°)$, then what is $\frac{A}{B}$ equal to?
(a) –1 (b) 0
(c) 1 (d) 2

91. What is the mean deviation from the mean of the numbers 10, 9, 21, 16, 24?
(a) 5·2 (b) 5·0
(c) 4·5 (d) 4·0

92. Three dice are thrown simultaneously. What is the probability that the sum on the three faces is at least 5?
(a) $\frac{17}{18}$ (b) $\frac{53}{54}$
(c) $\frac{103}{108}$ (d) $\frac{215}{216}$

93. Two independent events A and B have $P(A)=\frac{1}{3}$ and $P(B)=\frac{3}{4}$. What is the probability that exactly one of the two events A or B occurs?
(a) $\frac{1}{4}$ (b) $\frac{5}{6}$
(c) $\frac{5}{12}$ (d) $\frac{7}{12}$

94. A coin is tossed three times. What is the probability of getting head and tail alternately?
(a) $\frac{1}{8}$ (b) $\frac{1}{4}$
(c) $\frac{1}{2}$ (d) $\frac{3}{4}$

95. If the total number of observations is 20, $\Sigma x_i = 1000$ and $\Sigma x_i^2 = 84000$, then what is the variance of the distribution?
(a) 1500 (b) 1600
(c) 1700 (d) 1800

96. A card is drawn from a wel-shuffled deck of 52 cards. What is the probability that it is queen of spade?
(a) $\frac{1}{52}$ (b) $\frac{1}{13}$
(c) $\frac{1}{4}$ (d) $\frac{1}{8}$

97. If two dice are thrown, then what is the probability that the sum on the two faces is greater than or equal to 4?
(a) $\frac{13}{18}$ (b) $\frac{5}{6}$
(c) $\frac{11}{12}$ (d) $\frac{35}{36}$

98. A certain type of missile hits the target with probability p = 0.3. What is the least number of missiles should be fired so that there is at least an 80% probability that the target is hit?
(a) 5 (b) 6
(c) 7 (d) None of the above

99. For two mutually exclusive events A and B, P(A) = 0.2 and $P(\bar{A}\cap B) = 0.3$. What is $P(A\,|\,(A\cup B))$ equal to?
(a) $\frac{1}{2}$ (b) $\frac{2}{5}$
(c) $\frac{2}{7}$ (d) $\frac{2}{3}$

100. What is the probability of 5 Sundays in the month of December?

(a) $\frac{1}{7}$ (b) $\frac{2}{7}$

(c) $\frac{3}{7}$ (d) None of the above

101. If m is the geometric mean of

$$\left(\frac{y}{z}\right)^{\log(yz)}, \left(\frac{z}{x}\right)^{\log(zx)} \text{ and } \left(\frac{x}{y}\right)^{\log(xy)}$$

then what is the value of m?

(a) 1 (b) 3

(c) 6 (d) 9

102. A point is chosen at random inside a rectangle measuring 6 inches by 5 inches. What is the probability that the randomly selected point is at least one inch from the edge of the rectangle?

(a) $\frac{2}{3}$ (b) $\frac{1}{3}$

(c) $\frac{1}{4}$ (d) $\frac{2}{5}$

103. The mean of the series $x_1, x_2, ..., x_n$ is $\bar{X}$. If x_2 is replaced by λ, then what is the new mean?

(a) $\bar{X} - x_2 + \lambda$ (b) $\frac{\bar{X} - x_2 - \lambda}{n}$

(c) $\frac{\bar{X} - x_2 + \lambda}{n}$ (d) $\frac{n\bar{X} - x_2 + \lambda}{n}$

104. For the data

3, 5, 1, 6, 5, 9, 5, 2, 8, 6

the mean, median and mode are x, y and z respectively. Which one of the following is correct?

(a) $x = y \neq z$ (b) $x \neq y = z$

(c) $x \neq y \neq z$ (d) $x = y = z$

105. Consider the following statements in respect of a histogram:

1. The total area of the rectangles in a histogram is equal to the total area bounded by the corresponding frequnecy polygon and the x-axis.
2. When class intervals are unequal in a frequency distribution, the area of the rectangle is proportional to the frequency.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

106. A fair coin is tossed 100 times. What is the probability of getting tails an odd number of times?

(a) $\frac{1}{2}$ (b) $\frac{3}{8}$

(c) $\frac{1}{4}$ (d) $\frac{1}{8}$

107. What is the number of ways in which 3 holiday travel tickets are to be given to 10 employees of an organization, if each employee is eligible for any one or more of the tickets?

(a) 60 (b) 120

(c) 500 (d) 1000

108. If one root of the equation $(1-m)x^2 + lx + 1 = 0$ is double the other and l is real, then what is the greatest value of m?

(a) $-\frac{9}{8}$ (b) $\frac{9}{8}$

(c) $-\frac{8}{9}$ (d) $\frac{8}{9}$

109. What is the number of four-digit decimal numbers (<1) in which no digit is repeated?

(a) 3024 (b) 4536

(c) 5040 (d) None of the above

110. What is a vector of unit length orthogonal to both the vectors $\hat{i} + \hat{j} + \hat{k}$ and $2\hat{i} + 3\hat{j} - \hat{k}$?

(a) $\frac{-4\hat{i} + 3\hat{j} - \hat{k}}{\sqrt{26}}$ (b) $\frac{-4\hat{i} + 3\hat{j} + \hat{k}}{\sqrt{26}}$

(c) $\frac{-3\hat{i} + 2\hat{j} - \hat{k}}{\sqrt{14}}$ (d) $\frac{-3\hat{i} + 2\hat{j} + \hat{k}}{\sqrt{14}}$

111. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are the position vectors of the vertices of an equilateral triangle whose orthocentre is at the origin, then which one of the following is correct?

(a) $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ (b) $\vec{a} + \vec{b} + \vec{c} =$ unit vector

(c) $\vec{a} + \vec{b} = \vec{c}$ (d) $\vec{a} = \vec{b} + \vec{c}$

112. What is the area of the parallelogram having diagonals $3\hat{i} + \hat{j} - 2\hat{k}$ and $\hat{i} - 3\hat{j} + 4\hat{k}$?

(a) $5\sqrt{5}$ square units (b) $4\sqrt{5}$ square units

(c) $5\sqrt{3}$ square units (d) $15\sqrt{2}$ square units

113. Consider the following in respect of the matrix $A = \begin{pmatrix} -1 & 1 \\ 1 & -1 \end{pmatrix}$:

1. $A^2 = -A$
2. $A^3 = 4A$

Which of the above is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

114. Which of the following determinants have value 'zero'?

1. $\begin{vmatrix} 41 & 1 & 5 \\ 79 & 7 & 9 \\ 29 & 5 & 3 \end{vmatrix}$

2. $\begin{vmatrix} 1 & a & b+c \\ 1 & b & c+a \\ 1 & c & a+b \end{vmatrix}$

3. $\begin{vmatrix} 0 & c & b \\ -c & 0 & a \\ -b & -a & 0 \end{vmatrix}$

Select the correct answer using the code given below.

(a) 1 and 2 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1, 2 and 3

115. What is the acute angle between the lines represented by the equations $y-\sqrt{3}x-5=0$ and $\sqrt{3}y-x+6=0$?

(a) 30° (b) 45°
(c) 60° (d) 75°

116. The system of linear equations $kx+y+z=1$, $x+ky+z=1$ and $x+y+kz=1$ has a unique solution under which one of the following conditions?

(a) $k \neq 1$ and $k \neq -2$ (b) $k \neq 1$ and $k \neq 2$
(c) $k \neq -1$ and $k \neq -2$ (d) $k \neq -1$ and $k \neq 2$

117. What is the number of different messages that can be represented by three 0's and two 1's?

(a) 10 (b) 9
(c) 8 (d) 7

118. If $\log_a(ab)=x$, then what is $\log_b(ab)$ equal to?

(a) $\frac{1}{x}$ (b) $\frac{x}{x+1}$
(c) $\frac{x}{1-x}$ (d) $\frac{x}{x-1}$

119. If $y=\log_{10}x+\log_x 10+\log_x x+\log_{10}10$ then what is $\left(\frac{dy}{dx}\right)_{x=10}$ equal to?

(a) 10 (b) 2
(c) 1 (d) 0

120. Suppose ω_1 and ω_2 are two distinct cube roots of unity different from 1. Then what is $(\omega_1-\omega_2)^2$ equal to?

(a) 3 (b) 1
(c) –1 (d) –3

GENERAL ABILITY TEST

PART-A : ENGLISH

DIRECTIONS: *In this section, each of the following sentences has a blank space and four words given after the sentence. Select whichever word you consider most appropriate for the blank space and indicate your response in the Answer Sheet accordingly.*

1. When the bus was at full speed, its brakes failed and an accident was ________.

(a) inevitable (b) undeniable
(c) fatal (d) miserable

2. To explain his design to his visitors, the architect ________ a simple plan on the blackboard.

(a) built (b) finalised
(c) sketched (d) arranged

3. Though Bonsai, a well-known art form, originated in China, it was ________ by the Japanese.

(a) cultivated (b) finished
(c) perfected (d) enlarged

4. He is greatly admired for his ________ behaviour.

(a) decrepit (b) decadent
(c) decorative (d) decorous

5. Would you mind ________ to the Principal how the trouble started?

(a) remarking (b) saying
(c) explaining (d) talking

6. Vaccination will make people immune ________ certain diseases for a given period.

(a) against (b) to
(c) with (d) for

7. The two boys looked so alike that it was impossible to ________ between them.

(a) discriminate (b) discern
(c) distinguish (d) identify

8. The campers ________ their tents at the base of the mountain.

(a) installed (b) dug
(c) pitched (d) established

9. The enemy had captured him and his life was at stake, still he refused to ________ the state secrets.

(a) divulge (b) divert
(c) indulge (d) invert

DIRECTIONS : *Each item in this section consists of an underlined word in given sentences. Each sentence is followed by four words. Select the word which is most nearly* ***opposite*** *in meaning to the underlined word.*

10. He handled the machine with <u>deft</u> fingers.

(a) delicate (b) sturdy
(c) quick (d) clumsy

11. I was deeply affected by his <u>urbane</u> behaviour.

(a) rural (b) rude
(c) irrational (d) indifferent

12. His <u>timidity</u> proved costly.

(a) arrogance (b) boldness
(c) skilfulness (d) cunning

13. Arrangements were made to handle the <u>mammoth</u> gathering tactfully.

(a) significant (b) small
(c) unruly (d) noisy

14. He was <u>engrossed</u> in his work when I walked in.

(a) occupied (b) inattentive
(c) engaged (d) absent

15. These are the main points of the <u>preceding</u> paragraph.

(a) following (b) previous
(c) first (d) last

16. He made a <u>shrewd</u> guess.

(a) clever (b) wild
(c) incorrect (d) discriminating

17. He is suffering from a <u>severe</u> cough.

(a) violent (b) mild
(c) bad (d) continuous

18. <u>Cumulatively</u>, the effect of these drugs is quite bad.

(a) Individually (b) Obviously
(c) Clearly (d) Collectively

19. He was <u>conspicuous</u> because of his colourful shirt.

(a) charming (b) ugly
(c) small (d) unnoticeable

20. He hates these <u>continual</u> arguments with his friend.

(a) repeated (b) irrational
(c) occasional (d) regular

DIRECTIONS: *Each question in this section has a sentence with three underlined parts labelled (a), (b) and (c). Read each sentence to find out whether there is any error in any underlined part and indicate your response in the Answer Sheet against the corresponding letter i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d).*

21. She said that she was understanding (a) his point of view (b) very well. (c) No error. (d)

22. All the houses having been washed away (a) by the floods, (b) the villagers sought shelter in the panchayat office. (c) No error. (d)

23. It is necessary for us to familiarize with (a) get used to (b) the ways of the people among whom we live. (c) No error. (d)

24. The mother asked the child (a) why did she cry out (b) in her sleep. (c) No error. (d)

25. I asked him that (a) why he was angry (b) but he did not answer. (c) No error. (d)

26. Had I not taken ill, (a) I would have sent you (b) my research paper much earlier. (c) No error. (d)

27. The barn owl helps the farmer by destroying (a) rats which could, if left unchecked (b) do a lot of damage to the crops. (c) No error. (d)

28. He had gone (a) home three weeks ago and was expected (b) back yesterday, but he has not come (c) yet. No error. (d)

29. We must sympathize (a) for others (b) in their troubles. (c) No error. (d)

30. The scientists in America (a) are trying for long (b) to discover the genes responsible for ageing. (c) No error. (d)

DIRECTIONS: *In this section, look at the underlined part of each sentence. Below each sentence are given three possible substitutions for the underlined part. If one of them (a), (b) or (c) is better than the underlined part, indicate your response on the Answer Sheet against the corresponding letter (a), (b) or (c). If none of the substitutions improves the sentence, indicate (d) as your response on the Answer Sheet. Thus a "No improvement" response will be signified by the letter (d).*

31. When he heard the rhetorical speech of the leader, he was <u>carried along</u> by his enthusiasm.
(a) carried aloft (b) carried down
(c) carried away (d) No improvement

32. After the heavy rains last week, the water in the lake <u>raised another two feet.</u>
(a) rose another two feet
(b) arisen another two feet
(c) would raise another two feet
(d) No improvement

33. One can live and work in a town without being aware of the daily march of the sun across the sky without <u>never</u> seeing the moon and stars.
(a) seldom (b) hardly
(c) ever (d) No improvement

34. Applications of those <u>who are graduates</u> will be considered.
(a) whom are graduates
(b) whose are graduates
(c) whom are only graduates
(d) No improvement

35. It <u>is raining</u> heavily all through this week.
(a) has rained (b) rains
(c) rained (d) No improvement

36. The sparrow took no <u>notice about</u> the bread.
(a) notice of (b) notice from
(c) notice to (d) No improvement

37. As he spoke about his achievements, his <u>high</u> claims amused us.
(a) big (b) tall
(c) long (d) No improvement

38. We ought to <u>stand</u> for what is right.
(a) stand at (b) stand on
(c) stand up (d) No improvement

39. He enjoys <u>to tell stories</u> to children.
(a) how to tell stories (b) telling stories
(c) to narrate stories (d) No improvement

40. In a few minutes' time, when the clock strikes six, I <u>would be waiting</u> here for an hour.
(a) shall be waiting on (b) shall have been waiting
(c) shall wait (d) No improvement

DIRECTIONS: *Each item in this section consists of an underlined word in given sentences. Each sentence is followed by four words. Select the word which is most **similar** in meaning to the underlined word and mark your response in the Answer Sheet accordingly.*

41. Suddenly there was a bright flash, followed by a deafening explosion.
(a) dangerous (b) terrifying
(c) mild (d) very loud

42. He showed exemplary courage during the crisis.
(a) usual (b) durable
(c) commendable (d) some

43. When the new teacher entered the classroom, he found the pupils restive.
(a) at rest (b) idle
(c) quiet (d) impatient

44. There is no dearth of talent in this country.
(a) scarcity (b) availability
(c) plenty (d) absence

45. The servants retired to their quarters.
(a) entered (b) went away
(c) ran away (d) mobilised

46. The navy gave tactical support to the marines.
(a) sensitive (b) strategic
(c) immediate (d) expert

47. A genius tends to deviate from the routine way of thinking.
(a) dispute (b) disagree
(c) distinguish (d) differ

48. He was greatly debilitated by an attack of influenza.
(a) depressed (b) weakened
(c) worried (d) defeated

49. His efforts at helping the poor are laudable.
(a) welcome (b) sincere
(c) good (d) praiseworthy

50. His conduct brought him reproach from all quarters.
(a) rebuke (b) sympathy
(c) indifference (d) remorse

PART- B : GENERAL KNOWLEDGE

DIRECTIONS: *The following **05 (Five)** items consist of two statements, Statement I and Statement II. Examine these two statements carefully and select the answers to these items using the code given below:*

Code:
(a) Both the Statements are individually true and Statement II is the correct explanation of Statement I.
(b) Both the Statements are individually true but Statement II is ***not*** the correct explanation of Statement I.
(c) Statement I is true but Statement II is false.
(d) Statement I is false but Statement II is true.

51. *Statement I:* Petroleum is a mixture of many different hydrocarbons of different densities.
Statement II: The grade of petroleum depends mainly on the relative proportion of the different hydrocarbons.

52. *Statement I:* There is high salinity in Red Sea.
Statement II: Rate of evaporation is high in Red Sea.

53. *Statement I:* Volcanic eruption is accompanied by earthquakes.
Statement II: Volcanoes erupt water vapours and dust particles in the atmosphere.

54. *Statement I:* Plantation farming has mostly been practised in humid tropics.
Statement II: The soil of humid tropics is highly fertile.

55. *Statement I:* India has wide variation in population density.
Statement II: Factors like agricultral productivity and history of settlements have greatly influenced the population density pattern in India.

56. A container is first filled with water and then the entire water is replaced by mercury. Mercury has a density of 13.6×10^3 kg/m^3. If X is the weight of the water and Y is the weight of the mercury, then
(a) X = Y (b) X = 13.6 Y
(c) Y = 13.6 X (d) None of the above

57. Density of water is
(a) maximum at 0°C (b) minimum at 0°C
(c) maximum at 4°C (d) minimum at –4°C

58. The phosphorus used in the manufacture of safety matches is
(a) Red phosphorus (b) Blank phosphorus
(c) White phosphorus (d) Scarlet phosphorus

59. Which one of the following is ***not*** a chemical change?
(a) Ripening of fruits (b) Curdling of milk
(c) Freezing of water (d) Digestion of food

60. One of the main causes of air pollution in cities is emissions from vehicles like cars and trucks. Cars emit various pollutants which are bad for human health when inhaled, like
1. Nitrogen oxides (NO_x)
2. Carbon monoxide (CO)
3. Carbon dioxide (CO_2).
4. Benzone

Which of the above pollutants are ***not*** tolerated by human beings even at very low levels?
(a) 1 and 4 only (b) 1 and 2 only
(c) 1, 2 and 3 only (d) 1, 2 and 4 only

61. Arrange the following centres of AIIMS from East to West:
1. Rishikesh
2. New Delhi
3. Patna
4. Bhubaneswar

Select the correct answer using the code given below:
(a) 4-3-1-2 (b) 4-1-3-2
(c) 3-4-2-1 (d) 3-2-1-4

62. Suppose the force of gravitation between two bodies of equal masses is F. If each mass is doubled keeping the distance of separation between them unchanged, the force would become
(a) F (b) 2F
(c) 4F (d) $\frac{1}{4}$F

63. A body has a free fall from a height of 20 m. After falling through a distance of 5 m, the body would
(a) lose one-fourth of its total energy
(b) lose one-fourth of its potential energy
(c) gain one-fourth of its potential energy
(d) gain three-fourth of its total energy

64. Soap is sodium or potassium salt of
(a) Stearic acid (b) Oleic acid
(c) Palmitic acid (d) All of the above

65. Mass of a particular amount of substance
1. is the amount of matter present in it.
2. does not vary from place to place.
3. changes with change in gravitational force.

Select the correct answer using the code given below:
(a) 1, 2 and 3 (b) 1 and 2 only
(c) 2 and 3 only (d) 1 only

66. Which of the following substances are harmful for health if present in food items?
1. Pesticide residues
2. Lead
3. Metanil yellow
4. Mercury

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 1, 2 and 4 only
(c) 3 and 4 only (d) 1, 2, 3 and 4

67. In India, glacial terraces known as 'Karewas' are found in
(a) Sapt Kosi Valley (b) Jhelum Valley
(c) Alakananda Valley (d) Teesta Valley

68. Structurally, the Meghalaya region is a part of
(a) Shiwalik Range (b) Deccan Plateau
(c) Greater Himalaya (d) Aravalli Range

69. Two bodies A and B are moving with equal velocities. The mass of B is double that of A. In this context, which one of the following statements is correct?
(a) Momentum of B will be double that of A.
(b) Momentum of A will be double that of B
(c) Momentum of B will be four times that of A.
(d) Momenta of both A and B will be equal.

70. During solar eclipse
(a) the earth comes in between the sun and the moon.
(b) the moon comes in between the sun and the earth.
(c) the moon comes exactly halfway between the earth and the sun.
(d) the sun comes in between the earth and the moon.

71. The S.I. unit of acceleration is
(a) ms^{-1} (b) ms^{-2}
(c) cms^{-2} (d) kms^{-2}

72. An atom of carbon has 6 protons. Its mass number is 12. How many neutrons are present in an atom of carbon?
(a) 12 (b) 6
(c) 10 (d) 14

73. Which one of the following is a reduction reaction?

(a) $2Mg(s) + O_2(g) \longrightarrow 2\,MgO(s)$

(b) $S(s) + O_2(g) \longrightarrow SO_2(g)$

(c) $2HgO(s) \xrightarrow{\text{heat}} 2Hg(l) + O_2(g)$

(d) $Mg(s) + S(s) \longrightarrow MgS(s)$

74. Which of the commonly used household item(s) release Bisphenol A(BPA) which is an endocrine disruptor and bad for human health?
1. Steel utensils
2. Plastic coffee mugs
3. Aluminium utensils
4. Plastic water storage bottles

Select the correct answer using the code given below:
(a) 1 only (b) 1 and 2 only
(c) 2 and 4 only (d) 1, 2 and 3 only

75. The Nagarjuna Sagar Project is located on which one of the following rivers?
(a) Godavari (b) Krishna
(c) Kavery (d) Mahanadi

76. Consider the following statements:
1. Rajmahal highlands consist of lava flow deposits.
2. Bundelkhand gneiss belong to the oldest Achaean rocks of India.

Which of the statements given above is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

77. An object is placed at the centre of curvature of a concave mirror of focal length 16 cm. If the object iis shifted by 8 cm towards the focus, the nature of the image would be
(a) real and magnified (b) virtual and magnified
(c) real and reduced (d) virtual and reduced

78. A pencil is placed upright at a distance of 10 cm from a convex lens of focal length 15 cm. The nature of the image of the pencil will be
(a) real, inverted and magnified
(b) real, erect and magnified
(c) virtual, erect and reduced
(d) virtual, erect and magnified

79. Which one of the following is a conventional energy source?
(a) Tidal energy (b) Geothermal energy
(c) Solar energy (d) Biomass energy

80. Which one of the following oxides of nitrogen is known as 'anhydride' of nitric acid?
(a) N_2O (b) N_2O_3
(c) NO_2 (d) N_2O_5

81. Which one of the following is the chemical name for baking soda?
(a) Sodium bicarbonate (Sodium hydrogen carbonate)
(b) Sodium carbonate
(c) Potassium bicarbonate (Potassium hydrogen carbonate)
(d) Potassium carbonate

82. Which of the following statements about DNA is/are correct?
1. DNA is the hereditary material of all living organisms.
2. All segments of DNA code for synthesis of proteins.
3. Nuclear DNA is double helical with two nucleotide chains which run anti-parallel.
4. DNA is also found in mitochondria.

Select the correct answer using the code given below:
(a) 1, 2 and 3 only (b) 3 and 4 only
(c) 1, 3 and 4 only (d) 4 only

83. Which organisation prepares the topographical maps of India?
(a) Geological Survey of India
(b) Archaeological Survery of India
(c) Survery of India
(d) National Atlas and Thematic Mapping Organisation

84. Which one of the following is ***not*** an international boundary line ?
(a) Dresden Line (b) Durand Line
(c) Maginot Line (d) 38^{th} Parallel

85. A lady is standing in front of a plane mirror at a distance of 1 m from it. She walks 60 cm towards the mirror. The distance of her image now from herself (ignoring the thickness of the mirror) is
(a) 40 cm (b) 60 cm
(c) 80 cm (d) 120 cm

86. The brightness of a star depends on its
(a) size and temperature only
(b) size and distance from the earth
(c) size, temperature and mass
(d) size, temperature and distance from the earth

87. When a solid is heated, it turns directly into a gas. This process is called
(a) Condensation (b) Evaporation
(c) Sublimation (d) Diffusion

88. Which one of the following is water gas?
(a) Mixture of carbon monoxide and hydrogen
(b) Mixture of carbon monoxide and nitrogen
(c) Mixture of carbon dioxide and water vapour
(d) Mixture of carbon monoxide and water vapour

89. Which of the following statements are correct?
In honey bees
1. Males are haploid.
2. Workers are sterile and diploid.
3. Queen develops from diploid larvae that fed on royal jelly.
4. Honey is collected/made by males.

Select the correct answer using the code given below:
(a) 1, 2, 3 and 4 (b) 2 and 3 only
(c) 1, 2 and 3 only (d) 1 and 4 only

90. The Amarkantak Hills is the source of which of the following rivers?
1. Narmada 2. Mahanadi
3. Tapti 4. Son

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 2 only
(c) 1, 3 and 4 only (d) 1, 2 and 4 only

91. Which of the following statements in the context of northern hemisphere is/are correct?
1. Vernal equinox occurs on March 21.
2. Summer solstice occurs on December 22.
3. Autumnal equinox occurs on September 23.
4. Winter solstice occurs on June 21.

Select the correct answer using the code given below:
(a) 1 only (b) 1 and 3 only
(c) 2 and 4 only (d) 1, 2 and 3only

92. A glass vessel is filled with water to the rim and a lid is fixed to it tightly. Then it is left inside a freezer for hours. What is expected to happen ?
(a) The water freezes to ice and the level of ice comes down
(b) The water in the glass vessel simply freezes to ice
(c) The glass vessel breaks due to expansion as water freezes to ice
(d) The water does not freeze at all

93. A simple circuit contains a 12 V battery and a bulb having 24 ohm resistance. When you turn on the switch, the ammeter connected in the circuit would read
(a) 0.5 A (b) 2 A
(c) 4 A (d) 5 A

94. Three resistors with magnitudes 2, 4 and 8 ohm are connected in parallel. The equivalent resistance of the system would be
(a) less than 2 ohm
(b) more than 2 ohm but less than 4 ohm
(c) 4 ohm
(d) 14 ohm

95. Suppose you have four test tubes labelled as 'A', 'B', 'C', and 'D'. 'A' contains plain water, 'B' contains solution of an alkali, 'C' contains solution of an acid, and 'D' contains solution of sodium chloride. Which one of these solutions will turn phenolphthalein solution pink?
(a) Solution 'A' (b) Solution 'B'
(c) Solution 'C' (d) Solution 'D'

96. Which one of the following oxides dissolves in water?
(a) CuO (b) Al_2O_3
(c) Fe_2O_3 (d) Na_2O

97. To prevent heart problems, blood of a normal healthy person should have
1. low cholesterol level.
2. high HDL level.
3. high VLDL level.
4. high LDL level.

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 1, 2 and 4 only
(c) 3 and 4 only (d) 1, 2 and 3 only

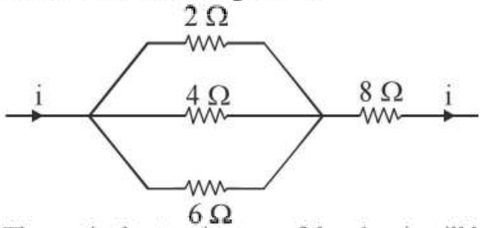
98. Spruce and Cedar are tree varieties of
(a) Equatorial forest
(b) Temperate coniferous forest
(c) Monsoon forest
(d) Temperate deciduous forest

99. 'Sal' tree is a
(a) Tropical evergreen tree
(b) Tropical semi-evergreen tree
(c) Dry deciduous tree
(d) Moist deciduous tree

100. Matter around us can exist in three different states, namely, solid, liquid and gas. The correct order of their compressibility is
(a) Liquid < Gas < Solid (b) Solid < Liquid < Gas
(c) Gas < Liquid < Solid (d) Solid < Gas < Liquid

101. The temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point. The melting point of a solid is an indication of
(a) strength of the intermolecular forces of attraction
(b) strength of the intermolecular forces of repulsion
(c) molecular mass
(d) molecular size

102. Consider the following circuit:



The equivalent resistance of the circuit will be

(a) $12\ \Omega$ (b) $8\frac{11}{12}\ \Omega$
(c) $9\frac{1}{11}\ \Omega$ (d) $\frac{24}{25}\ \Omega$

103. Which one of the following elements will ***not*** react with dilute HCl to produce H_2?
(a) Hg (b) Al
(c) Mg (d) Fe

104. Which of the following pairs of vector and disease is/are correctly matched ?

	Vector		Disease
1.	Anopheles	:	Malaria
2.	Aedes aegypti	:	Chikungunya
3.	Tsetse fly	:	Filariasis
4.	Bed bugs	:	Sleeping sickness

Select the correct answer using the code given below:
(a) 1, 2 and 3 only (b) 1 and 2 only
(c) 1 and 4 only (d) 2 only

105. Consider the following statements:
1. All Echinoderms are not marine.
2. Sponges are exclusively marine.
3. Insects are found in all kinds of habitats.
4. Many primates are arboreal.

Which of the statements given above is/are correct ?
(a) 1, 3 and 4 only (b) 3 and 4 only
(c) 2 and 4 only (d) 3 only

106. Areas which are engines for economic growth supported by quality infrastructure and complemented by an attractive fiscal package are known as
(a) Export Processing Zones
(b) Duty Free Tariff Zones
(c) Special Economic Zones
(d) Technology Parks

107. Deserts, fertile plains and moderately forested mountains are the characteristic features of which one of the following regions of India?
(a) South-Western border along Arabian Sea
(b) Coromandel Coast
(c) North-Eastern Frontier
(d) North-Western India

108. A racing car accelerates on a straight road from rest to a speed of 50 m/s in 25 s. Assuming uniform acceleration of the car throughout, the distance covered in this time will be
(a) 625 m (b) 1250 m
(c) 2500 m (d) 50 m

109. A man weighing 70 kg is coming down in a lift. If the cable of the lift breaks suddenly, the weight of the man would become
(a) 70 kg (b) 35 kg
(c) 140 kg (d) zero

110. A given conductor carrying a current of 1 A produces an amount of heat equal to 2000 J. If the current through the conductor is doubled, the amount of heat produced will be
(a) 2000 J (b) 4000 J
(c) 8000 J (d) 1000 J

111. Which one of the following carbon compounds will ***not*** give a sooty flame?
(a) Benzene (b) Hexane
(c) Naphthalene (d) Anthracene

112. Match List I with List II and select the correct answer using the code given below the Lists:

	List I *(Molecule)*		List II *(Product of digestion)*
A.	Proteins	1.	Nitrogenous bases and pentose sugars
B.	Carbohydrates	2.	Fatty acids and glycerol
C.	Nucleic acids	3.	Monosaccharides
D.	Lipids	4.	Amino acids

Code:

	A	B	C	D
(a)	2	3	1	4
(b)	2	1	3	4
(c)	4	1	3	2
(d)	4	3	1	2

113. In Thar region, the shifting sand dunes are locally known as
(a) Dhrian (b) Daurs
(c) Dhoros (d) Dhaya

114. The impulse on a particle due to a force acting on it during a given time interval is equal to the change in its
(a) force (b) momentum
(c) work done (d) energy

115. Which one of the following statements with regard to expansion of materials due to heating is ***not*** correct?
(a) As ice melts, it expands uniformly up to 4°C.
(b) Mercury thermometer works using the principle of expansion due to heating.
(c) Small gap is kept between two rails to allow for expansion due to heating.
(d) The length of metallic wire increases when its temperature is increased.

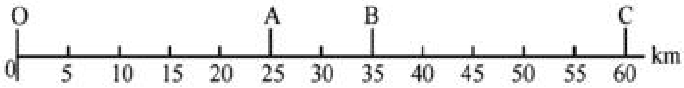
116. Which of the following pairs is/are correctly matched?

	(National Park)		*(Famous for)*
1.	Ranthambhore	:	Tiger
2.	Periyar	:	Elephant
3.	Manas	:	Lion
4.	Gir	:	Rhinoceros

Select the correct answer using the code given below:
(a) 1, 2 and 3 only (b) 1 and 2 only
(c) 1 and 4 only (d) 2 only

117. Which one of the following is ***not*** a form of stored energy?
(a) Nuclear energy (b) Potential energy
(c) Electrical energy (d) Chemical energy

118. The motion of a car along a straight path is shown by the following figure:



The car starts O and reaches at A, B and C at different instants of time. During its motion from O to C and back to B, the distance covered and the magnitude of the displacement are, respectively
(a) 25 km and 60 km (b) 95 km and 35 km
(c) 60 km and 25 km (d) 85 km and 35 km

119. Jelep La pass is located in
(a) Punjab Himalaya (b) Sikkim Himalaya
(c) Kumaon Himalaya (d) Kashmir Himalaya

120. What is the number of mole(s) of $H_2(g)$ required to saturate one mole benzene?

(a) 1 (b) 2
(c) 3 (d) 4

121. Which one of the following pairs of the Schedule in the Constitution of India and its Content is ***not*** correctly matched?

	Schedule		*Content*
(a)	Eighth Schedule	:	Languages
(b)	Second Schedule	:	The forms of oaths and affirmations
(c)	Fourth Schedule	:	Allocation of seats in the Council of States
(d)	Tenth Schedule	:	Provisions as to disquialification on the ground of defection

122. Consider the following statements:

1. The Constitution of India empowers the Parliament to form new States and to alter the areas, boundaries or names of existing States by passing a resolution in simple majority.
2. Jammu and Kashmir has been given special status under Article 370 of the Constitution of India.

Which of the statements given above is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

123. The Speaker of the Lok Sabha may resign his office by writing, addressed to the

(a) President of India
(b) Prime Minister of India
(c) Vice President of India
(d) Deputy Speaker of the Lok Sabha

124. Who among the following is the founder of the '*Bachpan Bachao Andolan*'?

(a) Shantha Sinha (b) Kailash Satyarthi
(c) Aruan Roy (d) Anil Agarwal

125. Which of the following are the features of *Pradhan Mantri Jan Dhan Yojana*?

1. Ensuring financial inclusion of the poor
2. Enhancing financial literacy
3. Provision for accidental insurance to account holders
4. Allowing bank accounts with zero balance

Select the correct answer using the code given below:

(a) 1 and 4 only (b) 1, 2 and 3 only
(c) 2 and 4 only (d) 1, 2, 3 and 4

126. The Election Commission recognizes a political party as a national party if

1. it secures at least six percent of the total valid votes polled in four or more States in a general election to the Lok Sabha or to the State Legislative Assemblies.
2. it wins at least four seats in a general election to the Lok Sabha from any State or States.

Select the correct answer using the code given below:

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

127. Which one of the following is ***not*** a feature of the Nehru-Mahalanobis model of development strategy ?

(a) Development of capital goods industries
(b) Major involvement of the State in the economy
(c) Industrial deregulation and disinvestment in the public sector
(d) Enhancing the scope and importance of the public sector

128. Which of the following best explains the stated broad vision and aspirations of the Twelfth Five Year Plan (2012-2017)?

(a) Faster, Substainable and More Inclusive Growth
(b) Modernisation of Industries and Strengthening Infrastructure.
(c) Enchancing Agricultural and Rural Incomes
(d) Checking Inflation and Strengthening non-economic variables like Nutritional Requirements, Health and Family Planing

129. *Nabhah Sprsain Diptam* is the motto of

(a) Central Industrial Security Force
(b) Indian Air Force
(c) ISRO
(d) Indian Navy

130. Consider the following statements:

1. The Amendment procedure has been provided in Artical 368 of the Constitution of India.
2. The consent of the States is mandatory for all Amendments to the Constitution of India.

Which of the statements given above is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

131. Which of the following statements relating to the comptroller and Auditor General (CAG) of India is/are correct?

1. The CAG can attend the sittings of the Committee on Public Accounts.
2. The CAG can attend the sittings of Lok Sabha and Rajya Sabha.
3. The jurisdiction of CAG is co-extensive with powers of the Union Governement.

Select the correct answer using the code given below:

(a) 1 only (b) 2 and 3 only
(c) 1 and 2 only (d) 1, 2 and 3

132. Which of the following statements relating to election as the President of India is/are correct?

1. A person above the age of thirty-five years is eligible for election as the President of India.
2. The President of India is eligible for re-election for more than one term.
3. A person is not eligible for election as the President of India if the person holds an office of profit.

Select the correct answer using the code given below:

(a) 1 and 2 only (b) 2 only
(c) 1, 2 and 3 (d) 3 only

133. Which one of the following nations adopted its first democratic constitution in September 2015?

(a) Bhutan (b) Myanmar
(c) Nepal (d) Singapore

134. Who among the following was defeated by Novak Djokovic in the final of the US Open Tennis Tournament Men's Singles event (2015)?

(a) Tommy Robredo (b) Fabio Fognini
(c) Roger Federer (d) Pablo Cuevas

135. The citizens of India do ***not*** have which one of the following Fundamental Rights?

(a) Right to reside and settle in any part of India
(b) Right to acquire, hold and dispose of property
(c) Right to practice any profession
(d) Right to form co-operative societies

136. Which one among the following Acts for the first time allowed Indians, at least theoretically, entry to higher posts in British Indian administration?
(a) Charter Act, 1813
(b) Charter Act, 1833
(c) Charles Wood's Education Despatch, 1854
(d) Indian Councils Act, 1861

137. Consider the following statements about Rashtrakuta kings:
1. They were ardent patrons of Shaivism and did not support other forms of religion.
2. They promoted only Sanskrit scholars and gave them large grants

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

138. After a ban on unscientific coal mining and transportation of coal in this region by the National Green Tribunal, many of those engaged in the activity have been switching to turmeric farming for their livelihood. The region referred above is
(a) Jaintia Hills, Meghalaya
(b) Koriya, Chhattisgarh
(c) Angul, Odisha
(d) Bardhaman, West Bangal

139. Which of the following statements about the first act of the Revolt of 1857 is/are true?
1. It occurred in Meerut, when two sepoys stole a superior officer's rifle.
2. It began when the Rani of Jhansi declared war on the British.
3. It began when Mangal Pandey fired at a European officer in Meerut.
4. It began when Mangal Pandey fired at a European officer in Barrackpore.

Select the correct answer using the code given below:
(a) 2 only (b) 1, 2 and 3 only
(c) 4 only (d) 1 and 4 only

140. Which of the following statements about *Gandhiji's Hind Swaraj* written in 1909 is/are true?
1. *Hind Swaraj* offers a civilizational concept of the Indian nation.
2. *Hind Swaraj* states that Parliamentary democracy was necessary for the amelioration of the sufferings of Indians.
3. *Hind Swaraj* argues that Industrial capitalism was responsible for the immorality of society.

Select the correct answer using the code given below:
(a) 3 only (b) 1, 2 and 3
(c) 1 and 3 only (d) 1 only

141. Division of labour often involves
1. specialized economic activity.
2. higly distinct productive roles.
3. involving everyone in many of the same activities.
4. individuals engage in only a single activity and are dependent on others to meet their various needs.

Select the correct answer using the code given below:
(a) 1, 3 and 4 only (b) 1, 2 and 4 only
(c) 3 only (d) 2 and 4 only

142. Who among the following is/was associated with 'Maharashtra Andhashraddha Nirmoolan Samiti'?
(a) Chandi Prasad Bhatt (b) Narendra Dabholkar
(c) G.D. Agrawal (d) Kailash Satyarthi

143. Consider the following statements:
1. Warran Hastings set up the Calcutta Madrassa for the study and teaching of Muslim law related subjects.
2. Jonathan Duncan started a Sanskrit College at Varanasi for the study of Hindu law and philiosophy.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

144. Consider the following statements about Sufism in India:
1. Pilgrimage called *ziyarat* to tombs of Sufi saints is an important feature.
2. The most influential group of Sufis in India were the Chishtis.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

145. Which of the following thinkers and movements influenced the development of Gandhiji's politial ideas ?
1. Henry David Thoreau
2. John Ruskin
3. John Milton
4. Jainism

Select the correct answer using the code given below:
(a) 1 only (b) 1, 2 and 3 only
(c) 1, 2 and 4 only (d) 2 and 4 only

146. Consider the following statements:
1. The *Arthashastra* is the first Indian text to define a State.
2. The main concerns of the *Arthashastra* are theoretical issues like the origins of the state.

Which of the statements given above is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

147. Which of the following is/are ***not*** FDI policy change(s) after 2010?
1. Permission of 100 percent FDI in automotive sector.
2. Permitting foreign airlines to make FDI up to 49 percent
3. Permission of up to 51 percent FDI under the government approval route in multi-brand retailing, subject to specified conditions
4. Amendment of policy on FDI in single-brand product retail trading for aligning with global practices

Select the correct answer using the code given below:
(a) 1 only (b) 2 and 4 only
(c) 1 and 2 only (d) 1, 2 and 3 only

148. Which of the following is/are the component/components of the Integrated Power Development Scheme launched by the Government of India recently ?
1. Strengthening of sub-transmission and distribution networks in the urban areas
2. Metering of distribution transformers/feeders/ consumers in the rural areas

Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

149. Which of the following statements about Brahmo Samaj is/are correct?

1. The Brahmo Marriage Act of 1872 allowed inter-caste and widow re-marriage only if the contracting parties declared themselves to be non-Hindus.
2. Keshub Chandra Sen arranged the marriage of his minor daughter with the Maharaja of Burdwan.
3. Keshub Chandra Sen's followers broke away to form the Naba Brahmo Samaj.
4. The Brahmo Samaj grew from a small elite group to a mass movement in the 19th century.

Select the correct answer using the code given below:

(a) 1 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1, 2, 3 and 4

150. Which of the following statements about the aims of the United Nations is/are ture?

1. To foster a mutual appreciation of each other's culture and literature among nations
2. To achieve international co-operation in solving problems of an economic, social, cultural, or humanitarian character
3. To foster relations between scholars and academics in different countries
4. To organize international conferences

Select the correct answer using the code given below:

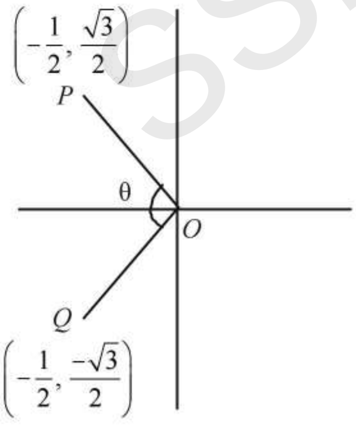
(a) 1 only (b) 1, 2 and 4 only
(c) 2 only (d) 1, 2 and 3 only

NDA 1 2016 Solutions

1. (a) $\because \omega = \frac{-1}{2} + i\frac{\sqrt{3}}{2}$

$\& \ \omega^2 = \frac{-1}{2} - i\frac{\sqrt{3}}{2}$

$-\frac{1}{2} + \frac{\sqrt{3}}{2}i$ $\quad (\because \omega \neq 1)$



P and Q are points on complex plane.
Angle between OP and OQ is

$$\theta = \tan^{-1}\left|\frac{m_1 - m_2}{1 + m_1 m_2}\right|$$

m_1 for line OP, $\quad$ m_2 for line OQ

$$m_1 = \frac{\frac{\sqrt{3}}{2} - 0}{\frac{-1}{2} - 0} \qquad m_2 = \frac{\frac{-\sqrt{3}}{2} - 0}{\frac{-1}{2} - 0}$$

$$\Rightarrow m_1 = -\sqrt{3} \qquad \Rightarrow m_2 = \sqrt{3}$$

$$\theta = \tan^{-1}\left[\frac{-\sqrt{3} - \sqrt{3}}{1 + (-\sqrt{3})(\sqrt{3})}\right]$$

$$= \tan^{-1}\left[\frac{-2\sqrt{3}}{-2}\right] = \tan^{-1}\sqrt{3} = \tan^{-1}\tan\frac{\pi}{3}$$

$$\theta = \frac{\pi}{3}$$

$$\boxed{\theta = 60^\circ}$$

2. (a) x and y are positive numbers.

$x \leq y^2$

Reflexive -

$x \leq x^2 \ \forall$ positive numbers.

Hence relation is reflexive.

Transitive -

$x \leq y^2 \qquad y \leq z^2$

Let $x = 5, y = 3, z = 2$

$5 \leq (3)^2 \qquad (3) \leq (2)^2$

but $5 \nleq (2)^2$

Hence, $x \leq y^2 \qquad y \leq z^2$

but $x \nleq z^2$

Thus relation is not transitive.

Symmetric

$1 \leq (2)^2$ while $2 \nleq (1)^2$

Hence relation is not symmetric.

Thus $x \leq y^2 \ \forall$ positive numbers is reflexive, but not transitive and symmetric.

3. (a) $x^2 - px + 4 > 0 \ \forall$ real values of x.

If $b^2 - 4ac < 0$

$\Rightarrow p^2 - 4(1)(4) < 0$

$\Rightarrow p^2 < 16 \Rightarrow |p| < 4$

4. (a) $z = x + iy$

$$= \left(\frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}\right)^{-25}$$

$$= \left[\cos\frac{\pi}{4} - i\sin\frac{\pi}{4}\right]^{-25}$$

$\because$ (Cosπ – i Sinπ)^n = Cosπ – i Sinπ

$$\begin{bmatrix} \cos(-\theta) = \cos\theta \\ \sin(-\theta) = -\sin\theta \end{bmatrix}$$

$$z = \left[\cos\left(\frac{25\pi}{4}\right) + i\sin\left(\frac{25\pi}{4}\right)\right]$$

$$= \left[\cos\left(6\pi + \frac{\pi}{4}\right) + i\sin\left(6\pi + \frac{\pi}{4}\right)\right]$$

$$= \cos\frac{\pi}{4} + i\sin\frac{\pi}{4}$$

$$= \frac{1+i}{\sqrt{2}}$$

$$\frac{z-\sqrt{2}}{z-i\sqrt{2}} = \frac{(1+i-2)\sqrt{2}}{\sqrt{2}(1+i-2i)}$$

$$= \frac{-1+i}{1-i} = -1$$

Amplitude $= \tan^{-1}\frac{b}{a} = \tan^{-1}\left(\frac{0}{-1}\right) = \tan^{-1}0$

$$= \tan^{-1}(\tan\pi) = \pi$$

Hence fundamental amplitude of $\left(\frac{z-\sqrt{2}}{z-i\sqrt{2}}\right)$ is π.

5. (a) $f(x_1) - f(x_2) = f\left(\frac{x_1 - x_2}{1 - x_1x_2}\right)$

$x_1, x_2 \in (-1, 1)$

then $f(x) = \log\frac{(1-x)}{(1+x)}$

$f(x_1) = \log\frac{1-x_1}{1+x_1}$ $\qquad$ $f(x_2) = \log\frac{1-x_2}{1+x_2}$

$$f(x_1) - f(x_2) = \log\frac{1-x_1}{1+x_1} - \log\frac{1-x_2}{1+x_2}$$

$$= \log\frac{(1-x_1)}{(1+x_1)} \times \frac{(1+x_2)}{(1-x_2)}$$

$$= \log\frac{(1-x_1+x_2-x_1x_2)}{(1+x_1-x_2-x_1x_2)}$$

$$= \log\frac{(1-x_1x_2)-(x_1-x_2)}{(1-x_1x_2)+(x_1-x_2)}$$

$$= \log\frac{1-\left(\frac{x_1-x_2}{1-x_1x_2}\right)}{1+\left(\frac{x_1-x_2}{1-x_1x_2}\right)}$$

$$f(x_1) - f(x_2) = f\left(\frac{x_1-x_2}{1-x_1x_2}\right)$$

6. (a) Function $y = \frac{x^2}{1+x^2} \quad x \in R$

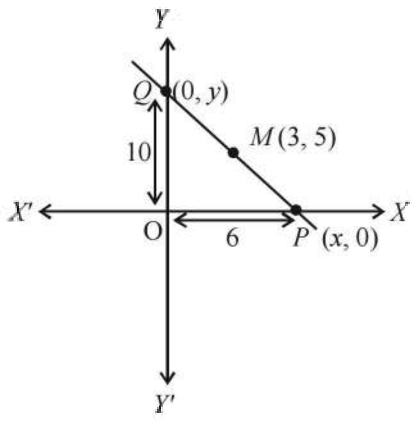
$x = 0$	$y = 0$
$x = 1, -1$	$y = \frac{1}{2}$
$x = 2, -2$	$y = \frac{4}{5}$
$x = 3, -3$	$y = \frac{9}{10}$
.	.
.	.
.	.

Clearly $0 \le y < 1$

$\Rightarrow y \in [0, 1)$

Hence Range of $y = [0, 1)$

7. (d) As we know that line PQ intersects x-axis and y-axis at P and Q.



$\because$ M is the mid point of PQ

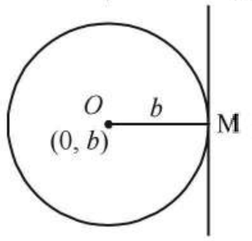
$\therefore \ \frac{x+0}{2} = 3$ and $\frac{0+y}{2} = 5$

$\Rightarrow x = 6$ and $y = 10$

Hence area of triangle $OPQ = \frac{1}{2} \times 6 \times 10 = 30$ sq. unit

8. (a) Distance from the centre to the point of line which touches circle is OM = radius

$$y = x - \sqrt{2} \ or \ x - y - \sqrt{2} = 0$$



$$r = \frac{|Ax_0 + By_0 + C|}{\sqrt{A^2 + B^2}}$$

$\because \ x_0 = 0$

& $Y_0 = b$

$$b = \frac{|1(0) + (-1)(b) - \sqrt{2}|}{\sqrt{(1)^2 + (-1)^2}}$$

$$b = \frac{b + \sqrt{2}}{\sqrt{2}}$$

$$(\sqrt{2} - 1)b = \sqrt{2}$$

$$\Rightarrow \boxed{b = 2 + \sqrt{2}}$$

9-11. $f(\theta) = 4(\sin^2\theta + \cos^4\theta)$

$$= 4(\sin^2\theta + \cos^2\theta(1 - \sin^2\theta))$$

$$= 4(\sin^2\theta + \cos^2\theta - \sin^2\theta\cos^2\theta)$$

$$= 4\left(1 - \frac{1}{4}\sin^2 2\theta\right) \qquad [\because \sin 2\theta = 2\sin\theta\cos\theta]$$

9. (d) For maximum value of $f(\theta)$, $\sin^2 2\theta$ should be minimum. i.e. $\sin^2 2\theta = 0$

$$f(\theta)|_{max} = 4(1 - 0) = 4$$

10. (d) For minimum value of $f(\theta)$, $\sin^2 2\theta$ should be maximum i.e. $\sin^2 2\theta = 1$.

$$f(\theta)|_{min} = 4\left(1 - \frac{1}{4}(1)\right) = 4 \times \frac{3}{4} = 3$$

11. (c) $f(\theta) = 2$

$$4\left(1 - \frac{1}{4}\sin^2 2\theta\right) = 2$$

$$\Rightarrow 1 - \frac{1}{4}\sin^2 2\theta = \frac{2}{4}$$

$$\Rightarrow -\frac{1}{4}\sin^2 2\theta = +\frac{1}{2} - 1$$

$$\Rightarrow -\frac{1}{4}\sin^2 2\theta = -\frac{1}{2}$$

$$\Rightarrow \sin^2 2\theta = 2$$

$$\Rightarrow \sin 2\theta = \pm\sqrt{2}$$

Since sin θ cannot have vlaue greater than 1 & less than –1.

Hence $f(\theta) = 2$ has no solution.

$$f(\theta) = \frac{7}{2}$$

$$4\left(1 - \frac{1}{4}\sin^2 2\theta\right) = \frac{7}{2}$$

$$\Rightarrow \left(1 - \frac{1}{4}\sin^2 2\theta\right) = \frac{7}{8}$$

$$\Rightarrow -\frac{1}{4}\sin^2 2\theta = \frac{7}{8} - 1$$

$$\Rightarrow -\frac{1}{4}\sin^2 2\theta = -\frac{1}{8}$$

$$\Rightarrow \sin^2 2\theta = \frac{1}{2}$$

$$\Rightarrow \sin 2\theta = \pm\frac{1}{\sqrt{2}}$$

$$\Rightarrow \sin 2\theta = \pm\sin\frac{\pi}{4}$$

$$\Rightarrow \sin 2\theta = \sin(\pm\pi/4)$$

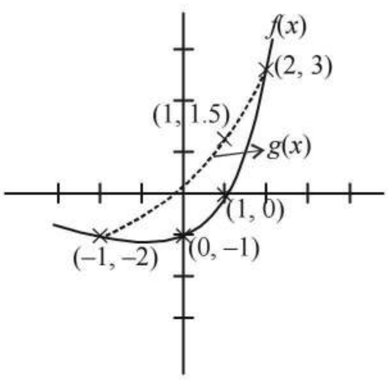
$$\Rightarrow 2\theta = \pm\pi/4$$

$$\boxed{\theta = (\pm)\frac{\pi}{8}}$$

Hence $f(\theta) = \frac{7}{2}$ has a solution.

12. (c) $f(x) = x|x| - 1$

$$f(x) = \begin{cases} x^2 - 1 & x > 0 \\ -x^2 - 1 & x \le 0 \end{cases} \qquad g(x) = \begin{cases} \frac{3x}{2} & x > 0 \\ 2x & x \le 0 \end{cases}$$



Hence $f(x)$ and $g(x)$ intersects at (–1, –2) and (2, 3).

13. (b) Area $=\int_{-1}^{2}[g(x)-f(x)]dx$

$$=\int_{-1}^{0}[g(x)-f(x)]dx+\int_{0}^{2}[g(x)-f(x)]dx$$

$$=\int_{-1}^{0}(2x+x^2+1)dx+\int_{0}^{2}\left[\frac{3x}{2}-x^2+1\right]dx$$

$$=I_1+I_2$$

$$I_1=\left(\frac{2x^2}{2}+\frac{1}{3}x^3+x\right)_{-1}^{0}$$

$$=(0+0+0)-\left((-1)^2+\frac{1}{3}(-1)^3+(-1)\right)$$

$$=-\left(1-\frac{1}{3}-1\right)=\frac{1}{3}$$

$$I_2=\int_{0}^{2}\left[\frac{3x}{2}-x^2+1\right]dx$$

$$=\left[\frac{3}{2}\frac{x^2}{2}-\frac{1}{3}x^3+x\right]_0^2$$

$$=\left(\frac{3}{4}\times 4-\frac{1}{3}\times 8+2\right)-(0)$$

$$=5-\frac{8}{3}=\frac{7}{3}$$

Area $=I_1+I_2=\frac{1}{3}+\frac{7}{3}$

$\boxed{\text{Area}=\frac{8}{3}}$ square units.

(14-15) : $f(x)=\frac{27}{4}(x^{2/3}-x)$

$$=\frac{27}{4}((x^2)^{1/3}-x)$$

14. (b) For $f(x)=1$

$$\frac{27}{4}((x^2)^{1/3}-x)=1$$

$$(x^{1/3})^2-x=\frac{4}{27}$$

Put $x^{1/3}=y$

$x=y^3$

$$y^2-y^3=\frac{4}{27}$$

$$\Rightarrow y^3-y^2+\frac{4}{27}=0$$

$$\Rightarrow 27y^3-27y^2+4=0$$

This is a cubic equation.

If we put $y=-\frac{1}{3}$ then $(3y+1)=0$ is a factor of cubic equation.

$$\begin{array}{r|l} 3y+1 & 27y^3-27y^2+4 \;(9y^2-12y+4 \\ & \underline{27y^3+9y^2} \\ & -36y^2+4 \\ & \underline{-36y^2-12y} \\ & 12y+4 \\ & \underline{12y+4} \\ & \times \end{array}$$

$$(3y+1)(9y^2-12y+4)=0$$

$$(3y+1)(3y-2)^2=0$$

Hence $y=-\frac{1}{3},\frac{2}{3}$

Thus $f(x)=1$ has two solutions.

15. (b) Similarly for $f(x)=-1$ we will get $27y^3-27y^2-4=0$ and after solving it we will find that it has two solutions.

$y_0=1.1184,-0.05922.$

16. (b) $\int_{1/3}^{1/2}g(x)dx$

$$g(x)=\begin{cases}2, & \text{if } \frac{1}{3}<x\le\frac{1}{2}\\ 3, & \text{if } x=\frac{1}{3}\end{cases}$$

As g(x) is a gretest integer function so value of g(x) in integral limit will be

So $\int_{1/3}^{1/2}g(x)\,dx=\int_{1/3}^{1/2}2\,dx$

$$=2[x]_{1/3}^{1/2}$$

$$=2\left[\frac{1}{2}-\frac{1}{3}\right]$$

$$=\frac{1}{3}$$

17. (a) $\int_{1/3}^{1} f(x)\,dx = \int_{1/3}^{1/2} f(x)\,dx + \int_{1/2}^{1} f(x)\,dx$ ...(1)

f(x)=xg(x)

$g\left(\frac{1}{3}\right)=3 \quad g\left(\frac{1}{2}\right)=2 \quad g(1)=1$

The value of g(x) in value $\left(\frac{1}{2},\frac{1}{3}\right)$ will be 2 and in range $\left(\frac{1}{2},1\right)$ it will be 1

form (1)

$$\int_{1/3}^{1} f(x)\,dx = \int_{1/3}^{1/2} xg(x)\,dx + \int_{1/2}^{1} xg(x)\,dx.$$

$$= \int_{1/3}^{1/2} x\cdot 2\,dx + \int_{1/2}^{1} x\times 1\,dx.$$

$$= \left[x^2\right]_{1/3}^{1/2} + \left[\frac{x^2}{2}\right]_{1/2}^{1}$$

$$= \left[\frac{1}{4}-\frac{1}{9}\right] + \frac{1}{2}\left[1-\frac{1}{4}\right]$$

$$= \frac{5}{36}+\frac{3}{8} = \frac{37}{72}$$

18. (b) $f(x) = |x-1| + x^2 \quad \forall \quad x \in R$

$f_1(x) = |x-1|,\ f_2(x) = x^2$

$f_1(x)$ and $f_2(x)$ both are continuous. Hence $f(x)$ is continuous.

$f(x)$ in differentiable at $x=0$

$f_1(x)$ is not differentiable at $x=1$.

Hence $f(x)$ is continuous but not differentiable at $x=1$.

19. (b) As we know,

$f(x) = |x-1| + x^2 \quad \forall \quad x \in R$

$$f(x) = \begin{cases} x-1+x^2 & x \geq 1 \\ 1-x+x^2 & x < 1 \end{cases}$$

$$\Rightarrow f'(x) = \begin{cases} 2x+1 \;; & x \geq 1 \\ 2x-1 \;; & x < 1 \end{cases}$$

$f(x)$ is in quadratic form (parabola). Hence $f(x)$ is decreasing in $\left(-\infty, \frac{1}{2}\right)$ and increasing $\left(\frac{1}{2}, \infty\right)$.

20. (c) $f(x)$ has local minimum at one point only in $(-\infty, \infty)$.

$$f'(x) = \begin{cases} 2x-1 \;; & x < 1 \\ 2x+1 \;; & x \geq 1 \end{cases}$$

Clearly; for $(x > 1)$; $f'(x) > 0 \geq$ & for $(x < 1)$

$x = \frac{1}{2}$ is the point of local minima

21. (a) $f(x) = \begin{cases} x^2+x-1 & x \geq 1 \quad \forall \quad x \in R \\ x^2-x+1 & x < 1 \end{cases}$

Hence area required for given region is

$$A_1 = \int_{1/2}^{1} f(x)\,dx$$

$$= \int_{1/2}^{1} (x^2-x+1)\,dx$$

$$= \left[\frac{1}{3}x^3 - \frac{x^2}{2} + x\right]_{1/2}^{1}$$

$$= \left(\frac{1}{3}\times 1 - \frac{1}{2} + 1\right) - \left(\frac{1}{3}\times\frac{1}{8} - \frac{1}{2}\times\frac{1}{4} + \frac{1}{2}\right)$$

$\boxed{A_1 = \frac{5}{12}}$ square unit.

22. (d) Area required for given region is

$$A_2 = \int_{1}^{3/2} f(x)\,dx$$

$$= \int_{1}^{3/2} [x^2+x-1]\,dx$$

$$= \left[\frac{1}{3}x^3 + \frac{1}{2}x^2 - x\right]_{1}^{3/2}$$

$$A_2 = \left(\frac{1}{3}\left(\frac{27}{8}\right) + \frac{1}{2}\left(\frac{9}{4}\right) - \frac{3}{2}\right) - \left(\frac{1}{3}(1) + \frac{1}{2}(1) - 1\right)$$

$\boxed{A_2 = \frac{11}{12}}$ square unit

23. (c) $a_n = \int_0^{\pi} \frac{\sin^2\{(n+1)x\}}{\sin 2x}\,dx$

Since it is a definite integral will have a definite value.

The sequence $\{a_{2n}\}$ is in AP with common difference.

Statement (1) is correct.

The sequence $\{a_{2n+1}\}$ is also in AP with common difference.

Statement (2) is correct.

24. (b) $\because$ given sequence a_n also AP with no difference.

Thus $a_{n-1} - a_{n-4} = 0$

25. (d) $x + |y| = 2y$

$x = 2y - |y|$

$2y - |y| = x$

$2y - y = x$ [for $y \geq 0$]

$y = x$

$2y + y = x$ [for $y < 0$]

$3y = x$

$y = \frac{1}{3}x$

$y = \begin{cases} x & y \geq 0 \\ \frac{1}{3}x & y < 0 \end{cases}$ function is defined for all value of x.

or y = $\begin{cases} x & ; \ x \geq 0 \\ \frac{1}{3}x & ; \ x < 0 \end{cases}$

$\therefore$ by checking

y as a function of x is continuous at $x = 0$, but not differentiable at $x = 0$.

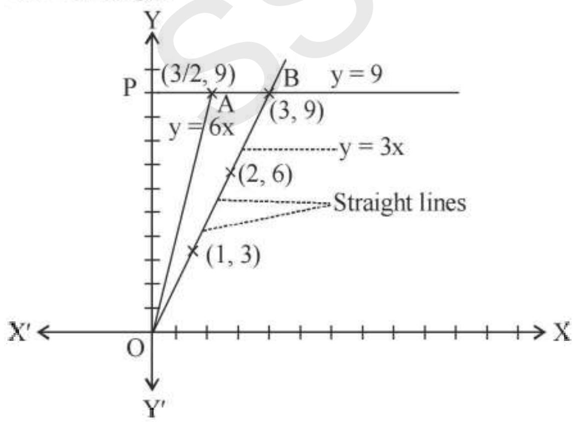
So all of the statements are not correct.

26. (d) $y = \frac{1}{3}x$ for $x < 0$.

Hence $\frac{dy}{dx} = \frac{1}{3}$

Option (d) is correct.

27. (a) OAB is triangle.



Area of triangle $= \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times \text{AB} \times \text{OP}$

$= \frac{1}{2} \times \frac{3}{2} \times 9 = \frac{27}{4}$

Area of triangle $= \frac{27}{4}$ square units

28. (b) Coordinates of O, A, B are $(0, 0)$ $\left(\frac{3}{2}, 9\right)$, $(3, 9)$ respectively.

$\therefore$ Centroid $C = \left[\left(\frac{0 + \frac{3}{2} + 3}{3}\right), \left(\frac{0 + 9 + 9}{3}\right)\right] = \left(\frac{3}{2}, 6\right)$

29. (c) $f(x) = (x-1)^2(x+1)(x-2)^3$

$f'(x) = 2(x-1)(x+1)(x-2)^3 + (x-1)^2(x-2)^3 + (x-1)^2(x+1)3(x-2)^2$

$= (x-1)(x-2)^2[2(x+1)(x-2) + (x-1)(x-2) + 3(x-1)(x+1)]$

$f'(x) = (x-1)(x-2)^2[2x^2 - 2x - 4 + x^2 - 3x + 2 + 3x^2 - 3]$

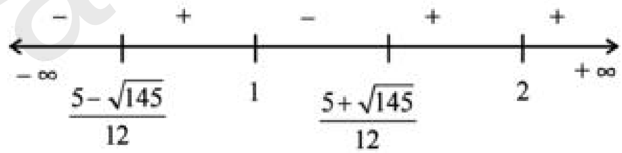
$= (x-1)(x-2)^2[6x^2 - 5x - 5]$

For maxima and minima

$f'(x) = 0$

$(x-1)(x-2)^2[6x^2 - 5x - 5] = 0$

$x = 1, 2, 2, \frac{5 \pm \sqrt{145}}{12}$ The change in signs of $f'(x)$ for diffrent values of x is shown:



$\therefore$ Local Minima are

$x = \frac{5 - \sqrt{145}}{12}$ & $x = \frac{5 + \sqrt{145}}{12}$

30. (b) Local Maxima is $[x = 1]$

31. (a) $f''(x) = g''(x)$

integrate b|s w.r.t. (x)

$f'(x) + C_1 = g'(x) + C_2$ ...(1)

Putting $x = 1$

$f'(1) + C_1 = g'(1) + C_2$

$\Rightarrow C_1 - C_2 = g'(1) - f'(1)$

$\Rightarrow C_1 - C_2 = 6 - 4 = 2$

again integrating equation (1)

$f(x) + C_1 x + a_1 = g(x) + C_2 x + a_2$ ...(3)

Putting $x = 2$

$f(2) + C_1 \times 2 + a_1 = g(2) + 2C_2 + a_2$

$\Rightarrow a_1 - a_2 = g(2) + 2C_2 - 2C_1 - f(2)$

$= 9 - 3 - 2(C_1 - C_2)$

$= 6 - 2 \times 2 = 2$

$\Rightarrow a_1 - a_2 = 2$

Rearranging equation (3) again, we get

$f(x) - g(x) = -x(C_1 - C_2) - (a_1 - a_2)$

Putting $x = 4$, we get

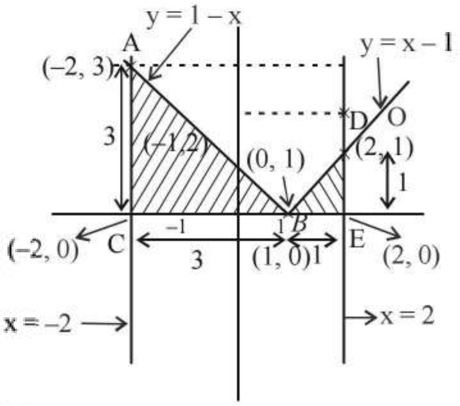
$[f(x) - g(x)]_{x=4} = -4(C_1 - C_2) - (a_1 - a_2)$

$= -4 \times (2) - 2$

$[f(x) - g(x)]_{x=4} = -10$

32. (c) $y = |x-1|$ and $|x| = 2$

$$y = \begin{cases} x-1 & x \geq 1 \\ 1-x & x < 1 \end{cases}$$



and $x = 2$

$x = -2$

Hence curves intersect at $(-2, 3)$ and $(2, 1)$.

33. (c) Bounded region is shaded.

So area of bounded region has two triangles *ACB* and *BDE*.

$$\text{Area of } \Delta ACB = \frac{1}{2} \times 3 \times 3 = \frac{9}{2}$$

$$\text{Area of } \Delta BDE = \frac{1}{2} \times 1 \times 1 = \frac{1}{2}$$

Area of region bounded by curves and x-axis is

$$\text{Area} = \Delta ACB + \Delta BDE = \frac{9}{2} + \frac{1}{2} = 5 \text{ square units}$$

34. (d) $f(x) = \begin{vmatrix} x^3 & \sin x & \cos x \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix}$

$$f'(x) = \begin{vmatrix} 3x^2 & \cos x & -\sin x \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix} + \begin{vmatrix} x^3 & \sin x & \cos x \\ 6 & -1 & 0 \\ 0 & 0 & 0 \end{vmatrix} + \begin{vmatrix} x^3 & \sin x & \cos x \\ 0 & 0 & 0 \\ p & p^2 & p^3 \end{vmatrix}$$

$$f'(x) = \begin{vmatrix} 3x^2 & \cos x & -\sin x \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix}$$

$$f'(0) = \begin{vmatrix} 0 & \cos 0 & -\sin 0 \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix}$$

$$= -6p^3$$

35. (a)

$$f''(x) = \begin{vmatrix} 6x & -\sin x & -\cos x \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix}$$

$$f''(0) = \begin{vmatrix} 0 & 0 & -\cos 0 \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix}$$

$$= -1\,(6p^2 + p)$$

$f''(0) = 0$

$-(6p^2 + p) = 0$

$p\,(6p + 1) = 0$

$p = 0$ or $p = -\frac{1}{6}$

36. (c) Given $\cos A + \cos B + \cos C = \sqrt{3} \sin \frac{\pi}{3}$

$\cos A + \cos B + \cos C$

$$= 2\cos\frac{A+B}{2}.\cos\frac{A-B}{2} + \left(1 - 2\sin^2\frac{C}{2}\right)$$

$$= 2\sin\frac{C}{2}\cos\frac{A-B}{2} + 1 - 2\sin^2\frac{C}{2}$$

$$\left(\because \frac{A+B}{2} = 90^\circ - \frac{C}{2}\right)$$

$$= 1 + 2\sin\frac{C}{2}\left[\cos\frac{A-B}{2} - \sin\frac{C}{2}\right]$$

$$= 1 + 2\sin\frac{C}{2}\left[\cos\frac{A-B}{2} - \cos\frac{A+B}{2}\right]$$

$$= 1 + 4\sin\frac{C}{2}\sin\frac{A}{2}\sin\frac{B}{2}$$

$$\cos A + \cos B + \cos C = \sqrt{3}\sin\frac{\pi}{3}$$

$$1 + 4\sin\frac{C}{2}\sin\frac{A}{2}\sin\frac{B}{2} = \sqrt{3}\sin\frac{\pi}{3}$$

$$\Rightarrow 1 + 4\sin\frac{C}{2}\sin\frac{A}{2}\sin\frac{B}{2} = \sqrt{3} \times \frac{\sqrt{3}}{2}$$

$$\Rightarrow 4\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2} = \frac{3}{2} - 1$$

$$\boxed{\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2} = \frac{1}{8}}$$

37. (d) As we know that

$$\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2} = \frac{1}{8}$$

$$\because \left(\frac{A+B}{2} = \frac{\pi}{2} - \frac{C}{2}\right)$$

$$\therefore \boxed{\cos\left(\frac{A+B}{2}\right)\cos\left(\frac{B+C}{2}\right)\cos\left(\frac{C+A}{2}\right) = \frac{1}{8}}$$

38. (d) $x^2+bx+c=0 \qquad b \neq 0$

$\because$ tan α and tan β are roots of equation.

$\therefore \tan\alpha+\tan\beta=\frac{-b}{1}=-b \qquad ...(1)$

$\therefore \tan\alpha\tan\beta=\frac{c}{1}=c$

$\tan(\alpha+\beta)=\frac{\tan\alpha+\tan\beta}{1-\tan\alpha\tan\beta}=\frac{-b}{1-c}$

$=b(c-1)^{-1}$

39. (b) $\sin(\alpha+\beta)\sec\alpha\sec\beta$

$=\frac{\sin\alpha\cos\beta+\cos\alpha\sin\beta}{\cos\alpha\cos\beta}$

$=\tan\alpha+\tan\beta$

$=-b$

(40–41) : Given equation of circles

$(x-1)^2+(y-3)^2=r^2$

$(h_1, k_1) \equiv$ coordinates of centre $\equiv (1, 3)$

$\therefore x^2+y^2-8x+2y+8=0$

$\Rightarrow (x-4)^2+(y+1)^2=(3)^2$

$(h_2, k_2) \equiv$ coordinates of centre $\equiv (4, -1)$

40. (a) Distance between centres of two circles

$d=\sqrt{(h_1-h_2)^2+(k_1-k_2)^2}$

$\Rightarrow d=\sqrt{(1-4)^2+(3+1)^2}$

$\Rightarrow d=\sqrt{25}$

$d=5$ units

41. (d) Radius of circle one $=r_1=r$

Radius of circle two $=r_2=3$

$\because$ Circle intersects at two points so distance between circle is $d<r_1+r_2$

$5<r+3$

$r>2$

(42–43) : Equations of lines

$x+y+1=0$

$3x+2y+1=0$

$$\begin{array}{r} 3x+3y+3=0 \\ 3x+2y+1=0 \\ - \quad - \quad - \quad - \\ \hline y=-2 \\ x=1 \end{array}$$

Points of intersection $(1, -2)$.

42. (d) Equation of x-axis

$y=0$

Line parallel to x axis is

$y=k$

If this line passes through $(1, -2)$ then

$k=-2$

$\Rightarrow y=-2$

$\Rightarrow y+2=0$

Equation of line passing through $(1, -2)$ and parallel to x-axis is

$y+2=0$

43. (b) Equation of y-axis

$x=0$

Equation of line parallel to y-axis is

$x=k$

If this line passes through $(1, -2$ then)

$x=1$

Hence equation of line which passes through point of intersection of given line $(1, -2)$ and parallel to y-axis

$x=1$

$\Rightarrow x-1=0$

44. (b) $K\sin x+\cos 2x=2K-7$

$K\sin x+(1-2\sin^2 x)=(2K-7)$

$2\sin^2 x-K\sin x+(2K-8)=0$

This is a quadratic equation in $\sin x$.

$\sin x=\frac{-(-K)\pm\sqrt{K^2-4(2)(2K-8)}}{2\times 2}$

For minimum value of K

$\sin x=-1$

$\Rightarrow \frac{K\pm\sqrt{K^2-16K+64}}{4}=-1$

$\Rightarrow (\pm)\sqrt{K^2-16K+64}=-K-4$

Squaring both sides, we get

$K^2-16K+64=K^2+16+8K$

$\Rightarrow 24K=48$

$\Rightarrow K=2$

45. (d) For maximum value of K

$\sin x=1$

$\frac{K\pm\sqrt{K^2-16K+64}}{4}=1$

$\Rightarrow (\pm)\sqrt{K^2-16K+64}=(-K+4)$

Squaring both sides, we get

$K^2-16K+64=K^2+16-8K$

$\Rightarrow 8K=48$

$\Rightarrow K=6$

46. (b) Given $f(x)=\frac{a^{[x]+x}-1}{[x]+x}$

$\therefore \lim_{x\to 0^+} f(x)=\lim_{h\to 0}\frac{a^{[0+h]+(0+h)}-1}{[0+h]+(0+h)}$

$=\lim_{h\to 0}\frac{a^{[h]+(h)}-1}{[h]+h}$

$=\lim_{h\to 0}\frac{(a^h-1)}{h}$

$=\log_e a$

47. (c) $\lim_{x\to 0^-} f(x) = \lim_{h\to 0}\left[\dfrac{a^{[0-h]+(0-h)}-1}{[0-h]+(0-h)}\right]$

$$= \lim_{h\to 0}\frac{a^{[-h]-h}-1}{[-h]+(-h)}$$

$$= \lim_{h\to 0}\frac{a^{-1-h}-1}{-1-h}$$

$$= \frac{a^{-1-0}-1}{-1-0} = \frac{a^{-1}-1}{-1}$$

$$= \lim_{h\to 0^-} f(x) = (1-a^{-1})$$

48. (c) Given $z^2 = i\bar{z}$

Let us suppose that $z = x+iy$

$\Rightarrow (x+iy)^2 = i(x-iy)$

$\Rightarrow x^2 - y^2 + 2xyi = ix + y$

Comparing real and imaginary part of both sides

$x^2 - y^2 = y$ and $2xy = x$.

Taking $2xy = x$

$(2y-1)x = 0$

$\Rightarrow x = 0$ and $y = \dfrac{1}{2}$

if $x = 0$

$\therefore y + y^2 = 0$ $\quad (\because x^2 - y^2 = y)$

$y(y+1) = 0$

$y = 0$ and -1

$x = 0$ $\quad y = 0$ and -1

If $y = \dfrac{1}{2}$

$x^2 - \dfrac{1}{4} = \dfrac{1}{2}$

$\Rightarrow x^2 = \dfrac{3}{4}$

$\Rightarrow x = \pm\dfrac{\sqrt{3}}{2}$

Since given numbers are non zero complex numbers.

So, $z_1 = 0 + (-1)i = -i$

$z_2 = \dfrac{\sqrt{3}}{2} + \dfrac{1}{2}i \qquad z_3 = \dfrac{-\sqrt{3}}{2} + \dfrac{1}{2}i$

$z_1 + z_2 + z_3 = (-i) + \left(\dfrac{\sqrt{3}}{2} + \dfrac{1}{2}i\right) + \left(-\dfrac{\sqrt{3}}{2} + \dfrac{1}{2}i\right) = 0$

Hence $z_1 + z_2 + z_3 = 0$

49. (c) $z_1z_2z_3 = (-i)\left(\dfrac{\sqrt{3}+i}{2}\right)\left(\dfrac{-\sqrt{3}+i}{2}\right)$

$$= \frac{-i}{4}(i^2 - (\sqrt{3})^2)$$

$$= \frac{-i}{4}(-3-1) = i$$

Hence $z_1z_2z_3$ is purely imaginary.

$z_1z_2 = -i\left(\dfrac{\sqrt{3}+i}{2}\right) = \dfrac{-\sqrt{3}i+1}{2}$

$z_2z_3 = \dfrac{(\sqrt{3}+i)(-\sqrt{3}+i)}{4}$

$$= \left(\frac{-3-\sqrt{3}i+\sqrt{3}i+i^2}{4}\right) = -1$$

$z_3z_1 = \dfrac{(-\sqrt{3}+i)(-i)}{2} = \dfrac{+\sqrt{3}i+1}{2}$

$z_1z_2 + z_2z_3 + z_3z_1 = \left(\dfrac{-\sqrt{3}i+1}{2}\right) + (-1) + \left(\dfrac{\sqrt{3}i+1}{2}\right)$

$$= \left(\frac{-\sqrt{3}i+1+\sqrt{3}i+1}{2}\right) - 1$$

$$= 0 \in R$$

Hence $z_1z_2 + z_2z_3 + z_3z_1 = 0$ is purely real.

Hence both statements are correct.

50. (c) Given $\log_x y$, $\log_z x$, $\log_y z$ are in G.P.

$\therefore (\log_z x)^2 = (\log_x y)(\log_y z)$

$\left(\dfrac{\log x}{\log z}\right)^2 = \left(\dfrac{\log y}{\log x}\right)\left(\dfrac{\log z}{\log y}\right) = \dfrac{\log z}{\log x}$

$\Rightarrow \left(\dfrac{\log x}{\log z}\right)^3 = 1$

$\Rightarrow \log x = \log z \Rightarrow x = z$

$\because xyz = 64$

$y = \dfrac{64}{x^2}$

Also given x^3, y^3 and z^3 are in A.P.

$\therefore y^3 = \dfrac{x^3+z^3}{2} = \dfrac{x^3+x^3}{2}$

$y^3 = x^3 \Rightarrow y = x$

$\Rightarrow x = y = z$

$x \,.\, y \,.\, z = 64$

$x = y = z = 4$

Thus x, y, z are in A.P. and G.P. both.

51. (c) Similarly xy, yz, zx are also in A.P. and G.P. both.

52. (a) $\left|\frac{z-4}{z-8}\right| = 1$ and $\left|\frac{z}{z-2}\right| = \frac{3}{2}$

$\Rightarrow |z-4| = |z-8|$

Let $z = x + iy$

$|x + iy - 4| = |x + iy - 8|$

Squaring both sides, we get

$[(x-4)^2 + y^2] = [(x-8)^2 + y^2]$

$(x-4)^2 = (x-8)^2$

$\Rightarrow x^2 + 16 - 8x = x^2 + 64 - 16x$

$\Rightarrow 8x = 48 \Rightarrow x = 6$

when $\left|\frac{z}{z-2}\right| = \frac{3}{2}$

$\Rightarrow 2|z| = 3|z-2|$

Squaring both sides, we get

$4(x^2 + y^2) = 9[(x-2)^2 + y^2]$

$\Rightarrow 4x^2 + 4y^2 = 9x^2 + 36 - 36x + 9y^2$

$\Rightarrow 5x^2 + 5y^2 - 36x + 36 = 0$

as we know $x = 6$

$5(6)^2 + 5y^2 - 36 \times 6 + 36 = 0$

$\Rightarrow 5y^2 = 0 \Rightarrow y = 0$

Hence $x = 6$ and $y = 0$.

$\Rightarrow z = 6$

$|z| = 6$

53. (d) $\left|\frac{z-6}{z+6}\right| = \left|\frac{6-6}{6+6}\right| = 0$

54. (c) Given

$$f(x) = \begin{cases} (x+\pi) & \text{for } x \in [-\pi, 0] \\ \pi\cos x & \text{for } x \in \left[0, \frac{\pi}{2}\right] \\ \left(x - \frac{\pi}{2}\right)^2 & \text{for } x \in \left(\frac{\pi}{2}, \pi\right] \end{cases}$$

For continuity,

$f(a) =$ L.H.L. $=$ R.H.L.

At $x = 0$

$f(0) = \pi\cos 0 = \pi$

L.H.L. $= \lim_{x\to 0^-} f(x-h)$

$= \lim_{h\to 0} f(-h)$

$= \lim_{h\to 0}(-h+\pi) = \pi$

R.H.L. $= \lim_{x\to 0^+} f(x+h)$

$= \lim_{h\to 0} f(0+h)$

$= \lim_{h\to 0} \pi\cos h$

$= \pi\cos 0 = \pi$

$f(0) =$ L.H.L. $=$ R.H.L.

Hence function is continuous at $x = 0$.

Statement (1) is correct.

At $x = \frac{\pi}{2}$

L.H.L. $= \lim_{x\to \frac{\pi}{2}^-} f(x-h)$

$= \lim_{h\to 0} f\left(\frac{\pi}{2} - h\right)$

$= \lim_{h\to 0} \pi\cos\left(\frac{\pi}{2} - h\right)$

$= \pi\cos\frac{\pi}{2} = 0$

R.H.L. $= \lim_{x\to \frac{\pi}{2}^+} f(x+h)$

$= \lim_{h\to 0} f\left(\frac{\pi}{2} + h\right)$

$= \lim_{h\to 0}\left(\frac{\pi}{2} + h - \frac{\pi}{2}\right)^2 = 0$

$f\left(\frac{\pi}{2}\right) = \pi\cos\frac{\pi}{2} = 0$

L.H.L. $=$ R.H.L. $= f\left(\frac{\pi}{2}\right)$

Hence function is continuous at $x = \frac{\pi}{2}$

Statement (2) is correct.

55. (d) For differentiability,

L.H.D. $=$ R.H.D.

Thus at $x = 0$

L.H.D. $= \lim_{h\to 0} \frac{f(0-h) - f(0)}{-h}$

$= \lim_{h\to 0} \frac{f(-h) - f(0)}{-h}$

$= \lim_{h\to 0} \frac{(-h+\pi) - (\pi\cos 0)}{-h} = 1$

L.H.D. $= 1$

R.H.D. $= \lim_{h\to 0} \frac{f(0+h) - f(0)}{h}$

$= \lim_{h\to 0} \frac{f(h) - f(0)}{h}$

$= \lim_{h\to 0} \frac{\pi\cos h - \pi\cos 0}{h}$

$$= \lim_{h\to 0} \frac{\pi[\cos h - 1]}{h}$$

$$= \lim_{h\to 0} \frac{\pi\left[1 - \frac{h^2}{2!} + \frac{h^4}{4!} \ldots\ldots - 1\right]}{h}$$

$$= \lim_{h\to 0} \frac{\pi\left[1 - \frac{1}{2}h^2 + \frac{1}{24}h^4 \ldots\ldots - 1\right]}{h}$$

$$= \lim_{h\to 0} \frac{\pi\left[-\frac{1}{2}h^2 + \frac{1}{24}h^4 \ldots\ldots\right]}{h} = 0$$

L.H.D. $\neq$ R.H.D.

So at $x = 0$ function is not differentiable.

Statement (1) is not correct.

At $x = \frac{\pi}{2}$

$$f\left(\frac{\pi}{2}\right) = \pi\cos\frac{\pi}{2} = 0$$

$$\text{R.H.D.} = \lim_{h\to 0} \frac{f\left(\frac{\pi}{2}+h\right) - f\left(\frac{\pi}{2}\right)}{-h}$$

$$= \lim_{h\to 0} \frac{\left(\frac{\pi}{2}+h-\frac{\pi}{2}\right)^2 - 0}{h}$$

$$= \lim_{h\to 0} \frac{h^2}{h} = 0$$

$$\text{L.H.D.} = \lim_{h\to 0} \frac{f\left(\frac{\pi}{2}-h\right) - f\left(\frac{\pi}{2}\right)}{-h}$$

$$= \lim_{h\to 0} \frac{\pi\cos\left(\frac{\pi}{2}-h\right) - 0}{-h}$$

$$= \lim_{h\to 0} \pi\left(\frac{\sin h}{-h}\right)$$

$$= -\pi \lim_{h\to 0}\left(\frac{\sin h}{h}\right) = -\pi(1) = -\pi$$

L.H.D. $\neq$ R.H.D.

Hence function is not differentiable at $x = \frac{\pi}{2}$.

Statement (2) is not correct.

56. (c) Given quadratic equation,
$x^2 + bx + c = 0$ and roots are α and β where $\alpha < \beta$.
Hence roots of given quadratic equation are

$$\beta = \frac{-b + \sqrt{b^2 - 4c}}{2}$$

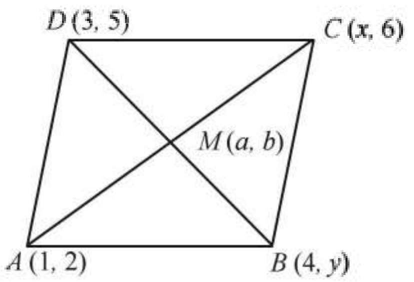
$$\alpha = \frac{-b - \sqrt{b^2 - 4c}}{2} \qquad (\because \alpha < \beta)$$

$$\Rightarrow -\alpha = \frac{b + \sqrt{b^2 - 4c}}{2} \text{ and } |\alpha| = \frac{b + \sqrt{b^2 - 4c}}{2}$$

$\therefore$ $\beta < -\alpha$ and $\beta < |\alpha|$ both are correct.

57. (b) Sum of roots $= \alpha + \beta = -b$
Multiplication of roots $= \alpha\beta = c$
Hence
$\alpha + \beta + \alpha\beta = -b + c$ $\qquad$ $\alpha^2\beta + \beta^2 a = \alpha\beta(\alpha + \beta)$
$= -bc$
$\because$ $b > 0$ & $c < 0$
$\therefore$ $-b + c < 0$ & $-bc > 0$

58. (c) Suppose Mid point of AC and BD is $M(a, b)$.



$$a = \frac{1+x}{2} = \frac{3+4}{2}$$

$$\Rightarrow x = 6$$

$$b = \frac{5+y}{2} = \frac{2+6}{2}$$

$$\Rightarrow y = 3$$

$$a = \frac{7}{2},\ b = 4$$

$$AC^2 = (1-x)^2 + (2-6)^2 = (1-6)^2 + (-4)^2 = 41$$

$$BD^2 = (3-4)^2 + (5-3)^2 = 1 + 4 = 5$$

$$AC^2 - BD^2 = 41 - 5$$

$$\boxed{AC^2 - BD^2 = 36}$$

59. (a) Point of intersection (a, b) is $\left(\frac{7}{2}, 4\right)$.

60. (d) Area of parallelogram = 2 area of Δ ADB

$$\vec{a} = \overline{AB} = (4-1)i + (3-2)j$$

$$\vec{b} = \overline{AD} = (3-1)\hat{i} + (5-2)j$$

$$\therefore \text{Area of parallelogram} = 2\left[\frac{1}{2}|\vec{a}\times\vec{b}|\right] = |\vec{a}\times\vec{b}|$$

Now; $\vec{a}\times\vec{b}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 3 & 1 & 0\\ 2 & 3 & 0\end{vmatrix}=7\hat{r}.$

$\therefore$ Area $=|\vec{a}\times\vec{b}|=|7\hat{k}|=\sqrt{49}=7$ square unit

61. (d) $f(x)=x^3+x^2f'(1)+xf''(2)+f'''(3)$ ...(1)

$f'(x)=3x^2+2xf'(1)+f''(2)$ ...(2)

$f''(x)=6x+2f'(1)$ ...(3)

$f'''(x)=6$ ...(4)

$f'(1)=3+2f'(1)+f''(2)$ ...(5)

$f'(2)=12+2f'(1)$ ...(6)

Using (6) in (5), we get

$f'(1)=3+2f'(1)+12+2f''(1)$

$-3f'(1)=15$

$f'(1)=-5$

Using this value in eqn (6) we get

$f'(2)=12+2\times(-5)$

$f''(2)=2$

Using $x=3$ in eqn (4),

$f'''(3)=6$

Putting value of $f'(1)+f''(2)$ and $f'''(3)$ in eqn (1)

We get

$f(x)=x^3+x^2(-5)+x(2)+6$

$=x^3-5x^2+2x+6$

Putting $x=1$

$f(1)=(1)^3-5(1)^2+2(1)+6$

$f(1)=4$

62. (b) $f'(1)=-5$

63. (c) $f'''(10)=6$

64. (c) 1. $f(1)-f(0)=4-6$

$=-2$

$f(2)=8-20+4+6=-2$

Hence $f(2)=f(1)-f(0)$.

$\therefore$ Statement (1) is correct.

2. $f''(2)-2f'(1)=2-2(-5)$

$f''(2)-2f'(1)=12$

$\therefore$ Statement (2) is correct.

65. (a) To find, intersection point first put $z=0$

$2x-y=2$

$x+y=1$

$3x=3$

$x=1$

$x+y=1$

$y=1-x$

At $x=1, y=0$

$(x, y, z)\equiv(1,0,0)$

Putting $x=0$

$y-z=1$

$-y+3z=2$

$2z=3$

$z=\frac{3}{2}$

$y=1+z=1+\frac{3}{2}=\frac{5}{2}$

$(x, y, z)\equiv\left(0, \frac{5}{2}, \frac{3}{2}\right)$

Point of intersection $(x_1, y_1, z_1)\equiv(1, 0, 0)$

$(x_2, y_2, z_2)\equiv\left(0, \frac{5}{2}, \frac{3}{2}\right)$

Hence direction ratios of the line of intersection of given plane $<2,-5,-3>$.

66. (b) Eq. of plane through two given planes is :

$(2x-y+3z-2)+\lambda(x+y-z-1)=0$

$\because$ It passes through (1, 0, 1)

$\therefore 3-\lambda=0 \Rightarrow \lambda=3$

$\therefore$ Eq. of plane is:

$5x+2y-5=0$

67. (c) Plane P touches the sphere $x^2+y^2+z^2=r^2$ then

r = Distane between centre of sphere (0, 0, 0) to plance P.

$\Rightarrow r=\left|\frac{5(0)+2(0)-5}{\sqrt{5^2+2^2+(0)^2}}\right|$

$=\frac{5}{\sqrt{25+4}}$

$\boxed{r=\frac{5}{\sqrt{29}}}$

68. (c) Here; $f(x)=|x^2-5x+6|$

$f(x)=|(x-2)(x-3)|$

$f(x)=\begin{cases}(x-2)(x-3) & ; \quad x<2\\ -(x-2)(x-3) & ; \quad 2\le x<3\\ (x-2)(x-3) & ; \quad x\ge 3\end{cases}$

$f'(x)=\begin{cases}2x-5 & ; \quad x<2\\ -(2x-5) & ; \quad 2\le x<3\\ (2x-5) & ; \quad x\ge 3\end{cases}$

$f''(x)=\begin{cases}2 & ; \quad x<2\\ -2 & ; \quad 2\le x<3\\ 2 & ; \quad x\ge 3\end{cases}$

$\Rightarrow f'(4)=2(4)-5=3$

69. (b) $f''(2.5)=-2$

(70-71) : $f(x)\rightarrow$ greatest integer function

$f(x)=[x]$

$g(x)\rightarrow$ modulus function

$g(x)=|x|$

70. (c) $gof(x)=g(f(x)) = g([x]) = |[x]|$ $\quad fog(x)=f(g(x)) = f(|x|) = [|x|]$

$$gof\left(-\frac{5}{3}\right)=\left|\left[-\frac{5}{3}\right]\right| \;;\; fog\left(-\frac{5}{3}\right)=\left[\left|-\frac{5}{3}\right|\right]$$

$$=|-2| \;;\; =\left[\frac{5}{3}\right]$$

$$=2 \;;\; =1$$

$$gof\left(-\frac{5}{3}\right)-fog\left(-\frac{5}{3}\right)=2-1=1$$

71. (b) $fof(x)=f(f(x))=f([x])$

$$fof\left(-\frac{9}{5}\right)=f(-2) \qquad \because\left[-\frac{9}{5}\right]=-2$$

$$=[-2]=-2$$

$gog(x)=g(|x|) = ||x|| = |x|$

$gog(-2)=|-2|=2$

$$(fof)\left(-\frac{9}{5}\right)+gog(-2)=-2+2=0$$

72. (a) Suppose; $x^2+y^2+2gx+2fy+c=0$ is the eq. of the circle.
Since; it passes through
(0, 0); (a, b) & (–b, –a)
$\therefore C=0$
$a^2+b^2+2ga+2fb=0$ ...(1)
$\therefore a^2+b^2-2gb-2fb=0$ ...(2)
on solving:
$g=-f$
$\therefore$ centre $\equiv(-g,-f)$ or $(+f,-f)$
$\therefore$ from options:
$x+y=0$ is the line which passes through $(f,-f)$

73. (b) The two intercepts are : $-2g$ & $-2f$
$\therefore$ from eq (1) & (2) we get;

$$g=\frac{-1}{2}\left(\frac{a^2+b^2}{a-b}\right) \;\&\; f=\frac{1}{2}\left(\frac{a^2+b^2}{a-b}\right)$$

is sum of squares of intercepts

$$=\left(\frac{a^2+b^2}{a-b}\right)^2+\left(\frac{a^2+b^2}{a-b}\right)^2$$

$$=2\left[\frac{a^2+b^2}{a-b}\right]^2$$

74. (b) $\vec{a}$ and $\vec{b}$ are two unit vectors.
$\because$ Hence,

$$|\vec{a}+\vec{b}|^2=(\hat{a}+\hat{b}).(\hat{a}+\hat{b})$$

$$=\hat{a}.\hat{a}+\hat{a}.\hat{b}+\hat{b}.\hat{a}+\hat{b}.\hat{b}$$

$$=\hat{a}.\hat{a}+\hat{b}.\hat{b}+2\hat{a}.\hat{b}$$

$$=|\hat{a}|^2+2|\hat{a}||\hat{b}|\cos\theta+|\hat{b}||\hat{b}|$$

$$=1+2\cos\theta+1 \quad [\because \hat{b},\hat{a} \text{ are unit vector}]$$

$$=2(1+\cos\theta)$$

$$|\hat{a}+\hat{b}|^2=2.2\cos^2\frac{\theta}{2}$$

$$\cos\frac{\theta}{2}=\frac{|\hat{a}+\hat{b}|}{2}$$

75. (a) $|\hat{a}-\hat{b}|^2=(\hat{a}-\hat{b}).(\hat{a}-\hat{b})$

$$=\hat{a}.\hat{a}-\hat{b}.\hat{a}-\hat{a}.\hat{b}+\hat{b}.\hat{b}$$

$$=|\hat{a}|^2-2|\hat{a}||\hat{b}|\cos\theta+|\hat{b}|^2$$

$$=2-2\cos\theta$$

$$=2(1-\cos\theta)$$

$$|\hat{a}-\hat{b}|^2=2.2\sin^2\frac{\theta}{2}$$

$$\sin\frac{\theta}{2}=\frac{|\hat{a}-\hat{b}|}{2}$$

76. (b) $\theta\in\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$ for which $\tan^{-1}(\tan\theta)=\theta$.
Hence, statement (1) is incorrect.
if $x\ge 1; y\le 1 \;\&\; x^2+y^2\le 1$

$$\therefore \sin^{-1}(x)-\sin^{-1}y=\sin^{-1}\left[x\sqrt{1-y^2}+y\sqrt{1-x^2}\right]$$

$$\Rightarrow \sin^{-1}\frac{1}{3}-\sin^{-1}\frac{1}{5}$$

$$=\sin^{-1}\left[\frac{1}{3}\sqrt{1-\frac{1}{25}}-\frac{1}{5}\sqrt{1-\frac{1}{9}}\right]$$

$$=\sin^{-1}\left[\frac{1}{3\times 5}\sqrt{24}-\frac{1}{5\times 3}\sqrt{8}\right]$$

$$=\sin^{-1}\left[\frac{\sqrt{8\times 3}-\sqrt{8}}{15}\right]=\sin^{-1}\left[\frac{2\sqrt{2}(\sqrt{3}-1)}{15}\right]$$

Hence, statement (2) is correct.

77. (d) Statement-1

$$\because\left(\tan^{-1}x+\tan^{-1}y=\tan^{-1}\frac{x+y}{1-xy}\right)$$

$$\tan^{-1}x+\tan^{-1}\frac{1}{x}=\tan^{-1}\frac{x+\frac{1}{x}}{1-x.\frac{1}{x}}$$

$$=\tan^{-1}\frac{x^2+1}{0}$$

$$=\tan^{-1}\infty=\tan^{-1}\tan\frac{\pi}{2}$$

$$\boxed{\tan^{-1}x+\tan^{-1}\frac{1}{x}=\frac{\pi}{2}}$$

Statement (1) is wrong.
Statement 2,

$$\sin^{-1}x+\cos^{-1}y=\frac{\pi}{2} \qquad (x,\ y)\in(-1,\ 1)$$

Only when $x=y$
Here $x\neq y$.
Statement (2) is also wrong.

78. (d) Given :
Solution of differential equation is

$$y=cx+c^2-3c^{\frac{3}{2}}+2 \qquad ...(1)$$

To find order and degree of differential equation, we will find differential equation first.
Now differentiating equation (1) w.r.t. x and putting value of c to remove it, we get

$$\frac{dy}{dx}=c$$

$$y=x\frac{dy}{dx}+\left(\frac{dy}{dx}\right)^2-3\left(\frac{dy}{dx}\right)^{\frac{3}{2}}+2$$

$$\Rightarrow (y-2)^2+\left(\frac{dy}{dx}\right)^4+(2x-9)\left(\frac{dy}{dx}\right)^3$$

$$+(x^2-2y+4)\left(\frac{dy}{dx}\right)^2+(-2xy+4x)\frac{dy}{dx}=0$$

Hence order of differential equation is 1 and degree is 4.

79. (c) $\int_{-2}^{2}x\,dx-\int_{-2}^{2}[x]\,dx$

$$=\left[\frac{x^2}{2}\right]_{-2}^{2}-\int_{-2}^{-1}[x]\,dx-\int_{-1}^{0}[x]\,dx-\int_{0}^{1}[x]\,dx-\int_{1}^{2}[x]\,dx$$

$$=\frac{1}{2}[4-4]-(-2)-(-1)-0-(1)$$

$$=2+1-1=2$$

80. (b) $\int_{-2}^{5}f(x)dx=4$ and $\int_{0}^{5}\{1+f(x)\}\,dx=7$

$$\int_{0}^{5}f(x)dx=7-\int_{0}^{5}1\,dx=7-5=2 \qquad ...(1)$$

$$\int_{-2}^{0}f(x)dx=?$$

$$\int_{-2}^{0}f(x)dx+\int_{0}^{5}f(x)\,dx=4$$

$$\int_{-2}^{0}f(x)dx=4-\int_{0}^{5}f(x)\,dx$$

$$=4-2=2. \qquad \text{[Using eqn. (1)]}$$

$$\int_{-2}^{0}f(x)dx=2$$

81. (a) $\lim\limits_{x\to 0}\phi(x)=a^2 \qquad a\neq 0$

$$\Rightarrow \lim_{x\to 0}\phi\left(\frac{x}{a}\right)=a^2$$

[because function value is constant]

82. (a) $\lim\limits_{x\to 0}e^{-\frac{1}{x^2}}=e^{\frac{-1}{0}}=e^{-\infty}=0$

83. (b) Let $[A]=\begin{bmatrix}a & b\\ c & d\end{bmatrix}$

$$A^{-1}=\frac{1}{|A|}(adj.\ A)$$

$$=\frac{1}{(ad-bc)}\begin{bmatrix}d & -c\\ -b & a\end{bmatrix}^T=\frac{1}{(ad-bc)}\begin{bmatrix}d & -b\\ -c & a\end{bmatrix}$$

$$adj(A^{-1})=\frac{1}{(ad-bc)}\begin{bmatrix}a & c\\ b & d\end{bmatrix}^T=\frac{1}{(ad-bc)}\begin{bmatrix}a & b\\ c & d\end{bmatrix} \qquad ...(1)$$

$$adjA=\begin{bmatrix}d & -b\\ -c & a\end{bmatrix}$$

$$|adj\ A|=(ad-bc)$$

$$(adj\ A)^{-1}=\frac{1}{|adj\ A|}\begin{bmatrix}a & c\\ b & d\end{bmatrix}^T=\frac{1}{ad-bc}\begin{bmatrix}a & b\\ c & d\end{bmatrix} \qquad ...(2)$$

Subtracting eqn. (1) and (2),

$$adj(A^{-1})-(adj\ A)^{-1}=\begin{bmatrix}0 & 0\\ 0 & 0\end{bmatrix}$$

= null matrix.

84. (c)

$0.3125\times 2 = 0.6250$
$0.6250\times 2 = 1.2500$
$0.2500\times 2 = 0.5000$
$0.5000\times 2 = 1.0000$

$(0.3125)_{10}=(0.0101)_2$

85. (c) $nRm \Leftrightarrow n$ is a factor of m.
$\Rightarrow m$ is divisible by n.

Reflexivity

We know that
n is divisible by $n\ \forall\, n\in N$
$(n,\ n)\in R\ \ \forall\ \ n\in N$
R is reflexive.

Symmetric

$n, m \in N$

Let $n = 2, m = 6$

m is divisible by n but n is not divisible by m. Hence R is not symmetric.

Transitivity

Let $(n, m) \in R$ and $(m, p) \in R$ then $(n, m) \in R$ and $(m, p) \in R \Rightarrow (n, p) \in R$

or If m is divisible by n and p is divisible by m. Hence p is divisible by n.

$(n, p) \in R\ \forall\ n, p \in N$

R is transitive relation on N.

Hence R is reflexive, transitive but not symmetric.

$$\therefore \int_0^{2a} f(x)\,dx = 2\int_0^a f(x)\,dx \ \ if\ f(2a-x) = fx$$

86. (d) $\int_0^{4\pi} |\cos x|\,dx = 4\int_0^{\pi} |\cos x|\,dx$

$$= 4\left[\int_0^{\pi/2} \cos x\,dx - \int_{\pi/2}^{\pi} \cos x\,dx\right]$$

$$= 4\left[(\sin x)_0^{\pi/2} - (\sin x)_{\pi/2}^{\pi}\right]$$

$$= 4\left[\sin\frac{\pi}{2} - 0 - \sin\pi + \sin\frac{\pi}{2}\right]$$

$$= 4\left[2\sin\frac{\pi}{2}\right] = 8$$

87. (b) Let A, B & C be the sets of numbers divisible by 10, 15 & 25 respectively

No. divisible by 10 = 100 = n(A)

No. divisible by 15 = 66 = n (B)

No. divisible by 25 = 40 = n (C)

No. divisible by (10 & 15) = 33 = n $(A \cap B)$

No. divisible by (15 & 25) = 13 = n $(B \cap C)$

No. divisible by (25 & 10) = 20 = n $(A \cap C)$

No. divisible by (10, 15 & 25) = 6 = n $(A \cap B \cap C)$

No. divisible by 10, 15 and 25 = n $(A \cup B \cup C)$

= 100 + 66 + 40 – 33 – 13 – 20 + 6 = 146

Thus, no. which are neither divisible by 10 nor 15 nor 25 = 1000 – 146 = 854.

88. (a) $M \equiv$ mid point of line segment PQ

P — M — Q

(K, 4) (a, 2b) (10, –6)

$$\frac{K+10}{2} = a \Rightarrow K = (2a - 10)$$

$$2b = \frac{4-6}{2} = -1$$

given $a - 2b = 7$ ...(1)

Put the values of a & ab in eq (1), we get

$$\frac{K+10}{2} + 1 = 7$$

$$\frac{K+10}{2} = 6 \Rightarrow K = 12 - 10$$

$$\boxed{K = 2}$$

89. (b) $\because ABC$ is an equilateral triangle.

$\therefore A = B = C = 60°$

L.H.S. = 3 tan $(A + B)$ tan C

= 3 tan 120° tan 60°

$= 3(-\sqrt{3})(\sqrt{3})$

$= -9 \neq 1$

Hence statement (1) is incorrect.

Statement-2

ABC is a triangle such that $A = 78°$ and $B = 66°$

$C = 180 - (78 + 66) = 180 - 144 = 36°$

$$\frac{A}{2} + C = \frac{78}{2} + 36°$$

$$= 39 + 36 = 75°$$

$$\tan\left(\frac{A}{2} + C\right) < \tan A$$

$\Rightarrow \tan 75° < \tan 78°$

Hence statement (2) is correct.

Statement (3)

In a triangle ABC

$A + B + C = 180°$

$A + B = 180° - C$

$$\frac{A+B}{2} = \frac{180° - C}{2}$$

$$\Rightarrow \frac{A+B}{2} = 90 - \frac{C}{2}$$

$$\Rightarrow \tan\left(\frac{A+B}{2}\right) = \tan\left(90 - \frac{C}{2}\right)$$

$$\Rightarrow \tan\left(\frac{A+B}{2}\right) = \cot\frac{C}{2} \quad ...(1)$$

$$\therefore \tan\left(\frac{A+B}{2}\right).\sin\frac{C}{2} = \cot\frac{C}{2}.\sin\frac{C}{2} = \cos\frac{C}{2}$$

$$\Rightarrow \tan\left(\frac{A+B}{2}\right).\sin\frac{C}{2} = \cos\frac{C}{2}$$

We can see that statement (3) is not correct.

Hence only 2nd statement is correct.

90. (c) Given $A = (\cos 12° - \cos 36°)(\sin 96° + \sin 24°)$

$B = (\sin 60° - \sin 12°)(\cos 48° - \cos 72°)$

$$\frac{A}{B} = \frac{[-2\sin 24° \sin 12°][2\sin 60° \cos 36°]}{[2\cos 36° \sin 24°][-2\sin 60° \sin 12°]}$$

$$\Rightarrow \frac{A}{B} = 1$$

91. (a) Given numbers - 10, 9, 21, 16, 24

Mean $= \frac{10+9+21+16+24}{5} = \frac{80}{5} = 16$

Numbers	Distance (d) from mean (16)
10	6
9	7
21	5
16	0
24	8

$\Sigma d = 26$

Mean deviation $= \frac{\Sigma d}{5} = \frac{26}{5} = 5.2$

92. (b) As we know that 3 dice are thrown. We want prob. of sum on three faces at least 5 i.e. some may be 5 or more. We will find prob. of sum on three faces not 5 or less. i.e. sum on faces is 3 and 4 (1, 2 is not possible because of 3 dice).
No. of ways for sum on faces not 5 or more = 4
[(1, 1, 1), (1, 2, 1), (1, 1, 2), (2, 1, 1)]
Total out comes = 216

Prob. of not 5 or more $= \frac{4}{216}$

Prob. of sum on three faces at least 5

$= 1 - \frac{4}{216} = \frac{212}{216} = \frac{53}{54}$

93. (d) A and B are independent.

$P(A) = \frac{1}{3}$ $\qquad$ $P(B) = \frac{3}{4}$

We want to find probability that exactly one of the two events A or B occurs i.e. when A occurs B does not and vice-versa.
Lets take desired prob. is P.
$\therefore P = P(A)(1 - P(B)) + P(B)(1 - P(A))$

$= \frac{1}{3}\left(1 - \frac{3}{4}\right) + \frac{3}{4}\left(1 - \frac{1}{3}\right)$

$= \frac{1}{3} \times \frac{1}{4} + \frac{3 \times 2}{12}$

$\boxed{P = \frac{7}{12}}$

94. (b) Coin is tossed three times i.e. total outcomes $= 2^3 = 8$
[(H, H, H), (H, H, T), (H, T, H), (H, T, T), (T, H, H), (T, H, T), (T, T, H), (T, T, T)]
Alternate head and tail are coming two times only.

Thus prob. of getting head and tail alternately $= \frac{2}{8} = \frac{1}{4}$

95. (c) Total no. of observation $(n) = 20$

$\Sigma x_i = 1000$

$\bar{x} = \frac{\Sigma x_i}{n} = \frac{1000}{20} = 50$

Variance $= sd^2$

$sd = \sqrt{\frac{1}{n}\Sigma x_i^2 - (\bar{x})^2}$

$(sd)^2 = \frac{1}{n}\Sigma x_i^2 - (\bar{x})^2 = \frac{84000}{20} - (50)^2$

$= 4200 - 2500 = 1700.$

Variance = 1700

96. (a) Prob. of getting queen of spade $= \frac{^1C_1}{^{52}C_1} = \frac{1}{52}$

97. (c) Since two dice are thrown so number of outcomes are 36.
No. of ways when sum on two faces less than 4 = 3.
[(1, 1), (1, 2), (2, 1)]
Hence prob of getting sum on two faces less than 4

$= \frac{3}{36} = \frac{1}{12}$

Thus required prob. that sum on the two faces is greater than or equal to 4 $= 1 - \frac{1}{12} = \frac{11}{12}$

98. (a) Probability of hittiy the forget = 0.3
If 'n' is the no. of times that the Missile is fired.
$\therefore$ Probability of hitting at least once $= 1 - [1 - 0.3]^n = 0.8$
$0.7^n = 0.2$
$n \log 0.7 = \log 0.2$
$\Rightarrow n = 4.512$
for $n = 4$; $p < 0.8$
take $n = 5$

$\boxed{n = 5}$

Hence 5 missiles should be fired so that there is at least 80% prob. that the target is hit.

99. (b) Events A and B are mutually exclusive.

Hence $P(A \cap B) = \phi = 0$

$\therefore P(A \cup B) = P(A) + P(B)$ ...(1)

$P(A) = 0.2$ [given]

$P(B) = P(\bar{A} \cap B) + P(A \cap B)$

$P(B) = P(\bar{A} \cap B)$ $\qquad$ $[\because P(A \cap B) = 0]$

$= 0.3$

$P(A \cup B) = 0.2 + 0.3 = 0.5$

$P(A | (A \cup B)) = \frac{P(A)}{P(A \cup B)} = \frac{0.2}{0.5} = \frac{2}{5}$

$P(A | (A \cup B)) = \frac{2}{5}$

100. (c) In month of December 31 days i.e. (28 + 3) days.
In 28 days will get 4 Sundays.
If we get any Sunday in first 3 days of December than only we can get 5 Sundays in month.
n (5th Sunday) = 3 [4 weeks + 3 days]
$n(5) = 7$

Hence prob. of 5 Sundays in month of December $= \frac{3}{7}$.

101. (a) Three terms are

$$G_1 = \left(\frac{y}{z}\right)^{\log yz} \quad G_2 = \left(\frac{z}{x}\right)^{\log zx} \quad G_3 = \left(\frac{x}{y}\right)^{\log xy}$$

Geometric mean of three terms is

$$m = \sqrt[3]{G_1 G_2 G_3} \quad ...(1)$$

$$\therefore G_1 G_2 G_3 = \left(\frac{y}{z}\right)^{\log yz} \cdot \left(\frac{z}{x}\right)^{\log zx} \cdot \left(\frac{x}{y}\right)^{\log xy}$$

$$= \frac{y^{\log y} \cdot y^{\log z}}{z^{\log y} \cdot z^{\log z}} \times \frac{z^{\log z} \cdot z^{\log x}}{x^{\log z} \cdot x^{\log x}} \times \frac{x^{\log x} \cdot x^{\log y}}{y^{\log x} \cdot y^{\log y}}$$

$$= \left(\frac{y}{x}\right)^{\log z} \cdot \left(\frac{z}{y}\right)^{\log x} \cdot \left(\frac{x}{z}\right)^{\log y}$$

Taking log both sides

$$\log G_1 G_2 G_3 = \log\left[\left(\frac{y}{x}\right)^{\log z}\right] + \log\left[\left(\frac{z}{y}\right)^{\log x}\right] + \log\left[\left(\frac{x}{z}\right)^{\log y}\right]$$

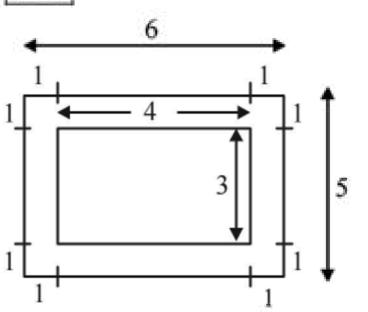
$$= \log z \log y - \log z \log x + \log x \log z - \log x \log y + \log y \log x - \log y \log z$$

$\log G_1 G_2 G_3 = 0$
$G_1 G_2 G_3 = e^0 = 1$

Hence $m = \sqrt[3]{G_1 G_2 G_3} = (1)^{\frac{1}{3}}$

$\boxed{m = 1}$

102. (d)



Probability that the randomly selected point is at least one inch from the edge of the rectangle

$$= \frac{4 \times 3}{6 \times 5} = \frac{12}{30} = \frac{2}{5}$$

103. (d) Mean of series $(x_1, x_2, x_3 \ldots.. x_n)$

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \ldots..x_n}{n}$$

$$\Rightarrow x_1 + x_2 + x_3 + \ldots..x_n = n\bar{x}$$

Now we will replace x_2 by λ so no. of elements in series will not change.
New series will include λ and exclude x_2
Hence new series sum :

$$(x_1 + x_2 + \ldots..x_n) - x_2 + \lambda = n\bar{x} + \lambda - x_2$$

$$\text{Now new mean} = \frac{n\bar{x} + \lambda - x_2}{n} = \frac{n\bar{x} - x_2 + \lambda}{n}$$

104. (d) Given data 3, 5, 1, 6, 5, 9, 5, 2, 8, 6 and mean, median and mode are x, y, z respectively.
Rearranging data
1, 2, 3, 5, 5, 5, 6, 6, 8, 9

$$\text{Mean} = x = \frac{1+2+3+5+5+5+6+6+8+9}{10} = \frac{50}{10} = 5$$

$$\text{Median} = y = \frac{\frac{n}{2}^{\text{th}} \text{term} + \left(\frac{n}{2}+1\right)^{\text{th}} \text{term}}{2}$$

$$y = \frac{5+5}{2} = 5$$

Mode (z) = most frequently occuring value = 5
Hence $x = y = z$.

105. (c) Statement (1) is correct because total area of the rectangles in a histogram is equal to the total area bounded by the corresponding frequency polygon and x-axis. Statement (2) is also correct.

