BITSAT 2022

Sample Paper

Q.1   What will be the electric ux through a disc by a point a charge which is kept at in nite distance from the disc?

Option 1:
0

Option 2:
$$\frac{q}{2\varepsilon_o}$$

Option 3:
$$\frac{q}{\varepsilon_o}$$

Option 4:
∞

Correct Answer:
0

Solution:

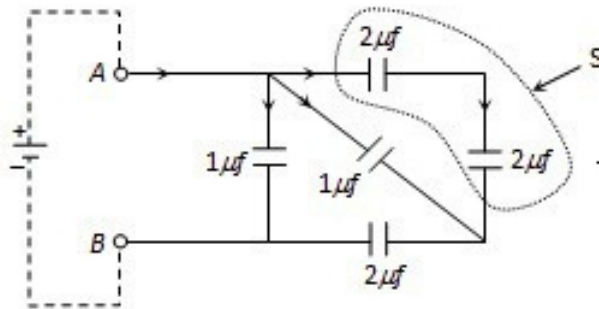As we know that the electric ux through a disc is given by -

$$\phi = \frac{q}{2\varepsilon_0}\left(1 - \frac{a}{\sqrt{a^2 + R^2}}\right)$$

$If\ a\ tends\ to\ \infty then,$

$$\phi = \frac{q}{2\varepsilon_0}\left(1 - \frac{a}{a\sqrt{1 + \frac{R^2}{a^2}}}\right)$$

$$\phi = \frac{q}{2\varepsilon_0}(1 - 1) = 0$$

Q. 2   Five capacitors are connected as shown in the gure. The equivalent capacitance between the point A and B is

Option 1:
$1\mu F$

Option 2:
$2\mu f$

Option 3:
$3\mu f$

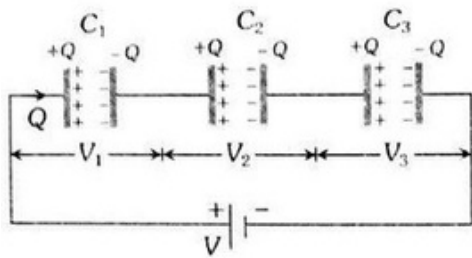**Option 4:**
$4\mu f$

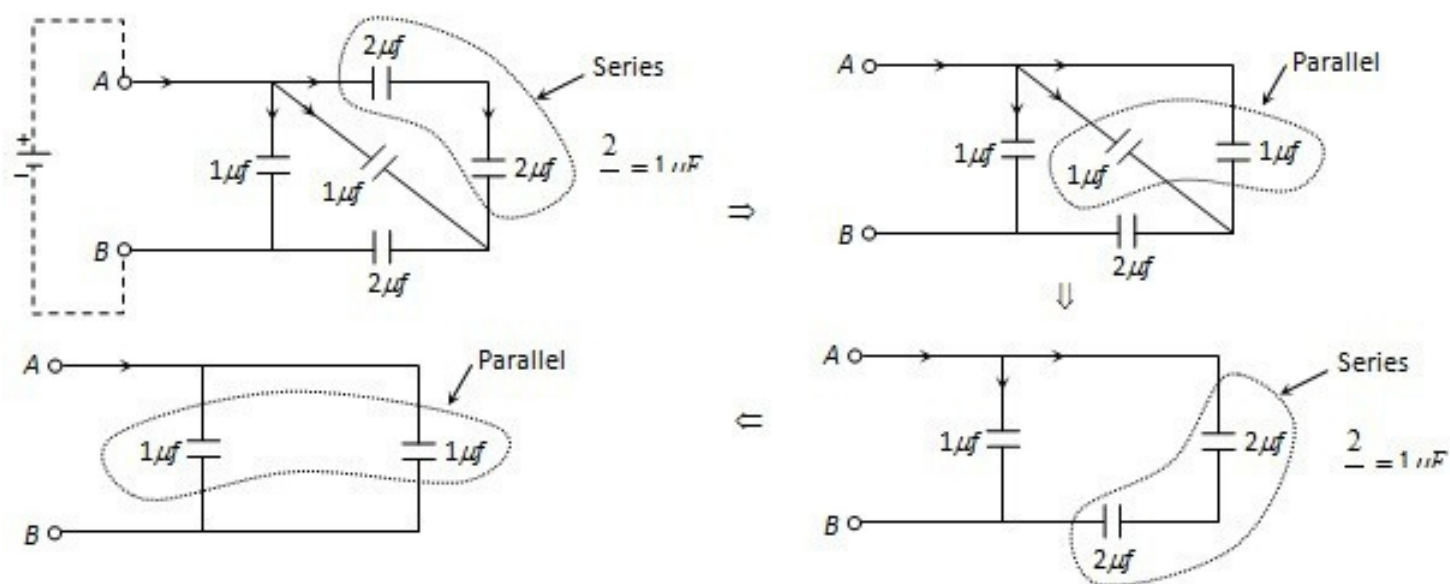**Correct Answer:**
$2\mu f$

Solution:
As we have learned

Series Grouping -

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots$$

- wherein

Hence equivalent capacitance between A and B is $2\mu F$

Q. 3   A long straight wire along the z-axis carries a current I in the negative z direction. The magnetic vector eld $\vec{B}$ at a point having coordinates (x, y) in the z = 0 plane is

Option 1:

$$\frac{\mu 0 I \left(y i^{\wedge} - x j^{\wedge}\right)}{2\pi \left(x^2 + y^2\right)}$$

Option 2:

$$\frac{\mu 0 I \left(x i^{\wedge} - y j^{\wedge}\right)}{2\pi \left(x^2 + y^2\right)}$$

Option 3:

$$\frac{\mu 0 I \left(x j^{\wedge} - y i^{\wedge}\right)}{2\pi \left(x^2 + y^2\right)}$$

Option 4:

$$\frac{\mu 0 I \left(x i^{\wedge} - y j^{\wedge}\right)}{2\pi \left(x^2 + y^2\right)}$$

Correct Answer:

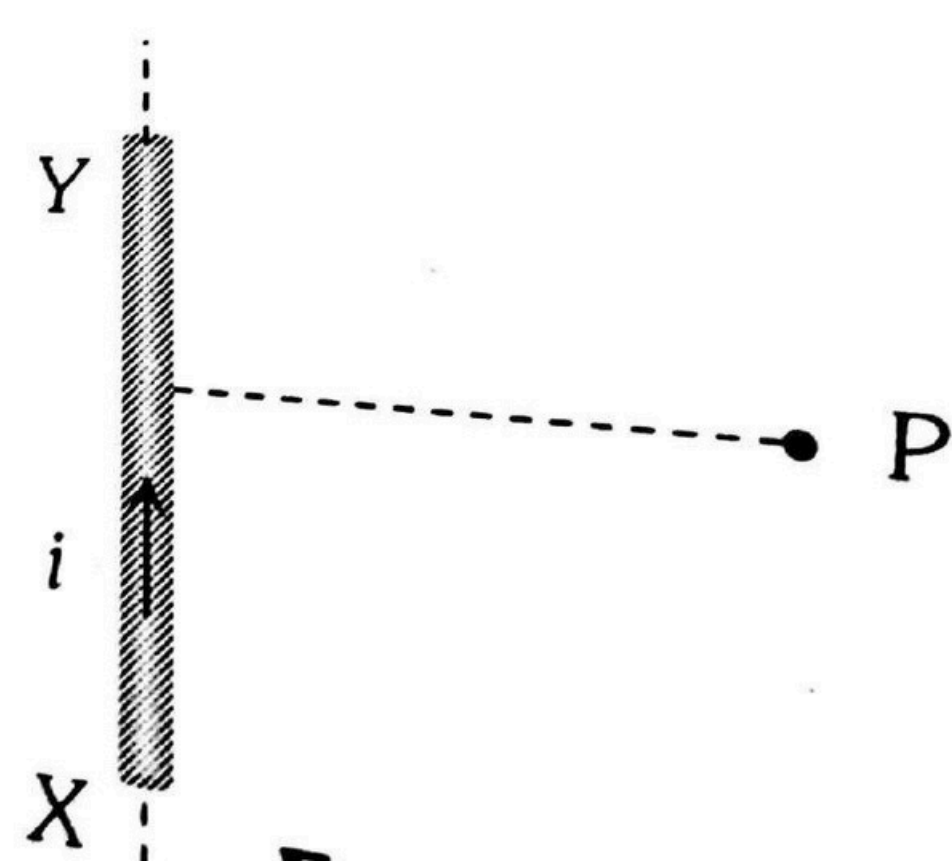$$\frac{\mu 0 I \left(y i^{\wedge} - x j^{\wedge}\right)}{2\pi \left(x^2 + y^2\right)}$$
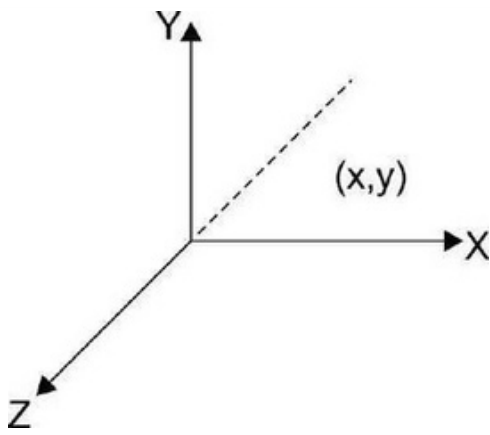
Solution:
As we learnt in

For In nite Length -

$\phi_1 = \phi_2 = 90°$

$$B = \frac{\mu_o}{4\pi} \frac{2i}{r}$$

- wherein

Magnitude of magnetic eld $= \dfrac{\mu_o I}{2\pi r} = \dfrac{\mu_o I}{2\pi (x^2 + y^2)^{1/2}}$

Direction of eld along tangential direction $= \dfrac{y\hat{i} - x\hat{j}}{\sqrt{x^2 + y^2}}$

$\therefore \vec{B} = \dfrac{\mu_o I}{2\pi (x^2 + y^2)} \cdot (y\hat{i} - x\hat{j})$

Q. 4   A vernier callipers has 20 divisions on the vernier scale which coincide with 19 divisions on the main scale. The least count of the instrument of 0.1mm. The main scale divisions are of

Option 1:
0.5 mm

Option 2:
1mm

Option 3:
2 mm

Option 4:
$$\frac{1}{4} \, mm$$

Correct Answer:
2 mm

Solution:
Least count of vernier scale

Lc=1MSD-1VSD

put the value get the result

we get 2mm

Q. 5   The viscous force acting on a body falling under gravity in a viscous uid will be

Option 1:

$$\frac{6\pi\vartheta}{\eta r}$$

Option 2:

$$\frac{6\pi\eta r}{\vartheta}$$

Option 3:

$$6\pi\eta r\vartheta$$

Option 4:

$$\frac{r\vartheta}{6\pi\eta}$$

Correct Answer:
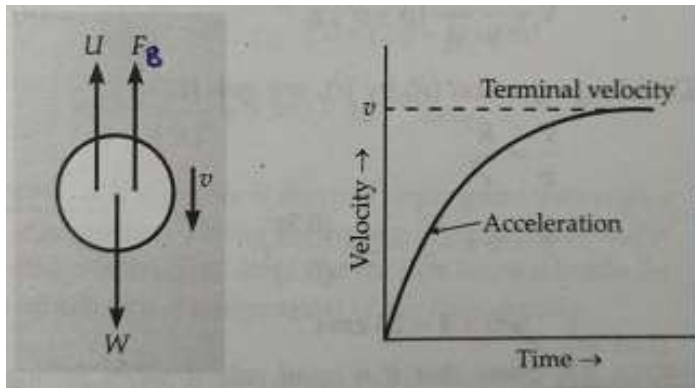
$$6\pi\eta r\vartheta$$

Solution:
As we learned

Stoke's law -

The magnitude of the viscous force depends on shape/size ,velocity and viscosity of liquid.

- wherein

Viscous force $F = 6\pi\eta rbv$

$\eta = coefficient\ of\ viscosity$

$r = radius\ of\ body$

$v = velocity\ of\ spherical\ body$

Q. 6

Consider a sphere of radius R which carries a uniform charge density ρ. If a sphere of radius $\dfrac{R}{2}$ is carved out of it, as

shown, the ratio $\dfrac{\left|\hat{E}_A\right|}{\left|\hat{E}_B\right|}$ of magnitude of electric eld $\hat{E}_A$ and $\hat{E}_B$, respectively, at points A and B due to the

remeaning portion is:
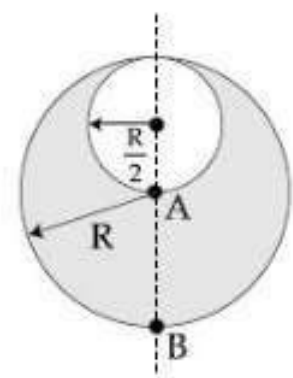
Option 1:

$\dfrac{21}{34}$

Option 2:

$\dfrac{18}{54}$

Solution:

Condider a sphere of density $-\rho$ and radius R/2 is removed from a sphere of radius R

then, Electric eld at A is $\quad E_A = E_\rho + E_{-\rho} = 0 - \dfrac{\rho\left(\frac{R}{2}\right)}{3\epsilon_0} = \dfrac{\rho R}{6\epsilon_0}$

electric eld at B is $\quad E_B = E_\rho + E_{-\rho} = \dfrac{\rho(R)}{3\epsilon_0} - \dfrac{k\rho\frac{4}{3}\pi\left(\frac{R}{2}\right)^3}{\left(\frac{3R}{2}\right)^2} = \dfrac{17\rho R}{54\epsilon_0}$

$\left|\dfrac{E_A}{E_B}\right| = \dfrac{9}{17} \Rightarrow \dfrac{18}{34}$

Hence the correct option is (4).

Q. 7

In a certain region of space,gravitational eld is given by $\quad I = -\left(\dfrac{K}{R}\right)$ .Taking the reference point to be at $\quad r = r_0$

and potential at reference point as $\quad V = V_0.$

Then Find the potential at general point

Option 1:
$K\log(\dfrac{r}{r_0}) + v_0$

Option 2:
$K\log(\dfrac{r_0}{r}) + v_0$

Option 3:

$$K \log\left(\frac{r}{r_0}\right) - v_0$$

Option 4:

$$K \log\left(\frac{r_0}{r}\right) - v_0$$

Correct Answer:

$$K \log\left(\frac{r}{r_0}\right) + v_0$$

Solution:
we know that gravitational eld intensity is given as

$$I = \frac{-dv}{dr}$$

$dv \rightarrow$ Change in potential

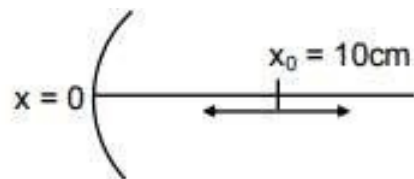$dr \rightarrow$ distance

As $I = \frac{-dv}{dr}$ or $dv = -I dr$

$$\int_{v_0}^{v} dv = -\int_{r_0}^{r} \left(\frac{-k}{r}\right) dr$$

$$[V]_{vo}^{v} = K\,[logr]_{ro}^{r} = K\,[logr - logro]$$

$$V - V_0 = Klog\frac{r}{r_o} \Rightarrow V = Klog\frac{r}{r_0} + V_o$$

Q. 8   A particle is oscillating on the X-axis with an amplitude 2 cm about the point =10 cm, with a frequency ω. A concave mirror of focal length 5 cm is placed at the origin (see gure).

Identify the correct statements.

(A) The image executes periodic motion.

(B) The image executes non-periodic motion.

(C) The turning points of the image are asymmetric w.r.t. the image of the point at x=10 cm.

(D) The distance between the turning points of the oscillation of the image is $\dfrac{100}{21}\,cm.$

.

Option 1:

(A), (D)

Option 2:

(A), (C), (D)

Correct Answer:
(A), (C), (D)

Solution:
As we learned

Mirror Formula -

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

- wherein

$u =$ Object distance from pole of mirror.

$v =$ Image distance from pole of mirror.

$f =$ focal length of the mirror.

For u = -10cm, f = -5cm

$$\frac{1}{v} = \frac{-1}{5} + \frac{1}{10} = \frac{-1}{10}cm$$

v = 10cm , u= -8cm & u = -12cm

$$u_1 = -8cm$$

$$\frac{1}{v_1} = \frac{1}{f} - \frac{1}{u_1} = \frac{-1}{5} + \frac{1}{8} = \frac{-3}{40}orv_1 = \frac{-40}{3}cm$$

for $u_2 = -12cm$

$$\frac{1}{v_2} = \frac{1}{f} - \frac{1}{u_2} = \frac{-1}{5} + \frac{1}{12} = \frac{-7}{60}orv_2 = \frac{-60}{7}cm$$

di erence between $v_1 and v_2$

$$= v_2 - v_1 = \frac{-60}{7} + \frac{40}{3} = \frac{-180 + 280}{21}$$

$$= \frac{100}{21}cm$$

Q.9   Lorentz force can be calculated using the formula

Option 1:
$$F = q(\vec{E} + \vec{v} \times \vec{B})$$

Option 2:
$$F = q(\vec{E} - \vec{v} \times \vec{B})$$

Option 3:
$$F = q(\vec{E} + \vec{v}.\vec{B})$$

Option 4:
$$F = q(E \times v + B)$$

Correct Answer:
$$F = q(\vec{E} + \vec{v} \times \vec{B})$$

Solution:
As we learnt

Lorentz Force -

$$F = q(\vec{E} + \vec{v} \times \vec{B})$$

Q.10   Resistance of non-ohmic substance

Option 1:

is constant with change in potential

Option 2:

always increases with increase in temperature

Option 3:

changes with change in potential

Option 4:

none of the above

Correct Answer:

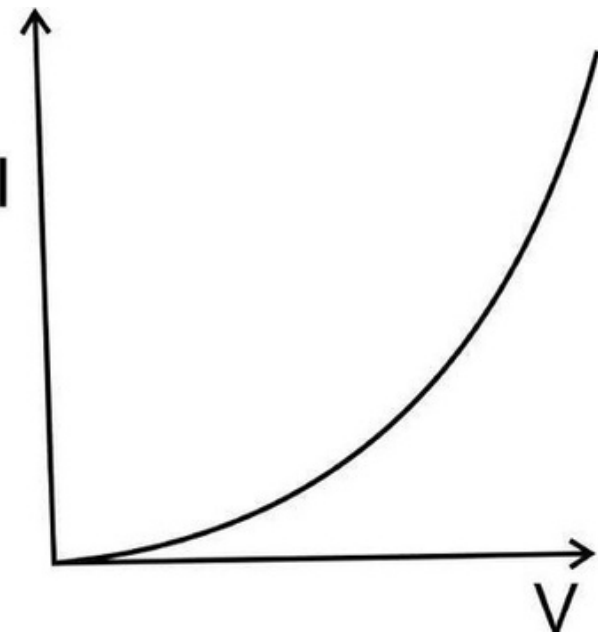changes with change in potential

Solution:
As we learnt

Non-ohmic -

Those substance which don't obey Ohm's law are known as Non ohmic or non linear conductors.

- wherein

i.e. gases , crystal recti ers , etc.

Resistance of nonohmic substances

changes with potential

Q. 11   A sphere is released on a smooth inclined plane from the top. When it moves down its angular momentum is:

Option 1:
conserved about every point

Option 2:
conserved about the point of contact only

Option 3:
Conserved about the centre of the sphere only

Option 4:

conserved about any point on a line parallel to the inclined plane and passing through
the centre of the ball.

Correct Answer:

conserved about any point on a line parallel to the inclined plane and passing through
the centre of the ball.

Solution:

As the inclined plane is smooth ,the sphere can never roll rather it will just slip down. Hence , the angular momentum remains conserved about any point on a line parallel to the inclined plane and passing through the centre of the ball.

Q. 12   A 90 kg person is sitting in a boat at rest with a mass of 100 kg. In the boat is a stone with a mass of 5.0 kg. The person throws the stone at 4.00 m/s horizontally in the NORTH direction. The velocity of the person and the boat after the throwing the stone is

Option 1:
2.00 m/s NORTH

Option 2:
1.21 m/s SOUTH.

Option 3:
1.21 m/s NORTH.

Option 4:
0.11 m/s SOUTH.

Correct Answer:
0.11 m/s SOUTH.

Solution:
As we learnt in

Perfectly Inelastic Collision -

$$V = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

- wherein

Two bodies stick together after the collision ,so there will be a nal common velocity (v)

$m_1, m_2 = masses$

$v_1 = initial\ velocity\ mass\ m_1$

$v_2 = initial\ velocity\ mass\ m_2$

$$(100kg + 90kg)V = 20kgms^{-1}$$

where 20 kgm/s is stone Momentum.

$$190V = 20 \Rightarrow V = \frac{20}{190} = 0.11ms^{-1}$$

Q. 13   A coil having *n* turns and resistance *R* . $_\omega$ is connected with a galvanometer of resistance *4R* . This combination is moved in time *t* seconds from a magnetic eld *W*1 weber to *W*2 weber. The induced current in the circuit is

Option 1:
$$-\frac{W_2 - W_1}{5Rnt}$$

Option 2:
$$-\frac{n(W_2 - W_1)}{5Rt}$$

Option 3:
$$-\frac{(W_2 - W_1)}{Rnt}$$

Option 4:
$$-\frac{n(W_2 - W_1)}{Rt}$$

Correct Answer:
$$-\frac{n(W_2 - W_1)}{5Rt}$$

Solution:
As we learnt in

Induced current $\quad I = \dfrac{-n}{R'}\dfrac{d\phi}{dt} = \dfrac{-n}{R'}\dfrac{dW}{dt}\quad where$

$\phi = W = flux \ \times \ per \ unit \ turn \ of \ the \ coil$

$\therefore \quad I = -\dfrac{1}{(R+4R)}\dfrac{n(W_2 - W_1)}{t} = -\dfrac{n(W_2 - W_1)}{5Rt}$

Change in ux = $\ W_2 - W_1$

For N turns -

$\varepsilon = \dfrac{-N\,d\phi}{dt}$

- wherein

N= Number of turns in the Coil

Negative sign shows that induced emf change the ux.

Total current per coil

$\therefore I = \dfrac{\xi}{R_{eq}} = \dfrac{n}{R_{eq}}\dfrac{\Delta\phi}{\Delta t}$

$$I = \frac{n(W_2 - W_1)}{(R + 4R)t} = \frac{n(W_2 - W_1)}{5Rt}$$

Induced current is oppoiste to its cause of production

$$I = \frac{-n(W_2 - W_1)}{5Rt}$$

Q. 14   If $\vec{w} = \hat{l} - 2\hat{j} + 2\hat{k}$ and $\vec{r} = 4\hat{j} - 3\hat{k},$ then the magnitude of $\vec{V}$ is where V is the linear velocity, w is angular velocity and r is the radius vector

and $\vec{V}$ is given by $\left(\vec{V} = \vec{\omega} \times \vec{r} \right)$

Option 1:
$\sqrt{29}\ units$

Option 2:
$\sqrt{31}\ units$

Option 3:
$\sqrt{37}\ units$

Option 4:
$\sqrt{41}\ units$

Solution:
Solution

Vector or cross product -

$$\vec{V} = \vec{\omega} \times \vec{r}$$

$$\left| \vec{V} \right| = \left| \vec{\omega} \times \vec{r} \right|$$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -2 & 2 \\ 0 & 4 & -3 \end{vmatrix} = \left| [\hat{i}(6-8) - \hat{j}(-3-0) + \hat{k}(4-0)] \right|$$

$$= \left| -2\hat{i} + 3\hat{j} + 4\hat{k} \right| = \sqrt{4+9+16} = \sqrt{29} \ unit$$

Q. 15   EMF in secondary coil is greater than primary coil in which of the following transformer?

Option 1:
Step Up transformer

Option 2:
Step Down transformer

Option 3:
Ideal Transformer

Option 4:
None

Correct Answer:
Step Up transformer

Solution:
As we learnt

Step up transformer If increase voltage and decrease current -

$$K > 1$$

-

In step up transformer, $E_S > E_P$

Q. 16   A long wire carries a steady current. It is bent into a circle of one turn and the magnetic eld at the centre of the coil is B It is then bent into a circular loop of n turns. The magnetic eld at the centre of the coil will be

Option 1:

nB

Option 2:

$n^2 B$

Option 3:

$2nB$

Option 4:

$2n^2 B$

Correct Answer:

$n^2 B$

Solution:

As we discussed in

Magnetic Field due to Circular Current at the center -

$$B_{centre} = \frac{\mu_0 N i}{2r}$$

Let the length of wire will be l

: Initially, $r_1 = radius\ of\ coil = \dfrac{l}{2}\pi$

$\therefore\quad B = \dfrac{\mu_0 i}{2r_i} = \dfrac{2\mu_o i\pi}{2l}$

Finally $r_2 = radius\ of\ coil = \dfrac{l}{2\pi n}$

$\therefore\quad B' = \dfrac{\mu_0 i \times n}{2r_2} = \dfrac{n\mu_0 i \times 2\pi n}{2l} = \dfrac{2\mu_0 i n^2 \pi}{2l}$

$\dfrac{B'}{B} = \dfrac{2\mu_0 i n^2 \pi}{2l} \times \dfrac{2l}{2\mu_0 i\pi} = n^2$

$B' = n^2 B$

Q. 17   A bullet of mass 10 g and speed 500 m/s is red into a door and gets embedded exactly at the centre of the door. The door is 1.0 m wide and weighs 12 kg. It is hinged at one end and rotates about a vertical axis practically without friction. The angular speed of the door just after the bullet embeds into it will be:

Option 1:
6.25 rad/sec

Solution:

$Angular\ momentum impartedbythebullet L = mv \times r = \left(10 \times 10^{-3}\right) \times$

$500 \times \dfrac{1}{2} = 2.5$

$Also,\ I = \dfrac{ML^2}{3} = \dfrac{12 \times 1.0^2}{3} = 4kgm^2$

$As\ L = I\omega \therefore \Omega = \dfrac{L}{I} = \dfrac{2.5}{4} = 0.625 rad/sec$

Q. 18   The potential energy function for the force between two atoms in a diatomic molecule is approximately given by
$U(x) = \dfrac{a}{x^{12}} - \dfrac{b}{x^6}$, where a and b are constants and is the distance between the atoms. If the dissociation energy of the molecule is

$$D = [U\,(x = \infty) - U_{at\ equilibrium}], \quad D\ is$$

Option 1:
$$\dfrac{b^2}{6a}$$

Option 2:
$$\dfrac{b^2}{2a}$$

Option 3:
$$\dfrac{b^2}{12a}$$

Option 4:
$$\dfrac{b^2}{4a}$$

Solution:
As we have learned

Conservative Force -

$$F = \frac{-dU}{dr}$$

- wherein

Negative of the rate of change of potential energy with respect to position

$$U = \frac{a}{x^{12}} - \frac{b}{x^6}$$

At equilibrium F = - dU/dx = 0

$$\Rightarrow a\frac{-12}{x^{13}} - b\frac{-6}{x^7} = 0$$

or

$$x^6 = \frac{12a}{6b} \quad or \quad x = \left(\frac{2a}{b}\right)^{1/6}$$

$$U_{equilibrium} = \frac{a}{\left(\frac{2a}{b}\right)^2} - \frac{b}{\left(\frac{2a}{b}\right)} = \frac{-b^2}{4a}$$

$$D = U(x = \infty) - U_{equilibrium} = 0 - \left(-\frac{b^2}{4a}\right) = +\frac{b^2}{4a}$$

Q. 19   A wire xed at the upper end stretches by length by applying a force f The work done in stretching is

Option 1:
$F/2l$

Option 2:
Fl

Option 3:
$2Fl$

Option 4:
$Fl/2$

Solution:
As we learnt in

Work Done in Stretching Wire / Elastic P.E. -

$$= \frac{1}{2}\frac{YAl^2}{L} = \frac{1}{2}Fl$$

- wherein

L - Length of wire

l - increase in length

 Work done by constant force

$$W = \frac{1}{2} \times stress \times strain \times volume$$

$$W = \frac{1}{2} \times \frac{F}{A} \times \frac{l}{L}.AL = \frac{Fl}{2}$$

$$W = \frac{Fl}{2}$$

Correct option is 4.

