UPKAR'S

PRACTICE WORK-BOOK

NDA & NA EXAMINATION

SELECTED QUESTIONS WITH EXPLANATORY ANSWERS

Dr. H.P. Sharma & Dr. M.B. Lal

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According to the Latest Syllabus

By
Dr. H.P. Sharma
&
Dr. M.B. Lal

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IMPORTANT INSTRUCTIONS AND SYLLABUS

A. SCHEME OF THE EXAMINATION

1. The subjects of the written examination, the time allowed and the maximum marks allotted to each subject will be as follows :

Subject	Subject Code	Duration	Max. Marks
Mathematics	01	$2\frac{1}{2}$ hours	300
General Ability Test	02	$2\frac{1}{2}$ hours	600
		Total	900

2. THE PAPERS IN ALL THE SUBJECTS WILL CONSIST OF OBJECTIVE TYPE QUESTIONS ONLY. THE QUESTION PAPERS (TEST BOOK-LETS) OF MATHEMATICS AND PART 'B' OF GENERAL ABILITY TEST WILL BE SET BILINGUALLY IN HINDI AS WELL AS ENGLISH.

3. In the question papers, wherever necessary, questions involving the Metric System of Weights and Measures only will be set.

4. Candidates must write the papers in their own hand. In no circumstances will they be allowed the help of a scribe to write the answers for them.

5. The Commission have discretion to fix qualifying marks in any or all the subjects at the examination.

6. The candidates are not permitted to use calculators or Mathematical or logarithmic table for answering objective type papers (Test Book-lets). They should not, therefore, bring the same inside Examination Hall.

B. SYLLABUS OF THE EXAMINATION

Paper–I (Code No. 01)

MATHEMATICS

(Maximum Marks–300)

1. Algebra :

Concept of a set, operations on sets, Venn diagrams. De Morgan laws. Cartesian product, relation, equivalence relation.

Representation of real numbers on a line Complex numbers—basic properties, modulus, argument, cube roots of unity. Binary system of numbers. Conversion of a number in decimal system to binary system and vice-versa. Arithmetic, Geometric and Harmonic progressions. Quadratic equations with real coefficients. Solution of linear inequations of two variables by graphs. Permutation and Combination. Binomial theorem and its applications. Logarithms and their applications.

2. Matrices and Determinants :

Types of matrices, operations on matrices. Determinant of a matrix basic properties of determinants. Adjoint and inverse of a square matrix Applications—Solution of a system of linear equations in two or three unknowns by Cramer's rule and by Matrix Method.

3. Trigonometry :

Angles and their measures in degrees and in radians. Trigonometrical ratios. Trigonometric identities Sum and difference formulae. Multiple and Sub-multiple angles. Inverse trigonometric functions. Applications—Height and distance, properties of triangles.

4. Analytical Geometry of Two and Three Dimensions :

Rectangular Cartesian Coordinate system. Distance formula. Equation of a line in various forms. Angle between two lines. Distance of a point from a line. Equation of a circle in standard and in general form. Standard forms of parabola, ellipse and hyperbola. Eccentricity and axis of a conic. Point in a three dimensional space, distance between two points. Direction Cosines and direction ratios. Equation of a plane and a line in various forms. Angle between two lines and angle between two planes. Equation of a sphere.

5. Differential Calculus :

Concept of a real valued function-domain, range and graph of a function. Composite functions, one to one, onto and inverse functions. Notion of limit, Standard limits—examples. Continuity of functions—examples, algebraic operations on continuous functions. Derivative of function at a point, geometrical and physical interpretation of a derivative-applications. Derivatives of sum, product and quotient of functions, derivative of a function with respect to another function, derivative of a composite function. Second order derivatives. Increasing and decreasing functions. Application of derivatives in problems of maxima and minima.

6. Integral Calculus and Differential Equations :

Integration as inverse of differentiation, integration by substitution and by parts, standard integrals involving algebraic expressions, trigonometric, exponential and hyperbolic functions. Evaluation of definite integrals—determination of areas of plane regions bounded by curves—applications. Definition of order and degree of a differential equation, formation of a differential equation by examples. General and particular solution of a differential equation, solution of first order and first degree differential equations of various types—examples. Application in problems of growth and decay.

7. Vector Algebra :

Vectors in two and three dimensions, magnitude and direction of a vector. Unit and null vectors, addition of vectors, scalar multiplication of a vector, scalar product or dot product of two vectors. Vector product or cross product of two vectors. Applications-work done by a force and moment of a force, and in geometrical problems.

8. Statistics and Probability :

Statistics : Classification of data. Frequency distribution, cumulative frequency distribution-examples. Graphical representation—Histogram, Pie Chart, frequency polygon—examples. Measure of Central tendency—Mean, median and mode. Variance and standard deviation—determination and comparison. Correlation and regression.

Probability : Random experiment, outcomes and associated sample space, events, mutually exclusive and exhaustive events, impossible and certain events. Union and intersection of events. Complementary, elementary and composite events. Definition of probability—classical and statistical-examples. Elementary theorems on probability— simple problems. Conditional probability, Bayes' theorem-simple problems. Random variable as function on a sample space. Binomial distribution, examples of random experiments giving rise to Binomial distribution.

Paper–II (Code No. 02)

GENERAL ABILITY TEST

(Maximum Marks–600)

PART 'A'

ENGLISH

(Maximum Marks–200)

The question paper in English will be designed to test the candidate's understanding of English and work-man-like use of words. The syllabus covers various aspects like : Grammar and usage, vocabulary, comprehension and cohesion in extended texts to test the candidate's proficiency in English.

PART 'B'

GENERAL KNOWLEDGE

(Maximum Marks–400)

The question paper on General Knowledge will broadly cover the subjects : Physics, Chemistry, General Science, Social Studies, Geography and Current Events.

The syllabus given below is designed to indicate the scope of these subjects included in this paper. The topics mentioned are not to be regarded as exhaustive and questions on topics of similar nature not specifically mentioned in the syllabus may also be asked. Candidate's answers are expected to show their knowledge and intelligent understanding of the subject.

Section 'A' (Physics)

Physical Properties and States of Matter, Mass, Weight, Volume, Density and Specific Gravity, Principle of Archimedes, Pressure Barometer.

Motion of objects, Velocity and Acceleration, Newton's Laws of Motion, Force and Momentum, Parallelogram of Forces, Stability and Equilibrium of bodies, Gravitation, elementary ideas of Work, Power and Energy.

Effects of Heat. Measurement of Temperature and Heat. Change of State and Latent Heat. Modes of transference of Heat.

Sound waves and their properties. Simple musical instruments.

Rectilinear propagation of Light. Reflection and refraction, Spherical mirrors and Lenses, Human Eye.

Natural and Artificial Magnets. Properties of a Magnet. Earth as a Magnet.

Static and Current Electricity. Conductors and Non-conductors, Ohm's Law. Simple Electrical Circuits. Heating, Lighting and Magnetic effects of Current. Measurement of Electrical Power, Primary and Secondary Cells. Use of X-rays.

General Principles in the working of the following :

Simple Pendulum, Simple Pulleys, Siphon, Levers, Balloon, Pumps, Hydrometer, Pressure Cooker, Thermos Flask, Gramophone, Telegraphs, Telephone, Periscope, Telescope, Microscope, Mariner's Compass, Lightning Conductors, Safety Fuses.

Section 'B' (Chemistry)

Physical and Chemical changes. Elements, Mixtures and Compounds, Symbols, Formulae and Simple Chemical Equations. Law of Chemical Combination (excluding problems). Properties of Air and Water.

Preparation and Properties of Hydrogen, Oxygen, Nitrogen and Carbondioxide, Oxidation and Reduction.

Acids, Bases and Salts.

Carbon–Different forms.

Fertilizers–Natural and Artificial.

Materials used in the preparations of substances like Soap, Glass, Ink, Paper, Cement, Paints, Safety Matches and Gun-powder.

Elementary ideas about the Structure of Atom, Atomic Equivalent and Molecular Weights. Valency.

Section 'C' (General Science)

Difference between the living and non-living.

Basis of Life—Cells Protoplasms and Tissues.

Growth and Reproduction in Plants and Animals.

Elementary knowledge of human Body and its important organs.

Common Epidemics, their causes and prevention.

Food—Source of Energy for Man, Constituent of food, Balanced Diet.

The Solar System Meteors and Comets, Eclipses.

Achievements of Eminent Scientists.

Section 'D' (History, Freedom Movement etc.)

A broad survey of Indian History, with emphasis on Culture and Civilisation.

Freedom Movement in India.

Elementary study of Indian Constitution and Administration.

Elementary knowledge of Five Year Plans of India.

Panchayati Raj. Co-operatives and Community Development.

Bhoodan. Sarvodaya, National Integration and Welfare State, Basic teachings of Mahatma Gandhi.

Forces shaping the modern World; Renaissance Exploration and Discovery. War of American Independence, French Revolution. Industrial Revolution and Russian Revolution, Impact of Science and Technology on Society. Concept of One World, United Nations Panchsheel, Democracy, Socialism and Communism. Role of India in the Present World.

Section 'E' (Geography)

The Earth, its shape and size, Latitudes and Longitudes. Concept of Time, International Date line, Movements of Earth and their effects.

Origin of Earth, Rocks and their classification; Weathering—Mechanical and Chemical. Earthquakes and Volcanoes.

Ocean Current and Tides.

Atmosphere and its composition; Temperature and Atmospheric Pressure, Planetary winds. Cyclones and Anti-cyclones; Humidity; Condensation and Precipitation; Types of Climate. Major Natural regions of the World.

Regional Geography of India—Climate. Natural Vegetation. Mineral and Power resources; location and distribution of agricultural and industrial activities.

Important Sea Ports and main sea. land and air routes of India. Main items of Imports and Exports of India.

Section 'F' (Current Events)

Knowledge of Important events that have happened in India in the recent years.

Current important world events.

Prominent personalities—both Indian and International including those connected with cultural activities and sports.

Note—Out of maximum marks assigned to Part 'B' of this paper questions on Sections 'A', 'B'. 'C', 'D'. 'E' and 'F' will carry approximately 25%, 15%, 10%. 20%, 20% and 10% weightages respectively.

INTELLIGENCE AND PERSONALITY TEST

The SSB procedure consists of two stage Selection process-stage-I and stage-II. Only those candidates who clear the stage-I are permitted to appear for stage II. The details are :

(a) **Stage-I** comprises of Officer Intelligence Rating (OIR) tests are Picture Perception *Description Test (PP & DT). The candidates will be shortlisted based on combination of performance in QIR Test and PP and DT.

(b) **Stage-II** comprises of Interview, Group Testing Officer Tasks, Psychology Tests and the Conference. These tests are conducted over 4 days. The details of these tests are given on the website www.joinindianarmy. nic.in.

The personality of a candidate is assessed by three different assessors *viz*. the Interviewing Officer (IO), Group Testing Officer (GTO) and the Psychologist. There are no separate weightage for each test. The mks are allotted by assessors only after taking into consideration the performance of the candidate holistically in all the test. In addition, marks for Conference are also allotted based on the initial performance of the Candidate in the three techniques and decision of the Board. All these have equal weightage.

The various tests of IO. GTO and Psych are designed to bring out the presence/absence of Officer Like Qualities and their trainability in a candidate. candidates are Recommended or Not Recommended at the SSB

NDA
Practice Sets

Practice Set–1

Paper-I
Mathematics

1. Let Z and ω be the two non-zero complex numbers such that $|Z| = |\omega|$ and arg Z + arg $\omega = \pi$. Then Z is equal to—
   (A) ω (B) $-\infty$
   (C) $\bar{\omega}$ (D) $-\bar{\omega}$

2. The vector $Z = 3 - 4i$ is terned anticlockwise through an angle of 180° and streched 2·5 times. The complex number corresponding to the newly obtained vector is—
   (A) $\frac{15}{2} - 10i$ (B) $-\frac{15}{2} + 10i$
   (C) $-\frac{15}{2} - 10i$ (D) $\pm\frac{15}{2} - 10i$

3. If A = {1, 2}; B = {2, 5}, C = {5, 7}, then (A × B) ∩ (A × C) is equal to—
   (A) {(2, 5) (1, 5)} (B) {(2, 2) (5, 5)}
   (C) {(2, 7), (1, 5)} (D) {(2, 5), (2, 7)}

4. The points z_1, z_2, z_3, z_4 in the complex plane are the vertices of a parallelogram taken in order if and only if—
   (A) $z_1 + z_4 = z_2 + z_3$ (B) $z_1 + z_3 = z_2 + z_4$
   (C) $z_1 + z_2 = z_3 + z_4$ (D) None of these

5. If $z(3 + 4i) = 2 + 3i$, then the value of z is—
   (A) $(18 - i)/25$ (B) $(9 + 9i)/16$
   (C) $(18 + i)/25$ (D) $(5 + 2i)/9$

6. If x, y, z are in H.P., then the value of $\log (x + 3) + \log (x - 2y + z)$ is equal to—
   (A) 0 (B) $\log (x + z)^2$
   (C) $\log (x - z)^2$ (D) None of these

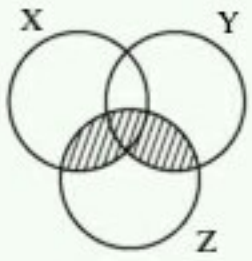
7. The 5th term of a H.P. is $\frac{1}{45}$ and 11th term is $\frac{1}{69}$, then its 16th term will be—
   (A) 1/89 (B) 1/85
   (C) 1/80 (D) 1/79

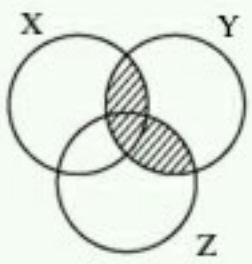
8. If ${}^{56}P_{r+6} : {}^{54}P_{r+3} = 30800 : 1$, then the value of r is—
   (A) 30 (B) 37
   (C) 41 (D) None of these

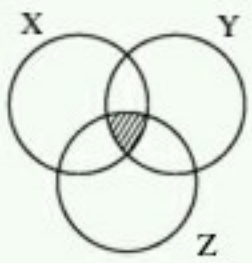
9. How many different words can be formed from the word DAUGHTER so that ending and beginning letters are consonant ?
   (A) 7200 (B) 14400
   (C) 360 (D) None of these

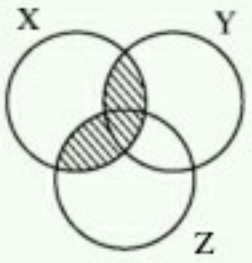
10. The sum of first n terms of the given series $1^2 + 2\cdot2^2 + 3^2 + 2\cdot4^2 + 5^2 + 2\cdot6^2 + \ldots\ldots$ is $\frac{n(n+1)^2}{2}$ when n is even. When n is odd, the sum will be—
    (A) $\frac{n(n+1)^2}{2}$ (B) $\frac{1}{2}n^2(n+1)$
    (C) $n(n+1)^2$ (D) $n^2(n+1)$

11. Which Venn diagram show Y ∩ (X ∪ Z)—

(A)


(B)


(C)


(D)


12. If in a set A the relation R is equivalence, then R^{-1} is—
(A) Reflexive (B) Symmetric
(C) Transitive (D) All of these

13. Let a, b, c be real numbers $a \neq 0$. If α is a root of $a^2x^2 + bx + c = 0$, β is a root $a^2x^2 - bx - c = 0$ and $0 < \alpha < \beta$, then the equation $a^2x^2 + 2bx + 2c = 0$ has a root γ that always satisfies—
(A) $\gamma = \frac{\alpha + \beta}{2}$ (B) $\gamma = \alpha + \frac{\beta}{2}$
(C) $\gamma = \alpha$ (D) $\alpha < \gamma < \beta$

14. The fourth term in the expansion of $\left(2x - \frac{1}{3}\right)^8$ is—
(A) ${}^8C_5 \cdot x^5 \frac{22}{27}$ (B) $-{}^8C_5 \cdot x^5 \frac{27}{32}$
(C) $-{}^8C_5 \cdot x^5 \frac{32}{27}$ (D) None of these

15. If $[1 \ x \ 1]\begin{bmatrix} 2 & 3 & 2 \\ 0 & 5 & 1 \\ 0 & 3 & 2 \end{bmatrix}\begin{bmatrix} 1 \\ 1 \\ x \end{bmatrix} = 0$, then the value of x are—
(A) 1, 8 (B) – 1, 8
(C) – 1, – 8 (D) 1, – 8

16. If $J = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$, then J^2 is equal to—
(A) 3J (B) 2J
(C) 4J (D) $\frac{1}{2}$J

17. If α_1, α_2 and β_1, β_2 are the roots of the equations $ax^2 + bx + c = 0$ and $px^2 + qx + r = 0$ respectively and the system of equations $\alpha_1 y + \alpha_2 z = 0$ and $\beta_1 y + \beta_2 z = 0$ has a non-zero solution, then—
(A) $\alpha^2 qc = p^2 br$ (B) $b^2 pr = q^2 ac$
(C) $c^2 ar = r^2 pb$ (D) None of these

18. m men and n women are to be seated in a row so that no two women sit together. If $m > n$, then the number of ways in which they can be seated—
(A) $\frac{m!\,(m+1)!}{(m-n+1)!}$ (B) $\frac{m!\,(m-1)!}{(m-n+1)}$
(C) $\frac{(m-1)!\,(m+1)!}{(m-n+1)!}$ (D) None of these

19. If $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$, then A (BA) is equal to—
(A) $\begin{bmatrix} 14 & 14 \\ 13 & 13 \end{bmatrix}$ (B) $\begin{bmatrix} 14 & 13 \\ 13 & 14 \end{bmatrix}$
(C) $\begin{bmatrix} 13 & 14 \\ 14 & 13 \end{bmatrix}$ (D) $\begin{bmatrix} 14 & 13 \\ 14 & 13 \end{bmatrix}$

20. If $|z - 1| = 2$, then the value of $z\bar{z} - z - \bar{z}$ is—
(A) 4 (B) 2
(C) 1 (D) 3

21. If $a_1, a_2, a_3, \ldots a_{24}$ are in Arithmetic progression and $a_1 + a_5 + a_{10} + a_{15} + a_{20} + a_{24} = 225$, then $a_1 + a_2 + a_3 + \ldots a_{24}$ is—
(A) 909 (B) 75
(C) 750 (D) 900

22. Given that fourth term in the expansion of $\left(px + \frac{1}{x}\right)^n$ is $\frac{5}{2}$, then the value of p is—
(A) 6 (B) 3
(C) 1/2 (D) None of these

23. The value of $\sin\left(\frac{\pi}{10}\right)\sin\left(\frac{13\pi}{10}\right)$ is equal to—
(A) 1/2 (B) – 1/2
(C) – 1/4 (D) 1

24. If $\tan\alpha = \frac{m}{m+1}$ and $\tan\beta = \frac{1}{(2m+1)}$, then $\alpha + \beta$ is equal to—
(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{3}$
(C) $\frac{\pi}{4}$ (D) None of these

25. $2\sin^2\theta = 3\cos\theta, 0 \leq \theta \leq 2\pi$, then the value of θ is—
(A) $\pi/3$ and $5\pi/3$ (B) $\pi/3$ and $2\pi/3$
(C) $2\pi/3$ and $4\pi/3$ (D) None of these

26. A ladder rests against a wall at an angle α to horizontal. Its foot is pulled away from the wall through a distance a, so that it slides a distance b down the wall making an angle β with the horizontal, then $\tan\frac{1}{2}(\alpha + \beta)$ is equal to—
(A) $\frac{a}{b}$ (B) $\frac{b}{a}$
(C) $\frac{a-b}{a+b}$ (D) $\frac{a+b}{a-b}$

27. From the top of the light house 60 metre high with its base at the sea level, the angle of depression of boat is 15°. The distance of the boat from the foot of the light house is—
(A) $60(\sqrt{3} - 2)$ (B) $120(2 - \sqrt{3})$
(C) $60(\sqrt{3} + 2)$ (D) $40(\sqrt{3} + 2)$

28. r^{th} term in the expansion of $(a + 2x)^n$ is—
(A) $\frac{n(n+1)\ldots(n-r+1)}{r!}a^{n-r+1}(2x)^r$
(B) $\frac{n(n-1)\ldots\ldots(n-r+2)}{(r-1)!}a^{n-r+1}(2x)^{r-1}$

(C) $\frac{n(n+1)\ldots\ldots(n-r)}{(r+1)!}\,a^{n-r}\,(n)^r$

(D) None of the above

29. At an election three wards of a town are convassed by 4, 5 and 8 men respectively. If 20 men volunteer in, how many ways can they be allotted to the different wards ?

(A) ${}^{20}P_4 \times {}^{16}C_5$

(B) ${}^{20}C_4 \times {}^{20}C_5 \times {}^{20}C_8$

(C) ${}^{20}C_4 + {}^{16}C_5 + {}^{11}C_8$

(D) ${}^{20}C_4 \times {}^{16}C_5 \times {}^{11}C_8$

30. The system $\begin{bmatrix} x+2y & 6 \\ 0 & 2x-y \end{bmatrix} = \begin{bmatrix} 3 \\ 0 \end{bmatrix}$. [– 1, 2] has the solution—

(A) $x = -\frac{6}{5}, y = -\frac{3}{5}$ (B) $x = -\frac{3}{5}, y = -\frac{6}{5}$

(C) $x = \frac{3}{5}, y = -\frac{6}{5}$ (D) $x = \frac{3}{5}, y = \frac{6}{5}$

31. If $\begin{vmatrix} 6i & -3i & 1 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix} = x + iy$, then (x, y) is—

(A) (3, 1) (B) (1, 3)

(C) (0, 3) (D) (0, 0)

32. The value of $\cot^{-1} 21 + \cot^{-1} 13 + \cot^{-1}(-8)$ is equal to—

(A) 0 (B) $\cot^{-1} - 1$

(C) ∞ (D) None of these

33. If sin A = sin B and cos A = cos B, then the value of A – B is equal to—

(A) $2n\pi$ (B) $n\pi$

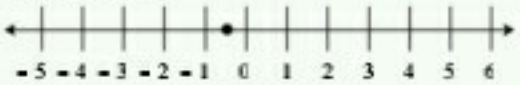
(C) $n\pi/2$ (D) None of these

34. If for positive integers $r > 1$, $n > 2$, the coefficient of the $(3r)^{th}$ and $(r+2)^{th}$ powers of x in the expansion of $(1+x)^{2n}$ are equal, then—

(A) $n = 2r$ (B) $n = 3r$

(C) $n = 2r + 1$ (D) $n = 4r$

35. The number line



represent—

(A) $\{x : 1 < x < 5 \text{ and } x \in R\}$

(B) $\{x : 1 \geq x \geq 5 \text{ and } x \in R\}$

(C) $\{x : 1 \leq x < 5 \text{ and } x \in R\}$

(D) None of these

36. The sides of a triangle are 7 cm, $4\sqrt{3}$ cm and $\sqrt{13}$ cm, then the smallest angle is—

(A) 15° (B) 30°

(C) 45° (D) None of these

37. If the distance between $(x, 4)$ and $(5, 0)$ is 5, then x is equal to—

(A) – 2, 8 (B) 2, 8

(C) 2, 6 (D) – 2, – 6

38. The value of $\log_e\left(1 + ax^2 + a^2 + \frac{a}{x^2}\right)$ is—

(A) $a\left(x^2 - \frac{1}{x^2}\right) - \frac{a^2}{2}\left(x^4 - \frac{1}{x^4}\right) + \frac{a^3}{3}\left(x^6 - \frac{1}{x^6}\right) - \ldots\ldots$

(B) $a\left(x^2 + \frac{1}{x^2}\right) - \frac{a^2}{2}\left(x^4 + \frac{1}{x^4}\right) + \frac{a^3}{3}\left(x^6 + \frac{1}{x^6}\right) - \ldots\ldots$

(C) $a\left(x^2 + \frac{1}{x^2}\right) + \frac{a^2}{2}\left(x^4 + \frac{1}{x^4}\right) + \frac{a^3}{3}\left(x^6 + \frac{1}{x^6}\right) + \ldots\ldots$

(D) $a\left(x^2 - \frac{1}{x^2}\right) + \frac{a^2}{2}\left(x^4 - \frac{1}{x^4}\right) + \frac{a^3}{3}\left(x^6 - \frac{1}{x^6}\right) + \ldots\ldots$

39. The latus rectum of the hyperbola $16x^2 - 9y^2 = 144$ is—

(A) 16/3 (B) 32/3

(C) 8/3 (D) 4/3

40. $\int \frac{x}{\sqrt{x-1}}\,dx$ is equal to—

(A) $\frac{2}{3}(x-1)^{3/2} + 2(x-1)^{-1/2} + C$

(B) $\frac{2}{3}(x-1)^{3/2} + 2(x-1)^{1/2} + C$

(C) $\frac{2}{3}(x-1)^{3/2} - 2(x-1)^{-1/2} + C$

(D) $\frac{2}{3}(x-1)^{-3/2} + 2(x-1)^{-1/2} + C$

41. If a, b, c are three unequal numbers such that a, b, c are in A.P. and $b - a, c - b$, a are in G.P., then $a : b : c$ is—

(A) 1 : 2 : 3 (B) 1 : 3 : 5

(C) 2 : 3 : 4 (D) 1 : 2 : 4

42. The following system of equations $3x - 2y + z = 0$, $\lambda x - 14y + 15z = 0$, $x + 2y - 3z = 0$ has a solution other than $x = y = z = 0$ for λ equal to—

(A) 1 (B) 2

(C) 3 (D) 5

43. $\int \frac{\cot x}{\sqrt{\sin x}}\,dx$ is equal to—

(A) $2\sqrt{\sin x}$ (B) $-2\sqrt{\sin x}$

(C) $\frac{2}{\sqrt{\sin x}}$ (D) $\frac{-2}{\sqrt{\sin x}}$

44 If $x = cy + bz$, $y = az + cx$, $z = bx + ay$ where, x, y, z are not all zero, then—

(A) $a^2 + b^2 + c^2 - 2abc = 0$

(B) $a^2 + b^2 + c^2 + 2abc = 0$

(C) $a^2 + b^2 + c^2 + 2abc = 1$

(D) $a^2 + b^2 + c^2 - 2abc = 1$

45. In a triangle ABC cosec A (sin B· cos C + cos B· sin C) is equal to—

(A) 1 (B) bc

(C) a/c (D) None of these

46. Degree and order of the differential equation $\sqrt{2\left(\frac{dy}{dx}\right)^3 - y} = \left(\frac{d^2y}{dx^2}\right)^{3/2}$ are respectively of—

(A) order 2, degree 3 (B) order 1, degree 3

(C) order 3, degree 2 (D) order 3, degree 3

47. If $y = \tan^{-1}\frac{\sqrt{1-x^2}}{x}$, then $\frac{dy}{dx}$ is equal to—

(A) $\sqrt{1-x^2}$ (B) $\frac{1}{\sqrt{1-x^2}}$

(C) $\frac{-1}{\sqrt{1-x^2}}$ (D) None of these

48. If $\vec{u} = \hat{i} \times (\vec{a} \times \hat{i}) + \hat{j} \times (\vec{a} \times \hat{j}) + \hat{k} \times (\vec{a} \times \hat{k})$, then—

(A) $\vec{u} = 0$ (B) $\vec{u} = 2\vec{a}$

(C) $\vec{u} = \vec{a}$ (D) $\vec{u} = \hat{i} + \hat{j} + \hat{k}$

49. If $f(x) = \begin{vmatrix} 1 & x & 1+x \\ 2x & x(x-1) & (1+x)x \\ 3x(x-1) & x(x-1)(x-2) & (1+x)x(x-1) \end{vmatrix}$, then $f(100)$ equal to—

(A) 0 (B) 1

(C) 100 (D) None of these

50. If $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$, then A^5 equal to—

(A) 10A (B) 4A

(C) 5A (D) 16A

51. For all values of A, B, C and P, Q, R the value of $\begin{vmatrix} \cos(A-P) & \cos(A-Q) & \cos(A-R) \\ \cos(B-P) & \cos(B-Q) & \cos(B-R) \\ \cos(C-P) & \cos(C-Q) & \cos(C-R) \end{vmatrix}$ is—

(A) 0 (B) cos A.cos B.cos C

(C) sin A.sin B.sin C (D) cos P.cos Q.cos R

52. If $\vec{a} = \hat{i} + \hat{j} - \hat{k}$, $\vec{b} = \hat{i} - \hat{j} + \hat{k}$, $\vec{c} = \hat{i} - \hat{j} - \hat{k}$, then $\vec{a} \times (\vec{b} \times \vec{c})$ is—

(A) $\hat{i} - \hat{j} + \hat{k}$ (B) $2\hat{i} - 2\hat{j}$

(C) $3\hat{i} - \hat{j} + \hat{k}$ (D) $2\hat{i} + 2\hat{j} - \hat{k}$

53. In a triangle ABC $\frac{2\cos A}{a} + \frac{\cos B}{b} + \frac{2\cos C}{c} = \frac{a}{bc} + \frac{b}{ca}$, then the value of the angle A is—

(A) 30° (B) 60°

(C) 45° (D) 90°

54. The value of $\tan\left[\cos^{-1}\left(\frac{4}{5}\right) + \tan^{-1}\left(\frac{2}{3}\right)\right]$ is equal to—

(A) $\frac{6}{17}$ (B) $\frac{7}{16}$

(C) $\frac{17}{6}$ (D) None of these

55. $\int_0^{\pi/2} \sin^8 x \cdot dx$ is equal to—

(A) $\frac{21\pi}{128}$ (B) $\frac{35\pi}{256}$

(C) $\frac{63\pi}{512}$ (D) None of these

56. The area of the parallelogram whose adjacent sides are $\hat{i} - 2\hat{j} + 3\hat{k}$ and $2\hat{i} + \hat{j} - 4\hat{k}$ is—

(A) $\sqrt{14}$ (B) $\sqrt{21}$

(C) $5\sqrt{6}$ (D) $7\sqrt{6}$

57. For any 2×2 matrix A, if A (adj A) $= \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$, then | A | is equal to—

(A) 0 (B) 10

(C) 20 (D) 100

58. The equation of the locus of a point equidistant from the points (a_1, b_1) and (a_2, b_2) is $(a_1 - a_2)x + (b_1 - b_2)y + c = 0$, then the value of c is—

(A) $a_1^2 - a_2^2 + b_1^2 - b_2^2$

(B) $\sqrt{a_1^2 + b_1^2 - a_2^2 - b_2^2}$

(C) $\frac{1}{2}(a_1^2 + a_2^2 + b_1^2 + b_2^2)$

(D) $\frac{1}{2}(a_2^2 + b_2^2 - a_1^2 - b_1^2)$

59. If $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$, then $(\vec{a} + t\vec{b})$ is $\perp^r$ to $\vec{c}$, the value of t is—

(A) 3 (B) 4

(C) 5 (D) 8

60. A bag contains 5 brown and 4 white socks. A man pulls out two socks. The probability that they are of the same colour is—

(A) 1/6 (B) 5/108

(C) 4/9 (D) 5/18

61. The equation of a circle is $9x^2 + y^2 = 4(x^2 - y^2 - 2x)$, then its centre is—

(A) $\left(-\frac{4}{5}, 0\right)$ (B) $\left(\frac{4}{5}, 0\right)$

(C) $\left(-\frac{4}{5}, \frac{3}{5}\right)$ (D) $\left(\frac{4}{5}, -\frac{3}{5}\right)$

62. A differential equation $\frac{dy}{dx} = y \tan x - 2 \sin x$ has an integrating factor—

(A) $\cos x$

(B) $e^{\int \tan x \cdot dx}$

(C) $e^{-\int \sin x \cdot dx}$

(D) $e^{\int \cos x \cdot dx}$

63. There are 3 Mathematics, 4 Physics and one Chemistry books and they are placed in a self. The probability that the books of the same subject is placed together is—

(A) $\frac{1}{40}$ (B) $\frac{3}{140}$

(C) $\frac{9}{70}$ (D) None of these

64. The equation of the projection of the line $\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-3}{3}$ on the plane $x + y + z - 1 = 0$ are—

(A) $x + y + z - 1 = 0 = 2x - y - z + 3$

(B) $x + y - z - 1 = 0 = x + 2y - z + 3$

(C) $2x - y + 3z - 1 = 0 = x + y + z + 1$

(D) $x + 2y - 3z = 0 = x + y + z + 1$

65. If $\frac{dy}{dx} = x\sqrt{2x^2 + 3}$ and $t = 2x^2 + 3$, then $\frac{dy}{dt}$ is equal to—

(A) $\frac{t}{2}$ (B) $\frac{t}{4}$

(C) $\frac{t^2}{4}$ (D) None of these

66. From the top of a light house, 60 metres high with its base at the sea level, the angle of depression of a boat is 15°. The distance of the boat from the foot of the light house is—

(A) $\left(\frac{\sqrt{3}-1}{\sqrt{3}+1}\right)60$ m (B) $\left(\frac{\sqrt{3}+1}{\sqrt{3}-1}\right)60$ m

(C) $\frac{\sqrt{3}+1}{\sqrt{3}-1}$ m (D) None of these

67. If 3 is the mean and $\frac{3}{2}$ is the S.D. of a binomial distribution, the distribution is—

(A) $\left(\frac{1}{4} + \frac{3}{4}\right)^{12}$ (B) $\left(\frac{1}{3} + \frac{2}{3}\right)^{12}$

(C) $\left(\frac{1}{5} + \frac{4}{5}\right)^{12}$ (D) None of these

68. If $A_\alpha = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$, then $A_{\alpha+\beta}$ equals—

(A) $A_\alpha + A_\beta$ (B) $A_\alpha - A_\beta$

(C) $A_\alpha \cdot A_\beta$ (D) None of these

69. $\sin 12° . \sin 48° . \sin 54°$ is equal to—

(A) 1 (B) $\frac{1}{4}$

(C) $\frac{1}{8}$ (D) None of these

70. The mode and median of the following data 82, 98, 73, 71, 43, 82 and 90 are respectively—

(A) 82, 80 (B) 82, 78

(C) 82, 82 (D) None of these

71. If the function $f(x) = \frac{x}{x-1}$, express $f(3x)$ in term of $f(x)$—

(A) $\frac{3f(x)}{3f(x)-1}$ (B) $\frac{3f(x)}{3f(x)-3}$

(C) $\frac{3f(x)}{2f(x)+1}$ (D) $3f(x) - 1$

72. If $\lim_{x \to 1} \frac{f(x)-2}{f(x)+2} = 0$, then $\lim_{x \to 1} (x)$ is equal to—

(A) 1 (B) −1

(C) −2 (D) 2

73. The maximum value of $\frac{1}{\sqrt{2}}(\sin x - \cos x)$ is—

(A) 1 (B) $\sqrt{2}$

(C) $\frac{1}{\sqrt{2}}$ (D) 3

74. At a point on a level plane a tower subtends an angle θ and a flag-staff a feet in length at top of the tower subtends an angle ϕ. The height of the tower is—

(A) $\frac{a \sin\theta . \cos\phi}{\cos(\theta + \phi)}$

(B) $\frac{a \sin\theta \cos(\theta + \phi)}{\sin\phi}$

(C) $\frac{a \cos(\theta + \phi)}{\sin\theta . \sin\phi}$

(D) None of the above

75. The standard deviation of the set of first n natural numbers is—

(A) $\sqrt{\frac{n^2-1}{12}}$ (B) $\sqrt{\frac{n^2-1}{4n}}$

(C) $\sqrt{\frac{n^2+1}{4n}}$ (D) $\sqrt{\frac{n^2+1}{12}}$

76. Directrix of the parabola $y^2 + 4x + 4y - 3 = 0$ is—

(A) $4x = 11y$ (B) $4x = 11$

(C) $11x = 4$ (D) $x = y$

77. The distance between the planes $2x - 2y + z + 3 = 0$ and $4x - 4y + 2z + 5 = 0$ is—

(A) $\frac{1}{3}$ (B) $\frac{1}{2}$

(C) $\frac{1}{6}$ (D) $\frac{1}{5}$

78. $\int \frac{\cos x \cdot dx}{(1+\sin x)(2+\sin x)}$ is equal to—

(A) $\log \frac{2+\sin x}{1+\sin x}$

(B) $\log (1+\sin x)(2+\sin x)$

(C) $\log \frac{1+\sin x}{2+\sin x}$

(D) None of the above

79. If A, B and C are independent events such that P(A) = 0·2, P(B) = 0·1 and P(C) = 0·4, then P(A ∪ B ∪ C) equals—

(A) 0·9 (B) 0·008

(C) 0·560 (D) 0·568

80. The coefficient of x in the equation $x^2 + px + q = 0$ was taken as 17 in the place of 13 and its roots were found to be – 2 and – 15. The roots of the original equation are—

(A) 2, 15 (B) 10, 3

(C) – 10, – 3 (D) – 2, 15

81. The angle between the vectors $\vec{a} = 2\hat{i} + \hat{j} - 3\hat{k}$, $\vec{b} = 3\hat{i} - 2\hat{j} - \hat{k}$ is—

(A) π (B) $\frac{\pi}{2}$

(C) $\frac{\pi}{3}$ (D) None of these

82. A population grows at the rate of 8% per year. How long does it take for the population to triple use differential equation for it ?

