CAREERS 360

PRACTICE Series

KCET 2025

Sample Paper

Physics

Q. 1 Which among the following is true about the strong nuclear force

Option 1:
It is an Attractive force

Option 2:
Strongest fundamental force in nature

Option 3:
Its range is 10^{-15} m

Option 4:
All of the above

Correct Answer:
All of the above

Solution:

Strong Nuclear Force -

- This force binds protons and neutrons in the nucleus.
- Attractive force.
- Strongest fundamental force in nature.
- Range is 10^{-15} m.

-

Q. 2 For a measurement of the radius of a ball following readings are taken:

3.26cm 3.28cm 3.31cm

absolute error for the first reading is :

Option 1:
0.01

Option 2:
0.02cm

Option 3:
0.00cm

Option 4:
0.04cm

Correct Answer:
0.02cm

Solution:
As we learn

$$a_m = \frac{a_1 + a_2 + a_3}{3}$$

$$a_m = \frac{3.26 + 3.28 + 3.31}{3} = 3.28$$

$$\Delta a_1 = 3.28 - 3.26 = 0.02cm$$

Q. 3 Dimensions of $\frac{1}{\mu_0 \varepsilon_0}$, where symbols have their usual meaning, are

Option 1:
$[L^{-1}T]$

Option 2:
$[L^{-2}T^2]$

Option 3:
$\left[L^2T^{-2}\right]$

Option 4:
$\left[LT^{-1}\right]$

Correct Answer:
$\left[L^2T^{-2}\right]$

Solution:
The permittivity of free space -

$\epsilon_o = \ M^{-1}L^{-3}T^4A^2$

and,

The dimension of permeability of free space (μ_o)-$M^1L^1T^{-2}A^{-2}$

So,

The dimension of the required quantity is : L^2T^{-2}

Q. 4 A physical quantity is given by $X = \frac{P^aQ^b}{R^c}$. The percentage error in measurement of P,Q and R are $\alpha, \beta and \gamma$ respectively. Then maximum percentage error in quantity X is :

Option 1:
$a\alpha + b\beta - c\gamma$

Option 2:
$a\alpha + b\beta + c\gamma$

Option 3:
$\frac{a}{\alpha} + \frac{b}{\beta} + \frac{c}{\gamma}$

Option 4:
$\frac{a}{\alpha} + \frac{b}{\beta} - \frac{c}{\gamma}$

Correct Answer:
$a\alpha + b\beta + c\gamma$

Solution:

Error in quantity raised to some power -

$$x=\frac{a^n}{b^m}\rightarrow\frac{\Delta x}{x}=\pm\left(n\frac{\Delta a}{a}+m\frac{\Delta b}{b}\right)$$

- wherein

Δa= absolute error in measurement of a

Δb= absolute error in measurement of b

Δx= absolute error in measurement of x

$$\frac{\Delta X}{X}=\pm[a\frac{\Delta P}{P}+b\frac{\Delta Q}{Q}+c\frac{\Delta R}{R}]$$

$$\frac{\Delta X}{X}=\pm[a\alpha+b\beta+c\gamma]$$

Q. 5 Starting from rest acceleration of a particle is a = 2 (t-1) . The velocity of particle at t= 5 sec is

Option 1:
15 m/s

Option 2:
25 m/s

Option 3:
5 m/s

Option 4:
2 m/s

Correct Answer:
15 m/s

Solution:
As we have learned

Introduction to Integration -

$$\int x^n dx=\frac{x^{n+1}}{n+1}+C$$

C = constant

Here

$$a = dv/dt = 2(t-1)$$

$$dv = 2(t-1)dt$$

$$\int_{v_1}^{v_2} v = 2(t^2/2 - t)_0^5$$

$$v_2 - v_1 = 2[25/2 - 5] - 0$$

$$v_2 = 25 - 10 = 15m/s$$

Q. 6 Two particles moving in circular orbit having ratio of radius and velocity as $\frac{r_1}{r_2} = 3$ & $\frac{v_1}{v_2} = 4$ respectively. Then find ratio of their centripetal acceleration.

Option 1:
$\frac{13}{3}$

Option 2:
$\frac{14}{3}$

Option 3:
$\frac{15}{3}$

Option 4:
$\frac{16}{3}$

Correct Answer:
$\frac{16}{3}$

Solution:
As we learned

Centripetal acceleration -

When a body is moving in a uniform circular motion, a force is responsible to change direction of its velocity.This force acts towards the centre of circle and is called centripetal force.Acceleration produced by this force is centripetal acceleration.

$$a = \frac{v^2}{r}$$

- wherein

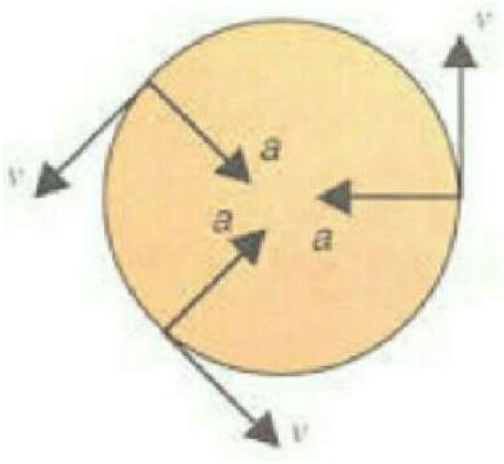


Figure Shows Centripetal acceleration

$$a_c = \frac{v^2}{r}$$

$$a_1 = \frac{v_1^2}{r_1} \qquad a_2 = \frac{v_2^2}{r_2}$$

$$\frac{v_1}{v_2} = 4 \ , \ \frac{r_1}{r_2} = 3$$

$$\frac{a_1}{a_2} = \left(\frac{v_1}{v_2}\right)^2 \left(\frac{r_2}{r_1}\right) = \frac{4 \times 4}{3} = \frac{16}{3}$$

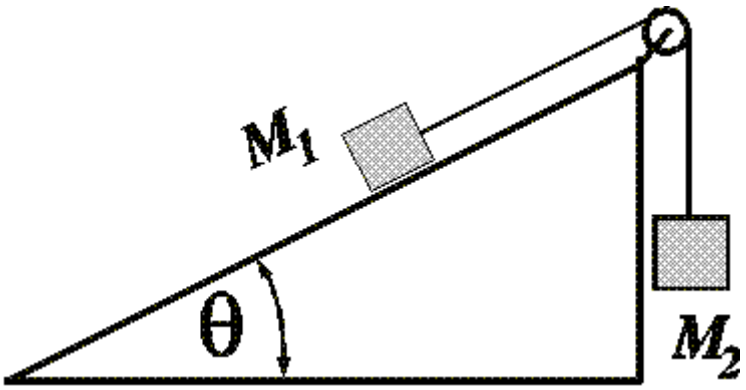
Q. 7

A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5m/s2. What would be the reading on the scale. (g=10m/s2)

Correct Answer:
1200

Solution:
Solution :
Reading of weighing scale = m(g+a) = 80(10 + 5) = 1200 N

Q. 8 Two masses m_1 and m_2 are attached to the ends of massless string as shown in fig. Here m_1 10 Kg and $\theta = 37^\circ$ then what should be the mass m_2 ofr the system to be in equilibrium . Assume that there is no friction b/w m_1 and inclined plane .



Option 1:
5 Kg

Option 2:
10 Kg

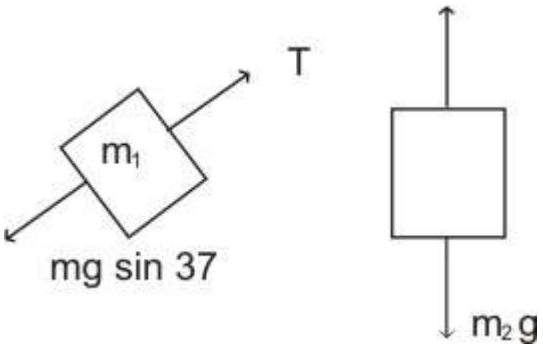
Option 3:
8 Kg

Option 4:
6 Kg

Correct Answer:
6 Kg

Solution:

FBD of m_1 and m_2



$$T = mgsin37$$

$$= 10 \times 10 \times 3/5$$

$$T = 60N$$

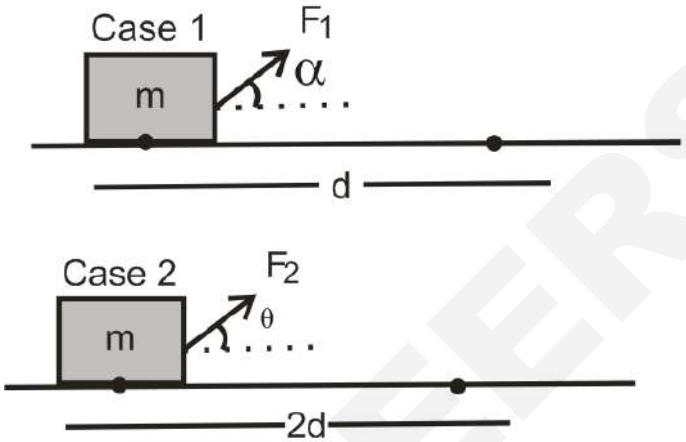
from FBD of m_2

$$T = m_2 g$$

$$= 60$$

$$m_2 = 6Kg$$

Q. 9



If for both case work done to displace block through a corresponding distance with the help of corresponding force is same. Then find the ratio of $\left(\frac{F_1}{F_2}\right)$

Option 1:

$\frac{\cos\theta}{\cos\alpha}$

Option 2:

$\frac{\cos\alpha}{\cos\theta}$

Option 3:

$\frac{2\cos\theta}{\cos\alpha}$

Option 4:

$\frac{2\cos\alpha}{\cos\theta}$

Correct Answer:

$\frac{2\cos\theta}{\cos\alpha}$

Solution:

As we learned

Definition of work by constant force -

$W = FS\cos\Theta$

Or work is defined as

The product of magnitude of force (F) magnitude of displacement (S) and cosine of the angle between them (Θ)

So using

$W = F \cdot S \cdot \cos\theta$

$W_1 = F_1 \times d \times \cos\alpha$

$W_2 = F_2 \times 2d \times \cos\theta$

as $W_1 = W_2$

So $\frac{F_1}{F_2} = \frac{2\cos\theta}{\cos\alpha}$

Q. 10 Two springs have a spring constant K_1 and K_2. These are the extended through a distance x_1 and x_2 respectively. If their elastic energies are equal. Then $\frac{x_1}{x_2}$ is equal to:

Option 1:

$\frac{K_1}{K_2}$

Option 2:

$\frac{K_2}{K_1}$

Option 3:

$$\sqrt{\frac{K_1}{K_2}}$$

Option 4:

$$\sqrt{\frac{K_2}{K_1}}$$

Correct Answer:

$$\sqrt{\frac{K_2}{K_1}}$$

Solution:
As we learn

Potential Energy stored in the spring -

$$U = \frac{1}{2}\,kx^2$$

- wherein

$$K = spring\ constant$$

x= elongation or compression of spring from natural position

So $U = \frac{1}{2}Kx^2$ = elastic energy

$$U_1 = \frac{1}{2}K_1x_1^2$$

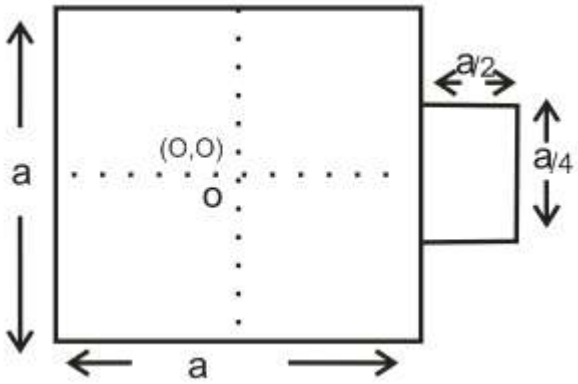
$$U_2 = \frac{1}{2}K_2x_2^2$$

$U_1 = U_2$

$$K_1x_1^2 = K_2x_2^2$$

$$\frac{x_1}{x_2} = \sqrt{\frac{K_2}{K_1}}$$

Q. 11 A square plate of side a and mass M is shown in figure another plate of same material of given dimension is added as shown in the diagram the C.M of given system origin o is



Option 1:

$\left[\frac{5a}{75}, 0\right]$

Option 2:

$\left[\frac{2a}{53}, \frac{2a}{53}\right]$

Option 3:

$\left[\frac{a}{12}, 0\right]$

Option 4:

$\left[0, \frac{2a}{53}\right]$

Correct Answer:

$\left[\frac{a}{12}, 0\right]$

Solution:

As we learned

Centre of mass when some mass is added in the body -

$$\vec{r}_{CM} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2}$$

- wherein

m_1 & $\vec{r_1}$ are mass and position of centre of mass for whole body. m_2 & $\vec{r_2}$ are mass and position of centre of mass of added mass.

$$X_{cri} = \frac{m_1x_1 + m_2x_2}{m_r + m_2} \qquad \begin{matrix} m_1 = M \\ m_2 = \frac{M}{8} \end{matrix}$$

$$X_{cm^2} = \frac{(M \times 0) + \frac{M}{8}(\frac{3a}{4})}{M + \frac{M}{8}} \qquad \begin{matrix} x_1 = 0 \\ x_2 = \frac{3a}{4} \end{matrix}$$

$$X_{cm} = \frac{a}{12}$$

$$y_{cm} = 0$$

Q. 12 A force $\vec{F} = 2\hat{i} + 2\hat{j} + k$ is acting a point $\vec{o} = i + 3j + 2R$. The torque acting about point $\vec{r_2} = 2\hat{i} + \hat{j} + 2\hat{k}$ is

Option 1:
$\hat{i} + 2\hat{j} + 6\hat{k}$

Option 2:
$2\hat{i} + \hat{j} - 6\hat{k}$

Option 3:
$3\hat{i} + 2\hat{j} + 2\hat{k}$

Option 4:
$\hat{i} + 2\hat{j} + 5\hat{k}$

Correct Answer:
$2\hat{i} + \hat{j} - 6\hat{k}$

Solution:
As we learned

Torque -

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

- wherein

This can be calculated by using either $\tau = r_1 F \; or \; \tau = r \cdot F_1$

r_1 = perpendicular distance from origin to the line of force.

f_1 = component of force perpendicular to line joining force.

$$\vec{r'} = \vec{r_1} - \vec{r_2}$$

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

$$\vec{r'} = -i + 2j$$

$$\vec{\tau} = \vec{r} \times \vec{f}$$

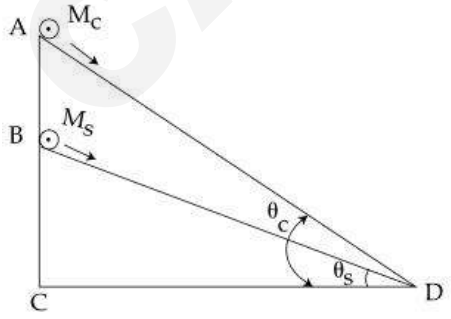
$$\begin{vmatrix} i & j & k \\ -1 & 2 & 0 \\ 2 & 2 & 1 \end{vmatrix}$$

$$= \vec{i}(2) - \hat{j}(-1) + \hat{k}(-2 - 4) = 2\hat{i} + \hat{j} - 6\hat{k}$$

Q. 13 A cylinder of mass M_c and sphere of mass M_s are placed at points A and B of two inclines, respectively.

(See Figure). If they roll on the incline without slipping such that their accelerations are the same, then

The ratio $\frac{\sin \Theta_c}{\sin \Theta_s}$ is



Option 1:

$\sqrt{\frac{8}{7}}$

Option 2:

$\sqrt{\frac{15}{14}}$

Option 3:

$\frac{8}{7}$

Option 4:

$\frac{15}{14}$

Correct Answer:

$\frac{15}{14}$

Solution:

Acceleration along inclined plane

$$a = \frac{g\sin\theta}{1+\frac{K^2}{R^2}}$$

For sphere

$$K^2 = 2/5R^2 \Rightarrow a_s = \frac{g\sin\theta_s}{1+2/5}$$

$$a_s = (5/7)g\sin\theta_s$$

For cylinder

$$K^2 = 1/2R^2 \Rightarrow a_c = \frac{g\sin\theta_c}{1+1/2}$$

$$a_c = 2/3g\sin\theta_c$$

$$a_s = a_c \Rightarrow 5/7(g\sin\theta_s) = 2/3(g\sin\theta_c)$$

$$\frac{\sin\theta_c}{\sin\theta_s} = 15/14$$

Q. 14 Escape velocity of a body of 1 kg mass on a planet is 50 m/sec. Then escape energy of the body is-

Option 1:
1000 J

Option 2:
5000 J

Option 3:
1250 J

Option 4:
-1500 J

Correct Answer:
1250 J

Solution:
As we learn

Escape energy -

$$\frac{GMm}{R} = Escape\ Energy$$

$m \rightarrow$ Mass of planet

$m \rightarrow$ mass of body

$g \rightarrow$ Gravitational constant

- wherein

Energy to be given to a object on the surface of earth so that it's total energy is 0

Escape energy = $\frac{GM}{R}$

$$V_e = \sqrt{\frac{2GM}{R}} = 50$$

$$\frac{2GM}{R} = 2500$$

$$\frac{GM}{R} = 1250J$$

Q. 15 Two Point mass of magnitude 4 unit & 9 unit respectively placed at a distance of 100 cm apart. The distance from the point mass 4 unit. Where will the gravitational field intensity be zero?

Option 1:
40 cm

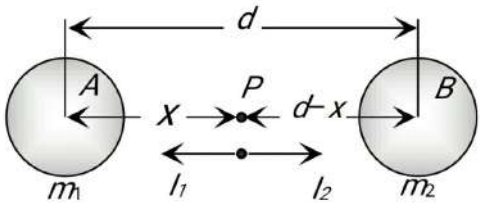
Option 2:
60 cm

Option 3:
50 cm

Option 4:
45 cm

Correct Answer:
40 cm

Solution:



$$\vec{I_1} = \frac{Gm_1}{x^2}$$

$$\vec{I_2} = \frac{Gm_1}{(d-x)^2}$$

For Neutral Point

$$I_1 = I_2$$

$$\Rightarrow \frac{Gm_1}{x^2} = \frac{Gm_1}{(d-x)^2}$$

Solving

$$x = \left[\frac{\sqrt{m_1}}{\sqrt{m_1}+\sqrt{m_2}}\right] d$$

or

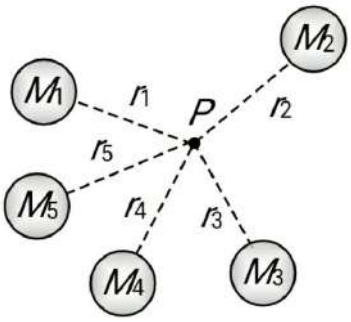
$$x = \left[\frac{\sqrt{4}}{\sqrt{4}+\sqrt{9}}\right] 100 = \frac{2}{5} \times 100 = 40cm$$

Q. 16 Infinity number of the masses, each 1 kg , are placed along the X-axis at $x = \pm 1m, \pm 2m, \pm 4m, \pm 8m, \pm 16m, - - - - -\infty$. The magnitude of the resultant gravitational potential in terms of gravitational constant G at the origin is $n \times G$. Then 'n' will be :

Correct Answer:
4

Solution:
As we learn

Superposition of Gravitational potential -



$$V = -G \sum_{i=1}^{i=n} \frac{M_i}{r_i}$$

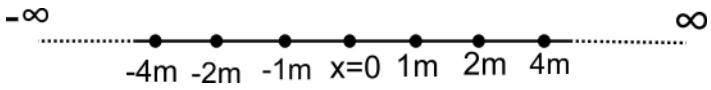
$M_i \rightarrow$ Sum of mass

$r_i \rightarrow$ distances

- wherein

$$V = V_1 + V_2 + V_3 \cdots$$

$$= -\frac{GM}{r_1} - \frac{GM}{r_2} - \frac{GM}{r_3} \cdots$$



As we know $V = \frac{-Gm}{r}$

$$|V| = \left|\frac{-Gm}{r}\right| = \frac{Gm}{r}$$

Total Potential (v) $= \frac{2Gm}{r}$ [because particle along the both sides]

$$V = 2Gm\left[1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+-----------\infty\right]\text{GP}$$

$$= 2Gm\left[\frac{1}{1-\frac{1}{2}}\right]\left[As\ S_\infty = \frac{a}{1-r}\right]$$

$$V = \frac{2Gm}{\frac{1}{2}} = 4Gm$$

As, m =1 kg

So, V= 4G

Hence n = 4.