106. (a) Let x denote number of tails. Then, X is a binomial variate with parameters:

$$x = 100 \;\&\; p = \frac{1}{2}$$

$$\therefore \; p(x = r) = {}^{100}C_r \left(\frac{1}{2}\right)^{100}; (r = 0, 1, 2, \ldots\ldots. 100)$$

Req. probability = $P(x = 1) + P(x = 3) + \ldots. + P(x = 99)$

$$= \left[\frac{1}{2}\right]^{100} \left[{}^{100}C_1 + {}^{100}C_3 + \ldots. + {}^{100}C_{99}\right]$$

$$= \frac{1}{2^{100}} 2^{99} = \frac{1}{2}$$

107. (d) No. of ways in which 3 holiday travel tickets are to be given to 10 employees = $10^3 = 1000$

108. (b) Given equation is
$(\ell - m)x^2 + \ell x + 1 = 0$
Roots are α, β.
$\because$ One root is double the other.
$\beta = 2\alpha$
Sum of roots = $\alpha + \beta$

$$3\alpha = \frac{-\ell}{\ell - m} \qquad \alpha(2\alpha) = \frac{1}{(\ell - m)}$$

$$\Rightarrow \alpha^2 = \frac{\ell^2}{9(\ell - m)^2} \qquad 2\alpha^2 = \frac{1}{\ell - m}$$

$$\Rightarrow 2\frac{\ell^2}{9(\ell - m)^2} = \frac{1}{(\ell - m)}$$

$$\Rightarrow \frac{2\ell^2}{9(\ell - m)} = 1$$

$$\Rightarrow 2\ell^2 = 9(\ell - m) \Rightarrow 2\ell^2 - 9\ell + 9m = 0$$

For ℓ to be real discriminant should be $b^2 - 4ac \geq 0$

$81 - 4 \times 2 \times 9m \geq 0$

$m \leq \frac{9}{8}$.

109. (b) Let the given 4 digit decimal number is • | | | | |

Places after decimal can be filled in the following ways:

• | 7 | 8 | 9 | 9 |

Total number of ways $= 7 \times 8 \times 9 \times 9 = 4536$

110. (b) $\vec{A} = \hat{i} + \hat{j} + \hat{k}$

$\vec{B} = 2\hat{i} + 3\hat{j} - \hat{k}$

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & 1 \\ 2 & 3 & -1 \end{vmatrix}$$

$$= \hat{i}(-1-3) - \hat{j}(-1-2) + \hat{k}(3-2)$$

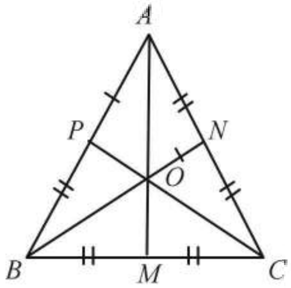
$$= -4\hat{i} + 3\hat{j} + \hat{k}$$

Vector of unit length orthogonal to both the vectors $\vec{A}$ and $\vec{B}$

$$= \frac{\vec{A} \times \vec{B}}{|\vec{A} \times \vec{B}|}$$

$$= \frac{-4i + 3j + k}{\sqrt{16+9+1}} = \frac{-4\hat{i} + 3\hat{j} + \hat{k}}{\sqrt{26}}$$

111. (a) Position vectors of vertices A, B and C are $\vec{a}$, $\vec{b}$ and $\vec{c}$.



$\because$ triangle is equilateral.

$\therefore$ Centroid and orthocenter will coincide.

Centroid $\equiv$ orthocenter position vector

$$= \frac{1}{3}(\vec{a} + \vec{b} + \vec{c})$$

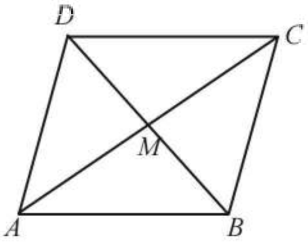
$\because$ given in question orthocenter is at origin.

Hence $\frac{1}{3}(\vec{a} + \vec{b} + \vec{c}) = 0$

$$\boxed{\vec{a} + \vec{b} + \vec{c} = 0}$$

112. (c) Diagonal d_1, $\overrightarrow{AC} = 3i + j - 2k$

Diagonal d_2, $\overrightarrow{BD} = i - 3j + 4k$



Area of parallelogram is $\frac{1}{2}|\vec{d_1} \times \vec{d_2}|$

$$\text{Hence area} = \frac{1}{2}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & -2 \\ 1 & -3 & 4 \end{vmatrix}$$

$$= \frac{1}{2}|[\hat{i}(4-6) - \hat{j}(12+2) + \hat{k}(-9-1)|$$

$$= \frac{1}{2}|-2\hat{i} - 14\hat{j} - 10\hat{k}|$$

$$= \frac{1}{2}\sqrt{4+196+100}$$

$$= \frac{10\sqrt{3}}{2} = 5\sqrt{3} \text{ square units}$$

113. (b) $A = \begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}$

$$A.A = \begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}\begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix} = -2\begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}$$

$A^2 = -2A$

$$A^2 . A = -2\begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}\begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}$$

$$= -2\begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix} = 4\begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}$$

$A^3 = 4A$

Hence $A^2 \neq -A$, $A^3 = 4A$

114. (d) 1. $\begin{vmatrix} 41 & 1 & 5 \\ 79 & 7 & 9 \\ 29 & 5 & 3 \end{vmatrix} = \begin{vmatrix} 40 & 1 & 5 \\ 72 & 7 & 9 \\ 24 & 5 & 3 \end{vmatrix}$ $\quad C_1 \to C_1 - C_2$

$$= 8\begin{vmatrix} 5 & 1 & 5 \\ 9 & 7 & 9 \\ 3 & 5 & 3 \end{vmatrix} = 0$$

$\because$ two columns are same so value of determinant is zero.

2. $\begin{vmatrix} 1 & a & b+c \\ 1 & b & c+a \\ 1 & c & a+b \end{vmatrix} = \begin{vmatrix} 1 & a+b+c & b+c \\ 1 & a+b+c & c+a \\ 1 & a+b+c & a+b \end{vmatrix}$ $\quad C_2 \to C_2 + C_3$

$$=(a+b+c)\begin{vmatrix}1 & 1 & b+c\\1 & 1 & c+a\\1 & 1 & a+b\end{vmatrix}=0$$

$\because$ two columns are same so value of determinant is zero.

3. $\begin{vmatrix}0 & c & b\\-c & 0 & a\\-b & -a & 0\end{vmatrix}=0$

$\because$ diagonal is zero so value of determinant is zero.

115. (a) $y-\sqrt{3}x-5=0$ line one

$\sqrt{3}y-x+6=0$ line two

$y=mx+c$

$y=\sqrt{3}x+5 \qquad y=\dfrac{x}{\sqrt{3}}-\dfrac{6}{\sqrt{3}}$

$m_1=\sqrt{3} \qquad m_2=\dfrac{1}{\sqrt{3}}$

Angle between two lines,

$$\tan\theta=\left|\frac{m_1-m_2}{1+m_1m_2}\right|$$

$$=\left|\frac{\sqrt{3}-\frac{1}{\sqrt{3}}}{1+\sqrt{3}\frac{1}{\sqrt{3}}}\right|=\frac{1}{\sqrt{3}}$$

$=\tan 30°$

$\boxed{\theta=30°}$

116. (a) Linear equations

$Kx+y+z=1$

$x+Ky+z=1$

$x+y+Kz=1$

$$\underset{A}{\begin{bmatrix}K & 1 & 1\\1 & K & 1\\1 & 1 & K\end{bmatrix}}\underset{X}{\begin{bmatrix}x\\y\\z\end{bmatrix}}=\underset{B}{\begin{bmatrix}1\\1\\1\end{bmatrix}}$$

$\boxed{X=A^{-1}B}$

Linear equantion will have unique solution when A^{-1} exist :

$|A|\neq 0$

$$\begin{bmatrix}K & 1 & 1\\1 & K & 1\\1 & 1 & K\end{bmatrix}\neq 0$$

$K(K^2-1)-1(K-1)+1(1-K)\neq 0$

$\Rightarrow K^3-K-K+1+1-K\neq 0$

$\Rightarrow K^3-3K+2\neq 0$

$(K-1)(K^2+K-2)\neq 0$

$(K-1)(K-1)(K+2)\neq 0$

$K\neq 1$, $K\neq 1$ and $K\neq -2$

$\Rightarrow K\neq 1$ and $K\neq -2$

117. (a) Number of different messages that can be represented by three 0's and two 1's is 10.

Option (a) is correct.

118. (d) $log_a ab=x$

$log_a a+log_a b=x$

$$\frac{1}{\log_b a}=x-1$$

$$\log_b a=\frac{1}{x-1} \qquad \text{...(1)}$$

$\log_b ab=\log_b a+\log_b b$

$$=\frac{1}{x-1}+1 \qquad \text{(From (1))}$$

$$=\frac{1+x-1}{x-1}$$

$$\boxed{\log_b ab=\frac{x}{x-1}}$$

119. (d) $y=\log_{10}x+\log_x 10+\log_x x+\log_{10}10$

$y=\log_{10}x+\log_x 10+1+1$

Differentiating equation w.r.t. x

$$\frac{dy}{dx}=\frac{1}{x\log_e 10}-\frac{1}{(\log_{10}x)^2}\cdot\frac{1}{(x\log 10)}$$

$$=\frac{1}{x\log_e 10}\left[1-\frac{1}{(\log_{10}x)^2}\right]$$

$$\left(\frac{dy}{dx}\right)_{x=10}=\frac{1}{10\log_e 10}[1-1]=0$$

$$\left[\begin{aligned}&\text{Note: }\log_x 10=\frac{\log_{10}10}{\log_{10}x}=\frac{1}{\log_{10}x}\\&\frac{d}{dx}\left[\frac{1}{\log_{10}x}\right]=-(\log_{10}x)^{-2}\times\frac{1}{x\log_e 10}\\&\qquad=-\frac{1}{(\log_{10}x)^2 x\log_e 10}\end{aligned}\right]$$

120. (d) Cube root of unity are 1, $-\dfrac{1}{2}\pm\dfrac{\sqrt{3}}{2}i$

w_1 and w_2 are two distinct cube roots of unity different from 1.

$$w_1=-\frac{1}{2}+\frac{\sqrt{3}}{2}i,\ w_2=-\frac{1}{2}-\frac{\sqrt{3}}{2}i$$

$$(w_1-w_2)^2=\left(-\frac{1}{2}+\frac{\sqrt{3}}{2}i+\frac{1}{2}+\frac{\sqrt{3}}{2}i\right)^2$$

$$=(\sqrt{3}i)^2=3i^2$$

$$(w_1-w_2)^2=-3$$

GENERAL ABILITY TEST

PART-A : ENGLISH

1. (a) Inevitable here refers to a situation that is unavoidable.
2. (c) Sketch means a quick or undetailed drawing or painting often made as a preliminary study or for a brief general account or presentation.
3. (c)
4. (d) Decorous means behaving politely and in a controlled way.
5. (c) 6. (b)
7. (c) Distinguish means to recognize or treat (someone or something) as different.
8. (c)
9. (a) Divulge means to disclose or reveal (something private, secret, or previously unknown).
10. (d) Deft means neatly skilful and quick in one's movements whereas Clumsy means awkward in movement or in handling things or without any specific skills. Therefore, 'Clumsy' is the antonym of the word 'deft'.
11. (b) Urbane means courteous and refined manner of a person, especially a man whereas rude means offensively impolite or bad-mannered. Therefore, 'Rude' is the antonym of the word 'Urbane'.
12. (b) Timidity means lacking in courage or self-confidence whereas boldness means not hesitating or fearful in the face of actual or possible danger. Therefore, 'Boldness' is the antonym of the word 'Timidity'.
13. (b) Mammoth in this case means something immense of its kind or huge. Therefore, 'small' is the antonym of 'mammoth'.
14. (b) Engrossed means absorb all the attention or interest about someone or something whereas inattentive means not attentive or not paying attention. Therefore, 'inattentive' is the antonym of 'Engrossed'.
15. (a) Preceding means existing, coming, or occurring immediately before in time or place whereas following means coming after or as a result of. Therefore, 'following' is the antonym of 'preceding'.
16. (b)
17. (b) Severe means causing great pain, difficulty, worry, damage, etc. whereas mild means not severe, serious, or harsh. Therefore, 'mild' is the antonym of 'severe'.
18. (a) Cumulatively means increasing or increased in quantity or degree whereas individually means relating to a single, separate person or thing. Therefore, 'individually' is the antonym of 'cumulatively'.
19. (d) Conspicuous means very noticeable or attracting attention, often in a way that is not wanted. Therefore, 'unnoticeable' is the antonym of 'conspicuous'.
20. (c) Continual means forming a sequence in which the same action or event is repeated frequently whereas occasional means done infrequently and irregularly. Therefore, 'occasional' is the antonym of 'continual'.

21. (a) 22. (c) 23. (d) 24. (b) 25. (a) 26. (a)
27. (d) 28. (a) 29. (b) 30. (b) 31. (c) 32. (a)
33. (c) 34. (d) 35. (a) 36. (a) 37. (b) 38. (d)
39. (b) 40. (b)

41. (d) Deafening means a noise which is so loud as to make it impossible to hear anything else.
42. (c) Exemplary refers to someone or something serving as a desirable model. Commendable means someone or something deserving praise.
43. (d) Restive means unable to stay still, silent, or submissive, especially because of boredom or dissatisfaction. Impatient means having or showing a tendency to be quickly irritated or provoked.
44. (a) Dearth means a scarcity or lack of something. So in the given sentence dearth means that there is absolutely no scarcity of talent in the country.
45. (b) Retired in this sentence means to take a break from the day's work.
46. (b) Tactical means relating to or constituting actions carefully planned to gain a specific military end. Strategic means relating to the gaining of overall or long-term military advantage.
47. (d) Deviate means to depart from an established course. Differ means to be of different opinion.
48. (b) Debilitated means to make (someone) very weak and infirm.
49. (d) Laudable refers to an action, idea, or aim deserving praise and commendation. Praiseworthy means deserving approval and admiration.
50. (a) Reproach means to express someone one's disapproval of or disappointment in their actions. Rebuke means to express sharp disapproval or criticism of (someone) because of their behaviour or actions.

PART- B : GENERAL KNOWLEDGE

51. (b) Both the statements are individually true but statement II is not the correct explanation of the statement I.
52. (a) Both the statements are individually true and statement II is the correct explanation of statement I. Higher the rate of evaporation, higher is salinity. The Highest evaporation has been recorded along the tropic of Cancer and that is one of the reasons that region of Red Sea and Persian Gulf has one of the highest salinity.
53. (b)
54. (a) Both the statements are individually true and statement II is the correct explanation of statement I. Plantation agriculture is confined within tropical areas, i.e. both sides of the equator. Plantations exist on every continent possessing a tropical climate. Highly productive soil is found in the tropics which help plantation to grow.
55. (a) 56. (c)
57. (c) Water has its maximum density of $1 g/cm^3$ at 4 degrees Celsius. When the temperature changes from either greater or less than 4 degrees, the density will become less then $1 g/cm^3$.
58. (a) Red phosphorus is used in the safety matches because it shows phosphorescence and cannot be converted to white phosphorous on heating.

59. (c) Freezing of water is not a chemical change as ice when melt changes back to water showing physical change.

60. (d) Nitrogen oxide is one of the major pollutants emitted from cars and trucks in cities causes air pollution. Other air pollutant which are carbon monoxide and benzene.

61. (a) Bhubaneshwar > Patna > Rishikesh > New Delhi.

62. (c) According to the universal law of gravitation, everybody in the universe attract other body with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. Therefore mass is doubled then the force acting between them F, will become 4F.

63. (b) According to law of conservation of energy total energy remains conserved.
P.E. = mgh = 20 mg
Loss in potential energy is observed, as
$(P.E.)^1 = mgh = 5mg$
$(P.E)^1/(P.E) = 5mg/20mg = 1/4$
$(P.E.)^1 = 1/4$ P.E

64. (d) Soaps are sodium or potassium salts of some long chain carboxylic acids, e.g. Stearic acid, Oleic acid and Palmitic acid.

65. (b) Mass of a particular amount of substance depends on the amount of matter present in it and it does not vary from place to place.

66. (d) Pesticides are chemicals used in agriculture to protect crops against insects, fungi, weeds and other pests and potentially toxic to human. Lead poisoning is a type of metal poisoning caused by lead in the body. The brain is the most sensitive to lead. Metanil yellow is a principal non-permitted food colour used extensively in India. The effect of long-term consumption of metanil yellow on the developing and adult brain causes neurotoxicity.

67. (b) Karewas are lacustrine deposits (deposits in lake) in the Valley of Kashmir and in Bhadarwah Valley of the Jammu Division also known as Jhelum valley.

68. (b) The hilly Meghalaya plateau lies in the south of the Brahmaputra valley. It, in fact, covers the entire Meghalaya state. The Meghalaya plateau is a part of the Deccan plateau and it is formed of hard ancient rocks.

69. (a) As we know
Momentum P = mv
Since, $V_A = V_B = V$, and $m_0 = 2m_A$
for A, $P_A = m_A v_A$
for B $P_B = (2m_A)\, v_A$
$P_B = 2P_A$

70. (b) Solar eclipse happens when the moon moves in front of the Sun as seen from a location on Earth.

71. (b) The SI unit of acceleration is the metre per second squared ($m\ s^{-2}$).

72. (b) Mass number = number of proton + number of neutron
12 = 6+number of neutron
12 – 6 = number of neutron
number of neutron= 6

73. (c) Mercuric oxides got reduced to mercury and its oxidation number changes from +2 to 0. Whereas in other reaction are showing oxidation reaction.

74. (c) Endocrine disruptors are chemicals (Bisphenol A) released from coffee mugs plastic water storage bottles, that may interfere with the body's endocrine system and produce adverse developmental, reproductive, neurological, and immune effects in both humans and wildlife.

75. (b) Nagarjuna Sagar Dam is located 150 kilometers from Hyderabad, on the Krishna River.

76. (c) Rajmahal hills of Jharkhand is the type area of this province. Multiple layers of solidified lava made 608 m (1,995 ft) thick Rajmahal hill. The chief characteristic of the geology and rocks of India arid-zone is noticed in its remarkable succession of pre-Cambrian rocks which go far down towards the base of the Archaean. This sequence commences for the Bundelkhand gneiss, which is one of the oldest granites exposed anywhere upon the earth' surface.

77. (a) Image formed by concave mirror when object is placed between centre of curvature and focus will be real and magnified.

78. (d) Image formed by covex mirror when object is placed between focus and optical centre will be virtual, erect and magnified.

79. (d) Biomass energy is considered as conventionl energy source as it has been used from ancient times.

80. (d) Two oxides of nitrogen are acid anhydrides; that is, they react with water to form nitrogen-containing oxyacids. Dinitrogen trioxide is the anhydride of nitrous acid, HNO2, and dinitrogen pentoxide is the anhydride of nitric acid, HNO3.

81. (a) Sodium bicarbonate is a chemical compound with the formula NaHCO3.

82. (b) Not all viruses have DNA e.g. HIV virus. It is double helical structure with two nucleotide chain which runs anti-parallel. DNA is also present in mitochondria. Only some segments of DNA code for proteins.

83. (c) Survey of India is India's central engineering agency which prepares topographical maps.

84. (a) Dresden line

85. (c) In plane mirror, distance of object from mirror = distance of image from mirror.
So the distance between mirror and object = 40 + 40 = 80 cm.

86. (d) The brightness of a star depends on its composition i.e. size and temperature (energy light radiation e.g. X-ray, etc.) and how far it is from the planet.

87. (c) Sublimation is the transition of a substance directly from the solid to the gas phase without passing through the intermediate liquid phase.

88. (a) A fuel gas consisting mainly of carbon monoxide and hydrogen, made by passing steam over incandescent coke.

89. (c) The queen is the only fertile female in the colony.

90. (d) River Narmada emerges from Amarkantak Hill of Maikal Range. The mighty Narmada river as well the Son, the Mahanadi, and Arnadoh which is a major tributary of the Godavari all arise in the Amarkantak plateau. Son river is largest of southern tributaries of Ganga that originates near Amarkantak in Madhya Pradesh near the source of Narmada River.

91. (b)

92. (c) When water freezes to ice its volume increases, so if it is kept in glass vessel in a freezer it may break the vessel.

93. (a) $i = V/R = 12/24 = 0.5A$

94. (a) $1/R = 1/R_1 + 1/R_2 + 1/R_3$
$= 1/2 + 1/4 + 1/8$
$= 7/8$
R=8/7, It is more than one and less than 2.

95. (b)

96. (d) Oxides of Sodium readily dissolved in water as it has ionic bond which breaks in water easily other oxides have covalent bond which do not break easily.

97. (a) Your blood lipids include the LDL and VLDL both are considered as bad cholesterol. HDL (good cholesterol; remember as "Healthy cholesterol") and triglycerides. The lower your LDL and the higher your HDL, the better your prognosis.

98. (b) Spruce and Cedar are tree varieties of temperate coniferous forest.

99. (d) Dominant species of Moist deciduous tree are Teak and Sal.

100. (b) The atoms and molecules in gases are much more spread out than in solids or liquids. They vibrate and move freely at high speeds. A gas will fill any container, but if the container is not sealed, the gas will escape. Gas can be compressed much more easily than a liquid or solid.

101. (a) The melting point is an important physical property of a compound. The melting point can be used to identify a substance and as an indication of its purity. The melting point of solid is defined as the temperature at which the solid exists in equilibrium with its liquid under an external pressure of one atmosphere.
Melting point also depends upon the intermolecular force of attraction between the molecule.

102. (c) $1/R = 1/R_1 + 1/R_2 + 1/R_3$
$= 1/2 + 1/4 + 1/6$
$= 11/12$
$R = 12/11$
Total resistance = 12/11+8=9 1/11ohm.

103. (a)

104. (b) Female Anopheles mosquito is the vector which spread malaria. Chikungunya virus is most often spread to people by Aedes aegypti and Aedes albopictus mosquitoes.

105. (b) Insects are the most diverse group of animals and are found in all types of environment. Primates evolved from their ancestors by adapting to arboreal life. Primates are thought to have developed several of their traits and habits initially while living in trees.

106. (c)

107. (d) Deserts, fertile plains and moderately forested mountains are the characteristics features of North-Western India.

108. (a) $a = v/t = 50/25 = 2 m/s^2$
$S = Ut + 1/2at^2$
$= 0 + 1/2 \times 2 \times 25 \times 25$
$= 625$ m

109. (d) If the cable of the lift breaks suddenly the weight of the man would become zero because the system would all begin to accelerate downward due to the force of gravity. All objects in the freefall accelerate downward with the same magnitude.

110. (c) Heat produced by the wire, $W = I^2R$
$W_1/W_2 = (I_1)^2/(I_2)^2$
$2000/W_2 = (1)^2/(2)^2$
$W_2 = 2000X4/1$
$W_2 = 8000J$

111. (b) Hexane do not give sooty flame as it is alkane and saturated compound where as Benzene, Naphthalene and Anthracene are aromatic and unsaturated so they give sooty flame.

112. (d) Proteins - amino acid
Carbohydrates - monosaccharide
Nucleic acids - nitrogenous bases and pentose sugar
Lipids - fatty acids and glycerol

113. (a) In Thar desert the shifting sand dunes are locally known as Dhrian.

114. (b) The impulse-momentum theorem states that the change in momentum of an object equals the impulse applied to it.

115. (a) Most solids expand when heated and contract when cooled. Water/ice is anomalous in that it expands when cooled, at least near its freezing point.

116. (b) Ranthambore national park is famous for Tigers, Periyar national park is famous for elephant, Manas Sanctuary is famous for Rhinoceros and Gir forest is famous for lion.

117. (c) Nuclear potential and chemical energies implies the stored form of energy. But electrical energy is not a form of stored energy.

118. (d) Distance covered by the car = OA + AB + BC + CB = 25 + 10 + 25 + 25 = 85Km
Displacement by the car = OB = 35Km

119. (b) Jelep La or Jelep Pass elevation 4,267 m or 13,999 ft, is a high mountain pass between East Sikkim District, Sikkim, India and Tibet Autonomous Region, China.

120. (c)

121. (b) **122.** (c)

123. (d) On the dissolution of the Lok Sabha, although the Speaker ceases to be a member of the House, she does not vacate her office. The Speaker may, at any time, resign from office by writing under her hand to the Deputy Speaker. The Speaker can be removed from office only on a resolution of the House passed by a majority of all the then members of the House.

124. (b) Bachpan Bachao Andolan was founded in 1980 by Kailash Satyarthi, who has since become a worldwide acclaimed anti-child labour activist.

125. (d) Pradhan Mantri Jan-Dhan Yojana (PMJDY) is National Mission for Financial Inclusion to ensure access to financial services, namely, Banking/ Savings & Deposit Accounts, Remittance, Credit, Insurance, Pension in an affordable manner. Account can be opened in any bank branch or Business Correspondent (Bank Mitr) outlet. PMJDY accounts are being opened with Zero balance. However, if the account-holder wishes to get cheque book, he/she will have to fulfill minimum balance criteria

126. (c) **127.** (c) **128.** (a)

129. (b) The Motto of Indian Air Force is Nabha sparsham Deeptam. It has been taken from eleventh chapter of the Gita, the Discourse given by Lord Krishna to Arjuna on the battlefield of Kurukshetra during the Great War of Mahabharata. The Lord is showing His Supreme Divine form to Arjuna and the great form of the Lord is reaching the sky with glory, evoking fear and loss of self-control in the mind of Arjuna.

130. (a) **131.** (a) **132.** (c)

133. (c) On 20 September 2015, a new constitution, the "Constitution of Nepal 2015" was announced by President Ram Baran Yadav in the constituent assembly. The constituent assembly was transformed into a legislative parliament by the then-chairman of that assembly. The new constitution of Nepal has changed Nepal practically into a federal democratic republic by making 7 unnamed states.

134. (c) World number one Novak Djokovic beat Roger Federer in four dramatic sets to win his second US Open and 10th Grand Slam title at the US Open 2015 in New York.

135. (b) **136.** (b) **137.** (d) **138.** (a)

139. (c) **140.** (c) **141.** (b)

142. (b) Narendra Achyut Dabholkar was an Indian rationalist and author from Maharashtra, India. In 1989 he founded and became president of the Maharashtra Andhashraddha Nirmoolan Samiti (MANS), (the Committee to Eradicate superstition in Maharashtra).

143. (c) Aliah University has with it the rich heritage of the 235-year-old educational and cultural institution, Mohammedan College of Calcutta, popularly known as Madrasah-i-Aliah or Calcutta Madrasah, the first educational institution set up in India in 1780 by Warren Hastings, the then Governor General of Bengal Presidency. In 1791, during the period of British rule in India, Jonathan Duncan, the representative of the East India Company proposed the establishment of a Sanskrit college for development and preservation of the Sanskrit Vangmaya and to show that the English people were in favour of the development of the Indian culture.

144. (c) **145.** (c)

146. (a) The title "Arthashastra" is often translated to "the science of politics", but the book Arthashastra has a broader scope. It includes books on the nature of government, law, civil and criminal court systems, ethics, economics, markets and trade, the methods for screening ministers, diplomacy, theories on war, nature of peace, and the duties and obligations of a king.

147. (a) **148.** (a)

149. (a) After the controversy of underage marriage of Keshub Chunder Sen's daughter, the Special Marriages Act of 1872 was enacted to set the minimum age of 14 years for marriage of girls. All Brahmo marriages were thereafter solemnised under this law. The 1872 Act was repealed by the Special Marriage Act, 1954 under which any person of any religion could marry. The Hindu Marriage Act, 1955 applies to all Hindus including followers of the Brahmo Samaj.

150. (b)

NDA 2 2015 Question Paper

MATHEMATICS

1. Let X be the set of all persons living in Delhi. The persons *a* and *b* in X are said to be related if the difference in their ages is at most 5 years. The relation is
(a) an equivalence relation
(b) reflexive and transitive but not symmetric
(c) symmetric and transitive but not reflexive
(d) retlexive and symmetric but not transitive

2. The matrix $A=\begin{bmatrix}1 & 3 & 2\\ 1 & x-1 & 1\\ 2 & 7 & x-3\end{bmatrix}$ will have inverse for every real number x ***except*** for
(a) $x=\frac{11\pm\sqrt{5}}{2}$
(b) $x=\frac{9\pm\sqrt{5}}{2}$
(c) $x=\frac{11\pm\sqrt{3}}{2}$
(d) $x=\frac{9\pm\sqrt{3}}{2}$

3. If the value of the determinant $\begin{vmatrix}a & 1 & 1\\ 1 & b & 1\\ 1 & 1 & c\end{vmatrix}$ is positive, where $a\neq b\neq c$, then the value of abc
(a) cannot be less than 1
(b) is greater than –8
(c) is less than –8
(d) must be greater than 8

4. Consider the following statements in respect of the determinant
$$\begin{vmatrix}\cos^2\frac{\alpha}{2} & \sin^2\frac{\alpha}{2}\\ \sin^2\frac{\beta}{2} & \cos^2\frac{\beta}{2}\end{vmatrix}$$
where α, β are complementary angles
1. The value of the determinant is $\frac{1}{\sqrt{2}}\cos\left(\frac{\alpha-\beta}{2}\right)$.
2. The maximum value of the determinant is $\frac{1}{\sqrt{2}}$.
Which of the above statements is/ are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

5. What is $(1000000001)_2-(0.0101)_2$ equal to ?
(a) $(512.6775)_{10}$
(b) $(512.6875)_{10}$
(c) $(512.6975)_{10}$
(d) $(512.0909)_{10}$

6. If $A=\begin{bmatrix}1 & 0 & -2\\ 2 & -3 & 4\end{bmatrix}$, then the matrix X for which $2X+3A=0$ holds true is
(a) $\begin{bmatrix}-\frac{3}{2} & 0 & -3\\ -3 & -\frac{9}{2} & -6\end{bmatrix}$
(b) $\begin{bmatrix}\frac{3}{2} & 0 & -3\\ 3 & -\frac{9}{2} & -6\end{bmatrix}$
(c) $\begin{bmatrix}\frac{3}{2} & 0 & 3\\ 3 & \frac{9}{2} & 6\end{bmatrix}$
(d) $\begin{bmatrix}-\frac{3}{2} & 0 & 3\\ -3 & \frac{9}{2} & -6\end{bmatrix}$

7. If z_1 and z_2 are complex numbers with $|z_1|=|z_2|$, then which of the following is/are correct?
1. $z_1=z_2$
2. Real part of z_1 = Real part of z_2
3. Imaginary part of z_1 = Imaginary part of z_2
Select the correct answer using the code given below :
(a) 1 only
(b) 2 only
(c) 3 only
(d) None

8. If $A=\begin{bmatrix}1 & 1 & -1\\ 2 & -3 & 4\\ 3 & -2 & 3\end{bmatrix}$ and $B=\begin{bmatrix}-1 & -2 & -1\\ 6 & 12 & 6\\ 5 & 10 & 5\end{bmatrix}$ then which of the following is/are correct ?
1. *A* and *B* commute.
2. *AB* is a null matrix.
Select the correct answer using the code given below:
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

9. The number of real roots of the equation $x^2-3|x|+2=0$ is
(a) 4
(b) 3
(c) 2
(d) 1

10. If the sum of the roots of the equation $ax^2+bx+c=0$ is equal to the sum of their squares, then
(a) $a^2+b^2=c^2$
(b) $a^2+b^2=a+b$
(c) $ab+b^2=2ac$
(d) $ab-b^2=2ac$

11. If $A=|x\in IR : x^2+6x-7<0\}$ and $B=\{x\in IR : x^2+9x+14>0\}$, then which of the following is/ are correct?
1. $(A\cap B)=(-2,1)$
2. $(A\backslash B)=(-7,-2)$
Select the correct answer using the code given below:
(a) 1 only
(b) 2 Only
(c) Both 1 and 2
(d) Neither 1 nor 2

12. A, B, C and D are four sets such that $A \cap B = C \cap D = \phi$. Consider the following :

1. $A \cup C$ and $B \cup D$ are always disjoint.
2. $A \cap C$ and $B \cap D$ are always disjoint

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

13. If A is an invertible matrix of order n and k is any positive real number, then the value of $[\det(kA)]^{-1} \det A$ is

(a) k^{-n} (b) k^{-1}
(c) k^{n} (d) nk

14. The value of the infinite product $6^{\frac{1}{2}} \times 6^{\frac{1}{2}} \times 6^{\frac{3}{8}} \times 6^{\frac{1}{4}} \times \ldots$ is

(a) 6 (b) 36
(c) 216 (d) ∞

15. If the roots of the equation
$x^2 - nx + m = 0$
differ by 1, then

(a) $n^2 - 4m - 1 = 0$ (b) $n^2 + 4m - 1 = 0$
(c) $m^2 + 4n + 1 = 0$ (d) $m^2 - 4n - 1 = 0$

16. If different words are formed with all the letters of the word 'AGAIN' and are arranged alphabetically among themselves as in a dictionary, the word at the 50th place will be

(a) NAAGI (b) NAAIG
(c) IAAGN (d) IAANG

17. The number of ways in which a cricket team of 11 players be chosen out of a batch of 15 players so that the captain of the team is always included, is

(a) 165 (b) 364
(c) 1001 (d) 1365

18. In the expansion of $\left(\sqrt{x} + \frac{1}{3x^2}\right)^{10}$ the value of constant term (independent of x) is

(a) 5 (b) 8
(c) 45 (d) 90

19. The value of $\sin^2 5° + \sin^2 10° + \sin^2 15° + \sin^2 20° + \ldots + \sin^2 90°$ is

(a) 7 (b) 8
(c) 9 (d) $\frac{19}{2}$

20. On simplifying $\frac{\sin^3 A + \sin 3A}{\sin A} + \frac{\cos^3 A - \cos 3A}{\cos A}$, we get

(a) sin3A (b) cos3A
(c) sin A + cos A (d) 3

21. The value of $\tan\left(2\tan^{-1}\frac{1}{5} - \frac{\pi}{4}\right)$ is

(a) $-\frac{7}{17}$ (b) $\frac{5}{16}$
(c) $\frac{5}{4}$ (d) $\frac{7}{17}$

22. Two poles are 10 m and 20 m high. The line joining their tops makes an angle of 15° with the horizontal. The distance between the poles is approximately equal to

(a) 36.3 m (b) 37.3 in
(c) 38.3 m (d) 39.3 in

23. If $g(x) = \frac{1}{f(x)}$ and $f(x) = x, x \neq 0$, then which one of the following is correct

(a) $f(f(f(g(g(f(x)))))) = g(g(f(g(f(x)))))$
(b) $f(f(g(3(g(f(x)))))) = g(g(f(g(f(x)))))$
(c) $f(g(f(g(g(f(g(x))))))) = g(g(f(g(f(x)))))$
(d) $f(f(f(f(f(f(x)))))) = f(f(f(g(f(x)))))$

24. Consider the following :

1. $\sin^{-1}\frac{4}{5} + \sin^{-1}\frac{3}{5} = \frac{\pi}{2}$
2. $\tan^{-1}\sqrt{3} + \tan^{-1}1 = -\tan^{-1}(2+\sqrt{3})$

which of the above is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

25. If A is an orthogonal matrix of order 3 and $B = \begin{bmatrix} 1 & 2 & 3 \\ -3 & 0 & 2 \\ 2 & 5 & 0 \end{bmatrix}$, then which of the following is/are correct ?

1. $|AB| = \pm 47$
2. $AB = BA$

Select the correct answer using the code given below :

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

26. If a, b, c are the sides of a triangle ABC, then $a^{\frac{1}{p}} + b^{\frac{1}{p}} - c^{\frac{1}{p}}$ where $p > 1$, is

(a) always negative
(b) always positive
(c) always zero
(d) positive if $1 < p < 2$ and negative if $p > 2$

27. If a, b, c are real numbers, then the value of the determinant

$$\begin{vmatrix} 1-a & a-b-c & b+c \\ 1-b & b-c-a & c+a \\ 1-c & c-a-b & a+b \end{vmatrix}$$ is

(a) 0 (b) $(a-b)(b-c)(c-a)$
(c) $(a+b+c)^2$ (d) $(a+b+c)^3$

28. If the point $z_1 = 1 + i$ where $i = \sqrt{-1}$ is the reflection of a point $z_2 = x + iy$ in the line $i\bar{z} - iz = 5$, then the point z_2 is

(a) $1+4i$ (b) $4+i$
(c) $1-i$ (d) $-1-i$

29. If $\sin x + \sin y = a$ and $\cos x + \cos y = b$, then $\tan^2\left(\frac{x+y}{2}\right) + \tan^2\left(\frac{x-y}{2}\right)$ is equal to

(a) $\frac{a^4 + b^4 + 4b^2}{a^2b^2 + b^4}$ (b) $\frac{a^4 - b^4 + 4b^2}{a^2b^2 + b^4}$
(c) $\frac{a^4 - b^4 + 4a^2}{a^2b^2 + a^4}$ (d) None of the above

30. A vertical tower standing on a levelled field is mounted with a vertical flag staff of length 3 m. From a point on the field, the angles of elevation of the bottom and tip of the flag staff are 30° and 45° respectively. Which one of the following gives the best approximation to the height of the tower ?
(a) 3.90m (b) 4.00m
(c) 4.10m (d) 4.25m

For the next three (03) items that follow:

Consider the expansion of $(1+x)^{2n+1}$

31. If the coefficients of x^r and x^{r+1} are equal in the expansion, then r is equal to
(a) n (b) $\frac{2n-1}{2}$
(c) $\frac{2n+1}{2}$ (d) n + 1

32. The average of the coefficients of the two middle terms in the expansion is
(a) ${}^{2n+1}C_{n+2}$ (b) ${}^{2n+1}C_n$
(c) ${}^{2n+1}C_{n-1}$ (d) ${}^{2n}C_{n+1}$

33. The sum of the coefficients of all the terms in the expansion is
(a) 2^{2n-1} (b) 4^{n-1}
(c) 2×4^n (d) None of the above

34. The *n*th term of an AP. is $\frac{3+n}{4}$, then the sum of first 105 terms is
(a) 270 (b) 735
(c) 1409 (d) 1470

35. A polygon has 44 diagonals. The number of its sides is
(a) 11 (b) 10
(c) 8 (d) 7

36. If p, q, r are in one geometric progression and a, b, c are in another geometric progression, then ap, bq, cr are in
(a) Arithmetic progression (b) Geometric progression
(c) Harmonic progression (d) None of the above

For the next two (02) items that follow :

Consider a triangle ABC satisfying

$$2a\sin^2\left(\frac{C}{2}\right)+2c\sin^2\left(\frac{A}{2}\right)=2a+2c-3b$$

37. The sides of the triangle are in
(a) G.P.
(b) A.P.
(c) H.P.
(d) Neither in G.P. nor in A.P nor in H.P.

38. sin A, sin B, sin C are in
(a) G.P.
(b) A.P.
(c) H.P.
(d) Neither in G.P. nor in A.P nor in H.P.

39. If $p=\tan\left(-\frac{11\pi}{6}\right)$, $q=\tan\left(\frac{21\pi}{4}\right)$ and $r=\cot\left(\frac{283\pi}{6}\right)$, then which of the following is/are correct ?
1. The value of $p \times r$ is 2.
2. p, q and r are in G.P.
Select the correct answer using the code given below :
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

40. The number of ways in which 3 holiday tickets can be given to 20 employees of an organization if each employee is eligible for any one or more of the tickets, is
(a) 1140 (b) 3420
(c) 6840 (d) 8000

41. What is the sum of n terms of the series
$\sqrt{2}+\sqrt{8}+\sqrt{18}+\sqrt{32}+\ldots$?
(a) $\frac{n(n-1)}{\sqrt{2}}$ (b) $\sqrt{2}n(n+1)$
(c) $\frac{n(n+1)}{\sqrt{2}}$ (d) $\frac{n(n-1)}{2}$

42. The coefficient of x^{99} in the expansion of $(x-1)(x-2)(x-3)\ldots(x-100)$ is
(a) 5050 (b) 5000
(c) –5050 (d) –5000

43. $z\bar{z}+(3-i)z+(3+i)\bar{z}+1=0$ represents a circle with
(a) centre (–3, –1) and radius 3
(b) centre (–3, 1) and radius 3
(c) centre (–3, –1) and radius 4
(d) centre (–3, 1) and radius 4

44. The number of 3-digit even numbers that can be formed from the digits 0, 1, 2, 3, 4 and 5, repetition of digits being not allowed, is
(a) 60 (b) 56
(c) 52 (d) 48

45. If $\log_8 m + 1\log_8 \frac{1}{6}=\frac{2}{3}$, then m is equal to
(a) 24 (b) 18
(c) 12 (d) 4

46. The area of the figure formed by the lines ax + by + c = 0, ax – by + c = 0, ax + by – c = 0 and ax – by – c = 0 is
(a) $\frac{c^2}{ab}$ (b) $\frac{2c^2}{ab}$
(c) $\frac{c^2}{2ab}$ (d) $\frac{c^2}{4ab}$

47. If a line is perpendicular to the line 5x – y = 0 and forms a triangle of area 5 square units with co-ordinate axes, then its equation is
(a) $x+5y\pm5\sqrt{2}=0$ (b) $x-5y\pm5\sqrt{2}=0$
(c) $5x+y\pm5\sqrt{2}=0$ (d) $5x-y\pm5\sqrt{2}=0$

48. Consider any point P on the ellipse $\frac{x^2}{25}+\frac{y^2}{9}=1$ in the first quadrant. Let r and s represent its distances from (4, 0) and (–4, 0) respectively, then (r + s) is equal to
(a) 10 unit (b) 9 unit
(c) 8 unit (d) 6 unit

49. A straight line x = y + 2 touches the circle $4(x^2+y^2)=r^2$. The value of r is
(a) $\sqrt{2}$ (b) $2\sqrt{2}$
(c) 2 (d) 1

50. The three lines $4x+4y=1$, $8x-3y=2$, $y=0$ are
(a) the sides of an isosceles triangle
(b) concurrent
(c) mutually perpendicular
(d) the sides of an equilateral triangle

51. The line $3x+4y-24=0$ intersects the x-axis at A and y-axis at B. Then the circumcentre of the triangle OAB where O is the origin is
(a) (2, 3) (b) (3, 3)
(c) (4, 3) (d) None of the above

52. The eccentricity of the hyperbola $16x^2-9y^2=1$ is
(a) $\frac{3}{5}$ (b) $\frac{5}{3}$
(c) $\frac{4}{5}$ (d) $\frac{5}{4}$

53. The product of y the perpendiculars from the two points ($\pm$ 4, 0) to the line $3x\cos\phi+5y\sin\phi=15$ is
(a) 25 (b) 16
(c) 9 (d) 8

54. If the centre of the circle passing through the origin is (3, 4), then the intercepts cut off by the circle on x-axis and y-axis respectively are
(a) 3 unit and 4 unit (b) 6 unit and 4 unit
(c) 3 unit and 8 unit (d) 6 unit and 8 unit

55. The lines $2x=3y=-z$ and $6x=-y=-4z$
(a) are perpendicular (b) are parallel
(c) intersect at an angle 45° (d) intersect at an angle 60°

56. Two straight lines passing through the point A(3, 2) cut the line $2y=x+3$ and x-axis perpendicularly at P and Q respectively. The equation of the line PQ is
(a) $7x+y-21=0$ (b) $x+7y+21=0$
(c) $2x+y-8=0$ (d) $x+2y+8=0$

57. The radius of the sphere $3x^2+3y^2+3z^2-8x+4y+8z-15=0$ is
(a) 2 (b) 3
(c) 4 (d) 5

58. The direction ratios of the line perpendicular to the lines with direction ratios $<1,-2,-2>$ and $<0,2,1>$ are
(a) $<2,-1,2>$ (b) $<-2,1,2>$
(c) $<2,1,-2>$ (d) $<-2,-1,-2>$

59. What are the co-ordinates of the foot of the perpendicular drawn from the point (3, 5, 4) on the plane $z=0$?
(a) (0, 5, 4) (b) (3, 5, 0)
(c) (3, 0, 4) (d) (0, 0, 4)

60. The lengths of the intercepts on the co-ordinate axes made by the plane $5x+2y+z-13=0$ are
(a) 5, 2, 1 unit (b) $\frac{13}{5},\frac{13}{2}$, 13 unit
(c) $\frac{5}{13},\frac{2}{13},\frac{1}{13}$ unit (d) 1, 2, 5 unit

61. The area of the square, one of whose diagonals is $3\hat{i}+4\hat{j}$ is
(a) 12 square unit (b) 12.5 square unit
(c) 25 square unit (d) 156.25 square unit

62. ABCD is a parallelogram and P is the point of intersection of the diagonals. If O is the origin, then $\overrightarrow{OA}+\overrightarrow{OB}+\overrightarrow{OC}+\overrightarrow{OD}$ is equal to
(a) $4\overrightarrow{OP}$ (b) $2\overrightarrow{OP}$
(c) $\overrightarrow{OP}$ (d) Null vector

63. If $\vec{b}$ and $\vec{c}$ are the position vectors of the points B and C respectively, then the position vector of the point D such that $\overrightarrow{BD}=4\overrightarrow{BC}$ is
(a) $4(\vec{c}-\vec{b})$ (b) $-4(\vec{c}-\vec{b})$
(c) $4\vec{c}-3\vec{b}$ (d) $4\vec{c}+3\vec{b}$

64. If the position vector $\vec{a}$ of the point (5, n) is such that $|\vec{a}|=13$, then the value/values of n an be
(a) ± 8 (b) ± 12
(c) 8 only (d) 12 only

65. If $|\vec{a}|=2$ and $|\vec{b}|=3$, then $|\vec{a}\times\vec{b}|^2+|\vec{a}.\vec{b}|^2$ is equal to
(a) 72 (b) 64
(c) 48 (d) 36

66. Consider the following inequalities in respect of vectors $\vec{a}$ and $\vec{b}$:
1. $|\vec{a}+\vec{b}|\le|\vec{a}|+|\vec{b}|$
2. $|\vec{a}-\vec{b}|\ge|\vec{a}|-|\vec{b}|$

Which of the above is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

67. If the magnitude of difference of two unit vectors is $\sqrt{3}$, then the magnitude of sum of the two vectors is
(a) $\frac{1}{2}$ unit (b) 1 unit
(c) 2 unit (d) 3 unit

68. If the vectors $\alpha\hat{i}+\alpha\hat{j}+\gamma\hat{k}, \hat{i}+\hat{k}$ and $\gamma\hat{i}+\gamma\hat{j}+\beta\hat{k}$ lie on a plane, where α, β and γ are distinct non-negative numbers, then γ is
(a) Arithmetic mean of α and β
(b) Geometric mean of α and β
(c) Harmonic mean of α and β
(d) None of the above

69. The vectors $\vec{a},\vec{b},\vec{c}$ and $\vec{d}$ are such that $\vec{a}\times\vec{b}=\vec{c}\times d$ and $\vec{a}\times\vec{c}=\vec{b}\times\vec{d}$. Which of the following is/ are correct ?
1. $(\vec{a}-\vec{d})\times(\vec{b}-\vec{c})=\vec{0}$
2. $(\vec{a}\times\vec{b})\times(\vec{c}\times\vec{d})=\vec{0}$

Select the correct answer using the code given below :
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

70. The value of
$$\int_a^b \frac{x^7+\sin x}{\cos x}dx \text{ where } a+b=0 \text{ is}$$
(a) $2b-a\sin(b-a)$ (b) $a+3b\cos(b-a)$
(c) $\sin a-(b-a)\cos b$ (d) 0

71. If $f(x)=\sqrt{25-x^2}$, then what is $\lim\limits_{x\to 1}\dfrac{f(x)-f(1)}{x-1}$ equal to ?

(a) $\dfrac{1}{5}$ (b) $\dfrac{1}{24}$

(c) $\sqrt{24}$ (d) $-\dfrac{1}{\sqrt{24}}$

72. Consider the function

$$f(x)=\begin{cases} ax-2 & \text{for } -2<x<-1 \\ -1 & \text{for } -1\le x\le 1 \\ a+2(x-1)^2 & \text{for } 1<x<2 \end{cases}$$

What is the value of a for which f(x) is continuous at $x=-1$ and $x=1$?

(a) -1 (b) 1

(c) 0 (d) 2

73. The function $f(x)=\dfrac{1-\sin x+\cos x}{1+\sin x+\cos x}$ is not defined at $x=\pi$. The value of $f(\pi)$ so that f(x) is continuous at $x=\pi$ is

(a) $-\dfrac{1}{2}$ (b) $\dfrac{1}{2}$

(c) -1 (d) 1

74. Consider the following functions :

1. $f(x)=\begin{cases} \dfrac{1}{x} & \text{if } x\neq 0 \\ 0 & \text{if } x=0 \end{cases}$

2. $f(x)=\begin{cases} 2x+5 & \text{if } x>0 \\ x^2+2x+5 & \text{if } x\le 0 \end{cases}$

Which of the above functions is/are derivable at $x=0$?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

75. The domain of the function $f(x)=\dfrac{1}{\sqrt{|x|-x}}$ is

(a) $[0,\infty)$ (b) $(-\infty,0)$

(c) $[1,\infty)$ (d) $(-\infty,0]$

76. Consider the following statements :

1. The function $f(x)=x^2+2\cos x$ is increasing in the interval $(0,\pi)$

2. The function $f(x)=\ln(\sqrt{1+x^2}-x)$ is decreasing in the interval $(-\infty,\infty)$

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

77. The derivative of $\ln(x+\sin x)$ with respect to $(x+\cos x)$ is

(a) $\dfrac{1+\cos x}{(x+\sin x)(1-\sin x)}$ (b) $\dfrac{1-\cos x}{(x+\sin x)(1+\sin x)}$

(c) $\dfrac{1-\cos x}{(x-\sin x)(1+\cos x)}$ (d) $\dfrac{1+\cos x}{(x-\sin x)(1-\cos x)}$

78. If $y=\cot^{-1}\left[\dfrac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right]$, where $0<x<\dfrac{\pi}{2}$, then $\dfrac{dy}{dx}$ is equal to

(a) $\dfrac{1}{2}$ (b) 2

(c) $\sin x+\cos x$ (d) $\sin x-\cos x$

79. The function $f(x)=\dfrac{x^2}{e^x}$ monotonically increasing if

(a) $x<0$ only (b) $x>2$ only

(c) $0<x<2$ (d) $x\in(-\infty,0)\cup(2,\infty)$

80. If $x^a y^b=(x-y)^{a+b}$, then the value of $\dfrac{dy}{dx}-\dfrac{y}{x}$ is equal to

(a) $\dfrac{a}{b}$ (b) $\dfrac{b}{a}$

(c) 1 (d) 0

81. If $f: \mathrm{IR}\to\mathrm{IR}$, $g: \mathrm{IR}\to\mathrm{IR}$ be two functions given by $f(x)=2x-3$ and $g(x)=x^3+5$, then $(fog)^{-1}(x)$ is equal to

(a) $\left(\dfrac{x+7}{2}\right)^{\frac{1}{3}}$ (b) $\left(\dfrac{x-7}{2}\right)^{\frac{1}{3}}$

(c) $\left(x-\dfrac{7}{2}\right)^{\frac{1}{3}}$ (d) $\left(x+\dfrac{7}{2}\right)^{\frac{1}{3}}$

82. If $0<a<b$, then $\displaystyle\int_a^b \frac{|x|}{x}dx$ is equal to

(a) $|b|-|a|$ (b) $|a|-|b|$

(c) $\dfrac{|b|}{|a|}$ (d) 0

83. $\displaystyle\int_0^{2\pi}\sin^5\left(\frac{x}{4}\right)dx$ is equal to

(a) $\dfrac{8}{15}$ (b) $\dfrac{16}{15}$

(c) $\dfrac{32}{15}$ (d) 0

84. If $f(x)=\dfrac{\sin(e^{x-2}-1)}{\ln(x-1)}$, then $\lim\limits_{x\to 2}f(x)$ is equal to

(a) -2 (b) -1

(c) 0 (d) 1

85. Consider the following statements :

1. $f(x)=\ln x$ is an increasing function on $(0,\infty)$.
2. $f(x)=e^x-x(\ln x)$ is an increasing function on $(1,\infty)$.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

86. If $s=\sqrt{t^2+1}$, then $\frac{d^2s}{dt^2}$ is equal to

(a) $\frac{1}{s}$ (b) $\frac{1}{s^2}$

(c) $\frac{1}{s^3}$ (d) $\frac{1}{s^4}$

87. Consider the following statements :
Statement 1 : The function $f: IR \to IR$ such that $f(x)=x^3$ for all $x \in IR$ is one-one.
Statement 2 : $f(a) \Rightarrow f(b)$ for all $a, b \in IR$ if the function f is one-one.
Which one of the following is correct in respect of the above statements ?

(a) Both the statements are true and Statement 2 is the correct explanation of Statement 1.
(b) Both the statements are true and Statement 2 is *not* the correct explanation of Statement 1.
(c) Statement 1 is true but Statement 2 is false.
(d) Statement 1 is false but Statement 2 is true.

88. $\int \frac{dx}{1+e^{-x}}$ is equal to

(a) $1+e^x+c$ (b) $\ln(1+e^{-x})+c$
(c) $\ln(1+e^x)+c$ (d) $2\ln(1+e^{-x})+c$

where c is the constant of integration

89. $\int_{-1}^{1} x|x|\,dx$ is equal to

(a) 0 (b) $\frac{2}{3}$

(c) 2 (d) -2

90. The area bounded by the coordinate axes and the curve $\sqrt{x}+\sqrt{y}=1$, is

(a) 1 square unit (b) $\frac{1}{2}$ square unit

(c) $\frac{1}{3}$ square unit (d) $\frac{1}{6}$ square unit

For the next two (02) items that follow :

Consider the function

$$f(x)=\left(\frac{1}{x}\right)^{2x^2}, \text{ where } x>0$$

91. At what value of x does the function attain maximum value?

(a) e (b) $\sqrt{e}$

(c) $\frac{1}{\sqrt{e}}$ (d) $\frac{1}{e}$

92. The maximum value of the function is

(a) e (b) $e^{\frac{2}{e}}$

(c) $e^{\frac{1}{e}}$ (d) $\frac{1}{e}$

For the next two (02) items that follow :

Consider $f'(x)=\frac{x^2}{2}-kx+1$ such that $f(0)=0$ and $f(3)=15$

93. The value of k is

(a) $\frac{5}{3}$ (b) $\frac{3}{5}$

(c) $-\frac{5}{3}$ (d) $-\frac{3}{5}$

94. $f''\left(-\frac{2}{3}\right)$ is equal to

(a) -1 (b) $\frac{1}{3}$

(c) $\frac{1}{2}$ (d) 1

For the next two (02) items that follow :

Consider the function
$f(x)=-2x^3-9x^2-12x+1$

95. The function f(x) is an increasing function in the interval

(a) $(-2,-1)$ (b) $(-\infty,-2)$
(c) $(-1,2)$ (d) $(-1,\infty)$

96. The function f(x) is a decreasing function in the interval

(a) $(-2,-1)$ (b) $(-\infty,-2)$ only
(c) $(-1,\infty)$ only (d) $(-\infty,-2)\cup(-1,\infty)$

For the next two (02) items that follow :

Consider the integrals

$$A=\int_0^{\pi}\frac{\sin x\,dx}{\sin x+\cos x} \text{ and } B=\int_0^{\pi}\frac{\sin x\,dx}{\sin x-\cos x}$$

97. Which one of the follwing is correct ?

(a) $A=2B$ (b) $B=2A$
(c) $A=B$ (d) $A=3B$

98. What is the value of B?

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$

(c) $\frac{3\pi}{4}$ (d) π

For the next two (02) items that follow :

Consider the function

$$f(x)=\begin{cases} -2\sin x & \text{if } x \le -\frac{\pi}{2} \\ A\sin x+B & \text{if } -\frac{\pi}{2}<x<\frac{\pi}{2} \\ \cos x & \text{if } x \ge \frac{\pi}{2} \end{cases}$$

which is continuous everywhere.

99. The value of A is
(a) 1 (b) 0
(c) –1 (d) –2

100. The value of B is
(a) 1 (b) 0
(c) –1 (d) –2

101. The degree of the differential equation
$$\frac{dy}{dx} - x = \left(y - x\frac{dy}{dx}\right)^{-4}$$ is
(a) 2 (b) 3
(c) 4 (d) 5

102. The solution of $\frac{dy}{dx} = \sqrt{1 - x^2 - y^2 + x^2y^2}$ is
(a) $\sin^{-1} y = \sin^{-1} x + c$
(b) $2\sin^{-1} y = \sqrt{1-x^2} + \sin^{-1} x + c$
(c) $2\sin^{-1} y = x\sqrt{1-x^2} + \sin^{-1} x + c$
(d) $2\sin^{-1} y = x\sqrt{1-x^2} + \cos^{-1} x + c$
where c is an arbitrary constant.

103. The differential equation of the family of circles passing through the origin and having centres on the x-axis is
(a) $2xy\frac{dy}{dx} = x^2 - y^2$ (b) $2xy\frac{dy}{dx} = y^2 - x^2$
(c) $2xy\frac{dy}{dx} = x^2 + y^2$ (d) $2xy\frac{dy}{dx} + x^2 + y^2 = 0$

104. The order and degree of the differential equation of parabolas having vertex at the origin and focus at (a, 0) where a > 0, are respectively
(a) 1, 1 (b) 2, 1
(c) 1, 2 (d) 2, 2

105. f(xy) = f(x) + f(y) is true for all
(a) Polynomial functions f
(b) Trigonometric functions f
(c) Exponential functions f
(d) Logarithmic functions f

106. Three digits are chosen at random from 1, 2, 3, 4, 5, 6, 7, 8 and 9 without repeating any digit. What is the probability that the product is odd ?
(a) $\frac{2}{3}$ (b) $\frac{7}{48}$
(c) $\frac{5}{42}$ (d) $\frac{5}{108}$

107. Two events A and B are such that P(not B) = 0.8, P(A∪B) = 0.5 and P(A|B) = 0.4. Then P(A) is equal to
(a) 0.28 (b) 0.32
(c) 0.38 (d) None of the above

108. If mean and variance of a Binomial variate X are 2 and 1 respectively, then the probability that X takes a value greater than 1 is
(a) $\frac{2}{3}$ (b) $\frac{4}{5}$
(c) $\frac{7}{8}$ (d) $\frac{11}{16}$

109. Seven unbiased coins are tossed 128 times. In how many throws would you find at least three heads ?
(a) 99 (b) 102
(c) 103 (d) 104

110. A coin is tossed five times. What is the probability that heads are observed more than three times ?
(a) $\frac{3}{16}$ (b) $\frac{5}{16}$
(c) $\frac{1}{2}$ (d) $\frac{3}{32}$

111. The geometric mean of the observations $x_1, x_2, x_3, \ldots\ldots x_n$ is G_1. The geometric mean of the observations $y_1, y_2, y_3, \ldots y_n$ is G_2. The geometric mean of observations
$\frac{x_1}{y_1}, \frac{x_2}{y_2}, \frac{x_3}{y_3}, \ldots, \frac{x_n}{y_n}$ is
(a) G_1G_2 (b) $\ln(G_1G_2)$
(c) $\frac{G_1}{G_2}$ (d) $\ln\left(\frac{G_1}{G_2}\right)$

112. The arithmetic mean of 1, 8, 27, 64,..... up to n terms is given by
(a) $\frac{n(n+1)}{2}$ (b) $\frac{n(n+1)^2}{2}$
(c) $\frac{n(n+1)^2}{4}$ (d) $\frac{n^2(n+1)^2}{4}$

113. An unbiased coin is tossed until the first head appears or until four tosses are completed, whichever happens earlier. Which of the following statements is/are correct ?
1. The probability that no head is observed is $\frac{1}{16}$.
2. The probability that the experiment ends with three tosses is $\frac{1}{8}$.

Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

114. If $x \in [0, 5]$, then what is the probability that $x^2 - 3x + 2 \geq 0$?
(a) $\frac{4}{5}$ (b) $\frac{1}{5}$
(c) $\frac{2}{5}$ (d) $\frac{3}{5}$

115. A bag contains 4 white and 2 black balls and another bag contains 3 white and 5 black balls. If one ball is drawn from each bag, then the probability that one ball is white and one ball is black is
(a) $\frac{5}{24}$ (b) $\frac{13}{24}$
(c) $\frac{1}{4}$ (d) $\frac{2}{3}$

116. A problem in statistics is given to three students A, B and C whose chances of solving it independently are $\frac{1}{2}, \frac{1}{3}$ and $\frac{1}{4}$ respectively. The probability that the problem will be solved is

(a) $\frac{1}{12}$ (b) $\frac{11}{12}$

(c) $\frac{1}{2}$ (d) $\frac{3}{4}$

117. An insurance company insured 2000 scooter drivers, 4000 car drivers and 6000 truck drivers. The probabilities of an accident involving a scooter driver, car driver and a truck driver are 0.01, 0.03 and 0.15 respectively. One of the insured persons meets with an accident. The probability that the person is a scooter driver is

(a) $\frac{1}{52}$ (b) $\frac{3}{52}$

(c) $\frac{15}{52}$ (d) $\frac{19}{52}$

118. A coin is tossed 5 times. The probability that tail appears an odd number of times, is

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$

(c) $\frac{2}{5}$ (d) $\frac{1}{5}$

119. The regression coefficients of a bivariate distribution are –0.64 and –0.36. Then the correlation coefficient of the distribution is

(a) 0.48 (b) –0.48

(c) 0.50 (d) –0.50

120. What is the probability that the sum of any two different single digit natural numbers is a prime number ?

(a) $\frac{5}{27}$ (b) $\frac{7}{18}$

(c) $\frac{1}{3}$ (d) None of the above

GENERAL ABILITY

PART-A : ENGLISH

DIRECTIONS: *In this section, look at the underlined part of each sentence. Below each sentence are given three possible substitutions for the underlined part. If one of them (a), (b) or (c) is better than the underlined part, indicate your response on the Answer Sheet against the corresponding letter (a), (b) or (c). If none of the substitutions improves the sentence, indicate (d) as your response on the Answer Sheet. Thus, a "No improvement" response will be signified by the letter (d).*

1. Had she been hungry, she would have devoured the whole lot of it.

(a) Unless she had been hungry
(b) However she had been hungry
(c) As if she had been hungry
(d) No improvement

2. Until you don't finish the work, you won't be given leave.

(a) Until you must finish (b) Until finishing
(c) Until you finish (d) No improvement

3. The names of the defaulters have been cut off the register.

(a) cut out (b) struck out
(c) struck off (d) No improvement

4. This is a matter I'd rather not talk about.

(a) of which I'd rather not talk about
(b) I rather not talk about
(c) than I'd rather not talk about
(d) No improvement

5. Only when you left I did sleep.

(a) I slept (b) did I sleep
(c) had I slept (d) No improvement

6. I will be happy if you will buy me apples.

(a) buy (b) bought
(c) will be buying (d) No improvement

7. After I saved some money, I shall go abroad.

(a) shall save (b) should have save
(c) have saved (d) No improvement

8. Can you arrange the car to be ready this evening ?

(a) arrange with the car (b) arrange for the car
(c) arrange that the car (d) No improvement

9. Hardly had he reached home when the telephone rang.

(a) he had reached (b) did he reach
(c) he reached (d) No improvement

10. He is likely to win the elections by the sweeping majority.

(a) with the sweeping majority
(b) in sweeping majority
(c) by a sweeping majority
(d) No improvement

DIRECTIONS: *Each of the following items in this section consists of a sentence the arts of which have been Jumbled. These parts have been labelled P, Q, R and S. Given below each sentence are four sequences namely (a), b), (c) and (d). You are required to re-arrange the jumbled parts of the sentence and select the correct sequence.*

11. His uncle for success in life, (P) always advised his son, (Q) who was a self-made man (R) to depend on his own efforts (S)

The proper sequence should be:

(a) SQPR (b) RQSP
(c) PRSQ (d) QPSR

12. The doctor did not like the behavior of the patients (P) who was very competent in his profession (Q) when they talked at length (R) about their problems (S)

The proper sequence should be:

(a) RPSQ (b) SRPQ
(c) QPRS (d) PRQS

13. from leadership in culture (P)
in military situations and in face-to-face small groups (Q)
leadership has wide range of expressions (R)
to leadership in politics (S)
The proper sequence should be:
(a) RSQP (b) PQRS
(c) RPSQ (d) SQRP

14. He sat glancing occasionally (P) peering through the window (Q)
at the figure of the old woman (R)
until he was chilled with the cold (S)
The proper sequence should be:
(a) PSRQ (b) QRPS
(c) SPRQ (d) PRSQ

15. After the earthquake tremors, the TV showed a haggard man shaking his fist at the sky (P)
clambering over the ruins (Q)
and collapsing with a howl of revolt (R)
of his house and factory (S)
The proper sequence should be:
(a) SRQP (b) QSPR
(c) PQRS (d) RPSQ

16. Everyone acknowledges (P) when he considers the case calmly (Q)
who knows you (R) that you have been wronged (S)
The proper sequence should be:
(a) RSQP (b) RPQS
(c) PQRS (d) QRPS

DIRECTIONS: *Each item in this section consists of a sentence with an underlined word followed by four words. Select the word that is nearest in meaning to the underlined word and mark your response in your Answer Sheet accordingly.*

17. Many of his acquaintances avoid him because he is so garrulous.
(a) unreasonable (b) talkative
(c) quarrelsome (d) proud

18. He bore the pain with great fortitude.
(a) resignation
(b) defiance
(c) indifference
(d) forbearance

19. He gave his tacit approval to the proposition.
(a) full (b) loud
(c) clean (d) implied

20. In spite of hard work, the farmers could only get a meagre yield.
(a) satisfactory (b) scanty
(c) plenty (d) normal

21. He was exhilarated at the outcome of the election results.
(a) satisfied (b) surprised
(c) disappointed (d) overjoyed

DIRECTIONS: *Each item in this section consists of a sentence with an underlined word followed by four words. Select the word that is* ***opposite in meaning*** *to the underlined word and mark your response in your Answer Sheet accordingly.*

22. He concealed his thoughts very cleverly.
(a) emphasized (b) expressed
(c) affirmed (d) revealed

23. The proposal was denounced by one and all.
(a) renounced (b) recommended
(c) announced (d) commended

24. She was skeptical about the safety of the new drug.
(a) doubtful (b) certain
(c) hopeful (d) sanguine

25. The answers to the question were coherent.
(a) relaxed (b) loose
(c) consistent (d) disconnected

26. It was no altruistic motive that prompted him to help her.
(a) selfish (b) inhuman
(c) brutal (d) wicked

DIRECTIONS: *Each of the following sentences in this section has a blank space and four words or group of words given after the sentence. Select whichever word or group of words you consider most appropriate for the blank space and indicate your response on the Answer Sheet accordingly.*

27. Man has won his dominant position on this planet by his ________ of technology.
(a) command (b) emphasis
(c) belief (d) stress

28. The day was extremely hot and, in no time, my back was drenched with ________ .
(a) prickly heat (b) perspiration
(c) sores (d) fatigue

29. The Government is encouraging village upliftment ________ in the country.
(a) programmes (b) designs
(c) talks (d) propaganda

30. Satish was endowed ________ a natural talent for music.
(a) in (b) by
(c) for (d) with

31. Mr. Ghosh is very happy ________ his son's excellent result.
(a) for seeing (b) to see
(c) by seeing (d) see

32. Sunlight filtering ________ the stained glass window created a mosaic of colours on the floor.
(a) in (b) through
(c) at (d) into

33. Are you feeling doubtful ________ your decision?
(a) about (b) upon
(c) at (d) for

34. I want to study Geology now for I _______ Zoology for the last three years.
(a) am studying (b) have been studying
(c) had studied (d) had been studying

35. Increase in storage facilities has made it possible to store goods at places __________ to people all over the country.
(a) safe (b) easy
(c) proper (d) convenient

36. To say that we were surprised at the cleverness of the child is an understatement; we were really__________
(a) annoyed (b) astounded
(c) flattered (d) confused

37. In spite of the old woman's repeated entreaties, he remained __________.
(a) ashamed (b) docile
(c) indifferent (d) lethargic

38. There was _______ competition for electoral seats.
(a) diligent (b) rapid
(c) cut-throat (d) sparse

39. The cricket team _______ mainly of State players.
(a) composed (b) consist
(c) made with (d) comprises

40. His love for money is the only _______ that drives him to work so hard.
(a) programme (b) plan
(c) reason (d) greed

41. According to _______ sources, the Chief Minister did not consult his Cabinet Members on this issue.
(a) intelligent (b) simple
(c) reliable (d) fundamental

DIRECTIONS: *Each item in this section has a sentence with three underlined parts labelled (a), (b) and (c). Read each sentence to find out whether there is any error in any underlined part and indicate your answer in the Answer Sheet against the corresponding letter i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d).*

42. I am told (a) John is ill (b) since Monday. (c) No error. (d)

43. I shall leave school (a) as soon as (b) I shall find a job. (c) No error. (d)

44. He is a rich man: (a) he is owning (b) a number of buildings in Bombay. (c) No error. (d)

45. We were able to make it (a) in spite of (b) a bad weather. (c) No error. (d)

46. Neither of the two letters of credit (a) were useful (b) when he needed it. (c) No error. (d)

47. Little he realized (a) that he wouldn't live (b) to see his grandson married. (c) No error (d)

48. A difficult syllabus (a) is supposed to hurt (b) juvenile mind. (c) No error. (d)

49. The voice of sanity and patriotism (a) are important to dispel (b) the prevailing confusion (c) No error. (d)

50. You were going to explain (a) your late arrival, (b) isn't it? (c) No error. (d)

PART- B : GENERAL KNOWLEDGE

51. A brass ball is tied to a thin wire and swung so as to move uniformly in a horizontal circle. Which of the following statements in this regard is/are true?
1. The ball moves with constant velocity
2. The ball moves with constant speed
3. The ball moves with constant acceleration
4. The magnitude of the acceleration of the ball is constant

Select the correct answer using the code given below:
(a) 1 only (b) 1 and 3
(c) 1, 2 and 4 (d) 2 and 4 only

52. Two long wires each carrying a d.c. current in the same direction are placed close to each other. Which one of the following statements is correct?
(a) The wires will attract each other
(b) The wires will repel each other
(c) There will be no force between the wires
(d) There will be a force between the wires only at the moment when the current is switched ON or OFF

53. The first Indian Satellite, Aryabhatt, was launched in the year:
(a) 1972 (b) 1975
(c) 1976 (d) 1979

54. Which one of the following sea routes is the shortest from point to point?
(a) Kolkata to Yangoon (b) Kolkata to Chennai
(c) Chennai to Port Blair (d) Mumbai to Colombo

55. Which one of the following is **not** a Green House Gas?
(a) Water vapours (b) Methane
(c) Ozone (d) Carbon Monoxide

56. Muscle fatigue is due to the accumulation of :
(a) Cholesterol (b) Lactic acid
(c) Lipoic acid (d) Triglycerides

57. The absolute zero, i.e., temperature below which is **not** achievable, is about:
(a) 0°C (b) –273 K
(c) –273 °C (d) –300°C

58. Lightning conductors are used to protect building from lightning strikes. Which of the following statements is / are true about lightning conductors?

1. Lightning conductors create an electric field at its top so that lightning strikes it preferentially
2. Lightning conductors reduce the effect of the strike by uniformly distributing the charge (current) over the surface of the building
3. Lightning conductors take all charge (current) to deep down in the earth
4. Lightning conductors must be installed at a place taller than the building

Select the correct answer using the code given below:

(a) 1 and 2 (b) 3 and 4 only
(c) 1, 3 and 4 (d) 4 only

59. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Manufacturing site)*	**List II** *(Industry)*
A. Ludhiana	1. Auto parts
B. Kanpur	2. Woollen garments
C. Varanasi	3. Leather
D. Vijayawada	4. Handloom

Code:

	A	B	C	D
(a)	1	4	3	2
(b)	2	3	4	1
(c)	2	4	3	1
(d)	1	3	4	2

60. Which one of the following is **not** a sea port?

(a) Paradeep (b) Haldia
(c) Diamond Harbour (d) Dhamra

61. Consider the following reaction:

$$CH_4(g) + H_2O(g) \xrightarrow{1270K} CO(g) + 3H_2(g)$$

In the reaction given above, the mixture of CO and H_2 is:

(a) natural gas (b) water gas
(c) producer gas (d) industrial gas

62. Living things are grouped into subgroups like plant kingdom/ animal kingdom. Which one of the following is **not** correct for animal kingdom?

(a) Cannot make their own food
(b) Body contains cellulose
(c) Do not have chlorophyll
(d) Migrate from one place to another

63. The silvering in thermos flasks is done to avoid heat transfer by:

(a) Convection
(b) Conduction
(c) Radiation
(d) Both convection and conduction

64. The Manas National Park is situated in the State of:

(a) Madhya Pradesh (b) Jharkhand
(c) Assam (d) West Bengal

65. Addition of gypsum to cement:

(a) reduces setting time to cement
(b) produces very light colour cement
(c) increases setting time of cement
(d) shining surface is formed

66. In case of a compound microscope which of the following statements is/are correct?

1. The focal length of the eye piece is larger than the focal length of the objective
2. The focal length of the eye piece is smaller than the focal length of the objective
3. The image produced in a normal optical microscope is real
4. The image produced in a normal optical microscope is virtual

Select the correct answer using the code given below:

(a) 1 only (b) 1 and 4
(c) 2 and 3 (d) 2 and 4

67. Which one of the following statements is **not** correct?

(a) The radius of curvature of a concave mirror is twice its focal length
(b) Power of a convex lens is negative and that of a concave lens is positive
(c) The radius of curvature of a plane mirror is infinity
(d) When a ray of light passes from an optically denser medium to an optically rarer medium, the angle of refraction is greater than the corresponding angle of incidence

68. Identify the place that is **not** an oil field:

(a) Naharkatiya (b) Kalol
(c) Ledo (d) Ankleshwar

69. Ammonia (NH_3) obtained from different sources always has same proportion of Nitrogen and Hydrogen. It proves the validity of law of:

(a) Reciprocal proportion
(b) Constant proportion
(c) Multiple proportions
(d) None of the above

70. Which one of the following statements is **not** correct?

(a) If the velocity and acceleration have opposite sign, the object is slowing down
(b) If the velocity is zero at an instant, the acceleration should also be zero at that instant
(c) If the velocity is zero for a time interval; the acceleration is zero at any instant within the time interval
(d) If the position and velocity have opposite sign, the object is moving towards the origin

71. The IST meridian 82½°E passes through a number of States in India. Which one of the following sets of States is correct in this respect?

(a) Uttarakhand, Uttar Pradesh, Chhatisgarh and Andhra Pradesh
(b) Uttar Pradesh, Jharkhand, Chhatisgarh and Odisha
(c) Uttarakhand, Uttar Pradesh, Madhya Pradesh and Chhatisgarh
(d) Uttar Pradesh, Odisha, Andhra Pradesh and Chhatisgarh

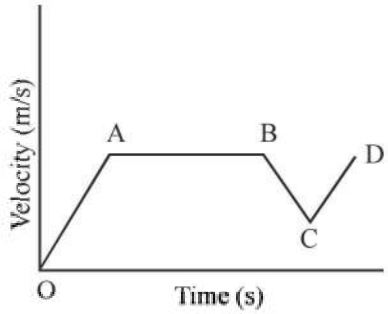
72. Boric acid is an acid because its molecule:

(a) accepts OH^- from water releasing proton
(b) combines with proton from water molecule
(c) contains replaceable H^+ ion
(d) gives up a proton

73. Who among the following discovered the antibiotic producing fungus from Penicillium genus?
(a) Louis Pasteur
(b) Sir Alexander Fleming
(c) Stanley Prusiner
(d) Robert Hooke

74. Three equal resistances when combined in series are equivalent to 90 ohm. Their equivalent resistance when combined in parallel will be:
(a) 10 ohm (b) 30 ohm
(c) 270 ohm (d) 810 ohm

75. The following figure represents the velocity-time graph of a moving car on a road:



Which segment of the graph represents the retardation?
(a) AB (b) BC
(c) CD (d) None

76. Which one among the following places is **not** an iron-ore mining area?
(a) Badampahar (b) Zawar
(c) Bailadila (d) Anantpur

77. Match List I with List II and select the correct answer using the code given below the Lists:

List I (Forest Conservation Type)	List II (Place)
A. National Park	1. Dudhwa
B. Sanctuary	2. Bhitarkanika
C. Biosphere Reserve	3. Chilka
D. Tiger Reserve	4. Nokrek

Code:

	A	B	C	D
(a)	2	3	4	1
(b)	1	4	3	2
(c)	2	4	3	1
(d)	1	3	4	2

78. The main constituent of Vinegar is:
(a) Acetic acid (b) Ascorbic acid
(c) Citric acid (d) Tartaric acid

79. White Phosphorus glows in the dark due to:
(a) amorphous character
(b) slow oxidation
(c) high ignition temperature
(d) good conducting property of electricity

80. Which one of the following is **not** an example of eukaryotic organism?
(a) Yeast (b) Bacteria
(c) Plant (d) Human being

81. Which one of the following statements is **not** correct?
(a) The Kelvin scale of temperature is called the Absolute scale
(b) Visible light radiation has wavelength range of 400-700 nm
(c) The capacity to do work is called power
(d) The wavelength of Gamma rays is less than that of X-rays

82. A man is sitting in a train which is moving with a velocity of 60 km/hour. His speed with respect to the train is:
(a) 10/3 m/s (b) 60 m/s
(c) infinite (d) zero

83. Match List I with List II and select the correct answer using the code given below the Lists:

List I (Place)	List II (Normal vegetation type)
A. Western Ghats	1. Tropical Moist Deciduous
B. Himachal Pradesh	2. Tropical Evergreen
C. Haryana and Punjab	3. Himalayan Moist Forest
D. Chhotanagpur Plateau	4. Tropical Thorny Forest

Code:

	A	B	C	D
(a)	2	3	4	1
(b)	1	4	3	2
(c)	2	4	3	1
(d)	1	3	4	2

84. The term 'Regur' is used to mean:
(a) Laterite soil (b) Deltaic soil
(c) Red soil (d) Black cotton soil

85. Graphite is a much better conductor of heat and electricity than diamond. This is due to the fact that each carbon atom in graphite:
(a) undergoes sp^2 hybridization and forms three sigma bonds with three neighbouring carbon atoms
(b) undergoes sp^3 hybridization
(c) is tetrahedrally bonded
(d) is free from van der Waals force

86. Which one of the following vitamins is synthesized in our own skin?
(a) Vitamin A (b) Vitamin B
(c) Vitamin C (d) Vitamin D

87. Which one of the following is the SI unit of the thermal conductivity of a material?
(a) $Wm^{-1}K^{-1}$ (b) Wm/K
(c) Wm^{-1}/K^{-1} (d) $Js^{-1}m^{-1}K$

88. Which one of the following statements is **not** correct?
(a) Conduction can occur easily in solids, less easily in liquids but hardly at all in gases
(b) Heat energy is carried by moving particles in a convection current
(c) Heat energy is carried by electromagnetic waves in radiation
(d) The temperature at which a solid changes into a liquid is called the boiling point

89. Which one of the following combinations of stalactites and stalagrnites occurrences is correct?
(a) Stalactites hang as icicles of different diameters and stalagmites hang from the floor of the caves
(b) Stalactites hang as icicles of different diameters and stalagmites rise up from the floor of the caves
(c) Stalactites rise up from the floor of the caves and stalagmites hang as icicles of different diameters
(d) Stalactites hang as icicles of different diameters and stalagmites also hang as icicles of different diameters

90. Which one of the following is the correct sequence about various levels of organization of Biosphere?
(a) Eco system -Biosphere - Community -Population
(b) Population - Organism - Eco system - Biosphere
(c) Organism - Community - Population - Biosphere
(d) Organism - Population - Eco system - Biosphere

91. Which of the following are the properties of an electron?
1. Electron is a constituent of cathode ray
2. Electron is a negatively charged particle
3. The mass of the electron is equal to the mass of the proton
4. Electron is deflected by the electric field but not by magnetic field

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 1, 2 and 3
(c) 3 and 4 (d) 1 and 4

92. Carbon and energy requirements of autotrophic organisms are fulfilled by:
(a) Photosynthesis (b) Gluconeogenesis
(c) Glycogenesis (d) External sources

93. The resistance of a wire of length *l* and area of cross-section a is *x* ohm. If the wire is stretched to double its length, its resistance would become:
(a) $2x$ ohm (b) $0.5x$ ohm
(c) $4x$ ohm (d) $6x$ ohm

94. Which one of the following describes the Lithosphere?
(a) Upper and lower mantle
(b) Crust and upper mantle
(c) Crust and core
(d) Mantle and core

95. Which of the following statements regarding heavy water are correct?
1. It is extensively used as a moderator in nuclear reactors
2. It cannot be used in exchange reaction to study reaction mechanism
3. Viscosity of heavy water is relatively smaller than that of ordinary water
4. The dielectric constant of heavy water is smaller than that of ordinary water

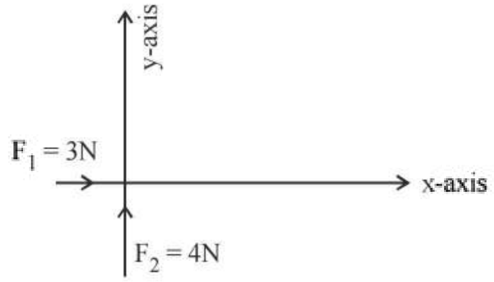
Select the correct answer using the code given below:
(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) 1 and 4

96. Conservation of momentum in a collision between particles can be understood on the basis of:
(a) Newton 's first law of motion
(b) Newton 's second law of motion only
(c) Both Newton's second law of motion and Newton's third law of motion
(d) Conservation of energy

97. Which one of the following statements is **not** correct?
(a) Temperatures decrease from the equator to poles
(b) Temperatures in equatorial regions change substantially from January to July
(c) Large land masses located in the subarctic and arctic zones develop centres of extremely low temperatures in winter
(d) Highlands are always colder than surrounding low lands

98. To weld metals together, high temperature is required. Such a high temperature is obtained by burning:
(a) Acetylene in oxygen
(b) LPG in oxygen
(c) Methane in oxygen
(d) Acetylene in nitrogen

99. Two forces, one of 3 newton and another of 4 newton are applied on a standard 1 kg body, placed on a horizontal and frictionless surface, simultaneously along the x-axis and the y-axis, respectively, as shown below:



The magnitude of the resultant acceleration is:
(a) $7\ m/s^2$ (b) $1\ m/s^2$
(c) $5\ m/s^2$ (d) $\sqrt{7}\ m/s^2$

100. Magnetic meridian is an imaginary:
(a) line along north-south
(b) point
(c) vertical plane
(d) horizontal plane

101. An up fold in rock is:
(a) graben (b) horse
(c) anticline (d) syncline

102. Which one of the following gases is found in highest quantity in Exosphere?
(a) Hydrogen (b) Helium
(c) Nitrogen (d) Oxygen

103. In blood, platelets are required for:
(a) transporting oxygen
(b) transporting carbon dioxide
(c) initiating blood clotting
(d) initiating degradation of urea

104. In SI unit of force 'Newton' (N) is given by (where m stands for metre and S stands for second):
(a) $1N = 1 kg/ms^2$" (b) $1N = 1 kgm/s^2$
(c) $1N = 1 kg\, s^2/m$ (d) $1N = 1 kg\, m\, s^2$

105. The acceleration due to gravity 'g' for objects on or near the surface of earth is related to the universal gravitational constant 'G' as ('M' is the mass of the earth and 'R' is its radius):

(a) $G = g\frac{M}{R^2}$ (b) $g = G\frac{M}{R^2}$

(c) $M = \frac{gG}{R^2}$ (d) $R = \frac{gG}{M^2}$

106. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Low-Latitude Climate)*		List II *(Characteristic)*	
A.	Wet Equatorial	1.	Uniform temperatures, mean near 27 °C
B.	Monsoon and trade wind coastal	2.	Marked temperature cycle with very high temperature before the rainy season
C.	Wet-dry tropical	3.	Temperatures show an annual cycle with high temperature in the high-Sun season
D.	Dry tropical	4.	Strong temperature cycle, with intense temperature during high-Sun season

Code:

	A	B	C	D
(a)	2	3	4	1
(b)	1	2	3	4
(c)	2	4	3	1
(d)	1	3	2	4

107. Match List I with List II and select the correct answer using the code given below the Lists:

List I *(Element)*		List II *(Use)*	
A.	Li	1.	Time keeper in atomic clocks
B.	Na	2.	Batteries
C.	K	3.	Transfer of nerve impulses
D.	Cs	4.	Control of the water content in the blood

Code:

	A	B	C	D
(a)	2	3	4	1
(b)	1	2	3	4
(c)	2	4	3	1
(d)	1	3	2	4

108. Which one of the following is **not** a site of action in human body for the malarial parasite plasmodium?

(a) Liver (b) Kidney

(c) Red blood cell (d) Brain

109. The loudness of sound is related to:

(a) its frequency (b) its amplitude

(c) its speed (d) its pitch

110. X-rays are electromagnetic radiation whose wavelengths are of the order of:

(a) 1 metre (b) 10^{-1} metre

(c) 10^{-5} metre (d) 10^{-10} metre

111. Which one of the following pairs of properties of typical air masses is correct?

	Air Mass		*Source Region*
(a)	Maritime Equatorial	:	Warm oceans in the equatorial zone
(b)	Maritime Polar	:	Warm oceans in the tropical zone
(c)	Continental Tropical	:	Less warm oceans in the tropical zone
(d)	Continental Polar	:	Moist oceans in the polar zone

112. The symbol of the element 'Tungsten' is:

(a) Ta (b) W

(c) Tl (d) Tc

113. In Egypt, ancient mummies can be found to have their arteries intact due to well preserved:

(a) mineralized blood (b) fibroblasts fibre

(c) elastic fibre (d) brown fat

114. Which one of the following statements is correct?

(a) The image formed by a concave mirror for an object lying at infinity is at the principal focus, highly diminished, real and inverted

(b) A ray of light parallel to the principal axis after reflection from a concave mirror appears to diverge from the principal focus of the mirror

(c) The focal length of a spherical mirror is double of its radius of curvature

(d) A ray of light travelling from a rarer medium to a denser medium bends away from the normal

115. Which one of the following statements is correct?

(a) Rutherford's alpha-particle scattering experiment led to the discovery of electron

(b) J J Thomson suggested that the nucleus of an atom contains protons

(c) The atomic number of an element is the same as the number of protons in the nucleus of its atom

(d) The mass number of an atom is equal to the number of electrons in its shells

116. Which one of the following statements is **not** correct?

(a) Application of lime makes the soil acidic

(b) High acidity in soil is typical of humid climate

(c) Increasing soil acidity results in declining soil fertility

(d) Arid climate is characterized by alkaline soil

117. The alkali metals have relatively low melting point. Which one of the following alkali metals is expected to have the highest melting point?

(a) Li (b) Na

(c) K (d) Rb

118. Which one of the following is useful in paper manufacturing industry?

(a) Fibrous plants

(b) Orchids

(c) Non-flowering plants

(d) Plants growing in high altitude

119. Which one of the following statements is **not** correct?
- (a) In steady flow of a liquid, the velocity of liquid particles reaching at a particular point is the same at all points
- (b) Steady flow is also called streamlined flow
- (c) In steady flow, each particle may not follow the same path as taken by a previous particle passing through that point
- (d) Two streamlines cannot intersect each other

120. According to the Geo-scientists, the shape of the earth is:
1. round
2. spherical
3. close to that of a sphere
4. an oblate ellipsoid

Select the correct answer using the code given below:
- (a) 2, 3 and 4
- (b) 1, 2 and 3
- (c) 1 and 2 only
- (d) 3 and 4 only

121. The word 'Secular' was inserted into the Constitution of India by:
- (a) 44^{th} Amendment Act
- (b) 52^{nd} Amendment Act
- (c) 42^{nd} Amendment Act
- (d) 34^{th} Amendment Act

122. Which one of the following is **not** correct in the context of balance of payments of India during 2013-2014?
- (a) India's exports were less than its imports
- (b) Trade balance was negative
- (c) Net invisibles were positive
- (d) Capital account balance was negative

123. Which one of the following continents accounts for the maximum share in exports from India?
- (a) Asia
- (b) Europe
- (c) Africa
- (d) North America

124. The two provisions of the Constitution of India that most clearly express the power of Judicial review are:
- (a) Article 21 and Article 446
- (b) Article 32 and Article 226
- (c) Article 44 and Article 152
- (d) Article 17 and Article 143

125. Which one of the following statements about Subsidiary Alliance devised by Lord Wellesley in the year 1798 is **not** correct?
- (a) The territories entering into a subsidiary alliance with the British were responsible for their own internal and external protection
- (b) In the territory of the ally, a British armed, contingent would be stationed
- (c) The ally would have to provide the resources for maintaining the British contingent in the territory
- (d) The permission of the British was needed for the ally to enter into agreements with other rulers

126. Who among the following was associated with the Mughal Court as a physician to Prince Dara Shukoh'?
- (a) Hakim Afzal Khan
- (b) Ibn Battuta
- (c) Francois Bernier
- (d) Duarte Barbosa

127. During the Eleventh Five Year Plan (FYP), agriculture sector in India witnessed a growth rate of 3.3 per cent per annum which is higher than 2.4 per cent per annum in the previous FYP. This is largely due to better performance of:
- (a) Crops and Livestock
- (b) Oilseeds and Fibres
- (c) Fishing and Oilseeds
- (d) Fibres and Fishing

128. An emergency under Article 352 of the Constitution of India can be declared only during:
- (a) War, external aggression or internal disturbance.
- (b) War, external aggression or armed rebellion.
- (c) Failure of Constitutional Machinery in the State.
- (d) Financial instability in the country.

129. Which of the following statements about the Livestock sector in India is/are correct ?
1. Livestock contributed about 25 per cent of gross value added in agriculture
2. It provides self employment to a large segment of population
3. Rapid growth of livestock sector can be egalitarian and inclusive

Select the correct answer using the code given below:
- (a) 3 only
- (b) 1 and 2 only
- (c) 2 and 3 only
- (d) 1, 2 and 3

130. Which one of the following statements about Khilafat Movement is **not** correct?
- (a) The Khilafat Movement demanded that the Khalifa must retain control over Muslim holy places
- (b) The radical trend in the Khilafat Movement was represented by younger leaders like Muhammad Ali, Shaukat Ali, and Maulana Azad
- (c) Indian Muslim leaders used Khilafat as a symbol that could unite the Indian Muslim community
- (d) The Delhi conference of the Central Khilafat Committee in 1920 decided to launch a massive Non-Cooperation Movement

131. Which one of the following is **not** correct in the current Indian scenario?
- (a) Life expectancy is on the increase and is about 67 years as of now
- (b) Infant mortality rate is on the decline and has reached 47 per thousand
- (c) Maternal mortality rate (MMR) is on the rise due to lack of medical facilities
- (d) Percentage of women giving birth in health institutions is on the rise

132. The Fourth Schedule to the Constitution of India deals with:
- (a) provisions related to the administration of tribal areas.
- (b) allocation of seats in the Council of States.
- (c) the Union List, The State List and the Concurrent List.
- (d) recognized languages of the Union of India.

133. The British Officer who was a representative of the Governor General and who lived in a State which was not under direct British rule was called:
- (a) Collector
- (b) Viceroy
- (c) Resident
- (d) Agent

134. Which of the following features of the Permanent Settlement of 1793 is / are correct?

1. The Permanent Settlement vested Land ownership rights in the peasants
2. The Permanent Settlement vested land ownership rights in the Zamindars
3. The Zamindars had to pay a fixed amount of rent by a particular date
4. The Zamindars benefited hugely from the Permanent Settlement while the peasants suffered

Select the correct answer using the code given below:

(a) 1 only (b) 2 and 3 only
(c) 4 (d) 1, 2 and 3

135. The Vijayanagara Empire received its death blow at the battle of:

(a) Talikota in 1565 (b) Panipat in 1661
(c) Talikota in 1665 (d) Raichur in 1510

136. The 'Basic Structure Doctrine' was enunciated by the Supreme Court during the:

(a) Golak Nath case
(b) Maneka Gandhi case
(c) Kesavananda Bharati case
(d) S R Bommai case

137. Consider the following statements about the travellers who visited India:

1. Abdur Razzaq Samarqandi from Herat visited Delhi and Daulatabad.
2. Ibn Battuta provides detailed accounts of both Delhi and Daulatabad.
3. According to Francois Bernier there was no private property in land in Mughal India.

Which of the statements given above is/are correct?

(a) 1 only (b) 1, 2 and 3
(c) 1 and 3 only (d) 2 and 3 only

138. Which of the following statements about hill stations of colonial India is/are correct?

1. The architecture of hill stations sought to recreate the European style
2. Hill stations were developed as sanitariums where soldiers were treated for illness
3. Shimla became the official residence of the Commander in Chief of the Indian Army
4. In 1864, Shimla had to be evacuated because of a Typhoid epidemic

Select the correct answer using the code given below:

(a) 1 only (b) 1, 2 and 3
(c) 3 and 4 (d) 2 and 3 only

139. Match List I with List II and select the correct answer using the code given below the Lists:

	List I (Dynasty)		List II (Architecture)
A.	Chalukyas	1.	Sun Temple, Konark
B.	Hoysalas	2.	Pattadakal Temples
C.	Pandyas	3.	Kesava Temple, Somnathpur
D.	Eastern Gangas	4.	Eastern *gopura* of Chidambaram Temple

Code:

	A	B	C	D
(a)	1	3	2	4
(b)	1	2	3	4
(c)	2	4	3	1
(d)	2	3	4	1

140. The Senia tradition is:

(a) musical tradition that emerged from the colonial army (Sena)
(b) dance drama written by Keshab Chandra Sen
(c) textile tradition of eastern UP
(d) musical tradition that invoked the name of Tansen, the celebrated musician of Akbar's Court

141. Who among the following founded the Rajahmundri Social Reform Association in 1878 in support of widow remarriage?

(a) Vishanshastri Pandit
(b) Ishwar Chandra Vidyasagar
(c) Pandita Ramabai
(d) Veeresalingam Pantulu

142. The SAARC Secretariat is located at:

(a) New Delhi (b) Colombo
(c) Kathmandu (d) Karachi

143. The 19th Century Faraizi Movement in eastern Bengal developed under the leadership of:

(a) Titu Rai (b) Haji Shariatullah
(c) Shah Sayyid Ahmad (d) Dudu Miyan

144. The Indian States Committee was formed in 1928 under:

(a) The Raja of Junagadh (b) Ian Copland
(c) Sir Harcourt Butler (d) Motilal Nehru

145. The Panchayati Raj system under Part-IX of the Constitution of India does **not** apply of the States of :

(a) Assam, Mizoram and Nagaland
(b) Nagaland, Meghalaya and Tripura
(c) Nagaland, Meghalaya and Mizoram
(d) Sikkim, Tripura and Meghalaya

146. The First Five Year Plan (1951-1956) was drafted by :

(a) P C Mahalanobis (b) K N Raj
(c) J C Kumarappa (d) Jawaharlal Nehru

147. Who among the following is the author of the book, "Pakistan Paradox: Instability and Resilience

(a) Christophe Jaffrelot (b) G Parthasarthy
(c) Imran Khan (d) Mamnoon Hussain

148. Which one of the following was the theme of the "International Day of United Nations Peacekeepers" for the year 2015 ?

(a) Peacekeeping in a Global Partnership
(b) UN 70 and UN Peacekeeping; Past, Present and Future
(c) Women in Peacekeeping
(d) A Force for the Future

149. Indian athlete Vikas Gowda is associated with :

(a) Wrestling (b) Sprint
(c) Discus throw (d) Archery

150. The 19th Federation Cup National Senior Athletic Championships (2015) was held in:

(a) Karnataka (b) Haryana
(c) Uttar Pradesh (d) Kerala

NDA 2 2015 Solution

MATHEMATICS

1. (d) $a - b \le 5$
Let $b - c \le 5$
so $a - c \le 10$
as $(a - b) \in R$ and $(b - c) \in R$
but $(a - c) \notin R$
So it is not a transitive relation.
By considering all the options, we come to the conclusion that only option (d) is correct.

2. (a)
$$A = \begin{bmatrix} 1 & 3 & 2 \\ 1 & x-1 & 1 \\ 2 & 7 & x-3 \end{bmatrix}$$
$|A| = 1[(x-1)(x-3)-7] - 3[(x-3)-2] + 2[7-2(x-1)]$
$= x^2 - 11x + 29$
If inverse will not exist then $|A| = 0$
$x^2 - 11x + 29 = 0$
$$x = \frac{11 \pm \sqrt{5}}{2}$$

3. (b)
$$\begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix} > 0$$
$\Rightarrow a(bc-1) - 1(c-1) + 1(1-b) > 0$
$\Rightarrow abc - a - c + 1 + 1 - b > 0$
$\Rightarrow abc + 2 - (a+b+c) > 0$
$\Rightarrow abc > (a+b+c) - 2$
Let; $a = -1$; $b = 0$ & $c = 1$
Then; $0 > -2$ [which is correct]
Hence, $abc = 0$
$\therefore$ After considering all the option; (b) is correct option.

4. **(d)** $\alpha + \beta = 90°$
$$\begin{vmatrix} \cos^2\frac{\alpha}{2} & \sin^2\frac{\alpha}{2} \\ \sin^2\frac{\beta}{2} & \cos^2\frac{\beta}{2} \end{vmatrix}$$
$$= \cos^2\frac{\alpha}{2}\cos^2\frac{\beta}{2} - \sin^2\frac{\alpha}{2}\sin^2\frac{\beta}{2}$$
$$= \left(\cos\frac{\alpha}{2}\cos\frac{\beta}{2} + \sin\frac{\alpha}{2}\sin\frac{\beta}{2}\right)\left(\cos\frac{\alpha}{2}\cos\frac{\beta}{2} - \sin\frac{\alpha}{2}\sin\frac{\beta}{2}\right)$$
$$= \cos\frac{(\alpha-\beta)}{2} + \cos\frac{(\alpha+\beta)}{2}$$
$$= \cos\frac{(\alpha-\beta)}{2} + \cos\frac{(90°)}{2}$$
$$= \cos\frac{(\alpha-\beta)}{2} + \frac{1}{\sqrt{2}}$$
Maximum value of $\cos\left(\frac{\alpha-\beta}{2}\right)$ is 1. So maximum value of determinent is $\left(1 + \frac{1}{\sqrt{2}}\right)$
So neither 1 nor 2 is correct.

5. (b) $(1000000001)_2$
$= 1 \times 2^0 + 0 \times 2^1 + 0 \times 2^2 + \ldots\ldots + 1 \times 2^9$
$= 1 + 0 + 0 + \ldots\ldots + 512$
$= (513)_{10}$
$(0.0101)_2 = 0 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4}$
$$= \frac{1}{4} + \frac{1}{16} = \frac{5}{16} = (0.3125)_{10}$$
$(1000000001)_2 - (0.0101)_2 = 513 - 0.312$
$= (512.6875)_{10}$

6. (d) $\because 2X + 3A = 0$
$$\Rightarrow x = \frac{-3}{2}A$$
$$\Rightarrow x = \frac{-3}{2}\begin{bmatrix} 1 & 0 & -2 \\ 2 & -3 & 4 \end{bmatrix}$$
$$\Rightarrow X = \begin{bmatrix} -\frac{3}{2} & 0 & 3 \\ -3 & \frac{9}{2} & -6 \end{bmatrix}$$

7. (d) Let $Z_1 = a_1 + ib_1$
$Z_2 = a_2 + ib_2$
$|Z_1| = |Z_2|$
$$\sqrt{(a_1)^2 + (b_1)^2} = \sqrt{(a_2)^2 + (b_2)^2}$$
It is true for many values of a_1, a_2 & b_1, b_2. So a_1 must not equal to a_2, and b_1 must not equal to b_2.

8. (b)
$$A = \begin{bmatrix} 1 & 1 & -1 \\ 2 & -3 & 4 \\ 3 & -2 & 3 \end{bmatrix}; B = \begin{bmatrix} -1 & -2 & -1 \\ 6 & 12 & 6 \\ 5 & 10 & 5 \end{bmatrix}$$
$$AB = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$BA = \begin{bmatrix} -8 & 7 & -10 \\ 48 & -42 & 60 \\ 40 & -35 & 50 \end{bmatrix}$$

as $AB \neq BA$

So A and B are not commute.

9. (a) $x^2 - 3|x| + 2 = 0$

Case (i) when $x \geq 0$

$x^2 - 3x + 2 = 0$

$(x-1)(x-2) = 0$

$x = 1, 2$ (both roots satisfy the condition $x \geq 0$)

Case (ii) when $x < 0$

$x^2 + 3x + 2 = 0$

$(x+1)(x+2) = 0$

$x = -1, -2$ (both roots satisfy the condition $x < 0$)

So no. of real roots is 4.

10. (c) $ax^2 + bx + c = 0$

Let the root be α and β.

$$\alpha + \beta = -\frac{b}{a}, \ \alpha\beta = \frac{c}{a}$$

$$\Rightarrow \ \alpha + \beta = \alpha^2 + \beta^2 \quad \ldots \text{(given)}$$

$$\Rightarrow \ \alpha + \beta = (\alpha + \beta)^2 - 2\alpha\beta$$

$$\Rightarrow \ -\frac{b}{a} = \left(-\frac{b}{a}\right)^2 - \frac{2c}{a}$$

$$\boxed{\Rightarrow b^2 + ab = 2ac}$$

11. (c) $x^2 + 6x - 7 < 0$

$\Rightarrow (x+7)(x-1) < 0$

$\Rightarrow x = (-7, 1)$

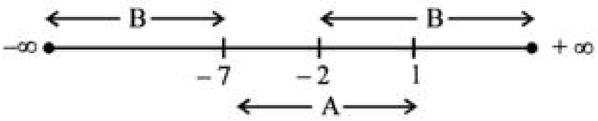
$\Rightarrow A = \{-7, -6, -5, -4, -3, -2, -1, 0, 1\}$

$\Rightarrow x^2 + 9x + 14 > 0$

$\Rightarrow (x+7)(x+2) > 0$

$\Rightarrow x = (-\infty, -7) \cup (-2, \infty)$

$\Rightarrow B = R - \{-7, -6, -5, -4, -3, -2\}$



So $A \cap B = (-2, 1)$

$A/B = (-7, -2)$.

12. (b) Let $A = \{1, 2\}$

$B = \{3, 4, 0\}$

$C = \{5, 6, 0\}$

$D = \{7, 8\}$

Such that $(A \cap B) = (C \cap D) = \phi$

$\Rightarrow (A \cup C) = \{1, 2, 5, 6, 0\}$

$\Rightarrow (B \cup D) = \{3, 4, 7, 8, 0\}$

$\Rightarrow (A \cup C) \cap (B \cup D) = \{0\}$

So $(A \cup C)$ and $(B \cup D)$ are not always dispoint

$\Rightarrow (A \cap C) = \phi$ and $(B \cap D) = \phi$

So $(A \cap C)$ and $(B \cap D)$ are always disjoint.

13. (a) If A is matrix that is invertible then det- (kA) will be k^n. det(A), where n is the order.

$$\therefore \quad \left[\det(KA)\right]^{-1} \det(A)$$

$$= \quad \left[(K)^n \times \det(A)\right]^{-1} . \det(A)$$

$$= \quad K^{-n} \times \frac{1}{\det(A)} \times \det(A)$$

$$= \quad K^{-n}$$

14. (c) $X = 6^{\left(\frac{1}{2}+\frac{1}{2}+\frac{3}{8}+\frac{1}{4}+\ldots\ldots\right)}$

$$= 6^{\left[\left(1\times\frac{1}{2}\right)+\left(2\times\frac{1}{4}\right)+\left(3\times\frac{1}{8}\right)+\left(4\times\frac{1}{16}\right)+\ldots\ldots\right]}$$

$\because$ It is arithmetic-geometric progression,

$\therefore a = \frac{1}{2}; d = 1 \ \& \ r = \frac{1}{2}$

$$\Rightarrow X = 6^{\left[\frac{a}{1-r}+\frac{dr}{(1-r)^2}\right]} = 6^{\left[\frac{1/2}{1-1/2}+\frac{1\times 1/2}{(1-1/2)^2}\right]} = 6^3 = 216$$

15. (a) Let the root be α and β

$\because \quad x^2 - nx + m = 0$

$\Rightarrow \quad \alpha + \beta = n; \alpha.\beta = m$

$\Rightarrow \quad \alpha - \beta = 1$

$\Rightarrow \quad (\alpha + \beta)^2 = (\alpha - \beta)^2 + 4\alpha\beta$

$\Rightarrow \quad n^2 = 1 + 4m$

$\Rightarrow \quad n^2 - 4m - 1 = 0$

16. (b)

First two words (according to dictionary)	no. of words form
AA – – –	$3! = 6$
AG – – –	$3! = 6$
AI – – –	$3! = 6$
AN – – –	$3! = 6$
GA – – –	$3! = 6$
GI – – –	$3!/2! = 3$
GN – – –	$3!/2! = 3$
IA – – –	$3! = 6$
IG – – –	$3!/2! = 3$
IN – – –	$3!/2! = 3$
NA – – –	$3! = 6$
	total = 54

it means 50^{th} word will be starting with 'NA'.

NA
- N A A G I (49^{th} place)
- N A A I G (50^{th} place)
- N A G A I (51^{th} place)
- N A G I A (52^{th} place)
- N A I A G (53^{th} place)
- N A I G A (54^{th} place)

17. (c) If captain is always included then we can choose 10 more players out of the remaining 14 players. So

$${}^{14}C_{10} = \frac{14!}{10!4!} = 1001$$

18. (a) Let r^{th} term is independent of x.

$T_r = {}^nC_r x^r y^{n-r}$

$$= {}^{10}C_r\left(\sqrt{x}\right)^r\left(\frac{1}{3x^2}\right)^{10-r}$$

$$= {}^{10}C_r\left(\frac{1}{3}\right)^{10-r}.\left(\sqrt{x}\right)^r\left(\frac{1}{x^2}\right)^{10-r}$$

Equating the coefficient of x to zero.

$\Rightarrow x^{r/2}.x^{-2(10-r)} = x^0$

$$\Rightarrow \frac{r}{2} - 20 + 2r = 0$$

$$\Rightarrow \frac{5}{2}r = 20 \Rightarrow r = 8$$

$$\text{Coefficient} = {}^{10}C_r\left(\frac{1}{3}\right)^{10-r}$$

$$= {}^{10}C_8\left(\frac{1}{3}\right)^{10-8}$$

$$= \frac{10\times 9}{2}\times\frac{1}{9} = 5$$

19. (d) $\sin^2 5° + \sin^2 10° + \sin^2 15° + \ldots\ldots\ldots + \ldots\ldots\ldots + \sin^2 75° + \sin^2 80° + \sin^2 85° + \sin^2 90°$

$\Rightarrow \sin^2 5° + \sin^2 10° + \sin^2 15° + \ldots\ldots \sin^2(90-15°) + \sin^2(90-10) + \sin^2(90-5) + 1$

$\Rightarrow \sin^2 5 + \sin^2 10 + \sin^2 15° + \ldots\ldots + \cos^2 15° + \cos^2 10° + \cos^2 5° + 1$

$\Rightarrow (1 + 1 + 1 + \ldots.\ 8 \text{ times}) + \sin^2 45° + 1$

$$\Rightarrow 8 + \frac{1}{2} + 1 = \frac{19}{2}$$

20. (d) $$\frac{\sin^3 A + \sin 3A}{\sin A} + \frac{\cos^3 A - \cos 3A}{\cos A}$$

$$\Rightarrow \frac{\sin^3 A + 3\sin A - 4\sin^3 A}{\sin A} + \frac{\cos^3 A - \left[4\cos^3 A - 3\cos A\right]}{\cos A}$$

$$\Rightarrow \frac{3\sin A - 3\sin^3 A}{\sin A} + \frac{\left(-3\cos^3 A + 3\cos A\right)}{\cos A}$$

$= 3 - 3\sin^2 A - 3\cos^2 A + 3$

$= 6 - 3(\cos^2 A + \sin^2 A)$

$= 6 - 3(1)$

$= 3$

21. (a) $$2\tan^{-1}\left(\frac{1}{5}\right) = \tan^{-1}\left[\frac{2\times\frac{1}{5}}{1-\left(\frac{1}{5}\right)^2}\right]$$

$$= \tan^{-1}\left[\frac{10}{24}\right]$$

$$= \tan^{-1}\left(\frac{5}{12}\right)$$

$$\text{Let } \tan\left(2\tan^{-1}\frac{1}{5} - \frac{\pi}{4}\right) = x$$

$$\Rightarrow \tan\left[\tan^{-1}\left(\frac{5}{12}\right) - \frac{\pi}{4}\right] = x$$

$$\Rightarrow \tan^{-1}\left(\frac{5}{12}\right) - \frac{\pi}{4} = \tan^{-1} x$$

$$\Rightarrow \tan^{-1}\left(\frac{5}{12}\right) - \tan^{-1}(1) = \tan^{-1} x$$

$$\Rightarrow \tan^{-1}\left[\frac{\left(\frac{5}{12}-1\right)}{1+\left(\frac{5}{12}\right)(1)}\right] = \tan^{-1} x$$

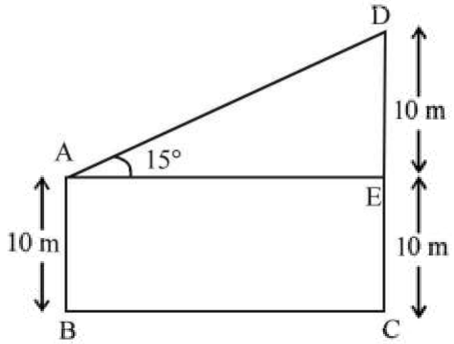
$$\Rightarrow x = \frac{-7/12}{17/12} = -7/17$$

22. (b) $\tan 15° = DE/AE$

$AE = 10\cot 15°$ ...(1)

$\cot(15°) = \cot(45 - 30°)$

$$= \frac{\cot 45°\cot 30° + 1}{\cot 30° - \cot 45°}$$



$$\cot 15° = \frac{1.\sqrt{3}+1}{\sqrt{3}-1} = 2+\sqrt{3}$$

Putting cot 15° in eq (1)

$AE = 10\cot 15°$

$= 10\left(2+\sqrt{3}\right)$

$= 10(3.73)$

$= 37.3$ m

23. (b) $f(x) = x$

$g(x) = 1/x$

Putting these values in the options, only (b) is correct.

24. (a) $\sin^{-1}x + \sin^{-1}y = \sin^{-1}\left(x\sqrt{1-y^2} + y\sqrt{1-x^2}\right)$

If $(-1 \le x)$; $(y \le 1)$ & $(x^2 + y^2 \le 1)$

$$\Rightarrow \sin^{-1}\left(\frac{4}{5}\right) + \sin^{-1}\frac{3}{5}$$

$$= \sin^{-1}\left[\frac{4}{5}\sqrt{1-\left(\frac{3}{5}\right)^2}+\frac{3}{5}\sqrt{1-\left(\frac{4}{5}\right)^2}\right]$$

$$= \sin^{-1}\left[\frac{16}{25}+\frac{9}{25}\right]$$

$$= \sin^{-1}(1) = \frac{\pi}{2}$$

$\therefore$ Statement (1) is correct

Again-

$$\tan^{-1}x+\tan^{-1}y = \pi+\tan^{-1}\left[\frac{x+y}{1-xy}\right]$$

If; $(x>0)$, $(y>0)$ and $(xy>1)$

$$\tan^{-1}\left(\sqrt{3}\right)+\tan^{-1}(1) = \pi+\tan^{-1}\left[\frac{\sqrt{3}+1}{1-\sqrt{3}}\right]$$

$$= \pi+\tan^{-1}\left[\frac{\left(\sqrt{3}+1\right)\left(1+\sqrt{3}\right)}{\left(1-\sqrt{3}\right)\left(1+\sqrt{3}\right)}\right]$$

$$= \pi+\tan^{-1}\left(\frac{4+2\sqrt{3}}{-2}\right)$$

$$= \pi+\tan^{-1}\left[-\left(2+\sqrt{3}\right)\right]$$

$$= \pi-\tan^{-1}\left(2+\sqrt{3}\right) \qquad \because \tan^{-1}(-x) = -\tan^{-1}x$$

$\therefore$ Statement (2) is incorrect.

25. (c) The determinent of a orthogonal matrix is always ± 1

$|A| = \pm 1$

$$B = \begin{bmatrix} 1 & 2 & 3 \\ -3 & 0 & 2 \\ 2 & 5 & 0 \end{bmatrix}$$

$|B| = -10-2(-4)+3(-15)$

$= -47$

$|AB| = |A|\,|B|$

$= (\pm 1)(-47)$

$= \pm 47$

Taking A as identity matrix we can prove $AB = BA$

26. (b) Consider any equilateral triangle:

$c = b = a = 1$ unit

Take value of p between 1 & 2 i.e., $\frac{3}{2}$

$$\therefore\ a^{1/p}+b^{1/p}-c^{1/p} = (1)^{2/3}+(1)^{2/3}-(1)^{2/3}$$

$= 1+1-1 = 1 > 0$

Take value of p greater than 2 i.e; 3.

$$\therefore\ a^{1/p}+b^{1/p}-c^{1/p} = (1)^{1/3}+(1)^{1/3}-(1)^{1/3} = 1 > 0.$$

$\therefore$ By considering all the options carefully; we came to a conclusion that opton (b) is correct.