(A) $\frac{25}{2}\log 9$ (B) $\frac{25}{2}\log 3$

(C) $25 \log 3$ (D) $\frac{25}{3}\log 3$

83. The conversion of $(11101)_2$ in decimal system is—

(A) 31 (B) 28

(C) 29 (D) None of these

Directions—(Q. 84) The people of various religion of a city are represent by the following Pie chart—

Total number of people of the city is 28800. Answer the question on the basis of the Pie chart.

84. How many number of Muslim people is less than the number of Hindu people—

(A) 3,200 (B) 2,400

(C) 4,800 (D) None of these

85. If $\log_e\left(\frac{a+b}{2}\right) = \frac{1}{2}(\log_e a + \log_e b)$, then relation between a and b will be—

(A) $a = b$ (B) $a = \frac{b}{2}$

(C) $2a = b$ (D) $a = \frac{b}{3}$

86. Equation of the circle, which passes through the origin and cuts orthogonally each of the circles $x^2 + y^2 - 8y + 12 = 0$ and $x^2 + y^2 - 4x - 6y - 3 = 0$, is—

(A) $x^2 + y^2 + 6x + 3y = 0$

(B) $x^2 + y^2 + 3x - 6y = 0$

(C) $x^2 + y^2 + 6x - 3y = 0$

(D) $x^2 + y^2 - 3x + 6y = 0$

87. $\int_{-\infty}^{\infty} \frac{1}{x^2+1} \cdot dx$ is equal to—

(A) ∞ (B) $\frac{\pi}{2}$

(C) 0 (D) π

88. $\int_1^2 \frac{1}{x^2} e^{-1/x} \cdot dx$ is equal to—

(A) $\frac{1}{\sqrt{e}} + \frac{1}{e}$ (B) $\frac{1}{\sqrt{e}} - \frac{1}{e}$

(C) $\frac{1}{\sqrt{e}} - \frac{1}{4}$ (D) None of these

89. The unit vector which is perpendicular to the vectors $\vec{a} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = 3\hat{i} + 4\hat{j} - \hat{k}$ is—

(A) $\frac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$ (B) $\frac{-\hat{i}+\hat{j}-\hat{k}}{\sqrt{3}}$

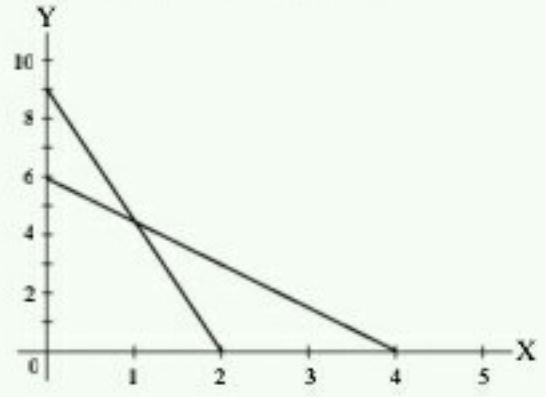
(C) $\frac{\hat{i}-\hat{j}+\hat{k}}{\sqrt{3}}$ (D) $\frac{-\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$

90. The angle of intersection of the sphere $x^2 + y^2 + z^2 + 2x - 2y + 6z + 2 = 0$ and $x^2 + y^2 + z^2 = 4$

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{3}$

(C) $\cos^{-1}\frac{1}{3}$ (D) $\cos^{-1}\frac{1}{6}$

91. Find the linear inequation for which the shaded area in given figure is the solution set is—



(A) $4x + y \le 9$, $3x + 2y \le 12$, $x, y \le 0$ (B) $4x + y \le 9$, $3x + 2y \ge 12$, $x, y \ge 0$

(C) $4x + y \le 9$, $3x + 2y \le 12$, $x, y \ge 0$ (D) $4x + y \le 9$, $3x + 2y \ge 12$, $x, y \le 0$

92. An office has 5 computers that are connected together in a linear network (*i.e.*, they will be arranged in 5 positions on one straight connecting cable, see figure below) communications can go either way along the cable. In how many different ways they can be arranged ?

$$A \rightleftarrows B \rightleftarrows C \rightleftarrows D \rightleftarrows E$$

(A) 40 (B) 50

(C) 60 (D) 80

93. $\int_0^{\pi/2} \frac{\cos(\log x)}{x} \cdot dx$ is equal to—

(A) $2\sin\left(\log\frac{\pi}{2}\right)$ (B) $\cos\left(\log\frac{\pi}{2}\right)$

(C) $\sin\left(\log\frac{\pi}{2}\right)$ (D) $\sin\frac{\pi}{2} - \log\frac{\pi}{2}$

94. If $\vec{a}$, $\vec{b}$, $\vec{c}$, $\vec{d}$ be the position vectors of vertices to a parallelogram, then—

(A) $\vec{a} + \vec{c} = \vec{b} + \vec{d}$

(B) $\vec{a} + \vec{b} = \vec{c} + \vec{d}$

(C) $\vec{a} + \vec{d} = \vec{b} + \vec{c}$

(D) $\vec{b} - \vec{a} = \vec{d} - \vec{c}$

95. $\lim_{x \to 0} \frac{\sqrt{1+x} - \sqrt{1-x}}{x}$ is given by—

(A) 0 (B) -1

(C) 1 (D) $\frac{1}{2}$

96. Solution of $\cos x \cdot \frac{dy}{dx} + y \sin x = 1$ is—

(A) $y \sec x \cdot \tan x = C$

(B) $y \sec x = \tan x + C$

(C) $y \tan x = \sec x + C$

(D) $y \tan x = \sec x \cdot \tan x + C$

97. The value of $\lim_{n \to \infty} \left(\frac{e^n}{\pi}\right)^{1/n}$ is—

(A) 1 (B) $1/\pi$

(C) e (D) ∞

98. Chord of curvature of the curve $y = a \log \sec\left(\frac{x}{a}\right)$ parallel to y-axis is—

(A) $a \sec\frac{x}{a}$ (B) $\frac{1}{2}a$

(C) $a \cos\frac{x}{a}$ (D) $2a$

99. The standard deviation of a set of values is 2·5. Now 16 is added to each of the given set of value. The standard deviation of the new set of values is—

(A) 2·5 (B) 6·5

(C) 18·5 (D) None of these

100. $\vec{a} \times (\vec{b} + \vec{c}) + \vec{b} \times (\vec{c} + \vec{a}) + \vec{c} \times (\vec{a} + \vec{b})$ is equal to—

(A) $2\vec{a} \cdot (\vec{b} \times \vec{c})$ (B) $3\vec{a} \times (\vec{b} \times \vec{c})$

(C) $[\vec{a} \cdot \vec{b} \cdot \vec{c}]$ (D) 0

101. Out of 50 student in a class, 10 were of the age of 10 years, 14 were of the age of 11 years and the remaining of 12 years. Then A.M. of student is—

(A) 11·5 (B) 11·24

(C) 11·32 (D) None of these

102. The variance of the following number 15, 25, 5, 10, 30 is—

(A) 50·20 (B) 9·27

(C) 430 (D) 86

103. If the probabilities that A and B will die within a year are p and q respectively, then the probability that only one of them will be alive at the end of the year is—

(A) $p + q$ (B) $p + q - 2pq$

(C) $p + q - pq$ (D) $p + q + pq$

104. If ${}^{n+1}C_3 = 2 \cdot {}^nC_2$, then $n =$

(A) 3 (B) 4

(C) 5 (D) 6

105. If relation R = {(a, c), (b, d), (c, c)}, then domain and range are—
(A) {a, b, c}, {a, b, c}
(B) {a, c, a}, {c, b, d}
(C) {a, b, c}, {c, d}
(D) {c, d}, {a, b, c}

106. A complex number is defined to be an ordered pair of—
(A) Integers
(B) Rational numbers
(C) Irrational numbers
(D) Real number

107. At $x = 1$, the function—

$$f(x) = \begin{cases} x^3 - 1 \; ; \; 1 < x < \infty \\ x - 1 \; ; \; -\infty < x \le 1 \end{cases}$$ is—

(A) Continuous and differentiable
(B) Continuous and not differentiable
(C) Discontinuous and differentiable
(D) Discontinuous and not differentiable

108. $\sin x \, . \, dx + y \cdot dy = 0$, $y(0) = -2$, then the value of $y(\pi)$ is—
(A) 2 (B) $\sqrt{2}$
(C) 0 (D) -2

109. $a^2b^2 - (\vec{a} \times \vec{b})^2$ is equal to—
(A) $(\vec{a} \cdot \vec{b})^2$
(B) 0
(C) $(\vec{a} + \vec{b})(\vec{a} - \vec{b})$
(D) None of the above

110. $\lim\limits_{x \to 0} \dfrac{\sin ax}{\sin bx} (a \neq 0, b \neq 0)$ is—
(A) $\dfrac{a}{b}$ (B) $\dfrac{b}{a}$
(C) $a \cdot b$ (D) Does not exist

111. The least value of $f(x) = 2x + \dfrac{8}{x^2}, x > 0$ is—
(A) 4 (B) 6
(C) 8 (D) None of these

112. If $\vec{a} = 2\hat{i} - 3\hat{j}$, $\vec{b} = \hat{i} + \hat{j} - \hat{k}$, $\vec{c} = 3\hat{i} - \hat{k}$, then $\vec{a} \cdot (\vec{b} \times \vec{c})$ is equal to—
(A) 1 (B) 2
(C) 3 (D) 4

113. The function $f(x) = \dfrac{\sin x + \cos x}{\sin x - \cos x}$ is continuous for—
(A) $0 \le x \le 2\pi$ (B) $-\pi \le x \le \pi$
(C) $-\dfrac{3\pi}{4} < x < \dfrac{\pi}{4}$ (D) $-\dfrac{\pi}{4} \le x \le \dfrac{\pi}{4}$

114. Three coins are tossed simultaneously. The probability of getting at least one head is—
(A) $\dfrac{3}{4}$ (B) $\dfrac{1}{8}$
(C) $\dfrac{5}{8}$ (D) $\dfrac{7}{8}$

115. $(\vec{a} - \vec{b}) \times (\vec{a} + \vec{b})$ is equal to—
(A) $\vec{a} \times \vec{b}$ (B) a^2b^2
(C) $2\vec{a} \times \vec{b}$ (D) 0

116. If $f(x) = 3^x$, then $f(0), f(1), f(2), \ldots$ are in—
(A) A.P. (B) G.P.
(C) H.P. (D) None of these

117. If $\sum x_i = 60$, $\sum y_i = -20$, $\sum x_i y_i = -105$ and $n = 10$, then the cov (x, y) between x and y is equal to—
(A) 3·8 (B) 2·5
(C) 1·5 (D) None of these

118. If an analysis of a correlation the following observation were obtained. $\Sigma xy = 40$, $\Sigma x^2 = 80$, $\Sigma y^2 = 20$ and $x = 100$ where $x = X - \overline{X}$, $y = Y - \overline{Y}$, then the coefficient of correlation will be—
(A) 0·5 (B) 0
(C) +1 (D) −1

119. The regression coefficient b_{xy} between x and y for the following data :
$\sum x = 20$, $\sum y = 45$, $\sum xy = 300$, $\sum x^2 = 125$, $\sum y^2 = 574$, $n = 4$ is—
(A) 2·5 (B) 2·1
(C) 3·0 (D) None of these

120. If $n = 10$ and $\sum d^2 = 280$, then the value of Spearman's rank correlation coefficient is—
(A) 0·28 (B) −0·28
(C) 0·7 (D) −0·7

Answers with Hints

1. (C) Let $z = r(\cos\theta + i \sin\theta)$ and $\omega = r(\cos\phi + i \sin\phi)$

$$\because \quad \arg r + \arg \omega = \pi$$
$$\therefore \quad \tan^{-1}\theta + \tan^{-1}\phi = \pi$$
$$\Rightarrow \quad \tan^{-1}\left[\frac{\theta - \phi}{1 - \theta.\phi}\right] = \pi$$
$$\Rightarrow \quad \theta + \phi = 0$$
$$\Rightarrow \quad \theta = -\phi$$
$$\Rightarrow \quad \arg z = \arg \overline{\omega}$$
$$\therefore \quad z = \overline{\omega}$$

2. (B) $3 - 4i$ *i.e.*, (3, −4) lie in fourth quadrant in complex plane, after turned anti-clockwise through 180° this will lie in 2nd quadrant, therefore, the number will be $-3 + 4i$, now after stretching it 2·5

times *i.e.*, multiplying by 2·5, the required complex number will be $-\frac{15}{2}+10i$

3. (A) $A \times B = \{(1,2),(1,5),(2,2),(2,5)\}$
$A \times C = \{(1,5),(1,7),(2,5),(2,7)\}$
$\therefore (A \times B) \cap (A \times C) = \{(1,5),(2,5)\}$

4. (B) Equating the complex numbers corresponding to the mid-point of the two diagonals, we have
$$\frac{z_1+z_3}{2} = \frac{z_2+z_4}{2}$$
$$\Rightarrow \quad z_1+z_3 = z_2+z_4$$

5. (C) $$z = \frac{2+3i}{3+4i} = \frac{(2+3i)}{(3+4i)} \times \frac{(3-4i)}{(3-4i)}$$
$$= \frac{(6+12)+(-8i+9i)}{9+16}$$
$$= \frac{18+i}{25}$$

6. (C) Since x, y, z are in H.P.
$$\therefore \quad y = \frac{2xz}{x+z}$$
$$\therefore \log(x+z)+\log(x-2y+z)$$
$$= \log(x+z)+\log\left\{x-2\left(\frac{2xz}{x+z}\right)+z\right\}$$
$$= \log(x+z)+\log\frac{(x-z)^2}{(x+z)} \Rightarrow \log(x-z)^2$$

7. (A) Here 5th term of the corresponding
A.P. $= a+4d = 45$ ...(1)
and 11th term of the corresponding
A.P. $= a+10d = 69$ ...(2)
Solving (1) and (2), we get
$a = 29, \ d = 4$
$\therefore$ 16th term of the corresponding A.P.
$= a+15d$
$= 2a+15\times 4 = 89$
Hence, 16th term of the H.P. $= \frac{1}{89}$

8. (C) $$\frac{{}^{56}P_{r+6}}{{}^{54}P_{r+3}} = \frac{30800}{1}$$
$$\frac{\lfloor 56}{\lfloor 50-r} \times \frac{\lfloor 51-r}{\lfloor 54} = 30800$$
$$\Rightarrow 56\times 55\times (51-r) = 30800$$
$$51-r = 10$$
$$r = 41$$

9. (B) Here total letters are 8. 3 vowels and 5 consonents. Here 2 consonents can be chosen in ${}^5C_2$ ways and these two consonent can be put in $\lfloor 2$ ways. The remaining 6 letters can be arranged in $\lfloor 6$ ways.
The words beginning and ending letters with consonent $= {}^5C_2 \times \lfloor 2 \times \lfloor 6 = 14400$

10. (B) The sum of the n terms
= [The sum of $(n-1)$ terms] + The n^{th} term
$$= \frac{1}{2}(n-1)n^2 + n^2$$
$$= \frac{1}{2}(n+1)n^2.$$

11. (B)

12. (D) If R is equivalence, then R^{-1} will also be equivalence.

13. (D) Since α and β are the roots of given equations. So we have
$$a^2\alpha + b\alpha + c = 0$$
and $$a^2\beta - b\beta - c = 0$$
Let $$f(x) = a^2x^2 + 2bx + 2c = 0$$
Then, $$f(\alpha) = a^2\alpha^2 + 2b\alpha + 2c = 0$$
$$= a^2\alpha^2 + 2(b\alpha + c)$$
$$= a^2\alpha^2 - 2a^2\alpha^2$$
$$= -a^2\alpha^2 = -\text{ve}$$
and $$f(\beta) = a^2\beta^2 + 2(b\beta + c)$$
$$= a^2\beta^2 + 2a^2\beta^2$$
$$= 3a^2\beta^2 = +\text{ve}$$
Since, $f(\alpha)$ and $f(\beta)$ are of opposite signs, therefore by theory of equations there lies a root γ of the equation $f(x) = 0$ between α and β *i.e.*, $\alpha < \gamma < \beta$.

14. (C) $$T_4 = {}^8C_3\,(2x)^{8-3}\left(-\frac{1}{3}\right)^3$$
$$= {}^8C_3 \cdot 2^5 \cdot x^5\left(-\frac{1}{27}\right) = -{}^8C_3\,x^5\frac{32}{27}$$
$$= -{}^8C_5 \cdot x^5\frac{32}{27}$$

15. (C) L.H.S. $= [1\ x\ 1]\begin{bmatrix} 2 & 3 & 2 \\ 0 & 5 & 1 \\ 0 & 3 & 2 \end{bmatrix}\begin{bmatrix} 1 \\ 1 \\ x \end{bmatrix}$
$$= [2 \quad 6+5x \quad 4+x]\begin{bmatrix} 1 \\ 1 \\ x \end{bmatrix}$$
$$= [2+6+5x+4x+x^2] = [8+9x+x^2] = 0$$
$$\therefore \quad (x+1)(x+8) = 0$$
$$x = -1, -8$$

16. (A) $$J^2 = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$
$$= \begin{bmatrix} 3 & 3 & 3 \\ 3 & 3 & 3 \\ 3 & 3 & 3 \end{bmatrix} = 3\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} = 3J$$

17. (B) On solving we get

$$\frac{cp}{ar} = \frac{\frac{b^2}{a^2} - 2\left(\frac{c}{a}\right)}{\frac{q^2}{p^2} - 2\left(\frac{r}{p}\right)}$$

$$= \frac{(b^2 - 2ac)p^2}{(q^2 - 2pr)a^2}$$

$$\Rightarrow \quad \frac{c}{r} = \frac{pb^2 - 2acp}{q^2a - 2ap^2}$$

$$\Rightarrow \quad b^2rp - 2acpr = q^2ac - br.2ac$$

$$\therefore \quad b^2pr = q^2ac$$

18. (A) First arrange m men, in a row in $m!$ ways. Since $n < m$ and no two women can sit together in any one of the $m!$ arrangement, there are $(m + 1)$ places in which n women can be arranged in ${}^{m+1}p_n$ ways. By the fundamental theorem, the required number of arrangements of m men and n women $(n < m)$

$$= \frac{m!\,(m+1)!}{(m-n+1)!}$$

19. (B) $\quad BA = \begin{bmatrix} 4 & 5 \\ 5 & 4 \end{bmatrix}$.

$$A(BA) = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}\begin{bmatrix} 4 & 5 \\ 5 & 4 \end{bmatrix} = \begin{bmatrix} 14 & 13 \\ 13 & 14 \end{bmatrix}$$

20. (D) Given that $\quad |z - 1| = 2 \quad \therefore |z - 1|^2 = 4$

$$\therefore \quad (z-1)(\bar{z}-1) = 4$$

$$z\bar{z} - z - \bar{z} + 1 = 4$$

$$\therefore \quad z\bar{z} - z - \bar{z} = 3$$

21. (D) $a_1 + a_5 + a_{10} + a_{15} + a_{20} + a_{24} = 225$

or $\quad a_1 + a_1 + 4d + a_1 + 9d + a_1 + 14d + a_1 + 19d + a_1 + 23d = 225$

or $\quad 6a_1 + 69d = 225 \quad \ldots(i)$

and $\quad a_1 + a_2 + a_3 + \ldots + a_{24}$

$$a_1 + a_1 + d + a_1 + 2d + \ldots\ldots + a_1 + 23d$$

$$= \quad 24a_1 + 276d = 4\,(6a_1 + 69d)$$

$$= \quad 4 \times 225 = 900$$

22. (C) $T_{3+1} = {}^nC_3 \cdot (px)^{n-3}\left(\frac{1}{x}\right)^3$

$$= {}^nC_3 \cdot p^{n-3} \cdot x^{n-6}$$

Given that $\quad T_4 = \frac{5}{2}$

$$\therefore \quad {}^nC_3 \cdot p^{n-3} = \frac{5}{2} \text{ and } n - 6 = 0$$

$$\Rightarrow \quad n = 6 \text{ and } {}^6C_3 \cdot p^3 = \frac{5}{2}$$

$$20p^3 = \frac{5}{2}$$

$$p = \frac{1}{2}$$

23. (C) $\sin\left(\frac{\pi}{10}\right) \cdot \sin\left(\frac{13\pi}{10}\right)$

$$= -\sin 18^\circ \cdot \sin 54^\circ$$

$$= -\frac{1}{4}\left(\sqrt{5} - 1\right) \cdot \frac{1}{4}\left(\sqrt{5} + 1\right)$$

$$= -\frac{1}{4}$$

24. (C) $\quad \tan(\alpha + \beta) = \frac{\frac{m}{m+1} + \frac{1}{(2m+1)}}{1 - \left(\frac{m}{m+1}\right) \cdot \left(\frac{1}{2m+1}\right)}$

$$= \frac{2m^2 + 2m + 1}{2m^2 + 3m + 1 - m}$$

$$= 1$$

$$\Rightarrow \quad \alpha + \beta = \frac{\pi}{4}$$

25. (A) $\quad 2\sin^2\theta = 3\cos\theta$

$$\Rightarrow \quad 2\cdot\cos^2\theta + 3\cos\theta - 2 = 0$$

$$(\cos\theta + 2)(2\cos\theta - 1) = 0$$

$$\therefore \quad \cos\theta = -2 \text{ is impossible}$$

$$\therefore \quad \cos\theta = \frac{1}{2} = \cos\frac{\pi}{3}$$

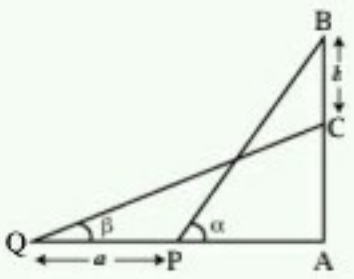
$$\theta = 2n\pi \pm \frac{\pi}{3}$$

We have to choose values of θ. S.t. $0 \le \theta \le 2\pi$

$$\therefore \quad \theta = \frac{\pi}{3}, 2\pi - \frac{\pi}{2} = \frac{5\pi}{3}$$

26. (A) Let l is the length of the ladder.

$$\therefore \quad b = BC = AB - AC = l\sin\alpha - l\sin\beta$$



$$a = PQ = AQ - AP$$

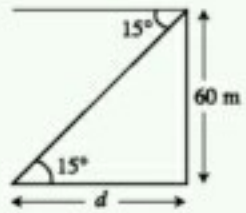
$$= l\cos\beta - l\cos\alpha$$

$$\frac{a}{b} = \frac{\cos\beta - \cos\alpha}{\sin\alpha - \sin\beta}$$

$$= \frac{2 \cdot \sin\left(\frac{\beta+\alpha}{2}\right) \cdot \sin\left(\frac{\alpha-\beta}{2}\right)}{2 \cdot \cos\left(\frac{\alpha+\beta}{2}\right) \cdot \sin\left(\frac{\alpha-\beta}{2}\right)}$$

$$\frac{a}{b} = \tan\left(\frac{\alpha+\beta}{2}\right)$$

27. (C) $\tan 15° = \frac{60}{d}$



$$\tan(45° - 30°) = \frac{60}{d}$$

$$\frac{\tan 45° - \tan 30°}{1 + \tan 45° \cdot \tan 30°} = \frac{60}{d}$$

$$\frac{1 - \frac{1}{\sqrt{3}}}{1 + \frac{1}{\sqrt{3}}} = \frac{60}{d}$$

$$\Rightarrow \quad d = \left(\frac{\sqrt{3}+1}{\sqrt{3}-1}\right) \times 60 \text{ m}$$

$$= \frac{(\sqrt{3}+1)(\sqrt{3}+1)}{(\sqrt{3}-1)(\sqrt{3}+1)} \times 60 \text{ m}$$

$$= 60(\sqrt{3}+2) \text{ m}$$

28. (B) r^{th} term of $(a + 2x)^n$ is ${}^nC_{r-1}\,(a)^{n-r+1}\,(2x)^{r-1}$

$$= \frac{n!}{(n-r+1)!\,(r-1)!} \cdot a^{n-r+1}\,(2x)^{r-1}$$

$$= \frac{n(n-1)\ldots\ldots(n-r+2)}{(r-1)!} \cdot a^{n-r+1}\,(2x)^{r-1}$$

29. (D) Let three wards A, B and C

Ward A	Ward B	Ward C
4	5	8
(4 out of 20)	(5 out of 16)	(8 out of remaining 11)

$\therefore$ Total No. of ways $= {}^{20}C_4 \times {}^{16}C_5 \times {}^{11}C_8$

30. (B) $\begin{bmatrix} x+2y & 6 \\ 0 & 2x-y \end{bmatrix} = \begin{bmatrix} -3 & 6 \\ 0 & 0 \end{bmatrix}$

$$\Rightarrow \quad x + 2y = -3 \text{ and } 2x - y = 0$$

Solving, we get $x = -\frac{3}{5}, y = -\frac{6}{5}$

31. (D) $6i\,(3i^2 + 3) + 3i\,(4i + 20) + 1\,(12 - 60i)$

$$= 0 - 12 + 60i + 12 - 60i$$

$$= 0$$

32. (D) $\cot^{-1} 21 + \cot^{-1} 13 + \cot^{-1}(-8)$

$$= \left(\frac{\pi}{2} - \tan^{-1} 21\right) + \left(\frac{\pi}{2} - \tan^{-1} 13\right) + \cot^{-1}(-8)$$

$$= \pi - [\tan^{-1} 21 + \tan^{-1} 13] + \cot^{-1}(-8)$$

$$= \pi - \tan^{-1}\left(-\frac{1}{8}\right) + \cot^{-1}(-8)$$

$$= \pi$$

33. (A) $\sin A - \sin B = 0$
and $\cos A - \cos B = 0$

$$\Rightarrow 2 \cdot \sin\left(\frac{A-B}{2}\right) \cdot \cos\left(\frac{A+B}{2}\right) = 0$$

$$\text{and } -2 \cdot \sin\left(\frac{A+B}{2}\right) \cdot \sin\left(\frac{A-B}{2}\right) = 0$$

Common factor is $\sin\frac{A-B}{2} = 0$

$$\Rightarrow \quad \frac{A-B}{2} = n\pi$$

$$A - B = 2n\pi$$

34. (C) In the expansion of $(1 + x)^{2n}$ the general term = ${}^{2n}C_r$, $0 \le k \in 2n$

As given for $r > 1$, $n > 2$,

$${}^{2n}C_{3r} = {}^{2n}C_{r+2}$$

$$\Rightarrow \quad 3r = r + 2$$

or $\quad 3r = 2n - (n + 2) \qquad [\because {}^nC_r = {}^nC_{n-r}]$

$$\Rightarrow \quad r = 1$$

or $\quad n = 2r + 1$

$\therefore \quad n = 2r + 1 \qquad$ (since $r > 1$)

35. (C)

36. (B) Since C is the smallest side. So C is the smallest angle

$$\cos C = \frac{a^2 + b^2 - c^2}{2ac} = \frac{\sqrt{3}}{2}$$

$$\Rightarrow \quad C = 30°$$

37. (B) $(x - 5)^2 + (4 - 0)^2 = 5^2$

$$(x - 5)^2 = 9$$

$$x - 5 = \pm 3$$

or $\quad x = 2, 8$

38. (B) $\log\left[1 + ax^2 + a^2 + \frac{a}{x^2}\right]$

$$= \log_e (1 + ax^2)\left(1 + \frac{a}{x^2}\right)$$

$$= \log_e (1 + ax^2) + \log_e \left(1 + \frac{a}{x^2}\right)$$

$$= \left[ax^2 - \frac{1}{2}a^2(x^4) + \frac{1}{3}a^3(x^6) \ldots\right] + \left[\frac{a}{x^2} - \frac{1}{2}a^2\left(\frac{1}{x^4}\right) + \frac{1}{3}a^3\left(\frac{1}{x^6}\right) \ldots\right]$$

$$= a\left(x^2 + \frac{1}{x^2}\right) - \frac{1}{2} \cdot a^2\left(x^4 + \frac{1}{x^4}\right) + \frac{1}{3}a^3\left(x^6 + \frac{1}{x^6}\right)$$

39. (B) $16x^2 - 9y^2 = 144$

$$\frac{x^2}{9} - \frac{y^2}{16} = 1$$

$$a = 3,\ b = 4$$

$$\text{L.R.} = \frac{2b^2}{a} = \frac{2 \times 16}{3} = \frac{32}{3}$$

40. (B) $\int \frac{x}{\sqrt{x-1}}\,dx = \int \frac{(x-1)+1}{\sqrt{x-1}} \cdot dx$

$= \int (\sqrt{x-1})\,dx + \int \frac{dx}{\sqrt{x-1}}$

$= \frac{2}{3}(x-1)^{3/2} + 2(x-1)^{1/2} + C$

41. (A) By the hypothesis $b - a = c - b$ and

$(c-b)^2 = a(b-a)$

$(b-a)^2 = a(b-a)$

$b - a = a \qquad \therefore\ b \neq a$

$b = 2a$ and $c = 3a$

$\therefore\ a : b : c = 1 : 2 : 3$

42. (D) The system of equations has infinitely many (non-trivial) solutions. if $\Delta = 0$

If $\begin{vmatrix} 3 & -2 & 1 \\ \lambda & -14 & 15 \\ 1 & 2 & -3 \end{vmatrix} = 0$

$\Rightarrow \qquad \lambda = 5$

43. (D) Let $I = \int \frac{\cot x}{\sqrt{\sin x}} \cdot dx = \int \frac{\cos x}{(\sin x)^{3/2}} \cdot dx$

Put $\sin x = t \Rightarrow \cos x \cdot dx = dt$

$\therefore \qquad I = \int \frac{dt}{t^{3/2}} = \frac{t^{-1/2}}{-\frac{1}{2}} = -2t^{-1/2}$

$= -2(\sin x)^{-1/2}$

$= \frac{-2}{\sqrt{\sin x}}$

44. (C) The system of homogeneous equations—

$x - cy - bz = 0$

$cx - y + az = 0$

$bx + ay - z = 0$

has a non-trivial solution.

If $\Delta = \begin{vmatrix} 1 & -c & -b \\ c & -1 & a \\ b & a & -1 \end{vmatrix} = 0$

$(1 - a^2) + c(-c - ab) - b(ca + b) = 0$

$a^2 + b^2 + c^2 + 2abc = 1$

45. (A) $\operatorname{cosec} A(\sin B \cdot \cos C + \cos B \cdot \sin C)$

$= \operatorname{cosec} A \cdot \sin (B + C)$

$= \operatorname{cosec} A \cdot \sin (\pi - A)$

$= \operatorname{cosec} A \cdot \sin A = 1$

46. (A) Squaring both side, we get

$2\left(\frac{dy}{dx}\right)^3 + 4 = \left(\frac{d^2y}{dx^2}\right)^3$

$\therefore$ Higher order = 2, degree = 3

47. (C) Let $x = \sin\theta$, $\therefore\ \theta = \sin^{-1}x$

Hence, $y = \tan^{-1}\frac{\sqrt{1-x^2}}{x}$

$= \tan^{-1}\frac{\sqrt{1-\sin^2\theta}}{\sin\theta}$

$= \tan^{-1}\frac{\cos\theta}{\sin\theta} = \tan^{-1}\cot\theta$

$y = \tan^{-1} \cdot \tan\left(\frac{\pi}{2} - \theta\right)$

$= \frac{\pi}{2} - \theta = \frac{\pi}{2} - \sin^{-1}x$

$\therefore \qquad \frac{dy}{dx} = \frac{d}{dx}\left(\frac{\pi}{2}\right) - \frac{d}{dx}\sin^{-1}x$

$= 0 - \frac{1}{\sqrt{1-x^2}} = -\frac{1}{\sqrt{1-x^2}}$

48. (B) $\vec{u} = (\hat{i} \cdot \hat{i}) \cdot \vec{a} - (\hat{i} \cdot \vec{a}) \cdot \hat{i} + (\hat{j} \cdot \hat{j}) \cdot \vec{a}$

$- (\hat{i} \cdot \vec{a}) \cdot \hat{j} + (\hat{k} \cdot \hat{k}) \cdot \vec{a} - (\hat{k} \cdot \vec{a}) \cdot \hat{k}$

$= \vec{a}\,(1) - (a_1)\hat{i} + \vec{a}\,(1) - (a_2)\hat{j} + \vec{a}\,(1) - (a_3)\hat{k}$

$= 3\vec{a} - (a_1\hat{i} + a_2\hat{j} + a_3\hat{k})$

$= 3\vec{a} - \vec{a}$

$= 2\vec{a}$

49. (A) Applying $C_1 + C_2$, we get

$f(x) =$

$$\begin{vmatrix} (1+x) & x & (1+x) \\ x(1+x) & x(x-1) & (1+x)x \\ (1+x)x(x-1) & x(x-1)(x-2) & (1+x)x(x-1) \end{vmatrix} = 0$$

as C_1 and C_2 are identical.