Q. 17 The ratio of diameter of two wires of same material is n:1. The length of wire 1 m each on applying the same load, the increase in the length of thin wire will be -

Option 1:

$n^2 times$

Option 2:

$n\ times$

Option 3:

$2n\ times$

Option 4:

$1/n\ times$

Correct Answer:

$n^2 times$

Solution:

As we learn

Young's modulus is given as

$$Y = \frac{mgL}{\pi r^2 \Delta l}$$

- wherein

r = Radius of wire

L = Original length

Δl = Change in length

Mg = weight

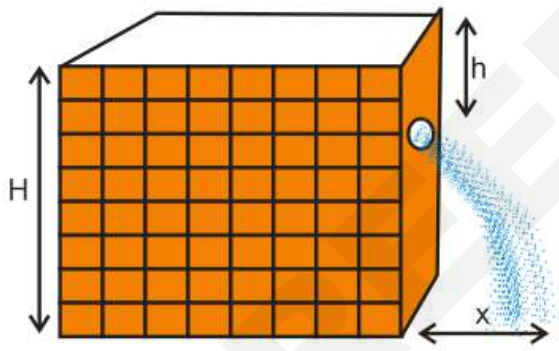
Let $\Delta l = l$

$$l\alpha\frac{FL}{r^2Y} \Rightarrow l\alpha\frac{1}{r^2}$$

$$\frac{l_2}{l_1} = (\frac{r_1}{r_2})^2 = n^2$$

$$l_2 = n^2 l_1$$

Q. 18 A tank is filled with water up to a height H. Water is allowed to come out of a hole as shown in diagram. Time taken by the liquid to reach the base level is :



Option 1:

$$\sqrt{\frac{2(H-h)}{g}}$$

Option 2:

$$2\sqrt{\frac{(H-h)}{g}}$$

Option 3:

$$\sqrt{\frac{(H-h)}{g}}$$

Option 4:

$$\sqrt{\frac{2H}{g}}$$

Correct Answer:

$$\sqrt{\frac{2(H-h)}{g}}$$

Solution:
As we learn

Time to reach the Ground -

$$T=\sqrt{\frac{2(H-h)}{g}}$$

- wherein

$\rightarrow$ H - height of vessel

$\rightarrow$ h - free surface to orifice

As horizontal initial velocity is zero so time taken to reach to ground is :

$$t=\sqrt{\frac{2(H-h)}{g}}$$

Q. 19 The volume of a metal sphere increased by 0.16 % when its temperature is raised by 40 $^{0}\mathrm{C}$. The coefficient of volume expansion of metal is

Option 1:

$6\times10^{-5}/^{0}c$

Option 2:

$2\times10^{-5}/^{0}c$

Option 3:

$3\times10^{-4}/^{0}c$

Option 4:
$4 \times 10^{-5}/^{0}c$

Correct Answer:
$4 \times 10^{-5}/^{0}c$

Solution:
As we learn

Co-efficient of Cubical Expansion -

$$\alpha_v = \frac{\Delta V}{V_0 \Delta T}$$

-

$$\frac{\Delta V}{V} = \gamma \Delta \Theta$$

$$\Rightarrow \gamma = \frac{\Delta V}{V \times \Delta \theta}$$

$$= \frac{0.16}{100 \times 40} = 4 \times 10^{-5}/^{0}C$$

Q. 20 If in a system an ideal gas change its temperature from $T_1 = 27^{\circ}c$ to $T_2 = 35^{\circ}c$ isochorically. Then find work done by the system.

Option 1:
$nR \times (35 - 27)$

Option 2:
$nR \times (35)$

Option 3:
$nR \times (27)$

Option 4:
$Zero$

Correct Answer:
$Zero$

Solution:
As we learned

Work done in isochoric process -

W = 0

- wherein

$\because W = \int P\, dV$

since $dv = 0$

W = 0

W=0 for isochoric process

Q. 21 An ideal gas changes its state from state 1 to state 2 isobarically. Then by keeping the temperature constant, it changes its state from state 2 state 3. where P_1, P_2, P_3 are pressure at state 1, 2, 3 respectively, while T_1, T_2, T_3 are Temperature at state 1, 2,3 respectively and U_1, U_2, U_3 are the volume of the system at state 1, 2, 3 respectively. Then chose correct equation

Option 1:
$P_1V_1T_2 = P_3V_3T_1$

Option 2:
$P_1V_1T_1 = P_3V_3T_2$

Option 3:
$P_1T_2V_3 = P_3V_1T_1$

Option 4:
$P_1V_1T_3 = P_3V_3T_2$

Correct Answer:
$P_1V_1T_2 = P_3V_3T_1$

Solution:
As we learned

Isobaric process -

A Thermodynamic process in which pressure remain constant.

- wherein

$$PV = nRT$$

$$\because P = constant$$

$$V \alpha T$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

For state 1-2

process is isobaric

so $\Delta P = 0$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} - - - - - - - - (1)$$

for process 2-3

$$\Delta T = 0$$

so, $P_1V_2 = P_3V_3 - - - - - (2)$

$$P_2 = P_1$$

so $P_1V_2 = P_3V_3 - - - (3)$

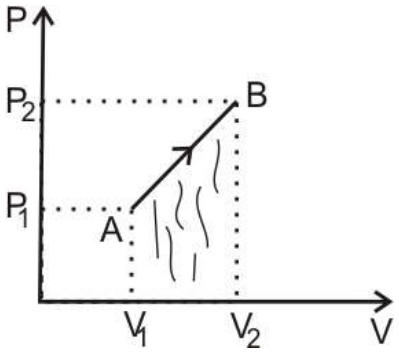
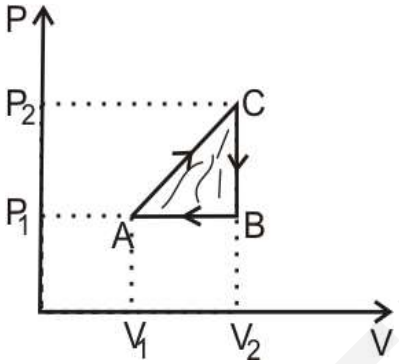
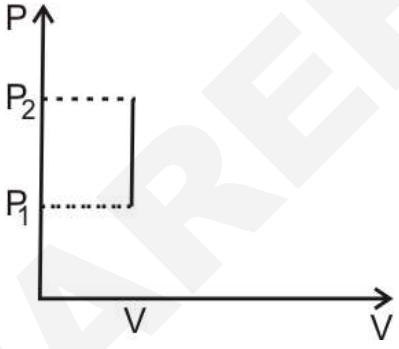
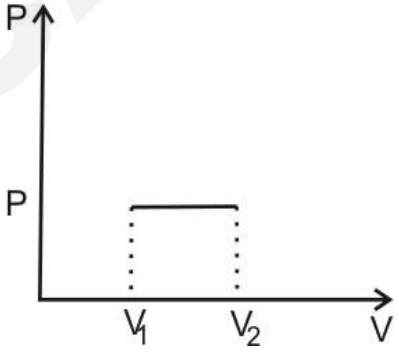
from (1) we get $V_2 = \frac{V_1}{T_1}T_2 - - - - (4)$

put this equation 4 is equation 3

$$P_1(\frac{V_1}{T_1})T_2 = P_3V_3$$

$$P_1V_1T_2 = P_3V_3T_1$$

Q. 22 choose the correct option

Graph		Work	
1		a	$P(V_2 - V_1)$
2		b	$W = 0$
3		c	$\frac{1}{2}(P_1 + P_2)(V_2 - V_1)$
4		d	$\frac{1}{2}(V_2 + V_1)(P_2 - P_1)$

Option 1:

1-a, 2-b, 3-c, 4-d

Option 2:
1-b, 2-a, 3-d, 4-c

Option 3:
1-c, 2-d, 3-a, 4-b

Option 4:
1-c, 2-d, 3-b, 4-a

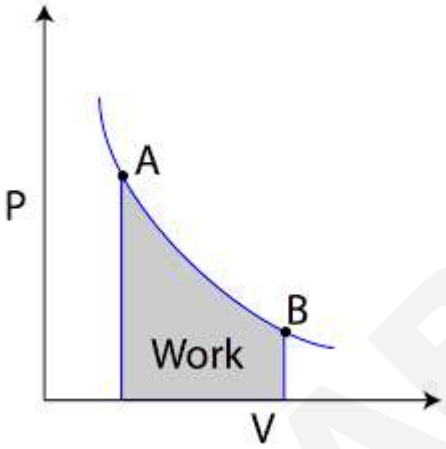
Correct Answer:
1-c, 2-d, 3-b, 4-a

Solution:
As we learned

Work by area -

If we plot a process on PV diagram.Then area under the curve will give work done.

- wherein



For a PV curve
Area under the curve will give the work done.

Q. 23 1mole of He gas expands adiabatically by decreasing its temperature by 2^{o} C Now tell the change in internal energy of the system during this process

$$\left(take \left[R = \frac{25}{3} Joule/K - Mol \right] \right)$$

Option 1:
$+25J$

Option 2:
$+30J$

Option 3:
$-25J$

Option 4:
$-30J$

Correct Answer:
$-25J$

Solution:
As we learned

Work done in Adiabatic process -

$$W = \int PdV$$

- wherein

$$W = \frac{nR\left(T_i - T_f\right)}{\gamma - 1}$$

$$\gamma = adiabatic\ exponent$$

For adiabatic process

$$\Delta Q = 0$$

$$\Delta W = \frac{nR\left(T_i - T_f\right)}{r - 1}$$

From 1st law

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

$$\Delta U = -\Delta W = \frac{nR\left(T_f - T_i\right)}{r - 1}$$

$$\Delta U = \frac{1 \times \frac{25}{3} \times (-2)}{\left(\frac{5}{3} - 1\right)} = -25 Joule$$

$$\Delta U = -25J$$

Q. 24 If m_1 is slope of PV curve for adiabatic process and m_2 is the slope of PV curve for isothermal process. Then $\frac{m_1}{m_2}$ is equal to

(slope of PV curve is $\frac{dP}{dV}$)

Option 1:

$\frac{1}{\gamma}$

Option 2:

γ

Option 3:

$(\gamma)^2$

Option 4:

$\frac{\gamma}{2}$

Correct Answer:

γ

Solution:

As we learned

Relation between slope of isothermal and adiabatic process -

$$\frac{dP}{dV}_{isothermal} = -\frac{P}{V}$$

$$\frac{dP}{dV}_{adiabatic} = -\gamma\frac{P}{V}$$

- wherein

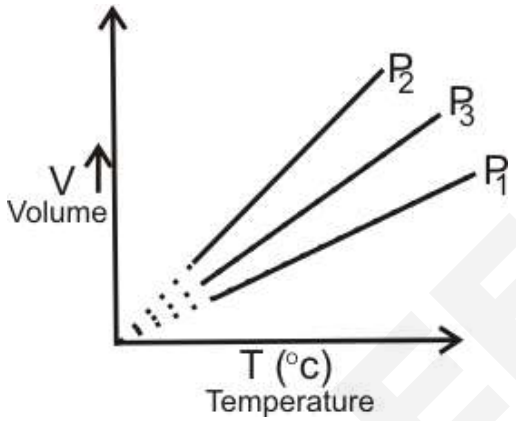
$$Slope\,of\,adiabatic\,process = \gamma \times Slope\,of\,isothermal\,process$$

$$\left(\frac{dP}{dV}\right)_{Isothermal} = m_2 = -\frac{P}{V}$$

$$\frac{dP}{dV}_{adiabatic} = m_1 = -Y\frac{P}{V}$$

$$\frac{m_1}{m_2} = \gamma\,(gamma)$$

Q. 25 What is the correct relation between $P_1\ and\ P_2\ and\ P_3$ according to chrles law , for the given V vs T graph for ideal gas



Option 1:
$P_1 > P_2 > P_3$

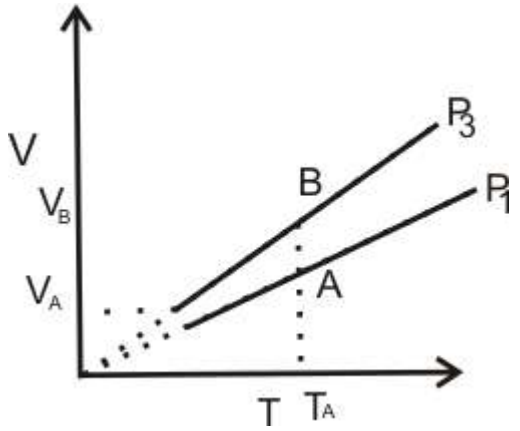
Option 2:
$P_1 > P_3 > P_2$

Option 3:
$P_3 > P_2 > P_1$

Option 4:
$P_3 > P_1 > P_2$

Correct Answer:
$P_1 > P_3 > P_2$

Solution:



Charles law says when pressure is constant then $V \propto T$

$$\Rightarrow \frac{V_1}{T_1} = \frac{V_2}{T_3} ----(1)$$

and for ideal gas

PV = nRT

for n = 1

$$P_1V_A = RT_A ---(2)(for\ A)$$

$$P_3V_B = RT_B ----(3)(For\ B)$$

$$T_A = T_B$$

$$P_3V_B = RT_A$$

$$\frac{P_1}{P_3} = \frac{V_B}{V_A}$$

$$P_1 > P_3 > P_2$$

Q. 26 3 mole of He is mixed with 2 mole of O_2 . Then find the value of $\frac{C_p}{C_v}$ for the mixture:

Option 1:

$\frac{5}{3}$

Option 2:

$\frac{5}{7}$

Option 3:

$\frac{17}{15}$

Option 4:

$\frac{29}{19}$

Correct Answer:

$\frac{29}{19}$

Solution:

for Monoatomic gas $\gamma = \frac{5}{3}$

for Diatomic gas $\gamma = \frac{7}{5}$

for Triatomic gas $\gamma = \frac{4}{3}$

For O_2

$C_{V_2} = \frac{5}{2}RT$

$C_{P_2} = \frac{7}{2}RT$

$n_2 = 2$

For He

$C_{V_1} = \frac{3}{2}RT$

$C_{P_1} = \frac{5}{2}RT$

$n_1 = 3$

$$\gamma_{mix} = \frac{n_1C_{P_1} + n_1C_{P_2}}{n_1C_{P_1} + n_1C_{P_2}} = \frac{3 * 5RT/2 \ + 2 * 7RT/2}{3 * 3RT/2 \ + 2 * 5RT/2} = 29/19$$

Q. 27 Two simple harmonic motions are represented by $y_1 = 2\sin\left(2\pi t + \frac{\pi}{2}\right)$ and $y_2 = 3\cos(2\pi t)$. The resultant amplitude is.

Option 1:
$\sqrt{13}\,unit$

Option 2:
5 units

Option 3:
$\sqrt{5}\,unit$

Option 4:
3 unit

Correct Answer:
5 units

Solution:
As we have learnt

Resultant Amplitude of Two SHM -

$$A = \sqrt{{A_1}^2 + {A_2}^2 + 2A_1A_2.\cos\phi}$$

$A_1 and A_2$ are amplitude of two SHM's. ϕ is phase difference.

- wherein

Both SHM's are along same direction and of same frequency.

$$y_1 = 2\sin\left(2\pi t + \frac{\pi}{2}\right) = 2\cos\left(2\pi t\right)$$

$$y_2 = 3\cos\left(2\pi t\right)$$

$$A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2 cos\phi}$$

$$\sqrt{4 + 9 + 12\cos\phi}$$

$$\sqrt{13 + 12}$$

5 units

Q. 28 A mass m is suspended seprately by two springs of spring constant $k_1 \; and \; k_2$. The time period obtained respectively are 3 sec and 4 sec. Now same mass is connected with series combination of springs. Then the new time period is.

Option 1:
1.2 sec

Option 2:
1 sec

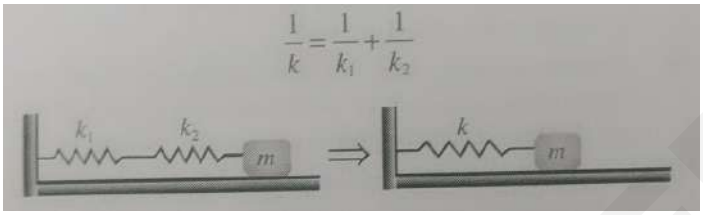
Option 3:
5 sec

Option 4:
13 sec

Correct Answer:
5 sec

Solution:
As we have learned

Series combination of spring -



- wherein

$$\frac{1}{K_{eq}}=\frac{1}{K_1}+\frac{1}{K_2}$$

$K_1 and\ K_2$ are spring constants of spring 1 & 2 respectively.

So

$$\frac{1}{K_s}=\frac{1}{K_1}+\frac{1}{K_2}$$

we have $T=2\pi\sqrt{\frac{m}{k}}\ ;m\ is\ same$

$K=\frac{d^2}{T^2}$ where d is some constant

$$\frac{1}{K}=\frac{T^2}{d^2}$$

$$\frac{T_s^2}{d^2}=\frac{T_1^2}{d^2}+\frac{T_2^2}{d^2}$$

$T_s^2=T_1^2+T_2^2$=9+16

T_s=5 sec

Q. 29 The time period of oscillation of a pendulum is T_1. Now the pendulum is kept in a lift moving downward with acceleration a. The time period of pendulum in lift is T_2. If the ratio $\frac{T_2^2}{T_1^2} = \frac{3}{2}$, Then acceleration is (g=10 m/s^2).

Option 1:
5 m/s^2

Option 2:
0.2 m/s^2

Option 3:
10 m/s^2

Option 4:
3.33 m/s^2

Correct Answer:
3.33 m/s^2

Solution:
Time period of simple pendulum accelerating downward -

$$T = 2\pi\sqrt{\frac{l}{g-a}}$$

- wherein

$l =$ length of pendulum

$g =$ acceleration due to gravity.

$A =$ acceleration of pendulum.

$$T_1 = 2\pi\sqrt{\frac{l}{g}}$$

$$T_2 = 2\pi\sqrt{\frac{l}{g-a}}$$

$$\frac{T_2^2}{T_1^2} = \frac{g}{g-a} = \frac{3}{2}$$

$$2g = 3g - 3a$$

$g = 3a$

$a = \frac{g}{3} = 3.33m/s^2$

Q. 30 Equation of a travelling wave is given by $y = Sin\left(10^9x - 222\pi \times 10^{12}t\right)$ The wave lengh is

Option 1:
$0.3m$

Option 2:
$2\,\pi\,nm$

Option 3:
$2\,\pi\,m$

Option 4:
$0.3\ nm$

Correct Answer:
$2\,\pi\,nm$

Solution:
As we learned

Traveling Wave Equation -

$y = A\sin\left(Kx - \omega t\right)$

- wherein

$K = 2\pi/\lambda$

$\omega = \frac{2\pi}{T}$

$\lambda =$ wavelength

$T =$ The time period of oscillation

$$y = Sin\,(Kx - wt)$$

$$K = \frac{2\pi}{\lambda} = 10^9$$

$$\therefore\ \lambda = 2\pi \times 10^{-9} m$$

Q. 31 The string was fixed at both ends and was oscillating in 3rd harmonic . Now if it is free from one and then it was oscillating in 2nd harmonic . Then what is the ratio of their frequency .

Option 1:
1

Option 2:
2

Option 3:
3

Option 4:
4

Correct Answer:
3

Solution:
As we learned from

String fixed at one end and free from other end -

$$f_n = n\frac{V}{4L}$$

$$n = 1, 3, 5.....$$

- wherein

$f_1 = \frac{V}{4L}$ is fundamental frequency

For string fixed at both ends

$$\nu_n = \frac{n}{2L} \times v$$

$$\nu_3 = \frac{3v}{2L}$$

For string fixed at one end and free from their end .

$$\nu_n = nV/4L$$

$$\nu_2 = 2V/4L$$

$$\frac{v_3}{v_2} = \frac{3v/4L}{2v/4L} = 3$$

Q. 32 A cylindrical piston of mass M slides smoothly inside a long cylinder closed at one end, enclosing a certain mass of gas. The cylinder is kept with its axis horizontal. If the position is disturbed from its equillibrium position, its oscillates simple harmonically. The period of the oscillation will be

Option 1:

$$T = 2\pi\sqrt{[\frac{Mh}{PA}]}$$

Option 2:

$$T = 2\pi\sqrt{[\frac{MA}{Ph}]}$$

Option 3:

$$T = 2\pi\sqrt{[\frac{M}{PAh}]}$$

Option 4:

$$T = 2\pi\sqrt{MPhA}$$

Correct Answer:

$$T = 2\pi\sqrt{[\frac{Mh}{PA}]}$$

Solution:

Let the piston be displaced through distance x towards left, then volume decreases, pressure increases. If ΔP is increase in pressure and ΔV is decrease in volume, then considering the process to take place gradually (i.e. isothermal)

$$P_1V_1 = P_2V_2$$
$$\Rightarrow PV = (P+\Delta P)(V-\Delta V)$$
$$\Rightarrow PV = PV + \Delta PV - P\Delta V - \Delta P\Delta V$$
$$\Rightarrow \Delta PV - P\Delta V = 0 \quad (neglecting\ \Delta P\Delta V)$$
$$\Rightarrow \Delta P(Ah) = P(Ax) \Rightarrow \Delta P = \frac{P\cdot x}{h}$$

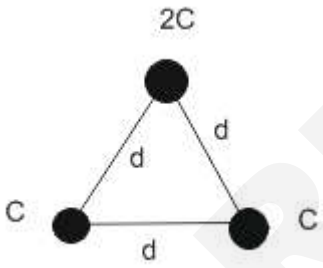
This execess pressure is resonsible for providing the restoring force (F) to the piston of mass m.

