



Hack book for SSC-CGL

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Algebra Hacks

Algebra is the easiest topic for SSC because you don't have to memorize any formula for it and all the questions can be solved within 10 seconds with *jugaad*.

First let me share with you the concept of symmetrical expressions (as I call it). A symmetrical expression is the one in which the weight of all the variables (a, b, c, etc.) is equal. Examples will make things clear.

Examples of symmetrical expressions -

- $a^3 + b^3 + c^3$
- $3a + 3b + 3c$
- $a^2 + b^2 + c^2$
- $a + b + c$
- $ab + bc + ca$

Examples of non - symmetrical expressions -

- $a - b + c$
- $2a + 3b + 3c$
- $a^3 + b^2 + c^3$
- $a + b + c^2$

Hack - 1 : "Whenever you encounter a symmetrical equation in any question, you can safely assume

:

$a = b = c$ (even if it is not given in the question)"

Let's solve previous year questions -

Q . 1.

If $3(a^2 + b^2 + c^2) = (a + b + c)^2$, then the relation between a, b, c is
 (A) $a = b = c$ (B) $a = b \neq c$
(C) $a < b < c$ (D) $a > b > c$

Here you can see that the LHS as well as the RHS of the equation is symmetrical, hence $a = b = c$

Answer : (A)

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66. If $a^2 + b^2 + c^2 = ab + bc + ac$ then the value of $\frac{a+c}{b}$ is
 (A) 0 (B) 2 (C) 1 (D) -1

Q .2.

We put $a = b = c$, hence $(a+c)/b$ becomes $(a+a)/a$, or 2

Answer : (B)

If $\frac{x - a^2}{b + c} + \frac{x - b^2}{c + a} + \frac{x - c^2}{a + b} = 4(a + b + c)$,
 then x is equal to
 (A) $(a + b + c)^2$
 (B) $a^2 + b^2 + c^2$
 (C) $ab + bc + ca$
 (D) $a^2 + b^2 + c^2 - ab - bc - ca$

Q .3.

In this question we have to find the value of x.

Here the equation is completely symmetrical, hence we assume $a = b = c$

Put $b=a$, $c=a$ (so that the whole equation is in terms of 'a')

Now LHS becomes $3(x - a^2)/2a$

RHS = $12a$

Solving this, you will get, $x = 9a^2$

From here we get that the value of x is $9a^2$

Now put $a = b = c$ in all the 4 options and check which option gives you the value $9a^2$

A) $9a^2$

B) $3a^2$

C) $3a^2$

D) 0

Answer : (A)

If $bc + ab + ca = abc$, then the value of $\frac{b+c}{bc(a-1)} + \frac{a+c}{ac(b-1)} + \frac{a+b}{ab(c-1)}$ is

(A) $-\frac{3}{2}$

(B) 1

(C) 0

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

Q. 4.

$bc + ab + ca = abc$ is symmetrical and hence we can assume $a=b=c$
Now put $b=a$ and $c=a$ in this equation. We will get -

$$3a^2 = a^3$$

So $a = 3$

Now put $a=b=c=3$ in the expression whose value we have to find. You will get the answer as 1.

Answer : (B)

Hack - 2 : "When only a single equation is given and based on that you have to find the value of an expression, you can assume the value of variables yourself. But make sure to assume only such values that will not make the denominator zero"

Examples :

If $x + y + z = 0$, then the value of

$$\frac{x^2 + y^2 + z^2}{x^2 - yz}$$
 is

(A) -1 (B) 0 (C) 1 (D) 2

Q. 5

In this question, only a single equation is given, i.e., $x + y + z = 0$, and based on this equation we have to find the value of an expression

We can assume $x = -1$, $y = 1$ and $z = 0$ (such that $x + y + z = 0$)

Now on putting these values in the expression, we get the answer as 2

Answer : (D)

If $a + b = 1$, find the value of $a^3 + b^3 - ab - (a^2 - b^2)^2$
(A) 0 (B) 1 (C) -1 (D) 2

Q . 6.

$$a + b = 1$$

Let's assume $a = 1$ and $b = 0$

Put the values in the expression, and you will get 0.

Answer : (A)

If $x = a^{1/2} + a^{-1/2}$, $y = a^{1/2} - a^{-1/2}$, then value of
 $(x^4 - x^2y^2 - 1) + (y^4 - x^2y^2 + 1)$
(A) 16 (B) 14 (C) 12 (D) 13

Q . 7.

In this question the values of x and y both depend on a constant ' a '. We can assume any value for ' a ' and this will give the values of x and y . Let us assume $a=1$

This will give $x = 2$ and $y = 0$

Put these values in the expression and you will get the answer as 16.

Answer : (A)

If $2s = a + b + c$, then the value of
 $s(s - c) + (s - a)(s - b)$ is

- (A) abc (B) $\frac{a+b+c}{2}$
(C) ab (D) 0

Q . 8

Pick values for a , b and c , such that their sum is $2s$. Let us assume $a = 2s$, $b = s$ and $c = -s$ (here you should not assume a, b or c to be zero because that will make the elimination of options difficult)

Put these values in the expression and you will get $2s^2$

Now check all the four options to see which of them will give the value $2s^2$ on putting $a=2s$, $b=s$ and $c=-s$

Answer : (C)

Sometimes the equations are complex and you will find it difficult to assume values for the variables.
Example -

$$\text{If } \frac{a^2 - bc}{a^2 + bc} + \frac{b^2 - ca}{b^2 + ca} + \frac{c^2 - ab}{c^2 + ab} = 1,$$

then the value of

$$\frac{a^2}{a^2 + bc} + \frac{b^2}{b^2 + ac} + \frac{c^2}{c^2 + ab} \text{ is}$$

(A) -1 (B) 2 (C) 0 (D) 1

Q. 1

Although the equation is symmetrical, we can't assume $a=b=c$, because that will make the LHS = 0. Such situations specially arise when the RHS is non-zero (here it is 1). Now what should we do? The trick is simple, there are three terms on the LHS, hence assume each term to be $1/3$ (so that all the three terms will add up to give 1). Why have we taken $1/3$, although it is obvious but still it comes from the formula - (value on RHS) / (No. of terms on LHS)

Here RHS = 1 and No. of terms on LHS = 3, hence we have assumed the value of each term as $1/3$.

$$(a^2 - bc)/(a^2 + bc) = 1/3 \dots (1)$$

$$(b^2 - ca)/(b^2 + ca) = 1/3 \dots (2)$$

$$(c^2 - ab)/(c^2 + ab) = 1/3 \dots (3)$$

From (1), we get $a^2 = 2bc \dots (4)$

. Similarly from (2) and (3), we get $b^2 = 2ca \dots (5)$

and $c^2 = 2ab \dots (6)$

Put the values of a^2 , b^2 and c^2 from (4), (5) and (6) in the expression whose value we have to find...

You will get 2 as the answer

Answer : (B)

$$\text{If } \frac{m - a^2}{b^2 + c^2} + \frac{m - b^2}{c^2 + a^2} + \frac{m - c^2}{a^2 + b^2} = 3, \text{ then}$$

the value of m is

(A) $a^2 + b^2$ (B) $a^2 + b^2 + c^2$
(C) $a^2 - b^2 - c^2$ (D) $a^2 + b^2 - c^2$

Q. 2

Here again, value on RHS = 3, No of terms = 3. Hence we assume each term to be $3/3 = 1$

Therefore, $(m - a^2)/(b^2 + c^2) = 1$

or $m = a^2 + b^2 + c^2$

Answer : (B)

Please note that this hack is also applicable only for symmetrical equations.

Now let us see some other questions where you can assume the values.

If average of two numbers x and $\frac{1}{x}$ (where $x \neq 0$) is A , what will be the average of x^3 and $\frac{1}{x^3}$?

- (A) $4A^3 - 4A$ (B) $4A^3 - A$
(C) $4A^3 - 2A$ (D) $4A^3 - 3A$

Q.3

Put $x = 1$, then since A is the average of x and $1/x$, its value will also be $A = 1$

The average of x^3 and $1/x^3 = 1$

Put $A = 1$ in all the 4 options to check which option will give '1' as the output.

Answer : (D)

If $2x = \sqrt{a} + \frac{1}{\sqrt{a}}$, $a > 0$, then the value of $\frac{\sqrt{x^2 - 1}}{x - \sqrt{x^2 - 1}}$ is

- (A) $\frac{1}{2}(a - 1)$ (B) $a - 1$
(C) $a + 1$ (D) $\frac{1}{2}(a + 1)$

Q.4

Here on putting $a=1$, you will find that both the options A and B will give the same result. Hence put $a = 4$, then $x = 1.25$

The value of the expression = $3/2$

Answer : (A)

Here, I have straight away put $a=4$, instead of 2 or 3 because in the question we have to calculate the square root of a . So if you will take a perfect square (like 4), the calculations will be much easier.

Note : In this question we calculated the square of 1.25, which is 1.5625. For those who don't know the trick for calculating the square of numbers ending with '5' (like 15, 65, 135, 225, etc.), let me share it.

In such cases, the last two digits are always 25.

E.g. the square of 65

The last two digits = 25

First 2 digits = $6 \times (6+1) = 42$

Hence square of 65 = 4225

Similarly square of 125

The last two digits = 25

First 3 digits = $12 \times (12+1) = 156$

Square of 125 = 15625

72. The value of

$$\frac{1}{a^2 + ax + x^2} - \frac{1}{a^2 - ax + x^2} + \frac{2ax}{a^4 + a^2x^2 + x^4}$$

is

- (A) 2 (B) 1 (C) -1 (D) 0

Q. 5.

Put $x = 0$

1st term = $1/a^2$

2nd term = $1/a^2$

3rd term = 0

1st term - 2nd term + 3rd term = 0

Answer : (D)

You can choose any value for 'x' and you would get the same answer. For e.g. let us take x

= 1

$$= 1/(a^2 + a + 1) - 1/(a^2 - a + 1) + 2a/(a^4 + a^2 + 1)$$

$$= -2a/(a^4 + a^2 + 1) + 2a/(a^4 + a^2 + 1)$$

$$= 0$$

Q. 6. $(a^2 + 2a)^2 + 12(a^2 + 2a) - 45$ can be expressed as:

(a) $(a - 1)(a - 3)(a^2 + 2a + 15)$

(b) $(a - 1)(a + 3)(a^2 + 2a + 15)$

(c) $(a + 1)(a + 3)(a^2 + 2a + 15)$

(d) $(a + 1)(a - 3)(a^2 + 2a + 15)$

Put $a = 0$

Hence, $(a^2 + 2a)^2 + 12(a^2 + 2a) - 45 = -45$

Now put $a = 0$ in all the four options and check which one is giving -45 as output

(a) 45

(b) -45

(c) 45

(d) -45

Hence (b) and (d), two options are possible

Now put $a = 1$

$(a^2 + 2a)^2 + 12(a^2 + 2a) - 45 = 0$

Put $a = 1$ in options (b) and (d) to see which one will give zero as the output

Answer: (b)

Approximation in Algebra

Approximation is a very important tool that can help you solve some complex and time taking questions. I will solve the below questions from SSC CGL with approximation technique to give you an idea of how it works. But before that, some basic rules of approximation:

1. Establish a limit within which the variable is falling.
2. Neglect the smaller terms of the expression (fractions with Denominator > Numerator)
3. Please use this technique only when the options have a significant difference between them. E.g. If in a question the 4 options are A. 4, B. 5, C. 6, D. 7, you can't use the approximation technique because the options are fairly close.

If $x^4 + \frac{1}{x^4} = 119$ & $x > 1$, then find the positive value of $x^3 - \frac{1}{x^3}$

(A) 25 (B) 27 (C) 36 (D) 49

Q. 1

Now how will you approach this question if you dont know how to solve it?

Given, $x^4 + 1/x^4 = 119$

We can safely assume that $3 < x < 4$ because $3^4 = 81$ and $4^4 = 256$ (119 lies between 81 and 256).

Moreover x will be closer to 3 as 119 is more close to 81 than 256

We have established the limit of the variable.

Let us take our first value. Go with $x = 3.2$

$3.2^4 = 104$ (approx), which is still a little away from 119

Hence let us take $x = 3.3$ as our second value

$3.3^4 = 118$ (approx) [PERFECT]

Now we have to find $x^3 - 1/x^3$

Note that $1/x^3$ is negligible and hence we can neglect it

So just find the value of 3.3^3

Answer : (C)

You won't take much time to calculate 3.2^4 or 3.3^4 , if you know a fast method to calculate the squares. I have written an article on it. [Click here to check]

If $\sqrt{x} = \sqrt{3} - \sqrt{5}$, then the value of $x^2 - 16x + 6$ is

(A) 0 (B) -2
(C) 2 (D) 4

Q. 2

Here again no need to figure out how to solve the question

$\sqrt{3} = 1.73$, $\sqrt{5} = 2.23$

Hence $\sqrt{x} = 1.73 - 2.23$ or $x = 0.25$

Put the value of x

$(0.25)^2 - 16 \cdot 0.25 + 6$

$= 0.0625 - 4 + 6$

$= 2$ (approx)

Answer : (C)

$x = \sqrt{5} + 2$, then the value of $\frac{x^4 - 1}{x^2}$ is

- (a) $8\sqrt{5}$ (b) $16\sqrt{5}$ (c) $24\sqrt{5}$ (d) $30\sqrt{5}$

Q. 3

$$x = \sqrt{5} + 2 = 4.23$$

$$(x^4 - 1)x^2 = x^2 - 1/x^2$$

Neglect $1/x^2$

$$x^2 = 4.23^2 = 17 \text{ (approx)}$$

Answer : (A)

If $5a + \frac{1}{3a} = 5$, then the value of

$9a^2 + \frac{1}{25a^2}$ is

- (A) $\frac{51}{5}$ (B) $\frac{29}{5}$
(C) $\frac{52}{5}$ (D) $\frac{39}{5}$

Q. 4

Again if you dont know how to solve the above question, then observe the above equation

If $a=1$, then LHS = 5.33 (which is little more than RHS, i.e., 5). We need to decrease the value of 'a'.

Hence let's take $a = 0.9$

$$5a + 1/3a = 4.8$$

Now LHS is more than RHS. We need to increase the value of 'a' slightly

So lets lock the final value $a = 0.95$ (Now no need to check the value of LHS for $a=0.95$)

$$9a^2 + 1/25a^2$$

Neglect $1/25a^2$

$$9a^2 = 8 \text{ (approx)}$$

Answer : (D)

If $x = 2 + \sqrt{3}$, then the value of $\sqrt{x} + \frac{1}{\sqrt{x}}$

- (A) $\sqrt{3}$ (B) $\sqrt{6}$
(C) $2\sqrt{6}$ (D) 6

Q. 5

$$x = 2 + \sqrt{3} = 2 + 1.73 = 3.73$$

Now you have to find the value of $\sqrt{x} + 1/\sqrt{x}$

$$\sqrt{x} = \sqrt{3.73}$$

You know that $19^2 = 361$

Hence $\sqrt{3.73} = 1.9$ (approx)

$$1/\sqrt{x} = 1/1.9 = 0.5$$

$$\sqrt{x} + 1/\sqrt{x} = 1.9 + 0.5 = 2.4 \text{ (which is close to } \sqrt{6}\text{)}$$

Answer : (B)

If $3x - \frac{1}{4y} = 6$, then the value of
 $4x - \frac{1}{3y}$ is
(A) 2 (B) 4 (C) 6 (D) 8

Q. 6

$$3x - \frac{1}{4y} = 6$$

Put $x=1$ and solve the equation for y

$$y = -1/12$$

Put $x = 1$ and $y = -1/12$ in the expression $(4x - 1/3y)$

You will get 8

Answer : (D)

If $x^2 + \frac{1}{x^2} = 66$, then the value of

$$\frac{x^2 - 1 + 2x}{x} = ?$$

- (A) 10, -6 (B) 6, -10
(C) ± 4 (D) ± 8

Q. 7

Here again we can say that the approx value of x is 8, because $8^2 = 64$

Put $x = 8$ in the expression

$$= (64 - 1 + 16)/8$$

$$= 10 \text{ (approx)}$$

Answer : (A)

Q. 8)

If $x^2 + x = 5$, find the value of $(x+3)^3 + \frac{1}{(x+3)^3}$

- A) 110 B) 120 C) 130 D) 140

Put $x=2$, the LHS becomes 6 and it is little more than RHS. So we need to decrease its value slightly

Let us take $x = 1.8$

$$\text{LHS} = (1.8)^2 + 1.8 = 5 \text{ (approx)}$$

LHS is almost equal to RHS, hence $x=1.8$ is a perfect value

Neglect $1/(x+3)^3$.

Now we only need to find the value of $(x+3)^3$

$$(x+3)^3 = (1.8+3)^3 = 110 \text{ (approx)}$$

Answer : (A)

Some important formulae:

$$\text{If } x + \frac{1}{x} = a, \text{ then } x^2 + \frac{1}{x^2} = a^2 - 2$$

$$\text{If } x + \frac{1}{x} = a, \text{ then } x^3 + \frac{1}{x^3} = a^3 - 3a$$

$$\text{If } x + \frac{1}{x} = a, \text{ then } x^4 + \frac{1}{x^4} = a^4 - 4a^2 + 2$$

$$\text{If } x - \frac{1}{x} = a, \text{ then } x^2 + \frac{1}{x^2} = a^2 + 2$$

$$\text{If } x - \frac{1}{x} = a, \text{ then } x^3 - \frac{1}{x^3} = a^3 + 3a$$

$$\text{If } x - \frac{1}{x} = a, \text{ then } x^4 + \frac{1}{x^4} = a^4 + 4a^2 + 2$$

Q. (1)

$$\text{If } \frac{4x-3}{x} + \frac{4y-3}{y} + \frac{4z-3}{z} = 0, \text{ then the value of } \frac{1}{x} + \frac{1}{y} + \frac{1}{z} \text{ is}$$

- (A) 3 (B) 4 (C) 6 (D) 9

Although this equation is symmetrical, and hence we can assume $x = y = z$ to solve it. But you should know one more thing about such equations. **If the sum of certain number of terms is zero, you can assume each term to be zero.** That means,

$$(4x - 3)/x = 0 \text{ or } x = 3/4$$

$$(4y - 3)/y = 0 \text{ or } y = 3/4$$

$$(4z - 3)/z = 0 \text{ or } z = 3/4$$

$$\text{So, } 1/x + 1/y + 1/z = 4$$

Answer: (B)

Q. (2) If $x^2 = y + z$, $y^2 = z + x$, $z^2 = x + y$, then find the value of

$$\frac{1}{1+x} + \frac{1}{1+y} + \frac{1}{1+z}$$

- (A) 1 (B) 2 (C) 0 (D) -1

Symmetrical equation, hence $x = y = z$

$$x^2 = x + x$$

$$x^2 = 2x$$

$$x = 2$$

Hence $x = y = z = 2$

Put in the expression

$$= \frac{1}{3} + \frac{1}{3} + \frac{1}{3}$$

$$= 1$$

Answer: (A)

Q. (3)

If $x^2 + y^2 + z^2 = 2(x - y - z) - 3$, then the value of $2x - 3y + 4z$ is

- (A) 3 (B) 0 (C) 9 (D) 1

This is a very famous question-type. In such questions we take everything on RHS to LHS and then try to make squares. You will get,

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

And like I said before, if the sum of certain number of terms is zero, we can assume each term to be zero.

$$(x - 1)^2 = 0, (y + 1)^2 = 0, (z + 1)^2 = 0$$

Hence, $x = 1$, $y = -1$ and $z = -1$

Put these values in $(2x - 3y + 4z)$

$$= 2(1) - 3(-1) + 4(-1)$$

$$= 1$$

Answer: (D)

Q. (4)

If $x^2 + y^2 + 1 = 2x$, then the value of $x^3 + y^5$

- (A) 2 (B) 0 (C) -1 (D) 1

Take everything to LHS,

$$(x - 1)^2 + y^2 = 0$$

Hence, $x = 1$ and $y = 0$

Put these values in the expression

$$= (1)^3 + 0^5$$

$$= 1$$

Answer: (D)

Q. (5)

If $\frac{\sqrt{3+x} + \sqrt{3-x}}{\sqrt{3+x} - \sqrt{3-x}} = 2$, then x is equal to

- (A) $5/12$ (B) $12/5$ (C) $5/7$ (D) $7/5$

By Componendo and Dividendo, whenever you see any equation written in the form

$$\frac{(m + n)}{(m - n)} = p$$

You can directly write $m/n = (p + 1)/(p - 1)$

In this question

$$m = \sqrt{3+x}, n = \sqrt{3-x}, p = 2$$

Hence, by Componendo-Dividendo

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

Squaring both sides

$$(3+x)/(3-x) = 9$$

Again apply componendo-dividendo

$$3/x = (9+1)/(9-1)$$

$$3/x = 5/4$$

$$x = 12/5$$

Answer: (B)

Q. (6) If $x = 332, y = 333, z = 335$, then the value of $x^3 + y^3 + z^3 - 3xyz$ is
 (A) 10000 (B) 7000 (C) 9000 (D) 8000

There is one more formula for $a^3 + b^3 + c^3 - 3abc$, apart from the one which you know

$$a^3 + b^3 + c^3 - 3abc = \frac{1}{2}(a + b + c)[(a - b)^2 + (b - c)^2 + (c - a)^2]$$

Hence,

$$\begin{aligned} x^3 + y^3 + z^3 - 3xyz &= \frac{1}{2}(332 + 333 + 335)[(332 - 333)^2 + (333 - 335)^2 + (335 - 332)^2] \\ &= \frac{1}{2}(1000)[1 + 4 + 9] \\ &= 7000 \end{aligned}$$

Answer: (B)

Q. 7)

If $a + b + c = 0$, then the value of

$$\frac{1}{a^3} + \frac{1}{b^3} + \frac{1}{c^3} + \frac{1}{(a+b)^3} + \frac{1}{(b+c)^3} + \frac{1}{(c+a)^3}$$

(A) -1 (B) 3abc (C) 1 (D) 0

$a + b + c = 0$ is symmetrical

Whenever any symmetrical equation is equal to zero, and the expression whose value is asked, is also symmetrical (and the numerator of the terms is also 1), then the value of that expression will also be zero.

If $a + b + c = 0$, then the value of

$$\frac{1}{a^3} + \frac{1}{b^3} + \frac{1}{c^3} + \frac{1}{(a+b)^3} + \frac{1}{(b+c)^3} + \frac{1}{(c+a)^3}$$

Symmetrical equation = 0

1. Symmetrical
2. All the terms have numerator = 1

Answer: (D)

Q. (8)

If $x + y + z = 0$, then the value of-

$$\frac{1}{x^2 + y^2 - z^2} + \frac{1}{x^2 + z^2 - y^2} + \frac{1}{y^2 + z^2 - x^2}$$

- (A) -2 (B) -1/2 (C) 0 (D) 1/2

Same logic

Value of the expression = 0

Answer: (C)

Q. (9)

If $a + b + c = 0$, then the value of

$$\left(\frac{a+b}{c} + \frac{b+c}{a} + \frac{c+a}{b}\right) \left(\frac{a}{b+c} + \frac{b}{c+a} + \frac{c}{a+b}\right)$$

- (A) 9 (B) 0 (C) 8 (D)

Although $a + b + c = 0$, is a symmetrical equation, and the expression $((a+b)/c + (b+c)/a + (c+a)/b)$ $(a/(b+c) + b/(c+a) + c/(a+b))$ is also symmetrical. But the numerator of the terms is not 1. Hence we can't say that the answer is zero.

We will solve it by assuming $a=b=c$. Hence

$$\left(\frac{a+b}{c} + \frac{b+c}{a} + \frac{c+a}{b}\right) \left(\frac{a}{b+c} + \frac{b}{c+a} + \frac{c}{a+b}\right) = \left(\frac{2a}{a} + \frac{2a}{a} + \frac{2a}{a}\right) \left(\frac{a}{2a} + \frac{a}{2a} + \frac{a}{2a}\right)$$

$$= (2 + 2 + 2)(1/2 + 1/2 + 1/2)$$

$$= 6 * 3/2$$

$$= 9$$

Answer: (A)

If $ab + bc + ca = 0$, then the value of

$$\frac{1}{a^2 - bc} + \frac{1}{b^2 - ac} + \frac{1}{c^2 - ab} \text{ is}$$

- (A) -1 (B) 0
(C) 1 (D) 2

Q. (10)

$ab + bc + ca = 0$ is symmetrical

Hence value of the expression = 0

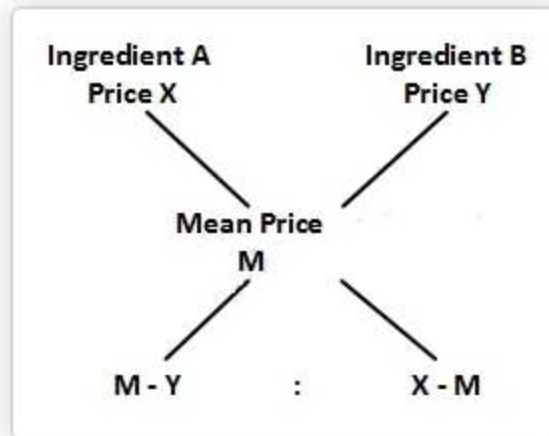
Answer: (B)

Mixture and Alligation Hacks

Alligation is a method of solving arithmetic problems related to mixtures of ingredients. Please note that alligation method is applied for percentage value, ratio, rate, prices, speed, etc. and not for absolute value. **That is whenever per cent, per km, per hour, per kg, are being compared, we can use Alligation.**

Common trick for Ratio-Proportion and Mixture Alligation : Almost 50% of the questions are solvable just by going through the options. Just go through the questions I have solved in this article and you will know the approach.

Rule of Alligation



Ingredient A : Ingredient B = M - Y : X - M

Here Mean Price is something which applies on the whole thing. If two varieties of tea costing Rs. X and Rs. Y respectively are mixed and sold at Rs. Z, then Z is the mean price because it is price of the mixture.

Now I will take up some SSC CGL questions of Ratio-proportion and Mixture-Alligation.

Q.1

Two types of tea costing ₹ 180/kg and ₹ 280/kg should be mixed in the ratio so that the mixture obtained, sold at ₹ 320/kg to earn a profit of 20% is

- (A) 1:13 (B) 2:13
(C) 3:13 (D) 4:13

Note that Rs. 180/kg and Rs. 280/kg are cost prices, while Rs. 320 is the selling price. To apply the alligation formula, all the three prices should be similar. So we will convert SP into CP

Given SP = Rs. 320/kg, Profit = 20%

Hence CP = $320/1.2 = \text{Rs. } 800/3$

So the Mean price is Rs. $800/3$ per kg

Now you can apply the formula-

Type 1 : Type 2 = $280 - 800/3 : 800/3 - 180 = 2 : 13$

Answer : (B)

There are two containers of equal capacity. The ratio of milk to water in the first container is 3 : 1, in the second container 5 : 2. If they are mixed up, the ratio of milk to water in the mixture will be

- (A) 28 : 41 (B) 41 : 28
(C) 15 : 41 (D) 41 : 15

Q. 2)

Both the containers have equal capacity. Let us assume that both containers are of 28 litres. Why 28? Because 28 is the LCM of (3 + 1) and (5 + 2) or 4 and 7. So taking the capacity as 28 litres will make your calculations easier.

In Container 1, we have $(3/4)*28 = 21$ litres of milk and $(1/4)*28 = 7$ litres of water.

In Container 2, we have $(5/7)*28 = 20$ litres of milk and $(2/7)*28 = 8$ litres of water.

Total milk in both the containers = $21 + 20 = 41$

Total water in both the containers = $7 + 8 = 15$

Milk : Water = 41 : 15

Answer : (D)

Shortcut

Container 1 has 3 times more milk than water

Container 2 has 2.5 times more milk than water

When the contents of the two containers are mixed, the milk will still be more than water. How much more? Somewhere between 2.5 and 3 times

(D) is the only option where the quantity of milk is around 2.7 times (i.e. between 2.5 and 3) that of the water.

106. The milk and water in two vessels A and B are in the ratio 4 : 3 and 2 : 3 respectively. In what ratio, the liquids in both the vessels be mixed to obtain a new mixture in vessel C containing half milk and half water ?
 (A) 7 : 5 (B) 5 : 2 (C) 3 : 11 (D) 1 : 2

Q. 3)

Milk in vessel A = $\frac{4}{7}$

Milk in vessel B = $\frac{2}{5}$

Milk in vessel C = $\frac{1}{2}$ (because in vessel C, milk and water are present in 1:1 ratio)

You have to mix $\frac{4}{7}$ and $\frac{2}{5}$, to produce $\frac{1}{2}$. Hence $\frac{1}{2}$ is the Mean Price.

$A : B = (\frac{1}{2} - \frac{2}{5}) / (\frac{4}{7} - \frac{1}{2}) = 14 : 10 = 7 : 5$

In a mixture of three varieties of tea, the ratio of their weights is 4 : 5 : 8. If 5 kg tea of the first variety, 10 kg tea of the second variety and some quantity of tea of the third variety are added to the mixture, the ratio of the weights of three varieties of tea becomes as 5 : 7 : 9. In the final mixture, the quantity (in kg) of the third variety of tea was

- (A) 48 (B) 40
 (C) 42 (D) 45

Q. 4)

Shortcut

Final ratio of the three varieties is 5 : 7 : 9

The question asks us the quantity of third variety of tea in the final mixture. From the above ratio, it is clear that the quantity of the third variety is a multiple of 9. So 45 is the only option possible.

Answer : (D)

Method

Let the three quantities be $4x$, $5x$ and $8x$

New quantities are $4x + 5$, $5x + 10$ and $8x + p$

Now $4x + 5 : 5x + 10 : 8x + p = 5 : 7 : 9$

$(4x + 5) / (5x + 10) = 5/7$ and $(4x + 5) / (8x + p) = 5/9$

Solving 1st equation, we get $x = 5$

Solving 2nd equation, we get $p = 5$

In the final mixture the quantity of the third variety is $8x + p = 8 \cdot 5 + 5 = 45$

A vessel contains 20 litres of acid. 4 litres of acid is taken out of the vessel and replaced by the same quantity of water. Next 4 litres of the mixture are withdrawn, and again the vessel is filled with the same quantity of water. The ratio of the quantity of acid left in the vessel with the quantity of acid initially in the vessel is

- (A) 16 : 25 (B) 1 : 5
(C) 4 : 5 (D) 4 : 25

Q. 5)

In this question we will use the below formula

Suppose a container contains x of liquid from which y units are taken out and replaced by water.

After n operations, the quantity of pure liquid = $\left[x \left(1 - \frac{y}{x} \right)^n \right]$ units.

So from the above formula

(Quantity of acid left)/(Quantity of acid in the original mixture) = $(1 - 4/20)^2 = 16:25$

Answer : (A)

A jar contains a mixture of two liquids A and B in the ratio 4 : 1. When 10 lt of the mixture is replaced with liquid B, the ratio becomes 2 : 3. The volume of liquid A present in the jar earlier was :

- (A) 20 lt (B) 10 lt
(C) 16 lt (D) 15 lt

Q. 6)

Let the original quantities of A and B be $4x$ and x

In 10 litres, quantity of A = $\frac{4}{5} * 10 = 8$ litres

In 10 litres, quantity of B = $(10 - 8) = 2$ litres

New quantities of A and B are $2x$ and $3x$

(Original Quantity of A) - (New quantity of A) = 8 litres [Because after taking out 10 litres of the mixture, the quantity of liquid A reduced by 8 litres]

So, $4x - 2x = 8$

or $x = 4$

Hence quantity of liquid A in original mixture = $4 * 4 = 16$ litres

Answer : (C)

Note : In the above question, there were two different ratios 4:1 and 2:3, then too I took the same constant of proportionality for them, i.e. 'x' because the following two conditions were met:

1. The volume of mixture did not change (Like in this question 10 litres were replaced, not removed)
2. The two ratios had same no. of parts (4:1 and 2:3 both have 5 parts)

You can take different constant to solve the question, but that will make the calculations little lengthy.

15 litres of a mixture contains alcohol and water in the ratio 1 : 4. If 3 litres of water is mixed in it, the percentage of alcohol in the new mixture will be

- (A) 15 (B) $16\frac{2}{3}$
(C) 17 (D) $18\frac{1}{2}$

Q. 7)

Since the ratio of alcohol and water is 1:4, hence quantities of alcohol and water in the mixture are 3 litres and 12 litres respectively.

Total volume will become 18 litres after adding 3 litres water

% of alcohol = $\frac{3}{18} * 100 = 50/3\%$

Answer : (B)

Q. 8)

In a library the ratio of story books and other books is 7 : 2 and there are 1512 story books. Due to collection of some more story books the said ratio becomes 15:4. The number of story books collected is

- (A) 100 (B) 97 (C) 108 (D) 205

Shortcut

Originally there are 1512 story books

Final ratio of Story books : Others = 15:4

That means the story books are a multiple of 15.

Just look at the options and see which number when added to 1512, will give a multiple of 15

Answer : (C)

Method

Let the no of story and other books be $7x$ and $2x$ respectively

Given $7x = 1512$

$x = 216$

Now let the final quantity of story and other books be $15y$ and $4y$ respectively.

Since only story books are added to the collection, hence the quantity of other books has remained unchanged.

So $2x = 4y$ or $y = x/2 = 108$

We have to find $15y - 7x = 15y - 14y = y$ [Since $x = 2y$]

So answer is 108.

Q. 9) A man spends 75% of his income. His income is increased by 20% and he increased his expenditure by 10%. His savings are increased by

(A) 50% (B) 25% (C) 75/2% (D) 10%

Let the income = Rs. 100

Then expenditure = 75% of 100 = Rs. 75

Savings = Rs. 25

New income = $1.2 * 100 =$ Rs. 120

New expenditure = $1.1 * 75 =$ Rs. 82.5

New savings = $120 - 82.5 =$ Rs. 37.5

% increase in savings = $(37.5 - 25)/25 * 100 = 50\%$

Answer: (A)

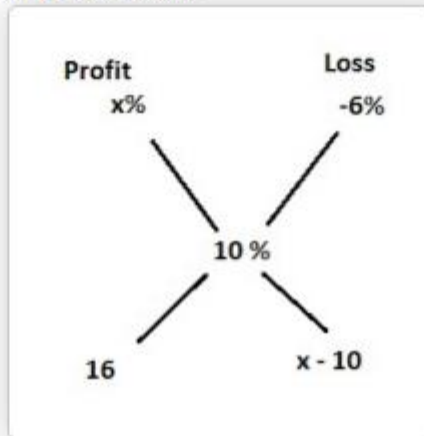
Let us solve some CGL questions that may not seem to belong to Mixture-Alligation category, but are easier to solve via Alligation formula...

Gita buys a plot of land for ₹ 96,000. She sells $\frac{2}{5}$ of it at a loss of 6%. She wants to make a profit of 10% on the whole transaction by selling the remaining land. The gain % on the remaining land is

- (A) 20 (B) $20\frac{2}{3}$
(C) 14 (D) 7

Q. 1)

Let the gain% of the remaining land be $x\%$. Then



Given, $\frac{2}{5}$ land is sold on loss and hence $\frac{3}{5}$ land is sold on profit

So, Profit : Loss = 3 : 2

Hence $16 : (x - 10) = 3 : 2$

$16/(x - 10) = 3/2$

or $x = 62/3\%$

Answer : (B)

A farmer travelled a distance of 61 km in 9 hours. He travelled partly on foot at the rate 4 km/hour and partly on bicycle at the rate 9 km/hour. The distance travelled on foot is

- (A) 14 km (B) 15 km
(C) 16 km (D) 17 km

Q. 2)

His average speed for the entire journey = $61/9$ km/hour

Time taken on foot : Time taken on bicycle = $(9 - 61/9)/(61/9 - 4) = 4:5$

Time taken on foot = $4/9 * 9 = 4$ hours

Hence distance travelled on foot = (Speed on foot * Time taken on foot) = $4 * 4 = 16$ km

Answer : (C)

Alternate method

This method is equally easy.