$\therefore\ f(100) = 0$

50. (D) $A^5 = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}^5 = 2^5 \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$= 2^4 \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix} = 16A$

51. (A) It can be expanded as—

$$\begin{vmatrix} \cos A.\cos P + \sin A.\sin P & \cos A.\cos Q + \sin A.\sin Q & \cos A.\cos R + \sin A.\sin R \\ \cos B.\cos P + \sin B.\sin P & \cos B.\cos Q + \sin B.\sin Q & \cos B.\cos R + \sin B.\sin R \\ \cos C.\cos P + \sin C.\sin P & \cos C.\cos Q + \sin C.\sin Q & \cos C.\cos R + \sin C.\sin R \end{vmatrix}$$

The determinant can be written as 8 determinants and the value of each of these 8 determinants is O,

$\cos P.\cos Q.\cos R$

$$\begin{vmatrix} \cos A & \cos A & \cos A \\ \cos B & \cos B & \cos B \\ \cos C & \cos C & \cos C \end{vmatrix} = 0$$

52. (B) $\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a} \cdot \vec{c})\cdot \vec{b} - (\vec{a} \cdot \vec{b})\cdot \vec{c}$
$= (1 - 1 + 1)(\hat{i} - \hat{j} + \hat{k}) - (1 - 1 - 1)(\hat{i} - \hat{j} - \hat{k})$
$= \hat{i} - \hat{j} + \hat{k} + \hat{i} - \hat{j} - \hat{k}$
$= 2(\hat{i} - \hat{j}) = 2\hat{i} - 2\hat{j}$

53. (D) $\dfrac{2\cos A}{a} + \dfrac{2\cos C}{c} + \dfrac{\cos B}{b} = \dfrac{a}{bc} + \dfrac{b}{ca}$

$\dfrac{2(c\cos A + a\cos C)}{ac} + \dfrac{\cos B}{b} = \dfrac{a^2 + b^2}{abc}$

$\Rightarrow \quad \dfrac{2b}{ac} + \dfrac{a^2 + c^2 - b^2}{2abc} = \dfrac{a^2 + b^2}{abc}$

or $\quad 4b^2 + c^2 + a^2 - b^2 = 2a^2 + 2b^2$

or $\quad b^2 + c^2 = a^2$

$\Rightarrow \quad \angle A = 90°$

54. (C) Let $\cos^{-1}\left(\dfrac{4}{5}\right) = x \Rightarrow \cos x = \dfrac{4}{5}$

$\therefore \quad \sin x = \sqrt{1 - \cos^2 x} = \dfrac{3}{5}$

$\therefore \quad \tan x = \dfrac{3/5}{4/5} = \dfrac{3}{4} \Rightarrow x = \tan^{-1}\dfrac{3}{4}$

$\therefore \quad \tan[\cos^{-1}(4/5) + \tan^{-1}(2/3)]$

$\therefore \quad \tan[\tan^{-1}(3/4) + \tan^{-1}(2/3)]$

$= \tan\left[\tan^{-1}\dfrac{17}{6}\right] = \dfrac{17}{6}$

55. (B) $\displaystyle\int_0^{\pi/2} \sin^8 x \cdot dx = \frac{7}{8}\cdot\frac{5}{6}\cdot\frac{3}{4}\cdot\frac{1}{2}\cdot\frac{\pi}{2} = \frac{35\pi}{256}$

56. (C) Area of Parallelogram $= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -2 & 3 \\ 2 & 1 & -4 \end{vmatrix}$

$= |\hat{i}(8 - 3) - \hat{j}(-4 - 6) + \hat{k}(1 + 4)|$

$= |5\hat{i} + 10\hat{j} + 5\hat{k}|$

$= \sqrt{25 + 100 + 25}$

$= 5\sqrt{6}$

57. (B) $A(\text{adj } A) = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix} = 10I = |A|I$

$|A| = 10$

58. (D) A point equidistant from the points (a_1, b_1) and (a_2, b_2) is (h, k)

then $\sqrt{(h - a_1)^2 + (k - b_1)^2} = \sqrt{(h - a_2)^2 + (k - b_2)^2}$

$\Rightarrow h^2 + a_1^2 - 2ha_1 + h^2 + b_1^2 - 2kb_1$

$= h^2 + a_2^2 - 2ha_2 + k^2 + b_2^2 - 2kb_2$

$\Rightarrow 2ha_1 - 2ha_2 + 2kb_1 - 2Kb_2 - a_1^2 - b_1^2 + a_2^2 + b_2^2 = 0$

$\Rightarrow (a_1 - a_2)h + (b_1 - b_2)K + \dfrac{1}{2}(a_2^2 + b_2^2 - a_1^2 - b_1^2) = 0$

$\therefore \quad c = \dfrac{1}{2}(a_2^2 + b_2^2 - a_1^2 - b_1^2)$

59. (C) $\vec{a} + t\vec{b} = (1 - t)\hat{i} + (2 + 2t)\hat{j} + (3 + t)\hat{k}$

If $\vec{a} + t\vec{b}$ is perpendicular to $\vec{c}$, then

$(\vec{a} + t\vec{b})\cdot\vec{c} = 0$

$\Rightarrow [(1 - t)\hat{i} + (2 + 2t)\hat{j} + (3 + t)\hat{k}]\cdot[3\hat{i} + \hat{j}] = 0$

$3(1 - t) + (2 + 2t) = 0$

$t = 5$

60. (C) The ways of pulling two socks $= {}^9C_2 = 36$

$\therefore$ Favourable ways $= {}^4C_2 + {}^5C_2$

$= 10 + 6 = 16$

$\therefore \quad$ Probability $= \dfrac{16}{36} = \dfrac{4}{9}$

61. (A) The given equation of circle is—

$9x^2 + y^2 = 4(x^2 - y^2 - 2x)$

or $\quad x^2 + y^2 + \dfrac{8}{5}x = 0$

Hence its centre is $\left(-\dfrac{4}{5}, 0\right)$

62. (A) $\dfrac{dy}{dx} - \tan x\cdot y = -2\sin x$

I.F. $= e^{-\int \tan x\,dx} = e^{(-\log\cos x)}$

$= e^{\log\cos x} = \cos x$

63. (B) Total No. of books

$= 3 + 4 + 1 = 8$

Total No. of ways in which 8 books can be placed = $\lfloor 8$

Total No. of ways in which 3 Math books can be placed = $\lfloor 3$

Total No. of ways in which 4 Physics books can be placed = $\lfloor 4$

Total No. of ways in which 3 subject can be placed = $\lfloor 3$

Required probability $= \dfrac{\lfloor 3 \times \lfloor 3 \times \lfloor 4}{\lfloor 8}$

$= \dfrac{3}{140}$

64. (A) Equation of given line is—

$\dfrac{x - 1}{2} = \dfrac{y - 2}{1} = \dfrac{z - 3}{3} \quad \ldots(1)$

and the plane is

$x + y + z - 1 = 0 \quad \ldots(2)$

The equation of any plane required through the given line is—

$a(x - 1) + b(y - z) + c(z - 3) = 0 \quad \ldots(3)$

where $\quad 2a + b + 3c = 0 \quad \ldots(4)$

the plane (4) will be perpendicular to the given plane if

$a + b + c = 0 \quad \ldots(5)$

On solving (4) and (5)

$$\frac{a}{-2} = \frac{b}{1} = \frac{c}{1}$$

Putting these proportionate values of a, b, c in (3). we have

$$-2(x-1)+(y-2)+(z-3) = 0$$
$$-2x+2+y-2+z-3 = 0$$
$$2x-y-z+3 = 0 \quad \ldots(6)$$

$\therefore$ The equation (2) and (6) together are the equations of the line of the projection.

65. (B) $t = 2x^2+3$ and $\frac{dy}{dx} = x\sqrt{2x^2+3}$

$$\therefore \frac{dt}{dx} = 4x \text{ But } \frac{dy}{dt} = \frac{dy/dx}{dt/dx} = \frac{x\sqrt{2x^2+3}}{4x}$$

$$\frac{dy}{dt} = \frac{1}{4}\sqrt{2x^2+3} = \frac{\sqrt{t}}{4} = \frac{t^{1/2}}{4}$$

66. (B) For mutual exclusive events A and B

$$P(A \cap B) = 0 \Rightarrow P(A \cup B) = P(A) + P(B)$$
$$\text{or } P(A+B) = P(A) + P(B)$$

67. (A) $np = 3$ and $\sqrt{npq} = 3/2$

$$\therefore \quad q = \frac{9/4}{3} = \frac{3}{4} \Rightarrow p = 1-q = 1/4$$
$$np = 3 \Rightarrow n = 12$$

$\therefore$ The binomial distribution is $(p+q)^n$

i.e., $\left(\frac{1}{4}+\frac{3}{4}\right)^{12}$

68. (C) $$A_{\alpha+\beta} = \begin{bmatrix} \cos(\alpha+\beta) & \sin(\alpha+\beta) \\ -\sin(\alpha+\beta) & \cos(\alpha+\beta) \end{bmatrix}$$
$$= \begin{bmatrix} \cos\alpha\cdot & \sin\alpha \\ -\sin\alpha\cdot\cos\alpha & \end{bmatrix} \begin{bmatrix} \cos\beta & \sin\beta \\ -\sin\beta & \cos\beta \end{bmatrix}$$
$$= A_\alpha \cdot A_\beta$$

69. (C) $\sin 12^\circ \cdot \sin 48^\circ \cdot \sin 54^\circ$

$$= \frac{1}{2}[(2\cdot \sin 12^\circ \cdot \sin 48^\circ)\cdot \sin 54^\circ]$$
$$= \frac{1}{2}[(\cos 36^\circ - \cos 60^\circ)\cdot \cos 36^\circ]$$
$$= \frac{1}{2}\left[\left(\frac{\sqrt{5}+1}{4}-\frac{1}{2}\right)\left(\frac{\sqrt{5}+1}{4}\right)\right]$$
$$= \frac{1}{2}\left[\left(\frac{\sqrt{5}+1}{4}\right)\left(\frac{\sqrt{5}-1}{4}\right)\right] = \frac{1}{8}$$

70. (C) The series can be written as—

43, 71, 73, 82, 90, 98

$\therefore$ Mode = The most frequency occurring item

$= 82$

$$\text{Median} = \frac{(7+1)^{\text{th}}}{2} \text{ item}$$
$$= 4\text{th item} = 82$$

71. (C) $$f(x) = \frac{x}{x-1} \Rightarrow x = \frac{f(x)}{f(x)-1}$$
$$\Rightarrow f(3x) = \frac{3x}{x-1} = \frac{3f(x)/f(x)-1}{[3f(x)/\{f(x)-1\}]-1}$$
$$= \frac{3f(x)}{2f(x)+1}$$

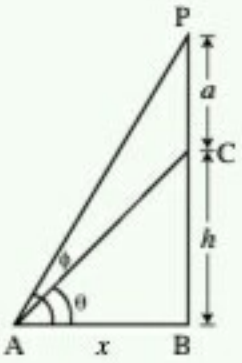
72. (D) $\therefore \lim_{x\to 1}\frac{f(x)-2}{f(x)+2} = 0$

$$\Rightarrow \frac{\lim_{x\to 1}[f(x)-2]}{\lim_{x\to 1}[f(x)+2]} = 0$$
$$\Rightarrow \lim_{x\to 1}[f(x-2)] = 0$$
$$\Rightarrow \lim_{x\to 1} f(x) = 2$$

73. (A) Let $$f(x) = \frac{1}{\sqrt{2}}(\sin x - \cos x)$$
$$= \sin x\cdot\cos\frac{\pi}{4} - \cos x\cdot\sin\frac{\pi}{4}$$
$$= \sin\left(x-\frac{\pi}{4}\right)$$

Since the maximum value of $\sin\theta$ is 1, hence maximum value of $f(x) = 1$.

74. (D) Let h be the height of tower and x be the distance from tower to the point, then



$$\tan\theta = \frac{h}{x}$$
$$h = x\tan\theta \quad \ldots(i)$$

Again $$\tan\phi = \frac{a+h}{x}$$
$$x = \frac{a+h}{\tan\phi} \quad \ldots(ii)$$

On solving eqn. (i) and (ii). we get

$$h = \frac{(a+h)}{\tan\phi}\cdot\tan\theta$$

$h\tan\phi - h\tan\theta = a\tan\theta$

$$h = \frac{a\tan\theta}{\tan\phi - \tan\theta}$$

$$\Rightarrow \quad h = \frac{\frac{a\sin\theta}{\cos\theta}}{\frac{\sin\phi}{\cos\phi}-\frac{\sin\theta}{\cos\theta}}$$

$$h = \frac{a \sin\theta.\cos\theta.\cos\phi}{\cos\theta(\sin\phi.\cos\theta - \sin\theta.\cos\phi)}$$
$$= \frac{a \sin\theta.\cos\phi}{(\sin\phi.\cos\theta - \cos\phi.\sin\theta)}$$
$$= \frac{a \sin\theta.\cos\phi}{\sin(\phi - \theta)}$$

75. (A) $\sigma^2 = \frac{1}{n}\sum x_i^2 - \left(\frac{1}{n}\sum x_i\right)^2$

$$= \frac{1}{n}(1^2 + 2^2 + \ldots + n^2) - \frac{1}{n^2}(1 + 2 + \ldots + n)^2$$
$$= \frac{n(n+1)(2n+1)}{6n} - \frac{1}{n^2}\left\{\frac{n(n+1)}{2}\right\}^2$$
$$= \frac{n^2 - 1}{12}$$
$$\sigma = \sqrt{\frac{n^2 - 1}{12}}$$

76. (B) The given equation can be written as

$$(y+2)^2 = -4\left(x - \frac{7}{4}\right)$$

or $\quad Y^2 = -4X$

where, $\quad a = -1$ and $Y = y + 2, X = x - \frac{7}{4}$

$\therefore$ The equation of directrix is—

$$X = -a$$
$$x - \frac{7}{4} = 1 \quad \text{or} \quad 4x = 11$$

77. (C) The given planes are parallel and can be written as.

$$2x - 2y + z + 3 = 0$$
$$2x - 2y + z + \frac{5}{2} = 0$$

$\therefore$ Distance between these planes

$$= \left|\frac{3 - \frac{5}{2}}{\sqrt{4+4+1}}\right| = \frac{1}{6}$$

78. (C) Let $I = \int \frac{\cos x\, dx}{(1 + \sin x)(2 + \sin x)}$

Put $\sin x = t \quad \Rightarrow \cos x \cdot dx = dt$

$$\therefore \quad I = \int \frac{dt}{(1+t)(2+t)}$$
$$= \left(\frac{1}{t+1} - \frac{1}{t+2}\right) \cdot dt$$
$$= \log(t+1) - \log(t+2)$$
$$= \log\frac{(t+1)}{(t+2)}$$
$$= \log\left(\frac{\sin x + 1}{\sin x + 2}\right)$$

79. (D) $P(A \cup B \cup C)$
$= P(A) + P(B) + P(C) - P(A \cap B) - P(B \cap C)$
$\quad - P(C \cap A) + P(A \cap B \cap C)$
$= P(A) + P(B) + P(C) - P(A) \cdot P(B) - P(B) \cdot P(C)$
$\quad - P(C) \cdot P(A) + P(A) \cdot P(B) \cdot P(C)$
$= 0{\cdot}2 + 0{\cdot}1 + 0{\cdot}4 - 0{\cdot}2 \times 0{\cdot}1 - 0{\cdot}1 \times 0{\cdot}4$
$\quad - 0{\cdot}4 \times 0{\cdot}2 + 0{\cdot}2 \times 0{\cdot}1 \times 0{\cdot}4$
$= 0{\cdot}568$

80. (C) The given equation is—

$$x^2 + px + q = 0$$

If the roots are -2 and -15, then the equation is—

$$x^2 - (-2 - 15)x + (-2)(-15) = 0$$
$$x^2 + 17x + 30 = 0$$

then the original equation is—

$$x^2 + 13x + 30 = 0$$
$$x^2 + 3x + 10x + 30 = 0$$
$$(x+3)(x+10) = 0$$
$$x = -3$$

or $\quad x = -10$

$\therefore$ The roots are $-3, -10$.

81. (C) $\vec{a} = 2\hat{i} + \hat{j} - 3\hat{k}$, $\vec{b} = 3\hat{i} - 2\hat{j} - \hat{k}$

$\therefore a = \sqrt{2^2 + 1^2 + (-3)^2} = \sqrt{14}$

and $b = \sqrt{3^2 + (-2)^2 + (-1)^2} = \sqrt{14}$

Angle between $\vec{a}$ and $\vec{b}$ is

$$\theta = \cos^{-1}\frac{\vec{a} \cdot \vec{b}}{ab}$$
$$= \cos^{-1}\frac{(2\hat{i} + \hat{j} - 3\hat{k}) \cdot (3\hat{i} - 2\hat{j} - \hat{k})}{\sqrt{14} \cdot \sqrt{14}}$$
$$= \cos^{-1}\frac{6 - 2 + 3}{14} = \cos^{-1}\frac{1}{2} = \frac{\pi}{3}$$

82. (B) Let P_0 be the initial population and let the population after t year be P. Then

$$\frac{dP}{dt} = \frac{8P}{100} \text{ (given)} \Rightarrow \frac{dP}{dt} = \frac{2P}{25}$$
$$\Rightarrow \frac{dP}{P} = \frac{2}{25}dt$$
$$\int \frac{1}{P} \cdot dP = \frac{2}{25}\int 1 \cdot dt$$
$$\Rightarrow \log P = \frac{2}{25}t + C \qquad \ldots(i)$$

At $\quad t = 0, P = P_0$, then $C = \log P_0$

Putting the value of C in (i)

$$\log P = \frac{2}{25}t + \log P_0$$
$$\therefore \quad t = \frac{25}{2} \cdot \log\left(\frac{P}{P_0}\right) \text{ when } P = 3P_0$$
$$\therefore \quad t = \frac{25}{2}\log 3$$

Hence, the population is trippled in $\frac{25}{2}\log 3$

83. (C) $(11101)_2$
$= 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 16 + 8 + 4 + 0 + 1$
$= 29$

84. (B) Number of the Muslim people
$$= \frac{80}{360} \times 28800$$
$$= 6{,}400$$
Number of Hindu people
$$= \frac{110}{360} \times 28800 = 8{,}800$$
Reqd. difference $= 8{,}800 - 6{,}400 = 2{,}400$

85. (A) Given $2\log_e\left(\frac{a+b}{2}\right) = \log_e(ab)$

or $\log_e\left(\frac{a+b}{2}\right)^2 = \log_e(ab)$

$$\left(\frac{a+b}{2}\right)^2 = ab$$
$$a^2 + b^2 + 2ab = 4ab$$
$$a^2 + b^2 - 2ab = 0 \Rightarrow (a-b)^2 = 0$$
$$\Rightarrow \quad a = b$$

86. (C) The given equations of circles are
$$x^2 + y^2 - 8y + 12 = 0$$
$$x^2 + y^2 - 4x - 6y - 3 = 0$$
Let the equation of required circle be
$$x^2 + y^2 + 2gx + 2fy + c = 0$$
then, $-8f = 12 + c$
and $-4g + 9 = -3 + 0$
$$g = 3$$
Therefore, the required equation of circle is—
$$x^2 + y^2 + 2 \times 3x + 2 \times \left(-\frac{3}{2}\right)y + 0 = 0$$
$$x^2 + y^2 + 6x - 3y = 0$$

87. (D) $\int_{-\infty}^{\infty} \frac{1}{1+x^2} \cdot dx = 2\int_0^{\infty} \frac{1}{1+x^2} \cdot dx$
$\because f(-x) = f(x)$
$= 2[\tan^{-1} x]_0^{\infty} = 2\tan^{-1}\infty$
$= 2 \cdot \frac{\pi}{2} = \pi$

88. (B) Let $I = \int_1^2 \frac{1}{x^2} \cdot e^{-1/x} \cdot dx$ $\quad \begin{cases} \text{Put } -\frac{1}{x} = t \\ \frac{1}{x^2} \cdot dx = dt \end{cases}$
$$\therefore \quad I = \int_{-1}^{-1/2} e^t \cdot dt = [e^t]_{-1}^{-1/2} = e^{-1/2} - e^{-1}$$
$$= \frac{1}{\sqrt{e}} - \frac{1}{e}$$

89. (D) $\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & 1 \\ 3 & 4 & -1 \end{vmatrix}$
$$= -5\hat{i} + 5\hat{j} + 5\hat{k}$$
$$\therefore \quad |\vec{a} \times \vec{b}| = \sqrt{(-5)^2 + 5^2 + 5^2}$$
$$= 5\sqrt{3}$$
$\therefore$ Unit vector perpendicular to both $\vec{a}$ and $\vec{b}$
$$= \frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|}$$
$$= \frac{5(-\hat{i} + \hat{j} + \hat{k})}{5\sqrt{3}} = \frac{-\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}}$$

90. (D) The centres of the sphere are $(-1, 1, -3)$ and $(0, 0, 0)$ respectively and radii are
$$r_1 = 3, \text{ and } r_2 = 2,$$
d = distance between the centre
$$= \sqrt{(-1-0)^2 + (1-0)^2 + (-3-0)^2} = \sqrt{11}$$
$\therefore$ The angle of intersection of given spheres.
$$= \frac{\cos^{-1} r_1^2 + r_2^2 - d^2}{2r_1r_2}$$
$$= \cos^{-1}\frac{9 + 4 - 11}{2 \times 3 \times 2}$$
$$= \cos^{-1}\left(\frac{1}{6}\right)$$

91. (C)

92. (C) The five computers can be arranged in $5! = 120$ ways but communication can go either way.
$\therefore$ Required number of arrangements
$$= \frac{120}{2!} = 60$$

93. (C) Let $I = \int_0^{\pi/2} \frac{\cos(\log x)}{x} \cdot dx$

Put $\log x = t \Rightarrow \frac{1}{x} \cdot dx = dt$ when $x = 1$,
$t = 0$ when $x = \frac{\pi}{2}$, $t = \log\frac{\pi}{2}$

$$I = \int_0^{\log\frac{\pi}{2}} \cos t \cdot dt \,[\sin t]_0^{\log\frac{\pi}{2}}$$
$$= \left[\sin\left(\log\frac{\pi}{2}\right) - \sin 0\right]$$
$$= \sin\left(\log\frac{\pi}{2}\right)$$

94. (A)

95. (C) $\lim_{x \to 0} \frac{\sqrt{1+x}-\sqrt{1-x}}{x} \times \left(\frac{\sqrt{1+x}+\sqrt{1-x}}{\sqrt{1+x}+\sqrt{1-x}}\right)$

$= \lim_{x \to 0} \frac{(1+x)-(1-x)}{x \cdot (\sqrt{1+x}+\sqrt{1-x})}$

$= \lim_{x \to 0} \frac{2x}{x(\sqrt{1+x}+\sqrt{1-x})}$

$= \frac{2}{\sqrt{1+0}+\sqrt{1-0}}$

$= \frac{2}{1+1} = 1$

96. (B) $\cos x \cdot \frac{dy}{dx} + y \sin x = 1$

$\frac{dy}{dx} + y \tan x = \sec x$

I. F. $= e^{\int \tan x \cdot dx} = e^{\log_e \sec x}$

$= \sec x$

$\therefore \int \left(\sec x \cdot \frac{dy}{dx} + y \cdot \tan x \cdot \sec x\right)$

$= \int \sec^2 x \cdot dx$

On integration

$y \sec x = \tan x + c$

97. (C) Let A $\lim_{n \to \infty} \left(\frac{e^n}{\pi}\right)^{1/n}$

$\therefore \log A = \lim_{n \to \infty} \frac{1}{n} \log \left(\frac{e^n}{\pi}\right)$

$= \lim_{n \to \infty} \frac{1}{n} [n \log e - \log \pi]$

$= \lim_{n \to \infty} \left[1 - \frac{\log \pi}{n}\right] = 1 - 0 = 1$

$\therefore \quad A = e$

98. (D) The given curve is—

$y = a \log \sec \left(\frac{x}{a}\right)$

$\frac{dy}{dx} = a \cdot \frac{1}{\sec \frac{x}{a}} \cdot \sec \frac{x}{a} \cdot \tan \frac{x}{a} \cdot \frac{1}{a}$

$= \tan \frac{x}{a}$

$\frac{d^2y}{dx^2} = \sec^2 \frac{x}{a} \cdot \frac{1}{a}$

$= \frac{1}{a} \cdot \sec^2 \frac{x}{a}$

$\tan \psi = \frac{dy}{dx} = \tan \frac{x}{a}$

$\psi = \frac{x}{a} \qquad \ldots(1)$

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

$= \frac{\left[1 + \tan^2 \frac{x}{a}\right]^{3/2}}{\frac{1}{a} \cdot \sec^2 \frac{x}{a}}$

$= a \sec \frac{x}{a} \qquad \ldots(2)$

Chord of curvature parallel to y axis

$= 2\rho \cos \phi$

$= 2a \sec \frac{x}{a} \cos \frac{x}{a}$

$= 2a$

99. (A) Standard deviation is not affected by adding anything to the given data.

100. (D) $\vec{a} \times \vec{b} + \vec{a} \times \vec{c} + \vec{b} \times \vec{c} + \vec{b} \times \vec{a} + \vec{c} \times \vec{a} + \vec{c} \times \vec{b}$

$= \vec{a} \times \vec{b} + \vec{a} \times \vec{c} + \vec{b} \times \vec{c} - \vec{a} \times \vec{b} - \vec{a} \times \vec{c} - \vec{b} \times \vec{c}$

$= 0$

101. (C)

Age x_i	No. of Students f_i	$f_i x_i$
10	10	100
11	14	154
12	26	312
	50	566

$\therefore \quad \text{Mean} = \frac{\sum f_i x_i}{\sum f_i} = \frac{566}{50} = 11{\cdot}32$

102. (D) $\bar{x} = \frac{15+25+5+10+30}{5} = 17$

Variance $\sigma^2 = \frac{(15-17)^2 + (25-17)^2 + (5-17)^2 + (10-17)^2 + (30-17)^2}{5}$

$= 86$

103. (B) Required probability—

$= P(A \text{ be died and } B \text{ be alive})$

or $P(B \text{ be died and } A \text{ be alive})$

$= P[(A \cap B') \cup (B \cap A')]$

Since the events are independent

$= P(A).P(B') + P(B).P(A')$

$[\because P(A) = p, P(B) = q]$

$= p(1-q) + q(1-p)$

$= p + q - 2pq$

104. (C) $\frac{\lfloor n+1}{\lfloor 3 \cdot \lfloor n-2} = 2 \frac{\lfloor n}{\lfloor n-2 \cdot \lfloor 2}$

$\Rightarrow \quad \frac{n+1}{3} = 2$

$\therefore \quad n = 5$

105. (C) 106. (D)

107. (B) (L.H.C. at $x = 1$)

$$\lim_{x \to 1^-} f(x) = \lim_{x \to 1} (x - 1) = 0$$

(R.H.C. at $x = 1$)

$$\lim_{x \to 1^+} f(x) = \lim_{x \to 1} (x^3 - 1) = 0$$

and $f(1) = 0$

$$\lim_{x \to 1^-} f(x) = f(1)$$

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

So, $f(x)$ is continuous at $x = 1$

Differentiability at $x = 1$, we have

$$\text{(L.H.D. at } x = 1) = \lim \frac{f(x) - f(1)}{x - 1}$$

$$= \lim_{x \to 1} \frac{(x - 1) - 0}{x - 1}$$

$$= 1$$

$$\text{(R.H.D at } x = 1) = \lim_{x \to 1^+} \frac{f(x) - f(1)}{x - 1}$$

$$= \lim_{x \to 1} \frac{(x^3 - 1) - 0}{x - 1}$$

$$= \lim_{x \to 1} x^2 + 1 + x$$

$$= 3$$

$\therefore$ (L.H.D at $x = 1$) $\neq$ (R.H.D at $x = 1$)

So, $f(x)$ is not differentiable at $x = 1$.

108. (C) $-\cos x + \frac{1}{2} y^2 = c$

$$y(0) = -2 \text{ (given)}$$

$$\therefore -\cos 0 + \frac{1}{2}(-2)^2 = c \Rightarrow c = 1$$

$$\Rightarrow \frac{1}{2} y^2 - \cos x = 1$$

Now put $x = \pi$

$$\frac{1}{2} y^2 - \cos \pi = 1 \Rightarrow y = 0$$

109. (A) $a^2b^2 - (\vec{a} \times \vec{b})^2 = a^2b^2 - (ab \sin \theta)^2$

$$= a^2b^2 (1 - \sin^2 \theta)$$

$$= a^2b^2 \cos^2 \theta$$

$$= (\vec{a} \cdot \vec{b})^2$$

110. (A) $\lim_{x \to 0} \frac{\sin ax}{\sin bx}$

$$= \lim_{x \to 0} \frac{a}{b} \left(\frac{\sin ax}{ax}\right) \left(\frac{bx}{\sin bx}\right)$$

$$= \frac{a}{b} (1)(1)$$

$$= \frac{a}{b}$$

111. (B) $f(x) = 2x + \frac{8}{x^2}$, $f'(x) = 2 - \frac{16}{x^3}$, $f''(x) = \frac{48}{x^4}$

For Maxima and Minima

$$f'(x) = 0$$

$$\Rightarrow 2 - \frac{16}{x^3} = 0 \quad \Rightarrow \quad x = 2$$

$$f''(2) = \frac{48}{16} = 3 > 0$$

$f(x)$ is least at $x = 2$

$\therefore$ Least value of $f(2) = 6$

112. (D) $\vec{a} \cdot (\vec{b} \times \vec{c}) = \begin{vmatrix} 2 & -3 & 0 \\ 1 & 1 & -1 \\ 3 & 0 & -1 \end{vmatrix} = 4$

113. (C) $f(x) = \frac{\sin x + \cos x}{\sin x - \cos x}$

$$= \frac{\sqrt{2}\left(\frac{1}{\sqrt{2}} \cdot \sin x + \frac{1}{\sqrt{2}} \cdot \cos x\right)}{\sqrt{2}\left(\frac{1}{\sqrt{2}} \cdot \sin x - \frac{1}{\sqrt{2}} \cdot \cos x\right)}$$

$$-\frac{\sin(\pi/4 + x)}{-\cos(\pi/4 + x)} = -\tan\left(\frac{\pi}{4} + x\right)$$

$\therefore \tan\left(\frac{\pi}{4} + x\right)$ is continuous for

$$-\frac{\pi}{2} < \frac{\pi}{4} + x < \frac{\pi}{2}$$

i.e., $\frac{-3\pi}{4} < x < \frac{\pi}{4}$

$\therefore$ $f(x)$ is continuous for $\frac{-3\pi}{4} < x < \frac{\pi}{4}$

114. (D) There are eight elements in the sample space.

$\therefore$ The probability of getting no head

$$= \frac{1}{8}$$

$\therefore$ The probability of getting at least one

$$\text{head} = 1 - \frac{1}{8}$$

$$= \frac{7}{8}$$

115. (C) $(\vec{a} - \vec{b}) \times (\vec{a} + \vec{b})$

$$= \vec{a} \times \vec{a} + \vec{a} \times \vec{b} - \vec{b} \times \vec{a} - \vec{b} \times \vec{b}$$

$$= 0 + \vec{a} \times \vec{b} + \vec{a} \times \vec{b} - 0 = 2\vec{a} \times \vec{b}$$

116. (B) $f(x) = 3^x \Rightarrow f(0) = 3^0 = 1$

$f(1) = 3 \quad \Rightarrow f(2) = 3^2 \quad \Rightarrow f(3) = 3^3$

$\because$ $1, 3, 3^2, 3^3, \ldots\ldots$ are in G.P.

$\therefore$ $f(0), f(1), f(2) \ldots\ldots$ are in G.P.

117. (C) $\text{cov}(x, y) = \frac{1}{n}\sum x_i y_i - \left(\frac{1}{n}\sum x_i\right)\cdot\left(\frac{1}{n}\sum y_i\right)$

$= \frac{-105}{10} - \left(\frac{60}{10}\right)\left(\frac{-20}{80}\right)$

$= -10{\cdot}5 + 12$

$= 1{\cdot}5$

118. (D) $r = \frac{\sum xy}{\sqrt{\sum x^2 \cdot \sum y^2}} = \frac{40}{\sqrt{80 \times 20}} = 1$

119. (C) $b_{xy} = \frac{n\sum xy - \sum x \cdot \sum y}{n\sum x^2 - (\sum x)^2}$

$= \frac{4(300) - (20)(45)}{4(125) - (20)^2} = 3$

120. (D) Rank Correlation Coefficient

$= 1 - \frac{6\sum d^2}{n(n^2-1)}$

$= 1 - \frac{6 \times 280}{10(10^2-1)} = -0{\cdot}7.$

Paper-II

General Ability Test

Part : A

USAGE

Spotting Errors (Items 1 to 6)

Directions—(i) In this section six sentences are given. Each sentence has three parts, indicated by (A), (B) and (C). Read each sentence to find out whether there is an error. If you find an error in any one of the parts (A, B, C), indicate your response by blackening the letter related to that part in the Answer-sheet provided. If a sentence has no error, indicate this by blackening 'D' which stands for 'No error'.

(ii) Errors may be in grammar, appropriate word usage or idioms. Examples P and Q have been solved for you.

P. My friend and myself / study together / duriing
(A) (B)
holidays. No error
(C) (D)

Q. The rice from Dehradun is / more superior/ to that
(A) (B)
of Saharanpur. No error
(C) (D)

Explanation—The correct answer for P is letter 'D' because the sentence has no mistake in it. The correct answer for Q is 'B' because the mistake in the sentence is in the part carrying the letter 'B'.

Now attempt items 1 to 6.

1. There is a good BritishLibrary in the city / and any
(A)
one interested in books / can avail of the facility.
(B) (C)
No error.
(D)

2. Being the second Saturday of the month, / he got up
(A)
late, and spent the whole day at home, / doing his
(B)
share of the household chores. No error.
(C) (D)

3. The flicker of light from the gas lamps / indicated
(A)
that the night / was barely passed. No error.
(B) (C) (D)

4. As economic restructuring in Central and Eastern
(A)
Europe progresses, / an estimated 15 million people
(B)
may be out of work / by the end of the year.
(C)
No error.
(D)

5. Such of those who \s\down6(\a(have,(A))) not paid the fees, / the circular says,/will not be permitted to
(B) (C)
attend classes. No error.
(D)

6. India was committed to keep maintaining peace /
(A)
and solving all outstanding problems / with her
(B)
neighbours through dialogue. No error.
(C) (D)

Sentence Improvement (Items 7 to 12)

Directions—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 letters (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).