Hence $F = \Delta P \cdot A = \frac{PAx}{h}$

Comparing it with $|F| = kx \Rightarrow k = M\omega^2 = \frac{PA}{h}$

$$\Rightarrow \omega = \sqrt{\frac{PA}{Mh}} \Rightarrow T = 2\pi\sqrt{\frac{Mh}{PA}}$$

Q. 33



Three charge particles of charge 1C , 1C and 2C are placed at the vertices og an eqilateral triangle of side d as shown in the diagram. Then net force on charge 2C is $P \times \frac{1}{4\pi\epsilon_0 d^2}$ then the value of P is:

Option 1:

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

Option 2:

$\sqrt{3}$

Option 3:

$2\sqrt{3}$

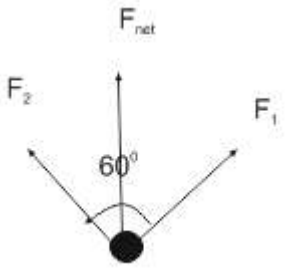
Option 4:
4

Correct Answer:
$2\sqrt{3}$

Solution:
As we learn

Magnitude of the Resultant force -

$$F_{net} = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\Theta}$$



$$F_1 = F_2 = \frac{1 \times 1 \times 2}{4\pi\epsilon_0 d^2} = \frac{2}{4\pi\epsilon_0 d^2}$$

$$F_{net} = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta} = \sqrt{2F^2 + 2F^2\cos 60} = \sqrt{2F^2 + 2F^2\frac{1}{2}}$$

$$F_{net} = \sqrt{3}F = \sqrt{3}\frac{2}{4\pi\epsilon_0 d^2} = 2\sqrt{3}\frac{1}{4\pi\epsilon_0 d^2}$$

Q. 34 If potential $V = -5x + 3y + \sqrt{15}z$, then electric field E(x, y, z) is:

Option 1:
10 unit

Option 2:
8 unit

Option 3:
7 unit

Option 4:
5 unit

Solution:
As we learn

Relation between field and potential -

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

- wherein

$\frac{dv}{dr}\ is$ Potential gradient.

$$\vec{E} == -gradV$$

$$\vec{E} = -\left[\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right]$$

$$\vec{E} = -\left[5\hat{i} + 3\hat{j} + \sqrt{15}\hat{k}\right] = \sqrt{25+9+15} = \sqrt{49} = 7unit$$

Q. 35 Electric current passing through a cross-section is given by $i(t) = 3t^2 + 2t + 4$. The quantity of charge which has passed through the cross-section during the time $t = 2sec$ to $t = 3sec$

Option 1:
8 coulomb

Option 2:
28 coulomb

Option 3:
107 coulomb

Option 4:
17 coulomb

Correct Answer:
28 coulomb

Solution:
As we learned

Total charge flowing -

$$dQ = Idt \Rightarrow \int dQ = \int Idt$$

$$Q = \int Idt$$

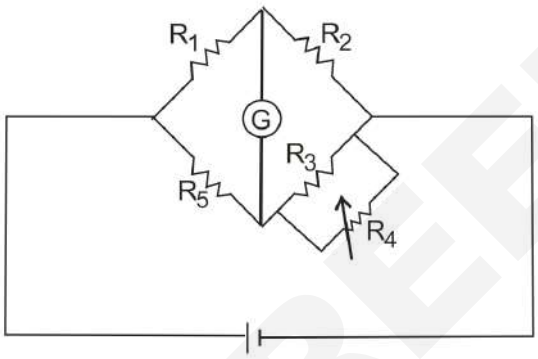
so

$$Q = \int_2^3 (3t^2 + 2t + 4)dt = (t^3 + t^2 + 4t)_2^3$$

$$= (27 + 9 + 12) - (8 + 4 + 8)$$

= 28 coulomb

Q. 36 If the galvanometer shows no deflection, then which of the following is right value of R_4



Option 1:

$$\frac{R_2R_3R_5}{R_1R_3 - R_2R_5}$$

Option 2:

$$\frac{R_1R_3}{R_2R_5}$$

Option 3:

$$\frac{R_2R_3}{R_2R_3 - R_5R_4}$$

Option 4:

None of these

Correct Answer:

$$\frac{R_2R_3R_5}{R_1R_3-R_2R_5}$$

Solution:
As we learned

Balanced Bridge -

when $\frac{P}{Q}=\frac{R}{S}$

(i.e Balanced condition)

then No current will flow through the galvanometer

So

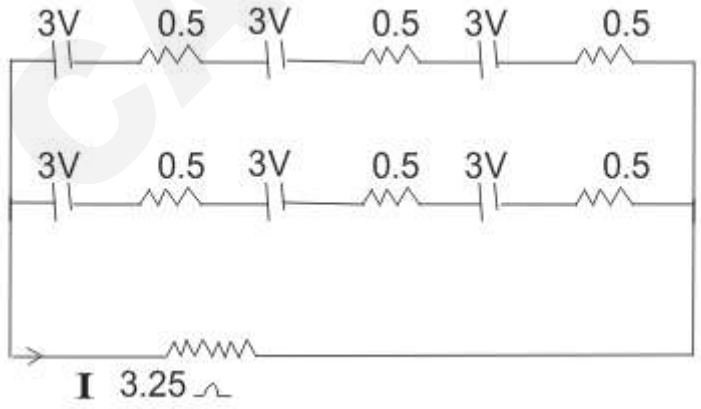
$$\frac{R_1}{R_2}=R_5\,\frac{(R_3+R_4)}{R_3R_4}$$

$$R_3R_4R_1=R_2R_3R_5+R_2R_4R_5$$

$$R_4\left(R_1R_3-R_2R_5\right)=R_2R_3R_5$$

$$R_4=\frac{R_2R_3R_5}{R_1R_3-R_2R_5}$$

Q. 37



The current flowing through 3.25Ω resistance is

Option 1:
$3A$

Option 2:
$2a$

Option 3:
$2.25A$

Option 4:
$1A$

Correct Answer:
$2.25A$

Solution:
As we learned

Main current flowing through the load -

$$i = \frac{nE}{R + \frac{nr}{m}} = \frac{mnE}{mR + nr}$$

-

$$i = \frac{nE}{R + \frac{n}{m}r}$$

n cells are connected in series and there are such m branches

$$i = \frac{3 \times 3}{3.25 + \frac{3}{2} \times 0.5}$$

$$= \frac{9 \times 2}{6.5 + 1.5} = \frac{9}{4} = 2.25A$$

Q. 38 A long straight wire of radius r carries a current i. The current is uniformly distributed across the cross - section. The ratio of magnetic field at $\frac{R}{3}$ and $\frac{3}{2}R$ is:

Option 1:
2

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

Option 3:
1

Option 4:
$\frac{2}{9}$

Correct Answer:
$\frac{1}{2}$

Solution:

Magnetic field inside the cylinder at $\frac{R}{3}$ is

$$B_1 = \frac{\mu_0 i \frac{r}{3}}{2\pi r^2} = \frac{\mu_0 i}{6\pi r}$$

Magnetic field outside at $\frac{3}{2}R$ is:

$$B_2 = \frac{\mu_0 i}{2\pi \frac{3}{2} r} = \frac{2\mu_0 i}{6\pi r}$$

$$\frac{B_1}{B_2} = \frac{1}{2}$$

Q. 39 An electric field of 1500 V/m and magnetic field of 0.5 weber / m act on a moving electron . The minimum uniform speed along a staright line the electron could have is

Option 1:
3000 m/s

Option 2:
1000 m/s

Option 3:
2500 m/s

Option 4:
2000 m/s

Correct Answer:
3000 m/s

Solution:
As we have learned

Lorentz Force -

$$\underset{F}{\rightarrow} = q[\underset{E}{\rightarrow} + (\underset{V}{\rightarrow} \times \underset{B}{\rightarrow})]$$

- wherein

Lorentz equation

$$\vec{F}_e = eE \quad \vec{F}_m = e(\vec{V} \times \vec{B})$$

for electron to move along straight at line with uniform field

$$\left|\vec{F}e\right| = \left|\vec{F}m\right| \Rightarrow eE = evB\sin\theta$$

$$v = E/B\sin\theta$$

for v to be minimum $\sin\theta$ should be minimum $\theta = 90^\circ$

v=1500 / 5 = 3000 m/s

Q. 40 A material is placed in a magnetic field and it is thrown out of it . Then the material is

Option 1:
paramagnetic

Option 2:
diamagnetic

Option 3:
ferromagnetic

Option 4:
non magnetic

Correct Answer:
diamagnetic

Solution:
As we have learned

Dia-magnetic Substance -

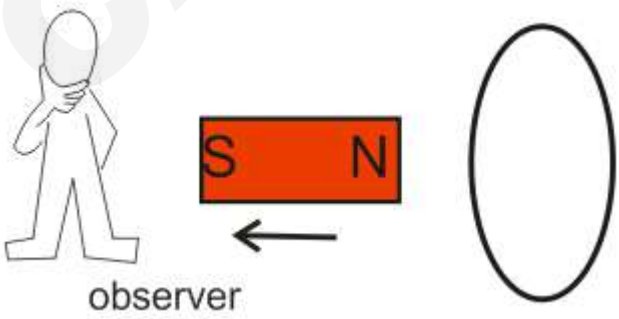
The substance which are feebly magnetised in a direction opposite to that of magnetising field in which those are placed.

- wherein

Bismuth antimony, copper gold quartz, etc are diamagnetic substance.

Diamagnetic magnetic susbstance is replied by magnetic field

Q. 41 As shown in diagram a bar magnet is taken away from a conducting coil, then as seen from the observer the induced current in the coil will be-



Option 1:
in clockwise direction

Option 2:
in anticlockwise direction

Option 3:
can't decide any direction.

Option 4:
no induced current will be there

Correct Answer:
in clockwise direction

Solution:
As we have learnt,

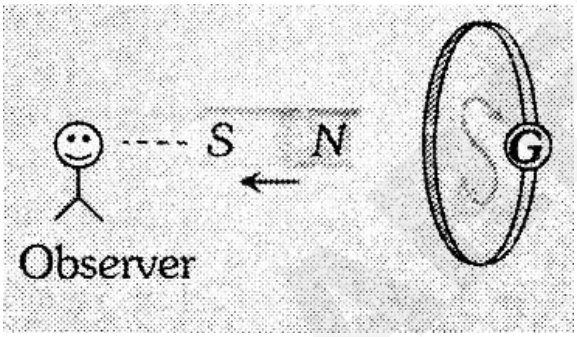
Direction of induced current -

Clockwise Direction

As a south pole

Attractive force

- wherein



According to Lenz law clockwise direction.

Q. 42 A metallic disc of radius 0.1 m is rotated about its centre with angular velocity $20\pi\ rad/sec$ in a uniform magnetic field of 0.1T with its plane perpendicular to the field. The emf induced across the radius of the disc is-

Option 1:
$2\pi \times 10^{-2}V$

Option 2:

$\pi \times 10^{-3} V$

Option 3:

$\frac{\pi}{2} \times 10^{-2} V$

Option 4:

$3\pi \times 10^{-2} V$

Correct Answer:

$\pi \times 10^{-3} V$

Solution:

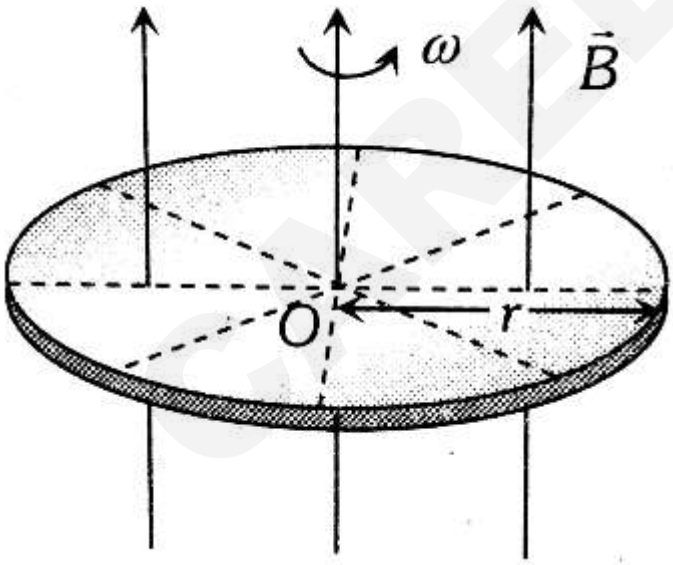
As we have learnt,

Motional E.m.f due to rotational motion -

Metal Disc

$$\varepsilon = \frac{1}{2} B w r^2$$

- wherein

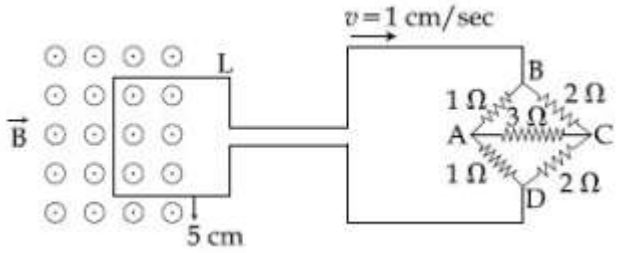


$$e = \frac{1}{2} B \omega l^2$$

$$= \frac{1}{2} \times (0.1) \times 2\pi \times (0.1)^2$$

$= \pi \times 10^{-2} V$

Q. 43 The figure shows a square loop L of side 5 cm which is connected to a network of resistances. The whole setup is moving towards right with a constant speed of $1cm\ s^{-1}$. At some instant, a part of L is in a uniform magnetic field of 1 T, perpendicular to the plane of the loop. If the resistance of L is 1.7Ω, the current (in μA) in the loop at that instant will be close to :



Option 1:
170

Option 2:
115

Option 3:
60

Option 4:
150

Correct Answer:
170

Solution:

Motional EMF -

$$\varepsilon = Blv$$

- wherein

$B \rightarrow$ magnetic field

$l \rightarrow$ length

$u \rightarrow$ velocity of u perpendicular to uniform magnetic field.

$B = 1T$

$L = 5 \times 10^{-2}m$

$v = 1 \times 10^{-2}m/s$

$E = BVL = 5 \times 10^{-4}V$

The circuit ABCD is a wheat stone bridge circuit

$\Rightarrow Req = \frac{4 \times 2}{4+2} = \frac{4}{3}\Omega$

It is given the resistance of square = 1.7Ω

R total = $\frac{4}{3} + 1.7\Omega$

$I = \frac{V}{R} = \frac{5 \times 10^{-4}}{\frac{4}{3} + 1.7} = 170\mu A$

Q. 44 A coil of area 100cm^2 has 100 turns the magnetic field of 0.1 weber/m^2 is perpendicular to the coil. The field reduced to zero in 0.02 sec. The induced emf in the coil is-

Option 1:
1V

Option 2:
50V

Option 3:
5V

Option 4:
10V

Correct Answer:
5V

Solution:
As we have learnt.

Flux may change with time in several ways -

$\varepsilon = N\frac{-d}{dt}(BA\cos\Theta)$

- wherein

$$\phi = BA\cos\Theta$$

$$e = -\frac{N(B_2 - B_1)A\cos 0}{\Delta t}$$

$$= -\frac{100(0 - 0.1)100 \times 10^{-4}}{0.02}$$

$$= 5V$$

Q. 45 An alternating current in a circuit is given by $I = 20\sin(100\pi t + 0.05\pi)A$. The frequency of the current is-

Option 1:
50Hz

Option 2:
100Hz

Option 3:
25Hz

Option 4:
75Hz

Correct Answer:
50Hz

Solution:
As we have learnt,

Equation of I -

$$I = I_0\sin\omega t = I_0\sin 2\,\pi\,\nu\,t$$

$$I = I_0\sin\frac{2\pi}{T}t$$

- wherein

$\omega =$ Angular frequency

ν = Frequency

T = time period

$$\omega = 100\pi = 2\pi f$$
$$\Rightarrow f = 50Hz$$

Q. 46 A resistance of 40ω and inductance of $\frac{1}{\pi}$ henry are connected in series in a 15 cycle/ second a.C circuit . The impendance of this combination is:

Option 1:
30 ohm

Option 2:
40 ohm

Option 3:
50 ohm

Option 4:
60 ohm

Correct Answer:
50 ohm

Solution:
As we learn

Impedence -

$$Z = \sqrt{R^2 + 4\pi^2\nu^2L^2}$$

-

Impedence $Z = \sqrt{R^2 + L^2w^2} = \sqrt{(40)^2 + \left(\frac{1}{\pi} \times 2\pi \times 15\right)^2} = \sqrt{(40)^2 + (30)^2} = 50$

Q. 47 When the rms voltages V_L, V_C and V_R are measured respectively across the inductor L, the capacitor C and the resistor R in a series LCR circuit connected to an AC source, it is found that the ratio $V_L : V_C : V_R = 1 : 2 : 3$. If the rms voltage of the AC source is 100 V, then V_R is close to :

Option 1:
50 V

Option 2:
70 V

Option 3:
90 V

Option 4:
110 V

Correct Answer:
90 V

Solution:

$$V_R = 3K,\ V_L = K,\ V_C = 2K$$

$$V = \sqrt{V_R^2 + (V_L - V_C)^2}$$

or $100V = \sqrt{9K^2 + K^2} = K\sqrt{10}$

$$\therefore V_R = 3 \times \frac{100}{\sqrt{10}} = 94.86$$

Q. 48 A plane electromagnetic wave of frequency 12.5 MHz travels in free space along the x - direction. At particular point in a space and time $E = 3.3\hat{j}\frac{V}{m}$.

What is B at this point?

Option 1:
2.1×10^{-8} T

Option 2:
3×10^{-8} T

Option 3:
1.1×10^{-8} T

Option 4:
4.4 x 10^{-8} T

Correct Answer:
1.1 x 10^{-8} T

Solution:
As we learn

Relation between Eo and Bo -

$$E_o = c.B_o$$

- wherein

E_o= Electric field amplitude

B_o = Magnetic field amplitude

C= Speed of light in vacuum

$$B = \frac{E}{C} = \frac{3.3}{3 \times 10^8} = 1.1 \times 10^{-8} T$$

Q. 49 If the total electromagnetic energy falling on a surface is U, then the total momentum change (for complete reflection) is

Option 1:
$\frac{u}{c}$

Option 2:
uc

Option 3:
$\frac{u}{c^2}$

Option 4:
$\frac{2u}{c}$

Correct Answer:
$\frac{2u}{c}$

Solution:
As we learned

Momentum of EM wave -

$$p = \frac{u}{c}$$

- wherein

u = Energy of EM wave

c = Speed of light in vacuum

For complete reflection

$$\Delta p = \frac{2u}{c}$$

Q. 50 In an Electromagnetic wave the amplitude of electric field is $1\frac{V}{m}$. The frequency of wave is $5 \times 10^{-14} Hz$. The wave is propagating along z axis, the average energy density of electric field will be.

Option 1:
1.1×10^{-11}

Option 2:
2.2×10^{-12}

Option 3:
3.3×10^{-15}

Option 4:
4.4×10^{-14}

Correct Answer:
2.2×10^{-12}

Solution:
As we learned

The average energy density of EM wave -

$$U_{avg} = \frac{1}{2}\epsilon_o E_o^2$$

- wherein

E_o = Electric field amplitude

ϵ_o = Permittivity of vacuum

The average energy density of the electric field $= \frac{1}{2}\epsilon_o E_{rms}^2 = \frac{1}{2}\epsilon_o E_{rms}^2 = \frac{1}{2}\epsilon_o \left(\frac{E_o}{\sqrt{2}}\right)^2$

$= \frac{1}{4}\epsilon_o E^2 = \frac{1}{4} \times 8.85 \times 10^{-12} \times (1)^2 = 2.2 \times 10^{-12} J/m^3$

Q. 51 A ray of light strikes a transprant slab of refractive index $\sqrt{2}$ at an angle of 45^0. the angle of refraction of light is

Option 1:
30^0

Option 2:
60^0

Option 3:
90^0

Option 4:
45^0

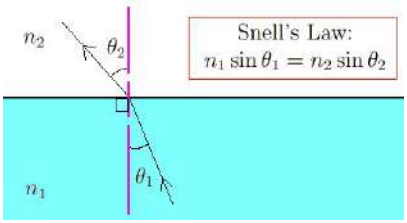
Correct Answer:
30^0

Solution:
as we learn

Relation between angle of incidence and angle of refaction -

$\mu_1 \sin i = \mu_2 \sin r$

- wherein



$\mu_1 =$ refractive index of medium of incidence.

$\mu_2 =$ refractive index of medium where rays is refracted.

$i =$ angle of incidence.

$R =$ angle of refraction.