Q. 20   An insulated container of gas has two chambers separated by an insulating partition. One of the chambers has volume V_1 and contains ideal gas at pressure P_1 and temperature T_1. The other chamber has volume V_2 and contains ideal gas at pressure P_2 and temperature T_2 . If the partition is removed without doing any work on the gas, the nal equilibrium temperature of the gas in the container will be

Option 1:
$$\frac{T_1 T_2 (P_1 V_1 + P_2 V_2)}{P_1 V_1 T_1 + P_2 V_2 T_2}$$

Option 2:
$$\frac{T_1 T_2 (P_1 V_1 + P_2 V_2)}{P_1 V_1 T_2 + P_2 V_2 T_1}$$

Option 3:
$$\frac{P_1 V_1 T_1 + P_2 V_2 T_2}{P_1 V_1 + P_2 V_2}$$

Option 4:
$$\frac{P_1 V_1 T_2 + P_2 V_2 T_1}{P_1 V_1 + P_2 V_2}$$

$$\frac{T_1 T_2 (P_1 V_1 + P_2 V_2)}{P_1 V_1 T_2 + P_2 V_2 T_1}$$

Solution:
As we learnt in

Change in internal energy for cyclic process -

$$\Delta U = 0$$

- wherein

Since in a cyclic process initial and nal state is same.

$$U_f = U_i$$

$$U_i = U_f$$

$$n_1 C_{V1} T_1 + n_2 C_{V2} T_2 = (n_1 + n_2) C_{Vf} T$$

$$C_{V1} = C_{V2} - C_{Vf}$$

$$\therefore T = \frac{n_1 C_{V1} T_1 + n_2 C_{V2} T_2}{(n_1 + n_2) C_v}$$

$$= \frac{n_1 T_1 + n_2 T_2}{n_1 + n_2}$$

$$n_1 = \frac{P_1 V_1}{R T_1}, \quad n_2 = \frac{P_2 V_2}{R T_2}$$

$$T = \frac{(P_1 V_1 + P_2 V_2) T_1 T_2}{P_1 V_1 T_2 + P_2 V_2 T_1}$$

Q. 21   Which among the following waveform represents pulse Amplitude modulated wave for the given sinusodial signal ?
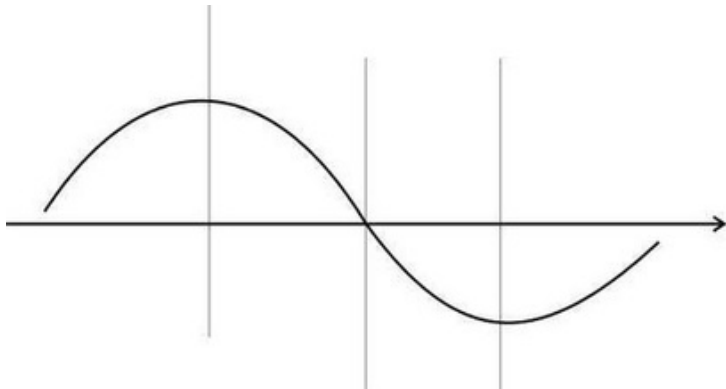
Option 1:
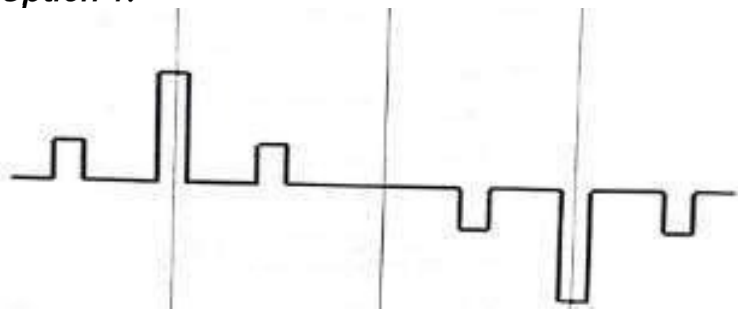
Option 2:
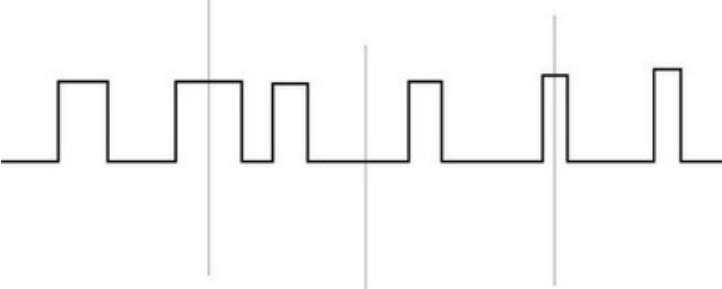
Option 3:
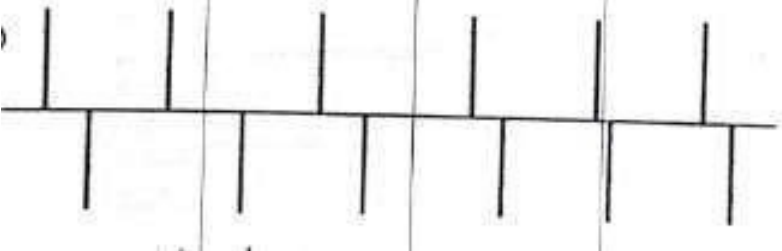
Option 4:
none

Correct Answer:
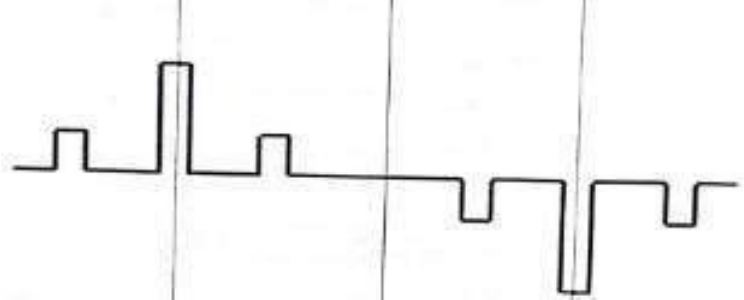
Solution:
As we have learned

Pulse amplitude modulation (PAM) -

The amplitude of the pulse varies in accordance with the modulating signal.

-

 In pulse amplitude modulatiomn signal is simpled at regular intervals and each sample is made proportional to the amplitude of the signal

Only (1) shows amplitude of pulse in proportion to value of analog signal at that instant Hence (1)

Q. 22   In young's double slit experiment the are illuminated by monochromatic light. The entire setup is immersed in pure water. Which of following cannot restore the original fringe width?

Option 1:
Bringing the silts closer together

Option 2:
Moving the screen away from the silt plane

Option 3:
Replacing the incident light by that of longer wavelength

Option 4:
Introducing a thin transparent slab in front of one of the silt

Correct Answer:
Introducing a thin transparent slab in front of one of the silt

Solution:
As we learn

Fringe Width in a medium -

$$\beta' = \frac{\beta}{\mu}$$

- wherein

Since wavelength in a medium become $\quad \lambda = \dfrac{\lambda_o}{\mu}$

$$\beta_w = \frac{\beta}{\mu} = \frac{\lambda_0 D}{\mu d}$$

β decreses to restore the fringe width we have to increse the value of β. Introducing a slab in front of any silt as not change the balue of β but it only shift the whole pattern.

Q. 23   A parallel plate capacitor with area 200 cm^2 and separation between the plates 1.5 cm, is connected across a battery of emf V. If the force of attraction between the plates is 25 × 10^{-6} N, the value of V is approximately :

$$\left[\epsilon_0 = 8.85 * 10^{-12} \frac{c^2}{Nm^2}\right]$$

Option 1:
250 V

Option 2:
100 V

Option 3:
300 V

Option 4:
150 V

Correct Answer:
250 V

Solution:
As we learnt

Force between Parallel Plates Capacitor -

$$F = \frac{\sigma^2 A}{2\epsilon_0} = \frac{Q^2}{2\epsilon_0 A} = \frac{CV^2}{2d}$$

- wherein

$\sigma - Surface\ charge\ density.$
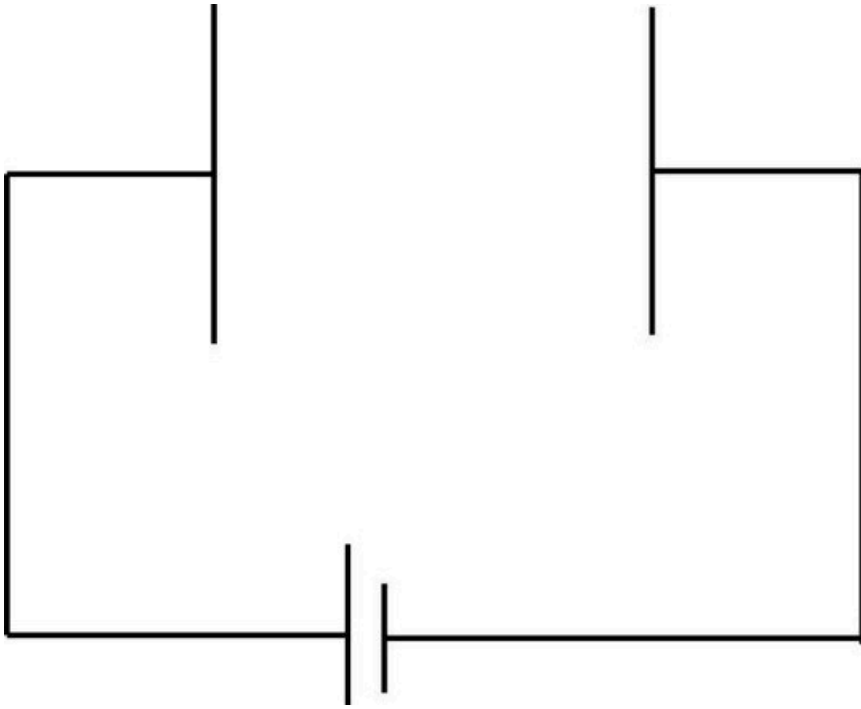
$$Force = \frac{\sigma^2 A}{2\epsilon_0} = \frac{1}{2}\epsilon_0 E^2 A$$

$$F = \frac{1}{2}\epsilon_0 \left(\frac{v}{d}\right)^2 A$$

$$v = d.\sqrt{\frac{2F}{\epsilon_0 A}}$$

$$v = 1.5 * 10^{-2} * \sqrt{\frac{2 * 25 * 10^{-6}}{8.85 * 10^{-12} * 200 * 10^{-4}}}$$

$$v = 1.5 * 10^{-2} * \sqrt{\frac{25}{8.85} * 10^8}$$

$$= \frac{1.5 * 10^{-2} * 5 * 10^4}{3} = 2.5 * 10^2 v = 250v$$

Q. 24   Find the e ciency of transformer when $P_{in} = 100W$ and Power loss=80W

Option 1:

10%

Option 2:

20%

Option 3:
30%

Option 4:
40%

Correct Answer:
20%

Solution:
As we learnt

practical transformer -

$$\eta \% = \frac{P_{in} - P_{loses}}{P_{in}} \times 100$$

-

$$= \frac{100 - 80}{100} * 100$$
$$= 20\%$$

Q. 25   With a concave mirror, object is placed at an distance of 16 cm from principal focus on the pricipal axis.The image is
         formed at a distance 4cm from the principal focus. The focal length of the mirror is :

Option 1:
64 cm

Option 2:
10 cm

Option 3:
2 cm

Option 4:
8 cm

Correct Answer:
8 cm

Solution:
As we learn @234

Newton's Formula -

$$XY = f^2$$

- wherein

$X, Y =$ distance (along the principal axis) of the object and image respectively from the principal focus.

Let X1 = 16 cm

X2 = 4 cm

$$u = f - x_1 \Rightarrow \frac{1}{f - x_2} + \frac{1}{f - x_1} = \frac{1}{f}$$

$$v = f - x_2$$

or

$$\frac{1}{f} = \frac{2f - (x_1 + x_2)}{(f - x_1)(f - x_2)}$$

$$\Rightarrow f^2 - (x_1 + x_2)f + x_1 x_2 = 2f^2 - (x_1 + x_2)f$$

$$\Rightarrow x_1 x_2 = f^2$$

$f = \sqrt{16 * 4}$ cm =8 cm

Q. 26 Following gure shows two processes A and B for a gas. If ΔQ_A and ΔQ_B are the amount of heat absorbed by the system in two cases, and ΔU_A and ΔU_B are changes in internal energies, respectively, then :
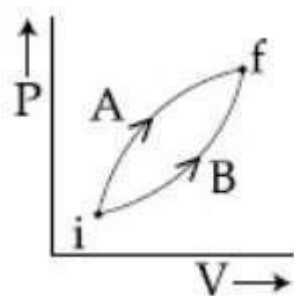
Option 1:
$\Delta Q_A < \Delta Q_B, \Delta U_A < \Delta U_B$

Option 2:
$\Delta Q_A > \Delta Q_B, \Delta U_A > \Delta U_B$

Option 3:
$\Delta Q_A > \Delta Q_B, \Delta U_A = \Delta U_B$

Option 4:
$\Delta Q_A = \Delta Q_B, \Delta U_A = \Delta U_B$

$$\Delta Q_A > \Delta Q_B, \Delta U_A = \Delta U_B$$

Solution:
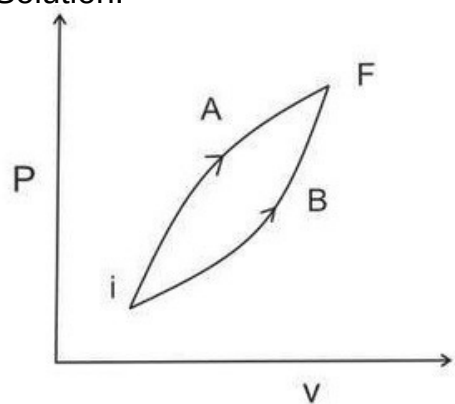
Internal energy is state function

So, $\Delta U_A = \Delta U_B$

Now, $\Delta Q = \Delta U + W$

Now $W_A > W_B$ (work is Area under the curve)

So, $\Delta Q_A > Q_B$.

'n' moles of an ideal gas undergoes a process A→B as shown in the gure. The maximum temperature of the gas during the process will be :
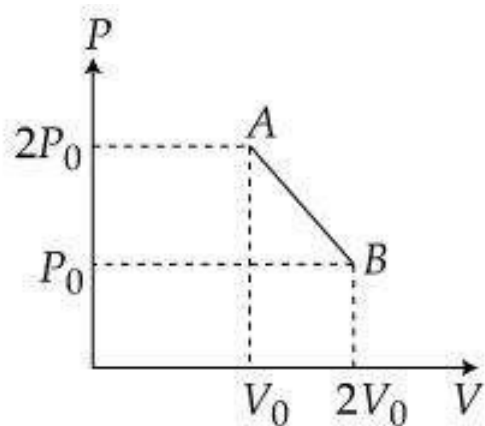
Option 1:

$$\frac{9P_0V_0}{4nR}$$

Option 2:

$$\frac{3P_0V_0}{2nR}$$

Option 3:

$$\frac{9P_0V_0}{2nR}$$

Solution:

At any point between A & B we can write relation between P & V by using equation of straight line

$$V - V_0 = \frac{2V_0 - V_0}{P_0 - 2P_0}(P - 2P_0)$$

$$V - V_0 = \frac{-V_0}{P_0}(P - 2P_6)$$

$$P\left(\frac{-V_0}{P_0}\right) + 2V_0 = V - V_0$$

$$P = \frac{-P_0}{V_0}(V - 3V_0)$$

From ideal gas equation

PV = nRT

$$\Rightarrow \quad \frac{nRT}{V} = \frac{-P_0}{V_0}(V - 3V_0)$$

$$T = \frac{-P_0}{nRV_0}(V^2 - 3V_0V)$$

For temperature to be maximum at any point $\quad \dfrac{dT}{dV} = 0$

$$\Rightarrow \quad 2V - 3V_0 = 0$$

$$\therefore \quad V = \frac{3V_0}{2}$$

$$\therefore \quad T_{max} = \frac{-P_0}{nRV_0}\left(\frac{9}{4}V_0^2 - \frac{9}{2}V_0^2\right) = -\frac{P_0}{nRV_0}\cdot\frac{-9}{4}V_0^2 = \frac{9}{4}\frac{P_0V_0}{nR}$$

Correct option is 1.

Q. 28   How sign convention is taken during traversing of capacitor

Option 1:

The change in potential in traversing a capacitor from the negative terminal to the positive terminal is $\quad +\dfrac{q}{C}$ while in opposite direction $\quad -\dfrac{q}{C}$.

Option 2:
The change in potential in traversing an emf source from negative to positive terminal is +E while in the opposite direction – E irrespective of the direction of current in the circuit.

Option 3:
a& B

Option 4:
none

Correct Answer:
a& B

Solution:
As we have learnt,

Sign Convention - - wherein
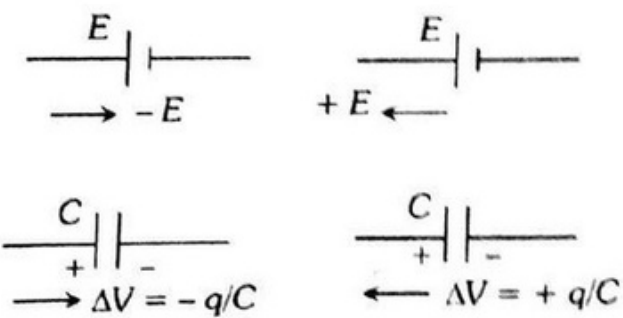
Q. 29   A liquid does not wet the sides of a solid , if the angle of contact is

Option 1:
Zero

Option 2:
obtuse

Option 3:
Acute

Option 4:
90

Correct Answer:
obtuse

Solution:
As we have learned

Ascent Formula -

For $\Theta < 90°$

For $\Theta > 90°$

For $\Theta = 90°$

- wherein

meniscus (concave) $\rightarrow$ Rise

meniscus (convex) $\rightarrow$ Fall

meniscus (Plane) $\rightarrow$ Plane

FOr obtuse angle , the liquid will fall and hence its a non weting liquid

---

Q. 30   Curie temperature is the temperature above which

Option 1:
a ferromagnetic material becomes paramagnetic

Option 2:
a paramagnetic material becomes diamagnetic

Option 3:
a ferromagnetic material becomes diamagnetic

Correct Answer:
a ferromagnetic material becomes paramagnetic

Solution:
As we learnt in

Curie Temperature or Curie Point -

With the rise of temperature susceptibility of ferromagnetic materials decreases.

- wherein

It is denoted by Tc

A ferromagnetic material becomes paramagnetic above Curie temperature.

Q. 31   In which process, the rate of transfer of heat is maximum

Option 4:
in all these, heat is transformed with the same rate.

Correct Answer:
Radiation

Solution:
As we have learnt,

Radiation -

The process of the transfer of heat from one place to anoter place without heating the interveing medium.

-

Radiation is the fastest mode of heat transfer.

Q. 32   The variation of acceleration due to gravity g with distance d from centre of the earth is best represented by

(R=Earth's radius) :

Option 1:
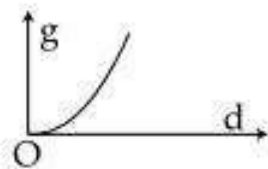
Option 2:
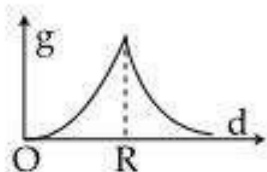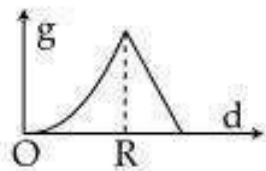
Option 3:

Option 4:
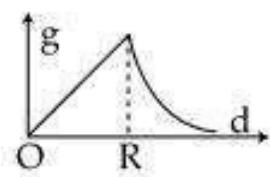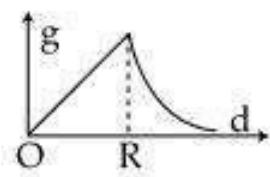
Solution:
As we learnt in

Value of 'g' at ∞ -

$$g' \alpha \frac{1}{r^2}$$

if $\quad r = \infty \qquad g' = 0$

$g' \rightarrow$ Value of acceleration due to gravity

$r \rightarrow$ height above earth's surface

- wherein

No e ect of earth gravitational pull at in nite distance.

if $d < g$ $g = \dfrac{Gm}{K^2}d$

$d = R,$ $g = \dfrac{Gm}{R^2}$

$d > R,$ $g = \dfrac{Gm}{d^2}$

i.e. $g \propto \dfrac{1}{d^2}$

Q. 33   A bullet of mass m moving with a velocity v strikes a suspended wooden block of mass M as shown in the gure and sticks to it. If the block rises to a height h then the initial velocity of the bullet is
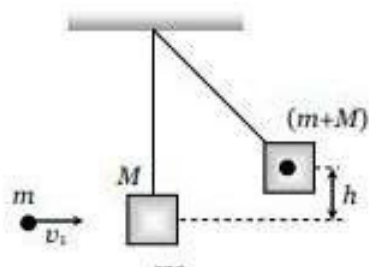
Option 1:

$\dfrac{m}{m-M}\sqrt{2gh}$

Option 2:

$$\frac{m}{m + M}\sqrt{2gh}$$

Option 3:

$$\frac{m + M}{m}\sqrt{2gh}$$

Option 4:

$$\frac{m - M}{m}\sqrt{2gh}$$

Correct Answer:

$$\frac{m + M}{m}\sqrt{2gh}$$

Solution:

Collision Between Bullet and Vertically Suspended Block -

A block of mass M suspended by vertical thread.

A bullet of mass m is red horizontally with velocity u in the block.
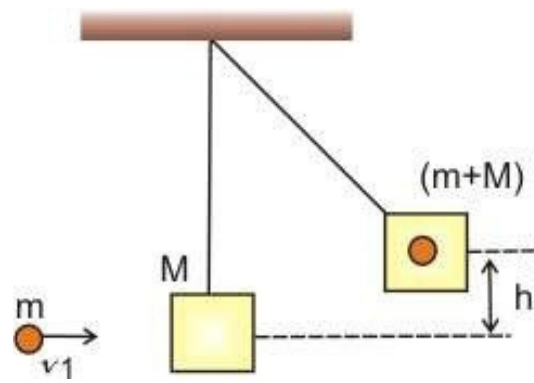
Let after the collision bullet gets embedded in block.

And, the combined system raised upto height h where the string makes an angle θ with the vertical.