Let the distance travelled on foot be X km. Then distance travelled on bicycle = $(61 - X)$

Now he travelled for 9 hours. Hence

$$X/4 + (61 - X)/9 = 9$$

Solve for X

You will get $X = 16$ km

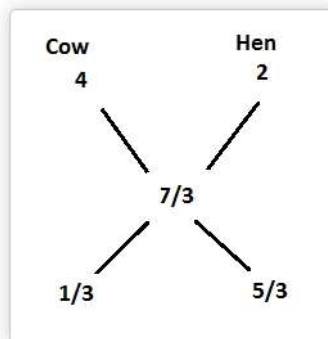
In a farm there are cows and hens. If heads are counted there are 180, if legs are counted there are 420. The number of cows in the farm is

- (A) 150 (B) 30 (C) 130 (D) 50

Q. 3)

Number of legs per head = $420/180 = 7/3$

Now cows have 4 legs while hens have 2 legs



Cows : Hens = $1/3 : 5/3 = 1 : 5$

Now total number of cows and hens = total number of heads = 180

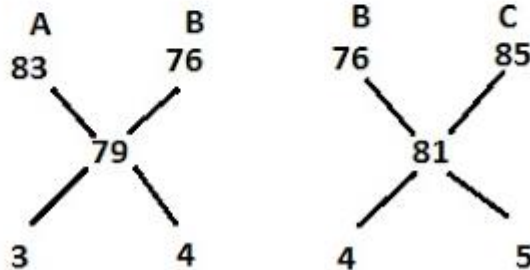
Number of cows = $1/6 * 180 = 30$

Answer : (B)

Three science classes A, B and C take a Life Science test. The average score of class A is 83. The average score of class B is 76. The average score of class C is 85. The average score of class A and B is 79 and average score of class B and C is 81. Then the average score of classes A, B and C is.

(A) 80.5 (B) 81.5 (C) 80 (D) 81

Q. 4)



A : B = 3 : 4 and B : C = 4 : 5

A : B : C = 3 : 4 : 5

Average score of classes A, B and C =

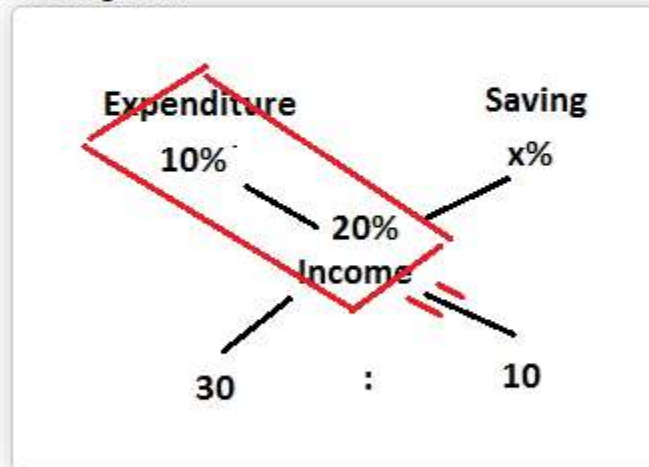
$$\frac{3(83) + 4(76) + 5(85)}{3 + 4 + 5} = 81.5$$

Answer : (B)

A man spends 75% of his income. His income increases by 20% and his expenditure also increases by 10%. The percentage of increase in his savings is
 (A) 40% (B) 30%
 (C) 50% (D) 25%

Q. 5)

The man spends 75% of his income, that means he saves 25%
 Hence Expenditure : Saving = 75 : 25 = 3 : 1
 Let the % increase in the savings be x.



I have written 3 : 1 as 30 : 10 so that (% increase in income - % increase in expenditure) could agree with 3 : 1 ratio. As we know 20 - 10 = 10, not 1.

So now from the figure we can see that $x - 20 = 30$

Hence $x = 50\%$

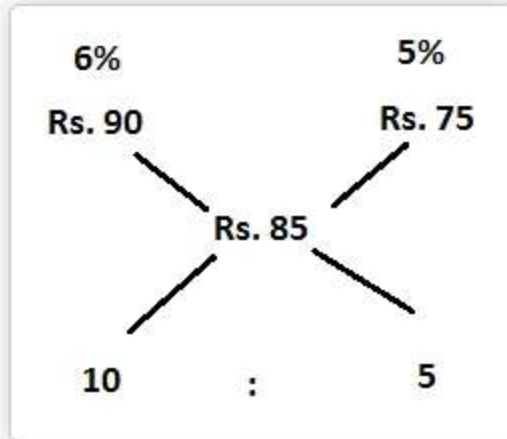
Answer : (C)

Rs. 1500 is invested in two such parts that if one part be invested at 6%, and the other at 5%, the total interest in one year from both investments is Rs 85. How much is invested at 5%?

Q. 6)

If whole money is invested at 6%, then interest = 6% of 1500 = Rs. 90

If whole money is invested at 5%, then interest = 5% of 1500 = Rs. 75



Hence, Money invested at 6% : Money invested at 5% = 10 : 5 = 2 : 1
 Money invested at 5% = $\frac{1}{3} * 1500 = \text{Rs. } 500$
Answer : Rs. 500

Alternate Method (Apply alligation on interest rates)

Rs. 85 interest is received in 1 year from an investment of Rs. 1500

$$SI = P * r * t / 100$$

$$r = 17/3\% \text{ [Put } SI=85, P=1500, t=1]$$

Now the mean ratio is $17/3$

Apply allegation formula-

$$\text{Money invested at 6\% : Money invested at 5\%} = (17/3) - 5 : 6 - 17/3 = 2 : 1$$

Sequence and Series Hacks

There are basically two types of questions that are asked by SSC from this part-

1. Finite sequence where the denominator is of the type $1 \times 3, 3 \times 5, 5 \times 7$, etc. (can be solved with direct formula)
2. An infinite sequence where you have to find the series (the sum of infinite sequence)

First of all let's see questions of type 1.

Q.1) $\frac{1}{2} + \frac{1}{6} + \frac{1}{12} + \frac{1}{20} + \frac{1}{30} + \frac{1}{42}$

First break it into the required form-

$$\frac{1}{1 \times 2} + \frac{1}{2 \times 3} + \frac{1}{3 \times 4} + \frac{1}{4 \times 5} + \frac{1}{5 \times 6} + \frac{1}{6 \times 7}$$

Now apply the direct formula-

$$\frac{(\text{First term} - \text{Last term})}{\text{Difference}}$$

$$\frac{1}{1 \times 2} + \frac{1}{2 \times 3} + \frac{1}{3 \times 4} + \frac{1}{4 \times 5} + \frac{1}{5 \times 6} + \frac{1}{6 \times 7}$$

First term Last term

Difference is the gap between the two numbers in the denominator. So here difference = $2 - 1 = 1$

$$\frac{1 - \frac{1}{7}}{1}$$

Answer : $\frac{6}{7}$

Next question

125. The value of the expression $\left\{ \frac{1}{(2^2-1)} \right\} + \dots$
 $\left\{ \frac{1}{(4^2-1)} \right\} + \left\{ \frac{1}{(6^2-1)} \right\} + \dots + \left\{ \frac{1}{(20^2-1)} \right\}$
is equal to
(A) $\frac{9}{19}$ (B) $\frac{10}{19}$ (C) $\frac{10}{21}$ (D) $\frac{11}{21}$

Q. 2

Apply the formula

$$\frac{1 - \frac{1}{21}}{2}$$

Answer : 10/21

Now let us move to the second type of questions where we will be applying the real tricks-

108. What is the Arithmetic mean of the first 'n' natural numbers?

(A) $\frac{n+1}{2}$

(B) $\frac{n^2(n+1)}{2}$

(C) $2(n+1)$

(D) $\frac{n(n+1)}{2}$

Q.3

To begin with, I have taken the most basic question. Although many of you might be knowing that the sum of first n natural numbers is $n(n+1)/2$ and hence the arithmetic mean of first n natural numbers will come out to be $(n+1)/2$

But let's say you forget the formula (exam pressure) and you can't recall it. What will your approach be? The trick is simple- suppose a value of 'n'.

'n' defines how many terms from the sequence you are taking

Let us take $n = 2$

Arithmetic mean of first 2 natural numbers = $(1+2)/2 = 3/2$

Now put $n = 2$ in all the four options and check which option is giving $3/2$ as the output

A) $3/2$

B) 6

C) 6

D) 3

Answer : (A)

Find the sum of

$$\left(1 - \frac{1}{n+1}\right) + \left(1 - \frac{2}{n+1}\right) + \left(1 - \frac{3}{n+1}\right) + \dots$$

$$\left(1 - \frac{n}{n+1}\right)$$

(A) n

(B) $\frac{1}{2}n$

(C) (n+1)

(D) $\frac{1}{2}(n+1)$

Q.4

I will take $n = 1$ (you can take $n = 2$ as well but that will make the calculations a little complex in this question). But I will solve this question by taking $n = 1$ and $n = 2$ both, so that you become well-versed with the concept.

$n = 1$

Sequence will reduce into $(1 - 1/(n + 1))$

Put $n = 1$

Value = $1/2$

Now put $n = 1$ in all the four options and check which one of them is giving $1/2$ as the output

A) 1

B) $1/2$

C) 2

D) 1

Answer : (B)

Now $n = 2$

Sequence will reduce into $(1 - 1/(n + 1)) + (1 - 2/(n + 1))$

Put $n = 2$

Value = $2/3 + 1/3 = 1$

Now put $n = 2$ in all the four options and check which one of them is giving 1 as the output

A) 2

B) 1

C) 3

D) $3/2$

Answer : (B)

Remember in the exam you will take either $n = 1$ or $n = 2$, I have taken both just to explain you the concept. But in some questions you may find that after taking $n = 1$, you are getting two options with the same value. In such cases you will have to take $n = 2$.

Let me take some questions of 'Averages' in this article itself. Firstly an easy one -

78. The average of five consecutive positive integers is n . If the next two integers are also included, the average of all these integers will
- (A) increase by 1 (B) remains the same
(C) increase by 2 (D) increase by 1.5

Q. 5.

Assume the numbers as 1, 2, 3, 4 and 5

Average of these numbers = 3

Include the next two numbers (6 and 7)

Average of 1, 2, 3, 4, 5, 6, 7 = 4

Average has increased from 3 to 4

Answer : (A)

Now a tougher one -

11. Average of n numbers is a . The first number is increased by 2, second one is increased by 4, the third one is increased by 8 and so on. The average of the new number is

(A) $a + 2 \frac{2^n - 1}{n}$

(B) $a + \frac{2^n - 1}{n}$

(C) $a + 2 \frac{2^n + 1}{n}$

(D) $a + \frac{2^{n+1} - 1}{n}$

Q . 6

This question appeared in Tier 2 (2015). It talks about **average** and hence it would be wise to at least take $n = 2$ or $n = 3$. Let us take $n = 2$.

It is given that 'Average of n numbers is a ' and no other information is given, so you can assume the numbers as well. Since you have assumed $n = 2$, so you will have to assume two numbers. Let me take 1 and 3 as the two numbers (note : you can take any two numbers you want).

Average of 1 and 3 = 2

Hence $a = 2$

First number is increased by 2 and second number is increased by 4. Hence 1 and 3 will become 3 and 7.

Average of 3 and 7 = $(3 + 7)/2 = 5$

Now put $a = 2$ and $n = 2$ in all the four options and check which one of them is giving **5 as the output**.

A) 5

B) 3.5

C) 7

D) 5.5

Answer : (A)

Simple and Compound Interest hacks

After reading this series (Part-1 and Part-2), you will be able to solve all the questions that are asked by SSC from this topic.

(1) The basic concept of CI and SI

Let's say you have Rs. 30000 and you keep this money in three different banks for 2 years (Rs. 10000 each). The three banks have different policy :

a) Bank A keeps your money at simple interest and offers you 5% interest

b) Bank B keeps your money at compound interest and offers you 5% interest. The interest is compounded annually.

Bank C keeps your money at compound interest and offers you 5% interest. The interest is compounded half-yearly.

After 2 years, which bank will give you most interest?

Let us calculate

Case (A)

Simple interest is calculated simply as $(P \cdot R \cdot T) / 100$

Here $P = 10000$, $r = 5\%$ and $T = 2$ years

$T = 2$ years. Let's divide this period in two equal intervals of 1 year each

Hence SI received for the period 0 to 1 = $10000 \cdot 5 \cdot 1 / 100 = \text{Rs. } 500$

SI received for the period 1 to 2 = $10000 \cdot 5 \cdot 1 / 100 = \text{Rs. } 500$

So after 2 years, you will get Rs. $10000 + 500 + 500 = \text{Rs. } 11000$

Note : Simple Interest is proportional. The interest received is same each year. So in the above example where SI was Rs. 500 for 1 years, that will mean the SI for 3 years is Rs. 1500, the SI for 5 years is Rs. 2500 and so on.

Case (B)

Compounded annually means whatever interest you will earn on first year, that interest will be added to the principal to calculate the interest for 2nd year. Let us see how

We know the CI formula is, $\text{Amount} = P(1 + r/100)^t$ (where $\text{Amount} = P + \text{CI}$)

CI received for the period 0 to 1 = $\text{Amount} - \text{Principal} = 10000(1 + 5/100)^1 - 10000 = \text{Rs. } 500$

Now the amount received after 1 year will act as the Principal for calculating the Amount for next year
For calculating the amount for second year, you won't take P as 10000, but as Rs. 10500. So unlike SI where the interest was same each year, in CI the interest increases every year (because the principal increases every year)

CI received for the period 1 to 2 = $\text{Amount} - \text{Principal} = 10500(1 + 5/100)^1 - 10500 = \text{Rs. } 525$

Total interest received after two years = Rs. 500 + Rs. 525 = Rs. 1025

Total amount received after two years = Rs. 11025

Note : In Case (b), to calculate the amount received after 2 years, I had divided the calculation into 2 intervals. It was done just for the sake of explanation. You can calculate the amount received after 2 years directly by $10000(1 + 5/100)^2$

Case (C)

Just like case (b), where Principal was getting updated every year, in case (c) we will update the Principal every 6 months (half-year)

Since I have given the explanation in case (b), so in this case I will directly apply the formula
Amount received after 2 years = $10000(1 + 2.5/100)^4 = \text{Rs. } 11038$ approx.

So sum it up

Case A - amount received after two years = Rs. 11000

Case B - amount received after two years = Rs. 11025

Case C - amount received after two years = Rs. 11038

Case C is giving the maximum return and rightly so because in Case (C) principal is increasing every 6 months.

Important formulas for Compound Interest-

1. Let Principal = P, Rate = R% per annum, Time = n years.

2. When interest is compounded Annually:

$$\text{Amount} = P \left(1 + \frac{R}{100} \right)^n$$

3. When interest is compounded Half-yearly:

$$\text{Amount} = P \left[1 + \frac{(R/2)}{100} \right]^{2n}$$

4. When interest is compounded Quarterly:

$$\text{Amount} = P \left[1 + \frac{(R/4)}{100} \right]^{4n}$$

5. When interest is compounded Annually but time is in fraction, say $3\frac{2}{5}$ years.

$$\text{Amount} = P \left(1 + \frac{R}{100} \right)^3 \times \left(1 + \frac{\frac{2}{5}R}{100} \right)$$

(2) A sum of money becomes x times in T years. In how many years will it become y times?

The approach to solve such questions is different for SI and CI

For SI : Formula = $[(y - 1)/(x - 1)] * T$

Q. 1) A sum of money becomes three times in 5 years. In how many years will the same sum become 6 times at the same rate of simple interest?

Solution : $[(6 - 1)/(3 - 1)] * 5 = 5/2 * 5 = 12.5$ years

Answer : 12.5 years

For CI : Formula = $(\log y / \log x) * T$

Now dont worry, I wont be asking you to study logarithms :)

But just remember one property of logs and that is enough to solve the questions

$\log(x^y) = y \cdot \log(x)$

Hence $\log(8) = \log(2^3) = 3 \cdot \log(2)$

Q. 2) A sum of money kept at compound interest becomes three times in 3 years. In how many years will it be 9 times itself?

Solution : $(\log 9 / \log 3) * 3 \dots (1)$

$\log 9 = \log(3^2) = 2 \cdot \log(3)$

Put this value in (1)

$= 2 \cdot \log(3) / \log(3) * 3$

$= 2 * 3 = 6$ years

Answer : 6 years

(3) Interest for a number of days

Q.3) Find the interest rate on Rs. 306.25 from March 3rd to July 27th at $3\frac{3}{4}\%$ per annum.

Here P = 306.25

R = $15/4\%$

T = Number of days/365

Number of days = Count the days from March 3rd to July 27th but **omit the first day, i.e., 3rd**

March

= 28 days(March) + 30 days(April) + 31 days(May) + 30 days(June) + 27 days(July)

= 146 days

We know SI = $(P * r * t) / 100$

Simple Interest = $306.25 * 146/365 * 15/4 * 1/100 = \text{Rs. } 4.59$

(4) Annual Instalments

This is the most dreaded topic of CI-SI. Before giving you the direct formula, I would like to tell you what actually is the concept of annual instalments (if you only want the formula and not the explanation, you can skip this part. But I would like you to read it)

Suppose you want to purchase an iPhone and its price is Rs. 100000 but you don't have Rs. 1 lakh as of now. What would you do? You have two options - either you can sell your kidney (which most of the iPhone buyers do :D), or you can go for instalments. But if you want to buy the iPhone through this instalment route, the seller will incur a loss. How? Had you paid Rs. 1 lakh in one go, the seller would have kept that money in his savings account and earned some interest on it. But you will pay this Rs. 1 lakh in instalments and that means the seller will get his Rs. 1 lakh after several years. So the seller is incurring a loss. The seller will compensate for this loss and will charge interest from you.

Let the annual instalment be Rs. x . and you pay it for 4 years.

After 1 year you will pay Rs. x and the seller will immediately put this money in his savings account (or somewhere else) to earn interest. He will earn interest on this Rs. x at the rate of $r\%$ for 3 years (because the total duration is 4 years and 1 year has already passed)

Hence the amount which the seller will get from this Rs. x instalment = $x(1 + r/100)^3$

After 2nd year, you will again pay Rs. x and the seller will earn interest on this Rs. x for 2 years.

The amount which the seller will get from this Rs. x instalment = $x(1 + r/100)^2$

After 3rd year, you will again pay Rs. x and the seller will earn interest on this Rs. x for 1 year.

The amount which the seller will get from this Rs. x instalment = $x(1 + r/100)^1$

After 4th year, you will pay Rs. x and your debt would be paid in full (no interest on this Rs. x)

The amount which the seller will get from this Rs. x instalment = x

Now let's add all the above four amounts to get the total amount the seller would get from all the instalments =

$$x(1 + r/100)^3 + x(1 + r/100)^2 + x(1 + r/100)^1 + x \quad \dots (1)$$

Now, had you paid Rs. 1 lakh in one go (without going for the instalment route), then the amount received by the seller after 4 years would have been = $100000(1 + r/100)^4 \quad \dots (2)$

Now (1) should be equal to (2) because only then the two routes (instalment route and direct payment route) will give the same return and seller would have no problem in giving you the iPhone in instalments.

$$100000(1 + r/100)^4 = x(1 + r/100)^3 + x(1 + r/100)^2 + x(1 + r/100)^1 + x$$

[Remember the above equation for solving questions of compound interest]

$$P + P*r*4/100 = (x + x*r*3/100) + (x + x*r*2/100) + (x + x*r*1/100) + x$$

[Remember the above equation for solving questions of simple interest]

Although for Simple Interest, we have a direct formula-

The annual instalment value is given by-

$$\frac{100A}{100t + \frac{rt(t-1)}{2}}$$

Now coming to the questions. There are two types of questions and they are bit confusing. In one type, the Amount is given and in another type, Principal is given

Type 1(Amount is given):

Q. 4) What annual installment will discharge a debt of Rs.6450 due in 4 years at 5% simple interest?

When the language the question is like "what annual payment will discharge a debt of ...", it means the Amount is given in the question.

In this question, the Amount(A) is given, i.e., Rs. 6450. So we can apply the formula directly

Here $A = 6450$, $r = 5\%$, $t = 4$ years

Solution : $100 * 6450 / [100 * 4 + 5 * 4 * 3 / 4]$

Answer : 1500

Type 2 (Principal is given) :

Q. 5) A sum of Rs. 6450 is borrowed at 5% simple interest and is paid back in 4 equal annual installments. What is amount of each installment?

Here the sum is given. Sum means Principal.

But our formula requires Amount(A)

So we will calculate Amount from this Principal

$A = P + SI = 6450 + 6450 * 5 * 4 / 100 = \text{Rs. } 7740$

Now put the values in the formula

$A = 7740$, $r = 5\%$, $t = 4$

Annual instalment = $100 * 7740 / (100 * 4 + 5 * 4 * 3 / 2)$

Answer : Rs. 1800

A sum of money is paid back in two annual instalments of ₹17,640 each, allowing 5% compound interest compounded annually. The sum borrowed was

(A) ₹32,400

(B) ₹32,800

(C) ₹32,000

(D) ₹32,200

Q. 6)

"Sum borrowed" means Principal.

This question is of Compound Interest and hence we cant apply the direct formula. We will solve this question with the help of the equation we derived earlier.

$$P(1+r/100)^2 = x(1+r/100) + x$$

$$P(1 + 5/100)^2 = 17640(1 + 5/100) + 17640$$

Solve for P, you will get $P = \text{Rs. } 32800$

Answer : (B)

Q. 7) What annual instalment will discharge a loan of Rs. 66000, due in 3 years at 10% Compound Interest?

Solution : Here again the question is of "Compound Interest" and hence we will solve it by equation :

Let each annual instalment be of Rs. x. Note that in this question, amount is given

$$\text{Amount} = x(1 + 10/100)^2 + x(1 + 10/100)^1 + x$$

$$66000 = x(1.21 + 1.1 + 1)$$

$$\text{So } x = \text{Rs. } 19939.58$$

Q. 8) What annual instalment will discharge a loan of Rs. 66000, due in 3 years at 10% Simple Interest?

I have just converted Q.7 into Simple Interest

Now we can either solve it by direct formula, or by equation

By Equation method :

$$66000 = (x + x*10*2/100) + (x + x*10*1/100) + x$$

$$66000 = x(3 + 0.2 + 0.1)$$

$$x = \text{Rs. } 20000$$

By Direct formula method :

$$A = 66000, t = 3, r = 10\%$$

$$x = 100A/[100t + t(t-1)r/2]$$

$$x = 100*66000/[100*3 + 3*2*10/2]$$

$$x = 6600000/(300 + 30)$$

$$x = \text{Rs. } 20000$$

Q. 1) If a sum of money becomes 3 times itself in 20 years at simple interest. What is the rate of interest?

In such questions apply the direct formula-

$$\text{Rate of interest} = [100*(\text{Multiple factor} - 1)]/T$$

$$\text{So } R = 100*(3 - 1)/20$$

Answer : 10%

Note : With this formula you can find Rate if Time is given and Time if rate is given.

Q. 2)

Divide Rs. 2379 into 3 parts so that their amounts after 2, 3 and 4 years respectively may be equal, the rate of interest being 5% per annum at simple interest. The first part is :

A. Rs. 759

B. Rs. 792

C. Rs. 818

D. Rs. 828

In such questions, just write this line :

$$\begin{aligned} \text{1st part : 2nd part : 3rd part} &= 1/(100+T_1 * r) : 1/(100+T_2 * r) : 1/(100+T_3 * r) \\ &= 1/(100+2 * 5) : 1/(100+3 * 5) : 1/(100+4*5) \\ &= 1/110 : 1/115 : 1/120 \\ &= 23*24 : 22*24 : 23*22 \end{aligned}$$

Hence 1st part = $(23*24)/(23*24 + 22*24 + 23*22) * 2379$

Answer : 828

Note : Surprisingly, such questions when asked mostly have this same data, i.e., $R=5\%$ and $T_1, T_2, T_3 = 2, 3, 4$ years, respectively. Only the Principal is changed. So it would be wise if you can just mug this line :

$$\text{1st part : 2nd part : 3rd part} = 23*24 : 22*24 : 23*22$$

Based on the above line, you would be able to solve such questions in a jiffy.

But note that it will only work if the question is on Simple Interest. Like the below question appeared in SSC CGL Tier 2-

A sum of ₹7,930 is divided into 3 parts and given on loan at 5% simple interest to A, B and C for 2,3 and 4 years respectively. If the amounts of all three are equal after their respective periods of loan, then the A received a loan of
(A) ₹2,750 (B) ₹2,800 (C) ₹2,760 (D) ₹3,050

Q. 4

Here the data is same, i.e., $R=5\%$ and $T_1, T_2, T_3 = 2, 3, 4$ years, respectively. So we will write directly -

$$\text{1st part : 2nd part : 3rd part} = 23*24 : 22*24 : 23*22$$

A received = $(23*24)/(23*24 + 22*24 + 23*22) * 7930$

Answer : Rs. 2760

Q. 5) If a certain sum of money P lent out for a certain time T amounts to P_1 at $R_1\%$ per annum and to P_2 at $R_2\%$ per annum, then

$$T = \frac{P_1 - P_2}{P_2 R_1 - P_1 R_2} \times 100 \text{ years}$$

The above formula is for calculating the Time, if the question asks the rate, then just interchange the rate and time. Hence the formula will become

$$R = \frac{(P_1 - P_2) * 100}{P_2 T_1 - P_1 T_2}$$

∴ A sum of money at simple interest amounts to Rs 600 in 4 years and Rs 650 in 6 years. Find the rate of interest per annum.

Apply the formula:

$$R = (650-600)*100/600*6 - 650*4$$

$$R = 5\%$$

Alternative Method :

You can solve such questions quickly without mugging the above formula. How?

The sum amounts to Rs. 600 in 4 years and Rs. 650 in 6 years. This means the simple interest is Rs. 50 for 2 years (because the amount increased from Rs. 600 to Rs. 650 in 2 years)

So the SI for 4 years is Rs. 100 (we have seen earlier than SI is proportional. So if SI = 100 for 2 years, then SI = 150 for 3 years, SI = 250 for 5 years and so on)

Now SI = Rs. 100; P = 600-100 = Rs. 500; t = 4 years

$$R = 100*SI/(P*t) = 10000/2000$$

Answer: 5%

For CI, the formula is different

If a certain sum of money at compound interest amounts to Rs.x in t_1 years and Rs.y in t_2 years, then the rate of interest per annum can be given by

$$R = \left[\left(\frac{y}{x} \right)^{1/(t_2-t_1)} - 1 \right] \times 100\%$$

Difference between CI and SI

This topic is very important from examination point of view. Note the following things-

If $t=1$ year, then SI = CI

If $t=2$ years then difference between CI and SI can be given by two formulas-

$$= P \left(\frac{R}{100} \right)^2$$

$$= \frac{R \times SI}{2 \times 100}$$

If $t=3$ years then difference between CI and SI can be given by two formulas-

$$= P \left(\frac{R}{100} \right)^2 \left(\frac{R}{100} + 3 \right)$$

$$= \frac{SI}{3} \left[\left(\frac{R}{100} \right)^2 + 3 \left(\frac{R}{100} \right) \right]$$

In all the above formulas we have assumed that the interest is compounded annually

Let us solve some CGL questions

If a sum of money compounded annually becomes 1.44 times of itself in 2 years, then the rate of interest per annum is

- (A) 25% (B) 22%
(C) 21% (D) 20%

Q. 6

$$A = P(1+r/100)^t$$

Given, $A=1.44P$ $t = 2$ years

$$1.44P = P(1 + r/100)^2$$

$$r = 20\%$$

Answer : (D)

What sum will give ₹ 244 as the difference between simple interest and compound interest at 10% in $1\frac{1}{2}$ years compounded half yearly ?

- (A) ₹ 40,000 (B) ₹ 36,000
(C) ₹ 32,000 (D) ₹ 28,000

Q. 7

Here the interest is compounded half yearly, so the formulas we mugged earlier are of no use here.

We will have to solve this question manually

$$SI = P * 10 * 1.5 / 100 = 0.15P$$

$$CI = P(1 + 5/100)^3 - P = P(1.05^3 - 1)$$

$$\text{Given } CI - SI = 244$$

$$P(1.05^3 - 1) - 0.15P = 244$$

$$P = \text{Rs. } 32000$$

Answer : (C)

If the compound interest on a sum for 2 years at $12\frac{1}{2}\%$ p.a. is ₹ 510, the simple interest on the same sum at the same rate for the same period of time is

- (A) ₹ 400 (B) ₹ 450
(C) ₹ 460 (D) ₹ 480

Q. 8

Time = 2 years

Hence apply the formula: $\text{Difference}(D) = R * SI / 200$

$$CI - SI = R * SI / 200$$

$$CI - SI = (12.5 / 200) * SI$$

$$510 = 1.0625 * SI \quad [\text{Since } CI = \text{Rs. } 510]$$

$$SI = \text{Rs. } 480$$

Answer : (D)

The compound interest on ₹ 1,800 at 10% per annum for a certain period of time is ₹ 378. Find the time in years.

(A) 2.5 years (B) 2.0 years

(C) 2.8 years (D) 3.0 years

Q. 9

CI for 1st year = 10% of 1800 = Rs. 180

CI for 2nd years = 180 + 10% of 180 = Rs. 198

Total = 180 + 198 = Rs. 378

Hence time = 2 years

Or you can apply the formula

$$A = P(1 + r/100)^t$$

Answer : (B)

The difference between the interests received from two different banks on ₹ 500 for two years is ₹ 2.50. The difference between their rates is

(A) 1 % (B) .5 %

(C) 2.5 % (D) .25 %

Q. 10

$$2.5 = P * R * 2 / 100 - P * r * 2 / 100$$

$$2.5 = 10R - 10r$$

$$R - r = 0.25$$

Answer : (D)

The compound interest on a certain sum of money for 2 years at 5% is ₹ 328, then the sum is

- (A) ₹ 3000 (B) ₹ 3600
(C) ₹ 3200 (D) ₹ 3400

Q. 11

CI for 1st year = 5% of P = $0.05P$

CI for 2nd year = 5% of P + 5% of (5% of P) = $0.05P + 0.0025P = 0.0525P$

Total CI = $0.05P + 0.0525P = 0.1025P$

Given, $0.1025P = 328$

P = ₹. 3200

Answer : (C)

Note : You can solve this question by the formula $A = P(1+r/100)^t$ as well

On a certain principal the compound interest compounded annually for the second year at 10% per annum is ₹ 132. The principal is

- (A) ₹ 1000 (B) ₹ 1320
(C) ₹ 1250 (D) ₹ 1200

Q. 12

Note that in this question the CI for 2 years is not given, but the CI for the 2nd year is given.

CI for 2nd year = 10% of P + 10% of (10% of P) = $0.1P + 0.01P = 0.11P$

Given, $0.11P = 132$

P = ₹. 1200

Answer : (D)

The principal which gives ₹ 1 interest per day at a rate of 5% simple interest per annum is

- (A) ₹ 7300 (B) ₹ 3650
(C) ₹ 5000 (D) ₹ 36500

Q. 13

Interest = Re. 1 per day = Rs. 365 for 1 year

$$SI = P \cdot r \cdot t / 100$$

$$t=1, r=5\%, SI = \underline{\text{Rs. 365}}$$

$$\text{So, } P = 365 \cdot 100 / 5 = \underline{\text{Rs. 7300}}$$

Answer : (A)

Q. 14

The difference between compound and simple rates of interest on Rs. 10000 for 3 years at 5% p.a. is

- (a) Rs. 76.50 (b) Rs. 76 (c) Rs. 76.25 (d) Rs. 76.75

We know

$$\text{Difference} = P(r/100)^2(r/100 + 3)$$

$$P = \underline{\text{Rs. 10000}}, r = 5\%, t = 3 \text{ years}$$

$$\text{Hence } D = \underline{\text{Rs. 76.25}}$$

Answer : (C)

Q. 15

An amount is invested in a bank at compound rate of interest, after first and third year is Rs. 1200 and Rs. 1587 respectively. What is the rate of interest?

- (a) 12% (b) 15% (c) 10% (d) 3.9%

$$\text{We know, } R = [(y/x)^{(1/T_2 - T_1)} - 1] \cdot 100$$

$$= [(1587/1200)^{1/(3 - 1)} - 1] \cdot 100$$

$$= [(1587/1200)^{1/2} - 1] \cdot 100$$

$$= 3/20 \cdot 100$$

$$= 15\%$$

Answer : (B)

Q.16) The difference between CI and SI on a certain sum at 10% per annum for 4 years is Rs 1282. Find the sum.

SI for 4 years @10% = $40P/100 = 0.4P$

CI for 4 years @10% = $P(1.1^4 - 1) = 0.4641P$

$$0.4641P - 0.4P = 1282$$

$$P = \text{Rs. } 20000$$

Q.17) A sum of money lent at compound interest for 2 years at 20% per annum would fetch Rs. 482 more of interest was payable half yearly than if it was payable annually. The sum is ?

When interest is compounded half-yearly

$$A = P(1 + 10/100)^4$$

When interest is compounded annually

$$A = P(1 + 20/100)^2$$

$$\text{Given, } P(1 + 10/100)^4 - P(1 + 20/100)^2 = 482$$

Solve for P

Answer : Rs. 20000

Note : In the question, they have given the difference between the interest but we have taken the difference between the Amounts because the difference in amount is equal to the difference in interest.

Speed, Time and Distance Hacks

A man travelled a distance of 80 km in 7 hrs partly on foot at the rate of 8 km per hour and partly on bicycle at 16 km per hour. The distance travelled on the foot is
(A) 32 km (B) 48 km
(C) 36 km (D) 44 km

Q. 1)

Let the distance travelled on foot be X km. Then distance travelled on bicycle will be Rs. $(80 - X)$
 $X/8 + (80 - X)/16 = 7$

After forming this equation, don't solve it for X. Just observe, $X/8$ denotes that X is a multiple of 8 (although you can't be 100% sure, but SSC generally likes whole numbers). That means answer is either 32 km or 48 km. Put $X = 32$ km in the equation and check if it satisfies the equation. It does!

Answer : (A)

A train 300 m long is running with a speed of 54 km/hr. In what time will it cross a telephone pole ?
(A) 20 sec (B) 15 sec
(C) 17 sec (D) 18 sec

Q. 2)

This is a commonly asked question. Just remember -

Time taken to cross a telephone pole = Time taken by the train to cover a distance equal to its length

Speed = 54 km/hr = $54 \times \frac{5}{18}$ m/sec = 15 m/sec

Time taken by the train to cover a distance equal to its length = $300/15 = 20$ sec

Answer : (A)

Two trains of equal length are running on parallel lines in the same direction at the rate of 46 km/hr and 36 km/hr. The faster train passes the slower train in 36 seconds. The length of each train is
(A) 50 m (B) 72 m
(C) 80 m (D) 82 m

Q. 3)

If two objects A and B are moving at a given speed and we are asked "when will A overtake B" or "When will the police catch the thief", we use the concept of **Relative Velocity**. It's very simple

When the objects are moving in opposite direction, Relative velocity = Speed of A + Speed of B

When the objects are moving in the same direction, Relative velocity = Speed of A - Speed of B

Let the length of each train be L metres.

Here, the trains are moving in the same direction, hence relative velocity = Speed of train A - Speed of Train B = $10 \text{ km/hr} = 10 * \frac{5}{18} \text{ m/sec} = \frac{25}{9} \text{ m/sec}$

We know, Distance = Speed * Time

Here, Distance = Sum of the length of both the trains, i.e., $2L$

Speed = Relative velocity

Time = Time taken by the faster train to overtake the slower train

So, $2L = 36 * \frac{25}{9}$

$L = 50 \text{ m}$

Answer : (A)

Two trains are running 40 km/hr and 20 km/hr respectively in the same direction. The fast train completely passes a man sitting in the slow train in 5 seconds. The length of the fast train is

(A) $23 \frac{2}{9} \text{ m}$

(B) 27 m

(C) $27 \frac{7}{9} \text{ m}$

(D) 23 m

Q. 4)

This question is similar to Q. No. 2. We just have to replace the Speed of the train, with Relative Velocity.

Let the length of the fast train be L.

Trains are running in the same direction, hence Relative Velocity = $40 - 20 = 20 \text{ km/hr} = \frac{50}{9} \text{ m/sec}$

$L = \frac{50}{9} * 5 = \frac{250}{9} \text{ metres}$

Answer : (C)

A and B are 20 km apart. A can walk at an average speed of 4 km/hour and B at 6 km/hr. If they start walking towards each other at 7 a.m., when they will meet ?

(A) 8.00 a.m.

(B) 8.30 a.m.

(C) 9.00 a.m.

(D) 10.00 a.m.