Applying sell's law

$\mu_a \sin i = \mu_g \sin r$

$\sin i = \sqrt{2} \sin r$

$\sin r = \frac{1}{2} \sin (45^0)$

$= \frac{1}{2}$

$r = \sin^{-1}(\frac{1}{2}) = 30^0$

Q. 52 A convex mirror having focal length 'F' form an image of $\frac{1}{n}$ times of object. The distance of the object from mirror is

Option 1:
$(n+1)\, f$

Option 2:
nf

Option 3:
$\frac{f}{n}$

Option 4:
$(n-1)\, f$

Correct Answer:
$(n-1)\, f$

Solution:
As we learn

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.

magnification is given by

$$m=\frac{1}{n}=\frac{-v}{u}$$

$$\Rightarrow v=-\frac{u}{n}$$

by using a mirror formula

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u} \quad =\frac{1}{-u \setminus n}+\frac{1}{u}$$

$$u=-(n-1) f$$

Q. 53 In Young's experiment the distance between the two slit is made half, then the fringe width will become

Option 1:
Unchanged

Option 2:
Double

Option 3:
One fourth

Option 4:
Half

Correct Answer:
Double

Solution:
AS we learn

Fringe Width -

$$\beta = \frac{\lambda D}{d}$$

- wherein

$\beta = y_{n+1} - y_n$

y_{n+1} = Distance of $(n+1)^{th}$

Maxima $= (n+1)\frac{\lambda D}{d}$

y_n = Distance of n^{th}

maxima $= \frac{n\lambda D}{d}$

$$\beta \propto \frac{1}{d}$$

Q. 54 If an α particle and a proton are accelerated, using a potential difference V_1 & V_2 respectively such that $V_1 = 4V_2$, Then find the ratio of $\left(\frac{\lambda_p}{\lambda_\alpha}\right)$

Option 1:
4

Option 2:
$4\sqrt{2}$

Option 3:
$\sqrt{2}$

Option 4:
$8\sqrt{2}$

Correct Answer:
$4\sqrt{2}$

Solution:
As we learned

De - Broglie wavelength with charged particle -

$$\lambda = \frac{h}{\sqrt{2mE}} = \frac{h}{\sqrt{2mE}}$$

$$\lambda = \frac{h}{\sqrt{2mqv}}$$

- wherein

$E \rightarrow kinetic\ energy\ of particle$

$q \rightarrow charged\ particle$

$$\lambda = \frac{h}{\sqrt{2mqv}}$$

$$\frac{\lambda_p}{\lambda_\alpha} = \frac{\sqrt{m_\alpha q_\alpha v_\alpha}}{\sqrt{m_p q_p v_p}} = \sqrt{\frac{4m_p \times e \times 4v_2}{m_p \times e \times v_2}}$$

$$\frac{\lambda_p}{\lambda_\alpha} = 4\sqrt{2}$$

Q. 55 Velocity of the electron in 4th orbital is V_1 while velocity of electron in 5th orbital is V_2 . Then ratio of $\frac{V_1}{V_2}$ will be:

Option 1:

$\frac{5}{4}$

Option 2:

$\frac{4}{5}$

Option 3:

$\frac{3}{4}$

Option 4:

$\frac{4}{3}$

Correct Answer:

$\frac{4}{5}$

Solution:

As we learn

Velocity of electron in nth orbital -

$$v = \left(\frac{e^2}{2\epsilon_0 h}\right)\frac{z}{n}$$

- wherein

$$v\ \alpha \frac{z}{n}$$

$$\frac{e^2}{2\epsilon_0 h} = \frac{c}{137}$$

$$V \propto \frac{Z}{n} \Rightarrow V = k\frac{Z}{n}$$ k = constant

$$V_1 = k\frac{Z}{4}$$

$$V_2 = k\frac{Z}{5}$$

$$\frac{V_1}{V_2} = \frac{4}{5}$$

Q. 56 The half-life period of a radio-active element **X** is same as the mean life time of another radio-active element **Y** . Initially they have the same number of atoms. Then

Option 1:

X and Y decay at same rate always

Option 2:

X will decay faster than **Y**

Option 3:
Y will decay faster than **X**

Option 4:
X and Y have same decay rate initially

Correct Answer:
X will decay faster than **Y**

Solution:
$\tau_{1/2}(i.e\ half\ life\ ) of X = \tau_{\gamma}(i.e\ mean\ life)\ of\ Y$

So

$$\frac{ln2}{\lambda_X} = \frac{1}{\lambda_Y} \Rightarrow \lambda_X = \lambda_Y ln2$$

$$\lambda_X > \lambda_Y$$

And corresponding Activity is given as

$$\therefore A_X = A_0 e^{-\lambda_X t}; A_Y = A_0 e^{-\lambda_Y t};$$

X will decay faster than Y

The correct option is 2

Q. 57 $\overline{E + \overline{C}D} =$

Option 1:
E . (C + D)

Option 2:
$\overline{E}.(\overline{C} + \overline{D})$

Option 3:
$\overline{E}.(C + \overline{D})$

Option 4:
None of these

Correct Answer:
$\overline{E}.(C + \overline{D})$

Solution:
As we learn

D'morgan's Theorem -

1) $\overline{A+B}=\bar{A}\cdot\bar{B}$

2) $\overline{A\cdot B}=\bar{A}+\bar{B}$

3) $\overline{\bar{A}+\bar{B}}=A\cdot B$

4) $\overline{\bar{A}\cdot\bar{B}}=A+B$

- wherein

A and B are input.

$$\begin{aligned}\overline{E+\overline{C}D}&=\overline{E}.\overline{\overline{C}D}\\&=\overline{E}(\overline{\overline{C}}+\overline{D})\\&=\overline{E}(C+\overline{D})\end{aligned}$$

Q. 58 In a sinusodial carrier voltage maximum and minimum modulated carrier amplitude of 110v &90v respectively then modulation index given by

Option 1:
o.2

Option 2:
0.1

Option 3:
0.3

Option 4:
0.4

Correct Answer:
0.1

Solution:
as we learn

Modulation Index if the maximum and minimum amplitude is given -

$$m_a=\frac{E_{max}-E_{min}}{E_{max}+E_{min}}$$

so

$$m_a = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} = \frac{110 - 90}{110 + 90} = \frac{20}{200} = 0.1$$

Q. 59 what should be the height of transmitting antenna if TV telecast is to cover a radius 128 Km

Option 1:
1280 m.

Option 2:
1560 m.

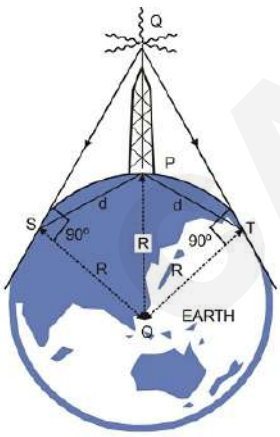
Option 3:
640 m.

Option 4:
320 m.

Correct Answer:
1280 m.

Solution:
Range of transmitting antenna -

$$d_T = \sqrt{2h_T R}$$



h_T = height of antenna

R = Radius of earth

$$d = \sqrt{2hR} = h = \frac{d^2}{2R} = h = \frac{(128 \times 10^3)^3}{2 \times 6400 \times 10^3} = \frac{128 \times 128 \times 10^6}{7 \times 64 \times 10^5}$$

d =1280 meter

Q. 60 A message signal of frequency 100 MHz and peak voltage 100V is used to execute amplitude modulation on a carrier wave of frequency 300 GHz and peak voltage 400V. The modulation index and difference between the two side band frequencies are:

Option 1:
$4; 1 \times 10^8\ Hz$

Option 2:
$4; 2 \times 10^8\ Hz$

Option 3:
$0.25; 2 \times 10^8\ Hz$

Option 4:
$0.25; 1 \times 10^8\ Hz$

Correct Answer:
$0.25; 2 \times 10^8\ Hz$

Solution:

Modulation Index -

The ratio of change of amplitude of carrier wave to the amplitude of original carrier wave.

- wherein

$$m_a = \frac{E_m}{E_c}$$

Side band frequency -

AM wave contains three frequency $f_c, (f_c + f_m)\ and\ (f_c - f_m)$

- wherein

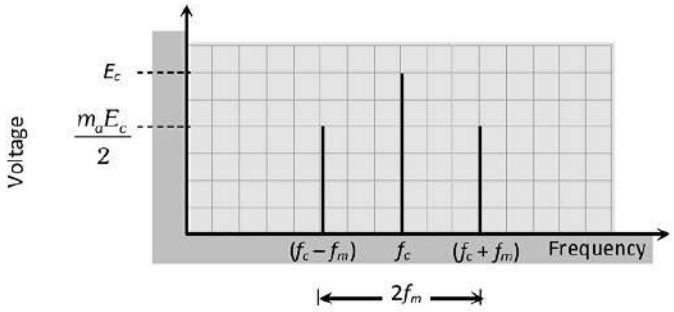
f_c is carrier frequency, $f_c - f_m\ and\ f_c + f_m$ are side band frequency.

Band Width -

The two side band lie on either side of the carrier frequency at equal frequency intravel, f_m

- wherein

$$Band\,Width = (f_c + f_m) - (f_c - f_m)$$
$$= 2f_m$$



$$f_m = 100MHz$$

$$E_m = 100V$$

$$f_c = 300GHz$$

$$E_c = 400V$$

Modulation index $= m = \frac{E_m}{E_c} = \frac{100}{400} = 0.25$

and

$$\Delta f = (f_c + f_m) - (f_c - f_m) = 2f_m$$

$$\Delta f = 2 \times 10^2 \times 10^6 Hz$$

$$\Delta f = 2 \times 10^8 Hz$$

Chemistry

Q. 1 Find the equivalent mass of H_3PO_4 in the reaction:

$$Ca(OH)_2 + H_3PO_4 \rightarrow CaHPO_4 + 2H_2O$$

Option 1:
55

Option 2:
43

Option 3:
49

Option 4:
37

Correct Answer:
49

Solution:
In this given reaction only two hydrogen atoms are replaced so its equivalent mass will be given as follows:

Equivalent mass of H_3PO_4 = (Molecular Mass of H_3PO_4) / 2

$\therefore$ 98 / 2 = 49

$\therefore$ Option (3) is correct

Q. 2 Which of the following pair are isobars?

Option 1:
$_6C^{13}$, $_7N^{13}$

Option 2:
$_6C^{13}$, $_7N^{14}$

Option 3:
$_7N^{14}$, $_8O^{15}$

Option 4:
$_7N^{13}$, $_8O^{15}$

Correct Answer:
$_6C^{13}$, $_7N^{13}$

Solution:
As we learn

Isobars -

Atoms with same mass number but different atomic number

-

$_6C^{13}$, $_7N^{13}$ is an isobaric pair.

Hence, the option number (1) is correct.

Q. 3 The increasing order of the ionic radii of the given isoelectronic species is :

Option 1:
$Cl^-, Ca^{2+}, K^+, S^{2-}$

Option 2:
$S^{2-}, Cl^-, Ca^{2+}, K^+,$

Option 3:
$Ca^{2+}, K^+, Cl^-, S^{2-}$

Option 4:
$K^+, S^{2-}, Ca^{2+}, Cl^-$

Correct Answer:
$Ca^{2+}, K^+, Cl^-, S^{2-}$

Solution:
As learnt in

Size of isoelectronic species -

Smaller the value of z/e, larger the size of that species.Smaller z means effective nuclear charge is small hence size is large.

-

For isoelectronic species as effective nuclear charge increases, ionic radii decreases. Nuclear charge is maximum of the species with maximum protons. Order of nuclear charge:

	Ca^{2+} >	K^+ >	Cl^- >	S^{2-}
Protons :	20	19	17	16
Electrons :	18	18	18	18

Thus increasing order of ionic radii

$Ca^{2+} < K^+ < Cl^- < S^{2-}$

Hence, the option number (3) is correct.

Q. 4 Hybridisation of X_eF_6 is:

Option 1:
Sp^3d

Option 2:
Sp^3d^2

Option 3:
Sp^3d^3

Option 4:
dsp^2

Correct Answer:
Sp^3d^3

Solution:
X_eF_6 :

Hybridisation $= X = \frac{1}{2}(V + S \pm C)$

$= \frac{1}{2}(8 + 6) = 7$

$\therefore$ Hybridisation = Sp^3d^3

Hence, the option number (3) is correct.

Q. 5 What is the state of water below 0^oC?

Option 1:
Solid

Option 2:
Liquid

Option 3:
Gas

Option 4:
Plasma

Correct Answer:
Solid

Solution:
Water exists in three different forms i.e, solid, liquid and gas. Below 0^oC, intermolecular hydrogen bonding is very strong between the different water molecules, thus water exists in solid form as ice.

Therefore, **Option(1) is correct.**

Q. 6 Lattice energy is inversely proportional to sum of radii of:

Option 1:
Cation

Option 2:
Anion

Option 3:
Atoms

Option 4:
Both cation and anion

Correct Answer:
Both cation and anion

Solution:
Lattice energy is directly related to the product of the ion charges and inversely related to the internuclear distance (which is the sum of radii of cation and anion).

Therefore, option(4) is correct.

Q. 7 Value of equilibrium constant depends upon:

Option 1:
Temperature

Option 2:
Method of expressing activity or active mass

Option 3:
Both 1 and 2

Option 4:
Volume

Correct Answer:
Both 1 and 2

Solution:
Equilibrium constants are changed if you change the temperature of the system. Kc or Kp is constant at a constant temperature, but they vary as the temperature changes.

- **The equilibrium constant K is determined by the activities of the components in the equilibrium expression.**
- **The value of Kc and Kp can be different in magnitude as well as dimensions.**

Therefore, the option number (3) is correct.

Q. 8 An example of a disproportionation reaction is :

Option 1:
$2CuBr \rightarrow CuBr_2 + Cu$

Option 2:
$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

Option 3:
$2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$

Option 4:
$2NaBr + CI_2 \rightarrow 2NaCI + Br_2$

Correct Answer:
$2CuBr \rightarrow CuBr_2 + Cu$

Solution:
Disproportionation reactions are those reactions where oxidation & reduction occur on the same species, simultaneously

$$2CuBr \rightarrow CuBr_2 + Cu$$

the oxidation state of Cu : $+1 \qquad +2 \qquad 0$

in KMnO4 reaction, Mn is going +7 to +6 and +4, only reduction.

In MnO^{4-} and I^- reaction, Mn is going to +7 to +2 and I is going to -1 to zero, both reduction and oxidation but with different atoms.

In NaBr and Cl_2 reaction, both reduction and oxidation but with different atoms.

Therefore, option (1) is correct

Q. 9 The structure of H_2O_2 molecule is:

Option 1:
Linear

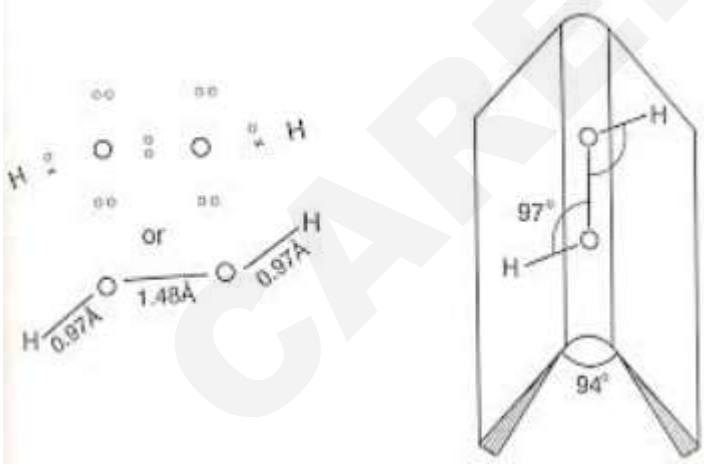
Option 2:
Closed book like

Option 3:
Half-open book like

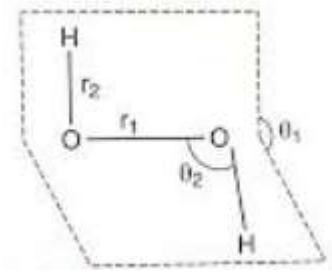
Option 4:
Cyclic

Correct Answer:
Half-open book like

Solution:
The molecule can be pictured as lying on the spine of a book open to an angle of 94°. The hydrogen atoms are present one on each cover and H-O bonds making angles of 97° with the O-O bond as shown in the figure given below



The structure of H_2O_2 is slightly different in the gas phase and crystalline phase.



So, "Half-open book like" will be correct.

Therefore, **Option(3) is correct**

Q. 10 Which of the following is an amphoteric hydroxide?

Option 1:
$Sr(OH)_2$

Option 2:
$Ca(OH)_2$

Option 3:
$Mg(OH)_2$

Option 4:
$Be(OH)_2$

Correct Answer:
$Be(OH)_2$

Solution:
Basic nature of hydroxides of alkaline metals -

Except $Be(OH)_2$ all hydroxides are basic in nature. this character increases down the group. The basic character increases down the group because the polarizing power of cation decreases down the group and hence, the covalent character.
$Be(OH)_2$ is amphoteric.

Due to the weak M-OH bond which breaks easily heterolytically to yield OH^-.

An Amphoteric hydroxide can neutralize acids and bases.

$$\text{Acid: } Be(OH)_2 + 6H^+ \longrightarrow 2Be^{2+} + 2H_2O$$
$$\text{Base: } Be(OH)_2 + 2OH^- \longrightarrow Be(OH)_4^{2-}$$

Hence, option number (4) is correct.

Q. 11 Arrange the following in decreasing order their melting point

1)NeoPentane 2)n-pentane 3)Isopentane

Option 1:
1>2>3

Option 2:
3>2>1

Option 3:
1>3>2

Option 4:
3>1>2

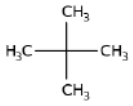
Correct Answer:
1>2>3

Solution:
As we learnt

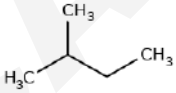
Melting Point -

On increasing molecular mass melting point of alkane increase. Also in the case of isomeric alkane neo alkane have highest melting point.

- wherein

Neopentane(C_5H_{12}): 

n-Pentane(C_5H_{12}): 

isopentane(C_5H_{12}): 

For different isomers of an alkane, alkane with a spherical shape molecule has the highest melting point due to the most compact packing in solid-state.

$$Melting\ Point \Rightarrow Neopentane > n-pentane > isopentane$$

Therefore, **option (1) is correct.**

Q. 12 The aerosol is a kind of colloid in which :

Option 1:
solid is dispersed in gas

Option 2:
gas is dispersed in solid

Option 3:
gas is dispersed in liquid

Option 4:
liquid is dispersed in water

Correct Answer:
solid is dispersed in gas

Solution:
As we have learnt,

Aerosol is suspension of fine solid or liquid particles in air or other gas.

Example :- fog,dust,smoke etc.

Therefore, option (1) is correct.

Q. 13 A metal has FCC structure and the edge length of its unit cell is 3.04 $\mathring{A}$. The volume of the unit cell in cm^3 will be

Option 1:
1.6×10^{-21} cm^3

Option 2:
2.9×10^{-23} cm^3

Option 3:
6.02×10^{-23} cm^3

Option 4:
6.6×10^{-24} cm^3

Correct Answer:
2.9×10^{-23} cm^3

Solution:
As we learnt in

Relation between radius of constituent particle, r and edge length, a for face centered cubic unit cell -

$$AB^2 = b^2 = a^2 + a^2.$$

$$b = 4r.$$

$$a = 2\sqrt{2}r.$$

-

$$volume\ of\ cube = a^3$$

$$= \left(3.04 \times 10^{-8}\right)^3$$

$$= 2.9 \times 10^{-23} cm^3$$

Q. 14 On increasing the temperature, the value of K_H will

Option 1:
Increase

Option 2:
Decrease

Option 3:
Remain Same

Option 4:
Either Increase or Decrease

Correct Answer:
Increase

Solution:
Henry's constant depends on temperature and nature of gas.

K_H increases on increasing temperature.

Therefore, **option (1) is correct**

Q. 15 Which of the following is true about chemical cells?

Option 1:
Convert chemical energy to electrical energy

Option 2:
most batteries are chemical cells

Option 3:
i and ii

Option 4:
none

Correct Answer:
i and ii

Solution:
As we learnt

Chemical Cells -

The cells in which electrical energy is produced from the energy change accompanying chemical reactions or a physical process are known as chemical cells.

-

Chemical cells convert chemical energy to electrical energy

Hence, the option number (3) is correct.

Q. 16 Adsorption is an

Option 1:
Endothermic process

Option 2:
Exothermic Process

Option 3:
Both A & B

Option 4:
None of these

Correct Answer:
Exothermic Process

Solution:
The heat of Adsorption -

An important factor with adsorption is the heat of adsorption. During adsorption, there is always a decrease in residual forces at the surface i.e. there is a decrease in surface energy which appears as heat., Heat is **released** during adsorption.

So, adsorption is an exothermic process.

Therefore, option (2) is correct.

Q. 17 The $C-C$ bond length is maximum in:

Option 1:
Graphite

Option 2:
C_{70}

Option 3:
C_{60}

Option 4:
Diamond

Correct Answer:
Diamond

Solution:
As we have learnt,

Graphite and Fullerenes (C_{60} and C_{70}) have a partial double bond character between the Carbon atoms due to conjugation.