Examples R and S have been solved for you.

R. The young child sung a very sweet song.

(A) singed the (B) singed
(C) sang a (D) No improvement

S. I have already read this book twice.

(A) I already twice have read this book

(B) I twice have already read this book
(C) I have twice already read this book
(D) No improvement

Explanation—For item R, the correct sentence should read, 'The young child sang a very sweet song'. 'C' is, therefore, the correct answer.

Item S is a correct sentence. None of the changes suggested will improve it. 'D' is, therefore, the correct answer.

Errors may be in grammar, appropriate word usage or idioms. There may be a necessary word missing or there may be a word which should be removed.

Now attempt items 7 to 12.

7. The criminal, as well as his accomplice was arrested.
   (A) were (B) are being
   (C) have been (D) No improvement

8. The world's population will continue to grow when the birthrate exceeds the deathrate.
   (A) as long as (B) unless
   (C) until after (D) No improvement

9. I can't tackle this problem which with all its complications have confused me.
   (A) has (B) had
   (C) will have (D) No improvement

10. My friend would have missed the train if he had not hurried.
    (A) had missed (B) has missed
    (C) missed (D) No improvement

11. We have plenty of time, isn't it ?
    (A) haven't we (B) have we
    (C) is it (D) No improvement

12. Until he does not ask for an apology, I am not going to reinstate him.
    (A) does ask for (B) asked for
    (C) asks for (D) No improvement

Synonyms (Items 13 to 17)

Directions—In this section you find a number of sentences, parts of which are underlined. You may also find only a group of words which is underlined. For each underlined part, four words/phrases are listed below. Choose the word/phrase nearest in meaning to the underlined part and blacken the corresponding space on the Answersheet.

Example E is solved for you.

E. His style is quite transparent.
   (A) verbose (B) involved
   (C) lucid (D) witty

Explanation—In item 'E' the word 'lucid' is nearest in meaning to the word 'transparent'. So 'C' is the correct answer.

Now attempt items 13 to 17.

13. The lassitude was caused by overwork.
    (A) laziness (B) boredom
    (C) weariness (D) sickness

14. Lunatics generally have queer ideas.
    (A) strange (B) clumsy
    (C) intricate (D) frivolous

15. Although he has become rich, he is still frugal.
    (A) miserly
    (B) careful in spending
    (C) generous with money
    (D) discourteous

16. The court questioned the veracity of the petition made.
    (A) right (B) truthfulness
    (C) argument (D) basis

17. Savita was asked to prove her allegations in the court.
    (A) credentials (B) cases
    (C) points (D) charges

Antonyms (Items 18 to 22)

Directions—In this section each item consists of a word or a phrase which is underlined in the sentence given. It is followed by four words or phrases. Select the word or phrase which is closest in meaning to the opposite of the underlined word or phrase.

Example 'F' has been solved for you.

F. Lucy is a smart girl.
   (A) lazy (B) active
   (C) indecent (D) casual

Explanation—The word 'lazy' is nearest in meaning to the opposite of the word 'smart'. So 'A' is the correct answer.

Now attempt items 18 to 22.

18. My old aunt, who is a spinster declared that all men are faithless.
    (A) a divorced lady
    (B) a married woman
    (C) an unmarried woman
    (D) a widow

19. The bank launched a deposit mobilisation drive in June.
    (A) terminated (B) cancelled
    (C) withheld (D) discontinued

20. He did not shed his hostility throughout his life.
    (A) hospitality (B) friendliness
    (C) kindness (D) fidelity

21. The management seemed very callous about the working conditions of the workers.
    (A) liberal (B) careful
    (C) sensitive (D) responsible

22. In this matter, it is difficult to persuade him; he is resolute about it.
    (A) unmindful (B) careful
    (C) indefinite (D) vascillating

COMPREHENSION

(Items 23 to 34)

Directions—In this section you have four short passages. After each passage you will find several questions based on the passage. First, read Passage I, and answer the questions based on it. Then go on to the other passages.

Examples 'I' and 'J' are solved for you.

Passage

In our approach to life, be it pragmatic or otherwise, a basic fact that confronts us squarely and unmistakenly is the desire for peace, security and happiness. Different forms of life at different levels of existence make up the teeming denizens of this earth of ours. And, no matter whether they belong to the higher groups such as human beings or to the lower groups such as animals, all beings primarily seek peace, comfort and security. Life is as dear to a mute creature as it is to a man. Even the lowliest insect strives for protection against dangers that threaten its life. Just as each one of us wants to live and not to die, so do all other creatures.

I. The author's main point is that—
    (A) different forms of life are found on earth
    (B) different levels of existence are possible in nature
    (C) peace and security are the chief goals of all living beings
    (D) even the weakest creature struggles to preserve its life

J. Which one of the following assumptions or steps is essential in developing the author's position?
    (A) All forms of life have a single overriding goal.
    (B) The will to survive of a creature is identified with a desire for peace.
    (C) All beings are divided into higher and lower groups.
    (D) A parallel is drawn between happiness and life, and pain and death.

Explanation—

I. The idea which represents the author's main point is 'peace and security are the chief goals of all living beings', which is response (C). So 'C' is the correct answer.

J. The best assumption underlying the passage is 'The will to survive of a creature is identified with a desire for peace', which is response (B). So 'B' is the correct answer.

Now attempt items 23 to 34.

Passage I

We had often animal visitors that were not welcome. Scorpions were frequently found in our cells, especially after a thunder-storm. It was surprising that I was never stung by one, for I would come across them in the most unlikely places—on my bed, or sitting on a book which I had just lifted up. I kept a particularly black and poisonous-looking brute in a bottle for sometime, feeding him with flies, etc., and then when I tied him up on a wall with a string he managed to escape. I had no desire to meet him loose again, and so I cleaned my cell out and hunted for him everywhere, but he had vanished.

23. Scorpions were unwelcome visitors because–
    (A) they were black and ugly
    (B) the author was afraid of them
    (C) they made the room dirty
    (D) the author did not love animals

24. The author kept a scorpion in a bottle because he wanted to—
    (A) feed him with flies
    (B) clean his room
    (C) watch him out of curiosity
    (D) torture him

25. When the scorpion escaped from the bottle, the author was—
    (A) happy (B) scared
    (C) indifferent (D) sad

Passage II

Perrault began to live the kind of life that he had always wanted to live. He had never had enough time for reading, now he had all the time in the world. He soon, of course, felt a great need for more books, but there were a few which he had brought with him, and they included an English grammar and dictionary. With these to work on, he managed to master all the difficulties of that language. His memory was astonishing, it almost seemed that he could now learn everything far more easily than he had been able to learn anything during his student days.

26. Perrault managed to learn English well because—
    (A) he read several books in English
    (B) he carefully studied its structure and words
    (C) he spent most of his time with English people
    (D) he spent most of his time thinking about English

27. The statement 'Perrault began to live the kind of life that he had always wanted to live' implies that—
    (A) he had always wanted to lead a life of action
    (B) he had always wanted to remain aloof from society

(C) he had always wanted to enjoy the company of books and thoughts

(D) he had always wanted to lead a life of devotion

28. In the passage 'to master all the difficulties' means—

(A) to remove all the difficulties

(B) to understand all the difficulties

(C) to overcome all the difficulties

(D) to teach the way of solving difficulties

Passage III

Henry Cavendish, the eldest son of Lord Charles Cavendish, was born at Nice in 1731. He was one of the pioneers in the study of gases. In 1766 he discovered 'inflammable air', now called 'hydrogen'. Later he showed that water was produced when this gas was burnt. In 1785 he discovered that nitric acid was produced by the combination of the two constituent gases of the atmosphere, oxygen and nitrogen. The discovery has since become immensely important in industry, especially in the manufacture of fertilizers. He also discovered but did not recognize the name Argon. The Cavendish Physical Laboratory at Cambridge has been named after him. He was such a withdrawn and shy man that he even ordered his dinner by placing a note on the dining table. He died in 1810, sixty-one years after he had entered Cambridge.

29. The parents of Cavendish christened him—

(A) Argon (B) Cavendish

(C) Lord (D) Henry

30. Cavendish is known for discovering—

(A) hydrogen and argon

(B) hydrogen and oxygen

(C) hydrogen and the constituents of nitric acid

(D) argon and the constituent of inflammable air

31. Cavendish's way of ordering his dinner shows that he was—

(A) introvert by nature

(B) kind to servants

(C) extrovert in nature

(D) amiable in temperament

Passage IV

The postmaster's salary was small. He had to cook his own meals, which he used to share with Ratan, an orphan girl of the village, who did odd jobs for him.

When in the evening, the postmaster would light his little lamp, and call out 'Ratan', Ratan would sit outside waiting for this call, and, instead of coming in at once, would reply, 'Did you call me, Sir ?'

'What are you doing ?' the postmaster would ask.

'I must go and light the kitchen fire,' she would reply.

And the postmaster would say : 'Oh, let the kitchen fire wait for a while; light me my pipe first.'

32. The postmaster had to cook his own meals because—

(A) he enjoyed cooking

(B) he cultivated this habit from his childhood

(C) his salary was small

(D) there was no hotel nearby

33. Ratan was the name of—

(A) the postmaster's daughter

(B) the postmaster's neighbour

(C) the postmaster's cousin

(D) the orphan girl who lived with the postmaster

34. When the lamp was lit, in the evening the post-master would call Ratan—

(A) to help her cooking

(B) to light his pipe

(C) to fetch a pot of water

(D) to gossip

ORDERING OF WORDS IN A SENTENCE

(Items 35 to 39)

Directions—In each of the items 35 to 39, there is a sentence of which some parts have been jumbled up. You are required to re-arrange these parts which are labelled P, Q, R and S to produce the correct sentence. Choose the proper sequence and mark in your Answer-sheet accordingly.

Example Z :

It is well-known that the effect (P) is very bad (Q) on children (R) of cinema. (S)

The proper sequence should be—

(A) P S R Q (B) S P Q R

(C) S R P Q (D) Q S R P

Explanation—The proper way of writing the sentence is 'It is well-known that the effect of cinema on children is very bad.' This is indicated by the sequence PSRQ and so 'A' is the correct answer.

Now attempt items 35 to 39.

35. In many countries

it is necessary to boil water (P)

in order to kill any infectious bacteria (Q)

it may contain (R)

especially those in tropical and sub-tropical (S)

regions.

The proper sequence should be—

(A) S R Q P (B) S P Q R

(C) P S R Q (D) P Q S R

36. Psychologists say an innate drive (P) to finish (Q) that humans have (R) what they start (S).

The proper sequence should be

(A) R P Q S (B) P Q S R
(C) R P S Q (D) P S Q R

37. The use of language primarily and predominantly involves (P) and receiving other people's speech noises (Q) making noises with our speech organs (R) through our ears. (S)

The proper sequence should be—

(A) Q S P R (B) P R Q S
(C) P S Q R (D) Q S R P

38. Nations of the world as they are fully aware (P) are making efforts in developing (Q) of the danger of their not coming together (R) peaceful international relations. (S)

The proper sequence should be—

(A) P R S Q (B) P S R Q
(C) Q S P R (D) Q P R S

39. George Bernard Shaw considered a considerable portion of his wealth (P) and in his will left behind (Q) current English spelling indefensible (R) for reforms in spelling. (S)

The proper sequence should be—

(A) R S P Q (B) R Q P S
(C) Q R P S (D) Q R S P

RECONSTRUCTING PASSAGE

(Items 40 to 44)

Directions—In items 40 to 44, there are six sentences marked S_1, S_6, P, Q, R, S. The positions of S_1 and S_6 are fixed as the first and last sentences of the passage. You are required to choose one of the four alternatives given below every passage which would be the most logical sequence of the sentences in the passage.

Mark your response on the Answer-sheet at the appropriate space.

Example X has been solved for you.

Example X :

S_1 : A poor peasant went off early one morning to plough, taking with him for his breakfast a piece of bread.

S_6 : He lifted the coat, but the bread was gone !

P : After a while, when his horse was tired and he was hungry, the peasant stopped ploughing.

Q : He hid it under a bush and started work.

R : He went to get his coat and his breakfast.

S : He got his plough ready and put his coat round the bread.

The proper sequence should be—

(A) S Q P R (B) Q P R S
(C) P R S Q (D) R S Q P

Explanation—The proper sequence in this example is SQPR which is marked (A). Therefore, 'A' is the correct answer.

Now attempt items 40 to 44.

40. S_1 : Migratory birds are infinitely more interesting than the tame ones and those around us throughout the year.

S_6 : Every year these cranes come to this sanctuary from far off Siberia and go back when the cold of winter is over.

P : I can visualize no purpose behind their fun and frolic.

Q : How conscious of their destination they would be then !

R : Watch the cranes afloat in this lake.

S : But wait for a month and gaze at them when they would be flying high across the sky.

The proper sequence should be—

(A) R S Q P (B) R P S Q
(C) S Q R P (D) S Q P R

41. S_1 : I had to postpone my first visit to Columbia last year.

S_6 : Either way, a traveller is a prime target.

P : Driving back to Bogota is dangerous because passengers carry newly purchased stones.

Q : Two weeks before I was to arrive, my host, one of the 3 principals at Muzo, was gunned down at his ranch, along with 17 bodyguards.

R : Later, when I resumed my Columbian plans, I was advised that all ground transportation is risky.

S : Driving to the mine in a car is dangerous because local bandits knew passengers carry cash to buy emeralds.

The proper sequence should be—

(A) R S P Q (B) Q R S P
(C) Q S P R (D) R S Q P

42. S_1 : The science of television is highly sophisticated and based on a delicate system of filming and recording.

S_6 : The picture-records of television known as telefilms can be retransmitted or repeated to an audience.

P : Its working does not consist in storing or recording an image, it rather catches and reflects an image like a mirror.

Q : Along with the reflection of the image, there is also recording of sound.

R : The image dies as soon as it is seen.

S : The image is recorded on films and the sound heard is recorded on the disc or tape.

The proper sequence should be—

(A) S P Q R (B) P R S Q

(C) S P R Q (D) P R Q S

43. S_1 : The ship anchored in a small bay.

S_6 : The seamen emptied the oysters out of the basket and began opening them in the hope of finding pearls.

P : He went deep down into the sea.

Q : Then they put a basket into his hand and let him down by a rope over the side of the ship.

R : At the orders of the master the sailors seized one of the youngest slaves, took off his chain and tied a heavy stone to his feet.

S : After sometime they pulled him up and he came out of the water with his basket full of oysters.

The proper sequence should be—

(A) P R S Q (B) R P Q S

(C) P R Q S (D) R Q P S

44. S_1 : The U. S. Space shuttle, Columbia, landed safely at the Edwards Air Force base in the Majave desert.

S_6 : It opened a new era in man's attempt to conquer space by proving that a reusable craft could now be used.

P : It was accomplished after a 54-hour space flight in which it circled the earth 36 times.

Q : 'Welcome home', mission control said as the Columbia executed history's first controlled landing of a space craft.

R : It moved smoothly to a stop as special crew and equipment rushed to greet it.

S : With astronaut John Young piloting the Columbia, the shuttle came to a halt on a dry lake bed.

The proper sequence should be—

(A) Q P R S (B) P S R Q

(C) P Q S R (D) Q R S P

SELECTING WORDS
(Items 45 to 50)

Directions—In the following sentences, at certain points you are given a choice of three words—one of which is most appropriate. 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. The river has been ..... all night.

(A) rising (B) raising

(C) arising

L. We built the raft ..... to hold us.

(A) too strong (B) very strong

(C) strong enough

Explanation—Out of the list given in 'K' only 'rising' is the correct answer because a river cannot be raised, it rises on its own. So 'A' is the correct answer for item 'K'. For item 'L' 'C' is the correct answer. In order to solve these items you have to first read the whole passage and then decide what the most appropriate word is.

Now attempt items 45 to 50.

One summer a Brazilian farmer took his donkey, Pele, with him to town. ...(45)... the market place, a small boy began ...(46)... Pele with a stick, and the donkey struck ...(47)... injuring the boy with a kick on the head. The police chief ...(48)... the farmer arrested. The ...(49)... wept so profusely in the jail cell that the police chief changed his mind and locked up the ...(50)... instead. The charge against the animal was attempt to murder.

45. (A) on (B) in

(C) at

46. (A) tormenting (B) playing

(C) teaching

47. (A) backward (B) forward

(C) back

48. (A) ordered (B) had

(C) has

49. (A) boy (B) farmer

(C) donkey

50. (A) boy (B) farmer

(C) donkey

Part : B

51. The time at any point on the earth's surface calculated when the sun reaches its highest position in the sky is known as—

(A) Local time

(B) Sidereal time

(C) Solar time

(D) Standard time

52. The dotted line in the given rough outline map of India shows the boundary of—

(A) Thorny vegetation
(B) Drought prone areas
(C) Deccan lavas
(D) Arabian Sea watershed

53. What will be the time at a place situated at 70° W when it is 4 p.m. at a place situated at 35° E ?
(A) 5 p.m. (B) 8 p.m.
(C) 11 a.m. (D) 9 a.m.

54. A traveller is thirsty in a desert at 15° E and 25° S. The desert in question is—
(A) Kalahari (B) Patagonia
(C) Sahara (D) Mohave

55. Which one of the following is a cold water current ?
(A) Canary current (B) Caribbean current
(C) Guinea current (D) Kuro-Shio current

56. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R)—

Assertion (A) : The hot deserts are found on the western margins of continents.

Reason (R) : Any area in which the rate of evaporation is higher than the rate of precipitation is a desert.

In the context of the above two statements, which one of the following is correct ?
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

57. Who was described as 'Naked faqir of India' by Winston Churchil ?
(A) Mohan Das Karam Chand Gandhi
(B) Madan Mohan Malviya
(C) Sheikh Mohd. Abdullah
(D) C. Rajgopalachari

58. Which one of the following is not a correct statement about the Trade winds ?
(A) They blow steadily over the oceans
(B) They blow-along a regular track
(C) They are fairly regular over the hot deserts
(D) They do not move northwards and southwards with the change in season

59. Given below are two statements one labelled as Assertion (A) and the other labelled as Reason (R)—

Assertion (A) : The equatorial belt of low pressure in which the Trade winds converge is known as Doldrums.

Reason (R) : The Doldrums have turbulent and stormy weather.

In the context of the above two statements, which one of the following is correct ?
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

60. The shaded areas in the given rough outline map of India show—

(A) Coal deposits
(B) Copper deposits
(C) Manganese deposits
(D) Mica deposits

61. The shaded circles in the given rough outline map of India show the areas of—

(A) Bauxite deposits (B) Coal deposits
(C) Iron ore deposits (D) Manganese deposits

62. Which one of the following is not a sea port ?
(A) Cairo (B) Dublin
(C) Lisbon (D) Rotterdam

63. Which one of the following is a land-locked country ?
(A) Albania (B) Bulgaria
(C) Hungary (D) Romania

64. Match List I with List II and select the correct answer by using the codes given below the lists—

List I	List II
(a) Mumbai	1. Tidal Port
(b) Kolkata	2. Natural Port
(c) Vishakhapatnam	3. Riverine Port
(d) Kandla	4. Deepest Port

Codes—

	(a)	(b)	(c)	(d)
(A)	2	3	4	1
(B)	2	4	1	3
(C)	3	2	4	1
(D)	1	3	2	4

65. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R)—

Assertion (A) : Sun is the main source of heat and light to the Earth.

Reason (R) : Temperature decreases with the increase in altitude.

In the context of the above two statements, which one of the following is correct ?
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

66. Which one of the following terms is used for the region of low atmospheric pressure ?
(A) Anticyclone
(B) Cyclone
(C) Hurricane
(D) Thunderstorm

67. Which is the correct Chronological sequence of the following stages in the political life of Mahatma Gandhi ?
1. Champaran
2. Ahmedabad Millstrike
3. Kheda
4. Non-Cooperation movement

Choose the correct answer from the following code—
(A) 4, 1, 3, 2 (B) 4, 3, 1, 2
(C) 2, 3, 1, 4 (D) 2, 4, 1, 3

68. Match List I with List II and select the correct answer by using the codes given below the lists—

List I	List II
(a) Sandstone	1. Gneiss
(b) Granite	2. Diamond
(c) Limestone	3. Quartzite
(d) Carbon	4. Marble

Codes—

	(a)	(b)	(c)	(d)
(A)	2	3	4	1
(B)	3	1	4	2
(C)	4	2	3	1
(D)	1	4	3	2

69. Which one of the following processes is not related with chemical weathering ?
(A) Carbonation (B) Exfoliation
(C) Hydration (D) Oxidation

70. The violent and destructive tropical cyclones in China and Japan are known as—
(A) Hurricanes (B) Tornadoes
(C) Typhoons (D) Willy-willies

71. Ornithology is the study of—
(A) Snakes (B) Ornaments
(C) Precious gems (D) Birds

72. The Olympic Games 2020 will be held at—
(A) Sydney (B) Beijing
(C) Tokyo (D) Toronto

73. The country in which the 'diplomatic hostage crisis' took place was—
(A) Peru (B) Mexico
(C) Spain (D) Uganda

74. Which Indian musician received the Grammy award ?
(A) Vishwa Mohan Bhatt
(B) Amjad Ali Khan
(C) Zakir Hussain
(D) Hari Prasad Chaurasia

75. Who among the following is the highest wicket taker in women's One day International Cricket ?
(A) Arjun Chopra
(B) Mithali Raj
(C) Amita Sharma
(D) Jhulan Goswami

76. Who is the present Chief of the Naval Staff of India ?
(A) Shankar Roy Chowdhury
(B) P.V. Nayak
(C) Admiral Sunil Lamba
(D) None of the above

77. India is a member of—
(A) G-7. G-15 and G-77
(B) G-15 and G-77
(C) G-7 and G-15
(D) G-7 and G-77

78. World's lightest satellite 'Kalamsat' has been built by—
(A) Sheikh Farooq
(B) Dilip Sangvan
(C) Rifath Sharook
(D) None of the above

79. Who among the following is winner of Dada Saheb Phalke award?
(A) Nargis
(B) Amitabh Bachchan
(C) Bharat Bhushan
(D) B. R. Chopra

80. International Museum Day is celebrated on—
(A) May 18th (B) June 3rd
(C) June 23rd (D) June 24th

81. The mode of propagation of heat from the Sun to the Earth is—
(A) conduction
(B) convection alone
(C) radiation alone
(D) convection and radiation

82. In a case of uniform circular motion, the acceleration is—
(A) zero
(B) constant in magnitude and directed radially inwards
(C) variable in magnitude but constant in direction
(D) variable in magnitude but tangential to the circle

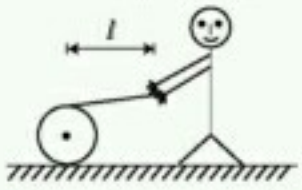
83. One micron is equal to—
(A) 10^{-6} m (B) 10^{-5} m
(C) 10^{-4} m (D) 10^{-3} m

84. Dimensions of electromotive force are—
(A) MLQ (B) ML^2T^{-2}
(C) ML^2Q^{-2} (D) $ML^2T^{-2}Q^{-1}$

85. A body spends 20 Joules of energy in 5 seconds. What is its power ?
(A) 100 W (B) 20 W
(C) 5 W (D) 4 W

86. The total energy of a particle executing simple harmonic motion is proportional to the—
(A) amplitude of the motion
(B) square of the amplitude of the motion
(C) cube of the amplitude of the motion
(D) square of the acceleration of the body

87. A string of negligible thickness wound several times around a cylinder (of circumference 'l') is kept on a rough horizontal surface. A man standing at a distance 'l' from the cylinder holds one end of the string and pulls the cylinder towards him (see figure). There is no slipping anywhere—



The length of the string passing through the hand of the man while the cylinder reaches his hand is—
(A) 1 l (B) 2 l
(C) 3 l (D) 4 l

88. An electric motor is used to convert—
(A) electrical energy into mechanical energy
(B) mechanical energy into kinetic energy
(C) mechanical energy into electrical energy
(D) higher voltage to lower voltage

89. The fraction of the total volume of an iceberg of density 0·92 gm/cm^3 floating in North Sea with density of 1·03 gm/cm^3 is—
(A) 1% (B) 11%
(C) 21% (D) 75%

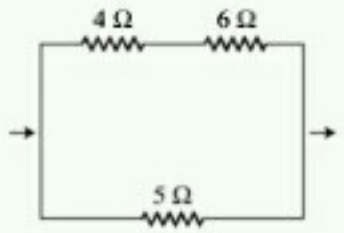
90. The normal temperature of human body is—
(A) 40°F (B) 40°C
(C) 100°F (D) 37°C

91. There are two identical organ pipes with same length and same diameter. One is closed at one end while the other is open at both the ends. The quality of sound is superior in the open-ended pipe due to the—
(A) absence of harmonics
(B) presence of two harmonics, both odd
(C) presence of two harmonics, both even
(D) presence of two harmonics, one odd and the other even

92. A battery used for charging an air capacitor is removed after the capacitor is fully charged. Some mica sheets (dielectric constant K) are inserted between the two plates. If E is the energy of the air capacitor, then the energy stored in the mica capacitor will be—
(A) KE (B) $\frac{1}{K}$E
(C) K^2 E (D) E

93. If a man approached a plane mirror at the rate of 2 km/hour, then his image would approach him at the rate of—
(A) 1 km/hour (B) 2 km/hour
(C) 4 km/hour (D) 8 km/hour

94. In the circuit shown in the given figure, the heat produced in the 5 Ω resistor due to a current flowing in it is 10 calories/sec—



The heat produced in the 4 Ω resistor is—

(A) 1 cal/sec (B) 2 cal/sec
(C) 3 cal/sec (D) 4 cal/sec

95. A nuclear reactor is a device to produce nuclear energy with the help of—

(A) nuclear fusion
(B) uncontrolled chain reaction
(C) controlled chain reaction
(D) graphite as fuel

96. The distance of distinct vision for a normal human eye—

(A) is 60 cm
(B) is 25 cm
(C) is 15 cm
(D) varies from individual to individual

97. Frequency of the A.C. mains in India is—

(A) 50 cps (B) 60 cps
(C) 100 cps (D) 120 cps

98. *n*-type semi-conductors are obtained by adding impurities to pure germanium. The impurities have to be—

(A) monovalent (B) trivalent
(C) tetravalent (D) pentavalent

99. When a ray of light is transmitted from air to glass the frequency—

(A) increases and wavelength decreases
(B) decreases and wavelength increases
(C) is unaltered but the wavelength decreases
(D) is unaltered but the wavelength increases

100. The main source of energy of the Sun is—

(A) fusion of heavy nuclei
(B) fusion of light nuclei
(C) fission of light nuclei
(D) both fusion and fission

101. The mean distance from the Earth to the Sun is—

(A) 450 million km (B) 250 million km
(C) 150 million km (D) 14 million km

102. A secondary cell of emf 2·5 volts and internal resistance of 0·05 ohm is being charged with a current of 10 amps. The potential difference between the two terminals of the secondary cell will be—

(A) 2·0 (B) 2·2
(C) 2·5 (D) 3·0

103. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R)—

Assertion (A) : Hot tea placed in a thermos flask, should remain hot for several hours.

Reason (R) : Heat rays cannot pass through vacuum.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

104. Escape velocity from the Earth's surface is—

(A) equal to that from the Moon's surface
(B) greater than that from the Moon's surface
(C) less than that from the Moon's surface
(D) equal to that from the Sun's surface

105. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R)—

Assertion (A) : An isolated stationary charge does not produce a magnetic field.

Reason (R) : For producing a magnetic field, a magnetic material is essential.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

106. Match List I with List II and select the correct answer by using the codes given below the lists—

List I (Minerals)	**List II (Elements)**
(a) Chile saltpetre	1. Mercury
(b) Fluorspar	2. Zinc
(c) Calamine	3. Sodium
(d) Cinnabar	4. Calcium

Codes—

	(a)	(b)	(c)	(d)
(A)	3	4	2	1
(B)	3	4	1	2
(C)	2	1	4	3
(D)	2	3	4	1

107. Match List I with List II and select the correct answer by using the codes given below the lists—

List I (Substance)	List II (Use)
(a) Diamond	1. Fertilizer
(b) Ammonium sulphate	2. Oxidizing agent
(c) Sodium periodate	3. Dry cells
(d) Manganese dioxide	4. Abrasive

Codes—

	(a)	(b)	(c)	(d)
(A)	4	1	3	2
(B)	4	1	2	3
(C)	1	4	2	3
(D)	1	4	3	2

108. Consider the following statements—

The atom $^{19}_{9}X$ has :

1. 9 protons
2. 9 electrons
3. 19 electrons
4. 10 neutrons

Of these statements—

(A) 1, 2 and 4 are correct
(B) 1, 3 and 4 are correct
(C) 2 and 4 are correct
(D) 1 and 3 are correct

109. The formula for washing soda is—

(A) Na_2CO_3
(B) $Na_2CO_3 \cdot H_2O$
(C) $Na_2CO_3 \cdot 7H_2O$
(D) $Na_2CO_3 \cdot 10H_2O$

110. Which of the following statements are in accordance with the laws of Chemical Combinations ?

1. Carbon dioxide will always be formed by the combination of 1 part of carbon and 2·66 parts of oxygen.
2. When pressure is applied to a gas at constant temperature, the volume decreases.
3. Equal volumes of carbon dioxide and oxygen gases will always contain the same number of molecules.
4. Atoms cannot be created, destroyed or divided.

Select the correct answer using the codes given below—

Codes—

(A) 1 and 2 (B) 1 and 4
(C) 2 and 3 (D) 3 and 4

111. When hard water is treated with zeolite the ions exchanged would include—

(A) Na^+ and H^+ (B) Na^+ and Mg^{2+}
(C) Na^+ and OH^- (D) Na^+ and SO_4^{2-}

112. Tritium nucleus consists of—

(A) one proton and two neutrons
(B) two neutrons and two protons
(C) two protons and one neutron
(D) one neutron and one proton

113. Which of the following is/are true of oxygen molecucle ?

1. It has one sigma bond and one pi bond.
2. It is a diatomic molecule.
3. It is a diamagnetic molecule.
4. It is a paramagnetic molecule.

Select the correct answer from the codes given below—

Codes—

(A) 1 and 4 (B) 1, 2 and 3
(C) 1, 2 and 4 (D) 2 alone

114. Which one of the following compounds has the highest percentage of nitrogen ?

(A) Ammonium nitrate
(B) Urea
(C) Calcium nitrate
(D) Ammonium chloride

115. In a redox reaction, MnO_4^{2-} has been converted to MnO_2. The number of electrons involved in the conversion is—

(A) 0 (B) 2
(C) 4 (D) 5

116. Which one of the following sequences is correct with respect to the acidity of the given sets of acids ?

(A) $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH > CH_3COOH$
(B) $CH_3COOH > ClCH_2COOH > Cl_2CHCOOH > Cl_3CCOOH$
(C) $Cl_2CHCOOH > Cl_3CCOOH > ClCH_2COOH > CH_3COOH$
(D) $ClCH_2COOH > Cl_2CHCOOH > Cl_3CCOOH > CH_3COOH$

117. Match List I with List II and select the correct answer by using the codes given below the lists—

List I (Equation)

(a) $H_2 + F_2 \rightarrow 2HF$
(b) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
(c) $CaCO_3 \rightarrow CaO + CO_2$
(d) $AgCl + 2NH_3 \rightarrow Ag(NH_3)Cl$

List II (Type of reaction)

1. Complex formation
2. Oxidation reduction
3. Hydrolysis
4. Decomposition
5. Precipitation

Codes—

	(a)	(b)	(c)	(d)
(A)	4	3	2	1
(B)	5	4	2	1
(C)	2	1	4	5
(D)	2	5	4	1

118. Which of the following materials are used for the manufacture of urea ?
1. Uric acid
2. Ammonia
3. Carbon monoxide
4. Carbon dioxide

Select the correct answer using the codes given below—

Codes—

(A) 1 and 2 (B) 1 and 3
(C) 2 and 3 (D) 2 and 4

119. Gunpowder consists of—
(A) 75% potassium nitrite + 15% charcoal + 10% sulphur
(B) 75% potassium nitrate + 10% charcoal + 15% sulphur
(C) 75% potassium nitrate + 10% charcoal + 15% sulphur
(D) 75% potassium nitrate + 15% charcoal + 10% sulphur

120. Match List I with List II and select the correct combination of ions and isoelectronic ions using the codes given below the lists—

List I	List II
(a) O^{2-}	1. V^{5+}
(b) Fe^{3+}	2. Na^{+}
(c) Be^{2+}	3. Mn^{2+}
(d) Ti^{4+}	4. Li^{+}

Codes—

	(a)	(b)	(c)	(d)
(A)	2	1	3	4
(B)	4	2	1	3
(C)	1	3	2	4
(D)	2	3	4	1

121. Select the odd one in the following groupings—
(A) Prawn, butterfly, cockroach, crab
(B) Crocodile, lizard, cobra, viper
(C) Yeast, penicillium, mushroom, smut
(D) Bat, dolphin, penguin, whale

122. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R)—

Assertion (A) : Mitochondria are called the powerhouses of the cell.

Reason (R) : ATP synthesis takes place mainly in the mitochondria.

In the context of the above two statements, which one of the following is correct ?
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

123. Which of the following are the characteristics of monocotyledon plants ?
1. Leaf veins run parallel to one another.
2. Tracheids are predominant.
3. Secondary growth is absent due to lack of cambium.
4. Vascular bundles are scattered randomly.

Select the correct answer by using the codes given below—

Codes—

(A) 1, 2 and 3 (B) 2, 3 and 4
(C) 1, 2 and 4 (D) 1, 3 and 4

124. Meninges are—
(A) membranes covering the heart
(B) connective tissue membranes covering the brain
(C) secretions of the pancreas
(D) myelin sheath on the nerve fibre

125. Which one of the following symptoms of nutritional deficiency disorders is specific to vitamin C deficiency ?
(A) Cracks on lips
(B) Spongy bleeding gums
(C) Pale conjunctivae
(D) Rashes on skin

126. Consider the following functions—
1. Regulating the loss of excess water from the body.
2. Removal of waste products from blood.
3. Maintaining the balance of the body.
4. Maintaining a constant composition of blood.

The main function(s) of the kidney would include—

(A) 1 alone (B) 1 and 2
(C) 2, 3 and 4 (D) 1, 2, 3 and 4

127. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R)—

Assertion (A) : On entering a dark room one can not see much but within a few seconds one's sight is adjusted to the dim light.