Q. 5)

You can solve such questions with two methods -

Method 1 (Relative Velocity)

Relative velocity of A and B = $6 + 4 = 10$ km/hr

They have to cover a distance of 20 km.

Hence they will meet in $20/10 = 2$ hours

So if they start at 7 a.m., they will meet at 9:00 a.m.

Answer : (C)

Method 2 (Equate the distance)

Let A and B after t hours

Then distance covered by A in t hours + Distance covered by B in t hours = 20

$$t \cdot 4 + t \cdot 6 = 20$$

$$\text{or } t = 2 \text{ hours}$$

A train leaves a station A at 7 am and reaches another station B at 11 am. Another train leaves B at 8 am and reaches A at 11.30 am. The two trains cross one another at

- (A) 8.36 am (B) 8.56 am
(C) 9.00 am (D) 9.24 am

Q. 6)

This question is similar to the above question. But it has a twist! The two trains are not moving at the same time. First train is starting at 7 am, while second train is starting at 8 am.

Method 1 (Relative Velocity)

Remember! To apply the relative velocity formula in such questions, we will first have to make the trains move at the same time. How?

Let the distance between the trains be X km

The first train takes 4 hours (7 am to 11 am) to move from A to B

Hence speed of the first train = $X/4$

The second train takes 3.5 hours (8 am to 11:30 am) to move from B to A

Hence speed of the second train = $X/3.5$

From 7 am to 8 am (1 hour), only the first train is moving. Distance travelled by the first train in 1 hour = $X/4 \cdot 1 = X/4$

Distance left between the two trains = $X - X/4 = (3/4)X$

Relative velocity of the trains = $X/4 + X/3.5$

Time taken by the trains to cross one another = (Distance between them) / (Relative velocity)

$$= (3/4)X / (X/4 + X/3.5)$$

$$= 1.40 \text{ hours}$$

$$= 1 \text{ hour } 24 \text{ minutes}$$

So the trains will cross one another at 8 am + 1 hr 24 min = 9 : 24 am

Answer (D)

Method 2 (Equate the distance)

Let the trains cross each other in t hours

First train starts early, so it will travel for complete t hours. But second train starts 1 hour after the first train, so it will travel for $(t - 1)$ hours

Distance travelled by first train in t hours + Distance travelled by second train in $(t - 1)$ hours = X

$$X/4 * t + X/3.5 * (t - 1) = X$$

$$t = 2.4 \text{ hours} = 2 \text{ hours } 24 \text{ minutes}$$

But this time will be added to 7 a.m.

So, Answer = 7 a.m. + 2 hours 24 minutes = 9:24 a.m.

A thief steals a car at 1.30 p.m. and drives it off at 40 km/hr. The theft is discovered at 2 p.m. and the owner sets off in another car at 50 km/hr. He will overtake the thief at

- (A) 4 p.m. (B) 4.30 p.m.
(C) 6 p.m. (D) 5 p.m.

Q. 7)

This question is similar to the above question.

Chor-Sipahi questions are best tackled with Relative Velocity.

Relative Velocity of the Thief and the Owner = $50 - 40 = 10$ km/hr

Distance travelled by the thief in half an hour (from 1:30 p.m. to 2 p.m.) = $0.5 * 40 = 20$ km

Now the distance between the owner and the thief is 20 km.

So time taken to catch the thief = Distance between them / Relative velocity = $20/10 = 2$ hours

He will catch the thief at 2 p.m. + 2 hours = 4 p.m.

Answer : (A)

P and Q starting simultaneously from two different places proceed towards each other at a speed of 20 km/hour and 30 km/hour respectively. By the time they meet each other, Q has covered 36 km more than P. The distance (in km.) between the two places is

- (A) 180 (B) 108
(C) 144 (D) 162

Q. 8)

Method 1 (Relative velocity)

Let P and Q meet in t hours

Distance travelled by P in t hours = $20t$ (because the speed of P is 20 km/hr)

Distance travelled by Q in t hours = $30t$ (because the speed of Q is 30 km/hr)

Given, $30t - 20t = 36$ km

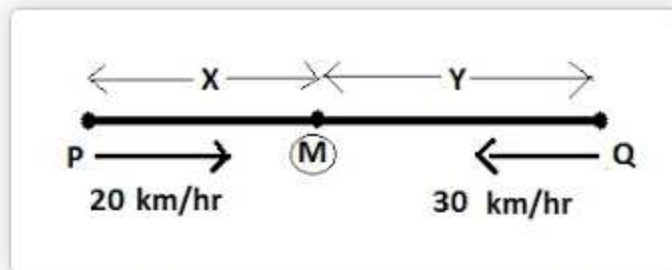
or $t = 3.6$ hours

So P and Q meet after 3.6 hours

Relative velocity of P and Q = $20 + 30 = 50$ km/hr

Distance between the two places = Time taken by P and Q to meet * Relative velocity = $50 * 3.6 = 180$ km

Answer : (A)

Method 2

Let P and Q meet at point M. P has to travel X km to reach M and Q has to travel Y km.

Time taken by P to reach M = Time taken by Q to reach M

$$X/20 = Y/30$$

$$X/Y = 2/3$$

Given, $Y - X = 36$ km

Divide the whole equation with Y

$$1 - X/Y = 36/Y$$

$$1 - 2/3 = 36/Y \text{ [Put } X/Y = 2/3]$$

$$Y = 108 \text{ km}$$

$$\text{Hence } X = Y - 36 = 72 \text{ km}$$

$$\text{Distance between the two places} = X + Y = 108 + 72 \text{ km} = 180 \text{ km}$$

Answer : (A)

A train goes from Ballygunge to Sealdah at an average speed of 20 km/hour and comes back at an average speed of 30 km/hour. The average speed of the train for the whole journey is

- (A) 27 km/hr (B) 26 km/hr
(C) 25 km/hr (D) 24 km/hr

Q. 1)

Apply the direct formula

Average speed for the complete journey = $\frac{2XY}{X+Y} = \frac{2 \times 20 \times 30}{50} = 24$ km/hr

Answer : (D)

On a journey across Mumbai, a taxi averages 20 m.p.h. for 70% of the distance, 25 m.p.h. for 10% of the distance and 8 m.p.h. for the remainder. Then the average speed of the whole journey is

- (A) 15.925 m.p.h. (B) 15.25 m.p.h.
(C) 15 m.p.h. (D) 15.625 m.p.h.

Q. 2)

Let the total distance be 100 km

Average Speed = Total Distance/Total Time

Total time = $\frac{70}{20} + \frac{10}{25} + \frac{20}{8} = 3.5 + 0.4 + 2.5 = 6.4$

Average Speed = $100/6.4 = 15.625$ m.p.h

If a boy walks from his house to school at the rate of 4 km per hour, he reaches the school 10 minutes earlier than the scheduled time. However, if he walks at the rate of 3 km per hour, he reaches 10 minutes late. Find the distance of his school from his house.

- (A) 5 km (B) 4 km
(C) 6 km (D) 4.5 km

Q. 3)

This is again a very frequently asked question. Let the distance of his school be X km.

(Time taken to reach the school at 3 km/hr) - (Time taken to reach the school at 4 km/hr) = (10 + 10) minutes or $\frac{1}{3}$ hours

$$\frac{X}{3} - \frac{X}{4} = \frac{1}{3}$$

Hence $X = 4$ km

Answer : (B)

Direct Formula

Distance = $\frac{S_1 \cdot S_2}{(S_1 - S_2)} \cdot \text{Time difference}$

$S_1 = 4$ km/hr, $S_2 = 3$ km/hr, Time Difference = $10 - (-10) = 20$ minutes or $\frac{1}{3}$ hours

$$\text{Distance} = \frac{4 \cdot 3}{(4-3)} \cdot \frac{1}{3} = 4 \text{ km}$$

Note: In the above formula, while calculating the time difference, "late" time is written with negative sign.

Two runners cover the same distance at the rate of 15 km and 16 km per hour respectively. Find the distance travelled when one takes 32 minutes longer than the other.

- (A) 128 km (B) 64 km
(C) 96 km (D) 108 km

Q. 4)

Method 1

Let time taken by second runner = t. So time taken by first runner = $t + \frac{32}{60} = t + \frac{8}{15}$

Since distance is constant, hence speed and time are inversely proportional

$$\frac{S_2}{S_1} = \frac{T_1}{T_2}$$

$$\frac{16}{15} = \frac{(t + \frac{8}{15})}{t}$$

$$\frac{16}{15} = 1 + \frac{8}{15t}$$

$$\frac{1}{15} = \frac{8}{15t}$$

$$t = 8 \text{ hours}$$

So second runner takes 8 hours to cover the distance with a speed of 16 km/hr

Hence distance = $8 \cdot 16 = 128$ km

Method 2

Let the distance be X km. Then,

$$\frac{X}{15} - \frac{X}{16} = \frac{32}{60}$$

Solve for X

$$X = 128 \text{ km}$$

Answer: (A)

Method 3 (Direct formula)-

In such questions you can use the same formula you used for Q. (3)

$$\text{Distance} = \frac{S_1 \cdot S_2}{(S_1 - S_2)} \cdot \text{Time difference}$$

$$\text{Distance} = \frac{16 \cdot 15}{(16 - 15)} \cdot \left(\frac{32}{60}\right) = 16 \cdot 15 \cdot \frac{32}{60} = 128 \text{ km}$$

A man rows down a river 15 km in 3 hrs. with the stream and returns in $7\frac{1}{2}$ hrs. The rate at which he rows in still water is

- (A) 2.5 km/hr (B) 1.5 km/hr
(C) 3.5 km/hr (D) 4.5 km/hr

Q. 5)

A man rows down a river 15 km in 3 hrs.

$$\text{Hence, Downstream Speed}(v) = \frac{15}{3} = 5 \text{ km/hr}$$

$$\text{Similarly, Upstream Speed}(u) = \frac{15}{7.5} = 2 \text{ km/hr}$$

$$v = \text{Rate in still water} + \text{Rate of stream}$$

$$u = \text{Rate in still water} - \text{Rate of stream}$$

Add the above 2 equations-

$$\text{Rate in still water} = \frac{(v + u)}{2} = \frac{(5 + 2)}{2} = 3.5 \text{ km/hr}$$

Answer: (C)

A man rows upstream 36 km and downstream 48 km taking 6 hours each time. The speed of the current is

- (A) 2 km/hour (B) 1.5 km/hour
(C) 0.5 km/hour (D) 1 km/hour

Q. 6)

We have in the above question-

$$\text{Speed of the current} = \frac{(v - u)}{2}$$

$$u = \frac{36}{6} = 6 \text{ km/hr}$$

$$v = \frac{48}{6} = 8 \text{ km/hr}$$

$$\text{Speed of the current} = \frac{(8 - 6)}{2} = 1 \text{ km/hr}$$

Answer: (D)

A boat takes half time in moving a certain distance downstream than upstream. The ratio of the speed of the boat in still water and that of the current is

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

Q. 7)

Let the distance be X km. Let he takes 't' time downstream, then he will take '2t' time upstream.

Downstream speed(v) = X/t

Upstream speed(u) = X/2t

Speed of the boat in still water/Speed of the current = (v + u)/(v - u) = (X/t + X/2t)/(X/t - X/2t)

= 3/2 : 1/2

= 3 : 1

Answer : (B)

Direct Formula

A man rows a certain distance downstream in t_1 hours and returns the same distance upstream in t_2 hours. If the speed of the stream is y km/hr, then the speed of the man in still water

$$= y \left(\frac{t_2 + t_1}{t_2 - t_1} \right) \text{ km/hr}$$

So, Speed of the boat in still water/Speed of the current = $(2t + t)/(2t - t) = 3 : 1$

A boat goes 24 km upstream and 28 km downstream in 6 hours. It goes 30 km upstream and 21 km downstream in 6 hours and 30 minutes. The speed of the boat in still water is

(A) 8 km/hr (B) 9 km/hr
(C) 12 km/hr (D) 10 km/hr

Q. 8)

Given,

$$24/u + 28/v = 6 \quad \text{or} \quad 12/u + 14/v = 3 \quad \dots (1)$$

$$30/u + 21/v = 6.5 \quad \dots (2)$$

The best way to solve (1) and (2) is by eliminating a variable.

Multiply equation (1) by 3

$$36/u + 42/v = 9 \quad \dots (3)$$

Multiply equation (2) by 2

$$60/u + 42/v = 13 \quad \dots (4)$$

Subtract equation (3) from (4)

$$24/u = 4$$

$$u = 6 \text{ km/hr}$$

Put $u = 6$ in equation (1)

$$v = 14 \text{ km/hr}$$

$$\text{Speed of the boat in still water} = (u + v)/2 = (6 + 14)/2 = 10 \text{ km/hr}$$

Answer: (D)

Q. 9) Two guns were fired from the same place at an interval of 13 minutes but a person in a train approaching the place hears the second shot 12 mins 30 seconds after the first. Find the speed of the train (approx) supposing that sound travels at 330 m/s.

A. 40 B. 47 C. 55 D. 60

Distance travelled by sound in 30 sec = Distance travelled by train in 12 min 30 sec

Let the speed of the train be X m/sec

Distance travelled by sound in 30 sec = 330×30 metres

Distance travelled by train in 12 min 30 sec (750 sec) = $X \times 750$

$$330 \times 30 = X \times 750$$

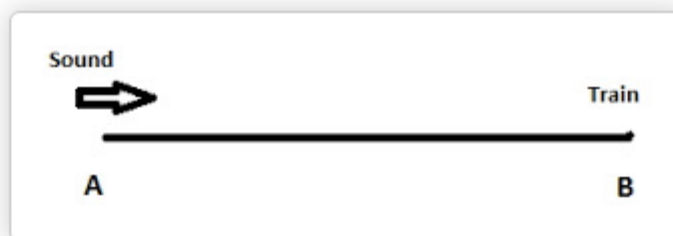
$$X = 13.2 \text{ m/sec} = 13.2 \times 18/5 \text{ km/hr} = 47.52 \text{ km/hr}$$

Answer: 47 km/hr

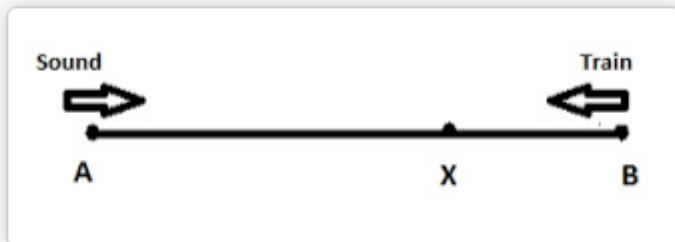
Explanation

When you hear the gun shot, that means the sound has travelled to your ears.

First consider a simple scenario when the train is not moving. When the two shots are fired from A, a person sitting in the train will hear them at an interval of 13 minutes only. The sound travels the distance from A to B.



Now let us consider the scenario when the train is moving from B to A. When the first shot is fired, the sound will travel from A to B and the person sitting inside the train will hear it instantly. Now when the second shot is fired after 13 minutes, the sound would not have to travel from A to B, because the person sitting inside the train is not at B any more. He has moved from position B to X. Hence the sound only needs to travel from A to X.



Hence in this case, the person is hearing the shot after 12 minutes 30 seconds. Instead of travelling for 13 minutes (from A to B), now the sound is travelling only for 12 min 30 sec (from A to X). Hence we can say,

AB = Distance travelled by sound in 13 minutes

AX = Distance travelled by sound in 12 minutes 30 seconds

XB = Distance travelled by sound in 30 seconds ... (1)

After 12 minutes 30 seconds, the sound moves from A to X and also the train moves from B to X.

BX = Distance travelled by train in 12 minutes 30 seconds ... (2)

Hence from (1) and (2) we can say-

Distance travelled by sound in 30 sec = Distance travelled by train in 12 min 30 sec

Q. 10) Two guns were fired from the same place at an interval of 10 minutes and 30 seconds, but a person in a train approaching the place hears second shot 10 minutes after the first. The speed of train (in km/hr), supposing that sound travels at 330m/s is:

- A. 19.8 B. 58.6 C. 59.4 D. 111.8**

Distance travelled by sound in 30 sec = Distance travelled by train in 10 minutes (600 sec)

$$330 \times 30 = X \times 600$$

$$X = 16.5 \text{ m/sec or } 59.4 \text{ km/hr}$$

Answer: (C)

Q. 11) A car travels from P to Q at a constant speed. If its speed is increased by 10 kmph, it would've taken 1 hour less to cover the distance. It would've taken further 45 minutes lesser if the speed was further increased by 10 kmph. The distance between P and Q is ?

Let the distance between P and Q be X km. Let the car travels this distance at the speed of S km/hr in T hours.

$$\text{Then, } S \cdot T = (S + 10)(T - 1)$$

$$ST = ST - S + 10T - 10$$

$$10T = S + 10 \quad \dots (1)$$

$$\text{Similarly, } ST = (S + 20)(T - 1.75)$$

For more, check-out: <http://sschacks.blogspot.in/>

$$ST = ST - 1.75S + 20T - 35$$

$$20T = 1.75S + 35 \quad \dots (2)$$

Solve (1) and (2). You will get $S = 60$ km/hr, $T = 7$ hours

$$X = ST = 60 \times 7 = 420 \text{ km}$$

Distance between P and Q = 420 km

45. By walking at $\frac{3}{4}$ of his usual speed, a man reaches his office 20 minutes later than his usual time. The usual time taken by him to reach his office is

- (a) 75 minutes
- (b) 60 minutes
- (c) 40 minutes
- (d) 30 minutes

$$\frac{\text{Numerator}}{(\text{Numerator} - \text{Denominator})} \times \text{Time}$$

Note : Always take the difference between numerator and denominator as positive.

$$\text{Answer : } 3/(4-3) \times 20 = 60 \text{ minutes}$$

Next question -

Rakesh runs at $\frac{5}{4}$ of his usual speed and reaches the playground 5 minutes earlier. What is his usual time?

$$\text{Answer : } 5/(5-4) \times 5 = 25 \text{ minutes}$$

Time and Work Hacks

Note: In the complete Time and Work series, Efficiency would mean "Work Done in 1 day", and efficiency has been denoted by small letters, e.g. "a" means "Efficiency of A".

If x can finish a job in 4 hours and y can finish the same job in 8 hours independently, then they together will finish the job in
(A) 160 minutes (B) 150 minutes
(C) 140 minutes (D) 120 minutes

Q. 1)

Let the total work be 8 units (because 8 is the LCM of 4 and 8)

Efficiency of x (Work done by x in 1 hour) = $8/4 = 2$ units

Efficiency of y (Work done by y in 1 hour) = $8/8 = 1$ unit

Work done by (x + y) in 1 hour = 3 units

3 units work in completed in 1 hour. Hence 8 units work will be completed in $8/3$ hours or 160 minutes.

Answer: (A)

Raj and Ram working together do a piece of work in 10 days. Raj alone can do it in 12 days. Ram alone will do the work in
(A) 20 days (B) 40 days
(C) 50 days (D) 60 days

Q. 2)

Let total work be 60 units (LCM of 10 and 12)

Raj completes the work in 12 days. Hence efficiency or per day work of Raj = $60/12 = 5$ units

Raj and Ram take 10 days to complete the work, hence their efficiency = $60/10 = 6$ units

Now Efficiency of Ram = (Efficiency of Raj and Ram) – (Efficiency of Raj) = $6 - 5 = 1$ unit

That means Raj completes 1 unit of work per day. So to perform 60 units of work, he will take 60 days.

Answer: (D)

A and B do a piece of work in 15 days. B and C can do a similar work in 12 days and C and A in 10 days. How many days will A take to do the work by himself?
(A) 40 (B) 8 (C) 13 (D) 24

Q. 3)

Let total work = 120 units

Efficiency of A + B = $120/15 = 8$ units

Efficiency of B + C = $120/12 = 10$ units

Efficiency of C + A = $120/10 = 12$ units

Adding all the above 3 equations –

$2 * (A + B + C) = 30$

Efficiency of (A + B + C) = 15 units

Efficiency of B + C = $120/12 = 10$ units

Hence Efficiency of A = Efficiency of (A + B + C) - Efficiency of (B + C) = $15 - 10 = 5$ units

Hence time taken by A to do 120 units of work = $120/5 = 24$ days

Answer: (D)

A tank has two pipes. The first pipe can fill it in 4 hours and the second can empty it in 16 hours. If two pipes be opened together at a time, then the tank will be filled in

(A) 10 hours (B) $5\frac{1}{3}$ hours

(C) $5\frac{1}{2}$ hours (D) 6 hours

Q. 4)

Let the total work be 16 units.

Efficiency of first pipe = $16/4 = +4$ units

Efficiency of second pipe = $16/16 = -1$ units [negative sign because this pipe is emptying the tank]

When both the pipes are opened together, their efficiency = $(+4) + (-1) = +3$ units [The positive sign indicates that when both the pipes are opened together, their net result will fill the tank]

3 units of work is done in 1 hour

16 units of work is done in $16/3$ hours

Answer: (B)

Note : In questions where one pipe is emptying the cistern while another is filling it, you must put a positive or negative sign before the efficiency. But in questions where both the pipes are emptying the cistern or both the pipes are filling the cistern, you can take the efficiency of both the pipes as positive.

Two pipes can fill a cistern in 3 hours and 3 hours 45 minutes respectively and a third pipe can empty the whole cistern in an hour. The cistern is half full of water and all the three pipes are opened together. The time after which the cistern will be emptied, is

(A) 1 hour 45 minutes
 (B) 45 minutes
 (C) 1 hour 15 minutes
 (D) 1 hour 30 minutes

$2m + 1w = 11$
 $4m + 1w = 11$

Q. 5)

Let the total work be 15 units.

Efficiency of first pipe = $15/3 = +5$ units

Efficiency of second pipe = $15/3.75 = +4$ units

Efficiency of third pipe = $15/1 = -15$ units

Efficiency of all the three pipes = $5 + 4 - 15 = -6$ units

If all the pipes are opened, it will take $15/6$ or $5/2$ hours to empty the cistern, but the cistern is already half empty, hence only $5/4$ hours are required to empty it.

Answer: (C)

A cistern is provided with two pipes A and B. A can fill it in 20 minutes and B can empty it in 30 minutes. If A and B be kept open alternately for one minute each, how soon will the cistern be filled ?

- (A) 121 minutes (B) 110 minutes
 (C) 115 minutes (D) 120 minutes

Q. 6)

Let the total work = 60 units

Efficiency of A = $60/20 = +3$ units

Efficiency of B = $60/30 = -2$ units

Now total work to be performed is 60 units. When 57 units work is complete, A will take 1 more minute to add 3 units and hence will make it a total of 60 units.

Hence time taken to fill the tank = Time taken to perform 57 units of work + 1 minute

Now A and B are opened alternatively. That means for the first minute only A is opened, for the second minute A is closed and B is opened, then for third minute again B is closed and A is opened and so on.

So for each 2 minutes cycle, work done = Efficiency of A + Efficiency of B = $+3 + (-2) = 1$ unit

1 unit work is done in 2 minutes, so 57 units work is done in 114 minutes

Time taken to fill the tank = $114 + 1 = 115$ minutes

Answer: (D)

Explanation : We have to perform a total of 60 units of work. For the 1st minute - A adds 3 units of work, but in the 2nd minute, B adds (-2) units of work and hence makes total work for 2 minutes = $(+3) + (-2) = 1$ unit. So effectively in 2 minutes, we are just adding 1 unit of work. Hence in 4 minutes, 2 units of work will be performed and in 6 minutes 3 units of work will be performed. Same sequence will continue till 57 units. As soon as 57 units of work is done (in 114 minutes), it will be A's turn to do the work. A will add 3 units of work(in 1 minute) and hence take the total work from 57 units to 60 units. B won't be needed any more.

If 40 men or 60 women or 80 children can do a piece of work in 6 months, then 10 men, 10 women and 10 children together do half of the work in

- (A) $5\frac{6}{13}$ months (B) 6 months
 (C) $5\frac{7}{13}$ months (D) $11\frac{1}{13}$ months

Q. 7)

Let the total work be 240 units.

40 men complete the work in 6 months. Hence 10 men can complete the work in $6 \times 4 = 24$ months.

Hence, Efficiency of 10 men = $240/24 = 10$ units

60 women complete the work in 6 months. Hence 10 women can complete the work in $6 \times 6 = 36$ months. Hence, Efficiency of 10 women = $240/36 = 20/3$ units

80 boys complete the work in 6 months. Hence 10 boys can complete the work in $6 \times 8 = 48$ months.

Hence, Efficiency of 10 boys = $240/48 = 5$ units

Efficiency of 10 men + Efficiency of 10 women + Efficiency of 10 boys = $10 + 20/3 + 5 = 65/3$ units

So, 10 men, 10 women and 10 boys complete $65/3$ units of work in 1 month. To complete 120 units(half of the work), they will take = $120 \times 3/65 = 72/13$ months

Answer: (C)

2 men and 1 women can complete a piece of work in 14 days while 4 women and 2 men can do the same work in 8 days. If a man gets ₹ 180 per day, then a woman will get per day

- (A) ₹ 120 (B) ₹ 160
 (C) ₹ 150 (D) ₹ 140

Q. 8)

Let the total work be 112 units and the efficiency of 1 man and 1 woman be m and w respectively

$$2m + w = 112/14 = 8$$

$$4w + 2m = 112/8 = 14$$

Solve the equations and you will get $w = 2$ and $m = 3$

Hence the wage of woman = $2/3 * 180 = \text{Rs. } 120$

Answer: (A)

A, B and C are employed to do a piece of work for ₹ 575. A and C are supposed to finish $\frac{19}{23}$ of the work together. Amount shall be paid to B is

- (A) ₹ 210 (B) ₹ 100
(C) ₹ 200 (D) ₹ 475

Q. 9)

A and C complete $19/23$ of the work. Hence B does $4/23$ of the work

Amount paid to B = $4/23 * 575 = \text{Rs. } 100$

Answer: (B)

Two workers A and B are engaged to do a piece of work. A working alone would take 8 hours more to complete the work than when work together. If B worked alone, would take $4\frac{1}{2}$ hours more than when work together. The time required to finish the work together is

- (A) 4 hours (B) 6 hours
(C) 5 hours (D) 8 hours

Q. 10)

Let A and B complete the work in x days

Then A will complete the work in $(x + 8)$ days and B will complete the work in $(x + 4.5)$ days. Now,

$$1/(x + 8) + 1/(x + 4.5) = 1/x$$

Solve the equation and you will get $x = 6$ hours

Answer: (D)

Three men A, B, C working together can do a job in 6 hours less time than A alone, in 1 hour less time than B alone and in one half the time needed by C when working alone. Then A and B together can do the job in

- (A) $\frac{2}{3}$ hours (B) $\frac{3}{4}$ hours
(C) $\frac{3}{2}$ hours (D) $\frac{4}{3}$ hours

Q. 11)

The question is same the previous one.

Let A, B and C take 'x' days to do the job. Then,

A takes (x + 6) days, B takes (x + 1) days and C taken 2x days

$$\frac{1}{x+6} + \frac{1}{x+1} + \frac{1}{2x} = \frac{1}{x}$$

$$\frac{1}{x+6} + \frac{1}{x+1} = \frac{1}{x} - \frac{1}{2x}$$

$$\frac{1}{x+6} + \frac{1}{x+1} = \frac{1}{2x} \quad \dots (1)$$

Solve it and you will get $x = \frac{2}{3}$

From equation (1) you can see that A and B take 2x days to complete the work

Answer: (D)

Note: In the complete Time and Work series, Efficiency would mean "Work Done in 1 day", and efficiency has been denoted by small letters, e.g. "a" means "Efficiency of A".

Pratibha is thrice as efficient as Sonia and is therefore able to finish a piece of work in 60 days less than Sonia. Pratibha and Sonia can individually complete the work respectively in
(A) 30, 60 days (B) 60, 90 days
(C) 30, 90 days (D) 40, 120 days

Q. 1)

If Pratibha finishes the work in X days, then Sonia will take 3X days to finish the same work

Given $3X - X = 60$

Or $X = 30$

Pratibha takes 30 days and Sonia takes 90 days

Answer: (A)

Sunil completes a work in 4 days, whereas Dinesh completes the work in 6 days. Ramesh works $1\frac{1}{2}$ times as fast as Sunil. The three together can complete the work in

- (A) $1\frac{5}{12}$ days (B) $1\frac{5}{7}$ days
(C) $1\frac{3}{8}$ days (D) $1\frac{5}{19}$ days

Q. 2)

Let the total work be 24 units.

Efficiency of Sunil = $24/4 = 6$ units (Since Sunil takes 4 days to complete the work)

Efficiency of Ramesh = $6 * 1.5 = 9$ units (Since Ramesh is 1.5 times efficient as Sunil)

Efficiency of Dinesh = $24/6 = 4$ units ((Since Sunil takes 6 days to complete the work))

Efficiency of (Sunil + Ramesh + Dinesh) = $6 + 9 + 4 = 19$ units

Time required to finish the complete work = $24/19$ days

Answer: (D)

Two workers A and B working together completed a job in 5 days. If A worked twice as efficiently as he actually did and B worked $\frac{1}{3}$ as efficiently as he actually did, the work would have been completed in 3 days. To complete the job alone, A would require

- (A) $5\frac{1}{5}$ days (B) $6\frac{1}{4}$ days
(C) $7\frac{1}{2}$ days (D) $8\frac{3}{4}$ days

Q. 3)

Let the total work be 15 units. Efficiency of A = a and Efficiency of B = b

A and B complete the work in 5 days.

Hence efficiency of A and B = $15/5 = 3$ units

So, $a + b = 3$... (1)

New efficiency of A = $2a$

New efficiency of B = $b/3$

With new efficiency the work was completed in 3 days.

So, $2a + b/3 = 15/3 = 5$... (2)

Solve (1) and (2), you will get $a = 12/5 = 2.4$ units

So A will complete 15 units work in $15/2.4$ or $25/4$ days

Answer: (B)

A takes three times as long as B and C together to do a job. B takes four times as long as A and C together to do the work. If all the three, working together can complete the job in 24 days, then the number of days, A alone will take to finish the job is

- (A) 100 (B) 96
(C) 95 (D) 90

Q. 4)

Let the total work be 24 units

Given, $3 \times \text{Efficiency of A} = \text{Efficiency of B} + \text{Efficiency of C}$

$$3a = b + c$$

A, B and C complete the work in 24 days.

Hence, $a + b + c = \frac{24}{24} = 1$ or $4a = 1$ [Put $b + c = 3a$]

$$a = \frac{1}{4} = 0.25 \text{ unit}$$

A completes 0.25 unit work in 1 day. So to complete 24 units of work, he will take $\frac{24}{0.25} = 96$ days

Answer: (B)

A man is twice as fast as a woman and a woman is twice as fast as a boy in doing a work. If all of them, a man, a woman and a boy can finish the work in 7 days, in how many days a boy will do it alone ?

(A) 49 (B) 7 (C) 6 (D) 42

Q. 5)

Let the total work be 7 units. Since they all complete the work in 7 days, so their total efficiency = $\frac{7}{7} = 1$ unit

Let efficiency of boy = x

Then efficiency of women = $2x$

Efficiency of man = $4x$

$$x + 2x + 4x = 1$$

$$7x = 1 \text{ or } x = \frac{1}{7}$$

The boy completes $\frac{1}{7}$ work in 1 day, so to complete 7 units of work, he will take 49 days

Answer: (A)

A does half as much work as B in three fourth of the time. If together they take 18 days to complete the work, how much time shall B alone take to do it ?

(A) 50 days (B) 30 days
(C) 40 days (D) 45 days

Q. 6)

A does $\frac{1}{2}$ as much work as B in $\frac{3}{4}$ of the time. Hence A will do $(\frac{1}{2} + \frac{1}{2})$ or complete work in $(\frac{3}{4} + \frac{3}{4})$ or 1.5 times more time than B.

$A = 1.5B$ (where A = no. of days taken by A to finish the work and B = no. of days taken by B to finish the work)

Also $A \cdot B / (A+B) = 18$

Put $A = 1.5B$ in the above equation and solve

$B = 30$ days

Answer: (B)

A can do a piece of work in 20 days and B in 30 days. They work together for 7 days and then both leave the work. Then C alone finishes the remaining work in 10 days. In how many days will C finish the full work ?

- (A) 25 days (B) 30 days
(C) 24 days (D) 20 days

Q. 7)

Let the total work = 60 units

Efficiency of A = $60/20 = 3$ units

Efficiency of B = $60/30 = 2$ units

Efficiency of (A + B) = 5 units

Work done by A and B in 7 days = $5 \cdot 7 = 35$ units

Work left = $60 - 35 = 25$ units

C completes 25 units of work in 10 days. Hence he will complete 60 units of work in $10 \cdot 60/25 = 24$ days

Answer: (C)

A, B and C can do a job in 6 days, 12 days and 15 days respectively. After $\frac{1}{8}$ of the work is completed, C leaves the job. Rest of the work is done by A and B together. Time taken to finish the work is

- (A) $5\frac{5}{6}$ days (B) $5\frac{1}{4}$ days
(C) $3\frac{1}{2}$ days (D) $3\frac{3}{4}$ days

Q. 8)

Let total work be 120 units.

Efficiency of A = $120/6 = 20$ units

Efficiency of B = $120/12 = 10$ units

Efficiency of C = $120/15 = 8$ units

Work left = $7/8 * 120 = 105$ units

Efficiency of A + B = 30 units

Hence time taken by A and B to complete 105 units of work = $105/30 = 3.5$

Answer: (C)

A, B and C together can do a piece of work in 40 days. After working with B and C for 16 days, A leaves and then B and C complete the remaining work in 40 days more. A alone could do the work in

- (A) 80 days (B) 90 days
(C) 100 days (D) 120 days

Q. 9)

Let the total work = 80 units

Efficiency of (A + B + C) = $80/40 = 2$ units

Work done by (A + B + C) in 16 days = $16 * 2 = 32$ units

Remaining work = $80 - 32 = 48$ units

B and C complete the remaining work (48 units) in 40 days.

Efficiency of B + C = $48/40 = 1.2$ units

Efficiency of A = Efficiency of (A + B + C) - Efficiency of (B + C) = $2 - 1.2 = 0.8$ unit

Time taken by A to complete the whole work = $80/0.8 = 100$ days

Answer: (C)

A and B can do a piece of work in 45 and 40 days respectively. They began the work together but A leaves after some days and B finished the remaining work in 23 days. A left after

- (A) 12 days (B) 5 days
(C) 6 days (D) 9 days

Q. 10)

Let the total work = 360 units

Efficiency of A = $360/45 = 8$ units

Efficiency of B = $360/40 = 9$ units

Efficiency of A + B = 17 units

Let A left after x days, that means A and B worked together for x days. Total work done by A and B together = $17x$

Then the remaining work is finished by B in 23 days. Hence work done by B alone = $23 * 9 = 207$ units

So, $17x + 207 = 360$

Or $x = 9$ days

Answer: (D)

P and Q together can do a job in 6 days. Q and R can finish the same job in 60/7 days. P started the work and worked for 3 days. Q and R continued for 6 days. Then the difference of days in which R and P can complete the job is

(A) 8 (B) 12 (C) 10 (D) 15

Q. 11)

This question appeared in SSC Tier-2 2015, and stumped many candidates. Although there is nothing tricky about it.

Let the total work be 60 units.

$p + q = 60/6 = 10$

$q + r = 60 * 7/60 = 7$

Given, Total work done = 3 days work of P + 6 days work of Q and R

$60 = 3 * p + 6 * (7)$

$p = 6$

Hence time taken by P to complete the work = $60/6 = 10$ days

$p + q = 10$, hence $q = 4$

$q + r = 7$, hence $r = 3$

Hence time taken by R to complete the work = $60/3 = 20$ days

Difference = $20 - 10 = 10$ days

Answer : (C)

Q. 12) 4 Men and 6 Women working together can complete the work in 10 days. 3 men and 7 women working together will complete the same work in 8 days. In how many days 10 women will complete this work?