Diamond on the other hand contains only singly bonded carbon atoms and hence, the bond length is greatest in Diamond.

Therefore, **option (4) is correct.**

Q. 18 In the extraction of which of the following, complex ion is formed:

Option 1:
Cu

Option 2:
Ag

Option 3:
Fe

Option 4:
Na

Correct Answer:
Ag

Solution:
The extraction of Silver is done using the McArthur Forest Cyanide method.

$$Ag_2S + 4NaCN \rightleftharpoons 2Na[Ag(CN)_2] + Na_2S$$

Sodium dicyano argentate

$$2Na[Ag(CN)_2] + Zn \rightarrow Na_2[Zn(CN)_4] + 2Ag$$

Sodium tetracyano zincate

Therefore, **option (2) is correct.**

Q. 19 The oxidation state of cobalt in the complex compound $[Co(NH_3)_6]Cl_3$ is

Option 1:
+3

Option 2:
+6

Option 3:
+5

Option 4:
+2

Correct Answer:
+3

Solution:
$[Co(NH_3)_6]Cl_3 \rightarrow [Co(NH_3)_6]^{3+} + 3Cl^-$

Applying charge balance on the cationic complex gives us

$x + 6(0) = +3$

$\Rightarrow x = 3$

Therefore, **Option(1) is correct.**

Q. 20 Alkyl halides react with dialkyl copper reagents to give:

Option 1:
alkenes

Option 2:
alkyl copper halides

Option 3:
alkanes

Option 4:
alkenyl halides

Correct Answer:
alkanes

Solution:
As we learnt in

The reaction of an alkyl halide with R2CuLi -

Corey House alkane synthesis, the alkane is obtained as a product.

- wherein

$$\text{R-X} + \text{Li} \rightarrow \text{R-Li} + \text{CuI} \rightarrow \text{R}_2\text{CuLi}$$

$$\text{R}_2\text{CuLi} + \text{R}'\text{-X} \rightarrow \text{R—R}' \text{ (alkane)}$$

$R_2CuLi + R' - X \rightarrow R - R'$ (alkane)

Hence, the option number (3) is correct.

Q. 21 Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. It is due to their:

Option 1:
more extensive association of carboxylic acid via van der Waals force of attraction

Option 2:
formation of carboxylate ion

Option 3:
formation of intramolecular H-bonding

Option 4:
formation of intermolecular H-bonding

Correct Answer:
formation of intermolecular H-bonding

Solution:
As we learnt in

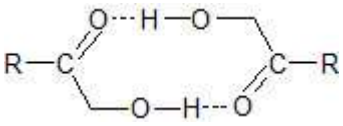
Carboxylic acids -

An organic acid containing one or more carboxyl (-COOH) groups as a functional group.

- wherein

$C_nH_{2n+1}COOH \quad or \quad C_nH_{2n}O_2$

This is due to the more extensive association through intermolecular H-bond



Hence, the option number (4) is correct.

Q. 22 Mulliken barker test induces which of the following?

Option 1:
Reduction of NO_2 group to $NHOH$

Option 2:
yellow precipitate

Option 3:
Fehling's test

Option 4:
White precipitate

Correct Answer:
Reduction of NO_2 group to $NHOH$

Solution:
As we have learned

Mullikan - Barker test -

Ethanolic solution of nitrobenzene is treated with Zinc dust and NH_4Cl solution. The mixture is heated and filtered in a test tube containing Tollen's reagent. A grey or black pricipitate (Ag mirror) is formed.

In the test $-NO_2$ is reduced to $-NHOH$ group. Hyroxlyamine group then reduces the fehlings reagent and gets oxidiised to nitroso compound

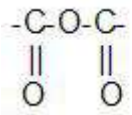
$$PhNO_2 + 4H \xrightarrow{Zn+NH_4Cl} PhNHOH + H_2O$$

$$PhNHOH + 2[Ag(NH_3)_2]OH \rightarrow PhN = O + 2H_2O + 4NH_3 + 2Ag$$

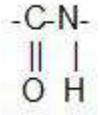
Therefore, **Option (1) is correct.**

Q. 23 Which of the following is a peptide bond ?

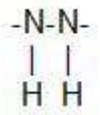
Option 1:



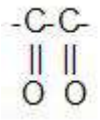
Option 2:



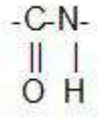
Option 3:



Option 4:



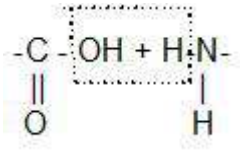
Correct Answer:



Solution:
As we have learnt,

Peptide bond is an amide linkage formed between two amino acids which is formed by condensation reaction.

The bond formed between two amino acids by the elimination of a water molecules is called peptide linkage or bond



Therefore, Option (2) is correct

Q. 24 Which one of the following is not an antibiotic?

Option 1:
Ofloxacin

Option 2:
Penicillin

Option 3:
Oxytocin

Option 4:
Ampicillin

Correct Answer:
Oxytocin

Solution:
Oxytocin is not an antibiotic but is a hormone that's produced in the hypothalamus and released into the bloodstream by the pituitary gland. Its main function is to facilitate childbirth, which is one of the reasons it is called the "love drug" or "love hormone."

Therefore, 3rd option is correct.

Q. 25 What volume (in L) of solution of 2M $BaSO_4$ contains 192 g of SO_4^{2-} ion?

Option 1:
0.5

Option 2:
1

Option 3:
2

Option 4:
1.5

Correct Answer:
1

Solution:
As we learnt in

Molarity -

Molarity (M) = (Number of moles of solute)/(volume of solution in litres)

- wherein

It is defined as the number of moles of the solute in 1 litre of the solution.

192 g of SO_4^{2-} = 2 moles of SO_4^{2-}

2 moles of $SO_4^{2-} \rightarrow$ 2 moles of $BaSO_4$

$$Volume = \frac{no.of moles}{molarity} = \frac{2}{2} = 1L$$

Q. 26 The de-Broglie's wavelength of electron present in first Bohr orbit of 'H' atom is :

Option 1:
0.529 Å

Option 2:
2π×0.529 Å

Option 3:
$\frac{0.598}{2\pi}\mathring{A}$

Option 4:
4×0.529 Å

Correct Answer:
2π×0.529 Å

Solution:
We know that

$$2\pi r = n\lambda$$

$$r = 0.529\,\frac{n^2}{Z}\,A^0, n = 1\ and\ Z = 1$$

$$\lambda = 2\pi r = 2\pi \times 0.529\mathring{A}$$

Hence, **the option number (2) is correct.**

Q. 27 The electronic configurations of four elements are given below: Arrange these elements in the correct order of the magnitude (without signs) of their electron gain enthalpy?

1)$2s^2 2p^5$
2)$3s^2 3p^5$
3)$2s^2 2p^4$
4)$3s^2 3p^4$

Option 1:
1<2<3<4

Option 2:
2<1<4<3

Option 3:
1<3<4<2

Option 4:
3<4<1<2

Correct Answer:
3<4<1<2

Solution:
Elements with half or full-filled orbitals are more stable. Energy is required to add an electron since they do not accept electron easily.

Electronic configuration 1,2, 3 & 4 represents F, Cl ,O & S

Left to right in a period then $\Delta_{eg}H$ becomes more negative

Top to bottom in a group then $\Delta_{eg}H$ becomes less negative

Correct order is: O < S < F < Cl

So, order is 3 < 4 < 1 < 2

Hence, option number (4) is correct.

Q. 28 In which of the following pairs of molecules/ ions BF_3, NO_2^- , NH_2^- and H_2O , the central atom is sp^2 hybridized?

Option 1:
NH_2^- and H_2O

Option 2:
NO_2^- and H_2O

Option 3:
BF_3 and NO_2^-

Option 4:
NO_2^- and NH_2^-

Correct Answer:
BF_3 and NO_2^-

Solution:
As we learnt in

Determination of shape of molecules using VSEPR Theory -

$$calculate\ X$$

$$X = (No.\ of\ valence\ electrons\ of\ central\ atom) + (No.\ of\ other\ atom) + (Negative\ charge\ on\ the\ molecule) - (Positive\ charge\ on\ the\ molecule)$$

-

$$H = \frac{1}{2}[V + M - C + A]$$

V = no. of valence electrons

M = no. of surrounding monovalent atoms

C = cationic charge

A = anionic charge

$$In\ BF_3, H = \frac{1}{2}[3+3-0+0] = 3, sp^2\ hybridization$$

$$In\ NO_2^-, H = \frac{1}{2}[5+0-0+1] = 3, sp^2\ hybridization$$

$$In\ NH_2^-, H = \frac{1}{2}[5+2-0+1] = 4, sp^3\ hybridization$$

$$In H_2O, H = \frac{1}{2}[6+2-0+0] = 4, sp^3\ hybridization$$

Hence, the option number (3) is correct.

Q. 29 The ratio of root mean square velocity to average velocity of gas molecules at a particular temperature is:

Option 1:
1.086 : 1

Option 2:
1 : 1.086

Option 3:
2 : 1.086

Option 4:
1.086 : 2

Correct Answer:
1.086 : 1

Solution:
As we learnt in

The average speed of gas molecules -

$$Vavg = \sqrt{(8RT/\pi M)}$$

- wherein

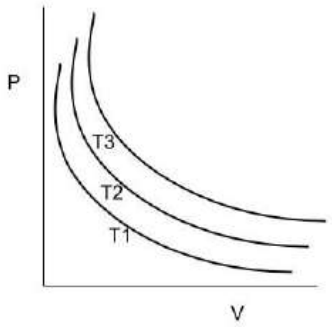
M- Molecular Mass, R- Gas Constant, T- Temperature

$$V_{rms} = \sqrt{\frac{3RT}{M}}, V_{av} = \sqrt{\frac{8RT}{\pi M}}; \frac{V_{rms}}{V_{av}} = \sqrt{\frac{3\pi}{8}}$$

$$= \sqrt{\frac{66}{56}} \Rightarrow \frac{1.086}{1}$$

Hence, the option number (1) is correct.

Q. 30 What is the relation between the temperatures in the below graph which represents isothermal expansion of gas at different temperatures?



Option 1:
$T1 > T2 > T3$

Option 2:
$T2 > T3 > T1$

Option 3:
$T3 > T2 > T1$

Option 4:
No relationship can be established

Correct Answer:
$T3 > T2 > T1$

Solution:
In isothermal process, Temperature is constant.
Also we know for an ideal gas, $PV = nRT$

As we can see T is constant, we can say $PV = k$ (here k is constant).

This equation of $PV = k$ represents the equation of hyperbola.

The more is the value of k the farther the curve is from origin. So we can conclude that
$T_3 > T_2 > T_1$
Hence, **Option number (3)** is correct

Q. 31 The K_{sp} for the following dissociation is 1.6×10^{-5}.

$$PbCl_2(s) = Pb^{2+}(aq) + 2Cl^{-}(aq)$$

Which of the following choices is correct for a mixture of 300mL, 0.134 M $Pb(NO_3)_2$ and 100 mL 0.4 M NaCl?

Option 1:
$Q < K_{sp}$

Option 2:
$Q > K_{sp}$

Option 3:
$Q = K_{sp}$

Option 4:
Not enough data is provided

Correct Answer:
$Q > K_{sp}$

Solution:
The K_{sp} for the following dissociation is 1.6×10^{-5}.

$$PbCl_2(s) = Pb^{2+}(aq) + 2Cl^{-}(aq)$$

So,

$$Q = \left[\mathrm{Pb}^{2+}\right]\left[\mathrm{Cl}^{2}\right]^{2}$$
$$Q = \frac{300 \times 0.134}{400} \times \left[\frac{100 \times 0.4}{400}\right]^{2}$$
$$Q = \frac{3 \times 0.134}{4} \times (0.1)^{2}$$
$$Q = 0.105 \times 10^{-2}$$
$$Q = 1.005 \times 10^{-3}$$

So, Q > Ksp

Hence, the option number (2) is correct.

Q. 32 The correct statements among (a) to (d) regarding H_2 as a fuel are :

(a) It produce less pollutants than petrol.

(b) A cylinder of compressed dihydrogen weighs ~ 30 times more than a petrol tank producing the same amount of energy

(c) Dihydrogen is stored in tanks of metal alloys like $NaNi_5$

(d) On combustion, values of energy released per gram of liquid dihydrogen and LPG are 50 and 142 KJ, respectively .

Option 1:
(a) , (b) and (c) only

Option 2:
(b) ,(c) and (d) only

Option 3:
(a) and (c) only

Option 4:
(b) and (d) only

Correct Answer:
(a) , (b) and (c) only

Solution:
As we know that (4) statement is wrong. Hydrogen produces more energy than fossil fuel.

LPG produces less energy than liquid dihydrogen

$E_{LPG} < E_{H_2}$

Therefore, **option(1) is correct.**

Q. 33 Among the fluorides of alkali metals, the lowest solubility of LiF in H_2O is due to :

Option 1:
Ionic nature of LiF

Option 2:
High lattice enthalphy

Option 3:
High hydration enthalphy for lithium ion

Option 4:
Low ionisation enthalphy of Li

Correct Answer:
High lattice enthalphy

Solution:
As we have learned

Due to the small size of $Li^+ \ and \ F^-$ ions , lattice enthalpy is much higher than hydration enthalpy and hence LiF is least soluble among alkali metal fluorides.

Hence, the option number (2) is correct.

Q. 34 The Van't Hoff factor will be highest for:

Option 1:
Sodium chloride

Option 2:
Magnesium chloride

Option 3:
Sodium phosphate

Option 4:
Urea

Correct Answer:
Sodium phosphate

Solution:
Van't Hoff factor for dissociation of strong electrolyte

$\mathrm{NaCl} \quad \mathrm{n} = 2$

$\mathrm{CaCl_2} \quad \mathrm{n} = 3$

$\mathrm{Na_3PO_4} \quad \mathrm{n} = 4$

$\mathrm{NH_2CONH_2} \quad \mathrm{n} = 1$

Na_3PO_4 gives the maximum ions and hence it shows the highest Van't Hoff factor.

Therefore, **option(3) is correct**

Q. 35 The standard Gibbs energy for the given cell reaction in $KJ\ mol^{-1}$ at $298\ K$ is :

$$Zn\,(s) + Cu^{2+}\,(aq) \rightarrow Zn^{2+}\,(aq) + Cu\,(s)\,,$$

$$E^0 = 2\ V\ at\ 298\ K$$

(Faraday's constant, $F = 96000\ C\ mol^{-1}$)

Option 1:
-384

Option 2:
384

Option 3:
192

Option 4:
-192

Correct Answer:
-384

Solution:

$$\Delta G^\circ = -nFE^\circ_{cell} = -2 \times 96500 \times 2.0$$

$$\Delta G^\circ = -386 \times 10^3$$

$$\Delta G^\circ = -386\ Kj/mol$$

$$\Delta G^\circ \simeq -384\ Kj/mol$$

Hence, **the option number (1) is correct.**

Q. 36 A first-order reaction is 50 % completed in 20 min at 27°C and in 5 min at 47°C. The energy of activation (in kJ/mol) of reaction is:

Correct Answer:
55.14

Solution:
Given,

A first-order reaction is 50 % completed in 20 min at 27°C and in 5 min at 47°C.

Case 1 ; T_1= 27°C = 300 K , $t_{1/2}$ = 20 min

$$k_1 = \frac{\ln 2}{t_{1/2}} = \frac{\ln 2}{20}$$

Case 1 ; T_2= 47°C = 320 K , $t_{1/2}$ = 5 min

$$k_2 = \frac{\ln 2}{t_{1/2}} = \frac{\ln 2}{5}$$

Now,

Arrhenius Equation -

$$k = Ae^{-E_a/RT}$$

$$\ln k = \ln A - \frac{E_a}{RT}$$

k = Rate constant

So,

$$\frac{k_2}{k_1} = \frac{e^{-E_a/RT_2}}{e^{-E_a/RT_1}}$$

Take both sides (ln)-

$$\ln \frac{k_2}{k_1} = \frac{-E_a}{RT_2} - \frac{-E_a}{RT_1}$$

$$\ln \frac{k_2}{k_1} = \frac{-E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Put values from the above calculations-

$$\ln\left(\frac{\ln 2/5}{\ln 2/20}\right) = \frac{-E_a}{R}\left(\frac{1}{320} - \frac{1}{300}\right)$$

$$\ln 4 = \frac{-E_a}{R}\left(\frac{-20}{320 \times 300}\right)$$

$$2 \times 2.303 \times 0.3010 = \frac{-E_a}{8.314}\left(\frac{-20}{320 \times 300}\right)$$

$$E_a = 55.14\ \text{kJ/mol}$$

Option (1) is correct.

Q. 37 According to Freundlich adsorption isotherm, which of the following is correct ?

Option 1:
$\frac{x}{m} \propto P^o$

Option 2:
$\frac{x}{m} \propto P^1$

Option 3:
$\frac{x}{m} \propto P^{1/n}$

Option 4:
All the above are correct for different ranges of pressure

Correct Answer:
All the above are correct for different ranges of pressure

Solution:
Freundlich adsorption isotherm is represented as (n>1)

$$\frac{x}{m} = kp^{1/n}$$

At high pressure $\frac{1}{n} = 0$

$$\Rightarrow \frac{x}{m} \propto P^0$$

At low pressure $\frac{1}{n} = 1$

$$\Rightarrow \frac{x}{m} \propto P$$

So, All the above are correct for different ranges of pressure

Therefore, option (4) is correct.

Q. 38 Calcination is the process in which :

Option 1:
ore is heated above its melting point to expel H_2O or CO_2 or SO_2.

Option 2:
ore is heated below its melting point to expel volatile impurities.

Option 3:
Ore is heated above its melting point to removes S, As and Sb as SO_2, As_2O_3 and Sb_2O_3 respectively.

Option 4:

Ore is heated below its melting point to expel H_2O or CO_2.

Correct Answer:

Ore is heated below its melting point to expel H_2O or CO_2.

Solution:
Calcination is a thermal treatment process in the presence of air to ores and other solid materials to bring about a thermal decomposition. Phase transition or removal of the volatile fraction.

OR

Calcination is a process of heating a substance to a high temperature but below the melting or fusion point, causing loss of moisture, reduction, or oxidation and dissociation into simpler substances.

Therefore, option (4) is correct.

Q. 39 When borax is heated strongly it gives:

Option 1:
B_2O_3

Option 2:
$Na_2B_4O_7$

Option 3:
$NaBO_2$

Option 4:
$NaBO_2 + B_2O_3$

Correct Answer:
$NaBO_2 + B_2O_3$

Solution:
As we have learnt,

Mild heating of Borax removes the water of hydration. On futher heating, it is converted to Sodium Metaborate and Boric Oxide

$$Na_2B_4O_7.10H_2O \xrightarrow[\Delta]{-10H_2O} Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$$

Therefore, **option (4) is correct.**

Q. 40 In any ferric salt, on adding potassium ferrocyanide, a Prussian blue colour is obtained, which is:

Option 1:
$K_3Fe(CN)_6$

Option 2:
$KFe[Fe(CN)_6]$

Option 3:
$FeSO_4 \cdot Fe(CN)_6$

Option 4:
$Fe_4[Fe(CN)_6]_3$

Correct Answer:
$Fe_4[Fe(CN)_6]_3$

Solution:
As we have learnt,

Potassium Ferrocyanide reacts with ferric chloride to form Prussian's Blue

$$3K_4[Fe(CN)_6] + 4FeCl_3 \rightarrow Fe_4[Fe(CN)_6]_3 + 12KCl$$

Therefore, **option (4) is correct.**

Q. 41 Types of isomerism shown by $[\mathrm{Cr(NH_3)_5NO_2}]\mathrm{Cl_2}$

Option 1:
Optical

Option 2:
Co-ordination

Option 3:
Geometrical

Option 4:
Linkage

Correct Answer:
Linkage

Solution:
As we have learnt,

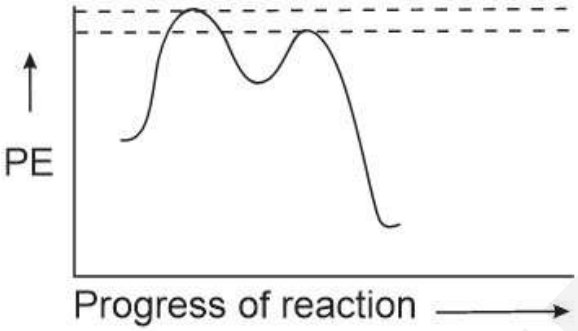
NO_2 is an ambidentate ligand and can be attached from both the N site as well as the O site in the form of $(-NO_2)$ and $(-ONO)$ respectively.