Reason (R) : Adaptation means any structural, physiological and biochemical change in the living organisms which enables it to take advantage of its environment.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not a correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

128. Which one of the following is an appropriate description of mangrove plants ?

(A) Large wood-yielding trees of the tropical forests.

(B) Red Sandalwood plants.

(C) Plants in marshy areas with breathing roots.

(D) Medicinal plants.

129. Which of the following base pairs occur in DNA double helix ?

1. Adenine and thymine
2. Guanine and cytosine
3. Guanine and thymine
4. Adenine and uracil

Select the correct answer using the codes given below—

Codes—

(A) 1 and 2 (B) 3 and 4

(C) 2 and 3 (D) 1, 2, 3 and 4

130. Which one of the following theories was proposed by A.I. Oparin and J.B.S. Haldane?

(A) Biochemical theory of origin of life

(B) Life begets life

(C) Chromosome theory of inheritance

(D) Theory of natural selection

131. Which one of the following statements regarding the Indus Valley Civilization is correct?

(A) The script in the seals has not been deciphered so far.

(B) No structure unearthed can be considered a religious structure.

(C) Elephant is one of the animals known to the Indus Valley people.

(D) The image of dancing girl is a figure in bronze.

132. The Vedic god Purandara was the same as—

(A) Varuna (B) Indra

(C) Yama (D) Rudra

133. The first Europeans, in modern times, to enter into trade relations with India were the—

(A) Dutch

(B) Portuguese

(C) French

(D) British

134. Which of the following are associated with Akbar ?

1. Din-e-Ilahi
2. Ibadat Khana
3. Fatehpur Sikri
4. The first battle of Panipat

Select the correct answer using the codes given below—

Codes—

(A) 1 and 4 (B) 1 and 2

(C) 1, 2 and 3 (D) 2, 3, and 4

135. In the context of Medieval History of India, match List I with List II and select the correct answer by using the codes given below the lists—

List I	**List II**
(a) Chaugan	1. Chess
(b) Pachisi	2. Festival
(c) Shab-i-Barat	3. Sport
(d) Nastaliq	4. Art

Codes—

	(a)	(b)	(c)	(d)
(A)	3	4	2	1
(B)	1	2	3	4
(C)	3	1	2	4
(D)	4	3	2	1

136. The decision to form INA (Azad Hind Fauj) was taken at—

(A) Tokyo (B) Bangkok

(C) Rangoon (D) Calcutta

137. Which one of the following illustrates the impact of the Industrial Revolution in India?

(A) Growth of industries in British India

(B) Destruction of handicraft industry

(C) Construction of dams across the rivers

(D) Creation of scientific laboratories

138. What is the correct chronological order in which the following leaders appeared on the political scene ?

1. Ranade 2. Gandhiji
3. Naoroji 4. Gokhale

Select the correct answer using the codes given below—

Codes—

(A) 1, 3, 4, 2 (B) 4, 3, 1, 2

(C) 3, 1, 4, 2 (D) 4, 1, 3, 2

139. The Maratha and the Kesari were the newspapers published by Lokmanya Tilak to awaken the people. In which language was the Maratha published ?

(A) Marathi (B) Gujarati

(C) Hindi (D) English

140. Who was the first Indian to have entered the Indian Civil Service ?
(A) Satyendra Nath Tagore
(B) C.C. Desai
(C) S.N. Banerjea
(D) Subhash Chandra Bose

141. First Five Year Plan started from 1st April, 1952 and ended with 31st March, 1957. Which Five Year Plan has commenced from 1st April, 2012 ?
(A) 12th Five Year Plan
(B) 9th Five Year Plan
(C) 10th Five Year Plan
(D) None of the above

142. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R)—

Assertion (A) : In India, the amendments to the Constitution can be initiated by the Centre alone.

Reason (R) : The amendment procedure laid down in the Indian Constitution is patterned on the Government of India Act, 1935.

In the context of the above two statements, which one of the following is correct ?
(A) Both A and R are true and R is the correct explanation of A
(B) Both A and R are true but R is not a correct explanation of A
(C) A is true but R is false
(D) A is false but R is true

143. The Constituent Assembly set up to prepare a draft Constitution of free India was chaired by—
(A) Dr. Rajendra Prasad
(B) Dr. B.R. Ambedkar
(C) Jawaharlal Nehru
(D) C. Rajgopalachari

144. Match List-I with List-II and select the correct answer by using the codes given below the lists—

List-I (Date)	**List-II (Events)**
(a) 24 Jan., 1966	1. Shimla Agreement signed
(b) 16 Dec., 1971	2. Death of Lal Bahadur Shastri
(c) 10 Jan., 1966	3. Emergence of an independent Bangladesh
(d) 2 July, 1972	4. Indira Gandhi took the oath of office of Prime Minister for the first time.
	5. Tashkent Agreement

Codes—

	(a)	(b)	(c)	(d)
(A)	1	2	4	5
(B)	5	3	1	2
(C)	4	3	2	1
(D)	4	3	5	1

145. Under the Bhoodan movement maximum land was donated from—
(A) Bihar (B) Tamil Nadu
(C) Maharashtra (D) Uttar Pradesh

146. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R)—

Assertion (A) : Industrial Revolution revolutionized the whole industrial system in England in the 18th century.

Reason (R) : Industrial Revolution brought the class conflict to an end.

In the context of the above two statements, which one of the following is correct ?
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

147. What is the correct chronological sequence of the following events ?
1. The Russian Revolution.
2. American War of Independence.
3. Green Revolution in India.
4. The French Revolution.

Select the correct answer using the codes given below—

Codes—
(A) 1, 2, 4, 3 (B) 2, 4, 1, 3
(C) 2, 1, 4, 3 (D) 4, 2, 3, 1

148. Five permanent members of the U.N. Security Council include—
(A) USA, UK, Russia, China and France
(B) UK, USA, India, China and France
(C) USA, UK, Russia, Switzerland and Germany
(D) UK, USA, Germany, Russia and France

149. Match List-I with List-II and select the correct answer using the codes given below the lists—

List-I (Political thinkers)	**List-II (Philosophy/ideas)**
(a) Voltaire	1. Civil Disobedience
(b) Thomas Paine	2. The Social Contract
(c) H.D. Thoreau	3. The Rights of Man
(d) Thomas Hobbes	4. Commonwealth

Codes—

	(a)	(b)	(c)	(d)
(A)	3	2	1	4
(B)	2	3	1	4
(C)	2	3	4	1
(D)	3	2	4	1

150. Who wrote 'Das Kapital'?
(A) Engel (B) Lenin
(C) Karl Marx (D) Adam Smith

Answers with Hints

1. (C) There should be **'avail himself'**, because there are some verbs which always take a Reflexive Pronoun (Pronouns with 'self') after them. These verbs are—avail, avenge, revenge, absent, enjoy, etc.
2. (A) There should be **'It being the second Saturday'**. 'Being' should have its subject before it.
3. (C) There should be **'had nearly passed'.**
4. (D)
5. (A) **'Such of'** is not required. There should be 'Those who have not...'
6. (A) There should be **'committed to maintaining peace'**. **'Keep'** is not needed.
7. (D) 8. (A)
9. (A) There should be **'has'.** The subject is **'problem'** which is singular in number.
10. (D)
11. (A) The negative of **'We have'** is 'haven't we'.
12. (C) There should be **'asks for',** because no negative expression can be used after 'until'.
13. (C) **'lassitude'** means 'tiredness, weakness'—'weariness'.
14. (A) **'queer'** means 'unusual'—'strange'.
15. (B) **'frugal'** means 'thrifty'— 'one careful in spending'.
16. (B) **'Veracity'** means 'truth'.
17. (D) **'allegations'** means **'blames'**—'charges'.
18. (B)
19. (C) **'launched'** means **'to introduce'**. Its opposite is 'withheld'—'to stop, to hold back'.
20. (B) **'hostility'** means 'enmity'. Its opposite is 'friendliness'.
21. (C) **'callous'** means 'feelingless'. Its opposite is 'sensitive'—'full of feelings'.
22. (D)
23. (B) **'scorpion'** is 'a poisonous insect'.
24. (C) 25. (C) 26. (B) 27. (C)
28. (C) **'to overcome'** means 'to win over'.
29. (D) 30. (C)
31. (A) **'introvert'** means 'reserved and self-centred'.
32. (C)
33. (D) **'orphan'** means 'one who has lost one's parents'.
34. (B) 35. (B)
36. (A) **'an innate drive'** means 'inner urge, an initiative'.
40. (B) **'Migratory birds'** are the birds that fly from country to country.
43. (D) **'anchored'** means 'to lay the ship on the shore'.
44. (B) In (S_1), **'Space shuttle'** means 'a craft flying into space'.

    In (S), **'astronaut'** means 'a person who flies into space'.
45. (C)
46. (A) **'tormenting'** means 'causing pain, teasing'.

47. (A) 48. (B) 49. (B) 50. (C) 51. (A) 52. (D)
53. (D) 54. (A) 55. (A) 56. (B) 57. (A) 58. (C)
59. (A) 60. (D) 61. (C) 62. (A) 63. (C) 64. (A)
65. (B) 66. (B) 67. (D) 68. (B) 69. (C) 70. (C)
71. (D) 72. (C) 73. (A) 74. (A) 75. (D) 76. (C)
77. (B) 78. (C) 79. (D) 80. (A) 81. (C) 82. (B)
83. (A) 84. (D) 85. (D) 86. (B) 87. (A) 88. (A)

89. (B) Let the total volume of the iceberg
$= V$
and the volume of the floating part
$= \Delta V$
volume of immersed part
$= V - \Delta V$
So, wt. of the iceberg
$= $ wt. of displaced water
$V \times \cdot 92 = (V - \Delta V) \times 1 \cdot 03$
$\cdot 92\, V = 1 \cdot 03\, V - 1 \cdot 03\, \Delta V$
$1 \cdot 03\, \Delta V = 1 \cdot 03\, V - \cdot 92\, V$
$1 \cdot 03\, \Delta V = \cdot 11\, V$
$\therefore \quad \frac{\Delta V}{V} \times 100 = \frac{\cdot 11}{1 \cdot 03} \times 100$
$= 11\%$

90. (D) The normal temperature of human body is 98·5° F
$$\frac{F - 32}{9} = \frac{C}{5}$$
$$\frac{98 \cdot 5 - 32}{9} = \frac{C}{5}$$
$$\frac{66 \cdot 5 \times 5}{9} = C$$
$$\Rightarrow \quad C = 37°$$

91. (D) 92. (B) 93. (C)
94. (B) $\because \quad H = \frac{V^2}{RJ}$

$$\therefore \quad 10 = \frac{V^2}{5 \times 4{\cdot}2}$$

$$\Rightarrow \quad V^2 = 10 \times 5 \times 4{\cdot}2$$

Heat produced in

$$4 + 6 = 10\ \Omega$$

$$H = \frac{V^2}{RJ}$$

$$= \frac{10 \times 5 \times 4{\cdot}2}{10 \times 4{\cdot}2}$$

$$= 5 \text{ cal/sec}$$

it current flows in

$$4 + 6 = 10\ \Omega$$

then $$H = \frac{i^2R}{J}$$

$$\therefore \quad 5 = \frac{i^2 \times 10}{4{\cdot}2}$$

or, $$i^2 = \frac{5 \times 4{\cdot}2}{10}$$

$$= 2{\cdot}1$$

The current i will flow in 4 Ω also since 4 Ω of 6 Ω are in series.

$\therefore$ Heat produced in 4 Ω

$$H = \frac{i^2R}{J}$$

$$= \frac{2{\cdot}1 \times 4}{4{\cdot}2}$$

$$= 2 \text{ cal/sec}$$

95. (C) 96. (B) 97. (A) 98. (D) 99. (C) 100. (B)
101. (C)

102. $E = V + IR$

$$2{\cdot}5 = V + 10 \times {\cdot}05$$

$$\Rightarrow \quad V = 2{\cdot}5 - 0{\cdot}5$$

$$= 2{\cdot}0 \text{ volt}$$

102. (A) 103. (C) 104. (B) 105. (B) 106. (A) 107. (B)
108. (A) 109. (D) 110. (C) 111. (B) 112. (A) 113. (C)
114. (B) 115. (B) 116. (A) 117. (D) 118. (D) 119. (A)
120. (D) 121. (D) 122. (A) 123. (D) 124. (B) 125. (B)
126. (B) 127. (B) 128. (C) 129. (A) 130. (A) 131. (A)
132. (B) 133. (B) 134. (C) 135. (C) 136. (A) 137. (B)
138. (C) 139. (B) 140. (D) 141. (A) 142. (B) 143. (A)
144. (D) 145. (D) 146. (C) 147. (B) 148. (A) 149. (B)
150. (C)

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UPKAR'S

PRACTICE WORK-BOOK

NDA & NA EXAMINATION

SELECTED QUESTIONS WITH EXPLANATORY ANSWERS

Dr. H.P. Sharma & Dr. M.B. Lal

Practice Set–2

Paper-I
Mathematics

1. If A = {1, 2, 3, 4}, B = {3, 4, 5, 6}, then A ∪ B is—
   (A) {1, 2, 3, 4, 5, 6} (B) {3, 4}
   (C) {5, 6} (D) None of these
2. If A = {1, 2, 3}, B = {3, 4, 5}, then A – B is—
   (A) {4, 5} (B) {3, 4}
   (C) {1, 2} (D) None of these
3. (A ∪ B)′ is equal to—
   (A) A′ ∪ B′ (B) A′ ∩ B′
   (C) A – B (D) A Δ B
4. (A ∩ B ∩ C)′—
   (A) A′ ∩ B′ ∩ C′ (B) A′ ∪ B′ ∪ C′
   (C) A ∩ B′ ∩ C (D) A ∩ B ∪ C′
5. If A = {a, b}, B = {α}, then A × B is equal to—
   (A) {(a, α) (b, α)} (B) {(α, a) (α, b)}
   (C) {a, b, α} (D) None of these
6. Which of the following is false ?
   (A) A ⊂ B – C – B ⊂ C – A
   (B) A ⊂ B ⇒ (A ∪ C) ⊂ (B ∪ C)
   (C) A ⊂ B ⇒ (U – B) ⊂ (U – A)
   (D) A ⊂ B ⇒ B ∩ C ⊂ A ∩ C

Directions—(Q. 7 to 10) For the next four (4) items that follows :—

Letter X is randomly selected from the set of odd numbers and Y is randomly selected from the set of seven numbers of the set {1, 2, 3, 4, 5, 6, 7}, Let Z = (X + Y).

7. What is P(Z = 5) equal to ?
   (A) $\frac{1}{2}$ (B) $\frac{1}{3}$
   (C) $\frac{1}{4}$ (D) $\frac{1}{6}$
8. What is P(Z = 10) equal to ?
   (A) 0 (B) $\frac{1}{2}$
   (C) $\frac{1}{3}$ (D) $\frac{1}{5}$
9. What is P(Z > 11) equal to ?
   (A) 0 (B) $\frac{1}{4}$
   (C) $\frac{1}{6}$ (D) $\frac{1}{12}$
10. What is P(Z is the product of two prime numbers) equal to ?
    (A) 0 (B) $\frac{1}{2}$
    (C) $\frac{1}{4}$ (D) None of these
11. What is the equation of parabola whose vertex 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) $x^2 - 8y = 0$
12. 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
13. $\log_l x$, $\log_m x$ and $\log_n x$ are in arithmetic progression, then ($x \neq 1$)—
    (A) $n^2 = (ln)^{\log_m l}$ (B) $n^2 = (ln)^{\log_l m}$
    (C) $n^2 = (ln)^{\log l}$ (D) $n^2 = (ln)^{\log m}$
14. The quadratic equation whose roots are 4 and 5 is given by—
    (A) $x^2 - 9x + 20 = 0$ (B) $x^2 + 9x - 20 = 0$
    (C) $x^2 - 9x - 20 = 0$ (D) $x^2 + 9x + 20 = 0$
15. The third term of a G.P. is 4. The product of first five term is—
    (A) 4^3 (B) 4^5
    (C) 4^4 (D) None of these
16. Let $Z = x + iy$ where x, y are real variable and $i = \sqrt{-1}$, if $|2z - 1| = |z - 2|$, then the point z describes—
    (A) A circle (B) An ellipse
    (C) A hyperbola (D) A parabola
17. If A.M. between a and b is twice as great as their G.M. then $a : b$ is—
    (A) $(2 + \sqrt{3}) : (2 - \sqrt{3})$
    (B) $(2 - \sqrt{3}) : (2 + \sqrt{3})$
    (C) $2 : \sqrt{3}$
    (D) None of the above

18. $(3 + \omega + 3\omega^2)^4$ is given by (where ω is cube root of unity)—
(A) 16 (B) 16ω
(C) $16\omega^2$ (D) None of these

19. The value of $(101101)_2$ is—
(A) 45 (B) 70
(C) 90 (D) 80

20. 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) $-abc$

21. A square matrix A is invertible if and only if—
(A) It has a non-zero element
(B) Determinant of A is zero
(C) Determinant of A is non-zero
(D) Has all elements not equal to zero

22. If $A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$, then A^2 is equal to—
(A) 3A (B) 2A
(C) 4A (D) $\frac{1}{2}$A

23. 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) $m \le n$

24. A is skew-symmetric if A′ is euqal to—
(A) A (B) $\frac{1}{2}$A
(C) 2A (D) − A

25. A is idempotent if—
(A) $A^2 = A$ (B) $A^2 = -A$
(C) $A^2 = I$ (D) $A^2 = -I$

26. If $A = \begin{bmatrix} 0 & 1+i \\ -1+i & 0 \end{bmatrix}$, then $\bar{A}$ is given by—
(A) $\begin{bmatrix} 0 & 1+i \\ -1-i & 0 \end{bmatrix}$
(B) $\begin{bmatrix} 0 & -1+i \\ 1-i & 0 \end{bmatrix}$
(C) $\begin{bmatrix} 0 & 1-i \\ -1-i & 0 \end{bmatrix}$
(D) None of the above

27. If the determinent $\begin{vmatrix} 1 & 0 & 0 \\ 2 & a & a \\ 2 & 1 & 1 \end{vmatrix}$ is zero for—
(A) every value of a (B) $a = 1$
(C) $a = 0$ only (D) $a = 0, 1$ only

28. 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 cosec A.cot A

29. 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

30. The solution of—
$$x + y + z = 3$$
$$2x + 2y + z = 5$$
$$x + y + 2z = 4$$
is given by—
(A) 1, 1, 2 (B) 1, 1, 1
(C) 2, 1, 1 (D) 2, 2, 2

31. Matrix form of the simultaneous equation
$$x - y = 4$$
$$2x + y = 3$$
is given by—
(A) $\begin{bmatrix} 1 & -1 \\ 2 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4 \\ 3 \end{bmatrix}$
(B) $\begin{bmatrix} 1 & 1 \\ -1 & 2 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4 \\ 3 \end{bmatrix}$
(C) $\begin{bmatrix} 1 & 2 \\ -1 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4 \\ 3 \end{bmatrix}$
(D) None of the above

32. What is the equation of the line midway between the lines $3x - 4x + 12 = 0$ and $3x - 4y = 6$?
(A) $3x - 4y - 9 = 0$ (B) $3x - 4y + 9 = 0$
(C) $3x - 4y - 3 = 0$ (D) $3x - 4y + 3 = 0$

33. If $A = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 6 \end{bmatrix}$, then A is—
(A) Scalar matrix (B) Nilpotent matrix
(C) Diagonal matrix (D) Idempotent matrix

34. The equations $x + 2y + 3z = 1, 2x + 3y + 3z = 2, 5x + 5y + 9z = 4$ have—
(A) Unique solution
(B) Infinitely many solutions
(C) Inconsistent
(D) None of the above

35. The angles of a quadrilateral are in A.P. and the greatest angle is 120° angle in radian will be—
(A) $\frac{\pi}{3}, \frac{4\pi}{9}, \frac{5\pi}{9}, \frac{2\pi}{3}$ (B) $\frac{\pi}{6}, \frac{4\pi}{3}, \frac{5\pi}{9}, \frac{2\pi}{3}$
(C) $\frac{5\pi}{9}, \frac{2\pi}{3}, \frac{4\pi}{9}, \frac{\pi}{3}$ (D) None of these

36. The efficiency E_1 of a certain screw jack is given by
$$E = \frac{1 - \mu \tan \alpha}{\mu + \tan \alpha}$$
If $\mu = \tan \lambda$, then E is equal to—
(A) $\tan(\alpha - \lambda)$ (B) $\tan(\lambda + \alpha)$
(C) $\cot(\lambda - \alpha)$ (D) $\cot(\lambda + \alpha)$

37. Maximum value of $\sin x + \cos x$ is—
(A) 1 (B) 2
(C) $\sqrt{2}$ (D) $\frac{1}{\sqrt{2}}$

38. The value of $\tan 3A - \tan 2A - \tan A$ is—
(A) $\tan 3A \tan 2A \tan A$
(B) $-\tan 3A \tan 2A \tan A$
(C) $\tan A \tan 2A - \tan 2A \tan 3A - \tan 3A \tan A$
(D) None of the above

39. If $A + B + C = 180°$, then the value of $\sin 2A + \sin 2B + \sin 2C$—
(A) $4 \cos A \cos B \cos C$
(B) $4 \sin A \sin B \sin C$
(C) $4 \sin A \sin B \cos C$
(D) None of the above

40. If $\cos^{-1}\left(\frac{1}{x}\right) = \theta$, then $\sin \theta$—
(A) $\sqrt{1 + \frac{1}{x^2}}$ (B) $\sqrt{x^2 - 1}$
(C) $\sqrt{1 - \frac{1}{x^2}}$ (D) None of these

41. $\sin^{-1}\frac{3}{5} + \cos^{-1}\frac{12}{13}$ is equal to—
(A) $\sin^{-1}\frac{56}{65}$ (B) $\cos^{-1}\frac{56}{65}$
(C) $\sin^{-1}\frac{65}{56}$ (D) None of these

42. The angle of elevation of a tower at a point distance 'd' metres from its base is 30°. If the tower is 20 m. high, then the value of d is—
(A) $10\sqrt{3}$ m (B) $\frac{20}{\sqrt{3}}$ m
(C) $20\sqrt{3}$ m (D) 10 m

43. A kite is flying at an inclination of 60° with the horizontal. If the length of the thread is 120 m, then the height of the kite is—
(A) $60\sqrt{3}$ (B) 60 m
(C) $\frac{60}{\sqrt{3}}$ m (D) 120 m

44. 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) $-x \cos x + c$

45. Three points $(p + 1, 1)$, $(2p + 1, 3)$ and $(2p + 2, 2p)$ are collinear if p—
(A) -1 (B) 1
(C) 2 (D) 0

46. The length of perpendicular from (4, 7) to the line $2x + 3y = 5$ is—
(A) $\frac{27}{\sqrt{13}}$ (B) $\frac{29}{\sqrt{13}}$
(C) $\frac{24}{\sqrt{13}}$ (D) None of these

47. What is the vector perpendicular to both the vectors $i - j$ and i ?
(A) $\hat{i}$ (B) $-\hat{j}$
(C) $\hat{j}$ (D) $\hat{k}$

48. Distance between the points $(am_1^2, 2am_1)$ and $(am_2^2, 2am_2)$ is—
(A) $a(m_1 - m_2)\sqrt{(m_1 + m_2)^2 + 4}$
(B) $(m_1 - m_2)\sqrt{(m_1 + m_2)^2 + 4}$
(C) $a(m_1 - m_2)\sqrt{(m_1 + m_2)^2 - 4}$
(D) $(m_1 - m_2)\sqrt{(m_1 + m_2)^2 - 4}$

49. For the circle $x^2 + y^2 + 6x - 8y + 9 = 0$, which of the following statement is true—
(A) Circle passes through (– 3, 4)
(B) Circle touches x-axis
(C) Circle touches y-axis
(D) None of the above

50. Two circles $x^2 + y^2 = 4$, $(x - 3)^2 + (y - 4)^2 = 9$ are given by—
(A) They touch internally
(B) They touch externally
(C) Cut each other
(D) None of the above

51. What is the value of p for which the vector $p(2i - j + 2k)$ is of 3 units length ?
(A) 1 (B) 2
(C) 3 (D) 6

52. A parabola $(x - 1)^2 = 6(y + 2)$, then the vertex is—
(A) (1, – 2) (B) (– 1, – 2)
(C) (– 2, 1) (D) (2, 3)

53. Ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$, eccentricity '$e$' is given by—
(A) $\frac{\sqrt{5}}{4}$ (B) $\frac{\sqrt{5}}{3}$
(C) $\frac{\sqrt{5}}{7}$ (D) None of these

54. Parametric point on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is—

(A) $(a\cos\phi, b\sin\phi)$ (B) $(a\sin\phi, b\cos\phi)$

(C) $(a\cos^2\phi, b\sin^2\phi)$ (D) None of these

55. Which of the following measures determined only after the construction cumulative frequency distribution ?

(A) Arithmetic Mean (B) Mode

(C) Median (D) Geometric Mean

56. If the points (0, 1, 2), (2, – 1, 3) and (1, – 3, 1) are the vertex of a triangle, then the triangle is—

(A) Right angled (B) Isosceles Right angled

(C) Equilateral (D) None of these

57. The direction cosines of the line joining A (1, 2, 3) and B(4, 5, 7) are—

(A) $\mp\frac{3}{\sqrt{34}}, \mp\frac{3}{\sqrt{34}}, \mp\frac{4}{\sqrt{34}}$

(B) $\frac{3}{\sqrt{34}}, \frac{3}{\sqrt{34}}, \frac{4}{\sqrt{34}}$

(C) $-\frac{3}{\sqrt{34}}, -\frac{3}{\sqrt{34}}, -\frac{3}{\sqrt{34}}$

(D) None of the above

58. Projection of AB on CD [If A(1, 2, 3), B(4, 1, 5); C(3, – 1, – 5), D(– 4, – 5, – 6)] is—

(A) $\frac{19}{\sqrt{67}}$ (B) $\frac{19}{\sqrt{69}}$

(C) $\frac{19}{\sqrt{66}}$ (D) None of these

59. What is the $\lim_{x\to 0}\frac{\cos x}{\pi - x}$ equal to ?

(A) 0 (B) π

(C) $\frac{1}{\pi}$ (D) 1

60. If the given lines $\frac{x-1}{-3}=\frac{y-2}{2k}=\frac{z-3}{2}$ and $\frac{x-1}{3k}=\frac{y-1}{1}=\frac{z-6}{-5}$ be perpendicular, then k —

(A) – 10 (B) $\frac{10}{7}$

(C) $-\frac{10}{7}$ (D) $-\frac{7}{10}$

61. Direction ratios of the normal to the plane passing through the points (0, 1, 1), (1, 1, 2) and (– 1, 2, – 2) are—

(A) (1, 1, 1) (B) (2, 1, – 1)

(C) (1, 2, – 1) (D) (1, – 2, – 1)

62. The centre and radius of the sphere $x^2+y^2+z^2+4x+6y+8z+3=0$ are—

(A) $(-2,-3,-4), \sqrt{26}$

(B) $(2,3,4), \sqrt{26}$

(C) $(2,-3,-4), \sqrt{26}$

(D) None of the above

63. Which of the following is not a function ?

(A) $y = 3x+5, x>1$
$= -3x+5, x\le 1$

(B) $R = \{(3,4),(4,5),(5,6),(6,7)\}$

(C) $R = \{(1,5),(2,5),(1,6)\}$

(D) $y = f(x) = \frac{1}{x}$ except $x=0$

64. Which of the following is false ?

(A) $f(x) = \sin x + \tan x$ is an odd function

(B) Constant function is an even function

(C) $f(x) = [x], x \in I$ is a periodic function, with period $\lambda, -<\lambda<1$

(D) $f(x) = x^2 - |x|$ is an odd function

65. If $f(x) = \sin(\log x)$, then the value of $f(xy) + f\left(\frac{x}{y}\right) - 2f(x)\cos(\log y)$ is—

(A) 1

(B) 0

(C) – 1

(D) $\sin\log x \cdot \cos(\log y)$

66. The range of the function $y = f(x) = x^2 - 4x + 7, 2 \le x \le 3$, is—

(A) $0 \le y \le 3$ (B) $2 \le y \le 3$

(C) $3 \le y \le 7$ (D) $3 \le y \le 4$

67. If $f(x) = 2x\sqrt{1-x^2}$, then $f\left(\sin\frac{x}{2}\right)$ is equal to—

(A) $\sin x$ (B) $\cos x$

(C) $\sin 2x$ (D) $\sin\frac{x}{2}$

68. 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) $x = -1$

69. If $\lim_{x\to 0}\frac{\sin x^0}{x}$ is equal to—

(A) 1 (B) $\frac{180}{\pi}$

(C) 0 (D) $\frac{\pi}{180}$

70. $\lim_{x\to 8}\frac{\sqrt{x}-2\sqrt{2}}{x-8}$ is equal to—

(A) $\frac{0}{0}$ (B) $\frac{1}{2}$

(C) $\frac{1}{4\sqrt{2}}$ (D) $\frac{1}{\sqrt{2}}$

71. What is the area bounded by the lims $x = 0$, $y = 0$ and $x + y + z = 0$?

(A) $\frac{1}{2}$ sq. unit (B) 1 sq. unit

(C) 2 sq. units (D) 4 sq. units

72. If $f(x) = \begin{cases} 2 + x, \text{ if } x \geq 0 \\ 2 - x, \text{ if } x < 0 \end{cases}$, then $f'(0)$ equals—

(A) -1 (B) 0

(C) 2 (D) Does not exist

73. 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) $-\frac{1}{2}$

74. 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) $2y + x = 0$

75. $\lim_{h \to 0} \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}$ equals—

(A) $2f''(x)$ (B) $f''(x)$

(C) $f'(x)$ (D) None of these

76. If a function $f(x)$ is differentiable at $x = a$, then—

1. f is continuous at $x = a$
2. $\lim_{h \to 0} f(a+h) = \lim_{h \to 0} f(a-h)$
3. $\lim_{h \to 0} \frac{f(a+h) - f(a)}{h} = \lim_{h \to 0} \frac{f(a-h) - f(a)}{-h}$
4. L. $\lim_{x \to a} f(x) =$ R. $\lim_{x \to a} f(x) \neq f(a)$

Select the correct answer using the codes given below :

Codes :

(A) 1 and 3 (B) 1, 3 and 4

(C) 1, 2 and 3 (D) 1, 2 and 4

77. What angle does the line segment joining (4, 2) and (6, – 15) subtend at (0, 0) ?

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{4}$

(C) $\frac{\pi}{2}$ (D) $\frac{3\pi}{4}$

78. The differential coefficient of $y = x^x$ is given by—

(A) $x^x \log\left(\frac{x}{e}\right)$ (B) $x^{x^x - 1}$

(C) $x^x \log x$ (D) $x^x (\log ex)$

79. 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)

80. The equation of tangent to the curve $y = x^2 + 1$ at (1, 2) is given by—

(A) $y - 2 = 2(x - 1)$ (B) $y - 2 = \frac{1}{2}(x - 1)$

(C) $y - 1 = 2(x - 2)$ (D) $y - 2 = -2(x - 1)$

81. If $y = \sin(\cos x)$, then differentiate of w.r.t. x^2 —

(A) $\frac{\sin x}{2x} \cos(\cos x)$ (B) $2x \sin x \cos(\cos x)$

(C) $-\frac{\sin x}{2x} \cos(\cos x)$ (D) None of these

82. The foci of the hyporbola $4x^2 - 9y^2 - 1 = 0$ 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

83. If $y = e^x (a \cos x + b \sin x)$ where a, b are constants, then $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y$ is equal to—

(A) -1 (B) 0

(C) $+2$ (D) None of these

84. The constant of integration—

(A) Is always a real number

(B) Is always a imaginary number

(C) May be imaginary

(D) None of the above

85. $\int \frac{x}{x^2 + 1} dx$ is equal to—

(A) $\frac{1}{2} \log(x^2 + 1)$ (B) $\log(x^2 + 1)$

(C) $\tan^{-1}\frac{x}{2}$ (D) None of these

86. $\int \frac{e^x + e^{-x}}{e^x - e^{-x}} dx$ is equal to—

(A) $\log(e^x - e^{-x})$ (B) $\log(e^x + e^{-x})$

(C) $\log(e^{-x} - e^{-x})$ (D) None of these

87. If $\frac{d}{dx} \sin(e^x) = (\cos e^x) e^x$, then $\int e^x \cos e^x \, dx$ is equal to—

(A) $\sin e^x$ (B) $\sin e^x + c$

(C) $\sin e^x + \cos e^x$ (D) None of these

88. If $f(a) = \frac{1}{\log a}$, $(a > 1)$ and $f(x) = \int a^x dx + k$,

then $f(x)$—

(A) $\frac{1}{\log a}(a^x - a^a + 1)$

(B) $\frac{1}{\log a}(a^x - a^a)$

(C) $\frac{1}{\log a}(a^x + a^a + 1)$

(D) $\frac{1}{\log a}(a^x + a^a - 1)$

89. $I = \int \frac{dx}{\sqrt{2x^2 + 3x + 4}}$ is equal to—

(A) $\frac{1}{\sqrt{2}} \sin^{-1} \frac{4x+3}{\sqrt{23}}$ (B) $\frac{1}{\sqrt{2}} \sinh^{-1} \frac{4x+3}{\sqrt{23}}$

(C) $\frac{1}{\sqrt{2}} \cosh^{-1} \frac{4x+3}{\sqrt{23}}$ (D) None of these

90. $I = \int_a^b \frac{\log x}{x} dx$ $(1 < a < b)$ is equal to—

(A) $\log \frac{b}{a} \cdot \log \sqrt{ab}$ (B) $\log \frac{b}{a} \cdot \log ab$

(C) $\log \frac{b}{a}$ (D) $\log ab$

91. $I = \int_{-1}^{1} \frac{|x|}{x} dx$ is equal to—

(A) 2 (B) 0

(C) 1 (D) $\frac{1}{2}$

92. 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) $2n^2$ (D) n^n

93. The area bounded by the curve $y = x$, x-axis and the ordinates $x = -1, x = 2$ is given by—

(A) $\frac{5}{2}$ (B) $\frac{9}{2}$

(C) $\frac{15}{2}$ (D) $\frac{17}{2}$

94. The area bounded by the parabola $y^2 = 4ax$ and its latus rectum is given by—

(A) $\int_0^a y\,dx$ (B) $2\int_0^a \sqrt{4ax}\,dx$

(C) $\int_0^a \frac{y^2}{4a} dy$ (D) $2\int_{-a}^{a} \sqrt{4ax}\,dx$

95. The arc of the closed curve $x = a \cos t, y = b \sin t$ is given by—

(A) $\frac{\pi}{2} ab$ (B) πab

(C) $\frac{\pi}{4} ab$ (D) $\frac{3}{2} \pi ab$

96. $\int \frac{x^5}{\sqrt{1+x^3}} dx$ is equal to—

(A) $\frac{2}{9}(1+x^3)^{3/2} + c$

(B) $\frac{2}{9}(1+x^3)^{3/2} + \frac{2}{3}(1+x^3)^{1/2} + c$

(C) $\frac{2}{9}(1+x^3)^{3/2} - \frac{2}{3}(1+x^3)^{1/2} + c$

(D) None of the above

97. The order and degree of the differential equation $y = x\frac{dy}{dx} + \sqrt{a^3\left(\frac{dy}{dx}\right)^2 + b^2}$ are—

(A) 1, 2 (B) 2, 1

(C) 1, 1 (D) 2, 2

98. If the positive integers a, b, c and d are in A.P., then the numbers abc, abd, acd, bcd are in—

(A) H.P. (B) A.P.