1. Common velocity of system just after the collision (V)

Here, system is (block + bullet)

$$P=\text{momentum}$$

$$P_{\text{bullet}} + P_{\text{block}} = P_{\text{system}}$$

.....(1)

$$mu + 0 = (m + M)V$$

$$V = \frac{mu}{m + M}$$

2. Initial velocity of the bullet in terms of h

By the conservation of mechanical energy

$(T.E \text{ of system }) \text{ Just after collision } = (T.E \text{ of system}) \text{ At height } h$

$$\frac{1}{2}(m + M)V^2 = (m + M)gh$$

$$V = \sqrt{2gh}$$

Equating (1) and (2)

We get $V = \sqrt{2gh} = \dfrac{mu}{m + M}$

$$u = \left(\frac{m + M}{m}\right)\sqrt{2gh}$$

So, the answer is -

$$\frac{m + M}{m}\sqrt{2gh}$$

Q. 34   compressibility is equal to

Option 1:
Bulk modulus

Option 2:
Reciprocal of bulk modulus

Option 3:
Square of bulk modulus

Option 4:
none of the above

Correct Answer:
Reciprocal of bulk modulus

Solution:
As we have learned

Compressibility -

Reciprocal of Bulk Modulus

- wherein

It is denoted by

$$C = \frac{1}{K}$$

Compressibility C = 1/K

Q. 35   A spherical condenser has inner and outer spheres of radii a and b respectively. The space between the two is filled with air. The difference between the capacities of two condensers formed when outer sphere is earthed and when inner sphere is earthed will be

Option 1:
zero

Option 2:
$4\pi\varepsilon_0 a$

Option 3:
$4\pi\varepsilon_0 b$

Option 4:
$4\pi\varepsilon_0 a\left(\dfrac{b}{b-a}\right)$

Correct Answer:
$4\pi\varepsilon_0 b$

Solution:
As we have learned

Capacitance -

$$C = 4\pi\epsilon_0 \frac{ab}{b-a}$$

$$C = \frac{ab}{b-a} \quad (C.G.S)$$

-

Capacity when outer sphere is earthed

$$C_1 = 4\pi\varepsilon_0 \frac{ab}{b-a}$$

Capacity when inner sphere is earthed   Difference in capacity $= C2 - C1 = 4pe0b$

Q. 36   A convex lens of focal length $20\ cm$ produces images of the same magni cation 2 when an object is kept at two distances $x_1\ and\ x_2(x_1 > x_2)$ from the lens . The ratio of $x_1\ and\ x_2$ is :

Option 1:
$2 : 1$

Solution:

Thin lens formula -

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

- wherein

$u \; and \; v$ are object and image distance from lens.

By using lens formula

$$\frac{1}{2X_1} - \frac{1}{-X_1} = \frac{1}{20}$$

$$\Rightarrow X_1 = 30$$

$$\frac{1}{-2X_2} - \frac{1}{-X_2} = \frac{1}{20}$$

$$\Rightarrow X_2 = 10$$

$$\Rightarrow X_1 : X_2 = 30 : 10 = 3 : 1$$

Q. 37   The ratio of the dimensions of Plank's constant and that of the moment of inertia is the dimension of :

Option 1:
frequency

Option 2:
velocity

Option 3:
angular momentum

Option 4: time

Solution:
As we have learnt in

Plank's Constant (h) -

$$M^1L^2T^{-1}$$

- wherein

Joule-sec

And as we know I=moment of inertia

so I has dimention M^1L^2

and Plank's constant (h) has dimention $M^1L^2T^{-1}$

So the $\dfrac{h}{I}$ will have dimention T^{-1}

which is dimention of $frequency$

Q. 38 At a point 20 *cm* from the centre of a uniformly charged dielectric sphere of radius 10 *cm*, the electric field is 100 *V/m* The electric field at 3 *cm* from the centre of the sphere will be

Option 1:
150 V/m

Option 2:
125 V/m

Option 3:
120 V/m

Option 4:
Zero

Correct Answer:
120 V/m

Solution:
As we had learnt in

If P lies inside -

$$E_{in} = \frac{1}{4\pi\epsilon_0}\frac{Qr}{R^3} \quad V_{in} = \frac{Q}{4\pi\epsilon_0}\frac{3R^2 - r^2}{2R^3}$$

$$E_{in} = \frac{\rho r}{3\epsilon_0} \qquad V_{in} = \frac{\rho \left(3R^2 - r^2\right)}{6\epsilon_0}$$

-

Electric eld outside of the sphere= $E_{out} = \dfrac{KQ}{r^2}$ .....(i)

Electric eld inside the dielectric sphere= $E_{in} = \dfrac{KQx}{R^3}$ ...(ii)

From (i) and (ii), $E_{in} = E_{Out} \dfrac{r^2 x}{R^3}$

At 3 cm $E_{in} = 100\dfrac{20^2 x}{10^3} = 120V/m$

Q. 39   A particle of charge q and mass m moves in a circular orbit of radius r with angular speed ω. The ratio of the magnitude of its magnetic moment to that of its angular momentum depends on

Correct Answer:
q and m

Solution:
As we learnt in

Magnetic moment (M) -

M=NiA

- wherein

N-number of turns in the coil

i-current throughout the coil

A-area of the coil

Magnetic moment $= I.A. = \frac{q}{T}.A$

$= \frac{q\omega}{2\pi}.\pi r^2 = \frac{1}{2}q\omega r^2$

angular momentum $= mr^2\omega$

$\therefore \frac{magnetic\ moment}{Angular\ momentum} = \frac{\frac{1}{2}q\omega r^2}{mr^2\omega} = \frac{q}{2m}$

Q. 40   Two charge +q and -q are situated at a certain distance. At the point exactly midway between them

Option 1:
Electric field and potential both are zero

Option 2:
Electric field is zero but potential is not zero

Solution:
As we learned

If at any point E = 0 -

V = constant

-

At O, $E \neq 0$, $V = 0$
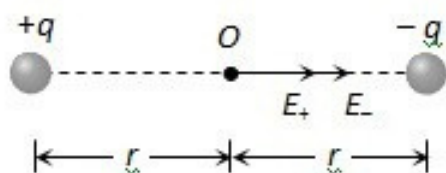
Chemistry

Q. 1   In manufacture of NH3 promoter is –

Option 1:
Fe

Option 2:
Cr

Option 3:
Mo

Option 4:
Mn

Correct Answer:
Mo

Solution:
As we have learnt,

Manufacture of ammonia by Haber's process -
Mixture of pure N2 and H2 (ration 1:3 by volume) passed over nely divided Fe (catalyst) and Mo (promoter)

$$N_2 + 3H_2 \xrightarrow[Mo(Promotor)]{Fe(Catalyst)} 2NH_3$$
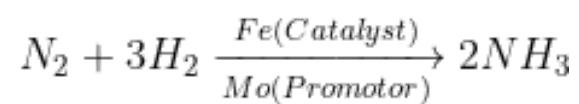
Therefore, option (3) is correct.

Q. 2   In the estimation of Bromine by carius method, the Bromine of organic compound is converted into,

Option 1:
Silver nitrate

Option 2:
Silver Bromide

Option 3:
Silver Sulphate

Option 4:
Silver Oxide

Correct Answer:
Silver Bromide

Solution:
As we learnt

Test for Bromine -

Yellowish ppt is obtained.

- wherein

Sparingly soluble in NH4OH con rm the presence of bromine.

In Carius method, estimation of halogens is carried out by converting the halogen in organic compound into silver halide

Q. 3   The process of separation of colloids by passing through a semipermeable membrane is called

Option 1:
 ltration

Option 2:
electrophoresis

Option 3:
Dialysis

Option 4:
ultra- ltration

Solution: Dialysis: It is the process of removing a dissolved substance from a colloidal solution by means of di usion through a suitable
membrane. Since particles (ions or smaller molecules) in a true solution can pass through the animal membrane (bladder) or parchment paper or cellophane sheet but not the colloidal particles, the membrane can be used for dialysis. The apparatus used for this purpose is called dialyser.

So, Option 3 is correct.

Q. 4   The following compound is
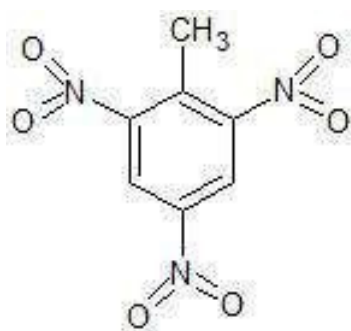
Option 1:
RDX

Option 2:
Trinitroglycerine

Option 4:
Trinitrotoluene

Correct Answer:
Trinitrotoluene

Solution:
As we have learned

Nitro Compounds -

In nitro compounds nitrogen atom is directly linked to a carbon of an alkyl or aryl group.

- wherein

R—NO₂ Aliphatic nitro compound
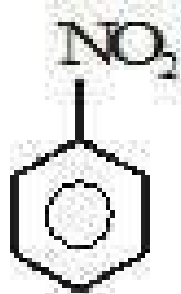
Aromatic nitro compound

The structure is that of the explosive TNT with military, industrial and mining application.

Therefore, Option(4) is correct

Q. 5   Chlorophyll and hameoglobin is complex of _____and _____ respectively.

Option 1:
Mg^{2+} and Ca^{2+}

Option 2:
Na+ and K+

Option 3:
Mg^{2+} and $4Fe^{2+}$

Option 4:
Cl- and Fe^{2+}

Correct Answer:
Mg^{2+} and $4Fe^{2+}$

Solution:
As we leran

Complex formation by alkaline earth metals -

Substantially greater tendency to form complex

- wherein

This tendency is greater in beryllium due to small size of Be^{2+}

Chlorophyll has Mg^{2+} ion and haemoglobin has Fe^{2+}

Complex formation by alkaline earth metals -

Substantially greater tendency to form complex

- wherein

This tendency is greater in beryllium due to small size of Be^{2+}

Q. 6   Which one of the following molecules is polar ?

Option 1:

XeF_4

Option 2:

IF_5

Option 3:

SbF_5

Option 4:

CF_4
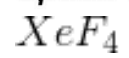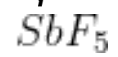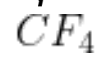
Q. 7   Boron cannot form which one of the following anions?

Option 1:

BF_6^{3-}

Option 2:

BH_4^-

Option 3:

$B(OH)_4^-$
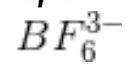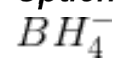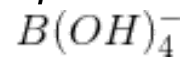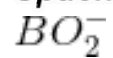
Correct Answer:
BF_6^{3-}
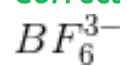
Solution:
As we have learnt,

 Boron cannot expand its octet due to non availability of d-orbitals. Maximum covalence cannot exceed 4.

Due to absence of low lying vacant d orbital in B, $sp^3 d^2$ hybridization is not possible hence BF_6^{3-} will not formed.

Therefore, option (1) is correct

Q. 8   Chlorination of P4O6 gives -

Option 1:
PCl5

Option 2:
PCl3

Option 3:
POCl3

Solution:
As we have learnt,

Reaction of phosphorus trioxide with chlorine -

Form a mixture of phosphoryl chloride and meta phosphoryl chloride

- wherein

$$P_4O_6 + 4Cl_2 \rightarrow 2POCl_3 + 2PO_2Cl$$

$$P_4O_6 + 6Cl_2 \rightarrow 4POCl_3 + O_2$$
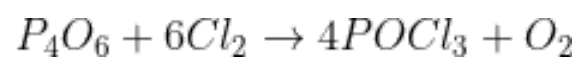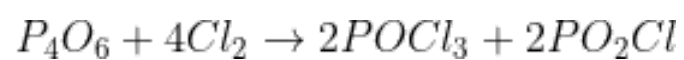
Q. 9   Identify the correct labels A. B and C in the following graph from the options given below:
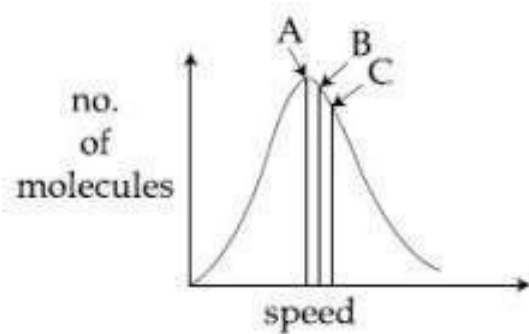
speed

Root mean square speed (V_{rms}) ; most probable speed (V_{mp}), Average speed (V_{av})

Option 1:
A - (V_{mp}), B- (V_{av}), C-(V_{rms})

Option 2:
A - (V_{mp}), B- (V_{rms}) , C-(V_{rms})

Option 3:
A - (V_{av}), B-(V_{rms}) ,C- (V_{av})

Option 4:
A - (V_{rms}) ,B- (V_{mp}), C- (V_{av})

Correct Answer:
A - (V_{mp}), B- (V_{av}), C-(V_{rms})

Solution:

Relation between u av, ump and urms

The three types of molecular speeds, namely, most probable speed(v_{mp}), average speed (v_{av}) and root mean square speed(v_{rms}) of a gas at a given temperature are related to each other as follows:

$$v_{mp} : v_{av} : v_{ms} = \sqrt{\frac{2RT}{M}} : \sqrt{\frac{8RT}{\pi M}} : \sqrt{\frac{3RT}{M}}$$
$$v_{mp} : v_{av} : v_{rms} = 1.414 : 1.596 : 1.732$$
$$v_{mp} : v_{av} : v_{rms} = 1 : 1.128 : 1.224$$

For a particular gas, at a particular temperature:

vmp < vav < vrms

It follows from the above relationship that:
Average speed(vav) =0.921 x Root mean square speed(vrms)
Most probable speed(vmp) = 0.817 x Root mean square speed(vrms)

CRMS > CAverage > CMPS.

A - VMPS, B - VAverage , C - VRMS

Therefore, Option(1) is correct.

Q. 10   What is the geometry of $\left[Ag(NH_3)_2\right]^+$?

Option 1:
tetrahedral

Option 2:
square planar

Option 3:
bent

Option 4:
linear

Correct Answer:
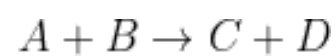linear

Solution:
As we learnt

Test of Silver ion -

$$AgCl + NH_3 \rightarrow [Ag(NH_3)_2]Cl$$

$$Ag(NH_3)_2Cl \overset{acid}{\rightarrow} AgCl \ (white \ ppt)$$
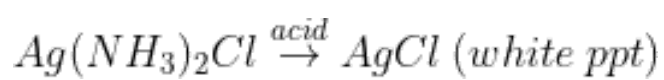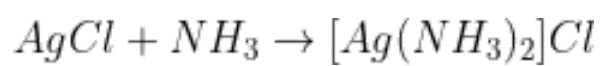
- wherein

White ppt of AgCl indicates the presence of Ag^+

$Ag(NH_3)_2^+ \Rightarrow [NH_3 \rightarrow Ag \leftarrow NH_3]a$

It has linear geometry.

Q. 11   Consider the given plot of enthalpy of the following reaction between A and B.

$$A + B \rightarrow C + D$$

Identify the incorrect statement.
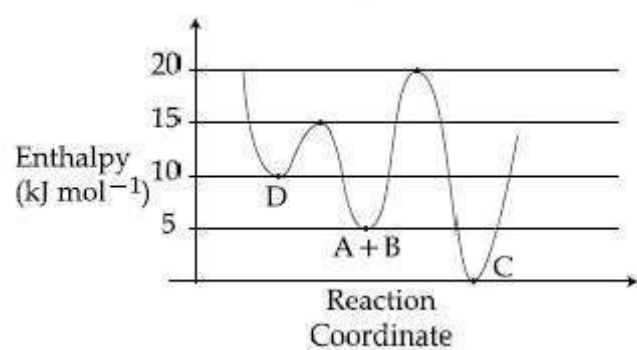
Option 1:
Activation enthalpy to form C is 5 kJmol^{-1} less than that to form D.

Option 2:
C is the thermodynamically stable product.

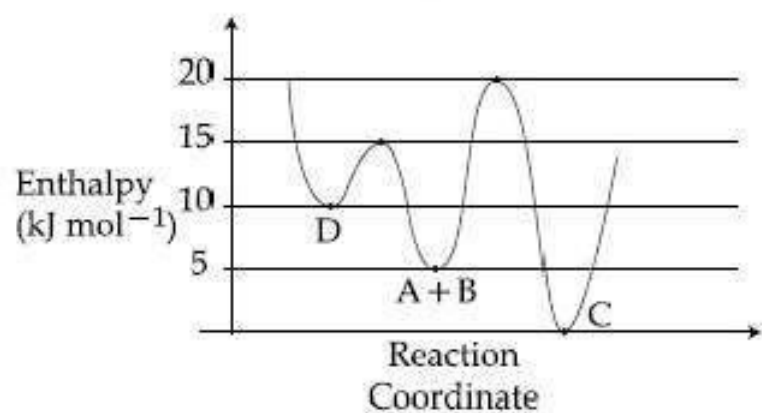## Option 3:
D is kinetically stable product .

Option 4:
Formation of A and B from C has the highest enthalpy of activation.

Correct Answer:
Activation enthalpy to form C is 5 kJmol^{-1} less than that to form D.

Solution:
The given plot-

From the above plot,

EC (activation energy of C) = (20-5) kJ/mol= 15 kJ/mol

ED (activation energy of D) = (15-5) kJ/mol = 10 kJ/mol

So, Activation energy of C is 5 kJ/mol more than that of D.

Now,

Thermodynamic stability is the stability of the lowest energy state of a system while kinetic stability is the stability of the highest energy state of a system.

C is the lowest energy state and D is the highest energy state.

So, C is the thermodynamically stable product and D is a kinetically stable product.

Ea = 20 -0 = 20 kJ/mol (formation of A and B from C)
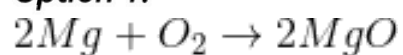
Ea = 15 -10 = 5 kJ/mol (formation of A and B from D)

So, Formation of A and B from C has highest enthalpy of activation
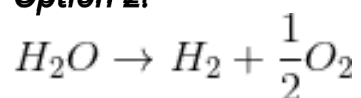
Only statement 1 is incorrect.

Hence, option number (1) is correct.

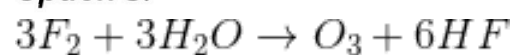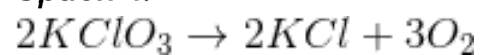Q. 12   Which of the following is a combination reaction?

Option 1:
$2Mg + O_2 \rightarrow 2MgO$

Option 2:
$H_2O \rightarrow H_2 + \frac{1}{2}O_2$

Option 3:
$$3F_2 + 3H_2O \rightarrow O_3 + 6HF$$

Option 4:
$$2KClO_3 \rightarrow 2KCl + 3O_2$$

Correct Answer:
$$2Mg + O_2 \rightarrow 2MgO$$
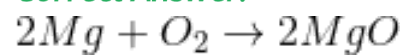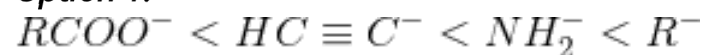
Solution:
Combination Reaction
These types of reactions are the opposite of decomposition reactions and hence involve the combination of two compounds to form a single compound.

$2Mg + O_2 \rightarrow 2MgO$ is the only combination reaction among the given.
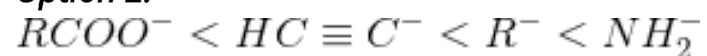Therefore,option(1) is correct.

Q. 13   The correct order of increasing basicity of the given conjugate bases (R = CH3) is
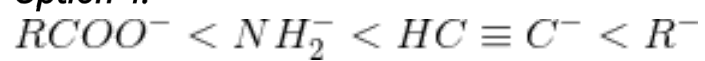
Option 1:
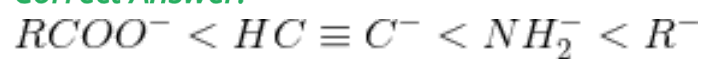$$RCOO^- < HC \equiv C^- < NH_2^- < R^-$$

Option 2:
$$RCOO^- < HC \equiv C^- < R^- < NH_2^-$$

Option 3:

$R^- < HC \equiv C^- < RCOO^- < NH_2^-$

Option 4:

$RCOO^- < NH_2^- < HC \equiv C^- < R^-$

Correct Answer:

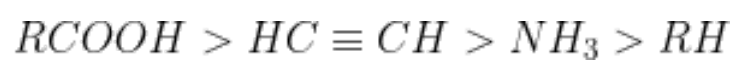$RCOO^- < HC \equiv C^- < NH_2^- < R^-$

Solution:
Bronsted-Lowry Acids and Bases

According to this concept, an acid and a base can de ne as follows :
Acid: It is a substance that can donate a proton.
Base: It is a substance that can accept a proton.

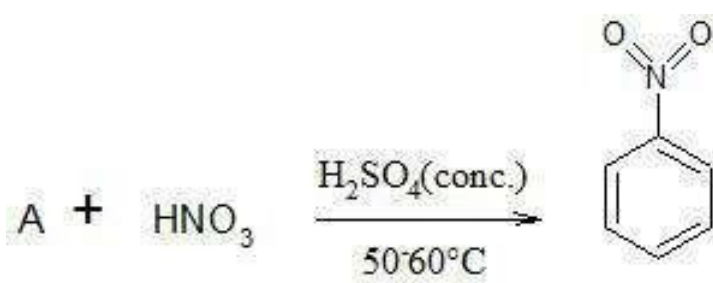Stronger acids have a weaker conjugate base.

acidity order :

$RCOOH > HC \equiv CH > NH_3 > RH$

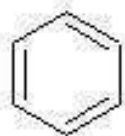So basicity order : $RCOO^- < HC \equiv C^- < NH_2^- < R^-$

Therefore, option number (1) is correct.

Q. 14

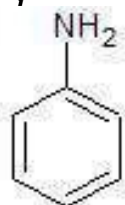$$A \ + \ HNO_3 \xrightarrow[\text{50-60°C}]{\text{H}_2\text{SO}_4\text{(conc.)}}$$

A is :

Option 1:

Option 2:
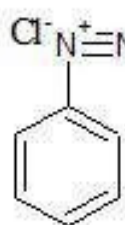
Option 3:

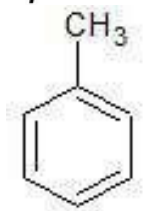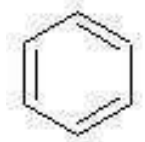*Option 4:*

Correct Answer:

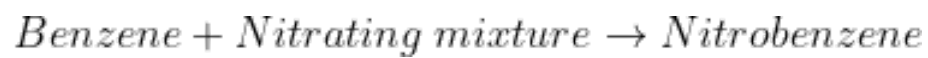
Solution:
As we have learned

Preparation of Nitrobenzene medium -

It is prepared by nitration of benzene by nitrating mixture conc. HNO3 and conc. H2SO4. At $50 - 60°C$

- wherein

$$Benzene + Nitrating\ mixture \rightarrow Nitrobenzene$$

Benzene can be nitrated with a mixture of concentrated nitric acid and concentrated sulphuric acid at temprature below 600 C

Q. 15   Statement 1 -> A fractional order reaction must be a complex reaction.

Statement 2-> Fractional order of ROS equal to overall order of a complex reaction.

Option 1:
Statement-1 is true, statement-2 is true and statement-2 is not the correct explanation for statement-1.

Option 2:
Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

Option 3:
Statement-1 is true, statement-2 is false

Option 4:
Statement-1 is false, statement-2 is true

Correct Answer:
Statement-1 is true, statement-2 is false

Solution:

Reaction Coordinate -

The reaction coordinate is the collection of motions such as changes in inter-atomic distances and bond angles and distortions that are directly involved in product formation.

Answer is (c).

Q.16   How many EDTA (ethylenediaminetetraacetic acid) molecules are required to make an octahedral complex with a Ca^{2+} ion ?

Option 1:
Six

Option 2:
Three

Option 3:
One

Option 4:
Two

Correct Answer:
One

Solution:

As we discussed in the concept

Spectrochemical series -

$$I^- < Br^- < SCN^- < Cl^- < S^{2-} < F^- < OH^- < C_2O_4^{2-} < H_2O < EDTA < NH_3 < en < Cn^- < CO$$

-
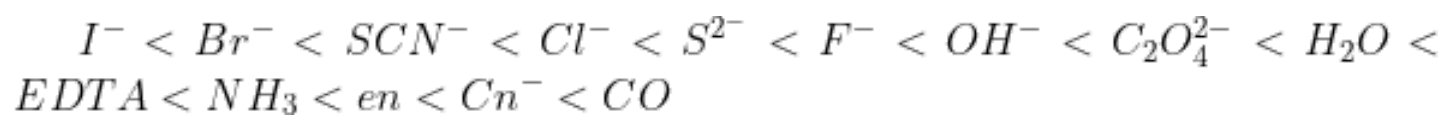
$EDTA^{4-}$ is a hexadentate ligand so far oetahedral complex only one $EDTA^{4-}$ ligand is required.

Q. 17   Morphine an alkaloid is

Option 1:
Anaesthetic

Option 2:
Analgesic

Option 3:
Antiseptic

Option 4:
Antibiotic

Solution:
As we learnt in

Narcotic analgesics -

Their chronic use leads to addiction. These are mainly opium and its products like morphine , codeine and heroin

- wherein

In high dooses cause unconsciousness

Morphine is a narcotic analgesic.

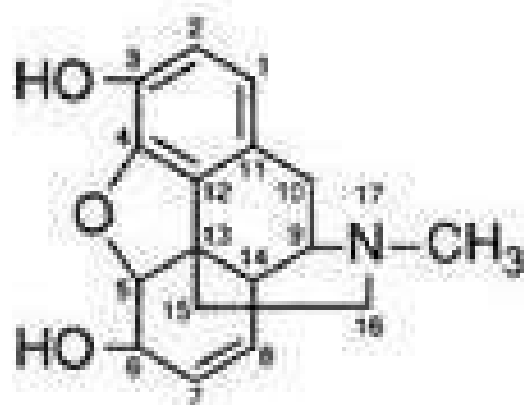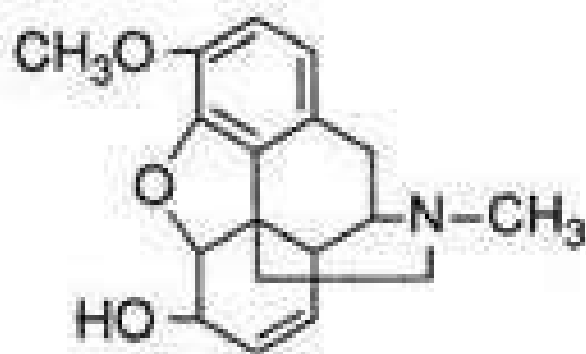Q. 18   Which of the following substances would make better permanent magnets?