Hence, the given complex can show Linkage isomerism

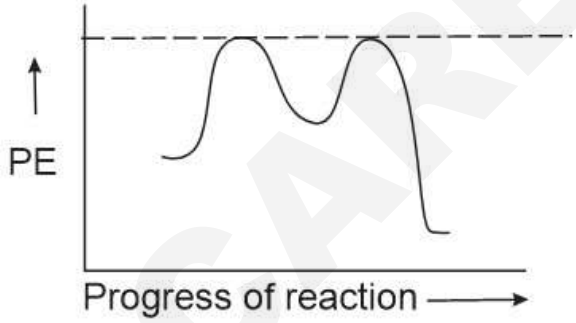
Therefore, **option (4) is correct.**

Q. 42 Which of the following potential energy (PE) diagram represents the SN_1 reaction?

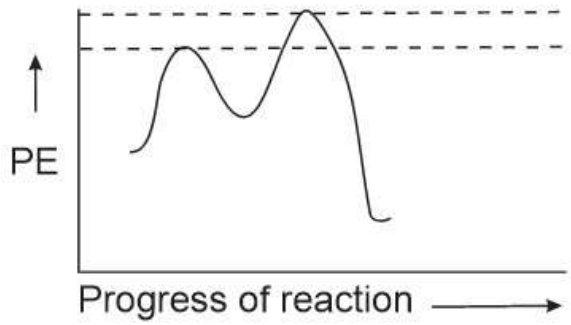
Option 1:



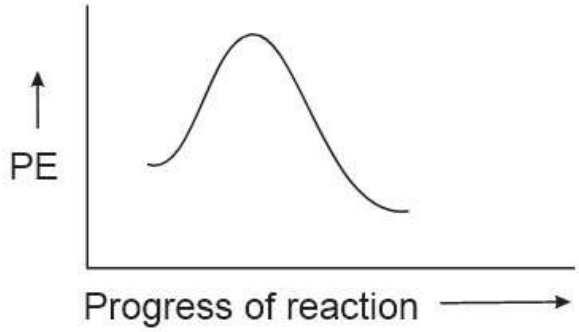
Option 2:



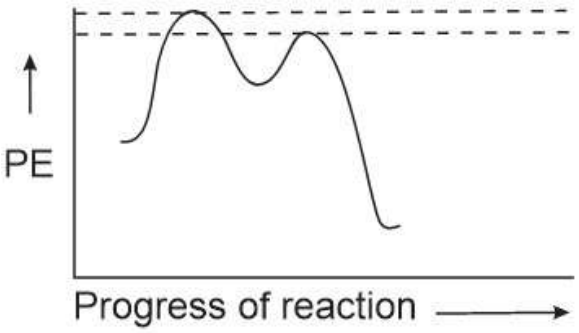
Option 3:



Option 4:

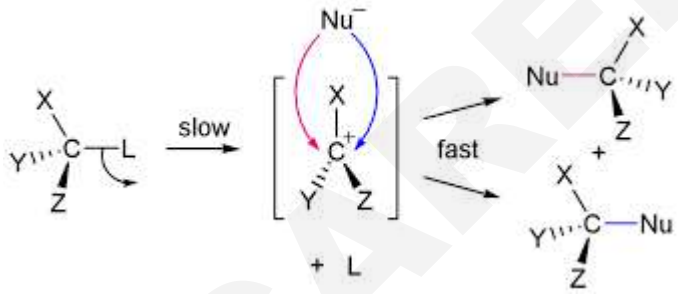


Correct Answer:



Solution:
As we have learnt,

SN_1 reaction occurs in two steps. The first step is the formation of the Carbocation while the second step is the attack of the nucleophile to form the final product.

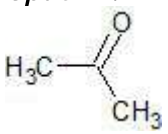


Since the formation of the Carbocation is the slow step in the reaction, the energy profile diagram will have a higher peak for the formation of the carbocation. The second peak represents the activation energy required for the nucleophile to bond with the Carbocation which will have a lower peak than the slowest step.

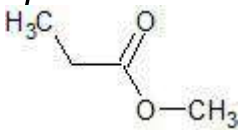
Therefore, **option (1) is correct.**

Q. 43 Which one of the following will give 2 different types of alcohol upon reduction ?

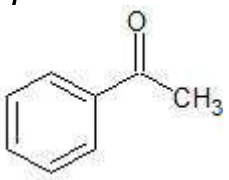
Option 1:



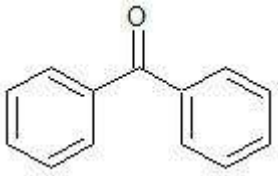
Option 2:



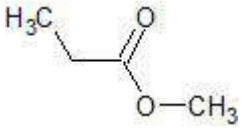
Option 3:



Option 4:



Correct Answer:



Solution:
As we learnt ,

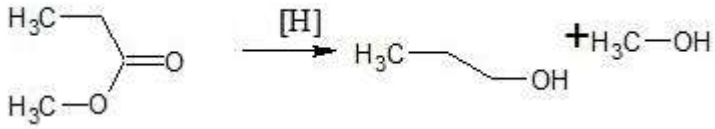
Alcohol formation by reduction of esters -

Yields two alcohols

- wherein

$$RCOOR' + 4[H] \rightarrow RCH_2OH + R'OH$$

Esters with two different R groups yields different alcohols :



Hence, the option number (2) is correct.

Q. 44 Consider the reaction:

$RCHO+NH_2NH_2 \longrightarrow RCH=N-NH_2$

What sort of reaction is it?

Option 1:
Electrophilic addition - elimination reaction

Option 2:
Free radical addition - elimination reaction

Option 3:
Electrophilic substitution - elimination reaction

Option 4:
Nucleophilic addition - elimination reaction

Correct Answer:
Nucleophilic addition - elimination reaction

Solution:
As we learnt in

Chemical properties of aldehydes and ketones -

Undergo nucleophilic addition reactions at carbon-oxygen double bond, hybridization of carbon changes from sp2 to sp2. Aldehydes are more reactive than ketones due to steric hindrance and +I effect of an alkyl group.

-

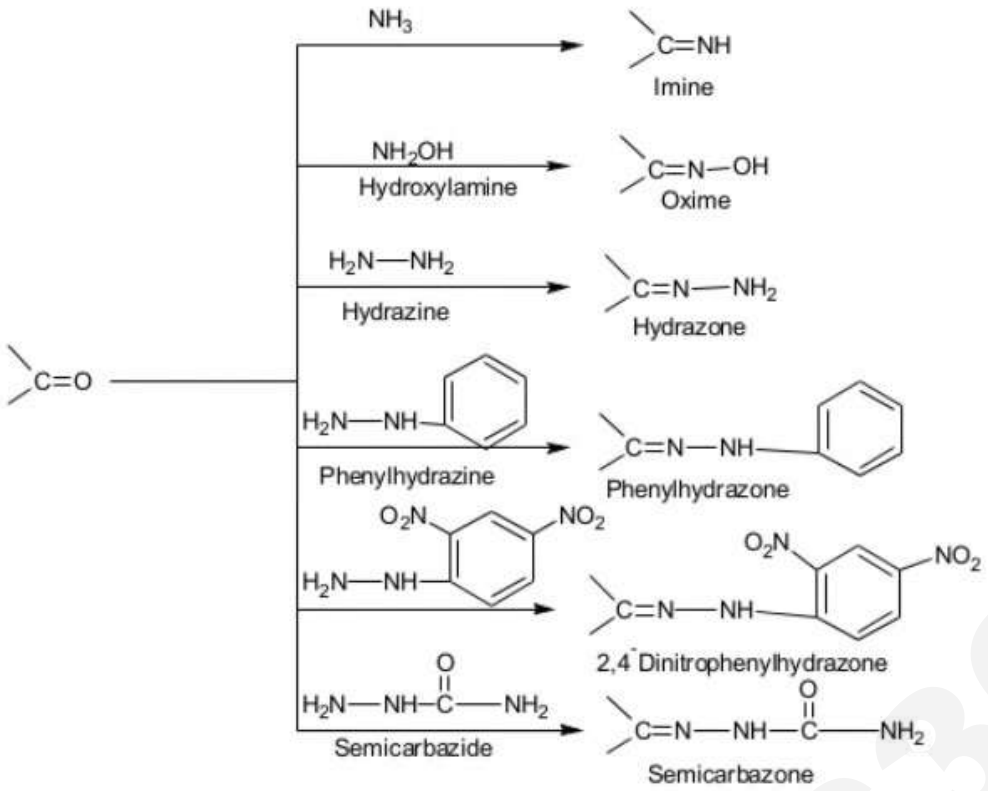
Addition of ammonia and its derivatives with aldehydes and ketones -

Product formation is favoured due to rapid dehydration of the intermediate to form

> C = NG

$$G \ may \ be \ -OH, \ -NH_2, \ -NHC_6H_5, \ -NHCONH_2, \ etc$$

- wherein



Addition product is formed and a water molecule is eliminated.

Hence, the option number (4) is correct.

Q. 45 Phenol, when it first reacts with concentrated sulphuric acid and then with concentrated nitric acid, gives:

Option 1:
nitrobenzene

Option 2:
2, 4, 6-trinitrobenzene

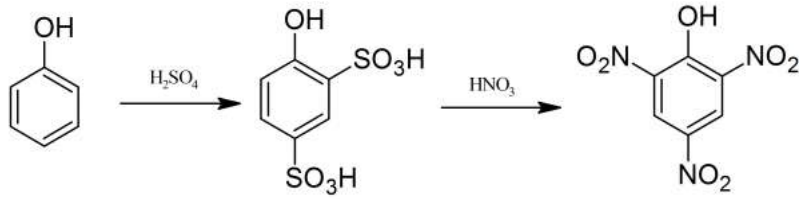
Option 3:
2,4,6- trinitrophenol

Option 4:
p-nitrophenol

Correct Answer:
2,4,6- trinitrophenol

Solution:
Direct nitration of phenol is difficult as it gets oxidised by the nitrating mixture $(\text{conc. } H_2SO_4 + \text{conc. } HNO_3)$. However, picric acid is formed as a minor product in the reaction.

To get a better yield of Picric acid, it is prepared by treating phenol first with concentrated sulphuric acid which converts it to phenol-2,4-disulphonic acid, and then with concentrated nitric acid to get 2,4,6-trinitrophenol.



Therefore, **option (3) is correct.**

Q. 46 During chlorination of methane to methyl chloride, the propagation step is represented by:

Option 1:

$Cl-Cl \overset{h\nu}{\rightarrow} Cl+Cl$

Option 2:

$C\dot{H}_3+\dot{C}l \rightarrow CH_3Cl$

Option 3:

$C\dot{H}_3+Cl-Cl \rightarrow CH_3-Cl+\dot{C}l$

Option 4:

$\dot{C}l+\dot{C}l \rightarrow Cl-Cl$

Correct Answer:

$C\dot{H}_3+Cl-Cl \rightarrow CH_3-Cl+\dot{C}l$

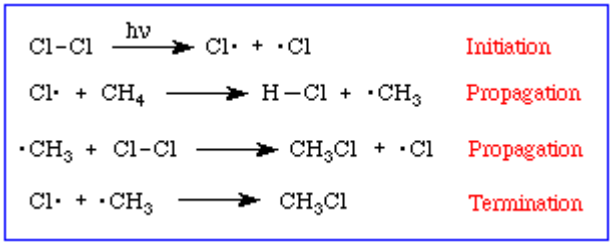
Solution:

Preparation of haloalkane by free radical halogenation of Alkanes -

Alkanes undergo free radical substitution reaction when treated Cl_2/Br_2 in presence of sunlight.

- wherein

$CH_4+Cl_2 \rightarrow CH_3Cl+HCl$



Hence, option (3) is correct.

Q. 47 Nylon threads are made of

Option 1:
polyvinyl polymer

Option 2:
polyester polymer

Option 3:
polyamide polymer

Option 4:
polyethylene polymer

Correct Answer:
polyamide polymer

Solution:
Nylon 6,6 is a condensation polymer of hexamethylene diamine and adipic acid.

So, Nylon threads are made of polyamide polymer.

Therefore, Option 3 is correct.

Q. 48 Which one of the following is not an antacid?

Option 1:
Calcium Carbonate

Option 2:
Magnesium Carbonate

Option 3:
Equanil

Option 4:
Aluminium Hydroxide

Correct Answer:
Equanil

Solution:
As we hav learnt,

Drugs -

Chemicals of low molecular masses which interact with macromolecular targets and produce a biological response.

-

Equanil is a tranquilizer.

Therefore, 3rd option is correct.

Q. 49 Number of sigma bonds in P_4O_{10} is :

Option 1:
6

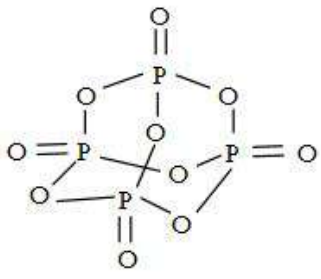
Option 2:
7

Option 3:
17

Option 4:
16

Correct Answer:
16

Solution:

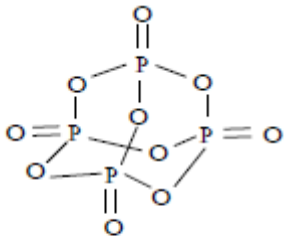


No of σ bonds $= 16$

No of π bonds$= 4$

The number of sigma bond in P_4O_{10} is 16

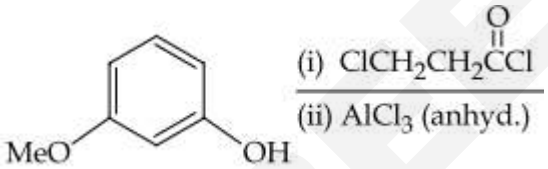
Hence, the option number (4) is correct.

(d) : 

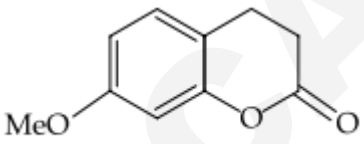
No. of σ bonds = 16
No. of π bonds = 4

Therefore, **Option(4) is correct**

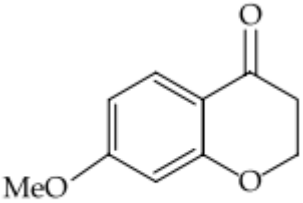
Q. 50 The major product of the following reaction is :



Option 1:

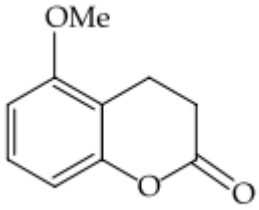


Option 2:

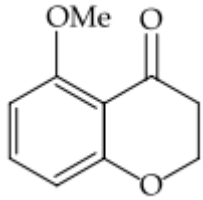


OMe

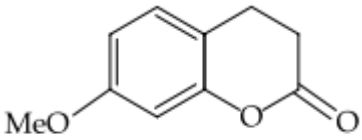
Option 3:



Option 4:

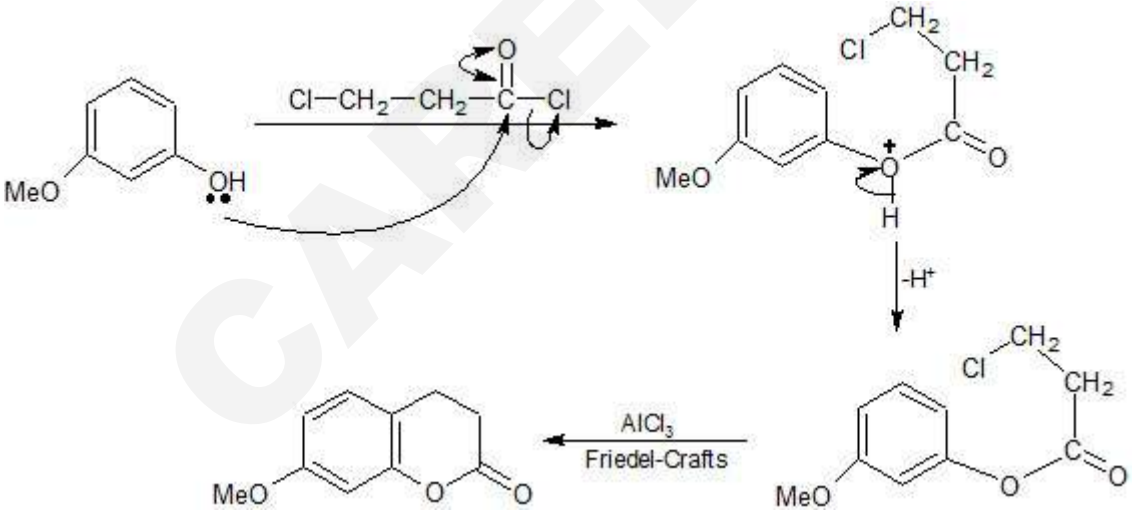


Correct Answer:



Solution:

Between OH and OMe, OH is more attacking species due to the formation of phenoxide ion by OH group.



Hence, the option number (1) is correct.

Q. 51 2 moles of an ideal gas $\left(C_{v,m}=15\ JK^{-1}mol^{-1}\right)$ are at $300\ K$ and $5\ L$. If the gas is heated to $350\ K$ and the volume changed to $15\ L$, Calculate the entropy (in J/K) change.

Option 1:

26.76

Option 2:
4.62

Option 3:
22.88

Option 4:
22.14

Correct Answer:
22.88

Solution:
We have given,

Initial volume, $V_1 = 5\ L$

Final volume, $V_2 = 15\ L$

Initial Temperature, $T_1 = 300\ K$

Final Temperature, $T_2 = 350\ K$

Number of moles, $n = 2$

Change in entropy as a function of T and V is given as,

$$\Delta S = nC_{v,m}\ In\frac{T_2}{T_1} + nR\ In\frac{V_2}{V_1}$$

$$\Delta S = 2 \times 15 \times\ In\frac{350}{300} + 2 \times 8.314 \times\ In\frac{15}{5}$$

$$\Delta S = 4.62 + 18.26$$

$$\Delta S = 22.88\ J/K$$

Hence, option number (3) is correct

Q. 52 The vapour density of N_2O_4 at a certain temperature is 30. Calculate the percentage dissociation of N_2O_4 at this temperature.

Option 1:
85.3%

Option 2:
63.6%

Option 3:
20%

Option 4:
53.3%

Correct Answer:
53.3%

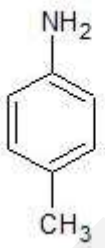
Solution:
$N_2O_4(g) \rightleftharpoons 2NO_2(g)$
Molecular mass of $N_2O_4 = (28 + 64) = 92$
Vapour density, $D = \frac{92}{2} = 46$
Let the degree of dissociation be x.
Given, $d = 30$
Applying the relationship,

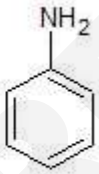
$$x = \frac{D-d}{d} = \frac{(46-30)}{30} = \frac{16}{30} = 0.533$$

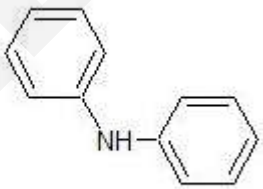
$$\text{Degree of dissociation } = 53.3\%$$

Therefore,**option(4) is correct**

Q. 53 Arrange the following in the order of basicity :

a) 

b) 

c) 

Option 1:
c > a > b

Option 2:
b > a> c

Option 3:
a > b > c

Option 4:
a > c > b

Correct Answer:
a > b > c

Solution:
All the given bases are aromatic amines having their lone pairs in conjugation with the Benzene ring.

Among the given bases, " a" is most basic because of methyl at the para position and "c" is least basic because it shares lone pair with both phenyl rings.