(C) G.P. (D) None of these

99. The solution of the differential equation $\frac{dy}{dx} + \frac{1+x^2}{x} = 0$ is—

(A) $y = \frac{1}{2}\tan^{-1} x + c$ (B) $y + \log x + \frac{x^2}{2} + c = 0$

(C) $y = \frac{1}{2}\tan^{-1} x + c$ (D) $y - \log x - \frac{x^2}{2} + c = 0$

100. 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

101. The order and degree of the differential equation

$$\frac{dy}{dx} = \sqrt{1 + \left(\frac{dy}{dx}\right)^2}$$

is—

(A) 4, 2 (B) 1, 2

(C) 2, 2 (D) 2, $\frac{1}{2}$

102. What is $\sum_{r=0}^{n} C(n, r)$ equal to ?

(A) $2^n - 1$ (B) n

(C) $n!$ (D) 2^n

103. Form the differential equation of $y = mx + c$ is—

(A) $\frac{dy}{dx} = m$ (B) $y = x \cdot \frac{dy}{dx} + c$

(C) $y\frac{dy}{dx} = x + c$ (D) None of these

104. How many real roots does the quadratic equation $f(x) = x^2 + 3|x| + 2 = 0$ have ?

(A) One (B) Two

(C) Four (D) No real root

105. Which of the following is false ?

(A) Vector addition is associative and commutative both

(B) $\vec{a} \cdot \vec{b} = \vec{b} \cdot \vec{a}$

(C) $a \cdot (\vec{b} \cdot \vec{c}) = (\vec{a} \cdot \vec{b}) \cdot \vec{c}$

(D) $\hat{k}(\vec{a} + \vec{b}) = \hat{k}\vec{a} + \hat{k}\vec{b}$, where $\hat{k}$ is any scalar.

106. Consider the following statements—

Assertion (A)—

$|\vec{a}| = |\vec{b}|$ does not implies that $\vec{a} = \vec{b}$

Reason (R)—If $\vec{a} = \vec{b}$, then

$\vec{a} \cdot \vec{b} = |\vec{a}|^2 = |\vec{b}|^2$,

of these statements—

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not a correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

107. What is the area of the parabola $x^2 = y$ bounded by the line $y = 1$?

(A) $\frac{1}{3}$ sq. unit (B) $\frac{2}{3}$ sq. unit

(C) $\frac{4}{3}$ sq. unit (D) 2 sq. unit

108. Consider the following statements—

(1) Vectors are collinear if their support are same and parallel

(2) If $\vec{a}$ and $\vec{b}$ are noncollinear vectors and $l\vec{a} + m\vec{b} = 0 \Rightarrow l = 0, m = 0$—

(3) $\vec{0} \cdot \vec{a} = \vec{0}$

(4) $k(\vec{a} \cdot \vec{b}) = (k\vec{a}) \cdot \vec{b}$ k is any scalar.

The correct statements are—

(A) Only (1), (3) and (4)

(B) Only (2), (3) and (4)

(C) Only (2) and (4)

(D) All (1), (2), (3) and (4)

109. 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

110. A force $F = \hat{i} + 2\hat{j} - 3\hat{k}$ displaces a body from A $(2\hat{i} - \hat{j} + 3\hat{k})$ to B $(\hat{i} - 2\hat{j} + \hat{k})$, the work done is—

(A) 3 unit (B) 6 unit

(C) 13 unit (D) None of these

111. 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) $x = -1$

112. The sine of the angle between the vectors $\hat{i} + 3\hat{j} + 2\hat{k}$ and $2\hat{i} - 4\hat{j} + \hat{k}$ is—

(A) $\sqrt{\frac{115}{147}}$ (B) $\sqrt{\frac{141}{153}}$

(C) $\sqrt{\frac{37}{43}}$ (D) None of these

113. The moment of the force $3\hat{i} + \hat{j} - 2\hat{k}$ acting through the point $\hat{i} - 2\hat{j} + 2\hat{k}$ about the point $2\hat{i} - \hat{j} + \hat{k}$ is—

(A) $\hat{i} + \hat{j} + \hat{k}$ (B) $\hat{i} + \hat{j} + 2\hat{k}$

(C) $\frac{1}{\sqrt{6}}(\hat{i} - \hat{j} - 2\hat{k})$ (D) None of these

114. Consider the following statements—

(1) In Δ ABC, the sum of $\vec{AB}$, $\vec{BC}$ and $\vec{CA}$ is zero

(2) ABCD is a parallelogram. If $\vec{AB} = \vec{a}$, $\vec{AD} = \vec{b}$, then the diagonal $\vec{AC}$ and $\vec{BD}$ are $\vec{a} + \vec{b}$ and $\vec{b} - \vec{a}$ respectively

(3) The sum of two vectors is minimum when they are unlike

(4) If ABCDE is pentagon, forces $\vec{AB}$, $\vec{AE}$, $\vec{BC}$, $\vec{DC}$, $\vec{ED}$ and $\vec{AC}$ act at a point then their resultant is 3 AC

The correct codes are—

(A) (1) and (2) (B) (1), (2) and (4)

(C) (1) and (4) (D) All (1), (2), (3) and (4)

115. Following are daily wages of 30 workers in a office

14, 16, 16, 14, 22, 13, 15, 24, 12, 23, 14, 20, 17, 21, 22, 18, 18, 19, 20, 17, 16, 15, 11, 12, 21, 20, 17, 18, 19, 23.

The number of workers with wages 17–19 are—

(A) 2 (B) 5

(C) 3 (D) 6

116. Class interval of '2' for the wages given in question number 115 is made. Corresponding to frequency '4' the class intervals are—

(A) 11–13; 13–15 (B) 21–23; 23–25

(C) 15–17; 17–19 (D) 13–15; 21–23

117. Cumulative frequency corresponding to class interval 21–23 of wages given in question number 115 is made—

(A) 23 (B) 27

(C) 30 (D) None of these

118. 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

119. The probability density function of Binomial distribution is—

(A) ${}^nC_r\, p^r\, q^{n-r}$ (B) $p^r\, q^{n-r}$

(C) ${}^nC_r\, p^r + q^{n-r}$ (D) None of these

120. A perfect cubical die is thrown a large number of times in sets of 8. The occurrence of 5 or 6 is called a success the probability of 3 successes will be—

(A) $\frac{56 \times 32}{243 \times 27}$ (B) $\frac{56 \times 36}{243 \times 27}$

(C) $\frac{56 \times 56}{243 \times 27}$ (D) None of these

Answers with Hints

1. (A) 2. (C) 3. (B) 4. (B) 5. (A) 6. (D)
7. (D) 8. (A) 9. (D) 10. (A)

11. (C) Focus $= (0, -2)$
$= (0, -a)$
Vertex $= (0, 0)$
Then, equation of parabola—
$x^2 - 4ay$
$x^2 = -4 \times 2 \times y$
$x^2 = -8y$
$x^2 + 8y = 0$

12. (D) $2a^2x^2 - 2abx + b^2 = 0$
Let the roots are α and β. then

$$\alpha + \beta = \frac{2ab}{2a^2} = \frac{b}{a} \quad \ldots(1)$$

$$\alpha - \beta = \frac{b^2}{2a^2}$$

$$\alpha - \beta = \sqrt{(\alpha+\beta)^2 - 4\alpha\beta}$$

$$= \sqrt{\frac{b^2}{a^2} - \frac{2b^2}{a^2}}$$

$$= \frac{b}{a} i \quad \ldots(2)$$

On solving (1) and (2)

$$\alpha = \frac{(1+i)b}{2a}$$

$$\beta = \frac{(1-i)b}{2a}$$

13. (B) Taking reciprocals we see that $\log_x l$, $\log_x m$, $\log_x n$ are in H.P.

$$\therefore \quad \log_x m = \frac{2\log_x l \cdot \log_x n}{\log_x l + \log_x n}$$

or $\frac{\log_x m}{\log_x l} = \frac{\log_x n^2}{\log_x ln}$

$\therefore \quad \log_l m = \log_{ln} n^2$

$\therefore \quad n^2 = (ln)^{\log_l m}$

14. (A)

15. (B) $T_3 = ar^2 = 4$

$T_1\, T_2\, T_3\, T_4\, T_5 = a \cdot ar \cdot ar^2 \cdot ar^3 \cdot ar^4$
$= a^5 r^{10} = (ar^2)^5$
$= 4^5$

16. (B) $|2z - 1| = |z - 2|$
$\Rightarrow \quad |2(x + iy) - 1| = |x + iy - 2|$
$\sqrt{(2x-1)^2 + (2y)^2} = \sqrt{(x-2)^2 + y^2}$
$3x^2 + 3y^2 - 3 = 0$
$\Rightarrow \quad x^2 + y^2 = 1$

17. (A) Given $\frac{a+b}{2} = 2\sqrt{ab}$

or, $\frac{a+b}{2\sqrt{ab}} = \frac{2}{1}$

$$\frac{a+b+2\sqrt{ab}}{a+b-2\sqrt{ab}} = \frac{2+1}{2-1}$$

(by Componendo and dividendo)

$$\frac{\left(\sqrt{a}+\sqrt{b}\right)^2}{\left(\sqrt{a}-\sqrt{b}\right)} = \frac{3}{1}$$

$$\frac{\sqrt{a}+\sqrt{b}}{\sqrt{a}-\sqrt{b}} = \frac{\sqrt{3}}{1}$$

Again com. and div. :

$$\frac{\sqrt{a}+\sqrt{b}+\sqrt{a}-\sqrt{b}}{\sqrt{a}+\sqrt{b}-\sqrt{a}+\sqrt{b}} = \frac{\sqrt{3}+1}{\sqrt{3}-1}$$

$$\frac{2\sqrt{a}}{2\sqrt{b}} = \frac{\sqrt{3}+1}{\sqrt{3}-1}$$

by Squaring—

$$\frac{a}{b} = \frac{\left(\sqrt{3}+1\right)^2}{\left(\sqrt{3}-1\right)^2}$$

$$= \frac{4+2\sqrt{3}}{4-2\sqrt{3}} = \frac{2+\sqrt{3}}{2-\sqrt{3}}$$

18. (B) $(3 + \omega + 3\omega^2)^4 = (2 + 1 + \omega + \omega^2 + 2\omega^2)^4$
$= [2(1 + \omega^2)]^4$
$= 2^4(-\omega)^4$
$= 16\omega$
$(\because\ 1 + \omega + \omega^2 = 0)$ and $1 + \omega^2 = -\omega)$

19. (C) $(101101)_2 = 1 \times 2^6 + 0 \times 2^5 + 1 \times 2^4$
$+ 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1$
$= 64 + 16 + 8 + 2$
$= 90$

20. (C) $\begin{vmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{vmatrix} = 0$

On applying $R_2 \to R_2 - R_3$ and $R_1 \to R_1 - R_3$

$$\begin{vmatrix} x & 0 & -x \\ 0 & x & -x \\ a & b & x+c \end{vmatrix} = 0$$

$$x^2 \begin{vmatrix} 1 & 0 & -1 \\ 0 & 1 & -1 \\ a & b & x+c \end{vmatrix} = 0$$

$$\Rightarrow \begin{vmatrix} 1 & 0 & -1 \\ 0 & 1 & -1 \\ a & b & x+c \end{vmatrix} = 0$$

$$x + c + b + 0 + a = 0$$

$$\Rightarrow x = -(a+b+c)$$

21. (C) 22. (C)

23. (C) When m and n will be equal (*i.e.*, $m = n$) then the product of AA is defined.

24. (D) 25. (A)

26. (C) $\bar{A}$ means write complex conjugate of all elements of A. So

$$\bar{A} = \begin{bmatrix} 0 & 1-i \\ -1-i & 0 \end{bmatrix}$$

27. (A) $\Delta = 1(a-a) + 0 = 0$ it holds for every value of a.

28. (C) $\dfrac{1+\sin A}{1-\sin A} - \dfrac{1-\sin A}{1+\sin A}$

$$= \frac{(1+\sin A)^2 - (1-\sin A)^2}{(1-\sin A)(1+\sin A)}$$

$$= \frac{4\sin A}{\cos^2 A}$$

$$= 4 \sec A . \tan A$$

29. (A) $(A + B + C) = \pi$

Then. $\cos (A + B) + \cos C$

$$= \cos(\pi - C) + \cos C$$

$$= -\cos C + \cos C$$

$$= 0$$

30. (B) $AX = B$ where $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 1 \\ 1 & 1 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 3 \\ 5 \\ 4 \end{bmatrix}$

then $X = A^{-1} B = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 1 \\ 1 & 1 & 2 \end{bmatrix}^{-1} \begin{bmatrix} 3 \\ 5 \\ 4 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$

31. (A)

32. (D) On adding both equation—

$$3x - 4y + 12 + 3x - 4y - 6 = 0$$

$$6x - 8y + 6 = 0$$

$$3x - 4y + 3 = 0$$

33. (C) By definition of diagonal matrix. Accordingly diagonal matrix is a square matrix with non-zero elements in leading diagonal.

34. (A) Reason $\begin{vmatrix} 1 & 2 & 3 \\ 2 & 3 & 3 \\ 5 & 5 & 9 \end{vmatrix}$

$= 1(27 - 15) - 2(18 - 15) + 3(10 - 15)$

$= 12 - 6 - 15 \neq 0$

In $AX = B$ if $|A| \neq 0$, then $X = A^{-1} B$ is unique solution.

35. (A) Let the angles in degrees be

$$\alpha - 3\delta, \alpha - \delta, \alpha + \delta, \alpha + 3\delta$$

Sum of the angles $= 4\alpha = 360°, \alpha = 90° = \dfrac{\pi}{2}$

The greatest angle $= \alpha + 3\delta = 120°$ (given)

Hence $3\delta = 30° \Rightarrow \delta = 10°$. Hence the angles are

$$90° - 30°, 90° - 10°, 90° + 10°, 90° + 30°$$

or $60°, 80°, 100°, 120°$

$\therefore$ In terms of radians, the angles are

$60 \times \dfrac{\pi}{180}$, $80 \times \dfrac{\pi}{180}$, $100 \times \dfrac{\pi}{180}$, and $120 \times \dfrac{\pi}{180}$

that is, $\dfrac{\pi}{3}, \dfrac{4\pi}{9}, \dfrac{5\pi}{9}, \dfrac{2\pi}{3}$

36. (D) $t = \dfrac{1 - \tan\lambda \tan\alpha}{\tan\lambda + \tan\alpha}$

$$= \frac{1}{\tan(\lambda + \alpha)}$$

$$= \cot(\lambda + \alpha)$$

37. (C) Maximum $(a \sin x + b \cos x)$

$$= \sqrt{a^2 + b^2} \left[\frac{a}{\sqrt{a^2+b^2}} \sin x + \frac{b}{\sqrt{a^2+b^2}} \cos x \right]$$

$$= \sqrt{a^2 + b^2} [\sin(x + \alpha)]$$

When $\cos\alpha = \left(\dfrac{a}{\sqrt{a^2+b^2}}, \sin\alpha = \dfrac{b}{a^2+b^2} \right)$

$\therefore$ Max. $(a \sin x + b \cos x) = \sqrt{a^2 + b^2}$

[$\because$ Max. $(\sin(x + \alpha)) = 1$]

Here $a = 1$, $b = 1$. Hence answer is $\sqrt{2}$.

38. (A) $\tan A = \dfrac{\tan 3A - \tan 2A}{1 + \tan 3A \tan 2A}$. Now by cross multiplication you can see the fact.

39. (B) $\sin 2A + \sin 2B + \sin 2C$

$= 2 \sin A \cos A + 2 \sin(B + C) \cos(B - C)$

$= 2 \sin A \cos A + 2 \sin A \cos(B - C)$

$= 2 \sin A (\cos A + \cos(B - C))$

$= 2 \sin A [\cos(B - C) - \cos(B + C)]$

$= 2 \sin A \cdot 2 \sin B \sin C$

$= 4 \sin A \sin B \sin C$

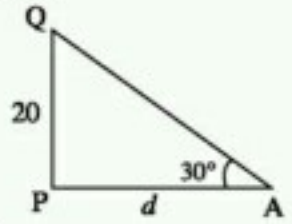
40. (C) $\frac{1}{x} = \cos\theta \qquad \therefore \quad \sin\theta = \sqrt{1-\frac{1}{x^2}}$

41. (A) L.H.S. $= \tan^{-1}\frac{3}{4} + \tan^{-1}\frac{5}{12}$

$$= \tan^{-1}\frac{\frac{3}{4}+\frac{5}{12}}{1-\frac{15}{48}} = \tan^{-1}\frac{56}{33}$$

$$= \sin^{-1}\frac{56}{65}$$

42. (C) PQ is tower.



PA $= d$

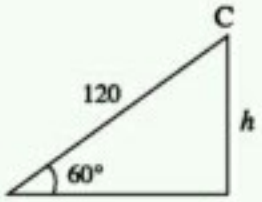
At A the angle of elevation of PB is 30°,

then $d = 20 \cot 30$

$= 20\sqrt{3}$ m.

43. (A) AC = Length of thread = 120

BC $= h$



$\angle$ BAC $= 60°$ given

then $h = 120 \sin 60 = 120 \cdot \frac{\sqrt{3}}{2}$

$= 60\sqrt{3}$ m

44. (A) $\int (x\cos x + \sin x)dx$

$= \int x\cos x\,dx + \int \sin x\,dx$

$= x\int \cos x\,dx - \int\left[\frac{d}{dx}(x)\cdot\int \cos x\,dx\right]dx$

$= x\sin x - \int 1.\sin x\,dx - \cos x + c$

$= x\sin x + \cos x - \cos x + c$

$= x\sin x + c$

45. (C) Points are collinear then the area of the triangle will be zero, so

$$\text{Area} = \frac{1}{2}\begin{vmatrix} p+1 & 1 & 1 \\ 2p+1 & 3 & 1 \\ 2p+2 & 2p & 1 \end{vmatrix} = 0$$

$(p+1)(3-2p) - 1(2p+1-2p-2)$

$+ 1(4p^2 + 2p - 6p - 6) = 0$

$3p + 3 - 2p^2 - 2p - 2p - 1 + 2p + 2 + 4p^2 + 2p - 6p - 6 = 0$

$2p^2 - 3p - 2 = 0$

$\therefore \quad 2p^2 - 4p + p - 2 = 0$

$\therefore \quad 2p(p-2) + 1(p-2) = 0$

or $(2p+1)(p-2) = 0$

or $p = -\frac{1}{2}, p = 2.$

46. (C) From (x_1, y_1) the perpendicular p on $ax + by + c = 0$ is given by

$$p = \frac{ax_1 + by_1 + c}{\sqrt{a^2+b^2}}$$

apply this formula here.

Here $x_1 = 4, y_1 = 7$

$a = 2, b = 3, c = -5$ etc.

$$p = \frac{2\times 4 + 3\times 7 - 5}{\sqrt{4+9}} = \frac{8+21-5}{\sqrt{13}}$$

$$= \frac{29-5}{\sqrt{13}} = \frac{24}{\sqrt{13}}$$

47. (D) The vector perpendicular to both the vector $i - j$ and i is—

$$(i-j)\times i = \begin{vmatrix} i & j & k \\ 1 & -1 & 0 \\ 1 & 1 & 0 \end{vmatrix}$$

$= i(0-0) - j(0-0) + k(0+1)$

$= k$

48. (A) Distance $= \sqrt{a^2(m_1^2 - m_2^2)^2 + \{2a(m_1 - m_2)\}^2}$

$= \sqrt{a^2(m_1+m_2)^2(m_1-m_2)^2 + 4a^2(m_1-m_2)^2}$

$= a(m_1 - m_2)\sqrt{(m_1+m_2)^2 + 4}$

49. (B) Centre is $(-3, 4)$, radius is 4.

Hence the y-coordinate of centre is equal to radius '4'.

50. (B) Centre are $(0, 0)$ and $(3, 4)$

Distance between centres

$= \sqrt{(3-0)^2 + (4-0)^2}$

$= 5$

Sum of their radius $= 2 + 3 = 5$

Now distance between centres = Sum of their radius,

Hence they touch externally.

51. (A) Length $= |p(2i - j + 2k)|$

$3 = p\sqrt{2^2 + (-1)^2 + (2)^2}$

$3 = p\sqrt{4+1+4}$

$3 = \sqrt{9}\,p$

$3 = 3p$

$p = 1$

52. (A)

53. (C) $b^2 = a^2(1-e^2) \Rightarrow 4 = 9(1-e^2) \Rightarrow e = \frac{\sqrt{5}}{3}$

54. (A) 55. (A)

56. (B) Let A (0, 1, 2), B(2, – 1, 3), C(1, – 3, 1)

$AB = \sqrt{4+4+1} = 3$

$BC = \sqrt{(2-1)^2+(-1+3)^2+(3-1)^2} = 3$

$AC = \sqrt{(0-1)^2+(1+3)^2+(2-1)^2}$

$= \sqrt{18}$

$\therefore AB^2 + BC^2 = AC^2$ and $AB = BC$

$\therefore$ Triangle is Isosceles right angled.

57. (A) D.R. of AB are $1-4, \quad 2-5, \quad 3-7$

i.e., $\quad -3 \quad -3 \quad -4$

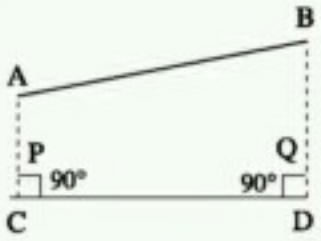
$\therefore$ D.C. of AB are $\pm\frac{3}{\sqrt{34}}, \pm\frac{3}{\sqrt{34}}, \pm\frac{4}{\sqrt{34}}$

58. (C) Projection of $\vec{AB}$ on $\vec{CD} = \vec{AB} \cdot \vec{CD}$

$= (3\hat{i} - \hat{j} + 2\hat{k}) \cdot \left(\frac{-7\hat{i} - 4\hat{j} - \hat{k}}{\sqrt{49+16+1}}\right)$

$= \frac{-21+4-2}{\sqrt{66}}$

$= -\frac{19}{\sqrt{66}}$ (–ve is discarded as it is length)



PQ = Projection of AB on CD

59. (C)

60. (C) $-3(3k) + 2k(1) + 2(-5) = 0$

$-9k + 2k - 10 = 0$

$-7k = 10$

$k = -\frac{10}{7}$

61. (D) Required plane is

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

$$\text{or } x\begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 1 \\ 2 & -2 & 1 \end{vmatrix} - y\begin{vmatrix} 0 & 1 & 1 \\ 1 & 2 & 1 \\ -1 & -2 & 1 \end{vmatrix} + z\begin{vmatrix} 0 & 1 & 1 \\ 1 & 1 & 1 \\ -1 & 2 & 1 \end{vmatrix} - 1\begin{vmatrix} 0 & 1 & 1 \\ 1 & 1 & 2 \\ -1 & 2 & -2 \end{vmatrix} = 0$$

or $\{1(2+2) - 1(1-2) + 1(-2-4)x$

$-\{-1(1+1) + 1(-2+2)\}y$

$+[-1(-1+1) + 1(2+1)]z$

$-[-1(2+2) + 1(2+1)] = 0$

$\{4+1-6\}x - (-2)y + z - (3) = 0$

$-x + 2y + z - 3 = 0$

$\therefore$ Direction ratio of normal is – 1, 2, 1

or (1, – 2, – 1).

62. (A) Centre for $x^2 + y^2 + z^2 + 2ux + 2vy + 2wz + d = 0$ is $(-u, -v, -w)$ and radius $\sqrt{u^2+v^2+w^2-d}$

Here $u = 2, v = 3, w = 4, d = 3$

$\therefore$ Centre is (– 2, – 3, – 4)

and radius $= \sqrt{4+9+16-3}$

$= \sqrt{26}$.

63. (C) 64. (D) 65. (B)

66. (D) $y = f(x) = x^2 - 4x + 7$

or, $x^2 - 4x + 7 - y = 0$

$\Rightarrow x = \frac{4 \pm \sqrt{16-4(7-y)}}{2}$

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

But $2 \le x \le 3$ (Given)

$\Rightarrow 2 \le 2 \pm \sqrt{y-3} \le 3$

$\Rightarrow 0 \le \pm\sqrt{y-3} \le 1$

$\Rightarrow 0 \le y - 3 \le 1$

$\Rightarrow 3 \le y \le 4$

67. (A) $f(x) = 2x\sqrt{1-x^2}$

$f(\sin x/2) = 2\sin\frac{x}{2}\sqrt{1-\sin^2 x/2}$

$= 2\sin\frac{x}{2}\sqrt{\cos^2 x/2}$

$= 2\sin\frac{x}{2}\cos\frac{x}{2}$

$= \sin x$

68. (A) For maximum value of the function—

$\frac{df(x)}{dx} = 0$

$\frac{d}{dx}[x^3 + 2x^2 - 4x + 6] = 0$

$3x^2 + 4x - 4 = 0$

$3x^2 + 6x - 2x - 4 = 0$

$3x(x+2) - 2(x+2) = 0$

$(x+2)(3x-2) = 0$

$x = -2, \frac{2}{3}$

69. (D) $\lim_{x \to 0} \frac{\sin x^\circ}{x}$

$= \lim_{x \to 0} \frac{\sin \frac{\pi}{180} x}{x}$

$= \lim_{x \to 0} \frac{\pi}{180} \left(\frac{\sin \frac{\pi}{180} x}{\frac{\pi}{180} x} \right)$

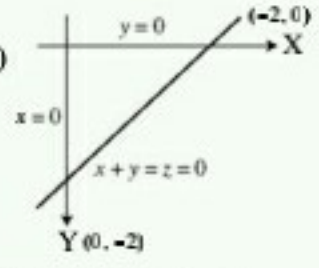
$= \frac{\pi}{180} \cdot 1 = \frac{\pi}{180}$

70. (C) $\lim_{x \to 8} \frac{\sqrt{x} - 2\sqrt{2}}{x - 8}$ $\left[\text{form } \frac{0}{0}\right]$

$= \lim_{x \to 8} \frac{\frac{1}{2\sqrt{x}}}{1}$ [By L' Hospital Rule]

$= \frac{1}{2\sqrt{8}} = \frac{1}{4\sqrt{2}}$

71. (C)



If forms a triangle. so

area $= \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times (-2) \times (-2)$

$= 2$ sq. units

72. (D) L. $f'(0) = \lim_{h \to 0} \frac{f(0-h) - f(0)}{-h}$

$= \lim_{h \to 0} \frac{[2 - (0 - h)] - 2}{-h}$

$= -1$

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

$= \lim_{h \to 0} \frac{[2 + (0 + h)] - 2}{h}$

$= 1$

$\because$ L. $f'(0) \neq$ R. $f'(0)$

$\therefore$ $f'(0)$ does not exist.

73. (D) Let the lines are at d_1 and d_2 distances

$3x + 4y = 1$

$4x + 3y + 2k = 0$

From the point (1, 1)

$d_1 = \frac{3 \times 1 + 4 \times 1 - 1}{\sqrt{3^2 + 4^2}}$

$= \frac{3 + 4 - 1}{\sqrt{9 + 16}} = \frac{6}{5}$

$d_2 = \frac{7 + 2k}{5}$

As per question—

$d_1 = d_2$

$\frac{6}{5} = \frac{7 + 2k}{5}$

$\therefore \quad 2k = -1$

$k = -\frac{1}{2}$

74. (C) The equation of the locus of point which equidistant from the axes is—

$y = \pm x$

75. (B)

76. (C) Every differentiable function be continuous statement (1). (2) and (3) are correct.

77. (C) Let the co-ordinates of point A, B and C are (5. 2), (6, – 15) and (0, 0).

Then, AB $= \sqrt{(5-6)^2 + (2+15)^2}$

$= \sqrt{1 + 289} = \sqrt{290}$

BC $= \sqrt{36 + 225} = \sqrt{261}$

CA $= \sqrt{25 + 4} = \sqrt{29}$

$AB^2 = BC^2 + CA^2$

$= 261 + 29$

$= 290$

Hence, BC and AC are perpendicular to each other.

So angle $= \frac{\pi}{2}$

78. (D) $y = x^x$

$\log y = x \log x$

$\frac{1}{y} \cdot \frac{dy}{dx} = 1 \cdot \log x + 1$

$\frac{dy}{dx} = y (\log x + 1)$

$= x^x (\log_e x + \log_e e)$

$= x^x (\log_e ex)$

$= x^x (\log ex)$

79. (C) 80. (A)

81. (C) $\frac{dy}{dx^2} = \frac{dy}{dx} \cdot \frac{dx}{dx^2}$

$= \cos(\cos x) \cdot (-\sin x) \cdot (2x)^{-1}$

$\left(\because \frac{dx^2}{dx} = 2x \right)$

$= -\frac{\sin x}{2x} \cdot \cos(\cos x)$

82. (B) $4x^2 - 9y^2 - 1 = 0$

$4x^2 - 9y^2 = 1$

$\Rightarrow \frac{x^2}{\left(\frac{1}{2}\right)^2} - \frac{y^2}{\left(\frac{1}{3}\right)^2} = 1$

Comparing with

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

Then, $a = \frac{1}{2}, \; b = \frac{1}{3}$

Here eccentricity $(e) = \frac{1}{a} \cdot \sqrt{a^2 + b^2}$

$$= \frac{1}{\frac{1}{2}} \cdot \sqrt{\frac{1}{4} + \frac{1}{9}}$$

$$= \frac{2\sqrt{13}}{6} = \frac{\sqrt{13}}{3}$$

Hence, foci of the hyperbola

$$= (\pm ae, 0)$$

$$= \left(\pm \frac{\sqrt{13}}{6}, 0\right)$$

83. (B) Given $y = e^x (a \cos x + b \sin x)$

$$\frac{dy}{dx} = e^x (-a \sin x + b \cos x) + e^x (a \cos x + b \sin x)$$

$$= e^x (-a \sin x + b \cos x) + y$$

$$\frac{d^2y}{dx^2} = e^x (-a \cos x - b \sin x) + e^x (-a \sin x + b \sin x) + \frac{dy}{dx}$$

$$= -y + \frac{dy}{dx} - y + \frac{dy}{dx}$$

$$= 2\frac{dy}{dx} - 2y$$

$$\therefore \quad \frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = 0$$

84. (C)

85. (A) Put $x^2 + 1 = t$

$$2x\,dx = dt$$

$$\therefore \quad x\,dx = \frac{1}{2}dt$$

Now given integration $= \frac{1}{2}\int \frac{1}{t}\,dt = \frac{1}{2}\log t$

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

86. (A) 87. (B)

88. (A) $F(x) = \frac{a^x}{\log a} + k$

$$\Rightarrow F(a) = \frac{a^a}{\log a} + k$$

$$\Rightarrow k = \frac{1}{\log a} - \frac{a^a}{\log a}$$

$$\therefore F(a) = \frac{a^x}{\log a} + \frac{1}{\log a} - \frac{a^a}{\log a}.$$

89. (B) $I = \frac{1}{\sqrt{2}} \int \frac{dx}{\sqrt{\left(x + \frac{3}{4}\right)^2 + \left(\frac{\sqrt{23}}{4}\right)^2}}$

$$= \frac{1}{\sqrt{2}} \sinh^{-1} \frac{x + \frac{3}{4}}{\frac{\sqrt{23}}{4}}$$

$$\left(\because \int \frac{dx}{\sqrt{x^2 + a^2}} = \sin h^{-1} \frac{x}{a} \right)$$

$$= \frac{1}{\sqrt{2}} \sinh^{-1} \frac{4x + 3}{\sqrt{23}}$$

90. (A) $I = \int_{\log a}^{\log b} t\,dt$, where $\log x = t, \frac{1}{x}dx = dt$

$$= \left(\frac{t^2}{2}\right)_{\log a}^{\log b}$$

$$= \frac{(\log b)^2 - (\log a)^2}{2}$$

$$= \frac{1}{2}\left[\log \frac{b}{a} \cdot \log ab\right]$$

$$= \log \frac{b}{a} \cdot \log \sqrt{ab}$$

91. (B) $I = \int_{-1}^{0} \frac{-x}{x}\,dx + \int_{0}^{1} \frac{x}{x}\,dx$

$$= \int_{-1}^{0} -dx + \int_{0}^{1} dx$$

$$= (-x)_{-1}^{0} + (x)_{0}^{1}$$

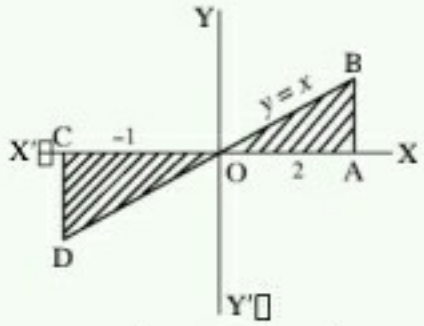
$$= -0 - (1) + (1 - 0)$$

$$= 0$$

92. (A)

93. (A) Area $= \int_{x=-1}^{x=2} y\,dx = \int_{-1}^{0} y\,dx + \int_{0}^{2} y\,dx$

(See figure)



$$= \int_{-1}^{0} (-y)\,dx + \int_{0}^{2} x\,dx$$

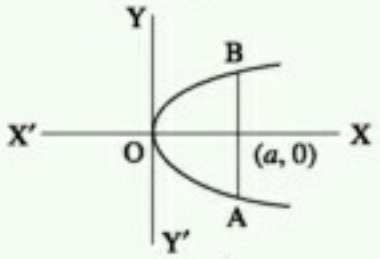
$$= \int_{-1}^{0} -x\,dx + \int_{0}^{2} x\,dx$$

$$= -\frac{1}{2}(x^2)_{-1}^{0} + \frac{1}{2}(x^2)_{0}^{2}$$

$$= -\frac{1}{2}(0-1)+\frac{1}{2}(4-0)$$

$$= \frac{1}{2}+2=\frac{5}{2}$$

94. (B) Area OAB $= 2\int_0^a y\,dx$ (See figure)



$$= 2\int_0^a \sqrt{4ax}\,dx$$

95. (B)

96. (C) $\frac{1}{3}3\int \frac{x^3\cdot x^2\,dx}{\sqrt{1+x^3}}$ · Put $1+x^3=t$, $3x^2\,dx=dt$

$$\frac{1}{3}\int\frac{(t-1)\,dt}{\sqrt{t}} = \int t^{1/2}\,dt-\int t^{-1/2}\,dt$$

$$= \frac{1}{3}\left[\frac{2}{3}t^{3/2}-2t^{1/2}+c\right]$$

$$= \frac{2}{9}(1+x^3)^{3/2}-\frac{2}{3}(1+x^3)^{1/2}+c$$

97. (A)

98. (A) $a, b, c, d \rightarrow$ in A.P.