Option 1:
Ferromagnetic materials

Option 2:
Ferrimagnetic materials

Option 3:
Diamagnetic materials

Option 4:
Paramagnetic materials

Correct Answer:
Ferromagnetic materials

Solution:
Ferromagnetic materials have higher curie temperature than other types of magnetic materials.
Basically, in ferromagnetic materials, metals ions randomly oriented in small regions known as domains. When a magnetic eld is applied on these domains, they get oriented in the direction of the magnetic eld and thus these materials become permanent magnets.
Option (a) is correct

Q. 19   28 g N2 and 6 g H2 were mixed. At equilibrium 17 g NH3 was formed. The mass of N2 and H2 of equilibrium are

Option 1:
11 g , zero

Option 2:
1 g , 3 g

Option 3:
14 g , 3 g

Option 4:
11 g , 3 g

Correct Answer:
14 g , 3 g

Solution:
As we learnt in

Law of Chemical equilibrium -

At a given temperature, the product of concentration of the reaction products raised to the respective stoichiometric coe cient in the balanced chemical equation divided by the product of concentration of the reactants raised to their individual stoichiometric coe cients has a constant value.

- wherein

$$aA + bB \rightleftharpoons cC + dD$$
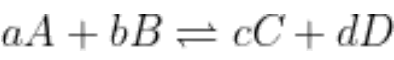
$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

$$[A], \ [B], \ [C] \ [D]$$

are equilibrium concentration

The reaction goes as follows:

$$N_2 + 3H_2 \ = \ 2NH_3$$
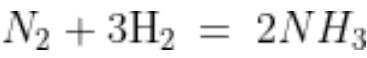
t = 0   1   3   0

At equilibrium   1/2   3/2   1

$$\therefore \ Mass \ of \ N_2 \ at \ equilibrium \ = \ 28 \times \frac{1}{2} \ = \ 14 \ g$$

$$\therefore \ Mass \ of \ H_2 \ at \ equilibrium \ = \ 2 \times \frac{3}{2} \ = \ 3 \ g$$

Q. 20
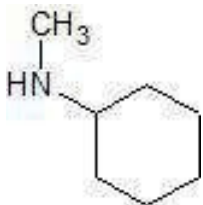
The IUPAC name of the above compound is :

Option 1:
N- methylcyclohexaneamine

Option 2:
N-cyclohexanemethylamine

Option 3:
Methylcyclohexaneamine

Option 4:
cyclohexanemethylamine

Correct Answer:
N- methylcyclohexaneamine

Solution:
As we have learned

Nomenclature of Secondary Amines -

As per IUPAC system secondary amines are named as N alkylalkanamines where alkyl is smaller group and alkane is larger group.

- wherein

CH₃CH₂NHCH₃
N-Methylethanamine
(Ethylmethylamine)

(CH₃CH₂)₂NH
N-Ethylethanamine
(Diethylamine)

—NHCH₃
N-Methylcyclohexanamine
(Cyclohexylmethylamine)

As per IUPAC system , secondary amines are named as N Alkylamines where alkyl is smaller group and the alkane is the larger groups

Q. 21   An ionic compound has a unit cell consisting of A ions at the corners of a cube and B ions on the centres of the faces of the cube. The empirical formula for this compound would be

Option 1:
AB

Option 2:
A_2B

Option 3:
AB_3

Correct Answer:

AB_3

Solution:
As we learnt in

No. of atoms(z) for face centered unit cell -

Lattice points: at corners and face centers of unit cell.

For face centered cubic (FCC), z=4.
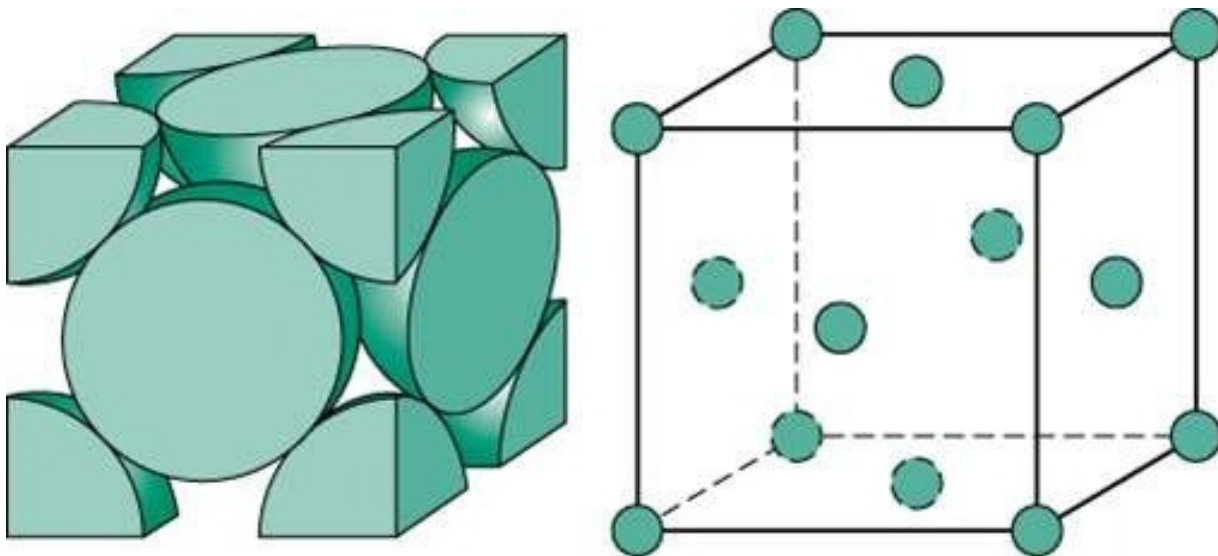
- wherein

No. of atoms(z) for simple cubic unit cell -

Lattice points: at corners

For simple cubic (SC), z=1

- wherein
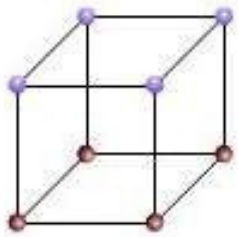
Number of A ions per unit cell $= \dfrac{1}{8} \times 8 = 1$

Number of B ions per unit cell $= \dfrac{1}{2} \times 6 = 3$

$Empirical\ formula\ = AB_3$

Correct option is 3.

Q. 22   Which of the following emits light when exposed to oxy – hydrogen flame?

Option 1:
$Ca(OH)_2$

Option 2:
$Ca(HCO_3)_2$

Option 3:
$CaCO3$

Option 4:
CaO

Solution:
CaO when exposed to oxy – hydrogen flame emits light known as lime light.

Therefore, option(4) is correct.

Q. 23   Which of the following expression is used for the detection of percentage of carbon?

Option 1:
$$\frac{2 * mass\ of\ H_2O * 100}{18 * mass\ of\ O.C}$$

Option 2:
$$\frac{28 * vol\ of\ N_2\ at\ STP}{224 * mass\ of\ O.C}$$

Option 3:
$$\frac{15 * N * N}{Mass\ of\ O.C}$$

Option 4:
$$\frac{12 * mass\ of\ CO_2 * 100}{44 * mass\ of\ O.C}$$

$$\frac{12 * mass \ of \ CO_2 * 100}{44 * mass \ of \ O.C}$$

Solution:
As we learnt

Quantitative analysis of Carbon -

$$percentage \ of \ carbon = \frac{12 \times m_{2 \times 100}}{44 \times m}$$

- wherein

$m_2 = Mass \ of \ CO_2 \ produced$

$m = Mass \ of \ organic \ compounds$

Q. 24   Consider the gure and mark the correct option
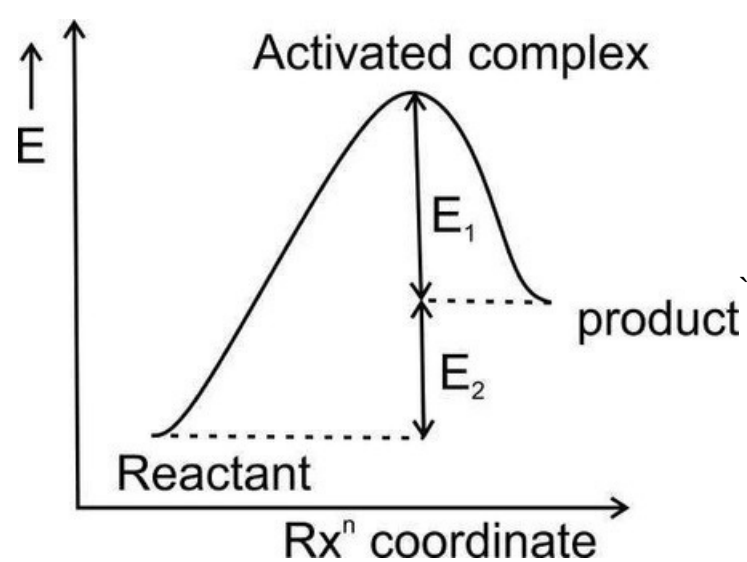
Option 1:
Activation energy of forward reaction is $E_1 + E_2$ and product is less stable than reactant.

Option 2:
Activation energy of forward reaction is $E_1 + E_2$ and product is more stable than reactant.

Option 3:
Activation energy of both forward and backward reaction is $E_1 + E_2$

Option 4:
Activation of backward reaction is E_2 and forward reaction is E_1

Solution:
The given gure is -
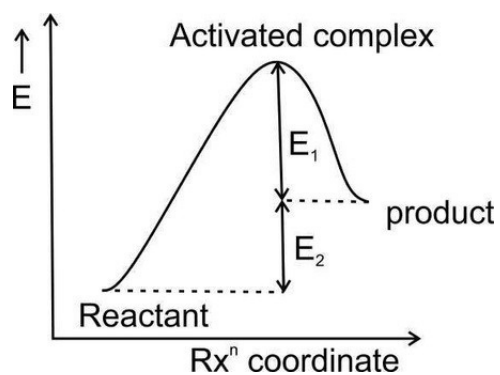
From above graph,

$$\text{Activation energy of forward reaction } = E_1 + E_2$$

$$\text{Activation energy of backward reaction } = E_1$$

Here, Product energy is more than reactant energy. So, the reactant is more stable than the product.

Therefore, option(1) is correct

Q. 25   According to molecular orbital theory, which of the following is true with respect to Li_2^+ and Li_2^-?

Option 1:
Li_2^+ is unstable and Li_2^- is stable

Option 2:
Li_2^+ is stable and Li_2^- is unstable

Option 3:
Both are stable

Option 4:
Both are unstable

Correct Answer:
Li_2^+ is stable and Li_2^- is unstable

Solution:
$$Li_2^+ \rightarrow 5_e^-, \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^1$$

$$Li_2^- \rightarrow 7_e^-, \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^1$$
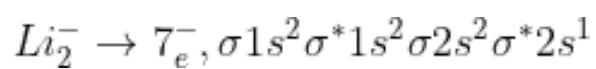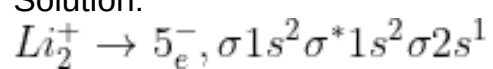
B.O. of $Li_2^+ = \dfrac{3-2}{2} = \dfrac{1}{2}$

B.O. of $Li_2^- = \dfrac{4-3}{2} = \dfrac{1}{2}$

Both have the same bond order.

stability depends upon the number of electrons present in bonding and anti-bonding orbitals.

To attain stability, the number of electrons present in the bonding orbital should be more than the number of electrons present in an antibonding orbital.

Li_2^+ has 2 antibonding and Li_2^- has 3 antibonding electrons.

So, Li_2^+ is stable and Li_2^- is unstable

Therefore, Option(2) is correct

Q. 26   All of the following share the same crystal structure excepts.

Option 1:
LiCl

Option 2:
NaCl

Option 3:
RbCl

Correct Answer:
CsCl

Solution:
As we learnt in

No. of atoms(z) for face centered unit cell -

Lattice points: at corners and face centers of unit cell.

For face centered cubic (FCC), z=4.

- wherein
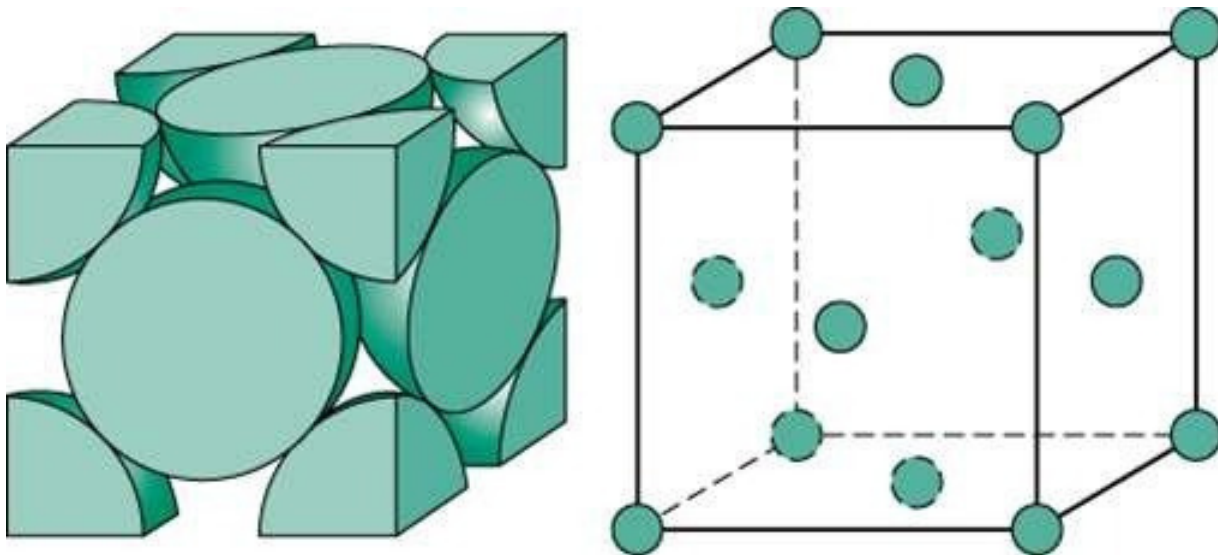
Structure of CsCl is di erent from LiCl, NaCl, RbCl.

Q. 27   White phosphorus is prepared by a reaction of P4O10 with

Option 1:
Mg

Option 2:
Si

Option 3:
C

Option 4:
N2

Correct Answer:
C

Solution:
White phosphorus can be prepared from P_4O_{10} by reduction with coke

$$P_4O_{10} + 10C \xrightarrow{\Delta} P_4 + 10CO$$
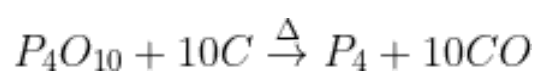
Therefore, option (3) is correct.

Q. 28   The number of $p\pi - p\pi$ bond in C_2H_2 is

Option 1:
1

Option 2:
2

Option 3:
3

Option 4:
4

Correct Answer:
2

Solution:
As we learnt

Important feature of the rst member of a group -

Greater ability to form $p\pi - p\pi$ multiple bonds to itself and to their second row elements

- wherein

E.g. $C = C, C \equiv C, O = O, C \equiv O, C = N, N \equiv O$

There are 2 $p\pi - p\pi$ bonds

Q. 29   Among the following, the INCORRECT statement about colloids is:

Option 1:
They can scatter light.

Option 2:
They are larger than small molecules and have high molar mass.

Option 3:
The osmotic pressure of a colloidal solution is of a higher order than the true solution at the same concentration.

Option 4:
The range of diameters of colloidal particles is between 1 and 1000 nm.

Correct Answer:
The osmotic pressure of a colloidal solution is of a higher order than the true solution at the same concentration.

Solution:
Colloidal particles being bigger aggregates, the number of particles in a colloidal solution is comparatively small as compared to a true solution. Hence, the values of colligative properties (osmotic pressure, lowering in vapour pressure, depression in freezing point and elevation in boiling point) are of small order as compared to values shown by true solutions at same concentrations

Hence, the answer is Option (3)

Q. 30   For an elementry chemical reation $A_2 \xrightarrow[k_{-1}]{k_1} 2A$ the expression for $\dfrac{d\,[A]}{dt}$ is:

Option 1:
$2k_1\,[A_2] - 2k_{-1}\,[A]^2$

Option 2:
$k_1\,[A_2] + 2k_{-1}\,[A]^2$

Option 3:
$2k_1\,[A_2] - k_{-1}\,[A]^2$

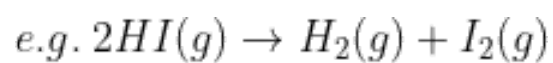**Option 4:**
$k_1\,[A_2] - k_{-1}\,[A]^2$

Correct Answer:
$2k_1\,[A_2] - 2k_{-1}\,[A]^2$

Solution:

Rates in presence of stoichiometry of reactants/products -

When stoichiometry coe cients of reactants/ products are not equal to one, the rate of disappearance of & the rate of appearance of products is divided by their respective stoichiometric coe cients

- wherein

$$e.g.\ 2HI(g) \rightarrow H_2(g) + I_2(g)$$

$$r = \frac{-1}{2} \cdot \frac{d}{dt}[HI]$$

$$= \frac{+d}{dt}[H2] = \frac{+d}{dt}[I_2]$$

Q. 31   A rigid close container contains an ideal gas at 27oC temperature and 2 atm pressure , if temperature raised to 127oC then nd the nal pressure of gas

Option 1:
2 atm

Option 2:
1.66 atm

Correct Answer:
2.66 atm

Solution:
As we learnt in

Gay Lussac's Law -

Pressure -Temperature Relationship

- wherein

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

According to Gay Lussac's law $P \, \alpha \, T$

$$\frac{P_1}{P_2} = \frac{T_1}{T_2}$$

$P_1 = 2\,atm$

$T_1 = 27 + 273 = 300\,k$

$T_2 = 127 + 273 = 400\,k$

$P_2 =?$

$$\frac{2}{P_2} = \frac{300}{400}$$

$$P_2 = \frac{800}{300} = 2.66\,atm$$

Q. 32   Two asks of equal volume are connected by a narrow tube (of negligible volume) all at 27º C and contain 0.70 moles of H2 at 0.5 atm. One of the ask is then immersed into a bath kept at 127º C, while the other remains at 27º C.

The number of moles of H2 in ask 1 and ask 2 are:

Option 1:
Moles in ask 1 = 0.4, Moles in ask 2 = 0.3

Option 2:
Moles in ask 1 = 0.2, Moles in ask 2 = 0.3

Option 3:
Moles in ask 1 = 0.3, Moles in ask 2 = 0.2

Solution:

To nd the number of moles of H2 in ask 1 and ask 2,

We can use PV = nRT

Two asks of equal volume, Let Vol. of each ask is 'V' L,

Total volume = V+V = 2V

Now. PV = nRT

So,

$$0.5 \times V = 0.7 \times R \times 300$$

$$V = 420R$$

In the 2nd case, the pressure will be the same in both asks and the sum of moles of gas will be 0.7. But Volume will be half 420R/2=210R

Now,

Flask 1-

PV=aRT

P X 210R=a X R X 300

a = 0.7P

Flask2-

PV=bRT

P X 210 R = b X R X 400

b = 0.525P

So,

a+b=1.225P=0.7

P=0.571atm

Now,

a = 0.7 X 0.571 = 0.399 = 0.4 moles

b = 0.525 X 0.571 = 0.299 = 0.3 moles

Q. 33   The bond order of NO is

Option 1:
3

Option 2:
2.5

Option 3:
2

Option 4:
1.5

Correct Answer:
2.5

Solution:
As we have learnt,

Nitric oxide -

NO (+2), colourless

- wherein

$N = O$
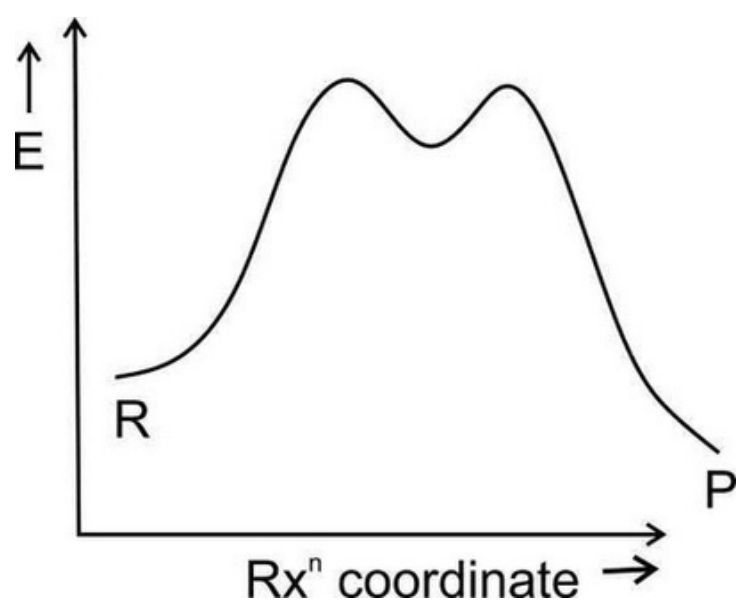
Bond Order of NO is 2.5

$$1s \Rightarrow \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2pz^2, \overset{\uparrow\downarrow}{\pi} 2px = \overset{\uparrow\downarrow}{\pi} 2py, \overset{\uparrow}{\pi^*} 2px = \pi^* 2py$$

Bond Order $= \dfrac{10 - 5}{2} = 2.5$

Q. 34   No. of transition state in given gure

Option 1:
1

Option 2:
2

Option 3:
3

Option 4:
4

Solution:
As we learnt

Transition State -

When the reacting molecules come to such a degree of closeness and distortion that a small further distortion sends them to product formation. This crucial con guration is called the Transition State.

Hence, the option number (2) is correct.

Q. 35   The number of bonds between sulphur and oxygen atoms in $S_2O_8^{2-}$ and the number of bonds between sulphur and sulphur atoms in rhombic sulphur, respectively, are:

Option 1:
$8 \ and \ 6$

Option 2:
4 and 6

Option 3:
8 and 8

Option 4:
4 and 8

Correct Answer:
8 and 8

Solution:
As we have learnt,

Sulphur - Allotropic Forms -

Sulphur forms numerous allotropes of which the yellow rhombic (α-sulphur) and monoclinic (β -sulphur) forms are the most important. The stable form at room temperature is rhombic sulphur, which transforms to monoclinic sulphur when heated above 369 K.

Rhombic sulphur (α-sulphur)
This allotrope is yellow in colour, m.p. 385.8 K and speci c gravity 2.06. Rhombic sulphur crystals are formed on evaporating the solution of roll sulphur in CS2. It is insoluble in water but dissolves to some extent in benzene, alcohol and ether. It is readily soluble in CS2

Monoclinic sulphur (β-sulphur) Its m.p. is 393 K and speci c gravity 1.98. It is soluble in CS2. This form of sulphur is prepared by melting rhombic sulphur in a
dish and cooling, till crust is formed. Two holes are made in the crust and the remaining liquid poured out. On removing the crust, colourless needle-shaped crystals of β-sulphur are formed. It is stable above 369 K and transforms into α-sulphur below it. Conversely, α-sulphur is stable below 369 K and transforms into β-sulphur above this. At 369 K both the forms are stable. This temperature is called transition temperature. Both rhombic and monoclinic sulphur have S8 molecules. These S8 molecules are packed to give di erent crystal structures. The S8 ring in both forms is puckered and has a crown shape. The molecular dimensions are given in the gure below.
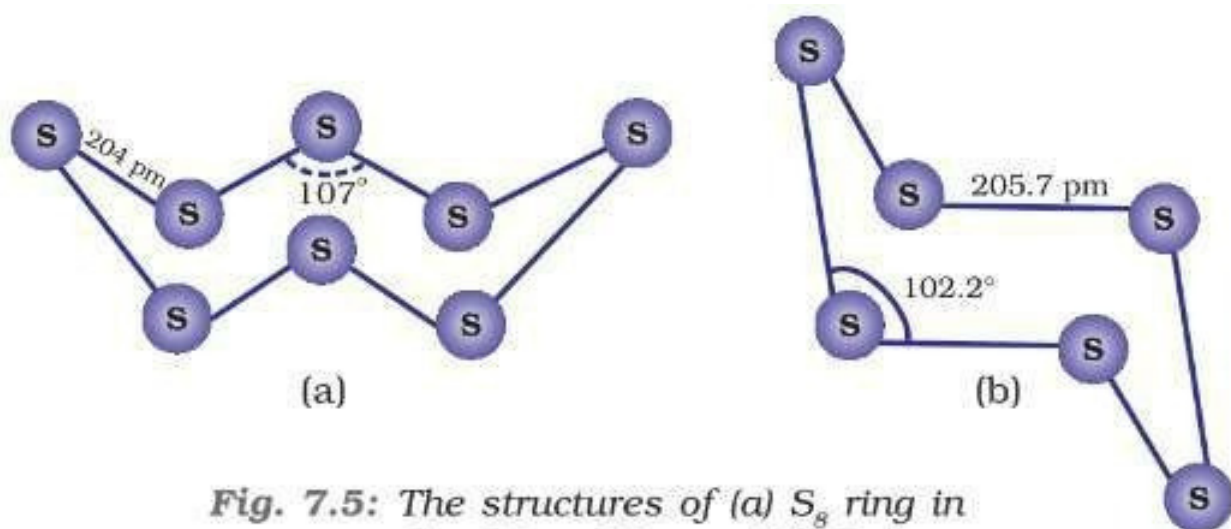

Fig. 7.5: The structures of (a) S_8 ring in rhombic sulphur and (b) S_6 form

Several other modi cations of sulphur-containing 6-20 sulphur atoms per ring have been synthesised in the last two decades. In cyclo-S6, the ring adopts the chair form and the molecular dimensions are as shown in the gure. At elevated temperatures (~1000K), S2 is the dominant species and is paramagnetic like O2.