One day work for a man = $1/m$

One day work for a woman = $1/w$

In one day, 4 men and 6 women will do $1/10$ of the work. Hence,

$$4/m + 6/w = 1/10 \quad \dots (i)$$

Similarly,

$$3/m + 7/w = 1/8 \quad \dots (ii)$$

Multiply equation (i) with 3 and equation (ii) with 4

$$12/m + 18/w = 3/10$$

$$12/m + 28/w = 1/2$$

Subtract the equations

$$10/w = 1/5$$

So 10 women will complete the work in 5 days

Answer: (5)

Q. 13) If 3 men or 4 women can reap a field in 43 days, how long will 7 men and 5 women take to reap it?

There is a direct formula to solve such questions

$$\text{Required no. of days} = \frac{1}{\frac{7}{43 * 3} + \frac{5}{43 * 4}} = \frac{43 * 3 * 4}{7 * 4 + 5 * 3} = 12 \text{ days}$$

- If M_1 men can do W_1 work in D_1 days working H_1 hours per day and M_2 men can do W_2 work in D_2 days working H_2 hours per day, then

$$\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$$

Here W is the work. For e.g., if 5 men are cutting 10 trees in 2 days, working 4 hours per day. Then, $M = 5$, $D = 2$, $H = 4$ and $W = 10$.

A farmer can plough a field working 6 hours per day in 18 days. The worker has to work how many hours per day to finish the same work in 12 days ?

- (A) 7 (B) 9
(C) 11 (D) 13

Q. 1)

$$H_1 = 6$$

$$D_1 = 18$$

$$D_2 = 12$$

$$H_2 = ?$$

We know, $H_1 * D_1 = H_2 * D_2$

$$6 * 18 = H_2 * 12$$

$$H_2 = 9 \text{ hours}$$

Answer : (B)

15 men take 20 days to complete a job working 8 hours a day. The number of hours a day should 20 men take to complete the job in 12 days

- (A) 5 hours (B) 10 hours
(C) 15 hours (D) 18 hours

Q. 2)

$$M_1 = 15$$

$$D_1 = 20$$

$$H_1 = 8$$

$$M_2 = 20$$

$$D_2 = 12$$

$$H_2 = ?$$

We know, $M_1 * D_1 * H_1 = M_2 * D_2 * H_2$

$$15 * 20 * 8 = 20 * 12 * H_2$$

$$H_2 = 10 \text{ hours}$$

Answer : (B)

Having the same capacity 9 taps fill up a water tank in 20 minutes. How many taps of the same capacity required to fill up the same water tank in 15 minutes ?

- (A) 10 (B) 12 (C) 15 (D) 18

Q. 3)

In this question, Taps = Men

Number of taps required = $20 \times 9 / 15 = 12$

Answer : (B)

A certain number of men can finish a piece of work in 100 days. However, if there were 10 men less, then it would take 10 days more for the work to be finished. How many men were there originally ?

- (A) 75 (B) 50
(C) 100 (D) 110

Q. 4)

Let there be X number of men.

X men can finish a piece of work in 100 days. Hence total work = $100X$

If there were (X - 10) men, it would have taken 110 days to finish the work. Total work in this case = $110(X - 10)$

Total work remains the same. Hence,

$$100X = 110(X - 10)$$

$$X = 110$$

Answer : (D)

Subhash can copy 50 pages in 10 hours; Subhash and Prakash can copy 300 pages in 40 hours. In how much time can Prakash copy 30 pages ?

- (A) 9 hours (B) 13 hours
(C) 10 hours (D) 12 hours

Q. 5)

Efficiency of Subhash = $50/10 = 5$ per hour

Efficiency of Subhash and Prakash = $300/40 = 7.5$ per hour

Efficiency of Prakash = (Efficiency of Subhash and Prakash) - (Efficiency of Subhash) = $7.5 - 5 = 2.5$

So Prakash can copy 2.5 pages per hour. To copy 30 pages, he would require $30/2.5$ or 12 hours.

Answer : (D)

40 men can finish a piece of work in 60 days. After some days, 10 men leave the work so that the work is finished in 70 days. The number of days after which 10 men left the work is
(A) 20 days (B) 25 days
(C) 30 days (D) 40 days

Q. 6)

40 men can finish a work in 60 days. Hence, total work = $40 \times 60 = 2400$

Let the 10 men leave after X days.

For X days, all the 40 men worked. Total work performed = $40X$

Now when 10 men quit, only 30 men were left to do the work and they took $(70 - X)$ more days to finish it.

Total work done by 30 men = $30 \times (70 - X)$

Now, $40X + 30 \times (70 - X) = 2400$

$X = 30$ days

Answer : (C)

A and B can do a piece of work in 45 and 40 days respectively. They began the work together but A leaves after some days and B finished the remaining work in 23 days, A left after

(A) 12 days

(B) 5 days

(C) 6 days

(D) 9 days

Q. 7)

Let the total work = 360 units

Efficiency of A = $360/45 = 8$ units

Efficiency of B = $360/40 = 9$ units

Efficiency of A + B = 17 units

Let A left after X days.

For X days, both A and B worked. Hence work performed = $17X$

B worked for 23 days. Hence work performed by B = $23 \times 9 = 207$ units

Now, $17X + 207 = 360$

$X = 9$ days

Answer : (D)

A, B, C are employed to do a piece of work for ₹ 5,290. A and B together are supposed to do $\frac{19}{23}$ of the work and B and C together $\frac{8}{23}$ of the work. Then A should be paid

- (A) ₹ 1,950 (B) ₹ 2,290
(C) ₹ 4,250 (D) ₹ 3,450

Q. 8)

B and C together do $\frac{8}{23}$ of the work, hence A does $(1 - \frac{8}{23})$ or $\frac{15}{23}$ of the work.

A should be paid = $\frac{15 \times 5290}{23}$ = Rs. 3450

Answer : (D)

Note : In this question, they have asked the wages of A. Had they asked the wages of B, firstly you would have calculated the work performed by B with the formula-

Work done by B = (Portion of work done by A and B) + (Portion of work done by B and C) - 1

Work done by B = $\frac{19}{23} + \frac{8}{23} - 1 = \frac{4}{23}$

Wages of B = $\frac{4 \times 5290}{23}$ = Rs. 920

A company employed 200 workers to complete a certain work in 150 days.

If only $\frac{1}{4}$ of the work has been done in 50 days, then in order to complete the whole work in time, the number of additional workers to be employed was

- (A) 300 (B) 200
(C) 100 (D) 600

Q. 9)

This is a very famous question. A company employed 200 workers to complete a certain work in 150 days. Here the total work is not 200×150 because 200 workers and 150 days was only a plan. In reality, only $1/4$ th of the work has been done in 50 days. So if they go with the same pace, 200 workers will take 200 days to complete the work.

So total work = 200×200 units

200 workers have worked for 50 days. Hence they have finished 200×50 units of work.

Remaining work = $200 \times 200 - 200 \times 50 = 200 \times 150$

Let the number of additional workers required = X.

Now $(200+X)$ workers will work for 100 days to finish the work as per the schedule.

Work they need to perform = $(200 + X) \times 100$

Now, $(200 + X) \times 100 = 200 \times 150$

X = 100

Answer : (C)

Q. 10) A contractor undertook to finish a certain work in 124 days and employed 120 men. After 64 days, he found that he had already done $2/3$ of work. How many men can be discharged now so that the work may finish in time?

A) 56 B) 44 C) 50 D) 60

120 workers finish $2/3$ of the work in 64 days. So to complete the whole work, workers will take $64 \times 3/2$ or 96 days.

Total work to be performed = 120×96

Now the workers have already finished $2/3$ of the work and only $1/3$ work has to be performed.

Remaining work = $120 \times 96/3 = 120 \times 32$

Let the contractor discharges X men. Remaining workers = $120 - X$. These workers will continue the work for $(124 - 64)$ or 60 days. Hence,

$120 \times 32 = (120 - X) \times 60$

X = 56

Answer : (A)

Method 2

$M_1 = 120, D_1 = 64, W_1 = 2/3$

$M_2 = 120 - x, D_2 = 60, W_2 = 1/3$

$(M_1 \times D_1) / W_1 = (M_2 \times D_2) / W_2$

$120 \times 64 \times 3/2 = (120 - x) \times 60 \times 3$

X = 56

A swimming pool is fitted with three pipes. The first two pipes working simultaneously, fill the pool in the same time as the third pipe alone. The second pipe alone fills the pool 5 hours faster than the first pipe and 4 hours slower than the third pipe. In what time will the second and third pipes together fill the pool ?

- (A) 3 hours (B) 3.75 hours
(C) 4 hours (D) 4.75 hours

Q. 11)

Let the second pipe fills the pool in X hours. Then first pipe takes (X+5) hours and the third pipe takes (X-4) hours to fill the pool. Now, 1st and 2nd pipe together take the same time to fill the pool as the 3rd pipe alone. Hence,

$$\frac{1}{X+5} + \frac{1}{X} = \frac{1}{X-4}$$

Solve this quadratic equation and you will get X = 10 hours

That means second pipe takes 10 hours to fill the pool while the third pipe takes 6 hours. Together they will take $10 \times 6 / (10 + 6)$ hours to fill the pool.

Answer: (B)

Q. 12) A can complete a job in 12 days, B in 15 days. Both of them worked for 5 days and rest of work was finished by C. If total earning is Rs. 720. Find wages of B.

Let the total work = 60 units

$$\text{Efficiency of B} = 60/15 = 4$$

$$\text{Work done by B in 5 days} = 5 \times 4 = 20$$

$$\text{Earning of B} = (20/60) \times 720 = \text{Rs. } 240$$

Q. 13) A, B and C undertake to complete a piece of work for Rs 2574. A works for 8 days, B for 9 days and C for 12 days. If their daily wages are in the ratio of 3:4:5 what does C get?

Let the daily wages of A, B and C be 3x, 4x and 5x

$$\text{A works for 8 days, hence total wages of A} = 8 \times 3x = 24x$$

$$\text{B works for 9 days, hence total wages of B} = 9 \times 4x = 36x$$

$$\text{C works for 12 days, hence total wages of C} = 12 \times 5x = 60x$$

$$\text{Ratio of wages of A, B and C} = 24x : 36x : 60x = 2 : 3 : 5$$

$$\text{C gets} = 5 \times 2574 / 10 = \text{Rs. } 1287$$

Q. 14) Two pipes can fill a cistern separately in 24 min and 40 min respectively. A waste pipe can drain off 30 litres per minute. If all the three pipes are opened the cistern fills in one hour. The capacity of Cistern is?

Let the capacity be X

In 1 minute, the first pipe adds $X/24$ litres

In 1 minute, the second pipe adds $X/40$ litres

In 1 minute, the third pipe drains off 30 litres

So in 1 minute, all the three pipes are adding $(X/24 + X/40 - 30)$ litres.

In 60 minutes, all the three pipes will add $60*(X/24 + X/40 - 30)$ litres. Hence

$$X = 60*(X/24 + X/40 - 30)$$

$$X = 600 \text{ litres}$$

Profit and Loss Hacks

Profit/Loss is another easy topic of SSC CGL. Most of the questions can be solved in less than 30 seconds. First let me introduce a formula that will be used in solving 50% of the questions.

$$\frac{SP}{CP} = \text{profit/loss factor}(f)$$

Where,

SP = Selling price

CP = Cost Price

f = Profit/loss factor

What is this profit/loss factor ? It's simple, 'f' depends on the profit/loss %

If profit% = 10, then f = 1.1

If profit% = 30, then f = 1.3

If profit% = 15, then f = 1.15

If loss% = 10, then f = 0.9

If loss% = 25, then f = 0.75

If loss% = 12.5, then f = 0.875

Please note that f depends on profit/loss percentage and not on the absolute value of Profit/Loss. So if in any question it is given that the profit is Rs. 30, then it doesn't mean that f = 1.3

Let us see some SSC CGL questions that can be solved with this formula

146. If the cost price of 6 articles is equal to the selling price of 4 articles, then gain percent is

- (A) 33% (B) 50%
(C) 66% (D) 75%

Q.1

Let 's' be the SP of 1 article and 'c' be the CP of 1 article.

Given, $6c = 4s$

Therefore $s/c = 1.5$

Gain % = 50

Answer : (B)

By selling 20 metres of cloth a man gains the selling price of 4 metres of cloth. Then the gain percent is

- (A) 35 (B) 20
(C) 25 (D) 30

Q.2.

Let 's' be the SP of 1 metre of cloth and 'c' be the CP of 1 metre of cloth

Total SP = 20s, Profit = 4s

CP = SP - Profit = 16s

The ratio $s/c = 20s/16s = 1.25$

Gain % = 25

Answer : (C)

Ten articles bought at ₹ 8, and sold at 8 for ₹ 10. Then the gain percent is

- ✓(A) 56.25% (B) 55%
(C) 54.75% (D) 57.25%

Q.3.

SP of 1 article(s) = Rs. $10/8 = 5/4$

CP of 1 article(c) = Rs. $8/10 = 4/5$

$s/c = 25/16 = 1.5625$

Gain % = 56.25

Answer : (A)

Q) 4. Kunal sold a shirt at a loss of 10%. Had he sold it for Rs 60 more, he would have gained 5% on it. Find the CP of the shirt.

In this question we have to find the CP of the article

$$c = s/f$$

From basic mathematics or elementary science we know that putting delta (Δ) sign in numerator and denominator doesn't change the equation. Δ stands for 'change'

$$c = \Delta s / \Delta f$$

where Δs = change in SP

Δf = change in factor

Therefore Δs = New SP - Old SP = Rs. 60

Δf = New factor - Old factor

New factor is the factor when profit is 5%. Old factor is the one with loss = 10%

$$\text{So } \Delta f = 1.05 - 0.9 = 0.15$$

$$c = \Delta s / \Delta f = 60 / 0.15 = \text{Rs. } 400$$

Answer : Rs 400

An article is sold at a gain of 15%. Had it been sold for ₹ 27 more, the profit would have been 20%. The cost price of the article is

(A) ₹ 500

(B) ₹ 700

(C) ₹ 540

(D) ₹ 545

Q. 5)

$$\text{Cost Price} = 27 / (1.2 - 1.15) = 27 / 0.05 = \text{Rs. } 540$$

Answer: (C)

If the ratio of cost price to selling price is 10 : 11, then the rate of percent of profit is

(A) 0.1%

(B) 1%

(C) 1.1%

(D) 10%

Q. 6)

$$c/s = 10/11$$

$$\text{Hence, } s/c = 11/10 = 1.1$$

Profit = 10%

Answer: (D)

On selling 17 balls at ₹ 720, there is a loss equal to the cost price of 5 balls. The cost price (in ₹) of a ball is

- (A) 45 (B) 50
(C) 55 (D) 60

Q. 7)

Let cost price of 1 ball be C. Hence total cost price = $17C$

Total loss = $5C$

Total SP = Rs. 720

Loss = CP - SP

$5C = 17C - 720$

$C = \text{Rs. } 60$

A sells a suitcase to B at 10% profit. B sells it to C at 30% profit. If C pays ₹ 2,860 for it, then the price at which A bought it is

- (A) ₹ 1,000 (B) ₹ 1,600
(C) ₹ 2,000 (D) ₹ 2,500

Q. 8)

Let A bought it for Rs. X

Then B paid Rs. $1.1x$

And C paid Rs. $1.1x * 1.3 = \text{Rs. } 1.43x$

Given, $1.43x = 2860$

Hence $x = \text{Rs. } 2000$

Answer: (C)

By selling an article for ₹ 102, there is a loss of 15%, when the article is sold for ₹ 134.40, the net result in the transaction is

- (A) 12% gain (B) 12% loss
(C) 10% loss (D) 15% gain

Q. 9)

SP = Rs. 102

Loss = 15% and hence $f = 0.85$

CP = $SP/f = 102/0.85 = \text{Rs. } 120$

New SP = Rs. 134.40

Net result (f) = $SP/CP = 134.4/120 = 1.12 = 12\% \text{ profit}$

Answer: (A)

There is a profit of 20% on the cost price of an article. The % of profit, when calculated on selling price is

- (A) $16\frac{2}{3}\%$ (B) 20%
 (C) $33\frac{1}{3}\%$ (D) None of these

Q. 10)

Given, Profit/CP = $20/100 = 0.2$ or Profit = $0.2CP$

Profit = $0.2(SP - \text{Profit})$

$1.2 * \text{Profit} = 0.2SP$

Profit/SP = $1/6$

Hence profit on SP = $100/6\% = 16\frac{2}{3}\%$

Answer: (A)

Direct formula: Profit % / (100 + Profit %) * 100 = $(20/120) * 100 = 100/6\%$

Given	To find	Formula
Profit on CP	Profit on SP	Profit% / (100 + Profit%) * 100
Loss on CP	Loss on SP	Loss% / (100 - Loss%) * 100
Profit on SP	Profit on CP	Profit% / (100 - Profit%) * 100
Loss on SP	Loss on CP	Loss% / (100 + Loss%) * 100

$$SP_1 + SP_2 = 100C + 84C = 184C$$

Q. 11) Two items are sold at the same price. The seller gains 75% from the 1st item while he makes 30% loss on the other. Find the overall profit/loss.

- (A) 20% profit (B) 35% profit (C) No profit No loss (D) 10% loss

If the selling price is same for the two items, then the overall profit/loss is given by $f = 2 * f_1 * f_2 / (f_1 + f_2)$

Here $f_1 = 1.75$, $f_2 = 0.7$

Hence overall factor (f) = $2 * 1.75 * 0.7 / (1.75 + 0.7) = 1$

We know if the value of factor is 1, it means no profit, no loss

Answer: (C)

Q. 10) The cost price of two articles is same. One is sold at a profit of 15% and the other is sold at a loss of 5%. What is the overall profit/loss?

- (A) 5% profit (B) 5% loss (C) 10% profit (D) No profit No loss

If the CP is same, then the overall profit/loss is average the two.

Average of 15% and -5% (loss is written with negative sign) = $[15 + (-5)]/2 = +5\%$

Answer: (A)

A shopkeeper buys 144 items at 90 paise each. On the way 20 items are broken. He sells the remainder at ₹ 1.20 each. His gain per cent correct to one place of decimal is

- (A) 13.8% (B) 14.6%
Q. 11) (C) 14.8% (D) 15.8%

Let the fruit-seller buys 100 oranges

Given, SP of 40 oranges = CP of 100 oranges

$40S = 100C$ (where $S =$ SP of 1 orange and $C =$ CP of 1 orange)

$S/C = 2.5$

$f = 2.5$ and hence Profit = 150%

He has already sold 40 oranges. Remaining oranges = 60

He sold 80% of remaining oranges at half the previous rate of profit.

That means he sold 48 oranges at 75% profit.

CP of 48 oranges = $48C$

$f = 1.75$

$SP_2 = 1.75 * 48C = 84C$

Total SP = $SP_1 + SP_2 = 100C + 84C = 184C$

Total CP = $100C$

$f = SP/CP = 184C/100C = 1.84$

Hence profit = 84%

Answer: (B)

Mensuration Hacks

Mensuration is a pure formula-based topic and tricks/shortcuts are seldom applied here. So in this series I will try to solve all the mensuration problems that have appeared in CGL lately and in the process I will share the important concepts/formulas.

The base of a prism is a right angled triangle with two sides 5 cm and 12 cm. The height of the prism is 10 cm. The total surface area of the prism is

- (A) 360 sq cm (B) 300 sq cm
(C) 330 sq cm (D) 325 sq cm

Q. 1)

For Prism and Calendar (figures with uniform girth) -

Lateral Surface Area = Height * Perimeter of the Base

Volume = Height * Area of the Base

In this question the Total surface area is being asked

Total Surface Area of a Prism = Lateral Surface Area + Area of the two bases

Height of the prism = 10 cm

Perimeter of the base = $5 + 12 + 13$ (Calculate the hypotenuse with Pythagoras Theorem) = 30 cm

So Lateral Surface Area = $10 * 30 = 300$ cm

Area of the base = $\frac{1}{2} * \text{base} * \text{height} = \frac{1}{2} * 5 * 12 = 30$ cm

So Total Surface Area = $300 + 2*30 = 360$ cm

Answer : (A)

The height of a cone is 30 cm. A small cone is cut off at the top by a plane parallel to the base. If its volume be $\frac{1}{27}$ th of the volume of the given cone, at what height above the base is the section made ?

- (A) 19 cm (B) 20 cm
(C) 12 cm (D) 15 cm

Q. 2)

In such questions, remember one thing SIMILARITY

$$r/R = h/H \quad \dots (1)$$

where r = radius of small cone

R = radius of Big cone

h = height of small cone

H = height of big cone

$$\text{Volume of cone} = \frac{1}{3} \pi r^2 h$$

Given, Volume of big cone = 27 * Volume of small cone

$$\frac{1}{3} \pi R^2 H = 27 * \frac{1}{3} \pi r^2 h$$

$$27 * (r/R)^2 = H/h$$

Put the value of r/R from equation (1)

$$27 * (h/H)^2 = H/h$$

$$27 * h^3 = H^3$$

Put $H = 30$ cm

So $h = 10$ cm

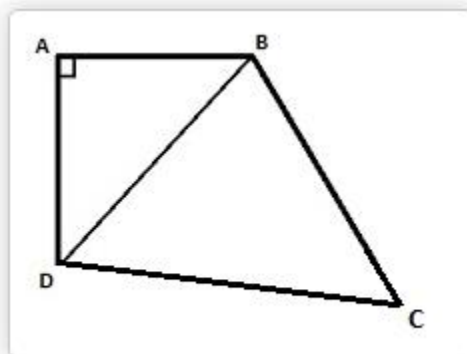
The question asks us the height above the base, which is $(30 - h) = 30 - 10 = 20$ cm

Answer : (B)

The base of a right prism is a quadrilateral $ABCD$. Given that $AB = 9$ cm, $BC = 14$ cm, $CD = 13$ cm, $DA = 12$ cm and $\angle DAB = 90^\circ$. If the volume of the prism be 2070 cm^3 , then the area of the lateral surface is

(a) 720 cm^2 (b) 810 cm^2
(c) 1260 cm^2 (d) 2070 cm^2

Q. 3)



The base of the prism looks like the figure above.

$AD = 12$ cm, $AB = 9$ cm

Hence $BD = 15$ cm (Pythagoras Theorem)

Area of base = Area of triangle ABD + Area of triangle BDC

Area of triangle ABD = $\frac{1}{2} * 9 * 12 = 54$ cm

Area of triangle BDC = 84 cm (Apply Heron's formula)

Area of base/quadrilateral = $84 + 54 = 138$ cm

Volume = Height * Area of the Base

$2070 = \text{Height} * 138$

So, Height of the prism = 15 cm

Lateral Surface Area = Height * Perimeter of the Base

Perimeter of the base = $AB + BC + CD + DA = 48$ cm

Lateral Surface Area = $48 * 15 = 720$ cm²

Answer : (A)

The base of a right prism is an equilateral triangle. If the lateral surface area and volume is 120 cm², $40\sqrt{3}$ cm³ respectively then the side of base of the prism is

- (A) 4 cm (B) 5 cm
(C) 7 cm (D) 40 cm

Q. 4)

Area of the base = $\frac{\sqrt{3}}{4} * a^2$, where a is the side of the equilateral triangle

Perimeter of the base = $3a$

Volume of the prism = Area of the base * Height = $\frac{\sqrt{3}}{4} * a^2 * h$... (1)

Lateral surface Area of the prism = Perimeter of the base * Height = $3a * h$... (2)

Divide equation (1) by (2)

Volume/Area = $(\frac{1}{4\sqrt{3}}) * a$

$40\sqrt{3}/120 = a/4\sqrt{3}$ [Since Volume = $40\sqrt{3}$ and Lateral surface Area = 120]

$a = 160 * 3/120$

$a = 4$ cm

Answer : (A)

Base of a right pyramid is a square whose area is 324 sqm. If the volume of the pyramid is 1296 cu.m., then the area (in m^2) of the slant surface is

- (A) 1080 (B) 360
(C) 432 (D) 540

Q. 5)

This question is about 'Pyramid'. So let me just give you some basic understanding of Pyramids. CGL can ask questions about two types of Pyramids - Pyramid with a Triangular Base and Pyramid with a square base. Both these pyramids have different formulas. Look at the below figure and understand the labellings, i.e., **Slant edge** and **Slant Height**

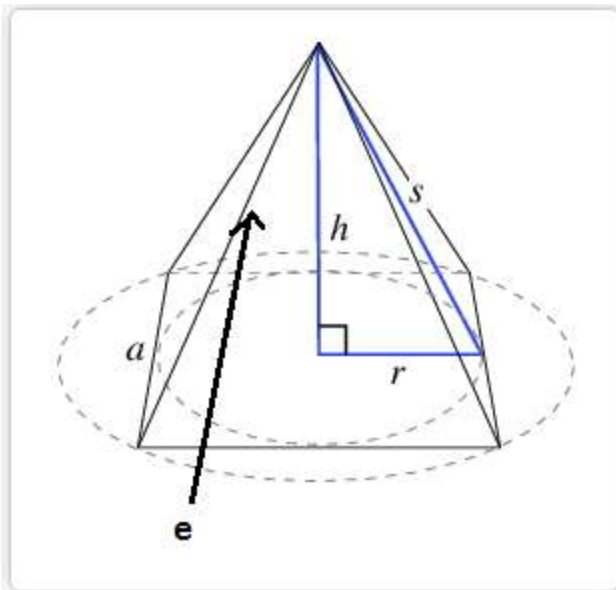
In the below image, I have written formulas for both types of Pyramids. The formula for Volume is same for both the Pyramids-

$$V = \frac{1}{3} * A * h$$

where A = Area of the base (calculation of A will be different for both)

h = Height of the Pyramid

When lateral surface area is asked, you will first calculate the 'Slant Height'. Then with the help of slant height you will find the area of one lateral face (let's call this area M). If the pyramid is having a triangular base then multiply M with 3, to get the lateral surface area of the pyramid. And if the pyramid is having a square base, then multiply M with 4.



For a pyramid with Triangular base -

e = lateral edge/slant edge

s = slant height

$$e = \sqrt{h^2 + \frac{1}{3} a^2}$$
$$s = \sqrt{h^2 + \frac{1}{12} a^2},$$

where h is the height and a is the length of a side of the base.

Like all pyramids, the volume of triangular pyramid is given by

$$V = \frac{1}{3} A h,$$

For a pyramid with Square base

$$e = \sqrt{h^2 + \frac{1}{2} a^2}$$
$$s = \sqrt{h^2 + \frac{1}{4} a^2}.$$

The area of the square is 324, hence its side is 18 cm

Volume of the pyramid = $\frac{1}{3}$ * Area of the base * Height

1296 = $\frac{1}{3}$ * 324 * Height

So Height = 12 cm

Slant Height of the pyramid with square base = $\sqrt{(h^2 + a^2/4)} = \sqrt{(12^2 + 18^2/4)}$

Slant Height = 15cm

Area of the lateral face = $\frac{1}{2}$ * Base * Height = $\frac{1}{2}$ * 18 * 15 = 135 cm²

Pyramid with a square base has 4 lateral faces, so lateral surface area of the pyramid = 4 * 135 = 540 cm²

Answer : (D)

Part - 2

A piece of wire when bent to form a circle will have a radius of 84 cm. If the wire is bent to form a square, the length of a side of the square is

- (A) 132 cm (B) 225 cm
(C) 152 cm (D) 168 cm

Q.1)

This is a famous question. Just remember whenever you are forming a circle and then a square, the side of that square is given by, $a = 1.6 * r$ (approx.), where r = radius of the circle
I have written approx. because the actual formula is $1.57 * r$, but it will make the calculations a bit lengthy.
So, just find $1.6 * r$ and the answer will be little less than that. Like here
Side = $1.6 * 84 = 134.4$, so the answer is 132cm

Answer: (A)

Method:

When the wire is bent in the form of a circle of radius 84cm, that means the circumference (or the length of the wire) of the circle is $2 * \pi * 84 = 44 * 12$ cm
Now this wire forms a square of (let's say) side 'a'
Then, $4a$ (perimeter of the square) = $44 * 12$
Hence $a = 132$ cm

At each corner of a triangular field of sides 26 m, 28 m and 30 m, a cow is tethered by a rope of length 7 m. The area (in m^2) unglazed by the cows is

- (A) 336 (B) 259
Q. 2) (C) 154 (D) 77

In such questions the grazed area is given by $\frac{\pi r^2}{2} = (22/7) * 7 * 7/2 = 77 \text{ cm}^2$

So the un-grazed area = Area of triangle – Grazed area

Area of triangle = Apply heron's formula

Semi-perimeter = $(a + b + c)/2 = 42$ cm

For more, check-out: <http://sschacks.blogspot.in/>

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{42(16)(14)(12)} = 336 \text{ cm}^2$$

$$\text{Un-grazed area} = \text{Area of triangle} - \text{Grazed area} = 336 - 77 = 259 \text{ cm}^2$$

Answer: (B)

A rectangular tin sheet is 12 cm long and 5 cm broad. It is rolled along its length to form a cylinder by making the opposite edges just to touch each other. Then the volume of the cylinder is

- (A) $\frac{100}{\pi} \text{ cm}^3$ (B) $\frac{60}{\pi} \text{ cm}^3$
(C) $\frac{180}{\pi} \text{ cm}^3$ (D) $\frac{120}{\pi} \text{ cm}^3$

Q. 3)

If the given rectangular sheet of paper (length = l , breadth = b) is rolled **across its length** to form a cylinder, having a height b , then volume of cylinder = $(l*b)/4\pi$

If rolled **across its breadth**, then = $(b*b*l)/4\pi$

In this question the sheet is rolled along its length, so volume = $(l*b)/4\pi = 12*12*5/(4*\pi)$

$$\text{Volume} = 180/\pi \text{ cm}^3$$

Answer: (C)

If the surface areas of two spheres are in the ratio 4 : 9, then the ratio of their volumes will be

- (A) 4 : 9 (B) 16 : 27
(C) 8 : 27 (D) 16 : 9

Q. 4)

In this question, the ratio of surface areas is given and they are asking the ratio of volumes. The word "sphere" is useless here. In such questions, just imagine area as A^2 and volume as A^3 . Now A^2 is given and you have to find A^3 . How will you do it? Simple, first take the square-root of A^2 to convert it into A , and then take the cube of A to find A^3 .

So for solving this question, we just have to take the square-root of 4:9. The ratio will become 2:3. Then take the cube of 2:3. Hence the answer is 8:27

If the ratio of the areas of two similar triangles is 4 : 9, then the ratio of their corresponding sides is

- Q. 5) (A) 2 : 3 (B) 3 : 2
(C) 4 : 9 (D) 9 : 4

Here again ratio of areas is given, that means A^2 is given, and we have to find A. So 4:9 will become 2:3

Answer: (A)

On increasing the diameter of a circle by 75%, the percentage increase in the perimeter is

- Q. 6) (A) 80% (B) 65%
(C) 70% (D) 75%

Diameter and perimeter are directly proportional, $P = D \cdot \pi$, where P is the perimeter and D is the diameter.

Hence a 75% increase in diameter means a 75% increase in perimeter

Answer: (D)

If the area of the base of a cone is increased by 100%, then the volume is increased by

- Q. 7) (A) 141% (B) 100%
(C) 200% (D) 182%

The area of base and the volume of a cone are directly proportional $V = A \cdot h/3$, where V = volume and h = height of the cone

Hence a 100% increase in the area of the base would mean a 100% increase in the volume

Answer: (B)

If each edge of a cube is increased by 50%, the percentage increase in surface area is

- Q. 8) (A) 125% (B) 50%
(C) 100% (D) 75% $50 + 50 + \frac{50 \cdot 50}{100}$

A is increased by 50% hence A^2 (or surface area) will increase by $(1.5 \times 1.5 - 1) \times 100\% = 125\%$

Similarly A^3 (or volume) will increase by $(1.5 \times 1.5 \times 1.5 - 1) \times 100\% = 237.5\%$

Answer: (A)

A rectangular block of metal has dimensions 21 cm, 77 cm and 24 cm. The block has been melted into a sphere. The radius of the sphere is (Take π as $\frac{22}{7}$)

(A) 21 cm

(B) 7 cm

Q. 9)

(C) 14 cm

(D) 28 cm

Where ever the word "melting" is used in mensuration, it means only one thing – equate the volume

The volume of the rectangular block = $l \times b \times h = 21 \times 77 \times 24 \text{ cm}^3$

Now this volume will be equal to the volume of the sphere formed after melting the block

Volume of sphere = $(\frac{4}{3}) \times \pi \times r^3 = 21 \times 77 \times 24$

Hence, $r = 21 \text{ cm}$

Answer: (A)

Marbles a diameter 1.4 cm are dropped into a cylindrical beaker containing some water and are fully submerged. The diameter of the beaker is 7 cm. Find how many marbles have been dropped in it if the water rises by 5.6 cm.

(A) 50

(B) 150

Q. 10)

(C) 250

(D) 350

The water rises by 5.6 cm. Take this 5.6 cm as the height of the cylindrical beaker and find its volume.

Volume of a cylinder = $\pi \times r \times r \times h = \pi \times (\frac{7}{2}) \times (\frac{7}{2}) \times 5.6$

Volume of the marbles (spherical in shape) = $(\frac{4}{3}) \times \pi \times r^3 = (\frac{4}{3}) \times \pi \times 0.7 \times 0.7 \times 0.7$

No. of marbles dropped = Volume of beaker/Volume of a marble = 150

Answer: (B)

For more, check-out: <http://sschacks.blogspot.in/>

A large solid sphere is melted and moulded to form identical right circular cones with base radius and height same as the radius of the sphere. One of these cones is melted and moulded to form a smaller solid sphere. Then the ratio of the surface area of the smaller to the surface area of the larger sphere is

- (A) $1 : 3^{4/3}$ (B) $1 : 2^{3/2}$
(C) $1 : 3^{2/3}$ (D) $1 : 2^{4/3}$

Q. 11)

Let the radius of the big sphere be R.

Volume of a cone = $(1/3) * \pi * R^3$ (since radius and height are same as the radius of the sphere)

Let the radius of the smaller sphere = r

Then volume of cone = volume of smaller sphere

$$(1/3) * \pi * R^3 = (4/3) * \pi * r^3$$

$$r : R = 1 : 2^{2/3}$$

$$\text{Surface area of smaller sphere}(s) = 4 * \pi * r^2$$

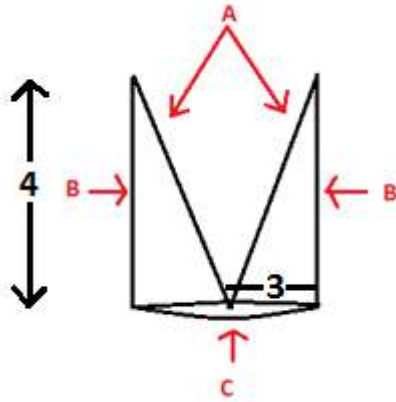
$$\text{Surface area of larger sphere}(S) = 4 * \pi * R^2$$

$$S/s = (r/R)^2 = 1 : 2^{4/3}$$

Answer: (D)

From a solid right circular cylinder of length 4 cm and diameter 6 cm, a conical cavity of the same height and base is hollowed out. The whole surface of the remaining solid (in square cm.) is

- Q. 12) (A) 15π (B) 24π (C) 48π (D) 63π



When a cone is hollowed out from a cylinder, we get the above figure

The whole surface area of the remaining solid = Area of A + Area of B + Area of C

A = curved surface area of the cone

B = curved surface area of the cylinder

C = area of the cylindrical base

$A = \pi * r * l$, where l = slant height of the cone, which is $\sqrt{r^2 + h^2}$ or $\sqrt{3^2 + 4^2} = 5 \text{ cm}$

Hence $A = \pi * 3 * 5 = 15\pi$

$B = 2\pi r h = 2\pi * 3 * 4 = 24\pi$

$C = \pi r^2 = \pi * 3^2 = 9\pi$

The whole surface area of the remaining solid = $15\pi + 24\pi + 9\pi = 48\pi$

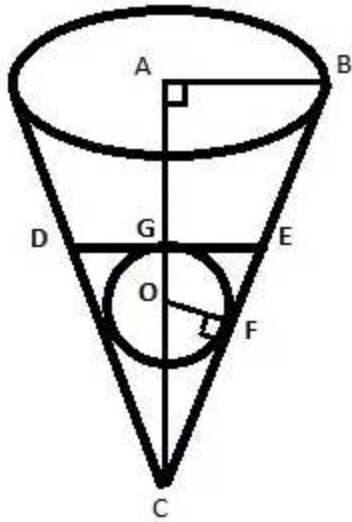
Answer: (C)

Q. 13)

A spherical ball of radius 1 cm is dropped into a conical vessel of radius 3 cm and slant height 6 cm.