27. (a) $$\begin{vmatrix} 1-a & a-b-c & b+c \\ 1-b & b-c-a & c+a \\ 1-c & c-a-b & a+b \end{vmatrix}$$

apply $C_2 \to C_2 + C_3$

$$\begin{vmatrix} 1-a & a & b+c \\ 1-b & b & c+a \\ 1-c & c & a+b \end{vmatrix}$$

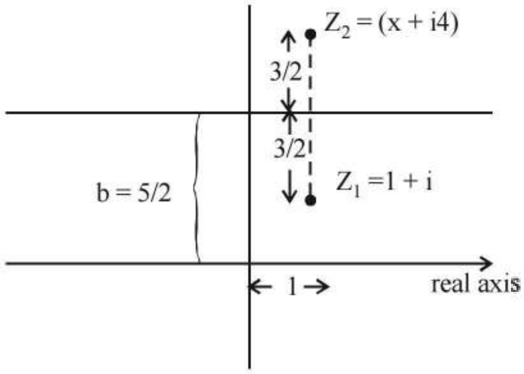
apply $C_1 \to C_1 + C_2$

$$\begin{vmatrix} 1 & a & b+c \\ 1 & b & c+a \\ 1 & c & a+b \end{vmatrix}$$

apply $C_3 \to C_2 + C_3$

$$(a+b+c)\begin{vmatrix} 1 & a & 1 \\ 1 & b & 1 \\ 1 & c & 1 \end{vmatrix} = 0$$

28. (a) Let $z = a+bi$



$\Rightarrow\ \bar{z} = a-bi$

$\therefore\ i\bar{z}-iz = i\left[(a-bi)-(a+bi)\right] = 5$

$\Rightarrow i[-2bi] = 5$

$\Rightarrow b = \frac{5}{2}$

So from figure it is clear that

$x = 1,\ y = \frac{5}{2}+\frac{3}{2} = 4$

$z_2 = 1+4i$

29. (b) $\sin x+\sin y = a$

$$\Rightarrow\ 2\sin\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right) = a \qquad ...(1)$$

$\cos x + \cos y = b$

$$\Rightarrow\ 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right) = b \qquad ...(2)$$

dividing eq (1) & (2)

$$\tan\left(\frac{x+y}{2}\right) = \frac{a}{b}$$

Squaring of eq (1) & (2) and adding -

$$4\cos^2\left(\frac{x-y}{2}\right)=a^2+b^2$$

$$\sec^2\left(\frac{x-y}{2}\right)=\frac{4}{a^2+b^2}$$

again-

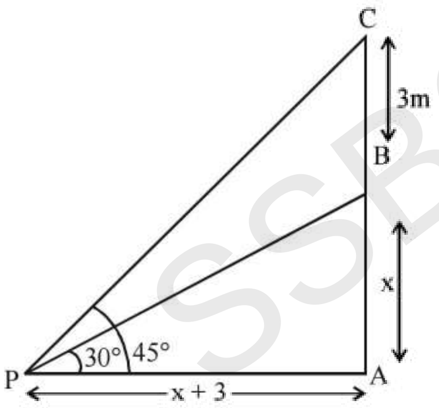
$$\tan^2\left(\frac{x+y}{2}\right)+\tan^2\left(\frac{x-y}{2}\right)$$

$$=\left(\frac{a}{b}\right)^2+\sec^2\left(\frac{x-y}{2}\right)-1$$

$$=\frac{a^2}{b^2}+\frac{4}{a^2+b^2}-1$$

$$=\frac{a^4-b^4+4b^2}{a^2b^2+b^4}$$

30. (c) as $\angle CPA=45°$



so $AC = AP = x + 3$

$$\tan 30° = \frac{AB}{AP}=\frac{x}{x+3}$$

$$\frac{1}{\sqrt{3}}=\frac{x}{x+3}$$

$$x+3=\sqrt{3}x$$

$$x=\frac{3}{\sqrt{3}-1}\times\frac{(\sqrt{3}+1)}{(\sqrt{3}+1)}$$

$$x=\frac{3\times 2.73}{2}=\frac{8.19}{2}=4.095\text{m}\approx 4.1\text{m}$$

31. (a) $(1+x)^{2n+1}={}^{(2n+1)}C_0x^0+{}^{(2n+1)}C_1x^1+\dots+{}^{(2n+1)}C_{2n+1}(x)^{2n+1}$

Coefficient of $x^r = {}^{(2n+1)}C_r$

Coefficient of $x^{r+1} = {}^{(2n+1)}C_{r+1}$

$${}^{(2n+1)}C_r={}^{(2n+1)}C_{r+1}$$

$$\Rightarrow \frac{(2n+1)!}{r!(2n+1-r)!}=\frac{(2n+1)!}{(r+1)!(2n-r)!}$$

$$\Rightarrow \frac{(2n+r)!}{(2n+1-r)(2n-r)!}=\frac{r!}{(r+1)r!}$$

$$\Rightarrow (r+1)=2n+1-r$$

$$\Rightarrow r=n$$

32. (b) Total no. of terms in the expansion is $2n+2$. The middle two terms will be n^{th}, $(n+1)^{th}$ term. So.

$$\text{Average}=\frac{{}^{(2n+1)}C_n+{}^{(2n+1)}C_{n+1}}{2}$$

$$=\left[\frac{(2n+1)!}{n!(n+1)!}+\frac{(2n+1)!}{(n+1)!n!}\right]/2$$

$$=\frac{(2n+1)!}{n!(n+1)!}$$

$$={}^{(2n+1)}C_n$$

33. (c) Sum of all coefficient

$$={}^{(2n+1)}C_0+{}^{(2n+1)}C_1+\dots\dots+{}^{(2n+1)}C_{2n+1}$$

$$=(1+1)^{2n+1}$$

$$=2^{(2n+1)}$$

$$=2.2^{2n}$$

$$=2.4^n$$

34. (d) $T_n=\frac{3+n}{4}$

$$S_n=\sum_{n=0}^{\infty}T_n$$

$$=\sum\left(\frac{3}{4}+\frac{n}{4}\right)$$

$$=\frac{3}{4}n+\frac{1}{4}\times\frac{n(n+1)}{2}$$

$$=\frac{7}{8}n+\frac{n^2}{8}$$

$$S_{105}=\frac{7}{8}\times 105+\frac{(105)^2}{8}=1470$$

35. (a) No. of diagonals in a polygen $= {}^nC_2-n$

$$\Rightarrow\ 44={}^nC_2-n$$

$$\Rightarrow\ 44=\frac{n!}{2!(n-2)!}-n$$

$$\Rightarrow\ 44=\frac{n(n-1)}{2}-n$$

$$\Rightarrow\ 44=\frac{n(n-3)}{2}$$

$\Rightarrow$ $n^2 - 3n - 88 = 0$
$\Rightarrow$ $(n-11)(n+8) = 0$
$n \neq -8$
$n = 11$

36. (b) Let the common ratio be K_1 for p, q and r.
$\therefore q = K_1 p$
$\& \ r = (K_1)^2 p$
Let the common ratio be K_2 for a, b and c
$\therefore b = K_2 a$
$\& \ c = (K_2)^2 a$
$\therefore bq = (K_1K_2)ap$
$\& \ Cr = (K_1K_2)^2 ap$
So ap, bq, cr are in G.P.

37. (b) $2a\sin^2\left(\frac{C}{2}\right) + 2c\sin^2\left(\frac{A}{2}\right) = 2a + 2c - 3b$

$\Rightarrow 2a \times \frac{(s-a)(s-b)}{ab} + 2c \times \frac{(s-b)(s-c)}{bc} = 2a + 2c - 3b$

$\Rightarrow \frac{2}{b}(s-b)[s-a+s-c] = 2a + 2c - 3b$

$\Rightarrow \frac{2}{b}(s-b)b = 2a + 2c - 3b \qquad [\because 2s - a - c = b]$

$\Rightarrow a + c = 2b$
So a, b, c are in A.P.

38. (b) As we have already proven
$2b = a + c$
as-
$a = R\sin A$
$b = R\sin B$
$c = R\sin C$
$\Rightarrow 2(R\sin B) = R\sin A + R\sin C$
$\Rightarrow 2R(\sin B) = R(\sin A + \sin C)$
$2\sin B = \sin A + \sin C$

39. (b) $p = \tan\left(-\frac{11\pi}{6}\right)$

$p = -\tan\left(2\pi - \frac{\pi}{6}\right)$

$p = \tan\frac{\pi}{6} = \frac{1}{\sqrt{3}}$

$q = \tan\left(\frac{21\pi}{4}\right)$

$= \tan\left(6\pi - \frac{3\pi}{4}\right)$

$q = -\tan\frac{3\pi}{4} = +\tan\frac{\pi}{4} = 1$

$r = \cot\left(\frac{283\pi}{6}\right)$

$= \cot\left(46\pi + \frac{7\pi}{6}\right)$

$= \cot\left(\pi + \frac{\pi}{6}\right)$

$r = \cot\frac{\pi}{6} = \sqrt{3}$

$p \times r = \frac{1}{\sqrt{3}} \times \sqrt{3} = 1$

$\therefore$ Statement (1) is incorrect.

also $\frac{p}{q} = \frac{q}{r} = \frac{1}{\sqrt{3}}$

So p, q, r are in G.P.
$\therefore$ Statement (2) is correct.

40. (d) $\because$ Each employee is eligible for 1 or more of the tickets.
$\therefore$ No. of ways $= 20 \times 20 \times 20 = 8000$.

41. (c) $\sqrt{2} + \sqrt{8} + \sqrt{18} + \sqrt{32} + \ldots..$
$= \sqrt{2} + 2\sqrt{2} + 3\sqrt{2} + 4\sqrt{2} + \ldots..$
$\therefore S_n = \sqrt{2}[1 + 2 + 3 + 4 + \ldots. n \text{ terms}]$

$= \sqrt{2}\frac{n(n+1)}{2}$

$= \frac{n(n+1)}{\sqrt{2}}$

42. (c) Coefficient of x^1 in $[(x-1)(x-2)$ or $(x^2 - 3x + 2)]$
$= -3 = -1 - 2 = -(1 + 2)$
Coefficient of x^2 in $[(x-1)(x-2)(x-3)$ or $(x^3 - 6x^2 + 5x - 6)]$
$= -6 = -[1 + 2 + 3]$.
Coefficient of x^3 in $[(x-1)(x-2)(x-3)(x-4)$ or $(x^4 - 10x^3 - 29x^2 - 11x + 24)]$
$= -10 = -[1 + 2 + 3 + 4]$
$\therefore$ Coefficient of x^{99} in $[(x-1)(x-2) \ldots\ldots. (x-100)]$

$= -[1 + 2 + 3 + \ldots.. + 100] = \frac{-100(100+1)}{2} = -5050.$

43. (a) Let $z = x + iy$

$\bar{z} = x - iy$

$\Rightarrow z\bar{z} + (3-i)z + (3+i)\bar{z} + 1 = 0$
$\Rightarrow (x+iy)(x-iy) + (3-i)(x+iy) + (3+i)(x-iy) + 1 = 0$
$\Rightarrow x^2 + y^2 + 6x + 2y + 1 = 0$
$\Rightarrow (x+3)^2 - 9 + (y+1)^2 - 1 + 1 = 0$
$\Rightarrow (x+3)^2 + (y+1)^2 = (3)^2$
Centre $(-3, -1)$
radius $= 3$

44. (c) No. of digits to be filled at one's place = 3
No. of digits to be filled at 10's place = 5
No. of digits to be filled at 100's place = 4
$\therefore$ Total no. of digits formed $= 3 \times 5 \times 4 = 60$
If zero is at 100's place;
Then; no. of digits to be filled at one's place = 2
& no. of digits to be filled at 10's place = 4
$\therefore$ No. of digits formed with zero at 100's place
$= 1 \times 2 \times 4 = 8$
$\therefore$ Required no. of digits formed $= 60 - 8 = 52$.

45. (a) $\log_8 m + \log_8 \frac{1}{6} = \frac{2}{3}$

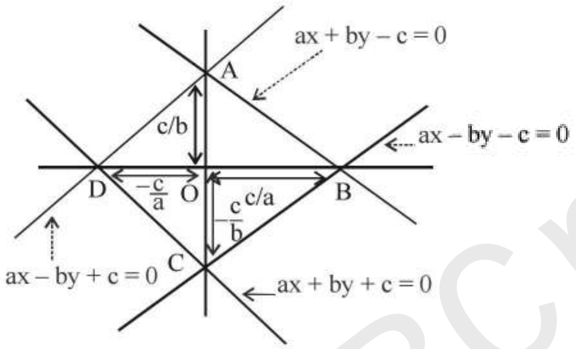
$\Rightarrow \quad \log_8\left(m.\frac{1}{6}\right) = \frac{2}{3}$

$\Rightarrow \quad (8)^{\frac{2}{3}} = m.\frac{1}{6}$

$\Rightarrow \quad m = 24$

46. (b) Area of triangle

$\Delta AOB = \frac{1}{2} \times \frac{c}{b} \times \frac{c}{a} = \frac{c^2}{2ab}$



Total area
$= 4 \times$ area ΔAOB

$= 4 \times \frac{c^2}{2ab}$

$= \frac{2c^2}{ab}$

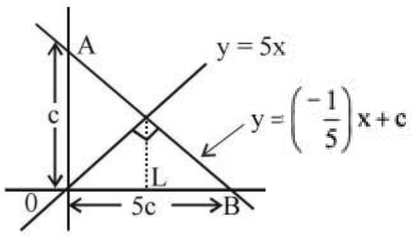
47. (a) $5x - y = 0$
$y = 5x$ ...(1)
Slope = 5

Slope of perpendicular line will be $-\frac{1}{5}$.

Let equation of line is

$y = \left(-\frac{1}{5}\right)x + c$ ...(2)

Putting y = 0
x = 5c
OB = 5c
Intersecting point A



Putting x = 0

$y = -\frac{1}{5} \times 0 + c$

y = c

area $\Delta AOB = \frac{1}{2} \times c \times 5c$

$5 = \frac{1}{2} \times 5c^2$

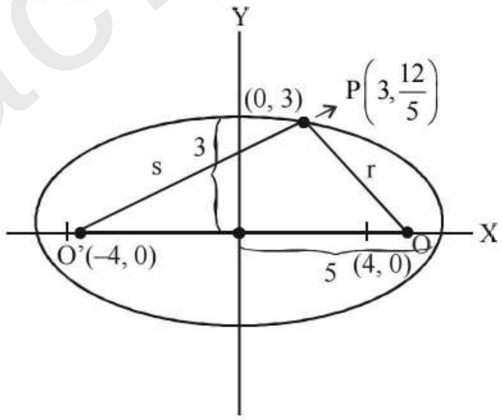
$c = \pm\sqrt{2}$

$y = \left(-\frac{1}{5}\right)x \pm \sqrt{2}$

$5y + x \pm 5\sqrt{2} = 0$

48. (a) $\frac{x^2}{25} + \frac{y^2}{9} = 1$

Put x = 3



$\frac{9}{25} + \frac{y^2}{9} = 1$

$y = \frac{12}{5}$

P = (3, 12/5)

$r = PO = \sqrt{(4-3)^2 + \left(0 - \frac{12}{5}\right)^2}$

$= 17/5$

$S = PO' = \sqrt{[-4-3] + \left(0 - \frac{12}{5}\right)^2}$

$= 33/5$

$r + s = \frac{17}{5} + \frac{33}{5} = \frac{50}{5} = 10$ unit

49. (b) $\because 4(x^2 + y^2) = r^2$

$\Rightarrow x^2 + y^2 = \left(\frac{r}{2}\right)^2$

Center (0, 0) and radius $\frac{r}{2}$

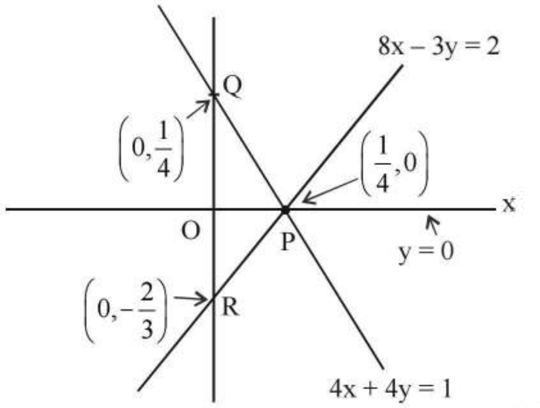
Eq. of line is ; $x-y-2=0$

$\because$ Line touches the circle.

$$\therefore \frac{r}{2}=\frac{|0-0-2|}{\sqrt{(1)^2+(-1)^2}}$$

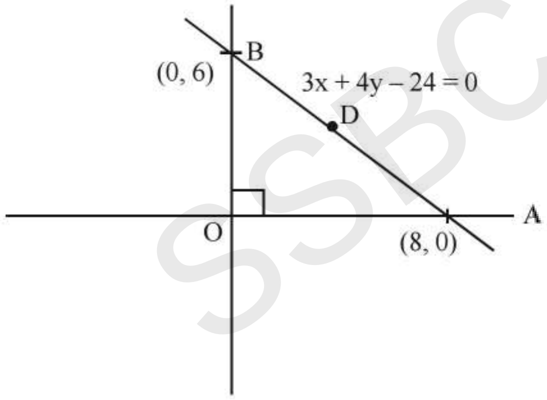
$r=2\sqrt{2}$

50. (b)



So from the figure it is clear that all the three lines are concurrent at point P.

51. (c)



Since circumcentre of right angled triangle lies on the midpoint of hypotenuse.

So mid point of AB is $\left(\frac{0+8}{2},\frac{6+0}{2}\right)$ or (4, 3)

52. (b) $\because 16x^2-9y^2=1$

$$\text{or } \frac{x^2}{\left(\frac{1}{4}\right)^2}-\frac{y^2}{\left(\frac{1}{3}\right)^2}=1$$

Comparing with $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$

$$\therefore a^2=\frac{1}{16}$$

$$\& \ b^2=\frac{1}{9}$$

$$\because e=\sqrt{1+\frac{b^2}{a^2}}$$

$$\therefore e=\sqrt{1+\frac{1/9}{1/16}}$$

$$\Rightarrow \quad e=\frac{5}{3}$$

53. (c) If length of perpendicular be p_1 from the point (4, 0)

$$p_1=\left|\frac{12\cos\phi-15}{\sqrt{(3\cos\phi)^2+(5\cos\phi)^2}}\right|$$

$$=\frac{15-12\cos\phi}{\sqrt{(3\cos\phi)^2+(5\cos\phi)^2}}$$

If length of perpendicular be p_2 from the point (– 4, 0)

$$p_2=\left|\frac{-12\cos\phi-15}{\sqrt{(3\cos\phi)^2+(5\cos\phi)^2}}\right|$$

$$=\frac{(12\cos\phi+15)}{\sqrt{(3\cos\phi)^2+(5\sin\phi)^2}}$$

$$p_1.p_2=\frac{(15-12\cos\phi)(12\cos\phi+15)}{(3\cos\phi)^2+(5\sin\phi)^2}$$

$$=\frac{(225-144\cos^2\phi)}{9\cos^2\phi+25\sin^2\phi}=\frac{9(25-16\cos^2\phi)}{25-16\cos^2\phi}$$

$= 9$

54. (d) Equation of circle having radius r and centre (3, 4) is

$=\ (x-3)^2+(y-4)^2=r^2$

if it is passing through (0, 0)

$\therefore\ (0-3)^2+(0-4)^2=r^2$

$\Rightarrow\ r^2=25$

equation of circle is

$(x-3)^2+(y-4)^2=25$

putting $y=0$

$\therefore\ x=6$ unit = interception x-axis

intercept on y axis (putting $x=0$) is

$y=8$ unit

55. (a) $2x=3y=-z$

$$\text{or } \frac{x}{3}=\frac{y}{2}=\frac{z}{-6}$$

$6x=-y=-4z$

$$\text{or } \frac{x}{2}=\frac{y}{-12}=\frac{z}{-3}$$

$$\cos\theta=\frac{x_1x_2+y_1y_2+z_1z_2}{\sqrt{x_1^2+x_2^2+x_3^2}\cdot\sqrt{y_1^2+y_2^2+y_3^2}}$$

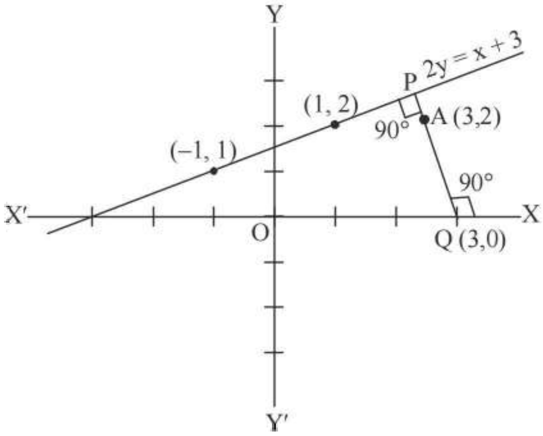
$$=\frac{(6-24+18)}{\sqrt{(3)^2+(2)^2+(-6)^2}.\sqrt{(2)^2+(-12)^2+(-3)^2}}$$

$\cos\theta=0$

$\theta=90°$

So lines are perpendicular

56. (a)



$\because$ Coordinates of Q are (3, 0) & it passes through PQ.
$\therefore$ Putting the values of $(x = 3)$ & $(y = 0)$ in options we get:
Equation of line $PQ = 7x + y - 21 = 0$

57. (b) $3x^2 + 3y^2 + 3z^2 - 8y + 4y + 8z - 15 = 0$

$$\Rightarrow \quad x^2 + y^2 + z^2 - \frac{8}{3}x + \frac{4}{3}y + \frac{8}{3}z - 5 = 0$$

$$\Rightarrow \quad \left(x - \frac{4}{3}\right)^2 - \frac{16}{9} + \left(y + \frac{2}{3}\right)^2 - \frac{4}{9} + \left(z + \frac{4}{3}\right)^2 - \frac{16}{9} - 5 = 0$$

$$\Rightarrow \quad \left(x - \frac{4}{3}\right)^2 + \left(y + \frac{2}{3}\right)^2 + \left(z + \frac{4}{3}\right)^2 = (3)^2$$

So radius is 3.

58. (a) Let the direction ratio be $\langle a, b, c \rangle$

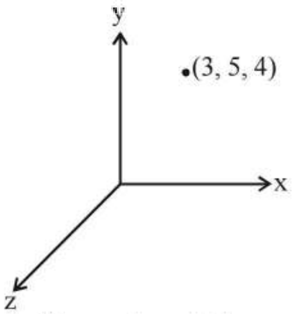
$$\cos 90° = \frac{(a)(1) + (b)(-2) + (c)(-2)}{\sqrt{a^2 + b^2 + c^2}\sqrt{(1)^2 + (-2)^2 + (-2)^2}}$$

$a - 2b - 2c = 0$ ...(1)

$$\cos 90° \frac{(a)(0) + b(2) + (c)(1)}{\sqrt{a^2 + b^2 + c^2}\sqrt{(0)^2 + (-2)^2 + (1)^2}}$$

$2b + c = 0$ ...(2)
From eq. (1) & (2)
$a = -2b$; $c = -2b$

59. (b) Plane $z = 0$ is simply
xy plane, so z quadrant value will be zero.



So, from options (b) is correct option.

60. (b) $5x + 2y + z - 13 = 0$
Putting $y = 0$ & $z = 0$

$$\boxed{x = \frac{13}{5}}$$

Putting $z = 0$ & $x = 0$

$$\boxed{y = \frac{13}{2}}$$

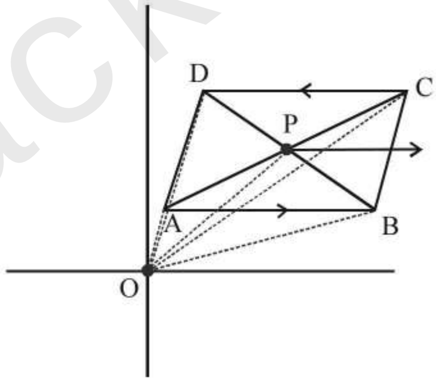
Putting $x = 0$ & $y = 0$

$$\boxed{z = 13}$$

61. (b) Length of diagonal
$= D = \sqrt{3^2 + 4^2}$
$\Rightarrow D = 5$

$$\therefore \text{Area} = \frac{1}{2}(D)^2 = \frac{25}{2}$$
$= 12.5$ units

62. (a)



$\because \overrightarrow{OA} = \overrightarrow{OP} - \overrightarrow{AP}$; $\overrightarrow{OB} = \overrightarrow{OP} + \overrightarrow{PB}$;
$\overrightarrow{OC} = \overrightarrow{OP} + \overrightarrow{PC}$ & $\overrightarrow{OD} = \overrightarrow{OP} - \overrightarrow{DP}$;
Also, $\overrightarrow{AP} = \overrightarrow{PC}$ & $\overrightarrow{DP} = \overrightarrow{PB}$
$\therefore \overrightarrow{OA} + \overrightarrow{OB} + \overrightarrow{OC} + \overrightarrow{OD} = 4\overrightarrow{OP}$

63. (c) $\overrightarrow{OB} = \vec{b}$
$\overrightarrow{OC} = \vec{c}$
$\overrightarrow{BD} = 4\overrightarrow{BC}$
$\overrightarrow{BO} + \overrightarrow{OD} = 4\left(\overrightarrow{BO} + \overrightarrow{OC}\right)$
$\overrightarrow{OD} = 3\overrightarrow{BO} + 4\overrightarrow{OC}$
$\overrightarrow{OD} = 4\overrightarrow{OC} - 3\overrightarrow{OB}$
$\overrightarrow{OD} = 4\vec{c} - 3\vec{b}$

64. (b) $\sqrt{(5-0)^2 + (n-0)^2} = 13$
$25 + n^2 = 169$
$n^2 = 144$
$n = \pm 12$

65. (d) $\vec{a} \times \vec{b} = |\vec{a}||\vec{b}|\sin\theta\hat{n}$
$\therefore |\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}|\sin\theta = 6\sin\theta$
& $|\vec{a}.\vec{b}| = |\vec{a}||\vec{b}|\cos\theta = 6\sin\theta$
$|\vec{a} \times \vec{b}|^2 + |\vec{a}.\vec{b}|^2 = (6\sin\theta)^2 + (6\cos\theta)^2$
$= 36\left(\sin^2\theta + \cos^2\theta\right)$
$= 36$

66. (c) $|\vec{a}+\vec{b}| \le |\vec{a}| + |\vec{b}|$

$|\vec{a}-\vec{b}| \ge |\vec{a}| - |\vec{b}|$

both are correct.

67. (b) $|\hat{a}-\hat{b}| = \sqrt{3}$

$\Rightarrow |\hat{a}-\hat{b}|^2 = (\sqrt{3})^2$

$\Rightarrow \hat{a}.\hat{a} + \hat{b}.\hat{b} - 2\hat{a}.\hat{b} = 3$

$\Rightarrow 2\hat{a}.\hat{b} = -1$

Now; $|\hat{a}+\hat{b}|^2 = \hat{a}.\hat{a} + \hat{b}.\hat{b} + 2\hat{a}.\hat{b} = 1 + 1 - 1$

$\Rightarrow |\hat{a}+\hat{b}|^2 = 1$

$\Rightarrow |\hat{a}+\hat{b}| = 1$

68. (b) If three vectors are co-planar.

$$\Rightarrow \begin{vmatrix} \alpha & \alpha & \gamma \\ 1 & 0 & 1 \\ \gamma & \gamma & \beta \end{vmatrix} = 0$$

$\Rightarrow \alpha[0-\gamma] - \alpha[\beta-\gamma] + \gamma[\gamma-0] = 0$

$\Rightarrow -\alpha\gamma - \alpha\beta + \alpha\gamma + \gamma^2 = 0$

$\Rightarrow \gamma^2 = \alpha\beta$

$\Rightarrow$ So α, γ, β are in G.P.

69. (c) $(\vec{a}-\vec{d}) \times (\vec{b}-\vec{c})$

$= \vec{a}\times\vec{b} - \vec{d}\times\vec{b} - \vec{a}\times\vec{c} + \vec{d}\times\vec{c}$

$= \vec{c}\times\vec{d} - \vec{d}\times\vec{b} - \vec{b}\times\vec{d} - \vec{c}\times\vec{d}$

$= -\vec{d}\times\vec{b} + \vec{d}\times\vec{b}$

$= 0$

again $(\vec{a}\times\vec{b}) = (\vec{c}\times\vec{d})$ given

$\Rightarrow (\vec{a}\times\vec{b})\times(\vec{c}\times\vec{d}) = (\vec{c}\times\vec{d})\times(\vec{c}\times\vec{d}) = 0$ $\quad (\text{as } \vec{a}\times\vec{a} = 0)$

So both (1) and (2) are correct.

70. (d) $a + b = 0 \Rightarrow a = -b$

$$I = \int_{-b}^{b} \frac{x^7 + \sin x}{\cos x}$$

Using property

$$\int_{-a}^{a} f(x)dx = \begin{cases} \int_0^{2a} f(x)dx & ;\text{if } f(x) \text{ is even} \\ 0 & ;\text{if } f(x) \text{ is odd} \end{cases}$$

$$f(x) = \frac{x^7 + \sin x}{\cos x}$$

$$f(-x) = \frac{(-x)^7 + \sin(-x)}{\cos(-x)} = \frac{-x^7 - \sin x}{\cos x}$$

$$= -\left[\frac{x^7 + \sin x}{\cos x}\right]$$

$= -f(x)$

So f(x) is odd hence

$I = 0$

71. (d) $f(x) = \sqrt{25 - x^2}$

$f(1) = \sqrt{24}$

$$\Rightarrow \lim_{x\to 1} \frac{f(x) - f(1)}{x - 1}$$

$\therefore$ It is $\frac{0}{0}$ (undefined condition) so using L'hospital's rule

$$\Rightarrow \lim_{x\to 1} \frac{f'(x) - 0}{1} = \lim_{x\to 1}\left(\sqrt{25 - x^2}\right)'$$

$$\Rightarrow \lim_{x\to 1} \frac{1}{2} \times \frac{1}{\sqrt{25 - x^2}}(-2x)$$

$$= \frac{1}{2} \times \frac{1}{\sqrt{25 - (1)^2}} \times (-2)$$

$$= -\frac{1}{\sqrt{24}}$$

72. (a) $f(x) = \begin{cases} ax - 2 & -2 < x < -1 \\ -1 & -1 \le x \le 1 \\ a + 2(x-1)^2 & 1 < x < 2 \end{cases}$

if f(x) is continuous at $x = -1$

then, $\lim_{x\to -1} (ax - 2) = \lim_{x\to -1} (-1)$

$\Rightarrow a(-1) - 2 = -1$

$\Rightarrow \boxed{a = -1}$

if f(x) is continuous at $x = 1$

then, $\lim_{x\to 1} a + 2(x-1)^2 = \lim_{x\to 1} -1$

$\Rightarrow a + 2(1-1)^2 = -1$

$\Rightarrow \boxed{a = -1}$

73. (c) $\lim_{x\to\pi}\frac{1-\sin x+\cos x}{1+\sin x+\cos x}$

Using L'hospital's rule

$\Rightarrow \lim_{x\to\pi}\frac{-\cos x-\sin x}{\cos x-\sin x}$

$\Rightarrow \frac{-\cos\pi-\sin\pi}{\cos\pi-\sin\pi}$

$\Rightarrow \frac{-(-1)-0}{-1-0}$

$\Rightarrow -1$

74. (b) $f(x)=\begin{cases}\frac{1}{x} & x\neq 0\\ 0 & x=0\end{cases}$

as there is a discontinuity at $x = 0$, so function is not differentiable at $x=0$

$f(x)=\begin{cases}2x+5 & x>0\\ x^2+2x+5 & x\le 0\end{cases}$

$f(0)=5$

$\text{LHD}=\lim_{x\to 0^-}\frac{f(x)-f(0)}{x-0}$

$=\lim_{x\to 0}\frac{x^2+2x+5-5}{x}=\lim_{x\to 0}x+2=2$

$\text{RHD}=\lim_{x\to 0^+}\frac{f(x)-f(0)}{x-0}$

$=\lim_{x\to 0}\frac{2x+5-5}{x}=2$

$\therefore$ It is differentiable at $x=0$

$\therefore$ Only (2) is differentiable at $x=0$

75. (b) $f(x)=\frac{1}{\sqrt{|x|-x}}$

$|x|-x\neq 0$

So $\boxed{x<0}$ ...(1)

$x=(-\infty,0)$

again $|x|-x>0$

$|x|>x$

it is possible only when x is negative.

$\boxed{x=(-\infty,0)}$ ...(2)

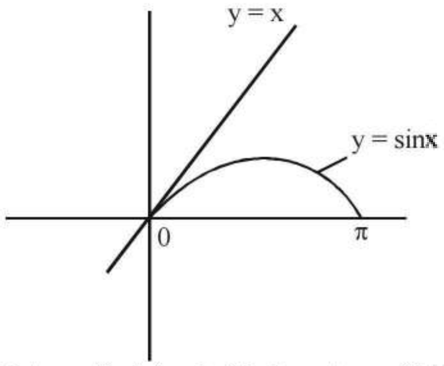
So from eq. (1) & eq. (2)

domain $x=(-\infty,0)$

76. (c) $f(x)=x^2+2\cos x$

$f'(x)=2x-2\sin x$

$=2[x-\sin x]$



Between $(0,\pi)$; $(x-\sin x)$ is always +ve, so $f'(x)$ is always +ve. Hence it is increasing.

$f(x)=\ln\left(\sqrt{1+x^2}-x\right)$

$f'(x)=\frac{1}{\sqrt{1+x^2}-x}\times\left[\frac{1.2x}{2\sqrt{(1+x^2)}}-1\right]$

$f'(x)=\frac{1}{\sqrt{1+x^2}-x}\times\left(\frac{x}{\sqrt{1+x^2}}-1\right)$

As $f'(x)$ is –ve always, so this function is decreasing always.

77. (a) $\ln(x+\sin x)^1=y$ (say)

$\frac{dy}{dx}=\frac{1}{(x+\sin x)}(1+\cos x)$

$=\frac{(1+\cos x)}{(x+\sin x)}$

$x+\cos x=z$ (say)

$\frac{dz}{dx}=(1-\sin x)$

derivative of $\ln(x+\sin x)$ w.r.t $(x+\cos x)$ is

$\frac{dy}{dz}=\frac{(1+\cos x)}{(x+\sin x)(1-\sin x)}$

78. (a) $y=\cot^{-1}\left[\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right]$

$$y=\cot^{-1}\left[\frac{\sqrt{\cos^2\frac{x}{2}+\sin^2\frac{x}{2}+2\sin\frac{x}{2}\cos\frac{x}{2}}+\sqrt{\cos^2\frac{x}{2}+\sin^2\frac{x}{2}-2\sin\frac{x}{2}\cos\frac{x}{2}}}{\sqrt{\cos^2\frac{x}{2}+\sin^2\frac{x}{2}+2\sin\frac{x}{2}\cos\frac{x}{2}}-\sqrt{\cos^2\frac{x}{2}+\sin^2\frac{x}{2}-2\sin\frac{x}{2}\cos\frac{x}{2}}}\right]$$

$$y = \cot^{-1}\left[\frac{\sqrt{\left(\cos\frac{x}{2}+\sin\frac{x}{2}\right)^2}+\sqrt{\left(\cos\frac{x}{2}-\sin\frac{x}{2}\right)^2}}{\sqrt{\left(\cos\frac{x}{2}+\sin\frac{x}{2}\right)^2}-\sqrt{\left(\cos\frac{x}{2}-\sin\frac{x}{2}\right)^2}}\right]$$

$$y = \cot^{-1}\left[\frac{\cos\frac{x}{2}+\sin\frac{x}{2}+\cos\frac{x}{2}-\sin\frac{x}{2}}{\cos\frac{x}{2}+\sin\frac{x}{2}-\cos\frac{x}{2}+\sin\frac{x}{2}}\right]$$

$$y = \cot^{-1}\left[\frac{2\cos\frac{x}{2}}{2\sin\frac{x}{2}}\right] = \cot^{-1}\left(\cot\frac{x}{2}\right) = \frac{x}{2}$$

$$\boxed{\frac{dy}{dx} = \frac{1}{2}}$$

79. (c) $f(x) = \frac{x^2}{e^x}$

$$f'(x) = \frac{2x.e^x - e^x.x^2}{\left(e^x\right)^2}$$

$$f'(x) = \frac{2x - x^2}{e^x}$$

as e^x is always positive and for monotonically increasing; $2x - x^2 > 0$

$\Rightarrow \quad x^2 - 2x < 0$

$\Rightarrow \quad x(x-2) < 0$

$\Rightarrow \quad x = (0, 2)$

80. (d) $x^a y^b = (x-y)^{a+b}$

taking log both the sides.

$$\log\left(x^a y^b\right) = \log(x-y)^{(a+b)}$$

$a \log x + b \log y = (a+b)\log(x-y)$

differentiating both sides w.r.t 'x'.

$$\frac{a}{x}+\frac{b}{y}\frac{dy}{dx} = \frac{(a+b)}{(x-y)}\left[1-\frac{dy}{dx}\right]$$

$$\frac{dy}{dx}\left[\frac{b}{y}+\frac{a+b}{x-y}\right] = \frac{a+b}{x-y}-\frac{a}{x}$$

$$\frac{dy}{dx}\left[\frac{bx-by+ay+by}{y(x-y)}\right] = \frac{ax+bx-ax+ay}{x(x-y)}$$

$$\frac{dy}{dx}\left[\frac{bx+ay}{y}\right] = \frac{bx+ay}{x}$$

$$\frac{dy}{dx} = \frac{y}{x}$$

$$\boxed{\frac{dy}{dx}-\frac{y}{x} = 0}$$

81. (b) $f(x) = 2x - 3$

$g(x) = x^3 + 5$

$fog(x) = f[g(x)] = f(x^3+5)$

$= 2(x^3+5) - 3$

$fog(x) = 2x^3 + 7 = y(\text{say})$

$\Rightarrow \; 2x^3 = y - 7$

$$\Rightarrow \; x = \left[\frac{y-7}{2}\right]^{\frac{1}{3}}$$

$$\Rightarrow \; fog^{-1}(y) = \left[\frac{y-7}{2}\right]^{\frac{1}{3}}$$

$$\Rightarrow \; fog^{-1}(x) = \left[\frac{x-7}{2}\right]^{\frac{1}{3}}$$

82. (a) $\int_a^b \frac{|x|}{x}dx$

when $x \geq 0$

$$\Rightarrow \int_a^b \frac{x}{x}dx$$

$$\Rightarrow \int_a^b (1)dx$$

$= [x]_a^b$

$= |b| - |a|$

when $x < 0$; as $0 < a < b$; x will not lie between a and b so

$$\int_a^b \frac{|x|}{x}dx = 0 \text{ for } x < 0$$

83. (c) $\int_0^{2\pi} \sin^5\left(\frac{x}{4}\right)dx = \int_0^{2\pi}\left(1-\cos^2\frac{x}{4}\right)\left(1-\cos^2\frac{x}{4}\right)\sin\frac{x}{4}.dx$

Put $\cos\left(\frac{x}{4}\right) = t$

$$\Rightarrow -\sin\left(\frac{x}{4}\right).\frac{dx}{4} = dt$$

$$\Rightarrow \sin\left(\frac{x}{4}\right)dx = -4dt$$

$$\Rightarrow \int_0^{2\pi}\sin^5\left(\frac{x}{4}\right)dx = -4\int(1-t^2)(1-t^2)dt$$

$$= -4\int(1+t^4-2t^2)dt$$

$$= -4\left[t+\frac{t^5}{5}-\frac{2t^3}{3}\right]$$

$$= -4\left[\cos\left(\frac{x}{4}\right) + \frac{\cos^5\left(\frac{x}{4}\right)}{5} - \frac{2\cos^3\left(\frac{x}{4}\right)}{3}\right]_0^{2\pi}$$

$$= -4\left[(0+0-0) - \left(1 + \frac{1}{5} - \frac{2}{3}\right)\right] = \frac{32}{15}$$

84. (d) $f(x) = \frac{\sin\left(e^{x-2}-1\right)}{\ln(x-1)}$

$$\lim_{x\to 2} \frac{\sin\left(e^{x-2}-1\right)}{\ln(x-1)} = L$$

It is $\frac{0}{0}$ (undefined) condition so using L'hospital's rule

$$\Rightarrow L = \lim_{x\to 2}\left[\frac{\left\{\sin\left(e^{x-2}-1\right)\right\}^{-}}{\left\{\ln(x-1)\right\}^{-}}\right]$$

$$\Rightarrow L = \lim_{x\to 2} \frac{\cos\left(e^{x-2}-1\right).e^{(x-2)}}{1/(x-1)}$$

$$\Rightarrow L = \lim_{x\to 2} \cos\left(e^{2-2}-1\right)e^{2-2}.(2-1)$$

$\Rightarrow L = \cos(0)\, e^0.1$

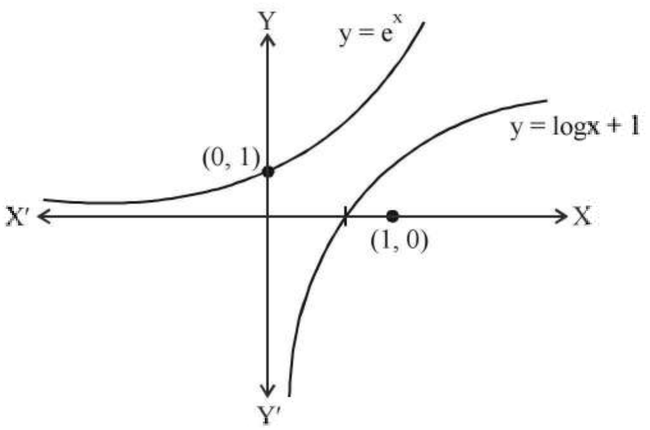
$\Rightarrow L = 1$

85. (c) $f(x) = \log x$

Clearly $f(x)$ is increasing on $(0, \infty)$

$f(x) = e^x - x\log x$

$f'(x) = e^x - (\log x + 1)$



From the figure it is clear that $f'(x) > 0$ on $(1, \infty)$.
So both statements (1) & (2) are correct.

86. (c) $s = \sqrt{t^2+1}$

$$\Rightarrow \frac{ds}{dt} = \frac{t}{\sqrt{t^2+1}}$$

$$\Rightarrow \frac{d^2s}{dt^2} = \frac{1}{\sqrt{\left(t^2+1\right)^3}}$$

$$\Rightarrow \boxed{\frac{d^2s}{dt^2} = \frac{1}{s^3}}$$

87. (a) $f(x) = x^3$

$f(x_1) = x_1^3$

$f(x_2) = x_2^3$

if $x_1 = x_2$

then $f(x_1) = f(x_2)$

So it is one-one function

Hence option (a) is correct.

88. (c) $\int \frac{dx}{1+e^{-x}}$

$$\Rightarrow \int \frac{e^x}{e^x+1}dx$$

Let $e^x + 1 = t$

$e^x dx = dt$

$$= \int \frac{dt}{t}$$

$\Rightarrow \log t + c$

$\Rightarrow \log\left(e^x+1\right) + c$

89. (a) $\int_{-1}^{1} x|x|dx$

$$= \int_{-1}^{0} x|x|dx + \int_{0}^{1} x|x|dx$$

$$= \int_{-1}^{0} x(-x)dx + \int_{0}^{1} x.xdx$$

$$= -\int_{-1}^{0} x^2dx + \int_{0}^{1} x^2dx$$

$$= -\left[\frac{x^3}{3}\right]_{-1}^{0} + \left[\frac{x^3}{3}\right]_0^1$$

$$= -\left[0 - \frac{(-1)^3}{3}\right] + \frac{1}{3}\left[(1)^3 - (0)^3\right]$$

$$= -\frac{1}{3} + \frac{1}{3} = 0$$

90. (d) Area $= \int y\,dx$

$$= \int_0^1 \left(1-\sqrt{x}\right)^2 dx$$

[$\because$ curve makes the intercept of 1 on both axes]

$$= \int_0^1 \left(1+x-2\sqrt{x}\right)dx$$

$$= [x]_0^1 + \frac{1}{2}\left[x^2\right]_0^1 - \frac{4}{3}\left[x^{\frac{3}{2}}\right]_0^1$$

$$= 1+\frac{1}{2}-\frac{4}{3}$$

$$= \frac{3}{2}-\frac{4}{3} = \frac{1}{6}\text{sq unit}$$

91. (c) $f(x) = \left(\frac{1}{x}\right)^{2x^2} = y \text{ (say)}$

$$\log y = 2x^2 \log\left(\frac{1}{x}\right)$$

$$\frac{1}{y}\frac{dy}{dx} = 2\left[2x.\log\left(\frac{1}{x}\right) + x^2.\frac{1}{1/x}.\left(\frac{-1}{x^2}\right)\right]$$

$$\frac{dy}{dx} = 2y\left[2x\log\left(\frac{1}{x}\right) - x\right]$$

For max. or min. value $\frac{dy}{dx} = 0$

$$2x\log\left(\frac{1}{x}\right) - x = 0$$

$$x\left[2\log\left(\frac{1}{x}\right) - 1\right] = 0$$

$\because x \neq 0$

$$\Rightarrow \quad 2\log\left(\frac{1}{x}\right) = 1$$

$$\Rightarrow \quad \frac{1}{x} = e^{\frac{1}{2}}$$

$$\Rightarrow \quad \boxed{x = e^{-\frac{1}{2}}}$$

Again $\frac{d^2y}{dx^2} = \left\{2xy\left[\log\left(\frac{1}{x}\right) - 1\right]\right\}$

$$= (2xy)'\left(\log\frac{1}{x} - 1\right) + 2xy\left[x.\left(-\frac{1}{x^2}\right)\right]$$

$$= (2xy)'\left(\log\frac{1}{x} - 1\right) - 2y$$

$$= 2\left[\left(y + xy^1\right)\left(\log\frac{1}{x} - 1\right) - y\right] < 0$$

So at $x = e^{-1/2}$ function is maximum.

92. (c) $f(x) = \left(\frac{1}{x}\right)^{2x^2}$

$$f\left(e^{-\frac{1}{2}}\right) = \left(e^{\frac{1}{2}}\right)^{2\times e^{-1}}$$

$$= \left(e^{\frac{1}{2}}\right)^{\frac{2}{e}}$$

$$= e^{\frac{1}{2}\times\frac{2}{e}}$$

$$= e^{1/e}$$

93. (c) $f'(x) = \frac{x^2}{2} - kx + 1$

$f(0) = 0; f(3) = 15$

$$f(x) = \frac{1}{6}x^3 - \frac{k}{2}x^2 + x + c$$

Putting $x = 0$

$$\boxed{f(0) = c = 0}$$

$$f(x) = \frac{x^3}{6} - \frac{k}{2}x^2 + x$$

Putting $x = 3$

$$f(3) = \frac{(3)^3}{6} - \frac{k}{2}(3)^2 + 3$$

$$15 = \frac{9}{2} - \frac{9}{2}k + 3$$

$$\Rightarrow k = -\frac{5}{3}$$

94. (d) $\because f'(x) = \frac{x^2}{2} + \frac{5}{3}x + 1$

$$\Rightarrow f''(x) = x + \frac{5}{3}$$

$$f''\left(-\frac{2}{3}\right) = \frac{-2}{3} + \frac{5}{3}$$

$= 1$

So option (d) is correct.

95. (a) $f(x) = -2x^3 - 9x^2 - 12x + 1$

$f'(x) = -6x^2 - 18x - 12$

for increasing function $f'(x) > 0$

$\Rightarrow -(6x^2 + 18x + 12) > 0$

$\Rightarrow (x^2 + 3x + 2) < 0$

$\Rightarrow (x+2)(x+1) < 0$

$x = (-2, -1)$

96. (d) For decreasing function $f'(x) < 0$

$\Rightarrow -(6x^2 + 18x + 12) < 0$

$\Rightarrow (x^2 + 3x + 2) > 0$

$\Rightarrow (x+2)(x+1) > 0$

$x = (-\infty, -2) \cup (-1, \infty)$

97. (c) $A = \int_0^\pi \frac{\sin x}{\sin x + \cos x} dx$

Using property (iv)

$$A = \int_0^\pi \frac{\sin(\pi - x)}{\sin(\pi - x) + \cos(\pi - x)} dx$$

$$A \int_0^\pi \frac{\sin x}{\sin x - \cos x} dx = B$$

$A = B$

98. (b) $B = \int_0^\pi \frac{\sin x}{\sin x - \cos x} \times \frac{(\sin x + \cos x)}{(\sin x + \cos x)} dx$

$$= -\int_0^\pi \frac{\sin^2 x + \sin x \cos x}{\cos 2x} dx$$

$$= \frac{-1}{2}\int_0^\pi \frac{2\sin^2 x}{\cos 2x} dx - \frac{1}{2}\int_0^\pi \frac{2\sin x \cos x}{\cos 2x} dx$$

$$= \frac{-1}{2}\int_0^\pi \frac{1 - \cos 2x}{\cos 2x} dx - \frac{1}{2}\int_0^\pi \tan 2x \, dx$$

$$= \frac{-1}{2}\int_0^\pi \sec 2x \, dx + \frac{1}{2}\int_0^\pi dx - \frac{1}{2}\int_0^\pi \tan 2x \, dx$$

$$= \frac{-1}{2}\left[\frac{\log|\sec 2x + \tan 2x|}{2}\right]_0^\pi + \frac{1}{2}[x]_0^\pi - \frac{1}{2}\left[\frac{\log|\sec 2x|}{2}\right]_0^\pi$$

$$= \frac{-1}{4}[\log(1+0) - \log(1+0)] + \frac{1}{2}[\pi + 0] - \frac{1}{4}[\log(1) - \log(1)]$$

$$= 0 + \pi/2 - 0 = \pi/2$$

99. (c) $\because f(x) = \begin{cases} -2\sin x & \text{if} \quad x \le -\pi/2 \\ A\sin x + B & \text{if} \quad -\pi/2 < x < \pi/2 \\ \cos x & \text{if} \quad x \ge \pi/2 \end{cases}$

$\because$ f(x) is continuous every where :

$\therefore \lim_{x \to \pi/2^+} f(x) = \lim_{x \to \pi/2^-} f(x)$

$\Rightarrow \lim_{x \to \pi/2} \cos x = \lim_{x \to \pi/2} A\sin x + B$

$\Rightarrow A + B = 0$ ... (1)

Also; $\lim_{x \to -\pi/2^+} f(x) = \lim_{x \to -\pi/2^-} f(x)$

$\Rightarrow \lim_{x \to -\pi/2} A\sin x + B = \lim_{x \to -\pi/2} -2\sin x$

$\Rightarrow -A + B = 2$ ... (2)

is from eq (1) & (2) we get,

$A = -1$

100. (a) Put the value of A in eq. (2) we get :

$\Rightarrow B = 1$

101. (d) $\because \frac{dy}{dx} - x = \left(y - x\frac{dy}{dx}\right)^{-4}$

$\Rightarrow \left(\frac{dy}{dx} - x\right)\left(y - x.\frac{dy}{dx}\right)^4 = 1$

$\therefore$ Order of the above differential equation = 1

& degree = 5

102. (c) $\because \frac{dy}{dx} = \sqrt{1 - x^2 - y^2 + x^2y^2}$

$\frac{dy}{dx} = \sqrt{(1 - x^2)(1 - y^2)}$

$\Rightarrow \frac{dy}{\sqrt{1 - y^2}} = \sqrt{1 - x^2}.dx$

$= \int \frac{dy}{\sqrt{1 - y^2}} = \int \sqrt{1 - x^2}.dx$ [integrating b/s]

$= \sin^{-1}\left(\frac{y}{1}\right) = \frac{x}{2}\sqrt{1 - x^2} + \frac{1}{2}\sin^{-1}\left(\frac{x}{1}\right) + c$

$= 2\sin^{-1} y = x\sqrt{1 - x^2} + \sin^{-1} x + c$

103. (b) Eq. of family of circles passing through the origin & having centres on the x-axis is :

$x^2 + y^2 + 2gx = 0$ ... (1)

$2x + 2y.\frac{dy}{dx} + 2g = 0$ [on differentiating]

$\Rightarrow g = -\left[x + y\frac{dy}{dx}\right]$

Putting the value of (g) in eq. (1) we get;

$2xy\frac{dy}{dx} = y^2 - x^2$

104. (a) The eq. of parabolas having vertex at (0, 0) & focus at (a, 0), where (a > 0) is :

$y^2 = 4ax$ ... (1)

$$2y.\frac{dy}{dx} = 4a \quad \text{[on differentiating]}$$

On putting the value of (4a) in eq. (1) we get,

$$2x.\frac{dy}{dx} - y = 0$$

in order =1 & degree = 1.

105. (d) Let $f(x) = \log x$

$\therefore f(y) = \log y$

& $f(xy) = \log(xy) = \log x + \log y$

$\Rightarrow f(xy) = f(x) + f(y)$

106. (c) Total no. of 3-digit numbers $= 9 \times 8 \times 7 = 504$

For product to be odd, we have to choose only from odd numbers.

$\therefore$ Total no. of 3-digit no. whose product are odd $= 5 \times 4 \times 3 = 60$

$\therefore$ Required probability $= \frac{60}{504} = \frac{5}{42}$

107. (c) $\because P(\bar{B}) = 0.8 \Rightarrow P(B) = 0.2$

$P(A \cup B) = 0.5$ & $P(A|B) = 0.4$

$\because P(A \cap B) = P(B) \times P(A|B) = 0.2 \times 0.4 = 0.08$

& $P(A) = P(A \cup B) - P(B) + P(A \cap B)$

$P(A) = 0.5 - 0.2 + 0.08 = 0.38$

108. (d) We have; $np = 2 = $ mean

$npq = 1 = $ variance

$\Rightarrow p = \frac{1}{2}; q = \frac{1}{2}$ & $n = 4$

Required probability $= P(x > 1)$

$= 1 - P(x \le 1)$

$= 1 - [P(x=0) + P(x=1)]$

$= 1 - [{}^4C_0 q^4 + {}^4C_1 q^3 p^1]$

$= 1 - \frac{5}{16} = \frac{11}{16}$

109. (a) Let X denote the no. of coins showing 3 or more heads in a set of 7 coins.

X follows binomial distribution with $n = 7$

$p = $ probability of getting a head in a single toss of a coin

$\Rightarrow p = \frac{1}{2}$; thus $q = 1 - p = \frac{1}{2}$.

$\therefore$ Probability of getting at least 3 heads

$= P(x \ge 3)$

$= 1 - P(x < 3)$

$= 1 - [P(x=0) + P(x=1) + P(x=2)]$

$= 1 - [{}^7C_0 + {}^7C_1 + {}^7C_2] \frac{1}{2^7}$

$= \frac{128}{128} - \frac{29}{128} = \frac{99}{128}$

$\therefore$ No. of throws $= \frac{99}{128} \times 128 = 99$

110. (a) Let P denote the probability of getting head in a single toss of a coin.

$\therefore p = \frac{1}{2} \Rightarrow q = \frac{1}{2}$

Let X denote the no. of heads in 5 tosses of a coin. then, X is a binomial variate with parameters; $n = 5$ & $p = \frac{1}{2}$.

$\therefore$ Req. probability $= P(x > 3)$

$= 1 - P(x \le 3)$

$= 1 - [P(x=0) + P(x=1) + P(x=2) + P(x=3)]$

$= 1 - [{}^5C_0 + {}^5C_1 + {}^5C_2 + {}^5C_3] \frac{1}{2^5}$

$= 1 - [1 + 5 + 10 + 10] \frac{1}{32}$

$= \frac{32}{32} - \frac{26}{32} = \frac{6}{32} = \frac{3}{16}$

111. (c) $G_1 = [x_1 \times x_2 \times x_3 \times \dots\dots \times x_n]^{1/n}$

$G_2 = [y_1 \times y_2 \times y_3 \times \dots\dots \times y_n]^{1/n}$

$$\Rightarrow \frac{G_1}{G_2} = \left[\frac{x_1}{y_1} \times \frac{x_2}{y_2} \times \frac{x_3}{y_3} \times \dots\dots \times \frac{x_n}{y_n}\right]^{1/n}$$

$\therefore \frac{G_1}{G_2}$ is the G.M of $\frac{x_1}{y_1}, \frac{x_2}{y_2}, \frac{x_3}{y_3}, \dots\dots, \frac{x_n}{y_n}$

112. (c) Sum of the given terms $= 1 + 8 + 27 + 64 \dots\dots +$ upto n terms

Sum $= 1^3 + 2^3 + 3^3 + 4^3 + \dots\dots +$ upto n terms

$$\text{Sum} = \left(\frac{n(n+1)}{2}\right)^2 = \frac{n^2(n+1)^2}{4}$$

$$AM = \frac{n^2(n+1)^2}{4} \times \frac{1}{n} = \frac{n(n+1)^2}{4}$$

113. (c) $S = \{H, TH, TTH, TTTH, TTTT\}$

$P(T) = P(H) = \frac{1}{2}$

[Probability of getting head or tail in a single toss]

$\therefore$ Probability that no head is observed $= P(TTTT)$

$= P(T)\,P(T)\,P(T)\,P(T)$

$= \frac{1}{2^4} = \frac{1}{16}$

And the probability that the experiment ends with 3 tosses

$= P(TTH)$

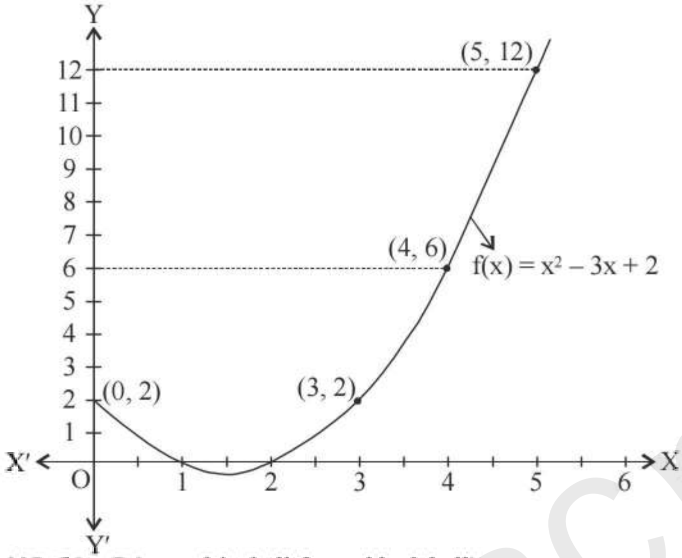
$= P(T)\,P(T)\,P(H)$

$= \frac{1}{8}$

Hence, both statements are correct.

114. (a) Let $x^2-3x+2=0$
$\Rightarrow x=1,2$
$\therefore x^2-3x+2\ge 0$ for $x\in[0,1]\cup[2,3]\cup[3,4]\cup[4,5]$.
It is given that :
$x\in[0,1]\cup[1,2]\cup[2,3]\cup[3,4]\cup[4,5]$

$\therefore$ Required probability $=\dfrac{4}{5}$



115. (b) P (one white ball & one black ball)
= P {[black from 1st bag & white from 2nd] or [white from 1st & black from 2nd]}
$=P([B_1\cap W_2)\cup(W_1\cap B_2)]$
$=P(B_1\cap W_2)+P(W_1\cap B_2)$
(By addition theorem for mutually exclusive events)
$=P(B_1)P(W_2)+P(W_1)P(B_2)$
($\therefore B_2$ & W_2; B_2 & W_1 are pairs of independent events)

$$=\left[\frac{2}{6}\times\frac{3}{8}\right]+\left[\frac{4}{6}\times\frac{5}{8}\right]$$

$$=\frac{13}{24}$$

116. (d) Let $P(A)=\dfrac{1}{2}$, $P(B)=\dfrac{1}{3}$ & $P(C)=\dfrac{1}{4}$

$$P(A\cup B\cup C)=1-P(\bar{A})P(\bar{B})P(\bar{C})$$

$$=1-\left(1-\frac{1}{2}\right)\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)$$

$$=1-\left[\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}\right]=1-\frac{1}{4}=\frac{3}{4}$$

117. (a) Let E_1, E_2, E_3 & A be events defined as follows.
E_1 = person chosen is a scooter driver
E_2 = person chosen is a car driver.
E_3 = person chosen is a truck driver &
A = person meets with an accident

$$P(E_1)=\frac{2000}{12000}=\frac{1}{6};\ P(E_2)=\frac{1}{3}\ \&\ P(E_3)=\frac{1}{2}$$

$\because$ Probability that a person meets with an accident given that he is a scooter driver $=P\left(A/E_1\right)=0.01$

$$P\left(A/E_2\right)=0.03\ \&\ P\left(A/E_3\right)=0.15$$

$\because$ the person meets with an accident.
$\therefore$ the probability that he was a scooter driver

$$=P\left(E_1/A\right)=\frac{P(E_1)P\left(A/E_1\right)}{P(E_1)P\left(A/E_1\right)+P(E_2)P\left(A/E_2\right)+P(E_3)P\left(A/E_3\right)}$$

$$=P\left(E_1/A\right)=\frac{1/6\times 0.01}{\left(\frac{1}{6}\times 0.01\right)+\left(\frac{1}{3}\times 0.03\right)+\left(\frac{1}{2}\times 0.15\right)}=\frac{1}{52}$$

118. (a) Let p denote the probability of getting tail in a single of a coin.

$\therefore p=\dfrac{1}{2}\Rightarrow q=\dfrac{1}{2}$ & $n=5$

Let X denot no. of tails in 5 tosses of coin.
$\therefore$ Required probability $=P(x=1)+P(x=3)+P(x=5)$

$$=\frac{1}{2^5}\left[{}^5C_1+{}^5C_3+{}^5C_5\right]$$

$$=\frac{1}{2^5}[5+10+1]=\frac{16}{32}=\frac{1}{2}$$

119. (b) Let $b_1=-0.64$
$b_2=-0.36$
$r=\pm\sqrt{-0.64\times-0.36}=\pm 0.48$
$\because b_1<0$ & $b_2<0$
$\therefore r<0$
$\Rightarrow r=-0.48$

120. (b) Total no. of two different single digit natural number $={}^9C_2=36$
The number of two different single digit natural no.s whose sum is a prime number (3, 5, 7, 11, 13 & 17) = 14

$\therefore$ Required probability $=\dfrac{14}{36}=\dfrac{7}{18}$

GENERAL ABILITY

PART-A: ENGLISH

1.	(d)	**2.**	(c)	**3.**	(c)	**4.**	(d)	**5.**	(b)
6.	(a)	**7.**	(c)	**8.**	(b)	**9.**	(d)	**10.**	(c)
11.	(b)	**12.**	(c)	**13.**	(c)	**14.**	(c)	**15.**	(b)
16.	(b)								

17. (b) Garrulous means excessively talkative, especially on unimportant matters. Therefore, talkative is the nearest in meaning or synonym of Garrulous.

18. (d) Fortitude means mental and emotional strength in facing difficulty, adversity, danger, or temptation courageously. Forbearance means being patient and keeping self-control. Therefore, forbearance is the nearest in meaning or synonym of fortitude.

19. (d) Tacit means something understood or implied without being stated. Implied means suggested but not directly expressed. Therefore, implied is the nearest in meaning or synonym of tacit.

20. (b) Meagre means very small or not enough in amounts or numbers. Scanty means small or insufficient in quantity or amount. Therefore, scanty is the nearest in meaning or synonym of meagre.

21. (d) Exhilarate means to cause to feel happily refreshed and energetic. Overjoyed means to be extremely happy and joyous about something. Therefore, overjoyed is the nearest n meaning or synonym of exhilarated.

22. (d) Concealed means to keep something or someone as secret or hidden. Reveal means to make some previously unknown or secret information known to others. Therefore, revealed is the opposite in meaning or antonym of concealed.

23. (d) Denounce means to publicly declare something or someone to be wrong or evil. Commended means praise formally or officially. Therefore, commended is the opposite in meaning or antonym of denounce.

24. (b) Sceptical not easily convinced; having doubts or reservations. Certain means to able to be firmly relied on to happen to be the case. Therefore, certain is the opposite in meaning or antonym of sceptical.

25. (d) Coherent means logically or aesthetically ordered or integrated. Disconnected means lacking a logical sequence. Therefore, disconnected is the opposite in meaning or antonym of coherent.

26. (a) Altruistic means showing a disinterested and selfless concern for the well-being or advantage of others. Therefore, selfish is the opposite in meaning or antonym of altruistic.

27. (a) Command here refers to the ability to use or control something. Therefore, it is the most appropriate word out of the given options to fill the blank.

28. (b) Perspiration here refers to the process of sweating. Therefore, it si the most appropriate word out of the given options to fill the blank.

29. **(a)** Programmes here means a planned series of future events or performances. Therefore, it is the most appropriate word out of the given options to fill the blank.

30. (d) **31.** (b) **32.** (b) **33.** (a) **34.** (b)

35. (d) Convenient here refers to a location situated so as to allow easy access to everyone. Therefore, it is the most appropriate word out of the given options to fill the blank.

36. (c) Astounded means to get shocked or greatly surprised. Therefore, it is the most appropriate word out of the given options to fill the blank.

37. (c) Indifferent means having no particular interest or sympathy or to be unconcerned. Therefore, it is the most appropriate word out of the given options to fill the blank.

38. (c) Cut-throat here means a competitive situation or activity which is fierce and intense or involving the use of ruthless measures. Therefore, it is the most appropriate word out of the given options to fill the blank.

39. (d) Comprises means to be composed of or contain. For example: The staff comprises of eight physicians, two dozen nurses, and various administrative people. Therefore, it is the most appropriate word out of the given options to fill the blank.

40. (c)

41. (c) Reliable here refers to someone or something capable of being relied on or dependable. For example : a reliable assistant; a reliable car.

42. (b) **43.** (c) **44.** (b) **45.** (c) **46.** (b)

47. (a) **48.** (c) **49.** (b) **50.** (c)

PART- B : GENERAL KNOWLEDGE

51. (d) Velocity is the vector quantity so it get changed as the direction changes. The ball will move with constant speed and magnitude of acceleration of the ball will also be constant.

52. (a) When wire carrying d.c. current in the same direction are placed close to each other, the wire will attract each other.

53. (b) **54.** (c)

55. (d) Green house gas consists of methane, water vapours, ozone and CFCs gases.

56. (b) Lactic acid is formed and accumulated in the muscle under conditions of high energy demand at the time of vigorous exercise and rapid fluctuations of the energy requirement and insufficient supply of O_2.

57. (c) At the physically impossible-to-reach temperature of zero kelvin, or minus 459.67 degrees Fahrenheit (minus 273.15 degrees Celsius), at which atoms would stop moving.

58. (c) Lightning conductor, is a good conductor of electric current, so it create an electric field at its top to attract lightning conduction (i.e., charge). It carries all charges to deep in the earth without harming the building. These conductors are installed at corners or sides walls taller than the walls so that lighting strikes these first.

59. (b) **60.** (c)

61. (b) Water gas is a fuel gas consisting mainly of carbon monoxide and hydrogen, made by passing steam over incandescent coke.

62. (b) Animal body do not contain cellulose.

63. (c) Silvering in thermos flask is done to avoid heat transfer by both radiation.

64. (c) Manas National park is situated at the base of the foot hills of Bhutan-Himalayas in the state of Assam.

65. (c) During the cement manufacturing process, upon the cooling of clinker, a small amount of gypsum is introduced during the final grinding process. Gypsum is added to increase the "setting of cement".

66. (b)

67. (b) When the image and object are at the two different sides of a lens the then focal length is positive. When the object and images are at the same side (one side only) then the focal length is negative.

68. (c)

69. (b) Ammonia (NH_3) obtained from different sources always has same proportion of Nitrogen and Hydrogen and it proves the validity of law of constant proportion.

70. (b) **71.** (d)

72. (a) Boric acid, also called hydrogen borate, is a week monobasic acid which accepts OH from water releasing proton.

73. (b) First antibiotic was obtained from genus *Penicillium* discovered by Sir Alexander Fleming.

74. (a) Three equal resistance in series are 90 ohm. therefore resistance is 30 ohm.
Three resistance each with 30 ohm in parallel gives 10 ohm.

75. (b) BC

76. (b)

77. (a) Bhitarkanika – National Park
Chilka – Sanctuary
Dudhwa – Tiger reserve
Nokrek – Biosphere Reserve

78. (a) The main constituent of vinegar is acetic acid; the other constituents will depend on the nature of the raw material that has undergone fermentation.

79. (b) White phosphorous when exposed to oxygen it get oxidized and produce light.

80. (b) Yeast plant and human being all are eukaryotic, only bacteria is a prokaryotic.

81. (c) Capacity to do work is called energy.

82. (d) Zero

83. (a) Western ghats – Tropical evergreen
Himachal Pradesh – Himalayan moist forest
Haryana and Punjab – Tropical thorny forest
Chhotanagpur Plateau – Tropical moist deciduous

84. (d) Regur is a black soils are found in lava-covered areas of Maharashtra, Saurashtra, Northern Karnataka, etc. and this soil is very good for cotton.

85. (a) Undergoes sp^2 hybridization and forms three sigma bonds with three neighbouring carbon atoms.

86. (d) Dermal synthesis of vitamin D from cholesterol is dependent on sun exposure.

87. (a) In SI units, thermal conductivity is measured in watts per meter kelvin (W/(m. K)).

88. (d) The temperature at which a solid changes into a liquid is called the melting point.

90. (d) Organism $\rightarrow$ Population $\rightarrow$ Ecosystem $\rightarrow$ Biosphere

91. (a) Cathode rays are composed of negatively charged particle electron.

92. (a) Photosynthesis is a process in which carbon is taken from the atmosphere is taken in form of carbon di oxide. Energy is also synthesized in light reaction is subsequent steps.

93. (c) Resistance is directly proportional to length(l)
$r \propto l, \; r \propto 1/a$
wire is stretched to double its length the resistance will become
$r \propto l, r \propto 1/a/2$ Combining these two $r \propto 4l/a$

94. (b) Lithosphere consists of crust and upper mantle.

95. (d) Most commercial nuclear reactors use normal water (also called light water) as a neutron moderator. Dielectric constant of heavy water is smaller than that of ordinary water.

96. (c) Conservation of momentum in a collision between particles is dependent on both Newton's second law of motion and Newton's third law of motion.

98. (a) Oxy-fuel welding (commonly called oxyacetylene welding, oxy welding, or gas welding) and oxy-fuel cutting are processes that use fuel gases and oxygen to weld and cut metals.

99. (c) Final force will be along the Z axis.
$F = \sqrt{(3)^2 + (4)^2}$
$= \sqrt{9+16} = \sqrt{25} = 5$
Acceleration(a) = F/m = 5/1 = 5m/s^2

100. (c) **101.** (c)

102. (a) Hydrogen is present throughout the exosphere, with some helium, carbon dioxide, and atomic oxygen near its base.

103. (c) Platelets are responsible for blood clotting.

104. (b) SI unit of force Kg.m/s^2

105. (b) $g = GM/R^2$

106. (d)

107. (a) Lithium batteries are batteries that have lithium as an anode. These types of batteries are also referred to as lithium-metal batteries. The membrane get polarized with the movement of Na+ ion and crate appropriate potential across membrane. K control the water balance in blood. Caesium clocks are the most accurate & commercially produced time and frequency standards, and serve as the primary standard for the definition of the second in SI (the metric system).

108. (b) Kidney is not a site of action in human body for malarial parasite *Plasmodium*.

109. (b) Loudness of sound is related to amplitude.

110. (d) X-rays electromagnetic radiation having wavelength 10^{-10} metre.

111. (a)

112. (b) Symbol of Tunguston is W.

113. (c) Arteries of mummies are intact with the elastic fibre when they are preserved.

114. (a) The image formed by the concave mirror for an object lying at infinity is at the principal focus highly diminished, real and inverted.

115. (c) In any atom atomic number represent the number of electrons which is equal to the number of proton.

116. (a)

117. (a) Li is the alkali metal which has highest melting point.

118. (a)

119. (c) In stream line each particle may not follow the same path as taken by a previous particle passing through that point.

120. (d) The simplest model for the shape of the entire Earth is a sphere. The Earth's radius is the distance from Earth's center to its surface, about 6,371 kilometers (3,959 mi). Earth is only approximately spherical, so no single value serves as its natural radius. Since the Earth is flattened at the poles and bulges at the equator, geodesy represents the shape of the earth with an oblate spheroid. The oblate spheroid, or oblate ellipsoid, is an ellipsoid of revolution obtained by rotating an ellipse about its shorter axis.

121. (c) Secularism in India means equal treatment of all religions by the state. With the 42nd Amendment of the Constitution of India enacted in 1976, the Preamble to the Constitution asserted that India is a secular nation. However, neither India's constitution nor its laws define the relationship between religion and state.

122. (d) **123.** (a)

124. (b) Legislature, executive and judiciary under the Constitution are to exercise powers with checks and balances, but not in water-tight rigid mould. In India, on the basis of Articles 32 and 136, the Supreme Court can exercise the power of judicial review.

125. (a) According to the terms of a subsidiary alliance, princely rulers were not allowed to have an independent armed force. They were to be protected by the East India

Company, but had to pay for the 'subsidiary forces' that the company was supposed to maintain for the purpose of this protection. If the Indian rulers failed to make the payment, then part of their territory was taken away as penalty.

126. (c) François Bernier was a French physician and traveller. He was briefly personal physician to Mughal prince Dara Shikoh, the elder son of the Mughal emperor Shah Jahan.

127. (a)

128. (b) National emergency under article 352, emergency can be declared on the basis of external aggression or armed rebellion in the whole of India or a part of its territory. Such an emergency was declared in India in 1962 (Indo-China war), 1971 (Indo-Pakistan war), and 1975 (declared by Indira Gandhi).

129. (d)

130. (d) The Khilafat movement (1919-22) was a pan-Islamic, political protest campaign launched by Muslims in British India to influence the British government. The movement became the reason for separation from mainland India of an Islamic Pakistan, in the process unleashing tremendous separation-trauma, mainly upon ethnic Punjabis. The movement was a topic in Conference of London (February 1920); however, Arabs saw it as threat of continuation of Turkish dominance of Arab lands.

131. (c)

132. (b) The Fourth Schedule (Articles 4(1) and 80(2)) of the Indian Constitution deals with the allocation of seats in the Rajya Sabha (the upper house of Parliament) per State or Union Territory.

133. (c) A Resident, or in full Resident Minister, is a government official required to take up permanent residence in another country. Instead of being a representative to a single ruler, a Resident could be posted to more than one native state, or to a grouping of states which the European power decided for its convenience. This could create an artificial geographical unit, as in Residency X in some parts of the British Indian Empire.

134. (b)

135. (a) The Vijayanagara Empire (also called Karnata Empire, and the Kingdom of Bisnegar by the Portuguese) was based in the Deccan Plateau region in South India. It was established in 1336 by Harihara I and his brother Bukka Raya I of Sangama Dynasty. It lasted until 1646, although its power declined after a major military defeat in 1565 by the Deccan sultanates.

136. (c) The Kesavananda Bharati case was the culmination of a serious conflict between the judiciary and the Government, which was headed by Mrs Indira Gandhi. Though, the phrase 'basic structure' was introduced for the first time by M.K. Nambiar and other counsels while arguing for the petitioners in the Golaknath case, it was only in the Kesavanada Bharati's case that the concept surfaced in the text of the apex court's verdict.

137. (d) Abd-ur-Razzaq was the ambassador of Shah Rukh, the Timurid dynasty ruler of Persia to Calicut, India, from January 1442 to January 1445. He wrote a 45-page narrative of this mission to India.

138. (b)

139. (d) Pattadakal, also spelled Pa??adakallu, is an UNESCO inscribed World Heritage site. It is 22 km from Badami, and about 10 km from Aihole, both of which are well known for Chalukya monuments. The Keshava temple is one of the finest and most complete examples of Hoysala architecture and is also one of the best preserved Hoysala temples. Konark Sun Temple is a 13th-century Sun Temple at Konark in Orissa, India. It is believed that the temple was built by king Narasimhadeva I of Eastern Ganga Dynasty in 1255 CE.

140. (d) The word "Senia" is related to Tansen, the father of Indian Classical Music. The word "Gharana" implies a style of music. The followers of Tansen's school of music are widely known as the followers of "Senia gharana".

141. (d) In 1878, the Rajahmundry Social Reform Association was founded that emphasized on Anti-nautch movement to discontinue the hiring of nautch girls. However, the association started concentrating on widow remarriage at a later stage. Under this association, Kandukuri Veeresalingam organized the first widow remarriage on December 11, 1881 of Gogulapati Sreeramulu and Gowramma.

142. (c) The SAARC Secretariat is based in Kathmandu, Nepal. It coordinates and monitors implementation of activities, prepares for and services meetings, and serves as a channel of communication between the Association and its Member States as well as other regional organisations.

143. (b) The Faraizi Movement was founded in 1818 by Haji Shariatullah to give up un-Islamic practices and act upon their duties as Muslims. The movement protected the rights of tenants to a great extent.

144. (c) The Indian states committee appointed a committee under the Chairmanship of Sir Harcourt Butler which was popularly known as 'the Butler Committee' to investigate and clarify the relationship between the paramount powers and the princely states in 1928.

145. (c) In the history of Panchayati Raj, in India, on 24 April 1993, the Constitutional (73rd Amendment) Act 1992 came into force to provide constitutional status to the Panchayati Raj institutions. Currently, the Panchayati Raj system exists in all the states except Nagaland, Meghalaya and Mizoram, and in all Union Territories except Delhi.

146. (b) Kakkadan Nandanath Raj was a veteran Indian economist. He is popularly known as K. N. Raj. He played an important role in India's planned development, drafting sections of India's first Five Year Plan.

147. (a) The Pakistan Paradox: Instability and Resilience is authored by Christophe Jaffrelot.

148. (b)

149. (c) Vikas Gowda is an Indian thrower and Shot putter. He won his first gold medal in Asian Championships in 2013 in Pune, with a throw of 64.90 meters.

150. (a) The 19th National Senior Athletic Championship for the Federation Cup was held at the Mangala stadium, Mangalore City, Karnataka from April 30 to May 4.

NDA 1 2015 Question Paper

MATHEMATICS

1. Let θ be a positive angle. If the number of degrees in θ is divided by the number of radians in θ, then an irrational number $\frac{180}{\pi}$ results. If the number of degrees in θ is multiplied by the number of radians in θ, then an irrational number $\frac{125\pi}{9}$ results. The angle θ must be equal to
(a) 30°
(b) 45°
(c) 50°
(d) 60°

2. In a triangle ABC, $a = (1+\sqrt{3})$ cm, $b = 2$ cm and angle $C = 60°$. Then the other two angles are
(a) 45° and 75°
(b) 30° and 90°
(c) 105° and 15°
(d) 100° and 20°

DIRECTIONS: For the next two (2) items that follow.
Let α be the root of the equation $25\cos^2\theta + 5\cos\theta - 12 = 0$, where $\frac{\pi}{2} < \alpha < \pi$.

3. What is $\tan\alpha$ equal to?
(a) $\frac{-3}{4}$
(b) $\frac{3}{4}$
(c) $\frac{-4}{3}$
(d) $\frac{-4}{5}$

4. What is $\sin 2\alpha$ equal to?
(a) $\frac{24}{25}$
(b) $\frac{-24}{25}$
(c) $\frac{-5}{12}$
(d) $\frac{-21}{25}$

5. The angle of elevation of the top of a tower from a point 20 m away from its base is 45°. What is the height of the tower?
(a) 10m
(b) 20m
(c) 30m
(d) 40m

6. The equation $\tan^{-1}(1+x) + \tan^{-1}(1-x) = \frac{\pi}{2}$ is satisfied by
(a) $x=1$
(b) $x=-1$
(c) $x=0$
(d) $x=\frac{1}{2}$

7. The angles of elevation of the top of a tower standing on a horizontal plane from two points on a line passing through the foot of the tower at distances 49 m and 36 m are 43° and 47° respectively. What is the height of the tower?
(a) 40m
(b) 42m
(c) 45m
(d) 47m

8. $(1-\sin A+\cos A)^2$ is equal to
(a) $2(1-\cos A)(1+\sin A)$
(b) $2(1-\sin A)(1+\cos A)$
(c) $2(1-\cos A)(1-\sin A)$
(d) None of the above

9. What is $\frac{\cos\theta}{1-\tan\theta}+\frac{\sin\theta}{1-\cot\theta}$ equal to?
(a) $\sin\theta - \cos\theta$
(b) $\sin\theta + \cos\theta$
(c) $2\sin\theta$
(d) $2\cos\theta$

DIRECTIONS : For the next three (3) items that follow.

Consider $x = 4\tan^{-1}\left(\frac{1}{5}\right)$, $y = \tan^{-1}\left(\frac{1}{70}\right)$ and $z = \tan^{-1}\left(\frac{1}{99}\right)$.

10. What is x equal to?
(a) $\tan^{-1}\left(\frac{60}{119}\right)$
(b) $\tan^{-1}\left(\frac{120}{119}\right)$
(c) $\tan^{-1}\left(\frac{90}{169}\right)$
(d) $\tan^{-1}\left(\frac{170}{169}\right)$

11. What is $x-y$ equal to?
(a) $\tan^{-1}\left(\frac{828}{845}\right)$
(b) $\tan^{-1}\left(\frac{8287}{8450}\right)$
(c) $\tan^{-1}\left(\frac{8281}{8450}\right)$
(d) $\tan^{-1}\left(\frac{8287}{8471}\right)$

12. What is $x-y+z$ equal to?
(a) $\frac{\pi}{2}$
(b) $\frac{\pi}{3}$
(c) $\frac{\pi}{6}$
(d) $\frac{\pi}{4}$

DIRECTIONS: For the next three (3) items that follow.
Consider the triangle ABC with vertices $A(-2, 3)$, $B(2, 1)$ and $C(1, 2)$.

13. What is the circumcentre of the triangle ABC ?
(a) (–2, –2)
(b) (2, 2)
(c) (–2, 2)
(d) (2, –2)

14. What is the centroid of the tirnalge ABC ?
(a) $\left(\frac{1}{3},1\right)$
(b) $\left(\frac{1}{3},2\right)$
(c) $\left(1,\frac{2}{3}\right)$
(d) $\left(\frac{1}{2},3\right)$

15. What is the foot of the altitude from the vertex A of the triangle ABC?

(a) $(1,4)$ (b) $(-1,3)$
(c) $(-2,4)$ (d) $(-1,4)$

16. Let X be the set of all persons living in a city. Persons x, y in X are said to be related as $x < y$ if y is at least 5 years older than x. Which one of the following is correct?

(a) The relation is an equivalence relation on X
(b) The relation is transitive but neither reflexive nor symmetric
(c) The relation is reflexive but neither transitive nor symmetric
(d) The relation is symmetric but neither transitive nor reflexive

17. Which one of the following matrices is an elementary matrix?

(a) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 5 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(c) $\begin{bmatrix} 0 & 2 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 5 & 2 \end{bmatrix}$

18. Consider the following statements in respect of the given equation :
$(x^2+2)^2 + 8x^2 = 6x(x^2+2)$

1. All the roots of the equation are complex.
2. The sum of all the roots of the equation is 6.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

19. In solving a problem that reduces to a quadratic equation, one student makes a mistake in the constant term and obtains 8 and 2 for roots. Another student makes a mistake only in the coefficient of first-degree term and finds –9 and –1 for roots. The correct equation is

(a) $x^2 - 10x + 9 = 0$ (b) $x^2 - 10x + 9 = 0$
(c) $x^2 - 10x + 16 = 0$ (d) $x^2 - 8x - 9 = 0$

20. If $A = \begin{bmatrix} 2 & 7 \\ 1 & 5 \end{bmatrix}$ then that is $A + 3A^{-1}$ equal to?

(a) $3I$ (b) $5I$
(c) $7I$ (d) None of these

where I is the identity matrix order 2.

21. In a class of 60 students, 45 students like music, 50 students like dancing, 5 students like neither. Then the number of students in the class who like both music and dancing is

(a) 35 (b) 40
(c) 50 (d) 55

22. If $\log_{10} 2$, $\log_{10}(2^x - 1)$ and $\log_{10}(2^x + 3)$ are three consecutive terms of an A.P, then the value of x is

(a) 1 (b) $\log_5 2$
(c) $\log_2 5$ (d) $\log_{10} 5$

23. The matrix $\begin{bmatrix} 0 & -4+i \\ 4+i & 0 \end{bmatrix}$ is

(a) symmetric (b) skew-symmetric
(c) Hermitian (d) skew-Hermitian

24. Let Z be the set of integers and aRb, where $a, b \in Z$ if and only if $(a-b)$ is divisible by 5.
Consider the following statements:

1. The relation R partitions Z into five equivalent classes.
2. Any two equivalent classes are either equal or disjoint.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

25. If $z = \frac{-2(1+2i)}{3+i}$ where $i = \sqrt{-1}$, then argument $\theta(-\pi < \theta \le \pi)$ of z is

(a) $\frac{3\pi}{4}$ (b) $\frac{\pi}{4}$

(c) $\frac{5\pi}{6}$ (d) $-\frac{3\pi}{4}$

26. If m and n are the roots of the equation $(x+p)(x+q) - k = 0$, then the roots of the equation $(x-m)(x-n) + k = 0$ are

(a) P and q (b) $\frac{1}{p}$ and $\frac{1}{q}$
(c) $-p$ and $-q$ (d) $p+q$ and $p-q$

27. What is the sum of the series $0.5 + 0.55 + 0.555 + \ldots$ to n terms?

(a) $\frac{5}{9}\left[n - \frac{2}{9}\left(1 - \frac{1}{10^n}\right)\right]$ (b) $\frac{1}{9}\left[5 - \frac{2}{9}\left(1 - \frac{1}{10^n}\right)\right]$

(c) $\frac{1}{9}\left[n - \frac{5}{9}\left(1 - \frac{1}{10^n}\right)\right]$ (d) $\frac{5}{9}\left[n - \frac{1}{9}\left(1 - \frac{1}{10^n}\right)\right]$

28. If 1, ω, ω^2 are the cube roots of unity, then the value of $(1+\omega)(1+\omega^2)(1+\omega^4)(1+\omega^8)$ is

(a) –1 (b) 0
(c) 1 (d) 2

29. Let A = {1, 2 , 3, 4, 5, 6, 7, 8, 9, 10}. Then the number of subsets of A containing exactly two elements is

(a) 20 (b) 40
(c) 45 (d) 90

30. What is the square root of i, where $i = \sqrt{-1}$?

(a) $\frac{1+i}{2}$ (b) $\frac{1-i}{2}$

(c) $\frac{1+i}{\sqrt{2}}$ (d) None of these

31. The point on the parabola $y^2 = 4ax$ nearest to the focus has its abscissa

(a) $x = 0$ (b) $x = a$

(c) $x = \frac{a}{2}$ (d) $x = 2a$

32. A line passes through (2, 2) and is perpendicular to the line $3x + y = 3$. Its y-intercept is

(a) $\frac{3}{4}$ (b) $\frac{4}{3}$

(c) $\frac{1}{3}$ (d) 3

33. The hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ passes through the point $(3\sqrt{5},1)$ and the length of its latus rectum is $\frac{4}{3}$ units. The length of the conjugate axis is
(a) 2 units (b) 3 units
(c) 4 units (d) 5 units

34. The Perpendicular distance between the straight lines $6x+8y+15=0$ and $3x+4y+9=0$ is
(a) $\frac{3}{2}$ units (b) $\frac{3}{10}$ unit
(c) $\frac{3}{4}$ unit (d) $\frac{2}{7}$ unit

35. The area of a triangle, whose vertices are (3, 4), (5, 2) and the point of intersection of the lines x = a and y = 5, is 3 square units. What is the value of a?
(a) 2 (b) 3
(c) 4 (d) 5

36. The length of perpendicular from the origin to a line is 5 units and the line makes an angle 120° with the positive direction of x-axis. The equation of the line is
(a) $x+\sqrt{3}y=5$ (b) $\sqrt{3}x+y=10$
(c) $\sqrt{3}x-y=10$ (d) None of these

37. The equation of the line joining the origin to the point of interesection of the lines $\frac{x}{a}+\frac{y}{b}=1$ and $\frac{x}{b}+\frac{y}{a}=1$ is
(a) $x-y=0$ (b) $x+y=0$
(c) $x=0$ (d) $y=0$

DIRECTIONS: For the next two (2) items that follow.
The projections of a directed line segment on the coordinate axes are 12, 4, 3 respectively.

38. What is the length of the line segment?
(a) 19 units (b) 17 units
(c) 15 units (d) 13 units

39. What are the direction cosines of the line segment?
(a) $\left\langle\frac{12}{13},\frac{4}{13},\frac{3}{13}\right\rangle$ (b) $\left\langle\frac{12}{13},-\frac{4}{13},\frac{3}{13}\right\rangle$
(c) $\left\langle\frac{12}{13},-\frac{4}{13},-\frac{3}{13}\right\rangle$ (d) $\left\langle-\frac{12}{13},-\frac{4}{13},\frac{3}{13}\right\rangle$

DIRECTIONS: For the next two (2) items that follow.
From the point $P(3,-1,11)$, a perpendicular is drawn on the line L given by the equation $\frac{x}{2}=\frac{y-2}{3}=\frac{z-3}{4}$. Let Q be the foot of the perpendicular.

40. What are the direction ratios of the line segment PQ?
(a) $\langle 1,6,4\rangle$ (b) $\langle -1,6,-4\rangle$
(c) $\langle -1,-6,4\rangle$ (d) $\langle 2,-6,4\rangle$

41. What is the length of the line segment PQ?
(a) $\sqrt{47}$ units (b) 7 units
(c) $\sqrt{53}$ units (d) 8 units

DIRECTIONS: For the next two (2) items that follow.
A triangular plane ABC with centroid (1, 2, 3) cuts the coordinate axes at A, B, C respectively.

42. What are the intercepts made by the plane ABC on the axes?
(a) 3, 6, 9 (b) 1, 2, 3
(c) 1, 4, 9 (d) 2, 4, 6

43. What is the equation of plane ABC?
(a) $x+2y+3z=1$ (b) $3x+2y+z=3$
(c) $2x+3y+6z=18$ (d) $6x+3y+2z=18$

DIRECTIONS: For the next two (2) items that follow.
A point P (1, 2, 3) is one vertex of a cuboid formed by the coordinate planes and the planes passing through P and parallel to the coordinate planes.

44. What is the length of one of the diagonals of the cuboid?
(a) $\sqrt{10}$ units (b) $\sqrt{14}$ units
(c) 4 units (d) 5 units

45. What is the equation of the plane passing through $P(1, 2, 3)$ and parallel to xy–plane?
(a) $x+y=3$ (b) $x-y=-1$
(c) $z=3$ (d) $x+2y+3z=14$

46. The decimal number $(127.25)_{10}$, when converted to binary number, takes the form
(a) $(1111111.11)_2$ (b) $(1111110.01)_2$
(c) $(1110111.11)_2$ (d) $(1111111.01)_2$

47. Consider the following in respect of two non-singular matrices A and B of same order:
1. $\det(A+B)=\det A+\det B$
2. $(A+B)^{-1}=A^{-1}+B^{-1}$

Which of the above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

48. If $X=\begin{bmatrix}3 & -4\\ 1 & -1\end{bmatrix}, B=\begin{bmatrix}5 & 2\\ -2 & 1\end{bmatrix}$ and $A=\begin{bmatrix}p & q\\ r & s\end{bmatrix}$ satisfy the equation $AX=B$, then the matrix A is equal to
(a) $\begin{bmatrix}-7 & 26\\ 1 & -5\end{bmatrix}$ (b) $\begin{bmatrix}7 & 26\\ 4 & 17\end{bmatrix}$
(c) $\begin{bmatrix}-7 & -4\\ 26 & 13\end{bmatrix}$ (d) $\begin{bmatrix}-7 & 26\\ -6 & 23\end{bmatrix}$

49. What is $\sum_{r=0}^{1} {}^{n+r}C_n$ equal to?
(a) ${}^{n+2}C_1$ (b) ${}^{n+2}C_n$
(c) ${}^{n+3}C_n$ (d) ${}^{n+2}C_{n+1}$

50. How many words can be formed using all the letters of the word 'NATION' so that all the three vowels should never come together?
(a) 354 (b) 348
(c) 288 (d) None of these

51. (x^3-1) can be factorised as
(a) $(x-1)(x-\omega)(x+\omega^2)$
(b) $(x-1)(x-\omega)(x-\omega^2)$
(c) $(x-1)(x+\omega)(x+\omega^2)$
(d) $(x-1)(x+\omega)(x-\omega^2)$

where ω is one of the cube roots of unity.

52. What is

$$\left[\frac{\sin\frac{\pi}{6}+i\left(1-\cos\frac{\pi}{6}\right)}{\sin\frac{\pi}{6}-i\left(1-\cos\frac{\pi}{6}\right)}\right]^3$$

where $i=\sqrt{-1}$, equal to?

(a) 1 (b) −1
(c) i (d) $-i$

53. Let

$$A=\begin{bmatrix} x+y & y \\ 2x & x-y \end{bmatrix}, B=\begin{bmatrix} 2 \\ -1 \end{bmatrix} \text{and } C=\begin{bmatrix} 3 \\ 2 \end{bmatrix}$$

If $AB=C$, then what is A^2 equal to?

(a) $\begin{bmatrix} 6 & -10 \\ 4 & 26 \end{bmatrix}$ (b) $\begin{bmatrix} -10 & 5 \\ 4 & 24 \end{bmatrix}$

(c) $\begin{bmatrix} -5 & -6 \\ -4 & -20 \end{bmatrix}$ (d) $\begin{bmatrix} -5 & -7 \\ -5 & 20 \end{bmatrix}$

54. The value of

$$\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix} \text{is}$$

(a) $x+y$ (b) $x-y$
(c) xy (d) $1+x+y$

55. If $A=\{x : x \text{ is a multiple of } 3\}$ and $B=\{x : x \text{ is a multiple of } 4\}$ and $C=\{x : x \text{ is a multiple of } 12\}$, then which one of the following is a null set?

(a) $(A/B)\cup C$ (b) $(A/B)/C$
(c) $(A\cap B)\cap C$ (d) $(A\cap B)/C$

56. If $(11101011)_2$ is converted decimal system, then the resulting number is

(a) 235 (b) 175
(c) 160 (d) 126

57. What is the real part of $(\sin x + i \cos x)^3$ where $i=\sqrt{-1}$?

(a) $-\cos 3x$ (b) $-\sin 3x$
(c) $\sin 3x$ (d) $\cos 3x$

58. If $E(\theta)=\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$, then $E(\alpha)E(\beta)$ is equal to

(a) $E(\alpha\beta)$ (b) $E(\alpha-\beta)$
(c) $E(\alpha+\beta)$ (d) $-E(\alpha+\beta)$

59. Let $A=\{x, y, z\}$ and $B=\{p, q, r, s\}$. What is the number of distinct relations from B to A?

(a) 4096 (b) 4094
(c) 128 (d) 126

60. If $2p+3q=18$ and $4p^2+4pq-3q^2-36=0$, then what is $(2p+q)$ equal to?

(a) 6 (b) 7
(c) 10 (d) 20

DIRECTIONS: For the next two (2) items that follow.

Given that $\frac{d}{dx}\left(\frac{1+x^2+x^4}{1+x+x^2}\right)=Ax+B.$

61. What is the value of A?

(a) −1 (b) 1
(c) 2 (d) 4

62. What is the value of B?

(a) −1 (b) 1
(c) 2 (d) 4

DIRECTIONS: For the next two (2) items that follow.

Given that $\lim_{x\to\infty}\left(\frac{2+x^2}{1+x}-Ax-B\right)=3.$

63. What is the value of A?

(a) −1 (b) 1
(c) 2 (d) 3

64. What is the value of B?

(a) −1 (b) 3
(c) −4 (d) −3

65. What is the solution of the differential equation

$$\frac{ydx-xdy}{y^2}=0?$$

(a) $xy=c$ (b) $y=cx$
(c) $x+y=c$ (d) $x-y=c$

where c is an arbitrary constant.

66. What is the solution of the differential equation

$$\sin\left(\frac{dy}{dx}\right)-a=0?$$

(a) $y=x\sin^{-1}a+c$ (b) $x=y\sin^{-1}a+c$
(c) $y=x+x\sin^{-1}a+c$ (d) $y=\sin^{-1}a+c$

where c is an arbitrary constant.

67. What is the solution of the differential equation

$$\frac{dx}{dy}+\frac{x}{y}-y^2=0?$$

(a) $xy=x^4+c$ (b) $xy=y^4+c$
(c) $4xy=y^4+c$ (d) $3xy=y^3+c$

where c is an arbitrary constant.

68. What is $\int\frac{xe^x dx}{(x+1)^2}$ equal to?

(a) $(x+1)^2 e^x+c$ (b) $(x+1)e^x+c$

(c) $\frac{e^x}{x+1}+c$ (d) $\frac{e^x}{(x+1)^2}+c$

where c is the constant integration.

69. The adjacent sides AB and AC of a triangle ABC are represented by the vectors $-2\hat{i}+3\hat{j}+2\hat{k}$ and $-4\hat{i}+5\hat{j}+2\hat{k}$ respectively. The area of the triangle ABC is

(a) 6 square units (b) 5 square units
(c) 4 square units (d) 3 square units

70. A force $\vec{F}=3\hat{i}+4\hat{j}-3\hat{k}$ is applied at the point P, whose position vector is $\vec{r}=2\hat{i}-2\hat{j}-3\hat{k}$. What is the magnitude of the moment of the force about the origin?

(a) 23 units (b) 19 units
(c) 18 units (d) 21 units

71. Given that the vectors $\vec{\alpha}$ and $\vec{\beta}$ are non-collinear. The values of x and y for which $\vec{u}-\vec{v}=\vec{w}$ holds true if $\vec{u}=2x\vec{\alpha}+y\vec{\beta}, \vec{v}=2y\vec{\alpha}+3x\vec{\beta}$ and $\vec{w}=2\vec{\alpha}-5\vec{\beta}$, are

(a) $x=2, y=1$ (b) $x=1, y=2$

(c) $x=-2, y=1$ (d) $x=-2, y=-1$

72. If $|\vec{a}|=7, |\vec{b}|=11$ and $|\vec{a}+\vec{b}|=10\sqrt{3}$, then $|\vec{a}-\vec{b}|$ is equal to

(a) 40 (b) 10

(c) $4\sqrt{10}$ (d) $2\sqrt{10}$

73. Let α, β, γ be distinct real numbers. The points with position vectors $\alpha\hat{i}+\beta\hat{j}+\gamma\hat{k}, \beta\hat{i}+\gamma\hat{j}+\alpha\hat{k}$ and $\gamma\hat{i}+\alpha\hat{j}+\beta\hat{k}$

(a) are collinear

(b) form an equilateral triangle

(c) form a scalene triangle

(d) form a right-angled triangle

74. If $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, then which of the following is/are correct?

1. $\vec{a}, \vec{b}, \vec{c}$ are coplanar.

2. $\vec{a}\times\vec{b}=\vec{b}\times\vec{c}=\vec{c}\times\vec{a}$

Select the correct answer using the code given below.

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

75. If $|\vec{a}+\vec{b}|=|\vec{a}-\vec{b}|$, then which one of the following is correct?

(a) $\vec{a}=\lambda\vec{b}$ for some scalar λ

(b) $\vec{a}$ is parallel to $\vec{b}$

(c) $\vec{a}$ is perpendicular to $\vec{b}$

(d) $\vec{a}=\vec{b}=\vec{0}$

76. If $G(x)=\sqrt{25-x^2}$, then what is $\lim\limits_{x\to 1}\frac{G(x)-G(1)}{x-1}$ equal to?

(a) $-\frac{1}{2\sqrt{6}}$ (b) $\frac{1}{5}$

(c) $-\frac{1}{\sqrt{6}}$ (d) $\frac{1}{\sqrt{6}}$

77. Consider the following statements:

1. $y=\frac{e^x+e^{-x}}{2}$ is an increasing function on $[0,\infty)$.

2. $y=\frac{e^x-e^{-x}}{2}$ is an increasing function on $(-\infty,\infty)$.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

78. For each non-zero real number x, let $f(x)=\frac{x}{|x|}$. The range of f is

(a) a null set

(b) a set consisting of only one element

(c) a set consisting of two elements

(d) a set consisting of infinitely many elements

79. Consider the following statements:

1. $f(x)=[x]$, where [.] is the greatest integer function, is discontinuous at $x=n$, where $n\in Z$.

2. $f(x)=\cot x$ is discontinuous at $x=n\pi$, where $n\in Z$.

which of the above statements is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 or 2

80. What is the derivative of $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ with respect to $\tan^{-1}x$?

(a) 0 (b) $\frac{1}{2}$

(c) 1 (d) x

81. If $f(x)=\log_e\left(\frac{1+x}{1-x}\right), g(x)=\frac{3x+x^3}{1+3x^2}$ and $g\,o\,f(t)=g(f(t))$, then what is $g\circ f\left(\frac{e-1}{e+1}\right)$ equal to?

(a) 2 (b) 1

(c) 0 (d) $\frac{1}{2}$

DIRECTIONS: For the next two (2) items that follow.

Given a function

$$f(x)=\begin{cases}-1 & \text{If } x\le 0\\ ax+b & \text{If } 0<x<1\\ 1 & \text{If } x\ge 1\end{cases}$$

where a, b are constants. The function is continuous everywhere.

82. What is the value of a?

(a) -1 (b) 0

(c) 1 (d) 2

83. What is the value of b?

(a) -1 (b) 1

(c) 0 (d) 2

84. Consider the following functions:

1. $f(x)=x^3, x\in\mathbb{R}$

2. $f(x)=\sin x, 0<x<2\pi$

3. $f(x)=e^x, x\in\mathbb{R}$

Which of the above functions have inverse defined on their ranges?

(a) 1 and 2 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1, 2 and 3

DIRECTIONS: For the next two (2) items that follow.

The integral $\int\frac{dx}{a\cos x+b\sin x}$ is of the form $\frac{1}{r}\text{In}\left[\tan\left(\frac{x+\alpha}{2}\right)\right]$.

85. What is r equal to?

(a) a^2+b^2 (b) $\sqrt{a^2+b^2}$

(c) $a+b$ (d) $\sqrt{a^2-b^2}$

86. What is α equal to?

(a) $\tan^{-1}\left(\frac{a}{b}\right)$ (b) $\tan^{-1}\left(\frac{b}{a}\right)$

(c) $\tan^{-1}\left(\frac{a+b}{a-b}\right)$ (d) $\tan^{-1}\left(\frac{a-b}{a+b}\right)$

DIRECTIONS: For the next two (2) items that follow.

Consider the function $f(x)=\frac{x^2-1}{x^2+1}$, where $x \in \mathbb{R}$

87. At what value of x does $f(x)$ attain minimum value?

(a) -1 (b) 0

(c) 1 (d) 2

88. What is the minimum value of $f(x)$?

(a) 0 (b) $\frac{1}{2}$

(c) -1 (d) 2

DIRECTIONS: For the next two (2) items that follow.

Consider the function

$$f(x)=\begin{cases}\frac{\alpha\cos x}{\pi-2x} & \text{If } x\neq\frac{\pi}{2}\\ 3 & \text{If } x=\frac{\pi}{2}\end{cases}$$

Which is continuous at $x=\frac{\pi}{2}$, where α is a constant.

89. What is the value of α?

(a) 6 (b) 3

(c) 2 (d) 1

90. What is $\lim_{x\to 0} f(x)$ equal to?

(a) 0 (b) 3

(c) $\frac{3}{\pi}$ (d) $\frac{6}{\pi}$

91. The mean and the variance 10 observations are given to be 4 and 2 respectively. If every observation is multiplied by 2, the mean and the variance of the new series will be respectively

(a) 8 and 20 (b) 8 and 4

(c) 8 and 8 (d) 80 and 40

92. Which one of the following measures of central tendency is used in construction of index numbers?

(a) Harmonic mean (b) Geometric mean

(c) Median (d) Mode

93. The correlation coefficient between two variables X and Y is found to be $0{\cdot}6$. All the observations on X and Y are transformed using the transformations $U=2-3X$ and $V=4Y+1$. The correlation coefficient between the transformed variables U and V will be

(a) $-0{\cdot}5$ (b) $+0{\cdot}5$

(c) $-0{\cdot}6$ (d) $+0{\cdot}6$

94. Which of the following statements is/are correct in respect of regression coefficients?

1. It measures the degree of linear relationship between two variables.
2. It gives the value by which one variable changes for a unit change in the other variable.

Select the correct answer using the code given below.

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

95. A set of annual numerical data, comparable over the years, is given for the last 12 years.

1. The data is best represented by a broken line graph, each corner (turning point) representing the data of one year.
2. Such a graph depicts the chronological change and also enables one to make a short-term forecast.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

96. Two men hit at a target with probabilities $\frac{1}{2}$ and $\frac{1}{3}$ respectively. What is the probability that exactly one of them hits the target?

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$

(c) $\frac{1}{6}$ (d) $\frac{2}{3}$

97. Two similar boxes B_i (i = 1, 2) contain $(i+1)$ red and $(5-i-1)$ black balls. One box is chosen at random and two balls are drawn randomly. What is the probability that both the balls are of different colours?

(a) $\frac{1}{2}$ (b) $\frac{3}{10}$

(c) $\frac{2}{5}$ (d) $\frac{3}{5}$

98. In an examination, the probability of a candidate solving a question is $\frac{1}{2}$. Out of given 5 questions in the examination, what is the probability that the candidate was able to solve at least 2 questions?

(a) $\frac{1}{64}$ (b) $\frac{3}{16}$

(c) $\frac{1}{2}$ (d) $\frac{13}{16}$

99. If $A \subseteq B$, then which one of the following is **not** correct?

(a) $P(A\cap\overline{B})=0$

(b) $P(A\mid B)=\frac{P(A)}{P(B)}$

(c) $P(B\mid A)=\frac{P(B)}{P(A)}$

(d) $P(A\mid(A\cup B))=\frac{P(A)}{P(B)}$

100. The mean and the variance in a binomial distribution are found to be 2 and 1 respectively. The probability $P(X=0)$ is

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$

(c) $\frac{1}{8}$ (d) $\frac{1}{16}$

101. The mean of five numbers is 30. If one number is excluded, their mean becomes 28. The excluded number is

(a) 28 (b) 30

(c) 35 (d) 38

102. If A and B are two events such that $P(A \cup B) = \frac{3}{4}$, $P(A \cap B) = \frac{1}{4}$ and $P(\overline{A}) = \frac{2}{3}$, then what is $P(B)$ equal to?

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$

(c) $\frac{1}{8}$ (d) $\frac{2}{9}$

103. The 'less than' ogive curve and the 'more than' ogive curve intersect at

(a) median (b) mode

(c) arithmetic mean (d) None of these

104. In throwing of two dice, the number of exhaustive events that '5' will never appear on any one of the dice is

(a) 5 (b) 18

(c) 25 (d) 36

105. Two cards are drawn successively without replacement from a wellshuffled pack of 52 cards. The probability of drawing two aces is

(a) $\frac{1}{26}$ (b) $\frac{1}{221}$

(c) $\frac{4}{223}$ (d) $\frac{1}{13}$

DIRECTIONS: For the next two (2) items that follows.

Consider the line $x = \sqrt{3}y$ and the circle $x^2 + y^2 = 4$.

106. What is the area of the region in the first quadrant enclosed by the x-axis, the line $x = \sqrt{3}$ and the circle?

(a) $\frac{\pi}{3} - \frac{\sqrt{3}}{2}$ (b) $\frac{\pi}{2} - \frac{\sqrt{3}}{2}$

(c) $\frac{\pi}{3} - \frac{1}{2}$ (d) None of these

107. What is the area of the region in the first quadrant enclosed by the x-axis, the line $x = \sqrt{3}y$ and the circle?

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{6}$

(c) $\frac{\pi}{3} - \frac{\sqrt{3}}{2}$ (d) None of these

DIRECTIONS: For the next two (2) items that follow.

Consider the curves $y = \sin x$ and $y = \cos x$.

108. What is the area of the region bounded by the above two curves and the lines x = 0 and $x = \frac{\pi}{4}$?

(a) $\sqrt{2} - 1$ (b) $\sqrt{2} + 1$

(c) $\sqrt{2}$ (d) 2

109. What is the area of the region bounded by the above two curves and the lines

$x = \frac{\pi}{4}$ and $x = \frac{\pi}{2}$?

(a) $\sqrt{2} - 1$ (b) $\sqrt{2} + 1$

(c) $2\sqrt{2}$ (d) 2

DIRECTIONS: For the next two (2) items that follow.

Consider the function

$$f(x) = 0 \cdot 75x^4 - x^3 - 9x^2 + 7$$

110. What is the maximum value of the function?

(a) 1 (b) 3

(c) 7 (d) 9

111. Consider the following statements:

1. The function attains local minima at x = – 2 and x = 3.
2. The function increases in the interval (–2, 0).

Which of the above statements is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

DIRECTIONS: For the next three (3) items that follow.

Consider the parametric equation

$$x = \frac{a\left(1-t^2\right)}{1+t^2}, y = \frac{2at}{1+t^2}$$

112. What does the equation represent?

(a) It represents a circle of diameter a

(b) It represents a circle of radius a

(c) It represents a parabola

(d) None of the above

113. What is $\frac{dy}{dx}$ equal to?

(a) $\frac{y}{x}$ (b) $-\frac{y}{x}$

(c) $\frac{x}{y}$ (d) $-\frac{x}{y}$

114. What is $\frac{d^2y}{dx^2}$ equal to?

(a) $\frac{a^2}{y^2}$ (b) $\frac{a^2}{x^2}$

(c) $-\frac{a^2}{x^2}$ (d) $-\frac{a^2}{y^3}$

115. Consider the following statements:

1. The general solution of $\frac{dy}{dx} = f(x) + x$ is of the form $y = g(x) + c$, where c is an arbitrary constant.
2. The degree of $\left(\frac{dy}{dx}\right)^2 = f(x)$ is 2.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

116. What is $\int \frac{dx}{\sqrt{x^2+a^2}}$ equal to?

(a) $\ln\left|\frac{x+\sqrt{x^2+a^2}}{a}\right|+c$ (b) $\ln\left|\frac{x-\sqrt{x^2+a^2}}{a}\right|+c$

(c) $\ln\left|\frac{x^2+\sqrt{x^2+a^2}}{a}\right|+c$ (d) None of these

where c is the constant of integration.

DIRECTIONS: For the next four (4) items that follow.

Consider the integral $I_m = \int_0^{\pi} \frac{\sin 2mx}{\sin x} dx$, where m is a positive integer.

117. What is I_1 equal to?

(a) 0 (b) $\frac{1}{2}$
(c) 1 (d) 2

118. What is $I_2 + I_3$ equal to?

(a) 4 (b) 2
(c) 1 (d) 0

119. What is I_m equal to?

(a) 0 (b) 1
(c) m (d) $2m$

120. Consider the following:

1. $I_m - I_{m-1}$ is equal to 0.
2. $I_{2m} > I_m$

Which of the above is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

GENERAL ABILITY

PART-A : ENGLISH

Spotting Errors

DIRECTIONS: *In this section, a number of sentences are given. The sentences are underlined in three parts and each one is labelled (a), (b), (c). Read each sentence to find out whether there is error in any underlined part. No sentence has more than one error. When you find an error in one of the underlined parts (a), (b) or (c), indicate your response on the Answer Sheet at appropriate space. You may feel that there is no error in a sentence. In that case letter (d) signify a 'No error' response.*

1. Unless you stop to make noise at once, (a) I will have no option but to (b) bring the matter to the attention of the police. (c) No error. (d)

2. He couldn't but help (a) shed tears at the plight of the villagers (b) rendered homeless by a devastating cyclone. (c) No error. (d)

3. Since it was his first election campaign, the candidate was (a) confused; none could clearly understand (b) either the principles he stood for or the benefits the promise (c). No error. (d)

4. It is an established fact that the transcendental American poets and philosophers, (a) who lived in the latter half of the nineteenth century, (b) were more influenced by Indian philosophy, in particular by Upanishadic Philosophy. (c) No error. (d)

5. No sooner did I open the door (a) when the rain, heavy and stormy, rushed in (b) making us shiver from head to foot. (c) No error. (d)

6. After opening the door (a) we entered into the room (b) next to the kitchen. (c) No error. (d)

7. When the dentist came in (a) my tooth was stopped aching (b) out of fear that I might lose my tooth. (c) No error. (d)

8. Emphasis on equality of life ensures (a) for the health and (b) happiness of every individual. (c) No error. (d)

9. The students were (a) awaiting for (b) the arrival of the chief (c) guest. No error. (d)

10. You will come (a) to my party tomorrow, (b) isn't it? (c) No error. (d)

11. Having read a number of stories (a) about space travel (b) his dream now is about to visit the moon. (c) No error. (d)

12. The meeting adjourned abruptly (a) by the Chairman after (b) about three hours of deliberation. (c) No error. (d)

13. Not one of the hundreds (a) of striking workers (b) were allowed to go near the factory. (c) No error. (d)

14. If I had known (a) this earlier (b) I will have helped him. (c) No error. (d)

15. Mr. Smith was accused for murder (a) but the court found him (b) not guilty (c) and acquitted him. No error. (d)

DIRECTIONS: *Look at the underlined part of each sentence. Below each sentence are given three possible substitutions for the underlined part. It one of them, (a), (b) or (c), is better than the underlined part, indicate your response on the Answer Sheet against the corresponding letter (a), (b) or (c). If none of the substitutions improve the sentence, indicate (d) as your response on the Answer Sheet. Thus a 'No improvement' response will be signified by the letter (d).*

16. Although India is still by far a poor country, it can become rich if its natural and human resources are fully utilised.
(a) few and far between (b) by and large
(c) by and by (d) No improvement

17. The more they earn, more they spend.
(a) More they earn, more they spend
(b) More they earn, the more they spend
(c) The more they earn, the more they spend
(d) No improvement

18. But in all these cases conversion from one scale to another is easy because scales have well-formulated.
(a) can be well-formulated (b) are well-formulated
(c) well-formulated (d) No improvement

19. Five years ago on this date, I am sitting in a small Japanese car, driving across Poland towards Berlin.
(a) was sitting (b) sat
(c) have been sitting (d) No improvement

20. The old man felled some trees in the garden with hardly no effort at all.
(a) hard effort (b) hardly any effort
(c) a hardly any effort (d) No improvement

21. She says she's already paid me back, but I can't remember, so I'll have to take her word.
(a) to take her word true (b) to take her at her word
(c) to take her word for it (d) No improvement

22. The workers are hell bent at getting what is due to them.
(a) hell bent on getting (b) hell bent for getting
(c) hell bent to getting (d) No improvement

23. You are warned against committing the same mistake again.
(a) to commit (b) for committing
(c) against to commit (d) No improvement

24. While we would like that all Indian children to go to school, we need to ponder why they do not.
(a) that all the Indian children
(b) if all the children of India
(c) all Indian children
(d) No improvement

25. Due to these reasons we are all in favour of universal compulsory education.
(a) Out of these reasons (b) For these reasons
(c) By these reasons (d) No improvement

26. When it was feared that the serfs might go too far and gain their freedom from serfdom, the Protestant leaders joined the princes at crushing them.
(a) into crushing (b) in crushing
(c) without crushing (d) No improvement

27. In India, today many of our intellectuals still talk in terms of the French revolution and the Rights of Man, not appreciating that much has happened since them.
(a) much has been happening
(b) much had happened
(c) much might happen
(d) No improvement

28. Taxpayers are to be conscious of their privileges.
(a) have to (b) need
(c) ought to (d) No improvement

29. I would have waited for you at the station if I knew that your would come.
(a) had known (b) was knowing
(c) have known (d) No improvement

30. No one could explain how a calm and balanced person like him could penetrate such a mindless act on his friends.
(a) perpetuate (b) perpetrate
(c) precipitate (d) No improvement

DIRECTIONS: *In items in this section, each passage consists of six sentences. The first and the sixth sentences are given in the beginning as S1 and S6. The middle four sentences in each have been removed and jumbled up. These are labelled P, Q, R and S. You are required to find out the proper order for the four sentences and mark accordingly on the Answer Sheet.*

31. S1 : At the roadside the driver will be asked to blow through a small glass tube into a plastic bag.
S6 : The driver will be asked to go to the police station.
P : And if the colour change does not reach the line the driver cannot be punished under the new law.
Q : Inside the tube are chemically treated crystals which change colour if the driver has alcohol on his breath.
R : But if the colour change does reach the line, then the test has proved positive.
S : If the colour change goes beyond a certain line marked on the tube this indicates that the driver is probably over the specified limit.
The proper sequence should be
(a) P S Q R
(b) S Q R P
(c) R P S Q
(d) Q S P R

32. S1 : Hope springs eternally in the heart of man.
S6 : This is the central idea of the poem.
P : But hope is everlasting.
Q : Love, friendship and youth perish.
R : It is nursed by the glorious elements of nature.
S : Man derives hope from nature in his gallant struggle after some noble ideal.
The proper sequence should be
(a) Q P R S
(b) S R Q P
(c) R S Q P
(d) Q P S R

33. S1 : Mr Sherlock Holmes and Doctor Watson were spending a weekend in a University town.
S6 : It was clear that something very unusual happend.
P : One evening they received a visit from an acquaintance, Mr Hilton Soames.