-

The structure of S2O$_8^{2-}$ is given below:
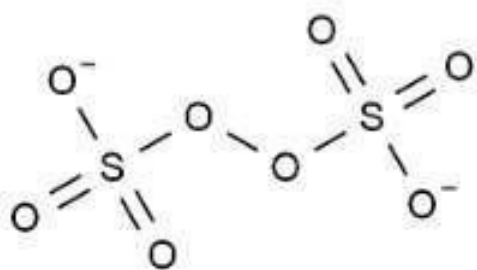
Rhombic sulphur
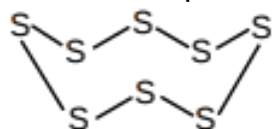
Thus, the number of S-S bonds is 8 and the number of S-O bonds is also 8.

Therefore, Option(3) is correct.

Q. 36   The major product of the following reaction is :
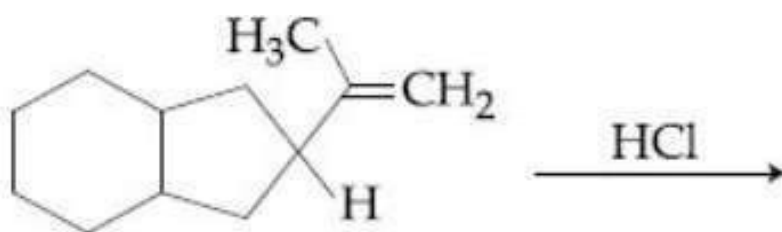
Option 1:
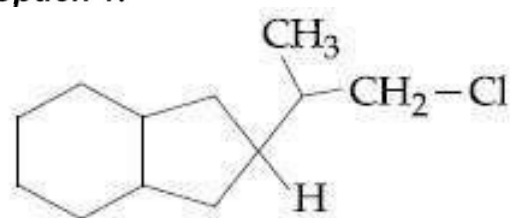
Option 2:
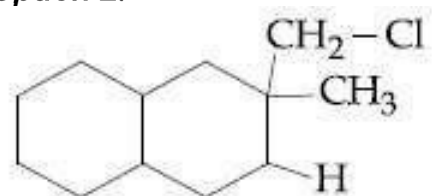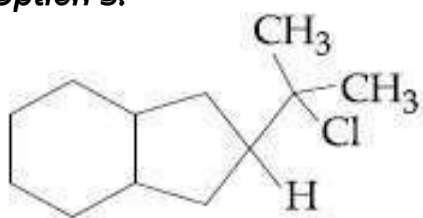
Option 3:

Option 4:
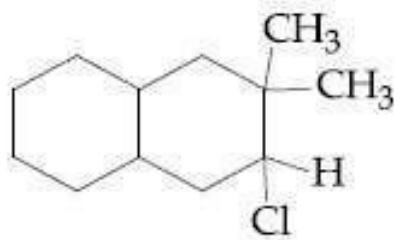
Correct Answer:
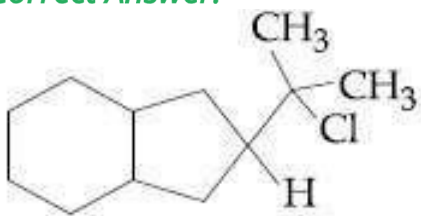
Solution:

Addition of Hydrogen Halide on alkene -

hydrogen halides add up to alkenes to form alkyl halides. The order of reactivity of the hydrogen halides is HI>HBr>HCl

- wherein
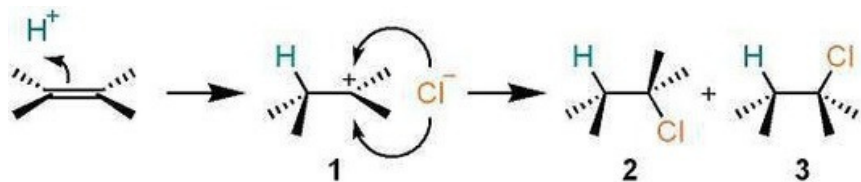
As we have learned when HCl is used as catalyst
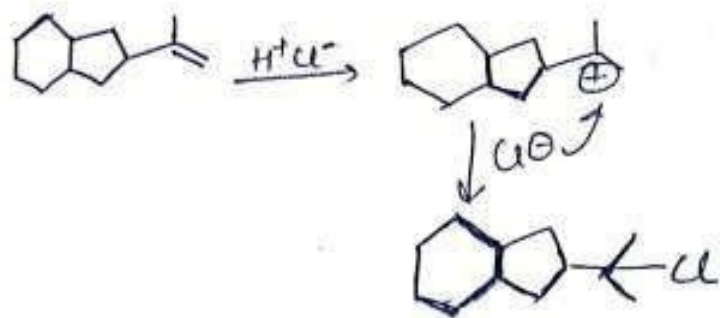
Q. 37   Sodium Carbonate can not be used in place of $(NH_4)_2CO_3$ for the identi cation of $Ca^{2+}, Ba^{2+}, and \ Sr^{2+}$ ions (in group V) during mixture analysis because :

Option 1:
Mg^{2+} ions will also be precipitated .

Concentration of CO_3^{2-} ions is very low .

Sodium ions will react with acid radicals .

Na^+ ions will interfere with the detection of $Ca^{2+}, Br^{2+}, Sr^{2+}$ ions .

Mg^{2+} ions will also be precipitated .

Q. 38   During con rmatory test of S^{2-} ion, purple colour appears due to presence of:

$Na_2[Fe(CN)_5NO]$

$Na_4[Fe(CN)_5NOS]$

$K_2[Fe(CN)_5NO]$

$Na_4[Fe(CN)_6]$

$$Na_4[Fe(CN)_5NOS]$$
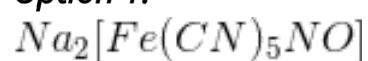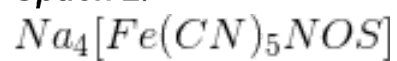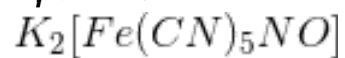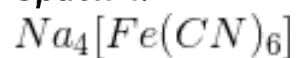
Solution:
As we learnt

Test of Sul de ion -

Add a Sodium nitroprusside solution in an alkaline midium

$$Na_2S + Na_2(Fe(CN)_5NO) \xrightarrow{NaOH} Na_4(Fe(CN)_6NOS) \; Purple$$
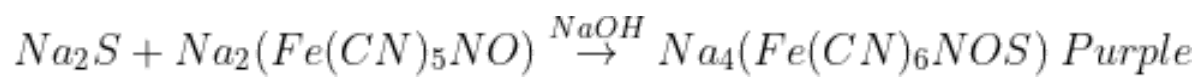
- wherein

Purple color con rm the presence of $\quad S^{2-}$

Purple color is due to the formation of

$$Na_4(Fe(CN)_6NOS)$$
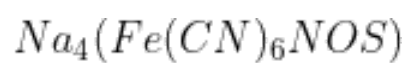
Q. 39   Pt and Pd adsorb large volumes of hydrogen under speci c conditions. The hydrogen that is adsorbed is called?

Option 1:
Adsorbed Hydrogen

Option 2:
Reductive hydrogen

Option 3:
Occluded hydrogen

Option 4:
Atomic hydrogen

Correct Answer:
Occluded hydrogen

Solution:
Adsorption of any gas on the metal surface is also sometimes referred to as occlusion. When hydrogen is adsorbed on a metal surface, then this hydrogen is known as occluded hydrogen.

Hence, the correct answer is Option (3)

Q. 40   Which of the following is correct?

Option 1:
CO is Lewis acid

Option 3:
CO is Lewis base

Option 4:
None of these

Correct Answer:
CO is Lewis base

Solution:

As we learn

Metal Carbonyls -

Compounds formed when CO reacts with metals when heated

- wherein

Due to the presence of lone pair, it acts as donor

CO has lone pair due to which it can donate it to metal and act as Lewis base to form metal carbonyls .

Therefore,o ption (3) is correct.

Maths

Q. 1 $\lim\limits_{x \to 0} \dfrac{\sqrt{1 - \cos 2x}}{\sqrt{2}\,x}$ is

Option 1:
1

Option 2:
-1

Option 3:
0

Option 4:
does not exist.

Correct Answer:
does not exist.

Solution:
As we learnt in

Evalution of Trigonometric limit -

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

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

$put \quad x = a + h \quad where \ h \to 0$

$Then \ it \ comes$

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

$$\therefore \quad \lim_{x \to 0} \frac{\sin x}{x} = 1 \quad and$$

$$\therefore \quad \lim_{x \to 0} \frac{\tan x}{x} = 1$$

-

$$\lim_{x \to 0} \frac{\sqrt{1 - \cos 2x}}{x\sqrt{2}}$$

$$\Rightarrow \lim_{x \to 0} \frac{\sqrt{2\sin^2 x}}{x\sqrt{2}}$$

$$\Rightarrow \lim_{n \to 0} \frac{\sqrt{2}}{\sqrt{2}} \cdot \frac{|\sin x|}{x}$$

for it is 1 0^+

for it is -1 0^-

So limit does not exist.

Q. 2 $f(x) = 2\sin^2 x + \cos^4 x - 3$ $x \epsilon R$

Find out the no. of solutions for f(x)=0

Option 1:
0

Option 2:
1

Option 3:
2

Option 4:
∞

Correct Answer:
0

Solution:

Trigonometric Functions of Acute Angles-

We can de ne the trigonometric functions in terms of an angle t and the lengths of the sides of the triangle. The adjacent side is the side closest to the angle, x. (Adjacent means "next to.") The opposite side is the side across from the angle, y. The hypotenuse is the side of the triangle opposite the right angle, 1.
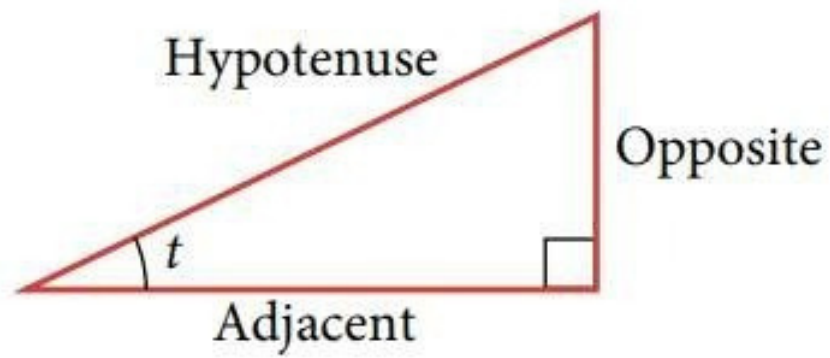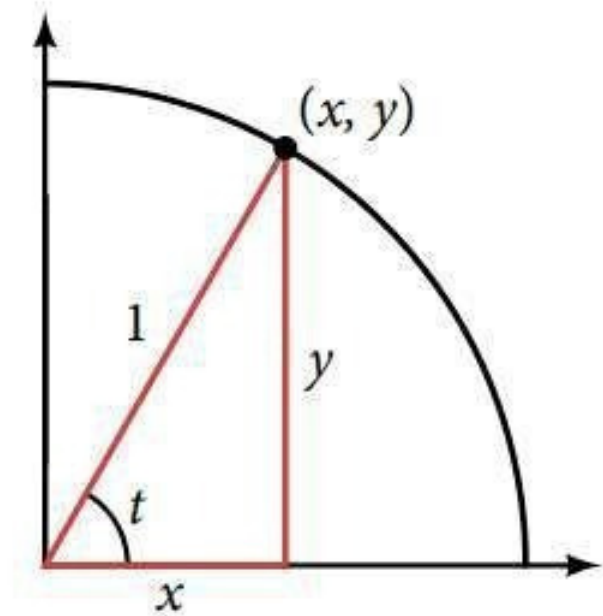
$$\text{Sine} \quad \sin t = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\text{Cosine} \quad \cos t = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\text{Tangent} \quad \tan t = \frac{\text{opposite}}{\text{adjacent}}$$

Reciprocal Function

In addition to sine, cosine, and tangent, there are three more functions. These too are de ned in terms of the sides of the

$$\text{Cosecant} \quad \csc t = \frac{\text{hypotenuse}}{\text{opposite}} = \frac{1}{\sin t}$$

triangle.
$$\text{Secent} \quad \sec t = \frac{\text{hypotenuse}}{\text{adjacent}} = \frac{1}{\cos t}$$

$$\text{Cotangent} \quad \cot t = \frac{\text{adjacent}}{\text{opposite}} = \frac{1}{\tan t}$$

Since, the hypotenuse is the greatest side in a right angle triangle, $\sin t$ and $\cos t$ can never be greater than unity and $\csc t$ and $\sec t$ can never by less than unity.

-

$$f(x) = 2\sin^2 x + \cos^4 x - 3 = 0 \qquad x \epsilon R$$
$$2\sin^2 x + \cos^4 x = 3$$
$$L.H.S < 3 \ for \ every \ x$$

Q. 3

If $\sin^{-1}(x - 1) + \cos^{-1}(x - 3) + \tan^{-1}\left(\dfrac{x}{2 - x^2}\right) = \cos^{-1} k + \pi$, then the value of k is equal to (Up to one

decimal point)

Option 1:

1

Option 2:

$-\dfrac{1}{\sqrt{2}}$

Option 3:

0.7

Option 4:

2

Correct Answer:

0.7

Solution:

Domains and Ranges of Inverse Trigonometric Functions -

For $\sin^{-1} x$

Domain $\in [-1, 1]$

Range $\in \left[-\dfrac{\pi}{2}, \dfrac{\pi}{2} \right]$

-

Domains and Ranges of Inverse Trigonometric Functions -

For $\cos^{-1} x$

Domain $\in [-1, 1]$

Range $\in [0, \pi]$

-

Domains and Ranges of Inverse Trigonometric Functions -

For $\tan^{-1} x$

Domain ϵR

Range $\epsilon \left[-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right]$

-

$\sin^{-1}(x-1) \Rightarrow -1 \leq x-1 \leq 1 \Rightarrow 0 \leq x \leq 2$

$\cos^{-1}(x-3) \Rightarrow -1 \leq x-3 \leq 1 \Rightarrow 2 \leq x \leq 4$

$\tan^{-1}\left(\dfrac{x}{2-x^2}\right) \Rightarrow x \in R, x \neq \sqrt{2},$

$\therefore x = 2$

$\sin^{-1}(2-1) + \cos^{-1}(2-3) + \tan^{-1}\dfrac{2}{2-4} = \cos^{-1} k + \pi$

$\sin^{-1} 1 + \cos^{-1}(-1) + \tan^{-1}(-1) = \cos^{-1} k + \pi$

$\dfrac{\pi}{2} + \pi - \dfrac{\pi}{4} = \cos^{-1} k + \pi$

$$\Rightarrow \cos^{-1} k = \frac{\pi}{4} \Rightarrow k = \frac{1}{\sqrt{2}}$$

Q.4   The volume of parallelopiped with its four vertices as $\vec{0}, \hat{i}, \hat{j}, \hat{k}$ is

Option 1:
$$\frac{1}{6}$$

Option 2:
$$\frac{1}{3}$$

Option 3:
$$\frac{1}{2}$$

Option 4:
1

Correct Answer:
1

Solution:
As we learned

Scalar Triple Product of unit vectors -

$$\left[\hat{i}\hat{j}\hat{k}\right]$$

- wherein

$\hat{i}\hat{j}\hat{k}$ are the three vectors.

Volume $= \left|\left[\hat{i}\hat{j}\hat{k}\right]\right| = \left|\left[\hat{i}\cdot(\hat{j}\times\hat{k})\right]\right| = 1$

Q. 5 $\displaystyle\int \sec^3\theta\, d\theta =$

Option 1:
1/2 [tanθ sec θ + log |(tan θ sec θ)|] + c

Option 2:
1/2 [tanθ + sec θ - log|(tan θ + sec θ)|] + c

Option 3:
1/2 [tan θ sec θ - log |(sec θ - tan θ)|] + c

Option 4:
none of these

1/2 [tanθ sec θ + log |(tan θ sec θ)|] + c

Solution:
As we learnt

Integration By PARTS -

Let u and v are two functions then

$$\int u \cdot v\,dx = u \int v\,dx - \int \left(\frac{du}{dx} \int v\,dx \right) dx$$

- wherein

Where u is the Ist function v is he IInd function

I

$$I = \int \sec\theta \sec^2\theta\,d\theta$$

$$= \sec\theta\tan\theta - \int \sec\theta\tan^2\theta\,d\theta$$

$$= \sec\theta\tan\theta - \int \sec^3\theta\,d\theta + \int \sec\theta\,d\theta$$

$$2I = \sec\theta\tan\theta + \log|\sec\theta + \tan\theta| + c$$

$$I = 1/2[\tan\theta\sec\theta + \log|\tan\theta + \sec\theta|] + c$$

Q. 6   The distance moved by the particle in time t is given by x= $t^3 - 12\,t^2 + 6t + 8$. At the instant when its acceleration is Zero, the velocity is

Option 1:

42

Option 2:

-42

Option 3:

48

Option 4:

-48

Correct Answer:

-42

Solution:

Derivative at a point -

The value of f'(x) obtained by putting x = a is called the derivative of f(x) at x = a and it is denoted by f'(a) or

$\dfrac{dy}{dx}$ at x = a.

$x = t^3 - 12t^2 + 6t + 8$

$\dfrac{dx}{dt} = 3t^2 - 24t + 6$

$\dfrac{d^2x}{dt^2} = 6t - 24 = 0$

$\therefore t = 4$ sec

$v = 3(4)^2 - 24 \times 4 + 6$

$\quad = 3 \times 16 - 96 + 6$

$\quad = 48 + 6 - 96$

$\quad = 48 - 90 = -42 m/s$

Q. 7   The locus of the mid-points of the perpendiculars drawn from points on the line, x=2y to the line x=y is :

Option 1:
$2x - 3y = 0$

Option 2:

$3x - 2y = 0$

Option 3:

$5x - 7y = 0$

Option 4:

$7x - 5y = 0$

Correct Answer:

$5x - 7y = 0$

Solution:

Straight Line -

Straight Line

The slope of the line joining two Points
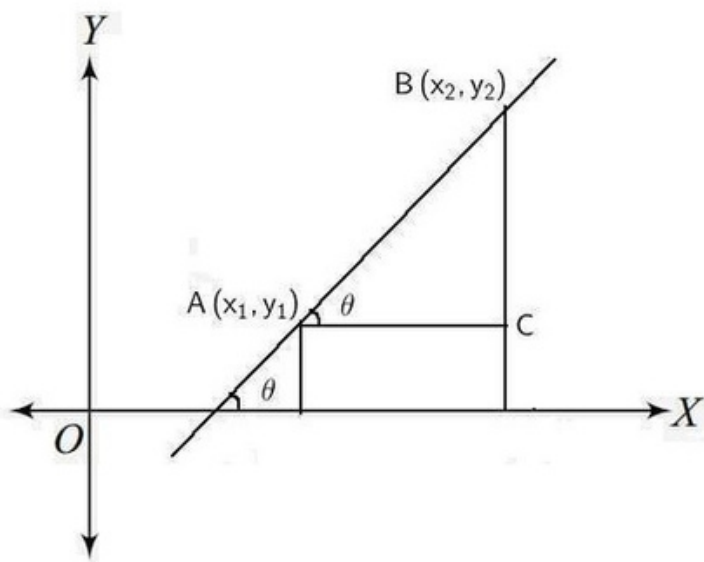
If $A\ (x_1, y_1)$ and $B\ (x_2, y_2)$ are two points on a straight line then the slope of the line is

$$.\tan\theta = \frac{BC}{AC} = \frac{y_2 - y_1}{x_2 - x_1}$$

-

Line parallel and perpendicular to a given line -

Line parallel and perpendicular to a given line

The equation of the line parallel to ax + by + c = 0 is given as ax + by + λ = 0, where λ is some constant.

Equation of the given line is ax + by + c = 0

Its slope is (-a/b)

So, any equation of line parallel to ax + by + c = 0 is

$$y = \left(-\frac{a}{b}\right)x + c_1$$
$$ax + by - bc_1 = 0$$
$$ax + by + \lambda = 0$$

The equation of the line perpendicular to ax + by + c = 0 is given as bx - ay + λ = 0, where λ is some constant.

Equation of the given line is ax + by + c = 0

Its slope is (-a/b)

Slope of perpendicular line will be (b/a)

So, any equation of line perpendicular to ax + by + c = 0 is

$$y = \left(\frac{b}{a}\right)x + c_1$$
$$bx - by - ac_1 = 0$$
$$bx - ay + \lambda = 0$$

-

slope of $PQ = \dfrac{x - a}{y - 2a} = -1$

$\Rightarrow x - a = -y + 2a$

$\Rightarrow a = \dfrac{x + y}{3}$

Using midpoint
$2x = 2a + b$
$2y = a + b$

$a = 2x - 2y$

$\dfrac{x + y}{3} = 2(x - y)$

so locus is $6x - 6y = x + y \quad \Rightarrow \quad 5x = 7y$

Correct Option (3)

Q. 8   What is the solution for $\tan^{-1} > \pi/4$?

Option 1:
$x \epsilon R$

Option 2:
$x \epsilon [1, \infty]$

Correct Answer:
$x\epsilon[1, \infty]$

Solution:
As we have learned

Graphs of Inverse Trigonometric Functions -

$\theta = \tan^{-1}x$
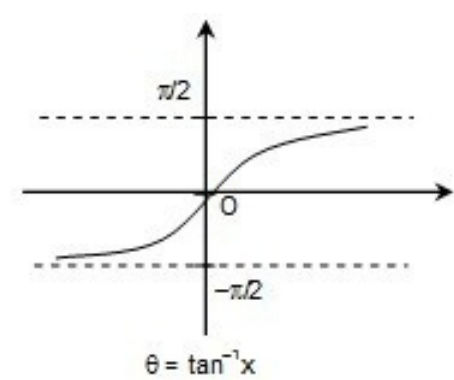
- wherein

This is the graph for $\tan^{-1}x$
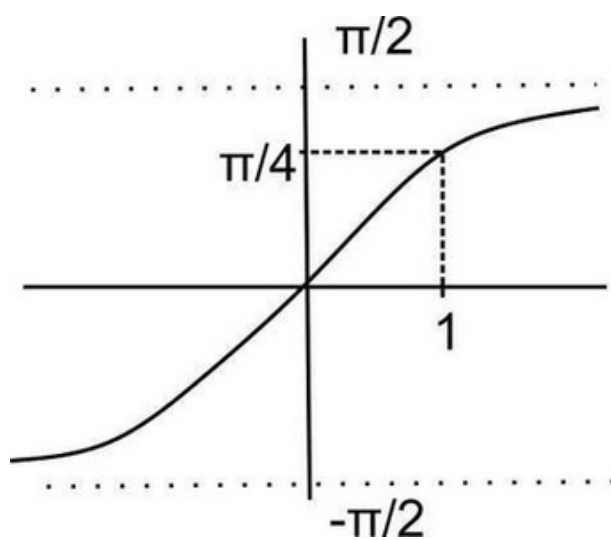
Solution will be $x \in [1, \infty)$

Q. 9　Lines $\dfrac{x-2}{2} = \dfrac{y-4}{-2} = \dfrac{z-0}{4}$ and $\dfrac{x-4}{-3} = \dfrac{y-4}{4} = \dfrac{z-1}{-2}$ are

Option 1:
Parallel and coincident lines

Option 2:
Parallel and non-coincident lines

Option 3:
intersecting lines

Solution:
As we have learned

Skew line -

Two straight lines in space which are neither parallel or neither intersecting are called skew lines.