The volume of water (in cm^3), that can just immerse the ball, is

- (A) $\frac{\pi}{3}$ (B) $\frac{4\pi}{3}$ (C) $\frac{5\pi}{3}$ (D) 3π



Given, $AB = 3$ cm, $BC = 6$ cm and $OF = 1$ cm

Height of the cone (AC) = $\sqrt{6^2 - 3^2} = 3\sqrt{3}$ cm

Triangles ABC and CFO are similar (RHS similarity)

So, $OC/BC = OF/AB$

$OC = 2$ cm, therefore $CG = 3$ cm ($OG = 1$ cm)

Now, ABC and CEG are similar

$GE/AB = CG/AC$

So, $GE = \sqrt{3}$ cm

Required volume = Volume of cone (CDE) - Volume of Sphere

$$= 3\pi - (4/3)\pi$$

$$= (5/3)\pi$$

Answer: (C)

Geometry Hacks

(1) Be it algebra or geometry, such questions are always there that don't deserve your rough space.

55. ABCD is a trapezium where $AD \parallel BC$. The diagonal AC and BD intersect each other at the point O. If $AO = 3$, $CO = x - 3$, $BO = 3x - 19$ and $DO = x - 5$, the value of x is
- (A) $-8, -9$ (B) $8, 9$
(C) $-8, 9$ (D) $8, -9$

Like the above questions asks you the value of x . Now value of x can't be negative in this context. Because $CO = x - 3$ and any negative value of ' x ' will make CO negative, like if $x = -8$, then $CO = -11$. We know that side can never be negative. Hence all the options that have negative value for x are wrong.

Answer : (B)

39. ABCD is a square inscribed in a circle of radius r . Then the total area (in square units) of the portions of the circle lying outside the square is
- (A) $\pi^2 r (r - 7)$ (B) $r^2 (\pi - 2)$
(C) $\pi (r^2 - 4)$ (D) $2\pi (r^2 - 1)$

In the above question a certain area is asked. Now see the options and observe that in options A, C and D if we take $r=7, 2$ and 1 respectively, then the area will become zero, and area can never be zero in this case, although value of ' r ' can be $7, 2$ or 1 .

Answer : (B)

Note : Such questions are rare in geometry and in most of the questions you will have to pick up your pen, but still I shared these questions just to unleash the *jugaad* within you. Moreover, if you are able to solve even a single question with such approach, you will save at least 1 crucial minute in the examination hall.

(2) In geometry too, my beloved concept of 'symmetry' plays an important role. If in any question you find that some symmetrical expressions/equations are given, you can assume the triangle to be equilateral.

a, b, c are the lengths of three sides of a triangle ABC. If a, b, c are related by the relation $a^2 + b^2 + c^2 = ab + bc + ca$, then the value of $(\sin^2 A + \sin^2 B + \sin^2 C)$ is

- (A) $\frac{3\sqrt{3}}{2}$ (B) $\frac{9}{4}$ (C) $\frac{3}{4}$ (D) $\frac{3}{2}$

Q. 1

In the above question you can assume that the triangle is equilateral. Then angles A, B and C will be 60. Hence $\sin^2 A + \sin^2 B + \sin^2 C = (\sqrt{3}/2)^2 + (\sqrt{3}/2)^2 + (\sqrt{3}/2)^2 = 9/4$

Answer : (B)

Note : If in any question, the sides of a triangle are given (like a, b and c), then you can assume $a = b = c$, but make sure any additional detail is not given. Like in the above question that I solved, some additional equations were given, but then too I supposed the triangle to be equilateral only because the equation was symmetrical. Had the equation been unsymmetrical, I could not have been able to assume $a = b = c$

37. From any point inside an equilateral triangle, the lengths of perpendiculars on the sides are 'a' cm, 'b' cm and 'c' cms. Its area (in cm^2) is

(A) $\frac{\sqrt{3}}{3} (a + b + c)$

(B) $\frac{\sqrt{2}}{3} (a + b + c)^2$

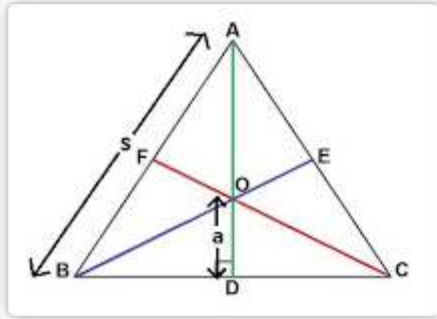
(C) $\frac{\sqrt{2}}{3} (a + b + c)$

(D) $\frac{\sqrt{3}}{3} (a + b + c)^2$

$\frac{1}{3} \times \text{side} \times \text{height}$
 $1 : 3 : 2$
 $2 \times \text{side} \times \text{height}$

Q. 2

Here the lengths of perpendiculars are given to be a, b and c. Note that no additional information is given, hence it is safe to assume $a = b = c$. Let the side of the triangle be 's'. The figure will look like this



We have to establish a relation between 'a' and 's'. In an equilateral triangle, the incentre, orthocentre, circumcentre and centroid, all coincide. So you can calculate 'a', by which ever method you like.

$a = \text{inradius} = s/2\sqrt{3}$ [The inradius of an equilateral triangle is $s/2\sqrt{3}$ and the circumradius is $s/\sqrt{3}$]

Hence $s = 2\sqrt{3}a$

We know the formula for calculating the area of an equilateral triangle = $(\sqrt{3}/4)s^2$

$= (\sqrt{3}/4)(2\sqrt{3}a)^2$

$= 3\sqrt{3}a^2$

Now put $a = b = c$ in all the options and check which one will give $3\sqrt{3}a^2$

A) $\sqrt{3}a$

B) $3\sqrt{2}a^2$

C) $\sqrt{2}a$

D) $3\sqrt{3}a^2$

Answer : (D)

I have found that SSC has some real love with 'Area of a triangle' and it keeps on asking it again and again under different contexts. Like in Tier 2 (2014) around 5 questions asked area of triangles.

Therefore it is very important that you memorize all the possible formulas to calculate it. This will save you a lot of time.

Note : All the below questions are taken from a single paper [Tier-2, 2014].

Formula 1 : (Applicable only for Right-Angled Triangle)

One of the angles of a right-angled triangle is 15° , and the hypotenuse is 1 m. The area of the triangle (in sq. cm.) is

(A) 1200

(B) 1215

(C) 1220

(D) 1250

Q. 3

In the above question you may struggle to calculate the area. You can try this question yourself (with a timer), to see how much time you are taking...

There is a direct formula for such questions -

$$\text{Area of a right-angled triangle} = \frac{h^2 \cdot \sin 2\theta}{4}$$

where,

h = hypotenuse of the triangle

θ = any of the angles of the triangle (except the 90 degree angle)

Apply this formula, area = $(100^2 \cdot \sin 30) / 4 = 1250$

Answer : (D)

Note : You can choose any of the angles of the triangle (except the 90 degree one) and you will get the same result. Like in the above question, the 3 angles of the triangle are 15, 75 and 90.

$$\sin 2 \cdot 15 = \sin 30$$

$$\sin 2 \cdot 75 = \sin 150$$

And we know that $\sin 150 = \sin 30$

Hence it doesn't matter which angle you take. But to avoid any confusion, always take the smaller angle (15 in this case).

Next question -

In a right angled triangle ΔPQR , PR is the hypotenuse of length 20 cm, $\angle PRQ = 30^\circ$, the area of the triangle is

- (A) $100\sqrt{3} \text{ cm}^2$ (B) $100\sqrt{3} \text{ cm}^2$
(C) $50\sqrt{3} \text{ cm}^2$ (D) $25\sqrt{3} \text{ cm}^2$

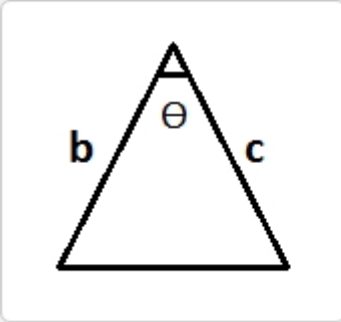
Q. 4

Again apply the same formula

Answer : (C)

Formula 2 : $\frac{1}{2} * b * c * \sin \theta$

This formula is only applicable when θ lies between the sides 'b' and 'c'.



If the length of each of two equal sides of an isosceles triangle is 10 cm. and the adjacent angle is 45° , then the area of the triangle is

- (A) $12\sqrt{2}$ square cm.
- (B) $15\sqrt{2}$ square cm.
- (C) $20\sqrt{2}$ square cm.
- (D) $25\sqrt{2}$ square cm.

Q.5

Apply the formula, area = $\frac{1}{2} * 10 * 10 * \sin 45$

Answer : (D)

Formula 3 : Area of a triangle = r * S

where r = inradius

S = semi-perimeter

The in-radius of a triangle is 6 cm, and the sum of the lengths of its sides is 50 cm. The area of the triangle (in sq. cm.) is

(A) 50 (B) 56 (C) 150 (D) 300

Q. 6

Given, perimeter = 50, hence semi-perimeter = 25

Area = $6 * 25 = 150$

Answer : (C)

Now when you know this formula, in Q. 2 above, where we had to establish relation between 's' and 'a', you can establish it by applying this formula too.

Area of an equilateral triangle = $(\sqrt{3}/4)s^2$

Area of a triangle = inradius * semi-perimeter = $a * (3s)/2$

Now,

$a * (3s)/2 = (\sqrt{3}/4)s^2$

or $s = 2\sqrt{3}a$ [Same result]

Orthocentre, Incentre, Circumcentre and Centroid :

This topic is very important from SSC point of view. You all must be knowing the theory of these terms, but I will reiterate -

Orthocentre - Point of intersection of altitudes of a triangle

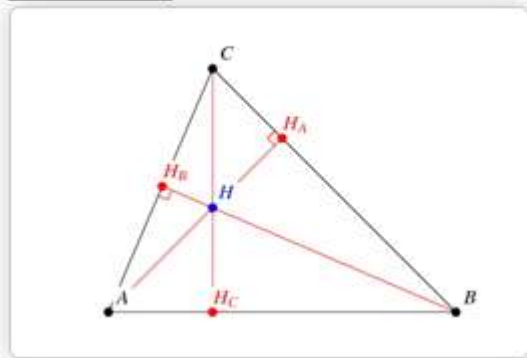
Incentre - Point of intersection of angle bisectors

Circumcentre - Point of intersection of perpendicular bisectors

Centroid - Point of intersection of medians

The above information, although important, is not sufficient enough to solve the questions. Each of these terms require different approach to solve the questions based on them.

Orthocentre



For more, check-out: <http://sschacks.blogspot.in/>

$\angle AHB + \angle ACB = 180$ [Whenever you see the word 'orthocentre' in the paper, you should immediately recall this formula]

Over the years SSC has asked many questions based on this simple formula. Like -

O is the orthocentre of ΔABC . Then

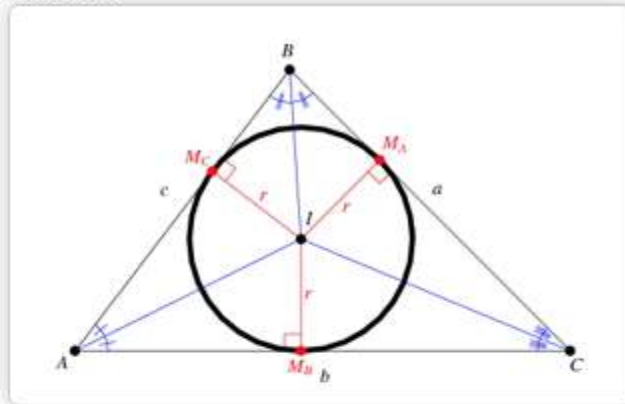
$\angle BOC + \angle BAC$ is equal to

- (A) 180° (B) 90°
(C) 120° (D) 135°

Q. 1

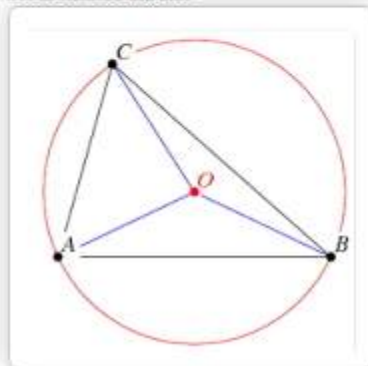
Answer : (A)

Incentre



$\angle AIC = 90 + \angle ABC/2$ [Whenever you see the word 'incentre' in the paper, you should immediately recall this formula]

Circumcentre



While solving questions on circumcentre, you should imagine the above figure. Here two things are quite useful -

$$\angle AOB = 2\angle ACB$$

$OA = OB = OC$ [radius of the circle]. And hence,

$$\angle OAB = \angle OBA$$

$$\angle OCA = \angle OAC$$

$$\angle OBC = \angle OCB$$

- $\triangle ABC$ is an equilateral triangle and O is its circumcentre, then the $\angle AOC$ is

(A) 100° (B) 110°

(C) 120° (D) 130°

Q. 2

Each angle of an equilateral triangle is 60° and we have seen earlier that the angle at the centre is twice that of the triangle.

Hence $\angle AOC = 120^\circ$

Answer : (C)

In $\triangle ABC$, $\angle ABC = 70^\circ$, $\angle BCA = 40^\circ$.
 O is the point of intersection of the perpendicular bisectors of the sides, then the angle $\angle BOC$ is

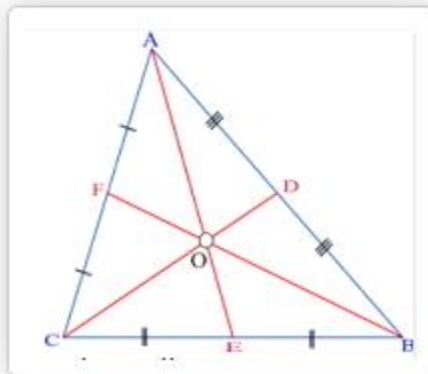
(A) 100° (B) 120°

(C) 130° (D) 140°

Q. 3

Answer : (D)

Centroid



Centroid divides the medians in the ratio 2:1. Hence for the median AE,

$$OA = \frac{2}{3}AE$$

$$OE = \frac{1}{3}AE$$

$$OA = 2OE$$

Similarly for the medians CD and BF.

Remember one more property related to centroid,

$$\text{Area}(\triangle OBC) = \frac{1}{3}\text{Area}(\triangle ABC)$$

If G be the centroid and AD be the median of $\triangle ABC$ and $AG = 4$ cm, then DG is

(A) 2 cm

(B) 3 cm

(C) 4 cm

(D) 5 cm

Q. 4

We know $DG = \frac{1}{2}AG$

Hence $DG = 2$ cm

Answer : (A)

Some additional things to remember :

1) The orthocentre, incentre, circumcentre and centroid of an equilateral triangle coincide, i.e., a single point acts as all the centres.

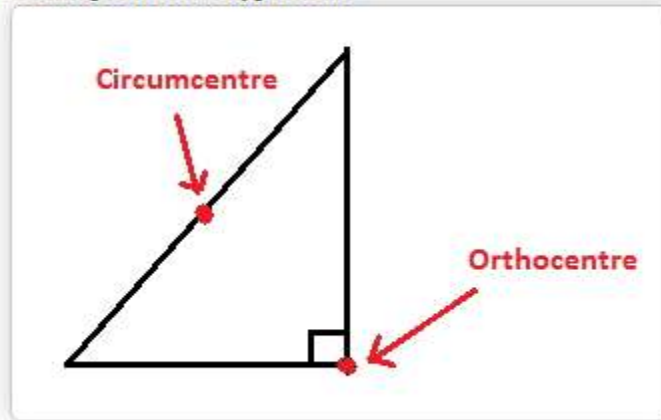
2) For an equilateral triangle-

- Inradius = $\frac{h}{3} = \frac{a}{2\sqrt{3}}$
- Circumradius or outer-radius = $\frac{2h}{3} = \frac{a}{\sqrt{3}}$
- Height(h) = $(\frac{\sqrt{3}}{2})a$

where a = side of the equilateral triangle

3) For a right-angled triangle

- Orthocentre is at the right angle vertex
- Circumcentre is the midpoint of the hypotenuse



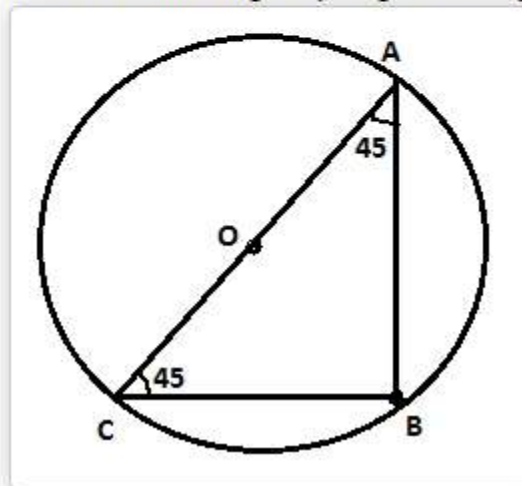
Here is a question based on this fact-

If the circumcentre of a triangle lie on the side whose adjacent angles are 45° each then find the other two sides if the radius of the circumcircle is 15 cm ?

- (A) 15 cm (B) 30 cm
(C) $15\sqrt{2}$ cm (D) $30\sqrt{2}$ cm

Q. 5

Two angles are 45 degrees and hence the third angle is 90 degrees. The figure will look like this-



Radius of the circumcircle = 15, hence diameter = 30cm

AC = 30cm

We have to find AB and BC.

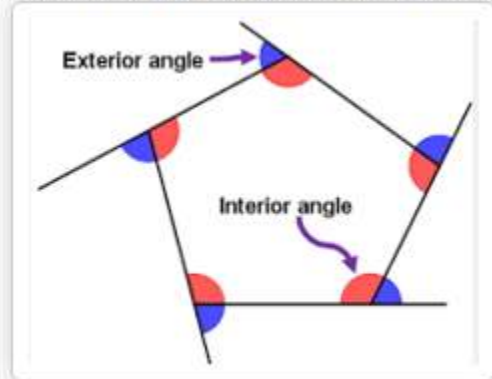
AB = BC [as $\angle ACB = \angle ABC = 45^\circ$]

AB = $\sin 45^\circ * AC = 30/\sqrt{2} = 15\sqrt{2}$

Answer : (C)

Interior and Exterior Angles

Another important topic of geometry is "Internal and External Angles" of polygon.



Now remember few formulae for such questions-

- 1) Sum of a interior angle and its corresponding exterior angle adds up to 180 degrees.
- 2) Sum of all exterior angles of a regular polygon is always 360.
- 3) Sum of interior angles = $(n-2)*180$
- 4) Each interior angle of a regular polygon is equal to $[(n-2)*180]/n$
- 5) Each exterior angle of a regular polygon is equal to $360/n$

Mug all these formulae well and you will be able to solve all questions on interior and exterior angles easily.

Now let's solve some CGL questions

If the sum of interior angles of a regular polygon is equal to two times the sum of exterior angles of that polygon, then the number of sides of that polygon is
(A) 5 (B) 6 (C) 7 (D) 8

Q. 6

Given

$$(n - 2)*180 = 2*360$$

$$\text{So } n - 2 = 4$$

$$\text{or } n = 6$$

Answer : (B)

The number of sides in two regular polygons are as 5 : 4 and difference between their angles is 6° . The number of sides in the polygons are
(A) 12 & 15 (B) 12 & 13
(C) 20 & 16 (D) 15 & 12

Q.7

Note : Here the difference between the "angles" of two polygons is given. You might be wondering that they haven't mentioned the type of angle, whether interior or exterior. Well, it doesn't matter! Because as far as two polygons are concerned-

Difference between their interior angles = Difference between their exterior angles

But I will take the angles to be exterior, because that will make our calculations simple

Let the sides be $5x$ and $4x$.

Measure of each exterior angle of Polygon 1 = $360/5x = 72/x$

Measure of each exterior angle of Polygon 2 = $360/4x = 90/x$

Given, $90/x - 72/x = 6$

so $x = 3$

The two angles are $5x$ and $4x$

$5x = 5 \cdot 3 = 15$

$4x = 4 \cdot 3 = 12$

Had I taken the angles to be interior -

We have seen earlier that the measure of each angle of a polygon is $[(n - 2) \cdot 180]/n$.

Given $[(5x - 2) \cdot 180]/5x - [(4x - 2) \cdot 180]/4x = 6$

Solve it and you will get $x = 3$

So the angles are 15 and 12

Answer : (D)

Trigonometry Hacks

Trigonometry is yet another scoring section of CGL. Most of the questions can be solved with *jugaad*.

Just like Algebra, where we assumed the values of variables, in trigonometry we will assume the value of 'theta'. And like algebra, make sure the value you are assuming for theta will not make the denominator zero.

How to assume value -

1. When you don't have to deal with fractions you can assume $\theta = 90$ or 0
E.g. $(a\cos\theta - b\sin\theta)$
2. When fraction is given and putting $\theta = 90$ or 0 is making denominator zero, then you can go with $\theta = 45$.
3. Don't assume a value for theta at which the trigonometric function is not defined. E.g. When $\tan\theta$ is given, you can't assume $\theta = 90$.
4. When you are assuming two angles, go with $A = 60$ and $B = 30$

Note : These are not hard and fast rules and you can assume any value you like, but make sure

denominator $\neq 0$. Sometimes when you assume θ , you may end up with two options (say A and B) that are giving similar results (but two options will still get eliminated, i.e., C and D). Now change the value of theta and check only A and B.

You only need to memorize the values of sin, cos and tan (for $\theta = 0, 30, 45$ and 60). The values of cosec, sec and cot can be obtained by reciprocating sin, cos and tan respectively.

Now let's solve CGL questions

94. If $x = a(\sin\theta + \cos\theta)$, $y = b(\sin\theta - \cos\theta)$

then the value of $\frac{x^2}{a^2} + \frac{y^2}{b^2}$ is

- (A) 0 (B) 1 (C) 2 (D) -2

Q. 1.

Put $\theta = 90$

$$x = a(1 + 0) = a$$

$$y = b(1 - 0) = b$$

$$\text{So } \frac{x^2}{a^2} + \frac{y^2}{b^2} = 2$$

Answer : C

Some complex questions can be solved by assuming the value of theta

63. If $a \sin \theta + b \cos \theta = c$, then $a \cos \theta - b \sin \theta$ is equal to

- (A) $\pm \sqrt{a^2 + b^2 + c^2}$
- (B) $\pm \sqrt{c^2 + a^2 - b^2}$
- (C) $\pm \sqrt{a + b - c}$
- (D) $\pm \sqrt{a^2 + b^2 - c^2}$

Q. 2.

Again assume $\theta = 90$

Then $a \cdot 1 + b \cdot 0 = c$ or $a = c$

You have to find the value of $a \cos \theta - b \sin \theta$

$a \cos \theta - b \sin \theta = -b$ (Since $\theta = 90$)

Now put $a = c$ in all the 4 options to check which one can give '-b' as the output

Answer : D

If $a(\tan \theta + \cot \theta) = 1$, $\sin \theta + \cos \theta = b$ with $0^\circ < \theta < 90^\circ$, then a relation between a and b is

- ✓(A) $2a = b^2 - 1$
- (B) $2a = b^2 + 1$
- (C) $b^2 = 2(a + 1)$
- (D) $b^2 = 2(a - 1)$

Q. 3

Assume $\theta = 45$

$a(\tan 45 + \cot 45) = 1$

So $a = 1/2$

$\sin 45 + \cos 45 = b$

So $b = \sqrt{2}$

Put $a = 1/2$ and $b = \sqrt{2}$ in all the options and check which among the 4 equations is right (i.e. LHS should be equal to RHS)

Answer : A (both LHS and RHS are equal to 1)

73. If $0^\circ < A < 90^\circ$, then the value of $\frac{\tan A - \sec A - 1}{\tan A + \sec A + 1}$ is

- (A) $\frac{1 - \cos A}{\sin A}$ (B) $\frac{\sin A + 1}{\cos A}$
 (C) $\frac{\sin A - 1}{\cos A}$ (D) $\frac{1 - \sin A}{\cos A}$

Assume $\theta = 45$

$(\tan A - \sec A - 1)/(\tan A + \sec A + 1) = -\sqrt{2}/(2 + \sqrt{2}) = -1/(\sqrt{2} + 1) = 1 - \sqrt{2}$ (rationalize)

Put $\theta = 45$ in all the 4 options and check which one will give $(1 - \sqrt{2})$ as the output

A) $\sqrt{2} - 1$

B) $\sqrt{2} + 1$

C) $1 - \sqrt{2}$

D) $\sqrt{2} - 1$

Answer : C

Sometimes you would need to assume two angles

25. If $\tan A = n \tan B$ and $\sin A = m \sin B$, then the value of $\cos^2 A$ is

- (A) $\frac{m^2 + 1}{n^2 + 1}$ (B) $\frac{m^2 - 1}{n^2 - 1}$
 (C) $\frac{m^2 + 1}{n^2 - 1}$ (D) $\frac{m^2 - 1}{n^2 + 1}$

Q.4

Let $A = 60$ and $B = 30$

Then $n = 3$ and $m = \sqrt{3}$

$\cos^2 A = 1/4$ (since $A = 60$)

Now put $n = 3$ and $m = \sqrt{3}$ in all the options and check which one will give $1/4$

Answer : B

There is one type of question which is frequently asked by SSC -

If $\sec \alpha + \tan \alpha = 2$, then the value of $\sin \alpha$ is
(assume that $0 < \alpha < 90^\circ$)
(A) 0.4 (B) 0.5 (C) 0.6 (D) 0.8

Q. 5.

When you see $\sec A + \tan A = \text{something}$ (let's say 'p') ... (1)

you can write, $\sec A - \tan A = 1/p$... (2)

Now add (1) and (2)

$$2\sec A = p + 1/p$$

$$\sec A = (p^2 + 1)/2p \text{ [You can memorize this formula]}$$

$$\tan A = (p^2 - 1)/2p$$

In the above question, $p=2$

$$\text{So } \sec A = 5/4$$

Now we have to find $\sin A$. The best way to determine the value of a trigonometric function when the value of other function is given, is by making a triangle.

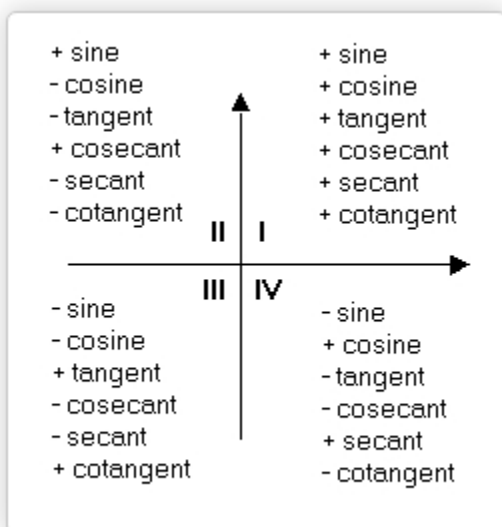
$$\sec \theta = \text{Hypotenuse/Base}$$

Here $\sec A = 5/4$, hence hypotenuse = 5 and base = 4, which means perpendicular = 3

$$\sin A = \text{perpendicular/hypotenuse} = 3/5 = 0.6$$

Answer : C

Part - 2



Few things which the above figure represents :

- There are 4 quadrants (shown with I, II, III and IV).
 - Quadrant I - 0° to 90°
 - Quadrant II - 90° to 180°
 - Quadrant III - 180° to 270°
 - Quadrant IV - 270° to 360°
- In the first quadrant, all the trigonometric functions are positive. So the values of $\sin 56$, $\cos 18$, $\tan 89$, $\cot 67$, $\operatorname{cosec} 33$, etc. are positive. Note that I have taken the angles 56, 18, 89, 67, 33 and all of them are less than 90 (hence belong to the first quadrant)
- In the second quadrant, only **sin** and **cosec** are positive, and rest are negative. Hence $\sin 91$, $\sin 135$, $\operatorname{cosec} 120$, $\sin 116$, etc. are positive while $\cos 135$, $\cot 120$, $\tan 95$, etc. are negative.
- In the third quadrant, only **tan** and **cot** are positive, and rest are negative. Hence $\tan 200$, $\tan 198$, $\cot 255$, etc. are positive while $\cos 255$, $\sin 220$, $\operatorname{cosec} 265$, etc. are negative.
- In the fourth quadrant, only **cos** and **sec** are positive, and rest are negative. Hence $\cos 300$, $\cos 350$, $\sec 290$, $\sec 285$, etc. are positive while $\tan 359$, $\cot 355$, $\sin 340$, etc. are negative.

- The mnemonic to remember which trigonometric function is positive in which quadrant is - **All Students Take Calculus**. "All" is the first word of the sentence and hence represents the first quadrant. All trigonometric functions are positive in the 1st quadrant. Second initial is "S" which represents sin (indicating sin/cosec are positive in 2nd quadrant). Third initial is "T" which represents tan (indicating tan/cot are positive in 3rd quadrant). Fourth initial is "C" which represents cos (indicating cos/sec are positive in 4th quadrant).
- **Gist:**
 - All trigonometric functions are positive in the 1st quadrant
 - sin/cosec are positive in 2nd quadrant (sin and cosec are reciprocal of each other and hence their signs are same)
 - tan/cot are positive in 3rd quadrant
 - cos/sec are positive in 4th quadrant

Converting trigonometric functions :

$\sin(90 - A) = \cos A$, and hence $\sin 65 = \sin(90 - 25) = \cos 25$

$\sin(90 + A) = \cos A$, and hence $\sin 135 = \sin(90 + 45) = \cos 45$

$\cos(90 - A) = \sin A$, and hence $\cos 85 = \cos(90 - 5) = \sin 5$

$\cos(90 + A) = -\sin A$, and hence $\cos 135 = \cos(90 + 45) = -\sin 45 = -(1/\sqrt{2})$

where A is any acute angle

Explanation

- $\sin(90 + A)$ refers to a value in the 2nd quadrant because A is an acute angle and hence $(90 + A)$ would cover angles from 90 to 180 degrees (depending upon the value of A). 90 to 180 degrees is the range of 2nd quadrant. Now we have seen that in the second quadrant sin is positive. Hence $\sin(90 + A) = +\cos A$.
- $\cos(90 + A) = -\sin A$, because in the second quadrant cos is negative.
- $(90 - A)$ represents the 1st quadrant and in the 1st quadrant, all the trigonometric functions are positive, hence:
 - $\sin(90 - A) = +\cos A$ and hence $\sin 75 = \sin(90 - 15) = \cos 15$ (here $A = 15$)
 - $\cos(90 - A) = +\sin A$
 - $\tan(90 - A) = +\cot A$
 - $\cot(90 - A) = +\tan A$
 - $\sec(90 - A) = +\operatorname{cosec} A$
 - $\operatorname{cosec}(90 - A) = +\sec A$

- Now instead of 90 degrees if we have 180 degrees, then the functions are not converted.
E.g.

- $\sin(180 - A) = \sin A$, and hence $\sin 135 = \sin(180 - 45) = \sin 45$
- $\cos(180 - A) = -\cos A$ and hence $\cos 165 = \cos(180 - 15) = -\cos 15$
- $\tan(180 - A) = -\tan A$
- $\operatorname{cosec}(180 - A) = \operatorname{cosec} A$
- $\sec(180 - A) = -\sec A$

- Note that in the above lines only sin and cosec are positive, because $(180 - A)$ represents 2nd quadrant and in the second quadrant only sin and cosec are positive.

Caution: While converting, please keep in mind that we check the sign of the function which is about to get converted. So if you want to convert $\sin X$ into $\cos Y$, first check where does X lie (in which quadrant), and then check the sign of "**sin**" (not **cos**) in that quadrant. If **sin** is positive in that quadrant, write $\sin X = +\cos Y$, else write $\sin X = -\cos Y$.

Gist:

- sin is converted into cos
- tan is converted into cot
- sec is converted into cosec

You need only this much knowledge to solve SSC questions [You don't have to do PhD after all :)]
Now let us solve some CGL questions:

If $\sin 3A = \cos (A - 26^\circ)$, where $3A$ is an acute angle then the value of A is

- (A) 29° (B) 26°
(C) 23° (D) 28°

Q. 1)

We have to convert $\sin 3A$ into \cos .

$3A$ is an acute angle and hence $\sin 3A$ lies in the 1st quadrant.

$\sin 3A = +\cos(90 - 3A)$ [sin is positive in 1st quadrant, hence we have written $+\cos(90 - 3A)$]

Hence, $\cos(90 - 3A) = \cos(A - 26)$

$90 - 3A = A - 26$ [Equating cos]

$4A = 116$

or $A = 29$

Answer : (A)

Note: In this question we had to convert sin into cos, hence we checked the sign of sin.

If $\sin 5\theta = \cos 20^\circ$ ($0^\circ < \theta < 90^\circ$) then the value of θ is

- (A) 4° (B) 22°
 (C) 10° (D) 14°

Q. 2)

$\cos 20^\circ = \cos(90^\circ - 70^\circ) = +\sin 70^\circ$ [$\cos 20^\circ$ lies in the 1st quadrant and \cos is positive in the 1st quadrant, hence we have written $+\sin 70^\circ$]

Hence, $\sin 5\theta = \sin 70^\circ$

$5\theta = 70^\circ$ [Equating sin]

$\theta = 14^\circ$

Answer : (D)

Note: In this question, don't write $\sin 5\theta = \cos(90^\circ - 5\theta)$, because this formula is applicable only for acute angles and 5θ is not necessarily an acute angle

I hope this concept of quadrants and conversion is clear.

Moving on, I discussed the basic trick of Trigonometry (putting the value of theta) in Part-1. Since this trick is extremely important, in each article of trigonometry I will solve some questions by assuming the value of θ so that you imbibe that method well. For reference, I am attaching the values-

$\angle A$	0°	30°	45°	60°	90°
$\sin A$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos A$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan A$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Not defined
$\operatorname{cosec} A$	Not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
$\sec A$	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Not defined
$\cot A$	Not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

Let us take some more questions from CGL-

$$\text{Value of } \sec^2 \theta - \frac{\sin^2 \theta - 2\sin^4 \theta}{2\cos^4 \theta - \cos^2 \theta} \text{ is}$$

- (A) 1 (B) 2 (C) -1 (D) 0

Q. 3)

In this question you can't take $\theta = 45, 90$ because that will make $2\cos^4 \theta - \cos^2 \theta = 0$, and we know that denominator can never be zero. So you are left with two values: 0, 30 or 60

Take $\theta = 0$

$$\sec 0 = 1$$

$$\sin 0 = 0$$

$$\cos 0 = 1$$

Put the above values and you will get the value of the expression as 1.

Answer: (A)

$$\frac{\sin A}{1 + \cos A} + \frac{\sin A}{1 - \cos A} \text{ is } (0^\circ < A < 90^\circ)$$

- (A) 2 cosec A (B) 2 sec A
(C) 2 sin A (D) 2 cos A

Q. 4)

Put $A = 30$

$$\text{The value of the expression} = \frac{1}{2} / (1 + \sqrt{3}/2) + \frac{1}{2} / (1 - \sqrt{3}/2) = (2 - \sqrt{3}) + (2 + \sqrt{3}) = 4$$

Now put $A = 30$ in all the 4 options

- (A) 4 (B) $4/\sqrt{3}$ (C) 1 (D) $\sqrt{3}$

Answer : (A)

Note : Don't put $A = 45$ in this question, because then options A and B will give the same output.

If $\tan \theta - \cot \theta = a$ and $\cos \theta - \sin \theta = b$, then the value of $(a^2 + 4)(b^2 - 1)^2$ is :

- (A) 4 (B) 1
(C) 2 (D) 3

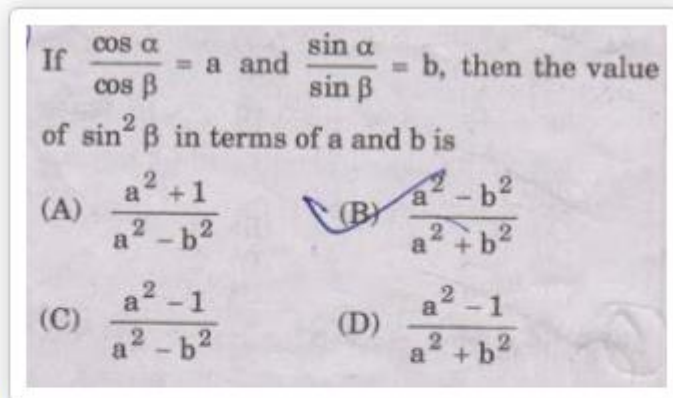
Q. 5)

Put $\theta = 45$

$$a = 0, b = 0$$

$$\text{Value of the expression} = (0 + 4)(0 - 1)^2 = 4$$

Answer : (A)



Q. 6)

We had seen earlier that when we have to assume two angles, it is best to assume them as 30 and 60.