Q: On that occasion he was in a state of great agitation.
R: They were staying in furnished rooms, close to the library.
S: Mr Soames was a tall, thin man of a nervous and excitable nature.
The proper sequence should be
(a) P R S Q
(b) R P S Q
(c) P Q R S
(d) R P Q S

34. S1: The machines that drive modern civilisation derive their power from coal and oil.
S6: Nuclear energy may also be effectively used in this respect.
P: But they are not inexhaustible.
Q: These sources may not be exhausted very soon.
R: A time may come when some other sources have to be tapped and utilised.
S: Power may, of course, be obtained in future from forestes, water, wind and withered vegetables.
The proper sequence should be
(a) P Q R S
(b) Q P R S
(c) S R Q P
(d) S P Q R

35. S1: The body can never stop.
S6: It comes from food.
P: To support this endless activity, the body needs all the fuel for action.
Q: Sometimes it is more active than at other times, but it is always moving.
R: Even in the deepest sleep we must breathe.
S: The fuel must come from somewhere.
The proper sequence should be
(a) P Q R S
(b) P R Q S
(c) Q R P S
(d) S R Q P

36. S1: American idealism is essentially a belief in the idea of progress.
S6: This sense they have inherited from the English.
P: Therefore, he believes that, because of human effort, the future will be better than the past.
Q: But if American are usually optimistic, they are not wholly unrealistic.
R: The American tends to view history as a record of human achievement.
S: They have some common sense practicality.
The proper sequence should be
(a) P Q R S
(b) P Q S R
(c) R P Q S
(d) P R Q S

DIRECTIONS: *In the following passage at certain points you are given a choice of three words marked (a), (b) and (c), one of which fits the meaning of the passage, Choose the best word out of the three Mark the letter, viz (a), (b) or (c), relating to this word on your Answer Sheet. Examples K and L have been solved for you.*

	K		L
The	(a) boy was in the school in Simila.		(a) She was home sick.
	(b) horse		(b) It
	(c) dog		(c) He

Explanation: Out of the list given in item K, only 'boy' is the correct answer because usually, a boy, and not a horse or a dog, attends school. So '(a)' is to be marked on the Answer Sheet for item K. A boy is usually referred to as 'he', so for item L, '(c)' is the correct answer. Notice that to solve the first item K you have to read the rest of the sentence and then see what first best.

Passage

After having slept for an hour, Bond decided to go out into the city and try to find his contact. After changing his suit, he carefully locked his room and stepped out of the hotel. No one was around. But he had walked only for a few minutes when it suddenly **37. (a) felt/ (b) occurred/ (c) happened** to him that he was being **38. (a) followed/ (b) shot/ (c) looked** by someone. There was really no **39. (a) reason/ (b) cause/ (c) evidence** for it except a very slight **40. (a) weight/ (b) sound./ (c) hurting.** of footsteps. He was now walking **41. (a) from/ (b) down/ (c) over** the main street, which was crowded **42. (a) with/ (b) by/ (c) in** people. He became extremely aware of the danger of people threatening him.

DIRECTIONS : *Each item in this section consists of a sentence with an underlined word followed by four words or group of words. Select the word or group of words that is most* ***similar*** *in meaning to the underlined word.*

43. He was <u>fired</u> for negligence on duty.
(a) relieved of his job (b) scolded
(c) rebuked (d) attacked

44. Democracy is not the standardising of everyone so as to <u>obliterate</u> all peculiarity.
(a) demolish (b) extinguish
(c) erase (d) change

45. Divine grace is truly <u>ineffable.</u>
(a) that which cannot be rubbed out
(b) incapable of being understood
(c) that which is too great to the expressed in words
(d) too powerful to be defeated

46. The convocation address was very <u>edifying</u>.
(a) tedious (b) in need of editing
(c) instructive (d) exciting

DIRECTIONS: *Each item in this section consists of a sentence with an underlined word, followed by four words. Select the word that is most nearly* ***opposite*** *in meaning to the underlined word.*

47. John is always <u>shabbily</u> dressed.
(a) decently (b) beautifully
(c) extravagantly (d) scantily

48. The new manager of the Bank is <u>urbane</u> in his manners.
(a) civilised (b) slow
(c) rude (d) foolish

49. It is necessary to develop <u>thrifty</u> habits to be able to lead a comfortable life.
(a) expensive (b) extravagant
(c) economical (d) good

50. Many people suffer because of <u>pride</u>.
(a) lowliness (b) submission
(c) humility (d) obedience

PART- B : GENERAL KNOWLEDGE

DIRECTIONS : *The following 8 (Eight) items consist of two statements, Statement I and Statement II. You are to examine these two statements carefully and select the answers to these items using the code given below :*

Code :

(a) Both the statements are individually true and Statement II is the correct explanation of Statement I
(b) Both the statements are individually true but Statement II is ***not*** the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is true but Statement II is true

51. **Statement I :** Growth of plants is smooth with a complete fertilizer.
Statement II : A complete fertilizer always contains N, P, K.

52. **Statement I :** The granules of modern gunpowder (also called black powder) are typically coated with Graphite.
Statement II : Graphite prevents the build-up of electrostatic charge.

53. **Statement I :** Colour of nitrogen dioxide changes to colourless at low temperature.
Statement II : At low temperature Nitrogen tetroxide (N_2O_4) is formed which is colourless.

54. **Statement I :** Diamond is very bright.
Statement II : Diamond has very low refractive index.

55. **Statement I :** Oxygen gas is easily produced at a faster rate by heating a mixture of potassium chlorate and manganese dioxide than heating potassium chlorate alone.
Statement II : Manganese dioxide acts as a negative catalyst.

56. **Statement I :** A body weighs less on a hill top than on earth's surface even though its mass remains unchanged.
Statement II : The acceleration due to gravity of the earth decreases with height.

57. **Statement I :** While putting clothes for drying up, we spread them out.
Statement II : The rate of evaporation increases with an increase in surface area.

58. **Statement I :** Due to diffused of irregular reflection of light, a closed room gets light even if no direct sunlight falls inside the room.
Statement II : Irregular reflection, where the reflected rays are not parallel, does not follow the laws of reflection.

59. Ultrasonic waves of frequency 3×10^5 Hz are passed through a medium where speed of sound is 10 times that in air (Speed of sound in air is 300 m/s). The wavelength of this wave in that medium will be of the order of
(a) 1 cm (b) 10 cm
(c) 100 cm (d) 0.1 cm

60. If radius of the earth were to shrink by 1%, its mass remaining the same, g would decrease by nearly
(a) 1% (b) 2%
(c) 3% (d) 4%

61. The displacement-time graph of a particle acted upon by a constant force is
(a) a straight line
(b) a circle
(c) a parabola
(d) any curve depending upon initial conditions

62. Which one of the following is ***not*** a result of surface tension?
(a) Nearly spherical drop of rain
(b) Capillary rise
(c) Removal of dirt by soap or detergent
(d) Flow of a liquid

63. Match List I with List II and select the correct answer using the code given below the Lists :

	List I *(Compound)*		**List II** *(Nature)*
A.	Sodium hydroxide	1.	Strong acid
B.	Calcium oxide	2.	Alkali
C.	Acetic acid	3.	Weak acid
D.	Hydrochloric acid	4.	Base

Code:

	A	B	C	D
(a)	2	3	4	1
(b)	2	4	3	1
(c)	1	4	3	2
(d)	1	3	4	2

64. Which one of the following statements is ***not*** correct ?
(a) Kerala is the largest producer of natural rubber in India
(b) Neyveli is an important thermal power generating area of Tamil Nadu
(c) Ratnagiri Bauxite mining area is located in Karnataka
(d) Assam is the largest tea producing state in India

65. Match List I with List II and select the correct answer using the code given below the Lists :

	List I *(Paper industry centre)*		**List II** *(State)*
A.	Kamptee	1.	Karnataka
B.	Rajahmundry	2.	Maharashtra
C.	Shahdol	3.	Andhra Pradesh
D.	Belagola	4.	Madhya Pradesh

Code :

	A	B	C	D
(a)	1	4	3	2
(b)	2	3	4	1
(c)	1	3	4	2
(d)	2	4	3	1

66. The newly formed state of Telengana is surrounded by
(a) 5 States (b) 4 States
(c) 6 States (d) 3 States

67. Energy is required for maintenance of life. It is obtained by a process called
(a) Metabolism (b) Phagocytosis
(c) Photorespiration (d) Decomposition

68. All life forms contain "molecules of life". These are
(a) Carbohydrates (b) Proteins
(c) Nucleic acids (d) All of these

69. If a charged particle ($+q$) is projected with certain velocity parallel to the magnetic field, then it will
(a) trace helical path
(b) trace circular path
(c) continue its motion without any change
(d) come to rest instantly

70. Optical fibres, though bent in any manner, allows light to pass through. What is the inference that one can draw from it ?

(a) The concept that light travels in straight path is wrong
(b) Light can flow through the optical fibres
(c) Light can travel through the fibres because of their ductility
(d) Light can travel through the fibres due to multiple total internal reflections

71. Which one among the following happens when a swing rises to a certain height from its rest position ?

(a) Its potential energy decreases while kinetic energy increases
(b) Its kinetic energy decreases while potential energy increases
(c) Both potential and kinetic energy decrease
(d) Both potential and kinetic energy increase

72. Which one among the following is used in making gunpowder ?

(a) Magnesium sulphate (b) Potassium nitrate
(c) Sodium stearate (d) Calcium sulphate

73. The cleaning action of soap and detergent in water is due to the formation of

(a) Micelle (b) Salt
(c) Base (d) Acid

74. The chemical used as a fixer/developer in photography is

(a) Sodium sulphate (b) Sodium sulphide
(c) Sodium thiosulphate (d) Sodium sulphite

75. Rain shadow effect is associated with

(a) Cyclonic rainfall (b) Orographic rainfall
(c) Convectional rainfall (d) Frontal rainfall

76. Match List I with List II and select the correct answer using the code given below the Lists :

List I *(Place)*		**List II** *(Industry)*
A. Jabalpur	1.	Petro-chemical industry
B. Bengaluru	2.	IT industry
C. Mathura	3.	Paper industry
D. Ballarpur	4.	Automobile industry

Code :

	A	B	C	D
(a)	4	1	2	3
(b)	3	2	1	4
(c)	4	2	1	3
(d)	3	1	2	4

77. Which one of the following irrigation canals is the most important in terms of area coverage in Haryana ?

(a) Bhakra canal
(b) The Western Yamuna canal
(c) Jawaharlal Nehru canal
(d) Gurgaon canal

78. Which one of the following is the smallest unit showing the properties of life such as capacity for metabolism, response to the environment, growth and reproduction ?

(a) Gene (b) Chromosome
(c) Nucleus (d) Cell

79. In plants, which one of the following gases is released during Photosynthesis ?

(a) Carbon dioxide (b) Oxygen
(c) Hydrogen (d) Methane

80. Match List I with List II and select the correct answer using the code given below the Lists :

List I *(Physical quantity)*		**List II** *(Unit)*
A. Distance	1.	Mole
B. Amount of material	2.	Coulomb
C. Amount of electrical change	3.	Light year
D. energy	4.	Watt hour

Code :

	A	B	C	D
(a)	3	1	2	4
(b)	3	2	1	4
(c)	4	2	1	3
(d)	4	1	2	3

81. A ray of light when refracted suffers change in velocity. In this context, which one among the following statements is correct ?

(a) Velocity increases as the ray passes from a rarer to a denser medium
(b) Velocity decreases as the ray passes from a denser to a rarer medium
(c) Velocity decreases as the ray passes from a rarer to a denser medium
(d) Change of velocity does not depend on the nature of medium

82. An object placed 10 cm in front of a convex lens of focal length 15 cm. The image produced will be

(a) Real and magnified
(b) Virtual and magnified
(c) Virtual and reduced in size
(d) Real and reduced in size

83. Why is Graphite used in electrolytic cells ?

(a) Graphite is soft and can be easily moulded into electrodes
(b) Graphite is made of layers of carbon atoms which can slide
(c) Graphite is inert to most of the chemicals and remains intact in electrolytic cells
(d) Graphite is a good conductor of electricity

84. Washing Soda is the comon name for

(a) Calcium Carbonate (b) Magnesium Carbonate
(c) Sodium Carbonate (d) Potassium Carbonate

85. Which one of the following Indian states has the highest proportion of area under forest cover ?

(a) Madhya Pradesh (b) Sikkim
(c) Meghalaya (d) Mizoram

86. Match List I with List II and select the correct answer using the code given below the Lists :

List I *(National Park/ Wildlife Sanctuary)*		**List II** *(State)*
A. Chandra Prabha	1.	Uttarakhand
B. Silent Valley	2.	Chhattisgarh
C. Valley of flowers	3.	Uttar Pradesh
D. Indravati	4.	Kerala

Code :

	A	B	C	D
(a)	2	1	4	3
(b)	3	4	1	2
(c)	2	4	1	3
(d)	3	1	4	2

87. To a perpendicular to the plane of ecliptic, Earth's axis of rotation makes an angle of $23\frac{1}{2}$ degrees. Had this angle been zero degree, which one among the following would result ?

(a) There would have been no season
(b) The length of day and night would have been the same throughout the year
(c) The length of the day and night would have been the same all over the earth
(d) All of the above

88. Gametophytes of sexually reproducing flowering plants are

(a) Haploid (b) Diploid
(c) Tetraploid (d) Polyploid

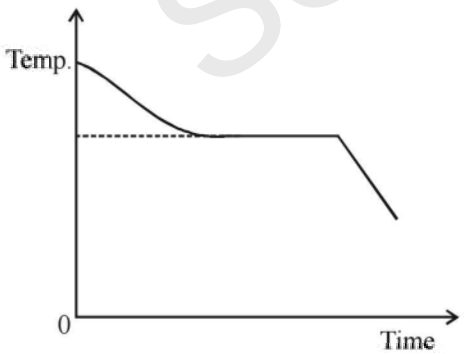
89. The seeds of flowering plants are made up of

(a) Ovary and ovary wall
(b) Embryo, food reserves and coat
(c) Cotyledons
(d) Zygotes

90. A person stands on his two feet over a surface and experiences a pressure P. Now the person stands on only one foot. He would experience a pressure of magnitude

(a) $4P$ (b) P
(c) $\frac{1}{2}P$ (d) $2P$

91. A solid is melted and allowed to cool and solidify again. The temperature is measured at equal intervals of time. The graph below shows the change of temperature with time.



The part of the curve that is practically horizontal due to

(a) latent heat given away by the liquid
(b) specific heat given away by the liquid
(c) thermal capacity changes with time keeping temperature constant
(d) change in density during transformation

92. A deep sea diver may hurt his ear drum during diving because of

(a) lack of oxygen (b) high atmospheric pressure
(c) high water pressure (d) All of these

93. When you walk on a woolen carpet and bring your finger near the metallic handle of a door an electric shock is produced. This is because

(a) charge is transferred from your body to the handle
(b) a chemical reaction occurs when you touch the handle
(c) the temperature of the human body is higher than that of the handle
(d) the human body and the handle arrive at thermal equilibrium by the process

94. Which one among the following does ***not*** wet the walls of the glass vessel in which it is kept ?

(a) Water (b) Alcohol
(c) Mercury (d) Phenol

95. Permanent hardness of water is due to the presence of

(a) sulphates of sodium and potassium
(b) sulphates of magnesium and calcium
(c) carbonates of sodium and magnesium
(d) bicarbonates of magnesium and calcium

96. In the reaction $ZnO + C \rightarrow Zn + CO$, 'C' acts as

(a) an acid (b) a base
(c) an oxidising agent (d) a reducing agent

97. Which of the following are the characteristics of organic farming ?

1. Use of chemical fertilizers to improve soil fertility.
2. Frequent decomposing and fallowing.
3. Use of herbs to control pests.
4. Higher productivity per hectare.

Select the correct answer using the code given below :

(a) 1 and 4 only (b) 1, 3 and 4
(c) 2 and 3 only (d) 2, 3 and 4

98. 'Yakuts' are the nomadic herders of

(a) Gobi (b) Sahara
(c) Tundra (d) Kalahari

99. A farmer in a semi-arid area claims that his farming practice is very environment friendly. Which of the following practices on his farm can justify his claim ?

1. Planting a tree belt.
2. Practising crop rotation.
3. Carrying out a large scale irrigation system.
4. Using organic fertilizers.

Select the correct answer using the code given below :

(a) 3 and 4 only (b) 1, 2 and 4
(c) 1, 3 and 4 (d) 1 and 2 only

100. The luxuriant growth of natural vegetation in tropical rainforest is due to

1. fertile soil.
2. hot and wet climate throughout the year.
3. intense sunlight for photosynthesis.
4. seasonal change to facilitate nutrient absorption.

Select the correct answer using the code given below :

(a) 1 and 4 only (b) 2 and 3 only
(c) 1, 2 and 3 only (d) 1, 2, 3 and 4

101. Which endocrine gland requires iodine to synthesize a particular hormone whose deficiency may cause goitre disease ?

(a) Hypothalamus (b) Pancreas
(c) Thymus (d) Thyroid gland

102. Which one of the following is ***not*** a part of nerves?

(a) Axons (b) Connective tissues
(c) Schwann cells (d) Smooth muscles

103. The product of counductivity and resistivity of a conductor

(a) depends on pressure applied
(b) depends on current flowing through conductor
(c) is the same for all conductors
(d) varies from conductor to conductor

104. We use CFL to save electrical energy and to provide surfficient light. The full form of CFL is
(a) Condensed filament light
(b) Compact filament lamp
(c) Condensed fluorescent lamp
(d) Compact fluorescent lamp

105. When the sun is 30° above the horizon, shadow of one tree is 17.3 m long. What is the height of this tree ?
(a) 20 m (b) 17.30 m
(c) 10 m (d) 1.73 m

106. When heat rays are reflected from Earth, gases like Carbon dioxide, Nitrous oxide do not allow them to escape back to the space causing our planet to heat up. These gases are known as
(a) Noble gas (b) Green-house gas
(c) Hot gas (d) Blue gas

107. A spring can be used to determine the mass *m* of an object in two ways: (i) by measuring the extension in the spring due to the object; and (ii) by measuring the oscillation period for the given mass. Which of these methods can be used in a space-station orbiting Earth ?
(a) Both
(b) Only the extension method
(c) Only the oscillation method
(d) Neither

108. Match List I with List II and select the correct answer using the code given below the Lists :

	List I *(Region)*		List II *(Vegetation)*
A.	Selvas	1.	Conifers
B.	Savannas	2.	Mosses and Lichens
C.	Taiga	3.	Epiphytes
D.	Tundra	4.	Grasses and trees

Code :

	A	B	C	D
(a)	4	1	2	3
(b)	3	2	1	4
(c)	3	4	1	2
(d)	4	2	1	3

109. Which of the following statements with regard to the western coastal plain of India are correct ?
1. It is a narrow belt.
2. It is an example of submerged coastal plain.
3. It provides natural conditions for development of ports.
4. It has well developed deltas.

Select the correct answer using the code given below :
(a) 1, 2 and 3 only (b) 1 and 2 only
(c) 1, 2, 3 and 4 (d) 3 and 4 only

110. Which one of the following weather conditions indicates a sudden fall in barometer reading ?
(a) Stormy weather (b) Calm weather
(c) Cold and dry weather (d) Hot and sunny weather

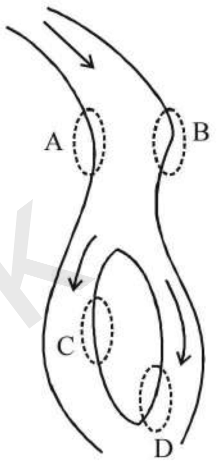
111. Match List I with List II and select the correct answer using the code given below the Lists :

	List I *(Island)*		List II *(Location)*
A.	Continental island	1.	Mauritius
B.	Coral island	2.	Madagascar
C.	Volcanic island	3.	Andaman and Nicobar islands
D.	Mountain island	4.	Maldives

Code:

	A	B	C	D
(a)	2	4	1	3
(b)	2	1	4	3
(c)	3	1	4	2
(d)	3	4	1	2

112. Consider the following diagram :



In which one among the following lettered area of the diagram would erosion most likely change the shapes of the riverbad?
(a) A (b) B
(c) C (d) D

113. Match List I with List II and select the correct answer using the code given below the Lists :

	List I *(Cloud)*		List II *(Characteristic)*
A.	Cirrus	1.	Rain giving
B.	Stratus	2.	Feathery appearance
C.	Nimbus	3.	Vertically growing
D.	Cumulus	4.	Horizontally spreading

Code :

	A	B	C	D
(a)	3	1	4	2
(b)	3	4	1	2
(c)	2	4	1	3
(d)	2	1	4	3

114. The concept of demographic transition provides a model for
(a) analyzing government responses to changing pattern of population growth
(b) explaining major patterns of global population movement throughout the history
(c) analyzing spatial variations in the distribution, growth and movement of population over time
(d) examining the relationship between economic development and natural population change

115. Precursor of which one of the following vitamins comes from β-carotene ?
(a) Vitamin A (b) Vitamin C
(c) Vitamin D (d) Vitamin K

116. 'Lub-dup' sound is produced due to action of
(a) Large intestine (b) Lungs
(c) Heart (d) Oesophagus

117. The sun is observed to be reddish when it is near the horizon, i.e., in the morning and the evening. This is because
(a) red light is least scattered by atmosphere
(b) red light is most scattered by atmosphere
(c) it is the colour of the Sun in the morning and evening
(d) Earth's atmosphere emits red light

118. Thermal conductivity of aluminium, copper and stainless steel increases in the order
(a) Copper < Aluminium < Stainless Steel
(b) Stainless Steel < Aluminium < Copper
(c) Aluyminium < Copper < Stainless Steel
(d) Copper < Stainless Steel < Aluminium

119. Perspiration cools the body because
(a) presence of water on the skin is cooling
(b) evaporation requires latent heat
(c) water has a high specific heat
(d) water is a poor conductor of heat

120. The radius of the Moon is about one-fourth that of the Earth and acceleration due to gravity on the Moon is about one-sixth that on the Earth. From this, we can conclude that the ratio of mass of Earth to the mass of the Moon is about
(a) 10 (b) 100
(c) 1,000 (d) 10,000

121. Which of the following country/countries successfully inserted a spacecraft into Mars orbit by maiden attempt ?
(a) USA (b) USA and Russia
(c) India (d) China

122. The European Space Agency (ESA) successfully landed a spacecraft on a speeding comet that lies 310 million miles away from Earth. As a result, the scientists may find out
(a) the age of the Sun
(b) the age of the Universe
(c) new fundamental atomic particles
(d) the role of the comets in bringing organic matter and water to Earth

123. Who among the following Nobel laureates has recently announced to put his Nobel Medal under auction ?
(a) Kailash Satyarthi (b) J D Watson
(c) Mikhail Gorbachev (d) Jody Williams

124. Which one among the following statements with regard to a climate deal adopted between USA and China in November 2014 is ***not*** correct?
(a) China committed to cap its output of carbon pollution by the year 2030 or earlier
(b) China committed to increase its use of zero emission energy to 20% by the year 2030
(c) USA agreed to reduce its emissions by 26% – 28% below its year 2005 levels in the year 2025
(d) Both the countries agreed to completely phase out coal technologies by the year 2020

125. Which one among the following books is centered around 'environment' ?
(a) The Late, Great Planet Earth
(b) Silent Spring
(c) Here I Stand
(d) And Then One Day

126. Who among the following cricket players has ***not*** died while playing a match ?
(a) Wasim Raja (b) Phillip Hughes
(c) Raman Lamba (d) Vijay Hazare

127. Which one among the following films was conferred the 'Golden Peacock' award in the 45th International Film Festival of India (2014) ?
(a) Ek Hazarachi Note (b) A Short Story
(c) Leviathan (d) Ajeyo

128. Which one among the following films was awarded the best motion picture (Drama) in the 72nd Golden Globe Awards ?
(a) The Theory of Everything
(b) Boyhood
(c) Still Alice
(d) Birdman

129. East Zone won the prestigious Deodhar Trophy cricket tournament 2014-15 by defeating
(a) South Zone (b) Central Zone
(c) West Zone (d) North Zone

130. Which one of the following books won the Man Booker Prize 2014 ?
(a) History of the Rain
(b) The Lives of Others
(c) The Narrow Road to the Deep North
(d) How to be Both

131. The Second Five Year Plan that called for the establishment of Socialist pattern of society was commonly referred to as the
(a) Harrod-Domar Plan (b) Mahalanobis Plan
(c) Nehru Plan (d) Peoples Plan

132. Harappan crafts display an amazing degree of standardization. According to Kenoyer, what was the possible reason for such an achievement ?
(a) Availability of raw materials at local level
(b) Centralized markets for crafts
(c) Specialized training centres for craftsmen
(d) State control

133. Consider the following statements about Ashokan rock edicts :
1. Major Rock Edict XIII records Ashoka's remorse at the sufferings caused by his Kalinga campaign.
2. Major Rock Edict X records Ashoka's visit to Lumbini.
3. Major Rock Edict XII refers to *Dhamma Mahamattas* as a new category of officers instituted by Ashoka.
4. Major Rock Edict XII speaks about showing tolerance towards all sects.

Which of the statements given above are correct ?
(a) 1 and 4 only (b) 2 and 3
(c) 3 and 4 only (d) 1, 3 and 4

134. Which one of the following is the common element among Rajagriha, Vaishali and Pataliputra ?
(a) Pali canon of the *Sthaviravadins* was compiled there
(b) Ashokan Major Rock Edicts were found there
(c) Places where Buddhist Councils were held
(d) Places associated with the compilation of Buddhist canons of the Mahasanghikas

135. Which one among the following sects was associated with Gosala Maskariputra ?
(a) Vajrayana (b) Ajivikas
(c) Sthaviravadins (d) Mahasanghikas

136. Consider the following statements about the early modern technology in India :
1. The Portuguese brought European movable metal types to Goa in 1550.

2. The first Indian script of which types were prepared was Tamil.
3. The English Company's first experiment with printing press was at Calcutta.
4. The English Company imported printing press to India in 1674-75 at the request of Bhimji Parak.

Which of the statements given above are correct ?

(a) 1 and 2 only (b) 2 and 3
(c) 3 and 4 (d) 1, 2 and 4

137. Which of the following statement(s) is/are true for Olympe de Gouges ?

1. She was one of the most important politically active woman in revolutionary France.
2. She was one of the memebers of the Committee that drafted the Declaration of Rights of Man and Citizen.
3. She wrote the Declaration of the Right of Woman and Citizen.

Select the correct answer using the code given below :

(a) 1 only (b) 3 only
(c) 1 and 2 (d) 1 and 3

138. Arrange the following inventions in the field of cotton industry in chronological order (starting with the earliest) :

1. James Hargreaves's Spinning Jenny
2. John Kay's Flying Shuttle
3. Samuel Crompton's Mule
4. Richard Arkwright's Water Frame

Select the correct answer using the code given below :

(a) 1, 3, 4, 2 (b) 2, 1, 4, 3
(c) 4, 1, 3, 2 (d) 2, 4, 1, 3

139. While opposing the Public Safety Bill, 1928 who among the following said that it was 'a direct attack on Indian nationalism, on the Indian National Congress' and as 'the Slavery of India, Bill No. 1' ?

(a) Motilal Nehru (b) Lala Lajpat Rai
(c) T Prakasam (d) Diwan Chaman Lal

140. Soon after the formation of Indian National Congress, the British became suspicious of nationalists. Who among the following called Congress representing only the elite — 'a microscopic minority' ?

(a) Lord Napier (b) Lord Dufferin
(c) Lord Ripon (d) Lord Lytton

141. What is the common element among Ram Prasad Bismil, Roshan Singh and Rajendra Lahiri ?

(a) They threw a bomb in the Central Legislative Assembly on 8 April, 1929
(b) They were the founder members of Swaraj Party
(c) They were the founders of Hindustan Republican Association
(d) They were associated with Kakori Conspiracy case

142. Which of the following is/are ***not*** fundamental right(s) under the Constitution of India ?

1. Right to education.
2. Right to work.
3. Right to form associations.
4. Right to practise any profession.

Select the correct answer using the code given below:

(a) 1 and 2 (b) 2 and 4
(c) 2 only (d) 1 and 3

143. Mahatma Gandhi's *Hindu Swaraj* is essentially

(a) a critique of Western modernity
(b) an outline of his philosophy of Satyagraha
(c) an invocation to Indians to free themselves from the British
(d) a blueprint of Gram Swaraj

144. The Seventh Schedule of the Constitution of India contains

(a) provisions regarding the administration of tribal areas
(b) the Union List, the State List and the Concurrent List
(c) a list of recognized languages
(d) provisions about the disqualification of Members of Legislatures on grounds of defection

145. Pochampally in Nalgonda district of Telengana became famous in April, 1951 because

(a) the Bhoodan movement was launched there by Vinoba Bhave
(b) the landless peasants rose up in arms against the landlords
(c) it witnessed violent anti-Hindi agitation
(d) Silk weavers' cooperative was formed for the first time in India

146. Who among the following was ***not*** associated with the Sarvodaya movement ?

(a) Jaya Prakash Narayan (b) Acharya Vinoba Bhave
(c) Dhirendra Mazumdar (d) G V Apparao

147. Article 368 of the Constitution of India deals with

(a) the powers of the Parliament of India to amend the Constitution
(b) financial emergency
(c) reservation of seats for Scheduled Castes and Scheduled Tribes in the Lok Sabha
(d) Official Language of the Union of India

148. Which among the following is ***not*** a basic feature of the Constitution of India ?

(a) Fundamental rights
(b) Independence of judiciary
(c) Federalism
(d) The unquestioned right of the Parliament to amend any part of the Constitution

149. Which one among the following is ***not*** a fundamental duty ?

(a) To abide by the Constitution of India and respect the national flag and national anthem
(b) To safeguard public property
(c) To protect the Sovereignty, Unity and Integrity of India
(d) To render compulsory military service

150. Which of the following are the basic features of the Constitution (73rd Amendment) Act ?

1. Provides for a three-tier structure of panchayats in the village, intermediary and district levels.
2. Reservation of seats for Scheduled Castes and Scheduled Tribes and women in all the tiers of panchayats.
3. Election to panchayats under the supervision of the State Election Commissions.
4. Introduction of the 11th Schedule to the Constitution.

Select the correct answer using the code given below :

(a) 1, 2 and 3 only (b) 3 and 4 only
(c) 1, 2, 3 and 4 (d) 2 and 4 only

NDA 1 2015 Solutions

MATHEMATICS

1. (c) From going by the options,
option (a), $\theta = 30°$, as we know that
$180° = \pi$ radian

$\therefore$ $30° = \frac{30\pi}{180}$ radian

Now according to question,

$\frac{30° \times 180°}{30° \pi} = \frac{180}{\pi}$

Now number of degree in θ is multiplied by number of radians in θ.

$\therefore$ $30° \times \frac{30\pi}{180} = \frac{900\pi}{180} = \frac{10\pi}{2} = 5\pi \neq \frac{125\pi}{9}$

From option (b),
$\theta = 45°$

$\therefore$ $45° = \frac{45°\pi}{180}$ radian

Now according to question,

$\frac{45° \times 180}{45°\pi} = \frac{180}{\pi}$

Now number of degree in θ is multiplied by number of radian in θ.

$\therefore$ $45° \times \frac{45°\pi}{180°} = \frac{45\pi}{4} \neq \frac{125\pi}{9}$

From option (c),
$\theta = 50°$
As we know that $180° = \pi$ radian

$\therefore$ $50° = \frac{50\pi}{180}$ radian

Now according to question

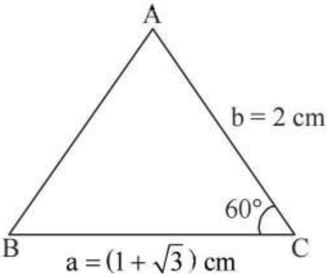
$\frac{50° \times 180°}{50° \pi} = \frac{180}{\pi}$

Now number of degree in 'θ' is multiplied by number of radian in θ.

$\therefore$ $50° \times \frac{50\pi}{180} = \frac{2500\pi}{180} = \frac{125\pi}{9}$

$\therefore$ Option (c) is correct.

2. (a)



Now as $a > b$

$\therefore$ $\angle A > \angle B$

Now from Sine Rule,

$\frac{\sin A}{a} = \frac{\sin B}{b}$

$\frac{\sin A}{1+\sqrt{3}} = \frac{\sin B}{2}$

From option (a),

$\frac{\sin 75}{1+\sqrt{3}} = \frac{\sin 45}{2}$

$\frac{\sqrt{6}+\sqrt{2}}{4\left(+\sqrt{3}\right)} = \frac{1}{2\sqrt{2}}$

$2\sqrt{12} + 4 = 4 + 4\sqrt{3}$

$4 + 4\sqrt{3} = 4 + 4\sqrt{3}$

$\therefore$ Option (a) is correct.

For (3-4):

3. (a) Here α is the root of equation
$25\cos^2\theta + 5\cos\theta - 12 = 0$

$\Rightarrow$ $25\cos^2\alpha + 5\cos\alpha - 12 = 0$

$\Rightarrow$ $25\cos^2\alpha + 20\cos\alpha - 15\cos\alpha - 12 = 0$

$\Rightarrow$ $5\cos\alpha(5\cos\alpha + 4) - 3(5\cos\alpha + 4) = 0$

$(5\cos\alpha - 3)(5\cos\alpha + 4) = 0$

$\cos\alpha = \frac{3}{5}$ or $\cos\alpha = \frac{-4}{5}$

Here, $\frac{\pi}{2} < \alpha < \pi$

$\therefore$ $\cos\alpha = \frac{-4}{5}$

($\because$ In 2^{nd} quadrant, $\cos\alpha$ value is negative)

Now, $\sin\alpha = \sqrt{1-\cos^2\alpha} = \sqrt{1-\frac{16}{25}}$

$\therefore$ $\sin\alpha = \frac{3}{5}$

$\therefore$ $\tan\alpha = \frac{\sin\alpha}{\cos\alpha} = \frac{3}{5} \times \frac{-5}{4} = \frac{-3}{4}$

$\therefore$ Option (a) is correct.

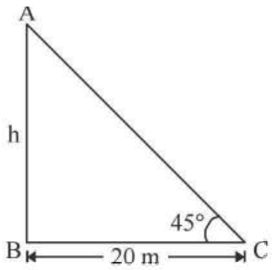
4. (b) $\sin 2\alpha = 2\sin\alpha \cdot \cos\alpha$

$= 2\left(\frac{3}{5}\right)\left(\frac{-4}{5}\right)$

$= \frac{6}{5} \times \frac{-4}{5} = \frac{-24}{25}$

$\therefore$ Option (b) is correct.

5. (b) In ΔABC,
$AB = h$
$BC = 20$ m
$\angle C = 45°$



$\therefore \quad \tan 45° = \frac{AB}{BC}$

$1 = \frac{h}{20} \qquad [\because \tan 45° = 1]$

$h = 20$ m

$\therefore$ Height of the tower = 20 m

$\therefore$ Option (b) is correct.

6. (c) $\tan^{-1}(1+x) + \tan^{-1}(1-x) = \frac{\pi}{2}$

$$\tan^{-1}\left[\frac{(1+x)+(1-x)}{1-(1+x)(1-x)}\right] = \frac{\pi}{2}$$

$$\Rightarrow \quad \frac{1+x+1-x}{1-(1+x)(1-x)} = \tan\frac{\pi}{2}$$

$$\Rightarrow \quad \frac{2}{1-(1+x)(1-x)} = \frac{1}{0}$$

$\Rightarrow \quad 1-(1+x)(1-x) = 0$

$\Rightarrow \quad (1+x)(1-x) = 1$

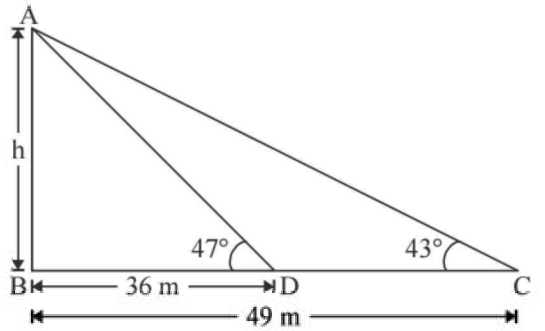
$1 - x^2 = 1$

$x^2 = 0$

$x = 0$

$\therefore$ Option (c) is correct.

7. (b) $AB = h$ (height of the tower)
$BD = 36$ m
$BC = 49$ m
$\angle D = 47°$
$\angle C = 43°$



Now, in ΔABD,

$$\tan 47° = \frac{h}{36\ m} \quad \text{...(i)}$$

and in ΔABC,

$$\tan 43° = \frac{h}{49\ m}$$

$$\tan(90° - 47°) = \frac{h}{49}$$

$$\therefore \quad \cot 47° = \frac{h}{49} \quad \text{...(ii)}$$

Multiplying equations (i) and (ii)

$$\tan 47°.\cot 47° = \frac{h}{36} \times \frac{h}{49} = 1 = \frac{h^2}{36 \times 49}$$

$h = 6 \times 7 = 42$ m

$\therefore$ Option (b) is correct

8. (b) $(1 - \sin A + \cos A)^2$

$= 1 + \sin^2 A + \cos^2 A - 2\sin A$
$\qquad - 2\sin A \cdot \cos A + 2\cos A$

$= 2 - 2\sin A - 2\sin A\cos A + 2\cos A$

$= 2(1 - \sin A) + 2\cos A(1 - \sin A)$

$= 2(1 + \cos A)(1 - \sin A)$

$\therefore$ Option (b) is correct.

9. (b) $\frac{\cos\theta}{1-\tan\theta} + \frac{\sin\theta}{1-\cot\theta}$

$$= \frac{\cos\theta}{1 - \frac{\sin\theta}{\cos\theta}} + \frac{\sin\theta}{1 - \frac{\cos\theta}{\sin\theta}}$$

$$= \frac{\cos^2\theta}{\cos\theta - \sin\theta} + \frac{\sin^2\theta}{\sin\theta - \cos\theta}$$

$$= \frac{\cos^2\theta}{\cos\theta - \sin\theta} - \frac{\sin^2\theta}{\cos\theta - \sin\theta}$$

$$= \frac{\cos^2\theta - \sin^2\theta}{\cos\theta - \sin\theta} = \frac{(\cos\theta - \sin\theta)(\cos\theta + \sin\theta)}{\cos\theta - \sin\theta}$$

$= \cos\theta + \sin\theta$

$\therefore$ Option (b) is correct.

10. (b) $x = 4\tan^{-1}\left(\frac{1}{5}\right)$

$$= 2\left[2\tan^{-1}\frac{1}{5}\right] = 2\left[\tan^{-1}\frac{\frac{2}{5}}{1-\left(\frac{1}{5}\right)^2}\right]$$

$$= 2\tan^{-1}\left(\frac{\frac{2}{5}\times 25}{24}\right) = 2\tan^{-1}\frac{10}{24} = 2\tan^{-1}\frac{5}{12}$$

$$= \tan^{-1}\left(\frac{2\times\frac{5}{12}}{1-\frac{25}{144}}\right) = \tan^{-1}\frac{120}{119}.$$

11. (c) $x-y=\tan^{-1}\left(\frac{120}{119}\right)-\tan^{-1}\frac{1}{70}$

$$=\tan^{-1}\left|\frac{\frac{120}{119}-\frac{1}{70}}{1+\left(\frac{120}{119}\times\frac{1}{70}\right)}\right|$$

$$=\tan^{-1}\left|\frac{\frac{8400-119}{8330}}{1+\frac{120}{8330}}\right|$$

$$=\tan^{-1}\left|\frac{\frac{8281}{\cancel{8330}}}{\frac{8450}{\cancel{8330}}}\right|=\tan^{-1}\frac{8281}{8450}$$

$\therefore$ option (c) is correct.

12. (d) $x-y=\tan^{-1}\frac{8281}{8450}\Rightarrow\tan^{-1}\left|\frac{8281}{8450}\right|+\tan^{-1}\left(\frac{1}{99}\right)$

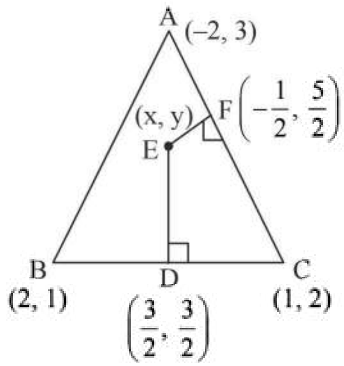
$$=\tan^{-1}\left|\frac{\frac{8281}{8450}+\frac{1}{99}}{1-\frac{8281}{8450}\times\frac{1}{99}}\right|$$

$$=\tan^{-1}\left|\frac{\frac{828269}{836550}}{\frac{828269}{836550}}\right|=1$$

$\tan^{-1}=(1)=\frac{\pi}{4}$

$\therefore$ Option (d) is correct.

13. (a) A circumcentre is a point at which perpendicular bisectors meet each other.
Here, 'E' represents circumcentre



Mid-point of BC $=\left(\frac{2+1}{2},\frac{1+2}{2}\right)=\left(\frac{3}{2},\frac{3}{2}\right)$

Slope of BC $=\frac{2-1}{1-2}=-1$

$\therefore$ Slope of DE = 1

Now, equation of $\overleftrightarrow{ED}$ is $\left(y-\frac{3}{2}\right)=1\left(x-\frac{3}{2}\right)$

$\therefore$ $2y-3=2x-3$

$\therefore$ $x=y$ ... (i)

Now, mid-point of AC $=\left(\frac{-2+1}{2},\frac{3+2}{2}\right)=\left(-\frac{1}{2},\frac{5}{2}\right)$

Slope of AC $=\frac{3-2}{-2-1}=-\frac{1}{3}$

$\therefore$ Slope of EF = 3

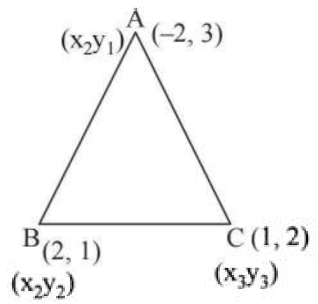
Now, equation of $\overleftrightarrow{EF}$ is $\left(y-\frac{5}{2}\right)=3\left(x+\frac{1}{2}\right)$

$\therefore$ $2y-5=6x+3$ ... (ii)

From equations (i) and (ii),
$x=-2$ and $y=-2$
Hence, circumcentre of ΔABC is $(x, y)=(-2,-2)$
$\therefore$ Option (a) is correct.

14. (b) Centroid of the triangle

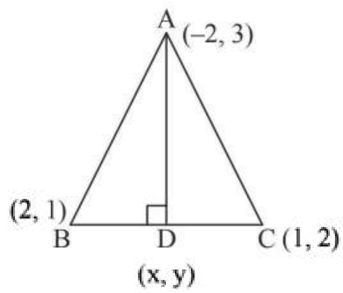
$$=\left(\frac{x_1+x_2+x_3}{3},\frac{y_1+y_2+y_3}{3}\right)$$



$$=\left(\frac{-2+2+1}{3},\frac{3+1+2}{3}\right)=\left(\frac{1}{3},2\right)$$

$\therefore$ Option (b) is correct.

15. (d) Slope of BC $=\frac{2-1}{1-2}=-1$



Slope of AD = 1

Now, equation of $\overline{BC}$ is
$y-2=-1(x-1)$

$\therefore$ $y-2=-x+1$

$\therefore$ $x+y-3=0$ ...(i)

and equation of $\overline{AD}$ is

$(y-3)=1(x+2)$

$\therefore$ $x-y+5=0$ ...(ii)

From equations (i) and (ii),

$x=-1$ and $y=4$

$\therefore$ Foot of altitude from the vertex A of the triangle ABC is $(-1,4)$

$\therefore$ Option (d) is correct.

16. (b) Given that $x<y$ if $y \geq x+5$

For Reflexive:

$x \nless x$

Hence, relation is not reflexive.

For Symmetry:

if $x<y$,

then $y \nless x$

Hence, relation is not symmetry.

For Transitive:

if $x<y$ and $y<z$,

then $x<z$

Hence, relation is transitive.

17. (b) $\begin{bmatrix} 1 & 5 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

An elementary matrix has each diagonal element 1. So, option (b) is correct answer.

18. (b) $(x^2+2)^2+8x^2=6x(x^2+2)$

Let $x^2+2=y$

$y^2+8x^2=6xy$

$y^2-6xy+8x^2=0$

$$y=\frac{6x \pm \sqrt{36x^2-32x^2}}{2}$$

$$y=\frac{6x \pm 2x}{2}=3x \pm x$$

$y=4x, 2x$

At $y=4x$,

$x^2+2=4x$

$x^2-4x+2=0$

Discriminant, $D=16-8=8>0$

Roots are real.

Sum of roots $=-(-4)=4$

At $x=2x$,

$x^2+2=2x$

$x^2-2x+2=0$

$D=4-8=-4<0$

Roots are complex.

Sum of roots $=2$

Sum of all roots $=4+2=6$

only statement 2 is correct.

$\therefore$ Correct option is (b)

19. (a) Let correct equation is $ax^2+bx+c=0$

According to first student, equation is:

$ax^2+bx+c_1=0$ and roots are 8 and 2

$$8+2=\frac{-b}{a} \Rightarrow \frac{b}{a}=-10$$

Quadratic equation according to second student

$ax^2+b_1x+c=0$ and roots are -9 and -1

$$(-9)\times(-1)=\frac{c}{a} \Rightarrow \frac{c}{a}=9$$

Putting value in original equation

$$x^2+\frac{b}{a}x+\frac{c}{a}=0$$

$x^2-10x+9=0.$

20. (c) $A=\begin{bmatrix} 2 & 7 \\ 1 & 5 \end{bmatrix}$

$$\text{Now, } A^{-1}=\frac{1}{|A|}\text{adj}(A)$$

$$=\frac{1}{(10-7)}\begin{bmatrix} 5 & -7 \\ -1 & 2 \end{bmatrix}$$

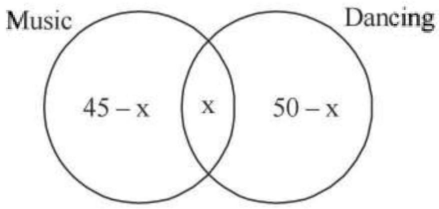
$$=\frac{1}{3}\begin{bmatrix} 5 & -7 \\ -1 & 2 \end{bmatrix}$$

$$\Rightarrow 3A^{-1}=\begin{bmatrix} 5 & -7 \\ -1 & 2 \end{bmatrix}$$

$$\text{Now, } A+3A^{-1}=\begin{bmatrix} 2 & 7 \\ 1 & 5 \end{bmatrix}+\begin{bmatrix} 5 & -7 \\ -1 & 2 \end{bmatrix}$$

$=\begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix}=7\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}=7I$ where I is Identity Matrix.

21. (b)



Let 'x' be the number of students who likes both music and dance.

5 students likes neither music nor dancing.

Hence, total number of remaining students

$=60-5=55$

Now from Venn diagram,

$45-x+x+50-x=55$

$\therefore$ $95-x=55$

$\therefore$ $x=95-55=40.$

22. (c) $\log_{10} 2$, $\log_{10}(2^x-1)$ and $\log_{10}(2^x+3)$ are in A.P.

Hence, common difference will be same.

$\therefore$ $\log_{10}(2^x-1)-\log_{10}2=\log(2^x+3)-\log_{10}(2^x-1)$

$\therefore \quad \log_{10}\left(\frac{2^x-1}{2}\right)=\log_{10}\left(\frac{2^x+3}{2^x-1}\right)$

$\Rightarrow \quad \frac{2^x-1}{2}=\frac{2^x+3}{2^x-1}$

$(2^x-1)^2=2(2^x+3)$

$2^{2x}-2^{x+1}+1=2^{x+1}+6$

$2^{2x}-2^{x+2}=5$

Let $2^x=y$, then

$y^2-4y-5=0$

$y^2-5y+y-5=0$

$y(y-5)+1(y-5)=0$

$y=-1, y=5$

Therefore, $2^x=5$

$x=\log_2 5.$

23. (d) The given matrix $A=\begin{bmatrix}0 & -4+i\\ 4+i & 0\end{bmatrix}$

Now, from options:
From option (a): For *Symmetric matrix*
$A^T=A$

Now, $A^T=\begin{bmatrix}0 & 4+i\\ -4+i & 0\end{bmatrix}\neq A$

$\therefore$ The given matrix is not symmetric
$\therefore$ option (a) is wrong.
From option (b): For *Skew-symmetric matrix*
$A^T=-A$

$=\begin{bmatrix}0 & 4+i\\ -4+i & 0\end{bmatrix}\neq -A$

$\therefore$ Given matrix is not skew-symmetric
$\therefore$ option (b) is wrong.
From option (c): For *Hermitian matrix*

$A^T=\overline{A}$, where $\overline{A}$ is conjugate of matrix A

$\overline{A}=\begin{bmatrix}0 & -4-i\\ 4-i & 0\end{bmatrix}\neq A^T$

$\therefore$ option (c) is wrong.
From option (d): For *Skew-Hermitian matrix*
The diagonal element of a skew-hermitian matrix are pure imaginary or zero.

$A=\begin{bmatrix}0 & -4+i\\ 4+i & 0\end{bmatrix}$

Here, diagonal element indicates that the given matrix is skew-hermitian matrix.
$\therefore$ option (d) is correct.

24. (b)

25. (b) $z=\frac{-2(1+2i)}{3+i}$

$=\frac{-2-4i}{3+i}=\frac{-2-4i}{3+i}\times\frac{3-i}{3-i}$

$=\frac{-6+2i-12i+4i^2}{10}$

$=\frac{-6-10i-4}{10}=\frac{-10-10i}{10}=-1-i$

$z=-1-i=r(\cos\theta+i\sin\theta)$

On comparing real and imaginary part on both sides, we get

$r\cos\theta=-1$ ...(i)

$r\sin\theta=-1$ ...(ii)

On dividing eq. (ii) by (i), we get

$\frac{r\sin\theta}{r\cos\theta}=\frac{-1}{-1}$

$\tan\theta=1=\tan\frac{\pi}{4}$

$\Rightarrow \quad \theta=\frac{\pi}{4}$

$\therefore \quad \theta=\frac{\pi}{4}$

$\therefore$ Option (b) is correct.

26. (c) Here m and n are the roots of equation.

$(x+p)(x+q)-k=0$

$x^2+x(p+q)+pq-k=0$ ... (i)

If m and n are the roots of equation, then

$(x-m)(x-n)=0$

$\therefore \quad x^2-(m+n)x+mn=0$ ... (ii)

Now equation (i) should be equal to equation (ii),

$(m+n)=-(p+q)$ and $mn=pq-k$

Now, we have to find roots of $(x-m)(x-n)+k=0$

$x^2-(m+n)x+mn+k=0$

$x^2+(p+q)x+(pq-k)+k=0$

$x^2+(p+q)x+pq=0$

$x^2+px+qx+pq=0$

$x(x+p)+q(x+p)=0$

$\therefore \quad x+q=0$ or $x+p=0$

$\therefore \quad x=-q$ and $x=-p$

$\therefore$ Option (c) is correct.

27. (d) Given $0.5+0.55+0.555+.....$ to n

$=5\,[0.1+0.11+0.111+.....$ to n terms$]$

$=\frac{5}{9}\,[0.9+0.99+0.999+.....$ to n terms$]$

$=\frac{5}{9}\left[\frac{9}{10}+\frac{99}{100}+\frac{999}{1000}+.....\text{ to n terms}\right]$

$=\frac{5}{9}\left[\left(1-\frac{1}{10}\right)+\left(1-\frac{1}{100}\right)+\left(1-\frac{1}{1000}\right)+.....\text{ to n terms}\right]$

$=\frac{5}{9}\left[\left(1-\frac{1}{10}\right)+\left(1-\frac{1}{10^2}\right)+\left(1-\frac{1}{10^3}\right)+.....\left(1-\frac{1}{10^n}\right)\right]$

$$= \frac{5}{9}\left[n - \left(\frac{1}{10} + \frac{1}{10^2} + \dots \frac{1}{10^n}\right)\right]$$

$$= \frac{5}{9}\left[n - \frac{1}{10}\frac{\left\{1 - \left(\frac{1}{10}\right)^n\right\}}{\left(1 - \frac{1}{10}\right)}\right]$$

$$= \frac{5}{9}\left[n - \frac{1}{9}\left(1 - \frac{1}{10^n}\right)\right]$$

28. (c) Here cube root of unity is $1, \omega, \omega^2$

Now as we know that $1 + \omega + \omega^2 = 0$ and $\omega^3 = 1$

$\omega^8 = (\omega^3)^2 . \omega^2 = \omega^2$

$\omega^4 = (\omega^3) . \omega = \omega$

Now, $(1 + \omega)(1 + \omega^2)(1 + \omega^4)(1 + \omega^8)$

$= (-\omega^2)(-\omega)(1 + \omega)(1 + \omega^2)$

$= \omega^3 (1 + \omega^2 + \omega + \omega^3)$

$= \omega^3 (\omega^3)$

$= (1)(1) = 1$

$\therefore$ Option (c) is correct.

29. (c) $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

Number of subsets of A containing two elements

$= 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1$

$= 45$ $\qquad \frac{9(9+1)}{2} = \frac{90}{2} = 45$

$\therefore$ Option (c) is correct

Alternate Method

The number of subsets of A containing exactly two elements is:

$${}^{10}C_2 = \frac{10 \times 9}{2 \times 1} = 45$$

30. (c) Let $\sqrt{i} = x + iy$

$i = (x + iy)^2$

$x^2 - y^2 + 2xyi = 0 + i$

$x^2 - y^2 = 0;\ 2xy = 1$

Now, $(x^2 + y^2)^2 = (x^2 - y^2)^2 + 4x^2 y^2$

$(x^2 + y^2)^2 = 0 + 1$

$x^2 + y^2 = 1$

$x^2 - y^2 = 0$ ...(i)

$x^2 + y^2 = 1$ ...(ii)

$2x^2 = 1$

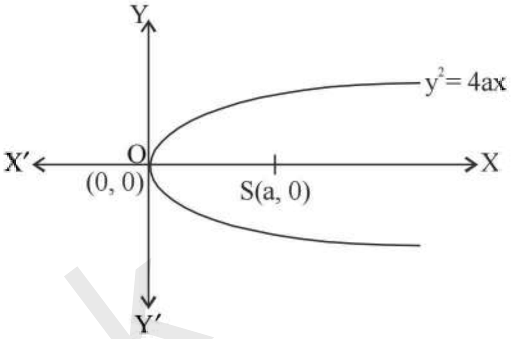
$$x^2 = \frac{1}{2} \Rightarrow x = \pm\frac{1}{\sqrt{2}}$$

$$y^2 = \frac{1}{2} \Rightarrow y = \pm\frac{1}{\sqrt{2}}$$

$$\therefore \sqrt{i} = \pm\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}i\right)$$

$$= \frac{1}{\sqrt{2}}(1 + i) \text{ or } \frac{-1}{\sqrt{2}}(1 + i).$$

31. (a) Here, 'S' represents focus O(0, 0) is a point which is on parabola $y^2 = 4ax$ and nearest to focus $(a, 0)$



$\therefore$ abscissa of O (0, 0) is $x = 0$

$\therefore$ Option (a) is correct.

32. (b) A line passes through (2, 2) and is perpendicular to the line $3x + y = 3$

Slope of line $3x + y = 3$ is -3

Slope of line which passes through (2, 2) is $\frac{1}{3}$

$\therefore$ Equation of line passes through (2, 2) and having slope $\left(\frac{1}{3}\right)$ is

$$(y - 2) = \frac{1}{3}(x - 2)$$

$\therefore$ $3y - 6 = x - 2$

$\therefore$ $x - 3y + 4 = 0$

In order to find y-intercept of the line

Put $x = 0$ in $x - 3y + 4 = 0$

$\therefore$ $-3y = -4$

$\therefore$ $y = \frac{4}{3}$

$\therefore$ Option (b) is correct.

33. (c) $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

Hyperbola passes through $(3\sqrt{5}, 1)$

$$\therefore \frac{(3\sqrt{5})^2}{a^2} - \frac{1}{b^2} = 1$$

$$\frac{45}{a^2} - \frac{1}{b^2} = 1 \qquad \text{...(i)}$$

Now length of latus rectum $= \frac{2b^2}{a}$

$$\Rightarrow \frac{4}{3} = \frac{2b^2}{a}$$

$$\Rightarrow \quad \frac{2}{3}=\frac{b^2}{a} \quad \Rightarrow a=\frac{3b^2}{2} \qquad \text{...(ii)}$$

Putting the value of 'a' from equation (ii) in equation (i),

$$\Rightarrow \quad \frac{45\times 4}{9b^4}-\frac{1}{b^2}=1$$

$$\Rightarrow \quad \frac{20}{b^4}-\frac{1}{b^2}=1$$

$20-b^2=b^4$

$b^4+b^2-20=0$

$b^4+5b^2-4b^2-20=0$

$b^2(b^2+5)-4(b^2+5)=0$

$(b^2-4)(b^2+5)=0$

$b^2=4,\ b^2=-5$

$\therefore \quad b^2=4 \Rightarrow b=2$

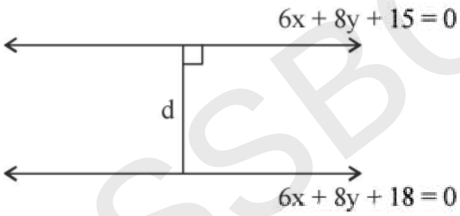
Now length of conjugate axis

$=2b=2(2)=4$

$\therefore$ Option (c) is correct.

34. (b) $6x+8y+15=0$ ...(i)

and $3x+4y+9=0$ ...(ii)



Multiply equation (ii) by 2, we get

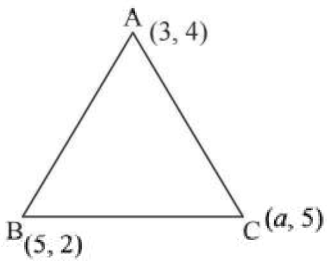
$6x+8y+18=0$

Distance between the straight lines

$$\frac{|c_2-c_1|}{\sqrt{a^2+b^2}}=\frac{18-15}{\sqrt{(6)^2+(8)^2}}=\frac{3}{10}\ \text{unit}$$

$\therefore$ Option (b) is correct.

35. (d) Area of $\Delta ABC=3$ sq. unit



$$\therefore \quad \frac{1}{2}\begin{vmatrix}3 & 4 & 1\\ 5 & 2 & 1\\ a & 5 & 1\end{vmatrix}=3$$

$$\therefore \quad \begin{vmatrix}3 & 4 & 1\\ 5 & 2 & 1\\ a & 5 & 1\end{vmatrix}=6$$

$\therefore \quad 3(2-5)-4(5-a)+1(25-2a)=6$

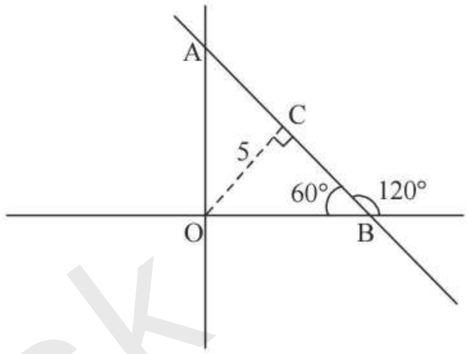
$-9-20+4a+25-2a=6$

$2a=10$

$a=5$

$\therefore$ Option (d) is correct.

36. (b)



In ΔOCB,

$$\sin 60^\circ=\frac{5}{OB} \Rightarrow OB=\frac{5}{\sin 60^\circ}$$

$$OB=\frac{5\times 2}{\sqrt{3}}=\frac{10}{\sqrt{3}}$$

In ΔACO,

$\angle OAC=30^\circ$

$$\sin 30^\circ=\frac{5}{AO} \Rightarrow AO=\frac{5\times 2}{1}=10$$

Normal form of line AB

$$\frac{X}{OB}+\frac{Y}{OA}=1$$

$$\frac{\sqrt{3}X}{10}+\frac{Y}{10}=1$$

$\Rightarrow \quad \sqrt{3}X+Y=10.$

37. (a) $\frac{x}{a}+\frac{y}{b}=1$ ...(i)

and $\frac{x}{b}+\frac{y}{a}=1$ ...(ii)

From solving equations (i) and (ii), we get the intersection point.

$bx+ay=ax+by$

$\Rightarrow \quad (b-a)x=(b-a)y$

$\therefore \quad x=y$ ...(iii)

$$\Rightarrow \quad \frac{x}{a}+\frac{x}{b}=1$$

$\therefore \quad x(a+b)=ab$

$$\therefore \quad x=\frac{ab}{a+b} \text{ and } y=\frac{ab}{a+b} \text{ from equation (iii)}$$

Now, equation of line joining (0, 0) and

$$\left(\frac{ab}{a+b},\frac{ab}{a+b}\right)$$

Here, slope of line = 1
∴ $y = x$
∴ $x - y = 0$
∴ Option (a) is correct.

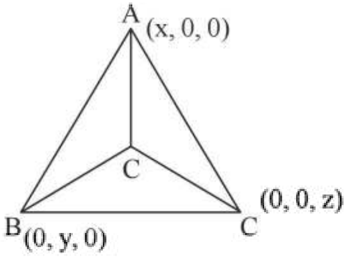
38. (d) The projection of a directed line segment on the co-ordinate axes are 12, 4, 3, respectively.
∴ Length of the line segment $= \sqrt{12^2 + 4^2 + 3^2}$
$= \sqrt{144 + 16 + 9} = \sqrt{169} = 13$ unit
∴ Option (d) is correct.

39. (a) Direction cosine of line segment $= \left(\frac{12}{13}, \frac{4}{13}, \frac{3}{13}\right)$
∴ Option (a) is correct.

40. (b) Equation of line passing through P(3, –1, 11) and perpendicular to $\frac{x}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ is:
$$\frac{x-3}{-1} = \frac{y-1}{6} = \frac{z-1}{-4}$$
The direction ratio are (–1, 6, –4)
∴ Option (b) is correct.

41. (c) Now $x_2 - x_1 = -1$
$x_2 - 3 = -1$
∴ $x_2 = 2$
Similarly,
$y_2 - y_1 = 6$
$y_2 + 1 = 6$
∴ $y_2 = 5$
and $z_2 - z_1 = -4$
$z_2 - 11 = -4$
$z_2 = -4 + 11 = 7$
∴ Co-ordinate of Q is (2, 5, 7)
∴ Length of segment PQ
$= \sqrt{(2-3)^2 + (5+1)^2 + (7-11)^2}$
$= \sqrt{1 + 36 + 16} = \sqrt{53}$ units.
∴ Option (c) is correct.

42. (a) Centroid $= \left(\frac{x_1}{3}, \frac{y_1}{3}, \frac{z_1}{3}\right)$



$(1, 2, 3) = \left(\frac{x_1}{3}, \frac{y_1}{3}, \frac{z_1}{3}\right)$

∴ $x_1 = 3, y_1 = 6$ and $z_1 = 9$
∴ Intercept made by plane on the axes are 3, 6 and 9, respectively.
∴ Option (a) is correct.

43. (d) The plane passes through the point A (3, 0, 0), B(0, 6, 0) and C(0, 0, 9). So, it should satisfy the equation given in option for all the three points.
From option (a)
For point A (3, 0, 0)
$x + 2y + 3z = 1$
⇒ $3 + 0 + 0 \neq 1$
∴ option (a) is wrong.
From option (b)
For point A(3, 0, 0)
$3x + 2y + z = 3$
∴ $3(3) + 0 + 0 \neq 3$
∴ option (b) is wrong.
From option (c)
For point A(3, 0, 0)
$2x + 3y + 6z = 18$
∴ $2(3) + 0 + 0 \neq 18$
∴ option (c) is wrong.
From option (d)
For point A (3, 0, 0)
$6x + 3y + 2z = 18$
⇒ $6(3) + 0 + 0 = 18$
For point B(0, 6, 0)
$6x + 3y + 2z = 18$
∴ $0 + 3(6) + 0 = 18$
For point C (0, 0, 9)
$6x + 3y + 2z = 18$
$0 + 0 + 2 \times 9 = 18$
∴ Option (d) is correct.

44. (b) Length of one of the diagonal of cube
$= \sqrt{(1)^2 + (2)^2 + (3)^2}$
$= \sqrt{1 + 4 + 9} = \sqrt{14}$ units
∴ Option (b) is correct.

45. (c) Equation of plane passing through (1, 2, 3) and parallel to xy-plane is $z = 3$.
∴ Option (c) is correct.

46. (d) $(127.25)_{10}$
Now,

2	127
2	63 – 1
2	31 – 1
2	15 – 1
2	7 – 1
2	3 – 1
	1 – 1

$127 = (1111111)_2$

Now,

$0.25 \times 2 = 0.5 \quad \longrightarrow \quad 0$

$0.5 \times 2 = 1.0 \quad \longrightarrow \quad 1$

$\therefore \quad (127.25)_{10} = (1111111.01)_2$

$\therefore$ Option (d) is correct.

47. (d) Non-singular matrix is a matrix whose determinate Value is non-zero.

Let $A = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

Here, A and B are non-singular matrix

Now from Statement 1:

$A + B = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} + \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 3 & 2 \\ 2 & 4 \end{bmatrix}$

$\det(A + B) = 12 - 4 = 8$

Now $\det(A) = \begin{vmatrix} 1 & 1 \\ 1 & 2 \end{vmatrix} = 1$

and $\det(B) = \begin{vmatrix} 2 & 1 \\ 1 & 2 \end{vmatrix} = 3$

Now, $\det(A + B) = 4 \neq \det(A + B)$

$\therefore$ Statement 1 is wrong.

Now from Statement 2:

$(A+B)^{-1} = \dfrac{1}{|A+B|} \text{adj}(A+B)$

$= \dfrac{1}{8}\begin{bmatrix} 4 & -2 \\ -2 & 3 \end{bmatrix}$

and $A^{-1} = \dfrac{1}{|A|} \text{adj}(A) = \dfrac{1}{1}\begin{bmatrix} 2 & -1 \\ -1 & 1 \end{bmatrix}$

and $B^{-1} = \dfrac{1}{|B|} \text{adj}(B) = \dfrac{1}{3}\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$

Now, $A^{-1} + B^{-1} = \begin{bmatrix} 2 & -1 \\ -1 & 1 \end{bmatrix} + \begin{bmatrix} \frac{2}{3} & \frac{-1}{3} \\ \frac{-1}{3} & \frac{2}{3} \end{bmatrix}$

$= \begin{bmatrix} \frac{8}{3} & \frac{-4}{3} \\ \frac{-4}{3} & \frac{5}{3} \end{bmatrix} \neq (A+B)^{-1}$

$\therefore$ Statement 2 is wrong

$\therefore$ Option (d) is correct.

48. (a) $X = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$, $B = \begin{bmatrix} 5 & 2 \\ -2 & 1 \end{bmatrix}$ and $A = \begin{bmatrix} p & q \\ r & s \end{bmatrix}$

Now, $AX = B$

$\therefore \quad \begin{bmatrix} p & q \\ r & s \end{bmatrix}\begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix} = \begin{bmatrix} 5 & 2 \\ -2 & 1 \end{bmatrix}$

$\Rightarrow \quad \begin{bmatrix} 3p+q & -4p-q \\ 3r+s & -4r-s \end{bmatrix} = \begin{bmatrix} 5 & 2 \\ -2 & 1 \end{bmatrix}$

$3p + q = 5$ ... (i)

$-4p - q = 2$ ... (ii)

$3r - s = -2$ ... (iii)

$-4r - s = 1$ ... (iv)

From equations (i) and (ii), we get

$-p = 7$

$\therefore \quad p = -7$

$\Rightarrow \quad q = 5 - 3(-7)$

$q = 26$

From equations (iii) and (iv),

$-r = -1$

$\therefore \quad r = 1$

$\Rightarrow \quad s = -2 - 3 = -5$

$\therefore \quad s = -5$

Hence, $A = \begin{bmatrix} p & q \\ r & s \end{bmatrix} = \begin{bmatrix} -7 & 26 \\ 1 & -5 \end{bmatrix}$

$\therefore$ Option (a) is correct.

49. (d) $\sum_{r=0}^{1} {}^{n+r}C_n = {}^{n}C_n + {}^{n+1}C_n$

$= 1 + \dfrac{(n+1)!}{(n+1-n)!\, n!}$

$= 1 + \dfrac{(n+1)(n!)}{n!}$

$= 1 + n + 1 = n + 2$

${}^{n+2}C_{n+1} = \dfrac{(n+2)!}{(n+2-n-1)!\,(n+1)!}$

$= \dfrac{(n+2)\,(n+1)!}{(n+1)!} = n + 2$

$\therefore$ Option (d) is correct.

50. (c) The given word is 'NATION'.

Total number of words that can be formed from given word 'NATION'

$= \dfrac{6!}{2!} = \dfrac{6 \times 5 \times 4 \times 3 \times 2!}{2!} = 360$

Now numbers of words that can be formed from given word 'NATION', so that all vowels never come together.

$= 360 - \left[4! \times \dfrac{3!}{2!}\right]$

$= 360 - [24 \times 3]$

$= 360 - 72 = 288$

$\therefore$ Option (c) is correct.

51. (b) As we know that cube root of unity is 1, ω and ω^2

$\therefore$ $x^3 - 1 = (x-1)(x-\omega)(x-\omega^2)$

$\therefore$ Option (b) is correct.

52. (c) $$\left[\frac{\sin\frac{\pi}{6} + i\left(1-\cos\frac{\pi}{6}\right)}{\sin\frac{\pi}{6} - i\left(1-\cos\frac{\pi}{6}\right)}\right]^3$$

$$= \left[\frac{2\sin\frac{\pi}{12}\cos\frac{\pi}{12} + i\left(2\sin^2\frac{\pi}{12}\right)}{2\sin\frac{\pi}{12}\cos\frac{\pi}{12} - i\left(2\sin^2\frac{\pi}{12}\right)}\right]^3$$

$$= \left[\frac{\cos\frac{\pi}{12} + i\sin\frac{\pi}{12}}{\cos\frac{\pi}{12} - i\sin\frac{\pi}{12}}\right]^3 = \left(\frac{e^{i\frac{\pi}{12}}}{e^{-i\frac{\pi}{12}}}\right)^3$$

$$= \left(e^{i\frac{\pi}{6}}\right)^3 = e^{i\times 3\times\frac{\pi}{6}} = e^{i\frac{\pi}{2}}$$

$$= \cos\frac{\pi}{2} + i\sin\frac{\pi}{2} = i$$

$\therefore$ Option (c) is correct.

53. (a) $A = \begin{bmatrix} x+y & y \\ 2x & x-y \end{bmatrix}$

$B = \begin{bmatrix} 2 \\ -1 \end{bmatrix}$ and $C = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$

Here AB = C

$\therefore$ $\begin{bmatrix} x+y & y \\ 2x & x-y \end{bmatrix}\begin{bmatrix} 2 \\ -1 \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$

$\Rightarrow$ $\begin{bmatrix} 2(x+y) & -y \\ 4x & -x+y \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$

$2x + y = 3$ ...(i)

$3x + y = 2$ ...(ii)

From equations (i) and (ii), we get

$x = -1$ and $y = 5$

$\therefore$ $A = \begin{bmatrix} 4 & 5 \\ -2 & -6 \end{bmatrix}$

Now, $A^2 = \begin{bmatrix} 4 & 5 \\ -2 & -6 \end{bmatrix}\begin{bmatrix} 4 & 5 \\ -2 & -6 \end{bmatrix}$

$$= \begin{bmatrix} 16-10 & 20-30 \\ -8+12 & -10+36 \end{bmatrix} = \begin{bmatrix} 6 & -10 \\ 4 & 26 \end{bmatrix}$$

$\therefore$ Option (a) is correct.

54. (c) $\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix}$

$= [(1+x)(1+y) - 1] - 1(1+y-1) + 1(1-1-x)$

$= 1 + x + y + xy - 1 - y - x$

$= xy$

$\therefore$ Option (c) is correct.

55. (d) $A = \{x : x \text{ is a multiple of } 3\}$

$\therefore$ $A = \{3, 6, 9, 12, 15, 18, 24, ...\}$

$\therefore$ $\frac{A \cap B}{C}$

$B = \{x : x \text{ is a multiple of } 4\}$

$\therefore$ $B = \{4, 8, 12, 16, 20, 24, 28, 32, ...\}$

$C = \{x : x \text{ is a multiple of } 12\}$

$\therefore$ $C = \{12, 24, 36, 48, 60, 72, 84, 96, ...\}$

$A \cap B = \{12, 24, ...\} = \frac{A \cap B}{C}$.

56. (a) $(11101011)_2$

$= (1\times 2^7 + 1\times 2^6 + 1\times 2^5 + 0\times 2^4 + 1\times 2^3 + 0\times 2^2 + 1\times 2^1 + 1\times 2^0)_{10}$

$= (128 + 64 + 32 + 8 + 2 + 1)_{10}$

$= (235)_{10}$

$\therefore$ Option (a) is correct.

57. (b) $(\sin x + i\cos x)^3$

$= \sin^3 x + (i)^3\cos^3 x + 3i(\sin x)(\cos x)(\sin x + i\cos x)$

$= \sin^3 x - i\cos^3 x + 3i\sin^2 x\cos x - 3\sin x\cos^2 x$

$= \sin^3 x - 3\sin x\cos^2 x + i\cos x(\cos^2 x + \sin^2 x)$

$= \sin x(\sin^2 x - 3\cos^2 x) + i\cos x$

Real part of $(\sin x + i\cos x)^3$

$= \sin x(\sin^2 x - 3\cos^2 x)$

$= \sin x[\sin^2 x - 3(1-\sin^2 x)]$

$= \sin x[4\sin^2 x - 3]$

$= 4\sin^3 x - 3\sin x$

$= -(3\sin x - 4\sin^3 x)$

$= -\sin 3x$

$\therefore$ Option (b) is correct.

58. (c) $E(\theta) = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

Now $E(\alpha) = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$

and $E(\beta) = \begin{bmatrix} \cos\beta & \sin\beta \\ -\sin\beta & \cos\beta \end{bmatrix}$

Now $E(\alpha)E(\beta) = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}\begin{bmatrix} \cos\beta & \sin\beta \\ -\sin\beta & \cos\beta \end{bmatrix}$

$$= \begin{bmatrix} \cos\alpha\cdot\cos\beta - \sin\alpha\sin\beta & \cos\alpha\sin\beta + \sin\alpha\cos\beta \\ -\sin\alpha\cos\beta - \cos\alpha\sin\beta & -\sin\alpha\sin\beta + \cos\alpha\cos\beta \end{bmatrix}$$

$$= \begin{bmatrix} \cos(\alpha+\beta) & \sin(\alpha+\beta) \\ -\sin(\alpha+\beta) & \cos(\alpha+\beta) \end{bmatrix}$$

$= E(\alpha+\beta)$

$\therefore$ Option (c) is correct.

59. (a) $A = \{x, y, z\}$

$B = (p, q, r, s)$

$n(A) = 3$

$n(B) = 4$

$\therefore$ Number of distinct relations

$= 2^{n(A) \times n(B)} = 2^{3 \times 4}$

$= 2^{12} = 4096$

$\therefore$ option (a) is correct.

60. (c) $4p^2 + 4pq - 3q^2 - 36 = 0$

$\Rightarrow (4p^2 + 4pq + q^2) - 4q^2 - 36 = 0$

$(2p + q)^2 = 4q^2 + 36$

$2p + 3q = 18$

$$p = \frac{18 - 3q}{2}$$

$$\Rightarrow \left[\frac{18 - 3p}{2} \times 2 + q\right]^2 = 4q^2 + 36$$

$\Rightarrow (18 - 3q + q)^2$

$\Rightarrow (18 - 2q)^2 = 4q^2 + 36$

$\Rightarrow 324 + 4q^2 - 72q = 4q^2 + 36$

$72q = 324 - 36 = 288$

$$q = \frac{288}{72} = 4$$

Putting the value of q in $2p + 3q = 18$

$2p + 3 \times 4 = 18$

$2p = 18 - 12$

$$p = \frac{6}{2} = 3$$

$(2p + q) = 2 \times 3 + 4 = 10$

$\therefore$ Option (c) is correct.

For (61-62)

$$\text{Given } \frac{d}{dx}\left(\frac{1 + x^2 + x^4}{1 + x + x^2}\right)$$

$$= \frac{d}{dx}\left[\frac{1 + x + x^2 + x^4 - x}{1 + x + x^2}\right]$$

$$= \frac{d}{dx}\left[1 + \frac{x^4 - x}{x^2 + x + 1}\right]$$

$$= \frac{d}{dx}\left[1 + \frac{x(x^3 - 1)}{x^2 + x + 1}\right]$$

$$= \frac{d}{dx}\left[1 + x(x - 1)\right]$$

$$= \frac{d}{dx}\left[1 + x^2 - x\right] = 2x - 1 \qquad \text{...(i)}$$

Now comparing equation (i) with AX + B, we get

$A = 2$ and $B = -1$.

61. (c)

62. (a)

For (63-64):

$$\lim_{x \to \infty}\left(\frac{2 + x^2}{1 + x} - Ax - B\right) = 3$$

$$\Rightarrow \lim_{x \to \infty}\left(\frac{2 + x^2 - Ax - B - Ax^2 - Bx}{1 + x}\right) = 3$$

$$\Rightarrow \lim_{x \to \infty}\left[\frac{(1 - A)x^2 - (A + B)x + 2 - B}{1 + x}\right] = 3$$

Applying L'Hospital rule,

$2x(1 - A) - (A + B) = 3$

Comparing coefficients

$2(1 - A) = 0$

$\therefore$ $A = 1$ and

$-(A + B) = 3$

$\therefore$ $B = -3 - 1 = -4$

$A + B = -3$

$A = 1, B = -4$

63. (b)

64. (c)

65. (b) $\dfrac{y\,dx - x\,dy}{y^2} = 0$

$\therefore$ $y\,dx - x\,dy = 0$

$\therefore$ $\dfrac{dy}{y} = \dfrac{dx}{x}$

Now integrating both sides,

$$\int \frac{dy}{y} = \int \frac{dx}{x}$$

$\Rightarrow \log y = \log x + \log c$

$\Rightarrow \log y = \log c\,x$

$\therefore$ $y = cx$

$\therefore$ Option (b) is correct.

66. (a) $\sin\left(\dfrac{dy}{dx}\right) - a = 0$

$$\sin\left(\frac{dy}{dx}\right) = a$$

$$\Rightarrow \frac{dy}{dx} = \sin^{-1} a$$

$dy = \sin^{-1} a\,dx$

Now integrating both sides,

$$\int dy = \int \sin^{-1} a\,dx$$

$y = x \sin^{-1} a + c$

$\therefore$ Option (a) is correct.

67. (c) $\frac{dx}{dy} + \frac{x}{y} - y^2 = 0$

$\frac{dx}{dy} + \frac{x}{y} = y^2$

This is a linear differential equation of the form

$\frac{dx}{dy} + P_1 x = Q_1$

Here, $P = \frac{1}{y}$ and $Q = y^2$

$\therefore$ I.F. $= e^{\int P\,dy} = e^{\int \frac{1}{y} dy} = e^{\log y} = y$

So, required solution is

$x \cdot y = \int y^2 \cdot y\,dy + c$

$xy = \int y^3\,dy + c$

$xy = \frac{y^4}{4} + c$

$4xy = y^4 + c$

$\therefore$ Option (c) is correct.

68. (c) $\int \frac{x e^x}{(1+x)^2} dx$

$= \int e^x \left[\frac{1}{1+x} - \frac{1}{(1+x)^2}\right] dx$

$= \frac{e^x}{1+x} + C \qquad \left\{\int e^x \left(f(x) + f'(x)\right) dx = e^x f(x)\right\}$

69. (d) Area of $\Delta ABC = \frac{1}{2}\left(\overline{AB} \times \overline{AC}\right)$

$= \frac{1}{2}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -2 & 3 & 2 \\ -4 & 5 & 2 \end{vmatrix}$

$= \frac{1}{2}\left[\hat{i}(6-10) - \hat{j}(-4+8) + \hat{k}(-10+12)\right]$

$= \frac{1}{2}\left[-4\hat{i} - 4\hat{j} + 2\hat{k}\right]$

$= \frac{1}{2}\sqrt{16+16+4} = \frac{1}{2}\sqrt{36} = \frac{1}{2} \times 6$

$= 3$ square units

$\therefore$ Option (d) is correct.

70. (a) Moment of force, $m = \vec{r} \times \vec{F}$

$m = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -2 & -3 \\ 3 & 4 & -3 \end{vmatrix}$

$= \hat{i}(6+12) - \hat{j}(-6+9) + \hat{k}(8+6)$

$= 18\hat{i} - 3\hat{j} + 14\hat{k}$

$= \sqrt{(18)^2 + (-3)^2 + (14)^2}$

$= \sqrt{529} = 23$ units.

71. (a) $\vec{u} - \vec{v} = \vec{w}$

$\left(2x\vec{\alpha} + y\vec{\beta}\right) - \left(2y\vec{\alpha} + 3x\vec{\beta}\right) = 2\vec{\alpha} - 5\vec{\beta}$

$(2x - 2y)\vec{\alpha} + (y - 3x)\vec{\beta} = 2\vec{\alpha} - 5\vec{\beta}$

$\therefore$ $2x - 2y = 2$ ...(i)

and $3x - y = -5$ ...(ii)

Solving equations (i) and (ii), we get

$x = 2$ and $y = 1$

$\therefore$ Option (a) is correct.

72. (d) $|\vec{a}| = 7$, $|\vec{b}| = 11$ and $|\vec{a} + \vec{b}| = 10\sqrt{3}$

Now $|\vec{a} + \vec{b}|^2 = |\vec{a}|^2 + |\vec{b}|^2 + 2|\vec{a}||\vec{b}|\cos\theta$

$\therefore$ $\left(10\sqrt{3}\right)^2 = 49 + 121 + 2 \times 7 \times 7 \cos\theta$

$\therefore$ $300 = 170 + 154\cos\theta$

$\frac{300 - 170}{154} = \cos\theta$

$\therefore$ $\frac{65}{77} = \cos\theta$

Now, $|\vec{a} - \vec{b}|^2 = |\vec{a}|^2 + |\vec{b}|^2 - 2|\vec{a}||\vec{b}|\cos\theta$

$= (7)^2 + (11)^2 - 2 \times 7 \times 11 \times \frac{65}{77}$

$= 49 + 121 - 2 \times 65$

$= 170 - 130 = 40$

$\therefore$ $|\vec{a} - \vec{b}| = \sqrt{40} = 2\sqrt{10}$

$\therefore$ Option (d) is correct.

73. (a) α, β and γ be distinct real numbers

$\alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$

$\beta\hat{i} + \gamma\hat{j} + \alpha\hat{k}$

$\gamma\hat{i} + \alpha\hat{j} + \beta\hat{k}$

$\vec{a}$, $\vec{b}$ and $\vec{c}$ are collinear

If $a = \alpha$, $b = \beta$, $c = \gamma$ $\qquad (\because \alpha = \hat{i} + \hat{j} + \hat{k})$

Hence, the option (a) is correct.

74. (c) According to statements (1) and (2),

when $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, then both statements are correct.

If $\vec{a}\times\vec{b}=\vec{b}\times\vec{c}=\vec{c}\times\vec{a}=0$, then $\vec{a}$, $\vec{b}$ and $\vec{c}$ are collinear.

Therefore, option (c) is correct.

75. (c) If $\left|\vec{a}+\vec{b}\right|=\left|\vec{a}-\vec{b}\right|$

We know that when $\left(\vec{a}+\vec{b}\right)\cdot\left(\vec{a}-\vec{b}\right)=0$, then $\vec{a}$ is perpendicular to $\vec{b}$.

$=\vec{a}.\vec{a}-\vec{a}.\vec{b}+\vec{b}.\vec{a}-\vec{b}.\vec{b}=0$

$\vec{a}$ is perpendicular to $\vec{b}$

$\therefore$ Option (c) is correct.

76. (a) $G(x)=\sqrt{25-x^2}$

Now,

$$\lim_{x\to 1}\frac{G(x)-G(1)}{x-1}$$

$$\lim_{x\to 1}\frac{\sqrt{25-x^2}-\sqrt{24}}{x-1} \qquad (\div \text{ form})$$

Applying L'Hospital rule,

$$\lim_{x\to 1}\frac{(-2x)}{2\sqrt{25-x^2}}=\frac{-2}{2\sqrt{25-x^2}}$$

$$=\frac{-2}{2\sqrt{24}}=\frac{-1}{\sqrt{24}}=\frac{-1}{2\sqrt{6}}$$

$\therefore$ Option (a) is correct.

For (77-79)

77. (c) From statement -1

$$y=\frac{e^x+e^{-x}}{2}$$

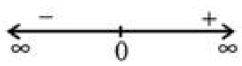
$$\therefore \frac{dy}{dx}=\frac{1}{2}[e^x-e^{-x}]$$

Now equating $\frac{dy}{dx}$ to zero we get,

$e^x-e^{-x}=0$

$\therefore e^x=e^{-x}$

$\therefore \frac{e^x}{e^{-x}}=1$



$\therefore e^{2x}=1$

$\therefore 2x=0$

$\therefore x=0$

The given function is increasing on interval $[0, \infty]$

From Statement -2

$$y=\frac{e^x-e^{-x}}{2}$$

$$\frac{dy}{dx}=\frac{1}{2}[e^x-e^x]$$

Now equating $\frac{dy}{dx}$ to zero, we get.

$e^x+e^{-x}=0$

$\therefore e^x+\frac{1}{e^x}=0$

$\therefore e^{2x}+1=0$

$\therefore e^{2x}=-1$

Hence, the given function is increacing from $[-\infty, \infty]$

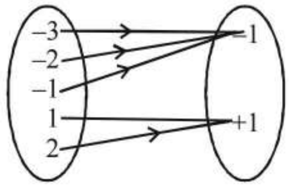
$\therefore$ Both statement are correct

$\therefore$ Option (c) is correct.

78. (c) For a non-zero real number x

$$f(x)=\frac{x}{|x|}$$

domain $f(x)=\frac{x}{|x|}$ range



Here we can not take value of 'x' as zero as (x) is non zero real number

for any value of x in domain a set consisting of two elements i.e. $(-1, +1)$

$\therefore$ Option (c) is correct.

79. (c) From statement-1

From the definition of greatest integer function

$f(x)=[x]$ is discontinuous at $x=n$ for any value of $n\in Z$

$\therefore$ Statement1 is correct

From statement-2

$f(x)=\cot x$

for $x=\pi=\cot\pi=-\infty$

for $x=2\pi$

$f(2\pi)=\cot 2\pi=-\infty$

Hence the function $f(x)=\cot x$ is discontinuous at $x=n\pi$ where $n\in Z$.

$\therefore$ Option (c) is correct.

80. (b) Let $y=\tan^{-1}\left[\frac{\sqrt{1+x^2}-1}{x}\right]$ and $u=\tan^{-1}x$

Put $x=\tan\theta\Rightarrow\theta=\tan^{-1}x$

Then, $y=\tan^{-1}\left[\frac{\sqrt{1+\tan^2\theta}-1}{\tan\theta}\right]$

$$=\tan^{-1}\left[\frac{\sqrt{\sec^2\theta}-1}{\tan\theta}\right]$$

$$= \tan^{-1}\left[\frac{\sec\theta - 1}{\tan\theta}\right] = \tan^{-1}\left[\frac{\frac{1}{\cos\theta} - 1}{\frac{\sin\theta}{\cos\theta}}\right]$$

$$= \tan^{-1}\left[\frac{1-\cos\theta}{\sin\theta}\right] = \tan^{-1}\left[\frac{2\sin^2\frac{\theta}{2}}{2\sin\frac{\theta}{2}, \cos\frac{\theta}{2}}\right]$$

$$\left(\because 1-\cos\theta = 2\sin^2\frac{\theta}{2} \text{ and } \sin x = 2\sin\frac{x}{2}\cdot\cos\frac{x}{2}\right)$$

$$= \tan^{-1}\left[\tan\frac{\theta}{2}\right]$$

$\Rightarrow \quad y = \frac{\theta}{2} \Rightarrow y = \frac{\tan^{-1}x}{2} \quad [\because \theta = \tan^{-1}x]$

$\Rightarrow \quad y = \frac{u}{2}$

$\frac{dy}{du} = \frac{1}{2}$

$\therefore$ Option (b) is correct.

81. (b)

For (82-83):

$$F(x) = \begin{cases} -1 & , \quad x \le 0 \\ ax+b & , \quad 0 < x < 1 \\ 1 & , \quad x \ge 1 \end{cases}$$

At $x = 0$,

L.H.L. = R.H.L.

$\lim_{x\to 0^-} f(x) = \lim_{x\to 0^+} f(x)$

$-1 = \lim_{x\to 0}(ax+b)$

$-1 = b$

Since the given function is also continuous at $x = 1$

L.H.L. = R.H.L.

$\lim_{x\to 1^-} f(x) = \lim_{x\to 1^+} f(x)$

$a + b = 1$

$a - 1 = 1$

$a = 1 + 1 = 2.$

82. (d) Function is continuous at $x = 0$

$\lim_{x\to 0^-} f(x) = \lim_{x\to 0^+} f(x)$

$-1 = a(0) + b \Rightarrow b = -1$

Now, f(x) is also continuous at $x = 1$

$\lim_{x\to 1^-} f(x) = \lim_{x\to 1^+} f(x)$

$a(1) + b = 1$

$a = 1 - b = 1 + 1$

$a = 2.$

83. (a) From solution 82, $b = -1$.

84. (c)

85. (b) Given that, $\int \frac{dx}{a\cos x + b\sin x} = \frac{1}{r}\ln\left[\tan\left(\frac{x+\alpha}{2}\right)\right]$

Let $a = r\sin\alpha$, $b = r\cos\alpha$

$\int \frac{dx}{r\sin\alpha\cos x + r\cos\alpha\sin x} = \frac{1}{r}\int\frac{1}{\sin(x+\alpha)}$

$= \frac{1}{r}\int \text{cosec}(x+\alpha)\,dx = \frac{1}{r}\ln\left[\tan\left(\frac{x+\alpha}{2}\right)\right]$

$a = r\sin\alpha \Rightarrow a^2 = r^2\sin^2\alpha$ ...(i)

$b = r\cos\alpha \Rightarrow b^2 = r^2\cos^2\alpha$ ...(ii)

Adding (i) and (ii), we get

$r^2 = a^2 + b^2$

$\Rightarrow \quad r = \sqrt{a^2 + b^2}.$

86. (a) $a = r\sin\alpha$ ...(i)

$b = r\cos\alpha$ ...(ii)

Dividing (i) from (ii),

$\frac{a}{b} = \tan\alpha$

$\alpha = \tan^{-1}\left(\frac{a}{b}\right).$

87. (b) Given $f(x) = \frac{x^2-1}{x^2+1}$

In order to find the value of 'x', where f(x) is maximum or minimum; equation $f'(x)$ equal to zero.

$$\therefore \quad f'(x) = \frac{\left(x^2+1\right)\frac{d}{dx}\left(x^2-1\right) - \left(x^2-1\right)\frac{d}{dx}\left(x^2+1\right)}{\left(x^2+1\right)^2}$$

$$\therefore \quad f'(x) = \frac{\left(x^2+1\right)(2x) - \left(x^2-1\right)(2x)}{\left(x^2+1\right)^2}$$

$$= \frac{2x\left[x^2+1-x^2+1\right]}{\left(x^2+1\right)^2}$$

$$\therefore \quad f'(x) = \frac{2x[2]}{\left(x^2+1\right)^2}$$

Now equating $f'(x)$ to zero, we get

$4x=0$

$\therefore$ $x=0$

Hence, $f(x)$ attain minimum value at $x=0$

$\therefore$ Option (b) is correct.

88. (c) $f(x)$ is minimum at $x=0$

$\therefore$ $f(0)=\frac{-1}{1}=-1$

$\therefore$ minimum value of $f(x)$ is -1

$\therefore$ Option (c) is correct.

89. (a) $f(x)=\begin{cases}\frac{\alpha\cos x}{\pi-2x} & \text{if } x\neq\frac{\pi}{2}\\ 3 & \text{if } x=\frac{\pi}{2}\end{cases}$

For continuity at $x=\frac{\pi}{2}$

L.H.L. $=\lim_{x\to\frac{\pi^-}{2}} f(x)=\lim_{x\to\frac{\pi^-}{2}}\frac{\alpha\cos x}{\pi-2x}$

Put $x=\frac{\pi}{2}-h$ where $x\to\frac{\pi}{2}$, then $h\to 0$

$\therefore$ L.H.L. $=\lim_{h\to 0}\frac{\alpha\cos\left(\frac{\pi}{2}-h\right)}{\pi-2\left(\frac{\pi}{2}-h\right)}=\lim_{h\to 0}\frac{\alpha\sin h}{\pi-\pi+2h}$

$\left[\because \cos\left(\frac{\pi}{2}-\theta\right)=\sin\theta\right]$

$=\lim_{h\to 0}\frac{2\alpha\sin h}{2h}=\frac{\alpha}{2}\lim_{h\to 0}\frac{\sin h}{h}$

$=\frac{\alpha}{2}\cdot 1=\frac{\alpha}{2}$ $\left[\because \lim_{\theta\to 0}\frac{\sin\theta}{\theta}=1\right]$

and R.H.L. $=\lim_{x\to\frac{\pi^+}{2}} f(x)\ \lim_{x\to\frac{\pi^+}{2}}\frac{\alpha\cos x}{\pi-2\pi}$

Put $x=\frac{\pi}{2}+h$ when $x\to\frac{\pi}{2}$, then $h\to 0$

$\therefore$ R.H.L. $=\lim_{h\to 0}\frac{\alpha\cos\left(\frac{\pi}{2}+h\right)}{\pi-2\left(\frac{\pi}{2}+h\right)}=\lim_{h\to 0}\frac{\alpha(-\sin h)}{\pi-\pi-2h}$

$=\lim_{h\to 0}-\frac{\alpha\sin h}{-2h}$ $\left[\because \cos\left(\frac{\pi}{2}+\theta\right)=-\sin\theta\right]$

$=\frac{\alpha}{2}\lim_{h\to 0}\frac{\sin h}{h}=\frac{\alpha}{2}$ $\left(\because \lim_{\theta\to 0}\frac{\sin\theta}{\theta}=1\right)$

Also, $f\left(\frac{\pi}{2}\right)=3$

Since, $f(x)$ is continuous at $x=\frac{\pi}{2}$

$\therefore$ L.H.L. = R.H.L. $=f\left(\frac{\pi}{2}\right)$

$\frac{\alpha}{2}=\frac{\alpha}{2}=3$

$\alpha=6$

Hence, for $\alpha=6$, the given function (f) is continuous at $x=\frac{\pi}{2}$.

90. (d) $\lim_{x\to 0} f(x)=\frac{\alpha\cos x}{\pi-2x}$

$=\frac{\alpha(\cos 0)}{\pi-2(0)}=\frac{6}{\pi}$

$\therefore$ Option (d) is correct.

91. (c) Mean $(\overline{X})=4$

Variance $(X)=2$

Number of observations = 10

New average $=\frac{(4\times 10)\times 2}{10}=8$

New variance $=(2)^2\times$ Variance (X)

$=4\times 2=8$

$\therefore$ Option (c) is correct.

92. (b) Geometric mean is used in construction of index numbers.

$\therefore$ option (b) is correct.

93. (a)

94. (a) Regression coefficients measures the degree of linear relationship between two variables and does not give the value by which one variable changes for a unit change in the other variable.

$\therefore$ option (a) is correct.

95. (a) The annual numerical data for comparable for last 12 years is represented by broken line graph, where each turning point represent the data of a particular year, while such graph do not depict the chronological change.

$\therefore$ Option (a) is correct.

96. (a) $P=P(E_1)\ P\left(\overline{E}_2\right)+P\left(\overline{E}_1\right)\ P(E_2)$

$$= \frac{1}{2}\left(1-\frac{1}{3}\right)+\left(1-\frac{1}{2}\right)\frac{1}{3}$$

$$= \frac{1}{2}\times\frac{2}{3}+\frac{1}{2}\times\frac{1}{3}$$

$$= \frac{1}{3}+\frac{1}{6}=\frac{1}{2}$$

$\therefore$ Option (a) is correct.

97. (b)

98. (d) $P = {}^5C_2\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^3 + {}^5C_3\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right)^2$

$$+{}^5C_4\left(\frac{1}{2}\right)^4\left(\frac{1}{2}\right)^1 + {}^5C_5\left(\frac{1}{2}\right)^5\left(\frac{1}{2}\right)^0$$

$$= \left(\frac{1}{2}\right)^5\left[{}^5C_2 + {}^5C_3 + {}^5C_4 + {}^5C_5\right]$$

$$= \frac{1}{3^2}[10+10+5+1]$$

$$= \frac{1}{3^2}\times 26 = \frac{13}{16}.$$

99. (c)

100. (b) $nP = 2$

$n\,Pq = 1$

$q = \frac{1}{2}$

$P + q = 1$

$P = 1 - \frac{1}{2} = \frac{1}{2}$

$n\left(\frac{1}{2}\right) = 2$

$\therefore$ $n = 4$

$${}^4C_0 = \left(\frac{1}{2}\right)^{4-0} = \frac{1}{16}.$$

101. (d) Mean of 5 numbers = 30

$\therefore$ Total sum of 5 numbers $= 30 \times 5 = 150$

After excluded one number

Mean of 4 numbers will be = 28

$\therefore$ Total sum of 4 numbers $= 4 \times 28 = 112$

Thus, excluded number

= (sum of 5 numbers – sum of 4 numbers)

$= 150 - 112 = 38$

$\therefore$ Option (d) is correct.

102. (b) $P(A \cup B) = \frac{3}{4}$

$P(A \cap B) = \frac{1}{4}$

$P(\overline{A}) = \frac{2}{3},\ P(A) = \frac{1}{3}$

$\therefore$ $P(B) = \frac{3}{4} - \frac{1}{3} + \frac{1}{4} = \frac{9-4+3}{12} = \frac{\cancel{8}}{\cancel{12}} = \frac{2}{3}$

$\therefore$ Option (b) is correct.

103. (a) The 'less than' ogive curve and the 'more than' ogive curve intersect at median.

$\therefore$ Option (a) is correct.

104. (c) $n(S) = 6 \times 6 = 36$

1,1	1, 2	1, 3	1, 4	1, 5	1,6
2, 1	2, 2	2, 3	2, 4	2, 5	2, 6
3,1	3,2	3, 3	3, 4	3, 5	3,6
4,1	4,2	4, 3	4, 4	4, 5	4,6
5,1	5,2	5, 3	5, 4	5, 5	5,6
6,1	6,2	6, 3	6, 4	6, 5	6,6

$\therefore$ Required number of exhausistance events

$= (6-1)\times(6-1) = 5 \times 5 = 25$

$\therefore$ Option (c) is correct.

105. (b) $P(A) = \frac{{}^4C_1}{{}^{52}C_1} = \frac{4}{52} = \frac{1}{13}$

$P(B/A) = \frac{{}^3C_1}{{}^{51}C_1} = \frac{3}{51} = \frac{1}{17}$

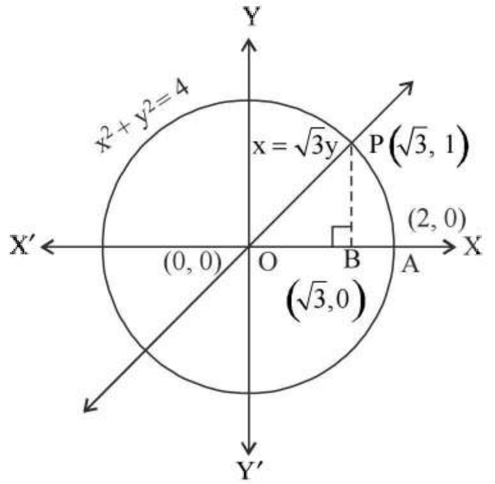
$\therefore$ Required probability $= \frac{1}{13}\times\frac{1}{17} = \frac{1}{221}$

$\therefore$ Option (b) is correct.

For (106-107)

$x^2 + y^2 = 4$ and $x = \sqrt{3}y$

$P(\sqrt{3}, 1)$ = First quadrant



The point of intersection of the line and the circle in the first quadrant is $(\sqrt{3}, 1)$.

Area of Δ OPA = Area of Δ OPB + Area PAB

$= \frac{1}{2} \times OB \times PB = \frac{1}{2} \times \sqrt{3} \times 1 = \frac{\sqrt{3}}{2}$

Area of PAB $\int_{\sqrt{3}}^{2} y\,dx$

$= \int_{\sqrt{3}}^{2} \sqrt{4-x^2}\,dx = \left[\frac{x}{2}\sqrt{4-x^2} + \frac{4}{2}\sin^{-1}\frac{x}{2}\right]_{\sqrt{3}}^{2}$

$\left[2 \times \frac{\pi}{2} - \frac{\sqrt{3}}{2}[\sqrt{4-3}] - 2\sin^{-1}\frac{\sqrt{3}}{2}\right]$

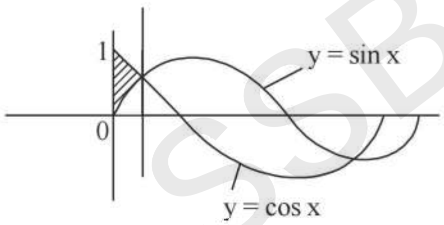
$= \pi - \frac{\sqrt{3}}{2} - \frac{2\pi}{3} = \frac{\pi}{3} - \frac{\sqrt{3}}{2}$

106. (a)

107. (a) Area enclosed by x-axis, the line $= \sqrt{3y}$, and the circle $x^2 + y^2 = 4$ in the first quadrant

$= \frac{\sqrt{3}}{2} + \frac{\pi}{3} - \frac{\sqrt{3}}{2} = \frac{\pi}{3}$

108. (a)



Area of shaded region $= \int_0^{\frac{\pi}{4}} (\cos x - \sin x)\,dx$

$= [\sin x + \cos x]_0^{\frac{\pi}{4}}$

$= \left[\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right) - (0+1)\right]$

$= \left(\sqrt{2} - 1\right)$ sq. units.

109. (a)

110. (c) $f(x) = 0.75x^4 - x^3 - 9x^2 + 7$

$f(0) = 7$

$f(-2) = 0.75(-2)^4 - (-2)^3 - 9(-2)^2 + 7$

$= 2 + 8 - 36 + 7 = -9$

$f(3) = 0.75(3)^4 - (3)^3 - 9(3)^2 + 7$

$= 60.75 - 27 - 81 + 7 = -40.25$

$\therefore$ maximum value of f(x) is 7

$\therefore$ Option (c) is correct.

111. (c) **From Statement 1:**

Function attain local minima at $x = -2$ and $x = 3$

As we have,

$f'(x) = 3x^3 - 3x^2 - 18x$

Now, $f''(x) = 9x^2 - 6x - 18$

For $x = -2$,

$f''(-2) = 9(-2)^2 - 6(-2) - 18$

$= 36 + 12 - 18 = 48 - 18$

$= 30 > 0$

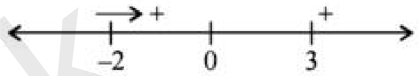
For $x = 3$,

$f''(3) = 9(3)^2 - 6(3) - 18$

$= 81 - 36 = 45 > 0$

$\therefore$ Statement 1 is correct

From Statement 2:



The function increases in the interval $(-2, 0)$

$\therefore$ Option (c) is correct.

112. (b) $x^2 + y^2 = \left[\frac{a\left(1-t^2\right)}{1+t^2}\right]^2 + \left[\frac{2at}{1+t^2}\right]^2$

$= \frac{a^2\left(1-t^2\right)^2}{\left(1+t^2\right)^2} + \frac{4a^2t^2}{\left(1+t^2\right)^2}$

$= \frac{a^2\left(1+t^4-2t^2\right) + 4a^2t^2}{\left(1+t^2\right)^2}$

$= \frac{a^2\left(1+t^4+2t^2\right)}{\left(1+t^2\right)^2} = \frac{a^2\left(1+t^2\right)^2}{\left(1+t^2\right)^2} = a^2$

Hence, the given equation represent a circle of radius (a)

$\therefore$ Option (b) is correct.

113. (d) Here, $x^2 + y^2 = a^2$

$\therefore \quad 2x + 2y\frac{dy}{dx} = 0$

$\therefore \quad \frac{dy}{dx} = \frac{2x}{-2y} = -\frac{x}{y}$

$\therefore$ Option (d) is correct.

114. (d) $\frac{d^2y}{dx^2} = \frac{y\frac{d}{dx}(-x) - (-x)\frac{dy}{dx}}{y^2}$

$= \frac{-y + x\frac{dy}{dx}}{y^2} = \frac{-y + x\left(\frac{-x}{y}\right)}{y^2}$

$$= \frac{-y^2 - x^2}{y^3} = \frac{-\left(x^2 + y^2\right)}{y^3} = -\frac{a^2}{y^3}$$

$\therefore$ Option (d) is correct.

115. (c) **Statement 1:**

The general solution of $\frac{dy}{dx} = f(x) + x$

Now integrating on both side

$$\int \frac{dy}{dx} = \int \left[f(x) + x\right] dx$$

$\therefore$ $y = f(x) + C$

$\therefore$ Statement 1 is correct.

Statement 2:

$$\frac{dy}{dx} = f(x) + c$$

Squaring both sides,

$$\left(\frac{dy}{dx}\right)^2 = \left(f(x) + c\right)^2$$

$$\left(\frac{dy}{dx}\right)^2 = \left[f(x)^2 + 2c\, f(x) + c^2\right]$$

Hence, the differential equation is of order –1 and degree –2.

$\therefore$ both Statements 1 and 2 are correct.

$\therefore$ Option (c) is correct.

116. (a) $\int \frac{dx}{\sqrt{x^2 + a^2}}$

Let $x = a \tan u$

$dx = a \sec^2 u\, du$

$$= \int \frac{a \sec^2 u\, du}{\sqrt{a^2 + \tan^2 u + a^2}}$$

$$= a \int \frac{\sec^2 u\, du}{\sqrt{a^2\left(1 + \tan^2 u\right)}} \Rightarrow \frac{a}{a} \int \frac{\sec^2 u\, du}{\sec u}$$

$$= \int \frac{\sec^2 u\, du}{\sec u} = \int \sec u\, du$$

$$= \ln[\tan(u) + \sec(u)] + c \qquad \left[\because \int \sec x\, dx = \tan x\right]$$

$$= \ln\left[\frac{x}{\sqrt{a^2}} + \sqrt{1 + \frac{x^2}{a^2}}\right] + c$$

$$= \ln\left[\frac{x}{a} + \frac{\sqrt{a^2 + x^2}}{a}\right] + c$$

$$= \ln\left[\frac{x + \sqrt{x^2 + a^2}}{a}\right] + c$$

$\therefore$ Option (a) is correct.

117. (a) $I_m = \int_0^{\pi} \frac{\sin 2mx}{\sin x} dx$

$\therefore$ $I_1 = \int_0^{\pi} \frac{\sin 2x}{\sin x} dx = \int_0^{\pi} \frac{2 \sin x \cos x}{\sin x} dx$

$$= 2\int_0^{\pi} \cos x\, dx = 2\left[\sin x\right]_0^{\pi} = 2\left[\sin \pi - \sin 0\right]$$

$= 2(0) = 0$

$\therefore$ Option (a) is correct.

118. (d) $I_2 = \int_0^{\pi} \frac{\sin 4x}{\sin x} dx = \int_0^{\pi} \frac{2 \sin 2x \cos 2x}{\sin x} dx$

$$= 2\int_0^{\pi} \frac{2 \sin x \cos x \cos 2x}{\sin x} dx$$

$$= 4\int_0^{\pi} \cos x\left(1 - 2\sin^2 x\right) dx$$

$$= 4\int_0^{\pi} \cos x\, dx - 8\int_0^{\pi} \cos x \sin^2 x\, dx = 0$$

Let $\sin x = t$

$\cos x\, dx = dt$

$= 4(\sin \pi - \sin 0) - 0 = 0$

$$I_3 = \int_0^{\pi} \frac{\sin 6x}{\sin x} dx$$

$$= \int_0^{\pi} \frac{2\left[3 \sin x - 4 \sin^3 x\right] \cos 3x}{\sin x} dx$$

$$= \int_0^{\pi} 2\left(3 - 4\sin^2 x\right) \cos 3x\, dx$$

$$= \int_0^{\pi} 6 \cos 3x\, dx - \int_0^{\pi} 8 \sin^2 x \cos 3x\, dx$$

$$= \frac{6 \sin 3x}{3}\Big|_0^{\pi} - 8 \cdot \frac{1}{2}\left[\int_0^{\pi} \sin x\left(\sin 4x - \sin 2x\right) dx\right]$$

$$= 6 - \frac{8}{2}\left[\int_0^{\pi} \left(\sin x \sin 4x - \sin x \cdot \sin 2x\right) dx\right]$$

$$= \frac{-8}{2}\left[\frac{1}{2}\int_0^{\pi} \cos 3x - \cos 5x - \cos x + \cos 3x\, dx\right]$$

$$= -2\left[\frac{2 \sin 3x}{3} - \frac{\sin 5x}{5} - \sin x\right]_0^{\pi} = 0$$

Hence, $I_2 + I_3 = 0 + 0 = 0$

$\therefore$ Option (d) is correct.

119. (a) $I_m = \int_0^{\pi} \frac{\sin 2mx}{\sin x} dx$

$= \int_0^{\pi} \frac{\sin 2m(\pi - x)}{\sin(\pi - x)} dx$

$= \int_0^{\pi} \frac{\sin(2m\pi - 2mx)}{\sin x} dx$

$= \int_0^{\pi} \frac{-\sin 2mx}{\sin x} dx$

$I_m = -\int_0^{\pi} \frac{\sin 2mx}{\sin x} dx$

$2I_m = 0 \Rightarrow I_m = 0.$

120. (a) $I_{2m} > I_m$ is wrong statement
Because, $I_m = I_{m-1} = ... = I_n$
Thus,
$I_m - I_{m-1} = 0$ is the only correct statement.
$\therefore$ Option (a) is correct.

GENERAL ABILITY

PART-A: ENGLISH

1. (a) Unless you stop making noise at once I will have no option but to bring the matter to the attention of the police.
2. (b) Instead of 'shed' it should be 'shedding'.
3. (c) Whether the principles he stood for or the benefits .....
4. (b) 'Later' half of the nineteenth century.
5. (b) No sooner did I open the door than the rain, heavy and stormy, rushed in making us shiver from head to foot.
6. (b) After opening the door we entered the room next to the kitchen.
7. (b) When the dentist came in my tooth stopped aching out of fear that I might lose my tooth.
8. (b) Emphasis on equality of life ensures the health and happiness of every individual.
9. (b) The students were awaiting the arrival of the chief guest.
10. (c) You will come to my party, won't you?
11. (c) Having read a number of stories about space travel he now dreams of visiting the moon.
12. (a) The meeting was abruptly adjourned by the Chairman after about three hours of deliberation.
13. (c) Not one of the hundreds of striking workers was allowed to go near the factory.
14. (c) If I had known this earlier I would have helped him.
15. (a) Mr.Smith was accused of murder but the court found him not guilty and acquitted him.
16. (b) Although India is still by and large a poor country, it can become rich if its natural and human resources are fully utilised.
17. (c) The more they earn, the more they spend.
18. (b) But in all these cases conversion from one scale to another is easy because scales are well-formulated.
19. (b) Five years ago on this date, I sat in a small Japanese car, driving across Poland towards Berlin.
20. (b) The old man felled some trees in the garden with hardly any effort at all.
21. (c) She says she's already paid me back, but I can't remember, so I 'll have to take her word for it.
22. (a) The workers are hell bent on getting what is due to them.
23. (d) You are warned against committing the same mistake again.
24. (c) While we would like all Indian children to go to school, we need to ponder why they do not.
25. (b) For these reasons we are all in favour of universal compulsory education.
26. (b) When it was feared that the serfs might go too far and gain their freedom from serfdom, the protestant leaders joined the princes in crushing them.
27. (d) In India today many of our intellectuals still talk in terms of the French Revolution and the Rights of Man, not appreciating that much has happened since then.
28. (a) Taxpayers have to be conscious of their privileges.
29. (a) I would have waited for you at the station if I had known that you would come.
30. (b) No one could explain how a calm and balanced person like him could perpetrate such a mindless act on his friends.
31. (d) The correct sequence is QSPR. The sentence S1 tells us about a small glass tube. The next sentence should be a description about the tube and hence Q. Now S should come next because it gives the introduction of the color change followed by Sentence P. Sentence S6 is in sync with Sentence R because they tell what will happen if the line is crossed. Thus R should come before S6.
32. (c) The correct sequence is RSQP. The sentence S1 describes how hope springs eternally in the heart of man. The next sentence should be R because it describes the elements of hope and how they are nursed by nature. Thus the next sentence should be S which describes the nature and ideal of hope. The following sentence should be Q because it describes love, friendship and youth perish and is in continuation of S. The next sentence should be its continuity that all these perish but hope remains and hence P. It is in continuation of S6.
33. (b) The correct sequence is RPSQ. The sentence S1 describes that Mr. Sherlock Holmes and Dr. Watson are spending a weekend in University town. The next sentence should be R because it is in continuation of S1 and describes where they are staying. The next sentence should be P because it describes the event that they get visited by Mr. Soames. Next sentence should be S because it describes Mr. Soames. The next sentence should be Q because it describes his state of mind and is in continuation of the S6 sentence.
34. (c)
35. (c) The correct sequence is QRPS. The sentence S1 talks about how our body never stops. The next sentence

should be Q because it describes that the body is continuously moving. The next sentence should be R because it describes that even while we are sleeping our body moves when we breathe. Following this sentence should be P which tells that fuel is needed for all these activities. Sentence S and S6 are in sync and continuation.

36. (c) The correct sequence is RPQS. The sentence S1 talks about the American idealism. The next sentence should be a continuation of the same describing the American idealism and hence R. The next sentence should be in continuance and thus P because it describes the idealism of American. The next sentence should be Q. Sentence S and S6 are in sync and continuation.

37. (b) Occurred is the most appropriate word.

38. (a). Followed is the most appropriate word.

39. (c) Evidence is the most appropriate word.

40. (b) Sound is the most appropriate word.

41. (b) down is the most appropriate word.

42. (a) With is the most appropriate word.

43. (a) Fired means dismiss (an employee) from a job. Its synonym is relived from the job. Rebuke and scolded means express sharp disapproval or criticism of (someone) because of their behaviour or actions. Attacked means criticize.

44. (c) Obliterate means destroy utterly; wipe out. Its synonym is erase. Demolish means to destroy(it is used generally for buildings). Extinguish means to wipe out.

45. (c) Ineffable means too great for words.

46. (c) Edifying means providing moral or intellectual instruction. Therefore its synonym is instructive. Tedious means monotonous. Exciting means appealing.

47. (a) Shabbily means showing signs of wear and tear; threadbare or worn-out. Its antonym is decently dressed meaning appropriately. Extravagant means indulgent and scantily means hardly dressed.

48. (c) Urbane means courteous and refined in manner, civilised. Its antonym is rude meaning uncivilised and disrespectful. Foolish means stupid. Slow means dumb.

49. (b) Thrifty means economical. Its antonym is extravagant meaning indulgent and wasteful. Expensive means costly. Good means fine.

50. (c) Pride means consciousness of one's own dignity. Its antonym is humility meaning humbleness. Lowliness means bashfulness, submission means compliance and obedience means good behaviour.