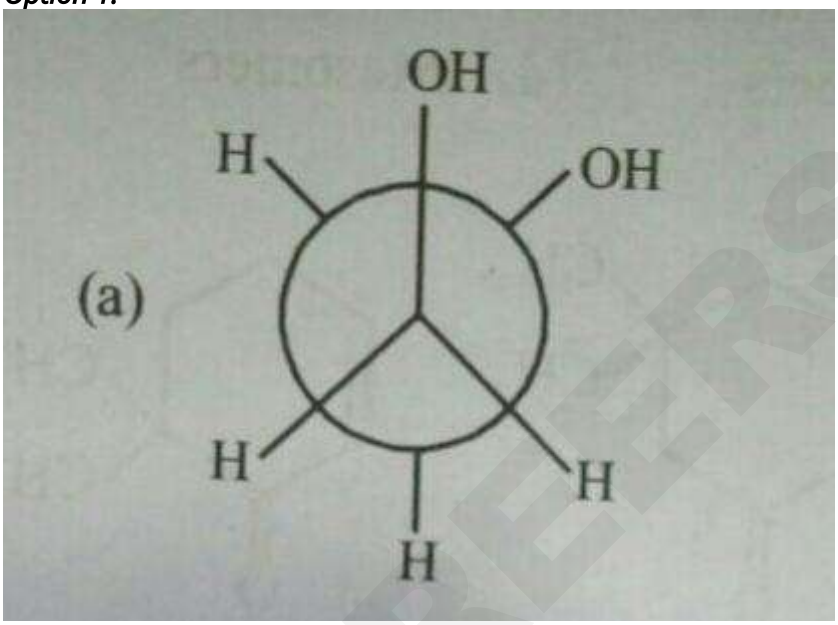
Therefore, the correct order of basic strength of the given aromatic amines follow the order:

(a) > (b) > (c)

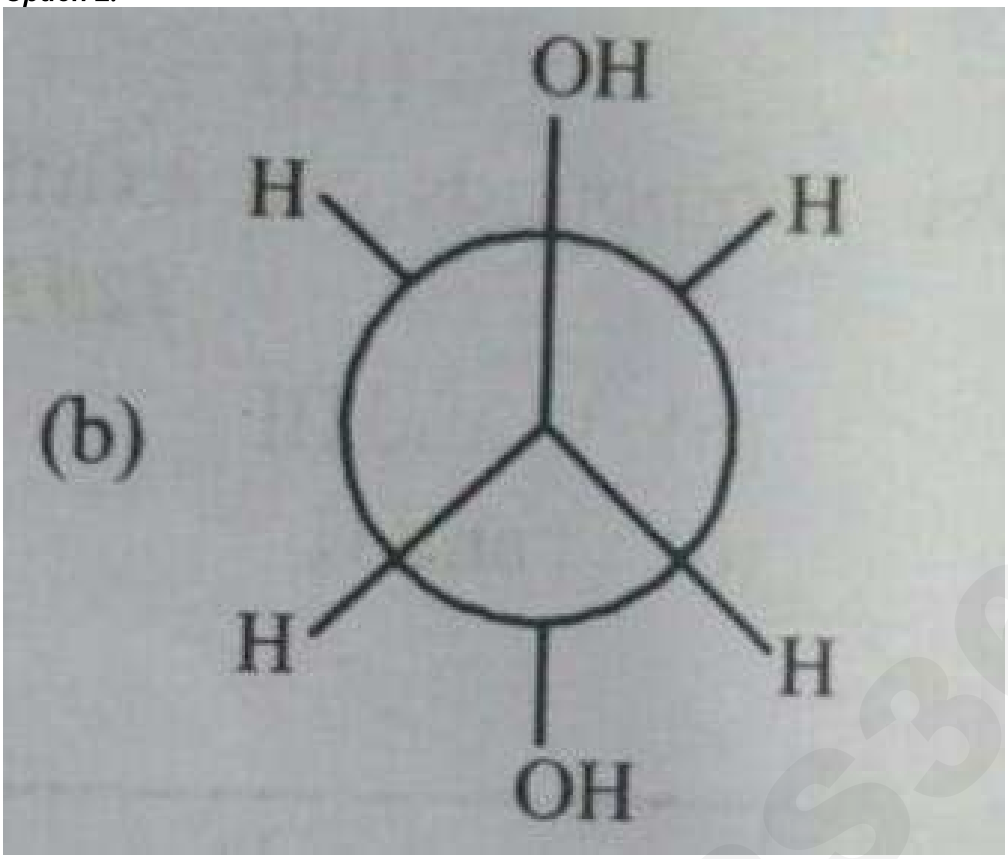
Hence, option number (3) is correct.

Q. 54 Which of the following conformers for ethylene glycol is most stable?

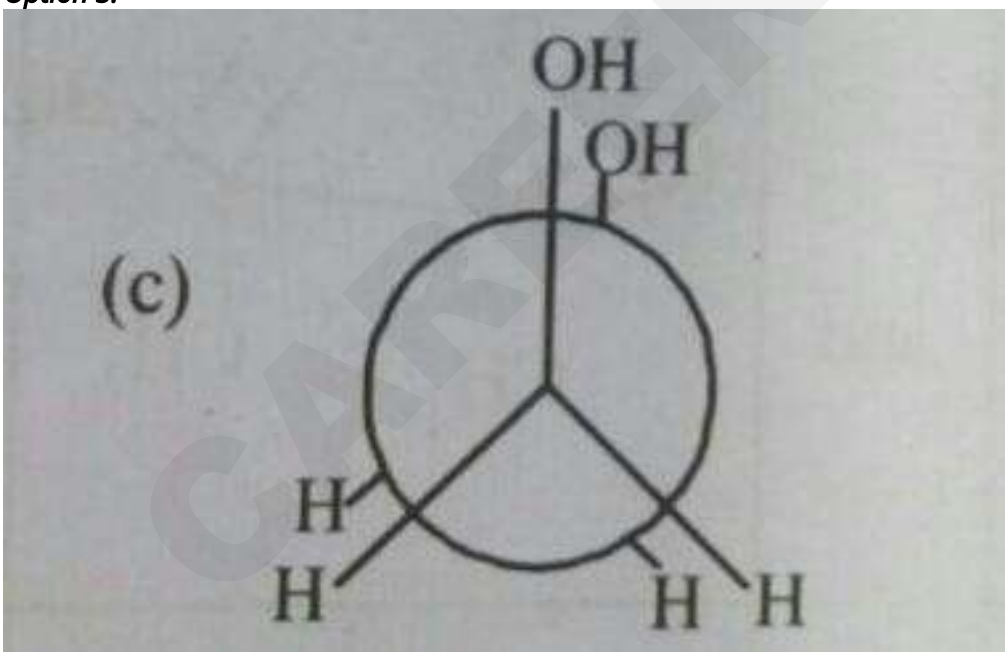
Option 1:



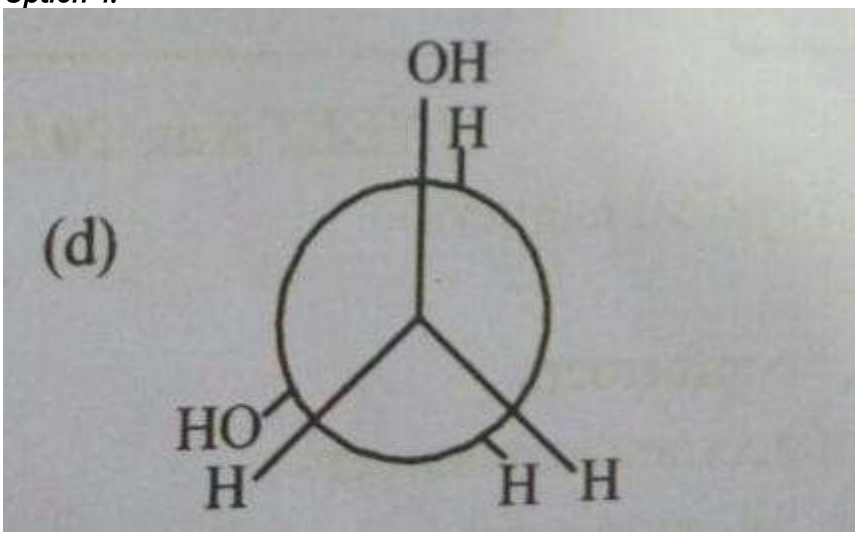
Option 2:



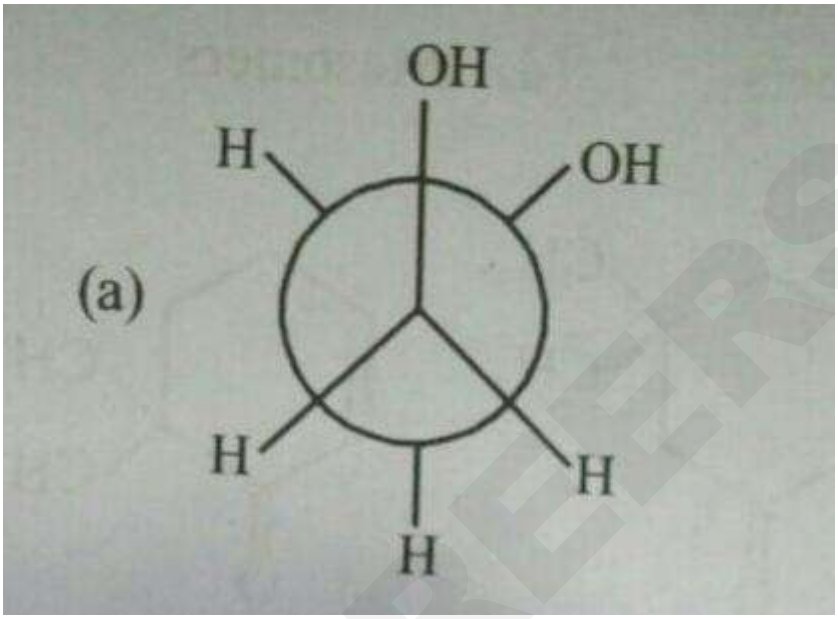
Option 3:



Option 4:



Correct Answer:



Solution:
The conformation in which the heavier groups are present at maximum separation so that forces of repulsion get weak is more stable.

Hence option (2) is correct since OH is at maximum distance.

Q. 55 The major product of the following reaction is/are:

$$\text{n} - \text{Hexane} \xrightarrow{\text{Anhyd } AlCl_3\text{, HCl}}$$

Option 1:
2 - methyl pentane

Option 2:
3 - methyl pentane

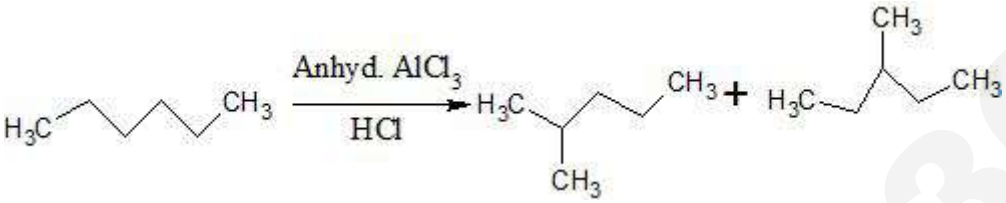
Option 3:
2 - methylpropane

Option 4:
Both 1 & 2

Correct Answer:
Both 1 & 2

Solution:
The reaction is an example of aromatisation reaction.

The reaction will be -



The product will be 3-methyl pentane and 2-methyl pentane.

Therefore, **option(4) is correct.**

Q. 56 The osmotic pressure of solution increases, if

Option 1:
Temperature is decreased

Option 2:
Solution concentration is increased

Option 3:
Number of solute molecules is increased

Option 4:
Volume is increased

Correct Answer:
Number of solute molecules is increased

Solution:
As we learned

Osmotic Pressure -

Osmotic Pressure (π) is excess pressure developed on solution side due to osmosis.

-

As soon as the solute molecules increases the osmotic pressure of solution increase.

Therefore, option (3) is correct.

Q. 57 If the conductivity of the cell is $0.08Sm^{-1}$,then find the resistance of the cell. Cell constant =$40m^{-1}$

Option 1:
3.2

Option 2:
500

Option 3:
0.002

Option 4:
0.3125

Correct Answer:
500

Solution:
As we learnt

Conductivity -

The inverse of resistivity is called conductivity. $\kappa = \frac{1}{\rho}$

- wherein

SI unit of Conductivity = Sm^{-1}

$$R = \frac{\rho l}{A}$$

$$R = \frac{1}{k} \times \frac{l}{A}$$

$$(0.08)^{-}1 * 40 = \frac{40}{0.08} = 500$$

Hence, the option number (2) is correct.

Q. 58 The half life of a first order reaction varies with temperature according to

Option 1:
$\ln t_{\frac{1}{2}} = \frac{a}{T} + b$

Option 2:
$\ln t_{\frac{1}{2}} = aT + b$

Option 3:
$\ln t_{\frac{1}{2}} = \frac{a}{T^2} + b$

Option 4:
$\ln t_{\frac{1}{2}} = aT^2 + b$

Correct Answer:
$\ln t_{\frac{1}{2}} = \frac{a}{T} + b$

Solution:
As we learnt for a first order reaction,

$$t_{\frac{1}{2}} = \frac{0.693}{k} \text{ and } k = Ae^{-E_a/RT}$$

$$t_{\frac{1}{2}} = \frac{0.693}{Ae^{-E_a/RT}} \quad \left[\text{Assume} \frac{0.693}{A} = c\right]$$

$$t_{\frac{1}{2}} = ce^{E_a/RT}$$

$$\ln t_{1/2} = \ln c + \frac{E_a}{RT}$$

Now, ln(c) = b and E_a/R = a

So,

$$\ln t_{1/2} = \frac{a}{T} + b$$

Hence, option number (1) is correct.

Q. 59 Which one of the following ions exhibits d-d transition and paramagnetism as well ?

Option 1:
MnO_4^-

Option 2:
$Cr_2O_7^{2-}$

Option 3:
CrO_4^{2-}

Option 4:
MnO_4^{2-}

Correct Answer:
MnO_4^{2-}

Solution:
As we learnt in

Diamagnetism -

When substance unaffected by a magnetic field or the central metal atom doesn't have unpaired e^- called Diamagnetic substance or character.

- wherein

$eg \quad Sc^{+++} \Rightarrow 3d^{\ 0}9s^2$

No unpaired e^-

Paramagnetism -

When a substance is attracted by a magnetic field or have unpaired e^- called a paramagnetic substance.

- wherein

$eg \Rightarrow \quad Cr^+ - 3d^5$

5 unpaired e^-

Paramagnetism — It is due to the presence of unpaired electrons in a material, meaning all atoms with incompletely filled atomic orbitals are paramagnetism.

MnO_4^{2-} has one unpaired electron so it can show d-d transition and it is paramagnetic. Since it has one unpaired electron which can be shifted between the lower energy level and the higher energy level and thus a d-d transition exists.

Hence, the option number (4) is correct.

Q. 60 Cobalt (III) chloride forms several octahedral complexes with ammonia. Which of the following will not give test of chloride ions with silver nitrate at $25^{\circ}C$?

Option 1:
$CoCl_3 \cdot 4NH_3$

Option 2:
$CoCl_3 \cdot 5NH_3$

Option 3:
$CoCl_3 \cdot 6NH_3$

Option 4:
$CoCl_3 \cdot 3NH_3$

Correct Answer:
$CoCl_3 \cdot 3NH_3$

Solution:
As we learnt in

Coordination Sphere -

The central atom/ion and the ligands attached to metal are enclosed in the square bracket and this collectively termed as coordination sphere

- wherein

eg:

$K_4\left[Fe\left(CN\right)_6\right]$

$K^+ \rightarrow$ Counter ion

$\left[Fe\left(CN\right)_6\right]^{4-} \rightarrow$ Coordination sphere

The co-ordination number of Cobalt (III) in the octahedral complex is 6. In $CoCl_3.3NH_3$, all we have is 6 ligands, which implies all of them are in the co-ordination sphere and won't ionize.

$\therefore$ There will be no precipitation of AgCl and no test will be positive.

Hence, the option number (4) is correct.

Maths

Q. 1 How many relations can be made from set A to set B where n(A)=5 and n(B)=2?

Option 1:
1024

Option 2:
10

Option 3:
32

Option 4:
512

Correct Answer:
1024

Solution:
As we learnt

Number of Relations -

If A having m elements and B having n elements, then 2^{mn}=No. of relations

-

No. of elements in AxB =10

$\rightarrow$No. of subsets of AxB = $2^{10} = 1024$

Q. 2 Find the equation of line $2x - y + 7 = 0$ intercept

Option 1:
x/7 - y/7 = 1

Option 2:
x/(-7/2) + y/7 = 1

Option 3:
7x/2 - y/7 = 1

Option 4:
none

Correct Answer:
x/(-7/2) + y/7 = 1

Solution:
As we have learned

Intercept form of a straight line -

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

- wherein

A and b are the x-intercept and y -intercept respectively.

$$2x-y+7=0$$

$$2x-y=-7$$

$$\Rightarrow \frac{x}{(-7/2)}+\frac{y}{(7)}=1$$

Q. 3

If C1 : $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$

If C2 : $\frac{y^2}{b^2}-\frac{x^2}{a^2}=1$

have e1 and e2 as their eccentricities respectively. Then $e_1^{-2}+e_2^{-2}=?$

Option 1:
-1

Option 2:
1

Option 3:
2

Option 4:
0

Correct Answer:
1

Solution:
As we have learned

Eccentricities of Hyperbola -

$$\frac{1}{e_1^2}+\frac{1}{e_2^2}=1$$

- wherein

e_1 and e_2 are eccentricities of the hyperbola and its conjugate.

Q. 4 What is the distancxe between 3x-4y+2 = 0 and 6x-8y= 15 parallel lines ?

Option 1:
2

Option 2:
21 /10

Option 3:
19 /10

Option 4:
13/5

Correct Answer:
19 /10

Solution:
As we have learned

Distance between two parallel lines -

$$\rho = \frac{|c_2 - c_1|}{\sqrt{a^2 + b^2}}$$

- wherein

ρ is the distance between $ax + by + c_1 = 0$ and $ax + by + c_2 = 0$

Lines are 3x-4y+2 = 0 ....(1)

6x-8y-15 = 0

3x-4y-7.5 = 0 ....(2)

$$d = \frac{|2 - (-15/2)|}{\sqrt{3^2 + 4^2}}$$

$$= \frac{19/2}{5} = 19/10$$

Q. 5 For the products x and y, which of the following could be a linear programming objective function?

Option 1:
C=x+2y

Option 2:
$C = x - 2y^2$

Option 3:
c=x+2x/y

Option 4:
All of the above

Correct Answer:
C=x+2y

Solution:

Different Types of Linear Programming Problems -

-

As we learnt in

Corner Point Method -

This method of solving an LPP graphically is based on the principle of extreme points theorem.

-

Z must be linear so that c = x+2y

Q. 6 Which one of the following is transpose conjugate of matrix $A = \begin{bmatrix} 4+i & i \\ 0 & i-1 \end{bmatrix}$?

Option 1:
$A = \begin{bmatrix} 4-i & -i \\ 0 & -i-1 \end{bmatrix}$

Option 2:
$A = \begin{bmatrix} 4-i & 0 \\ -i & -i-1 \end{bmatrix}$

Option 3:
$A = \begin{bmatrix} 4+i & 0 \\ -i & -i-1 \end{bmatrix}$

Option 4:

$$A=\begin{bmatrix}4+i & -i\\ 0 & i-1\end{bmatrix}$$

Correct Answer:

$$A=\begin{bmatrix}4-i & 0\\ -i & -i-1\end{bmatrix}$$

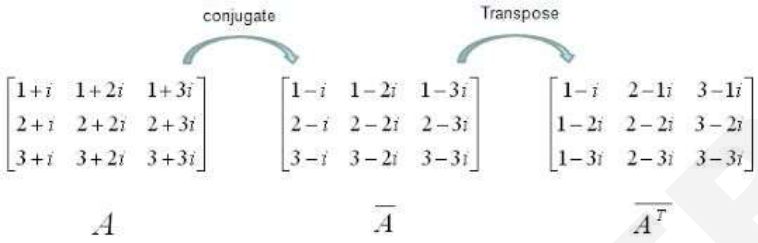
Solution:
As we have learned,

Transpose conjugate of a Matrix -

The transpose of the conjugate of a matrix

- wherein

It is denoted by A^{Θ} and $(A')=A^{\Theta}$



$$A^*=(\overline{A})^T \; or \; \overline{(A^T)}$$

$$A^T=\begin{bmatrix}4+i & 0\\ i & i-1\end{bmatrix}$$

$$\overline{A^T}=\begin{bmatrix}4-i & 0\\ -i & -i-1\end{bmatrix}$$

Q. 7 The value of the determinant is $\begin{vmatrix}1+w^3 & 1 & 1\\ 1 & 1+w^2+w & 1\\ 1+w & w & w^6\end{vmatrix}$ where ω is the cube root of unity.

Option 1:
1

Option 2:
0

Option 3:
-1

Option 4:
2

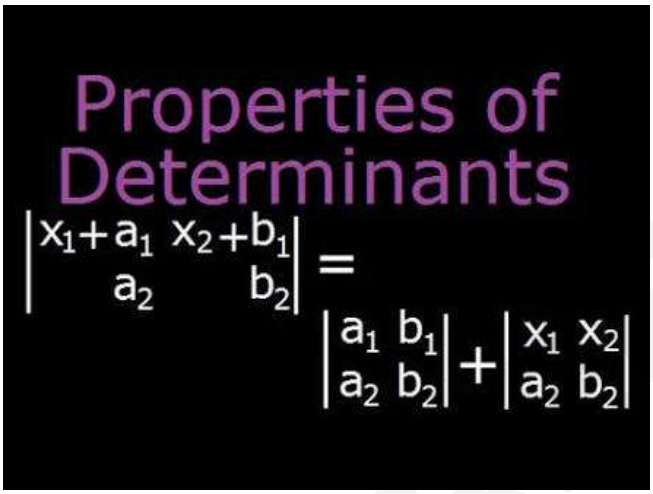
Correct Answer:
0

Solution:
As we learnt

Property of determinant -

If each element in a row (or column) of a determinant is written as the sum of two or more terms then the determinant can be written as the sum of two or more determinants

- wherein



Property of determinant -

If each element in a row (or column) of a determinant is written as the sum of two or more terms then the determinant can be written as the sum of two or more determinants

- wherein

$$\begin{vmatrix} 1+\omega^3 & 1 & 1 \\ 1 & 1+\omega+\omega^2 & 1 \\ 1+\omega & \omega & \omega^6 \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & \omega & 1 \end{vmatrix} + \begin{vmatrix} \omega^3 & 1 & 1 \\ 0 & 0 & 1 \\ \omega & \omega & 1 \end{vmatrix} = 0$$

$\because 1+\omega+\omega^2 = 0$ and $\omega^3 = 1$

Q. 8 For $n \in N, 4^{2n+1} + 3^{3n}$ is divisible by

Option 1:
9

Option 2:
3

Option 3:
Both (1) and (2)

Option 4:
None

Correct Answer:
None

Solution:
As we learned

Divisibility -

To show that an expression is divisible by an integer.