$\alpha = 30$ and $\beta = 60$

Then $a = \sqrt{3}$ and $b = 1/\sqrt{3}$

Then $\sin^2 \beta = 3/4$

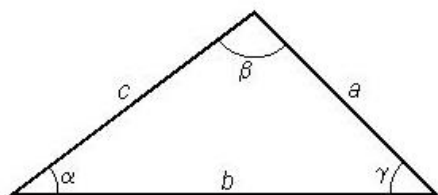
Put $a = \sqrt{3}$ and $b = 1/\sqrt{3}$ in all the 4 options and check which one of them is giving $3/4$ as the output

Answer : (C)

Part – 3

Sine and Cosine Rule

Determining Sides and Angles of Any Triangle



$$\frac{\sin \alpha}{a} = \frac{\sin \beta}{b} = \frac{\sin \gamma}{c} \quad (\text{Law of Sines})$$

$$c^2 = a^2 + b^2 - 2ab \cos \gamma \quad (\text{Law of Cosines})$$

Known Sides and Angles

All three sides (SSS)
 a , b , and c

Example

$$\cos \alpha = \frac{b^2 + c^2 - a^2}{2bc}$$

Two sides and the angle included between them (SAS)
 b , α , and c

$$a^2 = b^2 + c^2 - 2bc \cos \alpha$$

Two sides and an angle not included between them (SSA)
 a , b , and α

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

One side and two angles (SAA)
 a , α , and β

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

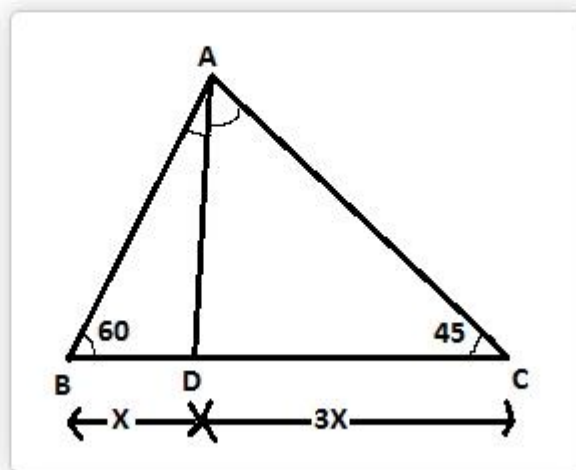
See the image above and mug the formulas thoroughly. Sin and cosine rules are important in trigonometry and can help you in solving some complex questions.

In a ΔABC , $\angle B = \frac{\pi}{3}$, $\angle C = \frac{\pi}{4}$ and D divides BC internally in the ratio $1 : 3$ then $\frac{\sin \angle BAD}{\sin \angle CAD}$ is equal to

- (A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{\sqrt{3}}$
 (C) $\frac{1}{\sqrt{6}}$ (D) $\sqrt{6}$

Q. 1)

The figure will look something like this -



In triangle ACD

$$\sin \angle CAD / 3x = \sin 45 / AD \quad \dots (1)$$

In triangle ABD

$$\sin \angle BAD / x = \sin 60 / AD \quad \dots (2)$$

Divide equation (2) by (1)

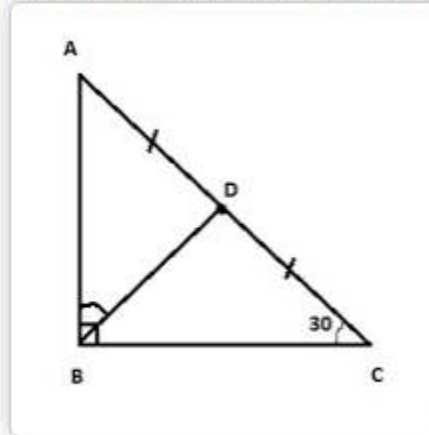
$$3 * \sin \angle BAD / \sin \angle CAD = \sin 60 / \sin 45$$

$$\sin \angle BAD / \sin \angle CAD = \sqrt{6} / 6 = 1 / \sqrt{6}$$

Answer: (C)

Similarly you can use cosine law to find any angle, if all the sides are given or to find a side, if the other two sides and an angle is given.

Q. 2) In the below figure, ABC is right angled at B and AD = CD. If $\angle ACB = 30^\circ$, find $\angle ABD$



- (A) 30 (B) 60 (C) 45 (D) 75

$$\angle BAD = 180 - (90 + 30) = 60$$

In triangle ABD

$$\sin \angle ABD / AD = \sin 60 / BD \quad [\text{Since } \angle BAD = 60]$$

In triangle BCD

$$\sin \angle CBD / CD = \sin 30 / BD$$

Divide equation (2) by (1)

$$\sin \angle CBD / \sin \angle ABD = \sin 30 / \sin 60 \quad [AD = CD \text{ and hence they will cancel out}]$$

$$\text{Now, } \sin \angle CBD = \sin(90 - \angle ABD) = \cos \angle ABD$$

$$\text{Hence, } \cos \angle ABD / \sin \angle ABD = \sin 30 / \sin 60$$

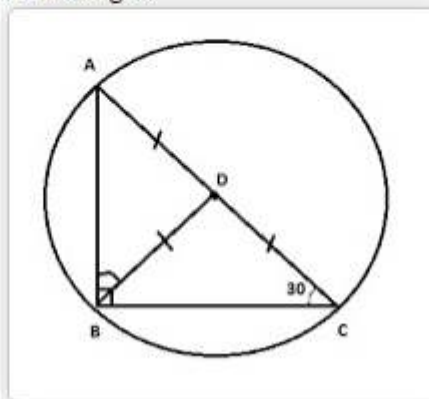
$$\cot \angle ABD = 1/\sqrt{3}$$

$$\text{Hence } \angle ABD = 60$$

Answer: (B)

Alternative Method

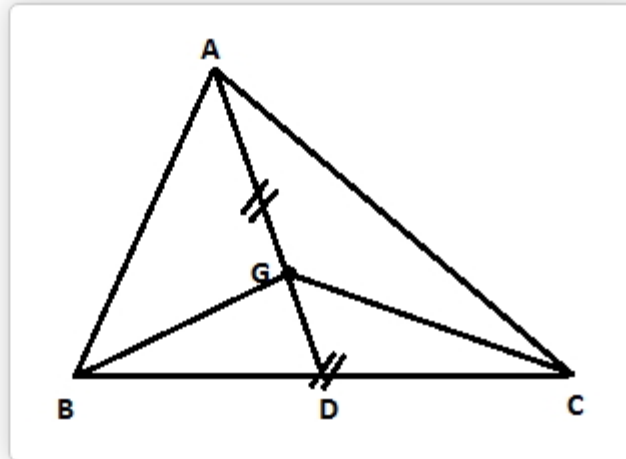
The figure given in this question is very important and at times it is embedded in some other figures. There is one short-cut to calculate the angle.



Now let us see a CGL question, in which the above figure was embedded.

Q. 3) G is the centroid of Triangle ABC, and $AG=BC$. Find angle BGC.

(A) 60 (B) 90 (C) 120 (D) 75



Let $AG = 2x$

Then $BG = x$ (centroid divided the median in 2:1 ratio)

$BC = AG = 2x$

Let AG when extended cuts BC at D

Then D is the midpoint of BC (as AD is the median)

$BD = DC = x$ [Since $BC = 2x$]

Now $DG = BD = DC = x$

That means D is the centre of a circle with diameter BC and one of the radius as DG.

Hence $BGC = 90$ (angle in a semi-circle)

Answer: (B)

If θ is positive acute angle and $3(\sec^2\theta + \tan^2\theta) = 5$, then the value of $\cos 2\theta$ is

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

Q. 4)

$$\sec^2 x + \tan^2 x = 5/3$$

We know, $\sec^2 x - \tan^2 x = 1$

Adding the above two equations

$$2\sec^2 x = 8/3 \text{ or } \sec^2 x = 4/3$$

$$\sec x = 2/\sqrt{3}$$

That means $x = 30$

$$\cos 2x = \cos 60 = 1/2$$

Answer: (C)

Method 2:

$$\sec^2 x = 4/3$$

That means, $\cos^2 2x = 3/4$ and $\sin^2 2x = 1 - 3/4 = 1/4$

$$\cos 2x = \cos^2 2x - \sin^2 2x = 3/4 - 1/4 = 1/2$$

$$\text{Solve: } \frac{\cos \theta - \sin \theta}{\cos \theta + \sin \theta} = \frac{\sqrt{3} - 1}{\sqrt{3} + 1}$$

$(0^\circ \leq \theta \leq 90^\circ)$

(A) $\pi/6$ (B) $\pi/3$ (C) $\pi/2$ (D) $\pi/4$

Q. 5)

Multiply and Divide RHS by 2

$$(\cos x - \sin x)/(\cos x + \sin x) = (\sqrt{3}/2 - 1/2)/(\sqrt{3}/2 + 1/2)$$

Match RHS with LHS and you can easily see $x = 30$

Answer: (A)

Method 2

Cross multiply

$$(\cos x - \sin x)(\sqrt{3} + 1) = (\cos x + \sin x)(\sqrt{3} - 1)$$

Solve it and you will get, $\tan x = 1/\sqrt{3}$

Hence $x = 30$

If $2y \cos \theta - x \sin \theta = 0$ and $2x \sec \theta - y \operatorname{cosec} \theta = 3$, then the value of $x^2 + 4y^2$ is
(A) 0 (B) 2 (C) 4 (D) 8

Q. 6)

Put $\theta = 45$
 $2y \cos 45 - x \sin 45 = 0$
 $2y = x \dots (1)$
 $2x \sec 45 - y \operatorname{cosec} 45 = 3$
 $2x - y = 3/\sqrt{2}$
 $4y - y = 3/\sqrt{2}$ [Put $x = 2y$]
 $y = 1/\sqrt{2}$
Hence, $x = 2y = \sqrt{2}$
 $x^2 + 4y^2 = 2 + 4(1/2) = 2 + 2 = 4$
Answer: (C)

Some important values to mug:

1. $\sin 15 = (\sqrt{3} - 1) / 2\sqrt{2}$
2. $\cos 15 = (\sqrt{3} + 1) / 2\sqrt{2}$
3. $\tan 15 = 2 - \sqrt{3}$
4. $\cot 15 = 2 + \sqrt{3}$

These values are very important to solve some tricky trigonometric questions. Examples :

Q. 7)

One of the angles of a right-angled triangle is 15° , and the hypotenuse is 1 m. The area of the triangle (in sq. cm.) is

- (A) 1200 (B) 1215
(C) 1220 (D) 1250

Although you can solve this question with the direct formula, which I discussed in Geometry Tricks - 1. But let us assume, you forget that formula. In such cases, the values of $\sin 15$ and $\cos 15$ will come handy.

Let the perpendicular and base of the triangle be P and B, respectively.

$$\sin 15 = \text{Perpendicular/Hypotenuse} = P/100$$

$$P = \sin 15 * 100$$

$$\text{Similarly, } B = \cos 15 * 100$$

$$\text{Area} = 1/2 * P * B = 1/2 * \sin 15 * 100 * \cos 15 * 100 = (\sqrt{3} - 1) / 2\sqrt{2} * (\sqrt{3} + 1) / 2\sqrt{2} * 100 * 100 / 2$$

$$\text{Area} = 100 * 100 / 8 = 1250$$

Answer: (D)

Q. 8)

$$\text{Find the value of : } \frac{\cot x}{\cot x - \cot 3x} + \frac{\tan x}{\tan x - \tan 3x}$$

- A) 0 B) 1 C) -1 D) 2

Put $x = 15$

$$= \cot 15 / (\cot 15 - \cot 45) + \tan 15 / (\tan 15 - \tan 45)$$

$$= (2 + \sqrt{3}) / (1 + \sqrt{3}) + (2 - \sqrt{3}) / (1 - \sqrt{3})$$

$$= 1$$

Answer: (B)

Minimum and Maximum value of Trigonometric Functions

Few points to remember:

1. $\sin \theta$ and $\cos \theta$ both have "1" as their maximum value and "-1" as their minimum value. Hence the values of $\sin x$, $\sin 2x$, $\cos x$, $\cos 3x$, etc. lie between -1 and 1.
2. For $\sin^2 x$ and $\cos^2 x$
 - Minimum value = 0
 - Maximum value = 1
3. For $\sin x \cos x$
 - Minimum value = -1/2
 - Maximum value = 1/2
4. Minimum value of $(\sin \theta \cos \theta)^n = (-1/2)^n$

Type	Minimum Value	Maximum Value
$a\sin\theta \pm b\cos\theta$	$-\sqrt{a^2 + b^2}$	$\sqrt{(a^2 + b^2)}$
$a\sin^2\theta + b\cos^2\theta$	<ul style="list-style-type: none"> • b, if $b < a$ • a, if $a < b$ 	<ul style="list-style-type: none"> • b, if $b > a$ • a, if $a > b$
The functions which are reciprocal of each other: <ul style="list-style-type: none"> • $a\sin^2\theta + b\operatorname{cosec}^2\theta$ • $a\tan^2\theta + b\cot^2\theta$ • $a\sec^2\theta + b\cos^2\theta$ 	$2\sqrt{ab}$	Not applicable

Q. 1) What is the least value of $2\sin^2\theta + 3\cos^2\theta$

- (A) 1 (B) 2 (C) 3 (D) 0

Since 2 is less than 3

Minimum value = 2

Answer: (B)

Q. 2) What is the maximum value of $2\sin\theta + 3\cos\theta$

- (A) 2 (B) $\sqrt{13}$ (C) $\sqrt{15}$ (D) 1

$$\text{Maximum value} = \sqrt{2^2 + 3^2} = \sqrt{13}$$

Answer: (B)

Q. 3) What is the least value of $4\sec^2\theta + 9\operatorname{cosec}^2\theta$?

- (A) 1 (B) 19 (C) 25 (D) 7

$$= 4(1 + \tan^2\theta) + 9(1 + \cot^2\theta)$$

$$= 13 + (4\tan^2\theta + 9\cot^2\theta)$$

Now we have to find the least value of $(4\tan^2\theta + 9\cot^2\theta)$

$$\text{Least value of } 4\tan^2\theta + 9\cot^2\theta = 2\sqrt{ab} = 2\sqrt{4 \cdot 9} = 2 \cdot 6 = 12$$

Hence the least value of $4\sec^2\theta + 9\operatorname{cosec}^2\theta = 13 + 12 = 25$

Answer: (C)

Q. 4) The maximum of $3\sin x - 4\cos x$ is
(A) -1 (B) 5 (C) 7 (D) 9

Maximum value = $\sqrt{3^2 + 4^2} = \sqrt{25} = 5$

Answer: (B)

Sometimes they ask the minimum/maximum value of a function. In CGL, that function would always be quadratic ($ax^2 + bx + c$). Please note that a quadratic function can't have both maximum and minimum values.

- If "a" is positive, then the quadratic function will only have a minimum value. The maximum value would be infinite.
- If "a" is negative, then the quadratic function will only have a maximum value. The minimum value would be infinite.

But the process to find both minimum and maximum values is same. Hence you shouldn't be worried about the words "maximum" or "minimum". When finding the minimum/maximum value of a function, we use the concept of "differentiation". Although differentiation is a wide topic in itself, but for CGL purpose, we only have to learn the basics.

Just remember following things:

1. Differentiation of $ax^n = a \cdot n \cdot x^{n-1}$. Hence differentiation of $4x^3 = 12x^2$ and differentiation of $3x^2 = 6x$
2. Differentiation of $ax = a$. Hence differentiation of $4x$ is 4.
3. Differentiation of any constant is zero. Hence differentiation of 5 is 0.
4. If you have to differentiate $ax^2 + bx + c$, just differentiate each of its term separately and add the result.
5. Process of finding the minimum value of a function :
 1. Differentiate the function
 2. What ever result you get, equate it with zero
 3. Find the value of x
 4. Put this value of x in the original function to get the minimum value.

Q. 5) Find the minimum value of $(x - 2)(x - 9)$

(A) $-11/4$ (B) $49/4$ (C) 0 (D) $-49/4$

$$(x - 2)(x - 9) = x^2 - 11x + 18$$

Now we will differentiate $(x^2 - 11x + 18)$

Note that in this question, the value of a is positive, i.e., $+1$ and hence the question has asked you the "minimum" value. Had the value of " a " been negative (like -1), they would have asked you the "maximum" value.

Term	Differentiation
x^2	$2x$
$-11x$	-11
18	0

Hence, differentiation of $(x^2 - 11x + 18) = 2x - 11$

Now $2x - 11 = 0$

$$x = 11/2$$

Put $x = 11/2$ in $(x^2 - 11x + 18)$ to get the minimum value

$$\text{Minimum value of } x^2 - 11x + 18 = (11/2)^2 - 11*(11/2) + 18 = -49/4$$

Answer: (D)

Reasoning Hacks

The moment you receive your question paper, just write A=1, B=2, C=3...Z=26 at the back of it. This is better than memorizing the values because exam pressure is a bitch :) you may end up recalling wrong values. Moreover, it is easier to decipher the pattern if you have written down the alphabets on a paper.

Since the reasoning questions are pre-defined, I will try to give tricks for few of them.

1. 2-3 questions in reasoning section are vocabulary based. Many students leave these questions because they are confusing/difficult. But these questions are the easiest.

(1) 11. (A) Enforce (B) Revoke
(C) Nullify (D) Expunge

(2) Voyage : Sea sickness :: Heights : ?
(A) Ship (B) Travel
(C) Giddiness (D) Motion

These questions may pose difficult if you don't know the meaning of the words giddiness, expunge, etc. But don't worry SSC itself solves these questions for you. How? Have a look at the hindi translation of these questions(which is usually given on the adjacent page)...

(1) 11. (A) लागू करना (B) रद्द करना -
(C) निष्प्रभाव करना (D) मिटा देना -

(2) जहाज़ी यात्रा : जहाज़ी मतली :: ऊँचाई : ?
(A) जहाज़ (B) यात्रा
(C) चक्कर (सिर में) (D) अस्थिरता

Looking at this, you can easily decipher that the answers for the above questions are (A) and (C)
Always refer the hindi translation when ever you face any difficulty in solving vocabulary based questions of Reasoning section.

2. Then there are questions, where you have to arrange some words alphabetically. Don't commit the mistake of forming the entire sequence. Learn to solve such questions with options.

33. Arrange the following words as per order in the dictionary :

1. Recollect
 2. Remember
 3. Report
 4. Repeat
 5. Repeal

(A) 1, 3, 2, 4, 5 (B) 3, 2, 1, 4, 5
 (C) 5, 3, 4, 2, 1 (D) 1, 2, 5, 4, 3

Handwritten notes: 543, 70 x 190, 100/90, 9/11

Like in the above question it is clear that the first 2 words will be Recollect and Remember. So the sequence will start with 1, 2, ... Stop here only and look at the options. Only option D starts with 1, 2... Don't go on arranging the rest of the words because it is not required and will only waste your time. Similarly for the below question

32. Which one of the given responses would be a meaningful order of the following?

1. Elephant 2. Cat 3. Mosquito
 4. Tiger 5. Whale

(A) 5, 3, 1, 2, 4 (B) 1, 3, 5, 4, 2
 (C) 3, 2, 4, 1, 5 (D) 2, 5, 1, 4, 3

Smallest organism among these is the mosquito. Hence the sequence will start with 3. Option C is the only option starting with C.

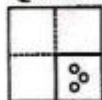
3. Now let us see a very famous question of CGL - Paper cutting. There are two rules to solve such questions -

- a) Note the position at which the cut is made (most of the questions can be solved with this rule only)
- b) Count the layers

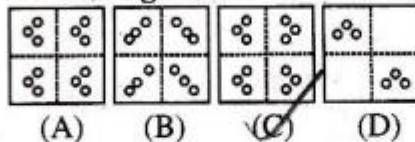
This will make sense if we take any example -

A piece of paper is folded and cut as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.

Question figure:



Answer figures:



To solve this question, just look at the position at which the cut is made (let's call it position X)

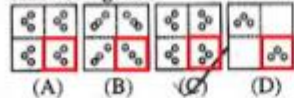
A piece of paper is folded and cut as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.

Question figure:



Notice the position at which the cut is made...

Answer figures:

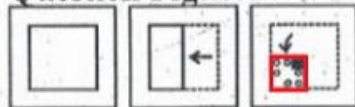


Now match the pattern of X with all the 4 options and see which option has exactly the same pattern.

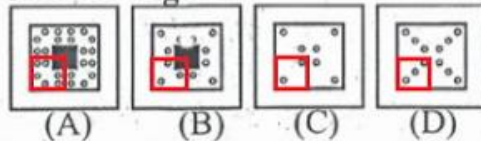
Answer : C

48. A piece of paper is folded and cut as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.

Question Figures :



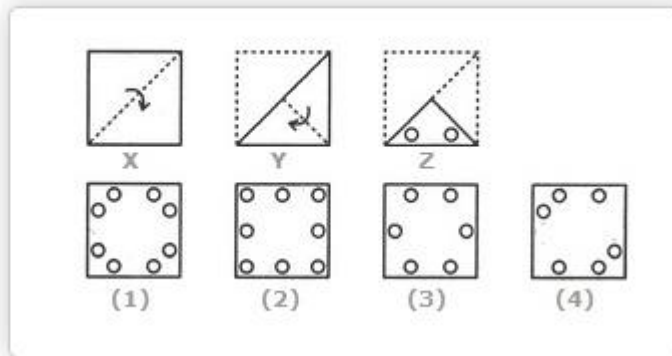
Answer Figures :



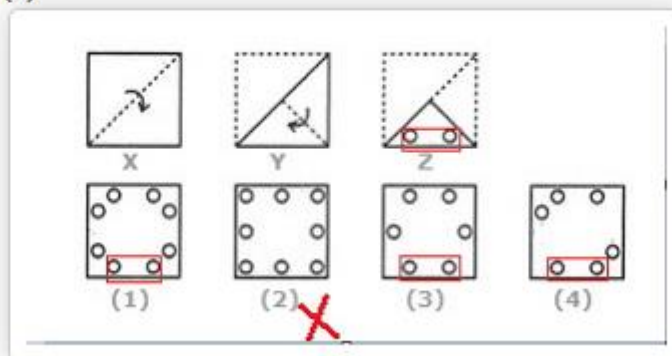
Again you can see that option A matches the pattern

Answer : A

Both the questions above were solved with rule (a). Now let's see some questions where rule (b) is helpful -

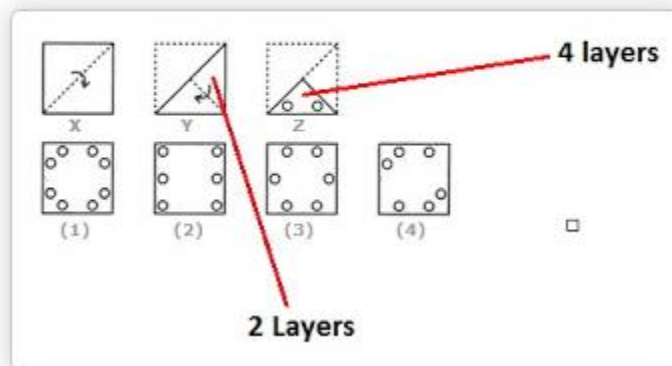


First of all apply rule (a)



Rule (a) only eliminates Option (2).

So here we will apply rule (b), i.e. counting the number of layers on which the cut is made.



When you are holding a piece of paper, you are actually holding 1 layer. When you fold it once, you will get 2 layers. Making a third fold will result in 4 layers and fourth fold will result in 8 layers.

In this question, the paper is folded twice and hence total no. of layers formed are 4.

There are total 4 layers and two holes are made on them.

So total holes in the final figure = No of layers * No of holes made = $4 * 2 = 8$

This means in the answer, there will be 8 holes in total

Options (1) and (2) have 8 holes, but option (2) was eliminated with rule (a). Hence

Answer : (1)

Dice

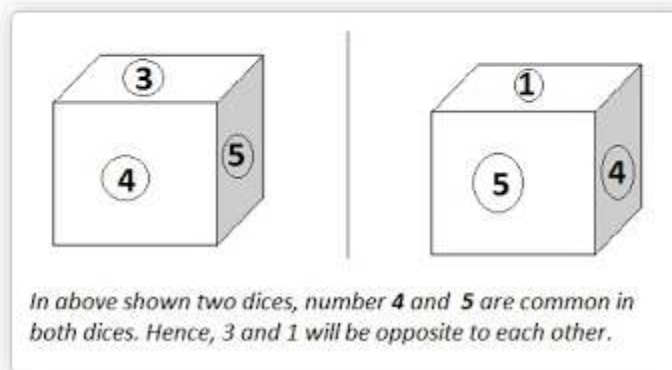
Firstly you should know that there are 2 types of dice - Standard and Ordinary.

In a standard dice, the sum of opposite faces is 7 [Remember that], so if they ask which face is opposite to 2, you can say it is $7-2 = 5$. But mostly the questions are from ordinary dice, where the sum is not 7.

There are various rules to solve the problems on dice -

1. If two sides of Dices are common

If two sides of cubes are common (has same numbers or symbols), then the remaining two will be opposite to each other.



2. If one side of Dices is common

If one side of given dices is common then list these sides (numbers on them) either in clock-wise or anti-clockwise. Comparing the numbers obtained from both dice will give you the opposite numbers.

The diagram shows two dice side-by-side. The left die has faces 2 (top), 4 (front), and 1 (right). The right die has faces 3 (top), 2 (front), and 6 (right).

In this figure, number 2 is common in both dices. Now, writing the remaining no. in clock-wise direction, we get:

2-----1-----4 (dice 1)


2-----3-----6 (dice 2)

Through the above observed data, we can say that :

- 1 is opposite to 3
- 4 is opposite to 6
- 2 is opposite to 5

3. If one side is common and its place is same in both dices.

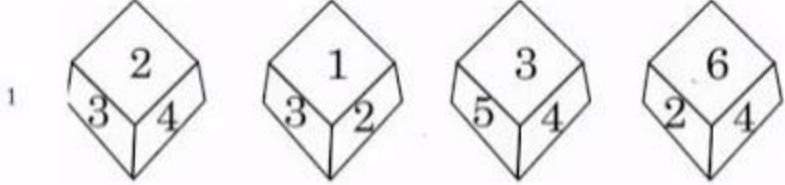
If one side is common in both cubes and its place is also same, then the remaining two sides of respective dices will be the opposite to each other.



As you can see, number 2 is common in both of these dices and it appears in the same face in both these dices. In such case, the remaining two sides in both dices will be opposite to each other. In this figure, the opposite sides are:

- 4 is opposite to 3 (as the position of 4 and 3 are same on two dices)
- 6 is opposite to 1 (as the position of 6 and 1 are same on two dices)
- 2 is opposite to 5 (we already know the position of 1,6,3,4 and 2. The only one remaining is 5)

Now let's move to a typical CGL question -



Find the number which is opposite to the face 2?

In this question the face opposite to 2 is asked, so just look at each cube and list the neighbours of 2

From 1st cube :

Neighbours of 2 = 3,4 ... (1)

From 2nd cube :

Neighbours of 2 = 1,3 ... (2)

In the third cube '2' is not present, so we will skip this cube

From 4th cube :

Neighbours of 2 = 4,6 ... (3)

Now merge all the three results and prepare a consolidated list of the neighbours

Neighbours of 2 = 1, 3, 4, 6

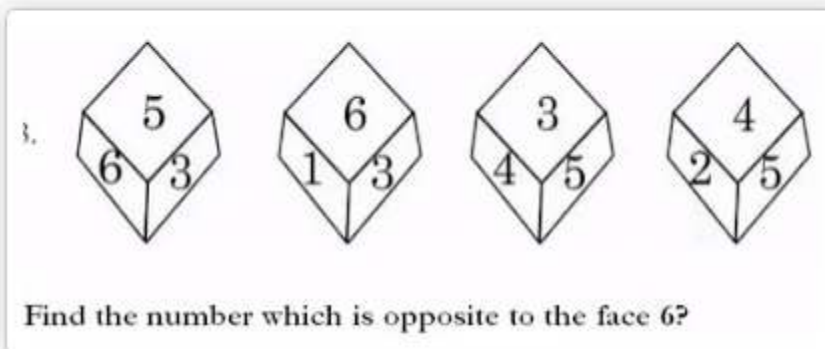
Note the number which is missing from the list. Here it is 5

So 5 is opposite to 2.

Answer : 5

Note : For each face, there are 4 neighbours and 1 opposite face. So make sure when you make the final consolidated list for a face, it has 4 neighbours [like our list contained 4 neighbours]

Next question



From the above figure, neighbours of 6 = 1,3,5

Note that there are only 3 neighbours in the list and hence we can't be sure of the face that is opposite to 6. Either it can be 2 or 4 (both are missing from the list)

When you encounter such situations, pick the face which is featured in most of the cubes. We can see that 3 is present in three of the cubes, so let's pick it.

Neighbours of 3 = 1, 4, 5, 6

From above data we can deduce that the face opposite to 3 is 2. Now since 2 is opposite to 3, it can't be opposite to 6. Hence the face opposite to 6 is 4

Answer : 4

Unfolded Cubes

<p>1 lies opposite of 6</p> <p>2 lies opposite of 4</p> <p>3 lies opposite of 5</p>		<p>1 lies opposite of 5</p> <p>2 lies opposite of 4</p> <p>3 lies opposite of 6</p>	
<p>1 lies opposite of 3</p> <p>2 lies opposite of 5</p> <p>4 lies opposite of 6</p>		<p>1 lies opposite of 4</p> <p>2 lies opposite of 6</p> <p>3 lies opposite of 5</p>	
<p>1 lies opposite of 4</p> <p>2 lies opposite of 5</p> <p>3 lies opposite of 6</p>			

In short, no matter which figure of an unfolded cube is given in the question, the alternate faces are opposite to each other.

Now a SSC question -

वह घन चुनिए जो प्रश्न आकृति में दर्शाए अनुसार कागज को मोड़कर बनाया जाएगा।
 प्रश्न आकृति :

उत्तर आकृतियाँ :

(A)

(B)

(C)

(D)

From the unfolded cube it is clear that-

Circle is opposite to Triangle

Square is opposite to Heart

Diamond(\diamond) is opposite to Clubs(\clubsuit)

(A) In option A we can see that triangle is shown adjacent to circle, but we know that they are opposite. Hence option A is wrong

(C) In option C, square is adjacent to heart, but they are opposite. Hence C is wrong

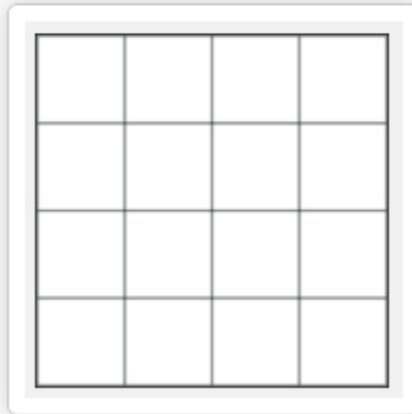
(D) In option D, diamond is adjacent to clubs, but they are opposite. Hence D is wrong.

Answer : (B)

Counting Squares, Rectangles, Triangles

Many of you wanted shortcuts to count the number of triangles. So I am writing this post which will cover every possible scenario for counting squares, rectangles and triangles. If the question doesn't fall in any of the below category, you will have to count manually :)

1) Counting squares within a square



How many squares are there in the above figure?

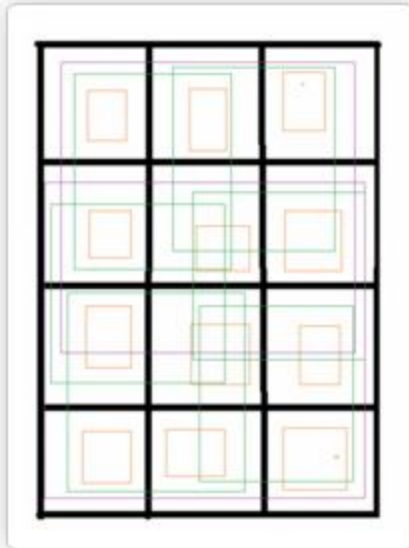
Solution : There are 4 rows in the above figure. Hence $n=4$

Apply the formula $[n(n+1)(2n+1)/6]$

$$= 4*5*9/6$$

Answer : 30

2) Counting squares within a rectangle



How many squares are there in the above figure?

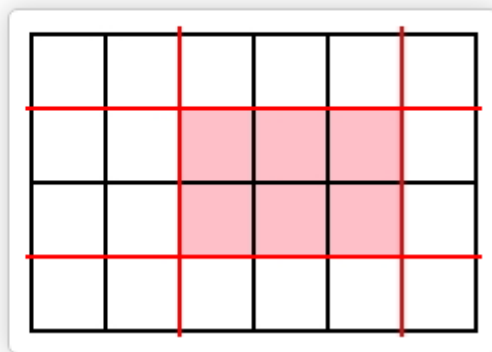
Solution : This rectangle is a 4 x 3 grid [4 rows and 3 columns]

So total number of squares is $\frac{m(m+1)(2m+1)}{6} + \frac{(n-m)*m(m+1)}{2}$. where n is the larger dimension

Here n = 4, m = 3

Answer : 20

3) Counting rectangles within a rectangle



How many rectangles are there in the above figure?

Solution : For a 'n x m' grid ['n' is the number of rows and 'm' is the number of columns]

Number of rectangles = $\frac{m(m+1)}{2} \times \frac{n(n+1)}{2} = \frac{m(m+1)(n)(n+1)}{4}$

In the above figure

n = 4, m=6

Put the values

Answer : 210

4) Counting rectangles in a square

The formula to count the number of rectangles within a square can be obtained by putting n = m in the above formula (3rd case)

So, No. of rectangles = $[\frac{n(n+1)}{2}]^2$

Ques. How many rectangles are there in a chess board?



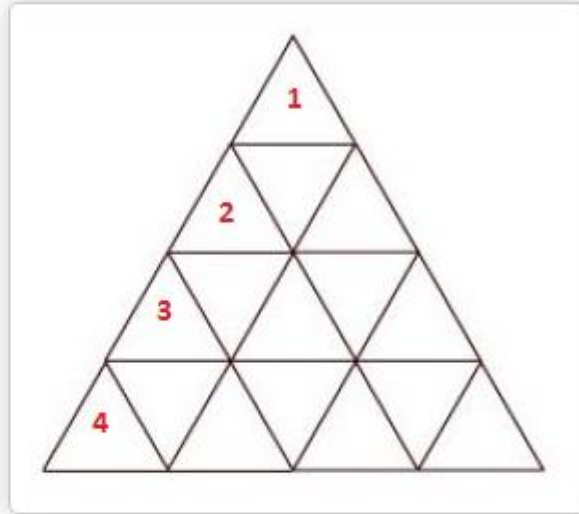
Solution : We know that the chess board is a 8 x 8 grid

Put n = 8 in the above formula

Answer : 1296

Note : From the above formulae, you only have to mug two, i.e., **2** and **3**. Formula **1** can be obtained by putting n=m in formula **2** and formula **4** can be obtained by putting n=m in formula **3**.

5) Counting triangles within a triangle



How many triangles are there in the above figure?

The formula is given by -

$$\left\lfloor \frac{n(n+2)(2n+1)}{8} \right\rfloor$$

You should note 3 things about this formula-

The formula is given by -

$$\left\lfloor \frac{n(n+2)(2n+1)}{8} \right\rfloor$$

You should note 3 things about this formula-

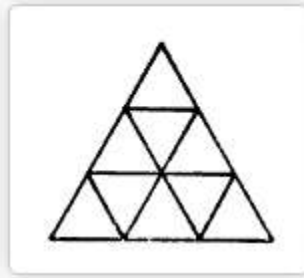
1. It is only applicable for matchstick arrangement (like the figure above)
2. n = number of unit triangles in a side. In this question $n=4$ (I have counted the triangles for you)
3. Those are not brackets enclosing the formula; they denote floor function. So after applying the formula, if you are not getting an integer, you should completely reject the decimal numbers. E.g. 17.12 will become 17 and 56.98 will become 56

Caution : You don't have to round off the number, so 77.9 will be equal to 77 not 78.