PART- B: GENERAL KNOWLEDGE

51. (b) Complete fertilisers are usually defined as fertilizers containing all three macronutrients: nitrogen, phosphorus and potassium (N, P, K)

52. (a) Commercial black powder looks black because the little lumps of the stuff are coated with graphite. In the manufacturing process, the powder's mixed with water or some other liquid binder, pressed into cakes and dried, then crushed and screened into powders of various particle size, larger particles producing a slower burn. The graphite serves no chemical purpose, but it lubricates the particles, and also makes the bulk powder electrically conductive enough that it is unlikely to initiate proceedings unexpectedly because of a static-electricity spark.

53. (a) NO_2 exists in equilibrium with the colourless gas dinitrogen tetroxide (N_2O_4). At higher temperature NO_2 is favoured while at low temperature N_2O_4 predominates.

54. (c) The refractive index of diamond is very high (2.417).

55. (c) Heating a mixture of potassium chlorate and manganese dioxide produces oxygen gas and manganese dioxide acts as a positive catalyst.

56. (a) Mass is an invariant quantity. Acceleration due to gravity (g) decreases with altitude as one rises above the Earth's surface because greater altitude means greater distance from the Earth's centre.

Weight , w = mass (m) × acc. due to gravity (g)

$$g_{height} = g/\left(1+\frac{h}{R}\right)^2.$$

Hence body weighs less on hill top than on earth's surface.

57. (a) An increased surface area means that more liquid will be exposed to air at one time, and therefore, more water can evaporate in a given time period.

58. (a) Diffuse reflection is the reflection of light from a rough surface such that an incident rays are reflected at many angles rather than at just one angle. In diffused reflection reflect rays are not parallel but obey laws of reflection

59. (a) Given : Frequency, $f = 3 \times 10^5$HZ

Speed of sound in medium $= 10 \times V_{air}$
$= 10 \times 300 = 3000$ m/s

As we know, $V = f\lambda$

or, $\lambda = V/f = \frac{3000}{3\times105} = 10^{-2}\,m = 10^{-2}\times 100 = 1\,cm$

60. (*) If the radius of the earth were to shrink by one percent, mass remaining the same, the value of g will increase by 2%.

$$g = \frac{GM}{R^2}$$

If mass remains constant, then $g \propto \frac{1}{R^2}$

% increase in g = 2 (% decrease in R)
= 2 × 1% = 2%

Therefore value of g will increase by 2%.

61. (c) Constant force means constant acceleration.

Now $s = ut + 1/2\, at^2$.

It represents a parabola.

62. (d) Surface tension is the elastic tendency of liquids which makes them acquire the least surface area possible. (a) (b) and (c) are due to surface tension.

63. (b) Sodium hydroxide is an alkali hydroxide. Calcium oxide is a base. Acetic acid is a weak acid and hydrochloric acid is a strong acid.

64. (c) Ratnagiri Bauxite mines are located in Maharashtra.
65. (b) Kamptee is a city and a municipal council in Nagpur district in the Indian state of Maharashtra. Rajahmundry is one of the major cities in the Indian state of Andhra Pradesh. Shahdol is a city in Shahdol district in the Indian state of Madhya Pradesh. Belagola is a village in the southern state of Karnataka, India.
66. (b) Telangana is bordered by the states of Maharashtra, Chhattisgarh to the north, Karnataka to the west, and Andhra Pradesh to the south, east and north east.
67. (a) Metabolism refers to all the physical and chemical processes in the body that convert or use energy, such as breathing, circulating blood, controlling body temperature, food digestion etc.
68. (d) The basic types of molecules are carbohydrates, lipids, proteins and nucleic acids.
69. (c) If the charged particle is moving along the magnetic field – parallel or antiparallel to the magnetic field–then there would be no force on it as $F = qv\,B\sin\theta$
70. (d) Once the light enters the end of the tube or fibre, it experiences total internal reflection because of the large angle of incidence.
71. (b) As the swing rises, its kinetic energy changes to potential energy; as with height potential energy P.E. = mgh increases. And according to law of conservation of energy total energy E = K.E + P. E constant.
72. (b) Gunpowder is a mixture of sulfur, charcoal, and potassium nitrate (saltpeter).
73. (a) A spherical aggregate of soap molecules in the soap solution in water is called micelle. When soap is dissolved in water, it forms a colloidal suspension in which the soap molecules cluster together to form spherical micelles.
74. (c) Fixation is commonly achieved by treating the film or paper with a solution of thiosulfatesalt. Popular salts are sodium thiosulfate-commonly called hypo-and ammonium thiosulfate–commonly used in modern rapid fixer formulae.
75. (b) The condition exists because warm moist air rises by orographic lifting to the top of a mountain range. As atmospheric pressure decreases with increasing altitude, the air has expanded and adiabatically cooled to the point that the air reaches its adiabatic dew point. At the adiabatic dew point, moisture condenses onto the mountain and it precipitates on the top and windward sides of the mountain.
76. (c) Jabalpur is the place of commercial automobiles. Bangalore is the IT hub. Mathura is famous for its petro-chemical industries. Ballarpur has paper industries.
77. (b) The total length of the canal along with its distributaries is 3,200 km and it irrigates about 4 lakh hectares in Ambala, Kurukshetra, Kamal, Panipat, Rohtak, Hissar, Sirsa, Faridabad and Jind districts. It's important branches are, the Delhi, the Hansi and the Sirsa branch.
78. (d) Cells are the smallest unit of life that can replicate independently, and are often called the "building blocks of life"
79. (b) In photosynthesis, oxygen is also released as a waste product.
80. (a) Large distance is measured in light year. Amount of a material is measured by mole. Amount of electrical charge is measured in coulomb. Energy is measured in watt hour.
81. (c) As we know refractive index

$$\mu = \frac{\text{velocity of light in vaccum}}{\text{velocity of light in medium}}$$. The velocity of light decreases as the ray passes from a rarer to a denser medium.
82. (b) When the object is located between F and optical centre, the image produced is virtual and magnified.
83. (d) Graphite contain free electrons in their structures and is thus a good conductor of electricity.
84. (c) Sodium carbonate is also known as washing soda, soda ash and soda crystals.
85. (d) In terms of percentage of forest cover with respect to total geographical area, Mizoram with 90.38 percent had the highest forest cover in terms of percentage of forest cover to Geographical area
86. (b) The Chandra Prabha Wildlife Sanctuary is situated in the eastern region of Uttar Pradesh. Silent Valley National Park is in Kerala. Valley of flowers is in Uttarakhand. Indravati National Park is the finest and most famous wildlife parks of Chhattisgarh.
87. (a) In astronomy, axial tilt (also called obliquity) is the angle between an object's rotational axis and the perpendicular to its Orbital plane, both oriented by the right hand rule. At an obliquity of 0°, these lines point in the same direction i.e. the rotational axis is perpendicular to the orbital plane. Axial tilt differs from inclination. Over the course of an orbit, the angle of the axial tilt does not change, and the orientation of the axis remains the same relative to the background stars. This causes one pole to be directed toward the Sun on one side of the orbit, and the other pole on the other side, the cause of the seasons on the Earth.
88. (a) The gametophyte is the multi-cellular structure (plant) that is haploid, containing a single set of chromosomes in each cell. The gametophyte produces male or female gametes (or both) by a process of cell division called mitosis.
89. (b) Seeds are the package of food. It contains embryo and is covered with a coat.
90. (d) Pressure, $P = F/A$; $P' = F/A/2 = 2F/A$; $P' = 2P$
91. (a) Latent heat is the energy absorbed or released at constant temperature per unit mass for change of state.
92. (c) As you descend, water pressure increases, and the volume of air in your body decreases. This can cause problems such as sinus pain or a ruptured ear drum.
93. (a) All materials are made up of negatively- and positively-charged particles. These usually exist in equal amounts, balancing each other out. But when two materials come into contact, one may 'steal' negatively-charged electrons from the other. One material ends up with more negative charges than positive ones, meaning

that it becomes negatively-charged overall, whilst the other becomes positively-charged. If the charges cannot move away as they are produced, they accumulate in the material as static charge, or electricity. Once you have built up a big enough static charge, an electric shock is almost inevitable. The moment you touch a conducting material such as metal, the excess electrons jump between your hand and the conductor, giving you a shock.

94. (c) Mercury in a glass flask is a good example of the effects of the ratio between cohesive and adhesive forces. Because of its high cohesion and low adhesion to the glass, mercury does not spread out to cover the top of the flask, and if enough is placed in the flask to cover the bottom, it exhibits a strongly convex meniscus, whereas the meniscus of water is concave. Mercury will not wet the glass, unlike water and many other liquids, and if the glass is tipped, it will 'roll' around inside.

95. (b) Permanent hardness of water is usually caused by the presence of calcium sulfate and/or magnesium sulfates in the water.

96. (d) 'C' acts as a reducing agent in this reaction. A reducing agent is a substance that loses electrons, making it possible for another substance to gain electrons and be reduced. The oxidized substance is always the reducing agent.

Reduction

$$\overset{+2}{Zn}O + \overset{0}{C} \longrightarrow \overset{0}{Zn} + \overset{+2}{C}O$$

Oxidation

97. (c) In organic farming, weed and pest control is based on methods like crop rotation, biological diversity, natural predators, organic manures and suitable chemical, thermal and biological intervention.

98. (c) Yakuts are the nomadic reindeer herder of Tundra.

99. (b) 1, 2 and 4 are correct.

100. (b) What makes humid tropical forests so productive is the combination of high temperatures, light, and rainfall year-round (good growing conditions) coupled with especially efficient nutrient recycling.

101. (d) Thyroid gland requires iodine to produce its hormone.

102. (d) A nerve is an enclosed, cable-like bundle of axons (the long, slender projections of neurons) in the peripheral nervous system. Neurons are sometimes called nerve cells, though this term is potentially misleading since many neurons do not form nerves, and nerves also include non-neuronal Schwann cells that coat the axons in myelin. Finally, the entire nerve is wrapped in a layer of connective tissue called the epineurium.

103. (c) Conductivity (σ) is the reciprocal of resistivity.

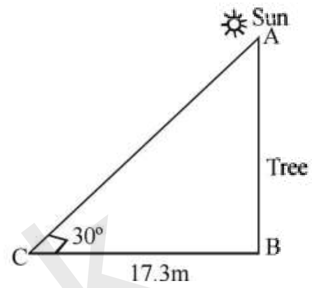
i.e., $\sigma = \dfrac{1}{\rho}$

104. (d) Compact Fluorescent Lamp is the energy saving lamp, designed to reduce the electric power consumption.

105. (c) From trigonometry $\tan 30° = \dfrac{\text{height of free AB}}{\text{BC}}$

$\therefore$ Height of tree, $AB = \tan 30° BC = \dfrac{1}{\sqrt{3}} \times 17.3$

$= 10$ cm



106. (b) A greenhouse gas (sometimes abbreviated GHG) is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone.

107. (*)

108. (c) Selva is dense equatorial forest, in the Amazon basin, characterized by tall broad-leaved evergreen trees, epiphytes, lianas, etc Taiga also known as boreal forest or snowforest, is a biome characterized by coniferous forests consisting mostly of pines, spruces and larches. In Tundra, the vegetation is composed of dwarf shrubs, sedges and grasses, mosses, and lichens. A Savannah or Savannah is a grassland ecosystem characterised by the trees being sufficiently widely spaced so that the canopy does not close.

109. (b) Only 1 and 2 are correct.

110. (a) A rapid fall of barometer reading means stormy conditions.

111. (a) Maldives consists of 1,192 coral islands. The island of Mauritius is relatively young geologically, having been created by volcanic activity some 8 million years ago. Madagascar is a special type of continental island is the microcontinental island, which results when a continent is rifted.

112. (d)

113. (c) Cirrus is a genus of atmospheric cloud generally characterized by thin, wispy strands. Stratus clouds are a genus of low-level cloud characterized by horizontal layering with a uniform base, as opposed to convective or cumuliform clouds that are formed by rising thermals. nimbus indicates a precipitating cloud. Cumulus clouds, being low-stage clouds, are generally less than 1,000 m (3,300 ft) in altitude unless they are the more vertical cumulus congestus form. Cumulus clouds may appear by themselves, in lines, or in clusters.

114. (c) Demographic transition (DT) refers to the transition from high birth and death rates to low birth and death rates as a country develops from a pre-industrial to an industrialized economic system.

115. (a) The human body converts beta-carotene into vitamin A (retinol) - beta-carotene is a precursor of vitamin A.

116. (c) In healthy adults, there are two normal heart sounds often described as a lub and a dub (or dup) that occur in sequence with each heartbeat. These are the first heart sound (S1) and second heart sound (S2) produced by the closing of the AV valves and semilunar valves, respectively.

117. (a) Tiny molecules in our atmosphere cause light to scatter. That's why our sky looks blue: it's because the atmosphere scatters the bluish component of white sunlight. And it's why the sun looks reddish when it's near the horizon. Sunlight encounters more air molecules when the sun is low in the sky than when the sun is overhead. Even more blue light is scattered away, leaving mostly the reddish scattering $\propto \frac{1}{\lambda^4}$ component of white sunlight to travel the straighter path to your eyes. So the setting and rising sun looks red.

118. (b) Among the three aluminium, copper and stainless steel copper is the best conduction of heat. Thermal conductivity (in W/m K) for copper, aluminium and stainless steel is 385, 205 and 50.2 respectively.

119. (b) This is because when we sweat, the liquid (sweat) present on our body takes the heat equivalent to the latent heat of vaporisation from our body and therefore we feel cool.

120. (b) $R_m = R_e/4$; $g_m = g_e/6$

$g = GM/R_2$

$g_e / g_m = (M_e/ R_e^2) / (M_m / R_m^2)$

$g_e / g_m = (M_e/ M_m) / (R_m/ R_e)^2$

$(M_e/ M_m) = (g_e / g_m) X (R_e / R_m)^2$

$= (6 g_m/ g_m) X (4 R_m / R_m)2$

$= 6 X 4 X 4 = 96 \approx 100$

121. (c) India scripted space history as the Indian Space Research Organisation (ISRO) successfully inserted its low-cost Mars Orbiter Mission (MOM) spacecraft, or Mangalyaan, into an orbit around the Red Planet in its very first attempt.

122. (d) The scientific goals of the mission focus on "elemental, isotopic, molecular and mineralogical composition of the cometary material, the characterization of physical properties of the surface and subsurface material, the large-scale structure and the magnetic and plasma environment of the nucleus.

123. (b) James Watson, one of the scientists credited with discovering the structure of DNA, recently made history when he became the first-ever living Nobel laureate to put his prize medal up for auction. On Dec. 4, 2014 his little gold medal is sold for a record-breaking $ 4.76 million.

124. (d) The two countries have created the U.S.-China Clean Energy Research Center, which facilitates collaborative work in carbon capture and storage technologies, energy efficiency in buildings, and clean vehicles. It includes continued funding for three existing tracks on building efficiency, clean vehicles and advanced coal technology and launching a new track on the energy-water nexus.

125. (b) The Late, Great Planet Earth is a religious book of Christianity. Silent Spring is an environmental science book written by Rachel Carson. Here I stand has been described as part manifesto, part autobiography of writer Paul Robeson. And then One day is the autobiography of Naseerudin Shah.

126. (d) Vijay Hazare died in December 2004 following prolonged illness caused by intestinal cancer. Wasim Raja died of a heart attack in Marlow, Buckinghamshire, England in August 2006 while playing cricket for the Surrey over-50s side. Phillip Hughes died because of sport-related blunt cerebro-vascular injury during the match at the Sydney Cricket Ground on 25 November 2014. Raman Lamba died after slipping into coma due to internal haemorrhage, three days after being hit on the temple by a cricket ball while fielding in Bangladesh's league cricket.

127. (c) Russian film Leviathan won the prestigious Golden Peacock Award for the best film at the 45th International Film Festival Of India.

128. (b) Boyhood, wins the Best Motion Picture Drama award at the 72nd Golden Globe Awards.

129. (c) East Zone won the Deodhar Cricket tournament after beating the defending champions West Zone in the final by 24 runs.

130. (c) Richard Flanagan on 14 October 2014 was announced as the winner of the 2014 Man Booker Prize for Fiction for The Narrow Road to the Deep North, published by Chatto & Windus.

131. (b) The Second Plan was particularly in the development of the public sector. The plan followed the Mahalanobis model, an economic development model developed by the Indian statistician Prasanta Chandra Mahalanobis in 1953.

132. (d) Kenoyer has suggested that state control may have been responsible for high level of standardisation in crafts that were considered to have a value in maintaining the socio-economic or ritual order and which used non-local raw materials and highly complex technologies.

133. (a) The statements 1 and 4 are correct.

134. (c) The First Buddhist council immediately following the death of the Buddha and the Second Buddhist council in the reign of Ashoka occurred in Patliputra and Rajgira. The Second Buddhist Council occurred in Vaisali.

135. (b) Makkhali Gosala (Pali; Sanskrit Gosala Maskariputra, c. 484 BCE) as the founder of the Ajivika sect; other sources state that Gosala was only a leader of a large Ajivika congregation of ascetics, but not the founder of the movement himself.

136. (d) Statements 1, 2 and 4 are correct.

137. (d) The statements (1) and (3) are correct.

138. (b) James Hargreaves spinning jenny was invented in 1764. John Kay's flying shuttle was invented in 1733. Samuel Crompton's mule was invented in 1779. Richard Awkwart's water frame was patented in 1769.

139. (a) Motilal Nehru narrated his experiences in the Soviet Union and condemned anti-soviet propaganda. He described the Public Safety Bill as' a direct attack on the Indian nationalism, on Indian National Congress' and as ' Slavery of India, Bill No.1".

140. (b) Lord Dufferin initially called Congress as representative of "microscopic minority of India" but later in the fourth session of Allahabad, the Government servants were disallowed to take part in the proceedings of the Congress.

141. (d) Kakori Revolution was a train robbery plan executed by Ram Prasad Bismil, Ashfaqulla Khan, Rajendra Lahiri, Chandrashekhar Azad, Sachindra Bakshi, Keshab Chakravarty, Manmathnath Gupta,Murari Sharma (fake name of Murari Lal Gupta) Mukundi Lal (Mukundi Lal Gupta) and Banwari Lal. Roshan Singh had not taken part in the Kakori conspiracy, yet he was arrested and confined to capital punishment of death sentence by the then British Government.

142. (c) The seven fundamental rights are Right to equality, Right to freedom, Right against exploitation, Right to freedom of religion, Cultural and Educational rights, Right to constitutional remedies and Right to life.

143. (a) Hind Swaraj or Indian Home Rule is a book written by Mohandas K. Gandhi in 1909. In the book Gandhi gives a diagnosis for the problems of humanity in modern times, the causes, and his remedy .

144. (b) The Seventh Schedule is given under Article 246 and includesThe union (central government) state, and concurrent lists of responsibilities.

145. (a) On 18 April 1951, Vinoba Bhave started his land donation movement at Pochampally of nalgonda district Telangana, the Bhoodan Movement.

146. (d) Acharya Vinoba Bhave, Jaya Prakash Narayan, Dada Dharmadhikari, Dhirendra Mazumdaar, Shankarrao Deo, K. G Mashruwala were active members of the Sarvodaya movement.

147. (a) The Article 368 deals with power of Parliament to amend the Constitution and its procedure.

148. (d) The unquestioned right of the Parliament to amend any part of the Constitution is not a basic feature of the Constitution of India.

149. (d) To render compulsory military service is not a fundamental duty of the Indian Citizens.

150. (c) All of these are correct.

NDA 2 2014 Question Paper

MATHEMATICS

1. Let X be the set of all citizens of India. Elements x, y in X are said to be related if the difference of their age is 5 years. Which one of the following is correct ?
   (a) The relation is an equivalence relation on X.
   (b) The relation is symmetric but neither reflexive nor transitive.
   (c) The relation is reflexive but neither, symmetric nor transitive.
   (d) None of the above

2. Consider the following relations from A to B where $A = \{u, v, w, x, y, z\}$ and $B = \{p, q, r, s\}$.
   1. $\{(u,p), (v,p), (w,p), (x,q), (y,q), (z,q)\}$
   2. $\{(u,p), (v,q), (w,r), (z,s)\}$
   3. $\{(u,s), (v,r), (w,q), (u,p), (v,q), (z,q),\}$
   4. $\{(u,q), (v,p), (w,s), (x,r), (y,q), (z,s),\}$

   Which of the above relations are not functions ?
   (a) 1 and 2 (b) 1 and 4
   (c) 2 and 3 (d) 3 and 4

3. If α and β are the roots of the equation $ax^2 + bx + c = 0$, where $a \neq 0$, then $(a\alpha + b)(a\beta + b)$ is equal to :
   (a) ab (b) bc
   (c) ca (d) abc

4. Let S denote set of all integers. Define a relation R on S as 'aRb if $ab \geq 0$ where $a, b \in S$'. Then R is :
   (a) Reflexive but neither symmetric nor transitive relation
   (b) Reflexive, symmetric but not transitive relation
   (c) An equivalence relation
   (d) Symmetric but neither reflexive nor transitive relation

5. The roots of the equation $2a^2x^2 - 2abx + b^2 = 0$ when $a < 0$ and $b > 0$ are :
   (a) Sometimes complex (b) Always irrational
   (c) Always complex (d) Always real

6. What is the sum of the two numbers $(11110)_2$ and $(1010)_2$?
   (a) $(101000)_2$ (b) $(110000)_2$
   (c) $(100100)_2$ (d) $(101100)_2$

7. Let N denote the set of all non-negative integers and Z denote the set of all integers. The function $f: Z \to N$ given by $f(x) = |x|$ is:
   (a) One-one but not onto (b) Onto but not one-one
   (c) Both one-one and onto (d) Neither one-one nor onto

8. If P and Q are two complex numbers, then the modulus of the quotient of P and Q is :
   (a) Greater than the quotient of their moduli
   (b) Less than the quotient of their moduli
   (c) Less than or equal to the quotient of their moduli
   (d) Equal to the quotient of their moduli

9. Let $z = x + iy$ Where x, y are real variables $i = \sqrt{-1}$. If $|2z - 1| = |z - 2|$, then the point z describes :
   (a) A circle (b) An ellipse
   (c) A hyperbola (d) A parabola

10. The sum of an infinite GP is x and the common ratio r is such that $|r| < 1$. If the first term of the GP is 2, then which one of the following is correct ?
    (a) $-1 < x < 1$ (b) $-\infty < x < 1$
    (c) $1 < x < \infty$ (d) None of these

11. A box contains 3 white and 2 black balls. Two balls are drawn at random one after the other. If the balls are not replaced, what is the probability that both the balls are black?
    (a) 2/5 (b) 1/5
    (c) 1/10 (d) None of these

12. For two variables x and y, the two regression coefficients are $b_{yx} = -3/2$ and $b_{xy} = -1/6$. The correlation coefficient between x and y is :
    (a) $-1/4$ (b) $1/4$
    (c) $-1/2$ (d) $1/2$

13. The variance of numbers $x_1, x_2 x_3, \ldots\ldots x_n$ is V. Consider the following statements :
    1. If every x_1 is increased by 2, the variance of the new set of the new set of numbers is V.
    2. If the numbers x_i is squared, the variance of the new set is V^2.

    Which of the following statements is/are correct ?
    (a) 1 only (b) 2 only
    (c) Both 1 and 2 (d) Neither 1nor 2

14. What is the mean of the squares of the first 20 natural numbers ?
    (a) 151.5 (b) 143.5
    (c) 65 (d) 72

15. p, q, r, s, t, are five numbers such that the average of p, q and r is 5 and that of s and t is 10. What is the average of all the five numbers ?
    (a) 7.75 (b) 7.5
    (c) 7 (d) 5

16. The cumulative frequency of the largest observed value must always be :
    (a) Less than the total number of observations
    (b) Greater than the total number of observations
    (c) Equal to total number of observations
    (d) Equal to mid point of the last class interval

17. It has been found that if A and B play a game 12 times, A wins 6 times, B wins 4 times and they draw twice. A and B take part in a series of 3 games. The probability that they win alternately, is :

(a) 5/12 (b) 5/36
(c) 19/27 (d) 5/27

18. Out of 7 consonants and 4 vowels, words are to be formed by involving 3 consonants and 2 vowels. The number of such words formed is :

(a) 25200 (b) 22500
(c) 10080 (d) 5040

19. Let X denote the number of scores which exceed 4 in 18, tosses of a symmetrical die. Consider the following statements :

1. The arithmetic mean of X is 6.
2. The standard deviation of X is 2.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

20. How many different words can be formed by taking four letters out of the letters of the word 'AGAIN' if each word has to start with A ?

(a) 6 (b) 12
(c) 24 (d) None of the above

21. The sum of the series formed by the sequence 3, $\sqrt{3}$, 1...... upto infinity is :

(a) $\frac{3\sqrt{3}(\sqrt{3}+1)}{2}$ (b) $\frac{3\sqrt{3}(\sqrt{3}-1)}{2}$

(c) $\frac{3(\sqrt{3}+1)}{2}$ (d) $\frac{3(\sqrt{3}-1)}{2}$

22. If $|z+\bar{z}|=|z-\bar{z}|$, then the locus of z is:

(a) A pair of straight lines
(b) A line
(c) A set of four straight lines
(d) A circle

23. The number 251 in decimal system is expressed in binary system by :

(a) 11110111 (b) 11111011
(c) 11111101 (d) 11111110

24. What is the argument of the complex number $\frac{(1+i)(2+i)}{3-i}$ where $i=\sqrt{-1}$?

(a) 0 (b) $\frac{\pi}{4}$

(c) $-\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

25. Consider the following statements in respect of the matrix

$$A=\begin{bmatrix} 0 & 1 & 2 \\ -1 & 0 & -3 \\ -2 & 3 & 0 \end{bmatrix}$$

1. The matrix A is skew-symmetric.
2. The matrix A is symmetric.
3. The matrix A is invertible.

Which of the above statements is/are correct ?

(a) 1 only (b) 3 only
(c) 1 and 3 (d) 2 and 3

26. Consider two matrices $A=\begin{bmatrix} 1 & 2 \\ 2 & 1 \\ 1 & 1 \end{bmatrix}$ and $B=\begin{bmatrix} 1 & 2 & -4 \\ 2 & 1 & -4 \end{bmatrix}$.

Which one of the following is correct ?

(a) B is the right inverse of A
(b) B is the left inverse of A
(c) B is the both sided inverse of A
(d) None of the above

27. One of the roots of

$$\begin{vmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{vmatrix}=0 \text{ is:}$$

(a) abc (b) $a+b+c$
(c) $-(a+b+c)$ (d) $-abc$

28. If A is any matrix, then the product AA is defined only when A is a matrix of order $m \times n$ where :

(a) $m>n$ (b) $m<n$
(c) $m=n$ (d) $m \le n$

29. The determinant of an odd order skew symmetric matrix is always :

(a) Zero (b) One
(c) Negative (d) Depends on the matrix

30. If any two adjacent rows or columns of a determinant are intercharged in position, the value of the determinant :

(a) Becomes zero (b) Remains the same
(c) Changes its sign (d) Is doubled

DIRECTION: (For the next three (03) items that follow):

In a survey of 25 students, it was found that 15 had taken Mathematics, 12 had taken Physics and 11 had taken Chemistry, 5 had taken Mathematics and Chemistry, 9 had taken Mathematics and Physics, 4 had taken Physics and Chemistry and 3 had taken all the three subjects.

31. The number of students who had taken only physics is :

(a) 2 (b) 3
(c) 5 (d) 6

32. The number of students who had taken only two subjects is :

(a) 7 (b) 8
(c) 9 (d) 10

33. Consider the following statements :

1. The number of students who had taken only one subject is equal to the number of students who had taken only two subjects.

2. The number of students who had taken at least two subjects is four times the number of students who had taken all the three subjects.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

DIRECTIONS: (For the next three (03) items that follow) :

In the expansion of $\left(x^3 - \frac{1}{x^2}\right)^n$ where n is a positive integer, the sum of the coefficients of x^5 and x^{10} is 0.

34. What is n equal to ?

(a) 5 (b) 10
(c) 15 (d) None of these

35. What is the value of the independent term ?

(a) 5005 (b) 7200
(c) –5005 (d) –7200

36. What is the sum of the coefficients of the two middle terms ?

(a) 0 (b) 1
(c) –1 (d) None of these

DIRECTIONS : (For the next three (03) items that follow) :

Given that $C(n, r) : C(n, r+1) = 1 : 2$ and $C(n, r+1) : C(n, r+2) = 2 : 3$.

37. What is n equal to ?

(a) 11 (b) 12
(c) 13 (d) 14

38. What is r equal to ?

(a) 2 (b) 3
(c) 4 (d) 5

39. What is $P(n, r) : C(n, r)$ equal to ?

(a) 6 (b) 24
(c) 120 (d) 720

40. The complete solution of $3\tan^2 x = 1$ is given by :

(a) $x = n\pi \pm \frac{\pi}{3}$ (b) $x = n\pi + \frac{\pi}{3}$ only

(c) $x = n\pi \pm \frac{\pi}{6}$ (d) $x = n\pi + \frac{\pi}{6}$ only

where $n \in Z$

41. What is the value of cos 36° ?

(a) $\frac{\sqrt{5}-1}{4}$ (b) $\frac{\sqrt{5}+1}{4}$

(c) $\frac{\sqrt{10+2\sqrt{5}}}{4}$ (d) $\frac{\sqrt{10-2\sqrt{5}}}{4}$

42. Consider the following statements :

1. Value of $\sin\theta$ oscillates between –1 and 1.
2. Value of $\cos\theta$ oscillates between 0 and 1.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

43. If x and y are positive and $xy > 1$, then what is $\tan^{-1}x + \tan^{-1}y$ equal to ?

(a) $\tan^{-1}\left(\frac{x+y}{1-xy}\right)$ (b) $\pi + \tan^{-1}\left(\frac{x+y}{1-xy}\right)$

(c) $\pi - \tan^{-1}\left(\frac{x+y}{1-xy}\right)$ (d) $\tan^{-1}\left(\frac{x-y}{1+xy}\right)$

44. Consider the following statements :

1. $n\left(\sin^2 67\frac{1°}{2} - \sin^2 22\frac{1°}{2}\right) > 1$ for all positive integers $n \geq 2$.
2. If x is any positive real number, then $nx > 1$ for all positive integers $n \geq 2$.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

45. Consider the following statements :

1. If 3θ is an acute angle such that $\sin 3\theta = \cos 2\theta$, then the mesurement of θ in radian equals to $\frac{\pi}{10}$.
2. One radian is the angle subtended at the centre of a circle by an arc of the same circle whose length is equal to the diameter of that circle.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

46. From an aeroplane above a straight road the angle of depression of two positions at a distance 20 m apart on the road are observed to be 30° and 45°. The height of the aeroplane above the ground is :

(a) $10\sqrt{3}$m (b) $10\left(\sqrt{3}-1\right)$m

(c) $10\left(\sqrt{3}+1\right)$m (d) 20m

47. Consider the following statements :

1. There exists no triangle ABC for which $\sin A + \sin B = \sin C$.
2. If the angle of a triangle are in the ratio 1 : 2 : 3, then its sides will be in the ratio $1 : \sqrt{3} : 2$.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

48. Consider the following statements :

1. $\sin|x| + \cos|x|$ is always positive.
2. $\sin(x^2) + \cos(x^2)$ is always positive.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

49. What is $\frac{1+\sin A}{1-\sin A}-\frac{1-\sin A}{1+\sin A}$ equal to ?
(a) $\sec A-\tan A$ (b) $2\sec A\,.\,\tan A$
(c) $4\sec A\,.\,\tan A$ (d) $4\operatorname{cosec} A\,.\,\cot A$

50. What is $\frac{\cot 224°-\cot 134°}{\cot 226°+\cot 316°}$ equal to ?
(a) $-\operatorname{cosec} 88°$ (b) $-\operatorname{cosec} 2°$
(c) $-\operatorname{cosec} 44°$ (d) $-\operatorname{cosec} 46°$

51. Consider the following statements :
1. $\tan^{-1} 1+\tan^{-1}(0.5)=\pi/2$
2. $\sin^{-1}(1/3)+\cos^{-1}(1/3)=\pi/2$
Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

52. If $A+B+C=\pi$, then what is $\cos(A+B)+\cos C$ equal to ?
(a) 0 (b) $2\cos C$
(c) $\cos C-\sin C$ (d) $2\sin C$

53. What is $\cos 20°+\cos 100°+\cos 140°$ equal to ?
(a) 2 (b) 1
(c) 1/2 (d) 0

54. What is $\sin^{-1}\sin\frac{3\pi}{5}$ equal to ?
(a) $\frac{3\pi}{5}$ (b) $\frac{2\pi}{5}$
(c) $\frac{\pi}{5}$ (d) None of these

55. What is $\sin^2(3\pi)+\cos^2(4\pi)+\tan^2(5\pi)$ equal to ?
(a) 0 (b) 1
(c) 2 (d) 3

56. Consider the following points :
1. (0, 5)
2. (2, –1)
3. (3, –4)
Which of the above lie on the line $3x+y=5$ and at a distance $\sqrt{10}$ from (1, 2) ?
(a) 1 only (b) 2 only
(c) 1 and 2 only (d) 1, 2 and 3

57. What is the equation of the line through (1, 2) so that the segment of the line intercepted between the axes is bisected at this point ?
(a) $2x-y=4$ (b) $2x-y+4=0$
(c) $2x+y=4$ (d) $2x+y+4=0$

58. What is the equation of straight line passing through the point (4, 3) and making equal intercepts on the coordinate axes ?
(a) $x+y=7$ (b) $3x+4y=7$
(c) $x-y=1$ (d) None of these

59. What is the equation of the line mid-way between the lines $3x-4y+12=0$ and $3x-4y=6$?
(a) $3x-4y-9=0$ (b) $3x-4y+9=0$
(c) $3x-4y-3=0$ (d) $3x-4y+3=0$

60. What is the sum of the major and minor axes of the ellipse whose eccentricity is 4/5 and length of latus rectum is 14.4 unit ?
(a) 32 units (b) 48 units
(c) 64 units (d) None of these

DIRECTIONS: (For the next three (03) items that follow) :

A straight line passes through (1, –2, 3) and perpendicular to the plane $2x+3y-z=7$.

61. What are the direction ratios of normal to plane ?
(a) <2, 3, –1> (b) <2, 3, 1>
(c) <–1, 2, 3> (d) None of these

62. Where does the line meet the plane ?
(a) (2, 3, –1) (b) (1, 2, 3)
(c) (2, 1, 3) (d) (3, 1, 2)

63. What is the image of the point (1, –2, 3) in the plane ?
(a) (2, –1, 5) (b) (–1, 2, –3)
(c) (5, 4, 1) (d) None of these

DIRECTIONS : (For the next three (02) items that follow) :

Consider the spheres $x^2+y^2+z^2-4y+3=0$ and $x^2+y^2+z^2+2x+4z-4=0$.

64. What is the distance between the centres of the two spheres ?
(a) 5 units (b) 4 units
(c) 3 units (d) 2 units

65. Consider the following statements :
1. The two spheres intersect each other.
2. The radius of first sphere is less than that of second sphere.
Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

DIRECTIONS: (For the next three (03) items that follow) :

The vertices of a triangle ABC are A (2, 3, 1), B (–2, 2, 0), and C (0, 1, –1).

66. What is the cosine of angle *ABC* ?
(a) $\frac{1}{\sqrt{3}}$ (b) $\frac{1}{\sqrt{2}}$
(c) $\frac{2}{\sqrt{6}}$ (d) None of these

67. What is the area of the triangle ?
(a) $6\sqrt{2}$ square unit (b) $3\sqrt{2}$ square unit
(c) $10\sqrt{3}$ square unit (d) None of these

68. What is the magnitude of the line joining mid points of the sides *AC* and *BC* ?
(a) $\frac{1}{\sqrt{2}}$ unit (b) 1 unit
(c) $\frac{3}{\sqrt{2}}$ unit (d) 2 unit

DIRECTIONS: (For the next two (02) items that follow) :

Consider the vectors $\bar{a} = \hat{i} - 2\hat{j} + \hat{k}$ and $\bar{b} = 4\hat{i} - 4\hat{j} + 7\hat{k}$.

69. What is the scalar projection of $\bar{a}$ on $\bar{b}$?

(a) 1 (b) 19/9
(c) 17/9 (d) 23/9

70. What is the vector perpendicular to both the vectors ?

(a) $-10\hat{i} - 3\hat{j} + 4\hat{k}$ (b) $-10\hat{i} + 3\hat{j} + 4\hat{k}$

(c) $10\hat{i} - 3\hat{j} + 4\hat{k}$ (d) None of these

DIRECTIONS: (For the next two (02) items that follow) :

Let a vector $\bar{r}$ make angle 60°, 30° with x and y-axes respectively.

71. What angle does $\bar{r}$ make with z-axis ?

(a) 30° (b) 60°
(c) 90° (d) 120°

72. What are the direction cosines of $\bar{r}$?

(a) $\left\langle \frac{1}{2}, \frac{\sqrt{3}}{2}, 0 \right\rangle$ (b) $\left\langle \frac{1}{2}, \frac{\sqrt{3}}{2}, 0 \right\rangle$

(c) $\left\langle \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0 \right\rangle$ (d) $\left\langle -\frac{1}{2}, \frac{\sqrt{3}}{2}, 0 \right\rangle$

DIRECTiONS : (For the next two (02) items that follow) :

Let $|\bar{a}| = 7$, $|\bar{b}| = 11$, $|\bar{a} + \bar{b}| = 10\sqrt{3}$

73. What is $|\bar{a} - \bar{b}|$ equal to ?

(a) $2\sqrt{2}$ (b) $2\sqrt{10}$
(c) 5 (d) 10

74. What is the angle between $(\bar{a} + \bar{b})$ and $(\bar{a} - \bar{b})$?

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$

(c) $\frac{\pi}{6}$ (d) None of these

75. A line passes through the points (6, –7, –1) and (2, –3, 1). What are the direction ratios of the line ?

(a) $<4, -4, 2>$ (b) $<4, 4, 2>$
(c) $<-4, 4, 2>$ (d) $<2, 1, 1>$

76. What is $\lim_{x \to 0} \frac{(1+x)^n - 1}{x}$ equal to ?

(a) 0 (b) 1
(c) n (d) $n - 1$

77. What is $\lim_{x \to 0} \frac{x}{\sqrt{1 - \cos x}}$ equal to ?

(a) $\sqrt{2}$ (b) $-\sqrt{2}$

(c) $\frac{1}{\sqrt{2}}$ (d) Limit does not exist

78. What is the derivative of $\sqrt{\frac{1 + \cos x}{1 - \cos x}}$?

(a) $\frac{1}{2}\sec^2 \frac{x}{2}$ (b) $-\frac{1}{2}\operatorname{cosec}^2 \frac{x}{2}$

(c) $-\operatorname{cosec}^2 \frac{x}{2}$ (d) None of these

79. What is $\int_0^1 \frac{e^{\tan^{-1} x} dx}{1 + x^2}$ equal to ?

(a) $e^{\frac{\pi}{4}} - 1$ (b) $e^{\frac{\pi}{4}} + 1$
(c) $e - 1$ (d) e

80. What is the slope of the tangent to the curve $y = \sin^{1}(\sin^2 x)$ at $x = 0$?

(a) 0 (b) 1
(c) 2 (d) None of these

81. The solution of $\frac{dy}{dx} = |x|$ is :

(a) $y = \frac{x|x|}{2} + c$ (b) $y = \frac{|x|}{2} + c$

(c) $y = \frac{x^2}{2} + c$ (d) $y = \frac{x^3}{2} + c$

Where c is an arbitary constant

82. What is the solution of $\frac{dy}{dx} + 2y = 1$ satisfying $y(0) = 0$?

(a) $y = \frac{1 - e^{-2x}}{2}$ (b) $y = \frac{1 + e^{-2x}}{2}$

(c) $y = 1 + e^{x}$ (d) $y = \frac{1 + e^{x}}{2}$

DIRECTION: (For the next two (02) items that follow) :

Consider the curve $y = e^{2x}$.

83. What is the slope of the tangent to the curve at (0, 1) ?

(a) 0 (b) 1
(c) 2 (d) 4

84. Where does the tangent to the curve at (0, 1) meet the x-axis ?

(a) (1,0) (b) (2,0)
(c) (–1/2, 0) (d) (1/2, 0)

DIRECTIONS: (For the next two (02) items that follow) :

Consider an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

85. What is the area of the greatest rectangle that can be inscribed in the ellipse ?

(a) ab (b) $2\,ab$
(c) $ab/2$ (d) $\sqrt{ab}$

86. What is the area included between the ellipse and the greatest rectangle inscribed in the ellipse ?
(a) $ab(\pi - 1)$ (b) $2ab(\pi - 1)$
(c) $ab(\pi - 2)$ (d) None of these

DIRECTION: For the next two (02) items that follow :

Consider the integrals

$$I_1 = \int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\tan x}} \text{ and } I_2 = \int_{\pi/6}^{\pi/3} \frac{\sqrt{\sin x}\,dx}{\sqrt{\sin x}+\sqrt{\cos x}}$$

87. What is $I_1 - I_2$ equal to ?
(a) 0 (b) $2I_1$
(c) π (d) None of the above

88. What is I_1 equal to ?
(a) $\pi/24$ (b) $\pi/18$
(c) $\pi/12$ (d) $\pi/6$

DIRECTION: For the next two (02) items that follow :

Consider the function $f(x) = \dfrac{1-\sin x}{(\pi - 2x)^2}$

Where $x \neq \dfrac{\pi}{2}$ and $f\left(\dfrac{\pi}{2}\right) = \lambda$

89. What is $\lim\limits_{x \to \frac{\pi}{2}} f(x)$ equal to ?
(a) 1 (b) 1/2
(c) 1/4 (d) 1/8

90. What is the value of λ if the function is continuous at $x = \dfrac{\pi}{2}$?
(a) 1/8 (b) 1/4
(c) 1/2 (d) 1

91. If $f(9) = 9$ and $f'(9) = 4$ then what is $\lim\limits_{x \to 9} \dfrac{\sqrt{f(x)} - 3}{\sqrt{x} - 3}$ equal to ?
(a) 36 (b) 9
(c) 4 (d) None of these

92. What is $\displaystyle\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} x \sin x \, dx$ equal to ?
(a) 0 (b) 2
(c) –2 (d) π

93. What is the general solution of the differential equation $x\,dy - y\,dx = y^2$?
(a) $x = cy$ (b) $y^2 = cx$
(c) $x + xy - cy = 0$ (d) None of these

Where c is an arbitrary constant

94. Consider the following statements :
1. The function $f(x) = \sqrt[3]{x}$ is continuous at all x except at $x = 0$.
2. The function $f(x) = [x]$ is continuous at $x = 2.99$ where [.] is the bracket function.

Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

95. Consider the following statements :
1. The function $f(x) = |x|$ is not differentiable at $x = 1$.
2. The function $f(x) = e^x$ is not differentiable at $x = 0$.

Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

96. If $z = f \circ f(x) = x^2$ where $f(x) = x^2$, then what is $\dfrac{dz}{dx}$ equal to ?
(a) x^3 (b) $2x^3$
(c) $4x^3$ (d) $4x^2$

DIRECTION: For the next two (02) items that follow :

Consider the function $f(x) = \dfrac{x^2 - x + 1}{x^2 + x + 1}$

97. What is the maximum value of the function ?
(a) 1/2 (b) 1/3
(c) 2 (d) 3

98. What is the minimum value of the function ?
(a) 1/2 (b) 1/3
(c) 2 (d) 3

DIRECTION: For the next three (03) items that follow :

Let $f(x)$ be a function defined in $1 \leq x < \infty$ by

$$f(x) = \begin{cases} 2 - x & \text{for } 1 \leq x \leq 2 \\ 3x - x^2 & \text{for } x > 2. \end{cases}$$

99. Consider the following statements :
1. The function is continuous at every point in the interval $(1, \infty)$.
2. The function is differentiable at $x = 1.5$.

Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

100. What is the differentiable coefficient of $f(x)$ at $x = 3$?
(a) 1 (b) 2
(c) –1 (d) –3

101. Consider the following statements :
1. $f'(2 + 0)$ does not exist.
2. $f'(2 - 0)$ does not exist.

Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

102. What is $\int_0^{\frac{\pi}{2}} \ln(\tan x)dx$ equal to ?

(a) ln 2 (b) –ln 2
(c) 0 (d) None of these

DIRECTIONS: (For the next three (03) items that follow) :
The general solution of the differential equation $(x^2 + x + 1) dy + (y^2 + y + 1) dx = 0$ is $(x + y + 1) = A(1 + Bx + Cy + Dxy)$ where B, C and D are constants and A is parameter.

103. What is B equal to ?
(a) –1 (b) 1
(c) 2 (d) None of these

104. What is C equal to ?
(a) 1 (b) –1
(c) 2 (d) None of these

105. What is D equal to ?
(a) –1 (b) 1
(c) –2 (d) None of these

106. Consider the following statements :
1. The function $f(x) = \sin x$ decreases on the interval $(0, \pi/2)$.
2. The function $f(x) = \cos x$ increases on the interval $(0, \pi/2)$.

Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

107. What is the number of arbitrary constants in the particular solution of differential equation of third order ?
(a) 0 (b) 1
(c) 2 (d) 3

108. What is the equation of a curve passing through (0, 1) and whose differential equation is given by $dy = y \tan x\, dx$?
(a) $y = \cos x$ (b) $y = \sin x$
(c) $y = \sec x$ (d) $y = \text{cosec } x$

109. Consider the following statements in respect of the differential equation

$$\frac{d^2y}{dx^2} + \cos\left(\frac{dy}{dx}\right) = 0$$

1. The degree of the differential equation is not defined.
2. The order of the differential equation is 2.

Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

110. What is the equation of parabola whose verted is at (0, 0) and focus is at (0, –2) ?
(a) $y^2 + 8x = 0$ (b) $y^2 - 8x = 0$
(c) $x^2 + 8y = 0$ (d) $x^2 - 8y = 0$

DIRECTIONS: (For the next four (04) items that follow) :
Number of X is randomly selected from the set of odd numbers and Y is randomly selected from the set of even numbers of the set {1, 2, 3, 4, 5, 6, 7}. Let Z = (X + Y)..

111. What is $P(Z = 5)$ equal to ?
(a) 1/2 (b) 1/3
(c) 1/4 (d) 1/6

112. What is $P(Z = 10)$ equal to ?
(a) 0 (b) 1/2
(c) 1/3 (d) 1/5

113. What is $P(Z = 11)$ equal to ?
(a) 0 (b) 1/4
(c) 1/6 (d) 1/12

114. What is P(Z is the product of two prime numbers) equal to ?
(a) 0 (b) 1/2
(c) 1/4 (d) None of these

DIRECTIONS: (For the next three (03) items that follow) :
Number of telephone calls received in 245 succesive one minute intervals at an exchange is given below in the following frequency distribution.

Number of calls	0	1	2	3	4	5	6	7
Frequency	14	21	25	43	51	40	39	12

115. What is the mean of the distribution ?
(a) 3.76 (b) 3.84
(c) 3.96 (d) 4.05

116. What is the median of the distribution ?
(a) 3.5 (b) 4
(c) 4.5 (d) 5

117. What is the mode of the distribution ?
(a) 3 (b) 4
(c) 5 (d) 6

DIRECTIONS: (For the next three (03) items that follow) :
The mean and standard deviation of 100 items are 50, 5 and that of 150 items are 40, 6 respectively.

118. What is the combined mean of all 250 items ?
(a) 43 (b) 44
(c) 45 (d) 46

119. What is the combined standard deviation of all 250 items ?
(a) 7.1 (b) 7.3
(c) 7.5 (d) 7.7

120. What is the variance of all 250 items ?
(a) 50.6 (b) 53.3
(c) 55.6 (d) 59.6

GENERAL ABILITY

PART-A : ENGLISH

DIRECTIONS: *In this section, you have to spot errors in sentences. Read each sentence to find out whether there is an error in any underlined part. Errors, if any, are only in the underlined parts. No sentence has more than one error. Letters (a), (b) and (c) have been placed beneath the underlined parts for their identification. When you find an error in any one of the underlined parts, indicate your response on the separate Answer Sheet in the relevant column. You may feel that there is no erro in the sentence. In that case, letter (d) will signify a 'No error' response.*

1. The pile of books are missing. No error
   (a) (b) (c) (d)
2. Either he or I are wrong. No error
   (a) (b) (c) (d)
3. Please tell to him to do his work. No error
   (a) (b) (c) (d)
4. Though he is good he is mischievous. No error
   (a) (b) (c) (d)
5. The thief hit me suddenly and hardly. No error
   (a) (b) (c) (d)
6. The number of books in our library is less. No error
   (a) (b) (c) (d)
7. The general said, "Soldiers, do not fire till I will give the
   (a) (b) (c)
   order". No error
   (d)
8. Neither of the candidates are good. No error
   (a) (b) (c) (d)
9. This machine is more efficient than any other equipments
   (a) (b) (c)
   in the workshop. No error
   (d)
10. The tin deposits in that area would probably be exhausted
    (a) (b)
    in to near future. No error
    (c) (d)
11. The operation of this machine is different to that of the
    (a) (b) (c)
    other. No error
    (d)

DIRECTIONS: *Look at the underlined part of each sentence. Below each sentence three possible substitutions are given for the underlined part. If one of them, i.e., (a), (b) or (c) is better than the underlined part, indicate your response on the Answer Sheet against the corresponding letter. If none of the substitutions improves the sentence, indicate (d) as your response on the Answer Sheet.*

12. I don't remember exactly when did I go to Shimla last year.
    (a) when I did go (b) when I was going
    (c) when I went (d) No improvement
13. Even he worked hard, he failed in the examination.
    (a) Since (b) Although
    (c) For (d) No improvement
14. He was asked to arbitrate with two merchants in a dispute.
    (a) to arbitrate between (b) to arbitrate at
    (c) to arbitrate (d) No improvement
15. He is definitely the cleverer among the two.
    (a) in (b) of
    (c) than (d) No improvement
16. He is resembling his father.
    (a) has resembled (b) was resembling
    (c) resembles (d) No improvement
17. Would you mind closing the window?
    (a) to close (b) in closing
    (c) for close (d) No improvement
18. I can be grateful if you could write to me about it.
    (a) would be (b) should be
    (c) must be (d) No improvement
19. A majority of the passengers could have been saved if the driver had applied the brakes in time
    (a) have been saved (b) may have been saved
    (c) could have saved (d) No improvement
20. He is living in this house for the past ten years.
    (a) was living (b) had been living
    (c) has been living (d) No improvement
21. He is knowing the secret.
    (a) knows (b) has been knowing
    (c) was knowing (d) No improvement
22. The meeting has been put off to Friday next.
    (a) put on (b) put out
    (c) put for (d) No improvement
23. If you will come with me I shall be happy.
    (a) come with me (b) had come with me
    (c) came with me (d) No improvement

DIRECTIONS: *Each of the items in this section contains a blank followed by words listed as (a), (b), (c) and (d). Choose the most appropriate word to fill in the blank and indicate your response in the answer sheet accordingly.*

24. When the police arrived, the thief ______ away.
    (a) strolled (b) moved
    (c) galloped (d) ran
25. His ______ as an officer was not quite satisfactory.
    (a) acting (b) doing
    (c) deed (d) record
26. The two children stood at the ______ of the table.
    (a) conclusion (b) terminal
    (c) end (d) termination
27. The old man was ______ weak to open the door.
    (a) very (b) far
    (c) much (d) too

DIRECTIONS: *Each question in this section consists of a word printed in capital letters followed by words listed as (a), (b), (c) and (d). Choose from these the word that has most nearly the meaning* ***opposite*** *to the word in capital letters and indicate your response in the Answer Sheet accordingly.*

28. FRAIL
    (a) strong (b) big
    (c) old (d) weak
29. INDIGENOUS
    (a) genuine (b) foreign
    (c) indigent (d) indignant

30. POVERTY
(a) prosperity (b) adversary
(c) adversity (d) diversity

31. WHOLESOME
(a) complete (b) unhealthy
(c) incomprehensible (d) few

DIRECTIONS: *Read the following short passage. After each passage, you will find several questions based on what is stated or implied in the passages. Answer the questions that follow each passage.*

PASSAGE - I

In a free country, the man who reaches the position of leader is usually one of the outstanding character and ability. Moreover, it is usually possible to foresee that he will reach such a position, since early in life one can see his qualities of character. But this is not always true in the case of a dictator; often he reaches his position of power through chance, very often through the unhappy state of his country. It is possible that Hitler would never have become the leader of Germany if that country had not been driven to despair.

32. In a free country, one who becomes a leader
(a) must be of outstanding character and ability
(b) must show qualities of character from an early age
(c) is generally of a remarkable character and ability
(d) must see that his country is free from despair

33. Hitler became a leader because
(a) he exhibited leadership qualities
(b) Germany was a free country
(c) Germany was in despair
(d) Germans wanted a dictator

34. The passage seems to suggest that
(a) despair sometimes leads to dictatorship
(b) Hitler was no leader
(c) a leader is chosen only by a free country
(d) a leader foresees his future position

PASSAGE - II

The dog is a very intelligent animal and it can be trained for many duties. Some dogs work with the police and the army as sentries and trackers, and there are medals that are awarded to dogs for bravery in action. Other dogs act as seeing-eyes for the blind, and some breeds are specially trained for rescue work among mountains and snow. Jobs like herding sheep and cattle and guarding homes are also done by them. Whenever man lives and works in the Arctic Circle, in the desert, in the jungle, in the moors or mountains, the dog is his faithful companion and help. A common mongrel may possess these qualities just as much as the aristocratic bloodhound.

35. The passage tells us that dogs
(a) can be trained to do different kinds of work
(b) are capable of difficult work
(c) are of different types
(d) alone are a great help to man

36. Medals are awarded to some dogs for
(a) their brave deeds
(b) working with the police
(c) serving as sentries
(d) being able to perform difficult work

37. The passage implies that
(a) only dogs are faithful but not man
(b) man would have felt helpless without dogs
(c) the dog has certain qualities that make it man's trustworthy companion
(d) dogs can do almost anything

38. The phrase 'aristocratic bloodhound' in the passage means
(a) the dog kept by wealthy people
(b) a pedigree dog
(c) a dog fond of blood
(d) any big dog

DIRECTIONS: *In the following passage at certain points, you are given a choice of three words marked (a), (b) and (c), one of which fits the meaning of the passage. Choose the best word out of the three. Mark the letter, viz., (a), (b) or (c), relating to this word on your answer sheet. Examples **K** and **L** have been solved for you.*

The **K.** (a) boy was in the school in Shimla. **L.** (a) She was homesick.
(a) boy (b) Horse
(c) dog

Explanation: One of the list given in item **K**, only 'boy' is the correct answer because usually, a boy, and not a horse or a dog, attends school. So (a) is to be marked on the Answer Sheet for item **K**. A boy is usually referred to as 'he', so for item **L**, (c) is the correct answer. Notice that to solve the first item **K**, you have to read the rest of the sentence and then see what fits the best.

PASSAGE

Drobny defied the critics. He had played through the Wimbledon fortnight and reached the final. Could he win just one more match and take the crown, or would he fail again at the last test and justify those who said that he lacked that little extra something that makes the champion? His opponent was the Australian Ken Rosewall, **39. (a) that/ (b) a/ (c) the** brilliant youngster and already a master **40. (a) with / (b) of/ (c) for** world experience behind him. Jaroslav Drobny, **41. (a) a/ (b) that/ (c) the** son of a Czech carpenter who **42. (a) had/ (b) was/ (c) has** started the boy off at the **43. (a) age/ stage/ (c) career** of five with a wooden 'bat' in lieu **44. (a) for/ (b) of/ (c) to** a racquet, went on **45. (a) to/ (b) for/ (c) with** the famous Centre Court at Winbledon **46. (a) in/ (b) on/ (c) that** day with the full knowledge that this **47. (a) can/ (b) must/ (c) would** be the game of his **48. (a) life/ (b) age / (d) day** He had kept on typing, and **49. (a) he/ (b) one/ (c) you** could keep on trying, but **50. (a) games/ (b) matches/ (c) opportunities** would become fewer and fewer. He knew that he had to gain an advantage from the start, and he had this young rival set off against him.

PART- B: GENERAL KNOWLEDGE

51. Which of the following statements about the Progressive Writers' Association, which created a generation of creative people, is/are correct?
1. It thought critically about the poverty and hunger of the Indian people.
2. It brought out of the positive developments of colonialism.
3. Its creative pursuit began with a critical evaluation of Gandhian politics.
4. It planned India's development model.

Select the correct answer using the code given below.
(a) 1 only (b) 2 and 3
(c) 1 and 4 (d) 1 and 3

52. E. V. Ramaswami Naicker was associated with
1. reforming Brahminism
2. the Self-Respect Movement
3. the Low Caste Movement
4. the Communist Movement

Select the correct answer using the code given below.
(a) 1, 2, 3 and 4 (b) 1 and 3 only
(c) 1 and 4 only (d) 2 and 3 only

53. Consider the following statements about 'Param Vir Chakra':
1. It is the highest peacetime gallantry award.
2. It is the replacement of British Victoria Cross.
3. It can be awarded to civilians.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) 2 and 3 only (d) 1, 2 and 3

54. Gandhiji's 'Harijan Campaign' sought to
1. attack caste system as a whole
2. open wells, road, temples, etc to Harijans
3. encourage social work among Harijans

Select the correct answer using the code given below.
(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 3 only

55. The Salt Satyagraha called by Mahatma Gandhi saw the
1. violation of salt laws along coastal India
2. participation of women
3. upward swing when it came to the working class joining in

Select the correct answer using the code given below.
(a) 1 and 3 only (b) 2 only
(c) 1 and 2 only (d) 1, 2 and 3

56. What was the code name for the Indian Air Force operations during the Kargil Conflict of 1999?
(a) Operation Vijay
(b) Operation Meghdoot
(c) Operation Indradhanush
(d) Operation Safed Sagar

57. During the Civil Disobedience Movement, tribals in Chota Nagpur
1. gave up opium consumption
2. wore Khadi
3. gave up drinking liquor and eating meat.

Select the correct answer using the code given below.
(a) 1 and 3 only (b) 1 only
(c) 1, 2 and 3 (d) 2 and 3 only

58. Which of the following was/were the new feature/features visible in the Quit India Movement (1942)?
1. Large-scale movements in some of the industrial areas.
2. Large-scale mass involvement in some of the Princely States
3. Increase in the activities of the Kisan Sabha

Select the correct answer using the code given below.
(a) 1, 2 and 3 (b) 1 only
(c) 1 and 3 only (d) 3 only

59. The Financial Sector Legislative Reforms Commission report submitted recently, among others, contained which of the following proposals?
1. All regulators will have an empowered board, the role of each of the members has been defined.
2. The Commission envisages an important process of judicial review of the regulations.
3. The draft code does not mention about executive powers.

Select the correct answer using the code given below.
(a) 1 and 2 only (b) 2 only
(c) 1 and 3 only (d) 1, 2 and 3

60. The Swadeshi Movement evoked serious responses in
(a) Madras and Hyderabad
(b) Bengal and Maharashtra
(c) Bihar and Orissa
(d) The Princely States

61. Who among the following was associated with the Gudem-Rampa Rebellion?
(a) Birsa Munda (b) Kushal Konwar
(c) Alluri Sitarama Raju (d) Mangal Pandey

62. The Bali Ministerial Declaration and the ministerial decisions that were adopted on 7th December, 2013 contained several issues. Which of the following are related to the Least-Developed Countries?
1. Preferential Rules of Origin for Least-Developed Countries
2. Operationalization of the Waiver Concerning Preferential Treatment to Services
3. Duty-Free and Quota-Free (DFQF) Market Access for Least-Developed Countries

Select the correct answer using the code given below.
(a) 1, 2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

63. The 'Doctrine of Lapse' was a policy that aimed to
(a) control the rebellions in the Princely States
(b) extend the military strength of the British
(c) regulate the landlords
(d) extend the territorial boundaries of the English East India Company

64. The Permanent Settlement of 1793 introduced
- (a) peasant rights
- (b) bourgeois property rights in land to Zamindars
- (c) shipping rights for the English East India Company
- (d) rights for women to have property rights

65. Which of the following is/are true relating to the Lokpal Bill, 2013, which was assented to by the President on 1st January, 2014?
1. It provides for creation of antigraft ombundsman to investigate corruption charges against public functionaries including the Prime Minister, Ministers and Members of the Parliament.
2. The Bill makes it incumbent upon States to make within a year their own law for setting up Lokayuktas on the lines of the Lokpal Bill.
3. States are free not to set up Lokayuktas, if they do not so desire.

States the correct answer using the code given below.
- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 only
- (d) 1, 2 and 3

66. Who among the following was associated with the Hindustan Socialist Republican Association?
- (a) Subhash Chandra Bose
- (b) Mahatma Gandhi
- (c) Bhagat Singh
- (d) Laxmi Sehgal

67. The Indian National Army was organized to fight against
- (a) Germany and Japan
- (b) the British in India
- (c) Japan
- (d) Russia

68. Which of the following is/are true relating to Nelson Mandela?
1. He was the first President of South Africa.
2. Mandela spent 18 years in prison on Robben Island.
3. Mandela became the President in 1990 after his release from the prison.

Select the correct answer using the code given below
- (a) 1 and 3 only
- (b) 2 and 3 only
- (c) 2 only
- (d) 1, 2 and 3

69. The Non-Cooperation Movement was withdrawn for the
- (a) First World War
- (b) Chauri-Chaura Incident
- (c) Bardoli Satyagraha
- (d) Gandhi-Irwin Pact

70. Which of the following books was written by B. R. Ambedkar?
- (a) The Discovery of India
- (b) My Life
- (c) Buddha or Karl Marx
- (d) Hind Swaraj

71. Which of the following is/are correct relating to the North-Eastern Region Community Resources Management Project for upland areas?
1. It is a livelihood and rural development project aimed to transform the lives of the poor and marginalized tribal families in North-East India.
2. This Project is initiated exclusively by the North-Eastern Council.

Select the correct answer using the code given below.
- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

72. Which of the following statements are true for the Fundamental Right to Life and Personal Liberty as guaranteed under Article 21 of the Constitution of India?
1. The Right is available to citizens as well as aliens.
2. It covers protection against arbitrary executive and legislative action.
3. It includes the right to live with human dignity.
4. It can be taken away according to the procedure established by law.

Select the correct answer using the code given below.
- (a) 1, 2 and 3 only
- (b) 2, 3 and 4 only
- (c) 1, 2, 3 and 4
- (d) 1 and 4 only

73. Consider the following statements:
1. 'SAMRATH 2014' a national festival for showcasing the abilities of persons with disabilities, was organized recently in New Delhi by the Ministry of Culture.
2. India is a party to the United Nations Convention on the Rights of Persons with Disabilities.

Which of the statements given above is/are correct?
- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

74. Consider the following statements about 'Sahayog Kaijin':
1. It is a joint exercise of the Coast Guards of India and Japan.
2. Its 13th edition was held recently off Chennai Port.

Which of the statements given above is/are correct?
- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

75. Consider the following statements about grand slam tennis tournaments:
1. There are four grand slam annual tennis tournaments.
2. The first grand slam of a year is the US Open.
3. The Australian and the US tournaments are played on grass court.

Which of the statements given above is/are correct?
- (a) 1, 2 and 3
- (b) 1 and 2 only
- (c) 1 only
- (d) 2 and 3 only

DIRECTIONS: *The following* ***six (6)*** *items consist of two statements, Statement I and Statement II. You are to examine these two statements carefully and select the answers to these items using the code given below:*

Code:

(a) Both the statements are individually true and Statement II is the correct explanation of Statement I
(b) Both the statements are individually true but Statement II is ***not*** the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

76. **Statement I:** Minerals are formed by slow cooling of the magma.
Statement II: Very small crystals are formed when lava cools quickly on the surface.

77. **Statement I:** The Kullu Valley in Himachal Pradesh receives copious snowfall during winter.
Statement II: The Kullu Valley receives moisture-bearing wind of the Western Disturbances during winter.

78. **Statement I:** The hills with dense vegetation cover do not experience heavy soil erosion.
Statement II: The vegetation cover helps infiltration of rainwater and binding of soils.

79. **Statement I:** The decrease of air temperature with increasing altitudes in the atmosphere is called the vertical temperature gradient.
Statement II: In Troposphere, air temperature decreases with increasing altitude due to radiation from the Earth.

80. **Statement I:** Chemical weathering processes are found more active in hot and humid environment.
Statement II: High temperature and rainfall help in the process of decomposition of rocks.

81. **Statement I:** The acceleration due to gravity decreases with increase in height from the surface of the Earth.
Statement II: The acceleration due to gravity is inversely proportional to the square of the distance from the centre of the Earth.

82. The number of valence electrons in the O^{2-} ion is
(a) 4 (b) 6
(c) 8 (d) 10

83. Within an animal cell, the most abundant inorganic constituent of protoplasm is
(a) sodium and potassium salt
(b) water
(c) iron
(d) phosphate

84. Two conducting wires A and B are made of same material. If the length of B is twice that of A and the radius of circular cross-section of A is twice that of B, then their resistances R_A and R_B are in the ratio
(a) 2 : 1 (b) 1 : 2
(c) 1 : 8 (d) 1 : 4

85. Consider the following statements:
A real image
1. can be formed on a screen
2. is always magnified and inverted

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

86. Which one of the following is the correct electronic configuration of chlorine?
(a) 2, 7, 8 (b) 2, 8, 7
(c) 2, 8, 8 (d) 7, 8, 2

87. In honey, which one among the following sugars predominates?
(a) Sucrose (b) Fructose
(c) Galactose (d) Maltose

88. During short-circuiting, the current flowing in the electrical circuit
(a) reduces substantially
(b) does not change
(c) increases instantaneously
(d) varies continuously

89. The number of aluminium ions present in 54g of aluminium (atomic weight 27) is
(a) 2 (b) 18
(c) 1.1×10^{24} (d) 1.2×10^{24}

90. What is 'breakbone fever' most commonly known as?
(a) Typhoid (b) Rhinitis
(c) Yellow fever (d) Dengue

91. Van de Graaff generator is used for
(a) accelerating charged particles
(b) generating large currents
(c) generating electric field
(d) generating high-frequency voltage

92. The most stable form of carbon is
(a) diamond (b) graphite
(c) fullerene (c) coal

93. Which one among the following is **not** a sexually transmitted disease?
(a) Syphilis (b) Gonorrhea
(c) Scurvy (c) Hepatitis B

94. The summer and winter seasons in a year are caused by
(a) aphelion (farthest) and perihelion (nearest) positions of the Earth from the Sun during the annual revolution
(b) rotation of the Earth on its axis
(c) variation in solar insolation
(d) revolution of the Earth on its inclined axis.

95. The latest discovered state of matter is
(a) solid
(b) Bose-Einstein condensate
(c) plasma
(d) liquid

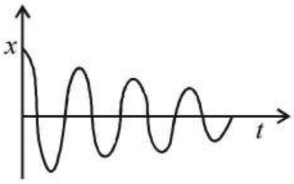
96. Which of the following pairs represents isoelectric ions?
(a) Na^+, K^+ (b) K^+, Mg^{2+}
(c) Mg^{2+}, Ca^{2+} (d) Ca^{2+}, S^{2-}

97. After diagnosis of disease in a person, the doctor advises the patient iron and folic acid tablets. The person is suffering from
(a) osteoporosis
(b) anaemia
(c) goitre
(d) protein-energy malnutrition

98. Which one among the following is the coral group of islands of India?
(a) Andaman (b) Nicobar
(c) Minicoy (d) Lakshadweep

99. Bernoulli's principle is based on which one among the following laws?
(a) Conservation of mass
(b) Conservation of momentum
(c) Conservation of angular momentum
(d) Conservation of energy

100.



The displacement (x)-time (t) graph given above approximately represents the motion of a
(a) simple pendulum placed in a vacuum
(b) simple pendulum immersed in water
(c) simple pendulum placed in outer space
(d) point mass moving in air

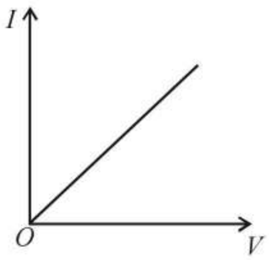
101. Dihydrogen can be prepared on a commercial scale by the action of steam on hydrocarbons, when a mixture of CO and H_2 gas is formed. It is known as
(a) water gas (b) producer gas
(c) industrial gas (d) fuel gas

102. Dropsy is a disease caused due to adulteration in
(a) ghee (b) arhar dal
(c) mustard oil (d) turmeric powder

103. Consider the following surface winds:
1. Doldrums
2. Trade winds
3. Westerlies
4. Polar winds

Which one among the following is the idealized global pattern of these winds from the Equator to the Pole?
(a) 1-2-3-4 (b) 1-3-2-4
(c) 2-1-4-3 (d) 3-1-2-4

104.



The current (I)-voltage (V) plot of a certain electronic device is given above. The device is
(a) a semiconductor
(b) a conductor which obeys Ohm's law
(c) a superconductor
(d) an insulator

105. Which of the following statements about hydrogen is/are correct?
1. Hydrogen has three isotopes of which protium is the most common.
2. Hydrogen ion (H^+) exists freely in solution.
3. Dihydrogen, H_2, acts as a reducing agent.

Select the correct answer using the code given below.
(a) 1, 2 and 3 (b) 1 only
(c) 1 and 3 only (d) 3 only

106. Leaves of which of the following plants are ***not*** used for the rearing of silkworms?
(a) Mulberry (b) Castor
(c) Oak (d) Teak

107. Taungup Pass is a mountain corridor connecting India with
(a) Afghanistan (b) China
(c) Pakistan (d) Myanmar

108. The temperature of water at the bottom of a lake whose upper surface has frozen to ice would be around
(a) $-10°C$ (b) $0°C$
(c) $4°C$ (d) $-4°C$

109. Which of the following statements is correct?
(a) Fullerenes have only six-membered carbon rings
(b) Fullerenes are cage-like molecules
(c) Diamond is thermodynamically the most stable allotrope of carbon
(d) Graphite is slippery and hard, and is therefore used as a dry lubricant in machines

110. Which one among the following groups is the most abundant in terms of number of species identified?
(a) Fungi (b) Green plants
(c) Bacteria (d) Insects

111. Consider the following statements:
1. Crystallization is a form of mechanical weathering.
2. Hydration causes granular disintegration.
3. Frost action is synonymous with freeze-thaw action.

Which of the statements given above are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

112. Lapland is a cultural region largely within the Arctic Circle in the north of the Scandinavian Peninsula. Who inhabited the Lapland?
(a) Sami people (b) Padaung people
(c) Hamar people (d) Himba people

113. If speed of light in air is 3×10^8 m/s, the speed of light in glass (with refractive index 1.5) would be
(a) 2×10^8 m/s (b) 4.5×10^8 m/s
(c) 3×10^8 m/s (d) 1.5×10^8 m/s

114. While looking at an image formed by a convex lens (one half of the lens is covered with a black paper), which one of the following will happen to the image?
(a) Half of the image will be visible
(b) Intensity of the image will be diminished
(c) Image will be inverted now
(d) One can see an image of smaller size

115. Which of the following acids is a mineral acid?
(a) Citric acid (b) Hydrochloric acid
(c) Ascorbic acid (d) Tartaric acid

116. Considering the locations of mountains in India, which one among the following is in right sequence from south to north?
(a) Doddabetta, Kailash, Dhaulagiri, Vindhyachal
(b) Doddabetta, Vindhyachal, Dhaulagiri, Kailash
(c) Dhaulagiri, Kailash, Doddabetta, Vindhyachal
(d) Dhaulagiri, Vindhyachal, Doddabetta, Kailash

117. A balloon filled up with gas would only go up in air if it is filled up with
(a) a gas whose density is lower than air
(b) a gas whose density is higher than air
(c) cold air
(d) water vapour

118. Planet *A* has double the radius than that of Planet *B*. If the mass of Planet *A* is 4 times heavier than the mass of Planet *B*, which of the following statements regarding weight of an object is correct?
(a) Heavier on Planet *A* than on Planet *B*
(b) Heavier on Planet *B* than on Planet *A*
(c) Same on both the Planets
(d) Cannot be measured on Planet *B*

119. Which of the following is correct regarding the reaction of fluorine with water?
$2F_2(g) + 2H_2O(l) \rightarrow 4H^+(aq) + 4F^-(aq) + O_2(g)$
(a) Fluorine is oxidized to F^-
(b) Water is oxidized to O_2.
(c) Water is reduced to H^+
(d) Oxidation state of fluorine does not change

120. The site of cellular respiration in animal cell is
(a) ribosome (b) mitochondria
(c) endoplasmic reticulum (d) lysosome

121. Which one among the following lakes is situated on the west coast of India?
(a) Chilika (b) Ashtamudi
(c) Pulicat (d) Kolleru

122. Sound waves are similar to the waves
(a) of laser light passing through air
(b) generated in a stretched wire by hitting or plucking the wire
(c) generated in a pipe filled with air by moving the piston attached to the pipe up and down
(d) generated by the mobile phone towers

123. A sound wave has frequency of 2 kHz and wavelength of 35 cm. If an observer is 1.4 km away from the source, after what time interval could the observer hear the sound?
(a) 2 s (b) 20 s
(c) 0.5 s (d) 4 s

124. Which of the following is/are amphoteric?
(a) $Al(OH)_3\,(s)$ and $Fe(OH)_3\,(s)$
(b) $Al(OH)_3\,(s)$ and $HCO^-_3\,(aq)$
(c) $Ba(OH)_2\,(s)$ and $NaOH\,(aq)$
(c) $Al(OH)_3\,(s)$ only

125. Which of the following statements about vitamins are correct?
1. Vitamin C is essential to make connective tissue in body.
2. Vitamin D is needed for synthesis of eye pigment.
3. Vitamin B_{12} helps in maturation of RBC.
4. Vitamin C is required to make use of calcium absorbed from the intestine.

Select the correct answer using the code given below.
(a) 1 and 2 (b) 1 and 3
(c) 2 and 4 (d) 1 and 4

126. What is the correct sequence from the smallest to the largest grain of the following types of clastic rocks?
(a) Shale, sandstone, conglomerate, siltstone
(b) Shale, siltstone, sandstone, conglomerate
(c) Conglomerate, sandstone, shale, siltstone
(d) Sandstone, siltstone, conglomerate, shale

127. Which one among the following waves bats use to detect the obstacles in their flying path?
(a) Infrared waves
(b) Electromagnetic waves
(c) Ultrasonic waves
(d) Radio waves

128. A fuse is used in an electric circuit to
(a) break the circuit when excessive current flows through the circuit
(b) break the circuit when power gets off
(c) indicate if the current is flowing uninterrupted
(d) complete the circuit for flow of current

129. The most of the mass of the atom can be found in
(a) electrons (b) charges
(c) nucleus (d) electron cloud

130. The Faroe is a group of islands lying in the Atlantic Ocean between Scotland and Iceland. This island group is also known as
(a) Island of Sheep (b) Island of Goats
(c) Island of Cows (d) Island of Buffaloes

131. The pressure of an ideal gas undergoing isothermal change is increased by 10%. The volume of the gas must decrease by about
(a) 0.1% (b) 9%
(c) 10% (d) 0.9%

132. Tuareg is a pastoral nomad living in the desert of
(a) Kalahari (b) Sahara
(c) Arabia (d) Patagonia

133. A passenger in a moving train tosses a coin upward which falls behind him. It implies that the motion of the train is
(a) accelerated (b) uniform
(c) retarded (d) along the circular tracks

134. The mass number of an atom is determined by
(a) adding the number of neutrons and number of electrons
(b) adding the number of protons and number of electrons
(c) the number of protons only
(d) adding the number of neutrons and number of protons

135. Match List-I and List-II and select the correct answer using the code given below the Lists:

List - I (Region)	**List - II (Characteristic vegetation)**
A. Selvas	1. Tropophytes
B. Savanna	2. Mosses and lichens
C. Tundra	3. Epiphytes
D. Monsoon land	4. Grasses and trees

Code:

	A	B	C	D
(a)	3	2	4	1
(b)	1	4	2	3
(c)	1	2	4	3
(d)	3	4	2	1

136. In optical instruments, the lenses are used to form image by the phenomenon of
(a) reflection (b) refraction
(c) scattering (d) diffusion

137. Note the following balanced chemical equation:

$2CO + O_2 \rightleftharpoons 2CO_2$

Which one of the following statements is significant in relation to the above chemical equation?
(a) One can add to a vessel only 2 mol of CO for each mol of O_2 added
(b) No matter how much of these two reagents are added to a vessel, 1 mol of O_2 is consumed
(c) When they react, CO reacts with O_2 in a 2 : 1 mol ratio
(d) When 2 mol of CO and 1 mol of O_2 are placed in a vessel, they will react to give 1 mol of CO_2

138. Which of the following is/are the most likely cause/causes of sheet-flood found in western part of Rajasthan?
1. Scanty rainfall
2. Sudden high intensity rain
3. Loose sandy soil with scanty vegetation

Select the correct answer using the code given below.
(a) 1 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1, 2 and 3

139. Mulching, an agronomic measure of soil conservation, is very effective because it
1. protects soil from gully erosion
2. protects soil from sheetwash and wind erosion
3. helps soil to retain moisture and nutrients

Select the correct answer using the code given below.
(a) 1 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1, 2 and 3

140. How many cubic centimeters (cm^3) are in a cubic metre (m^3)?
(a) 10^3 (b) 10^6
(c) 10^9 (d) 10^{12}

141. A semiconducting device is connected in a series circuit with a battery and a resistance. Current is found to pass through the circuit. If the polarity of the battery is reversed, the current drops to zero. The device may be
(a) *p*-type semiconductor
(b) *n*-type semiconductor
(c) an intrinsic semiconductor
(d) *p-n* junction

142. A fertilizer contains 20% nitrogen by mass. To provide a fruit tree with an equivalent of 1 kg of nitrogen, the quantity of fertilizer required is
(a) 20 kg (b) 0.20 kg
(c) 0.05 kg (d) 5 kg

143. Why is hydrolysis an effective form of chemical decomposition of bedrock in humid tropics?
1. Humid tropics experience high temperature and humidity.
2. There is high diurnal range in temperature.

Select the correct answer using the code given below.
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

144. If the distance *S* covered by a moving car in rectilinear motion with a speed *v* in time *t* is given by $S = vt$, then the car undergoes
(a) a uniform acceleration
(b) a non-uniform acceleration
(c) a uniform velocity
(d) a non-uniform velocity

145. The phenomenon of electromagnetic induction implies a production of induced
(a) resistance in a coil when the magnetic field changes with time
(b) current in a coil when an electric field changes with time
(c) current in a coil when a magnetic field changes with time
(d) voltage in a coil when an electric field changes with time

146. Which one among the following is ***not*** a characteristic of a federal system?
(a) There are two distinct levels of government
(b) The responsibilities and powers of each level of government are clearly defined in a written Constitution
(c) There is no separation of powers between the legislative and executive branches of government
(d) A Supreme Court is entrusted with the responsibility of interpreting these provisions and arbitrating in matters of dispute

147. The Constitution of India guarantees the Fundamental Right to Freedom of Religion to all its citizens. Which among the following is ***not*** true for this Rights?
(a) It gives freedom of conscience and freedom to profess, practice and propagate any religion
(b) It gives freedom to establish and maintain institution for religious and charitable purposes
(c) The Right is subject to public order, morality and health
(d) The State cannot make any law which abrogates this Right for citizens

148. The Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act, 1989 may be seen as giving effect to which of the following Fundamental Rights?
1. Equality before the Law
2. Right against Discrimination
3. Abolition of Untouchability
4. Right to Freedom of Religion

Select the correct answer using the code given below.
(a) 1, 2 and 3 only (b) 2 and 3 only
(c) 2, 3 and 4 only (d) 1, 2, 3 and 4

149. Under which of the following Acts is the National Population Register being created?
(a) The Citizenship Act of India, 1955 as amended in 2004
(b) The Census Act, 1948
(c) The UID Act, 2010
(d) None of the above

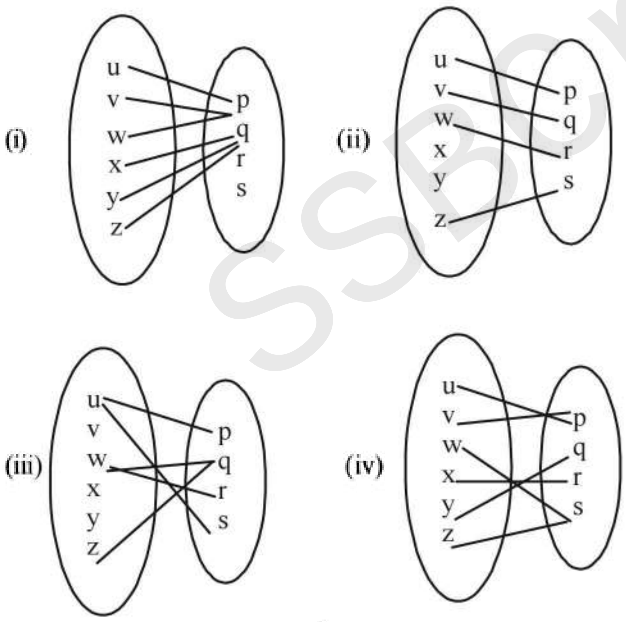
150. Which one among the following is ***not*** true about Bal Gangadhar Tilak?
(a) He started the New English School in Poona
(b) He founded the Shri Shivaji Fund Committee for celebration of Shiv Jayanti
(c) He preached the cult of self-reliance
(d) He transformed the household worshipping of Ganesha into a public event

NDA 2 2014 Solutions

MATHEMATICS

1. (b) X = Set of all citizens of India
$R = \{(x, y) : x, y \in X, |x - y| = 5\}$
$|x - x| = 0 \neq 5$ (R is not reflexive)
$xRy \Rightarrow |x - y| = 5$
$\Rightarrow |y - x| = 5$ (R is symmetric)
$xRy \Rightarrow |x - y| = 5$
$yRz \Rightarrow |y - z| = 5$
But $|x - z| \neq 5$ (R is not transitive)

2. (c) Given that, $A = \{u, v, x, y, z\}$; $B = \{p, q, r, s\}$
As we know, a mapping $f : x \to y$ is said to be a function, if each element in the set x has its image in set y. It is also possible that these are few elements in set y which are not the image of any element in set x. Every element in set x should have one and only one image.



(ii) and (iii) are not functions.

3. (c) Given equation $ax^2 + bx + c = 0$ (where $a \neq 0$)
α and β are roots of given equation.
$(a\alpha + b)(a\beta + b) = a^2\alpha\beta + ab\alpha + ab\beta + b^2$
$= a^2\alpha\beta + ab(\alpha + \beta) + b^2$
From the given quadratic equation

$$\alpha + \beta = \frac{-b}{a}, \alpha\beta = \frac{c}{a}$$

$$a^2 \times \frac{c}{a} + ab \times -\frac{b}{a} + b^2 = ac$$

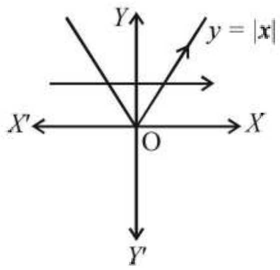
4. (c) S = Set of all integers and
$R = \{(a, b), a, b \in S \text{ and } ab \geq 0\}$
For reflexive : $aRa \Rightarrow a.a = a^2 \geq 0$
for all integers a. $a \geq 0$
For symmetric : $aRb \Rightarrow ab \geq 0 \ \forall\ a, b \in S$
If $ab \geq 0$, then $ba \geq 0 \Rightarrow bRa$
For transitive :
If $ab \geq 0$, $bc \geq 0$, then also $ac \geq 0$
Rlation R is reflexive, symmetric and transitive. Therefore relation is equivalence.

5. (c) We have, $2a^2x^2 - 2abx + b^2 = 0$
Discriminent, $D = (-2ab)^2 - 4(2a^2)(b^2)$
$= 4a^2b^2 - 8a^2b^2 = -4a^2b^2 < 0$
Roots are always complex.

6. (a) $(11110)_2 = 2^4 \times 1 + 2^3 \times 1 + 2^2 \times 1 + 2^1 \times 1 + 2^0 \times 0$
$= 16 + 8 + 4 + 2 + 0 = 30$
$(1010)_2 = (2^3 \times 1 + 2^2 \times 0 + 2^1 \times 1 + 2^0 \times 0 = 8 + 0 + 2 + 0) = 10$
Sum = 30 + 10 = 40
$= (101000)_2$

2	40	
2	20	0
2	10	0
2	5	0
2	2	1
	1	0

7. (d) $f : Z \to N$ and $f(x) = |x|$
When we draw a parallel line to x-axis.
It cuts the curve into more than one point.
Therefore, $f(x) = |x|$ is not one-one.



8. (d) The two complex numbers are
$P = x + iy$ and $Q = \alpha + i\beta$

$$\text{Quotient} = \frac{P}{Q} = \frac{x + iy}{\alpha + i\beta}, \left|\frac{P}{Q}\right| = \left|\frac{x + iy}{\alpha + i\beta}\right|$$

$$= \frac{\sqrt{x^2 + y^2}}{\sqrt{\alpha^2 + \beta^2}} = \sqrt{\frac{x^2 + y^2}{\alpha^2 + \beta^2}} = \left|\frac{Z_1}{Z_2}\right| = \left|\frac{Z_1}{Z_2}\right|$$

Hence, the quotient of their modulus is equal to the quotient of their moduli.

9. (a) $|2z - 1| = |z - 2|$
$|2(x + iy) - 1| = |x + iy - 2|$
$|(2x - 1) + 2yi| = |(x - 2) + iy|$

$$\sqrt{(2x - 1)^2 + y^2} = \sqrt{(x - 2)^2 + y^2}$$

Squaring both sides
$4x^2 + 1 - 4x + 4y^2 = x^2 + 4 - 4x + y^2$

$\Rightarrow 3x^2 + 3y^2 = 3$
$\Rightarrow x^2 + y^2 = 1$
It is the equation of a circle.
$\therefore$ The point z describes a circle.

10. (c) GP = x

$\frac{a}{1-r} = x$(where, a = Ist term and r = common ratio)

$\Rightarrow \frac{2}{1-r} = x$...(i) ($\because$ Given a = 2 and $|r| < 1$)
$\Rightarrow -1 < r < 1 \Rightarrow 1 > -r > -1$
$\Rightarrow 1 + 1 > 1 - r > 1 - 1$
$\Rightarrow 0 < 1 - r < 2$

$\Rightarrow \frac{1}{1-r} > \frac{1}{2}, \frac{2}{1-r} > 1$
from equation (i) $x > 1$
Hence, $1 < x < \infty$.

11. (c) Total number of balls = 5
Number of black balls = 2
Required probability

$= \frac{n(E)}{n(S)} = \frac{{}^3C_0 \times {}^2C_2}{{}^5C_2} = \frac{2}{5} \times \frac{1}{4} = \frac{1}{10}$

12. (c) $r = \sqrt{b_{xy} . b_{yx}}$

$= \sqrt{\left(-\frac{1}{6}\right) \times \left(-\frac{3}{2}\right)} = \sqrt{\frac{1}{2} \times \frac{1}{2}} = \pm\frac{1}{2}$

b_{xy} and b_{yx} both have negative sign. Therefore we have to take negative sign

Hence, correlation coefficient (r) = $-\frac{1}{2}$.

13. (c) I: Variance is not dependent on change of origin. Therefore, if every x_i is increased by 2, the variance of the new set of numbers is not changed.
II: Variance is dependent on change of scale. If the number x_i is squared the variance of the new set is V^2
$V_{xi} \times V_{xi} = V. V = V^2$

14. (b) Mean of the squares of the first 20 natural number

$= \frac{(n+1)(2n+1)}{6} = \frac{21 \times 41}{6} = 143.5$

15. (c) According to question $p + q + r = 5 \times 3 = 15$ ...(i)
$s + t = 10 \times 2 = 20$ ...(ii)
From equations (i) and (ii), $p+q+r+s+t = 15+20 = 35$

Average p, q, r, s and t = $\frac{35}{5} = 7$

16. (a) The cumulative frequency of the largest observed value must always be less then the total number of observations.

17. (b) $P(A) = \frac{6}{12} = \frac{1}{2}, P(B) = \frac{4}{12} = \frac{1}{3}$

Req. probability $= \frac{1}{2}.\frac{1}{3}.\frac{1}{2} + \frac{1}{3}.\frac{1}{2}.\frac{1}{3} = \frac{1}{12} + \frac{1}{18} = \frac{5}{36}$

18. (a) Number of words = $5! \times {}^7C_3 \times {}^4C_2$

$= 120 \times \frac{7!}{4!3!} \times \frac{4!}{2!2!} = 25200$

19. (c) Statement 1 :
$n(X) = 2$

$p = \frac{n(X)}{n(S)} = \frac{2}{6} = \frac{1}{3}$

$q = 1 - p = 1 - \frac{1}{3} = \frac{2}{3}$
arithmetic mean of X = np

$= 18 \times \frac{1}{3} = 6$
Statement 2 : Standard deviation of
$X = \sqrt{\text{variance of X}}$

$= \sqrt{18 \times \frac{1}{3} \times \frac{2}{3}} = \sqrt{4} = 2$

Hence, statements 1 and 2 both are correct.

20. (c) As 'A' must be first letter of each word.
Total number of words = 4! = 24

21. (a) $3, \sqrt{3}, 1, \frac{1}{\sqrt{3}}, \ldots, \infty$

This is a Geometric Progression with a = 3, $r = \frac{1}{\sqrt{3}}$

$S_\infty = \frac{a}{1-r} = \frac{3}{1 - \frac{1}{\sqrt{3}}}$

$= \frac{3\sqrt{3}}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1} = \frac{3\sqrt{3}(\sqrt{3}+1)}{2}$

22. (a) Let $z = x + iy$, $\bar{z} = x - iy$
$|z + \bar{z}| = |z - \bar{z}|$
$|(x + iy) + (x - iy)| = |(x + iy) - (x - iy)|$
$|2x| = |2y|$
$x = \pm y$

23. (b)

2	251	1
2	125	1
2	62	0
2	31	1
2	15	1
2	7	1
2	3	1
	1	

Therefore, $(251)_{10} = (11111011)_2$

24. (d) $\frac{(1+i)(2+i)}{3-i} = \frac{1+3i}{3-i}$

$= \frac{1+3i}{3-i} \times \frac{3+i}{3+i} = \frac{10i}{10} = i \text{ or } 0+i$

argument, $\theta = \tan^{-1}\left(\frac{1}{0}\right) = \tan^{-1}\left(\tan\frac{\pi}{2}\right) = \frac{\pi}{2}$

25. (a) $A = \begin{bmatrix} 0 & 1 & 2 \\ -1 & 0 & -3 \\ -2 & 3 & 0 \end{bmatrix}$

$A^T = \begin{bmatrix} 0 & -1 & -2 \\ 1 & 0 & 3 \\ 2 & -3 & 0 \end{bmatrix} = -\begin{bmatrix} 0 & 1 & 2 \\ -1 & 0 & -3 \\ -2 & 3 & 0 \end{bmatrix} = -A$

Hence, A is skew symmetric matrix

$|A| = \begin{vmatrix} 0 & 1 & 2 \\ -1 & 0 & -3 \\ -2 & 3 & 0 \end{vmatrix} = 1(-6) - 2(-3) = -6 + 6 = 0$

Therefore A is non-invertible.

26. (b) I. $AB = \begin{vmatrix} 1 & 2 \\ 2 & 1 \\ 1 & 1 \end{vmatrix}_{3\times 2} \begin{vmatrix} 1 & 2 & -4 \\ 2 & 1 & -4 \end{vmatrix}_{2\times 3}$

$= \begin{vmatrix} 5 & 4 & -12 \\ 4 & 5 & -12 \\ 3 & 3 & -8 \end{vmatrix}_{3\times 3}$

II. $BA = \begin{vmatrix} 1 & 2 & -4 \\ 2 & 1 & -4 \end{vmatrix}_{2\times 3} \begin{vmatrix} 1 & 2 \\ 2 & 1 \\ 1 & 1 \end{vmatrix}_{3\times 2}$

$= \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix}_{2\times 2}$

Here, B is not the right inverse of A but B is the left inverse of A.

27. (c) $\begin{vmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{vmatrix} = 0$

Applying, $C_1 \to C_1 + C_2 + C_3$

$\begin{vmatrix} (a+b+c+x) & b & c \\ (a+b+c+x) & x+b & c \\ (a+b+c+x) & b & c+x \end{vmatrix} = 0$

$(a+b+c+x)\begin{vmatrix} 1 & b & c \\ 1 & x+b & c \\ 1 & b & c+x \end{vmatrix} = 0$

$C_2 \to C_2 - C_1, C_3 \to C_3 - C_1$

$(a+b+c+x)\begin{vmatrix} 1 & b & c \\ 0 & x & 0 \\ 0 & 0 & x \end{vmatrix} = 0$

$(a+b+c+x)\,1.\,x^2 = 0$

$x = 0, -(a+b+c) \quad (\because x \neq 0)$

28. (c) A A is defined only when A is a matrix of order $m \times n$ where $m = n$.
$A \times A = (m \times n)(m \times n) = (m \times n)(n \times n)$ if $m = n$
$= m \times n = n \times n$ or $m \times m$.
$=$ A is a square matrix.

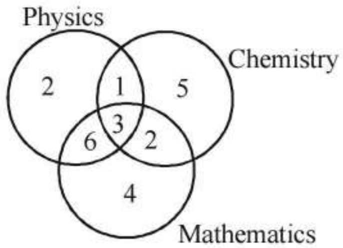
29. (d) We know that, elements of principal diagonals of a skew-symmetric matrix are all zero.

$A = \begin{vmatrix} 0 & a & b \\ -a & 0 & -c \\ -b & c & 0 \end{vmatrix}_{3\times 3} \Rightarrow |A| \begin{vmatrix} 0 & a & b \\ -a & 0 & -c \\ -b & c & 0 \end{vmatrix}$

$= abc - abc = 0$

30. (c) If any two adjacent rows or columns of a determinant are interchanged in position, the value of the determinant changes its sign.

(For 31-33)



31. (a) Only Physics $= 12 - (1+3+6) = 2$

32. (c) Only two subjects $= 6 + 2 + 1 = 9$

33. (b) **Statement 1 :**
Students, who had taken only one subject
$= 2 + 5 + 4 = 11$
Students, who had taken only two subjects
$= 6 + 2 + 1 = 9$
$1 \neq 9$
Statement 2 :
Students who had taken atleast two subject
$= 1 + 2 + 6 + 3 = 12$
Students who had taken all three subjects
$= 4 \times 3 = 12$

(For 34-36) $\left(x^3 - \frac{1}{x^2}\right)^n$

General term, $T_{r+1} = {}^nC_r (x^3)^{n-r}.\left(\frac{1}{x^2}\right)^r$

$= {}^nC_r . 3^{(3n-3r)}.(-1)^r.r^{-2r}$

$= {}^nC_r .(-1)^r . x^{(3n-5r)}$ ...(i)

For the coefficient x^5

Put $3n - 5r = 5$
$5r = 3n - 5$

$\therefore\ r = \frac{3n}{5} - 1$

$\therefore$ Coefficient of $x^5 = {}^nC_{\left(\frac{3n}{5}-1\right)}(-1)^{\left(\frac{3n}{5}-1\right)}$

For the coefficient of x^{10}
Put $3n - 5r = 10$
$5r = 3n - 10$

$\therefore\ r = \frac{3n}{5} - 2$

$\therefore$ Coefficient of $x^{10} = {}^nC_{\left(\frac{3n}{5}-2\right)}(-1)^{\left(\frac{3n}{5}-2\right)}$

The sum of the coefficient of x^5 and $x^{10} = 0$

$\Rightarrow {}^nC_{\left(\frac{3n}{5}-1\right)}(-1)^{\left(\frac{3n}{5}-1\right)} + {}^nC_{\left(\frac{3n}{5}-2\right)}(-1)^{\left(\frac{3n}{5}-2\right)} = 0$

$\Rightarrow (-1)^{\frac{3n}{5}}\left[{}^nC_{\left(\frac{3n}{5}-1\right)}\cdot(-1)^{-1} + {}^nC_{\left(\frac{3n}{5}-2\right)}\cdot(-1)^{(-2)}\right] = 0$

$\Rightarrow -{}^nC_{\left(\frac{3n}{5}-1\right)} + {}^nC_{\left(\frac{3n}{5}-2\right)} = 0$ ...(ii)

34. (c) From equation (ii)

${}^nC_{\left(\frac{3n}{5}-2\right)} = {}^nC_{\left(\frac{3n}{5}-1\right)}$

$\Rightarrow n = \left(\frac{3n}{5} - 2\right) + \left(\frac{3n}{5} - 1\right)$

$\left[\because {}^nC_x = {}^nC_y \Rightarrow n = x + y\right]$

$\Rightarrow n = \frac{6n}{5} - 3 \Rightarrow \frac{6n}{5} - n = 3$

$\Rightarrow \frac{n}{5} = 3$ $\qquad \therefore n = 15$

35. (c) For the independent term,
put $3n - 5r = 0$ [from eq. (i)]
$\Rightarrow 5r = 3n = 3 \times 15$
$5r = 3 \times 3 \times 5$
$r = 9$

Putting the value of r in eq. (i), we get
$T_{9+1} = {}^{15}C_9 \cdot (-1)^9 \cdot x^{(3 \times 15 - 5 \times 9)}$
$\Rightarrow T_{10} = -{}^{15}C_9 \cdot x^0 = -{}^{15}C_9$
$\Rightarrow T_{10} = -{}^{15}C_6$ $\qquad \left[\because {}^nC_r = {}^nC_{n-r}\right]$

$= \frac{-15!}{6!9!}$ $\qquad \left[\because {}^nC_r = \frac{n!}{r!(n-r)!}\right]$
$= -5005$

36. (a) $n = 15$

Total term in the expansion of $\left(x^3 - \frac{1}{x^2}\right)^{15}$ is 16.

$\therefore$ middle term = 8^{th} term and 9^{th} term
$T_8 = T_{(7+1)} = {}^{15}C_7 \cdot (-1)^7 \cdot x^{(3 \times 15 - 5 \times 7)}$
$= -{}^{15}C_7 \cdot x^{10}$ (from eq. (i))
$T_9 = T_{(8+1)} = {}^{15}C_8 \cdot (-1)^8 \cdot x^{(3\times15-5\times8)}$
$= -{}^{15}C_8 \cdot x^5$ (from eq. (ii))
The sum of the coefficients of the two middle terms
$= -{}^{15}C_7 + {}^{15}C_8 = -{}^{15}C_7 + {}^{15}C_7 \cdot \left[\because {}^nC_r = {}^nC_{n-r}\right]$
$= 0$

For (37-39)

$\frac{{}^nC_r}{{}^nC_{r+1}} = \frac{1}{2}$

$\frac{\lfloor n \lfloor r+1 \lfloor n-r-1}{\lfloor r \lfloor n-r \lfloor n} = \frac{1}{2}$

$\frac{r+1}{n-r} = \frac{1}{2} \Rightarrow 3r - n + 2 = 0$ ...(i)

$\frac{{}^nC_{r+1}}{{}^nC_{r+2}} = \frac{2}{3}$

$\frac{\lfloor n \lfloor r+2 \lfloor n-r-2}{\lfloor r+1 \lfloor n-r-1 \lfloor n} = \frac{2}{3}$

$\frac{r+2}{n-r-1} = \frac{2}{3} \Rightarrow 5r - 2n + 8 = 0$ ...(ii)

Solving equations (i) and (ii), we get
$n = 14, r = 4$

37. (d) **38.** (c)

39. (b) $P(n, r) : C(n, r) = \lfloor r = 24$

40. (c) $3\tan^2 x = 1$

$\tan x = \pm\frac{1}{\sqrt{3}}$

$\tan x = \tan\left(\pm\frac{\pi}{6}\right)$

$x = n\pi \pm \frac{\pi}{6}$

41. (b)

42. (a) –1. $\sin\theta \in [-1, 1]$; $Q \in R$, the value of $\sin\theta$ lies between –1 to 1.
2. $\cos\theta \in [-1, 1]$; $Q \in R$, the value of $\sin\theta$ lies between –1 to 1.

43. (b) $\tan^{-1}x + \tan^{-1}y = \pi + \tan^{-1}\left[\frac{x+y}{1+xy}\right]$

if $x < 0,\ y < 0$ and $xy > 1$, then

$\tan^{-1}x + \tan^{-1}y = -\pi + \tan^{-1}\left(\frac{x+y}{1-xy}\right)$

44. (a) **Statement 1 :**

Given $n\left(\sin^2 67\frac{1^\circ}{2}-\sin^2 22\frac{1^\circ}{2}\right)$

or $n\left(\sin^2\frac{135^\circ}{2}-\sin^2\frac{45^\circ}{2}\right)$

$= n\left(\sin\frac{135^\circ}{2}+\sin\frac{45^\circ}{2}\right)\left(\sin\frac{135^\circ}{2}-\sin\frac{45^\circ}{2}\right)$

$= n\left[2\sin\frac{\left(\frac{135^\circ}{2}+\frac{45^\circ}{2}\right)}{2}.\cos\frac{\left(\frac{135^\circ}{2}-\frac{45^\circ}{2}\right)}{2}\right]$

$\left[2.\cos\frac{\left(\frac{135^\circ+45^\circ}{2}\right)}{2}.\sin\frac{\left(\frac{135^\circ-45^\circ}{2}\right)}{2}\right]$

$= n\left[2.\sin\left(\frac{90^\circ}{2}\right).\cos\left(\frac{45^\circ}{2}\right)\right]$

$\left[2.\cos\left(\frac{90^\circ}{2}\right).\sin\left(\frac{45^\circ}{2}\right)\right]$

$= 2n\left(2\sin\frac{45^\circ}{2}.\cos\frac{45^\circ}{2}\right)$ $(\sin 45^\circ . \cos 45^\circ)$

$= 2n . \sin\left(2\times\frac{45^\circ}{2}\right)\left(\frac{1}{\sqrt{2}}\times\frac{1}{\sqrt{2}}\right)$

$= 2n.\sin 45\times\frac{1}{2} = n.\frac{1}{\sqrt{2}} = \frac{n}{\sqrt{2}}$

$\therefore \frac{n}{\sqrt{2}} > 1$ for all positive integers $n \geq 2$.

$\therefore$ Statement 1 is true

Statement 2

$nx > 1, \forall\ n \geq 2$

$\Rightarrow n > \frac{1}{x}, \forall n \geq 2$

$x \in (0, \infty)$, then we take $x = 1$

$n > 1$, but n is always greater or equal to 2 for all x positive real number.

$\therefore$ Statement 2 is false.

45. (a) **Statement : 1**

$\sin 3\theta = \cos 2\theta$

$\sin 3\theta = \sin\left(\frac{\pi}{2}-2\theta\right)$

$3\theta = \frac{\pi}{2}-2\theta$

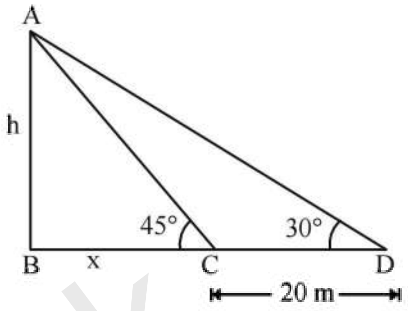
$5\theta = \frac{\pi}{2} \Rightarrow \theta = \frac{\pi}{10}$

Statement : 2

One radian is the angle subtended at the centre of a circle by an arc of the same circle whose length is equal to radius of that circle.

Hence, statement 1 is correct.

46. (c)



In Δ ABC, $\tan 45^\circ = \frac{AB}{BC} = \frac{h}{x}$

$1 = \frac{h}{x}$

$h = x$ ...(i)

In ΔABD,

$\tan 30^\circ = \frac{AB}{BD}$

$\frac{1}{\sqrt{3}} = \frac{h}{x+20}$

$x+20 = \sqrt{3}h$

$h+20 = \sqrt{3}h$

$20 = \left(\sqrt{3}-1\right)h$

$h = \frac{20}{\sqrt{3}-1}$

$= \frac{20}{\sqrt{3}-1}\times\frac{\sqrt{3}+1}{\sqrt{3}+1}$

$= \frac{20(\sqrt{3}+1)}{2} = 10(\sqrt{3}+1)$ m

Hence the height is $10\left(\sqrt{3}+1\right)$ m

47. 1. Given, $\sin A + \sin B = \sin C$

$a+b = c$ $\left(\because \text{By sine law}, \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} = K\right)$

Here, the sum of two sides of ΔABC is equal to the third side, but it is not possible

(Because by triangle inequality, the sum of the length of two sides of a triangle is always greater than the length of the third side)

$\boxed{a+b>c}$

2. Ratio of angles of a triangle

$A : B : C = 1 : 2 : 3$

$A+B+C = 180^\circ$

$\therefore A = 30°$
$B = 60°$
$C = 90°$

the ratio in sides according to sine rule

$a : b : c = \sin A : \sin B : \sin C$

$= \sin 30° : \sin 60° : \sin 90°$

$= \frac{1}{2}, \frac{\sqrt{3}}{2}, 1 = \frac{1}{2} : \frac{\sqrt{3}}{2} : 1$

48. (d) **Statement 1 :** $f_1(x) = \sin|x| + \cos|x|$, the value of $|\sin x|$ and $(\cos x)$ depends on its angles. $\sin|x| + \cos|x|$ is not always positive.

Statement 2 : $f_2(x) = \sin(x^2) + \cos(x^2)$, the value of x^2 between any value which lies in the interval $\left(\pi, \frac{3\pi}{2}\right)$, then value of $f_2(x) = \sin(x^2) + \cos(x^2)$ is always negative.

49. (c) $\frac{1+\sin A}{1-\sin A} - \frac{1-\sin A}{1+\sin A}$

$= \frac{(1+\sin A)^2 - (1-\sin A)^2}{(1-\sin A)(1+\sin A)} = \frac{4\sin A}{\cos^2 A}$

$= \frac{4\sin A}{\cos A} \cdot \frac{1}{\cos A} = 4 \sec A . \tan A$

50. (b) $\frac{\cot 224° - \cot 134°}{\cot 226° + \cot 316°}$

$= \frac{\cot(180° + 44°) - \cot(180° - 46°)}{\cot(180 + 46°) + \cot(270° + 46)°}$

$= \frac{\cot 44° + \cot 46°}{\cot 46° - \tan 46°} = \frac{\tan 46° + \tan 44°}{\tan 44° - \tan 46°}$

$= \frac{\sin(46° + 44°)}{\sin(44° - 46°)} = -\text{cosec } 2°$

51. (b) 1. L.H.S.

$\tan^{-1} + \tan^{-1}\left(\frac{1}{2}\right)$

$= \tan^{-1} + \cot^{-1}\left(\frac{1}{\frac{1}{2}}\right)$

$= \tan^{-1} + \cot^{-1} 2 \neq \frac{\pi}{2}$

So, L.H.S. $\neq$ R.H.S.

2. $\sin^{-1}\frac{1}{3} + \cos^{-1}\left(\frac{1}{3}\right) = \frac{\pi}{2}$

$\left\{\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}\right\}$

52. (a) $A + B + C = \pi$

$A + B = \pi - C$

$\cos(A + B) = \cos(\pi - C)$

$\cos(A + B) = -\cos C$

or $\cos(A + B) + \cos C = 0$

53. (d) $\cos 20° + \cos 100° + \cos 140°$

$= (\cos 140° + \cos 20°) + \cos 100°$

$= 2\cos\left(\frac{160°}{2}\right) . \cos\left(\frac{120°}{2}\right) + \cos 100°$

$= 2 . \cos 80° . \frac{1}{2} + \cos 100°$

$= 2\cos\left(\frac{180°}{2}\right) . \cos\left(\frac{20°}{2}\right)$

$= 2\cos 90° . \cos 10°$

$= 2 \times 0 \times \cos 10° = 0$

54. (b) $\sin^{-1}\sin\frac{3\pi}{5} = \sin^{-1}\sin\left(\pi - \frac{2\pi}{5}\right)$

$= \sin^{-1}\sin\frac{2\pi}{5} = \frac{2\pi}{5}$

55. (b) $\sin^2(3\pi) + \cos^2(4\pi) + \tan^2(5\pi)$

$= \sin^2(3\pi) + \cos^2(\pi + 3\pi) + \tan^2(5\pi)$

$= (\sin^2(3\pi) + \cos^2(3\pi)) + \tan^2(2 \times 2\pi + \pi)$

$= 1 + \tan^2\pi = \sec^2\pi = 1$

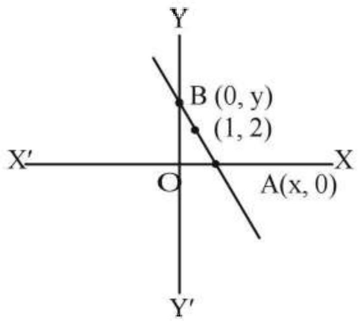
56. (c) All three points (0, 5), (2, –1) and (3, – 4) lie on $3x + y = 5$

$\sqrt{(0-1)^2 + (5-2)^2} = \sqrt{10}$

$\sqrt{(2-1)^2 + (-1-2)^2} = \sqrt{10}$

$\sqrt{(3-1)^2 + (-4-2)^2} = \sqrt{40} = 2\sqrt{10}$

57. (c)



$\frac{0+x}{2} = 1; \ \frac{0+y}{2} = 2$

$x = 2; y = 4$

Equation of line passing through (2, 0) and (0, 4)

$y - 0 = \frac{4-0}{0-2}(x - 2)$

$y = -2x + 4$

$2x + y = 4$

58. (a) Let equation of line be $\frac{x}{a} + \frac{y}{a} = 1$ or $x + y = a$

line passing through (4, 3), then a = 0

Required equation, $x + y = 7$

59. (d) $3x-4y+12=0$ or $y=\frac{3}{4}x+3$

$3x-4y=6$ or $y=\frac{3}{4}x-\frac{3}{2}$

Equation of line mid-way between these two lines

$$y=\frac{3}{4}x+\left(\frac{3-\frac{3}{2}}{2}\right)$$

$$y=\frac{3}{4}x+\frac{3}{4}$$

$4y=3x+3$

$3x-4y+3=0$

60. (c) Let 2a and 2b be the length of major and minor axis respectively.

$$\sqrt{1-\frac{b^2}{a^2}}=\frac{4}{5}$$

$$\frac{b^2}{a^2}=\frac{9}{25} \quad ...(i)$$

Also, $\frac{2b^2}{a}=14.4$

$\frac{b^2}{a}=7.2, b^2=7.2a$

Putting value of $\frac{b^2}{a}$ in equation (i)

$\frac{7.2}{a}=\frac{9}{25} \Rightarrow a=20$

$b^2=7.2\times 20=144$

$b=12$

the sum of the major and minor axes

$=2a+2b$

$=2(a+b)=2(20+12)=64$ units

61. (a) Direction ratios of normal to plane $2x+3y-z=7$ is $<2,3,-1>$

62. (d) Equation of line, $\frac{x-1}{2}=\frac{y+2}{3}=\frac{z-3}{-1}$

Let $P(2r+1, 3r-2, -r+3)$ of the line meets the plane.

Then, $2(2r+1)+3(3r-2)-(-r+3)=0$

$4r+2+9r-6+r-3=7$

$14r=14$

$r=1$

$P(3,1,2)$ meets the plane.

63. (c) Let $Q(x,y,z)$ is the image of $(1,-2,3)$ in the plane

$\frac{x+1}{2}=3\Rightarrow x=5$

$\frac{y-2}{2}=1\Rightarrow y=4$

$\frac{z+3}{2}=2\Rightarrow z=1$

$\therefore$ Image of $(1,-2,3)$ are $(5,4,1)$

For (64-65)

$x^2+y^2+z^2-4y+3=0$

$x^2+y^2-4y+4-4+z^2+3=0$

$x^2+(y-2)^2+z^2=1 \quad ...(i)$

Sphere with centre (0, 2, 0) and radius 1 unit.

$x^2+y^2+z^2+2x+4z-4=0$

$x^2+2x+1-1+y^2+z^2+4z+4-4-4=0$

$(x+1)^2+y^2+(z+2)^2=3^2 \quad ...(ii)$

Sphere with centre $(-1,0,-2)$ and radius 3 units.

64. (c) $C_1C_2=\sqrt{(0+1)^2+(2-0)^2+(0+2)^2}=3$ units

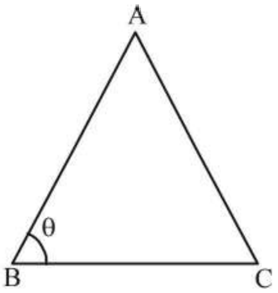
65. (c) $r_1+r_2=3+1=4$

$C_1C_2<r_1+r_2$

$\therefore$ Two spheres intersect each other.

66. (a) $\overrightarrow{BA}=4\hat{i}+\hat{j}+\hat{k}$

$\overrightarrow{BC}=2\hat{i}-\hat{j}-\hat{k}$



$$\cos B=\frac{\overrightarrow{BA}.\overrightarrow{BC}}{|\overrightarrow{BA}||\overrightarrow{BC}|}$$

$$=\frac{(4\hat{i}+\hat{j}+\hat{k}).(2\hat{i}-\hat{j}-\hat{k})}{|\sqrt{4^2+1^2+1^2}||\sqrt{2^2+(-1)^2+(-1)^2}|}$$

$$=\frac{6}{\sqrt{18}\sqrt{6}}=\frac{1}{\sqrt{3}}$$

67. (b) Area of triangle ABC $=\frac{1}{2}|\overrightarrow{BA}\times\overrightarrow{BC}|$

$$\overrightarrow{BA}\times\overrightarrow{BC}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 4 & 1 & 1\\ 2 & -1 & -1\end{vmatrix}$$

$=\hat{i}(0)-\hat{j}(-6)+\hat{k}(-6)$

$|\overrightarrow{BA}\times\overrightarrow{BC}|=|6\hat{j}-6\hat{k}|=\sqrt{6^2+(-6)^2}$

$=6\sqrt{2}$

Area of triangle $=\frac{1}{2}\times 6\sqrt{2}=3\sqrt{2}$

68. (c) Mid-point of A and C, $\left(\frac{2+0}{2}, \frac{3+1}{2}, \frac{1-1}{2}\right) = (1, 2, 0)$

Mid-point of B and C, $\left(\frac{-2+0}{2}, \frac{2+1}{2}, \frac{0-1}{2}\right)$

$= \left(-1, \frac{3}{2}, \frac{-1}{2}\right)$

Magnitude $= \sqrt{(1+1)^2 + \left(2-\frac{3}{2}\right)^2 + \left(\frac{1}{2}\right)^2}$

$= \sqrt{4+\frac{1}{4}+\frac{1}{4}} = \frac{3}{\sqrt{2}}$ units

69. (b) Projection of $\vec{a}$ on $\vec{b} = \frac{\vec{a}.\vec{b}}{|\vec{b}|} = \frac{(\hat{i}-2\hat{j}+\hat{k}).(4\hat{i}-4\hat{j}+7\hat{k})}{|\sqrt{4^2+(-4)^2+7^2}|}$

$= \frac{19}{9}$

70. (a) Vector perpendicular to $\vec{a}$ and $\vec{b} = \vec{a} \times \vec{b}$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -2 & 1 \\ 4 & -4 & 7 \end{vmatrix} = \hat{i}(-14+4) - \hat{j}(7-4) + \hat{k}\,(-4+8)$

$= -10\hat{i} - 3\hat{j} + 4\hat{k}$

71. (c) $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

$\cos^2 60° + \cos^2 30° + \cos^2\gamma = 1$

$\frac{1}{4} + \frac{3}{4} + \cos^2\gamma = 1$

$\cos^2\gamma = 0 \Rightarrow \gamma = 90°$

72. (a) $r = <l, m, n>$; $r = <\cos 60°, \cos 30°, \cos 90°>$

Direction cosines of $\vec{r} = <\frac{1}{2}, \frac{\sqrt{3}}{2}, 0>$

73. (b) Let angle between $\vec{a}$ and $\vec{b}$ be θ.