$\frac{a}{abcd}, \frac{b}{abcd}, \frac{c}{abcd}, \frac{d}{abcd} \rightarrow$ in A.P.

$\frac{1}{bcd}, \frac{1}{acd}, \frac{1}{abd}, \frac{1}{abc} \rightarrow$ in A.P.

So, $bcd, acd, abd, abc \rightarrow$ in H.P.

Hence abc, abd, acd, bcd are in H.P.

99. (B) Given differential equation is

$$\frac{1+x^2}{x}\,dx+dy = 0$$

Integrating, we get

$$\log x+\frac{x^2}{2}+y = c$$

100. (D) The relation R in the set of integers given by R is an equivalence relation.

101. (A)

102. (D) $\sum_{r=0}^{n} C(n,r) = {}^nC_0+{}^nC_1+{}^nC_2+{}^nC_3$

$$+\ldots\ldots+{}^nC_n$$

Using Binomial theorem

$${}^nC_0x^n+{}^nC_1x^{n-1}\cdot a+{}^nC_2x^{n-2}\cdot a^2+\ldots\ldots$$

$$+{}^nC_n\,a^n$$

$$= (x+a)^n$$

So, $\sum_{r=0}^{n}(n,r) = (1+1)^n = 2^n$

103. (B)

104. (D) $f(x) = x^2+3|x|+2=0$

$x>0$, then

If $f(x) = x^2+3x+2=0$

$x = -1, -2$

If $x<0$, then,

$f(x) = x^2-3x+2=0$

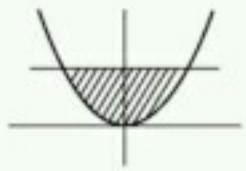
$x = 1, 2$

So equation $f(x)$ has no real root.

105. (C) 106. (B)

107. (C) Area of parabola

$$= 2\int_{-1}^{1} y\,dx$$



$$= 2\int_{-1}^{1} x^2\,dx = 2\left[\frac{x^3}{3}\right]_{-1}^{1}$$

$$= \frac{2}{3}[1^3-(-1)^3]$$

$$= \frac{2}{3}[2]=\frac{4}{3}\text{ sq. units}$$

108. (C)

109. (C) $\lim_{x\to 0}\frac{\sin 2x+4x}{2x+\sin 4x} = \lim_{x\to 0}\frac{\frac{\sin 2x}{2x}+\frac{4x}{2x}}{\frac{2x}{2x}+\frac{\sin 4x}{2x}}$

$$= \frac{1+2}{1+2}=\frac{3}{3}=1$$

110. (A) Work done $= (\hat{i}+2\hat{j}-3\hat{k})\cdot(-\hat{i}-\hat{j}-2\hat{k})$

$$= -1-2+6$$

$$= 3\text{ units}$$

111. (A) For maximum value of the function—

$$\frac{df(x)}{dx} = 0$$

$$\frac{d}{dx}(x^3+2x^2-4x+6) = 0$$

$$3x^2+4x-4 = 0$$

$$3x(x+2)-2(x+2) = 0$$

$$(x+2)(3x-2) = 0$$

$$x = -2, \frac{2}{3}$$

112. (A) If θ is the angle between them

$$\cos\theta = \frac{1\cdot 2+3(-4)+2\cdot(1)}{\sqrt{1+9+4}\sqrt{4+16+1}}$$

$$= \frac{8}{\sqrt{14}\sqrt{21}}=\frac{8}{\sqrt{294}}$$

$$\sin\theta = \sqrt{1-\cos^2\theta}$$
$$= \sqrt{1-\frac{64}{294}} = \sqrt{\frac{230}{294}}$$
$$= \sqrt{\frac{115}{147}}$$

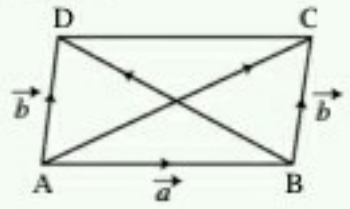
113. (B) Let O$(2\hat{i}-\hat{j}+\hat{k})$ and P be $(\hat{i}-2\hat{j}+2\hat{k})$

then $\overrightarrow{OP} = -\hat{i}-\hat{j}+\hat{k}$

Moment about O

$$= (-\hat{i}-\hat{j}+\hat{k}) \times (3\hat{i}+\hat{j}-2\hat{k})$$
$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & -1 & 1 \\ 3 & 1 & -2 \end{vmatrix}$$
$$= \hat{i}+\hat{j}+2\hat{k}$$

114. (D) (1) is obvious



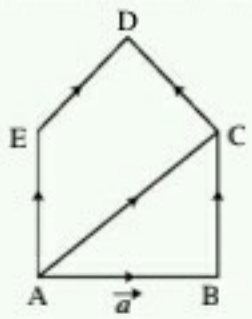
(2) $\overrightarrow{AC} = \vec{a} + \vec{b}$

$\overrightarrow{BD} = \overrightarrow{BA} + \overrightarrow{AD}$

$= \vec{b} - \vec{a}$

(3) is obvious.

(4) Resultant $R = \overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{DC} + \overrightarrow{ED} + \overrightarrow{AE} + \overrightarrow{AC}$



$= (\overrightarrow{AB} + \overrightarrow{BC}) + (\overrightarrow{AE} + \overrightarrow{ED} + \overrightarrow{DC}) + \overrightarrow{AC}$

$= \overrightarrow{AC} + \overrightarrow{AC} + \overrightarrow{AC} = 3\overrightarrow{AC}$

Hence (1), (2), (3), (4) all are true.

115. (D)

116. (D) Frequency Distribution is

Wages in ₹	No. of Workers	Cumulative frequency
11–13	3	3
13–15	4	7
15–17	5	12
17–19	6	18
19–21	5	23
21–23	4	27
23–25	3	30

From frequency distribution frequency y, the class intervals are 13–15, 21–23.

117. (B)

118. (A) $\left(\frac{dy}{dx}\right)^2 + \left(\frac{dy}{dx}\right) - \sin^2 y = 0$

In this highest derivative is $\frac{dy}{dx}$, which is the first derivative of y.

Hence, the order of the given differential equation is 1.

119. (A)

120. (A) Here $n = 8, p = \frac{1}{3}, q = \frac{2}{3}$

$$P(x=3) = {}^8C_3\, p^3\, q^{8-3}$$
$$= {}^8C_3\left(\frac{1}{3}\right)^3\left(\frac{2}{3}\right)^5$$
$$= \frac{8\times7\times6}{6}\times\frac{1}{27}\times\frac{32}{27\times9}$$
$$= \frac{56\times32}{27\times27\times9}$$
$$= \frac{56\times32}{243\times27}.$$

Paper-II

General Ability Test

Part : A

SPOTTING ERRORS

(Items 1 to 6)

Directions—(i) In this section six sentences are given. Each sentence has three underlined parts, indicated by (A), (B) and (C). Read each sentence to find out whether there is an error. If you find an error in any one of the underlined parts (A, B, C), indicate your response by blackening the letter related to that part in the Answer Sheet provided. If a sentence has no error, indicate this by blackening 'D' which stands for "No error".

(ii) Errors may be in grammar, appropriate word usage or idioms. Examples P and Q have been solved for you.

P. My friend and myself (A) study together (B) during holidays. (C) No error. (D)

Q. The rice from Dehradun is (A) / more superior (B) / to that of Saharanpur. (C) / No error. (D)

Explanation—The correct answer for P is letter 'D' because the sentence has no mistake in it. The correct answer for Q is 'B' because the mistake in the sentence is in the part carrying the letter 'B'.

Now attempt items 1 to 6.

1. The pirates who had hidden the treasure (A) / on the island (B) / returned back again because they thought (C) / they could now remove it with safety. (D) / No error.

2. I asked him how far had he come (A) / in his research but he just refused (B) / to give me a straight answer. (C) / No error. (D)

3. It is alleged that the number of athletes (A) / taking performance-boosting drugs (B) / are on the rise. (C) / No error (D)

4. A good statesman, like any other sensible (A) / human being, (B) / always learns more from his opponents (C) / than from his fervent supporters. (D) / No error.

5. They informed him that (A) / he will have to pay the bill (B) / when the goods arrived. (C) / No error. (D)

6. When I reminded of the mistake (A) / I had made (B) / I was struck with a deep sense of remorse. (C) / No error. (D)

SENTENCE IMPROVEMENT

(Items 7 to 12)

Directions—Look at the **bold** part of each sentence. Below each sentence are given three possible substitutions for the bold part. If one of them (A), (B) or (C) is better than the bold 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). Examples R and S have been solved for you.

R. The young child **sung a** very sweet song.
(A) singed the (B) singed
(C) sang a (D) No improvement

S. **I have already read this book twice.**
(A) I already twice have read this book
(B) I twice have already read this book
(C) I have twice already read this book
(D) No improvement

Explanation—For item R, the correct sentence should read, "The young child sang a very sweet song." 'C' is, therefore, the correct answer.

Item S is a correct sentence. None of the changes suggested will improve it. 'D' is, therefore, the correct answer.

Errors may be in grammar, appropriate word usage or idioms. There may be a necessary word missing or there may be a word which should be removed.

Now attempt items 7 to 12.

7. Unless you stop **to interfere** in the matter, I'll go away.
(A) by interfering (B) from interfering
(C) interfering (D) No improvement

8. **I have been knocking** at the door five times; I don't think anybody is in.
(A) am knocking (B) had been knocking
(C) have knocked (D) No improvement

9. **Supposing if he fails** again, will he be able to hold his head high ?
(A) Suppose he fails
(B) Suppose if he fails
(C) Supposing he will fail
(D) No improvement

10. The jury could not arrive at any decision **in the strength of** scanty evidence.
    (A) with the strength of
    (B) on the strength of
    (C) on strength with
    (D) No improvement

11. They will come if you **will invite** them.
    (A) would invite (B) invite
    (C) did invite (D) No improvement

12. A man's modesty is **in inverse proportion with** his ignorance.
    (A) with inverse proportion to
    (B) in inverse proportion to
    (C) at inverse proportion with
    (D) No improvement

SYNONYMS

(Items 13 to 17)

Directions—In this section you find a number of sentences, parts of which are **bold.** You may also find only a group of words which is bold. For each bold part, four words/phrases are listed below. Choose the word/phrase nearest in meaning to the bold part and blacken the corresponding space on the Answer Sheet.

Example 'E' is solved for you.

E. His style is quite **transparent.**
    (A) verbose (B) involved
    (C) lucid (D) witty

Explanation—In item 'E' the word 'lucid' is nearest in meaning to the word 'transparent'. So 'C' is the correct answer.

Now attempt items 13 to 17.

13. The striking labourers attempted to **intimdate** the loyal and dutiful labourers.
    (A) persuade (B) attack
    (C) inform (D) threaten

14. Sohrab **parried** the blow aimed at him by Rustum.
    (A) evaded (B) opposed
    (C) defied (D) spared

15. He has been **exonerated** by the court.
    (A) forgiven
    (B) suspended
    (C) declared innocent
    (D) warned

16. The teacher **reiterated** his statement.
    (A) contradicted (B) disputed
    (C) repeated (D) elaborated

17. We agreed to have the Town Hall as the **rendezvous** for all the scout-troops.
    (A) assembly (B) camping ground
    (C) picnic spot (D) meeting place

ANTONYMS

(Items 18 to 22)

Directions—In this section each item consists of a word or a phrase which is **bold** in the sentence given. It is followed by four words or phrases. Select the word or phrase which is closest in meaning to the opposite of the bold word or phrase.

Example "F" has been solved for you.

F. Lucy is a **smart** girl.
    (A) lazy (B) active
    (C) indecent (D) casual

Explanation—The word 'lazy' is nearest in meaning to the opposite of the word 'smart'. So 'A' is the correct answer.

Now attempt items 18 to 22.

18. His behaviour was **reprehensible.**
    (A) admirable
    (B) comprehensible
    (C) responsible
    (D) representative

19. The expression on his face clearly showed that his mother's condition had **deteriorated.**
    (A) aggravated (B) improved
    (C) worsened (D) changed

20. The pupils of your eyes **dilate** when you enter a dark room.
    (A) distend (B) contract
    (C) blink (D) stretch

21. A feeling of stillness, almost of **ecstasy,** came over Miriam.
    (A) grief (B) bereavement
    (C) sorrow (D) agony

22. The recommendation was **discarded.**
    (A) highlighted (B) forwarded
    (C) elaborated (D) accepted

COMPREHENSION

(Items 23 to 34)

Directions—In this section you have four short passages. After each passage you will find several questions based on the passage. First, read Passage I and answer the questions based on it. Then go on to the other passages.

Examples 'I' and 'J' are solved for you.

PASSAGE

In our approach to life, be it pragmatic or otherwise, a basic fact that confronts us squarely and unmistakenly is the desire for peace, security and happiness. Different forms of life at different levels of existence make up the teeming denizens of this earth of ours. And, no matter whether they belong to the higher groups such as human beings or to the lower groups such as animals, all beings primarily seek peace, comfort and security. Life is as dear to a mute creature as it is to a man. Even the

lowliest insect strives for protection against dangers that threaten its life. Just as each one of us wants to live and not to die, so do all other creatures.

I. The author's main point is that—
   (A) different forms of life are found on earth
   (B) different levels of existence are possible in nature
   (C) peace and security are the chief goals of all living beings
   (D) even the weakest creature struggles to preserve its life

J. Which one of the following assumptions or steps is essential in developing the author's position ?
   (A) All forms of life have a single over-riding goal
   (B) The will to survive of a creature is identified with a desire for peace
   (C) All beings are divided into higher and lower groups
   (D) A parallel is drawn between happiness and life, and pain and death

Explanation—

I. The idea which represents the author's main point is 'peace and security are the chief goals of all living beings', which is response (C). So 'C' is the correct answer.

J. The best assumption underlying the passage is 'The will to survive of a creature is identified with a desire for peace', which is response (B). So 'B' is the correct answer.

Now attempt items 23 to 34.

PASSAGE I

(Items 23 to 25)

Ants seem to be able to do everything but think. When an individual ant is subjected to any kind of intelligence test it generally comes out of it rather badly. An ant has very little individuality and is not beset by any anti-social urges or desires as men and women so often are; there are no counterparts of police in an ant's nest because there would be nothing for them to do. Any food an ant finds is shared, and it will unhesitatingly sacrifice its life if the nest is threatened. All the work it does is done for the community. The amazing industry and selflessness of ants has excited the admiration of man since the time of Solomon.

23. The individual ant generally comes out of the intelligence test badly because—
   (A) it is not used to tests
   (B) it is bad at taking tests
   (C) it is not equipped to think
   (D) it has examination fear

24. There is no police in an ant's nest because—
   (A) they are friendly creatures by nature
   (B) they never harm other ants, or create problems
   (C) they do nothing at all, all day long
   (D) they are harmful creatures

25. Ants are different from the human beings because unlike the human beings they—
   (A) are peace loving and generous
   (B) have minds of their own
   (C) are anti-social
   (D) have their own industries

PASSAGE II

(Items 26 to 28)

The first spectacles in England were highly ridiculed. Physicians scorned them and feared them, and stuck to their eye-ointments and lotions. The clergy violently opposed them, saying it was impertinent defiance against the hand of God to try to restore failing sight. But the fame of spectacles spread, partly because of the ridiculous caricatures of the artist William Hogarth. Pantaloon, the comic old man of Italian folk drama, often wore spectacles. Gradually, of course, people needing visual aid tried them and the spectacles themselves won out over opposition and ridicule.

26. The passage states that the first spectacles in England were—
   (A) greatly admired (B) greatly made fun of
   (C) deeply loved (D) highly respected

27. The fame of the spectacles spread partly because—
   (A) the clergy made fun of them
   (B) the Italian folk used them
   (C) the artist William Hogarth caricatured them
   (D) the physicians scorned them

28. The clergy opposed the use of spectacles because—
   (A) William Hogarth made fun of them
   (B) the physicians scorned them
   (C) the clergy wanted people to go blind
   (D) they were not created by God

PASSAGE III

(Items 29 to 31)

A wounded dolphin must be handled with great care. Its tender skin, as fragile as wet paper, must be protected from drying out–on this occasion with ordinary cooking oil. The animal must be kept wet and cool, or it will literally die under its own weight. Once the dolphin is removed from the water, its body weight is its enemy. Its fins can get crushed under its own weight.

29. The skin of the dolphin is—
   (A) thick and rough (B) soft and delicate
   (C) dry and rugged (D) hard and durable

30. A dolphin stranded on land suffers most because of—
   (A) the men who hurt it
   (B) the birds of prey
   (C) its own weight
   (D) injuries

31. The best way to help a wounded dolphin is to—
    (A) rub oil on its body
    (B) take it to a doctor
    (C) dry its skin immediately
    (D) unfold its fins

PASSAGE IV

(Items 32 to 34)

Each novel is a world by itself. It deals with the characters of varied types and temperaments. As a reader goes through the pages of a novel, he feels that he is moving on a familiar ground. When one reads the novels of Sarat Chandra or Premchand, one feels that one is moving about the villages of India. The writers like Shivshankar Pillai, Pannalal Patel and Birendra Kumar Bhattacharya can take their readers to the hard but compassionate world. Similarly, Walter Scott and Bankim Chandra bring a reader face to face with the gorgeous realities of history.

32. Each novel constitutes a world by itself because—
    (A) it tells us a long story
    (B) different men and women inhabit it
    (C) it tells stories about villages
    (D) it teaches us history

33. When a reader goes through the pages of a novel—
    (A) he feels that he is moving on a known ground
    (B) he develops a sort of imaginary excursion
    (C) he has a feelling of nostalgia
    (D) he feels that he is restricted to a familiar ground

34. The author is of the opinion that—
    (A) novel reading is a great pleasure
    (B) the novel today is the most popular form of literature
    (C) Walter Scott and Bankim Chandra are great novelists
    (D) only Walter Scott could expose the reality of history

ORDERING OF WORDS IN A SENTENCE

(Items 35 to 39)

Directions—In each of the items 35-39, there is a sentence of which some parts have been jumbled up. You are required to re-arrange these parts which are labelled P, Q, R and S to produce the correct sentence. Choose the proper sequence and mark in your Answer Sheet accordingly.

Example—

Z. It is well-known that
    P. the effect Q. is very bad
    R. on children S. of cinema
    The proper sequence should be—
    (A) P S R Q (B) S P Q R
    (C) S R P Q (D) Q S R P

Explanation—The proper way of writing the sentence is "It is well-known that the effect of cinema on children is very bad." This is indicated by the sequence P S R Q and so 'A' is the correct answer.

Now attempt items 35 to 39.

35. On seeing the tiger,
    P. the lamb
    Q. began to cry
    R. which had lost its mother
    S. and tried to run away.
    The proper sequence should be—
    (A) P Q R S (B) P R Q S
    (C) P Q S R (D) P R S Q

36. Her mother
    P. when she was at school
    Q. often failed to pay Madhu's fees
    R. who died at an early age
    S. after the death of the father.
    The proper sequence should be—
    (A) Q S R P (B) S R P Q
    (C) S R Q P (D) Q P S R

37. I told my friend
    P. on the first of April
    Q. that I was going to Germany
    R. whom I met at Nagpur
    S. at a Conference in January.
    The proper sequence should be—
    (A) Q S R P (B) R S Q P
    (C) R P Q S (D) Q P R S

38. A magician
    P. failed to satisfy the students
    Q. who was invited to the college
    R. the old tricks to them
    S. when he showed.
    The proper sequence should be—
    (A) Q S R P (B) S P R Q
    (C) S R P Q (D) Q P S R

39. The primitive people
    P. that all natural events
    Q. who believed
    R. were ignorant of the physical world
    S. were caused by some power.
    The proper sequence should be—
    (A) Q R P S (B) R P Q S
    (C) Q P S R (D) R Q P S

RECONSTRUCTING PASSAGE

(Items 40 to 44)

Directions—In items 40 to 44, there are six sentences marked S_1, S_6, P, Q, R, S. The positions of S_1 and S_6 are fixed as the first and last sentences of the passage. You are required to choose one of the four alternatives given below every passage which would be the most logical sequence of the sentences in the passage.

Mark your response on the Answer Sheet at the appropriate space.

Example X has been solved for you.

Example X—

S_1 A poor peasant went off early one morning to plough, taking with him for his breakfast a piece of bread.

S_6 He lifted the coat, but the bread was gone!

P. After a while, when his horse was tired and he was hungry, the peasant stopped ploughing.

Q. He hid it under a bush and started work.

R. He went to get his coat and his breakfast.

S. He got his plough ready and put his coat round the bread.

The proper sequence should be—

(A) S Q P R (B) Q P R S

(C) P R S Q (D) R S Q P

Explanation—The proper sequence in this example is : S Q P R which is marked (A). Therefore 'A' is the correct answer.

Now attempt items 40 to 44.

40. S_1 I stood staring into the pit.

S_6 At the sound of birds overhead, I looked up at the huge Fighting Machine that would fight no more.

P. Across on the other side of the pit, huge and strange, lay a great Flying Machine.

Q. The huge engines, so great and wonderful in their power, so unearthly in their shapes, rose out of the shadows.

R. They must have been experimenting with this when decay and death stopped them.

S. A crowd of dogs fought over the bodies that lay in the depth of the pit, far below me.

The proper sequence should be—

(A) Q S P R (B) Q R S P

(C) P Q S R (D) P R Q S

41. S_1 A superstition is a belief people hold which is not based on reason.

S_6 In this way, they feel they will avoid bad luck.

P. People believe that they can bring themselves good luck by acting in certain ways.

Q. When some people spill salt they immediately take some of it and throw it over their left shoulder.

R. These beliefs often go against the laws of nature as we know them.

S. An example of this involves salt.

The proper sequence should be—

(A) R S Q P (B) P R S Q

(C) R P S Q (D) P S Q R

42. S_1 There is a widespread assumption that work gets harder after 40.

S_6 But you must have done the right things before that milestone birthday.

P. The responsibilities may be heavier but now you are judged for your experience.

Q. But in most places work gets dramatically easier after 40.

R. Most of the major rewards of success tend to accumulate after the age of 40.

S. Of course, a few things do get harder, like getting up in the morning without any pain or ache.

The proper sequence should be—

(A) P S R Q (B) S Q P R

(C) S P Q R (D) P R Q S

43. S_1 One day Phatik lost his lesson-book.

S_6 Even his cousins were ashamed to own him.

P. His condition became miserable.

Q. Even with the help of books he had found it difficult to prepare his lesson.

R. The teacher would cane him mercilessly.

S. Now it was impossible.

The proper sequence should be—

(A) P R Q S (B) P S R Q

(C) Q S R P (D) Q P R S

44. S_1 One day he stole a piece of gold.

S_6 His father read the confession and then tore up the paper without saying a word.

P. Stealing was a great sin.

Q. He wrote a confession of his crime and handed the paper to his father who was ill at that time.

R. He decided never in his life to steal again.

S. He knew that he had committed a great crime.

The proper sequence should be—

(A) P R S Q (B) P S R Q

(C) R Q S P (D) R Q P S

SELECTING WORDS
(Items 45 to 50)

Directions—In the following sentences, at certain points you are given a choice of three words—one of which is most appropriate. 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. The river has been.....all night.

(A) rising (B) raising

(C) arising

L. We built the raft.....to hold us.

(A) too strong (B) very strong

(C) strong enough

Explanation—Out of the list given in 'K' only 'rising' is the correct answer because a river cannot be raised, it rises on its own. So 'A' is the correct answer for item 'K'. For item 'L', 'C' is the correct answer. In order to solve these items you have to first read the whole passage and then decide what the most appropriate word is.

Now attempt items 45 to 50.

The British lived in India for nearly a hundred and fifty years but they remained foreigners to the last, unlike all other foreign people who had come to India before.

45. .....took for themselves everything they
(A) Many (B) They
(C) Some

46. .....get from our land and
(A) could (B) would
(C) can

47. .....people, leaving the country in a
(A) poor (B) our
(C) their

48. .....and more miserable condition than
(A) wretched (B) poorer
(C) richer

49. .....had ever been before. How
(A) it (B) we
(C) they

50. .....we allow this to happen ?
(A) can (B) should
(C) did

Part : B

51. Which one of the following statements is correct ?
(A) All chordates are vertebrates, but all vertebrates are not chordates.
(B) All chordates are vertebrates and all vertebrates are also chordates.
(C) All vertebrates are chordates, but all chordates are not vertebrates.
(D) All invertebrates are chordates, but all vertebrates are not chordates.

52. If an organism is treated with a chemical that destroys the spindle, then which one of the following events will follow ?
(A) Cytokinesis will go on, but karyokinesis will stop.
(B) Karyokinesis will go on, but cytokinesis will stop.
(C) Neither karyokinesis nor cytokinesis will stop.
(D) Along with the spindle, the chromosomes will also disintegrate.

53. Match List-I with List-II and select the correct answer using the codes given below the Lists—

	List-I *(Diseases)*	**List-II** *(Crops)*
(a)	Black heart	1. Peas
(b)	Red rot	2. Wheat
(c)	Karnal bunt	3. Sugarcane
(d)	Powdery mildew	4. Potatoes

	(a)	(b)	(c)	(d)
(A)	4	2	3	1
(B)	4	3	2	1
(C)	1	2	3	4
(D)	1	3	2	4

54. The following layers are found in the structure of the eye—
1. Conjunctiva 2. Choroid
3. Retina 4. Sclerotic
The correct sequence of these layers from outer to inner layers is—
(A) 4, 1, 3, 2 (B) 4, 1, 2, 3
(C) 1, 4, 2, 3 (D) 1, 4, 3, 2

55. Mitochondria are called 'Power Houses' of the cell because—
(A) Mitochondria store ATP
(B) Mitochondria store high energy compounds such as glucose, proteins etc.
(C) Enzymatic reactions take place in the mitochondria leading to the production and storage of ATP
(D) ATP breakdown takes place in mitochondria

56. The age of a tree can be determined by—
(A) Measuring its height
(B) Measuring its diameter
(C) Analysing its sap
(D) Counting the annual growth rings of its stem

57. Match List-I with List-II and select the correct answer using the codes given below the Lists—

	List-I	**List-II**
(a)	Running water ecosystem	1. Typha
(b)	Pond ecosystem	2. Hydrilla
(c)	Amphibian plant	3. Lotic
(d)	Submerged plant	4. Lentic

	(a)	(b)	(c)	(d)
(A)	3	1	2	4
(B)	3	4	1	2
(C)	4	3	1	2
(D)	4	3	2	1

58. Consider the following pairs—
1. Robert Koch...Anthrax bacterium
2. Edward Jenner...Vaccine
3. Pasteur...Rabies
4. Emil von Behring...Passive immunity

Which of these pairs is/are correctly matched ?

(A) 1 alone (B) 2, 3 and 4

(C) 1, 2 and 4 (D) 1, 2, 3 and 4

59. Which one of the following diseases is NOT prevalent in India ?

(A) Hepatitis (B) Fluorosis

(C) Yellow fever (D) Meningitis

60. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R) :

Assertion (A) : The wood produced by gymnosperms is commercially known as 'Softwood'.

Reason (R) : The wood of gymnosperms is soft in nature.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not a correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

61. Consider the following :

1. Samhitas 2. Brahmanas

3. Aranyakas 4. Upanishads

Which of these formed a part of the Vedas ?

(A) 1, 2 and 3 (B) 1, 2 and 4

(C) 1, 3 and 4 (D) 2, 3 and 4

62. Consider the following events :

1. Civil Disobedience Movement
2. Nehru Report
3. Communal Award

The correct chronological sequence of these events is—

(A) 2, 1, 3 (B) 1, 3, 2

(C) 3, 2, 1 (D) 2, 3, 1

63. Eminent lawyers in the INA Defence Committee included—

(A) Bhulabhai Desai, Tej Bahadur Sapru and Pandit Nehru

(B) Tej Bahadur Sapru, Kailashnath Katju and Pandit Nehru

(C) Bhulabhai Desai, Pandit Nehru and M. A. Jinnah

(D) Asaf Ali, Tej Bahadur Sapru and Pandit Nehru

64. Who was called the pioneer of the Panchayati Raj for introducing local self-government in British India ?

(A) Warren Hastings

(B) Lord William Bentinck

(C) Lord Canning

(D) Lord Ripon

65. Which one of the following was greatest contribution of Alauddin Khalji in the field of Agrarian administration ?

(A) He brought the peasant in direct relation with the state.

(B) He tried to curb and control the intermediaries.

(C) He was the first to introduce the system of measurement of land for the assessment of revenue.

(D) The records of the village accountant were audited.

66. The traveller from the west who visited the Bahmani Kingdom in 1417 was—

(A) Marco Polo (B) Nicolo Conti

(C) Afnasius Nikitin (D) Ibn Batuta

67. Who was the founder of the first *Sufi* order in India ?

(A) Khwaja Qutab-ud-din Bakhtiar Kaki

(B) Shaikh Nizam-ud-din Auliya

(C) Khwaja Muinud-din-Chisti

(D) Shaikh Nasir-ud-din Mahmud

68. The founder of the Vikramsila University was—

(A) Devapala (B) Harshavardhana

(C) Sasanka (D) Dharmapala

69. Who is referred to in the following statement ?

"Contrary to the existing notions, he suggested that the earth revolves around the sun and rotates on its axis."

(A) Aryabhatta (B) Brahmagupta

(C) Bhaskara (D) None of these

70. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R) :

Assertion (A) : The Saka era is reckoned from A. D. 78.

Reason (R) : Kanishka founded the Mahayana sect in A.D. 78.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not a correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

71. Which one of the following is essentially a solo dance ?

(A) Kuchipudi (B) Kathak

(C) Manipuri (D) Mohiniattam

72. In which one of the following languages is the *Dalit* writing more conspicuous ?

(A) Punjabi (B) Assamese

(C) Marathi (D) Odiya

73. Which one of the following statements about Panchayati Raj is correct ?
    (A) Balwant Rai Mehta Committee Report recommended a two-tier set-up.
    (B) Elections to Panchayati Raj institutions was made compulsory under the Fundamental Rights of the Constitution of India.
    (C) 'Empowering people for prosperity' is the guiding principle of the Seventy-third Constitutional Amendment.
    (D) The main difficulty faced by Panchayati Raj institutions is the inadequate participation by women and weaker sections.

74. The slogan "No taxation without representation" was raised during—
    (A) American War of Independence
    (B) Russian Revolution
    (C) French Revolution
    (D) Indian Freedom Struggle

75. SIMBEX-17 is being organized from 18th to 24th May, 2017 between navies of Singapore and India in—
    (A) Indian Ocean (B) Bay of Bengal
    (C) South China Sea (D) Arab Sea

76. 'Dronacharya Award' is given to—
    (A) Sports coaches
    (B) The archers
    (C) Outstanding contribution to Indian literature
    (D) The sportsmen/sportswomen for their individual performance

77. India recently test fired a surface-to-air missile 'Spyder'. What does the word 'spyder' stand for ?
    (A) Surface-to-air PYthon and DERby
    (B) Surface-to-air PAnther and DERby
    (C) Surface-to-air PYthon and SPyder
    (D) None of the above

78. GATT is—
    (A) General Association for Trade and Transport
    (B) General Agreement for Trade and Transport
    (C) General Agreement on Tariffs and Trade
    (D) None of the above

79. Deep Blue Black box is connected with—
    (A) Computer science (B) Medical science
    (C) Space science (D) Aircraft industry

80. In the nineteenth century, the people of Europe started moving from the villages to cities due to the impact of—
    (A) Epidemics
    (B) War
    (C) Industrialisation
    (D) Population explosion in villages

81. Consider the following statements about Agni-III—
    1. It is a surface-to-surface missile and its range is more than 3,000 km.
    2. It is a two-stage missile and is capable of carrying 1·5 tons of warheads with itself.
    3. It has been deployed in the Armed Forces.
    4. Its successful test was done by Indian Navy.
    Choose the correct option from the codes given below—
    Codes :
    (A) Only 1 and 2
    (B) Only 1, 2 and 4
    (C) Only 1, 2 and 3
    (D) All of the above

82. The important cause of Civil War in America was—
    (A) Abolition of slavery
    (B) Quest for freedom
    (C) Industrialisation
    (D) Rebelion by the native Americans

83. According to the Law Commission's re-commendations regarding election reforms, the increased seats in Lok Sabha can be filled by—
    (A) Direct election
    (B) Indirect election
    (C) Proportional representation or list system
    (D) None of the above

84. Industrial Revolution could not have come about without—
    (A) Merchant capitalism
    (B) The Enclosure Movement
    (C) The services of the proletariat class
    (D) An agricultural Revolution

85. Consider the following—
    1. NITI AYOG
    2. National Development Council
    3. Indian Parliament
    4. Finance Commission
    Those associated with the planning process in India include—
    (A) 1 and 2 (B) 1, 2 and 3
    (C) 1 and 4 (D) 3 and 4

86. Consider the following statements—
    The French Revolution came about mainly due to the
    1. Extreme poverty of the people
    2. Impact of the works of great writers
    3. Cruelty of the rulers
    4. Impact of impulsive reaction
    Which of the above statements are correct ?
    (A) 1, 2 and 4 (B) 2 and 3
    (C) 1, 3 and 4 (D) 1, 2, 3 and 4

87. Match List-I with List-II and select the correct answer using the codes given below the Lists—

List-I
(Organisation)

(a) All-India Harijan Sangh
(b) Congress-Khilafat Swaraj Party
(c) Khudai Khitmatgars
(d) Brahmo Samaj

List-II
(Founder)

1. Khan Abdul Ghaffar Khan
2. Raja Ram Mohan Roy
3. Dadabhai Naoroji
4. Motilal Nehru
5. Mahatma Gandhi

	(a)	(b)	(c)	(d)
(A)	5	4	1	2
(B)	4	5	1	2
(C)	3	4	2	1
(D)	5	3	2	1

88. Which army recently tested the Brahmos land attack supersonic cruise missile successfully ?
(A) Indian Army
(B) Indian Navy
(C) Indian Coast Guard
(D) Indian Air Force

89. Consider the following inventions in the textile industry :
1. Spinning Jenny
2. Power-loom
3. Water frame
4. Cotton gin

The correct chronological sequence of these inventions is—
(A) 1, 3, 2, 4 (B) 3, 1, 4, 2
(C) 3, 1, 2, 4 (D) 1, 3, 4, 2

90. Recently between the navies of which of the following countries, joint bilateral naval exercise 'Varun' has been started ?
(A) India and Russia
(B) India and America
(C) India and France
(D) India and Britain

91. Which one of the following is a metamorphic rock ?
(A) Granite (B) Basalt
(C) Marble (D) Sandstone

92. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).