Put $n=4$ in the formula

Answer : 27

Next question-



Here $n=3$

Apply the formula and you will get 13.125. Reject the decimal places-

Answer : 13

Keep Reading :)

Additional Hacks

In SSC CGL, there is a very common question of nested square roots and there are total 3 cases for it (addition, subtraction and multiplication)

$$\sqrt{\sqrt{12 + \sqrt{12 + \sqrt{12 + \dots}}}} = ?$$

Case 1

In such questions, you should avoid forming quadratic equations because that will be time consuming. Here is the trick : Break the number written inside the square root into $n*(n + 1)$ form. So $12 = 3*4$
Answer is $(n+1)$, i.e., 4

Similarly, for 72 (written as $8*9$), the the answer will be 9; for 20(written as $4*5$) the answer will be 5, and so on. In CGL questions, the number will always break into $n*(n + 1)$ form.

$$\sqrt{\sqrt{72 - \sqrt{72 - \sqrt{72 - \dots}}}} = ?$$

Case 2

If instead of '+' you have '-' (above image), then

$$72 = 8*9$$

The answer is n , instead of $n+1$. So the above expression evaluates to 8.

If instead of + you have * (multiplication), then the answer is the number itself. E.g. -

$$\sqrt{\sqrt{72 \cdot \sqrt{72 \cdot \sqrt{72 \cdot \dots}}}} = 72$$

Case 3

45. By walking at $\frac{3}{4}$ of his usual speed, a man reaches his office 20 minutes later than his usual time. The usual time taken by him to reach his office is

- (a) 75 minutes
- (b) 60 minutes
- (c) 40 minutes
- (d) 30 minutes

I will tell you a formula that no 'paramount' will tell you :P

$$\frac{\text{Numerator}}{(\text{Numerator} - \text{Denominator})} \times \text{Time}$$

Note : Always take the difference between numerator and denominator as positive.

Answer : $3/(4-3) * 20 = 60$ minutes

Next question -

Rakesh runs at $5/4$ of his usual speed and reaches the playground 5 minutes earlier.

What is his usual time?

Answer : $5/(5-4) * 5 = 25$ minutes

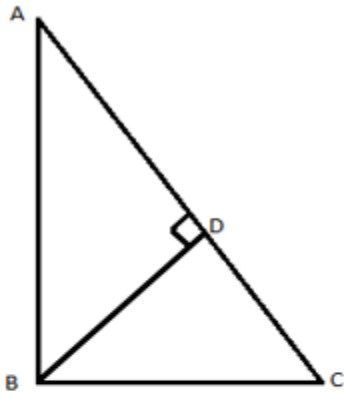
Direct formulae:

- If A's income is X% more than B, then B's income is $= \frac{X\%}{100+X\%} * 100$ % less than A
- If A's income is X% less than B, then B's income $= (X\%)/(100-X\%)*100$
- If price of a commodity increases by X%, then reduction in consumption to keep the expenditure same $= (X/(100+X))*100$ %
- If price of a commodity decreases by X%, then increase in consumption to keep the expenditure same $= (X/(100-X))*100$ %

- Sum of first n odd numbers $= n^2$
- Sum of first n even numbers $= n(n+1)$
- Area of regular polygon $= [n*a*a*\cot(180/n)]/4$

- If a reduction of x% in the price of an article enables a person to buy n kg more for Rs| A, then the reduced and the original prices per kg of the article are $(Ax/100n)$ per kg and $(Ax/(100-x)n)$ per kg respectively.
- If an increase of x% in the price of an article enables a person to buy n kg less for Rs A, then the reduced and the original prices per kg of the article are $(Ax/100n)$ per kg and $(Ax/(100+x)n)$ per kg respectively.

Special Right-angled Triangle:



In right-triangle ABC-

$$AB^2 = AC \cdot AD$$

$$BD^2 = AD \cdot CD$$

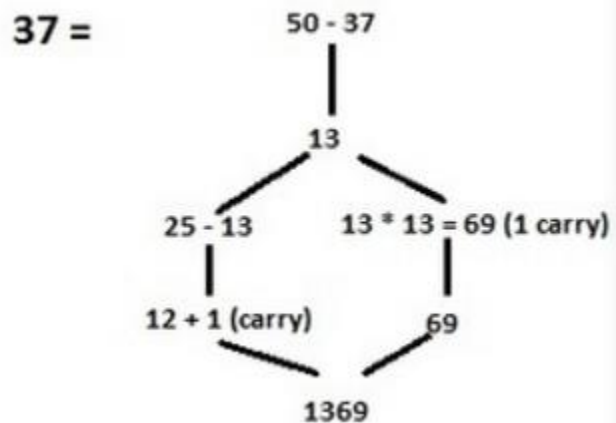
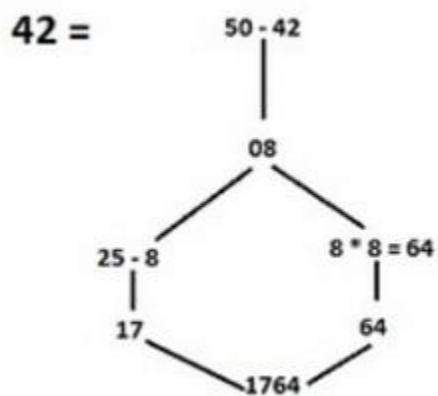
$$BC^2 = AC \cdot CD$$

$$1/BD^2 = 1/AB^2 + 1/BC^2$$

Trick to calculate Square of a number quickly

(a) For numbers close to 50

(i) Numbers less than 50



(ii) Numbers greater than 50

The process is almost same - Compute $(N - 50)$

Add this difference to 25

E.g. $56 * 56 =$

1. $56 - 50 = 6$

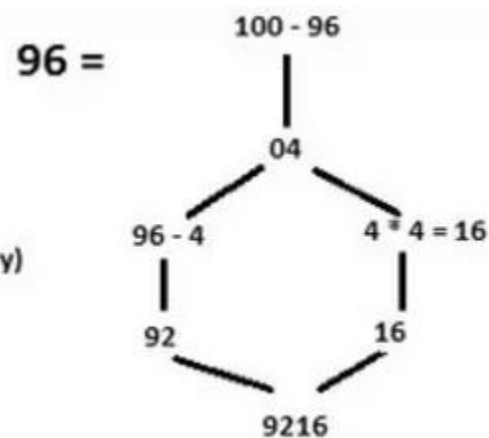
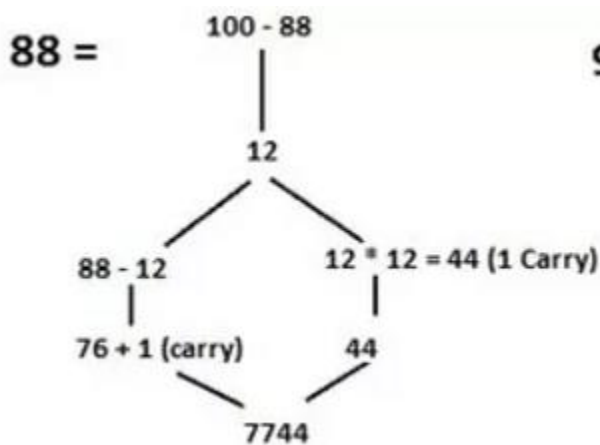
2. Last two digits = $6 * 6 = 36$

3. First two digits = $25 + 6 = 31$

Therefore, $56 * 56 = 3136$

(b) Numbers close to 100

(i) Numbers less than 100



(ii) Numbers greater than 100

The process is almost same - Compute $(N - 100)$

Add this difference to N

E.g. $107 * 107 =$

1. $107 - 100 = 7$

2. Last two digits = $7 * 7 = 49$

3. First *three* digits = $107 + 7 = 114$

Therefore, $107 * 107 = 11449$

Active and Passive Voice

Active form

In active sentences, the thing doing the action is the subject of the sentence and the thing receiving the action is the object. Most sentences are active.

[Thing doing action] + [verb] + [thing receiving action]

The professor **teaches** **the students.**
subject verb object
doing action receiving action

John **washes** **the dishes.**
subject verb object
doing action receiving action

Passive Form

In passive sentences, the thing receiving the action is the subject of the sentence and the thing doing the action is optionally included near the end of the sentence. You can use the passive form if you think that the thing receiving the action is more important or should be emphasized. You can also use the passive form if you do not know who is doing the action or if you do not want to mention who is doing the action.

[Thing receiving action] + [be] + [past participle of verb] + [by] + [thing doing action]

[be] = is/am/are

Examples:

The students **are taught** **by the professor.**
subject passive verb doing action
receiving action

The dishes **are washed** **by John.**
subject passive verb doing action
receiving action

Passive Voice for all tenses

I will explain all the types of tenses (for your revision) and then the Passive voice rules for that tense

Present Simple Tense

It is used to express an action in present time, habitual or usual actions or daily event or **universal fact**. It is used to express an action in present time which is usually done on a regular basis. For example a student says, "I go to school". It is a daily activity of a student to go to school, so such actions are expressed by present simple tense. Another example is, "I work in a factory". It tells about a usual action of a person that he works in a factory on regular basis.

Structure of sentence

Subject + 1st form of verb (or base verb) + Object

Note: If the subject in a sentence is "he, she, it, singular or proper noun" then "s" or "es" is added to the first form of verb or base form in the sentence.

Examples

1. I sing a song. (Positive sentence)
2. He drinks water. (Positive sentence)
3. Does he sing a song? (Interrogative Sentence)
4. John does not reach home in time. (Negative sentence)

Rule to convert a simple present sentence into Passive voice

Present Simple Tense (passive Voice) Auxiliary verb in passive voice: am/is/are	
Active voice: He sings a song. He does not sing a song [Does he sing a song?]	Passive voice: A song is sung by him. A song is not sung by him. Is a song sung by him?

Present Continuous Tense

It is used to express a continued or ongoing action at present time. It expresses an action which is in progress at the time of speaking. For example, a person says, "I am writing a letter". It means that he is in the process of writing a letter right now. Such actions which are happening at time of speaking are expressed by present continuous tense. Present Continuous tense is also called Present progressive tense.

Structure of the sentence

For positive sentences: [Subject + am/is/are + (1st form of verb or base verb + **ing**) + object]

For interrogative sentences: Auxiliary verb + Subject + main verb-ing (Present participle) + object

Examples

1. He is driving a car.
2. Are they reading their lessons?

Rule to convert a simple present sentence into Passive voice

Present Continuous Tense (passive Voice) Auxiliary verb in passive voice: am being/is being/are being	
Active voice: I am writing a letter (Positive) I am not writing a letter. (Negative) Am I writing a letter? (Interrogative)	Passive voice: A letter is being written by me. A letter is not being written by me. Is a letter being written by me?

Present Perfect tense

It is used to express an action which happened in the near past (which has just been completed).

Structure of sentence

Positive sentence: Subject + has/have + 3rd form of verb or past participle + subject

Interrogative sentence: Has/have + Subject + 3rd form of verb or past participle + subject

Examples

1. They have gone to school.
2. The guests have arrived.
3. Has she learnt a lesson?
4. John has left for home.

Rules to convert Present Perfect Tense into Passive Voice

Present Perfect Tense (passive Voice)	
Auxiliary verb in passive voice: has been/have been	
Active voice: She has finished his work She has not finished her work. Has she finished her work?	Passive voice: Her work has been finished by her. Her work has not been finished by her. Has her work been finished by her?

Present Perfect Continuous tense

It is used to express a continued or ongoing action that started in past and is continued until now. There will be a time reference, such as “**since** 1980, **for** three hours etc” from which the action has been started. A sense of time reference is found in these sentences which gives an idea that action has been continued from some time in past till now. So the reference of time differentiates between Present perfect continuous tense and Present continuous tense.

Structure of sentence

Subject + has been/have been + (1st form of verb or base verb + ing) + object + time reference

If the subject is “He, She, It, singular or proper name” then auxiliary verb “has been” is used after subject in sentence.

If subject is “You, They or plural” then auxiliary verb “have been” is used after subject in sentence.

Examples

1. He has been watering the plants **for** two hours.
2. I have been studying **since** 3 O'clock.
3. Have I been living in America since 2003?

Rules to convert Present Perfect Continuous Tense into Passive Voice

You won't find a question in the exam that would want you to convert a Present Perfect continuous sentence into passive voice, for the simple of reason that the sentence formation looks weird and is seldom used in communication. E.g.

Sentence: Recently, John has been doing the work.

Passive Voice: Recently, the work has been being done by John.

Past Simple Tense

It is used to express an action that happened or completed in past

Structure of sentences

Positive sentence: Subject + 2nd form of verb (past simple) + object

Interrogative sentence: Did + subject + 1st form of verb (or base verb) + object

Examples:

1. I killed a snake.
2. He ate a mango.
3. Did they go to cinema?

Rules to convert Past Simple Tense into Passive Voice

Past Simple Tense (passive Voice) Auxiliary verb in passive voice: was/were	
Active voice: I killed a snake I did not kill a snake. Did I kill a snake?	Passive voice: A snake was killed by me. A snake was not killed by me. Was a snake killed by me?

Past Continuous Tense

This sentence shows ongoing action (laughing) of a person which occurred in past.

Structure of sentence

Positive Sentence: Subject + was/were + (1st form of verb or base verb + ing) + object

Interrogative sentence: Was/were + Subject + (1st form of verb or base verb +ing) + object

Examples:

1. She was crying yesterday.
2. Were they climbing on a hill?

Rules to convert Past Continuous Tense into Passive Voice

Past Continuous Tense (Passive Voice) Auxiliary verb in passive voice: was being/were being	
Active voice: He was driving a car. He was not driving a car. Was he driving a car?	Passive voice: A car was being driven by him. A car was not being driven by him. Was a car being driven by him?

Past Perfect Continuous Tense

It is used for past actions that were unfinished when another action happened: "I had been studying at university for 6 months before I met her." - studying at university = past unfinished action; I met her (second action happened / interrupted the first action).

Structure of Sentence

Positive Sentence: Subject + had been + (1st form of verb or base verb + ing) + object + time reference

Interrogative Sentence: Had + Subject + been + (1st form of verb or base verb + ing) + object + time reference

Examples

1. I had been waiting for him for one hour.
2. She had been playing chess since 7 O'clock.
3. Had it been raining for three days?

Rules to convert Past Perfect Continuous Tense into Passive Voice

You won't find a question in the exam that would want you to convert a Past Perfect continuous sentence into passive voice, for the simple of reason that the sentence formation looks weird and is seldom used in communication. E.g.

Sentence: Chef Jones **had been** preparing the restaurant's fantastic dinners **for** two years before he moved to Paris.

Passive Voice: The restaurant's fantastic dinners **had been being** prepared by Chef Jones for two years before he moved to Paris.

Future Simple Tense

It is used to express an action which has not occurred yet and will occur in future.

Structure of sentence

Positive sentence: Subject + will + (1st form of verb or base form +ing) + object

Interrogative sentence: Will + subject + (1st form of verb or base form +ing) + object

Examples

1. They will come here.
2. Will you buy a computer tomorrow?

Rules to convert Future Simple Tense into Passive Voice

Future Simple Tense (Passive Voice) Auxiliary verb in passive voice: will be	
Active voice: She will buy a car. She will not buy a car. Will she buy a car?	Passive voice: A car will be bought by her. A car will not be bought by her. Will a car be bought by her?

Future Perfect tense

It is used to express an action which will occur in future and is thought to be completed in future. It expresses a sense of completion of an action which will occur in future. For example, "John will have gone tomorrow".

Structure of sentence

Positive Sentence: Subject + will have + 3rd form of verb or past participle + object

Interrogative sentence: Will + Subject + have + 3rd form of verb or past participle + object

Examples:

1. Will she have finished the work by Wednesday?
2. You will have made a new chair.

Rules to convert Future Perfect Tense into Passive Voice

Future Perfect Tense (passive Voice) Auxiliary verb in passive voice: will have been	
Active voice: You will have started the job. You will have not started the job. Will you have started the job?	Passive voice: The job will have been started by you. The job will not have been started by you. Will the job have been started by you?

Future Continuous tense

It is used to express a continued or an ongoing action in future. For example, "I will be waiting for you tomorrow", it conveys ongoing nature of an action (waiting) which will occur in future.

Structure of sentence

Positive Sentence: Subject + will be+ 1st form of verb or base form+ing (present participle) + object

Interrogative sentence: Will + subject + be+ 1st form of verb or base form+ing (present participle) + object

Examples:

1. He will be flying a kite.
2. Will we be shifting to a new home next year?

Rules to convert Future Continuous Tense into Passive Voice

Seldom used in communication. E.g.

Sentence: At 8:00 PM tonight, John will be washing the dishes.

Passive Voice: At 8:00 PM tonight, the dishes will be being washed by John.

Future Perfect Continuous tense

It is used to express a continued or ongoing action that will start in future and is thought to be continued till sometime in future.

Structure of sentence

Positive Sentence: Subject + will have been + (1st form of verb or base verb + ing) + object + time reference

Interrogative Sentence: Will + Subject + have been + (1st form of verb or base verb+ing) + object + time reference

Examples

1. I will have been living in America since 2003.
2. Will it have been raining for three days?

Rules to convert Future Continuous Tense into Passive Voice

Seldom used in communication. E.g. The famous artist will have been painting the mural for over six months by the time it is finished.

Passive voice: The mural will have been being painted by the famous artist for over six months by the time it is finished.

Summary:

Tenses	Identification	Passive Voice Conversion
Present Simple Tense	is/am/are	is/am/are + 3 rd form of verb
Present Continuous Tense	is/am/are + ing	is/am/are + being + 3 rd form
Present Perfect Tense	Has/have	Has/have + been + 3 rd form
Past Simple Tense	2nd form of verb (past simple) OR 'Did' for interrogation	was
Past Continuous Tense	Was/were + ing	Was/were + being
Past Perfect Tense	Had	Had been
Future Simple Tense	will	Will be
Future Perfect Tense	Will have	Will have been

Passive Voice for Modals

- Can – can be
- May – may be
- Might – might be
- Should – should be
- Must – must be
- Ought to – ought to be
- May have – may have been
- Might have – might have been
- Should have – should have been
- Must have – must have been
- Ought to have – ought to have been

Disclaimer: Don't commit the blunder of converting Can into Could, May into Might, etc. This is done in Direct-Indirect speech.

Passive voice of imperative sentences

A sentence which expresses command or request or advice is called imperative sentence. Examples:

- Open the door.
- Turn off the television.
- Learn your lesson.

Passive voice of "Imperative Sentences"	
Active Voice	Passive Voice
Open the door.	Let the door be opened.
Complete the work.	Let the work be completed.
Turn off the television.	Let the television be tuned off.
Learn your lesson.	Let your lesson be learnt.
Kill the snake.	Let the snake be killed.
Punish him.	Let him be punished.
Speak the truth.	Let the truth be spoken.
Help the poor.	Let the poor be helped.
Revise your book.	Let your book be revised.
Clean your room.	Let your room be cleaned.

Rules for converting Active Voice into Passive Voice

1. Check the tense of the sentence and add the necessary word as given in the table.
2. Use the 'past participle' form of the verb.
3. Look out for the modals and add 'be' or 'been' as per the case.

SSC CGL Questions (Tier-2 Re-exam 2013)

Q. 1)

Did everybody miss the first bus ?

- (A) The first bus was missed by everybody ?
- (B) Was the first bus missed by everybody ?
- (C) Everybody missed the first bus ?
- (D) Had the first bus been missed by everybody ?

Tense: Simple Past

Word you should be looking for: **Was**

Answer: (B)

Q. 2)

We will not allow them to run away.

- (A) They will not be allowed to run away by us
- (B) They would not be allowed to run away
- (C) They are not allowed to run away
- (D) They were not allowed to run away

Tense: Simple Future

Word you should be looking for: **Will be**

Answer: (A)

Q. 3)

Everyone must read this book.

- (A) This book should be read by everyone
- (B) This book has to be read by everyone
- (C) This book is to be read by everyone
- (D) This book must be read by everyone

'Must' is converted into 'must be' (We saw that in Modals)

Answer: (D)

Q. 4)

He knew that his own life was unjust.

- (A) It was known to him that his own life had been unjust
- (B) It was known by him that his own life was unjust
- (C) It was known to him that his own life was unjust
- (D) It was known by him that life was unjust

Tense: Simple past

Word: **was**

We use "known to" instead of "known by"

Answer: (C)

Q. 5)

The student has learnt the answer by heart.

- (A) The answer was learnt by the student by heart
- (B) The answer is learnt by heart by the student
- (C) The answer by the student was learnt by heart
- (D) The answer has been learnt by heart by the student

Tense: Present Perfect

Word: Has been

Answer: (D)

Q. 6)

This watch was given to me by my grandfather.

- (A) My grandfather gave me this watch
- (B) My grandfather gives me this watch
- (C) My grandfather had given this watch to me
- (D) My grandfather has given this watch to me

This sentence is in Passive voice

The word 'was' indicates that the active voice sentence will be in Simple past. Hence the past participle form of the verb will be used (which is 'gave' here)

Answer: (A)

Q. 7)

By whom is the child being fed ?

- (A) Who is feeding the child ?
- (B) Who has fed the child ?
- (C) Who was feeding the child ?
- (D) Who has been feeding the child ?

The sentence is in Passive voice. The words 'is' and 'being' suggest that the active voice sentence will be in present continuous tense.

Word: 'is' + ing

Answer: (A)

Q. 8)

Alexander expected to conquer the world.

- (A) It was expected by Alexander that he should conquer the world
- (B) It was expected by Alexander that he would conquer the world
- (C) It was expected by Alexander that he will conquer the world
- (D) It had been expected by Alexander that he would conquer the world

Tense: Simple past

Word: was

'Will' is used when you are sure about something, while 'Would' suggests possibility. Here the word 'expected' shows that Alexander thought there was a possibility of conquering the world. Hence we will use 'would' in the passive voice.

Answer: (B)

Q. 9)

She begins her day with a cup of coffee.

- (A) Her day is being begun with a cup of coffee
- (B) Her day is begun with a cup of coffee
- (C) A cup of coffee is beginning her day
- (D) A cup of coffee has begun her day

Tense: Simple present

Word: is

The past participle of begin is 'begun'. Option A is eliminated because 'being' is used with continuous tense

Answer: (B)

Q. 10)

Cacao is bitter when it is tasted.

- (A) Cacao is bitter
- (B) Cacao tastes bitter
- (C) Cacao's taste is bitter
- (D) Cacao tasted bitter

The sentence is in passive voice. 'is' suggests the active voice is in Simple Present.

Also we had seen in the 'Present Sime Tense' above that if the subject in a sentence is "he, she, it, singular or proper noun" then "s" or "es" is added to the first form of verb or base form in the sentence.

Answer: (B)

Q. 11)

A great man acknowledged me as a flatterer to him.

- (A) I was acknowledged by a great man to be a flatterer
- (B) I was acknowledged by a great man to have been a flatterer
- (C) I am acknowledged as a flatterer by a great man
- (D) I was acknowledged as a flatterer to a great man

Tense: Simple past

Had the sentence been 'A great man acknowledged me as a flatterer' we would have gone with option (A), but the sentence is 'A great man acknowledged me as a flatterer to him', hence we will go with option 'D'. Option C is ruled out because it contains 'am', but with simple past we use 'was'

Answer: (D)

Q. 12)

Let us help him.

- (A) Let him help us
- (B) Let he is helped
- (C) Let he be helped
- (D) Let him be helped by us

This is an imperative sentence and hence we will use 'be'. Now we are left with C and D. Notice that 'be' is infinitive here. Infinitive means that it is in its basic form (E.g. 'see' is in the basic form, but 'saw' is not). With infinitive/non-tensed form, we use 'him'.

Answer: (D)

Q. 13)

Can those happy moments be ever forgotten by me ?

- (A) Shall I ever forget those happy moments ?
- (B) Can I ever forget those happy moments ?
- (C) Will I ever forget those happy moments ?
- (D) Could I ever forget those happy moments ?

This is in passive voice. Hence 'Can be' will be converted into 'can'.

Answer: (B)

Q. 14)

You have to do this immediately.

- (A) This has been done by you immediately
- (B) This is being done by you immediately
- (C) This was being done by you immediately
- (D) This has to be done by you immediately

This is an imperative sentence, hence will include the word 'be', and not 'been' or 'being'

Answer: (D)

Q. 15)

The labourers were digging a canal.

- (A) A canal is being digged by the labourers
- (B) A canal was dug by the labourers
- (C) A canal was being dug by the labourers
- (D) A canal had been dug by the labourers

Tense: Past continuous

Words: was + being

Answer: (C)

Q. 16)

The watchman switched on the lights before it began to grow dark.

- (A) The lights were only switched on before it began to grow dark
- (B) The lights are being switched on before it began to grow dark
- (C) The lights were being switched on by the watchman before it began to grow dark
- (D) The lights were switched on by the watchman before it began to grow dark

Tense: Simple past, and hence we can't use 'being'

Option A doesn't talk about the watchman.

Answer: (D)

Q. 17)

Where do you keep the current magazines ?

- (A) Where were the current magazines kept ?
- (B) Where have the current magazines been kept ?
- (C) Where are the current magazines being kept ?
- (D) Where are the current magazines kept by you ?

Tense: Simple present, and hence you can't use the words 'been' or 'being' in the passive voice

Answer: (D)

Q. 18)

She will be rewarded for her kind deed.

- (A) Her kind deed will reward her
- (B) Her kind deed will have rewarded her
- (C) Her kind deed will be her reward
- (D) Her kind deed will have been her reward

The sentence is in passive voice and hence 'will be' converts into 'will', and not 'will have' or 'will have been'.

Answer: (A)

Q. 19)

God gives us happiness.

- (A) Happiness is given by God
- (B) 'Happiness is being given to us by God
- (C) Happiness has been given by God
- (D) Happiness will be given by God

Tense: Simple present, hence 'being', 'been' or 'will be' can't be used in the passive voice.

Answer: (A)

Direct and Indirect Speech

Introduction

There are two ways to convey a message of a person, or the words spoken by a person to another person.

1. Direct speech
2. Indirect speech

Suppose your friend whose name is John tells you in school, "I will give you a pen". You come home and you want to tell your brother what your friend told you. There are two ways to tell him.

Direct speech: John said, "I will give you a pen".

Indirect Speech: John said that he would give me a pen.

In direct speech the original words of a person are narrated (no change is made) and are enclosed in quotation marks. While in indirect speech some changes are made in the original words of the person because these words have been uttered in the past so the tense will change accordingly and pronouns may also be changed accordingly.

Fundamental rules for indirect speech

1. Reported speech is not enclosed in quotation marks.
2. Use of word "that": The word "that" is used as a conjunction between the reporting verb and reported speech.
3. Change in pronoun: The pronoun (subject) of the reported speech is changed according to the pronoun of the reporting verb or object (person) of the reporting verb (first part of sentence). Sometimes the pronoun may not change.

Changes in time and adverbs in indirect speech

Today changes to **that day/the same day**

Tomorrow changes to the **next day/the following day**

Yesterday changes to **the day before/the previous day**

Next week/month/year changes to the **following week/month/year**

Last week/month/year changes to **the previous week/month/year**

Now/just changes to **then**

Ago changes to **before**

Here changes to **there**

This changes to **that**

Changes in pronoun in Indirect Speech

The pronoun (subject) of the reported speech is changed according to the Pronoun of reporting verb or object (person) of reporting verb (first part of sentence). Sometimes the pronoun may not change.

- First person pronoun in reported speech i.e. I, we, me, us, mine, or our, is changed according to the pronoun of reporting verb if pronoun in reporting verb is third person pronoun i.e. he, she, it, they, him, his, her, them or their.

Examples

Direct speech: He said, "I live in New York"

Indirect speech: He said that he lived in New York.

Direct speech: They said, "We love our country"

Indirect speech: They said that they loved their country

- First person pronoun in reported speech i.e. I, we, me, us, mine, or our, is not changed if the pronoun (Subject) of reporting is also first person pronoun i.e. I or we.

Examples

Direct speech: I said, "I write a letter"

Indirect speech: I said that I wrote a letter.

Direct speech: We said, "We completed our work"

Indirect speech: We said that we completed our work.

- Second person pronoun in reported speech i.e. you, yours is changed according to the person of object of reporting verb.

Examples

Direct speech: She said to him, "you are intelligent"

Indirect speech: She said to him that he was intelligent.

Direct speech: He said to me, "you are late for the party"

Indirect speech: He said to me that I was late for the party.

- Third person pronoun in reported speech i.e. he, she, it, they, him, his, her, them or their, is not changed in indirect speech.

Examples

Direct speech: They said, "He will come"

Indirect speech: They said that he would come.

Direct speech: You said, "They are waiting for the bus"

Indirect speech: You said that they were waiting for the bus.

Change in tense of reported speech

DIRECT SPEECH	INDIRECT SPEECH
PRESENT TENSE	
PRESENT SIMPLE changes into PAST SIMPLE	
He said, "I write a letter"	He said that he wrote a letter.
She said, "he goes to school daily"	He said that she went to school daily.
They said, "we love our country"	They said that they loved their country
He said, "he does not like computer"	He said that he did not like computer.
PRESENT CONTINUOUS changes into PAST CONTINUOUS	
He said, "he is listening to the music"	He said that he was listening to the music.
She said, "I am washing my clothes"	She said that she was washing her clothes.
They said, "we are enjoying the weather"	They said that they were not enjoying the weather.
I said, "it is raining"	She said that she was not laughing.
She said, "I am not laughing"	
PRESENT PERFECT changes into PAST PERFECT	
She said, "he has finished his work"	She said that he had finished his work.
He said, "I have started a job"	He said that he had started a job.
I said, "she have eaten the meal"	I said that she had eaten the meal.
They said, "we have not gone to New York."	They said that they had not gone to New York.

PRESENT PERFECT CONTINUOUS changes into PAST PERFECT CONTINUOUS

He said, "I have been studying since 3 O'clock"	He said that he had been studying since 3 O'clock.
She said, "It has been raining for three days."	She said that it been raining for three days.
I said, "She has been working in this office since 2007"	I said that she had been working in this office since 2007.

PAST TENSE

PAST SIMPLE changes into PAST PERFECT

He said to me, "you answered correctly"	He said to me that I had answered correctly.
John said, "they went to cinema"	John said that they had gone to cinema.
He said, "I made a table"	He said that he had made a table.
She said, "I didn't buy a car"	She said that she had not bought a car.

PAST CONTINUOUS changes into PAST PERFECT CONTINUOUS

They said, "we were enjoying the weather"	They said that they had been enjoying.
He said to me, " I was waiting for you"	He said to me that he had been waiting for me.
I said, "It was raining"	I said that it had been raining.
She said, "I was not laughing"	She said that she not been laughing.

PAST PERFECT changes into PAST PERFECT (tense does not change)

She said, "She had visited a doctor"

She said that she had visited a doctor.

He said, "I had started a business"

He said that he had started a business.

I said, "she had eaten the meal"

I said that she had eaten the meal.

They said, "we had not gone to New York.

They said they had not gone to New York.

FUTURE TENSE

**FUTURE SIMPLE TENSE
WILL changes into WOULD**

He said, "I will study the book"

He said that he would study the book.

She said, "I will buy a computer"

She said that she would buy a computer.

They said to me, "we will send you gifts"

They said to me that they would send you gifts.

I said, "I will not take the exam"

I said that I would not take the exam.

**FUTURE CONTINUOUS TENSE
WILL BE changes into WOULD BE**

I said to him, " I will be waiting for him"

I said to him that I would be waiting for him.

She said, " I will be shifting to new home"

She said that she would be shifting to a new home.

He said, "I will be working hard"

He said that he would be working hard.

He said, "he will not be flying kite"

She said that he would not be flying kites.

FUTURE PERFECT TENSE
WILL HAVE changes into WOULD HAVE

He said, "I will have finished the work"

He said that he would have finished the work.

She said, "they will have passed the examination"

She said that they would have passed the examination.

He said, "I will have gone"

He said that he would have gone.

To summarize:

Present simple tense *into* Past simple

Present Continuous tense *into* Past continuous

Present Perfect tense *into* Past perfect

Present Perfect Continuous *into* Past perfect continuous

Past simple *into* Past Perfect

Past Continuous *into* Past Perfect Continuous

Past Perfect *into* Past Perfect

Future simple, will *into* would

Future Continuous, will be *into* would be

Future Perfect, will have *into* would have

Note: The tense of reported speech may not change if reported speech is a universal truth though its reporting verb belongs to past tense.

Examples

Direct speech: He said, "Mathematics is a science"

Indirect Speech: He said that mathematics is a science.

Direct speech: He said, "Sun rises in east"

Indirect Speech: He said that sun rises in east.

Change of Modals

- CAN changes into COULD
- MAY changes into MIGHT
- WILL and SHALL change into WOULD
- MUST changes into HAD TO

These modals do not change:

- Would
- Could
- Might
- Should
- Ought to

Indirect speech for imperative sentences

A sentence which expresses command, request, advice or suggestion is called imperative sentence. For example:

- Open the door.
- Please help me.
- Learn your lesson.

To change such sentences into indirect speech, the word “ordered” or “requested” or “advised” or “suggested” or “forbade” or “not to do” is added to reporting verb depending upon nature of imperative sentence in reported speech.

Examples.

Direct speech: He said to me, “please help me”

Indirect Speech: He *requested* me to help him.

Direct speech: She said to him, “you should work hard for exam”

Indirect Speech: He *suggested* him to work hard for exam.

Direct speech: They said to him, “do not tell a lie”

Indirect Speech: They said to him *not to* tell a lie.

Direct speech: He said, “open the door”

Indirect Speech: He *ordered* to open the door.

Direct speech: The teacher said to student, “do not waste time”

Indirect Speech: The teacher *advised* the students not to waste time.

Direct speech: He said, “please give me glass of water”

Indirect Speech: He *requested* to give him a glass of water.

Direct speech: Doctor said to me, “Do not smoke”

Indirect Speech: Doctor *advised* me not to smoke.

Direct speech: The teacher said to him, “Get out”

Indirect Speech: The teacher *ordered* him to get out.

Indirect speech for exclamatory sentences

Sentence which expresses state of joy or sorrow or wonder is called exclamatory sentence.

For example.

- Hurrah! We won the match.
- Alas! I failed the test.
- Wow! What a nice shirt it is.

To change such sentences into indirect speech, the word “ordered” or “requested” or “advised” or “suggested” or “forbade” or “not to do” is added to reporting verb depending upon nature of imperative sentence in reported speech.

Examples.

Direct speech: He said, “Hurrah! I won a prize”

Indirect Speech: He *exclaimed with joy* that he had won a prize.

Direct speech: She said, “Alas! I failed in exam”

Indirect Speech: She *exclaimed with sorrow* that she failed in the exam.

Direct speech: John said, “Wow! What a nice shirt it is”

Indirect Speech: John *exclaimed with wonder* that it was a nice shirt.

Direct speech: She said, “Hurrah! I am selected for the job”

Indirect Speech: She *exclaimed with joy* that she was selected for the job.

Direct speech: He said, “Oh no! I missed the train”

Indirect Speech: He *exclaimed with sorrow* that he had missed the train.

Direct speech: They said, “Wow! What a pleasant weather it is”

Indirect Speech: They *exclaimed with wonder* that it was a pleasant weather.

Indirect speech for Interrogative (question) sentence

A question can be of two types. One type which can be answered in only YES or NO and other type which needs a little bit explanation for its answer and cannot be answered in only YES or NO.

Questions which can be answered in YES/NO

To change questions (which can be answered in yes or no) into indirect speech, word “if” or “whether” is used before the question in indirect speech. Rules for change in tense of question sentences are same as for change in normal tenses in indirect speech but sentence will not start with the auxiliary verb of the tense. The word “that” is not used between reporting verb and reported speech as conjunction in indirect speech for question sentence. Question mark is not used in indirect speech.

Direct speech: She said, “Will he participate in the quiz competition?”

Indirect Speech: She asked me if he would participate in quiz competition.

Direct speech: I said to him, “are you feeling well?”

Indirect Speech: I asked him if he was feeling well.

Direct speech: They said to me, “did u go to school?”

Indirect Speech: They asked me if I had gone to school.