$|\vec{a}+\vec{b}| = \sqrt{|\vec{a}|^2 + |\vec{b}|^2 + 2|\vec{a}||\vec{b}|\cos\theta|}$

$10\sqrt{3} = \sqrt{49+121+2\times 7\times 11\cos\theta}$

$300 = 170 + 154\cos\theta$

$154\cos\theta = 130$

$|\vec{a}-\vec{b}| = \sqrt{|\vec{a}|^2 + |\vec{b}|^2 - 2|\vec{a}||\vec{b}|\cos\theta}$

$|\vec{a}-\vec{b}| = \sqrt{170 - 154\cos\theta}$

$|\vec{a}-\vec{b}| = \sqrt{170-130} = \sqrt{40}$ or $2\sqrt{10}$

74. **(d)** Let angle between $(\vec{a}+\vec{b})$ and $(\vec{a}-\vec{b})$ be α

$\cos\alpha = \frac{(a+b)(a-b)}{|a+b||a-b|}$

$= \frac{(7)^2-(11)^2}{10\sqrt{3}\times 2\sqrt{10}} = \frac{(7+11)(7-11)}{20\sqrt{3}\times\sqrt{10}} = \frac{-18}{5\sqrt{30}}$

$= \frac{-6\times 3}{5\sqrt{30}} \times \frac{\sqrt{30}}{\sqrt{30}} = -\frac{3\sqrt{30}}{25}$

$\alpha = \cos^{-1}\left(\frac{-3}{5}\sqrt{\frac{6}{5}}\right)$

75. (c) Direction ratios $<(2-6), (-3+7), (1+1)>$

$= <-4, 4, 2>$

76. (c) $\lim\limits_{x\to 0} \frac{(1+x)^n - 1}{x}$

$= \lim\limits_{x\to 0} \frac{{}^nC_0 + {}^nC_1 x + {}^nC_2 x^2 + ... + {}^nC_n x^n - 1}{x}$

$= \lim\limits_{x\to 0} \frac{x({}^nC_1 + {}^nC_2 x + ... + {}^nC_n x^{n-1})}{x}$

$= \lim\limits_{x\to 0} {}^nC_1 + {}^nC_2 x + ... {}^nC_n x^{n-1}$

Put $x = 0 \Rightarrow {}^nC_1 = n$

77. (d) $\lim\limits_{x\to 0} \frac{x}{\sqrt{1-\cos x}} = \lim\limits_{x\to 0} \frac{x}{\sqrt{1-\left(1-2\sin^2\frac{x}{2}\right)}}$

$= \lim\limits_{x\to 0} \frac{x}{\sqrt{2\sin^2\frac{x}{2}}} = \frac{1}{2} \lim\limits_{x\to 0} \frac{x}{\left|\sin\frac{x}{2}\right|}$

$\text{L.H.L} = f(0-0) = \lim\limits_{h\to 0} \frac{x}{\left|\sin\frac{x}{2}\right|}$

$= -\frac{1}{\sqrt{2}} \lim\limits_{x\to 0} \frac{2\left(\frac{h}{2}\right)}{\sin\frac{h}{2}}$

$= \frac{1}{\sqrt{2}} \times 2 \times 1 \qquad \left(\because \lim\limits_{\theta\to 0} \frac{\theta}{\sin\theta} = 1\right)$

$= \sqrt{2}$

$\text{RHL} = f(0+0) = \lim\limits_{h\to 0} f(0+h)$

$= \frac{1}{\sqrt{2}} \lim\limits_{h\to 0} \frac{2\left(\frac{h}{2}\right)}{\sin\frac{h}{2}} = \frac{1}{\sqrt{2}} \times 2 \times 1$

$= \text{LHL} \neq \text{RHL} = \sqrt{2}$

Therefore limit does not exist.

78. (b) Let $y=\sqrt{\dfrac{1+\cos x}{1-\cos x}}$

$$=\frac{\sqrt{2}\cos\frac{x}{2}}{\sqrt{2}\sin\frac{x}{2}}=\cot\frac{x}{2}$$

$$\frac{dy}{dx}=-\text{cosec}^2\frac{x}{2}.\frac{1}{2}=-\frac{1}{2}\ \text{cosec}^2\ \frac{x}{2}$$

79. (a) $I=\int_0^1 \dfrac{e^{\tan^{-1}x}}{1+x^2}dx$

Let $\tan^{-1}x=t$

$$\frac{1}{1+x^2}dx=dt$$

Lower limit $\to t=\tan^{-1}0=0$

upper limit $\to t=\tan^{-1},=\pi/4$

$$\therefore \int_0^{\pi/4} e^t-dt=\left[e^t\right]_0^{\pi/4}$$

$e^{\pi/4}-e^o \quad \Rightarrow e^{\pi/4}-1$

$=(-a\cos\theta,-b\sin\theta)$

80. (a) $y=\sin^{-1}(\sin^2 x)$

$$\frac{dy}{dx}=\frac{2\sin x\cos x}{\sqrt{1-\sin^4 x}}\Rightarrow\frac{dy}{dx}=\frac{\sin 2x}{\sqrt{1-\sin^4 x}}$$

at $x=0,\ \dfrac{dy}{dx}=0$

81. (a) $\dfrac{dy}{dx}=|x|$

$\dfrac{dy}{dx}=x$ for $x\ge 0$; $\dfrac{dy}{dx}=-x$ for $x<0$

$$\int dy=\int x\,dx$$

$y=\dfrac{x^2}{2}+C_1$ ...(i); $\int dy=-1\,x\,dx$

$y=-\dfrac{x^2}{2}+C_1$ ...(ii)

From (i) and (ii)

$$y=\frac{x|x|}{2}+C$$

82. (a) $\dfrac{dy}{dx}+2y=1$

$$\frac{dy}{dx}=1-2y$$

$$\int\frac{dy}{1-2y}=\int dx$$

$$-\frac{1}{2}\log|1-2y|=x+C$$

at $x=0,y=0$

$$-\frac{1}{2}\log 1=0+C\Rightarrow C=0$$

$1-2y=e^{-2x}$

$$y=\frac{1-e^{-2x}}{2}$$

83. (c) $y=e^{2x}$

$$\frac{dy}{dx}=2e^{2x}$$

$$\left.\frac{dy}{dx}\right|_{(x,y)=(0,1)}=2e^0=2$$

84. (c) Equation of line passing through (0, 1) and slope = 2

$y-1=2(x-0)$

$y-2x+1$

let line meets at (x, 0)

$$0=2x_1+1\Rightarrow x_1=-\frac{1}{2}$$

Tangent to the curve at (0, 1) meets the x-axis at $\left(-\dfrac{1}{2},0\right)$

85. (b) Given equation of ellipse, $\dfrac{x^2}{a^2}+\dfrac{y^2}{b^2}=1$

Let A $(a\cos\theta, b\sin\theta)$ be any point on ellipse (1st quadrant)

Coordinate of B = $[a\cos(\pi-\theta), b\sin(\pi-\theta)]$

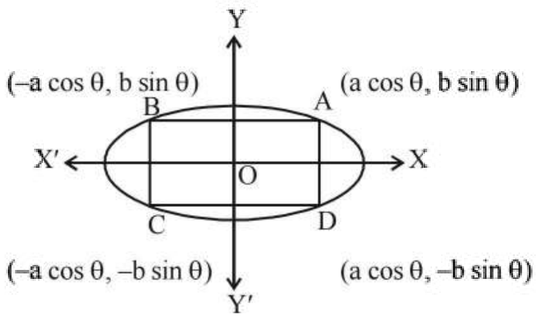
$=(-a\cos\theta, b\sin\theta)$ (2nd quadrant)

Coordinate of C = $[a\cos(\pi+\theta), b\sin(\pi+\theta)]$

(3rd quadrant)

Coordinate of D = $[a\cos(2\pi-\theta), b\sin(2\pi-\theta)]$

$=(a\cos\theta,-b\sin\theta)$ (4th quadrant)



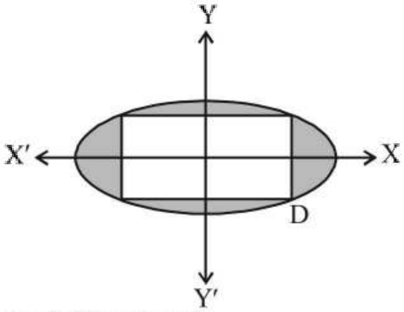
Area of the rectangle ABCD

$=(a\cos\theta+a\cos\theta)(b\sin\theta+b\sin\theta)$

$=2a\cos\theta\times 2b\sin\theta=2ab\sin 2\theta$

$=2ab\times 1=2ab$

86. (c) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$



Area of ellipse is πab

Area of shaded region = Area of ellipse – Area of rectangle

$= \pi ab - 2ab = ab(\pi - 2)$

87. (a) $I_1 = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{dx}{1+\sqrt{\tan x}}$

$$= \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{\sqrt{\cos x}}{\sqrt{\sin x}+\sqrt{\cos x}}dx$$

$$= \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{\sqrt{\cos\left(\frac{\pi}{2}-x\right)}}{\sqrt{\sin\left(\frac{\pi}{2}-x\right)}+\sqrt{\cos\left(\frac{\pi}{2}-x\right)}}dx$$

$$= \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{\sqrt{\sin x}}{\sqrt{\cos x}+\sqrt{\sin x}}dx$$

Hence, $I_1 = I_2$

$\therefore I_1 - I_2 = 0$

88. (c) Adding I_1 and I_2

$$I_1 + I_2 = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{\sqrt{\sin x}+\sqrt{\cos x}}{\sqrt{\sin x}+\sqrt{\cos x}}dx = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} dx$$

$$= [x]_{\frac{\pi}{6}}^{\frac{\pi}{3}} = \frac{\pi}{6} = \frac{\pi}{12} \qquad (\because I_1 + I_2 = 2I)$$

89. (d) $\lim\limits_{x\to\frac{\pi}{2}} f(x) = \lim\limits_{x\to\frac{\pi}{2}} \frac{1-\sin x}{(\pi-2x)^2}$

$$= \lim_{x\to\frac{\pi}{2}} \frac{-\cos x}{(\pi-2x)(-2)}$$

$$= \lim_{x\to\frac{\pi}{2}} \frac{\cos x}{4(\pi-2x)}$$

and $= \lim\limits_{x\to\frac{\pi}{2}} \frac{-\sin x}{4(-2)} = \lim\limits_{x\to\frac{\pi}{2}} \frac{\sin x}{8}$

$$= \frac{1}{8}.\sin\frac{\pi}{2} = \frac{1}{8}\times 1 = \frac{1}{8}$$

90. (a) Function is continuous at $x = \frac{\pi}{2}$

$$f\left(\frac{\pi}{2}\right) = \lim_{x\to\frac{\pi}{2}} \frac{1-\sin x}{(\pi-2x)^2} = \frac{1}{8}$$

91. (c) $\lim\limits_{x\to 0} \frac{\sqrt{f(x)}-3}{\sqrt{x}-3} = \lim\limits_{x\to 0} \frac{\frac{1}{2\sqrt{f(x)}}f'(x)}{\frac{1}{2\sqrt{x}}.1}$

(By L' Hospital rule)

$$= \lim_{x\to 0} \frac{f'(x)\times\sqrt{x}}{\sqrt{f(x)}} = \frac{f'(9)\times\sqrt{9}}{\sqrt{f(9)}}$$

$$= \frac{4\times 3}{\sqrt{9}} = \frac{4\times 3}{3} = 4$$

92. (b) $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} x\sin x\, dx = 2\int_0^{\frac{\pi}{2}} x\sin x\, dx$

{x sin x is an even function}

$$= 2[-x\cos x + \sin x]_0^{\frac{\pi}{2}} = 2$$

93. (a) Differential equation $x\,dy - y\,dx = y^2$

$= (y\,dx - x\,dy) = y^2$

$\therefore d\left(\frac{x}{y}\right) = 0$

$\frac{x}{y} = C \therefore x = Cy$

94. (b) LHL $f(2.99-0) = \lim\limits_{h\to 0} (2.99-h)$

$\lim\limits_{h\to 0} (2.99 - h \lim\limits_{h\to 0} 2 = 2$

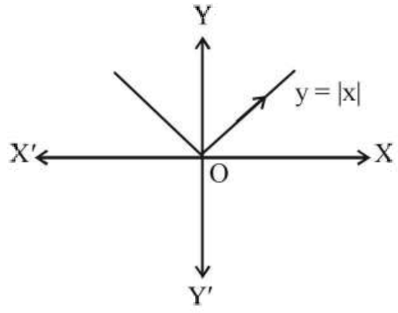
RHL $f(2.99-0) = \lim\limits_{h\to 0} f(2.99+h)$

$= \lim\limits_{h\to 0} (2.99+h) = \lim\limits_{h\to 0} 2 = 2$

LHL = RHL

$\therefore f(x)$ is continous at $x = 2.99$

95. (b) **Statement 1 :** $f(x) = |x|$



From the graph, the curve has sharp turn at $x = 0$.
Therefore, the function $f(x) = |x|$ is not differentiable only $x = 0$, it is differentiable at $x = 1$

Statement 2 : $f(x) = e^x$

$$Rf'(0) = \lim_{h\to 0} \frac{f(0+h) - f(0)}{h}$$

$$= \lim_{h\to 0} \frac{e^{(0+h)} - e^{o}}{h} = \lim_{h\to 0} \frac{e^h - 1}{h}$$

Use L'Hospital rule

$$= \lim_{h\to 0} \frac{e^h - 0}{1} = e^{o} = 1$$

$$= \lim_{h\to 0} \frac{1 - e^{-h}}{h}$$

Use L' Hospital rule

$$= \lim_{h\to 0} \frac{e^{-h}}{1} = e^{-0} = 1$$

Therefore $f(x) = e^x$ is differentiable at $x = 1$

96. (c) $z = fof(x) = f(x^2) = x^4$

$$\frac{dz}{dx} = 4x^3$$

97. (d) $f(x) = \dfrac{x^2 - x + 1}{x^2 + x + 1}$

$$f'(x) = \frac{(x^2 + x + 1)(2x - 1) - (x^2 - x + 1)(2x + 1)}{(x^2 + x + 1)^2}$$

$$= \frac{2x^2 - 2}{(x^2 + x + 1)^2}$$

Put $f'(x) = 0$
$2x^2 - 2 = 0$
$x = \pm 1$

$$f''(x) = \frac{(x^2 + x + 1)^2(4x) - 2(2x^2 - 2)(x^2 + x + 1)(2x + 1)}{(x^2 + x + 1)^4}$$

$$f''(-1) = \frac{-36}{81} < 0$$

$f(x)$ is maximum at $x = -1$
$f(-1) = 3$

98. (b) $f''(-1) = \dfrac{36}{81} > 0$

$f(x)$ is minimum at $x = 1$

$$f(1) = \frac{1}{3}$$

99. (b) **Statement 1 :** Given $f(x) = \begin{cases} 2 - x & \text{for} \quad 1 \le x \le 2 \\ 3x - x^2 & \text{for} \quad x > 2 \end{cases}$

function defined in $1 \le x < \infty$
the function is polynomial, so it is continous and differentiable in its domain $[1, \infty] - \{2\}$

$$LHL\, f(2-0) = \lim_{h\to 0} f(2-h)$$

$$= \lim_{h\to 0} h = 0$$

$$RHL\, f(2+0) = \lim_{h\to 0} (2+h)$$

$= 6 - 4 = 2$
$f(2) = 2 - 2 = 0 \therefore$ LHL $\neq$ RHL

Statement 2 :

$$Rf''(1.5) = \lim_{h\to 0} \frac{f(1.5+h) - f(1.5)}{h}$$

$$= \lim_{h\to 0} \frac{2(1.5+h) - (2 - 1.5)}{h} = \lim_{h\to 0} \frac{-h}{h} = -1$$

$$Lf'(1.5) = \lim_{h\to 0} \frac{f(1.5-h) - f(1.5)}{-h}$$

$$= \lim_{h\to 0} \frac{2 - (1.5 - h) - (2 - 1.5)}{-h}$$

$$= \lim_{h\to 0} \frac{h}{-h} = -1$$

Therefore, the function is differentiable at $x = 1.5$

100. (d) $f'(x) = \begin{cases} -1 & \text{for} \quad 1 \le x \le 2 \\ 3 - 2x & \text{for} \quad x > 2 \end{cases}$

$f(x)$ at $x = 3$
$f'(3) = 3 - 2(3) = 3 - 6 = -3$

101. (d) $f'(2+0) = \lim_{h\to 0} f'(2+h)$

$$= \lim_{h\to 0} 3 - 4 - 2h = -1$$

$$f(2-0) = \lim_{h\to 0} f'(2-h) = -1$$

So, $f'(x)$ exist at $x = 2$

102. (c) $I = \int_0^{\frac{\pi}{2}} \ln(\tan x)\, dx$ ...(i)

$$I = \int_0^{\frac{\pi}{2}} \ln\left(\tan\left(\frac{\pi}{2} - x\right)\right) dx$$

$$= \int_0^{\frac{\pi}{2}} \ln \cot x\, dx \qquad \text{...(ii)}$$

Adding equations (i) and (ii)

$$2I=\int_0^{\frac{\pi}{2}} \ln(\tan x.\cot x)dx$$

$2I=0$

$I=0$

For (103-105)

$(x^2+x+1)\,dy+(y^2+y+1)\,dx=0$

$(x^2+x+1)\,dy=-(y^2+y+1)\,dx$

$$\frac{dx}{(1+x+x^2)}+\frac{dy}{(1+y+y^2)}=0$$

$$\Rightarrow \int\frac{dx}{\left(x+\frac{1}{2}\right)^2+\left(\frac{\sqrt{3}}{2}\right)^2}+\int\frac{dy}{\left(y+\frac{1}{2}\right)^2+\left(\frac{\sqrt{3}}{2}\right)^2}=0$$

$$\Rightarrow \frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2x+1}{\sqrt{3}}\right)+\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2y+1}{\sqrt{3}}\right)$$

$$=\frac{2}{\sqrt{3}}\tan^{-1}C_1$$

$$\Rightarrow \tan^{-1}\left\{\frac{\left(\frac{2x+1}{\sqrt{3}}\right)+\left(\frac{2y+1}{\sqrt{3}}\right)}{1-\left(\frac{2x+1}{\sqrt{3}}\right)\left(\frac{2y+1}{\sqrt{3}}\right)}\right\}=\tan^{-1}C_1$$

$$\left[\because \tan^{-1}x+\tan^{-1}y=\tan^{-1}\left(\frac{x+y}{1-xy}\right)\right]$$

$$\Rightarrow \frac{\sqrt{3}[(2x+1)+(2y+1)]}{3-(2x+1)(2y+1)}=C_1$$

$$\Rightarrow \frac{2\sqrt{3}(x+y+1)}{-4xy-2y-2x+2}=C_1$$

$$\Rightarrow 2\sqrt{3}(x+y+1)=C_1(2-2x-2y-4xy)$$

$$\Rightarrow 2\sqrt{3}(x+y+1)=2C_1(1-x-y-2xy)$$

$$\Rightarrow (x+y+1)=\frac{C_1}{\sqrt{3}}(1-x-y-2xy)$$

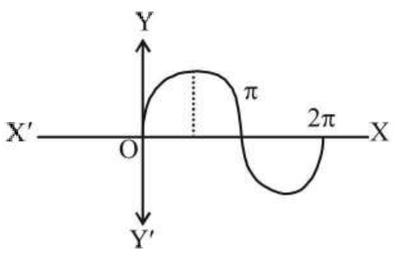
$(x+y+1)=A(1+Bx+Cy+Dxy)$

103. (a) $B=-1$

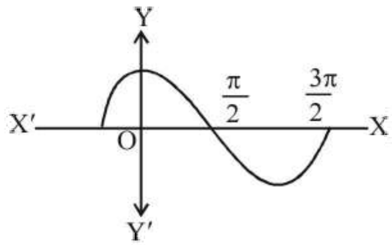
104. (b) $C=-1$

105. (c) $D=-2$

106. (d) sin x increases on the interval $\left(0,\frac{\pi}{2}\right)$



cos x decreases on the interval $\left(0,\frac{\pi}{2}\right)$



107. (a) Particular solution do not have any constant

108. (c) $dy=y\tan x\,dx$

$$\int\frac{dy}{y}=\int\tan x\,dx$$

$\log|y|=\log|\sec x|+\log|c|$

$\log|y|=\log|c\sec x|$

$y=c\sec x$

at $x=0, y=1$

$y=c$

Solution is given by

$y=\sec x$

109. (c) **Statement 1:** Differential equation is not a polynomial equation in its derivatives. So, its degree is not defined.
Statement 2 : The highest order derivative in the given polynomial is 2.

110. (c) Focus is $(0,-2)$

$a=-2$ and parabola is along y-axis downward

$x^2=4ay$

$x^2=-8y$

or $x^2+8y=0$

For (111–114)

Set $A=\{1,2,3,4,5,6,7\}$ and $z=x+y$

x = set of odd numbers

y = set of even numbers

111. (d) $n(S)=12$

$n(E_1)=2$

$$P(Z=5)=\frac{n(E_1)}{n(S)}=\frac{2}{12}=\frac{1}{6}$$

112. (a) $P(Z=10)=\frac{n(E_2)}{n(S)}=\frac{0}{12}=0$

113. (d) $Z>11$ is only possible when $x=7$ and $y=6$

$$P(>11)=\frac{n(E_3)}{n(S)}=\frac{1}{12}$$

114. (c) Z = product of two prime numbers

$Z=x+y=7+6=13$

$n(E_4)=3$

$$P(Z=9)=\frac{n(E_4)}{n(S)}=\frac{3}{12}=\frac{1}{4}$$

For (115-117)

115. (a) $\frac{\Sigma fx}{N}=\frac{922}{245}=3.76$

Numbers(x)	Frequency(f)	c.f.	$\sum fx$
0	14	14	0
1	21	35	21
2	25	60	50
3	43	103	129
4	51	154	204
5	40	194	200
6	39	233	234
7	12	245	84
	N = 245		$\sum fx = 922$

116. (b) $\frac{N}{2}=\frac{245}{2}=122.5$

Required mean = 4

117. (b) The higher frequency is 51

$\therefore$ mode = value of the variable corresponding to the higher frequency 154 = 4

For (118-120)

Mean of 100 items = $\bar{x}_{100}=50$

Mean of 150 items = $\bar{x}_{150}=40$

Standard deviation of 100 items = $\sigma_{100}=5$

Standard deviation of 150 items = $\sigma_{150}=6$

118. (b) $\bar{x}_{250}=\frac{n_1.\bar{x}_{100}+n_2.\bar{x}_{150}}{n_1+n_2}=\frac{(100\times 50)+(150\times 40)}{100+150}$

$=\frac{11000}{250}=44$

119. (c) $d_1=50-44=6 \qquad d_1^2=36$

$d_2=40-44=-4 \qquad d_2^2=16$

$$\sigma_{250}=\frac{\sqrt{n_1(\sigma_{100}^2+d_1^2)+n_2(\sigma_{150}^2+d_2^2)}}{n_1+n_2}$$

$=\frac{\sqrt{390}}{5}=\frac{37.28}{5}=7.456=7.5$

120. (c) Variance of all 250 items $=(\sigma_{250})^2=(7.456)^2=55.6$

GENERAL ABILITY

PART-A : ENGLISH

1. (b) Option (a) "the pile of books" is correct in every sense. Pile is always used with books, sheets, etc. option (c) 'missing' is one word describing that the action is in continuation. Option (b) though has the usage of are, which is incorrect. This auxiliary verb is used for the word 'pile' which is singular. Option b being incorrect rules out option (d).

2. (c) Option (c) is the answer. 'are wrong' is a wrong form of usage. When alternative subjects are joined by "or" or "nor" (including "either . . . or" and "neither . . . nor" correlatives) the verb agrees with the closest part of the compound. Thus, the correct form is- Either he or I am wrong. Or to be on the safer side, one could also use 'either he is wrong or I am'.

3. (b) Option (b) has an error and hence is the answer. 'tell to' is incorrect form of usage. We usually follow tell with a personal object (the person that we are speaking to) right after it and do not accompany any other word like 'to'. Option (a) and (c) have no error.

4. (d) The correct answer is d. No error as the sentence makes complete sense. The sentence has two parts and the first corresponds with the other without showing any grammatical error. Thus the sentence, though he is good he is mischievous is correct.

5. (c) Option (c) is absolutely wrong. Here the usage of *hardly* is in wrong form. The word *hardly* is an adverb, Learners often imagine that *hardly* is related to the word hard and is its adverbial form. This leads to errors. Its main use is to say that something is almost not true or almost does not happen at all. On the other hand, "The thief hit me" is formed in correct manner.

6. (c) The option (c) "is less" has been used in an inappropriate manner, so it's wrong. Number of books in our library depicts the noun to be countable in nature. However less is used in sentences where the noun cannot be counted or it's not in plural form (for eg: music, air, rain, etc).

7. (c) Option (c) is the answer as the phrase "till I will give the order" has been used incorrectly because in English grammar, **after till or until** we use present tenses to talk about the future so the correct form would be till I give you the order. The phrase "general said, soldiers do not shoot" depicts usage of direct speech and its error free.

8. (d)

9. (c) In this sentence last phrase that is option (c) has an error. The usage of any equipments with than does not completely make sense. In a comparative form of sentence "than" is generally used when comparing two objects or persons. Moreover when using any, it suggests depicting one object out of many so the correct usage would be "any of the other equipments" or "any other equipment". Thus option (c) is the answer.

10. (c) In option (c) "in to near future", usage of "to" seems unnecessary. 'In' is already a preposition which fits well in this phrase. So it could be simply in near future. "To" is generally used when defining relationship between two parts of a sentence, indicate a limit, indicate the place, person, or thing that someone or something moves toward etc. thus correct answer is (c).

11. (c) Again in this question, preposition 'to' has been incorrectly used in option (c) here "to that" does not fit aptly as the sentence indicates differentiating between the working of objects not just the traits. Thus the right form of usage would be "from the other". Hence option (c) is the answer.

12. (c) Option (a) is incorrect as I followed by did is mostly to lay stress on the verb/action while the actual emphasis is on the first part of sentence. Option (b) is incorrect as the word 'going' brings the sentence in present continuous while the actual sentence is in the past tense. Use of verb 'do' twice is not preferred over the 'went'. Hence, option (c) is correct.

13. (b) Even is a word used to express surprise, as comparatives or for balance. You use although to introduce a subordinate clause in which you mention something that contrasts with what you are saying in the main clause. Since gives the starting point of actions, events or states. It refers to when things began. We use For when we measure the duration - when we say how long something lasts. Out of all these options, although seems more appropriate.

14. (a) Arbitrate means to mediate to settle differences "**between**" two parties. Arbitrate is usually followed by between and not with or at, ruling out option (d) and (b). It necessarily needs a preposition to follow, ruling out option (c) as well. Here option a between fits well as there are two persons involved in the dispute. Hence, answer option (a).

15. (b) The underlined word among is used to indicate group of people, more than two. Option a "in" is a preposition used when denoting something inside. Thus it gets rejected. Option (b) of is used to indicate reference, showing something, belonging something. Option (c) can be out rightly rejected as "than" differentiates one from the other. But here,"than" is followed by both persons collectively. Thus option (b) of is the best option.

16. (c) It's natural that when comparing or relating a father and his son, the usage of tense has to be in present tense. This is because if a son resembles his father, he will always resemble him, not for a specific period of time. Thus option (c) resembles suits best in this sentence as it is in present tense. The underlined word "is resembling" is in present continuous tense. Option (a) "was resembling" is also wrong as it is past continuous tense and option (c) resembles depicts present tense as said before.

17. (d) Option (d), no improvement, is the correct answer as the original sentence makes perfect sense.

18. (a) Option (a) "would" is more polite, because it expresses the idea of probability, and of willingness, and of the desire that something be done, whereas option (b) "should" is the past tense of shall, but it is an auxiliary verb with a few uses, not all of which are in the past tense. Itis used to ask question, to show obligation or to show a possible future event. Option (c) 'must' is specifically used when an order is given or something is necessary to do. The underlined word can be shows the capability of the subject to do an action. Thus, from the above explanations, it is clear that option (a) is most appropriate in this sentence

19. (d)

20. (c) In this sentence, we get the idea that the action is in continuation from the past 10 years. The underlined phrase is living is in present continuous form. Whereas option (a) was living is in past continuous form both of which do not suit the situation. However option (c) has been living is in present perfect which indicates the continuation of the action from the said period. Thus of all the options, option (c) is the correct answer.

21. (a) Know is a verb which can be used with different tenses. Here the noun secret is abstract noun and suggests the action is being performed in the present form. The underlined phrase is knowing is in present continuous tense and does not fit here as a secret cannot be known(verb) continuously. "Has been knowing"i.e., option (b) indicates present perfect tense which again does not make meaningful sense. Option (c) "was knowing" is in past continuous form and one cannot stop knowing a secret after some time. However, option a knows completely makes sense as it establishes the fact that the person is well aware of the secret at present and every time he will be aware of it. Thus option (a) is the answer.

22. (d) The phrasal verbs used here indicate different actions. Option a put on means to clothe or apply. Option (b) put out means to extinguish. Option (c) put for is generally used to take place 'for', in place 'of'. The underlined phrasal verb put off means to delay or postpone. Thus, going by the meaning of sentence the underlined word itself seems correct as a meeting can be delayed or postponed. Option (d) is the correct answer.

23. (a) The sentence shows very clearly that the sentence is in present form and the person is being asked to come at that present moment. Option (a) 'come' with me suggests present form of the sentence. Option (b) had come with me is in past perfect which will not go with the word shall in the sentence which depicts future tense. Option (c) came with me can be rejected as it is in past tense again. The underlined word will come with me can be replaced with option (c) come with me, making better sense. Thus option (a) is the answer.

24. (d) Stroll means to walk in a leisurely way. Move means go in a specified direction or manner; change position. Gallop means the fastest pace of a horse or other quadruped, with all the feet off the ground together in each stride. While the first two options do not convey the intensity with which the thief would react on seeing the police, third option gallop is used only for horses or other quadruped. Hence, option (d) 'ran' seems most appropriate.

25. (d) Acting is the art of performing fictional roles while becoming an officer is real as given in sentence. This rules out option (a). Doing is present continuous verb not suiting the flow of the sentence and highly inappropriate. Deed is an action that is performed intentionally or consciously. Also it is a one time thing, while his run as an officer is a prolonged activity. Record, meaning the sum of the past achievements or performance of a person, organization or thing fits most perfectly here. Hence, option (d).

26. (c) Conclusion means the end or finish of an event, process, or text and not a table or similar furniture. Terminal is theend or extremity of something, either for a disease or a track, etc. termination is the act of ending or finishing something, a noun form not suitable in the sentence. Option (c) 'end' fits the sentence most simply and well.

27. (d) In this sentence a man's inability to open the door due to weakness is emphasized. The option **much** (adv.) is used toemphasize a comparative adjective.Whereas **too is used to** modify an adjective creating the meaning of an unacceptable, excessive degree. Option very is used in cases to intensify an adjective .far is again used where comparative degree of adjectives are used. Here the sentence highlights the inability of the man due to excessive weakness. Thus it needs an adverb to highlight the severity of the problem. Thus option (d) is correct.

28. (a) The word in question "frail" means timid, weak etc. The opposite of frail should be related to strength. Option (a) strong denotes physical power. Option (b) "big" means large in size and shape. Option (c) old indicates weakness. Option (d) is weak itself. Thus after analyzing the options, it is clearly visible that the correct antonym would be option (a) 'strong'.

29. (b) The word indigenous means local or native. Genuine means original, true. Foreign means alien, outsider. Indigent means poor, needy, impoverished. Indignant means angry, annoyed. From the above descriptions, it is evident that option (b) foreign is the correct answer.

30. (a) Poverty means scarcity or paucity. Option (a) "prosperity" means wealth or affluence. Option (b) adversary means opponent or challenger. Adversity means hardship or difficulty. Diversity means variety or myriad. Looking at the options it's evident that option (a) "prosperity" is the antonym of poverty thus the answer.

31. (b) Wholesome, the word in question means nutritious, hearty. Option (a) is complete which has synonym very close to wholesome. Option (b) unhealthy means something which is not good for health or deficient in nutrition. Option (c) incomprehensible means inexplicable or inconceivable thus this word has no relation with the word wholesome. Option (d) "few" is an adverb used for countable nouns. After going through the option it is clear that option (b) unhealthy is the most appropriate answer.

32. (c) In the given passage it is clearly narrated in the very line that one who reaches the position of leader is one with outstanding character and ability so option (a) is the closest to the main sentence in the passage but the option has the word must which lends the edge of necessary condition for becoming a leader. Option (b) also mentions the word must which takes away the essence of the main sentence. Option (c) sounds closest to the main sentence as the remarkable goes well in place of the word outstanding. Option (d) also does not go with the original sentence.

33. (c) From the passage we get to know that the reason why Hitler rose to being a dictator was the fact that Germany was in despair. The option (c) clearly lends support to this fact. Other options just vaguely revolve around the passage's theme. Thus option (c) is the answer.

34. (a) The gist of the passage suggests in the last line of the passage that due to disparity and unfavorable condition in a country, unworthy people can get a chance to abuse their power and proclaim dictatorship. The very first option a clearly sends this very message. Option (b) is naturally untrue. Option (c) even though is close to the real message is not in context with the passage. Option (d) is also not related to the passage in exact sense. Thus option (a) is the answer.

35. (a) After reading the passage it is clear that dog is being talked about as an intelligent animal and thus it can be trained to perform different types of duties. The first option a is very much close to the real sentence in passage. Specifically it is not suggested that dogs can do difficult works only. Also it is being said although they are of different types, they have learning ability which is quite similar. Option (a) alone 'are help for man' is totally out of context statement. Thus option (a) is the correct answer.

36. (a) It is written in the passage that medals are awarded only to those dogs in the police and army department who do brave deeds, not every dog helping the police or those serving in the sentries. So out of all the options, option (a) fulfills all the conditions required for the dog to attain a medal.

37. (c) Reading the passage throws light on the message that dogs are faithful companions of man who can be trusted on every difficult situation. The option that only dogs are faithful to man and dogs can do almost anything for man is totally distorted in meaning. Also man is not totally helpless without dogs although they help us in lot of ways. Thus clearly option (c) is the best statement and therefore correct.

38. (b) Pertaining to this question, we must first understand the meaning of aristocratic bloodhound. It means that the dog which is full blooded, pure and of rare breed, having family lineage. The meaning is closest to the word pedigree in option (b). Thus automatically option (b) becomes the correct answer, hardly leaving any chance for considering any other option.

39. (b) Out of the list of options provided for question 39, a suits best with the remaining phrase because when we talk about youngster, it's a generic word , suggesting lot of people are young. That brilliant does not sound appropriate as the person in question is directly being talked about. He is not far off or is not in a particular direction. The can also be not used as it is used with a specific or exclusive word or group. Thus option (b) is the answer.

40. (a) Here we must notice that preposition is used for the word experience. Option (a) "with" is a preposition used to indicate "having". Option (b) "of" isused for belonging to, relating to, or connected with. Option (c) for is used to indicate the use of something. Out of all three options, option (a) is the best and correct answer as experience is something one has or possesses.

41. (c) In this sentence it is mentioned about the son of Jaroslov Drobny, a Czech carpenter. Now Jaroslov Drobny is a particular man with an exclusive identity, so his son is also a particular person being referred to. So in this case before son "the" should be used not "a" or "that". Thus "the" is the answer.

42. (a) If we closely look at the sentence then we find that it is indicating the starting point of play in his career. When we say about starting something by a second person then has or had is used. Has for present tense and had for past tense. Here option (a) is "had". Was cannot be used here as it does not refer to the starting of just playing. Since the sentence is referring to an incident of the past has cannot be used. Thus we are left with the option (a) ie, had.

43. (a) The boy started playing at the age of five. Age fits the blank perfectly as the next word is anumerical value. We generally refer to someone's age by a number. Now for stage we cannot use a number. Similarly for career, a number cannot be used. Thus option (a) is the answer.

44. (a) In English grammar, it is known that with in lieu, always' of' is used not "for" or "to". Thus in lieu of is a phrase generally used for in place of. Option (a) is the answer.

45. (a) We always go to a place. We don't go for or with a place. To is preposition which is used to indicate the place, person, or thing that someone or something moves toward, or the direction of something. For is used to indicate the use of something, time or duration. 'With' is used to indicate being together or being involved. Thus the most suitable preposition would be option (a) "to".

46. (c) If we look at the option (a) "in", it should be noted that in cannot be used with day, grammatically. So this option is nullified. It is a common practice that when we use on to denote a day or a date then we use the before the word day. But here in the sentence "the" has not been used. Now we are left with the option (c) that, which fits well when we direct towards a particular day in the past.

47. (b) It is evident that the person has full knowledge of his mental state and he is driving himself to do the best. Going by the mental situation of the subject, it hints that the work he is doing is extremely necessary for him without a doubt. In places where full willingness and authority is represented then 'can' or 'would' should not be used as these words suggest capability and politeness in attitude respectively. But option (b) must define the person's stance that he has to complete the work whatsoever.

48. (a) From the previous item, we know that how much important this game is for the subject. It was his dream to play in Wimbledon. Seeing the importance of this match, it should be noted that this match is not just important for this particular day but for his life. Option (b) 'age' also does not lend edge to the statement. Thus, option (a) 'life' is the best and correct answer.

49. (a) In this sentence the subject is the player and "he" has been used as a pronoun. The second part of the sentence also keeps talking about the player only not for a general person. Thus you or one cannot be used in this sentence. However 'he' fits the bill as the sentence is in continuation with the person's actions.

50. (c) From the previous item we get the hint that the person has played an important match and wants to excel from the very beginning as he knows that life is dynamic and the same person does not always get unlimited chances although games and matches would always happen. So the sentence becomes a little philosophical and hints more at number of opportunities available than at games and matches, thus option (c) opportunities seems the most correct answer.

PART- B: GENERAL KNOWLEDGE

51. (d) The Progressive Writers' Association was established in London in 1935 by Indian writers and intellectuals, with the encouragement and support of some British literary figures. It was a group of writers, including Mulk Raj Anand, Sajjad Zaheer and Jyotirmaya Ghosh. It thought critically about the problems of hunger and poverty, social backwardness, and political subjection of Indian people. Gandhi became the central theme of these writers.

52. (d) E. V. Ramaswami Naicker was a social activist who started the Self-Respect Movement or the Dravidian Movement. He was anti-Brahmin activist and supported low caste Movement. He was born in Erode, Madras Presidency to a wealthy family of Balijas.

53. (b) Ashok Chakra Award is the peace time award. The Param Vir Chakra (PVC) is India's highest military decoration awarded for the highest degree of valour or self-sacrifice in the presence of the enemy and cannot be awarded to civilians. It replaced the former British colonial Victoria Cross.

54. (b) Gandhiji never attacked caste system.

55. (d)

56. (d) Operation Safed Sagar was the code name assigned to the Indian Air Force's strike to support the ground troops during Kargil war.

57. (c) During the Civil Disobedience Movement,tribals in Chota Nagpur wore Khadi gave up opium consumption, drinking liquor and eating meat.

58. (a) On 8 August 1942 at the All-India Congress Committee session in Bombay, Mohandas Karamchand Gandhi launched the 'Quit India' movement. It was a civil disobedience movement.

59. (a) Option (a) is the correct choice.

60. (b) The Swadeshi movement was started to oppose the British decision to partition Bengal. During the movement, people of Bengal had boycotted the British products and advocated the Swadeshi products.

61. (c) Alluri Sitarama Raju was associated with the Gudem-Rampa Rebellion.

62. (a)

63. (d) The Doctrine of Lapse was devised by Lord Dalhousie and that aimed to extend the territorial boundaries of the English East India Company.

64. (b) The Permanent Settlement was introduced by Lord Cornwallis.It was an agreement between the British East India Company and the Landlords of Bengal to settle the Land Revenue to be raised. The landlords were given the right to transfer or sell their lands if they liked.

65. (a) The Lokpal Act, 2013, officially 'The Lokpal and Lokayuktas Act, 2013', is an anti-corruption Act of Indian Parliament in India which "seeks to provide for the establishment of the institution of Lokpal to inquire into allegations of corruption against certain public functionaries and for matters connecting them". According to the Act,Lokpal will be applicable at the Centre and Lokayukta at the States.

66. (c) Hindustan Socialist Republican Association was a revolutionary organization. It was established in 1928. Bhagat Singh, Chandrasekhar Azad, Sukhdev were associated with it.

67. (b) The Indian National Army was organized to fight against British in India. The Indian National Army (INA) was originally founded by Capt Mohan Singh in Singapore in September 1942. It was revived with the arrival of Subhash Chandra Bose in the Far East in 1943.

68. (c) Nelson Mandela was the first black president of South Africa (1994-99). Mandela spent 18 years(From 1964 to 1982) in prison on Robben island.

69. (b) The non-cooperation movement was withdrawn after the Chauri Chaura incident in February 1922.

70. (c) Buddha or Karl Marx was written by B.R Ambedkar.

71. (a) North Eastern Region Community Resource Management Project(NERCORMP) is a livelihood and rural development project aimed to transform the lives of the poor and marginalized tribal families in North East(NE) India. NERCORMP is a joint developmental initiative of the North Eastern Council(NEC), Ministry of DONER(Ministry of Development of North Eastern Region) Govt. of India and International Fund for Agricultural Development(IFAD).

72. (c) Option (c) is the correct answer.

73. (b) SAMARTH 2014 was organized by the Department of Disability Affairs under the Ministry of Social Justice and Empowerment, Government of India. The Convention on the Rights of Persons with Disabilities is an international human rights treaty of the United Nations intended to protect the rights and dignity of persons with disabilities. India is a party to the convention.

74. (a) The 13th edition of joint exercise by the Indian Coast Guard and its Japanese counterpart held approximately at 20 nautical miles off Kochi.

75. (c) The Grand Slam itinerary consists of the Australian Open (mid January), the French Open (May/June), Wimbledon (June/July) and the US Open (August/September.). First grand slam of the year is Australian Open.

76. (b) If the magma cools quickly, the crystals do not have much time to form, so they are very small. If the magma cools slowly, then the crystals have enough time to grow and become large. Mineral crystals that form when magma cools slowly are larger than crystals that form when lava cools rapidly.

77. (a) (a) is correct and statement II is the correct explanation of statement I.

78. (a) (a) is correct and statement II is the correct explanation of statement I .

79. (a) (a) is correct and statement II is the correct explanation of statement I.

80. (b) Both statements are correct but statement II is not the correct explanation of statement I.

81. (a)

82. (d) No. of valence electron in one O atom = 8
O^{2-} represents gain of two electrons
$\therefore$ No. of valence electrons = 8 + 2 = 10

83. (b) The most abundant inorganic constituent of protoplasm is water.

84. (c) Given that $\ell_B = 2\ell_A$ and $r_A = 2r_B$

Now, from $R = \rho\frac{\ell}{A}$

$$\frac{R_A}{R_B} = \frac{\ell_A}{\ell_B} \times \frac{r_B^2}{r_A^2} = \frac{\ell_A}{2\ell_A} \times \frac{r_B^2}{(2r_B)^2} = \frac{1}{8}$$

$= 1:8$

85. (c)

86. (b) We know that,
atomic number of chlorine = 17
Therefore, the chlorine configuration $1s^2\ 2s^2 2p^6\ 3s^2\ 3p^5$
So, 2, 8, 7 is correct answer.

87. (b) Fructose, predominates in Honey.

88. (c) During short circuiting, the current flowing in the electrical circuit increase instantaneously.

89. (d) Number of aluminium ions present in 54g of aluminium

$$= \frac{6.203 \times 10^{23} \times 54}{27} = 1.2 \times 10^{24}$$

90. (d) Dengue fever is also known as breakbone fever. Symptoms of the disease include headache, fever, prostration, severe joint and muscle pain, swollen glands (lymphadenopathy) and rashes.

91. (d) A Van de Graaff generator is an electrostatic generator which uses a moving belt to accumulate electric charge on a hollow metal globe on the top of an insulated column, creating very high electric potentials. It produces very high voltage direct current (DC) electricity at low current levels. A tabletop version can produce on the order of 100,000 volts and can store enough energy to produce a visible spark. It was invented by Robert J. Van de Graaff in 1929.

92. (a) Diamond is the most stable form of carbon.

93. (c) Scurvy is a disease caused by a diet that lacks vitamin C (ascorbic acid). Patients develop anemi, debility, exhaustion, edema (swelling) in some parts of the body, and sometimes ulceration of the gums and loss of teeth. Humans cannot synthesize vitamin C, which is necessary for the production of collagen and iron absorption. We have to obtain it from external sources, i.e. from fruits and vegetables.

94. (d) The summer and winter seasons in a year are caused by revolution of the earth on its inclined axis.

95. (c) There are four states of matter- solid, liquid, gas and plasma. A plasma can be created by heating a gas or subjecting it to a strong electromagnetic field applied with a laser or microwave generator.

96. (d) When two elements and/or ions have the same electronic configurations, it is said that they are "isoelectronic" with one another.

97. (b) Anaemia is a medical condition in which the red blood cell count or haemoglobin is less than normal. For men, anaemia is typically defined as haemoglobin level of less than 13.5 gram/100 ml and in women as haemoglobin of less than 12.0 gram/100 ml. Vitamin supplements given orally (folic acid or vitamin B12) or intramuscularly (vitamin B12) will replace specific deficiencies. So,the doctor advices advises the patient iron and folic acid tablets.

98. (d) Lakshadweep is about 220 to 440 Kms away from the cost of Kerala, lying one of the world's most spectacular tropical Islands systems in a scattered group of 36 coral islands. All these islands have been built up by corals and have fringing coral reefs very close to their shores.

99. (d) Bernoulli's principle is based on the principle of conservation of energy. This states that, in a steady flow, the sum of all forms of energy in a fluid along a streamline is the same at all points on that streamline. This requires that the sum of kinetic energy, potential energy and internal energy remains constant.

100. (b) When a simple pendulum immersed in water then its oscillations are damped and its wave is cosine wave.

101. (b) Producer gas, mixture of flammable gases (principally carbon monoxide and hydrogen) and non-flammable gases (mainly nitrogen and carbon dioxide) is made up throughby the partial combustion of carbonaceous substances, usually coal, in an atmosphere of air and steam.

102. (c) Dropsy is a disease, which means swelling of the body. Main symptoms of 'Dropsy' are: (i) swelling of the whole body especially legs (ii) gastrointestinal symptoms like vomitting, diarrhoea, loss of appetite (iii) tingling sensation in the skin (iv) tenderness in the calf muscles (v) increased intra-occular (inside the eye) pressure which is known as glaucoma.It is caused by adulteration in mustard oil.

103. (a) Doldrums are a low pressure area around equator after which come the trade wind whose expanse is from tropic of cancer to tropic of capricorn. They move in North-East direction in the Northern hemisphere and North-East in the Southern hemisphere. They are followed by westerlies that prevail in mid latitude between 30 and 60 degrees latitude. As the name suggests polar winds are closer to the poles. The correct answer is (a).

104. (a) Ohm's Law is the linear proportionality between current and voltage that occurs for most conductors of electricity. A graph of voltage against current is a straight line.

105. (b) Hydrogen has three naturally occurring isotopes denoted by 1H(Protium), 2H(Deuterium) and 3H (Tritium). Protium is the most prevalent hydrogen isotope, with an abundance of 99.98%. It consists of one proton and one electron.

106. (b) Castor plants are not used for rearing of silkworms. Castor oil has many uses in medicine and other applications.

107. (d) Taungup Pass is a mountain corridor connecting India with Myanmar. Taungup is situated located in Sandoway district of Myanmar.

108. (c) The temperature of water at the bottom of a lake whose upper surface has frozen to ice would be around 4 degree Celsius.

109. (d) Graphite is slippery and hard and is therefore used as a dry lubricant in machines. Graphite is a good conductor of heat and electricity. This is because, like metals, graphite contains delocalized electrons. These electrons are free to move through the structure of the graphite.

110. (d) Insects are abundant in terms of number of species identified.

111. (d) Crystallisation is a form of mechanical weathering. It is operative especially in arid climates. Due to dry weather, moisture is drawn to the surface of rocks. Hydration is another process which involves water, but there is no chemical change whatsoever. Hydration causes granular disintegration.
Frost action is also termed as synonymous with freeze-thaw action.

112. (a) The Sami people are an indigenous Finno-Ugric people inhabiting the Arctic area of Sápmi, which today encompasses parts of far northern Norway, Sweden,Finland, the Kola Peninsula of Russia, and the border area between south and middle Sweden and Norway.

113. (a) Given that
$C = 3 \times 10^8 m/s,\ H = 1.5$

then $V = \frac{C}{H} = \frac{3\times10^8}{1.5} = 2\times10^8 m/s$

114. (b)

115. (b) A mineral acid is an acid derived from one or more inorganic compounds. Examples of mineral acids are Hydrochloric acid, nitric acid, sulphuric acid phosphoric acid, boric acid, and hydrofluoric acid.

116. (b) Doddabetta is the highest mountain in the Nilgiri Hills (Tamil Nadu)at 2,637 metres.
The Vindhyas run across most of central India.
The Dhaulagiri massif in Nepal extends 120 km from the Kaligandaki River west to the Bheri.
Mt. Kailash peak is standing in the remote south-west corner of Tibet in the Himalayan Mountains.

117. (a) A body floats, if its density is less than fluid i.e. floating medium.

118. (c) As we know, $g = \frac{GM}{R^2}$

From question, $R_A = 2R_B$ and $M_A = 4M_B$

$\therefore\ g_A = g_B$

Hence weight of the object ($w = mg$) is same on both the planets.

119. (b) In the given reaction F_2 is an oxidising agent which oxides H_2O to O_2. Oxidation state of fluorine changes 0 to – 1.

120. (b) Mitochondria are fascinating structures that create energy to run the cell. It is the site of cellular respiration in animal cell.

121. (b) Ashtamudi lake is situated in the Kollam District of Kerala.

122. (c)

123. (a) $f = 2\,kHz = 2\times10^3 Hz$
$\lambda = 35cm = 35\times10^{-2}m$
$d = 1.4km = 1.4\times10^3 m;\ v = f\lambda = 2\times10^3\times35\times10^{-2} = 700 m/s$

$t = \frac{d}{v} = \frac{1.4\times10^3}{700} = 2$

124. (d)
125. (b)
126. (c)
127. (c) Bats use a variety of ultrasonic ranging (echolocation) techniques to detect obstacles in their flying path. They can detect frequencies beyond 100 kHz, possibly up to 200 kHz.
128. (a) A fuse is used in an electric circuit to break the circuit when excessive current flows through the circuit.
129. (c)
130. (a) The Faroe Islands are an archipelago between the Norwegian Sea and the North Atlantic Ocean. The Faroese sheep is a breed of domestic sheep native to the Faroe Islands. Thus, this group of islands is also known as Island of Sheep.

131. (b) Given that $\Delta p = \frac{10}{100} \times p = 0.1p$

Now $(p + \Delta p) = 1.1p$.

From $\Delta v = \left(\frac{v - v'}{v}\right) \times 100$

$$= \left(1 - \frac{10}{11}\right) \times 100 = 9\%$$

132. (b) The Tuareg is a pastoral nomad living in the desert of Sahara. They are found in Algeria, Mali and Niger.
133. (a) It implies that the motion of the train is accelerated.
134. (d) The atomic mass is determined by adding the number of protons and neutrons in the atom.
135. (b) Selvas- Tropophytes
Savanna- Grasses and Trees
Tundra- Mosses and Lichens
Mansoon land - Epiphytes
136. (b) Refraction is the change in direction of propagation of a wave due to a change in its transmission medium.
137. (c) This is according to law if definite proportions. In this reaction, CO reacts with O_2 in 2:1 mol ratio.Option (c) is the correct answer.
139. (d) Mulches are materials placed over the soil surface to maintain moisture and improve soil conditions. Mulching has proven to be an effective soil conservation practice, reducing both wind and water erosion during the winter period.
140. (b)
141. (d) The device is a pn junction. When a current flows across the junction, it is forward biased. On reversing, the polarity of the battery, it is reverse biased and current drops to almost zero.

142. (d) Mass $\% = \frac{\text{(mass of nitrogen)}}{\text{(mass of fertiliser)}} \times 100$

$$\Rightarrow \quad 20 = \frac{1\text{kg}}{x} \times 100 \Rightarrow x = \frac{100}{20} = 5\text{kg}$$

143. (c) Hydrolysis is the weathering reaction that occurs when the two surfaces of water and compound meet. It involves the reaction between mineral ions and the ions of water (OH- and H+), and results in the decomposition of the rock surface by forming new compounds. Temperatures usually stay high (above 70) throughout the year. Humid Subtropical climate is known for hot humid summers. During the summer the average temperature is between 70 and 80 degrees.
144. (c) As the body moves with a constant speed v along a straight line or rectilinear path hence body undergoes a uniform velocity. Here direction of the moving body is unchanged.
145. (c) According to Faraday's law of electromagnetic induction,

emf induced, $e = -\frac{d\phi}{dt}$

where, $d\phi$ = change in magnetic flux
146. (c) One of the features of the federal system is the distribution of power between the federal government and the government of the states.Some powers are given to the federal government and some other remaining powers are given to the government of states. The federal government is powerful over the matter of national (or) general importance. Both federal and state governments functioning strictly within the sphere demarcated for them.
147. (d) The state can make laws which abrogate the right in case there is a threat to public order, morality and health.
148. (a) The Scheduled Castes and Tribes (Prevention of Atrocities) Act, 1989, an Act of the Parliament of India enacted to prevent atrocities against scheduled castes and scheduled tribes. It extends to the whole of India except the State of Jammu & Kashmir. It may be seen as giving effect to equality before law, right against discrimination and abolition of Untouchability. Freedom of religion in India is a fundamental right guaranteed by Article 15 to Article 25 of the Constitution of India.
149. (c) The national Population Register was created by the UID Act 2010. The Unique Identification Authority of India (UIDAI) was established in January 2009 and is a part of the Planning Commission of India. UIDAI aims to provide a unique 12 digit ID number to all residents in India on a voluntary basis. The number will be known as AADHAAR.
150. (c) Lokmanya Bal Gangadhar Tilak, in 1895, founded the Shri Shivaji Fund Committee for celebration of 'Shiv Punya Tithi' and for the reconstruction of the Samadhi of Shivaji Maharaj. In 1894, Tilak transformed household worshipping of Ganesha into Sarvajanik Ganeshotsav. New English School was founded by Shri Vishnushastri Chiplunkar along with Lokmanya Bal Gangadhar Tilak, in year 1880. Ravindra Nath Taigore preached the cult of self reliance or atmashakti.The cult of atmashaki included assertion of national dignity, honour, confidence and working towards social and economic regeneration of Indian villages.

NDA 1 2014 Question Paper

MATHEMATICS

1. Every quadratic equation $ax^2+bx+c=0$ where $a, b, c \in R, a \neq 0$ has
(a) exactly one real root. (b) at least one real root.
(c) at least two real roots. (d) at most two real roots.

2. The relation S is defined on the set of integers Z as xSy if integer x devides integer y. Then
(a) s is an equivalence relation.
(b) s is only reflexive and symmetric.
(c) s is only reflexive and transitive.
(d) s is only symmetric and transitive.

3. If $a \neq b \neq c$ are all positive, then the value of the determinant $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ is
(a) non-negative (b) non-positive
(c) negative (d) positive

4. Let A and B be two matrices such that $AB = A$ and $BA = B$. Which of the following statements are correct ?
1. $A^2 = A$
2. $B^2 = B$
3. $(AB)^2 = AB$

Select the correct answer using the code given below :
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

5. What is $(1001)_2$ equal to ?
(a) $(5)_{10}$ (b) $(9)_{10}$
(c) $(17)_{10}$ (d) $(11)_{10}$

6. What is $\left(\frac{\sqrt{3}+i}{\sqrt{3}-i}\right)^6$ equal to, where $i=\sqrt{-1}$?
(a) 1 (b) 1/6
(c) 6 (d) 2

7. Let z be a complex number such that $|z| = 4$ and $\arg z = \frac{5\pi}{6}$.
Where $i - \sqrt{-1}$. What is z equal to ?
(a) $2\sqrt{3}+2i$ (b) $2\sqrt{3}-2i$
(c) $-2\sqrt{3}+2i$ (d) $-\sqrt{3}+i$

8. If $\begin{vmatrix} 6i & -3i & 1 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix} = x+iy$, where $i=\sqrt{-1}$, then what is x equal to ?
(a) 3 (b) 2
(c) 1 (d) 0

9. If α, β are the roots of $ax^2+bx+c=0$ and $a+h, \beta+h$ are the roots of $px^2+qx+r=0$, then what is h equal to ?
(a) $\frac{1}{2}\left(\frac{b}{a}-\frac{q}{p}\right)$ (b) $\frac{1}{2}\left(-\frac{b}{a}+\frac{q}{p}\right)$
(c) $\frac{1}{2}\left(\frac{b}{p}+\frac{q}{a}\right)$ (d) $\frac{1}{2}\left(-\frac{b}{p}+\frac{q}{a}\right)$

10. If the matrix A is such that $\begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix} A = \begin{pmatrix} 1 & 1 \\ 0 & -1 \end{pmatrix}$, then what is A equal to ?
(a) $\begin{pmatrix} 1 & 4 \\ 0 & -1 \end{pmatrix}$ (b) $\begin{pmatrix} 1 & 4 \\ 0 & 1 \end{pmatrix}$
(c) $\begin{pmatrix} -1 & 4 \\ 0 & -1 \end{pmatrix}$ (d) $\begin{pmatrix} 1 & -4 \\ 0 & -1 \end{pmatrix}$

11. Consider the following statements :
1. Determinant is a square matrix.
2. Determinant is a number associated with a square matrix.

Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1nor 2

12. If A is an invertible matrix, then what is $\det(A^{-1})$ equal to ?
(a) $\det A$ (b) $\frac{1}{\det A}$
(c) 1 (d) None of the above

13. From the matrix equation $AB = AC$, Where A, B, C are the square matrices of same order, we can conclude $B = C$ provided
(a) A is non-singular. (b) A is singular.
(c) A is symmetric. (d) A is skew symmetric.

14. If $A=\begin{pmatrix}4 & x+2\\ 2x-3 & x+1\end{pmatrix}$ is symmetric, then what is x equal to ?

(a) 2 (b) 3
(c) –1 (d) 5

15. If $\begin{vmatrix}a & b & 0\\ 0 & a & b\\ b & 0 & a\end{vmatrix}=0$, then which one of the following is correct?

(a) $\frac{a}{b}$ is one of the cube roots of unity.
(b) $\frac{a}{b}$ is one of the cube roots of –1.
(c) a is one of the cube roots of unity.
(d) b is one of the cube roots of unity.

16. The function $f: N \to N$, N being the set of of natural numbers, defined by $f(x)=2x+3$ is

(a) injective and surjective
(b) injective but not surjective
(c) not injective but surjective
(d) neither injective nor surjective

17. What is $\frac{(1+i)^{4n+5}}{(1-i)^{4n+3}}$ equal to, where n is a natural number and $i=\sqrt{-1}$?

(a) 2 (b) $2i$
(c) –2 (d) i

18. What is the number of ways in which one can post 5 letters in 7 letters boxes ?

(a) 7^5 (b) 3^5
(c) 5^7 (d) 2520

19. What is the number of ways that a cricket team of 11 players can be made out of 15 players ?

(a) 364 (b) 1001
(c) 1365 (d) 32760

20. A and B are two sets having 3 elements in common. If $n(A)=5$, $n(B)=4$, then what is $n(A\times B)$ equal to ?

(a) 0 (b) 9
(c) 15 (d) 20

21. If $f(x)=ax+b$ and $g(x)=cx+d$ such that $f[g(x)]=g[f(x)]$ then which one of the following is correct?

(a) $f(c)=g(a)$ (b) $f(a)=g(c)$
(c) $f(c)=g(d)$ (d) $f(d)=g(b)$

22. If A and B are square matrices of second order such that $|A|=-1$, $|B|=3$, then what is $|3AB|$ equal to ?

(a) 3 (b) –9
(c) –27 (d) None of these

DIRECTIONS: For the next three (03) items that follow :

Consider the function $f(x)=\frac{x-1}{x+1}$.

23. What $=\frac{f(x)+1}{f(x)-1}+x$ is equal to ?

(a) 0 (b) 1
(c) $2x$ (d) $4x$

24. What is $f(2x)$ equal to ?

(a) $\frac{f(x)+1}{f(x)+3}$ (b) $\frac{f(x)+1}{3f(x)+1}$
(c) $\frac{3f(x)+1}{f(x)+3}$ (d) $\frac{f(x)+3}{3f(x)+1}$

25. What is $f(f(x))$ equal to ?

(a) x (b) $-x$
(c) $-\frac{1}{x}$ (d) None of these

DIRECTIONS: For the next five (05) items that follow :

Consider the expansion $\left(x^2+\frac{1}{x}\right)^{15}$.

26. What is the independent term in the given expansion ?

(a) 2103 (b) 3003
(c) 4503 (d) None of these

27. What is the ratio of coefficient of x^{15} to the term independent of x in the given expansion ?

(a) 1 (b) 1/2
(c) 2/3 (d) 3/4

28. Consider the following statements :

1. There are 15 terms in the given expansion.
2. The coefficient of x^{12} is equal to that of x^3.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

29. Consider the following statements :

1. The term containing x^2 does not exist in the given expansion.
2. The sum of the coefficients of all the terms in the given expansion is 2^{15}.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

30. What is the sum of the coefficients of the middle terms in the given expansion ?

(a) C(15, 9) (b) C(16, 9)
(c) C(16, 8) (d) None of these

31. What is $\sqrt{1+\sin 2\theta}$ equal to ?

(a) $\cos\theta-\sin\theta$ (b) $\cos\theta+\sin\theta$
(c) $2\cos\theta+\sin\theta$ (d) $\cos\theta+2\sin\theta$

32. A lamp post stands on a horizontal plane. From a point situated at a distance 150 m from its foot, the angle of elevation of the top is 30°. What is the height of the lamp post ?

(a) 50m (b) $50\sqrt{3}$ m

(c) $\frac{50}{\sqrt{3}}$ m (d) 100m

33. If cot A = 2 and cot B = 3, then what is the value of A + B ?

(a) $\pi/6$ (b) π

(c) $\pi/2$ (d) $\pi/4$

34. What is $\sin^2 66\frac{1^\circ}{2} - \sin^2 23\frac{1^\circ}{2}$ equal to ?

(a) sin 47° (b) cos 47°

(c) 2 sin 47° (d) 2 cos 47°

35. What is $\sin^{-1}\frac{3}{5} - \sin^{-1}\frac{4}{5}$ equal to ?

(a) $\pi/2$ (b) $\pi/3$

(c) $\pi/4$ (d) $\pi/6$

36. What is $\frac{\cos 7x - \cos 3x}{\sin 7x - 2\sin 5x + \sin 3x}$ equal to ?

(a) tan x (b) cot x

(c) tan 2x (d) cot 2x

37. In a triangle ABC, c = 2, A = 45°, a = $2\sqrt{2}$, than what is C equal to ?

(a) 30° (b) 15°

(c) 45° (d) None of these

38. In a triangle ABC, sin A – cos B = cos C, then what is B equal to ?

(a) π (b) $\pi/3$

(c) $\pi/2$ (d) $\pi/4$

39. If $\frac{\sin(x+y)}{\sin(x-y)} = \frac{a+b}{a-b}$, then what is $\frac{\tan x}{\tan y}$ equal to ?

(a) $\frac{b}{a}$ (b) $\frac{a}{b}$

(c) ab (d) 1

40. If sin A sin (60° – A) sin (60° + A) = k sin 3A, then what is k equal to ?

(a) 1/4 (b) 1/2

(c) 1 (d) 4

41. The line $y = \sqrt{3}$ meets the graph y = tan x, where $x \in \left(0, \frac{\pi}{2}\right)$, in k points. What is k equal to?

(a) One (b) Two

(c) Three (d) Infinity

42. Which one of the following is one of the solutions of the equation of the equation $\tan 2\theta . \tan\theta = 1$?

(a) $\pi/12$ (b) $\pi/6$

(c) $\pi/4$ (d) $\pi/3$

DIRECTIONS : For the next three (03) items that follow :

Given that $16\sin^5 x = p\sin 5x + q\sin 3x + r\sin x$.

43. What is the value of p ?

(a) 1 (b) 2

(c) –1 (d) –2

44. What is the value of q ?

(a) 3 (b) 5

(c) 10 (d) –5

45. What is the value of r ?

(a) 5 (b) 8

(c) 10 (d) –10

DIRECTIONS : For the next two (02) items that follow :

Let S_n denote the sum of the n terms of an AP and $3S_n = S_{2n}$.

46. What is $S_{3n} = S_n$ equal to ?

(a) 4 : 1 (b) 6 : 1

(c) 8 : 1 (d) 10 : 1

47. What is $S_{3n} = S_{2n}$ equal to ?

(a) 2 : 1 (b) 3 : 1

(c) 4 : 1 (d) 5 : 1

48. What is the length of the latus rectum of the ellipse $25x^2 + 16y^2 = 400$?

(a) 25/2 (b) 25/4

(c) 16/5 (d) 32/5

DIRECTIONS : For the next two (02) items that follow :

Consider the circles $x^2 + y^2 + 2ax + c = 0$ and $x^2 + y^2 + 2by + c = 0$.

49. What is the distance between the centres of the two circles?

(a) $\sqrt{a^2+b^2}$ (b) $a^2 + b^2$

(c) $a + b$ (d) $2(a + b)$

50. The two circles touch each other if

(a) $c = \sqrt{a^2+b^2}$ (b) $\frac{1}{c} = \frac{1}{a^2} + \frac{1}{b^2}$

(c) $c = \frac{1}{a^2} + \frac{1}{b^2}$ (d) $c = \frac{1}{a^2+b^2}$

51. A (3, 4) and B(5, –2) are two points and P is a point such that PA = PB. If the area of triangle PAB is 10 square unit, what are the coordinates of P ?

(a) (1, 0) only (b) (7, 2) only

(c) (1, 0) or (7, 2) (d) Neither (1, 0) nor (7, 2)

52. What is the product of the perpendiculars drawn from the points $(\pm\sqrt{a^2-b^2}, 0)$ upon the line bx cos α + ay sin α = ab ?

(a) a^2 (b) b^2

(c) $a^2 + b^2$ (d) $a + b$

53. Which of the following is correc in respect of the equations $\frac{x-1}{2}=\frac{y-2}{3}$ and $2x+3y=5$?

(a) They represent two lines which are parallel.
(b) They represent two lines which are perpendicular.
(c) They represent two lines which are neither parallel nor perpendicular.
(d) The first equation does not represent a line.

DIRECTIONS : For the next three (03) items that follow :

Consider a sphere passing through the origin and the points $(2, 1, -1), (1, 5, -4), (-2, 4, -6)$.

54. What is the radius of the sphere ?

(a) $\sqrt{12}$ (b) $\sqrt{14}$
(c) 12 (d) 14

55. What is the centre of the sphere ?

(a) $(-1, 2, -3)$ (b) $(1, -2, 3)$
(c) $(1, 2, -3)$ (d) $(-1, -2, -3)$

56. Consider the following statements :

1. The sphere passes through the point (0, 4, 0).
2. The point (1, 1, 1) is at a distance of 5 unit from the centre of the sphere.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

DIRECTIONS : For the next two (02) items that follow :

The line joining the points (2, 1, 3) and (4, –2, 5) cuts the plane $2x+y-z=3$.

57. Where does the line cut the plane ?

(a) $(0, -4, -1)$ (b) $(0, -4, 1)$
(c) $(1, 4, 0)$ (d) $(0, 4, 1)$

58. What is the ratio in which the plane divideds the line ?

(a) 1 : 1 (b) 2 : 3
(c) 3 : 4 (d) None of these

For the next two (02) items that follow :

Consider the plane passing through the points A (2, 2, 1), B (3, 4, 2) and C (7, 0, 6).

59. Which one of the following points lines on the plane ?

(a) (1, 0, 0) (b) (1, 0, 1)
(c) (0, 0, 1) (d) None of these

60. What are the direction ratios of the normal to the plane ?

(a) $<1, 0, 1>$ (b) $<0, 1, 0>$
(c) $<1, 0, -1>$ (d) None of these

DIRECTIONS : For the next three (03) items that follow :

Consider the function $f(x)=\begin{cases} x^2-5, & x\le 3 \\ \sqrt{x+13} & x>3 \end{cases}$

61. What is $\lim_{x\to 3} f(x)$ equal to ?

(a) 2 (b) 4
(c) 5 (d) 13

62. Consider the following statements :

1. The function is discontinuous at $x = 3$.
2. The function is not differentiable at $x = 0$.

What of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

63. What is the differential coefficient of $f(x)$ at $x = 12$?

(a) 5/2 (b) 5
(c) 1/5 (d) 1/10

DIRECTIONS : For the next three (03) items that follow :

The line $2y = 3x + 12$ cuts the parabola $4y = 3x^2$.

64. Where does the line cut the parabola ?

(a) At (–2, 3) only
(b) At (4, 12) only
(c) At both (–2, 3) and (4, 12)
(d) Neither at (–2, 3) nor (4, 12)

65. What is the area enclosed by the parabola and the line ?

(a) 27 square unit (b) 36 square unit
(c) 48 square unit (d) 54 square unit

66. What is the area enclosed by the parabola, the line and the Y-axis in the first quadrant ?

(a) 7 square unit (b) 14 square unit
(c) 20 square unit (d) 21 square unit

67. Consider the function

$$f(x)=\begin{cases} \frac{\tan kx}{x}, & x<0 \\ 3x+2k^2, & x\ge 0 \end{cases}$$

What is the non-zero value of k for which the function is continuous at $x = 0$?

(a) 1/4 (b) 1/2
(c) 1 (d) 2

68. Consider the following statements :

1. The function $f(x) = [x]$, where [.] is the greatest integer function defined on R, is continuous at all points except at $x = 0$.
2. The function $f(x) = \sin|x|$ is continuous for all $x \in R$.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

DIRECTIONS : For the next two (02) items that follow :

Consider the curve $x = a(\cos\theta + \theta\sin\theta)$ and $y = a(\sin\theta - \theta\cos\theta)$.

69. What is $\frac{dy}{dx}$ equal to ?

(a) $\tan\theta$ (b) $\cot\theta$
(c) $\sin 2\theta$ (d) $\cos 2\theta$

70. What is $\frac{d^2y}{dx^2}$ equal to ?

(a) $\sec^2\theta$ (b) $-\operatorname{cosec}^2\theta$
(c) $\frac{\sec^3\theta}{a\theta}$ (d) None of these

71. What is the area of the parabola $y^2 = 4bx$ bounded by its latus rectum ?
(a) $2b^2/3$ square unit (b) $4b^2/3$ square unit
(c) b^2 square unit (d) $8b^2/3$ square unit

72. If $y = x\ ln\ x + xe^x$, then what is the value of $\frac{dy}{dx}$ at $x = 1$?
(a) $1 + e$ (b) $1 - e$
(c) $1 + 2e$ (d) None of these

73. What is $\lim_{x\to 0} \frac{\log_5(1+x)}{x}$ equal to ?
(a) 1 (b) $\log_5 e$
(c) $\log_e 5$ (d) 5

74. What is $\lim_{x\to 0} \frac{5^x - 1}{x}$ equal to ?
(a) $\log_e 5$ (b) $\log_5 e$
(c) 5 (d) 1

75. What is $\lim_{n\to\infty} \frac{1+2+3+...+n}{1^2+2^2+3^2+...n^2}$ equal to ?
(a) 5 (b) 2
(c) 1 (d) 0

DIRECTIONS : For the next three (03) items that follow :

Consider $I = \int_0^{\pi} \frac{xdx}{1+\sin x}$

76. What is I equal to ?
(a) $-\pi$ (b) 0
(c) π (d) 2π

77. What is $\int_0^{\pi} \frac{(\pi - x)dx}{1+\sin x}$ equal to ?
(a) π (b) $\pi/2$
(c) 0 (d) 2π

78. What is $\int_0^{\pi} \frac{dx}{1+\sin x}$ equal to ?
(a) 1 (b) 2
(c) 4 (d) –2

DIRECTIONS : For the next two (02) items that follow :

Consider $\int x \tan^{-1} x\, dx = A(x^2+1)\tan^{-1} x + Bx + C,$

where C is the constant of integration.

79. What is the value of A ?
(a) 1 (b) 1/2
(c) –1/2 (d) 1/4

80. What is the value of B ?
(a) 1 (b) 1/2
(c) –1/2 (d) 1/4

DIRECTIONS : For the next two (02) items that follow :

Consider the integral $I = \int_0^{\pi} \ln(\sin x)dx$

81. What is $\int_0^{\pi/2} \ln(\sin x)dx$ equal to ?
(a) $4I$ (b) $2I$
(c) I (d) $I/2$

82. What is $\int_0^{\pi/2} \ln(\cos x)dx$ equal to ?
(a) $I/2$ (b) I
(c) $2I$ (d) $4I$

DIRECTIONS : For the next two (02) items that follow :
A rectangular box is to be made from a sheet of 24 inch length and 9 inch width cutting out identical squares of side length x from the four corners and turning up the sides.

83. What is the value of x for width the vulume is maximum ?
(a) 1 inch (b) 1.5 inch
(c) 2 inch (d) 2.5 inch

84. What is the maximum volume of the box ?
(a) 200 cubic inch (b) 400 cubic inch
(c) 100 cubic inch (d) None of these

85. What is the degree of the differential equation

$$\left(\frac{d^3y}{dx^3}\right)^{3/2} = \left(\frac{d^2y}{dx^2}\right)^2 ?$$

(a) 1 (b) 2
(c) 3 (d) 4

86. What is the solution of the equation

$$\ln\left(\frac{dy}{dx}\right) + x = 0 ?$$

(a) $y + e^x = c$ (b) $y - e^{-x} = c$
(c) $y + e^{-x} = c$ (d) $y - e^x = c$

87. Eliminating the arbitrary constants B and C in the expresion

$y = \frac{2}{3C}(Cx-1)^{3/2} + B,$ we get

(a) $x\left[1+\left(\frac{dy}{dx}\right)^2\right] = \frac{d^2y}{dx^2}$

(b) $2x\left(\frac{dy}{dx}\right)\frac{d^2y}{dx^2} = 1+\left(\frac{dy}{dx}\right)^2$

(c) $\left(\frac{dy}{dx}\right)\frac{d^2y}{dx^2} = 1$

(d) $\left(\frac{dy}{dx}\right)^2 + 1 = \frac{d^2y}{dx^2}$

DIRECTIONS : For the next three (03) items that follow :

Let $f(x) = ax^2 + bx + c$ such that $f(1) = f(-1)$ and a, b, c are in Arithmetic Progression.

88. What is the value of b ?
(a) -1
(b) 0
(c) 1
(d) Cannot be determined deu to insufficient data

89. $f'(a), f'(b), f'(c)$ are
(a) A.P.
(b) G.P.
(c) H.P.
(d) Arithmetico-geometric progression

90. $f''(a), f''(b), f''(c)$ are
(a) in A.P. only (b) in G.P. only
(c) in both A.P. and G.P. (d) neither in A.P. nor in G.P.

91. If $|\vec{a}| = 2, |\vec{b}| = 5$ and $|\vec{a} \times \vec{b}|$, then what is $\vec{a}.\vec{b}$ equal to ?
(a) 6 (b) 7
(c) 8 (d) 9

92. If $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$, then which one of the following is correct ?
(a) $|\vec{a}| = |\vec{b}|$.
(b) $\vec{a}$ is parrallel to $\vec{b}$.
(c) $\vec{a}$ is perpendicular to $\vec{b}$.
(d) $\vec{a}$ is a unit vector.

93. What is the area of the triangle OAB where O is the origin, $\overline{OA} = 3\hat{i} - \hat{j} + \hat{k}$ and $\overline{OB} = 2\hat{i} - \hat{j} + 3\hat{k}$?
(a) $5\sqrt{6}$ square unit (b) $\frac{5\sqrt{6}}{2}$ square unit
(c) $\sqrt{6}$ square unit (d) $\sqrt{30}$ square unit

94. Which one of the following is the unit vector perpendicular to both $\bar{a} = -\hat{i} + \hat{j} + \hat{k}$ and $\bar{b} = \hat{i} - \hat{j} + \hat{k}$?
(a) $\frac{\hat{i} + \hat{j}}{\sqrt{2}}$ (b) $\hat{k}$
(c) $\frac{\hat{j} + \hat{k}}{\sqrt{2}}$ (d) $\frac{\hat{i} - \hat{j}}{\sqrt{2}}$

95. What is the interior acute angle of the parallelogram whose sides are represented by the vectors $\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} + \hat{k}$ and $\frac{1}{\sqrt{2}}\hat{i} - \frac{1}{\sqrt{2}}\hat{j} + \hat{k}$?
(a) 60° (b) 45°
(c) 30° (d) 15°

96. For what value of λ are the vectors $\lambda\hat{i} + (1+\lambda)\hat{j} + (1+2\lambda)\hat{k}$ and $(1-\lambda)\hat{i} + \lambda\hat{j} + 2\hat{k}$ perpendicular ?
(a) $-1/3$ (b) $1/3$
(c) $2/3$ (d) 1

DIRECTIONS : For the next four (04) items that follow :

$\bar{a} + \bar{b} + \bar{c} = \bar{0}$ such that $|\bar{a}| = 3, |\bar{b}| = 5$ and $|\bar{c}| = 7$.

97. What is the angle between $|\bar{a}|$ and $|\bar{b}|$?
(a) $\pi/6$ (b) $\pi/4$
(c) $\pi/3$ (d) $\pi/2$

98. What is $\bar{a}.\bar{b} + \bar{b}.\bar{c} + \bar{c}.\bar{a}$ equal to ?
(a) -83 (b) $-83/2$
(c) 75 (d) $-75/2$

99. What is cosine of the angle between $\bar{b}$ and $\bar{c}$?
(a) 11/12 (b) 13/14
(c) $-11/12$ (d) $-13/14$

100. What is $|\bar{a} + \bar{b}|$ equal to ?
(a) 7 (b) 8
(c) 10 (d) 11

101. What is $\int_0^{\pi/2} \frac{dx}{a^2 \cos^2 x + b^2 \sin^2 x}$ equal to ?
(a) $2ab$ (b) $2\pi ab$
(c) $\frac{\pi}{2ab}$ (d) $\frac{\pi}{ab}$

DIRECTIONS : For the next two (02) items that follow :

A cylinder is inscribed in a sphere of radius r.

102. What is the height of the cylinder of maximum volume ?
(a) $\frac{2r}{\sqrt{3}}$ (b) $\frac{r}{\sqrt{3}}$
(c) $2r$ (d) $\sqrt{3}r$

103. What is the radius of the cylinder of maximum volume ?
(a) $\frac{2r}{\sqrt{3}}$ (b) $\frac{\sqrt{2}r}{\sqrt{3}}$
(c) r (d) $\sqrt{3}r$

DIRECTIONS : For the next two (02) items that follow:

Consider the function $f''(x) = \sec^4 x + 4$ with $f(0) = 0$ and $f'(0) = 0$.

104. What is $f'(x)$ equal to ?
(a) $\tan x - \frac{\tan^3 x}{3} + 4x$ (b) $\tan x + \frac{\tan^3 x}{3} + 4x$
(c) $\tan x - \frac{\sec^3 x}{3} + 4x$ (d) $-\tan x - \frac{\tan^3 x}{3} + 4x$

105. What is $f(x)$ equal to ?

(a) $\frac{2\ln\sec x}{3}+\frac{\tan^2 x}{6}+2x^2$

(b) $\frac{3\ln\sec x}{2}+\frac{\cot^2 x}{6}+2x^2$

(c) $\frac{4\ln\sec x}{3}+\frac{\sec^2 x}{6}+2x^2$

(d) $\ln\sec x+\frac{\tan^4 x}{12}+2x^2$

106. Suppose A and B are two events. Event *B* has occurred and it is known that P(B) < 1. What is $P(A|B^c)$ equal to ?

(a) $\frac{P(A)-P(B)}{1-P(B)}$ (b) $\frac{P(A)-P(AB)}{1-P(B)}$

(c) $\frac{P(A)+P(B^c)}{1-P(B)}$ (d) None of these

DIRECTIONS: For the next four (04) items that follow :

Consider events A, B, C, D, E of the sample space S = {n : n is an integer such that $10 \le n \le 20$} given by :

A is the set of all even numbers.

B is the set of all prime numbers.

C=(15).

D is the set of all integers ≤ 16.

E is the set of all double digit numbers expressible as a power of 2.

107. A, B and D are

(a) Mutually exclusive events but not exhaustive events
(b) Exhaustive events but not mutually exclusive events
(c) Mutually exclusive and exhaustive events
(d) Elementary events

108. A, B and C are

(a) Mutually exclusive events but not exhaustive events
(b) Exhaustive events but not mutually exclusive events
(c) Mutually exclusive and exhaustive events
(d) Elementary events

109. B and C are

(a) Mutually exclusive events but not exhaustive events
(b) Compound events
(c) Mutually exclusive and exhaustive events
(d) Elementary events

110. C and E are

(a) Mutually exclusive events but not elementary events
(b) Exhaustive events but not mutually exclusive events
(c) Mutually exclusive and exhaustive events
(d) Elementary and mutually exclusive events

111. Consider the following statements in respect of histogram :

1. The histogram is a suitable representation of a frequency distribution of a continuous variable.
2. The area included under the whole histogram is the total frequency.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

112. The regression lines will be perpendicular to each other if the coefficient of correlation *r* is equal to

(a) 1 only (b) 1 or –1
(c) –1 only (d) 0

113. For any two events A and B, which one of the following holds ?

(a) $P(A\cap B)\le P(A)\le P(A\cup B)\le P(A)+P(B)$

(b) $P(A\cup B)\le P(A)\le P(A\cap B)\le P(A)+P(B)$

(c) $P(A\cup B)\le P(B)\le P(A\cap B)\le P(A)+P(B)$

(d) $P(A\cap B)\le P(B)\le P(A)+P(B)\le P(A\cup B)$

114. The probability that in a random arrangement of the letters of the word 'UNIVERSITY', the two I's do **not** come together is

(a) 4/5 (b) 1/5
(c) 1/10 (d) 9/10

115. Threre are 4 white and 3 black balls in a box. In another box, there are 3 white and 4 black balls. An unbiased dice is rolled. If it shows a number less than or equal to 3, then a ball is drawn from the second box, otherwise from the first box. If the ball drawn is black then the possibility that the ball was drawn from the first box is

(a) 1/2 (b) 6/7
(c) 4/7 (d) 3/7

116. If $\bar{x}$ and $\bar{y}$ are the means of two distrubutions such that $\bar{x}<\bar{y}$ and $\bar{z}$ is the mean of the combined distrubution, then which one of the following statements is correct ?

(a) $\bar{x}<\bar{y}<\bar{z}$ (b) $\bar{x}>\bar{y}>\bar{z}$

(c) $\bar{z}=\frac{\bar{x}+\bar{y}}{2}$ (d) $\bar{x}<\bar{z}<\bar{y}$

117. What is the mean deviation about the mean for the data 4, 7, 8, 9, 10, 12, 13, 17 ?

(a) 2.5 (b) 3
(c) 3.5 (d) 4

118. The variance of 20 observations is 5. If each observation is multiplied by 2, then what is the new varianve of the resulting observations ?

(a) 5 (b) 10
(c) 20 (d) 40

119. Two students X and Y appeared in an examination. The probability that X will qualify the examination is 0.05 and Y will qualify the examination is 0.10. The probability that both will qualify the examination is 0.02. What is the probability that only one of them will qualify the examination ?

(a) 0.15 (b) 0.14
(c) 0.12 (d) 0.11

120. A fair coin is tossed four times. What is the probability that at most three tails occur ?

(a) 7/9 (b) 15/16
(c) 13/16 (d) 3/4

GENERAL ABILITY

PART A : ENGLISH

DIRECTIONS: *In this section, each question has a sentence with three underlined parts labeled (a), (b) and (c). Read each sentence to find out whether there is any error in any underlined part and indicate your response in the Answer Sheet against the corresponding letter, i.e., (a) or (b) or (c). If you find 'No error', your response should be indicated as (d).*

1. It was nearly thirty years ago, (a) since this magazine was (b) first published. (c) No error (d)

2. Ten years ago he was having an income (a) of over ten thousand rupees a monthly; (b) he must indeed be a wealthy man by now (c) No error (d)

3. In spite of the fact (a) that the meeting was about to end, (b) he insisted to ask several questions. (c) No error (d)

4. Hardly had he entered into the room (a) and taken his seat, (b) when the girls began to giggle. (c) No error (d)

5. I was disappointed (a) when I came for seeing you last evening (b) but could not find you at home. (c) No error (d)

6. The number of jobs (a) that would be satisfactory in all respects (b) are small. (c) No error (d)

7. I have found the man (a) whom I know (b) is the thief. (c) No error (d)

8. There is no reason (a) why he should not come (b) since he is in town and is free. (c) No error (d)

9. It is high time (a) we cried a halt to the existing corrupt practices (b) followed in the educational sphere. (c) No error (d)

10. The situation in perilous (a) but if we are prepared promptly to (b) act, there is still one chance of escape. (c) No error (d)

DIRECTIONS: *In this section, you find a number of sentences, parts of which are underlined. For each underlined part, four words are listed below. Choose the word nearest in meaning to the underlined part and indicate your response in the Answer Sheet.*

11. We should always try to maintain and promote communal amity.

(a) bondage (b) contention
(c) friendship (d) understanding

12. Many species of animals have become extinct during the last hundred years.

(a) aggressive (b) non-existent
(c) scattered (d) feeble

13. True religion does not require one to proselytise through guile or force.

(a) translate (b) hypnotise
(c) attack (d) convert

14. That the plan is both inhuman and preposterous needs no further proof.

(a) heartless (b) impractical
(c) absurd (d) abnormal

15. The attitude of the Western countries towards the third-world countries is rather callous to say the least.

(a) passive (b) unkind
(c) cursed (d) unfeeling

16. Whatever the verdict of history may be, Chaplin will occupy a unique place in its pages.

(a) judgment (b) voice
(c) outcome (d) prediction

17. He corroborated the statement of his brother.

(a) confirmed (b) disproved
(c) condemned (d) seconded

18. Whatever opinion he gives is sane.

(a) rational (b) obscure
(c) wild (d) arrogant

19. The story is too fantastic to be credible.

(a) believable (b) false
(c) readable (d) praiseworthy

20. Catching snakes can be hazardous for people untrained in the art.

(a) tricky (b) harmful
(c) difficult (d) dangerous

DIRECTIONS: *In this section, each item consists of a sentence with an underlined word. It is followed by four words, one of which is closest to the* ***opposite*** *in meaning of the underlined word. Choose the word and indicate your response in the Answer Sheet.*

21. His short but pointed speech was applauded by all sections of the audience.

(a) disapproved (b) misunderstood
(c) praised (d) welcomed

22. In ancient India, scholars had no interest in political power or material growth.

(a) internal (b) spiritual
(c) psychic (d) celestial

23. A friendly dog met us at the farm gate.
(a) helpful (b) understanding
(c) quiet (d) hostile

24. He is extremely intelligent but proud.
(a) dull (b) weak
(c) ignorant (d) arrogant

25. The young leader was reluctant to shoulder the responsibilities of the ministerial office.
(a) wanting (b) willing
(c) anxious (d) eager

26. He abandoned his family.
(a) supported (b) encouraged
(c) pleased (d) saved

27. History abounds in instances of courage.
(a) shines (b) lacks
(c) suffices (d) fails

28. Adversity teaches man to be humble and self-reliant.
(a) Sincerity (b) Animosity
(c) Curiosity (d) Prosperity

29. Like poverty, affluence can sometimes create its own problems.
(a) indigence (b) opulence
(c) sorrow (d) exuberance

30. The habit of squandering money should not be encouraged.
(a) discarding (b) hoarding
(c) donating (d) stealing

DIRECTIONS: *In this section, each of the following sentences has a black space and four words are given after the sentence. Select whichever word you consider the most appropriate for the blank space and indicate your response on the Answer Sheet.*

31. You haven't had your lunch yet, _____ you?
(a) are (b) aren't
(c) have (d) haven't

32. Life is to death as pleasure is to _____.
(a) poverty (b) suffering
(c) anguish (d) pain

33. The French ____ reputed to have a very good sense of humour.
(a) is (b) was
(c) are (d) will be

34. 'Please' and 'Thank you' are the little courtesies by which we keep the ____ of life oiled and running smoothly.
(a) path (b) machine
(c) garden (d) river

35. Many of the advances of civilization have been conceived by young people just on the _____ of adulthood.
(a) boundary (b) threshold
(c) peak (d) horizon

36. The more your action and thought are allied and _____, the happier you grow.
(a) divergent (b) unravelled
(c) integrated (d) invincible

37. He _____ in wearing the old fashioned coat in spite of his wifes disapproval.
(a) insists (b) persists
(c) desists (d) resists

38. It is not what you say that _____, but what you do.
(a) matches (b) implies
(c) matters (d) moves

39. Physically we are now all neighbours, but psychologically we are _____ to each other.
(a) primitive (b) complementary
(c) strangers (d) cowards

40. The old 'Nature' versus _____ debate regarding crime continues even today.
(a) 'Man' (b) 'Universe'
(c) 'Culture' (d) 'Nurture'

DIRECTIONS: *In this section, look at the underlined part of each sentence. Below each sentence are given three possible substitutions for the underlined part. If one of them, i.e., (a), (b) or (c) is better than the underlined part, indicate your response on the Answer Sheet against the corresponding letter (a), (b) or (c). If none of the substitutions improves the sentence, indicate (d) as your response on the Answer Sheet. Thus a 'No improvement' response will be signified by the letter (d).*

41. As the parties failed to reach any agreement, the meeting broke through.
(a) broke out (b) broke away
(c) broke up (d) No improvement

42. If I have reached there by this time tomorrow, I will write to you immediately.
(a) reached (b) reach
(c) am reaching (d) No improvement

43. My friend met me, unexpectedly, when I looked for a taxi, desperately.
(a) had looked (b) was looking
(c) had been looking (d) No improvement

44. Her learning makes up towards her want of beauty.
(a) for (b) to
(c) against (d) No improvement

45. If he got his enemy in his hand, he would have crushed him to death.
(a) has got (b) was getting
(c) had got (d) No improvement

46. Please ask your son to turn off the radio so that it is not quite so loud.
(a) in (b) back
(c) down (d) No improvement

47. He said that when I have worked for him for six months I would get a pay rise
(a) had worked (b) have had worked
(c) did work (d) No improvement

48. I am looking forward to joining your organization.
(a) join (b) join in
(c) having joined (d) No improvement

49. I am not sure why she is wanting to see him.
(a) she wants (b) is she wanting
(c) she want (d) No improvement

50. Everyone who finished writing can go home.
(a) had finished (c) have finished
(c) has finished (d) No improvement

PART B : GENERAL KNOWLEDGE

DIRECTIONS: *The following **seven (7)** items consists of two statements, Statement I and Statement II. You are to examine these two statements carefully and select the answers to these items using the code given below.*

Code:

(a) Both the statements are individually true and Statement II is the correct explanation of Statement I.
(b) Both the statements are individually true but Statement II is not the correct explanation of Statement I.
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true.

51. **Statement I:**
Grand Banks are one of the major fishing grounds of the world due to the presence of a vast continental shelf.
Statement II:
Planktons grow in the shallow waters.

52. **Statement I:**
Amoeba is a unicellular organism and the single cell performs all functions of a living organism.
Statement II:
Cell is the fundamental unit of living organism.

53. **Statement I:**
The first coins to bear the names and images of rulers were issued by the Kushanas.
Statement II:
The first gold coins were issued by the Kushanas.

54. **Statement I:**
Jahandar Shah's reign came to an early end in January 1713.
Statement II:
He was defeated at Agra by Farrukhsiyar, his nephew.

55. **Statement I:**
The defects of the Regulating Act and the exigencies of British politics necessitated the passing of the Pitt's India Act.
Statement II:
The Pitt's India Act gave the British Government supreme control over the Company's affairs and its administration in India.

56. **Statement I:**
It is not necessary that every bar magnet has one North Pole and one South Pole.
Statement II:
Magnetic poles occur in pair.

57. **Statement I:**
A body moving in a circular path is acted upon by the centripetal force.
Statement II:
Centripetal force acting on the body is doing work to keep it rotating in the circular path.

58. Which of the following statements is/are correct?
1. The tropical cyclones of China Sea are called typhoon's.
2. The tropical cyclones of the West Indies are called tornadoes.
3. The tropical cyclones of Australia are called williywillies.
4. Formation of an anticyclone results in stormy weather condition.

Select the correct answer using the code given below.
(a) 1, 2, 3 and 4 (b) 1, 2 and 4 only
(c) 1 and 3 only (d) 3 only

59. Which one of the following is **not** an ASEAN member?
(a) Cambodia (b) Laos
(c) Myanmar (d) Taiwan

60. Heat given to a body which raises its temperature by 1°C is known as
(a) water equivalent (b) thermal capacity
(c) specific heat (d) temperature gradient

61. Consider the following reaction:
$xAs_2S_3 + yO_2 \rightarrow zAs_2O_3 + wSO_2$
What is y (the coefficient for O_2) when this equation is balanced using whole number coefficients?
(a) 5 (b) 7
(c) 9 (d) 11

62. Growth and repair of damaged tissue involve
(a) mitotic cell division only
(b) both mitotic and meiotic cells divisions
(c) meiotic cell division only
(d) amitotic cell division only

63. Rotterdam of Netherlands is largely famous for
(a) textiles (b) dairying
(c) shipbuilding (d) paper industry

64. If the motion of an object is represented by a straight line parallel to the time axis in a distance-time graph, then the object undergoes
(a) an acceleration motion
(b) a decelerated motion
(c) a uniform non-zero velocity motion
(d) a zero velocity motion

65. How many grams of $MgCO_3$ contain 24.00 g of oxygen? (The molar mass of $MgCO_3$ is 84.30 g mol^{-1})
(a) 42.15 g (b) 84.30 g
(c) 126.00 g (d) 154.00 g

66. Which one of the following is **not** a function of liver?
(a) Conversion of glucose into glycogen
(b) Production of urea
(c) Destruction of dead and worn-out red blood cells
(d) Absorption of food and excess water from the undigested food

67. Which one of the following is the correct sequence of economic sectors in terms of their contribution to the GDP of India in decreasing order?
(a) Service–Industry–Agriculture
(b) Agriculture–Industry–Service
(c) Industry–Service–Agriculture
(d) Agriculture–Service–Industry

68. A force $\vec{F}$ acting on an electric charge q, in presence of an electromagnetic field, moves the charge parallel to the magnetic field with velocity $\vec{v}$. The $\vec{F}$ is equal to (where $\vec{E}$ and $\vec{B}$ are electric field and magnetic field respectively)
(a) $q\vec{E}$ (b) $q(\vec{v} \times \vec{B})$
(c) $q(\vec{v} \times \vec{E})$ (d) $q\vec{B}$

69. What is the oxidizing agent in the following equation?
$HAsO_2(aq) + Sn^{2+}(aq) + H^+(aq) \rightarrow As(s) + Sn^{4+}(aq) + H_2O(l)$
(a) $HAsO_2(aq)$ (b) $Sn^{2+}(aq)$
(c) $H^+(aq)$ (d) $Sn^{4+}(aq)$

70. What one of the following is **not** a part of female reproductive system?
(a) Fallopian tube (b) Cervix
(c) Urethra (d) Vagina

71. If a news is broadcast from London at 1:45 p.m. on Monday, at what time and on what day it will be heard at Dhaka (90° E)?
(a) 7:45 p.m. on Monday (b) 7:45 a.m. on Monday
(c) 7:45 p.m. on Tuesday (d) 7:45 a.m. on Sunday

72. Which of the following are the correct parameters for the common domestic power supply in India?
(a) 220 V, 110 Hz (b) 220 V, 50 Hz
(c) 110 V, 220 Hz (d) 110 V, 50 Hz

73. Which one of the following substances is most likely to be used as soap?
(a) $CH_3(CH_2)_{12}COOCH_3$ (b) $CH_3(CH_2)_5O(CH_2)_5CH_3$
(c) $CH_3(CH_2)_{12}COONa$ (d) $CH_3(CH_2)_{12}CHCl_2$

74. Which one of the following animals is cold-blooded?
(a) Dolphin (b) Shark
(c) Whale (d) Porpoise

75. Match List-I with List-II and select the correct answer using the code given below the Lists:

List-I (Geographical feature)		**List-II** (Type of geographic process)	
A.	Cirque	1.	Erosional feature of wind
B.	Yardang	2.	Depositional feature of glacier
C.	Barkhan	3.	Depositional feature of wind
D.	Drumlin	4.	Erosional feature of glacier

Code:

	A	B	C	D
(a)	4	1	3	2
(b)	4	1	3	2
(c)	2	3	1	4
(d)	2	1	3	4

76. A ray of light travels from a medium of refractive index n_1 to a medium of refractive index n_2. If angle of incidence is i and angle of refraction is r, then $\frac{\sin i}{\sin r}$ is equal to
(a) n_1 (b) n_2
(c) $\frac{n_2}{n_1}$ (d) $\frac{n_1}{n_2}$

77. A sample of gas is to be identified by means of its behaviour in the presence of a glowing splint. Which of the following gases will neither itself burn nor cause the splint to burn?
(a) Oxygen (b) Nitrogen
(c) Hydrogen (d) Methane

78. Leprosy is caused by
(a) virus (b) bacteria
(c) protozoa (d) retrovirus

79. A topographical map with scale 1 : 50000 indicates 1 cm to
(a) 50 km (b) 500 m
(c) 50 m (d) 5 km

80. Light waves projected on oil surface show seven colours due to the phenomenon of
(a) polarization (b) refraction
(c) reflection (d) interference

81. A monatomic species that has 18 electrons and a net charge of 2^- has
(a) the same number of electrons as a neutral argon atom
(b) more protons than electrons
(c) 2 unpaired electrons
(d) 20 protons

82. Which one among the following is a plant hormone?
(a) Insulin (b) Thyroxin
(c) Gibberellin (d) Estrogen

83. Quartzite is metamorphosed from
(a) limestone (b) plutonic rock
(c) sandstone (d) shale

84. Which one of the following processes explains the splitting of a beam of white light into its constituent colours?
(a) Dispersion (b) Reflection
(c) Diffraction (d) Polarization

85. The very high heat of vaporization of water is mainly a result of
(a) van der Waals forces (b) covalent bonds
(c) interionic attraction (d) hydrogen bonding

86. Which of the following groups of plants can be used as indicators of SO_2 pollution of air?
(a) Ferns (b) Mentha
(c) Lichens (d) Hornworts

87. The permanent wind that blows from the horse latitude to the equatorial region is known as
(a) westerly (b) trade wind
(c) doldrum (d) easterly

88. Two bodies A and B having masses m and 4m respectively are moving with equal linear momentum. The ratio of kinetic energies between A and B is
(a) 1 : 4 (b) 4 : 1
(c) 1 : 1 (d) 1 : 2

89. Optical glass used in the construction of spectacles is made by
(a) flint glass (b) Crookes glass
(c) quartz glass (d) hard glass

90. Which one of the following cell organelles is absent in animal cell
(a) Cell membrane (b) Endoplasmic reticulum
(c) Cell wall (d) Mitochondria

91. Which one of the following is a warm ocean current?
(a) Labrador current (b) Kuroshio current
(c) Peru current (d) Benguela current

92. A force apllied on a body is represented as
$\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$
and accelerates it at 1 m/s². The mass of the body is
(a) 10 kg (b) $10\sqrt{2}$ kg
(c) $2\sqrt{10}$ kg (d) 8 kg

93. The burning sensation of beesting can be stopped by rubbing the affected area with soap. This is because
(a) a beesting is acidic and soap, an alkali, neutralizes it
(b) a beesting is alkaline and soap, an acid, neutralizes it
(c) soap cleans the affected area and removes the sting
(d) soap acts as an anesthetic and dulls the sensation

94. Consider the following statements:
1. Carbohydrates are the only source of energy to humans.
2. Fats give maximum energy on oxidation as compared to other foods.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

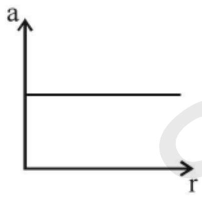
95. The place located at the confluence of Alaknanda and Bhagirathi rivers is
(a) Badrinath (b) Rishikesh
(c) Rudraprayag (d) Devprayag

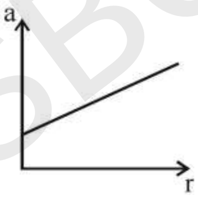
96. Light waves are
(a) electro-mechanical waves
(b) electro-magnetic waves
(c) electro-optical waves
(d) magneto-optical waves

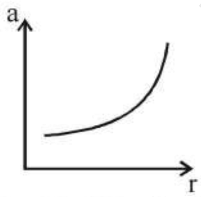
97. A sample of carbon dioxide that undergoes a transformation from solid to liquid and then to gas would undergo
(a) a change in mass
(b) a change in density
(c) a change in composition
(d) no change in physical properties

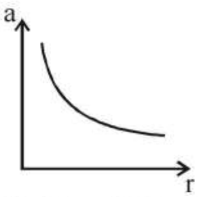
98. Which one of the following pairs of power projects is **not** correctly matched?
(a) Papanasam-Hydropower
(b) Neyveli-Hydropower
(c) Ukai-Thermal power
(d) Rana Pratap Sagar-Hydropower

99. A particle is moving in a circular path of radius r at a constant speed v. Which one of the following graphs correctly represents its acceleration a?

(a)


(b)


(c)


(d)


100. Which of the following element combinations will form ionic compounds?
1. Ca (Z = 20) and Ti (Z = 22)
2. Si (Z = 14) and Br (Z = 35)
3. Mg (Z = 12) and Cl (Z = 17)

Select the correct answer using the code given below.
(a) 2 only (b) 3 only
(c) 2 and 3 only (d) 1, 2 and 3

101. In the term GIS, 'G' stands for
(a) Global (b) Geographical
(c) Goodness (d) Geological

102. A thermodynamic process where no heat is exchanged with the surroundings is
(a) isothermal (b) adiabatic
(c) isobaric (d) isotropic

103. A compound X_2O_3 contains 31.58% oxygen by weight. The atomic mass of X is
(a) 34.66 g mol^{-1} (b) 45.01 g mol^{-1}
(c) 52.00 g mol^{-1} (d) 104.00 g mol^{-1}

104. Which one of the following is the correct sequence of oil refineries in India in respect of their time of establishment (starting from the earliest)?
(a) Barauni–Haldia – Guwahati–Mathura (b) Barauni–Mathura – Guwahati–Haldia
(c) Guwahati–Haldia – Mathura–Barauni (d) Guwahati–Barauni – Haldia–Mathura

105. Which one of the following circuit elements is an active component?
(a) Resistor (b) Transistor
(c) Inductor (d) Capacitor

106. Which one among the following contains the most neutrons?
(a) ${}^{59}_{26}Fe$ (b) ${}^{61}_{29}Cu$
(c) ${}^{61}_{30}Zn$ (d) ${}^{60}_{30}Zn^{2+}$

107. Movements of tides are mostly determined by
(a) albedo effect (b) wind velocity
(c) rotation of the Earth (d) revolution of the Earth

108. Fahrenheit and Celsius are the two scales used for measuring temperature. If the numerical value of a temperature recorded in both the scales is found to be same, what is the temperature?
(a) $-40°$ (b) $+40°$
(c) $+72°$ (d) $-72°$

109. Turpentine oil in paints is used as a
(a) pigment (b) film-forming material
(c) thinner (d) drier

110. Match List-I with List-II and select the correct answer using the code given below the Lists:

List - I (Textile industry)		List-II (Place)	
A.	Woolen textile	1.	Sualkuchi
B.	Cotton textile	2.	Rishra
C.	Silk textile	3.	Ludhiana
D.	Jute textile	4.	Davangere

Code:
(a) A B C D: 3 4 1 2
(b) A B C D: 2 1 4 3
(c) A B C D: 2 4 1 3
(d) A B C D: 3 1 4 2

111. Kerosene oil rises in a wick of lantern because of
(a) buoyancy of air
(b) diffusion of the oil through the wick
(c) capillary action in the wick
(d) gravitational pull of the wick

112. If the reaction of 1.0 mol $NH_3(g)$ and 1.0 mol O_2 (g)
$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$
is carried to completion, then
(a) all the $O_2(g)$ is consumed
(b) 4.0 mol NO (g) is produced
(c) 1.5 mol H_2O (*l*) is produced
(d) all the $NH_3(g)$ is consumed

113. Which of the following sequences is correct for rainfall?
(a) Slow ascent of air → slow condensation → heavy downpour
(b) Rapid ascent of air → large raindrops → heavy downpour
(c) Pressure decreased → air compressed → heavy downpour
(d) Descent of air → air warmed → heavy downpour

114. The working of a microwave oven involves
(a) absorption of microwaves by matter
(b) reception of microwaves by optical fibre
(c) microwave amplification by stimulated emission of radiation
(d) transmission of microwaves through a metal

115. What would be the total population at the end of the year if population at the beginning of the year is 5000 and population changed during the year is – birth 250, death 60, immigration 30 and emigrant 15?
(a) 5205 (b) 5235
(c) 5310 (d) 5180

116. Two cars A and B have masses m_A and m_B respectively, with $m_A > m_B$. Both the cars are moving in the same direction with equal kinetic energy. If equal braking force is applied on both, then before coming to rest
(a) A will cover a greater distance
(b) B will cover a greater distance
(c) both will cover the same distance
(d) distance covered by them will depend on their respective velocities

117. If the length of the Equator is about 40000 km and the velocity of rotation is about 1700 km per hour, what would be the velocity of rotation at the Pole?
(a) Zero (b) 850 km/hr
(c) 1700 km/hr (d) 3400 km/hr

118. A bullet is fired vertically up from a 400 m tall tower with a speed 80 m/s. If g is taken as 10 m/s^2, the time taken by the bullet to reach the ground will be
(a) 8 s (b) 16 s
(c) 20 s (d) 24 s

119. A cyclotron accelerates particles of mass m and charge q. The energy of particles emerging is proportional to
(a) q^2/m (b) q/m^2
(c) q^2/m^2 (d) q

120. The electric field inside a perfectly conducting hollow object is
(a) 4π (b) infinite
(c) zero
(d) dependent upon the shape of the object

121. The densities of three liquids are D, 2D and 3D. What will be the density of the resulting mixture if equal volumes of the three liquids are mixed?
(a) 6D (b) 1.4D
(c) 2D (d) 3D

122. A particle is moving with uniform acceleration along a straight line ABC, where AB = BC. The average velocity of the particle from A to B is 10 m/s and from B to C is 15 m/s. The average velocity for the whole journey from A to C in m/s is
(a) 12 (b) 12.5
(c) 13 (d) 13.5

123. The dimension of 'impulse' is the same as that of
(a) pressure (b) angular momentum
(c) work (d) linear momentum

124. Consider the following statements:
1. China won both Thomas Cup and Uber Cup Badminton Tournaments, 2014.
2. The Uber Cup is the World Team Championship for women and the Thomas Cup is for men.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

125. Consider the following statements about *Drishti* system:
1. It is a sophisticated instrument to assess the runway visual range.
2. This system is developed by Airports Authority of India.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

126. Which of the following about Malavath Poorna is correct?
(a) First Indian swimmer to cross Suez Canal
(b) Youngest woman to scale Everest
(c) First Indian to win FIDE World Junior Championship
(d) Winner of Young Scientist Award, 2014

127. Which one among the following countries was the top contributor to India's FDI for the year 2013-14?
(a) Mauritius (b) Singapore
(c) USA (d) Japan

128. Which of the following statements about SIMBEX 14 is/are correct?
1. It was a bilateral naval exercise between Indian navy and Sri Lankan navy.
2. It was the 21st in the series.
3. It was conducted in the Andaman Sea.

Select the correct answer using the code given below.
(a) 1, 2 and 3 (b) 2 and 3 only
(c) 2 only (d) 1 and 3 only

129. Consider the following statements:
1. *Mobile Seva*, the National Mobile Governance Initiative of Department of Electronics and Information Technology of India, has won the United Nations Public Service Award, 2014.
2. The innovative initiative is aimed at mainstreaming mobile governance in the country.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

130. Consider the following statements about Prithvi-II Missile:
1. It is a nuclear-capable ballistic missile.
2. It has a maximum range of 100 km
3. It is India's first native made ballistic missile.

Which of the statements given above is/are correct?
(a) 1, 2 and 3 (b) 1 only
(c) 1 and 3 only (d) 2 and 3 only

131. Consider the following statements about Indian Regional Navigation Satellite System (IRNSS):
1. IRNSS is a constellation of five satellites, which were launched by PSLV.
2. It is an independent regional navigation satellite system designed to provide position information in the Indian region.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

132. The National Defence Academy has foreign cadets from which of the following countries?
1. Bhutan 2. Bangladesh
3. Nepal 4. Afghanistan

Select the correct answer using the code given below.
(a) 1, 2, 3 and 4 (b) 1, 3 and 4 only
(c) 3 and 4 only (d) 1 and 2 only

133. From which one among the following countries has India recently (May 2014) recalled its troops, who went for a joint combat exercise in the country?
(a) Malaysia (b) Thailand
(c) Egypt (d) Singapore

134. Who among the following was associated with the formulation of the basic ideas of the Mahayana Buddhism?
(a) Nagarjuna (b) Kashyapa Matanga
(c) Menander (d) Kanishka

135. Consider the following statements about Harappan Culture:
1. The Harappan Culture matured in Sind and Punjab.
2. It spread from there to Southwards and Eastwards
3. The area, where it spread, was bigger than Egypt and Mesopotamia.

Which of the statements given above is/are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 3 only (d) 1, 2 and 3

136. Megasthenes was a
(a) Greek ambassador to the court of Chandragupta Maurya
(b) Greek trader during Ashoka's time
(c) Greek trader in the Gupta period
(d) Chinese pilgrim during Harsha's time

137. By the late 19th century, India was one of the largest producers and exporters of
(a) cotton yarn and wheat (b) sugar and rice
(c) sugar and alcohol (d) iron and steel

138. Which one of the following is the correct sequence of appearance of the poet-saints of the Bhakti-Sufi tradition?
(a) Basavanna–Appar – Mira Bai – Lal Ded (b) Appar – Mira Bai – Lal Ded–Basavanna
(c) Appar – Basavanna – Lal Ded–Mira Bai (b) Basavanna – Mira Bai – Lal Ded–Appar

139. Who among the following did not bring trading ships to the port of Surat in pre-British times?
(a) Portuguese and English
(b) Russian and German
(c) English and Arab
(d) French and Arab

140. The Factory Act of 1891 in India was enacted to
(a) improve the condition of labour in India
(b) ensure greater governmental control over industry in India.
(c) provide a level playing field for English manufacturers
(d) enable greater political control over Indian industry

141. Which of the following statements is correct?
(a) The Presiding Officer of the Rajya Sabha is elected every year
(b) The Presiding Officer of the Rajya Sabha is elected for a term of 5 years
(c) The Presiding Officer of the Rajya Sabha is elected for a term of 6 years
(d) The Vice President of India is the Ex Officio Presiding Officer of the Rajya Sabha

142. Who among the following was **not** a member of the Drafting Committee of the Constitution of India?
(a) B. R. Ambedkar (b) K. M. Munshi
(c) Krishnaswamy Iyer (d) M. K Gandhi

143. Who among the following was **not** a member of the 'Big Four' in the Congress of Vienna (1815)?
(a) Great Britain (b) Russia
(c) Austria (d) France

144. The Stamp Act Congress consisting of delegates from nine of the thirteen colonies met in 1765 at
(a) Philadelphia (b) New York City
(c) Boston (d) Providence

145. Which of the following American colonies did **not** attend the first Continental Congress held in Philadelphia?
(a) Rhode Island (b) Connecticut
(c) Georgia (d) Maryland

146. The Bolshevik Revolution started in Russia during the reign of
(a) Czar Alexander I (b) Czar Alexander II
(c) Czar Alexander III (d) Czar Nicholas II

147. Which of the following is/are **not** related to fundamental duties?
1. To cherish and follow the noble ideals which inspired our national struggle for freedom
2. To value and preserve the rich heritage of our composite culture
3. To promote the educational and economic interests of the weaker sections of the people, especially the Scheduled Castes and Scheduled Tribes.
4. To protect all monuments of historic interest and national importance.

Select the correct answer using the code given below.
(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) 4 only

148. Joint sittings of the two Houses of Indian Parliament are held to
(a) elect the President of India
(b) elect the Vice President of India
(c) adopt a Constitution Amendment Bill
(d) consider and pass a Bill on which the two Houses diagree

149. The President of India can issue proclamation of Emergency
(a) on the advice of the Prime Minister
(b) on the advice of the Council of Ministers
(c) in his own discretion
(d) when the decision of the Union Cabinet for the issue of such proclamation has been communicated to him in writing

150. Which of the following statements is/are correct about the working of the Permanent Settlement in Bengal?
1. The traditional Zamindars lost their lands.
2. The reason for the Zamindars' inability to pay up land revenues was that the Ryots defaulted on payment of revenue.
3. A new group of farmers – the Jotedars – became influential.
4. The Collector replaced the Zamindars as the alternative focus of authority

Select the correct answer using the code given below.
(a) 1 only (b) 1 and 4 only
(c) 2 and 3 only (d) 1, 2, 3 and 4

NDA 1 2014 Solutions

MATHEMATICS

1. (d) Every quadratic equation
$ax^2+bx+c=0$, where $a, b, c \in R, a \neq 0$
has at most two real roots.

2. (c) The relation S is defined on the set of integers Z and xSy, if integer x divides integer y.
Reflexive : Since, every integer divides itself
$\therefore$ integer x divides integer x
$\Rightarrow$ xSx
Hence, S is reflexive.
Symmetric : Let $x, y \in Z$ such that xSy
i.e., integer x divides integer y
Now, this does not implies that integer y divides integer x.
e.g. Take $x=2$ and $y=4$
Then, 2 divides 4 but 4 does not divides 2.
Thus, S is not symmetric.
Transitive : Let $x, y, z \in Z$ such that xSy and ySz.
$\Rightarrow$ integer x divides integer y and integer y divides integer z
$\Rightarrow$ integer x divides integer z
$\Rightarrow$ xSz
Hence, S is transitive.