-

here $a_1 = 2, b_1 = -2, c_1 = 4$ and $a_2 = -3, b_2 = 4, c_2 = -2$

and $\dfrac{a_1}{a_2}, \dfrac{b_1}{b_2}, \dfrac{c_1}{c_2}$ are not all equal so lines are not parallel so (A) and (B) rejected

For option (C) Let us assume they are intersecting lines

∴.Point on rst line →(2t+2,4-2t,4t)

Point on second line $\rightarrow (4 - 3t_1, 4 + 4t_1, 1 - 2t_1)$

when they intersect $: 2t + 2 = 4 - 3t_1 \Rightarrow 2t + 3t_1 = 2 \rightarrow (1)$

$4 - 2t = 4 + 4t_1 \Rightarrow 2t + 4t_1 = 0 \rightarrow (2)$

and $4t = 1 - 2t_1 \rightarrow (3)$

From (1) and (2)

$t_1 = -2, t = 4$

But it doesnt satisfy (3) so lines dont intersect as well so neither parallel nor intersecting lines

$\therefore$ Skew lines

Option (D)

Q. 10   If the pair of lines $ax^2 + 2(a + b)xy + by^2 = 0$ lie along diameters of a circle and divide the circle into four sectors such that the area of one of the sectors is thrice the area of another sector then

Option 1:
$3a^2 - 2ab + 3b^2 = 0$

Option 2:
$3a^2 - 10ab + 3b^2 = 0$

Option 3:
$3a^2 + 2ab + 3b^2 = 0$

Solution:
As we learned

$$\tan\theta = 2\left|\frac{\sqrt{h^2 - ab}}{a + b}\right|$$

Here a =a, b=b, h=a+b

$$\text{So,}\tan\theta = 2\left|\frac{\sqrt{(a + b)^2 - ab}}{a + b}\right|$$

where $\theta = \dfrac{180 - \theta}{3} \Rightarrow \theta = 45°$

$$\Rightarrow 2\sqrt{(a + b)^2 - ab} = a + b$$

$$\Rightarrow 4a^2 + 4b^2 + 4ab = a^2 + b^2 + 2ab$$

$$\Rightarrow 3a^2 + 3b^2 + 2ab = 0$$

Q. 11   Let $\vec{a}, \vec{b}, \vec{c}$ are three non-coplanar vectors , and $\vec{a'}, \vec{b'}, \vec{c'}$ are reciprocal system of vectors then $\vec{a} \cdot \vec{a'} + \vec{b} \cdot \vec{b'} + \vec{c} \cdot \vec{c'}$ equals

Option 1:
1

Option 2:
2

Option 3:
3

Option 4:
4

Correct Answer:
3

Solution:
As we have learned

Reciprocal System of Vectors -

$$\vec{a} \cdot \vec{a'} = \vec{b} \cdot \vec{b'} = \vec{c} \cdot \vec{c'} = 1$$

- wherein

$\vec{a}, \vec{b}, \vec{c}$ are vectors

$\vec{a}', \vec{b}', \vec{c}'$ are reciprocal system of vectors.

$\because \vec{a} \cdot \vec{a'} = \vec{b} \cdot \vec{b'} = \vec{c} \cdot \vec{c'} = 1$

$\therefore \vec{a} \cdot \vec{a'} + \vec{b} \cdot \vec{b'} + \vec{c} \cdot \vec{c'} = 3$

Q. 12

If matrix $A = \begin{bmatrix} a + bi & -c + id \\ c + id & a - ib \end{bmatrix}$ is Unitary matrix then

Option 1:
$a^2 + b^2 + c^2 + d^2 = 1$

Option 2:
$a^2 + b^2 = c^2 + d^2$

Option 3:
$a^2 + c^2 = b^2 + d^2$

Solution:

Orthogonal matrix, Unitary matrix and Idempotent matrix -

Unitary matrix

 Let A is a square matrix, and if AA? = I, where I is the identity matrix, then A is said to be a unitary matrix.

Note:

1. If AA? = I, then A-1 = A?

2. If A and B are unitary, Then AB is also unitary.

3. If A is unitary, then A-1 and A' are also unitary.

-

$$A = \begin{bmatrix} a+bi & -c+id \\ c+id & a-ib \end{bmatrix}$$

$$A \cdot A^\theta = \begin{bmatrix} a+bi & -c+id \\ c+id & a-ib \end{bmatrix} \cdot \begin{bmatrix} a-bi & c-id \\ -c-id & a+ib \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} a^2+b^2+c^2+d^2 & 0 \\ 0 & a^2+b^2+c^2+d^2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

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

hence, option (a) is correct

Q. 13   For each $t\epsilon R$, let [t] be the greatest integer less than or equal to t. then

$$\lim_{x \to 1^+} \frac{(1 - |x| + \sin|1-x|)\sin\left(\frac{\pi}{2}[1-x]\right)}{|1-x|[1-x]}$$

Option 1:

equals 1

Option 2:

equals 0

Option 3:

equals -1

Correct Answer:
equals 0

Solution:

Limit of product / quotient -

Limit of product/quotient is the product/quotient of individual limits such that

$$\lim_{x \to a} (f(x).g(x))$$

$$= \lim_{x \to a} f(x). \lim_{x \to a} g(x)$$, given that f(x) and g(x) are non-zero nite values

$$\lim_{x \to a} \frac{f(x)}{g(x)} = \frac{\lim_{x \to a} f(x)}{\lim_{x \to a} g(x)}$$, given that f(x) and g(x) are non-zero nite values

$$Also \ \lim_{x \to a} k f(x)$$

$$= k \lim_{x \to a} f(x)$$

-

Evalution of Trigonometric limit -

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

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

$put \quad x = a + h \quad where \ h \to 0$

$Then \ it \ comes$

$$\lim_{h \to 0} \frac{sinh}{h} = \lim_{h \to 0} \frac{tanh}{h} = 1$$

$$\therefore \quad \lim_{x \to 0} \frac{sinx}{x} = 1 \quad and$$

$$\therefore \quad \lim_{x \to 0} \frac{tanx}{x} = 1$$

-

$$\lim_{x \to 1^+} \frac{\left(1 - |x| + sin|1 - x| \ sin\left(\frac{\pi}{2}[1 - x]\right)\right)}{|1 - x| \ [1 - x]}$$

$$= \lim_{x \to 1^+} \frac{(1-x) + \sin(x-1)}{(x-1)(-1)} \cdot \sin\left(\frac{\pi}{2}(-1)\right)$$

$$= \lim_{x \to 1^+} \left(1 - \frac{\sin(x-1)}{x-1}\right)(-1) = 0$$

Q. 14   What is the solution set of sec x > 2 in the interval $x\epsilon[0, \pi]$?

Option 1:
$(0, \pi/2)$

Option 2:
$(0, \pi/3)$

Option 3:
$(\pi/3, \pi/2)$

Option 4:
$(0, \pi)$

Correct Answer:
$(\pi/3, \pi/2)$

Solution:
As we have learned

Graph of Trigonometric Ratios -

Graph of y = sec x
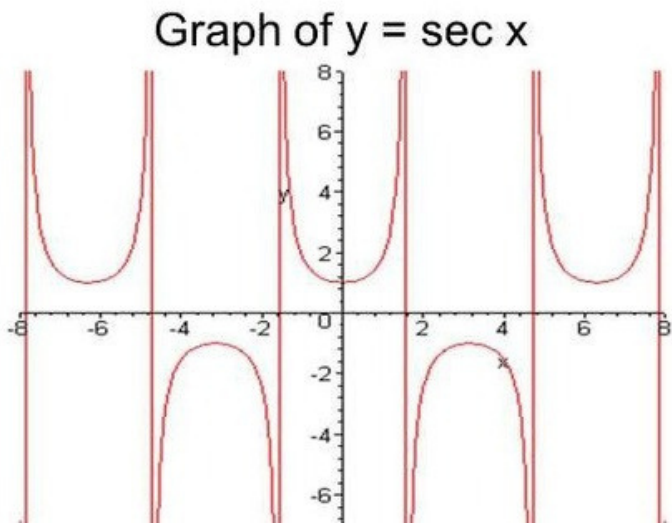
- wherein

This is the graph of $y = \sec x$
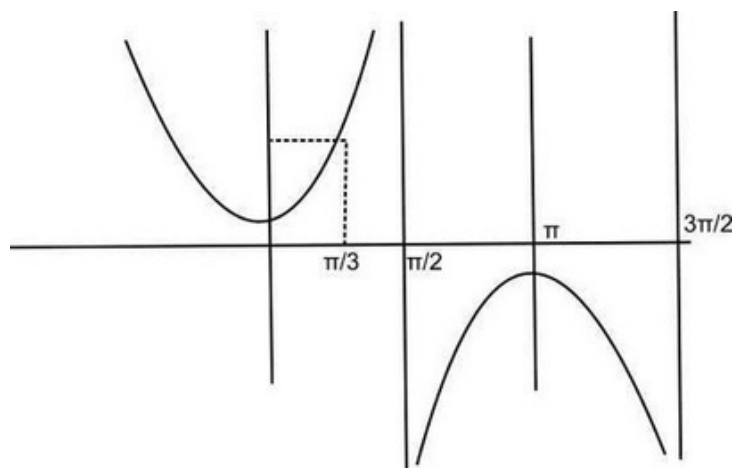
Solution set is $x\epsilon\left(\pi/3, \pi/2\right)$

Q. 15   Which of the following is true?

Option 1:
$$\binom{10}{6} = \frac{5}{2}\binom{9}{5}$$

Option 2:
$$\binom{10}{6} = \frac{5}{3}\binom{9}{5}$$

Solution:
As we learnt

Properties of Binomial Theorem

$${}^{n}C_{r} = \frac{n}{r}\ {}^{n-1}C_{r-1} = \frac{n}{r} \cdot \frac{n-1}{r-1}\ {}^{n-2}C_{r-2}\ and\ so\ on...$$

Thus,

$$\binom{10}{6} = \frac{10}{6}\binom{9}{5} = \frac{5}{3}\binom{9}{5}$$

Q. 16

$$\left(\frac{-1}{2} + \frac{i\sqrt{3}}{2}\right)^{100} + \left(\frac{-1}{2} - \frac{i\sqrt{3}}{2}\right)^{200} \text{ equals}$$

Option 1:

$-1 + i\sqrt{3}$

Option 2:

$-1 - i\sqrt{3}$

Option 3:

$1 + i\sqrt{3}$

Option 4:

$1 - i\sqrt{3}$

Correct Answer:

$-1 + i\sqrt{3}$

Solution:
As we learnt in

Cube roots of unity -

$$z = (1)^{\frac{1}{3}} \Rightarrow z = \cos\frac{2k\pi}{3} + i\sin\frac{2k\pi}{3}$$

k=0,1,2 so z gives three roots

$$\Rightarrow 1, \frac{-1}{2} + i\frac{\sqrt{3}}{2}\ (\omega), \frac{-1}{2} - i\frac{\sqrt{3}}{2}\ (\omega^2)$$

- wherein

$$\omega = \frac{-1}{2} + \frac{i\sqrt{3}}{2}, \omega^2 = \frac{-1}{2} - \frac{i\sqrt{3}}{2}, \omega^3 = 1, 1 + \omega + \omega^2 = 0$$

$1, \omega, \omega^2$ are cube roots of unity.

given is $\rightarrow w^{100} + (w^2)^{200} = w^{100} + w^{400}$

$$= (w^3)^{33} \cdot (w^3)^{133} \cdot w = 2w = -1 + i\sqrt{3}$$

Q. 17   The equation to the chord joining two points $(x_1, y_1)\ and\ (x_2, y_2)$ on the rectangular hyperbola $xy = c^2$ is :

Option 1:

$$\frac{x}{x_1 + x_2} + \frac{y}{y_1 + y_2} = 1$$

Option 2:

$$\frac{x}{x_1 - x_2} + \frac{y}{y_1 - y_2} = 1$$

Option 3:

$$\frac{x}{y_1 + y_2} + \frac{y}{x_1 + x_2} = 1$$

Option 4:

$$\frac{x}{y_1 - y_2} + \frac{y}{x_1 - x_2} = 1$$

Correct Answer:

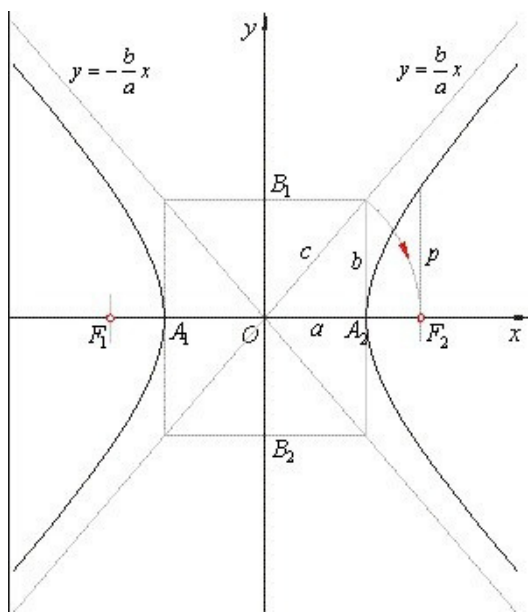$$\frac{x}{x_1 + x_2} + \frac{y}{y_1 + y_2} = 1$$

Solution:

Rectangular Hyperbola -

$$x^2 - y^2 = a^2$$

- wherein

Mid point is $M\left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right)$

$\therefore$ equation of the chord to the hyperbola $\quad xy = c^2$

whose midpoint is M, is $\quad \dfrac{x}{\frac{x_1 + x_2}{2}} + \dfrac{y}{\frac{y_1 + y_2}{2}} = 2$

$$\dfrac{x}{x_1 + x_2} + \dfrac{y}{y_1 + y_2} = 1$$

Q. 18   In triangle ABC if r_1, r_2, r_3 are radii of excircle and $r_2 = r_1, +r_3 + r$ then which of following is true?

Option 1:

A is a acute angle

Option 2:

B is a right angle

Option 3:

C is a acute angle

Option 4:

All of above

Correct Answer:

All of above

Solution:

Escribed Circle of Triangle -

Escribed Circle of Triangle

The circle which touches the side BC and two sides AB and AC produced of triangle ABC is called the escribed circle opposite· to the angle A. Its radius is denoted by r1. Similarly, r2 and r3 denote the radii of the escribed circles opposite to the angles 8 and C, respectively.
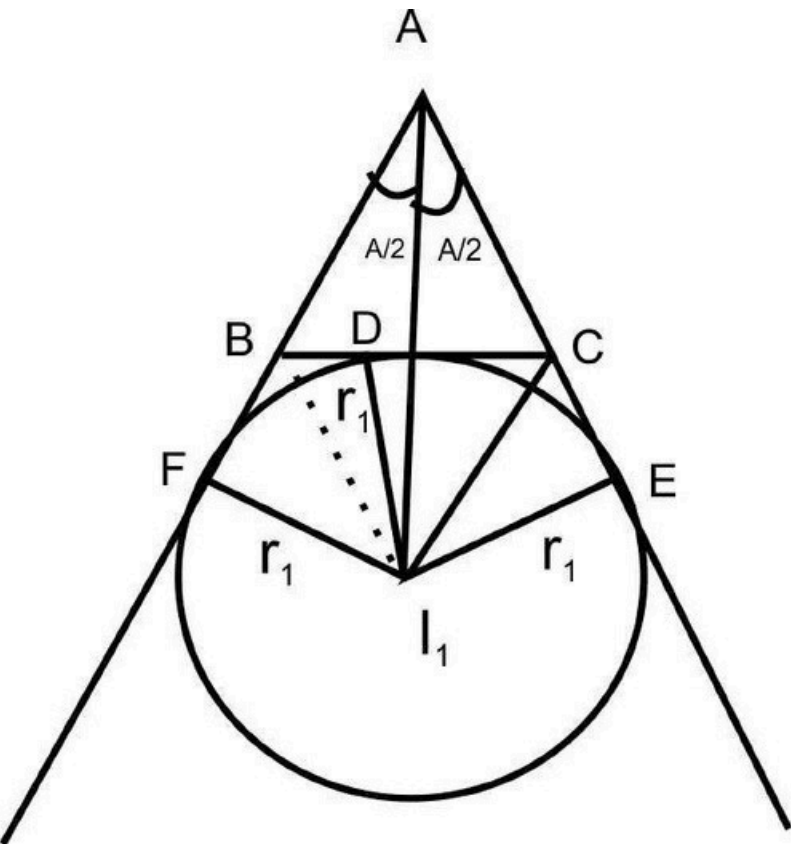
Formulae for r_1, r_2 and r_3

1. $r_1 = \dfrac{\Delta}{s-a}, \quad r_2 = \dfrac{\Delta}{s-b}, \quad r_3 = \dfrac{\Delta}{s-c}$

2. $r_1 = s\tan\dfrac{A}{2}, \quad r_2 = s\tan\dfrac{B}{2}, \quad r_3 = s\tan\dfrac{C}{2}$

3. $r_1 = 4R\sin\dfrac{A}{2}\cos\dfrac{B}{2}\cos\dfrac{C}{2}$

   $r_2 = 4R\cos\dfrac{A}{2}\sin\dfrac{B}{2}\cos\dfrac{C}{2}$

   $r_3 = 4R\cos\dfrac{A}{2}\cos\dfrac{B}{2}\sin\dfrac{C}{2}$

-

$$r_2 = r_1, + r_3 + r$$
$$r_2 - r = r_1, + r_3$$
$$\frac{\Delta}{(s-b)} - \frac{\Delta}{(s)} = \frac{\Delta}{(s-a)} + \frac{\Delta}{(s-c)}$$
$$\frac{\Delta b}{s(s-b)} = \frac{\Delta(2s - a - c)}{(s-a)(s-c)}$$
$$s(s-b) = (s-a)(s-c)$$
$$s^2 - sb = s^2 - s(a+c) + ac$$
$$s(a + c - b) = ac$$
$$(a + b + c)(a + c - b) = 2ac$$
$$(a + c)^2 - b^2 = 2ac$$
$$a^2 + c^2 = b^2$$

Q. 19   The area (in sq. units) bounded by the parabola $y = x^2 - 1$, the tangent at the point $(2, 3)$ to it and y-axis is:

Option 1:
$$\frac{8}{3}$$

Option 2:
$$\frac{32}{3}$$

Option 3:
$$\frac{56}{3}$$

Solution:

Introduction of area under the curve -

The area between the curve $y = f(x)$, x axis and two ordinates at the point $x = a \; and \; x = b \; (b > a)$ is given by

$$A = \int_a^b f(x)dx = \int_a^b y \, dx$$

- wherein
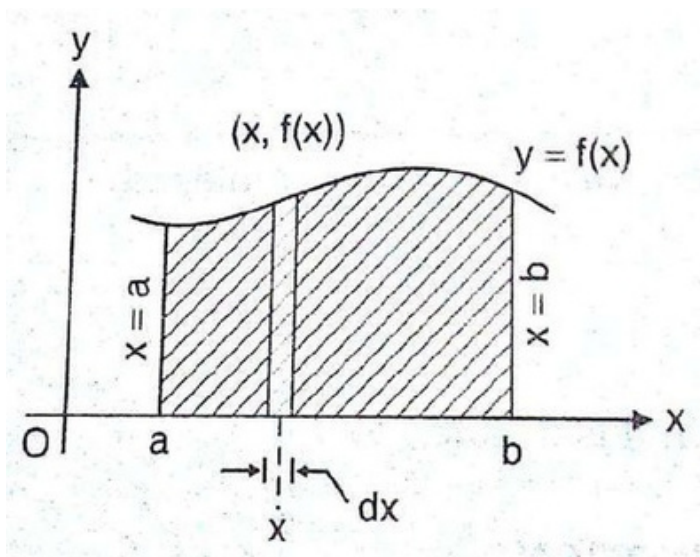
Area along x axis -

Let $y_1 = f_1(x) \; and \; y_2 = f_2(x)$ be two curve then area bounded between the curves and the lines

x = a and x = b is

$$\left| \int_a^b \Delta y \, dx \right| = \left| \int_a^b (y_2 - y_1) \, dx \right|$$

- wherein
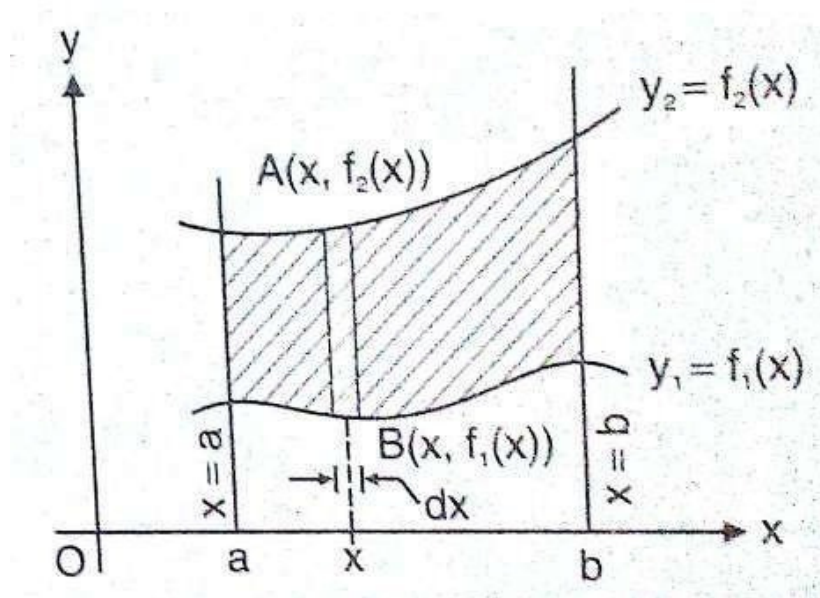
Where $\Delta y = f_2(x) - f_1(x)$

Tangent to the parabola $y = x^2 - 1$ at $(2, 3)$ is $yy_1 = 2a(x + 4)$
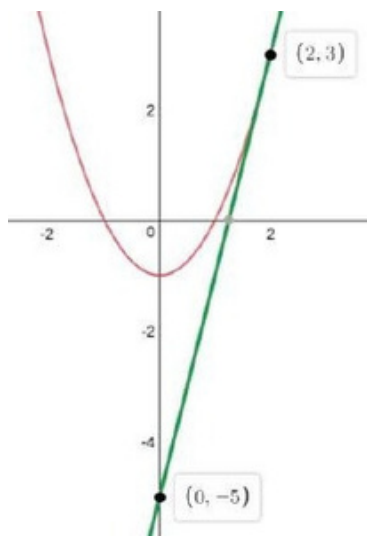
Required shaded area

$$= ar\,(\triangle ABC) - \int_{-1}^{3} \sqrt{y + 1}\,dy$$

$$= \frac{1}{2} \times 8 \times 2 - \frac{2}{3}(y+1)^{\frac{3}{2}}\,\big|_{-1}^{3}$$

$$= \frac{8}{3}\,sq.unit.$$

Q. 20 If (a, a^2) falls inside the angle made by the lines $y = \frac{x}{2},\, x > 0\ and\ y = 3x,\, x > 0,\ then\ a$ belongs to

Option 1:

$\left(0, \dfrac{1}{2}\right)$

Option 2:

$(3, \infty)$

Option 3:

$\left(\dfrac{1}{2}, 3\right)$

Option 4:

$\left(-3, -\dfrac{1}{2}\right)$

Correct Answer:

$\left(\dfrac{1}{2}, 3\right)$

Solution:
As we learnt in

Slope of a line -

$$m = \dfrac{y_2 - y_1}{x_2 - x_1}$$

- wherein

Slope of line joining A(x1,y1) and B(x2,y2) .
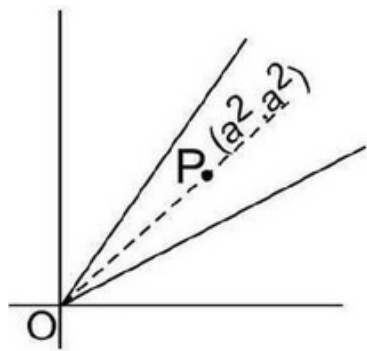
Slope of $OP = \dfrac{a^2}{a} = a$

now slop of $\; y = \dfrac{x}{2} \;$ is $\; m = \dfrac{1}{2}$

Slop of y=3x is m=3

Thus $\; \dfrac{1}{2} < a < 3$

Q. 21

If $\cos^{-1}\left(\dfrac{1}{x}\right) = \theta$ then $\tan\theta =?$

Solution:

Inverse Trigonometric Function -

Inverse Trigonometric Function

if f(x) = sin x, then we would write f −1 (x) = sin $^{-1}$ x. Be aware that sin $^{-1}$ x does not mean 1/sinx . The following examples illustrate the inverse trigonometric functions:

1. sin (π/6) = ½, then π/6 = sin-1 (½)

2. cos(π) = −1, then π = cos−1 (−1)

3. tan (π/4) = 1, then (π/4) = tan−1 (1)

-

$$\cos^{-1}\left(\frac{1}{x}\right) = \theta$$
$$\cos\theta = \frac{1}{x}$$
$$\tan\theta = \sqrt{x^2 - 1}$$

Q. 22

Let $a_1, a_2, a_3, \cdots$ be terms of an A.P. If $\dfrac{a_1 + a_2 + \ldots\ldots + a_p}{a_1 + a_2 + \ldots\ldots + a_q} = \dfrac{p^2}{q^2}, p \neq q,$ then $\dfrac{a_6}{a_{21}}$ equals:

Option 1:

41/11

Option 2:

7/2

Correct Answer:
11/41

Solution:
As we learnt in

Sum of n terms of an AP -

$$S_n = \frac{n}{2}\left[2a + (n-1)\,d\right]$$

or

Sum of n terms of an AP

$$S_n = \frac{n}{2}\left[a + l\right]$$

where

$a \rightarrow$ rst term

$d \rightarrow$ common di erence

$n \rightarrow$ number of terms

Now, given a1 ,a2, a3...are in A.P and

$$\frac{a_1 + a_2 + a_3 + \ldots\ldots + a_p}{a_1 + a_2 + a_3 + \ldots + a_q} = \frac{p^2}{q^2}$$

$$\therefore \frac{\frac{p}{2}[2a_1 + (p-1)d]}{\frac{q}{2}[2a_1 + (q-1)d]} = \frac{p^2}{q^2}$$

$$\Rightarrow \frac{[2a_1 + (p-1)d]}{[2a_1 + (q-1)d]} = \frac{p}{q}$$

$$\Rightarrow 2a_1(q-p) = d[p(q-1) - q(p-1)]$$

$$\Rightarrow 2a_1(q-p) = d[q-p]$$

$$\Rightarrow 2a_1 = d$$

$$\frac{a_6}{a_{21}} = \frac{a_1 + 5d}{a_1 + 20d} = \frac{a_1 + 10a_1}{a_1 + 40a_1} = \frac{11}{41}$$

Q. 23   Torque on a bolt when pulling with a force of 200 N directed perpendicular to a wrench of length 20 cm is

Option 1:

10 Nm

Correct Answer:
40Nm

Solution:
As we have learned

Applications of Vectors -

$$\vec{M} = \vec{r} \times \vec{F}$$

- wherein

$\vec{r}$ is positio vector of P part M is moment of $\vec{F}$ about O. Direction of $\vec{M}$ is along the normal to the plane OPN.