Direct speech: He said to me, “Have you taken the breakfast?”

Indirect Speech: He asked me if I had taken the breakfast

Question which cannot be answered in YES/NO

To change such questions into indirect speech, the words “if” or “whether” is not used. The tense of the question is changed according to the rules for change in normal tenses in indirect speech but sentence will not start with the auxiliary verb of the tense. The word “that” is not used between reporting verb and reported speech as conjunction, in indirect speech for question sentence. Question mark is not used in indirect speech.

Examples.

Direct speech: He said to me, “how are you?”

Indirect speech: He asked me how I was. (Not, how was I)

Direct speech: Teacher said to him, “what is your name?”

Indirect speech: Teacher asked him what his name was.

Direct speech: She said to him, “why did you come late?”

Indirect speech: She asked him why he had come late.

Direct speech: He said, “when will they come?”

Indirect speech: He asked when they would come.

Direct speech: She asked his son, “why are you crying?”

Indirect speech: She asked her son why he was crying.

SSC CGL Questions Tier-2 (2013 Re-Exam)

Q. 1)

She said to me, "It has been raining heavily and you cannot go".

- (A) She told me that it had been raining heavily and I could not go.
- (B) She told me that it was raining heavily and I could not go.
- (C) She told me that it has been raining heavily and I could not go.
- (D) She told me that it is raining heavily and I could not go.

"Has been" is converted into "Had been"

Answer: (A)

Q. 2)

John said to me, "Where have you been last night ?"

- (A) John asked me where had I been the previous night
- (B) John asked me where I have been the previous night
- (C) John asked me where I am the previous night
- (D) John asked me where I had been the previous night

"Have been" is converted into "Had been" and "Last night" into "Previous night"

Note: In the indirect speech, the pronoun is moved ahead of the auxiliary verb

Answer: (A)

Q. 3)

"I'm taking my children to the zoo tomorrow", she said, "to see the baby white tiger".

- (A) She said that she will take the children to the zoo to see the baby white tiger tomorrow.
- (B) She said that she would take the children to the zoo the next day to see the baby white tiger.
- (C) She said that she was taking her children to the zoo the next day to see the baby white tiger.
- (D) She said that she was taking the children to the zoo that day to see the baby white tiger.

"Tomorrow" into "the next day"

"I am taking" into "She was taking"

Answer: (C)

Q. 4)

She said, "Mother, please cook me something nice today".

- (A) She told her mother to cook her something nice today
- (B) She ordered her mother to cook her something nice that day
- (C) She requested her mother to cook her something nice that day
- (D) She asked her mother if she could cook her something nice that day

The word "please" shows a request

Answer: (C)

Q. 5)

John said, "I shall be 21 tomorrow".

- (A) John said that he would be 21 tomorrow
- (B) John said that he would be 21 the following day
- (C) John said that he should be 21 the following day
- (D) John said that I shall be 21 tomorrow

We know "will" and "shall" are changed into "would"
"Tomorrow" into "following day"

Answer: (B)

Q. 6)

She asked, "Is the secretary coming to the meeting?"

- (A) She asked that the secretary was coming to the meeting
- (B) She asked that if the secretary was coming to the meeting
- (C) She asked if the secretary is coming to the meeting
- (D) She asked if the secretary was coming to the meeting

The question can be answered in YES/NO, hence we will use "if"
"Is" is changed into "was"

"That" is not used in interrogative sentences

Answer: (D)

Q. 7)

The convict said, "Let me speak freely please".

- (A) The convict suggested that he must be allowed to speak freely
- (B) The convict requested that he must be allowed to speak freely
- (C) The convict requested that he be allowed to speak freely
- (D) The convict proposed that he might be allowed to speak freely

"Please" shows request. Hence we are left with options B and C

We generally don't add the word "must" on our own. So option C is more appropriate

Answer: (C)

Q. 8)

Nisha told Monica, "What a beautiful dress you are wearing !"

- (A) Nisha exclaimed that Monica was wearing a very beautiful dress
- (B) Nisha exclaimed that it is a very beautiful dress
- (C) Nisha exclaimed that Monica is wearing a very beautiful dress
- (D) Nisha told Monica that was a beautiful dress

The indirect form should contain the word "was". Option A is apt.

Answer: (A)

Q. 9)

"Call the witness", said the magistrate.

- (A) The magistrate requested to call the witness
- (B) The magistrate begged for calling the witness
- (C) The magistrate ordered to call the witness
- (D) The magistrate prayed to call the witness

Magistrate orders.

Answer: (C)

Q. 10)

"Have you done this sort of work before ?" said his new employer.

- (A) His new employer asked him whether he has done that sort of work before
- (B) His new employer asked him whether he has done this sort of work before
- (C) His new employer asked him whether he had done that sort of work before
- (D) His new employer asked him whether he had done this sort of work before

“Have” into “had”

“This sort of work” into “that sort of work”

Answer: (C)

Q. 11)

Rahul says that Azhar loves cricket.

- (A) Rahul said, “Azhar loves cricket”.
- (B) Rahul said, “Azhar loved cricket”.
- (C) Rahul says, “Azhar loved cricket”.
- (D) Rahul says, “Azhar loves cricket”.

Says I not converted into anything. Moreover, the verb form is also not changed.

Answer: (D)

Q. 12)

“I came home last night”, said he.

- (A) He told that he had come home last night
- (B) He said that he came home last night
- (C) He said that he had come home the previous night
- (D) He says that he came home the previous night

Past tense is converted into Past Perfect. Hence the word “had” will be used.

“Last night” into “previous night”

Answer: (C)

Q. 13)

The beggar said, “Poverty is a great curse”.

- (A) The beggar said poverty has a great curse
- (B) The beggar said that poverty is a great curse
- (C) The beggar said that poverty was a great curse
- (D) The beggar said that poverty had been a great curse

We know, if the sentence is a universal truth, then we don’t change the tense

Answer: (B)

Q. 14)

“If you want to smoke, you’ll have to go out”, said the conductor.

- (A) The conductor ordered me to go out and smoke
- (B) The conductor said that if I/he wanted to smoke, I/he would have to go out
- (C) The conductor told me that smoking is not permitted in the bus
- (D) The conductor told me that I will have to go out and smoke

No option except B, is in congruence with the Direct speech

Answer: (B)

Q. 15)

“Be careful; the steps are very slippery”, I warned him.

- (A) I warned him to be careful as the steps were very slippery
- (B) I warned him to be careful as the steps are very slippery
- (C) I warned him to be careful and steps were very slippery
- (D) I told him to be careful and the steps are very slippery

“Are” into “Were”

Answer: (A)

Q. 16)

The old lady declared that she was going to walk where she pleased. They had the liberty.

- (A) The old lady said that, “I was going to walk where I pleased. They have the liberty”.
- (B) The old lady : “I am going to walk where I please. We have the liberty”.
- (C) The old lady : “I was going to walk where I pleased. They have the liberty”.
- (D) The old lady : “I am going to walk where I pleased. They had the liberty”.

Direct speech should be in Present Tense.

Answer: (B)

Q. 17)

The teacher asked me why I had been absent the day before.

- (A) The teacher asked me, "Why were you absent yesterday ?"
- (B) The teacher asked me, "Why are you absent yesterday ?"
- (C) The teacher asked me, "Why are you absent the day before ?"
- (D) The teacher asked me, "Were you absent the day before ?"

Past perfect is changed into Simple Past (when we convert from Indirect to Direct). Hence "why were you" will be used.

Answer: (A)

Q. 18)

Mr Robinson asked his son what he wanted to be when he grew up.

- (A) "My son," said Mr Robinson, "what will you be when you grow up ?"
- (B) "My son," said Mr Robinson, "what do you want to be when you grow up ?"
- (C) Mr Robinson said, "My son, what did you want to be when you grew up ?"
- (D) Mr Robinson said, "My son, what would you be when you grow up ?"

Here "did", "will" and "would" can't be used in the Indirect speech

Answer: (B)

Q. 19)

The boys respectfully wished their teacher good morning.

- (A) "Good morning," said the boys to their teacher
- (B) "Good morning," said the boys to the teacher
- (C) "Good morning, Madam," said the boys to the teacher
- (D) "Good morning, Madam," said the boys to their teacher

"Good morning, Madam" is the respectful way to greet the teachers. Moreover, "their" remains as it is.

Q. 20)

She said, "I am sorry, I am not able to submit those papers".

- (A) She said she was sorry, she is not able to submit those papers
- (B) She said that she was sorry and she will not be able to submit those papers
- (C) She apologized for not being able to submit those papers
- (D) She exclaimed with sorrow that she was sorry and she will not be able to submit those papers

All the options (except C) are changing the meaning of the sentence.

Answer: (C)

Q. 21)

The girl wondered where the sparrows had gone.

- (A) The girl said, "Oh! Where the sparrows have gone?"
- (B) The girl said, "Oh! Where are the sparrows?"
- (C) The girl said, "Oh! Where had the sparrows gone?"
- (D) The girl said, "Oh! Where have the sparrows gone?"

The direct speech should contain the word "had", since the indirect contains "have". Options A and D are left. Now, as I said earlier, in such situations, don't match the exact sequence of words. Like in the indirect speech it is written "the sparrows had gone", hence the direct speech won't have the exact sequence "the sparrows have gone"

Answer: (D)

Q. 22)

She said to me, "I'm going shopping. Can I get you something?"

- (A) She said she was going shopping and said to me if I wanted something
- (B) She said she was going shopping and asked if I wanted something
- (C) She said she was going shopping and asked if she could get me something
- (D) She said she is going shopping and asked if she could get me something

**Tense: Simple Present, and hence it will be converted into Simple Present
Can is converted into Could**

Answer: (C)

Q. 23)

Ramesh informed his friend that he could make use of his car while he was away.

- (A) Ramesh said to his friend, "You will make use of my car while I was away".
- (B) Ramesh said to his friend, "Use my car while I go away".
- (C) Ramesh said to his friend, "You can make use of my car while I am away".
- (D) Ramesh asked his friend, "Will you make use of my car while I am away?"

Indirect sentence has the word "could". That means Direct sentence contains the words "can"

Answer: (C)

Q. 24)

Kala said to Radha, "Who were you speaking to over the phone?"

- (A) Kala asked Radha who she had been speaking to over the phone
- (B) Kala asked Radha who she has been speaking to over the phone
- (C) Kala asked Radha that who she was speaking to over the phone
- (D) Kala asked Radha that who she had been speaking to over the phone

Tense: Past continuous, hence it would be converted into Past Perfect Continuous. So "had been" will be used in the Indirect sentence.

We are left with options A and D. Now, the indirect interrogative sentence doesn't contain the word "that".

Answer: (A)

Q. 25)

The king said to his men, "Do not be afraid of the enemy. Face them bravely."

- (A) The king ordered his men to not be afraid of the enemy and that they had to be faced bravely
- (B) The king asked his men to not be afraid of the enemy but they should be faced bravely
- (C) The king advised his men not to be afraid of the enemy but to face them bravely
- (D) The king told his men not to be afraid of the enemy and they had faced them bravely

Tense: Simple Present, so it would be converted into Simple Past

Answer: (C)

Q. 26)

Kannan said to Subha, "I'll return the book after I have read it".

- (A) Kannan told Subha that he will return the book after he has read it
- (B) Kannan told Subha that he would return the book after he has read it
- (C) Kannan told Subha that he will return the book after he read it
- (D) Kannan told Subha that he would return the book after he had read it

Will is converted into "would"

Answer: (D)

Q. 27)

The boss said to his secretary, "Did you discuss this matter with the manager ?"

- (A) The boss asked his secretary whether he discussed that matter with the manager
- (B) The boss asked his secretary if you have discussed that matter with the manager
- (C) The boss asked his secretary if he had discussed that matter with the manager
- (D) The boss asked his secretary whether he has discussed that matter with the manager

Tense: Simple Past, hence it would be converted into "Past Perfect". Hence "had" will be used

Answer: (C)

Para-jumble

Rules for solving Para-jumble

1. Don't form the entire sequence. Just form a sub-sequence and try to match the options. E.g.

1. Children are not the only ones who can fly kites.
 - P. In some countries like Malaysia, there are kite festivals.
 - Q. These experts are mostly adult amateur kite fliers.
 - R. Kite flying is a good leisure activity for parents with their children.
 - S. Self designed kites are flown by experts during such times.
 6. Some of them play music too.
- (A) PSQR (B) SRPQ
(C) QSPR (D) RPSQ

In sentence Q, they have used the words "These experts". This means, the sentence immediately before Q is having the word "experts". That sentence is S. Hence [SQ] is the sub-sequence for this question. Now you can eliminate options B and C because they don't contain the sub-sequence [SQ]. Again in sentence 6, the word "them" is used. So Q is the perfect match to precede 6. Hence the sequence is RPSQ

Answer: (D)

1. Abanidranath Tagore was the leading painter of Bengal.
 - P. He tried to modernise Mughal and Rajput styles to offset their influence.
 - Q. He countered the British Raj through his paintings.
 - R. He succeeded and his style was accepted as a natural Indian style.
 - S. During his time western model of art was taught in the schools.
 6. Above all this great painter was a nephew of Rabindranath Tagore.
- (A) QPSR (B) SPQR
(C) RPSQ (D) QSPR

Sentence P is introducing his “style” and then sentence R is stating that his style succeeded.
Hence the sub-sequence is [PR]

Answer: (D)

2. The sentence containing the full name of a personality will come before the sentence containing the short form. E.g. The sentence “APJ Abdul Kalam Azad was the most respected President of India” will come before “Mr Kalam was popularly known as the Missile Man of India”. Same thing goes with the abbreviations. “World Health Organization” will come before the sentence containing the word “WHO”
3. The sentences containing the transition words like “but”, “although”, “however”, “moreover”, “therefore”, “hence”, “on the other hand”, etc. will not come at the beginning. Although such sentences are very useful in forming sub-sequences.
4. Personal Pronouns: Personal pronouns like he, she, it, him, her, they, you, your, etc. always refer to a person, place or thing. Therefore if a sentence contains a personal pronoun without mentioning the person/place/thing it is referring to, then the person/place/thing, must have been mentioned in the previous sentence. E.g.
 1. Gulliver landed on the shores of Lilliput.
 - P. He planned to carry Gulliver to the capital city.
 - Q. The Lilliputians put an ointment on Gulliver’s wounds.
 - R. He fell asleep thereafter.
 - S. The Emperor of the land was informed.

6. It alleviated all the pain and discomfort.

(A) PQSR (B) RSPQ
(C) SRQP (D) QSPR

P contains the pronoun “he”. The pronoun “he” must be referring to the Emperor, who is mentioned in sentence S. Hence [SP] is the sub-sequence. B and D are the two options left. B is more logical because R should be the opening sentence. Gulliver landed on the shore → he fell asleep.

Answer: (B)

5. Articles: When the author uses ‘a/an’ – he wants to make a general statement – wants to introduce the noun for the first time. But when he uses ‘the’, he wants to refer back to some previously discussed noun. It means having ‘the’ is very unlikely in the first sentence.

SSC CGL questions on Para-Jumble

Q. 1)

- I. Many scientists are working on safer and better ways to kill mosquitoes.
 - P. Bringing more of these animals into places where mosquitoes live might help.
 - Q. Mosquitoes have many natural enemies like bats, birds, etc.
 - R. Mosquito nets can be used for protection.
 - S. But, there is no sure way to protect everyone from their deadly bites.
 6. This is a natural solution.
- (A) SRQP (B) PQRS
(C) SRPQ (D) RSQP

Notice sentence "6", the word "this" has been used. Hence the sentence preceding it should contain a natural solution to kill mosquitoes. Sentence P provides a solution. Hence last sentence would be P. We are left with options A and D. Option A is more logical.

Answer: (A)

Q. 2)

- I. The spider fell seven times to reach its goal but didn't give up hope.
 - P. The king learnt a lesson from the spider.
 - Q. It tried again and this time it succeeded in reaching the top.
 - R. Then he attacked his enemies repeatedly.
 - S. He appealed to the people for help and collected soldiers to form a large army.
 6. At last he won the battle and got back his kingdom.
- (A) PQSR (B) QPSR
(C) RSQP (D) PSRQ

The first sentence talks about the spider. Sentence Q contains the word "it" which must be referring to the spider. Hence the sequence will start with Q.

Answer: (B)

Q. 3)

1. A few workmen came to cut down the tree.
- P. It took them all morning.
- Q. They did not know what to do with the roots.
- R. It was not an easy job to cut down such a huge tree.
- S. They decided that the roots had to be dug out.
6. At last the tree was lying on the ground.

- (A) PQRS (B) RPQS
(C) RPSQ (D) SRQP

In sentence Q it is written that they did not know what to do with the roots and in S, they have come up with a solution to tackle roots. So the sub-sequence is [QS]

Answer: (B)

Q. 4)

1. A mob went berserk at R G Kar Hospital on Friday.
- P. The agitators also smashed equipment and windows of the hospital.
- Q. The boy had died on the operating table soon after being administered anaesthesia.
- R. This happened after the death of a 15 year old boy.
- S. The victim's relatives and neighbours clashed with the police.
6. Work at the hospital stopped for the rest of the day.

- (A) QSPR (B) PRQS
(C) RQSP (D) SQPR

"This" (in sentence R) is the transition word and hence the best hint. A mob went berserk and sentence R provides an explanation for the same. Hence the sequence will start with R.

Answer: (C)

Q. 5)

1. Children are not the only ones who can fly kites.
 - P. In some countries like Malaysia, there are kite festivals.
 - Q. These experts are mostly adult amateur kite fliers.
 - R. Kite flying is a good leisure activity for parents with their children.
 - S. Self designed kites are flown by experts during such times.
6. Some of them play music too.
- (A) PSQR (B) SRPQ
(C) QSPR (D) RPSQ

**Sentence Q contains the words “These experts” and sentence S introduces the experts. Hence the sub-sequence is [SQ]. Now we are left with two options A and D. Sentence 6 should be preceded by Q.
Answer: (D)**

Q. 6)

1. The motor car is one of the useful gifts of modern science.
 - P. One of these is the smoke and pollution that it creates.
 - Q. It has made short and medium distance journeys fast and comfortable.
 - R. The other is that it has made journey by road hazardous.
 - S. Yet we cannot say that a motor car is a blessing without disadvantages.
6. Finally, in this age of energy crisis, a personal car is an expensive object to maintain.
- (A) QSPR (B) RSPQ
(C) PSRQ (D) SQPR

**Sentence P is listing a disadvantage of motor car (Hint: “One of these”). That means the sentence preceding it must be talking about disadvantages. That sentence is S. Hence the sub-sequence is [SP]. We are left with options A and B. Option A is logical.
Answer: (A)**

Q. 7)

1. A mule began to day dream that he was a good runner as his mother was a race horse.
- P. The master sat on the mule, whipped him hard because he was in a hurry to reach the market.
- Q. He started running across the field.
- R. Forced to run faster, the mule collapsed on the ground.
- S. When his master saw him running fast he thought that his mule was a good runner.
6. He thought, "Though my mother was a race horse but my father was only a donkey."

- (A) QSPR (B) SPRQ
(C) PSQR (D) RPQS

Sentence Q says the mule started running across the field and sentence S says "When his master saw him running". So the sub-sequence is [QS]. We are left with options A and D. Option A is more logical. Answer: (A)

Q. 8)

1. The highway bypass would have disastrous effects on the area's home owners.
- P. Finally the new road would cause residential properties to depreciate.
- Q. What is more, home owners would have to deal with the increased noise and pollution.
- R. This would increase vehicles in the neighbourhood.
- S. The new road would cut directly through the middle of the subdivision.
6. This means that families who chose to move away would have to sell their homes for far less than their current value

- (A) SRQP (B) PQRS
(C) SPQR (D) QRPS

Sentence 6 contains the words "This means". As I said earlier the transitive words like "this", "because", etc. are most helpful in solving para-jumble. The best sentence to precede 6 is P.

Answer: (A)

Q.9)

1. A devastating earthquake struck Maharashtra and parts of Karnataka.
- P. The communication network cut off the quake hit villages from the rest of the world.
- Q. The quake measured 6.6 on the Richter scale.
- R. Ten thousand people were killed and an equal number of people were injured.
- S. 40 villages of Maharashtra were destroyed completely.
6. 10 medical teams of the Army were sent from Mumbai to the devastated zone.

- (A) SPQR (B) SQPR
(C) QRSP (D) PQSR

Whenever the first sentence introduces a person/place/thing. See if there is another sentence that adds a description of that person/place/thing. That sentence will be the first sentence of the sequence.

Here sentence 1 talks about the earthquake and sentence Q states the magnitude of this earthquake. Hence the sequence will start with Q.

Answer: (C)

Q. 10)

1. Phillip is a 55 year old blind man.
- P. He enjoys the sweet smell itself.
- Q. He can smell a rose but can't tell its colour.
- R. He has been blind since birth.
- S. It does not matter to him.
6. People sometimes pity him but he tells them he is happy.

- (A) SQRP (B) RQSP
(C) PQRS (D) QPSR

Like Q.9, in this question too, sentence “1” introduces a person, and sentence R is an extension of the introduction. Hence the sequence will start with R.

Answer: (B)

Q.11)

1. At the age of four, Jagadish Chandra Bose was sent to a village ‘Pathshala’.
 - P. This step proved beneficial to the boy, for he thus became familiar with his mother tongue and learnt to read and write it.
 - Q This was very unusual because a man of his father’s status was expected to send his son to an English school.
 - R. He also became acquainted with some of the rich treasures of Indian culture.
 - S. He mixed with children of all castes and lost the sense of class superiority.
 6. His mother, too, reinforced what he learnt and did at school.
- (A) PRQS (B) RQPS
(C) QPSR (D) SQRP

Again the best hint is the word “this”. It is used in 2 sentences P and Q. Notice sentence Q, it is the extension of the first sentence. Hence the sequence will begin with Q.

Answer: (C)

Important Grammar Rules

Part of speech	What it does	Main kinds	Examples	
Noun	Names of person, place or thing. The thing may be real or imaginary.	Proper	Akbar, Mumbai, Himalayas	
		Common	man, city, mountain	
		Collective	crowd, army, herd	
		Abstract	kindness, growth, childhood	
		Countable	book, pen, worker	
		Uncountable	sugar, honesty, gold	
Pronoun	Words used instead of a noun	Personal	First	I, we, myself, our, us, mine
			Second	you, your, yours
			Third	he, she, it, they, its, them, his, her
		Impersonal	it	
		Indefinite	one, none, some, other, everybody	
		Distributive	each, either, neither	
		Relative	who, whose, which	
Adjective	Adds something to a noun/pronoun	Of quality (<i>what kind?</i>)	Mumbai is a <i>busy</i> city.	
			The <i>smart</i> crow fooled the dog.	
		Of quantity (<i>how much?</i>)	I picked <i>some</i> flowers.	
			There are <i>five</i> minarets.	
		Demonstrative (<i>which?</i>)	<i>This</i> boy is better than Ram. Why use <i>such</i> a colour?	
		Interrogative (<i>asks a question</i>)	<i>Which</i> train will take us to Indore? <i>Whose</i> work is that?	
Verb	Expresses an action or a state	Transitive (needs an object)		The driver <i>stopped</i> the car.
		Intransitive (no object needed)		The baby <i>sleeps</i> .
		Voice	Active	The boy <i>kicks</i> the ball.
			Passive	The ball <i>is kicked</i> by the boy.
		Tense	Present	I <i>play</i> football.
			Past	I <i>played</i> football.
Future	I <i>will play</i> football.			
Adverb	Adds something to a verb, an adjective or an adverb	Of time (<i>when?</i>)		He came <i>yesterday</i> .
		Of frequency (<i>how often?</i>)		He comes <i>often</i> .
		Of place (<i>where?</i>)		The giant looked <i>down</i> .
		Of manner (<i>how?</i>)		She studies <i>hard</i> .
		Of degree or quantity (<i>how much? To what extent?</i>)		These bananas are <i>almost</i> ripe.
				The meeting was <i>very</i> stormy.
		Of affirmation and negation		He <i>definitely</i> cheats.
				I do <i>not</i> think so.
Of reason		He is <i>hence</i> charged as accused.		

1. Subject Verb Agreement – The rule is simple. Just identify the subject and use the verb accordingly.

E.g. The dog, who is chewing on my books, is/are usually very good

Here the subject is 'dog' which is singular, and hence a singular verb will be used with it. So the sentence becomes-

The dog, who is chewing on my books, is usually very good.

- i. **If two subjects are joined by and, they typically require a plural verb form.**
E.g. - The cow **and** the pig are jumping over the moon.
- ii. The verb is singular if the two subjects separated by 'and' refer to the same person/thing.
E.g. – **Rajma and rice** is my mother's favourite dish.
- iii. If **each** or **every** comes before the subject, the verb is singular.
E.g. - Every man and woman is required to check in.
- iv. If the subjects are both singular and are connected by the words **or, nor, neither/nor, either/or**, and **not only/but also** the verb is singular.
E.g. - Jessica or Christian is to blame for the accident
- v. If the subjects are both plural and are connected by the words or, nor, neither/nor, either/or, and not only/but also, the verb is plural.
E.g. - Dogs and cats are both available at the pound.
- vi. If one subject is singular and one plural and the words are connected by the words or, nor, neither/nor, either/or, and not only/but also, you use the verb form of the subject that is nearest the verb.
E.g. - Either the bears or the lion **has** escaped from the zoo.
- vii. Indefinite pronouns (except **few, many, several, both, all, some**) take singular verbs.
E.g. - Everybody **wants** to be loved.
- Few **were** left alive after the flood.
- viii. Collective nouns like herd, senate, class, crowd, etc. usually take a singular verb form.
E.g. - The herd is stampeding.
- ix. A Collective Noun takes a Singular Verb when the collection is thought of as a whole, a Plural Verb when the individuals of which it is composed are thought of.
E.g. - The Council has chosen the President.
- The military were called out.
- x. Sometimes the subject is separated from the verb by such words as **along with, as well as, besides, not, together with, in addition to**, etc. These words and phrases are not part of the subject. Ignore them and use a singular verb when the subject is singular.
E.g. - Excitement, as well as nervousness, **is** the cause of her shaking.

Remember, only the subject affects the verb!

2. Many a student have failed in the Mathematics test.

[A very famous question of CGL]

Remember! We use singular verb with '**Many a**'. So correct sentence would be:

Many a student **have** failed in the Mathematics test.

3. **Hardly** the inspector had arrived there to investigate the crime when the house was set ablaze.
Correction: Use had immediately after Hardly. Hence the sentence becomes-
Hardly had the inspector arrived there to investigate the crime when the house was set ablaze.

4. Difference between 'among' and 'between'
- Between is used when naming distinct, **individual items** (can be 2, 3, or more)
 - Among is used when the items are **part of a group**, or are not specifically named (MUST be 3 or more)

E.g.

The negotiations **between** Brazil, Argentina, and Chile are going well.

The negotiations **among** the countries of South America are going well. (the countries are part of a group called South America)

SSC Question-

The property was divided among the two brothers.

Correct sentence: The property was divided between the two brothers.

5. Seldom we have been treated in such a rude manner by the police personnel.
Correction: Seldom have we been treated in such a rude manner by the police personnel.
Just like 'hardly', 'seldom' is also followed by has/have/had.

6. Difference between FOR and SINCE
- Use FOR to express a period of time, like 10 years, three weeks, etc.
 - Use SINCE to talk about a specific point in time, like since Monday, since last week etc.

E.g.

I've been living in London for 10 years.

I've been living in London since 2003.

SSC Question

I am told that Anjali has been suffering from fever since ten days.

I am told that Anjali has been suffering from fever **for** ten days.

7. He is living in Delhi for 4 years.
SSC tries to confuse you between **is** and **have been**.
Use have been whenever you see any action that started in the past and is continuing in the present.
Correct sentence: He has been living in Delhi for 4 years.

8. Advice/Advise and Practice/Practise
Advice and Practice are nouns, while Practise and Advise are verbs.

E.g. I want an advice.

Thanks for advising me.

9. Every Participle must have a Subject of Reference.
E.g. Being a rainy day I decided to stay at home.
Correct sentence - It being a rainy day I decided to stay at home.

10. When there are two Subjects in a sentence and they are not in the same Number, then we must have to use separate Auxiliaries (is, are, am, was, were, have, has) for both of them.

E.g. Three killed and one was injured.

Correction – Three were killed and one was injured.

11. A single Verb should be made to serve two Subjects, only when the form of Verb is same for both the subjects.

E.g. I **am** seventeen years old and my sister fourteen.

I **am** seventeen years old and my sister **is** fourteen. [**Am** and **is** are different forms of verb, and hence you should include 'is']

12. IT'S (HIGH) TIME + PAST SUBJUNCTIVE

E.g. – It is high time you buy a house.

Correction – It is high time you **bought** a house.

13. Difference between 'me' and 'I'

E.g. Hector and me won the race

The trick to correct such errors is – You will only confuse between I and me, when they are used with other nouns/pronouns. Eliminate those nouns/pronouns to make your sentence simpler. Your sentence becomes:

Me won the race.

Now you can easily say that the above sentence is wrong.

Correction – I won the race.

Hence the complete sentence becomes – Hector and I won the race.

14. Double comparatives and superlatives should not be used.

E.g. - Incorrect- He is the most cleverest boy in the class.

Correct- He is the cleverest boy in the class.

Incorrect- He is more wiser than his brother.

Correct- He 'is wiser than his brother.

15. The comparative Adjectives superior inferior, senior, junior, prior, anterior, posterior prefer, etc., should be followed by 'to' instead of 'than'.

Incorrect- He is senior than me.

Correct- He is senior to me.

16. Adjectives like 'unique', ideal, perfect, complete, universal, entire, extreme, chief, full square and round, which do not admit different degrees of comparison should not be compared.

Incorrect- It is the most unique thing.

Correct- It is a unique thing.

17. All the Adjectives which refer to the same Noun should be in the same degree of comparison.

Incorrect- He is the wisest and honest worker in the office.

Correct- He is the wisest and most honest worker in the office.

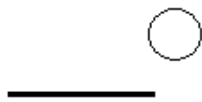
18. Too means more than required and it is used with Unpleasant Adjective. So, we cannot use too glad, too happy, too pleasant, too healthy.

Incorrect- I am too glad to meet you.

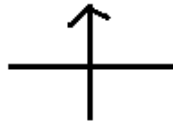
Correct- I am very glad to meet you.

19.

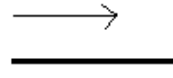
Prepositions



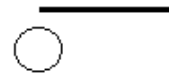
Above



Across



Along



Below



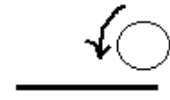
inside



into



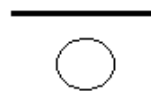
on



onto



Over



Under

Below (Thing is not directly underneath)

Under (Thing is directly underneath)

Above (Thing is not directly above)

Over (Thing is directly above)
Along (Talk about movement on or beside a line)
Across (From one side to another)
On (Stationary thing on the surface)
Inside (Enclosed within boundaries)
Onto (motion of object on the surface)
Into (motion of object within the space)

20. 'To' should not be separated from its verb by adverb.
You are requested to kindly stay for some time.
Correction: You are requested kindly to stay for some time.
21. Use of infinitive (to) + "ing" with [be used to, accustomed to, averse to, with a view to, addicted to, devoted to, in addition to, object to, look forward to, owing to, given to, taken to]
E.g. We are looking forward to meet you.
Correction: We are looking forward to **meeting** you.
22. Double future tense is not used.
Anyone will tell you the shop, if you will ask.
Correction: Remove the one after conditional word 'if'. Hence the sentence becomes-
Anyone will tell you the shop, if you ask.
23. He is **one of the boys** who works hard.
Correction: He is one of the boys who work hard.
Similarly,
Magic realism is one of the latest addition to good literature.
Correction: Magic realism is one of the latest **additions** to good literature.
24. World War II was fought between 1914 to 1918.
With 'between' we use 'and'
With 'from' we use 'to'
Correction: World War II was fought from 1914 to 1918.
25. The following nouns are always used in the plural form only:
Jeans / Cattle / People / Police / Electorate / Poultry /Trousers / Scissors / Spectacles / Binoculars
/Crackers / Swine / Gentry / Clergy
E.g. The scissor is very sharp.
Correction: The scissors are very sharp.
26. The following words are uncountable and are normally used in the singular form only. The indefinite article "A or An" should not be used with them-
Equipment / Luggage / Baggage / Breakage / Advice / Furniture / Information / Scenery / Poetry /
Work / Soap / Food / Bread / Fish / Paper / Machinery

E.g. I have purchased all the equipments.
Correction: I have purchased all the equipment.

27. The words such as News / Maths / Ethics / Politics / Phonetics / Economics / Statistics / Measles / Mumps / Rickets / Billiards / Innings look like plural nouns but give singular meaning. So, they take singular form of verbs.
E.g. The news are not reliable.
Correction: The news is not reliable.

28. Some Nouns have the same form whether singular or plural.
Aircraft / Swine / Sheep / Deer / Service / Series / Species / Fish / Apparatu
E.g. I saw three deers in the zoo.
Correction: I saw three deer in the zoo.

29. The Reciprocal pronouns "Each other / One another"
Each other - For two persons
One another - For more than two persons.
E.g. The two sisters hate each other.
The five brothers love one another.

30. The present perfect tense should not be used with adverbs indicating past time. Instead the simple past tense should be used.
E.g. He has left for Hyderabad last week.
Correction: He left for Hyderabad last week.

31. In Conditional Sentences, to express improbability in the Present, the Simple Past Tense in the 'if' clause and the Present Conditional Tense in the main clause are used. E.g.
If I am the Principal, I would Punish Him. X
If I were the Principal, I would Punish Him. ✓
If he is rich, he would buy a car. X
If he were rich, He would buy a car ✓

32. Elder / Eldest should be used with the members of the same family.
Older/ Oldest these comparative adjective denote the age of person / thing.
E.g. He is elder to me. (He and me belong to one family).
Ronald Reagan was the oldest person elected to the

33. While comparing the objects, we should see that a noun is compared with another but not with some other word.
E.g.
Ooty is better than Chennai. ✓
The climate of Ooty is better than Chennai. X
The climate of Ooty is better than that of Chennai. ✓

34. After 'comparatively / relatively' an adjective under positive degree should be used.

E.g.

The weather is comparatively hotter today X

The weather is comparatively hot today. ✓

35. After 'prefer / preferable' instead of than, 'to' should be used.

She prefers milk than coffee X

She prefers milk to coffee ✓

Winter is preferable than summer X

Winter is preferable to summer ✓

36. The indefinite article 'A' should be used before the word 'Half' when it follows a whole number.

E.g.

I stayed in Madras for one and half years. X

I stayed in Madras for one and a half years. ✓

37. The adverbs 'too much' is used with nouns and 'much too' is used with adjectives.

E.g.

His failure is too much painful for me X

His failure is much too painful for me ✓

38. The co-relative conjunctions are used in pairs.

Not only - but also

Either - or

Neither - nor

Both - and

Though - yet

Whether – or

E.g.

Though he is rich but he is economical. X

Though he is rich yet he is economical. ✓

39. After the subordinating conjunction 'lest' the auxiliary 'should' is used.

Work hard lest you fail. X

Work hard lest you should fail. ✓

40. Dispose of - Sell away.

He disposed off his scooter. X

He disposed of his scooter. ✓

41. The indefinite pronoun "One" should be used as "One's" for its possessive case.

One should love his country. X

One should love one's country. ✓

42. After negative sentences, the question tag used should be in an ordinary interrogative form.

He works hard, does he? X

He works hard, doesn't he? ✓

43. After negative sentences, the question tag used should be in an ordinary interrogative form.

She didn't like that book, didn't she? X

She did not like that book, did she? ✓

44. Despite and In spite of

Despite of his hard work, he failed in the examination. X

Despite his hard work he failed in the examination. ✓

In spite of my busy schedule I manage to get 8 hours of sleep every night. ✓

45. Parallelism

He is young, intelligent, and has charm. X

He is young, intelligent, and charming. ✓

She likes to read, to travel and blogging. X

She likes to read, to travel, and to blog. ✓



This marks the end of this book. Try to understand each trick thoroughly. After going through this hack-book, I am sure you would be able to add at least 15-20 more marks in your mark-sheet.

If you have any suggestions/complaints for this book, please drop a comment at –

- My blog - sschacks.blogspot.in, or
- [My facebook account](#), or
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