3. (c) $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = \begin{vmatrix} a+b+c & b & c \\ a+b+c & c & a \\ a+b+c & a & b \end{vmatrix} (\because C_1 \to C_1+C_2+C_3)$

$= (a+b+c)\begin{vmatrix} 1 & b & c \\ 1 & c & a \\ 1 & a & b \end{vmatrix}$

[on taking $(a+b+c)$ common from C_1]
$= (a+b+c)\,[1\,(bc-a^2) - b\,(b-a) + c\,(a-c)]$
$= (a+b+c)\,[bc-a^2-b^2+ab+ac-c^2]$
$= (a+b+c)\,[-(a^2+b^2+c^2-ab-bc-ca)]$
$= -\frac{1}{2}\,(a+b+c)\,[(a-b)^2+(b-c)^2+(c-a)^2]$
Hence, the determinant is Negative value

4. (d) We have, $AB = A$
$\therefore \quad A^2 = (AB).(AB) = A.(BA)B$
$= ABB \qquad (\because BA = B)$
$= AB$
$= A \qquad (\because AB = A)$
Also, $B^2 = (BA).(BA) = B.(AB).A$
$= B.A.A \qquad (\because AB = A)$
$= B.A$
$= B \qquad (\because BA = B)$
Again, $(AB)^2 = (AB).(AB) = A.(BA)B$
$= A.B.B \qquad (\because BA = B)$
$= A.B$
$= A \qquad (\because AB = A)$

5. (b) $(1001)_2$
$= (2^3 \times 1 + 2^2 \times 0 + 2^1 \times 0 + 2^0 \times 1)_{10} = (8+1)_{10} = (9)_{10}$

6. (a) $\left(\frac{\sqrt{3}+i}{\sqrt{3}-i}\right) = \frac{\sqrt{3}+i}{\sqrt{3}-i} \times \frac{\sqrt{3}+i}{\sqrt{3}+i}$

$= \frac{3+i^2+2\sqrt{3}\,i}{3-i^2} = \frac{3-1+2\sqrt{3}i}{3+1}$

$= \frac{2(1+\sqrt{3}i)}{4} = \frac{1}{2} + i\frac{\sqrt{3}}{2}$

$= \left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right) = e^{i\frac{\pi}{3}}$

$\therefore \left(\frac{\sqrt{3}+i}{\sqrt{3}-i}\right)^6 = (e^{i\frac{\pi}{3}})^6 = e^{i2\pi} \; \cos 2\pi + i\sin 2\pi$

$= 1 + 0.i = 1$

7. (d) Since, $\arg z = \frac{5\pi}{6}$
So, z lies in second quadrant.
Let $z = a + ib$
and $|z| = a^2 + b^2 = 4$

Also, $\tan\alpha = \left(\pi - \frac{5\pi}{6}\right) = \frac{\pi}{6} \Rightarrow \alpha = \frac{\pi}{6}$

$\therefore \tan\alpha = \frac{1}{\sqrt{3}} \qquad \left[\because \tan\alpha = \left(\frac{b}{a}\right)\right]$

$\therefore z = -\sqrt{3} + i \qquad (\because a < 0 \text{ and } b > 0)$

8. (d) $\begin{vmatrix} 6i & -3i & 1 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix}$

$= 6i\,[3i^2+3] + 3i\,[4i+20] + 1\,[12-60i]$
$= 6i\,[-3+3] + 12i^2 + 60i + 12 - 60i$
$= -12 + 12 = 0 = x + iy$
$\therefore x = 0$

9. (a) $\because \alpha + \beta = -\frac{b}{a}$ and $\alpha\beta = \frac{c}{a}$

Also, $\alpha + h + \beta + h = -\frac{q}{p}$

$\Rightarrow \alpha + \beta + 2h = -\frac{q}{p}$

$\Rightarrow 2h = -\frac{q}{p} + \frac{b}{a}$ $\left(\because \alpha + \beta = -\frac{b}{a}\right)$

$\Rightarrow h = \frac{1}{2}\left[\frac{b}{a} - \frac{q}{p}\right]$

10. (a) $\because \begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix} A = \begin{pmatrix} 1 & 1 \\ 0 & -1 \end{pmatrix}$

Let B $= \begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix}$ and $|B| = 1$

$\therefore B^{-1} = \begin{pmatrix} 1 & -3 \\ 0 & 1 \end{pmatrix}$ $\left(\because A^{-1} = \frac{1}{|A|}\text{adj}\,A\right)$

$\therefore A = \begin{pmatrix} 1 & -3 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 1 \\ 0 & -1 \end{pmatrix} = \begin{pmatrix} 1 & 4 \\ 0 & -1 \end{pmatrix}$

11. (b) 1. We know that, determinant is not a square matrix, so it is not a true statement.
2. It is true that, determinant is a number associated with a square matrix.
Hence, Statement 2 is correct

12. (b) $\det(A^{-1}) = \frac{1}{\det A}$

13. (a) From the matrix equation, AB = AC, where A, B and C are the square matrices of same order.
We can conclude B = C provided and A is non-singular.

14. (d) $\because A = A'$

$\Rightarrow \begin{pmatrix} 4 & x+2 \\ 2x-3 & x+1 \end{pmatrix} = \begin{pmatrix} 4 & 2x-3 \\ x+2 & x+1 \end{pmatrix}$

$\Rightarrow 2x - 3 = x + 2$
$\therefore x = 5$

15. (b) $\begin{vmatrix} a & b & 0 \\ 0 & a & b \\ b & 0 & a \end{vmatrix}$

$= a[a^2 - 0] - b[-b^2] + 0$
$= a^3 + b^3 = 0$
$\Rightarrow a^3 = -b^3$

$\Rightarrow \left(\frac{a}{b}\right)^3 = -1$

Hence, $\frac{a}{b}$ is one of the cube roots of -1

16. (b) Given $f: N \to N$
$\therefore f(x) = 2x + 3 \Rightarrow f'(x) = 2 > 0$
So, f(x) is increasing, $\forall\, x \in N$.
Hence, f(x) is injective.
Let f(x) = y

$\Rightarrow y = 2x + 3 \Rightarrow x = \frac{y-3}{2}$

Let y = 4

$\therefore x = \frac{1}{2}$

and $y \in N$ but $x \notin N$
Hence, f(x) is not surjective.

17. (a) Given $\frac{(1+i)^{4n+5}}{(1-i)^{4n+3}}$

$= \frac{(1+i)^{4n+3}.(1+i)^2}{(1-i)^{4n+3}} = \left(\frac{1+i}{1-i}\right)^{4n+3}.(1+i)^2$

$= \left[\frac{(1+i)(1+i)}{(1-i)(1+i)}\right]^{4n+3} \bullet (1 + i^2 + 2i)$

$= \left[\frac{1+i^2+2i}{1+1}\right]^{4n+3}.2i = (i)^{4n+3}.2i = 2(i)^{4n+4}$

$= 2.(i^{4(n+1)}) = 2$

18. (a) First letter can be put any 7 letters boxes = 7 ways
Similarly, 2nd, 3rd, 4th and 5th letters be put in 7 ways each, respectively
$\therefore 7 \times 7 \times 7 \times 7 \times 7 = 7^5$

19. (c) Number of ways that a cricket team of 11 players can be made out of 15 players $= {}^{15}C_{11} = \frac{15!}{11!\,4!}$

$= \frac{15 \times 14 \times 13 \times 12 \times 11!}{11! \times 1 \times 2 \times 3 \times 4} = 1365$

20. (d) Here, n(A) = 5 and n(B) = 4
$\therefore n(A \times B) = 5 \times 4 = 20$
$[\because n(A) = m, n(B) = n \Rightarrow n(A \times B) = mn]$

21. (d) $f(x) = ax + b$ and $g(x) = cx + d$
$f[(g(x))] = a(cx + d) + b$
$= acx + ad + b$
and $g[f(x)] = c(ax + b) + d$
$= acx + dc + d$
$\therefore f[(gx)] = g[f(d)]$
$\Rightarrow ad + b = bc + d$
$\Rightarrow f(d) = g(b)$

22. (c) We know that, $|kA| = k^n|A|$, where n is order of matrix A.
$\therefore |3AB| = 3^2|A||B|$ $(\because |AB| = |A||B|)$
$= 9(-1)(3)$
$= -27$ $(\because |A| = -1, |B| = 3)$

23. (a) Given $f(x) = \frac{x-1}{x+1}$
Applying componendo and dividendo, we get

$\frac{f(x)+1}{f(x)-1} = \frac{x-1+x+1}{x-1-x-1}$

$\Rightarrow \frac{f(x)+1}{f(x)-1} = -x$

Now, $\frac{f(x)+1}{f(x)-1} + x = -x + x = 0$

24. (c) $f(x)=\frac{x-1}{x+1} \Rightarrow x=\frac{1+f(x)}{1-f(x)}$

$$\Rightarrow f(2x)=\frac{2x-1}{2x+1} \Rightarrow f(2x)=\frac{2\left[\frac{[1+f(x)]}{1-f(x)}\right]-1}{2\left[\frac{[1+f(x)]}{1-f(x)}\right]+1}$$

$$\Rightarrow f(2x)=\frac{3f(x)+1}{f(x)+3}$$

25. (c) Given $f(x)=\frac{x-1}{x+1}$

$$\Rightarrow f[f(x)]=\frac{f(x)-1}{f(x)+1}$$

$$\Rightarrow f[f(x)]=-\frac{1}{x} \qquad \left[\because x=-\left\{\frac{f(x)+1}{-f(x)-1}\right\}\right]$$

26. (b) $\left(x^2+\frac{1}{x}\right)^{15}$

$$T_{r+1}={}^{15}C_r(x^2)^{15-r}\left(\frac{1}{x}\right)^r$$

$$={}^{15}C_r x^{30-2r-r}={}^{15}C_r x^{30-3r}$$

For independent term,
$30-3r=0 \Rightarrow r=10$
Put $r=10$, we get

$$T_{10+1}={}^{15}C_{10}=\frac{15!}{10!5!}$$

$$=\frac{15\times14\times13\times12\times11\times10!}{10!\times1\times2\times3\times4\times5}=3003$$

27. (a) For coefficient of x^{15},
$30-3r=15$
$\Rightarrow r=5$
$\therefore$ the coefficient of x^{15} is ${}^{15}C_5$.
and coefficient of independent of x is
$30-3r=0$
$\Rightarrow r=10$
So, coefficient of independent of x is ${}^{15}C_{10}$.

$$\therefore \text{Required ratio}=\frac{{}^{15}C_5}{{}^{15}C_{10}}=\frac{{}^{15}C_5}{{}^{15}C_5}=1$$

$$\left(\because {}^nC_r={}^nC_{n-r}\right)$$

28. (b) 1. We know that, $(a+b)^n$ have total number of terms is $n+1$

So, $\left(x^2+\frac{1}{x}\right)^{15}$ haver 16 terms.

Hence, Statement 1 is false.

2. For coefficient of x^{12}
$30-3r=12 \Rightarrow r=6 \Rightarrow {}^{15}C_6$
and for coefficient of x^3,
$30-3r=3 \Rightarrow r=9 \Rightarrow {}^{15}C_9$
${}^{15}C_6={}^{15}C_9$
Hence, statement 2 is correct.

29. (c) 1. For coefficient of x^2,

$$30-3r=2 \Rightarrow r=\frac{28}{3}, r \notin N$$

So, x^2 does not exist in the expansion
Hence, Statement 1 is correct.

2. Now, $\left(x^2+\frac{1}{4}\right)^{15}={}^{15}C_0(x^2)^{15}+{}^{15}C_1(x^2)^{14}\left(\frac{1}{x}\right)+\ldots+{}^{15}C_{15}\left(\frac{1}{x}\right)^{15}$

Put $x=1$ both sides, we get
$(1+1)^{15}={}^{15}C_0+{}^{15}C_1+\ldots+{}^{15}C_{15}$
$\Rightarrow 2^{15}={}^{15}C_0+{}^{15}C_1+\ldots+{}^{15}C_{15}$
Hence, Statement 2 is correct

30. (c) Given $\left(x^2+\frac{1}{x}\right)^{15}$

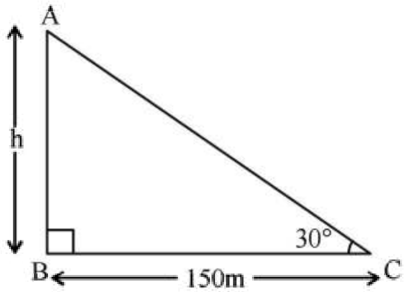
Since, n is odd.
So, it has two middle terms T_8 and T_9.
$\therefore T_8+T_9={}^{15}C_7+{}^{15}C_8={}^{16}C_8$
$\left(\because {}^nC_{r-1}+{}^nC_r={}^{n+1}C_r\right)$

31. (b) Consider, $\sqrt{1+\sin2\theta}$

$$=\sqrt{\sin^2\theta+\cos^2\theta+2\sin\theta\cos\theta}$$

$$=\sqrt{(\sin\theta+\cos\theta)^2}=\sin\theta+\cos\theta$$

32. (b) In ΔABC, we have $BC=150$ m, $AB=h$
$\angle C=30°$



$$\tan30°=\frac{h}{150}$$

$$\Rightarrow \frac{1}{\sqrt3}=\frac{h}{150}$$

$$\therefore h=\frac{150}{\sqrt3}\text{ m}$$

$$=\frac{150\times\sqrt3}{3}=50\sqrt3\text{ m}$$

33. (d) cot A = 2 and cot B = 3

$$\cot(A+B)=\frac{\cot A\cot B-1}{\cot A+\cot B}=\frac{6-1}{2+3}=\frac{5}{5}=1$$

$$\Rightarrow \cot(A+B)=\cot\left(\frac{\pi}{4}\right)\Rightarrow A+B=\frac{\pi}{4}$$

34. (b) $\sin^2 66\frac{1°}{2}-\sin^2 23\frac{1°}{2}$

$$=\left[\sin\left(90°-23\frac{1°}{2}\right)\right]^2-\sin^2 23\frac{1°}{2}$$

$$=\cos^2 23\frac{1°}{2}-\sin^2 23\frac{1°}{2}$$

$$=\cos 2\left(23\frac{1°}{2}\right)=\cos 47°$$

$(\because \cos 2A=\cos^2 A-\sin^2 A)$

$$=\cos\left[2\times\left(\frac{47}{2}\right)\right]=\cos 47°$$

35. (a) $\sin^{-1}\frac{3}{5}+\sin^{-1}\frac{4}{5}$

$$=\sin^{-1}\frac{3}{5}+\cos^{-1}\frac{3}{5}$$

$\left(\text{let}\sin^{-1}\frac{4}{5}=\theta\Rightarrow\sin\theta=\frac{4}{5}\Rightarrow\cos\theta=\frac{3}{5}\right)$

$$=\frac{\pi}{2}$$

36. (b) $\frac{\cos 7x-\cos 3x}{\sin 7x-2\sin 5x+\sin 3x}$

$$=\frac{-2\sin\frac{7x+3x}{2}.\sin\frac{7x-3x}{2}}{2\sin\frac{7x+3x}{2}.\cos\frac{7x-3x}{2}-2\sin 5x}$$

$$\left(\begin{array}{l}\because \sin C+\sin D=2\sin\left(\frac{C+D}{2}\right).\cos\left(\frac{C-D}{2}\right)\\ \text{and}\cos C-\cos D=-2\sin\left(\frac{C+D}{2}\right)\sin\left(\frac{C-D}{2}\right)\end{array}\right)$$

$$=\frac{-2\sin 5x.\sin 2x}{2\sin 5x\cos 2x-2\sin 5x}$$

$$=\frac{-2\sin 5x.\sin 2x}{-2\sin 5x[1-\cos 2x]}$$

$$=\frac{\sin 2x}{1-1+2\sin^2 x}\qquad(\because \cos 2x=1-2\sin^2 x)$$

$$=\frac{2\sin x\cos x}{2\sin^2 x}=\cot x$$

37. (a) According to sine rule,

$$\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$$

$$\therefore \frac{a}{\sin A}=\frac{c}{\sin C}$$

$$\Rightarrow \sin C=\frac{c.\sin A}{a}=\frac{2.\sin 45°}{2\sqrt{2}}$$

$$=\frac{1}{\sqrt{2}}.\frac{1}{\sqrt{2}}=\frac{1}{2}=\sin 30°$$

$\therefore C=30°$

38. (c) In a ΔABC, we have

$\sin A-\cos B=\cos C\Rightarrow \sin A=\cos B+\cos C$

$$\Rightarrow 2\sin\frac{A}{2}.\cos\frac{A}{2}=2\cos\left(\frac{B+C}{2}\right).\cos\left(\frac{B-C}{2}\right)$$

$[\because \sin 2A=2\sin A.\cos A]$

and $\cos B+\cos C=2\cos\left(\frac{B+C}{2}\right).\cos\left(\frac{B-C}{2}\right)$

$$\Rightarrow 2\sin\frac{A}{2}.\cos\frac{A}{2}=2\cos\left(90°-\frac{A}{2}\right).\cos\left(\frac{B-C}{2}\right)$$

$\left[\because A+B+C=180°\Rightarrow\left(\frac{B+C}{2}\right)=90°-\frac{A}{2}\right]$

$$\Rightarrow 2\sin\frac{A}{2}.\cos\frac{A}{2}=2\sin\frac{A}{2}.\cos\left(\frac{B-C}{2}\right)$$

$[\because \cos(90°-\theta)=\sin\theta]$

$$\Rightarrow \cos\frac{A}{2}=\cos\left(\frac{B-C}{2}\right)$$

$$\Rightarrow \frac{A}{2}=\frac{B-C}{2}$$

$\Rightarrow A+C=B$ ...(i)

Also, $A+C=180°-B$ ...(ii)

So, $180°-B=B$

$\Rightarrow 2B=180°$

$\therefore B=90°$

39. (b) $\frac{\sin(x+y)}{\sin(x-y)}=\frac{a+b}{a-b}$

Applying componendo and dividendo, we get

$$\frac{\sin(x+y)+\sin(x-y)}{\sin(x+y)-\sin(x-y)}=\frac{(a+b)+(a-b)}{(a+b)-(a-b)}$$

$$\Rightarrow \frac{2\sin x.\cos y}{2\cos x.\sin y}=\frac{2a}{2b}\Rightarrow \tan x\,.\cot y=\frac{a}{b}$$

$$\therefore \frac{\tan x}{\tan y}=\frac{a}{b}$$

40. (a) $\sin A \cdot \sin(60° - A)\sin(60° + A) = k \sin 3A$

$\Rightarrow \sin A . \frac{\sin 3A}{4 \sin A} = k . \sin 3A$

$\left[\because \sin(60° + A).\sin(60° - A) = \frac{\sin 3A}{4 \sin A}\right]$

$\Rightarrow \frac{\sin 3A}{4} = k . \sin 3A$

$\therefore k = \frac{1}{4}$

41. (a) Line $y = \sqrt{3}$ and graph $= y = \tan x$

Now, we have $\sqrt{3} = \tan x$

$\Rightarrow \tan x = \tan 60°$

$\Rightarrow x = 60°$ $\left[\because x \in \left(0, \frac{\pi}{2}\right)\right]$

Hence, one intersecting point is possible in the given domain i.e., $k = 1$.

42. (b) $\tan 2\theta . \tan \theta = 1$

$\Rightarrow \frac{2 \tan \theta}{1 - \tan^2 \theta} . \tan \theta = 1$

$\Rightarrow 2 \tan^2 \theta = 1 - \tan^2 \theta \Rightarrow 3 \tan^2 \theta = 1$

$\Rightarrow \tan^2 \theta = \frac{1}{3} = \left(\frac{1}{\sqrt{3}}\right)^2$

$\Rightarrow \tan^2 \theta = \tan^2 (30°) = \tan^2 \left(\frac{\pi}{6}\right)$ $\left[\because \theta = n\pi \pm \frac{\pi}{6}\right]$

$\therefore \theta = \frac{\pi}{6}$

For (Qs. 43–45)

$16 \sin^5 x = 16 (\sin^2 x)^2 . \sin x$

$= 16\left(\frac{1 - \cos 2x}{2}\right)^2 . \sin x$

$= 4 (1 + \cos^2 2x - 2 \cos 2x) . \sin x$

$= 4\left(1 + \frac{1 + \cos 4x}{2} - 2 \cos 2x\right) . \sin x$

$= \frac{4}{2}(3 + \cos 4x - 4 \cos 2x) . \sin x$

$= (6 + 2 \cos 4x - 8 \cos 2x) \sin x$

$= 6 \sin x + 2 \sin x \cos 4x - 8 \cos 2x . \sin x$

$= 6 \sin x + \sin 5x - \sin 3x - 4 (\sin 3x - \sin x)$

$[\because 2 \sin A \cos B = \sin (A + B) + \sin (A - B)]$

$= 6 \sin x + \sin 5x - \sin 3x - 4 \sin 3x + 4 \sin x$

$= \sin 5x - 5 \sin 3x + 10 \sin x.$

43. (a) Clearly, $p = 1$, hence option (a) is correct.

44. (d) Clearly, $q = -5$, hence option (d) is correct.

45. (c) Clearly, $r = 10$, hence option (c) is correct.

46. (b) Given, S_n = Sum of first n terms of an AP.

$S_n = \frac{h}{2}[2a + (n - 1)d]$ or $S_{2n} = \frac{2n}{2}[2a + (2n - 1) d]$

Similarly, $S_{3n} = \frac{3n}{2}[3a + (3n - 1) d]$

According to direction, $3S_n = 2S_{2n}$

Putting the value of S_n and S_{2n} in above equation.

$3\left(\frac{n}{2}\right)[2a + (n - 1) d] = 2\left(\frac{n}{2}\right)[2a + (2n - 1) d]$

$6a + 3 (n - 1) d = 4a + 2(n - 1)d$

$2a = d (n + 1)$

$\therefore S_n = \frac{n}{2}[d(n + 1) + d (n - 1)]$

$= \frac{n}{2}[dn + d + dn - d]$

$= \frac{n}{2}(2 dn) = n^2 d$

Now, $S_{2n} = n [d (n + 1) + (2n - 1) d] = 3n^2 d$

$S_{3n} = \frac{3n}{2}[d (n + 1 + 3n - 1)] = 6n^2 d$

Hence, $\frac{S_{3n}}{S_n} = \frac{6n^2 d}{n^2 d} = \frac{6}{1} = 6 : 1$

47. (a) From explanation $\frac{S_{3n}}{S_{2n}} = \frac{6n^2 d}{3n^2 d} = \frac{2}{1} = 2 : 1$

48. (d) Equation of ellipse is $25x^2 + 16y^2 = 400$

$\frac{x^2}{16} + \frac{y^2}{25} = 1$

Here, $a^2 = 16$ and $b^2 = 25$

$\therefore$ Length of latus rectum $= \frac{2a^2}{b} = \frac{2 \times 16}{5} = \frac{32}{5}$

49. (a) Equations of circles are

$x^2 + y^2 + 2ax + c = 0$

and $x^2 + y^2 + 2by + c = 0$

Since, the centres of two circles are $(-a, 0)$ and $(0, -b)$

$\therefore$ Distance between two centres $= \sqrt{a^2 + b^2}$

50. (b) Two circles touch each other, iff distance between two centres = Sum of radius of two circles

$\sqrt{a^2 + b^2} = \sqrt{a^2 - c} + \sqrt{b^2 - c}$

On squaring both sides, we get

$a^2 + b^2 = a^2 - c + b^2 - c + 2\sqrt{(a^2 - c)(b^2 - c)}$

$\Rightarrow c = \sqrt{(a^2 - c)(b^2 - c)}$

Again, squaring both sides, we get

$c^2 = a^2 b^2 - a^2 c - b^2 c + c^2$

$\Rightarrow a^2 b^2 = (a^2 + b^2) c \Rightarrow \frac{1}{c} = \frac{1}{a^2} + \frac{1}{b^2}$

51. (c) Given A (3, 4) and B (5, –2)
Let, P (x, y)
Given that, PA = PB
$\Rightarrow PA^2 = PB^2$
$\Rightarrow (x-3)^2 + (y-4)^2 = (x-5)^2 + (y+2)^2$
$\Rightarrow x^2 - 6x + 9 + y^2 - 8y + 16$
$= x^2 - 10x + 25 + y^2 + 4y + 4$
$\Rightarrow 4x - 12y = 4$
$\Rightarrow x - 3y = 1$ ...(i)
$\because$ Area of $\Delta PAB = 10$

$$\therefore \frac{1}{2}\begin{vmatrix} x & y & 1 \\ 3 & 4 & 1 \\ 5 & -2 & 1 \end{vmatrix} = \pm 10$$

$\Rightarrow x(4+2) - y(3-5) + 1(-6-20) = \pm 20$
$\Rightarrow 6x + 2y - 26 = \pm 20$
$\Rightarrow 6x + 2y - 26 = 20$
or, $6x + 2y - 26 = -20$
$\Rightarrow 6x + 2y = 46$ ...(ii)
or $6x + 2y = 6$ ...(iii)
From eqs. (i) and (ii), we get
$x = 7, y = 2$
Similarly, from eqs. (i) and (iii), we get
$x = 1, y = 0$
Hence, coordinates of P are (7, 2) or (1, 0)

52. (b) Given equation of line is $bx\cos\alpha + ay\sin\alpha = ab$

Perpendicular distance from point $\left(\sqrt{a^2-b^2}, 0\right)$ is

$$d_1 = \left|\frac{b\cos\alpha\sqrt{a^2-b^2} + 0 - ab}{\sqrt{b^2\cos^2\alpha + a^2\sin^2\alpha}}\right|$$

($\because$ distance from (x_1, y_1) to $ax + by + c = 0$ is $= \left|\frac{ax_1 + by_1 + c}{\sqrt{a^2+b^2}}\right|$

Similarly, perpendicular distance from point $(-\sqrt{a^2-b^2}, 0)$ is

$$d_2 = \left|\frac{-b\cos\alpha\sqrt{a^2-b^2} + 0 - ab}{\sqrt{b^2\cos^2\alpha + a^2\sin^2\alpha}}\right|$$

By product of d_1 and d_2, we get

$$= \frac{(b\cos\alpha\sqrt{a^2-b^2} - ab)(b\cos\alpha\sqrt{a^2-b^2} + ab)}{(\sqrt{b^2\cos^2\alpha + a^2\sin^2\alpha})(\sqrt{b^2\cos^2\alpha + a^2\sin^2\alpha})}$$

$$= \frac{b^2\cos^2\alpha(a^2-b^2) - a^2b^2}{b^2\cos^2\alpha + a^2\sin^2\alpha}$$

$$= \frac{a^2b^2\cos^2\alpha - b^4\cos^2\alpha - a^2b^2}{b^2\cos^2\alpha + a^2\sin^2\alpha}$$

$$= \frac{a^2b^2(\cos^2\alpha - 1) - b^4\cos^2\alpha}{b^2\cos^2\alpha + a^2\sin^2\alpha}$$

$$= \frac{-b^2[a^2\sin^2\alpha + b^2\cos^2\alpha]}{b^2\cos^2\alpha + a^2\sin^2\alpha}$$

Hence, product of the perpendiculars $= -b^2 = b^2$ (since, distance is positive)

53. (b) Given equation of line is

$\frac{x-1}{2} = \frac{y-2}{3}$
$\Rightarrow 3x - 3 = 2y - 4 \Rightarrow 3x - 2y + 1 = 0$
$\Rightarrow y = \frac{-3x}{2} + \frac{1}{2}$
and equation of second line is $2x + 3y = 5$
$\Rightarrow y = \frac{-2}{3}x + \frac{5}{3}$

$\therefore$ Slope of first line, $m_1 = \frac{3}{2}$

and slope of second line, $m_2 = -\frac{2}{3}$

$\therefore m_1 m_2 = -1$
Hence, two lines are perpendicular to each other.

54. (b) Equation of sphere passing through origin is
$x^2 + y^2 + z^2 + 2ux + 2vy + 2wz = 0$
which passes through the points (2, 1, –1), (1, 5, –4), and (–2, 4, –6)
$\therefore 4u + 2v - 2w = -6$ ...(i)
$2u + 10v - 8w = -42$ ...(ii)
and $-4u + 8v - 12w = -56$ ...(iii)
From eqns (i), (ii) and (iii), we get
$u = 1, v = -2$ and $w = 3$
$\therefore$ Radius of sphere $= \sqrt{u^2 + v^2 + w^2}$
$= \sqrt{1+4+9} = \sqrt{14}$

55. (a) From explanation 54
Centre of sphere,
$(-u, -v, -w) = (-1, 2, -3)$

56. (a) (1) Equation of sphere is
$x^2 + y^2 + z^2 + 2x - 4y + 6z = 0$
Put the value (0, 4, 0), we get
$0 + 16 + 0 + 0 - 16 + 0 = 0$
So, the sphere passes through the point (0, 4, 0).
Hence, Statement 1 is correct.
2. Distance between the point (1, 1, 1) and centre of sphere (–1, 2, –3)
$= \sqrt{(1+1)^2 + (1-2)^2 + (1+3)^2}$
$= \sqrt{4+1+16} = \sqrt{21} \neq 5$
Hence, statement 2 is not correct.

57. (d) Equation of line passing through the points (2, 1, 3) and (4, –2, 5) is

$$\frac{x-2}{4-2}=\frac{y-1}{-2-1}=\frac{z-3}{5-3}=\lambda$$

$$\Rightarrow \frac{x-2}{2}=\frac{y-1}{-3}=\frac{z-3}{2}=\lambda$$

$\Rightarrow x=2\lambda+2,\ y=-3\lambda+1$ and $z=2\lambda+3$

Since, this line cuts the plane $2x+y-z=3$

So, $(2\lambda+2,\ -3\lambda+1,\ 2\lambda+3)$ satisfies the equation of plane

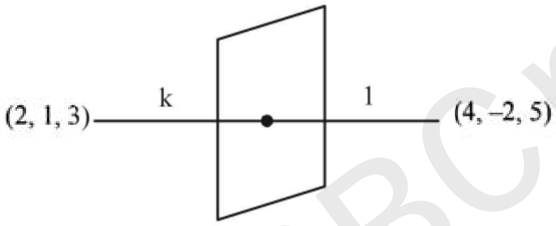
$\therefore 2\lambda+2-3\lambda+1-2\lambda-3=3$

$\Rightarrow -3\lambda=3$

$\Rightarrow \lambda=-1$

Hence, points are $[2(-1)+2, -3(-1)+1, 2(-1)+3]$ i.e., (0, 4, 1).

58. (d) Let the ratio is k : 1



Then, $0=\dfrac{4k+2}{k+1}$

$\Rightarrow 4k+2=0 \Rightarrow k=-\dfrac{1}{2}$

and $4=\dfrac{-2k+1}{k+1} \Rightarrow 4k+4=-2k+1 \Rightarrow k=-\dfrac{1}{2}$

Hence, plane divides the line in ratio 1 : 2 externally.

59. (b) We know that, equation of plane passing through three non-collinear points $(x_1, y_1, z_1), (x_2, y_2, z_2)$ and (x_3, y_3, z_3) is

$$\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ x_2-x_1 & y_2-y_1 & z_2-z_1 \\ x_3-x_1 & y_3-y_1 & z_3-z_1 \end{vmatrix}=0$$

Put the value of (x_1, y_1, z_1), (x_2, y_2, z_2) and (x_3, y_3, z_3) we get

$$\begin{vmatrix} x-2 & y-2 & z-1 \\ 1 & 2 & 1 \\ 5 & -2 & 5 \end{vmatrix}=0$$

$\Rightarrow (x-2)(10+2)-(y-2)(5-5)+(z-1)(-2-10)=0$

$\Rightarrow 12x-12z=12 \Rightarrow x-z=1$

Hence the equation of plane parses through (1, 0, 1)

60. (c) Direction ratios of the nomal to the plane $x-z=1$ are $(1, 0, -1)$.

61. (b) $f(x)=\begin{cases} x^2-5 & , \ x\le 3 \\ \sqrt{x+13} & , \ x>3 \end{cases}$

To find $\lim\limits_{x\to 3} f(x)$

$\text{LHL}=\lim\limits_{x\to 3^-} f(x)$

$=\lim\limits_{x\to 3^-}(x^2-5)=\lim\limits_{x\to(3-h)}[(3-h)^2-5]$

$=\lim\limits_{h\to 0}(9-6h+h^2-5)=4$

$\text{RHL}=\lim\limits_{x\to 3^+}(\sqrt{x+13})$

$=\lim\limits_{x\to(3+h)}(\sqrt{3+h+13})=\lim\limits_{h\to 0}(\sqrt{16+h})=4$

$\because \lim\limits_{x\to 3^-} f(x)=\lim\limits_{x\to 3^+} f(x)=4$

$\therefore \lim\limits_{x\to 3} f(x)=4$

62. (d) 1. $\lim\limits_{x\to 3^-} f(x)=\lim\limits_{x\to 3^+} f(x)=f(3)$

$\therefore \lim\limits_{x\to 3^-} f(x)=\lim\limits_{x\to 3^+} f(x)=4$

Therefore f(x) is continuous at $x=4$

2. Given $f(x)=x^2-5\ x\le 3$

$f'(x)=2x$

$f'(0)=0$

So, f (x) is differentiable at $x=0$

Therefore, neither statement 1 nor 2 is correct.

63. (d) Given, $f(x)=\sqrt{x+13}, x>3$

$f'(x)=\dfrac{1}{2\sqrt{x+13}}$

$\Rightarrow f'(12)=\dfrac{1}{2\sqrt{12+13}}$

$=\dfrac{1}{2\times 5}=\dfrac{1}{10}$

64. (c) Equation of line

$2y=3x+12$ ...(i)

Equation of parabola

$4y=3x^2$ ...(ii)

From eqs. (i) and (ii), we get

$2(3x+12)=3x^2$

$3x^2-6x-24=0$

$x^2-2x-8=0$

$(x-4)(x+2)=0$

$\therefore x=4$

and $x=-2$

Now putting the value of x in eqn (ii)

We get $y=12$ and $y=3$

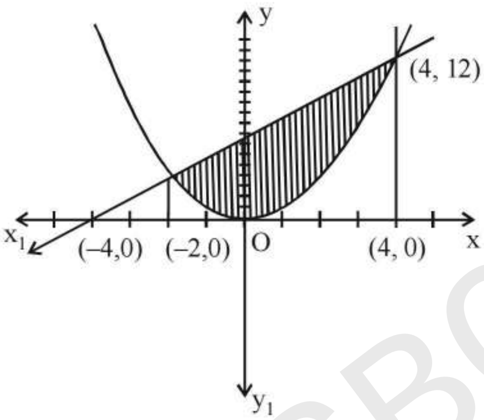
Thus, the points $(-2, 3)$ and $(4, 12)$

65. (a) Equation of line $2y = 3x + 12$, $y = \frac{3x+12}{2}$

Equation of parabola $4y = 3x^2$, $y = \frac{3x^2}{4}$

$= \int_{-2}^{4} \left[\frac{3x+12}{2} - \frac{3x^2}{4}\right] dx$

$= \frac{1}{2}\left[\frac{3x^2}{2} + 12x\right]_{-2}^{4} - \frac{3}{4}\left[\frac{x^3}{3}\right]_{-2}^{4}$



$= \frac{1}{2}\left[\left\{\frac{3(4)^2}{2} + 12(4)\right\} - \left\{\frac{3(-2)^2}{2} + 12(-2)\right\}\right]$

$- \frac{3}{4}\left[\frac{4^3}{3} - \frac{(-2)^3}{3}\right]$

$= \frac{1}{2}[24 + 48 - 6 + 24] - \frac{3}{4}\left[\frac{64+8}{3}\right]$

$= \frac{1}{2} \times 90 - 18 = 27$ sq. units.

66. (c) Equation of line $2y = 3x + 12$ and equations of parabola $4y = 3x^2$

$= \int_{0}^{4} \left(\frac{3x+12}{2} - \frac{3x^2}{4}\right) dx = \left(\frac{3}{4}x^2 + 6x - \frac{x^3}{4}\right)_0^4$

$= 3 \times 4 + 24 - 16 = 36 - 16 = 20$ sq. units.

$\therefore$ Area enclosed by the parabola, the line and the y axis in first quadrant = 20 sq. units

67. (b) Given, $f(x) = \begin{cases} \frac{\tan kx}{x}, & x < 0 \\ 3x + 2k^2, & x \ge 0 \end{cases}$

When function is continuous at $x = 0$, then

$\lim_{x \to 0^-} f(x) = \lim_{x \to 0^+} f(x) = f(0)$

$\therefore \lim_{x \to 0^-} \left(\frac{\tan kx}{x}\right) = \lim_{x \to 0^+} (3x + 2k^2) = 3(0) + 2k^2$

$\Rightarrow \lim_{x \to 0-h} \left[\frac{\tan k(0-h)}{(0-h)}\right] = \lim_{x \to 0+h} [3(0+h) + 2k^2] = 2k^2$

Therefore, $\lim_{h \to 0} \left(\frac{\tan kh}{h}\right) = 2k^2$

$k = 2k^2$ $\left[\because \lim_{x \to 0} \frac{\tan x}{x} = 1\right]$

Hence, $k = \frac{1}{2}$

68. (b) The greatest integer function is continuous at all statement points except integer. Hence, statement 1 is incorrect.

Statement 2 : Let $h(a) = \sin x$ and $g(x) = |x|$

$hog(x) = \sin |x|$

$\Rightarrow f(x) = hog(x) = \sin |x|$

Therefore, $g(x)$ is continuous, $\forall x \in R$ and

$h(x)$ is continous $\forall x \in R$

When both are continuous then $hog(x)$ is also continuous.

Thus, statement 2 is correct.

69. (a) Given, $x = a(\cos\theta + \theta \sin\theta)$ and

$y = a(\sin\theta - \theta\cos\theta)$

$\frac{dx}{d\theta} = a(-\sin\theta + \theta\cos\theta + \sin\theta) = a\theta\cos\theta$

$\frac{dy}{d\theta} = a(\cos\theta + \theta\sin\theta - \cos\theta) = a\theta\sin\theta$

Now $\frac{dy}{dx} = \frac{a\theta\sin\theta}{a\theta\cos\theta} = \tan\theta$

70. (c) Given $x = a(\cos\theta + \theta\sin\theta)$

$y = a(\sin\theta - \theta\cos\theta)$ and we have $\frac{dy}{dx} = \tan\theta$

According to question $\frac{d^2y}{dx^2} = \sec^2\theta \frac{d\theta}{dx}$

$= \sec^2\theta\left(\frac{1}{a\theta\cos\theta}\right)$

$\left[\because \frac{dx}{d\theta} = a\theta\cos\theta\right]$

Hence, $\frac{d^2y}{dx^2} = \frac{\sec^3\theta}{a\theta}$

71. (d) Given equation $y^2 = 4bx = 2\int_0^b \sqrt{4bx}\,dx$

$$= 4\sqrt{b} \times \frac{2}{3}\left[x^{\frac{3}{2}}\right]_0^b = \frac{8\sqrt{b}}{3}\left[b^{\frac{3}{2}} - 0\right]$$

$\therefore$ area of parabola bounded by its latus rectum

$$= \frac{8b^2}{3} \text{ sq. units}$$

72. (c) $y = x \ln x + xe^x$

After differentiating both sides with respect to x,

we get $\frac{dy}{dx} = x \cdot \frac{1}{x} + \log x + xe^x + e^x$

or $1 + \log x + xe^x + e^x$

Therefore $\left(\frac{dy}{dx}\right)_{x=1} = 1 + \log 1 + 1.e^1 + e^1 = 1 + 2e$

$[\because \log 1 = 0]$

73. (b) Given equation $\lim_{x\to 0} \frac{\log_5(1+x)}{x}$

$$= \lim_{x\to 0} \frac{\log_e(1+x)}{x\log_e 5} \qquad \left[\because \log_x y = \frac{\log_e y}{\log_e x}\right]$$

$$= \frac{1}{\log_e 5} \lim_{x\to 0} \frac{\log_e(1+x)}{x} = \log_5 e$$

$$\left[\because \lim_{x\to 0} \frac{\log_e(1+x)}{x} = 1, \log_x y = \frac{1}{\log_y x}\right]$$

74. (a) $\because \lim_{x\to 0} \frac{a^x - 1}{x} = \text{loe}_e a$

$\therefore \lim_{x\to 0} \frac{5^x - 1}{x} = \log_e 5$

Hence, option (a) is correct

75. (d) $\lim_{n\to\infty} \frac{1+2+3+\ldots+n}{1^2+2^2+3^2+\ldots+n^2} = \lim_{n\to\infty} \frac{\frac{n(n+1)}{2}}{\frac{n(n+1)(2n+1)}{6}}$

$\therefore \lim_{n\to\infty} \frac{3}{2n+1} = 0$

Note: $1 + 2 + 3 + \ldots + n = \frac{n(n+1)}{2}$

$1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{6}$

For (Q. 76–78)

Given, $I = \int_0^\pi \frac{x\,dx}{1+\sin x}$ ...(i)

$$= \int_0^\pi \frac{(\pi - x)}{1+\sin(\pi - x)}dx$$

$$\left[\because \int_0^a f(x)dx = \int_0^a f(a-x)dx\right]$$

$= \int_0^\pi \frac{(\pi - x)}{1+\sin x}dx$ ...(ii)

$[\because \sin(\pi - x) = \sin x]$

Adding eqs. (i) and (ii), we get

$2I = \pi\int_0^\pi \frac{dx}{1+\sin x}$ ...(iii)

$$\Rightarrow 2I = 2\pi\int_0^{\frac{\pi}{2}} \frac{dx}{1+\sin x}$$

$$\left[\because \int_0^{2a} f(x)dx = 2\int_0^a f(x)dx, \text{if } f(2a-x) = f(x)\right]$$

$$\Rightarrow I = \pi\int_0^{\frac{\pi}{2}} \frac{dx}{1+\left(\frac{2\tan\frac{x}{2}}{1+\tan^2\frac{x}{2}}\right)}$$

$$\Rightarrow I = \pi\int_0^{\frac{\pi}{2}} \frac{\sec^2\frac{x}{2}dx}{\tan^2\frac{x}{2} + 1 + 2\tan\frac{x}{2}}$$

$$\Rightarrow I = \pi\int_0^{\frac{\pi}{2}} \frac{\left(\sec^2\frac{x}{2}\right)dx}{\left(\tan\frac{x}{2}+1\right)^2}$$

Let $\tan\frac{x}{2} + 1 = t$

$\Rightarrow \sec^2\frac{x}{2}.\frac{1}{2}dx = dt$

$\Rightarrow \sec^2\frac{x}{2}dx = 2dt$

When $x = 0$, then $t = 1$ and when $x = \frac{\pi}{2}$, then $t = 2$

$$\therefore I = 2\pi\int_1^2 \frac{dt}{t^2} = 2\pi\left[\frac{t^{-2+1}}{-2+1}\right]_1^2 - 2\pi\left[\frac{1}{t}\right]_1^2$$

$$= -2\pi\left[\frac{1}{2} - 1\right]$$

$$= -2\pi\left(-\frac{1}{2}\right) = \pi$$

76. (c) According to the explanation, $I = \pi$

77. (a) Let $I_1 = \int_0^{\pi} \frac{(\pi - x)dx}{1 + \sin x}$

$$= \int_0^{\pi} \frac{[\pi - (\pi - x)]dx}{1 + \sin(\pi - x)}$$

$$\left[\because \int_0^a f(x)dx = \int_0^a f(a - x)dx\right]$$

$$I_1 = \int_0^{\pi} \frac{x\,dx}{1 + \sin x} = \pi \quad [\because \sin(\pi - x) = \sin x]$$

78. (b) From eq. (iii).

$$2I = \pi\int_0^{\pi} \frac{dx}{1 + \sin x}$$

$$\Rightarrow \int_0^{\pi} \frac{dx}{1 + \sin x} = \frac{2}{\pi}I$$

$$\Rightarrow \int_0^{\pi} \frac{dx}{1 + \sin x} = \frac{2}{\pi} \times \pi = 2 \qquad (\therefore I = \pi)$$

Explanations (Q. 79–80)

Given, $\int x \tan^{-1} x dx = A(x^2 + 1)\tan^{-1} x + Bx + C$

where, C is the constant of integration

Consider, $\int \underset{\text{II}}{x} \underset{\text{I}}{\tan^{-1}} x\,dx$

$$= \tan^{-1} x . \frac{x^2}{2} - \int \frac{d}{dx}(\tan^{-1} x). \frac{x^2}{2} dx$$

(using integration by parts)

$$= \frac{x^2 . \tan^{-1} x}{2} - \frac{1}{2}\int \frac{x^2}{1 + x^2} dx$$

$$= \frac{x^2 \tan^{-1} x}{2} - \frac{1}{2}\left(\int \left(\frac{1 + x^2 - 1}{1 + x^2}\right) dx\right)$$

$$= \frac{x^2 \tan^{-1} x}{2} - \frac{1}{2}\left(\int dx - \int \frac{dx}{1 + x^2}\right)$$

$$= \frac{x^2 \tan^{-1} x}{2} - \frac{1}{2}(x - \tan^{-1} x) + C$$

$$= \frac{x^2 \tan^{-1} x}{2} - \frac{x}{2} + \frac{\tan^{-1} x}{2} + C$$

$$= \frac{1}{2}(x^2 + 1)\tan^{-1} x - \frac{x}{2} + C$$

79. (b) $A = \frac{1}{2}$, hence option (b) is correct.

80. (b) $B = -\frac{1}{2}$, hence option (c) is correct.

For (Qs. 81–82)

Consider $I = \int_0^{\pi} \ln(\sin x)dx$

$$I = \int_0^{\pi} \ln(\sin x)dx$$

$$= 2\int_0^{\frac{\pi}{2}} \ln(\sin x)dx \qquad \text{...(i)}$$

$$\left[\because \int_0^{2a} f(x)dx = 2\int_0^a f(x)dx, \text{if } f(2a - x) = f(x)\right]$$

$$= 2\int_0^{\frac{\pi}{2}} \ln\left[\sin\left(\frac{\pi}{2} - x\right)\right]dx$$

$$\left(\because \int_0^a f(x)dx = \int_0^a f(a - x)dx\right)$$

$$= 2\int_0^{\frac{\pi}{2}} \ln(\cos x)dx \qquad \text{...(ii)}$$

81. (d) From eq. (i),

$$I = 2\int_0^{\frac{\pi}{2}} \ln(\sin x)dx$$

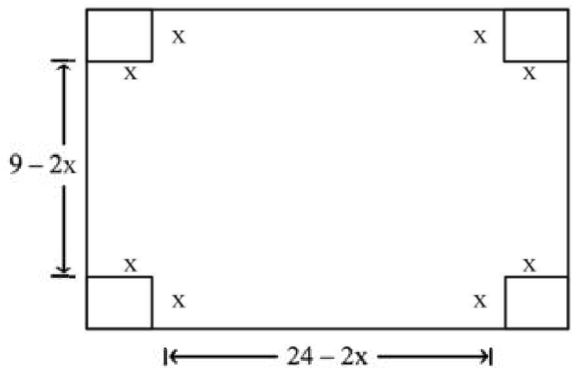
$$\Rightarrow \int_0^{\frac{\pi}{2}} \ln(\sin x)dx = \frac{1}{2}I$$

82. (a) From eq. (ii), we have

$$I = 2\int_0^{\frac{\pi}{2}} \ln(\cos x)dx$$

$$\Rightarrow \int_0^{\frac{\pi}{2}} \ln(\cos x)dx = \frac{1}{2}I$$

For (Qs. 83–84)



length of the box = 24 – 2x
width of the box = 9 – 2x

83. (c) Volume of the box = V

$V = (24-2x)(9-2x).\,x \quad (\because \text{ height of box} = x \text{ inch})$

$= (216-48x-18x+4x^2).\,x$

$V(x) = 4x^3 - 66x^2 + 216x$

$\Rightarrow V'(x) = 12x^2 - 132x + 216$

For maximum, put $V'(x) = 0$

$\Rightarrow 12x^2 - 132x + 216 = 0$

$\Rightarrow x^2 - 11x + 18 = 0$

$\Rightarrow x^2 - 9x - 2x + 18 = 0$

$\Rightarrow x(x-9) - 2(x-9) = 0$

$\Rightarrow (x-9)(x-2) = 0$

$\Rightarrow x = 9$ or $x = 2$

Now $V''(x) = 24x - 132$

$\therefore V''(9) = 216 - 132 = 84 > 0$

and $V''(2) = 48 - 132 = -84 < 0$

Thus, volume is maximum when $x = 2$ inch.

84. (a) Volume of box $= (24-4)(9-4).2$

$= 20 \times 5 \times 2 = 200$ cu inch

85. (c) Consider the given differential equation,

$$\left(\frac{d^3y}{dx^3}\right)^{\frac{3}{2}} = \left(\frac{d^2y}{dx^2}\right)^2 \qquad ...(i)$$

In order to find degree, differential equation should be free from fractional indices.

Now, squaring eqn (i) both sides, we get

$$\left(\frac{d^3y}{dx^3}\right)^3 = \left(\frac{d^2y}{dx^2}\right)^4$$

Since, the power of highest order derivative is 3, therefore degree = 3.

86. (c) Consider the given differential equation

$$\ln\left(\frac{dy}{dx}\right) + x = 0$$

$$\Rightarrow \ln\left(\frac{dy}{dx}\right) = -x$$

$$\Rightarrow \frac{dy}{dx} = e^{-x}$$

on separating the variables, we get

$dy = e^{-x}\,dx$,

on integrating both sides, we get

$$\int dy = \int e^{-x}dx$$

$$\Rightarrow y = \frac{e^{-x}}{-1} + C = -e^{-x} + C$$

$$\Rightarrow y + e^{-x} = C$$

87. (b) $y = \frac{2}{3C}(Cx-1)^{\frac{3}{2}} + B$

On differentiating both sides w.r.t. x, we get

$$\frac{dy}{dx} = \frac{2}{3C}.\frac{3}{2}(Cx-1)^{\frac{1}{2}}.C + 0 = (Cx-1)^{\frac{1}{2}}$$

$$\frac{dy}{dx} = (Cx-1)^{\frac{1}{2}}$$

On squaring both sides, we get

$$\left(\frac{dy}{dx}\right)^2 = Cx - 1$$

$$\Rightarrow \left(\frac{dy}{dx}\right)^2 + 1 = Cx \qquad ...(i)$$

Now, on differentiating w.r.t. x, we get

$$2\left(\frac{dy}{dx}\right).\frac{d^2y}{dx^2} = C$$

From eq. (i)

$$\left(\frac{dy}{dx}\right)^2 + 1 = 2x\left(\frac{dy}{dx}\right)\frac{d^2y}{dx^2}$$

88. (b) $f(x) = ax^2 + bx + c$

$\therefore \quad f(1) = a + b + c$

and $f(-1) = a - b + c$

$\therefore \quad f(1) = f(-1)$

$\Rightarrow a + b + c = a - b + c \Rightarrow b = 0$

89. (a) We have $f'(x) = 2ax + b$

$\therefore \quad f'(a) = 2a^2,\ f'(b) = 2ab = 0$

and $f'(c) = 2ac \qquad (\because b = 0)$

$\therefore \quad f'(a) = 2a^2$

$f'(b) = 0$

and $f'(c) = -2a^2 \qquad (\because 2b = a + c \Rightarrow c = -a)$

Hence $f'(a)$, $f'(b)$ and $f'(c)$ are in AP.

90. (c) $f''(x) = 2a$

$\therefore f''(a) = f''(b) = f''(c)$

Hence, $f''(a)$, $f''(b)$ and $f''(c)$ are in both AP and GP.

91. (a) Given $|a| = 2$, $|b| = 5$ and $|a \times b| = 8$

Also $|a \times b| = |a|\,.\,|b|\,.\,|\sin\theta|$

$$\Rightarrow |\sin\theta| = \frac{8}{2\times 5} = \frac{4}{5}$$

$$\Rightarrow |\cos\theta| = \frac{3}{5} \Rightarrow \cos\theta = \pm\frac{3}{5}$$

$$\therefore a.b = |a|\,.\,|b|\cos\theta = 2\times 5\times\frac{3}{5} = 6$$

92. (c) Since, $|a+b| = |a-b|$
$\Rightarrow [|a+b|]^2 = [a-b]^2$
$\Rightarrow a.a + b\,.\,b + a.\,b + b\,.\,a = a.\,a + b.b - a.b - b.a$
$\Rightarrow 4a\,.\,b = 0 \qquad (\because a.\,b = b.a)$
$\Rightarrow a\,.\,b = 0$
Hence, a is perpendicular to b.

93. (b) Area of $\Delta OAB = \frac{1}{2}|OA \times OB$

$$\therefore\ |OA \times OB| = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -1 & 1 \\ 2 & 1 & -3 \end{vmatrix}$$

$= \hat{i}[3-1] - \hat{j}[-9-2] + \hat{k}[3+2]$

$= 2\hat{i} + 11\hat{j} + 5\hat{k}$

$\therefore |OA \times OB| = \sqrt{2^2 + 11^2 + 5^2} = \sqrt{150} = 5\sqrt{6}$

$\therefore$ Required area $= \frac{1}{2} \times 5\sqrt{6} = \frac{5\sqrt{6}}{2}$ sq. units

94. (a) According to question $a = -\hat{i} + \hat{j} + \hat{k}$ and $b = \hat{i} - \hat{j} + \hat{k}$

$$\text{Then, } a \times b = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & 1 & 1 \\ 1 & -1 & 1 \end{vmatrix}$$

$= \hat{i}[1+1] - \hat{j}[-1-1] + \hat{k}[1-1]$

$= 2\hat{i} + 2\hat{j} + 0 = 2(\hat{i} + \hat{j})$

and $|a \times b| = \sqrt{4+4} = 2\sqrt{2}$

$\therefore$ Required unit vector $= \pm \frac{2(\hat{i}+\hat{j})}{2\sqrt{2}} = \pm \frac{\hat{i}+\hat{j}}{\sqrt{2}}$

95. (a) Let $a = \frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} + \hat{k}$

and $b = \frac{1}{\sqrt{2}}\hat{i} - \frac{1}{\sqrt{2}}\hat{j} + \hat{k}$

$\therefore \cos\theta = \frac{a.b}{|a||b|}$

$$= \frac{\left(\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} + \hat{k}\right).\left(\frac{1}{\sqrt{2}}\hat{i} - \frac{1}{\sqrt{2}}\hat{j} + \hat{k}\right)}{\sqrt{\frac{1}{2}+\frac{1}{2}+1}\sqrt{\frac{1}{2}+\frac{1}{2}+1}}$$

$$= \frac{1}{2}\left[\frac{1}{2} - \frac{1}{2} + 1\right] = \frac{1}{2} = \cos 60^\circ$$

$\therefore \theta = 60^\circ$

96. (a) Let $a = \lambda\hat{i} + (1+\lambda) + (1+2\lambda)\hat{k}$

and $b = (1-\lambda)\hat{i} + \lambda\hat{j} + 2\hat{k}$

For a and b to be perpendicular, we should have

$a.b = |a|\,|b|\,\cos\frac{\pi}{2} = 0$

$\Rightarrow [\lambda\hat{i} + (1+\lambda)\hat{j} + (1+2\lambda)\hat{k}].[(1-\lambda)\hat{i} + \lambda\hat{j} + 2\hat{k}] = 0$

$\Rightarrow \lambda - \lambda^2 + \lambda + \lambda^2 + 2 + 4\lambda = 0$

$\Rightarrow 6\lambda = -2$

$\therefore \lambda = -\frac{2}{6} = -\frac{1}{3}$

For (Qs. 97–100)

We have, $a + b + c = 0 \qquad$ ...(i)

On squaring both sides request.

$a^2 + b^2 + c^2 + 2ab + 2bc + 2ca = 0$
$(\because a.\,b = b.a,\ b.c = c.b \text{ and } c.a = a.c)$

$\Rightarrow |a|^2 + |b|^2 + |c|^2 = -2\,[a.b + b.c + c.a]$

$\Rightarrow (3)^2 + (5)^2 + (7)^2 = -2\,[a.b + b.c + c.a]$

$\Rightarrow a.b + b.c + c.a = \frac{9+25+49}{-2} = -\frac{83}{2}$

Now $a + b + c = 0 \qquad$ [using eq. (i)]

$\Rightarrow a + b = -c$

On squaring both sides, weget

$\Rightarrow a^2 + b^2 + 2a.b = c^2$

$\Rightarrow (3)^2 + (5)^2 + 2ab = (7)^2$

$\Rightarrow a.b = \frac{15}{2}$

$\Rightarrow |a|\,|b| \cos\theta = \frac{15}{2} \Rightarrow 3.5\cos\theta = \frac{15}{2}$

$\Rightarrow \cos\theta = \frac{1}{2} = \cos\frac{\pi}{3}$

$\therefore\ \theta = \frac{\pi}{3}$

From eq. (i),

$b + c = -a$

$\Rightarrow b^2 + c^2 + 2b.c = a^2$

$\Rightarrow 2b.c = a^2 - b^2 - c^2 = 9 - 25 - 49 = -65$

$\Rightarrow b.c = -\frac{65}{2} \Rightarrow |b|\,|c| \cos\theta = -\frac{65}{2}$

$\Rightarrow \cos\theta = \frac{65}{2} \times \frac{1}{5} \times \frac{1}{7} = -\frac{13}{14}$

Also, $|a+b| = |-c| = |c| = 7$

97. (c)
98. (b)
99. (d)
100. (a)

101. (c) Let $I = \int_0^{\frac{\pi}{2}} \frac{dx}{a^2\cos^2 x + b^2 \sin^2 x}$

$= \int_0^{\frac{\pi}{2}} \frac{\sec^2 x\, dx}{a^2 + b^2 \tan^2 x}$

[divide numerator and denominator by $\cos^2 x$]

Put $\tan x = t$

$\Rightarrow \sec^2 x\, dx = dt$

When $x = 0$, then $t = 0$ and when $x = \frac{\pi}{2}$, then $t = \infty$

$\therefore I = \int_0^{\infty} \frac{dt}{a^2 + b^2 t^2} = \frac{1}{b^2}\int_0^{\infty} \frac{dt}{\left(\frac{a}{b}\right)^2 + t^2}$

$= \frac{1}{b^2}\frac{1}{\left(\frac{a}{b}\right)}\left[\tan^{-1}\left(\frac{bt}{a}\right)\right]_0^{\infty}$

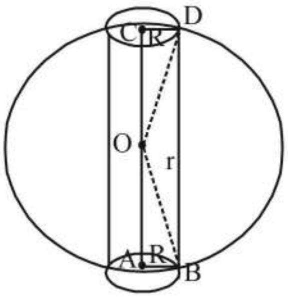
$\left[\because \int \frac{dx}{a^2+x^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + C\right]$

$= \frac{1}{ab}[\tan^{-1}(\infty) - \tan^{-1}(0)]$

$= \frac{1}{ab}\left[\frac{\pi}{2} - 0\right] = \frac{\pi}{2ab}$

102. (a) Let h be the height, R be the radius and V be the volume of cylinder.

In ΔOAB, we have



$r^2 = R^2 + \left(\frac{h}{2}\right)^2$ ...(i)

$\left(\because OA = \frac{h}{2} \text{ as } \Delta OAB \cong \Delta OCD\right)$

Clearly, $V = \pi R^2 h$

$\Rightarrow V(h) = \pi\left(r^2 - \frac{h^2}{4}\right)h$ [using eq. (i)]

$\Rightarrow V(h) = \pi\left(r^2 h - \frac{h^3}{4}\right)$

$\Rightarrow V'(h) = \pi\left(r^2 - \frac{3h^2}{4}\right)$ ...(ii)

For maximum put $V'(h) = 0$

$\Rightarrow r^2 = \frac{3h^2}{4} \Rightarrow h^2 = \frac{4r^2}{3}$

$\Rightarrow h = \frac{2r}{\sqrt{3}}$ $(\because h > 0)$

Differentiating eq. (ii) w.r.t. h, we get

$V''(h) = \pi\left(\frac{-6h}{4}\right)$

$\Rightarrow V''\left(\frac{2r}{\sqrt{3}}\right) = \pi\left(\frac{-6}{4} \times \frac{2r}{\sqrt{3}}\right) < 0$

Thus, the volume is maximum when $h = \frac{2r}{\sqrt{3}}$.

103. (b) Volume of cylinder is maximum when $h = \frac{2r}{\sqrt{3}}$

By using the relation $r^2 = R^2 + \left(\frac{h}{2}\right)^2$, we get

$R^2 = r^2 - \frac{h^2}{4} = r^2 - \frac{4r^2}{12}$

$R^2 = \frac{12r^2 - 4r^2}{12} = \frac{8r^2}{12} = \frac{2r^2}{3}$

$\Rightarrow R = \sqrt{\frac{2r^2}{3}} = \frac{\sqrt{2}r}{\sqrt{3}}$ $(\because R > 0)$

104. (b) $f'(x) = \int f''(x)dx + C_1$

$= \int (\sec^4 x + 4)dx + C_1$

$= \int \sec^2 x \sec^2 x\, dx + \int 4dx + C_1$

$= \int (1+\tan^2 x)\sec^2 x\, dx + 4x + C_1 = I_1 + 4x + C_1$

Put $\tan x = t$ in the integral I_1, then
$\sec^2 x\, dx = dt$

$\therefore I_1 = \int (1+t^2)dt = t + \dfrac{t^3}{3} + C'$

$= \tan x + \dfrac{\tan^3 x}{3} + C'$

$\therefore f'(x) = \tan x + \dfrac{\tan^3 x}{3} + 4x + C'$

where, $C = C_1 + C'$

$\because f'(0) = 0 \Rightarrow C\ 0$

Thus, $f'(x) = \tan x + \dfrac{\tan^3 x}{3} + 4x$

105. (a) $f(x) = \int f'(x)dx + C_2$

$= \int \left(\tan x + \dfrac{\tan^3 x}{3} + 4x\right)dx + C_2$

$= \int \tan x\, dx + \dfrac{1}{3}\int \tan^3 x\, dx + 4\int x\, dx + C_2$

$= \int \tan x\, dx + \dfrac{1}{3}\int \tan x(\sec^2 x - 1)dx + 4.\dfrac{x^2}{2} + C_2$

$= \dfrac{2}{3}\int \tan x\, dx + \dfrac{1}{3}\int \tan x.\sec^2 x\, dx + 2x^2 + C_2$

$= \dfrac{2}{3}\ln(\sec x) + \dfrac{1}{3}I_2 + 2x^2 + C_2$

Consider $I_2 = \int \tan x \sec^2 x\, dx$

Put $\tan x = t \Rightarrow \sec^2 x\, dx = dt$

$\Rightarrow I_2 = \int t\, dt = \dfrac{t^2}{2} + C_3 = \dfrac{\tan^2 x}{2} + C_3$

$\therefore f(x) = \dfrac{2}{3}\ln(\sec x) + \dfrac{1}{6}\tan^2 x + 2x^2 + C_4$

Here, $C_4 = C_2 + \left(\dfrac{C_3}{3}\right)$

$\because f(0) = 0$

$\Rightarrow 0 = \dfrac{2}{3}\ln(1) + 0 + 0 + C_4$

$\Rightarrow C_4 = 0$

$\therefore f(x) = \dfrac{2}{3}\ln(\sec x) + \dfrac{1}{6}\tan^2 x + 2x^2$

106. (a) $P(A/B') = \dfrac{P(A \cap B')}{P(B')} = \dfrac{P(A) - P(B)}{1 - P(B)}$

107. (b) A, B and D are exhaustive events but not mutually exclusive events.

108. (b) A, B and C are exhaustive events but not mutually exclusive events.

109. (a) B and C are mutually exclusive events but not exhaustive events.

110. (a) C and E are mutually exclusive and elementary events.

111. (a)

1. It is true that, the histogram is a suitable representation of a frequency distribution of a continuous variable. Hence, Statement 1 is correct.
2. We know that, the area of histogram is proportional to the frequency, so it is not true statement.

112. (d) When regression lines perpendicular to each other then angle will be :

$\tan\theta = \left\{\left(\dfrac{1-r^2}{r}\right)\left(\dfrac{\sigma_x.\sigma_y}{\sigma_x^2 + \sigma_y^2}\right)\right\}$

$\Rightarrow \tan\dfrac{\pi}{2} = \left(\dfrac{1-r^2}{r}\right)\left(\dfrac{\sigma_x.\sigma_y}{\sigma_x^2 + \sigma_y^2}\right)$

$\Rightarrow r.(\sigma_x^2 + \sigma_y^2) = 0$

$\therefore r = 0$

113. (a) Clearly, $A \cap B \subseteq A$

$\Rightarrow P(A \cap B) \le P(A)$ ...(i)

$A \subseteq A \cup B$

$\Rightarrow P(A) \le P(A \cup B)$ ...(ii)

We know that, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\Rightarrow P(A \cup B) \le P(A) + P(B)$ ...(iii)

From eqs. (i), (ii) and (iii), we get

$P(A \cap B) \le P(A) \le P(A \cup B) \le P(A) + P(B)$

114. (a) $\because$ 1U, 1N, 2I, 1V, 1E, 1R, 1S, 1T, 1Y

$\therefore$ Total number of possible arrangements $= \dfrac{10!}{2!}$

and favourable arrangements $= \dfrac{10!}{2!} - 9!$

$\therefore$ Required probability $= \dfrac{\dfrac{10!}{2!} - 9!}{\dfrac{10!}{2!}}$

$= \dfrac{9!(5-1)}{9! \times 10} \times 2 = \dfrac{4}{5}$

115. (d) Box I $\rightarrow$ 4 W; 3 B
Box II $\rightarrow$ 3 W; 4 B

Probability for choosing first box = $\frac{3}{6}=\frac{1}{2}$

Probability for choosing second box = $\frac{1}{2}$

$$\therefore \text{Required probability} = \frac{\frac{1}{2}\times\frac{3}{7}}{\frac{1}{2}\times\frac{3}{7}+\frac{1}{2}\times\frac{4}{7}}$$

$$=\frac{\frac{3}{14}}{\frac{3}{14}+\frac{4}{14}}=\frac{\frac{3}{14}}{\frac{7}{14}}=\frac{3}{7}$$

116. (d) It is obvious that, $\bar{x}<\bar{z}<\bar{y}$.

117. (b) Mean = $(\bar{x})=\frac{\Sigma xi}{N}$

Here $\bar{x}=\frac{4+7+8+9+10+12+13+17}{8}=10$

$\therefore$ Mean deviation about mean $=\frac{\Sigma|xi-\bar{x}|}{N}$

$$=\frac{|4-10|+|7-10|+|8-10|+|9-10|+|10-10|+|12-10|+|13-10|+|17-10|}{8}$$

$$=\frac{6+3+2+1+0+2+3+7}{8}=\frac{24}{8}=3$$

118. (c) Let $x_1, x_2, \ldots, x_{20}$ be the given observations.

Given, $\frac{1}{20}\sum_{i=1}^{20}(x_i-\bar{x})^2=5$

To find variance of $2x_1, 2x_2, 2x_3, \ldots, 2x_{20}$,
Let $\bar{x}$ denotes the mean of new observation,

Clearly, $\bar{x}=\frac{\sum_{i=1}^{20}2x_i}{20}=\frac{2\sum_{i=1}^{20}x_i}{20}=2\bar{x}$

Now, variance of new observation

$$=\frac{1}{20}\sum_{i=1}^{20}(2x_i-\bar{x})^2=\frac{1}{20}\sum_{i=1}^{20}(2x_i-2\bar{x})^2$$

$$=\frac{1}{20}\sum_{i=1}^{20}4(x_i-\bar{x})^2=4\left(\frac{1}{20}\sum_{i=1}^{20}(x_i-\bar{x})^2\right)=4\times5=20$$

119. (d) Let A and B be the events

$= P(A\cap\bar{B})+P(B\cap\bar{A})$

$= P(A)-P(A\cap B)+P(B)-P(A\cap B)$

$= P(A)+P(B)-2P(A\cap B)$

$=0.05+0.1-2(0.02)$

$=0.15-0.04=0.11$

Hence the pobability that only one of them will qualify the examination is 0.11.

120. (b) $n(S)=2^4=16$

and $n(E)={}^4C_0+{}^4C_1+{}^4C_2+{}^4C_3$

$=1+4+\frac{4\times3}{2\times1}+4=1+4+6+4=15$

$\therefore P(E)=\frac{n(E)}{n(S)}=\frac{15}{16}$

GENERAL ABILITY

PART-A: ENGLISH

1. (a) Use 'about' in place of 'nearly'. 'Nearly' is used when the sense is vague, incomplete and uncertain but here the duration has been definite as to be thirty years. So, use of 'about' is appropriate which gives the sense of 'definite nature'.
2. (c) Use of 'indeed' is not required here as it is superfluous. Using 'must' alone gives the proper sense here.
3. (c) Use 'intended' here in place of 'insisted'. Use of 'insisted' is wrong as it gives no proper sense here.
4. (a) Use of 'into' is not required here as we know that enter' agrees with no preposition.
5. (b) Use of infinitive is required here, so according to the structure of sentence, use 'to see' in place of 'for seeing' to make sentence completely correct.
6. (c) Here, subject is singular. So, use helping verb according to the subject The number of jobs which 'is' not 'are'.
7. (b) Use 'who' in place of 'whom' as the sentence is in need of adjective clause to make it correct.
8. (b) Use 'why should he' in place of 'why he should' for proper framing of sentence and grammatical accuracy.
9. (c) Use being' before 'followed' because a complete sense can be given only by using this word.
10. (b) Use 'prepared to act promptly' in place of 'prepared promptly to act' which gives a proper meaning here.
11. (c) 'Contention' means an angry agreement which is the opposite of the word 'amity'. 'Bondage' means being tied to, which does not relate to the meaning of the word 'amity'. 'Understanding' is closer to the meaning of 'amity' but it rather means mutual understanding in a relation. 'Friendship' is the exact and appropriate synonym of the underlined word 'amity'.
12. (b) Aggressive' is closer to the opposite of the word 'extinct'. 'Scattered' means spread far apart. 'Feeble' means lacking strength. All of these are irrelevant to the meaning of the word 'extinct'. 'Non-existent' means having no living members (like dinosaurs) which is exactly what the statement is talking about. So 'non-existent' is the best answer.

13. (d) 'Translate' means to express in another language. 'Hypnotise' refers to capturing the attention or to fascinate. 'Attack' means to act against. All these words do not relate to the meaning of the word 'Proselytise'. Proselytise directly implies to convert or attempt to convert from one religion to another. So, 'convert' is the best answer.
14. (c) 'Preposterous' means unreasonable and 'Absurd' is the nearest in the meaning of the word, fitting best to the statement.
15. (d) 'Callous' means not caring about other people' feelings or suffering. The best synonym to the word is 'Unfeeling' which means lacking sensitivity towards others. 'Cursed' relates to hateful and 'Unkind' relates to harsh, so these do not fit best with the meaning of the word.
16. (a) 'Verdict' means a formal answer or decision of the jury given to the court. 'Judgement' also means the decision of a court. So, it is the nearest in the meaning of the word 'verdict'. Whereas 'Voice' is an (informal) supposed utterance of words. 'Prediction' means to forecast which is closer to the opposite of the word 'verdict'.
17. (a) 'Disproved' and Condemned' are the opposite to the meaning of the word 'Corroborated'. Corroborated means to provide evidence to support a statement. So, 'Confirmed' refers to the correct answer among the options.
18. (a) 'Obscure' means not important. 'Wild' and 'Arrogant' do not relate to the word in the statement. Therefore, 'Rational' meaning logical is the appropriate answer among the options.
19. (a) The statement has already praised the story by the word 'fantastic', so the answer cannot be 'praiseworthy'. 'Credible' directly relates to believable or convincing. So, 'Believable' is the appropriate answer.
20. (d) 'Hazardous' means that can be dangerous or cause damage. 'Dangerous' relates to the possibility of causing harm and in the given statement catching snakes by untrained people is sure shot call for damage. So, it is the best answer.
21. (a) 'Applauded' means 'praised' so 'disapproved' is correct antonym which means 'not praised' or 'criticised'.
22. (b) 'Material' means 'Earthly' or 'related to wealth', so 'spiritual' is correct antonym which means 'divine'.
23. (d) 'Friendly' means 'supportive', so 'hostile' is correct antonym which means 'unfriendly'.
24. (a) 'Intelligent' means 'smart', so 'dull' is correct antonym which means 'stupid'.
25. (b) 'Reluctant' means 'unwilling', so 'willing' is correct antonym which means 'ready'.
26. (a) 'Abandoned' means 'left', so 'supported' is correct antonym which means 'defended'.
27. (b) 'Abound' means 'excessive', so 'lacks' is correct antonym which means 'deficit'.
28. (d) 'Adversity' means 'penury' or 'misery', so 'prosperity' is correct antonym which means 'happiness' or 'wealth'.
29. (a) Affluence' means 'state of richness', so 'indigence' is correct antonym which means 'extreme poverty'.
30. (b) 'Squandering' means 'wasting', so 'hoarding' is correct antonym which means 'to collecting'.
31. (c) Here, question tag is required in Present Tense. So, use of 'have'. It is proper in order to make Subject-Verb agreement in the sentence. Use of negative tags is improper and 'are' cannot be used as Perfect Tense is needed.
Suitable tag structure is as follows :-
Subject + Auxiliary verb + not + Verb + Object + [,] + Auxiliary verb + Subject + ?
32. (d) Here, use of 'pain' is suitable as in first pair also antonymous analogy words are used. We know that 'pain' is opposite to the 'pleasure'. Rest words are not antonyms of 'pleasure', so using them is not proper.
33. (c) Here, a complete race is addressed which is obviously a plural subject, so we will use plural helping verb according to the subject for proper sentence formation.
34. (b) Use of 'machine' is proper here because it needs oiling for smooth run. Path cannot be oiled, likewise there is no means of oiling river or garden. So use of machine is suitable.
35. (b) We get the sense of beginning phase of the stated stage of life so we should use word 'threshold' here.
36. (c) According to sense of sentence, here we should use a collective term which can show the coupled relation of both words. 'Divergent' cannot be used because it gives opposite sense, 'unravelled' and 'invincible' have also not suitable meanings according to sentence, so use of 'integrated' is proper.
37. (b) Use of 'persists' is proper as it gives required sense. We cannot use 'insists' as it means 'to demand'. Likewise, 'desists' cannot be used because it means 'to hate' and 'resists' means 'to protest' which gives no sense here. So, use of 'persists' is most suitable.
38. (c) Use of 'matters' gives a proper sense here. Use of 'implies' is not suitable here because it is not according to context of sentence. 'Matches' and 'moves' also give non contextual meaning here, so we should use 'matters' for complete sense.
39. (c) According to sense of the sentence, we need a word opposite to 'neighbours' which is 'strangers'. Primitives, Complementary and Cowards cannot be used because they don't give opposite sense of 'neighbours'.
40. (d) Best suitable phrase would be "Nature versus nurture" when it is related to crime. Nature is something that reflects the internal motto while Nurture reflects the idea of the upbringing.
41. (b) Use of 'Broke away' is suitable as it is a phrase which means 'to stop something', 'break out', 'break up' have no sense here. So use of these phrases are unsuitable in this context.
42. (b) According to proper tense structure, if any sentence contains condition, then we should use Present and Future Tenses. So, use of 'reach' is proper here, rest all are not in Simple Present so we should omit them.

43. (b) When two actions in the past are simultaneous then the syntax used is as follows : When + Subject + Was/Were + (V_1 + ing) + Object + Subject + V_2 + Object

44. (a) Use 'make up for' as it gives proper sense. We should take care of rules of preposition and except 'for', all other prepositions are not suitable here.

45. (c) Use of 'had got' is suitable here because here Past Perfect Tense is required. Rest words are not useful as they are not in Past Perfect Tense.

46. (c) 'Turn off' means to switch the radio off. Here, there is a sense of low sound with radio still playing. Hence, 'turn' down is suitable because it means to lower the volume.

47. (a) If two actions, out of which, if one is of near past we should use Simple Past and if the another is of remote past we should use Past Perfect. Hence, 'had worked' which is of Past Perfect Tense is suitable.

48. (d) No improvement

49. (a) We should use 'she wants' because sense related verbs are always used in Present Tense, not in progressive. Only 'she wants' is correct from grammar point of view, so it is correct option.

50. (c) Use Present Perfect Tense here because it is the requirement of sentence. Use of 'has finished' is appropriate.

PART-B : GENERAL KNOWLEDGE

51. (b) The Grand Banks is a large area of submerged highlands southeast of Newfoundland and east of the Laurentian Channel on the North American continental shelf. It is in this area that the cold Labrador Current mixes with the warm waters of the Gulf Stream. The mixing of these waters and the shape of the ocean bottom lifts nutrients to the surface. These conditions created one of the richest fishing grounds in the world. Plankton are organisms that live in the water. They are carried by waves, tides and currents. They are usually found in the shallow surface waters.

52. (a) Amoeba is a unicellular organism and the single cell performs all functions of a living organism because cell is the fundamental unit of living organism.

53. (c) The Indo Greek coins issued by the Greek rulers between the second century BC to second century A.D were bilingual in Greek and Arabic and carried legends in Greek. The Kushan Dynasty introduced gold coins for the first time in Indian coinage.

54. (a)

55. (b)

56. (d) It is necessary that every bar magnet has one North Pole and one South Pole. With a compass we can always tell which direction is north and if you know north, then you know all of the other directions. Magnetic poles always exist in pairs.

57. (c)

58. (c) A typhoon is the name of a strong tropical cyclone whose development is common in the Western North Pacific Ocean and South China Sea. The vast majority of tornadoes occur in the Tornado Alley region of the United States although they can occur nearly anywhere in North America. Willy willies is a severe tropical cyclone of Australia. Formation of an anti cyclone results in calm and settled weather.

59. (d) ASEAN (Association of Southeast Asian Nations) was founded on 8 August 1967 with five members: Indonesia, Malaysia, the Philippines, Singapore and Thailand. ASEAN has 10 Members which are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Taiwan is not a member of ASEAN.

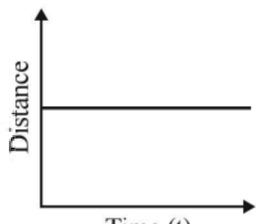
60. (c) Specific heat is the amount of heat needed to raise the temperature of a certain mass 1 degree Celsius.

61. (c) Balanced chemical equation is
$2As_2S_3 + 9\,O_2 \rightarrow 2\,As_2\,O_3 + 6SO_2$. So y is 9.

62. (a) Mitosisis used for growth and repair of the tissues. During mitosis, a cell makes an exact copy of itself and splits into two new cells. Each cell contains an exact copy of the original cell's chromosomes in their 23 pairs. This is the reason why all the cells in an organism are genetically identical.

63. (c) Rotterdam of Netherlands is largely famous for Shipbuilding. Rotterdam's economy is still almost based on shipping. The port lies at the heart of the densely populated and industrialized triangle of London, Paris, and the German Ruhr district and at the mouths of two important rivers (the Rhine and the Meuse).

64. (d) Distance time graph parallel to the time axis.



It is clear from the graph that the position of the object is not changing with the change in time, hence the object is at rest or in other words we can say that it is a zero velocity motion.

65. (a) In $MgCO_3$, there are 3 oxygen atoms in each mole. Atomic mass of oxygen 16g/mol. So there are (16×3) $= 48$
grams of oxygen in one mole of $= 84.30\ g/mol^{-1}$

$$\frac{48g\ of\ O}{84.3\,MgCO_3} = \frac{24g\ O}{xg\ MgCO_3}$$

$$x = 42.15\ g$$

66. (d) The small intestine is the location in the body where the majority of the nutrients from ingested food are absorbed. The large intestine is the final processing

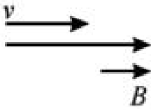
area for digested food. The main things left to do are to dry out the undigested food remnant by absorbing water and eliminate the useless waste from the body.

67. (a) The correct sequence is Service sector- Industry-Agriculture.

68. (a) Force on the charge q due to electric field $\vec{E}$,

$\vec{F}_E = q\vec{E}$

and force on the charge q due to magnetic



field B,

$\vec{F}_B = q(\vec{v} \times \vec{B}) \Rightarrow \vec{F}_B = qvB\sin\theta$

In the given case $\vec{v} \parallel \vec{B}$

$\Rightarrow \theta = 0^\circ \Rightarrow \vec{F}_B = 0$

Hence, the force $\vec{F}$ acting on the charge q is equal to

$\vec{F}_E = q\vec{E}$

69. (a) In the given reaction, $HAsO_2$ (aq) is the oxidising agent since the oxidation number of As decreases from + 3 to 0.

70. (c) In both genders, the urethra works as a tube connecting the urinary bladder to the genitals. The bladder collects and stores urine until when it is ready to be discharged through the urethra. It is not a part of reproductive system of female.

71. (a) When a news is broadcast from London at 1:45 pm on Monday, it will be heard at Dhaka (90 Degree E) at 7:45 pm.

72. (b) The correct parameters of domestic power supply in India are voltage 220 V and frequency of AC 50 Hz.

73. (c) $CH_3(CH_2)_{12}COONa$ is most likely to be used as soap. A soap is the sodium salt (or potassium salt) of a long chain carboxylic acid (or fatty acid).

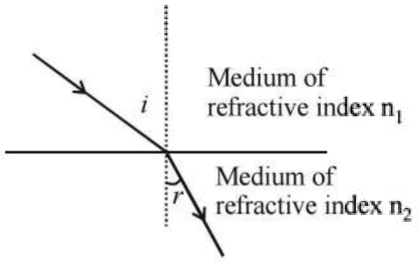
74. (b) Most sharks are cold-blooded. Partially warm-blooded Sharks are the Mako and the Great white shark.

75. (b) A cirque is an amphitheatre-like valley head, formed at the head of a valley glacier by erosion. Yardang is a keel-shaped crest or ridge of rock, formed by the action of the wind usually parallel to the prevailing wind direction. Barkhan is a crescent-shaped shifting sanddune convex on the windward side and steeper and concave on the leeward. It is an erosional feature of wind. Drumlin is a long, narrow or oval, smoothly rounded hill of unstratified glacial drift. Drumlins are generally found in broad lowland regions, with their long axes roughly parallel to the path of glacial flow.

76. (c) According to Snell's law,

$n_1 \times \sin i = n_2 \times \sin r$

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$$



77. (b) Nitrogen neither itself burns nor causes the splint to burn because Nitrogen is an inert gas and an inert gas does not undergo chemical reactions under a set of given conditions.

78. (b) Leprosy is a disease caused by bacteria called Mycobacterium Leprae. It affects mainly the skin and the nerves. Leprosy is also known as Hansen's disease after the scientist M. leprae who discovered it in 1873. Leprosy is spread between people. This is believed to occur through a cough or contact with fluid from the nose of an infected person.

79. (b) Topographic maps are detailed, accurate graphic representations of features that appear on the Earth's surface. A topographical map with scale 1:50000 indicates 1 cm to 500 m.

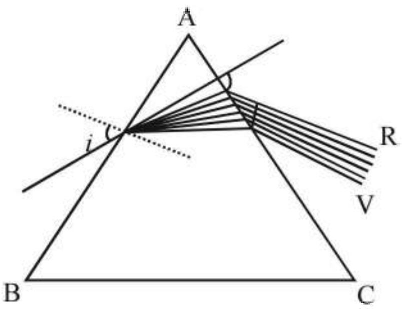
80. (b) Refraction is the change in direction of propagation of a wave due to a change in its transmission medium. Thus, light waves projected on oil surface show seven colours.

81. (a) A monatomic species has the same number of electrons as a neutral argon atom.

82. (c) Gibberellins are plant hormones that regulate growth and influence various developmental processes, including stem elongation, germination, dormancy, flowering, sex expression, enzyme induction, and leaf and fruit senescence.

83. (c) Sandstone is converted into quartzite through heating and pressure. Thus, Quartzite is metamorphosed from sandstone.

84. (a) A white light (sunlight) splits into its seven constituent colours VIBGYOR due to dispersion.



85. (d) The very high heat of vaporisation of water is mainly a result of hydrogen bonding.

86. (c) Lichens can be used as environmental indicators as they are very sensitive to sulphur dioxide pollution. Sulphur dioxide (SO_2) is a gas which is produced when a material containing sulphur is burned. If the air is badly polluted with sulphur dioxide, there may be no

lichens present. The most tolerant lichens are those that are crusty in appearance whereas the leafy lichens are not very pollutant tolerant.

87. (b) Blowing from the subtropical highs or horse latitudes toward the low pressure of the ITCZ are the trade winds. They are named by their ability to quickly propel trading ships across the ocean. They blow from 30 degree north and south the Equator.

88. (b) The relation between linear momentum (P) and kinetic energy (K) is $K = \frac{P^2}{2m}$

$$K_A = \frac{P_A^2}{2m} \text{ and } K_B = \frac{P_B^2}{2(4m)}$$

$$\frac{K_A}{K_B} = \frac{P_A^2}{2m} \times \frac{8m}{P_B^2} \qquad [P_A = P_B, \text{given}]$$

$$\frac{K_A}{K_B} = \frac{4}{1} = 4:1$$

89. (a) Flint glass, also called lead crystal, heavy and durable glass characterized by its brilliance, clarity, and highly refractive quality is used in the construction of spectacles.

90. (c) Cell wall is absent in animal cells. The main difference between plant and animal cells is that plant cells have a cell wall on the outer layer, whereas animal cells only have a cell membrane. The cell wall gives the plant its actual shape.

91. (b) Kuroshio current is a warm current in the Pacific Ocean along the southern and eastern shores of Japan.

92. (b) $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$

$$|\vec{F}| = \sqrt{(6)^2 + (-8)^2 + (10)^2}$$

$$= \sqrt{36 + 64 + 100} = 10\sqrt{2}\text{ N}$$

$$|\vec{a}| = 1\text{ m/s}^2$$

using $F = ma$

$\Rightarrow \quad 10\sqrt{2} = m \times 1$

$m = 10\sqrt{2}\text{ kg}$

93. (a) The burning sensation of a beesting can be stopped by rubbing the affected area with soap because a bee sting is acidic and soap is an alkali. That is why it neutralizes the acid injected by bee sting in to a person's skin.

94. (b) Carbohydrates are not the only source of energy to humans. They need carbohydrates, fats, proteins, water, vitamins, and minerals for energy. Fats give maximum energy on oxidation as compared to other foods.

95. (d) Devprayag is located in Tehri Garhwal district in Uttarakhand. At this place, Alaknanda and Bhagirathi rivers meet and take the name Ganga.

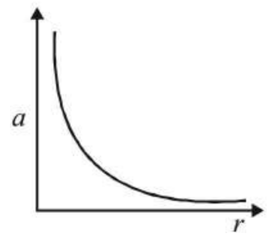
96 (b) Light waves are electromagnetic waves. Electromagnetic waves are formed by the vibrations of electric and magnetic fields. These fields are perpendicular to one another in the direction the wave is travelling.

97. (b) Density $= \frac{\text{Mass}}{\text{Volume}}$

Change in state of a substance does not involve change in mass, composition and physical properties instead of involves charge in volume which alter density.

98. (b) Neyveli Thermal Power Station is a set of power plants situated near lignite mines of Neyveli (Tamil Nadu). It is operated by NLC (Neyveli Lignite Corporation). It consists of two distinct units: Neyveli Thermal Power Station I -1020 MW and Neyveli Thermal Power Station-2 - 1,970 MW.

99. (d) The given situation is uniform circular motion. In this case, the centripetal acceleration $a_c = \frac{v^2}{r}$ as $|\vec{v}|$ is constant $\Rightarrow a \propto \frac{1}{r}$. Hence, the graph between 'a' and 'r' is



100. (b) An ionic bond is formed when one of the atoms can donate electrons to achieve the inert gas electron configuration, and the other atom need electron to achieve the inert gas electron configuration. Ionic bond is formed between metals and non-metals.

101. (b) In the term GIS, 'G' stands for Geographic. A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations.

102. (b) An adiabatic process is one that occurs without transfer of heat or matter between a system and its surroundings.

103. (c) In compound X_2O_3,
Percentage of oxygen by weight = 31.58
Percentage of X by weight = 68.42
Let the atomic mass of 'X' = x

$$\frac{2x}{2x + 48} \times 100 = 68.42$$

$\therefore \quad x = 50$

So, atomic mass of 'X' is 52 g mol^{-1}.

104. (d) Sequence of oil refineries in India according to their time of establishment is as follows:-
1. Guwahati Refinery - 1962
2. Barauni Refinery- 1964
3. Haldia Refinery - 1975
4. Mathura Refinery- 1982

105. (a) As $P_{av} = V_{rms} \times I_{rms} \cos \phi$ is zero in case of pure capacitor and inductor circuits, and in a resistor there is a power loss. Hence it is consider as active component of a circuit.

106. (a) Number of neutrons in ${}^{59}_{26}Fe = 59 - 26 = 33$

Number of neutrons in ${}^{61}_{29}Cu = 651 - 29 = 32$

Number of neutrons in ${}^{61}_{30}Zn = 61 - 30 = 31$

Number of neutrons in ${}^{60}_{30}Zn^{2+} = 60 - 30 = 30$

107. (c) Tides are the rise and fall of sea levels caused by the combined effects of gravitational forces exerted by the Moon, Sun, and rotation of the Earth.

108. (a) Relation between Fahrenheit and Celsius scale is

$$\frac{C - 0°}{5} = \frac{F - 32}{9}$$

Given that numercial value of a temperature recorded in both the scales are same.

$\Rightarrow$ °C = F = x

$\Rightarrow \quad \frac{x}{5} = \frac{x - 32}{9}$

$\Rightarrow \quad 9x = 5x - 32 \times 5$

$\Rightarrow \quad 4x = -32 \times 5$

$x = -\frac{32 \times 5}{4}$

$x = -40°$

109. (c) Turpentine oil is made from the resin of certain pine trees. Turpentine oil in paints is used as a thinner.

110. (a) Woolen textile- Ludhiana(Punjab)
Cotton textile - Davanagere (Karnataka)
Silk textile - Sualkuchi(Assam)
Jute textile - Rishra(West Bengal)

111. (c) The kerosene oil rises in a wick of lantern because of capillary action in the wick. Capillary action is the movement of liquid along a surface of a solid caused by the attraction of molecules of the liquid to the molecules of the solid. For example, plants use capillary action to bring water up the roots and stems to the rest of the plant.

112. (a) $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
4 mol 5 mol

1mol $\frac{5}{4} = 1.25$mol

Since, for 1 mol of NH_3, 1.25 mol of O_2 are required, therefore, O_2 is the limiting factor (here O_2 is only 1 mol). Hence, all O_2 will be consumed in reaching with 1 mol of NH_3.

113. (c) There is negative relationship between rainfall and pressure. When the air pressure is lower, more rainfall occurs. When there is low pressure in the atmosphere, the air bubbles that is rising, are always hotter than the air around. If the ground is heated then air will rise. The cool air will produce condensation that will ultimately lead to rainfall.

114. (c) A microwave oven is based on maser.' Maser' is a device that produces coherent electromagnetic waves through amplification by stimulated emission.

115. (a) Total population =
Population at the begining of the year +
[Birth + Immigration] – [Death + Emigration]
5000 + [250 + 30] – [60 + 15]= 5205

116. (b) Using $KE = \frac{P^2}{2m}$

$\frac{P_A^2}{2m_A} = \frac{P_B^2}{2m_B}$ $\quad$ [$KE_A = KE_B$ given]

$P_A < P_B$ $\quad$ [as, $m_A > m_B$]
Now from Newton's second law

$$F_{ext} = \frac{\Delta P}{\Delta t} \Rightarrow \Delta P = F_{ext}\,\Delta t$$

$\Rightarrow \quad \Delta P_A < \Delta P_B \Rightarrow F_{ext}\,\Delta t_A < F_{ext}\,\Delta t_B$

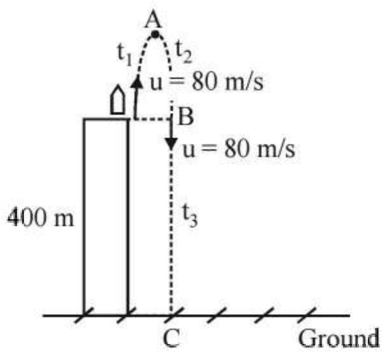
$\Rightarrow \Delta t_A < \Delta t_B$ [equal braking force is hence on comparing time Δt_A and Δt_B]
we can say that car B will cover a greater distance.

117. (a) Using $V_e = R_e W$
1700 km/h = 20000 × W

$W = \frac{1700}{20000} = \frac{17}{200}$ rotation/hour

Velocity of rotation of pole,
$V_p = R_p$
$R_P = 0 \Rightarrow V_P = 0$

118. (c) Total time taken to reach the ground $T = t_1 + t_2 + t_3$
u = 80 m/s



Velocity of the bullet at point A,

$V_A = 0$ m/s.
$a = -10$ m/s
$V = u + at$
$0 = 80 - 10t_1$
$t_1 = 8s$
$t_2 = t_1$ (as there is no air resistance)
Calculation for t_3
Velocity of the bullet at point B,
$V_B = u = 80$ m/s
$h = 400$m

Using $s = ut + \frac{1}{2}at^2$

$\Rightarrow \; 400 = 80 \times t_3 + \frac{1}{2} \times 10 \times t_3^2$

$\Rightarrow \; 5t_3^2 + 80t_3 - 400 = 0$

$\Rightarrow \; t_3^2 + 16t_3 - 80 = 0$

$\Rightarrow \; t_3(t_3 + 20) - 4(t_3 + 20) = 0$

$t_3 = -20s$ or $t_3 = 4s$

Time cannot be negative hence neglecting $t_3 = -20s$
Total time $T = 8 + 8 + 4 = 20$ s

119. (a) As we know, for cyclotron $qVB = \frac{mV^2}{r}$

$\frac{qBR}{m} = V$

$KE = \frac{1}{2}mv^2$

$\Rightarrow KE = \frac{1}{2}m\frac{q^2B^2r^2}{m^2} = \frac{q^2B^2r^2}{2m}$

$KE \propto \frac{q^2}{m}$

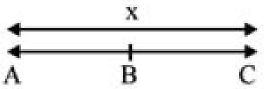
120. (c) The electric field inside a perfectly conducting hollow object is zero as there is no charge inside the object electrostatic shielding.

And from Gauss' law $\int E.ds = \frac{q_{inside}}{\varepsilon_0}$

Therefore electric field inside $E_{inside} = 0$

121. (c) If equal volume of liquids of density $\rho_1, \rho_2 \ldots\rho_n$ are mixed the density of the mixture is equal to the arithmetic mean of liquid densities $\rho_1, \rho_2 \ldots\rho_n$.
i.e., $\rho_{mix} = \rho_1 + \rho_2 + --- + \rho_n$

122. (a)



$V_1 = 10$ m/s $V_2 = 15$ M/S

Average velocity of whole journey

$V_{av} = \frac{x}{T}$

$V_{av} = \frac{x}{t_{AB} + t_{BC}} = \frac{x}{\frac{x}{2V_1} + \frac{x}{2V_2}} = \frac{x}{\frac{x}{20} + \frac{x}{30}}$

$V_{av} = \frac{20 \times 30}{20 + 30} = \frac{600}{50} = 12$ m/s

123. (d) Impulse = Change in linear momentum
Hence, the dimension of impulse is same as linear momentum.

124. (b) Japan won the Thomas Cup 2014 of badminton 2014. China won Uber Cup 2014 of badminton. Thomas Cup is for men and Uber Cup is related to Women.

125. (a) Drishti is an indigenously developed runway visibility measuring instrument. It will help pilots during landing and takeoff. The system is developed jointly by the National Aerospace Laboratories (NAL) Bengaluru and Indian Meteorological Department. IMD is responsible for providing navigation services at the airports.

126. (b) Malavath Purna (13 years old) from Telangana became the youngest female climber in the world to scale the Mount Everest.

127. (b) As per the data of the Department of Industrial Policy and Promotion (DIPP), during the financial year 2013-14, India received \$5.98 billion in FDI from Singapore. With this, Singapore has replaced Mauritius as the top contributor to India's FDI during 2013-14.

128. (B) SIMBEX 14 was a bilateral naval exercise between Indian Navy and the Republic of Singapore Navy. It was the 21st in the series. It was conducted in the Andaman Sea from 22 May to 28 May 2014.

129. (c) India's Mobile Governance Initiative (Mobile Seva) bags United Nations Public Service Award for 2014. It was launched by Department of Electronics and Information Technology (DeitY), Government of India. The "Mobile Seva" initiative of Government of India aims at mainstreaming mobile governance in the country as a compelling new paradigm for delivery of public services electronically through the mobile platform.

130. (c) Prithvi-II is a nuclear capable surface-to-surface missile. With a strike range of 350 km, Prithvi-II is capable of carrying 500 kg to 1,000 kg of warheads and is thrusted by liquid propulsion twine engines.

131. (b) The Indian Regional Navigation Satellite System (IRNSS) was developed by the Indian Space Research Organisation (ISRO). It is designed to provide accurate position information service to users in India as well as the region extending up to 1500 km from its boundary, which is its primary service area. The IRNSS would provide two services, with the Standard Positioning Service open for civilian use, and the Restricted Service (an encrypted one) for authorized users (including the military). IRNSS-1A, IRNSS-1B, IRNSS-1C, IRNSS-1D were launched by PSLV but IRNSS-1E, IRNSS-1F, IRNSS-1G have not been launched so far.

132. (b) The National Defence Academy has trained 700 cadets from the 28 friendly countries including Afghanistan, Bhutan , Ethiopia, Ghana , Fiji, Nepal etc.Bangladesh is not in the list.

133. (b) In May, 2014, India recalled its troops sent to Thailand for a joint combat exercise in the South-East Asian country. India withdraw the troops and called for an early restoration of demoncracy in Thailand.

134. (a) Nagarjuna was a Buddhist philosopher who is considered to be the founder of the Madhyamaka(Madhyamika) school of Mahayana Buddhism.

135. (d) Harappan culture developed and matured in to man urban civilization that developed in Sind and Punjab.From there it spread southwards Southwards and estwardsEastwards.Its area was 1,299,600 sq km,which is a larger area than that of Pakistan and certainly larger than Egypt and Mesopotamia.

136 (a) Megasthenes was a Greek ambassador to the court of Chandragupta Maurya. He was also the author of the book Indica.

137. (a) By the late 19th century India was one of the largest producers and exporters of Cotton cotton Yarn yarn and wheat. The export of Indian wheat progressed after Suez Canal opened in 1869. About 17% of India's wheat was exported by 1890s.

138. (c) The correct sequence is-
Appar- 7th century CE
Basavanna- 1134- 1196 CE
Lal Ded- 1320-1392 CE
Mira Bai- 1498- 1557 CE

139. (b) Russian and German did not bring trading ships to the port of Surat in pre-British times.

140. (a) The factory Act of 1891 in India was enacted to improve the condition of labour in India. It provided some specific rules and regulations including-the age of child labour to be established from nine to twelve,child labour could work maximum of six hours,women were given halfgiven half an hour break etc.

141. (d) The Vice-President of India is the ex-officio Chairman of Rajya Sabha. He is elected by the members of an electoral college consisting of members of both Houses of Parliament. Rajya Sabha also elects one of its members to be the Deputy Chairman.

142. (d) The Drafting Committee for framing the constitution was appointed on 29th August 1947.The committee comprised of a chairman and six other members. The committee members were:- Dr B. R. Ambedkar(Chairman), K M Munshi, Alladi Krishnaswamy Iyer, N Gopalaswami Ayengar, B L Mitter, Md. Saadullah and D P Khaitan.

143. (d) The Congress of Vienna was a conference of ambassadors of European states, and held in Vienna from September 1814 to June 1815. The goal was not simply to restore old boundaries, but to resize the main powers so they could balance each other off and remain at peace. The "Big Four" Mmembers included the "Big Four" and France are Austria, England, Prussia and Russia. Later on, France was also invited to join.

144. (b) The Stamp Act Congress met in a Federal Hall building was a meeting held between October 7 and 25, 1765 in New York City. iIt was the first gathering of elected representatives from several of the American colonies to devise a unified protest against new British taxation.

145. (c) The first Continental Congress met in Carpenter's Hall in Philadelphia, from September 5, to October 26, 1774. All of the colonies except Georgia sent delegates.Countries which sent their delegates are New Hampshire, Massachusetts Bay, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North and south Carolina.

146 (d) The Bolshevik Revolution started in Russia during the reign of Czar Nicholas II (1894–1917). Nicholas II was the last Emperor and the last Czar of Russia. He was executed along with his family by the Bolsheviks.

147. (c) Article 51(A), Part IV(A) of the Indian Constitution, specifies the list of fundamental duties of the citizens. According to it "to promote the educational and economic interests of the weaker sections of the people, especially the Scheduled castes and Scheduled Tribes" and "To protect all monuments of historic interests and national importance" are not fundamental duties.

148. (d) In case of a deadlock due to disagreement between the two Houses on a Bill, an extraordinary situation arises which is resolved by both the Houses sitting together.which is resolved by both the Houses sitting together.The Constitution empowers the President to summon a 'joint sitting' of both the Houses. Article 108 of the constitution deals with the Joint sitting of both Houses.

149. (d) Article 352 of the Indian Constitution mentions the National Emergency in India can be declared by . Tthe President can declare such an emergency only on the basis of a written request by the Council of Ministers headed by the Prime Minister.

150. (d)

NDA 2 2013 Question Paper

MATHEMATICS

1. What is the positive square root of $7+4\sqrt{3}$?
(a) $\sqrt{3}-1$ (b) $\sqrt{3}+1$
(c) $\sqrt{3}-2$ (d) $\sqrt{3}+2$

2. If $A=\{1,2\}$, $B=\{2,3\}$ and $C=\{3,4\}$, then what is the cardinality of $(A\times B)\cap(A\times C)$?
(a) 8 (b) 6
(c) 2 (d) 1

3. If α, β are the roots of the equation $x^2+x+2=0$, then what is $\dfrac{\alpha^{10}+\beta^{10}}{\alpha^{-10}+\beta^{-10}}$ equal to?
(a) 4096 (b) 2048
(c) 1024 (d) 512

4. If a and b are rational and b is not perfect square, then the quadratic equation with rational coefficients whose one root is $3a+\sqrt{b}$ is
(a) $x^2-6ax+9a^2-b=0$ (b) $3ax^2+x-\sqrt{b}=0$
(c) $x^2+3ax+\sqrt{b}=0$ (d) $\sqrt{b}x^2+x-3a=0$

5. If A is a finite set having n elements, then the number of relations which can be defined in A is
(a) 2^n (b) n^2
(c) 2^{n^2} (d) n^n

6. If the positive integers a, b, c, d are in AP, then the numbers abc, abd, acd, bcd are in
(a) HP (b) AP
(c) GP (d) None of the above

7. Which one of the following is an example of non-empty set?
(a) Set of all even prime numbers
(b) $(x : x^2-2=0$ and x is rational)
(c) $\{x : x$ is a natural number, $x<8$ and simultaneously $x>12\}$
(d) $\{x : x$ is a point common to any two parallel lines$\}$

8. What is one of the square roots of $3+4i$, where $i=\sqrt{-1}$?
(a) $2+i$ (b) $2-i$
(c) $-2+i$ (d) $-3-i$

9. The number 83 is written in the binary system as
(a) 100110 (b) 101101
(c) 1010011 (d) 110110

10. The relation R in the set Z of integers given by $R=\{(a,b) : a-b$ is divisible by $5\}$ is
(a) reflexive
(b) reflexive but not symmetric
(c) symmetric and transitive
(d) an equivalence relation

11. What is $\sum_{r=0}^{n} C(n,r)$ equal to?
(a) 2^n-1 (b) n
(c) $n!$ (d) 2^n

12. What is $0.9+0.09+0.009+....$ equal to?
(a) 1 (b) 1.01
(c) 1.001 (d) 1.1

13. How many real roots does the quadratic equation $f(x)=x^2+3|x|+2=0$ have?
(a) One (b) Two
(c) Fore (d) No real root

14. In a group of 50 people, two tests were conducted, one for diabetes and one for blood pressure. 30 people were diagnosed with diabetes and 40 people were diagnosed with high blood pressure. what is the minimum number of people who were having diabetes and high blood pressure?
(a) 0 (b) 10
(c) 20 (d) 30

15. Consider the following statements:
1. The product of two non-zero matrices can never be identity matrix.
2. The product of two non-zero matrices can never be zero matrix.

Which of the above statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

16. Consider the following statements:
1. The matrix $\begin{pmatrix} 1 & 2 & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{pmatrix}$ is singular.
2. The matrix $\begin{pmatrix} c & 2c & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{pmatrix}$ is non-singular.

Which of the above statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

17. The cofactor of the element 4 in the determinant

$$\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 5 & 8 & 9 \end{vmatrix} \text{ is}$$

(a) 2 (b) 4
(c) 6 (d) −6

18. If A is a square matrix of order 3 with $|A| \neq 0$, then which one of the following is correct ?

(a) $|adjA| = |A|$ (b) $|adjA| = |A|^2$
(c) $|adjA| = |A|^3$ (d) $|adjA|^2 = |A|$

19. Let $A = \{a, b, c, d\}$ and $B = \{x, y, z\}$. What is the number of elements in $A \times B$?

(a) 6 (b) 7
(c) 12 (d) 64

20. If $C(28, 2r) = C(28, 2r - 4)$, then what is r equal to ?

(a) 7 (b) 8
(c) 12 (d) 16

21. If A is a subset of B, then which one of the following is correct ?

(a) $A^c \subseteq B^c$ (b) $B^c \subseteq A^c$
(c) $A^c = B^c$ (d) $A \subseteq A \cap B$

22. If $A = \begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix}, B = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}, C = \begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix}$

where $i = \sqrt{-1}$, then which one of the following is correct?

(a) $AB = -C$
(b) $AB = C$
(c) $A^2 = B^2 = C^2 = I$, where I is the identity matrix
(d) $BA \neq C$

23. Let f be a function from the set of natural numbers to the set of even natural numbers given by $f(x) = 2x$. Then f is

(a) one to one but not onto
(b) onto but not one-one
(c) both one-one and onto
(d) neither one-one nor onto

24. If $2A = \begin{pmatrix} 2 & 1 \\ 3 & 2 \end{pmatrix}$, then what is A^{-1} equal to ?

(a) $\begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix}$ (b) $\frac{1}{2}\begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix}$
(c) $\frac{1}{4}\begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix}$ (d) None of these

25. If $\begin{pmatrix} 2 & 3 \\ 4 & 1 \end{pmatrix} \times \begin{pmatrix} 5 & -2 \\ -3 & 1 \end{pmatrix} = \begin{pmatrix} 1 & -1 \\ 17 & \lambda \end{pmatrix}$, then what is λ equal to ?

(a) 7 (b) −7
(c) 9 (d) −9

26. What is the angle (in circular measure) between the hour hand and the minute hand of a clock when the time is half past 4 ?

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{6}$ (d) None of these

27. The angle of elevation of the top of a tower from two places situated at distances 21m. and x m. from the base of the tower are 45° and 60° respectively. What is the value of x ?

(a) $7\sqrt{3}$ (b) $7 - \sqrt{3}$
(c) $7 + \sqrt{3}$ (d) 14

28. What is $\frac{\cot 54°}{\tan 36°} + \frac{\tan 20°}{\cot 70°}$ equal to ?

(a) 0 (b) 1
(c) 2 (d) 3

29. A person standing on the bank of a river observes that the angle subtended by a tree on the opposite of bank is 60°. When he retires 40 m. from the bank, he finds the angle to be 30°. What is the breadth of the river ?

(a) 60m (b) 40m
(c) 30m (d) 20m

30. If the angles of a triangle are 30° and 45° and the included side is $(\sqrt{3} + 1)$, then what is the area of the tringle ?

(a) $\frac{\sqrt{3}+1}{2}$ (b) $2(\sqrt{3}+1)$
(c) $\frac{\sqrt{3}+1}{3}$ (d) $\frac{\sqrt{3}-1}{2}$

31. What is $\sin^2 20° + \sin^2 70°$ equal to ?

(a) 1 (b) 0
(c) −1 (d) $\frac{1}{2}$

32. What is the value of the determinant

$$\begin{vmatrix} 1 & bc & a(b+c) \\ 1 & ca & b(c+a) \\ 1 & ab & c(a+b) \end{vmatrix} ?$$

(a) 0 (b) abc
(c) $ab + bc + ca$ (d) $abc\,(a+b+c)$

33. Consider the following :

1. $A \cup (B \cap C) = (A \cap B) \cup (A \cap C)$
2. $A \cap (B \cup C) = (A \cup B) \cap (A \cup C)$

Which of the above is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

34. Let n be a positive integer and
$(1 + x)^n = a_0 + a_1x + a_2x^2 + ... + a_nx^n$
What is $a_0 + a_1 + a_2 + ... + a_n$ equal to ?

(a) 1 (b) 2^n
(c) 2^{n-1} (d) 2^{n+1}

35. If α, β are the roots of the equation $ax^2 + bx + b = 0$, then what is the value of $\sqrt{\frac{\alpha}{\beta}} + \sqrt{\frac{\beta}{\alpha}} + \sqrt{\frac{b}{a}}$?

(a) –1 (b) 0
(c) 1 (d) 2

36. A number in binary system is 110001. It is equal to which one of the following numbers in decimal system ?

(a) 45 (b) 46
(c) 48 (d) 49

37. The roots of the equation

$x^2 - 8x + 16 = 0$

(a) are imaginary (b) are distinct and real
(c) are equal and real (d) cannot be ascertained

38. What is $\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{3}\right)$ equal to ?

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$
(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

39. What is $(1 - \sin^2\theta)(1 + \tan^2\theta)$ equal to ?

(a) $\sin^2\theta$ (b) $\cos^2\theta$
(c) $\tan^2\theta$ (d) 1

40. How many terms are there in the expansion of $(1 + 2x + x^2)^{10}$?

(a) 11 (b) 20
(c) 21 (d) 30

41. The sum of the first five terms and the sum of the first ten terms of an AP are same. Which one of the following is the correct statement ?

(a) The first term must be negative
(b) The common difference must be negative
(c) Either the first term or the common difference is negative but not both
(d) Both the first term and the common difference are negative

42. If $A = \{1, 3, 5, 7\}$, then what is the cardinality of the power set $P(A)$?

(a) 8 (b) 15
(c) 16 (d) 17

43. What is the difference in the roots of the equation $x^2 - 10x + 9 = 0$?

(a) 2 (b) 3
(c) 5 (d) 8

44. If $8x - 9y = 20$ and $7x - 10y = 9$, then what is $2x - y$ equal to ?

(a) 10 (b) 11
(c) 12 (d) 13

45. The quadratic equation $x^2 + bx + 4 = 0$ will have real roots if

(a) $b \le -4$ only (b) $b \ge 4$ only
(c) $-4 < b < 4$ (d) $b \le -4, b \ge 4$

46. What is the seventh term of the sequence 0, 3, 8, 15, 24,....?

(a) 63 (b) 48
(c) 35 (d) 33

47. What is tan 15° equal to ?

(a) $2-\sqrt{3}$ (b) $2+\sqrt{3}$
(c) $1-\sqrt{3}$ (d) $1+\sqrt{3}$

48. Consider the following:

1. $\tan\left(\frac{\pi}{6}\right)$ 2. $\tan\left(\frac{3\pi}{4}\right)$
3. $\tan\left(\frac{5\pi}{4}\right)$ 4. $\tan\left(\frac{2\pi}{3}\right)$

What is the correct order ?

(a) $1<4<2<3$ (b) $4<2<1<3$
(c) $4<2<3<1$ (d) $1<4<3<2$

49. If $\cos x = \frac{1}{3}$, then what is $\sin x \cdot \cot x \cdot \mathrm{cosec}\, x \cdot \tan x$ equal to ?

(a) $\frac{2}{3}$ (b) $\frac{3}{2}$
(c) 2 (d) 1

50. What is $\log_{81} 243$ equal to ?

(a) 0.75 (b) 1.25
(c) 1.5 (d) 3

51. If the three vertices of the parallelogram $ABCD$ are $A(1, a)$, $B(3, a)$, $C(2, b)$, then D is equal to

(a) $(3, b)$ (b) $(6, b)$
(c) $(4, b)$ (d) $(5, b)$

52. The value of k for which the lines $2x + 3y + a = 0$ and $5x + ky + a = 0$ represent family of parallel lines is

(a) 3 (b) 4.5
(c) 7.5 (d) 15

53. What is the equation of the line which passes through $(4, -5)$ and is perpendicular to $3x + 4y + 5 = 0$?

(a) $4x - 3y - 31 = 0$ (b) $3x - 4y - 41 = 0$
(c) $4x + 3y - 1 = 0$ (d) $3x + 4y + 8 = 0$

54. The foci of the hyperbola $4x^2 - 9y^2 - 1 = 0$ are

(a) $(\pm\sqrt{13}, 0)$ (b) $\left(\pm\frac{\sqrt{13}}{6}, 0\right)$
(c) $\left(0, \pm\frac{\sqrt{13}}{6}\right)$ (d) None of these

55. For what value of k are the two straight lines $3x + 4y = 1$ and $4x + 3y + 2k = 0$ equidistant from the point $(1, 1)$?