We know $\vec{M} = \vec{r} \times \vec{F} \Rightarrow |\vec{M}| = |\vec{r}||\vec{F}|| \sin \theta \uparrow$

here r = 0.2 m , F = 200 N , $\theta = \pi/2$

$\Rightarrow M = 0.2 \times 200 \times 1 = 40 Nm$

Q. 24   The order and the degree of the differential equation of all ellipses with centre at the origin, major axis along x-axis and

eccentricity $\dfrac{\sqrt{3}}{2}$ are, respectively :

Option 1:

2, 2

Option 2:

1, 1

Option 3:
2, 1

Option 4:
 1, 2

Solution:
As we learnt in

Order of a Di erential Equation -

The order of a di erential equation is order of highest order occuring in di erential equation

- wherein

order of

$$\frac{d^2 y}{dx^2} + 5 = 0$$

is 2.

Let the equation of ellipse is

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad but \ 1 - \frac{b^2}{a^2} = \frac{3}{4}$$

$$\therefore \frac{x^2}{4b^2} + \frac{y^2}{b^2} = 1 \quad \therefore \frac{b^2}{a^2} = \frac{1}{4}$$

$$\therefore x^2 + 4y^2 = 4b^2 \quad \therefore a^2 = 4b^2$$

$$\therefore 2x + 8y.\frac{dy}{dx} = 0$$

$$\therefore x + 4y.\frac{dy}{dx} = 0$$

$$order = 1$$
$$degree = 1$$

Q. 25   What are the su cient condition for the r in following context ?

If p then q and r

Option 1:
p

Option 2:
q

Solution:
As we have learned

If then Implications -

P is a su cient condition for q.

-

 P is here, su cient for q and r

Q. 26   The distance of the point (1, 0, 2) from the line point of intersection of the line

$$\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$$ and the plane $x - y + z = 16$, is:

Option 1:
$2\sqrt{14}$

Option 2:
8

Option 3:
$3\sqrt{21}$

Option 4:
13

Correct Answer:
13

Solution:
As we learnt in

Intersection of line and plane -

Let the line

$$\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c}$$ plane

$a_1 x + b_1 y + c_1 z + d = 0$ intersect at P

to find P assume general point on line as $(x_1 + \lambda a_1, y_1 + \lambda b_1, z_1 + \lambda c_1)$

now put it in plane to find λ,

$$a_1\left(x_1+\lambda a\right)+b_1\left(y_1+\lambda b\right)+c_1\left(z_1+\lambda c\right)+d=0$$

-

Point of intesection of line

$$\frac{x-2}{3}=\frac{y+1}{4}=\frac{z-2}{12}=k$$

x=3k+2, y=4k-1,z=12k+2

x-y+z=16

3k+2-4k+1+12k+2=16

11k-11$\rightarrow$ k=1

Point is (5,3,14)

Distance between (5,3,14) and (1,0,2)

is $\sqrt{4^2+3^2+12^2}=13$

Q. 27   The area of the plane region bounded by the curves $x+2y^2=0$ and $x+3y^2=1$ is equal to

Option 1:

$\dfrac{4}{3}$

Option 2:

$\dfrac{5}{3}$

Option 3:

$\dfrac{1}{3}$

Option 4:

$\dfrac{2}{3}$

Correct Answer:

$\dfrac{4}{3}$
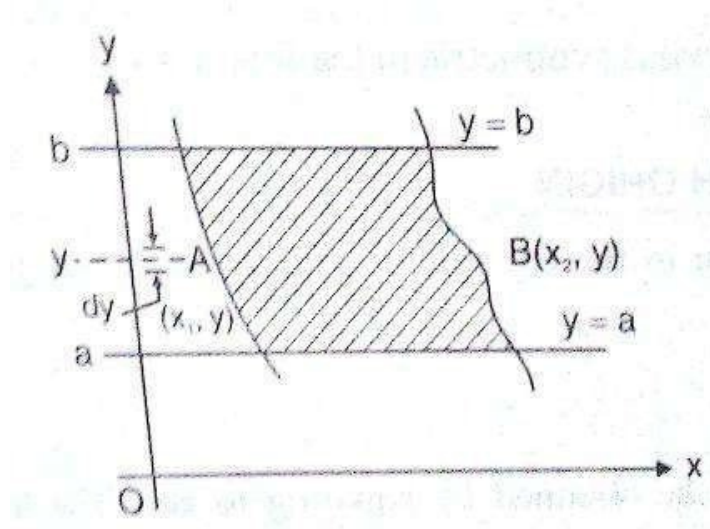
Solution:
As learnt in concept

Area along y axis -

Let $y_1 = f_1(x) \; and \; y_2 = f_2(x)$ be two curve, then area bounded by the curves and the lines

y = a and y = b is

$$A = \int_a^b (x_2 - x_1)\, dy$$

- wherein

x + 2y2=0 and x+3y2= 1

$$=>2 \int_0^{+1} (1 - 3y^2) - (-2y^2)\, dy$$

$$=2 \int_{-0}^{+1} (1 - y^2)\, dy$$

$$=2 \left[y - \frac{y^2}{3} \right]_0^1$$

$$= 2 \times \left(1 - \frac{1}{3}\right) = \frac{4}{3}$$

Q. 28 How many terms are there in the expansion $(x+y)^{10} + (x-y)^{10}$?

Option 1:
6

Option 2:
5

Option 3:
10

Option 4:
11

Correct Answer:
6

Solution:

$$(x+y)^{10} + (x-y)^{10} = 2\left[\binom{10}{0}x^{10} + \binom{10}{2}x^8 y^2 + \binom{10}{4}x^6 y^4 + \ldots + \binom{10}{10}y^{10}\right]$$

Thus we have 6 terms.

Q. 29   A vector $\vec{\gamma}$ is such that $\vec{\gamma} = 3\hat{i} - 6\hat{j} + 2\hat{k}$ then $\cos\alpha + \cos\beta + \cos\gamma$ equals:

Option 1:

-1/7

Option 2:

-2/7

Option 3:
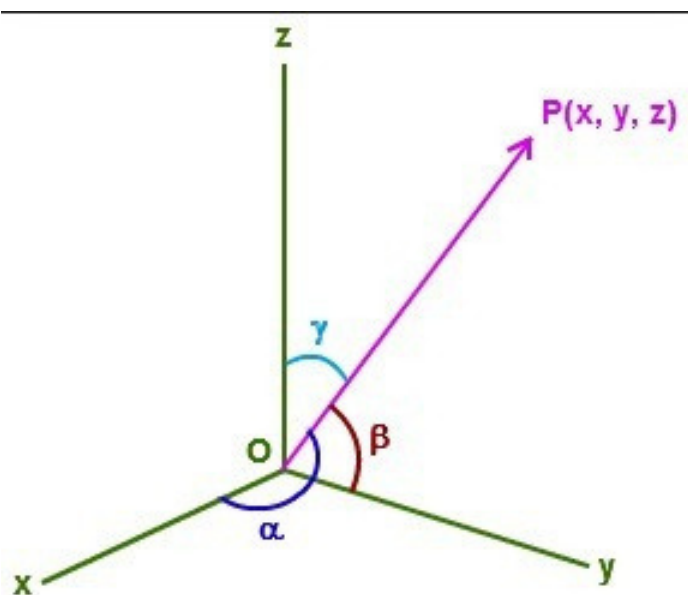
-4/7

Option 4:

-5/7

Correct Answer:

-1/7

Solution:
As we learn

Direction Cosines of a Vector -

$$\cos\alpha = \frac{x}{|r|}; \cos\beta = \frac{y}{|r|}; \cos\gamma = \frac{z}{|r|}$$

- wherein

$$cos\alpha = \frac{3}{\sqrt{49}} = \frac{3}{7}; cos\beta = \frac{-6}{7}; cos\gamma = \frac{2}{7}$$

$$\therefore cos\alpha + cos\beta + cos\gamma = \frac{-1}{7}$$

$\therefore$ option A

Q. 30   A stair-case of length *l* rests against a vertical wall and a oor of a room,. Let P be a point on the stair-case, nearer to its end on the wall, that divides its length in the ratio 1 : 2. If the stair-case begins to slide on the oor, then the locus of P is :

Option 1:
an ellipse of eccentricity $\dfrac{1}{2}$

Option 2:
an ellipse of eccentricity $\dfrac{\sqrt{3}}{2}$

Option 3:
a circle of radius $\dfrac{l}{2}$

Option 4:
a circle of radius $\dfrac{\sqrt{3}}{2}l$

Correct Answer:
an ellipse of eccentricity $\dfrac{\sqrt{3}}{2}$

Solution:

Line and the Ellipse -

Line and the Ellipse:

-As we learnt in

Selection formula -

$$x = \frac{mx_2 + nx_1}{m + n}$$

$$y = \frac{my_2 + ny_1}{m + n}$$

- wherein

If P(x,y) divides the line joining A(x1,y1) and B(x2,y2) in ratio $m : n$
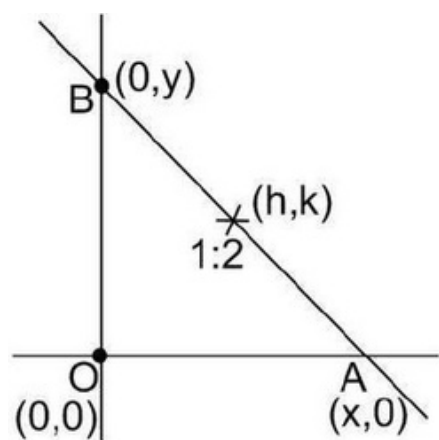
and

Eccentricity -

$$e = \sqrt{1 - \frac{b^2}{a^2}}$$

- wherein

For the ellipse

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

We know length = l

so, x2, + y2 = l2

now using section formula

P(h, k) is $\left(\dfrac{x}{3}, \dfrac{2y}{3}\right)$

$so, h = \dfrac{x}{3}; k = \dfrac{2y}{3}$

x = 3h; $y = \dfrac{3}{2}k$

$9h^2 + \dfrac{9k^2}{4} = l^2$, an ellipse

$\dfrac{h^2}{\frac{l^2}{9}} + \dfrac{k^2}{\frac{4l^2}{9}} = 1$

so $e = \sqrt{1 - \dfrac{l^2}{9 \times \frac{4l^2}{9}}} = \dfrac{\sqrt{3}}{2}$

Q. 31   n AM's are inserted between 2 and 38. If third AM is 14, then n is equal to

Option 1:
9

Option 2:
7

Option 3:
8

Option 4:
10

Correct Answer:
8

Solution:
As we learnt in

Inserting n AMs between a and b -

$a_1, A_1, A_2, A_3, A_4, ----A_n, b$ are in AP

- wherein

a is the rst term

b is the (n+2)th term of the AP.

$$2, A_1, A_2, A_3, ...A_n, 38$$

$$38 = 2 + (n + 1)d$$

$$Also\ 14 = 2 + 3d => d = 4$$

$$38 = 2 + (n + 1)\,4$$

$$36 = (n + 1)\,4 => n = 8$$

Q. 32   If in the binomial expansion of $(1 + x)^n$,the co-e cients of the 4th and 13th terms are equal to each other, the value of n is

Option 1:
9

Correct Answer:
15

Solution:
As we learnt in

The 4th term

$$T_4 =^n C_3 x^3 \qquad T_{13} =^n C_{12} x^3$$

$$Here \ ^n C_3 =^n C_{12}$$

Thus n=15

Q. 33   A plane bisects the line segment joining the points (1, 2, 3) and (−3, 4, 5) at right angles. Then this plane also passes through the point :
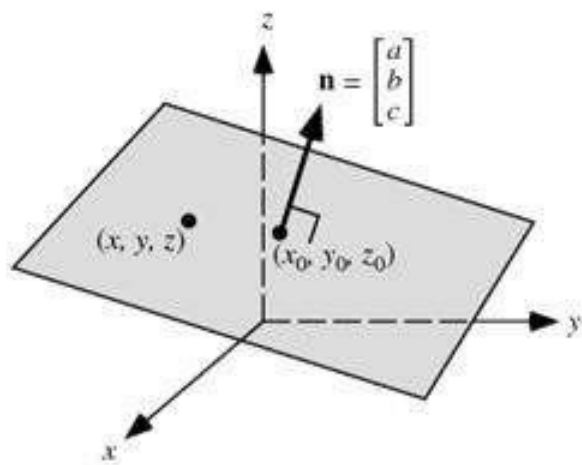
Solution:
As we learned,

Cartesian equation of plane passing through a given point and normal to a given vector -

$$(x - x_0) a + (y - y_0) b + (z - z_0) c = 0$$

- wherein

$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$\vec{a} = x_0\hat{i} + y_0\hat{j} + z_0\hat{k}$$

$$\vec{n} = a\hat{i} + b\hat{j} + c\hat{k}$$

Putting in

$$(\vec{r} - \vec{a}) \cdot \vec{n} = 0$$

We get $(x - x_0)\, a + (y - y_0)\, b + (z - z_0)\, c = 0$

and

Direction Ratios -

(i)   if a,b,c are direction ratios then direction cosines will be

$$l = \frac{\pm a}{\sqrt{a^2 + b^2 + c^2}}, m = \frac{\pm b}{\sqrt{a^2 + b^2 + c^2}}, n = \frac{\pm c}{\sqrt{a^2 + b^2 + c^2}}$$

(ii)   Direction ratios of line joining two given points

$A\left(x_1, y_1, z_1\right) \; and \; B\left(x_2, y_2, z_2\right)$ is given by

$$\left(x_2 - x_1, y_2 - y_1, z_2 - z_1\right)$$

(iii)   If $r = a\hat{i} + b\hat{j} + c\hat{k}$ be a vector with direction cosines l, m, n then

$$l = \frac{a}{|r|}, m = \frac{b}{|r|}, n = \frac{c}{|r|}$$

-

Plane must meet line at midpoint of line

i.e. (-1,3,4)

DCs of plane $\rightarrow$ (-4,2,2)

equation of plane $-4x + 2y + 2z = \lambda$

$\rightarrow$ -4x+2y+2z=18

Q. 34   If a circle C passing through (4,0) touches the circle $x^2 + y^2 + 4x - 6y - 12 = 0$ externally at a point (1,-1), then the radius of the circle C is

Option 1:

5

Option 2:

$2\sqrt{5}$

Option 3:

4

Option 4:

$\sqrt{57}$

Correct Answer:

5

Solution:
Given the equation of the circle is

$x^2 + y^2 + 4x - 6y - 12 = 0$
center, $C_1 = (-2, 3)$

Equation of tangent at $(1, -1)$

$x - y + 2(x + 1) - 3(y - 1) - 12 = 0$

$3x - 4y - 7 = 0$

equation of the required circle is

$x^2 + y^2 + 4x - 6y - 12 + \lambda(3x - 4y - 7) = 0$

this passes via (4,0), we get

$\lambda = -4$

Hence, the equation of the circle is

$\therefore\ (x^2 + y^2 + 4x - 6y - 12) - 4(3x - 4y - 7) = 0$
or $x^2 + y^2 - 8x + 10y + 16 = 0$
Radius $= \sqrt{16 + 25 - 16} = 5$

Q. 35   Which of the following relation is both re exive and an identity relation in set A = {a.b} from $A \to A$?

Option 1:
$\{(a, b); (a, a); (b, b)\}$

Option 2:
$\{(a, a); (b, b)\}$

Option 3:
$\{(a, b); (b, a); (a, a); (b, b)\}$

Option 4:
All of the above

Solution:
As we have learnt,

Identity Relation -

If every element of A is related to itself only.

- wherein

$I_A = \{(A, A) : a \epsilon A\}$

Though all the above are re exive relation but only {(a,a); (b.b)} is an identity relation.

Q. 36   The equation $Im\left(\dfrac{iz-2}{z-i}\right)+1=0, z\,\epsilon\,C, z\neq i$ represents a part of a circle having radius equal to :

Option 1:
2

Option 2:
1

Option 3:
$\dfrac{3}{4}$

Option 4:
$\dfrac{1}{2}$

Correct Answer:
$\dfrac{3}{4}$

Solution:
As we learnt in

De nition of Complex Number -

$z=x+iy, x, y\epsilon R$ & i2=-1

- wherein

Real part of z = Re (z) = x & Imaginary part of z = Im (z) = y

Equality in Complex Numbers -

z=x+iy & w=a+ib are equal i x=a & y=b

- wherein

Two complex numbers are equal i real parts as well as imaginary parts are equal.

$$Im\left(\frac{iz-2}{z-i}\right)+1=0$$

Take z = x + iy

$$Im\left(\frac{i(x+iy)-2}{x+iy-i}\right)+1=0$$

$$Im\left(\frac{ix-y-2}{x+i(y-1)}\right)+1=0$$

Proceeding further by Division of complex numbers

$$\frac{a+ib}{c+id} = \frac{ac+bd}{c^2+d^2} + i\frac{bc-ad}{c^2+d^2}$$

$$\therefore \quad \frac{-y-2+ix}{x+i(y-1)} = \frac{-yx-2x+xy-x}{x^2+(y-1)^2} + i\frac{x^2+y^2+y-2}{x^2+(y-1)^2}$$

$\therefore$ Im part = - 1

$$\therefore \quad \frac{x^2+y^2+y-2}{x^2+(y-1)^2} = -1$$

$$\therefore \quad x^2+y^2+y-2 = -x^2 - (y^2-2y+1)$$

$$x^2+y^2+y-2 = -x^2 - y^2 + 2y - 1$$

$$\therefore \quad 2x^2 + 2y^2 - y - 1 = 0$$

$$\therefore \quad x^2 + y^2 - \frac{1}{2}y - \frac{1}{2} = 0$$

$$\therefore \quad r = \sqrt{\frac{1}{16} + \frac{1}{2}} = \sqrt{\frac{9}{16}} = \frac{3}{4}$$

Correct option is 3.

Q. 37   Consider the system of equation

              x + 2y - z = 6

              2x + 3y + z = 3

              3x + 5y + z = μ then system has

Option 1:
Infinite solutions, if $\lambda = 0$, $\mu = 9$

Option 2:
No solution, if $\lambda \neq 0$, $\mu = 9$

Option 3:
Unique solution, if $\lambda \neq 0$, $\mu \neq 9$

Option 4:
All of these

Correct Answer:
All of these

Solution:
As we have learned

Inconsistent system of linear equation -
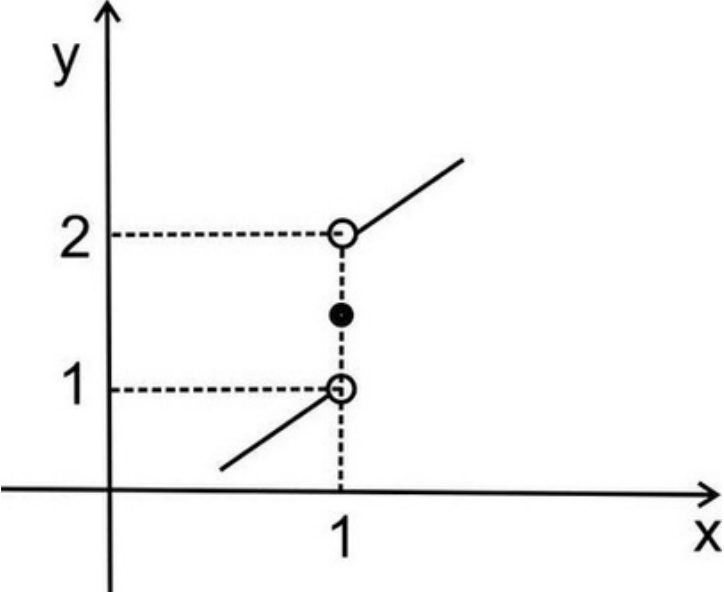
If the system of equations has no solutions

-

If $\lambda = 0$, then 3rd equation is I + II, so, for infinite solutions $\mu = 6 + 3$
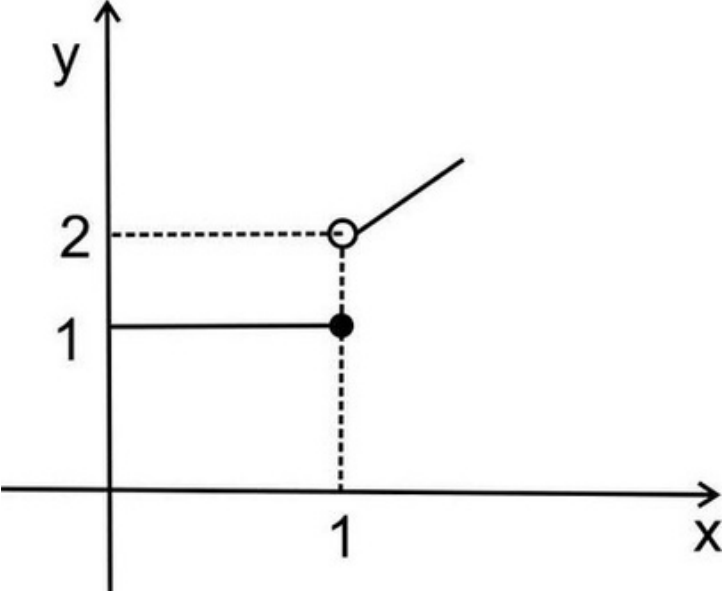
Similarly other cases.

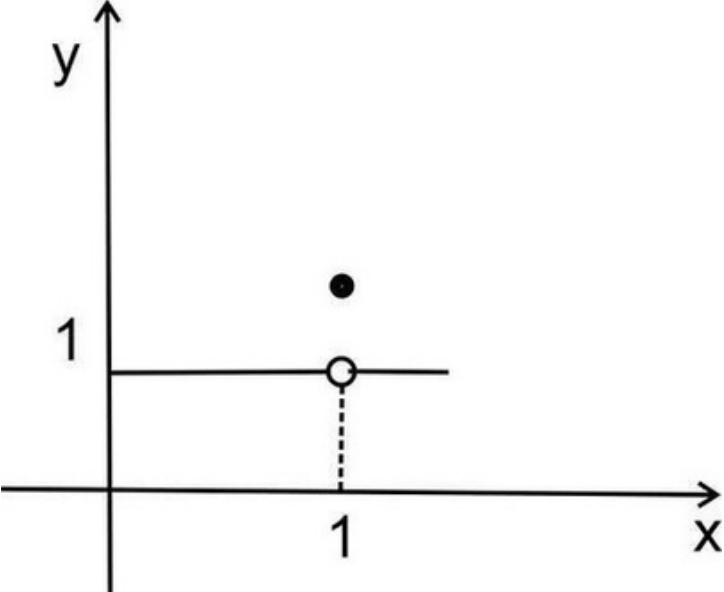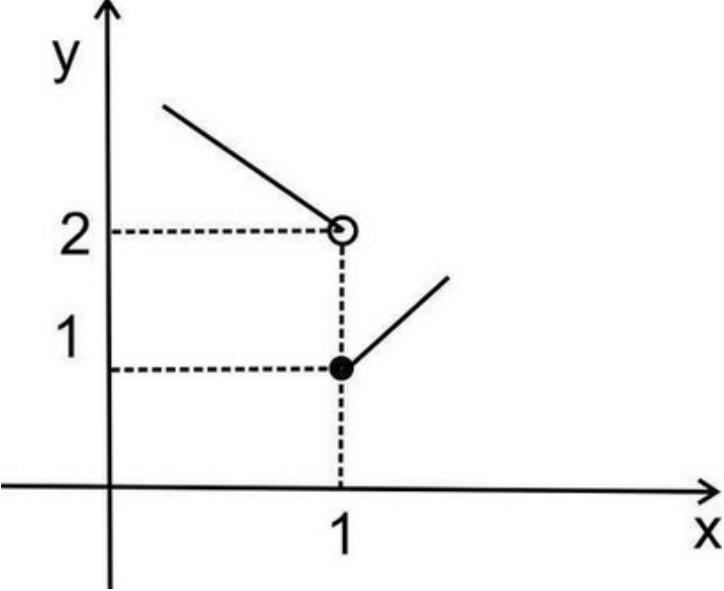Q. 38   Which of the following graphs shows that limit exits at x=1 ?
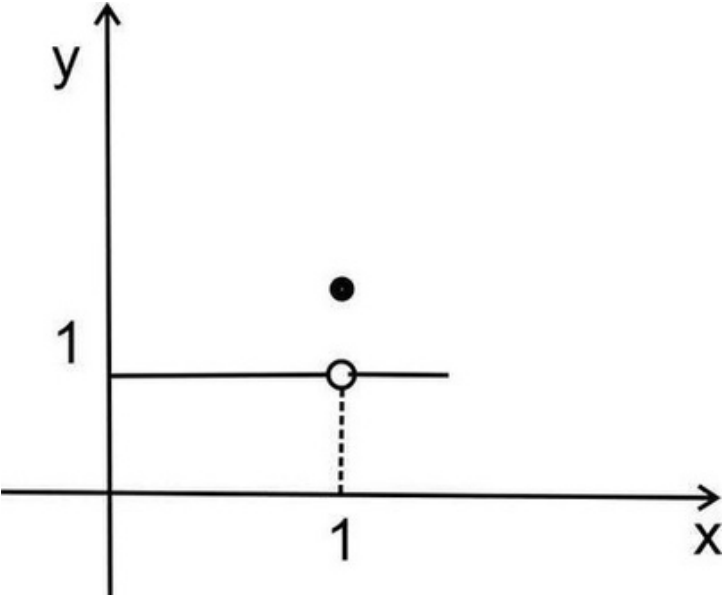
Option 1:

Option 2:

Option 3:

Option 4:

Solution:
As we have learned

Geometrical interpretation of continuity of a point -
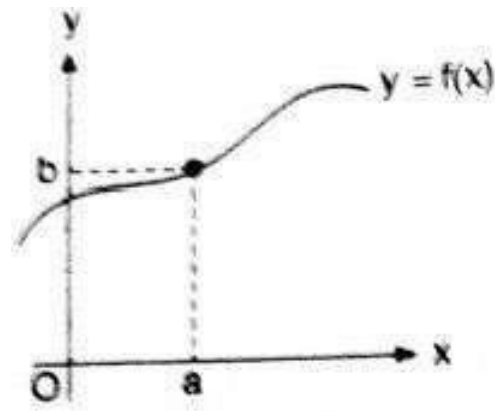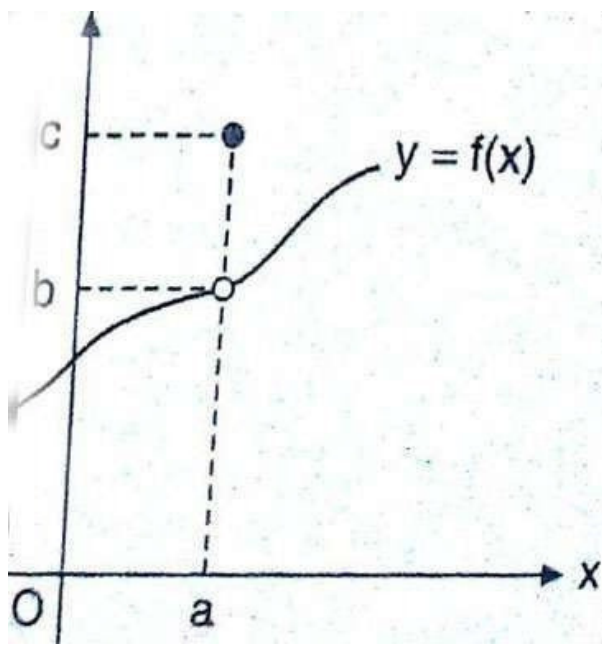
When a graph breaks at a particular point then it approaches from left and right.

$$\because \lim_{x \to a^-} f(x) = \lim_{x \to a^+} f(x)$$

So limit exist but not continuous: but when it is equal to x = a then f(x) is continuous.