Assertion (A) : The earth's surface moves through alternate periods of day and night.

Reason (R) : The earth rotates on its axis from west to east every 24 hours.

In the context of the above two statements, which one of the following is correct ?
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

93. The tropic of cancer does not pass through—
(A) Gujarat (B) Odisha
(C) Tripura (D) West Bengal

94. Which one of the following statements concerning weathering and erosion is correct ?
(A) Erosion is a static process while weathering is not.
(B) Weathering as a process follows the process of erosion.
(C) Both erosion and weathering are static processes.
(D) Weathering is a static process while erosion is not.

95. International Date line lies on—
(A) Greenwich meridian
(B) 90° East meridian
(C) 90° West meridian
(D) 180° EW meridian

96. The common elements of 'NIFE' layer of the earth include—
(A) Silicon and magnesium
(B) Nickel and iron
(C) Silver and tungsten
(D) Silicon and aluminium

97. The planet with the shortest rotation time around its axis is—
(A) Mars (B) Jupiter
(C) Earth (D) Uranus

98. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I *(Ocean currents)*	**List-II** *(Country)*
(a) Kuroshio	1. Namibia
(b) Gulf-stream	2. Mozambique
(c) Agulhas	3. Australia
(d) Bengucla	4. USA
	5. Japan

	(a)	(b)	(c)	(d)
(A)	4	5	2	3
(B)	5	3	4	1
(C)	1	4	3	2
(D)	5	4	2	1

99. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I	List-II
(a) Troposphere	1. Dust particles
(b) Stratosphere	2. Ozone layer
(c) Ionosphere	3. Meteors
(d) Exosphere	4. Aurora

	(a)	(b)	(c)	(d)
(A)	1	2	4	3
(B)	1	2	3	4
(C)	2	1	4	3
(D)	2	1	3	4

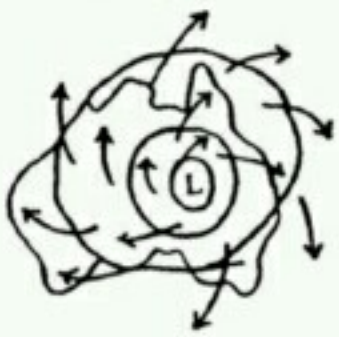
100. All the following are planetary winds *except*—
(A) Trade winds
(B) The westerlies
(C) Polar winds
(D) The Monsoon winds

101. Which one of the following diagrams showing the distribution of pressure and wind direction over Australia is the correct depiction of a *cyclonic condition* ?

(A)


(B)


(C)


(D)


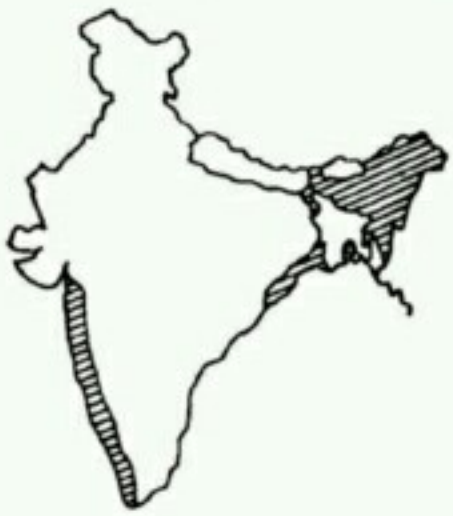
102. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).

Assertion (A) : Regions of mediterranean climate receive rainfall during winter months.

Reason (R) : These regions are exposed to cool, rain-bearing onshore westernly winds in winter.

In the context of the above two statements, which one of the following is correct ?
(A) Both A and R are true and R is the correct explanation of A
(B) Both A and R are true but R is not a correct explanation of A
(C) A is true but R is false
(D) A is false but R is true

103. Which one of the following pairs of cold deserts and continents is correctly matched ?
(A) Atacama—South America
(B) Gobi—Asia
(C) Kalahari—Africa
(D) Great Sandy (Warburton)—Australia

104.


The natural vegetation in the shaded parts shown in the above rough map of India is—
(A) Tropical rain forests
(B) Tropical deciduous forests
(C) Subtropical evergreen forests
(D) Equatorial forests

105. The production of rubber tree is better adapted to areas where the climate is—
(A) Warm and humid
(B) Warm and dry
(C) Cool and moist
(D) Cool and dry

106. 

Sites of four major power plants labelled as 1, 2, 3 and 4 are shown on the above rough map of India. Match the labels with the following names of places :

(a) Bhakara (b) Narora

(c) Rihand (d) Amarkantak

Select the correct answer using the codes given below—

	(a)	(b)	(c)	(d)
(A)	2	1	3	4
(B)	4	3	1	2
(C)	1	2	3	4
(D)	4	1	3	2

107. 

The states labelled 1 and 2 in the above map of India represent areas of—

(A) High and low density of population respectively

(B) High and low total fertility rate respectively

(C) High and low educational attainment of females respectively

(D) High and low urbanization respectively

108. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).

Assertion (A) : India ranks as one of the most populous countries in the world.

Reason (R) : The Ganga plain and coastal areas support a very high density of population.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not a correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

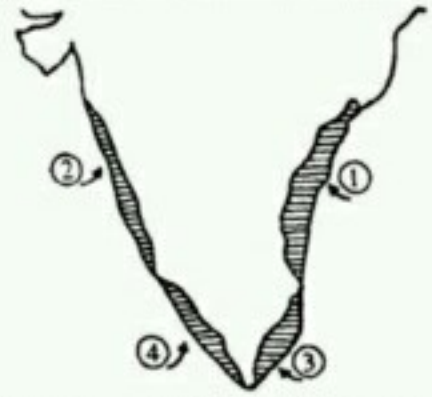
109. Which one of the following is the correct sequence in terms of population size of 4 major cities of India ? (As per census 2011)

(A) Mumbai, Delhi, Chennai, Kolkata

(B) Mumbai, Kolkata, Chennai, Delhi

(C) Kolkata, Mumbai, Delhi, Chennai

(D) Kolkata, Mumbai, Chennai, Delhi

110. 

The four shaded coastal regions shown in the above map and labelled as 1, 2, 3 and 4 are respectively—

(A) Coromandel, Malabar, Konkan and Northern Circars

(B) Northern Circars, Coromandel, Malabar and Konkan

(C) Northern Circars, Konkan, Coromandel and Malabar

(D) Northern Circars, Malabar, Coromandel and Konkan

111. In a system of units, the value of acceleration due to gravity is 1 and the unit of time is 1 second. In this system, length would be—

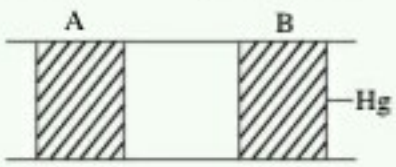
(A) 980 cm (B) $\sqrt{980}$ cm

(C) 98 cm (D) 1 cm

112. 'Thermal' neutrons have energy equal to—

(A) 2·5 eV (B) 0·25 eV

(C) 0·025 eV (D) 0·0025 eV

113. 

A small pellet of mercury is introduced into a capillary tube as shown in the above figure. If, in position A, its length is 1·000 cm while at B it is

1·010 cm, then the variation of radius of the capillary is—

(A) 0·5% (B) 1·0%

(C) 2·01% (D) 4·0%

114. A block of wood floats in water with $\frac{4}{5}$th part under water. If it floats in another liquid with $\frac{9}{10}$th part under water, then the relative density of this liquid will be—

(A) 0·90 (B) 0·89

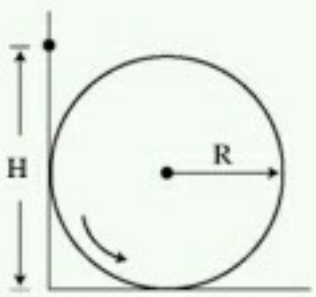
(C) 0·80 (D) 0·79

115. When a load of 1·0 kg is suspended from a 1·0 m long wire, its length increases by 1·0 mm. Its radius would change by—

(A) 1% (B) 2%

(C) 0·1% (D) 0·2%

116.



A small ball is released from a height 'H' (as shown in the above figure) in a vertical circular track so that it loops the inside of the circular track of radius R. The value of 'H' must be at least—

(A) R (B) $\frac{5}{2}$R

(C) $\frac{3}{2}$R (D) $\frac{2}{3}$R

117. A ball of 50 gm is dropped vertically downwards from the top of a 5 metres high tower. If the ball hits the ground and bounces back without any loss of energy, then the impulse of force exerted on the ground will be—

(A) 1 N sec (B) 0·5 N sec

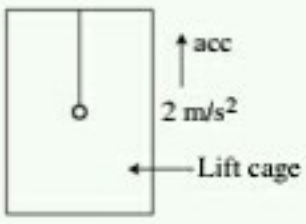
(C) 5×10^{-2} N sec (D) 10 N sec

118. A cylinder and a sphere have the same mass and same radius. The moment of inertia of the cylinder about its longitudinal axis is I_1 and that of the sphere about its diameter is I_2. The ratio I_1/I_2. The ratio I_1/I_2 is—

(A) 5/4 (B) 1

(C) 3/2 (D) 2/3

119.

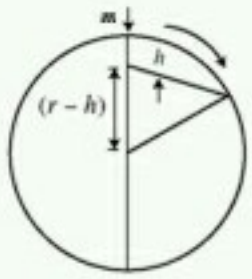


The periodic time of a simple pendulum is 2·0 s in a lab at rest. If it is suspended from the roof of a lift accelerating upwards with an acceleration 2 m/s^2, then its periodic time will be (assume g = 10 m/s^2)—

(A) $\sqrt{40/8}$ s (B) $\sqrt{12/40}$ s

(C) $\sqrt{8/40}$ s (D) $\sqrt{40/12}$ s

120.

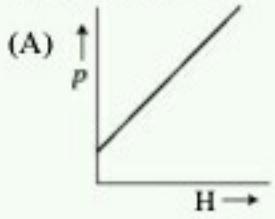


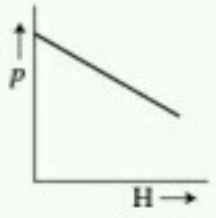
A small mass m starts from rest on the top of a smooth sphere of radius r and slides down as shown in the above figure. It will leave the sphere when h is equal to—

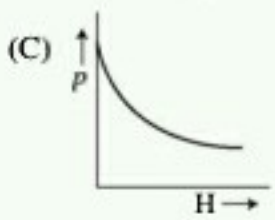
(A) r (B) $r/2$

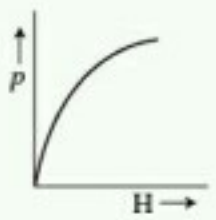
(C) $r/3$ (D) $r/4$

121. If atmospheric pressure (p) is measured at different heights (H) and plotted on a graph, the shape of the curve will be—

(A) 

(B) 

(C) 

(D) 

122. Consider the following properties—

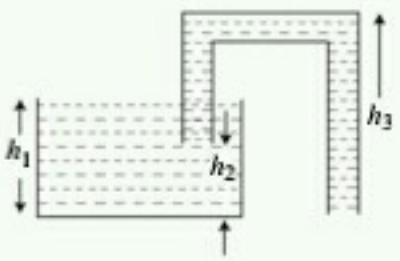
1. Gaseous at room temperature
2. Low latent heat of evaporation
3. Easily liquified by increase in pressure even at room temperature

Important properties of a good refrigerant would include

(A) 1 and 2 (B) 2 and 3

(C) 1 and 3 (D) 1, 2 and 3

123.



A liquid is being siphoned as shown in the above figure. The rate of flow will depend upon—

(A) h_1 and h_2 (B) h_2 and h_3

(C) h_1 alone (D) h_3 alone

124. If a 33 rpm record is played at 78 rpm, the—

(A) Intensity of sound will be different

(B) Pitch of sound will increase

(C) Loudness of sound will change

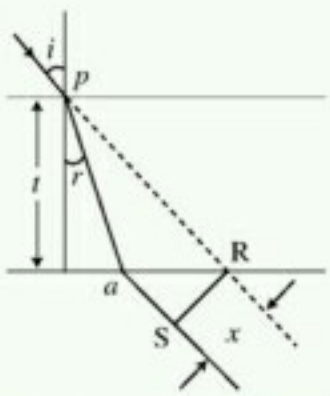
(D) Intensity, pitch and loudness will vary

125. The length of a pipe open at both ends is L_1 and that of another pipe closed at one end is L_2. Both these pipes resonate to the same tuning fork. If it is assumed that both vibrate in their lowest modes, then—

(A) $4L_1 = L_2$ (B) $L_1 = 2L_2$

(C) $2L_1 = L_2$ (D) $L_1 = 4L_2$

126.



A light ray is refracted by a glass plate of thickness t as shown in the above figure. The lateral displacement of the incident ray RS = x is given by—

(A) $\frac{t \sin (i-r)}{\cos i \cos r}$ (B) $(\tan i - \tan r)\, t \cos i$

(C) $\frac{t}{\cos r}$ (D) $t \tan r \sin r$

127. For a microscope, focal length of objective lens is 3·0 cm, focal length of eyepiece is 0·3 cm, the objective is placed at a distance of 3·5 cm from the objective and the least distance of distinct vision is 30 cm. Its magnification is nearly—

(A) 10 (B) 100

(C) 600 (D) 6000

128. If 'I' is the total intensity of earth's magnetic field, 'H' and 'V' are respectively horizontal and vertical components of earth's magnetic field and δ is the angle of dip, then which one of the following sets of relationships is correct ?

(A) $I = H \operatorname{cosec} \delta$

$I = V \sec \delta$

$V = I \cos \delta$

$I = \sqrt{V^2 + H^2}$

$\tan \delta = \frac{H}{V}$

(B) $I = H \sec \delta$

$I = V \operatorname{cosec} \delta$

$I = \sqrt{V^2 + H^2}$

$\tan \delta = \frac{V}{H}$

(C) $H = I \sec \delta$

$V = I \operatorname{cosec} \delta$

$I = \sqrt{\frac{V^2}{\sin^2 \delta} + \frac{H^2}{\cos^2 \delta}}$

$\tan \delta = \frac{H}{V}$

(D) $H = I \operatorname{cosec} \delta$

$V = I \sec \delta$

$I = \sqrt{\frac{V^2}{\cos^2 \delta} + \frac{H^2}{\sin^2 \delta}}$

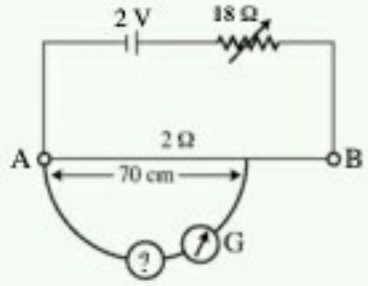
$\tan \delta = \frac{H}{V}$

129. N identical spherical drops charged to the same potential V are combined to form a big drop. The potential of the new drop will be—

(A) V (B) V/N

(C) V × N (D) $V \times N^{2/3}$

130.



For the simple potentiometer shown in the above figure, resistance wire AB is 1·0 m long and its resistance is 2·0 Ω. With a source of unknown e.m.f., the null point is obtained at a point 70 cm from A. The e.m.f. of the source is—

(A) 0·14 V (B) 0·06 V

(C) 0·70 V (D) 0·03 V

131. Three bulbs with power ratings of 40 W, 60 W and 100 W at 220 V are connected in series to a 220 V mains. Energy consumption will be—

(A) The highest for 100 W bulb

(B) The highest for 60 W bulb

(C) The highest for 40 W bulb

(D) The same for all the three bulbs

132. Internal resistance of a 12 volt car battery is 0·02 Ω. What is the theoretical maximum power which it can deliver ?

(A) 1800 W (B) 1200 W

(C) 2400 W (D) 3600 W

133. Consider the following factors :
1. Weight on the lid
2. Area of hole in the lid
3. Temperature of the flame
4. Atmospheric pressure

In a pressure cooker, the temperature at which the food is cooked will depend mainly upon—

(A) 1, 2 and 3 (B) 2, 3 and 4
(C) 1 and 2 (D) 3 and 4

134. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).

Assertion (A) : X-ray tubes have cooling arrangements.

Reason (R) : When high speed electrons hit a metal having high atomic number, all the energy of electrons is converted into X-rays.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

135. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).

Assertion (A) : Solar eclipse occurs once every 18 months.

Reason (R) : The angular diameter of the sun as seen from the earth is the same as the angular diameter of the moon.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not a correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

136. Which one of the following is a polysaccharide ?

(A) Nylon (B) Amylose
(C) Ribose (D) Polyethylene

137. Which one of the following is used as a disinfectant in water treatment ?

(A) Alum
(B) Charcoal
(C) Kieselguhr
(D) Potassium permanganate

138. Consider the following statements :

In the chemical reaction

$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

1. Manganese ion is oxidised
2. Manganese ion is reduced
3. Chloride ion is oxidised
4. Chloride ion is reduced

Which of these statements are correct ?

(A) 1 and 3 (B) 1 and 4
(C) 2 and 3 (D) 2 and 4

139. Which one of the following does not give CO_2 on heating ?

(A) $CaCO_3$ (B) Na_2CO_3
(C) $Ca(HCO_3)_2$ (D) $SrCO_3$

140. A metal when left exposed to the atmosphere for some time, becomes coated with green basic carbonate. The metal in question is—

(A) Copper (B) Nickel
(C) Silver (D) Zinc

141. One gram of a gas occupies 0·16 litres at STP. The molecular weight of the gas is—

(A) 64 (B) 140
(C) 160 (D) 224

142. Which one of the following is the most abundant element in the universe ?

(A) Nitrogen (B) Hydrogen
(C) Oxygen (D) Silicon

143. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I (*Electronic configuration*)	**List-II** (*Species*)
(a) $1s^2$	1. Chlorine
(b) $1s^2\ 2s^2\ 2p^6$	2. Fluoride ion
(c) $1s^2\ 2s^2\ 2p^6\ 3s^2$	3. Hydride ion
(d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$	4. Magnesium

	(a)	(b)	(c)	(d)
(A)	3	2	4	1
(B)	4	2	1	3
(C)	3	4	2	1
(D)	2	3	4	1

144. If 2·0 g of hydrogen on burning in 16·0 g of oxygen forms 16·0 g of water, then which one of the following laws will be isolated ?

(A) Law of conservation of mass
(B) Law of constant composition
(C) Law of multiple proportions
(D) Law of reciprocal proportions

145. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I	**List-II**
(a) Peroxide	1. C_3O_2
(b) Superoxide	2. PbO_2
(c) Dioxide	3. KO_2
(d) Suboxide	4. H_2O_2

	(a)	(b)	(c)	(d)
(A)	4	3	2	1
(B)	3	2	1	4
(C)	4	2	3	1
(D)	4	1	2	3

146. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).

Assertion (A) : pH of hydrochloric acid solution is less than that of acetic acid solution of the same concentration.

Reason (R) : In equimolar solutions, the number of titrable protons present in hydrochloric acid is less than that present in acetic acid.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not a correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

147. The correct sequence in *decreasing* order of the percentage of nitrogen in the given compounds is—

(A) Urea > Ammonium chloride > Ammonium nitrate > Ammonium nitrite

(B) Urea > Ammonium nitrate > Ammonium nitrite > Ammonium chloride

(C) Urea > Ammonium nitrite > Ammonium nitrate > Ammonium chloride

(D) Urea > Ammonium nitrite > Ammonium chloride > Ammonium nitrate

148. Given below are two statements. one labelled as Assertion (A) and the other labelled as Reason (R).

Assertion (A) : The position of an electron can be determined exactly with the help of an electron microscope.

Reason (R) : The product of uncertainty in the measurement of its momentum and the uncertainty in the measurement of its position cannot be less than a finite limit.

In the context of the above two statements, which one of the following is correct ?

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not a correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

149. The equivalent weight of sodium thiosulphate with respect to the reaction

$$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$$

is—

(A) One-fourth of its molecular weight

(B) Half of its molecular weight

(C) Double its molecular weight

(D) The same as its molecular weight

150. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I *(Compound)*	**List-II** *(Oxidation state of N)*
(a) NO_2	1. +5
(b) HNO	2. −3
(c) NH_3	3. +4
(d) N_2O_5	4. +1

	(a)	(b)	(c)	(d)
(A)	2	3	4	1
(B)	3	1	2	4
(C)	3	4	2	1
(D)	2	3	4	1

Answers with Hints

1. (B) We should not use **'back'** after **'returned.'**
2. (A) There should be **'how far he had come.'** In the Indirect Narration the sentence should not be in the Interrogative form.
3. (C) There should be **'is on the rise'**, 'the number' is used in the Singular Number.
4. (D)
5. (B) There should be **'he would have to pay.'**
6. (A) **'reminded myself'** should be used. A Reflexive Pronoun is needed here.
7. (C) 8. (C)
9. (A) **'Suppose'** and **'if'** cannot be used together.
10. (B)
11. (B) The Verb in the Subordinate Clause should be used in the Present Indefinite Tense.
12. (B)
13. (D) **'intimidate'** means **'to threaten.'**
14. (A) **'parried'** means **'to avoid.'**
15. (C) **'exonerated'** means **'to declare innocent.'**
16. (C) 17. (C)
18. (A) **'reprehensible'** means **'liable to be criticised.'**
19. (B)
20. (B) **'dilate'** means **'expand.'** Its opposite is **'contract.'**
21. (A) **'ecstasy'** means **'intense happiness.'**
27. **'caricatured'** means **'to ridicule through cartoons.'**
28. **'spectacles'** means **'looking glasses.'**

22. (D) 23. (C) 24. (B) 25. (A) 26. (B) 27. (C)
28. (D)
29. (B) **'dolphin'** is a kind of fish.
30. (C) 31. (A) 32. (B) 33. (A) 34. (A)

35. (B) The sentence would be—
"On seeing the tiger, the lamb which had lost its mother began to cry and tried to run away."

36. (C) The sentence would be—
"Her mother, after the death of the father who died at an early age, often failed to pay Madhu's fees when she was at school."

37. (B) The sentence would be—
"I told my friend whom I met at Nagpur at a conference in January that I was going to Germany on the first of April."

38. (D) The sentence would be—
"A magician who was invited to the college failed to satisfy the students when he showed the old tricks to them."

39. (C) The sentence would be—
"The primitive people who believed that all natural events were caused by some power were ignorant of the physical world."

40. (B) 41. (C) 42. (B) 43. (B) 44. (B) 45. (A)
46. (A) 47. (B) 48. (B) 49. (C) 50. (A) 51. (C)
52. (A) 53. (B) 54. (C) 55. (C) 56. (D) 57. (B)
58. (D) 59. (C) 60. (C) 61. (A) 62. (A)

63. (A) Eminent lawyers in the INA Defence committee were—Bhulabhai Desai, Tej Bahadur Sapru and and Pandit Jawaharlal Nehru.

64. (D) 65. (A) 66. (C) 67. (C) 68. (D) 69. (A)
70. (C) 71. (D) 72. (C) 73. (C) 74. (A) 75. (C)
76. (A) 77. (A) 78. (C) 79. (A) 80. (C) 81. (C)
82. (A) 83. (C) 84. (A) 85. (B) 86. (A) 87. (A)
88. (B) 89. (A) 90. (C) 91. (C) 92. (A)

93. (B) Tropic of cancer passes through Gujarat, Rajasthan, Madhya Pradesh, Bihar, West Bengal, Tripura and Mizoram.

94. (D) 95. (D) 96. (B) 97. (B) 98. (D) 99. (A)
100. (D) 101. (C) 102. (A) 103. (B) 104. (A) 105. (A)
106. (C) 107. (B) 108. (B) 109. (A) 110. (C)

111. (A) Let the unknown system be C.G.S. wherein g = 980 cm/s^2 and the known system be that given in the question.

$$n_2 = n_1\left[\frac{M_1}{M_2}\right]^a\left[\frac{L_1}{L_2}\right]^b\left[\frac{T_1}{T_2}\right]^c$$

Here $n_2 = 980$ cm/sec^2 and $n_1 = 1$

$T_1 = 1$ sec

$T_2 = 1$ sec

$L_1 = ?$

$L_2 = 1$ cm

Also $g = [M^0LT^{-2}]$

So that $a = 0, b = 1$ and $c = -2$

$$\therefore \quad 980 = 1\left[\frac{M_1}{M_2}\right]^0\left[\frac{L_1}{1\text{ cm}}\right]^1\left[\frac{1}{1}\right]^{-2}$$

$$980 = 1 \times 1 \times L_1 \times 1$$

$$\Rightarrow \quad L_1 = 980 \text{ cm}$$

112. (C)

113. (A) Let r_1 be the radius at A and r_2 the radius at B volume of the pellet will remain the same both at A and B.

$$\pi r_1^2 \times 1 = \pi r_2^2 \times 1{\cdot}010$$

$$\frac{r_2^2}{r_1^2} = \frac{1}{1{\cdot}010} = \frac{100}{101}$$

$$\Rightarrow \quad \frac{r_2}{r_1} = \frac{10}{10{\cdot}05}$$

$$\Rightarrow \quad \frac{r_1 - r_2}{r_1} = \frac{0{\cdot}05}{10{\cdot}05}$$

$$\Rightarrow \quad \frac{r_1 - r_2}{r_1} \times 100\% = \frac{0{\cdot}05}{10{\cdot}05} \times 100\%$$

$$= 0{\cdot}49\%$$

$$= 0{\cdot}5\%$$

114. (B) Wt. of solid = Upthrust of displaced water

$$V \times d_s = \frac{4}{5} V \times 1$$

$$\Rightarrow \quad d_s = 0{\cdot}8$$

Where, V = Volume of solid

d_s = Density of solid

d_l = Density of liquid

Density of water = 1 g/c.c.

Wt. of solid = Upthrust of displaced liquid

$$V \times d_s = \frac{9}{10} V \times d_l$$

$$0{\cdot}8 = \frac{9\, d_l}{10}$$

$$\Rightarrow \quad d_l = \frac{0{\cdot}8 \times 10}{9} = 0{\cdot}89$$

115. (C) Initial volume = Final volume

$$\pi r_1^2 L = \pi r_2^2 (L + l)$$

$$\frac{r_2^2}{r_1^2} = \frac{L}{L + l} = \frac{1}{1 + 0{\cdot}001}$$

$$= \frac{1}{1{\cdot}001}$$

$$\frac{r_2}{r_1} = \frac{1}{1{\cdot}0005}$$

$$1 - \frac{r_2}{r_1} = 1 - \frac{1}{1{\cdot}0005} = \frac{0{\cdot}0005}{1{\cdot}0005}$$

$$\frac{r_1 - r_2}{r_1} \times 100\% = \frac{0{\cdot}0005 \times 100}{1{\cdot}0005}\%$$

$$= 0{\cdot}049\% \simeq 0{\cdot}1\%$$

116. (B) P. E. of the body at height H = mg H

Critical speed of the ball at the bottom of loop so as to just make it reach the top

$$v_c = \sqrt{5gR}$$

K. E. at the bottom of the loop

$$= \frac{1}{2} m v_c^2$$

$$= \frac{1}{2} m \left(\sqrt{5gR}\right)^2$$

$$= \frac{1}{2} m \times 5gR$$

From conservation of energy

$$mg\,H = \frac{1}{2} \times m \times 5gR$$

$$\Rightarrow \quad H = \frac{5}{2} R$$

117. (A) Velocity of the ball on reaching the ground

$$v = \sqrt{2gR}$$

$$= \sqrt{2 \times 10 \times 5}$$

$$= 10 \text{ m/s}$$

Momentum of the ball before impact with the earth $= mv$

$$= 50 \times 10^{-3} \times 10$$

$$= 500 \times 10^{-3} \text{ kg-m/s}$$

Momentum after impact

$$= -500 \times 10^{-3} \text{ kg-m/s}$$

Change in momentum

$$= 500 \times 10^{-3} - (-500 \times 10^{-3})$$

$$= 1000 \times 10^{-3}$$

$$= 1 \text{ kg-m/s}$$

So, impulse = Change in momentum

= 1 Newton-second

118. (A) $I_1 = \frac{MR^2}{2}$ and $I_2 = \frac{2}{5} MR^2$

$$\frac{I_1}{I_2} = \frac{MR^2}{2} \times \frac{5}{2\,MR^2} = \frac{5}{4}$$

119. (D) $T = 2\pi \sqrt{\frac{l}{g}}$

When at rest $2 = 2\pi \sqrt{\frac{l}{10}}$

When accelerated upward

$$T = 2\pi \sqrt{\frac{l}{(10+2)}} = 2\pi \sqrt{\frac{l}{12}}$$

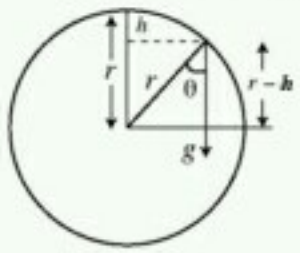
$$\frac{T}{2} = 2\pi \sqrt{\frac{l}{12}} \times \frac{1}{2\pi} \sqrt{\frac{10}{l}} = \sqrt{\frac{10}{12}}$$

$$\Rightarrow \quad T = 2\sqrt{\frac{10}{12}} = \sqrt{\frac{40}{12}} \text{ second}$$

120. (C) The body will lose contact when the centripetal acceleration become equal to the radial component of g.

Velocity gained on descending through h

$$= v = \sqrt{2gh}$$



Centripetal acceleration $= \frac{v^2}{r} = \frac{2gh}{r}$

Radial component of $g = g \cos\theta$

$$= g \times \frac{r-h}{r}$$

$$\therefore \quad \frac{2gh}{r} = g\frac{r-h}{r}$$

$$2h = r - h$$

$$\Rightarrow \quad h = \frac{r}{3}$$

121. (C) 122. (D) 123. (D) 124. (B)

125. (B) For closed organ pipe fundamental note

$$n_c = \frac{v}{4L_2}$$

For open organ pipe fundamental note

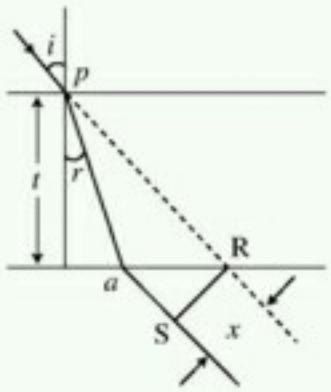
$$n_o = \frac{v}{2L_1}$$

Given $n_o = n_c$

$$\therefore \quad \frac{v}{4L_2} = \frac{v}{2L_1}$$

$$\Rightarrow \quad 2L_2 = L_1$$

126. (B)



$$\tan i = \frac{QR}{t}$$

$$\Rightarrow \quad QR = t \tan i$$

$$\tan r = \frac{QA}{t}$$

$$\Rightarrow \quad QA = t \tan r$$

$$AR = QR - QA$$

$$= t\tan i - t\tan r$$
$$= t(\tan i - \tan r)$$
$$\cos i = \frac{SR}{AR} = \frac{x}{AR}$$
$$\Rightarrow \quad x = AR\cos i$$
$$= t(\tan i - \tan r)\cos i$$
$$= (\tan i - \tan r)\, t\cos i$$

127. (C) $\quad \frac{1}{v_o} - \frac{1}{u_o} = \frac{1}{f_o}$

$$\frac{1}{v_o} - \frac{1}{-3{\cdot}5} = \frac{1}{3{\cdot}0}$$
$$\Rightarrow \quad v_o = 21 \text{ cm}$$
$$M = \frac{v_o}{u_o}\left(1 + \frac{D}{f_e}\right)$$
$$= \frac{21}{3{\cdot}5}\left(1 + \frac{30}{0{\cdot}3}\right)$$
$$= 606$$

128. (C)

129. (D) N × Volume of small drop

$$= \text{Volume of big drop}$$
$$N \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$
$$\Rightarrow \quad R = N^{1/3}\cdot r$$

Potential of small drop

$$= \frac{q}{4\pi\varepsilon_0 r} = V$$

Potential of big drop

$$= \frac{Nq}{4\pi\varepsilon_0 R} = \frac{Nq}{4\pi\varepsilon_0 \times N^{1/3}\cdot r}$$
$$= N^{2/3} \times \frac{q}{4\pi\varepsilon_0 r}$$
$$= N^{2/3} \times V$$

130. (A) Current in wire AB,

$$I = \frac{V}{R} = \frac{2}{18+2}$$
$$= \frac{2}{20} = \frac{1}{10}\text{A}$$

Resistance of AB,

$$R = \rho \times \frac{l}{A} = \frac{\rho}{A} \times 1{\cdot}0$$
$$= 2 \text{ (given)}$$
$$\Rightarrow \quad \frac{\rho}{A} = 2$$

Resistance of 0·70 m length of AB

$$R' = \frac{\rho}{A} \times 0{\cdot}70$$
$$= 2 \times 0{\cdot}70 = 1{\cdot}40\ \Omega$$

E.M.F. of the unknown source

$$= I \times R' = \frac{1}{10} \times 1{\cdot}40$$
$$= 0{\cdot}14 \text{ volt}$$

131. (C) We know that the power of a bulb

$$P = \frac{V^2}{R}$$

or $\quad R \propto \frac{1}{P}$

So, the resistance of least wattage bulb will be the highest. That is, how bulb has the highest resistance. But, rate of consumption of energy

$$E = I^2R$$

or, $\quad E \propto R$

Since, I is constant because the bulbs are connected in series.

Thus, energy consumption will be highest for 40 W bulb.

132. (A) Power delivery $= I^2R\left(\frac{V}{R+r}\right)^2 \times R$

(R is external resistance)

For the power to be the maximum $(R + r)^2$ should be minimum *i.e.*, $(R - r)^2 + 4R{\cdot}r$ should be minimum.

But R.r is constant (r being the internal resistance). Hence, the conduction for maximum power delivery is,

$$(R - r)^2 = 0$$

or, $\quad R = r$

So, Maximum power delivered

$$= \left(\frac{V}{r+r}\right)^2 \times R$$
$$= \left(\frac{12}{0{\cdot}02 + 0{\cdot}02}\right)^2 \times 0{\cdot}02$$
$$= \left(\frac{12}{0{\cdot}04}\right)^2 \times 0{\cdot}02$$
$$= 300 \times 300 \times 0{\cdot}02$$
$$= 1800 \text{ W}$$

133. (C) 134. (C) 135. (A) 136. (B) 137. (D) 138. (C)
139. (B) 140. (A) 141. (B) 142. (C) 143. (A) 144. (A)
145. (A) 146. (C) 147. (C) 148. (D) 149. (D) 150. (C)

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