(a) $\frac{1}{2}$ (b) 2
(c) –2 (d) $-\frac{1}{2}$

56. A point P moves such that its distances from (1, 2) and (–2, 3) are equal. Then the locus of P is

(a) straight line (b) Parabola
(c) ellipse (d) hyperbola

57. The equation of the locus of a point which is equidistant from the axes is

(a) $y=2x$ (b) $x=2y$
(c) $y=\pm x$ (d) $2y+x=0$

58. What angle does the line segment joining (5, 2) and (6, –15) subtend at (0, 0) ?

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{2}$ (d) $\frac{3\pi}{4}$

59. The length of latus rectum of the ellipse $4x^2+9y^2=36$ is

(a) $\frac{4}{3}$ (b) $\frac{8}{3}$
(c) 6 (d) 12

60. What is the equation to the straight line passing through (5, –2) and (–4, 7)?

(a) $5x-2y=4$ (b) $-4x+7y=9$
(c) $x+y=3$ (d) $x-y=-1$

61. What is the angle between the lines $x+y=1$ and $x-y=1$?

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

62. The axis of the parabola $y^2+2x=0$ is

(a) $x=0$ (b) $y=0$
(c) $x=2$ (d) $y=2$

63. The radius of the circle $x^2+y^2+x+c=0$ passing through the origin is

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) 1 (d) 2

64. The centroid of the triangle with vertices (2, 3), (–2, –5) and (3, 5) is at

(a) (1, 1) (b) (2, –1)
(c) (1, –1) (d) (1, 2)

65. The equation of the line, the reciprocals of whose intercepts on the axes are m and n, is given by

(a) $nx+my=mn$ (b) $mx+ny=1$
(c) $mx+ny=mn$ (d) $mx-ny=1$

66. If θ is the acute angle between the diagonals of a cube, then which one of the following is correct ?

(a) $\theta=30°$ (b) $\theta=45°$
(c) $2\cos\theta=1$ (d) $3\cos\theta=1$

67. What is the equation of the sphere with unit radius having centre at the origin ?

(a) $x^2+y^2+z^2=0$ (b) $x^2+y^2+z^2=1$
(c) $x^2+y^2+z^2=2$ (d) $x^2+y^2+z^2=3$

68. What is the sum of the squares of direction cosines of x-axis ?

(a) 0 (b) $\frac{1}{3}$
(c) 1 (d) 3

69. What is the distance of the line $2x+y+2y=3$ from the origin ?

(a) 1 units (b) 1.5 units
(c) 2 units (d) 2.5 units

70. If the projections of a straight line segment on the coordinate axes are 2, 3, 6, then the length of the segment is

(a) 5 units (b) 7 units
(c) 11 units (d) 49 units

71. Consider the following functions :

1. $f(x)=e^x$, where $x>0$
2. $g(x)=|x-3|$

Which of the above functions is/are continuous ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

72. What is the derivative of x^3 with respect to x^2 ?

(a) $3x^2$ (b) $\frac{3x}{2}$
(c) x (d) $\frac{3}{2}$

73. What is $\lim_{x\to 2}\frac{2-x}{x^3-8}$ equal to ?

(a) $\frac{1}{8}$ (b) $-\frac{1}{8}$
(c) $\frac{1}{12}$ (d) $-\frac{1}{12}$

74. A function $f: R\to R$ is defined as $f(x)=x^2$ for $x\geq 0$ and $f(x)=-x$ for $x<0$.

Consider the following statements in respect of the above function :

1. The function is continuous at $x=0$.
2. The function is differentiable at $x=0$.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

75. If $f(x)=2x^2+3x-5$, then what is $f'(0)+3f'(-1)$ equal to ?

(a) –1 (b) 0
(c) 1 (d) 2

76. What is $\lim_{x\to 0}\frac{1-\cos x}{x}$ equal to ?

(a) 0 (b) $\frac{1}{2}$
(c) 1 (d) 2

77. What is $\lim_{x\to 0}\frac{\cos x}{\pi-x}$ equal to ?

(a) 0 (b) π
(c) $\frac{1}{\pi}$ (d) 1

78. What is $\lim_{x \to 0} \frac{\sin 2x + 4x}{2x + \sin 4x}$ equal to ?

(a) 0 (b) $\frac{1}{2}$

(c) 1 (d) 2

79. The maximum value of the function $f(x) = x^3 + 2x^2 - 4x + 6$ exists at

(a) $x = -2$ (b) $x = 1$

(c) $x = 2$ (d) $x = -1$

80. The minimum value of the function $f(x) = |x - 4|$ exists at

(a) $x = 0$ (b) $x = 2$

(c) $x = 4$ (d) $x = -4$

81. What is $\int_1^2 \ell n\, x\, dx$ equal to ?

(a) $\ell n\, 2$ (b) 1

(c) $\ell n\left(\frac{4}{e}\right)$ (d) $\ell n\left(\frac{e}{4}\right)$

82. What is $\int \frac{dx}{\sqrt{4 + x^2}}$ equal to ?

(a) $\ell n \left|\sqrt{4 + x^2} + x\right| + c$ (b) $\ell n \left|\sqrt{4 + x^2} - x\right| + c$

(c) $\sin^{-1}\left(\frac{x}{2}\right) + c$ (d) None of these

Where c is an arbitrary constant.

83. What is the order of the differential equation

$$\left(\frac{dy}{dx}\right)^2 + \frac{dy}{dx} - \sin^2 y = 0\ ?$$

(a) 1 (b) 2

(c) 3 (d) Undefined

84. $y = 2\cos x + 3\sin x$ satisfies which of the following differential equations ?

1. $\frac{d^2y}{dx^2} + y = 0$

2. $\left(\frac{dy}{dx}\right)^2 + \frac{dy}{dx} = 0$

Select the correct answer using the code given below.

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

85. The differential equation of all circles whose centres are at the origin is

(a) $\frac{dy}{dx} = \frac{y}{x}$ (b) $\frac{dy}{dx} = \frac{x}{y}$

(c) $\frac{dy}{dx} = -\frac{x}{y}$ (d) None of the above

86. What is $\int \sin^2 x\, dx + \int \cos^2 x\, dx$ equal to ?

(a) $x + c$ (b) $\frac{x^2}{2} + c$

(c) $x^2 + c$ (d) None of these

Where c is an arbitary constant.

87. What is $\int e^{e^x} e^x dx$ equal to ?

(a) $e^{e^x} + c$ (b) $2e^{e^x} + c$

(c) $e^{e^x} e^x + c$ (d) $2e^{e^x} e^x + c$

Where c is an arbitary constant.

88. What is the area bounded by the lines $x = 0$, $y = 0$ and $x + y + 2 = 0$?

(a) $\frac{1}{2}$ square unit (b) 1 square unit

(c) 2 square units (d) 4 square units

89. What is the derivative of sin (sin x) ?

(a) cos (cos x) (b) cos (sin x)

(c) cos (sin x)cos$x$ (d) cos (cos x)cos$x$

90. What is the derivative of $|x - 1|$ at $x = 2$?

(a) -1 (b) 0

(c) 1 (d) Derivative does not exist

91. What is the area of the parabola $x^2 = y$ bounded by the line $y = 1$?

(a) $\frac{1}{3}$ square unit (b) $\frac{2}{3}$ square unit

(c) $\frac{4}{3}$ square units (d) 2 square units

92. What is the area bounded by $y = \tan x$, $y = 0$ and $x = \frac{\pi}{4}$?

(a) ℓn 2 square units (b) $\frac{\ell n 2}{2}$ square units

(c) 2 (ℓn 2)square units (d) None of these

93. What is $\int (x \cos x + \sin x) dx$ equal to ?

(a) $x \sin x + c$ (b) $x \cos x + c$

(c) $-x \sin x + c$ (d) $-x \cos x + c$

Where c is an arbitrary constant.

94. What is $\int_0^2 e^{\ln x} dx$ equal to ?

(a) 1 (b) 2

(c) 4 (d) None of these

95. If the angle between the vectors $\hat{i} - m\hat{j}$ and $\hat{j} + \hat{k}$ is $\frac{\pi}{3}$, then what is the value of m ?

(a) 0 (b) 2

(c) -2 (d) None of these

96. What is the vector perpendicular to both the vectors $\hat{i}-\hat{j}$ and $\hat{i}$?

(a) $\hat{i}$ (b) $-\hat{j}$

(c) $\hat{j}$ (d) $\hat{k}$

97. The position vectors of the points A and B are respectively $3\hat{i}-5\hat{j}+2\hat{k}$ and $\hat{i}+\hat{j}-\hat{k}$. What is the length of AB ?

(a) 11 (b) 9

(c) 7 (d) 6

98. The vectors $\hat{i}-2x\hat{j}-3y\hat{k}$ and $\hat{i}+3x\hat{j}+2y\hat{k}$ are orthogonal to each other. Then the locus of the point (x, y) is

(a) hyperbola (b) ellipse

(c) parabola (d) circle

99. What is the value of P for which the vector $p\left(2\hat{i}-\hat{j}+2\hat{k}\right)$ is of 3 units length ?

(a) 1 (b) 2

(c) 3 (d) 6

100. If $\vec{a}=2\hat{i}+2\hat{j}+3\hat{k}, \vec{b}=-\hat{i}+2\hat{j}+\hat{k}$ and $\vec{c}=3\hat{i}+\hat{j}$ are three vectors such that $\vec{a}+t\vec{b}$ is perpendicular to $\vec{c}$, then what is t equal to ?

(a) 8 (b) 6

(c) 4 (d) 2

101. The mean of 20 observations is 15. On checking, it was found that two observations were wrongly copied as 3 and 6. If wrong observations are replaced by correct values 8 and 4, then the correct mean is

(a) 15 (b) 15.15

(c) 15.35 (d) 16

102. The arithmetic mean of the squares of the first n natural numbers is

(a) $\frac{n(n+1)(2n+1)}{6}$ (b) $\frac{n(n+1)(2n+1)}{2}$

(c) $\frac{(n+1)(2n+1)}{6}$ (d) $\frac{(n+1)(2n+1)}{3}$

103. Consider the following statements :

1. Both the regression coefficients have same sign.
2. If one of the regression coefficients is greater than unity, the other must be less than unity.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

104. Which one of the following measures is determined only after the construction of cumulative frequency distribution ?

(a) Arithmetic mean (b) Mode

(c) Median (d) Geometric mean

105. Coefficient of correlation is the measure of

(a) central tendency

(b) dispersion

(c) both central tendency and dispersion

(d) neither central tendency nor dispersion

106. If three events A, B, C are mutually exclusive, then which one of the following is correct ?

(a) $P(A\cup B\cup C)=0$ (b) $P(A\cup B\cup C)=1$

(c) $P(A\cap B\cap C)=0$ (d) $P(A\cap B\cap C)=1$

107. What is the variance of the first 11 natural numbers ?

(a) 10 (b) 11

(c) 12 (d) 13

108. If A and B are independent events such that $P(A)=\frac{1}{5}, P(A\cup B)=\frac{7}{10}$, then what is $P(\overline{B})$ equal to ?

(a) $\frac{2}{7}$ (b) $\frac{3}{7}$

(c) $\frac{3}{8}$ (d) $\frac{7}{9}$

109. In a binomial distribution, the occurrence and the non-occurrence of an event are equally likely and the mean is 6. The number of trials required is

(a) 15 (b) 12

(c) 10 (d) 6

110. A die is tossed twice. What is the probability of getting a sum of 10 ?

(a) $\frac{1}{18}$ (b) $\frac{1}{6}$

(c) $\frac{1}{12}$ (d) $\frac{5}{12}$

111. Three dice are thrown. What is the probability of getting a triplet ?

(a) $\frac{1}{6}$ (b) $\frac{1}{18}$

(c) $\frac{1}{36}$ (d) $\frac{1}{72}$

112. Consider the following statements :

1. If A and B are exhaustive events, then their union is the sample space.
2. If A and B are exhaustive events, then their intersection must be an empty event.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

113. Consider the following statements :

1. The algebraic sum of the deviations of a set of n values from its arithmetic mean is zero.
2. In the case of frequency distribution, mode is the value of variable which corresponds to maximum frequency.

Which of the statements above given is/are correct ?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

114. Which one of the following may be the parameter of a binomial distribution ?

(a) $np=2, npq=4$ (b) $n=4,\ p=\frac{3}{2}$

(c) $n=8, p=1$ (d) $np=10, npq=8$

115. What is the number of outcomes when a coin is tossed and then a die is rolled only in case a head is shown on the coin ?

(a) 6 (b) 7
(c) 8 (d) None of these

116. If $P(A)=\frac{2}{3}, P(B)=\frac{2}{5}$ and $P(A\cup B)-P(A\cap B)=\frac{2}{5}$, then what is $P(A\cap B)$ equal to ?

(a) $\frac{3}{5}$ (b) $\frac{5}{11}$
(c) $\frac{1}{3}$ (d) None of these

117. What is the propability that there are 5 Mondays in the month of February 2016 ?

(a) 0 (b) $\frac{1}{7}$
(c) $\frac{2}{7}$ (d) None of these

118. Consider the following statements :

1. Pie diagrams are suitable for categorical data.
2. The arc length of a sector of a pie diagram is proportional to the value of the component represented by the sector.

Which of the statements given above is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

119. In a relay race, there are six teams *A, B, C, D, E* and *F.* What is the probability that *A, B, C* finish first, second, third respectively ?

(a) $\frac{1}{2}$ (b) $\frac{1}{12}$
(c) $\frac{1}{60}$ (d) $\frac{1}{120}$

120. The variance of 20 observations is 5. If each observation is multiplied by 2, then what is the new variance of the resulting observations ?

(a) 5 (b) 10
(c) 20 (d) 40

GENERAL ABILITY

PART-A: ENGLISH

DIRECTIONS: (For the 10 items which follow):

(i) In this section, a number of sentences are given. The sentences are underlined in three separate parts and each one is labelled (a), (b), (c). Read each sentence to find out whether there is an error in any underlined part. No sentence has more than one error. When you find an error in any one of the underlined part (a), (b) or (c) indicate your responses on the Answer Sheet at the appropriate space. You may feel that there is no error in a sentence. In that case, (d) will signify a 'No error' response.

(ii) Errors may be in grammar, word usage or idioms. There may be a word missing or there may be a word which should be removed.

(iii) You are not required to correct the error. You are required only to indicate your response on the answer sheet.

1. Suppose if you were left alone (a) to live on a desert island (b) what would you do?. (c) No error. (d)

2. He wondered that what (a) would be the next move of his (b) opponents who had vowed to see him dislodged from power. (c) No error. (d)

3. The nation should be greatful (a) to the armed forces for (b) protecting them. (c) No error. (d)

4. I do not know (a) what is he doing (b) to solve the problem. (c) No error. (d)

5. For so many years (a) it is almost his habit (b) to go to the bed at (c) 10 p.m. daily. No error. (d)

6. He took (a) down after (b) his father. (c) No error. (d)

7. His honesty (a) has never been (b) called the question. (c) No error. (d)

8. I see her (a) most weekends (b) but not very often between. (c) No error. (d)

9. The chancellor (a) was present (b) on both occasions. (c) No error. (d)

10. The deliberations by (a) the committee (b) are completely (c) confidential. No error. (d)

DIRECTIONS : (For the 10 items which follow):

Each of the following items consists of a sentence followed by four words or group of words. Select the ***synonym*** of the word (occurring in the sentence in capital letters) as per the context.

11. A wise man puts past RANCOUR behind and moves ahead.

(a) Dislike (b) Hatred
(c) Division (d) Criticism

12. Many of the villagers were ISOLATED by heavy showers of rains.

(a) Destroyed (b) Separated from others
(c) Battered (d) Devasted

13. A series of COLUMNS supporting a large porch is typical of medieval architecture.

(a) Statues (b) Arches
(c) Pillars (d) Murals

14. Trees that BLOCK the view of oncoming traffic should be cut down.

(a) Alter (b) Obstruct
(c) Improve (d) Spoil

15. The landscape changed ABRUPTLY after the snowfall.
(a) Suddenly (b) Sharply
(c) Favourably (d) Slightly

16. We saw a SCINTILLATING fireworks display.
(a) Fascinating (b) Unforgettable
(c) Beautiful (d) Sparkling

17. The PACT has been in effect for twenty years.
(a) Treaty (b) Monarchy
(c) Lease (d) Trend

18. He had a reputation of being a PRUDENT businessman.
(a) Skilful (b) Wealthy
(c) Careful (d) Dishonest

19. There was a signpost where the two paths CONVERGE.
(a) Separate (b) Intersect
(c) Merge (d) Diverge

20. The violence erupted because of the ZEALOT.
(a) Enthusiastic (b) Brave
(c) Timid (d) Fanatic

DIRECTIONS: (For the 10 items which follow):

Each of the following items consists of a sentence followed by four words or group of words. Select the ***antonym*** of the word (occurring in the sentence in capital letters) as per the context.

21. His CANDID remarks impressed the authorities
(a) Blunt (b) Guarded
(c) Sincere (d) Unconventional

22. The guilty appealed to the jury to CONDONE his punishment.
(a) Accept (b) Forgive
(c) Condemn (d) Criticize

23. His family SEVERED ties with him for marrying inter-caste.
(a) Joined (b) Included
(c) Detached (d) Disrupted

24. It is easy to understand his FUZZY thoughts.
(a) Misty (b) Vague
(c) Clear (d) Useful

25. He drove his car through SLIMY road to reach your office.
(a) Ugly (b) Clean
(c) Beautiful (d) Slippery

26. We are ANXIOUS to avoid any problems with regard to this.
(a) Cool (b) Composed
(c) Careless (d) Worried

27. The railway lines are EXTENDED and we are quite happy about it.
(a) Protracted (b) Widened
(c) Curtailed (d) Elongated

28. There was a fire this morning. They were lucky to ESCAPE it.
(a) Arrest (b) Elude
(c) Evade (d) Conceive

29. Domestic violence is a very INHUMAN act.
(a) Indifferent (b) Compassionate
(c) Terrible (d) Ferocious

30. His ELOQUENT speech helped him bag the award.
(a) Lucid (b) Vivid
(c) Short (d) Inarticulate

DIRECTIONS: (For the 10 items which follow):

Apply suitable preposition/phrasal verb in the blank of each item.

31. Universities in Germany and Denmark will have an input _______ the project.
(a) for (b) into
(c) about (d) at

32. He gave me a leg _______ when I was completely new to the business.
(a) up (b) down
(c) off (d) for

33. You should have nothing to do with those criminals; they all have violent attitudes and long records. They are men _______ the same kidney.
(a) with (b) in
(c) of (d) on

34. He didn't have the guts to stand _______ his friend when he was in trouble.
(a) with (b) for
(c) by (d) beside

35. He broke out of the prison _______ dressing as a woman.
(a) in (b) as
(c) by (d) with

36. When electricity failed, emergency generators _______.
(a) cut out (b) cut off
(c) cut on (d) cut in

37. We need two more hands to _______ the heavy rush of work.
(a) cope up (b) cope with
(c) cope to (d) cope in

38. Twenty-five candidates _______ each other for the first prize.
(a) compete for (b) compete with
(c) compete to (d) compete on

39. We must eliminate the ___________ rich and poor.
(a) disparity between
(b) disparity for
(c) disparity in
(d) disparity from

40. As an innovator, he __________ the beaten track and explored new religions.
(a) deviated from (b) deviated to
(c) deviated in (d) deviated for

DIRECTIONS: (For the next 04 items that follow):

Read the passage and answer the questions that follow:

It has often been said that the scale of natural phenomenon in India and her total dependence on the monsoon, have helped to form the character of her people. Even today, major disasters, such as flood, famine and plaque, are hard to check, and in older times, their control was almost impossible. Many other ancient civilizations, such as those of the Greeks, Romans and Chinese, had to contend with hard winters which encouraged sturdiness and resourcefulness. India, on the other hand, was blessed by a bounteous nature, who demanded little of man in return for sustenance, but in her terrible anger could not be appeased by any human effort. Hence it has been suggested, the Indian character has tended to quietism, accepting fortune and misfortune alike without complaint.

41. The author's main argument is
(a) description of natural phenomena of India
(b) unpredictability of Indian monsoon
(c) correlation between the climate and the character of the inhabitants of a region
(d) hardships caused by natural calamities

42. Which one of the following civilizations did not have to face hardships due to bad winter?
(a) Indian (b) Greek
(c) Chinese (d) Roman

43. The expression "India, on the other hand was blessed by a bounteous nature ________________ means
(a) Indian soil is fertile
(b) India is a land of flora and fauna
(c) Indian people have been rewarded more generously by nature in proportion to their efforts
(d) Indian soil is suited for growing a variety of crops

44. Which trait of Indian character has been formed by the monsoon?
(a) Fatalism (b) Sturdiness
(c) Asceticism (d) Epicureanism

DIRECTIONS: (For the 06 items that follow):

In the following sentences, some parts of the sentences have been jumbled up. You are required to rearrange these parts which are labelled P, Q, R, S to produce the correct sentence. Choose the proper sequence and mark in your answer sheet accordingly.

45. she (P) and neither have I (Q) the assignment yet (R) hasn't finished (S)
The correct sequence should be
(a) QRSP (b) QPSR
(c) PQSR (d) PSRQ

46. himself (P) a child (Q) can usually feed (R) by the age of six months (S)
The correct sequence should be
(a) QPRS (b) SRQP
(c) PQRS (d) QRPS

47. Every experience in life makes
on some of the cells (P) or other nerve centres (Q) of the brain (R)
an impression (S)
The correct sequence should be
(a) SPRQ (b) QRSP
(c) RSPQ (d) PSQR

48. You'll
know how to do it (P) have to (Q) because she does not (R) help her (S)
The correct sequence should be
(a) QSPR (b) SRPQ
(c) QPRS (d) QSRP

49. Would you
like to come (P) on Saturday (Q) at the International House (R)
to a concert (S)
The correct sequence should be
(a) PQRS (b) PSQR
(c) RSPQ (d) PQSR

50. It is
to be admitted (P) not necessary that (Q) to an engineering college (R)
you qualify an entrance examination (S)
The correct sequence should be
(a) SRQP (b) QSPR
(c) QRPS (d) SRPQ

PART- B: GENERAL KNOWLEDGE

51. Consider the following statements about the National Cyber Security Policy, approved by the Union Cabinet in May 2013:
1. The policy focuses on manpower training.
2. It aims to create a secured computing environment across the country.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

52. Which of the following statements about Dr. Aparajita Datta is/are correct?
1. She is a wildlife biologist.
2. She has been working for the conservation of hornbills in the dense tropical forests of Arunachal Pradesh.
3 She was honoured with the Whitley Award, also known as Green Oscar, in the year 2013 in London.

Select the correct answer using the code given below:
(a) 1, 2 and 3 (b) 2 and 3 only
(c) 1 and 2 only (d) 3 only

53. Who among the following won the Men's Singles title of the Madrid Open Tennis Tournament, 2013?
(a) Novak Djokovic (b) Rafael Nadal
(c) Roger Federer (d) Stanislas Wawrinka

54. Which one among the following films was presented the Best Feature Film award in the 60th National Film Awards?
(a) Dekh Indian Circus
(b) Vicky Donor
(c) Paan Singh Tomar
(d) Chittagong

55. Which one among the following is an indigenously built Weapon System Integrated helicopter handed over to the Indian Army in February 2013 by Hindustan Aeronautics Ltd.?
(a) Varun (b) Indra
(c) Rudra (d) Shiva

56. Who among the following is the Chairman of the Fourteenth Finance Commission?
(a) Abhijit Sen
(b) Y. V. Reddy
(c) Amartya Sen
(d) Montek Singh Ahluwalia

57. Which of the following statements about 'Chit Fund' in India is/are correct?
1. It is a kind of savings scheme.
2. There are no Acts regulating the activities relating to Chit Funds in India.

Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

58. Who among the following is the author of the book Pax Indica: India and the World of the 21st Century?
(a) Shashi Tharoor (b) Salman Khurshid
(c) S. M. Krishna (d) Pranab Mukherjee

59. Which one among the following about Prof. C.N.R. Rao is ***not*** correct?
(a) He worked mainly in solid-state and structural chemistry
(b) He is the head of the Scientific Advisory Council to the President of India
(c) He was conferred with China's top science award for the year 2013 for his contributions in boosting Sino-Indian scientific cooperation
(d) He is a member of the US National Academy of Sciences.

60. Identify the person from the information given below:
He was a popular Urdu poet and Hindi lyricist, who worked extensively in Hindi films. He was a Padma Shri and won two Filmfare awards. The President of India recently released a commemorative postage stamp on his birth anniversary at Rashtrapati Bhavan.
(a) Khayyam (b) Sahir Ludhianvi
(c) Ali Sardar Jafri (d) Salik Lucknawi

DIRECTIONS: The following 07 (Seven) items consist of two statements, statement I and statement II. You are to examine these two statements carefully and select the answers to these items using the code given below.
Code:
(a) Both the statements are individually true and Statement II is the correct explanation of Statement I
(b) Both the statements are individually true but Statement II is *not* correct explanation of Statement I
(c) Statement I is true but Statement II is false.
(d) Statement I is false but Statement II is true.

61. **Statement I:**
The process of decay and disintegration of rocks in situ is called weathering.
Statement II:
Weathering takes place both mechanically and chemically.

62. **Statement I:**
Doldrums is a calm belt between 5°N and 5°S of the equator.
Statement II:
The sun rays strike almost vertically over the equator throughout the year.

63. **Statement I:**
In the 19^{th} century, India was the largest British colony.
Statement II:
India became a big market for British manufactured goods and a field of investment for foreign capital in the 19^{th} century.

64. **Statement I:**
Glass is not considered as a true compound.
Statement II:
Glass does not have a definite melting point.

65. **Statement I:**
Limestone decomposes when it is heated in air.
Statement II:
Increase in the content of CO_2 in the atmosphere in recent years is mainly due to the using of limestone in the manufacture of cement.

66. **Statement I:**
Very little hydrogen is produced when sulphuric acid is added to calcium.
Statement II:
The salt that is produced, calcium sulphate, is insoluble.

67. **Statement I:**
Zinc is used for galvanization to protect iron from rusting.
Statement II:
Zinc is more reactive towards oxygen than iron.

68. Which of the following are the results of EI Nino?
1. Reduction in the amount of planktons which further reduces the number of fish in the sea.
2. Irregularities in the evaporation of sea water.
3. Distortion of equatorial atmospheric circulation.
Select the correct answer using the code given below:
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

69. 'Esker' is a geomorphic feature developed by
(a) mechanical weathering
(b) river action
(c) glaciofluvial deposits
(d) aeolian deposits

70. It is known that the atmosphere is divided into some layers. In which one among the following layers, is the percentage composition of Helium gas maximum?
(a) Troposphere (b) Stratosphere
(c) Exosphere (d) Ionosphere

71. The rigid lithospheric slabs are known as 'Plates'. What would be the result, if the oceanic plate collides with the continental plate?
1. Oceanic plate is forced below the continental plate.
2. Continental plate is forced below the oceanic plate.
3. Continental and oceanic plates never collide.
Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) 1 and 2 only (d) 1, 2 and 3

72. Consider the following layers of the atmosphere:
1. Troposphere
2. Stratosphere
3. Mesophere
4. Thermosphere
Which one among the following is the correct sequence of the layers with increasing altitude from the Earth's surface?
(a) 1-2-3-4 (b) 2-1-3-4
(c) 3-2-1-4 (d) 4-2-3-1

73. Match List I with List II and select the correct answer using the code given below the lists:

List I (Landform of peninsular India)	List II (Predominant rock)
A. Marwar upland	1. Quartzites Shales, Schists
B. Bundelkhand upland	2. Sandstone, Shale, Limestone
C. Meghalaya upland	3. Granite and Gneiss
D.. Maharashtra plateau	4. Basalt

Code:

	A	B	C	D
(a)	2	3	1	4
(b)	2	1	3	4
(c)	4	3	1	2
(d)	4	1	3	2

74. Jawahar tunnel on Jammu-Srinagar highway passes through
(a) Pir Panjal range (b) Karakoram range
(c) Zaskar range (d) Dhauladhar range

75. What would be the date and local time of a place located at 88°30′ E longitude when the local time at 0° longitude is 19.00 hrs. of 28th February 2013?
(a) 23-54 hrs. of 28th February
(b) 00-54 hrs. of 1st March
(c) 23-30 hrs. of 28th February
(d) 00-44 hrs. of 1st March

76. Which of the following statements about tornadoes are correct?
Tornadoes usually spin
1. anticlockwise in the northern hemisphere.
2. clockwise in the southern hemisphere.
3. clockwise in the northern hemisphere.
4. anticlockwise in the southern hemisphere.
Select the correct answer using the code given below:
(a) 1 and 3 (b) 1 and 2
(c) 2 and 4 (d) 2 and 3

77. Which one among the following terms is used to describe a plant that grows only in a mountainous environment?
(a) Orophyte (b) Geophyte
(c) Epiphyte (d) Bryophyte

78. Which of the following statements is/are correct?
1. Air close to the Earth's surface is heavier.
2. Air close to the Earth's surface contains larger quantity of water vapour and dust particles.
Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

79. Match List-I with List-II and select the correct answer using the code given below the list.

List I (Mineral)
A. Mica
B. Chromite
C. Magnesite
D. Zinc

List II (Location in Map)

Code:

	A	B	C	D
(a)	1	2	3	4
(b)	1	3	2	4
(c)	4	2	3	1
(d)	4	3	2	1

80. The term 'albedo' implies the
(a) capacity to absorb solar radiation.
(b) capacity to modify the path of solar radiation
(c) proportion of the shortwave solar radiation reflected by a surface.
(d) amount of solar radiation returned to air by a surface.

81. Which of the following statements are correct?
1. Assam produces nearly 80% of jute in India.
2. Jute grows well on loamy soil.
3. Hot and humid conditions are ideal for growing jute.
4. Jute is commonly cultivated with wheat in rotation.
Select the correct answer using the code given below:
(a) 1, 2 and 3 (b) 2, 3 and 4
(c) 2 and 3 only (d) 1 and 4 only

82. The Indian Standard Time is ahead of Greenwich Mean Time by
(a) 3 hrs and 30 minutes
(b) 4 hrs and 30 minutes
(c) 5 hrs and 30 minutes
(d) 6 hrs and 30 minutes

83. Which of the following is the main characteristic of Mediterranean climate?
(a) High temperature throughout the year
(b) Rainfall throughout the year
(c) Rain in winter season
(d) Convectional rain

84. Which one, among the following atmospheric gases, filters out most of the ultraviolet radiation of the Sun?
(a) Oxygen (b) Nitrogen
(c) Helium (d) Ozone

85. Which one among the following is not a factor that affects direction of wind?
(a) Pressure gradient (b) Friction
(c) Magnetism (d) Coriolis effect

86. Presbyopia is a visual defect caused by
(a) Elongation of the eye ball.
(b) Shortened curvature of the eye lens.
(c) Weakening of the ciliary muscles.
(d) Gradually increasing flexibility of the eye lens.

87. Which one among the following animals does not undergo periodic moulting of their external body covering?
(a) Cockroach (b) Cobra
(c) Earthworm (d) Dragonfly

88. Which one among the following organs in humans is not involved in elicitation of immune response?
(a) Thymus (b) Brain
(c) Spleen (d) Lymph Nodes

89. From which part of turmeric, is the turmeric powder obtained?
(a) Dried rhizome (b) Dried root
(c) Dried fruit (d) Seed

90. Which one among the following substances is never excreted out through urine under normal circumstances in any healthy individual?
(a) Urea (b) Sodium
(c) Amino acid (d) Potassium

91. Which one among the following animals gives birth to the biggest baby?
(a) Elephant (b) Rhinoceros
(c) Blue whale (d) Hippopotamus

92. Muscles of which one among the following body parts contract slowly but can remain contracted for a longer time?
(a) Face (b) Arms
(c) Intestine (d) Legs

93. Solutions of three enzymes were prepared namely lipase, trypsin and amylase, in order to remove stains from a piece

of cloth. Out of these three enzyme solutions, only lipase could completely remove the stain. This indicates that the stain was due to:
(a) Oil
(b) Protein
(c) Mixture of protein and oil
(d) Starch containing plant pigment

94. Which one among the following diseases is not caused by polluted water?
(a) Dysentery (b) Jaundice
(c) Typhoid (d) Tuberculosis

95. Which one among the following animals is a mammal?
(a) Great Indian Bustard (b) Gharial
(c) Platypus (d) Hornbill

96. Which of the following statements with regard to the 'Fifth Report' is/are correct?
1. It was submitted to the British Parliament in 1813 for consideration.
2. It became the basis of intense parliamentary debates on the nature of the East India Company's rule in India.
3. It was primarily on the economic conditions of the urban and industrial centres of India.

Select the correct answer using the code given below:
(a) 1 and 3 only (b) 1 and 2 only
(c) 2 only (d) 1, 2 and 3

97. Consider the following statements about Salt Satyagraha:
1. It was a form of Civil Disobedience.
2. It was the first nationalist activity in which women participated in large numbers.
3. Gandhiji first experimented with Salt Satyagraha in South Africa.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) 1 and 2 only (d) 1, 2 and 3

98. Which of the following statements about Ryotwari system is/are correct?
1. The government collected the revenue directly from the individual cultivators.
2. The cultivators were not recognized in law as the owners of the land.

Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

99. Which of the following statements about Russia is/are correct?
1. Russia emerged as the first socialist state in the world.
2. Socialist state in Russia was established by Bolsheviks in 1917.

Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

100. Consider the following statements:
1. Dadabhai Naoroji first put forward 'the theory of drain of wealth'.
2. The Indian National Congress adopted a resolution to criticize the drain of wealth in its annual session at Calcutta in 1896.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

101. Which of the following statements about Quit India Movement of 1942 is/are correct?
1. The movement was massive in character.
2. One of the unique features of the movement was the participation of the communists at the local level defying the official stand of the Communist Party.
3. It was a completely non-violent movement.

Select the correct answer using the code given below:
(a) 1 only (b) 1 and 2
(c) 2 only (d) 1 and 3

102. Consider the following statements:
1. Annie Besant was the first woman President of the Indian National Congress.
2. The historic Lucknow session of the Congress in 1916 was presided by Madan Mohan Malviya.
3. Mahatma Gandhi presided over the annual session of Congress only once at Belgaum in 1924.

Which of the statements given above is/are correct?
(a) 1, 2 and 3 (b) 2 and 3 only
(c) 1 and 3 only (d) 1 only

103. Match List I with List II and select the correct answer using the code given below the Lists:

List I (Book/Journal)	List II (Author/Editor)
A. Bande Mataram	1. Aurobindo Ghosh
B. New India	2. Mahatma Gandhi
C. India Today	3. Bipin Chandra Pal
D. Young India	4. R. P Dutt

Code:

	A	B	C	D
(a)	1	4	3	2
(b)	1	3	4	2
(c)	2	3	4	1
(d)	2	4	3	1

104. For Mahatma Gandhi, Satyagraha is
1. a political force.
2. a philosophy of life.
3. an ideology of action.

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

105. What was the common element among the following three newspapers?
(i) The Servant of India
(ii) Dnyan Prakash
(iii) Hitawad

(a) They were newspaper brought out by the Indian National Congress
(b) They were newspapers under the influence of socialism
(c) They were newspapers of moderate views brought out by the Servants of India Society
(d) They represented the Trade Union Movement in India

106. "... it has reduced us politically to serfdom. It has sapped the foundations of our culture ... it has degraded us spiritually.' This was Mahatma Gandhi complaining of the ill-effect on Indians of which action/policy of the colonial government?
(a) Salt tax (b) Inadequate franchise
(c) Press Act (d) Rowlatt Act

107. The Indian National Congress was founded during the Viceroyalty of
(a) Lord Lytton (b) Lord Ripon
(c) Lord Dufferin (d) Lord Mayo

108. *Kandh* Revolt against the British was led by
(a) Chakra Bishoyi (b) Dandasena
(c) Tomma Dora (d) Birsa Munda

109. The implementation of factory legislation in India in the nineteenth century was a result of the pressure on the Government of India from
(a) the trade unionists in India
(b) the socialists in India
(c) the manufacturers from Lancashire and Manchester
(d) the Indian National Congress

110. Who among the following was the President of Indian National Congress when India attained independence?
(a) Jawaharlal Nehru (b) Vallabhbhai Patel
(c) Maulana Azad (d) Acharya Kripalani

111. Who among the following has described the uprising of 1857 as the First Indian War of Independence?
(a) S. N. Sen (b) R. C. Majumdar
(c) B. G. Tilak (d) V. D. Savarkar

112. Arrange the following events of Indian freedom movement in correct sequence beginning from the earliest:
1. Second Round Table Conference
2. Communal Award
3. Poona Pact
4. Simon Commission

Select the correct answer using the code given below:
(a) 1-2-3-4 (b) 4-3-2-1
(c) 4-1-2-3 (d) 3-2-1-4

113. Consider the following statements:
1. Morley-Minto reforms ended the official majority in state legislative assemblies.
2. Despite the Government of India Act, 1909 the non-officials were elected to local bodies indirectly.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

114. No Indian "shall by reason only of his religion, place of birth, descent, colour or any of them be disabled from holding any office or employment under the company". This was a pledge first given by the
(a) Charter Act of 1813
(b) Charter Act of 1833
(c) Queen's Proclamation of 1858
(d) Indian Civil Service Act of 1861

115. A beautiful rainbow on the sky is due to the
(a) dispersion of sunlight from a water droplet only.
(b) reflection of sunlight from a water droplet only.
(c) reflection and refraction of sunlight from a water droplet only.
(d) refraction, dispersion and reflection of sunlight from a water droplet.

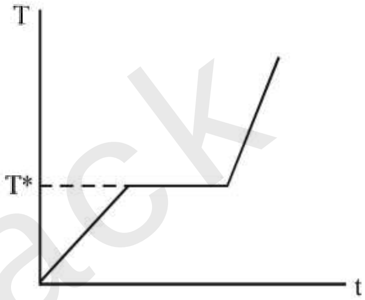
116. The weight of an object may be assigned by using Newton's
(a) first law of motion. (b) second law of motion.
(c) third law of motion. (d) laws of gravitation.

117. A current of 0.5A is drawn by a filament of an electric bulb for 20 minutes. The amount of electric charge that flows through the circuit is
(a) 1C (b) 10C
(c) 600C (d) 300 C

118. Which one among the following properties of a proton may change while it moves freely in a magnetic field?
(a) Speed (b) Charge
(c) Mass (d) Velocity

119. Power required by a boy of mass 30 kg to run up a staircase of 40 steps in 10 seconds is
(Height of each step is 15 cm)
(Take $g = 10\ m/s^2$)
(a) 1800 Watt (b) 180 Watt
(c) 18000 Watt (d) 18 Watt

120.



The figure given above shows the temperature (T) - time (t) plot when we start heating a piece of naphthalene. The temperature (T*) at the plateau of the curve signifies
(a) boiling point of naphthalene.
(b) freezing point of naphthalene.
(c) melting point of naphthalene.
(d) the temperature when naphthalene undergoes a chemical change upon heating.

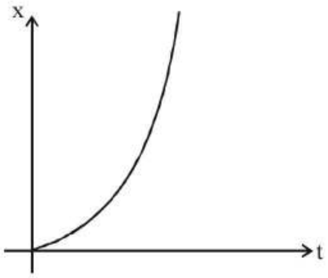
121. A piece of paper and a coin both having the same mass are dropped from the 10^{th} floor of building. The piece of paper would take more time to reach the ground because
(a) gravitational pull on the paper is less than the coin.
(b) buoyant force on the piece of paper is more than that on the coin.
(c) buoyant force on the coin is more and acts in the downward direction.
(d) the piece of paper takes a longer path to reach the ground.

122. During sunrise and sunset, sun appears reddish-orange because
(a) during that time sun emits only reddish-orange light.
(b) all other colours are absorbed by the atmosphere.
(c) reddish-orange light is least scattered by the atmosphere.
(d) all other colours apart from reddish-orange are reflected back by the atmosphere.

123. Ohm's law can also be taken as a statement for
(a) conservation of energy.
(b) conservation of electric charge.
(c) conservation of angular momentum.
(d) non-conservation of momentum of the flowing charges.

124. Motion, of a particle can be described in x-direction by $x = a \sin \omega t$, and y-direction by $y = b \cos \omega t$. The particle is moving on
(a) a circular path of radius 'a'.
(b) a circular path of radius 'b'.
(c) an elliptical path.
(d) a straight line.

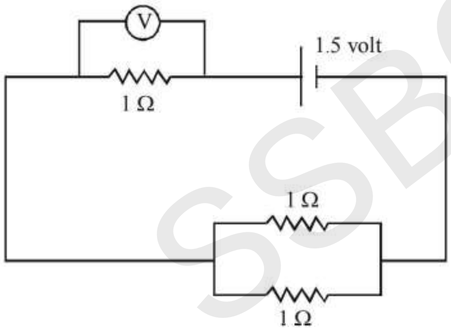
125.



The plot given above represents displacement 'x' of a particle with time 't'. The particle is
(a) moving with uniform velocity.
(b) moving with acceleration.
(c) moving with deceleration.
(d) executing a periodic motion.

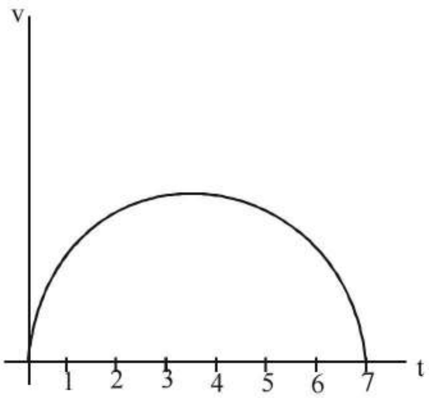
126. A bullet of mass 20 gm is fired in the horizontal direction with a velocity 150 m/s from a pistol of mass 1 kg. Recoil velocity of the pistol is
(a) 3 m/s (b) 3 km/s
(c) 300 m/s (d) 1/3 m/s

127.



What should be the reading of the voltmeter in the circuit given above?
(All the resistance are equal to 1 Ω and the battery is of 1.5 volt)
(a) 1.5 volt (b) 0.66 volt
(c) 1 volt (d) 2 volt

128.



The plot given above represents the velocity of a particle (in m/s) with time (in seconds). Assuming that the plot represents a semi-circle, distance traversed by the particle at the end of 7 seconds is approximately.
(a) 19m (b) 7m
(c) 3.2m (d) 4.75m

129. Suppose we have an iron nail and an iron ball of same mass. When submerged in water, the iron ball may float but the nail alway sinks. This is because
(a) buoyant force on the ball is larger than that of the nail due to their shapes.
(b) viscous force on the ball is higher.
(c) viscous force on the nail is higher.
(d) gravitational force affects the ball differently from the nail.

130. An electric heater is rated 1500 watt. If electric power costs ₹ 2 per kilo-watt-hour, then the cost of power of 10 hours running of the heater is
(a) ₹ 30 (b) ₹ 15
(c) ₹ 150 (d) ₹ 25

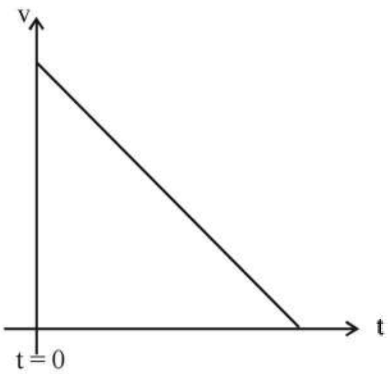
131. The ceilings of a concert hall are generally curved
(a) because they reflect the sound to the audience.
(b) because they can absorb noise.
(c) to have better aeration in the hall.
(d) as any sound from outside cannot pass through a curved ceiling.

132. Bats can know about their prey at a distance even in the night by emitting
(a) infra-red lights.
(b) ultraviolet lights.
(c) chemicals from their body.
(d) ultrasonic sounds.

133. Rays of light get refracted while passing from air to glass because
(a) density of glass is higher than that of air.
(b) they cannot be reflected from a glass surface.
(c) glass absorbs energy from the light rays.
(d) speed of light in glass is less than the speed of light in air.

134. White light while passing through a glass prism breaks up into light of different colours because
(a) refractive index of glass for different colours of light is different.
(b) glass prism absorbs white light and emits lights of several colours in different directions.
(c) of total internal reflection of white light on surfaces of the prism.
(d) of the interference of different colours inside the prism.

135.



Which one among the following situation is best represented by the velocity - time plot shown above?
(a) Uniform motion of a particle on a circle
(b) Accelerated motion of a particle which has a non-zero initial velocity
(c) Decelerated motion of a particle which has an initial non-zero velocity
(d) Decelerated motion of a particle which has no initial velocity

136. When long dry hair is brushed the strands often move away from each other because while brushing
(a) air is being blown through the strands.
(b) static electric charges are being induced on the hair.
(c) mechanical energy is being transferred into heat energy.
(d) the gravitational attraction among the strands becomes smaller.

137. If the length of a simple pendulum is being increased by 4-fold, time period of oscillation will be
(a) decreased by 4-fold.
(b) increased by 4-fold.
(c) decreased to half of the initial value.
(d) increased by a factor of 2 of its initial value.

138. A pressure cooker works on the principle of
(a) elevation of boiling point of water by application of pressure.
(b) making the food-grains softer by application of pressure.
(c) making the food-grains softer by application of pressure and temperature.
(d) keeping the food-grains inside steam for a longer time.

139. Pressure of a gas increases due to increase of its temperature because at higher temperature
(a) gas molecules repel each other more.
(b) potential energy of the gas molecules is higher.
(c) kinetic energies of the gas molecules are higher.
(d) gas molecules attract each other more.

140. The presence of sulphur in gunpowder.
(a) decreases the ignition temperature.
(b) increases the final temperature.
(c) increases explosiveness of the gunpowder.
(d) makes the powder smokeless.

141. Calcium ammonium nitrate (CAN) is a popular nitrogen fertilizer because it is
(a) slow supplier of nitrogen.
(b) having more percentage of nitrogen in it.
(c) fixing the nitrogen in the soil.
(d) capable of making the soil acidic.

142. Chromium oxide is used as an ingredient in paints to obtain
(a) green colour
(b) blue colour
(c) red colour
(d) violet colour

143. A mixture of sodium chloride and naphthalene can be separated by
(a) extraction with hot water
(b) extraction with cold water
(c) sublimation
(d) steam distillation

144. The pH of the solution obtained by dissolving pure sodium chloride in water is
(a) acidic
(b) basic
(c) neutral
(d) dependent on the amount of sodium chloride dissolved in water

145. Oxygen on reaction with non-metals forms oxides, which are
(a) basic oxides (b) acidic oxides
(c) amphoteric oxides (d) neutral oxides

146. Biogas consists of mainly
(a) Methane (b) Ethane
(c) Butane (d) Carbon dioxide

147. A gas is evolved when a piece of zinc metal placed in dilute sulphuric acid (H_2SO_4). What is the gas?
(a) Hydrogen (b) Oxygen
(c) Water vapour (d) Sulphur dioxide

148. Turmeric (Haldi) rapidly becomes colourless on addition of
(a) Baking soda (b) Vinegar
(c) Lemon juice (d) Alcohol

149. Metalloids are
(a) alloys of alkali metals with other metals.
(b) colloids of metals.
(c) elements having some properties of both metals and non-metals.
(d) metals heavier than lead.

150. Two reactants in a flask produce bubbles gas; it turns lime water into milky. The reactants in the flask are
(a) Zinc and hydrochloric acid
(b) Magnesium carbonate and hydrochloric acid.
(c) Magnesium nitrate and hydrochloric acid.
(d) Magnesium sulphate and hydrochloric acid.

NDA 2 2013 Solutions

MATHEMATICS

1. **(d)** $7+4\sqrt{3} = (\sqrt{4})^2+(\sqrt{3})^2+2\sqrt{4}\times\sqrt{3}$

$$= (\sqrt{4}+\sqrt{3})^2$$

$\sqrt{7+4\sqrt{3}} = 2+\sqrt{3}$

2. **(c)** $A\times B=\{(1,2),(1,3),(2,2),(2,3)\}$
$A\times C=\{(1,3),(1,4),(2,3),(2,4)\}$
Number of elements in $(A\times B)\cap(A\times C)=2$

3. **(c)** Here, α and β are the roots of the equation
$x^2+x+2=0$
$\alpha+\beta=-1$
$\alpha\beta=2$

$$\frac{\alpha^{10}+\beta^{10}}{\alpha^{-10}+\beta^{-10}}=\frac{\alpha^{10}+\beta^{10}}{\frac{1}{\alpha^{10}}+\frac{1}{\beta^{10}}}$$

$$=\frac{(\alpha^{10}+\beta^{10})(\alpha\beta)^{10}}{(\alpha^{10}+\beta^{10})}=(\alpha\beta)^{10}$$

$\therefore (\alpha\beta)^{10}=2^{10}=1024$

4. **(a)** Since b is not a perfect square, therefore other root will be $3a-\sqrt{b}$
Required quadratic equation is
$x^2-[(3a+\sqrt{b})+(3a-\sqrt{b})]x+(3a+\sqrt{b})(3a-\sqrt{b})=0$
$\Rightarrow x^2-6ax+9a^2-b=0$

5. **(c)** If A is a finite set having n elements, then the number of relations which can be defined in A set is $2^{n\times n}=2^{n^2}$.

6. **(a)** Given, a, b, c, d are in A.P.

$\Rightarrow \frac{1}{a},\frac{1}{b},\frac{1}{c},\frac{1}{d}$ are in H.P.

$\Rightarrow \frac{1}{d},\frac{1}{c},\frac{1}{b},\frac{1}{a}$ are also in H.P.

Now, multiply each term by abcd.

$\frac{abcd}{d},\frac{abcd}{c},\frac{abcd}{b},\frac{abcd}{a}$

abc, abd, acd, bcd, are in H.P.

7. **(a)** S be the set of all even prime numbers
S = 2 in an even prime number = (Non-empty set)

8. **(a)** $3+4i=2^2+i^2+2\times2\times i$
$=(2+i)^2$
$\sqrt{3+4i}=2+i$

9. **(c)**

2	83	1
2	41	1
2	20	0
2	10	0
2	5	1
2	2	0
	1	

Therefore, $(83)_{10}=(1010011)_2$

10. **(d)** **For reflexive :**
$(a, a)=a-a=0$ is divisible by 5.
For symmetric :
If $(a-b)$ is divisible by 5, then $b-a=-(a-b)$ is also divisible by 5.
Thus relation is symmetric.
For transitive
If $(a-b)$ and $(b-c)$ is divisible by 5.
Thus relation is transitive.
$\therefore$ R is an equivalence relation.

11. **(d)** $\sum_{r=0}^{n} c(n,r)={}^nC_0+{}^nC_1+{}^nC_2+....+{}^nC_n$
$2^n=(1+1)^n={}^nC_0+{}^nC_1+{}^nC_2+....+{}^nC_n$

$\therefore \sum_{r=0}^{n} c(n,r)=2^n$

12. **(a)** $S=0.9+0.09+0.009+...$
$=9(0.1+0.01+0.001+...)$

$$=9\left[\frac{0.1}{1-0.1}\right]=9\times\frac{0.1}{0.9}=1$$

13. **(d)** $f(x)=\begin{cases}x^2+3x+2=0, & \text{for } x\ge0\\ x^2-3x+2=0, & \text{for } x<0\end{cases}$

for $x\ge0$
$x^2+3x+2=0$

$$x=\frac{-3\pm\sqrt{9-8}}{2}=\frac{-3\pm1}{2}$$

$x=-2,-1$
for $x<0$
$x^2-3x+2=0$

$$x=\frac{3\pm\sqrt{9-8}}{2}=\frac{3\pm1}{2}$$

$x=2, 1$
Since x as negative, therefore $x\ne2, 1$
Hence the given equation has no real roots

14. (c) n (T) = 50
n (D) = 30
n (H) = 40
n(T) = n (D) + n(H) – n (DnH)
50 = 30 + 40 – n (D∩H)
n (D∩H) = 70 – 50 = 20
Number of people having diabetes and high blood pressure = 20

15. (d) If $B = A^{-1}$, then Ab = I (identity matrix)
Therefore, statement 1 is false.

$I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $A = \begin{bmatrix} 0 & 2 \\ 2 & 0 \end{bmatrix}$, then $IA = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$\begin{bmatrix} 0 & 2 \\ 2 & 0 \end{bmatrix} = 0$

Therefore, statement 2 is not correct.

16. (a)

1. $\begin{pmatrix} 1 & 2 & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{pmatrix} = 2\begin{pmatrix} 1 & 1 & 1 \\ a & a & 1 \\ b & b & 1 \end{pmatrix}$

$= 2\begin{vmatrix} 1 & 1 & 1 \\ a & a & 1 \\ b & b & 1 \end{vmatrix} = 0$

Hence matrix is singular.

2. $\begin{vmatrix} c & 2c & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{vmatrix} = 2\begin{vmatrix} c & c & 1 \\ a & a & 1 \\ b & b & 1 \end{vmatrix}$

$= 2\begin{vmatrix} c & c & 1 \\ a & a & 1 \\ b & b & 1 \end{vmatrix} = 0$

Hence matrix is singular.

17. (c) Co-factor of 4 = $(-1)^3 (2 \times 9 - 3 \times 8) = -(-6) = 6$

18. (b) $|\text{adj } A| = |A|^{n-1}$ {n is order of square matrix}
If A is square matrix of order 3, then $|\text{adj } A| = |A|^2$

19. (c) n(A) = 4 and n (B) = 3
Number of elements in n (A × B) = 4 × 3 = 12

20. (b) C (28, 2r) = C (28, 2r – 4)
$^{28}C_{2r} = {}^{28}C_{2r-4}$
⇒ 2r + 2r – 4 = 28
⇒ 4r = 32
⇒ r = 8

21. (b) Suppose U = {a, b, c, d, e, f, g, h}
A = {a, b, c, d}
B = {a, b, c, d, e} Given A ⊆ B
A^c = {e, f, g, h}, B^C = {f, g, h}
Hence, $B^C \subseteq A^C$

22. (a) $AB = \begin{pmatrix} i & 0 \\ 0 & -1 \end{pmatrix}\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & -i \\ -i & 0 \end{pmatrix}$

$AB = -\begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix} = -C$

23. (c)
1 2
2 4
3 6
4 8
. .
. .
. .
. .
. .

Domain (x) Co-domain (2x)
For each element in the domain there is only one element in the therefore f(x) is one–one.
No image in the co-domain which has no pre-image in the domain, therefore f(x) is onto
Hence f(x) both is one-one and onto.

24. (d) Given, $2A = \begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix}$

$A = \begin{pmatrix} 1 & \frac{1}{2} \\ \frac{3}{2} & 1 \end{pmatrix}$

$|A| = \frac{1}{4}$

$\text{adj } A = \begin{pmatrix} 1 & -\frac{1}{2} \\ \frac{-3}{2} & 1 \end{pmatrix}$

$A^{-1} = 4\begin{pmatrix} 1 & -\frac{1}{2} \\ \frac{-3}{2} & 1 \end{pmatrix} = \begin{pmatrix} 4 & -2 \\ -6 & 4 \end{pmatrix}$

25. (b) $\begin{pmatrix} 2 & 3 \\ 4 & 1 \end{pmatrix} \times \begin{pmatrix} 5 & -2 \\ -3 & 1 \end{pmatrix} = \begin{pmatrix} 1 & -1 \\ 17 & \lambda \end{pmatrix}$

$\begin{pmatrix} 1 & -1 \\ 17 & -7 \end{pmatrix} = \begin{pmatrix} 1 & -1 \\ 17 & \lambda \end{pmatrix}$

$\lambda = -7$

26. (b) Angle traced by the hour hand in 12 hours = 360°

Angle traced by it in 4 hr 30 min $\left(4h + \frac{30}{60} hr\right) = \frac{9}{2}$ hr

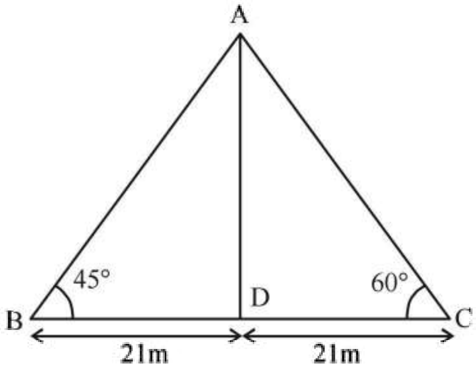
$= \frac{9}{2} \times \frac{360}{12} = 135°$

Angle traced by minute hand is 60° min = 360°

Angle traced by it in 30 min = $\frac{30}{60} \times 360 = 180°$

Required Angle = 180° – 135° = 45° ⇒ $45 \times \frac{\pi}{100} = \frac{\pi}{4}$ radian

27. (a)



In ΔADB, $\tan 45° = \dfrac{AD}{BD} = \dfrac{AD}{21}$

$AD = 21$ m

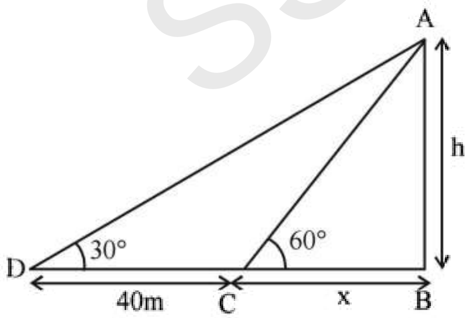
In ΔADC, $\tan 60° = \dfrac{AD}{x}$

$x = \dfrac{21}{\sqrt{3}} = 7\sqrt{3}$ m

28. (c) $\dfrac{\cot 54°}{\tan 36°} + \dfrac{\tan 20°}{\cot 70°} = \dfrac{\cot(90° - 36°)}{\tan 36°} + \dfrac{\tan(90° - 70°)}{\cot 70°}$

$= \dfrac{\tan 36°}{\tan 36°} + \dfrac{\cot 70°}{\cot 70°} = 1 + 1 = 2$

29. (d)



In ΔABC, $\tan 60° = \dfrac{h}{x}$

$\Rightarrow \sqrt{3} = \dfrac{h}{x} \Rightarrow h = \sqrt{3}x$ ...(1)

In ΔABD, $\tan 30° = \dfrac{h}{x + 40}$

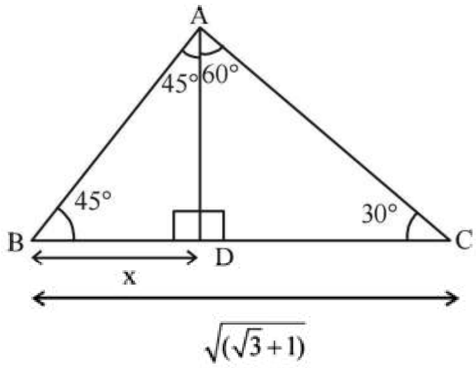
$\Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{h}{x + 40} \Rightarrow x + 40 = \sqrt{3}h$ ...(2)

Putting value of h from equation (1), we get

$x + 40 = 3x$

$x = 20$ m

30. (a)



From ΔADB, $AD = BD = x$

In ΔADC,

$\tan 30° = \dfrac{x}{\sqrt{3} + 1 - x}$

$\Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{x}{\sqrt{3} + 1 - x} \Rightarrow \sqrt{3}x = \sqrt{3} + 1 - x$

$\Rightarrow (\sqrt{3} + 1)x = \sqrt{3} + 1$

$x = \dfrac{\sqrt{3} + 1}{\sqrt{3} + 1}$

Area of $\Delta ABC = \dfrac{1}{2} \times (\sqrt{3} + 1) \times 1 = \dfrac{\sqrt{3} + 1}{2}$

31. (a) $\sin^2 20° + \sin^2 70°$

$= \sin^2 20° + \sin^2(90° - 20°)$

$= \sin^2 20° + \cos^2 20° = 1$

32. (a) $\begin{vmatrix} 1 & bc & a(b+c) \\ 1 & ac & b(c+a) \\ 1 & ab & c(a+b) \end{vmatrix}$

Applying $C_3 \to C_2 + C_3$

$$\begin{vmatrix} 1 & bc & ab+bc+ac \\ 1 & ac & ab+bc+ac \\ 1 & ab & ab+bc+ac \end{vmatrix}$$

$= (ab + bc + ac)\begin{vmatrix} 1 & bc & 1 \\ 1 & ac & 1 \\ 1 & ab & 1 \end{vmatrix}$

$= (ab + bc + ac) \times 0 = 0$

33. (d) According to 'Distribution law' in set theorry the given both statements are wrong.

Statement 1 – Distribution law

Statement 2 – Distribution law

34. (b) $(1 + x)^n = {}^nC_0 + {}^nC_1 x + {}^nC_2 x^2 + ... + {}^nC_n x^n$

Putting $x = 1$

$2^n = {}^nC_0 + {}^nC_1 + {}^nC_2 + ... + {}^nC_n$

$\Rightarrow a_0 + a_1 + ... a_n = 2^n$

[here ${}^nC_0 = a_0$, ${}^nC_1 = a_1$, ..., ${}^nC_n a_n$]

35. **(b)** α and β are the roots of the given equation, then

$\alpha+\beta=-\dfrac{b}{a}$ and $\alpha\beta=\dfrac{b}{a}$

$$\sqrt{\frac{\alpha}{\beta}}+\sqrt{\frac{\beta}{\alpha}}+\sqrt{\frac{b}{a}}$$

$$=\frac{\alpha+\beta}{\sqrt{\alpha\beta}}+\sqrt{\alpha\beta}$$

$$=\frac{\alpha+\beta+\alpha\beta}{\sqrt{\alpha\beta}}=\frac{-\frac{b}{a}+\frac{b}{a}}{\sqrt{\frac{b}{a}}}=0$$

36. **(d)** $(110001)_2=1\times2^5+1\times2^4+0\times2^3+0\times2^2+0\times2^1+1\times2$

$=32+16+0+0+0+1=(49)_{10}$

37. **(c)** Discriminant, $D=(-8)^2-4\times16=0$

$\therefore$ Roots are real and equal.

38. **(c)** $$\tan^{-1}\left(\frac{1}{2}\right)+\tan^{-1}\left(\frac{1}{3}\right)=\tan^{-1}\left(\frac{\frac{1}{2}+\frac{1}{3}}{1-\frac{1}{2}\times\frac{1}{3}}\right)$$

$$=\tan^{-1}\left(\frac{\frac{5}{6}}{\frac{5}{6}}\right)=\tan^{-1}(1)=\frac{\pi}{4}$$

39. **(d)** $(1-\sin^2\theta)(1+\tan^2\theta)=\cos^2\theta\,.\,\sec^2\theta$

$$=\cos^2\theta\,.\,\frac{1}{\cos^2\theta}=1$$

40. **(c)** $(1+2x+x^2)^{10}=[(x+1)^2]^{10}=(x+1)^{20}$

Number of terms in the expansion of $(x+1)^{20}$

$=20+1=21$

41. **(c)** $S_5=S_{10}$

$\Rightarrow \dfrac{5}{2}[2a+4d]=\dfrac{10}{2}[2a+9d]$

$\Rightarrow 5a+10d=10a+45d$

$\Rightarrow a=-7d$ or $d=\dfrac{-1}{7}a$

We see, If d is positive, then first term should be negative and common difference should be positive. If d is negative, then first term should be position and common difference should be negative.

42. **(c)** Number of element in set A is 4.

Cordinality of the power set $P(A)=2^4=16$

43. **(d)** $x^2-10x+9=0$

$x^2-x-9x+9=0$

$x(x-1)-9(x-1)=0$

$(x-1)(x-9)=0$

$x=1, 9$

Difference in roots $=9-1=8$

44. **(a)** $8x-9y=20$ or $80x-90y=200$ ...(1)

$7x-10y=9$ or $63x-90y=81$ ...(2)

Subtracting (2) from (1), we get

$17x=119$

$x=7$

$8\times7-9y=20$

$9y=36$

$y=4$

$2x-y=2\times7-4=10$

45. **(d)** If root are real

$b^2-4\times4\geq0$

$b^2\geq16$

$b\leq-4, b\geq4$

46. **(b)** $0+3=3, 3+5=8, 8+7=15, 15+9=24, 24+11=35, 35+13=48$

Sequence is 0, 3, 8, 15, 24, 35, 48

47. **(a)** $$\tan 15^\circ=\sqrt{\frac{1-\cos30^\circ}{1+\cos30^\circ}}=\sqrt{\frac{1-\frac{\sqrt3}{2}}{1+\frac{\sqrt3}{2}}}=\sqrt{\frac{2-\sqrt3}{2+\sqrt3}}$$

$$=\sqrt{\frac{2-\sqrt3}{2+\sqrt3}\times\frac{2-\sqrt3}{2-\sqrt3}}=\sqrt{\frac{(2-\sqrt3)^2}{1}}=2-\sqrt3$$

48. **(b)** 1. $\tan\left(\dfrac{\pi}{6}\right)=\dfrac{1}{\sqrt3}$ 2. $\tan\left(\dfrac{3\pi}{4}\right)=-1$

3. $\tan\left(\dfrac{5\pi}{4}\right)=1$ 4. $\tan\left(\dfrac{2\pi}{3}\right)=-\sqrt3$

$-\sqrt3<-1<\dfrac{1}{\sqrt3}<1$

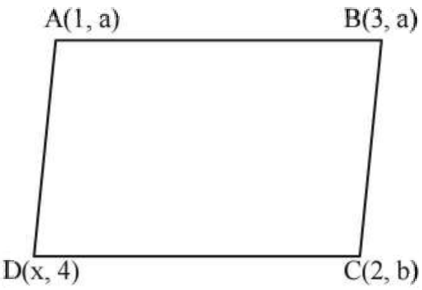
49. **(d)** $\sin x.\cot x.\operatorname{cosec} x.\tan x$

$=(\sin x.\operatorname{cosec} x).(\cot x.\tan x)$

$=1\times1=1$

50. **(b)** $\log_{81}243=\log_{3^5}3^6=\dfrac{\log 3^6}{\log 3^5}=\dfrac{6}{5}=1.25$

51. **(*)**



ABCD is a parallelogram.

AB ∥ DC, then slope of line AB = slope of line DC

$\dfrac{a-a}{3-1}=\dfrac{b-y}{2-x}\Rightarrow y=b$

Also, AD ∥ BC, $\dfrac{a-y}{1-x}=\dfrac{a-b}{3-2}$

$\dfrac{a-b}{1-x}=\dfrac{a-b}{3-2}\Rightarrow\dfrac{a-b}{1-x}\times\dfrac{1}{a-b}=1$

$1-x=1$

$x=0$

Then points D are (0, b)

52. **(c)** $2x + 3y + a = 0$ or $y = \frac{-2}{3}x - \frac{a}{3}$

Slope $= \frac{-2}{3}$

$5x + ky + a = 0$ or $y = \frac{-5}{k}x \frac{-a}{5}$

Slope $= \frac{-5}{x}$

lines are parallel

$\frac{-2}{3} = \frac{-5}{k}$

$k = \frac{15}{2} = 7.5$

53. **(a)** $3x + 4y + 5 = 0$ or $y = \frac{-3}{4}x + \frac{-5}{4}$

Slope $= \frac{-3}{4}$

Slope of required line, $m = \frac{-1}{-\frac{3}{4}} = \frac{4}{3}$

Also line passes through $(4, -5)$

Equation of line, $y + 5 = \frac{4}{3}(x - 4)$

$\Rightarrow 3y + 15 = 4x - 16$
$\Rightarrow 4x - 3y - 31 = 0$

54. **(b)** $4x^2 - 9y^2 = 1$

$$\frac{x^2}{\left(\frac{1}{2}\right)^2} - \frac{y^2}{\left(\frac{1}{3}\right)^2} = 1$$

eccentricity, $e = \sqrt{1 + \frac{\left(\frac{1}{3}\right)^2}{\left(\frac{1}{2}\right)^2}} = \frac{\sqrt{13}}{3}$

foci $= \left(\pm\frac{1}{2} \times \frac{\sqrt{13}}{3}, 0\right) = \left(\pm\frac{\sqrt{13}}{6}, 0\right)$

55. **(d)** $d_1 = \frac{|3 \times 1 \times 4 \times 1 - 1|}{\sqrt{3^2 + 4^2}} = \frac{6}{5}$

$d_2 = \frac{|4 \times 1 + 3 \times 1 + 2K|}{\sqrt{3^2 + 4^2}} = \frac{7 + 2K}{5}$

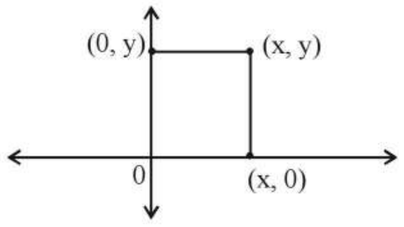
$d_1 = d_2$
$7 + 2K = 6$

$k = -\frac{1}{2}$

56. **(a)** Let moving point be $P(x, y)$

$\sqrt{(y-2)^2 + (x-1)^2} = \sqrt{(y-3)^2 + (x+2)^2}$
$\Rightarrow (y+2)^2 + (x-1)^2 = (y-3)^2 + (x+2)^2$
$\Rightarrow y^2 + 4 + 4y + x^2 + 1 - 2x = y^2 + 9 - 6y + x^2 + 4x + 4$
$\Rightarrow 10y - 6x - 8 = 0$
$\therefore$ Locus of P is a straight line.

57. **(c)**



$\sqrt{(x-0)^2 + (y+y)^2} = \sqrt{(x-x)^2 + (y-0)^2}$
$\Rightarrow \sqrt{(x-0)^2} = \sqrt{(y-0)^2}$
$\Rightarrow x^2 = y^2$
$\Rightarrow y = \pm x$

58. **(c)** Slope of line joining $(5, 2)$ and $(0, 0)$

$\tan A = m_1 = \frac{2-0}{5-0} = \frac{2}{5}$

Slope of line joining $(6, -15)$ and $(0, 0)$

$\tan B = m_2 = \frac{-15}{6} = \frac{-5}{2}$

$|m_2| = \frac{5}{2}$

$\tan(A + B) = \frac{\frac{2}{5} - \frac{5}{2}}{1 - \frac{2}{5} \times \frac{5}{2}} = \frac{\frac{-21}{10}}{0} = \infty$

$A + B = \tan^{-1}(\infty) \Rightarrow \tan^{-1}\tan\frac{\pi}{2}$

$A + B = \frac{\pi}{2}$

59. **(b)** $4x^2 + 9y^2 = 36$

$\frac{x^2}{3^2} + \frac{y^2}{2^2} = 1$

Length of latus rectum $= 2 \times \frac{2^2}{3} = \frac{8}{3}$

60. **(c)** Equation of line

$y + 2 = \frac{7+2}{-4-5}(x - 5)$
$\Rightarrow y + 2 = -x + 5$
$\Rightarrow x + y = 3$

61. **(d)** Slope of $x + y = 1$ is -1
Slope of $x - y = 1$ is 1
Let $\tan A = -1$, $\tan B = 1$

$A = \frac{3\pi}{4}, B = \frac{\pi}{4}$

$A - B = \frac{\pi}{2}$

62. **(b)** $y^2 + 2x = 0 \Rightarrow y^2 = -2x$, which is in the form $y^2 = -4ax$. Therefore axis of parabola is x-axis.

63. **(b)** Circle is passing through origin then C = 0

Now, $x^2 + y^2 + x = 0$

$$x^2 + x + \frac{1}{4} - \frac{1}{4} + y^2 = 0$$

$$\left(x + \frac{1}{2}\right)^2 + y^2 = \left(\frac{1}{2}\right)^2$$

$\therefore$ Radius of given circle is $\frac{1}{2}$ units

64. **(a)** Centroid $= \left(\frac{2-2+3}{3}, \frac{3-5+5}{3}\right)$

$= (1, 1)$

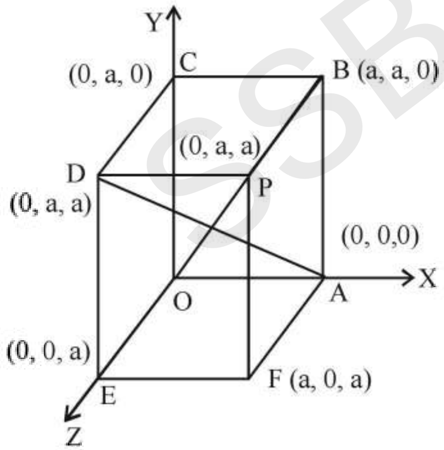
65. **(b)** Let line be $\frac{x}{a} + \frac{y}{b} = 1$

given that $\frac{1}{a} = m$ and $\frac{1}{b} = n$

$$a = \frac{1}{m}, b = \frac{1}{n}$$

equation of line, $mx + ny = 1$

66. **(d)**



diagonals = OP and AD and Acute anngle = θ

$$\cos\theta = \left|\frac{a_1a_2 + b_1b_2 + c_1c_2}{\sqrt{a_1^2 + b_1^2 + c_1^2}\sqrt{a_2^2 + b_2^2 + c_2^2}}\right|$$

$$= \left|\frac{a(-a) + (a)(a) + (a)(a)}{\sqrt{a^2 + a^2 + a^2}\sqrt{a^2 + a^2 + a^2}}\right|$$

$$= \left|\frac{-a^2 + a^2 + a^2}{\sqrt{3a^2}\sqrt{3a^2}}\right| = \left|\frac{a^2}{3a^2}\right| = \frac{1}{3}$$

$\Rightarrow 3\cos\theta = 1$

67. **(b)** $(x - x_1)^2 + (y - y_1)^2 + (z - z_1)^2 = r^2$

Centre (0, 0, 0) and radius = 1

$(x - 0)^2 + (y - 0)^2 + (z - 0)^2 = (1)^2$

$x^2 + y^2 + z^2 = 1$

68. **(c)** Sum of squares of direction cosines

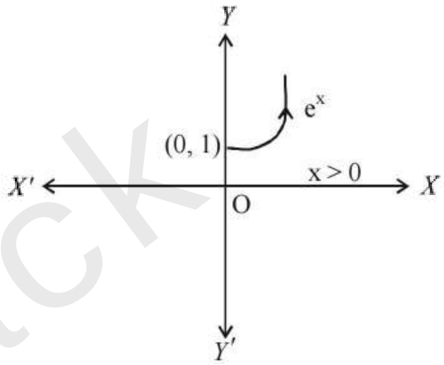
$= (1)^2 + (0)^2 + (0)^2 = 1$

69. **(a)** $d = \left|\frac{2 \times 0 + 0 + 2 \times 0 - 3}{\sqrt{2^2 + 1^2 + 2^2}}\right| = \frac{3}{3} = 1$ unit

70. **(b)** Position vector of line segment = $2\hat{i} + 3\hat{j} + 6\hat{k}$

length = $\sqrt{2^2 + 3^2 + 6^2} = \sqrt{49} = 7$ units

71. **(c)** $f(x) = e^x$, where $x > 0$



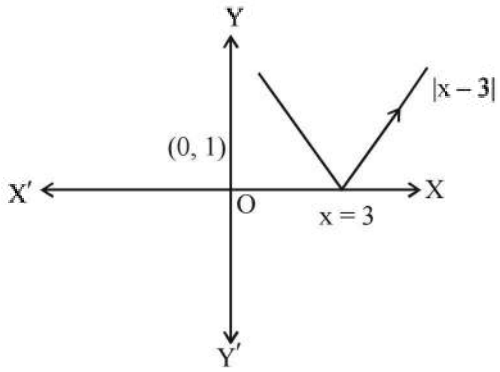
According to graph,

Graph of e^x is not breaking when $x > 0$

Therefore, graph is continuous at $x > 0$

Statement II

$g(x) = |x - 3|$



Graph of $|x - 3|$ is not breaking but have sharp turn at $x = 3$.

So, it is continuous

72. **(b)** $U = x^3$

$$\frac{dU}{dx} = 3x^2 \quad ...(1)$$

$V = x^2$

$$\frac{dV}{dx} = 2x \quad ...(2)$$

From (1) and (2)

$$\frac{dU}{dV} = \frac{3x^2}{2x} = \frac{3}{2}x$$

73. **(d)** $\lim\limits_{x \to 2} \frac{2 - x}{x^3 - 8} = \lim\limits_{x \to 2} \frac{2 - x}{(x - 2)(x^2 + 2x + 4)}$

$$= \lim_{x\to 2}\frac{-1}{x^2+2x+4}$$
Putting $x=2$, we get
$$\frac{-1}{2^2+4+4} = -\frac{1}{12}$$

74. **(a)** $f: R \to R, f(x) = \begin{cases} x^2 & , \quad x \geq 0 \\ -x & , \quad x < 0 \end{cases}$

For continuity at $x=0$

$f(0-0) = \lim_{h\to 0} f(0-h)$

$= \lim_{h\to 0}[(0-h)] = \lim_{h\to 0} h = 0$

$f(0+0) = \lim_{h\to 0} f(0+h) = \lim_{h\to 0}(0+h)^2 = 0$ and $f(0)=0$

$f(x)$ is continuous at $x=0$

For differentiability at $x=0$

$\lim_{h\to 0}\frac{-(-h)-0}{-h} = \lim_{h\to 0} = \frac{h}{-h} = -1$

and $\lim_{h\to 0}\frac{f(0+h)-f(0)}{h} = \lim_{h\to 0} h = 0$

$f(x)$ is not differentiable at $x-0$

75. **(b)** $F(x) = 2x^2+3x-5$

$F'(x) = 4x+3$

$F'(0)+3F'(-1) = 3+3(-4+3) = 0$

76. **(a)** $\lim_{x\to 0}\frac{1-\cos x}{x} = \lim_{x\to 0}\frac{2\sin^2\frac{x}{2}}{x}$

$$= 2\left[\lim_{x\to 0}\frac{\sin\frac{x}{2}}{\frac{x}{2}\times 2}.\lim_{x\to 0}\sin\frac{x}{2}\right]$$

$$= 2\left[\frac{1}{2}\times 0\right] = 0$$

77. **(c)** $\lim_{x\to 0}\frac{\cos x}{\pi - x} = \frac{\cos 0}{\pi - 0} = \frac{1}{\pi}$

78. **(c)** $\lim_{x\to 0}\frac{\sin 2x+4x}{2x+\sin 4x} = \lim_{x\to 0}\frac{\frac{\sin 2x}{x}+4}{2+\frac{\sin 4x}{x}}$

$$= \lim_{x\to 0}\frac{2\left(\frac{\sin 2x}{2x}\right)+4}{2+4\left(\frac{\sin 4x}{4x}\right)}$$

Applying limit, we get $\frac{2+4}{2+4} = 1$

79. **(a)** $f(x) = x^3+2x^2-4x+6$

$f'(x) = 3x^2+4x-4$

$f''(x) = 6x+4$

Put $f'(x) = 0$

$3x^2+4x-4 = 0$

$x = -2, \frac{2}{3}$

$f''(-2) = 6x-2+4 = -8 < 0$

$f''\left(\frac{2}{3}\right) = 6\times\frac{2}{3}+4 = 8 > 0$

Value is maximum at $x = -2$

80. **(c)** At $x=4$, $f(x)=0$

81. **(c)** $\int_\ell^2 \ln x\,dx = [x\ln x - x]_\ell^2$

$= 2\ln 2 - 2 - \ln l + l$

$= \ln - \ln e = \ln\left(\frac{4}{e}\right)$

82. **(a)** $\int\frac{dx}{\sqrt{4+x^2}} = \int\frac{dx}{\sqrt{2^2+x^2}} = \ln|\sqrt{4+x^2}+x|+C$

83. **(a)** Highest order derivative, present in the differential equations is $\left(\frac{dy}{dx}\right)$, therefore its order is one.

84. **(a)** $y = 2\cos x + 3\sin x$

$\frac{dy}{dx} = -2\sin x + 3\cos x$

$\frac{d^2y}{dx} = -2\cos x - 3\sin x$

$= -(2\cos x + 3\sin x)$

$= -y$

$\frac{d^2y}{dx^2} + y = 0$

85. **(c)** $x^2+y^2 = r^2$ [equation of circle]

Differentiating both sides w.r.t. x.

$2x + 2y\frac{dy}{dx} = 0$

$\frac{dy}{dx} = -\frac{x}{y}$

86. **(a)** $\int\sin^2 x\,dx + \int\cos^2 x\,dx = \int(\sin^2 x + (\cos^2 x)dx$

$dx = x + c$

87. **(a)** $I = \int e^{e^x}e^x dx$

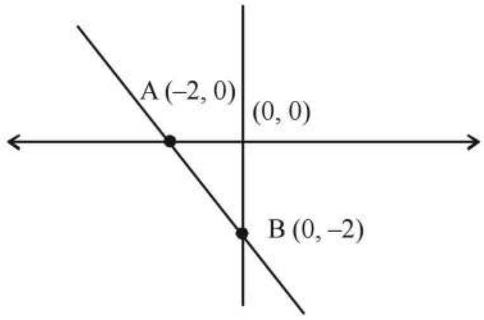
Let $e^x = y \Rightarrow e^x\,dx = dy$

$dx = \frac{dy}{e^x}$

$I = \int e^4 e^x\frac{dy}{e^x} = \int e^y dy = e^y + c$

$I = e^{e^x} + c$

88. **(c)**



Area of $\Delta OAB = \frac{1}{2} \times 2 \times 2 = 2$ square units

89. **(c)** $\frac{d}{dx}\sin(\sin x) = \cos(\sin x).\cos x$

90. **(c)** $f(x)=|x-1|$

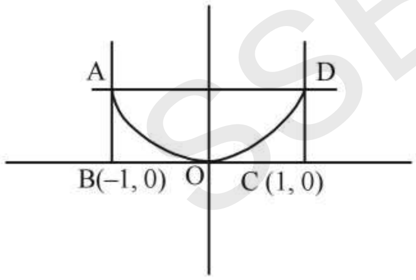
Redefined the function f(x)

$$f(x)=\begin{cases} 1-x, & x<1 \\ x-1, & x>1 \end{cases}$$

$$f'(x)=\begin{cases} -1; & x<1 \\ 1; & x>1 \end{cases}$$

$\therefore f'(2)=1$

91. **(c)**



Area of ABCD $= 2 \times 1 = 2$ sq. units

Area of BAODC $= \int_{-1}^{1} x^2 dx = \left.\frac{x^3}{3}\right|_{-1}^{1} = \frac{2}{3}$ sq. units

Required area $= 2 - \frac{2}{3} = \frac{4}{3}$ sq. units

92. **(b)** Required area $= \int_0^{\frac{\pi}{4}} \tan x\, dx$

$= \ln|\sec 1|_0^{\frac{\pi}{4}} = \ln\sqrt{2} = \frac{\ln 2}{2}$

93. **(a)** $\int(x\cos x + \sin x)dx = \int x\cos x\, dx + \int \sin x\, dx$

$= x\sin x - \int \sin x\, dx + \int \sin x\, dx = x\sin x + c$

94. **(b)** $\int_0^2 e^{\ln x}dx = \int_0^2 x\, dx = \left|\frac{x^2}{2}\right|_0^2 = 2$

95. **(d)** $\cos\frac{\pi}{3} = \frac{(\hat{i}-m\hat{j}).(\hat{j}+\hat{k})}{\left|\sqrt{1+m^2}\right|\left|\sqrt{1^2+1^2}\right|}$

$\frac{1}{2} = \frac{-m}{\sqrt{1+m^2}.\sqrt{2}}$

$\frac{1}{2} = \frac{m^2}{1+m^2}$

$m = \pm 1$

96. **(d)** $(\hat{i}-\hat{j})\times(\hat{i})$

$= \hat{i}\times\hat{i} - \hat{j}\times\hat{k} = \hat{k}$

97. **(c)** $\overrightarrow{AB} = -2\hat{i}+6\hat{j}-3\hat{k}$

$|\overrightarrow{AB}| = \sqrt{(-2)^2+6^2+(-3)^2} = \sqrt{49} = 7$

98. **(d)** $(\hat{i}-2x\hat{j}-3y\hat{k}).(\hat{i}+3x\hat{j}+2y\hat{k}) = 0$

$1-6x^2-6y^2=0$

$-6x^2-6y^2=-1$

$x^2+y^2=\frac{1}{6}$

$x^2+y^2=\left(\sqrt{\frac{1}{6}}\right)^2$

99. **(a)** $|P(2\hat{i}-\hat{j}+2\hat{k})| = 3$

$P\left|\sqrt{2^2+(-1)^2+2^2}\right| = 3$

$3P = 3 \Rightarrow P = 1$

100. **(a)** $\bar{a}+t\bar{b} = (2-t)\hat{i}+(2+2t)\hat{j}+(3+t)\hat{k}$

$(\vec{a}+t\vec{b})$ and $\vec{c}$ is perpendicular. Therefore,

$(\vec{a}+t\vec{b}).\vec{c} = 0$

$3(2-t)+2+2t=0$

$6-3t+2t+2=0$

$t=8$

101. **(b)** Sum of all observations $= 20 \times 15 = 300$

Sum of correct observations

$= 300-(3+6)+(8+4) = 303$

Correct mean $= \frac{303}{20} = 15.15$

102. **(c)** Sum of squares of first 'n' natural numbers

$= \frac{n(n+1)(2n+1)}{6}$

Mean of the squares of first 'n' natural numbers

$= \frac{(n+1)(2n+1)\times n}{6\times n} = \frac{(n+1)(2n+1)}{6}$

103. **(c)**

104. **(d)** After construction of cumulative frequency distribution, we can find out median easily.

105. **(b)**

106. (c) A, B and C are mutually exclusive
$A \cap B \cap C = 0$
$P(A \cap B \cap C) = 0$

107. (a) Variance of 11 natural numbers $= \frac{11^2 - 1}{12} = 10$

109. (b) $P = q = \frac{1}{2}, nP = 6$

$\frac{n}{2} = 6 \Rightarrow n = 12$

110. (c) Number of possible outcomes = 36
When sum is 10, samples are (5, 5), (4, 6) and (6, 4)

Required probability $= \frac{3}{36} = \frac{1}{12}$

111. (c) Number of possible outcomes = 216
triplets = (1, 1, 1), (2, 2, 2), (3, 3, 3), (4, 4, 4), (5, 5, 5), (6, 6, 6)

Required probability $= \frac{6}{216} = \frac{1}{36}$

112. (a)
113. (c)
114. (d) For binomial distribution
$p < 1, q < 1$ and $p + q = 1$

115. (b) Possible outcomes are (Head, 1), (Head, 2), (Head, 3), (Head, 4), (Head, 5), (Head, 6), Tail

116. (c) $P(A \cup B) - P(A \cap B) = \frac{2}{5}$

We know that, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\therefore P(A) + P(B) - P(A \cap B) - P(A \cap B) = \frac{2}{5}$

$\frac{2}{3} + \frac{2}{5} - 2P(A \cap B) = \frac{2}{5}$

$-2P(A \cap B) = \frac{2}{5} - \frac{2}{3} - \frac{2}{5}$

$-2P(A \cap B) = \frac{6-16}{15} \Rightarrow \frac{-10}{15} = -\frac{2}{3} \times \frac{-1}{2} = \frac{1}{3}$

117. (d) February 2016 has exactly 5 Mondays.

118. (c)

119. (d) Probability of $A = \frac{1}{6}$

Probability of $B = \frac{1}{5}$

Probability of $C = \frac{1}{4}$

Hence, required probability $= \frac{1}{6} \times \frac{1}{5} \times \frac{1}{4} = \frac{1}{120}$

120. (c) **Detailed Method:**

Variance $= \frac{\sum d^2}{n}$

$5 = \frac{\sum d^2}{20} \Rightarrow \sum d^2 = 100$

According to question

$\sum (d_1)^2 = \sum (2d)^2 = 4\sum d^2 = 4 \times 100 = 400$

New variance $= \frac{400}{20} = 20$

Shortcut Method:
If each observation is multiplied by 2
New variance $= 2^2 \times 5 = 20$

GENERAL ABILITY

PART-A: ENGLISH

1. (a)

2. (a) In this sentence, he wondered that what seems totally wrong as in English grammar what is never used after that. It does not seem necessary as directly what can be used after wondered. Other phrases don't have any error.

3. (c)

4. (b) In this particular sentence, it is to be noted that the sentence is of assertive type. Thus in an assertive type sentence, any phrase cannot be in interrogative form. Thus what is he doing sounds more like a question than a statement. Thus it is clear that error is in option (b).

5. (c) In this item option c has error as it suggests a person going to "the" bed. We cannot use the for bed in general sense. It is not about a particular or exclusive bed that we are talking about or he goes to for the last ten years. Thus option (c) is the answer.

6. (b) Here option (b) has the error in the usage of took down. Here the sentence means that soon has inherited his father's position. But for inheriting someone's position, we use the phrasal verb took up, not took down. Took down does not make any sense in this sentence. Thus option (b) is the answer.

7. (c) Called to question is an absolutely wrong phrase. Called for questioning should be the correct alternative as a person is called for an activity not "called" to as "for" relates to the purpose of calling. To hints out addressing someone. Thus to is not appropriate suggesting option (c) to be the correct answer.

8. (c) In this question option (c) has error as between does not have a preposition before it. And it looks a little vague. We are referring to the space in between the weekends, not just weekends itself. Thus in should be used before between. Thus option (c) is the answer.

9. (d) This question has no error. Thus option (d) is the answer.

10. (c) In this sentence unnecessary usage of the word completely has been done. When a document is confidential, it is understood that it is confidential on the whole. No clauses whatsoever. Thus completely confidential is incorrect itself. Thus option (c) is the answer.

11. (b) The word rancour (noun) means bitterness or resentfulness which is long standing. Option (a) dislike means to detest which is a verb. Option (b) hatred is a noun and has a similar meaning to the word rancour. Division means separation or partition. Criticism means condemnation. Thus we see that out of the list provided the closest meaning to rancour is option (c), hatred.

12. (b) The word isolated is an adjective which means cut-off or lonely. Option (a) destroyed is an adjective which means devastated. Option (b) separated from others also seems very close to the word lonely. Battered means shabby and tattered which has no connection with the word lonely. The word devastated means destroyed. Out of the given synonyms the closest to isolated is option (b) separated from others.

13. (c) The word in question, columns give a picture of vertical straight lines. Another meaning would be an upright pillar, typically cylindrical, supporting an arch, entablature, or other structure or standing alone as a monument. Option (a) statue means a carved or cast figure of a person or animal, especially one that is life-size or larger. Option (b) arches pertains to a curved masonry construction for spanning an opening, consisting of a number of wedge like stones, bricks. Pillars means tall vertical structures of stone, wood, or metal. Murals mean paintings or other works of art executed directly on a wall. Thus we derive from the above explanations that pillars is the closest in meaning to the word columns.

14. (b) The word block is a verb which means to obstruct or jam, hinder etc. alter means to change or modify. The next option, obstruct means to hinder, block very similar to the word in question. The word" improve" means to make better which has no direct relation to the word block. Spoil means to mess up or ruin. Thus we see that the correct answer is option (b) obstruct.

15. (a) The word abruptly means suddenly and surprisingly, unexpectedly. Suddenly means again the same as before, quickly and abruptly. Sharply means briskly or precisely. Favorably means suitably. Slightly means somewhat or to some extent. Thus after inspecting all the items, we conclude that option a suddenly is the correct answer.

16. (d) The word in question, scintillating means sparkling or shining brightly. Fascinating means charming or attractive. Unforgettable means memorable, treasured , cherished etc. beautiful means pretty or good looking. When we analyze the above words we notice that scintillating is closest in meaning to sparkling.

17. (a) the word in this item, pact means a formal agreement between individuals or parties. Monarchy means kingship or autocracy. Lease means a contract by which one party conveys land, property, services, etc. to another for a specified time, usually in return for a periodic payment. Trend means tendency or inclination. Going through the words and meanings, we see that pact means treaty. So option (a) is the correct answer.

18. (c) Prudent means cautious or sensible. Skillful means expert or masterly. Wealthy means rich. Careful means vigilant, watchful. Dishonest means deceitful or untruthful. It's clear that the synonym for prudent would b option (c), careful.

19. (c) Converge means meet or join. Separate means to part. Intersect means to divide or cut. Merge means to join. Diverge means to move away. Thus we see that converge is similar to merge. Therefore merge is the answer.

20. (d) The word zealot means supporter or believer. Option (a) enthusiastic means excited or eager. Brave means courageous or heroic. Timid means nervous, shy or fearful. Fanatic means extremist or uncompromising. Now when we look at the sentence, we see that violence is generally undertaken by fanatics. Thus option (d) is the correct answer.

21. (b) in this item, we have to point out the correct antonym. Candid means frank, open or honest. Now the first option, blunt means frank and straightforward. Option (b) guarded means defended or safeguarded or protected. Sincere means genuine and honest. Unconventional means unusual. After going through the given list we come to the conclusion that only guarded is the word which can be considered as the antonym of candid.

22. (c) The word in the sentence, condone means to forgive or pardon. Accept means to believe or recognize. Forgive means the same as condone. Condemn means to denounce or attack which seems opposite to the word condone. Criticize means to disapprove. The best answer would be option (c) that condemn.

23. (a) Severed means detached cut off. The word joined means attached which shows clearly that it could be the opposite of severed. The word included means built-in or integrated. Detached has the same meaning as severed. Disrupt means upset or interrupt. Thus the answer is option (a) joined.

24. (c) The word fuzzy means blurry or unclear. Option a misty means hazy and foggy. Vague means unclear. Clear is the only word which seems opposite to the word fuzzy. Useful has no negative or positive relation with fuzzy. Thus option (c) clear is the answer.

25. (b) Slimy is the main word which means greasy or slippery. Ugly means not good looking or unattractive. Clean means clear and without any filth. Beautiful means good looking. Slippery is synonym for slimy. Here the only word which seems opposite of slimy is clean.

26. (b) The word anxious means nervous or worried. Cool means calm and unruffled. Composed means calm and relaxed. Careless means irresponsible. Worried is a synonym of anxious. Out of cool and composed, composed suits better as the antonym as it is more formal in use.

27. (c) The word extended means total or complete. Protracted means prolonged or extended. Widened means broadened. Curtailed means cut or shortened. Elongated means lengthened or extended. The most possible antonym for extended would be option (c), curtailed.

28. (a) In this item, the word in question is escape. The meaning of escape is run away or get away. arrest means detain or capture. Elude means escape or evade. Conceive means imagine or visualize. Thus we analyze that proper antonym of escape would be option a , arrest.

29. (b) The word inhuman means brutal or heartless. Indifferent means unconcerned or unsympathetic. Compassionate means concerned and kind. Terrible means awful or dreadful. Ferocious means fierce or

violent. Now the antonym of inhuman should be humane, kind or sympathetic. The word matching this criterion is option (b), compassionate.

30. (d) Eloquent means clear and crisp in language, fluent, expressive etc. lucid is the synonym of eloquent. Vivid means clear and bright. Short means small in length. Inarticulate means inexpressive or hesitant, thus it is clear that inarticulate is the antonym of the word eloquent.

31. (a) for this question, the blank should be filled by option a, "for" as it is pointed out that universities in Germany and Denmark have some input belonging to the project.

32. (a) The correct answer would leg up as leg up is a phrasal verb which means a push to help someone to climb an obstacle upwards, to boost. This phrasal verb fits best as it is concerned about someone being boosted up in a new business. Other options are nullified as with leg no other prepositions are used i.e. for, down and off.

33. (c) They are men of the same kidney. Yes, this phrasal verb is generally used in places where similar mindset is defined. Of will be the answer as of is generally Used for belonging to, relating to, or connected within and on also cannot be used as they are used to indicate something which is over or inside which is not the case here. With is used to indicate being together or being involved. Thus option (c) of is the answer.

34. (c) Both 'stand with' and 'stand beside' take literal meanrefuse to endure or tolerate.ings and are not relevant here as the friend needs support and not physical presence. Stand for means to refuse to endure or tolerate which is out of context here. Stand by, however, means to be present while something bad is happening but fail to take any action to stop it, which best suits the message of the sentence. Thus, option (c) is the answer.

35. (c) When a person breaks out of a prison, he will do it by any means. Here he escapes by dressing as a woman. Thus by is the preposition which fits here. With does not suit here because it is used to indicate having or being together. As is used in matters of comparison and moreover as has already been used before a woman. In does not fit well here also. Thus option (c), by is the correct answer.

36. (b) Cut in means Enter a conversation by interrupting whereas cut off means to stop the supply of something. Cut out means to exclude. Thus, going by the meanings of these phrases we come to conclusion that cut off would be the most apt option as electricity supply is cut off, makes sense.

37. (b) It should be noticed that whenever we use phrasal verb, cope, we use "with" with it. Any other preposition is never used with cope. So when we deal with a situation, we cope with it. Thus option (b), with is the answer.

38. (b) When the verb "compete" is used in any sentence we use "with" with it. When there is competition among group of people they compete with each other. Compete for is used when an object of competition is indicated. Compete to is used when the purpose of competing is defined. Compete on is used when platform of completion is talked about. Thus here option (b), with is the perfect answer.

39. (a) In this question, disparity means difference; the two objects of differentiation are rich and poor. When two groups of objects are differentiated, we use "between" with them. For, in and from are not correct prepositions to use in this sentence. Thus option (a) "between" is the answer.

40. (a) First we should understand the meaning of deviate. It means to divert or diverge. The preposition generally used with deviate is form as from is used when parting from a part of the sentence or differentiating. To is used with deviate when the purpose for deviating is pointed out. Generally deviate in can be used when medium in which deviation took place is defined. Deviated for is used when the purpose of deviation is defined. Thus option (a) "from" is the answer.

41. (c) When we read the passage we come across the discussion over the Indian climate and its positive and negative relation with the civilizations and their attitude towards life. The passage does not talk just about climate or its impact on people. It tells about the impact of climate including rain fall and natural calamities on people and their culture. Thus keeping this in mind we feel that option (c) is the most probable answer.

42. (a) It is clearly noted in the passage that Chinese, Greek and Roman civilizations had to undergo hardships due to bad winter. But India did not have to face such harsh winters as we have a sub-tropical climate. Thus option (a) Indian is the correct answer.

43. (c) There is no mention of fertile soil or availability of flora and fauna specifically in this passage but it conveys that we were blessed with bounteous nature which asked for man's little efforts. This very sentence establishes that option c is closest to the real meaning of the passage. Thus option (c) is the correct answer.

44. (c) The word used in the passage for conveying India's character is quietism. Now fatalism is related to being dangerous. And sturdiness means strength and durability. Ascetism is related to being quiet. Whereas Epicureanism means devotion to pleasure, comfort, and high living. Thus the closest and exclusive meaning for quietism in this list is "Ascetism".

45. (d) The sentence cannot begin with an 'and' or 'haven't', therefore the first part should be she. This rules out option (a) and (b) completely. Now, she can only be followed by the auxiliary verb hasn't as the other option of using 'neither have I' will render part S useless. Thus, the correct sentence formation should be; She hasn't finished the assignment yet and neither have I.

46. (d) The sentence cannot begin with 'can'(as it is not a question) or 'himself' or 'by'. Thus it begins with 'a child', i.e part Q. This leaves us with options (a) and (d). this subject should be followed by a verb to give the flow to the sentence, which is 'can feed'. So, the proper structuring is ' a child can feed himself by the age of six months.

47. (a) The given part 'every experience in life makes' must be followed by a subject that answers what is made? This is given only by part S,i.e, an impression. While the answer is clear from here itself, we can still confirm by looking at other parts. As only cells are found in brain and not nerve centres, this confirms the flow- 'on some of the cells of the brain'-PR. Thus, the sequence is SPRQ.

48. (d) 'You'll needs to be either followed by have to or 'help her'. However, if we use help her right after, the part 'have to' would remain useless rendering the remaining sentence meaningless. This suggests that the first to come in sequence is part Q. this to should be followed by a verb, that is, help,given in the question. As the part 'because she does not' needs to have a predicate to follow, 'know how to do it' makes the best sense out the given question. Thus sequence is QSRP.

49. (b) 'would you' is always followed by a verb which among the options is only 'like to come' that is part P. in english language, the minute details are always given in the end to give a proper flow to the sentence. Therefore, the general information 'concert' needs to be given first. This leads to our answer as only option (b) has a sequence of PS. Thus, option (b).

50. (b) The only part that makes sense after the sentence begins with it is - is part Q 'not necessary that'. That must be followed by the condition introduced in the first part of sentence clarifying what is not necessary. That is given in part S - about qualifying the entrance exam. 'to be admitted' must be followed by its subject which answers where or when or how. This is done through part R(engineering college). Thus the sequence should be QSPR, option (b).

PART- B : GENERAL KNOWLEDGE

51. (c) The government approved the National Cyber Security policy on 8th May, 2013 that aims to create a secure computing environment in the country and build capacities to strengthen the current set-up with focus on manpower training.

52. (a) Dr. Aparajita Dutta is a wildlife biologist. She has been working in the forests of India for more than two decades. Now, she is one of the board members of the Nature Conservation Foundation, a non-governmental wildlife conservation organisation.

53. (b) Rafael Nadal and Serena Williams won the Men's and Women's single title respectively of the Madrid Open Tennis Tournament, 2013.

54. (c) Paan Singh Tomar is an Indian biographical, sports film based on the true story of an athlete Paan Singh Tomar employed by the Indian Army and who won a Gold Medal at Indian National Games, but was forced to become a notorious bandit. It is directed by Tigmanshu Dhulia.

55. (c) The HAL Rudra is an armed version of HAL Dhruv. Rudra is equipped with forward looking infra red and thermal imaging sights interface, a 20 mm turret gun, 70 mm rocket pods, anti-tank guided missiles and air-to-air missiles.

56. (b) The government on January 2nd, 2013 announced the Constitution of the 14th Finance Commission under the chairmanship of former RBI Governor YV Reddy.

57. (a) A chit fund is a kind of savings scheme practiced in India. A chit fund company is a company that manages, conducts, or supervises a chit scheme—as defined in Section of the Chit Funds Act, 1982. According to Section 2(b) of the Chit Fund Act, 1982:

58. (a) Shashi Tharoor is the author of the book 'Pax Indica: India and world of the 21st century'.

59. (b) Chintamani Nagesa Ramachandra Rao FRS, also known as C.N.R. Rao, is an Indian chemist who has worked mainly in solid-state and structural chemistry. He currently serves as the Head of the Scientific Advisory Council to the Prime Minister of India. On 16 November 2013, the Government of India announced his selection for Bharat Ratna, the highest civilian award in India, making him the third scientist after C.V. Raman and A. P. J. Abdul Kalam to receive the award.

60. (b) The President of India, Shri Pranab Mukherjee released a Commemorative Postage Stamp on late Shri Sahir Ludhianvi on the occasion of his birth anniversary I.E. March 8, 2013 at Rashtrapati Bhavan.

61. (b) Weathering is the breaking down of rocks, soils and minerals as well as artificial materials through contact with the Earth's atmosphere, biota and waters.

62. (b) Doldrums a zone of light, calm (westerly) winds in equatorial latitude, applicably largly to occens, moves few degress N and S of the equator seasonally sun fall vertically over the equator, causing 12 hour day 12 hour night.

63. (a) **64. (b)** **65. (c)**

66. (a) Both the statements are true. The chemical reaction can be expressed as:

$$Ca(s) + \underset{\text{Sulphuric Acid}}{H_2SO_4\,(aq)} \longrightarrow \underset{\substack{\text{Insoluble} \\ \text{(calcium sulphate)}}}{CaSO_4} + \underset{\text{Hydrogen}}{H_2}$$

67. (b)

68. (c) El-Nino a name given to the occasional development of a warm occean current along the Peru Coast as a temporary replacement of the cold. It is an extension of the equatorial current and leads to an increase of surface water temperatures of 10°C and a decrease in Plankton which thrive in colder current. El Nino occurs every seven to fourteen years and result forms a weakening of S.E. Trade Winds in the Pacific.

69. (c) Esker – A narrow, sinuous ridge of partly stratified coarse sand and gravel of glaciofluvial origin.

70. (c) The structure of Exosphere say, height of volume sphere is above 500 km, having maximum hydrogen and helium and the researches are being done for its specific situation of sphere. Since, structure of Atmosphere is divided into 6 spheres say– (i) Troposphere (upto 11 km), (ii) Tropopause, (iii) Stratosphere, (iv) Ozonosphere, (v) Ionosphere and (vi) Exosphere (above 500 km.)

71. (a) When two rigid slabs of lithospheric, known as plate collid with an another. The plate made of heavier material is tend to below the plate made of lights material (SIAG).

72. (a) Correct sequence of the layers given in Question is Troposphere – Stratosphere – Mesosphere (in between Stratosphere–Ionosphere). Thermosphere (Above the Mesosphere or synonymous Ionosphere.

73. (a)

74. (a) Jammu-Srinagar Highway passes through Banihel pass in Pir Panjal range.

75. (b) There is a time difference of 4 minutes at Eurg 1°. Hence the following calculation will be done.
Long Time difference
8803′ – 80-30′ × 4 = 5 hrs 54 minutes,
Countries in E of Greenwich Meridian, will get more time i.e., in East time will be added, while in West time will be less. At 0° longitude is 19 hrs of 28th Feb.
19 hrs + 5 hrs 54 minutes = 24 hrs–54 minutes the date will change at 24.01 hrs. So it will be 0-54 minutes of 1st March.

76. (b) **Tornado**–A rapidly rotating column of the air developed around a very intense low pressure area, associated with a dark funnel shaped cloud, originate at USA.
The air is anticlockwise in the northern hemisphere and clockwise in southern hemisphere.

77. (a) **Orophyte :** A plant that will grow only in a mountainous environment
Geophyte : One of the six major floral life from classes recognized by Danish Botanist Raunkiaer.
Epiphyte: Plant grows an another plant not in a parasitic way **Bryophyte**–A flower less green plant.

78. (c) At higher altitude air is lighter while close to earth surface its heavier. In Troposphere the dust particles and water is more than upperlayer.

79. (c) Mica–Gutur (Andhra Pradesh)
Chromite – Namakkal and Tiruchengode (Tamil Nadu)
Magnesite – Hindustan Produce Company (Kolkata)
Zinc – Zawar (Rajasthan)

80. (c) The short wave solar energy reflected by any surface (i.e., saud, snow, atmosphere etc.) without heating the surface is called Albedo.

81. (c) In India, Jute (corchorus spp) is produced about 75% in West Bengal (Ist rank}, 16% in Bihar (IInd rank) and about 5% in Assam (III rank) as per the statistical Data of year 2011-12. Jute grow well in loamy soils under hot and humid conditions-as ideal climatic condition. Generally Maize/Moong/Urd (spring season)-Jute-Rice crop rotation is followed, while Jute Rice-Wheat rotation is followed on less amount.

82. (c) Greenwich is 0° meridian, while Indian standard time is governed by 82½° East Long. The time difference shall be 5 hrs 30 minutes e.g., 82½° × 4 = 330 minutes or 5 hrs 30 minutes.

83. (c) In Mediterranean Region most of the rainfall occurs in winter season. Normally summer's leap is moderate.

84. (d) Ultra-violet rays are filtered by ozone gas present in the atmosphere.

85. (c)

86. (c) Presbyopia is a condition where, with age, the eye exhibits a progressively diminished ability to focus on near objects. It is caused by weakening of the ciliary muscles (the muscles that bend and straighten the lens)

87. (c) Earthworm does not undergo periodic moulting of their external body covering. Rest all the animals are examples of arthropods which undergo periodic ecdysis (casting of skin).

88. (b) Brain is not involved in elicitation of immune response. Lymph nodes are oval shaped organs of lymphatic system, distributed widely throughout our body and are garrisons of B, T and other immunity cells. The thymyus is on specialised organ of immune system within which the T-cell nature. The spleen is on cymphatic organ that plays an important role in protecting the body from invading pathogens.

89. (a) Turmeric powder is obtained from dried grounded underground stem 'rhizome'. The rhizome of the turmeric is yellowish orange tuberous and juicy.

90. (c) Amino acid is an organic compound, which, repelled by Glomenuli cells of Nephrox in Kidney .
So, it is not present is urine.

91. (c) Blue whale is largest baby at the time of birth weight (approximately 1 ton).

92. (c) Muscles in the intestine, stomach etc, are smooth muscles as opposed to muscles in the face, arms and legs which are known as skeletal muscles. Smooth muscles are involuntary muscles which contract slowly and remain contracted for a longer time without tiring.

93. (a)

94. (d) Tuberculosis (TB) is a common and in many cases lethal, infectious disease caused by various strains of mycobacterium. TB typically attacks the lungs, but can also affect other parts of the body.

95. (c) Duckbilled platypus is egg lying mammals, which is also called orinitho-rynchus or platypus animals.

96. (c) 5th Report, 1812 a famous document prepared by a select committee set-up in 1810 by the British Parliament to look into the affairs of the East India Company.

97. (c) Under the leadership of Gandhiji the Civil Disobedience Movement was launched in AD 1930. It began with the Dandi March on 12 March, 1930. Gandhiji with some of his followers left the Sabarmati Ashram at Ahmedabad and made their way towards Dandi, the group reached Dandi on 6 April, 1930. Here Gandhiji protested against the salt Law by making salt sail himself and throwing up a challenge to the British government. The Dandi March signified the start of the Civil Disobedience Movement.

98. (a) Ryotwari System was a way of collecting tax revenues (in British-controlled areas in India) directly from cultivators of farmland.

99. (c) The Russian Revolution is the collective term for a series of revolutions in Russia in 1917, which dismantled the Tsarist autocracy and led to the creation of Russian SFSR (Soviet Federative Socialist Republic.

100. (a) Dadabhai Naoroji was the first man to say that internal factors were not the reasons of poverty in India, but poverty was caused by the colonial rule that was draining the wealth and prosperity of India. In 1867, Dadabhai Naoroji put forward the 'Drain of wealth' theory in which he stated that the British was

completely draining India. He mentioned this theory in his book poverty and Un-British Rule in India.

101. (b) The Quit India Movement or the August Movement was a Civil Disobedience Movement launched in August, 1942 in response to Mahatma Gandhi's call for Satyagraha (Independence).

102. (c) Ambika Charan Majumdar presided over the Congress Session of Lucknow in 1916. This session was important for two reasons
(i) The extremists rejoined Congress.
(ii) Congress and Muslim League formed a pact.

103. (b)

104. (d) Satyagraha (or 'truth force') is a particularly philosophy and practice within the broader overall category generally, known as non-violent resistance or civil resistance. The term Satyagraha was coined and developed by Mahatma Gandhi.

105. (c)

106. (a)

107. (c) Lord Dufferin was the viceroy of India when the Indian National Congress was founded in 1885.

108. (a) In 1840, Kandh uprising broke out against British efforts to put an end to Kandh's practice of human sacrifice. This revolt was led by Chakra Bishoyi.

109. (a)

110. (d) J B Kripalani, popularly known as Acharya Kripalani, was an Indian politician, noted particularly for holding the presidency of the Indian National Congress during the transfer of power in, 1947.

111. (d) The term 'First War of Independence' was first used by Vinayak Damodar Savarkar in his 1909 book 'The History of the War of Indian Independence' which was originally written in Marathi.

112. (c) Simon Commission – November, 1927
Second Round Table Conference – September, 1931
Communal Award – August, 1932
Poona Pact - September, 1932

113. (b)

114. (b) The pledge was first given in the charter Act 1833 clause 87.

115. (d)

116. (d) Newton's law of universal gravitation states that every point mass in the universe attracts every other point mass with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

$$F = G\frac{m_1 m_2}{r^2}$$

where, F = Force between the masses
G = Gravitational constant
m_1 = First mass
m_2 = Second mass
r = Distance between the centre of the masses

117. (c) It is given that current (I) = 0.5 A Time (t) = 20 min = 1200 s
We know that charge (Q) = I × t = 0.5 × 1200 = 600C

118. (d) When some electrical charge moves in a magnetic field, a force acts on it. This force is called Lorentz force. This force changes the velocity of the proton.

119. (b) Force applied = *mg* = 30 × 10 Newton = 300 Newton.
Distance covered in the direction of the force
= 400 × 15 cm = 6 metres
W = F.S
= 300 Newton × 6 metres
= 1800 Newton - metre
= 1800 J

$$\text{Power} = \frac{\text{Work}}{\text{Time}}$$

$$= \frac{1800\text{J}}{10\text{seconds}}$$

= 180 joule/second
= 180 watt.

120. (c) The melting point of a substance is the temperature at which its state changes from solid to liquid.
Melting point of naphthalene is 80.26°C.

121. (b) The piece of paper would take more time to reach the ground than a coin because buoyant force on the piece of paper is more than that on the coin. If piece of paper and coin having the same mass are droped from the same height in vacuum then both will take the same time to reach the ground.

122. (c) Blue colour rays are small and scattered to a larger areas while red colour rays are larger and scattered to a smaller area.

123. (a) Ohm's law follow the law of conservation of energy.
According to ohm's law,

$$\text{Electric current (I)} = \frac{\text{Voltage (V)}}{\text{Resistance (R)}}$$

124. (c) $\sin^2 \omega t + \cos^2 \omega t = \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

125. (b)

126. (a) 20 gm = 0.02 kg
Momentum of the pistol = Momentum of the bullet
$\Rightarrow m_1 v_1 = m_2 v_2$
$\Rightarrow 1 \times v_1 = 0.02 \times 150$
$\Rightarrow v_1 = 3$ m/s

127. (c) Both the lower resistances are in parallel.

$$\therefore \frac{1}{R} = \frac{1}{1} + \frac{1}{1}$$

$$\Rightarrow R = \frac{1}{2}\Omega$$

Entire external resistance of the circuit

$$= \frac{1}{2} + 1 = 1.5\Omega$$

$$\text{Current in the circuit} = i = \frac{E}{R}$$

$$= \frac{1.5}{1.5} = 1\text{Å}$$

Reading of the voltmeter = V = i.R
= 1 × 1 volt
= 1 volt

128. (a) Area of the velocity-time plot (graph): represents the displacement of that object.

Radius of the semi-circle $= \frac{7}{2}$m

Area of the semi-circle $= \frac{1}{2}\pi r^2$

= displacement of the particle

$= \frac{1}{2} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}\text{m} = 19.25\text{m}$

129. (a) The iron ball, when submerged in water, may float, but the nail always sinks. This is because buoyant force on the ball is larger than that of the nail due to their shapes.

130. (a) Power = 1500 watt $= \frac{3}{2}$ kilowatt

Time = 10 Hrs

Electrical energy consumed

= Power × Time

$= \frac{3}{2}$ kilowatt × 10 Hrs.

= 15 kilowatt hour

Cost of electricity consumed = ₹ 15 × 2 = ₹ 30

131. (a) They are made curved so that the sound after reflecting form the ceiling reaches every corner of the concert hall and the audience listens the sound clearly.

132. (d)

133. (a) Rays of light get refracted while passing from air to glass because density of glass is higher than that of air refraction is the change in direction of a wave due to change in its transmission medium.

134. (a)

135. (c) From the graph it is clear that at t = 0 particle has non-zero velocity and after some time its velocity is zero, hence the motion of the particle is decelerated.

136. (b)

137. (d) $T = 2x . \sqrt{\frac{\ell}{g}}$

After the length is increased by 4-fold.

$T' = 2\pi.\sqrt{\frac{4\ell}{g}}$

$2 \times 2\pi.\sqrt{\frac{\ell}{g}} = 2 \times T$

138. (a) A pressure cooker works on the principle of elevation of boiling point of water by application of pressure.

139. (c) Pressure of a gas increase due to increase of its temperature because at higher temperature kinetic energies of the gas molecules are higher.

140. (a) Constituents of gun powder are–Potassium nitrate, charcoal and sulphur. Sulphur serves : as a fuel, lowers the ignition temperature and increases the rate of combustion.

141. (a) Calcium Ammonium Nitrate (CAN) fertilizer is almost neutral and can be safely applied even to acid soils. Its total nitrogen (N) content is higher and may vary from 25 to 28% N content. Half (12.5% N) of this total nitrogen is in the ammonical form and rest half (12.5% N) in nitrate form. This is a good fertilizer applied in Agriculture.

142. (a)

143. (c) The mixture of naphthalene and sodium chloride can be separated by the process of sublimation as naphthalene is a sublime, i.e. it turns into vapour without changing in liquid and its vapour change into solid without changing into liquid, while sodium chloride is not a sublime.

144. (c) The common salt (NaCl) is netural in nature so, it doesn't change the pH.

145. (b) Oxides of non-metals are usually acidic, e.g., CO_2, SO_2, SO_3,.....

$CO_2 + H_2O \rightarrow H_2CO_3$ (Carbonic acid)

$SO_2 + H_2O \rightarrow H_2SO_3$ (Sulphurous acid)

146. (a) Biogas typically refers to a gas produced by the breakdown of organic matter in the absence of oxygen. Methane is the main constituent (63%) of the biogas and CO_2 is approx 30% and may have small amounts of hydrogen sulphide (H_2S), moisture and siloxanes.

147. (a) Hydrogen gas is evolved when a piece of zinc metal is placed in dilute sulphuric acid (H_2SO_4). The chemical reaction is

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2.\uparrow$

148. (c) Turmeric (Haldi) rapidly becomes colourless on adulation of lemon juice.

149. (c) A metalloid is a chemical element with properties in between, or that are a mixture of, those of metals and non-metals. There is no standard definition of a metalloid, nor is there complete agreement as to which elements are appropriately classified as such.

The six commonly recognised metalloids are boron, silicon, germanium, arsenic, antimony and tellurium. Elements less commonly recognised as metalloids include carbon, aluminium, selenium, polonium, and astatine.

150. (b) The reactant in the flash are magnesium carbonate and hydrochloric acid the reactions are

$MgCO_3(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + CO_2(g) + H_2O(\ell)$

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