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

- wherein

In $(A) \rightarrow LHL = 1, RHL = 2$ so limit doesn't exist

In $(B) \rightarrow LHL = 1, RHL = 2$ so limit doesn't exist

In $(C) \rightarrow LHL = 1 = RHL$ so limit exist

In $(D) \rightarrow LHL = 2, RHL = 1$ so limit doesn't exist

Q. 39   If in a triangle ABC, $(s-a)(s-b) = s(s-c)$ then angle C is equal to ?

Option 1:
$$\frac{\pi}{4}$$

Option 2:
$$\frac{\pi}{2}$$

Option 3:
$$\frac{3\pi}{4}$$

Option 4:
None of these

Correct Answer:
$$\frac{\pi}{2}$$

Solution:

Half-Angle Formula (in terms of perimeter and sides of triangle)(part 2) -

$$\tan\frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$$

$$\tan\frac{B}{2} = \sqrt{\frac{(s-a)(s-c)}{s(s-b)}}$$

$$\tan\frac{C}{2} = \sqrt{\frac{(s-a)(s-b)}{s(s-c)}}$$

-

$$\tan\frac{C}{2} = \sqrt{\frac{(s-a)(s-b)}{s(s-c)}} \qquad \because (s-a)(s-b) = s(s-c)$$

$$\tan\frac{C}{2} = 1 = \tan\frac{\pi}{4}$$

$$C = \frac{\pi}{2}$$

Q. 40

The value of the integral $\int \left(x + \frac{1}{x}\right)^{n+5} \left(\frac{x^2 - 1}{x^2}\right) dx$ is equal to

Option 1:

$$\frac{\left(x + \frac{1}{x}\right)^{n+6}}{n+6} + c$$

Option 2:

$$\left(\frac{x^2 + 1}{x^2}\right)^{n+6} (n+6) + c$$

Option 3:

$$\left(\frac{x}{x^2 + 1}\right)^{n+6} (n+6) + c$$

Option 4:

Solution:
As we learnt

Type of Integration by perfect square -

Integration in the form of

(i) $\displaystyle\int f\left(x + \frac{1}{x}\right)\left(1 - \frac{1}{x^2}\right)dx$

(ii) $\displaystyle\int f\left(x - \frac{1}{x}\right)\left(1 + \frac{1}{x^2}\right)dx$

(iii) $\displaystyle\int f\left(x^2 + \frac{1}{x^2}\right)\left(x - \frac{1}{x^3}\right)dx$

(iv) $\displaystyle\int f\left(x^2 - \frac{1}{x^2}\right)\left(x + \frac{1}{x^3}\right)dx$

(v) $\displaystyle\int \frac{\left(1 \pm \frac{1}{x^2}\right)dx}{x^2 + \frac{1}{x^2}}$

(vi) $\displaystyle\int \frac{f(x)dx}{ax^4 + 2bx^3 + cx^2 + 2bx + a}$

- wherein

(i) → put $(x + \frac{1}{x}) = t$

(ii) → put $(x - \frac{1}{x}) = t$

(iii) → put $(x^2 + \frac{1}{x^2}) = t$

(iv) → put $(x^2 - \frac{1}{x^2}) = t$

(v) → for $1 + \frac{1}{x^2}$ put $\quad x - \frac{1}{x} = t$

→ for $1 - \frac{1}{x^2}$ put $\quad x + \frac{1}{x} = t$

(vi) → put $(x + \frac{1}{x}) = t$ if $b \neq 0$

put $(x^2 + \frac{1}{x^2}) = t$ if $b = 0$

$$I = \int p^{n+5} dp \quad If \ x + \frac{1}{x} = p \ then, \left(1 - \frac{1}{x^2}\right) dx = dp$$

$$\therefore \ I \ = \ \int \left(x + \frac{1}{x}\right)^{n+3} \left(\frac{x^2 - 1}{x^2}\right) \ dx \ = \ \int p^{n+5} dp \ = \ \frac{p^{n+6}}{n+6} + c \ = \ \frac{\left(x + \frac{1}{x}\right)^{n+6}}{n+6} + c$$

Q. 41

If $i = \sqrt{-1}$ then $4 + 5 \left(\frac{-1}{2} + \frac{i\sqrt{3}}{2}\right)^{334} - 3 \left(\frac{1}{2} + \frac{i\sqrt{3}}{2}\right)^{365}$ is equal to:

Option 1:
$1 - i\sqrt{3}$

Option 2:
$-1 + i\sqrt{3}$

Option 3:
$4\sqrt{3}\, i$

Option 4:
$-i\sqrt{3}$

Correct Answer:
$4\sqrt{3}\, i$

Solution:
As we learnt in

Properties of Conjugate of Complex Number -

$$\bar{\bar{z}} = z$$

- wherein

$\bar{z}$ denotes conjugate of z

$$4 + 5\left(\frac{-1}{2} + \frac{i\sqrt{3}}{2}\right)^{334} - 3\left(\frac{1}{2} + \frac{i\sqrt{3}}{2}\right)^{365}$$

$$4 + 5\left(\frac{-1}{2} + \frac{i\sqrt{3}}{2}\right) - \frac{3}{2} + \frac{3\sqrt{3}i}{2} \quad \left[w^{334} = w \;,\; \left(w^2\right)^{365} = w\right]$$

$$4 - 4 + 4\sqrt{3}i = 4\sqrt{3}i$$

Q. 42 Let $x = 2\sqrt{2}\cos\theta,\ y = 2\sqrt{2}\sin\theta$ and $x = 2t,\ y = \dfrac{2}{t}$ are two curves then there curves in rst quadrant

Option 1:
intersect at $\dfrac{\pi}{6}$

Option 2:
Touch each other

Option 3:
intersect at $\dfrac{\pi}{4}$

Option 4:
intersect at $\dfrac{\pi}{3}$

Correct Answer:
Touch each other

Solution:
As we have learened

Condition for the two curves to touch in parametric form -

$$\frac{g'_x}{g'_y} = \frac{f'_x}{f'_y}$$

- wherein

Where

$$x = f(t)$$

$$y = f(t)$$

For point of intersection or touching i.e common point : $2\sqrt{2}\cos\theta = 2t$ and

$2\sqrt{2}\sin\theta = 2/t$

$\Rightarrow t = \sqrt{2}\cos\theta$ and $2\sqrt{2}\sin\theta \times \sqrt{2}\cos\theta = 2 \Rightarrow \sin 2\theta$

$\Rightarrow \theta = \pi/4$ for rst quadrant common point and t =1

$\therefore$ point is (2,2)

$\dfrac{fx^1}{fy^1} = \dfrac{-2\sqrt{2}\sin\theta}{2\sqrt{2}\cos\theta} = -\tan\theta \Rightarrow \dfrac{fx^1}{fy^1}$ at $\theta = \pi/4$ is -1

$\dfrac{gx^1}{gy^1} = \dfrac{2}{-2/t^2} = -t^2 \Rightarrow \dfrac{gx^1}{gy^1}$ at t= 1 is -1

$\dfrac{fx^1}{fy^1} = \dfrac{gx^1}{gy^1}$ so curves touch each other at common point

Q. 43   The number of complex numbers such that

$|z - 1| = |z + 1| = |z - i|$ equals

Option 1:
0

Option 2:
1

Option 3:
2

Option 4:
∞

Correct Answer:
1

Solution:
As we have learned

Perpendicular bisector -

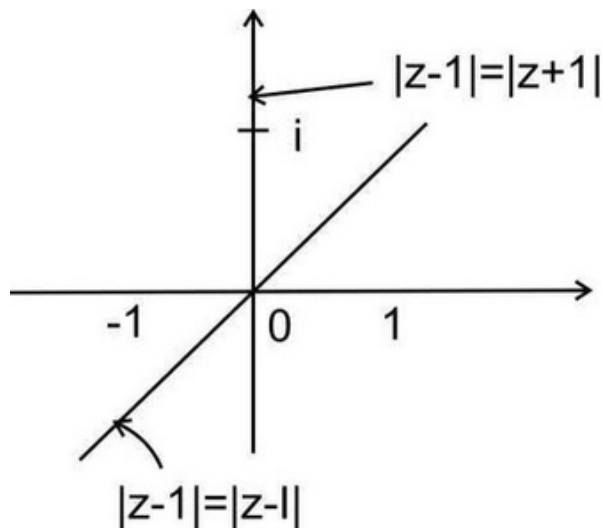Locus of point equidistant from two given points.

$|z - z_1| = |z - z_2|$

z will lie on perpendicular bisector of line joining Z_1 and Z_2 .

- wherein

Z_1 and Z_2 are any two xed points . z is a moving point in the plain which is equidistant from Z_1 and Z_2 .so z will lie on perpendicular bisector

So , x= 0

and y = x

are the lines which intersect at origin (0)

No. of values of z = 1

Q. 44   Let α, β be real and z be a complex number. If $z^2 + \alpha z + \beta = 0$ has two distinct roots on the line Re $z = 1$, then it is necessary that

Option 1:
$|\beta| = 1$

Option 2:
$\beta \in (1, \infty)$

Option 3:
$\beta \in (0, 1)$

Option 4:
$\beta \in (-1, 0)$

Correct Answer:
$\beta \in (1, \infty)$

Solution:

As we learnt in

De nition of Complex Number -

$z = x + iy, x, y \epsilon R$ & i2=-1

- wherein

Real part of z = Re (z) = x & Imaginary part of z = Im (z) = y

$z^2 + \alpha z + \beta = 0$

Let z = 1 + iy

So that $(1 + iy)^2 + \alpha(1 + iy) + \beta = 0$

$\Rightarrow \quad 1 - y^2 + i2y + \alpha + i\alpha y + \beta = 0$

$\therefore \quad (1 - y^2 + \alpha + \beta) + i(2 + \alpha)y = 0$

$\therefore \quad \alpha = -2$ and $\quad 1 - y^2 - 2 + \beta = 0$

$\Rightarrow \quad y^2 = \beta - 1 > 0$

$\therefore \quad \beta - 1 > 0$

$\quad \beta \epsilon(1, \, \infty)$

Correct option is 2.

Q. 45   The set of all values of λ for which the system of linear equations

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

$$x + 2y + z = \lambda y$$

$$-x - y = \lambda z$$

has a non-trivial solution :

Option 1:

contains more than two elements

Option 2:

is a singleton

Option 3:

is an empty set

Option 4:

contains exactly two elements

Solution:

Solution of a homogeneous system of linear equations -

Let $Ax = 0$

If A is singular then the system of equations will have infinitely many solutions

-

Cramer's rule for solving system of linear equations -

When $\Delta = 0$ and $\Delta_1 = \Delta_2 = \Delta_3 = 0$,

then the system of equations has infinite solutions.

- wherein

$$a_1 x + b_1 y + c_1 z = d_1$$
$$a_2 x + b_2 y + c_2 z = d_2$$

$a_3 x + b_3 y + c_3 z = d_3$

and

$$\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$\Delta_1, \Delta_2, \Delta_3$ are obtained by replacing column 1,2,3 of Δ by (d_1, d_2, d_3) column

For non-trivial solution , $\Delta = 0$

$$\Rightarrow \begin{vmatrix} 1-\lambda & -2 & -2 \\ 1 & 2-\lambda & 1 \\ -1 & -1 & -\lambda \end{vmatrix} = 0$$

$\Rightarrow \lambda = 1 \ (singleton)$

English

Q. 1   Find out the correct antonym for the given word:

Relegate

Option 1:
Devalue

Option 2:

Option 3:
Elevate

Demean

Option 4:

Belittle

Correct Answer:

Elevate

Solution:
Relegate means to reduce the status of someone. Elevate means to raise someone to a higher standard.

Q. 2   Find out the meaning of the phrasal verb

Ask out

Option 1:
Ask a question

Option 2:
Ask to quarrel

Option 3:
Ask to go on a date

Option 4:
Ask to come near

Option 5:
Ask to do something

Correct Answer:
Ask to go on a date

Solution:
The phrasal verb means to ask someone to go on a date

Q. 3   Read the paragraphs given in each question and choose a suitable summary from the given options

Emotions and feelings are central to our life. They allow us to exist and achieve the fullness of our personality by motivating us towards that which is good. However, as a result of traumatic experiences, our emotional life can become disordered. This abnormal expression of emotion can only be understood and addressed by having an adequate understanding of how emotions work and develop within the person. A brief study of anxiety will seek to show how emotions can become disordered, and the ways in which 'emotional literacy' provides a means of addressing this problem.

Option 1:
Emotions need to be organized with the tool of astuteness and acumen

Option 2:
Emotions are feelings are integral to the human heart

Option 3:
Emotional coddling is astonishingly significant

Option 4:
Emotions can make or break you.

Option 5:
Emotions and feelings are inseparable

Emotions need to be organized with the tool of astuteness and acumen

Solution:
Refer to the opening and the last lines. They evidently justify the selection of "Emotions need to be organized with the tool of astuteness and acumen".

Q. 4   Find out the odd one out among the following words:

Option 1:
Ecstasy

Option 2:
Revelry

Option 3:
Exhilaration

Option 4:
Happiness

Option 5:
Euphoria

Correct Answer:
Revelry

Solution:
Revelry means celebrating a moment with great noise and excitement while others denote intense happiness.

Q. 5   Find out the word which you think has been anagrammed to make another word.

Listen

Option 1:
Silence

Option 2:
Hassle

Option 3:
Silent

Option 4:
Salient

Option 5:
Whistle

Correct Answer:
Silent

Solution:
The letters in silent and listen are the same.

Q. 6   Find out the pair of words from the options which exhibits the same relationship as shown by the question pair of words:

Plateau: Altitude

Option 1:
Meticulous: Victory

Option 2:
Fraternity: Disunity

Option 3:
Palpable: Sensible

Option 4:
Astonish: Dexterous

Correct Answer:
Meticulous: Victory

Solution:
By being on plateau (the raised part of land) the altitude is enhanced, similarly, by being meticulous, victory may be achieved.

Q. 7   Find out the part which contains an error of subject-verb agreement:

Many a man along with some colleagues are speaking with the owner of the shop to ensure better parking.

Option 1:
some colleagues are

Option 2:
No error

Option 3:
the shop to ensure better parking

Option 4:
Many a man along with

Option 5:
speaking with the owner of

Correct Answer:
some colleagues are

Solution:
Man is singular, thus, the verb 'are' should be replaced with 'is'.

Q.8   Find out the uncountable noun in the following question:

To make it better, we need signi cant research which is pertaining to the present problem.

Option 1:
we

Option 2:
Need

Option 3:
Research

Option 4:
Signi cant

Option 5:
Make

Correct Answer:
Research

Solution:
Research cannot be counted. It is not tangible. Thus, it is uncountable.

Q. 9   Find out the correct prepositions.

The two friends will speak _____each other.

Option 1:
with

Option 2:
at

Option 3:
on

Option 4:
up

Option 5:
to

Correct Answer:
with

Solution:
During two way communication, we use 'with'.

Q. 10   Complete the following phrasal verb from the given choices:

You must ___ your sweater; otherwise, you will catch cold.

Option 1:
Put on
Option 2:
Option 2:
Wear
Option 3:
Option 3:
Put out

Option 4:
Put off

Option 5:
Option 5:

Put up

Correct Answer:
Correct Answer:

Put on

Solution:
Wear is wrong. The word means to carry something. Hence, put on is the best choice.

Q. 11   Spell the given word

Option 1:
convalesce

Option 2:
convalecse

Option 3:
convallesce

Option 4:
convalece

Option 5:
convelece

Correct Answer:
convalesce

Solution:
The correct spelling is convalesce

Q. 12   Find out the correct form of tense.

I am happy about the fact the house is not available any longer. It _____ to a school teacher.

Option 1:
would be sold

Option 2:
is sold

Option 3:
has been sold

Option 4:
was being sold

Option 5:
will be sold

Correct Answer:
has been sold

Solution:
Since the sentence depicts an action taken place in the recent past, present perfect tense is required to be used.

Q. 13   Find out the synonym for the given word:

Criticize

Option 1:
Exalt

Option 2:
Implore

Option 3:
Censure

Option 4:

Option 4:
Ensure

Option 5:
Exhort

Correct Answer:
Correct Answer:

Censure

Solution:
Censure means to criticize.

Q. 14   Change the speech.

The man said, "All the boys are playing in the street."

Option 1:
The man told us that all the boys had been playing in the street.

Option 2:
The man told us that all the boys were playing in the street.

Option 3:
The man told us that all the boys have been playing in the street.

Option 4:
The man told us that all the boys in the street are playing.

Option 5:
The man told us that all the boys play in the street.

Correct Answer:
The man told us that all the boys were playing in the street.

Solution:
While changing the speech, from direct to indirect, we remove the quotation marks and use a conjunction or a verb. Here, the old man has told. A is incomplete without since or for, C and D are idiomatically inappropriate.

Q. 15   Find out the correct antonym for the given word:

Validate

Option 1:
Refute

Option 2:

Buttress

Option 3:

Support
Option 4:

Rectify

Option 5:
Substantiate

Correct Answer:

Correct Answer:
Refute

Solution:
Validate means to prove or certify. Refute means to disprove of something.

Logical Reasoning

Q. 1   Earth is to Venus as Mercury is to

Option 1:
Sun

Option 2:
Pluto

Option 3:
Mars

Option 4:
Moon

Correct Answer:
Sun

Solution:
Venus is the planet nearest to the earth. Likewise ,Mercury is the planet nearest to the Sun.

Q. 2   9 : 80 : : 100 : ?

Option 1:
901

Option 2:
1009

Option 3:
9889

Option 4:
9999

Correct Answer:
9999

Solution:
The relationship is $x : (x^2 - 1)$

Q. 3   Study the following table carefully to answer the questions that follows. Insert the Missing Character.

27   54   42   84   ?   42

9   14   7
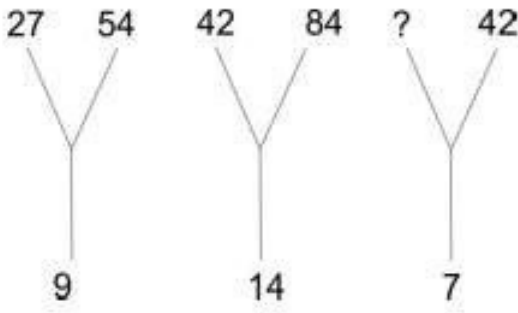
Option 1:
12

Option 2:
21

Option 3:
24

Option 4:
35

Correct Answer:
21

Solution:
we have (27+ 54)/ 9 = 9 ;

(42+ 84)/14 = 9

 (x + 42)/ 7 = 9

x = 21

Q. 4   In each question below is given a passage followed by several inferences. you have to example each inference separately in the context of the passage and decide upon its degree of truth or falsity.

Corel draw and photoshop are the old softwares used for designing purposes in industries, Adobe illustrator and the In Design are the new ones, but even today corel and photoshop are mostly used in the industries. These are designing softwares which are mostly used in Digital Marketing. Digital Marketing is a technique used for adversting on the web, like facebook marketing, instagram and E-mail marketing etc. Now these techniques are used by approx 70 % of companies to generate lead for their business. By 2022 there may be the end of traditional marketing strategies. By the coming of Internet in India from 1991 the scene of marketing is dramatically changed. In india only 35 % population is active on the internet.

Government is not doing anything for developing industries in India.

Option 1:
 if the inference is "" probably true"" though not de nitely true in the light of the facts given

Option 2:
 if the inference is "" de nitely true "" it directly follows from the facts given in the passage

Option 3:
if you think the data is inadequate , from the facts given you cannot say whether the inference is likely to be true or false

Option 4:
if you think the inference is "" probably false "" though not de nitely false in the light of the facts given

Solution:
Government role is not de ned in the passage.

Q. 5   How the gure wiil look after 180 degree rotation
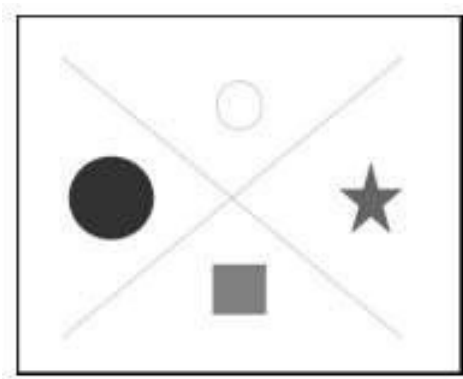
Option 1:

Option 2:

Option 3:

Option 4:

Correct Answer:

Solution:
it is clear from the gure

Q. 6   How the gure wiil look after 60 degree rotation anticlockwise
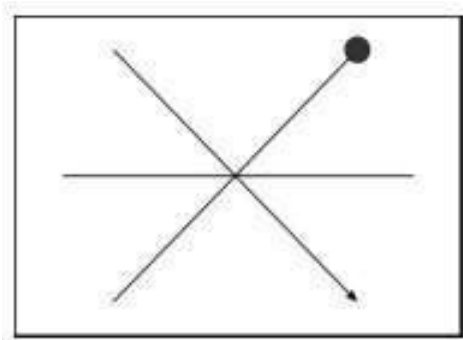
Option 1:
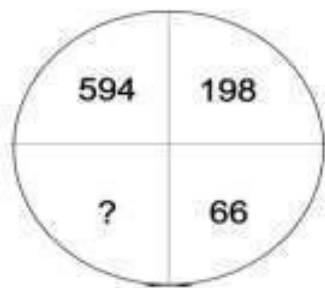

Option 2:

Option 3:

Option 4:

Correct Answer:

Solution:
it is clear from the gure

Q. 7   Study the following table carefully to answer the questions that follows. Insert the Missing Character

Option 1:

11

Option 2:

12

Option 3:

22

Option 4:

33

Correct Answer:

22

Solution:
Moving clockwise we have : 594/3=198; 198/3=66;

Q. 8   How the gure wiil look after 180 degree rotation
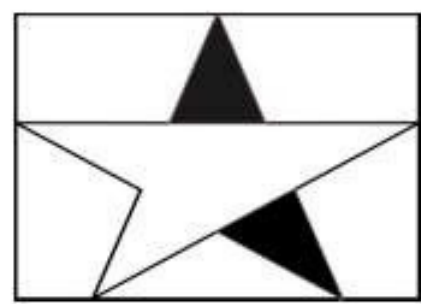
Option 1:

Option 2:

Option 3:

Option 4:

Solution:
After 180 degree the gure look like

Q. 9   6 : 222 : : 7 : ?

Option 1:
210

Option 2:
336

Option 3:
343
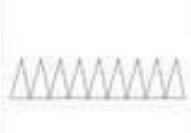
Solution:
The relationship is $x : (x^3 + x)$

Q. 10   Find the missing gure in the gure matrix

Option 1:

Option 2:

Option 3:

Option 4:

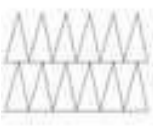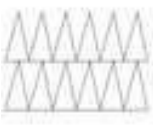*Correct Answer:*

Solution:
  the last figure have two rows and 6 items in each row.