We write

$a^{pn+r} = a^{pn}.a^r$

$= (a^p)^n .a^r$

- wherein

If a, p, n, r are positive integers.

Put $n = 1,$

$4^3 + 3^3 = 64 + 27 = 91$

Correct option is 4

Q. 9 $[3.6] - [-2.2] + [5] = ?$ where $[\ .\ ]$ stands for the greatest integer function.

Option 1:
10

Option 2:
5

Option 3:
0

Option 4:
11

Correct Answer:
5

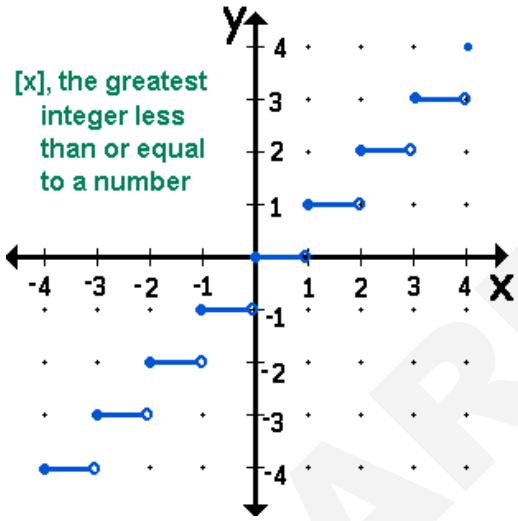
Solution:
As we have learnt,

Greatest Integer Function -

$[x] =$ Greatest integer less than or equal to x

$(for\, x\, \in\, R)$

- wherein



Range = Integers

$[3.6] = 3, [-2.2] = -3, [5] = 5$

Q. 10 if $x^{2n-1} + y^{2n-1}$ is divisible by x+y then n is

Option 1:
+ ve integer

Option 2:
even positive integer

Option 3:
an odd positive integer

Option 4:
n > 2

Correct Answer:
+ ve integer

Solution:
As we have learned

Divisibility -

The expression $a^n - b^n$ is divisible by $a - b$, if n is even or odd.

- wherein

Given,

$a \neq b$

$p(n) : x^{2n-1} + y^{2n-1} = \lambda(x + y)$

$p(1) : (x + y)\ is\ \ divisible\ \ by (x + y)$

$p(2) = x^3 + y^3 = (x + y)(x^2 - xy + y^2)$

Q. 11 The argument of the complex no. $\frac{2+3i}{3+i+(1+2i)^2}$ is

Option 1:
$\tan^{-1}\frac{3}{2}$

Option 2:
$\tan^{-1}(-2/3)$

Option 3:
$\tan^{-1}(2)$

Option 4:
$\tan^{-1}(-3)$

Correct Answer:
$\tan^{-1}(-2/3)$

Solution:

As we have learned

formula for the nth GM -

$$G_n = a\left(\frac{b}{a}\right)^{\frac{n}{n+1}}$$

- wherein

$B \rightarrow$ last term

$a \rightarrow$ first term

we have

$$\frac{2+3i}{(3+i)+(1+2i)^2} = \frac{2+3i}{(3+i)+(1+4-4)} = \frac{2+2i}{5i}$$

$$= 3/5 - 2/5i$$

$$= \tan^{-1}(-2/3)$$

Q. 12 The first term of an AP is -1 and sum of first 10 terms of an AP is -100 then find the last term of the AP.

Option 1:
-17

Option 2:
-15

Option 3:
-19

Option 4:
-21

Correct Answer:
-19

Solution:
As we have learnt,

Sum of n terms of an AP -

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

and

Sum of n terms of an AP

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

- wherein

$a \rightarrow$ first term

$d \rightarrow$ common difference

$n \rightarrow$ number of terms

$$\Rightarrow -100 = \frac{10}{2}[-1 + l]$$

$$-20 = -1 + l$$

$$-19 = l$$

Q. 13 Sum of 10 terms of an A.P is 110. If its first term is 2. FInd its common difference.

Option 1:
1

Option 2:
2

Option 3:
3

Option 4:
4

Correct Answer:
2

Solution:
As we have learnt,

General term of the sequence -

The n^{th} term of sequence denoted by T_n.

- wherein

For any n, there shall be a unique value for the n^{th} term.

Sum of n terms of an AP -

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

and

Sum of n terms of an AP

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

- wherein

$a \rightarrow$ first term

$d \rightarrow$ common difference

$n \rightarrow$ number of terms

$$\Rightarrow \frac{n}{2}[a+l] = 110$$

$$5[2+l] = 110$$

$$l = 20$$

$$T_{10} = 20$$

$$2 + (10-1)d = 20$$

$$9d = 18$$

$$d = 2$$

Q. 14 Find magnitude of vector joining (1,3,-1) and (2,-1,1),

Option 1:
$\sqrt{6}$

Option 2:
$\sqrt{11}$

Option 3:
$\sqrt{21}$

Option 4:
$\sqrt{5}$

Correct Answer:
$\sqrt{21}$

Solution:
As we have learnt

Magnitude of a Vector -

The length of the directed line segment $\overrightarrow{AB}$ is called its magnitude.

- wherein

It is denoted by $|\overrightarrow{AB}|$

$$l = \sqrt{(-2+1)^2 + (3+1)^2 + (-1-1)^2} = \sqrt{21}$$

Q. 15 The sine of the angle between the vectors $a = 3i + j + k, b = 2i - 2j + k$ is

Option 1:
$\sqrt{\frac{74}{99}}$

Option 2:
$\sqrt{\frac{25}{99}}$

Option 3:

$\sqrt{\frac{37}{99}}$

Option 4:

$\frac{5}{\sqrt{41}}$

Correct Answer:

$\sqrt{\frac{74}{99}}$

Solution:
As we learn

Vector Product of two vectors(cross product) -

If $\vec{A}$ and $\vec{B}$ are two vectors and θ is the angle between them , then $\vec{a} \times \vec{b} = \left|\vec{a}\right|\left|\vec{b}\right| Sin\Theta\hat{n}$

- wherein

$\hat{n}$ is unit vector perpendicular to both $\vec{a}\ and\ \vec{b}$

$$a \times b = \begin{vmatrix} i & j & k \\ 3 & 1 & 1 \\ 2 & -2 & 1 \end{vmatrix} = 3i - j - 8k; \sin\Theta = \frac{|a \times b|}{|a|\,|b|} = \frac{\sqrt{74}}{\sqrt{11}.\sqrt{9}} = \sqrt{\frac{74}{99}}$$

Q. 16 $\sec^{-1}(\sec(-\frac{\pi}{4})) =$

Option 1:

$\frac{3\pi}{4}$

Option 2:

$\frac{\pi}{4}$

Option 3:

$-\frac{\pi}{4}$

Option 4:
None of these

Correct Answer:

$\frac{\pi}{4}$

Solution:
As we have learnt

Important Results of Inverse Trigonometric Functions -

$\sec^{-1}(\sec\Theta) = \Theta$

- wherein

if $0 \leqslant \Theta < \frac{\pi}{2}$

or $\frac{\pi}{2} < \Theta \leqslant \pi$

$\sec^{-1}(\sec(-\frac{\pi}{4})) = \sec^{-1}(\sec\frac{\pi}{4}) = \frac{\pi}{4}$

Q. 17 $\frac{d}{dx}(e^x \cdot \sin^{-1} x) =$

Option 1:
$e^x \cdot \cos^{-1} x + e^x$

Option 2:
$e^x + \frac{1}{\sqrt{1-x^2}}$

Option 3:
$e^x\left(\frac{1}{\sqrt{1-x^2}} + \cos^{-1} x\right)$

Option 4:
$\frac{e^x}{\sqrt{1-x^2}} + e^x \cdot \sin^{-1} x$

Correct Answer:
$\frac{e^x}{\sqrt{1-x^2}} + e^x \cdot \sin^{-1} x$

Solution:
As we have learnt,

Product Rule for differentiation -

$$\frac{d}{dx}(f(x).g(x)) = f(x).\frac{d}{dx}g(x) + g(x).\frac{d}{dx}f(x)$$

$$\Rightarrow \frac{d}{dx}(u.v) = u.\frac{dv}{dx} + v.\frac{du}{dx}$$

- wherein

Take only one function for derivative along with other function.

$$e^x \frac{d}{dx}(\sin^{-1} x) + \sin^{-1} x \cdot \frac{d}{dx}(e^x) = \frac{e^x}{\sqrt{1-x^2}} + e^x \cdot \sin^{-1} x$$

Q. 18 Degree of the D.E is $\frac{d^2y}{dx^2} = \cos(\frac{dy}{dx})$

Option 1:
1

Option 2:
2

Option 3:
3

Option 4:
Not defined

Correct Answer:
Not defined

Solution:
As we learnt

Degree of a Differential Equation -

Degree of Highest order differential coefficient appearing in it, provided it can be expressed as a polynomial equation in derivatives

- wherein

$$\left(\frac{dy}{dx}\right)^2 + 3\left(\frac{dy}{dx}\right) - 5 = 0$$

Degree = 2

The given D.E cannot be written as a polynomial in the differential coefficients.

Hence, the Degree of the equation is not defined.

Q. 19 $\int \frac{dx}{40+24\cos x} = \frac{1}{16}\tan^{-1}\frac{B}{2}+C,\ \text{Then}\ B=?$

Option 1:
$\frac{\tan x}{2}$

Option 2:
$\tan\frac{x}{2}$

Option 3:
$\tan(x/2)/2$

Option 4:
$2\tan x/2$

Correct Answer:
$\tan\frac{x}{2}$

Solution:
As we have learned

Type of Integration -

The integrals are of the from

(i) $\int \frac{1}{a\cos x+b\sin x}dx$

(ii) $\int \frac{1}{a+b\cos x}dx$

(iii) $\int \frac{1}{a+b\sin x}dx$

- wherein

Working rule :

Resolve :

$$\cos x = \cos^2 \frac{x}{2} - \sin^2 \frac{x}{2}$$

and

$$\sin x = 2 \sin \frac{x}{2} \cos \frac{x}{2}$$

$$I = \frac{1}{8} \int \frac{\sec^2(x/2)}{2(\tan^2(x/2) + 4)} dx$$

$$u = \frac{\tan(2y_2)}{2}, dx = \frac{4}{\sec^2 x/2} du$$

$$I = 1/8 \int \frac{2}{4u^2 + 4} du =$$

$$= \frac{1}{16} \tan^{-1} u + C$$

$$u = \frac{\tan(x/2)}{2}$$

$$I = 1/16 \tan^{-1} \left(\frac{\tan(x/2)}{2} \right) + C$$

Q. 20 The expression $\frac{\tan A}{1 - \cot A} + \frac{\cot A}{1 - \tan A}$ can be written as:

Option 1:

$secA + cosecA$

Option 2:

$sinA\, cosA + 1$

Option 3:

$secA\, cosecA + 1$

Option 4:

$tanA + cotA$

Correct Answer:

$secA\, cosecA + 1$

Solution:

$$\frac{\tan A}{1 - \cot A} + \frac{\cot A}{1 - \tan A}$$

$$= \frac{\sin^2 A}{\cos A (\sin A - \cos A)} - \frac{cos^2 A}{(\sin A - \cos A)} \times \frac{1}{\sin A}$$

$$= \frac{\sin^3 A - \cos^3 A}{(\sin A \cos A)\ (\sin A - \cos A)}$$

$$= \frac{\sin^2 A + \cos^2 A + \sin A \cos A}{\sin A \cos A}$$

$$= \frac{1 + \sin A \cos A}{\sin A \cos A} = \sec A\ cosec\ A + 1$$

Q. 21 **p: Raj is kind**

q: Raj will help Nita

p implies **q** can be written as :

Option 1:
Raj will help Nita => Raj is kind

Option 2:
Raj is kind and will help Nita

Option 3:
Raj is kind => Raj will help Nita

Option 4:
None

Correct Answer:
Raj is kind => Raj will help Nita

Solution:
As we have learned

If then Implications -

P implies q is denoted by p $\longrightarrow$ q

- wherein

Symbol $\longrightarrow$ stands for implies

Q. 22 If mean of 15 numbers is 8 and mean of first 5 numbers is 10 the mean of last 10 numbers is

Option 1:
5

Option 2:
6

Option 3:
7

Option 4:
8

Correct Answer:
7

Solution:
As we have learned

Combined Mean -

If x_1 and x_2 be the means of two related groups having n_1 and n_2 items respectively then the combined mean $\bar{X}$ of both the groups is given by

$$\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

-

$$\frac{x_1 + x_2 + ...x_{15}}{15} = 8$$

$$\frac{x_1 + x_2 + ...x_5}{5} = 10$$

$$x_1 + x_2 + ...x_5 + \qquad x_6 + ...x_{15} = 120$$

$$50 \ \text{ first five number} \qquad \text{last ten number}$$

$$x_6 + x_7 + ...x_{15} = 120 - 50 = 70$$

$$\text{mean of last 10 numbers} = 70/10 = 7$$

Q. 23 Let A and B be two independent events such that $P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{6}$. Then, which of the following is TRUE?

Option 1:
$P(B/A) = \frac{1}{2}$

Option 2:
$P\left(A/B'\right) = \frac{1}{3}$

Option 3:

$P(A/B) = \frac{2}{3}$

Option 4:

$P(A'/B') = \frac{1}{3}$

Correct Answer:

$P(A/B') = \frac{1}{3}$

Solution:
A & B are independent events

So, A & B' are also independent events, and hence

$$P\left(\frac{A}{B'}\right) = P(A) = \frac{1}{3}$$

Correct Option (2)

Q. 24 Which of the following are equivalence sets?

Option 1:
A={2,3,4} and B={x:x∈N & 1<x<5}

Option 2:
A={1,3,5} and B={2,4,6}

Option 3:

$A = \{x : x \in I^+ \ and \ I < 3\} \quad B = \{101, 102\}$

Option 4:
All of the above

Correct Answer:
All of the above

Solution:
As we learnt

Equivalence Sets -

Two sets having same number of elements.

- wherein

eg. A= {H,T,P,V} and B= {1,2,3,4}

Q. 25 Write the equation of a line passing through (2,1) and slope -1 in parametric form

Option 1:
$\frac{x}{2}+\frac{y}{\sqrt{3}}=r$

Option 2:
$\frac{x}{\sqrt{3}}+\frac{y}{\sqrt{3}}-2=r$

Option 3:
$\frac{x-2}{-\sqrt{2}}+\frac{y-1}{\sqrt{2}}=r$

Option 4:
$\frac{x-2}{-1/\sqrt{2}}+\frac{y-1}{1/\sqrt{2}}=r$

Correct Answer:
$\frac{x-2}{-1/\sqrt{2}}+\frac{y-1}{1/\sqrt{2}}=r$

Solution:
As we have learned

Parametric form -

$$\frac{x-x_1}{\cos\Theta}=\frac{y-y_1}{\sin\Theta}=r$$

- wherein

Where θ is the inclination of the line and r is the distance between (x,y) and (x_1,y_1)

$\tan\theta=-1$

$\theta=135$

$=3\pi/4$

$$\frac{x-2}{\cos 3\pi/4}=\frac{y-1}{\sin 3\pi/4}=r$$

$$\frac{x-2}{-1/\sqrt{2}}+\frac{y-1}{1/\sqrt{2}}=r$$

Q. 26 For what value of C does the line 2x-y +c = 0 is tangent to the parabola: $y^2 - 32x = 0$

Option 1:
6

Option 2:
2

Option 3:
4

Option 4:
-4

Correct Answer:
4

Solution:
As we have learned

Line and a parabola -

$c = a/m$

- wherein

$y = mx + c$ is the tangent to

$y^2 = 4ax$

$y = 2x + c$

$y^2 = 32x$

$= 4(8)$

$so \;\; a = 8, m = 2$

$c = 8/2 = 4$

Q. 27 What is the value of parameter θ of point (-6,3) for hyperbola $\frac{x^2}{9} - \frac{y^2}{3} = 1$.

Option 1:
$\theta = \frac{2\pi}{3}$

Option 2:
$\theta = \frac{4\pi}{3}$

Option 3:
$\theta = \frac{\pi}{3}$

Option 4:
$\theta = \frac{\pi}{2}$

Correct Answer:
$\theta = \frac{4\pi}{3}$

Solution:
As we have learned

Parametric Coordinates -

$x = a \sec \Theta$

$y = b \tan \Theta$

- wherein

For the Hyperbola

$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ at Parametric θ

$-6 = 3 \sec \theta$

$3 = \sqrt{3} \tan \theta$

$\cos \theta = -1/2 \ \ and \ \ \tan \theta = \sqrt{3}$

$\theta = 180 + 60 = 240$

$= 4\pi/3$

Q. 28 Find the length of tangent from (7,4) to the circle $(x-1)^2 + (y+2)^2 = 9$

Option 1:
6

Option 2:
$\sqrt{31}$

Option 3:
$4\sqrt{2}$

Option 4:
$\sqrt{33}$

Correct Answer:
$\sqrt{31}$

Solution:
As we have learned

Length of a tangent -

$$L = \sqrt{{x_1}^2 + {y_1}^2 + 2gx_1 + 2fy_1 + c}$$

- wherein

Length of a tangent from an external point (x_1, y_1) to circle $x^2 + y^2 + 2gx + 2fy + c = 0$

Given circle is

$$x^2 + y^2 - 2x + 4y - 4 = 0$$

so the length of the tangent from (7,-4)

$$l = \sqrt{49 + 16 - 14 - 16 - 4} = \sqrt{31}$$

Q. 29 Consider the following linear programming problem:

Maximize 12x+10y

Subject to $4x + 3y \leq 480$

$2x + 3y \leq 360$

All variables ≥ 0

Which of the following (x,y) is feasible?

Option 1:
$(10, 120)$

Option 2:
$(120, 10)$

Option 3:
$(30, 100)$

Option 4:
$(60, 90)$

Correct Answer:
$(30, 100)$

Solution:
As we learnt in

Corner Point Method -

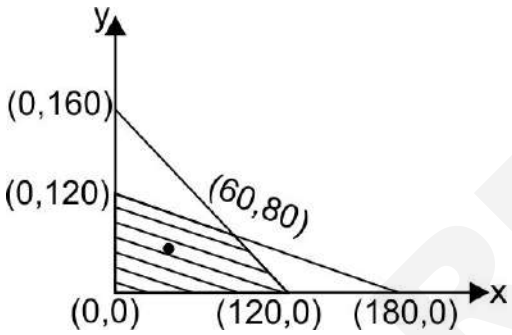
This method of solving a LPP graphically is based on the principle of extreme points theorem.

-

Z = 12x +10y

$4x + 3y \leq 480$

$2x + 3y \leq 360$



From fig (30, 100) lies between shaded portion.

Q. 30 If the system has a trivial solution then find the set of k.

$$x + y + z = 0,\ x + 2y + 3z = 0,\ x + 3y + kz = 0$$

Option 1:
$k \in \mathbb{R}$

Option 2:
$k \in \mathbb{R} - \{5\}$

Option 3:
$k \in \mathbb{R} - \{5, -5\}$

Option 4:
$k \in \mathbb{R} - \{-5\}$

Correct Answer:
$k \in \mathbb{R} - \{5\}$

Solution:
As we have learnt,

The solution of a system of homogeneous linear equations -

$(0, 0, 0)$ is a solution of the system of equations and is known as trivial solutions

-

For a trivial solution,

$$\begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 3 & k \end{vmatrix} \neq 0$$

$= (2k - 9) - (k - 3) + (3 - 2)$
$= 2k - 9 - k + 3 + 1$
$= k - 5 \neq 0$
$k \neq 5$

Q. 31 An equation has $\frac{1}{2}, 7 - 3$ is its roots and 2 as the leading coefficient what is the cubic equation

Option 1:
$x^3 - \frac{9}{2}x^2 - \frac{31}{2}x + 22 = 0$

Option 2:
$2x^3 - 9x^2 - 31x + 42 = 0$

Option 3:
$2x^3 + 9x^2 - 31x + 42 = 0$

Option 4:
None of these

Correct Answer:
$2x^3 - 9x^2 - 31x + 42 = 0$

Solution:
As we learned

Factor Theorem -

Any polynomial can be written in terms of product of its factors.

- wherein

If $P(x)=0$ has roots $\alpha_1, \alpha_2, \cdots \alpha_n$ and $P(x)$ has leading coefficient 'A' then then $P(x)=a(x-\alpha_1)(x-\alpha_2)\cdots(x-\alpha_n)$

$$2\left(x-\frac{1}{2}\right)(x-7)(x+3)=0$$

$$2\left(x^2-\frac{15}{2}x+7\right)(x+3)=0$$

$$2\left(x^3-\frac{9}{2}x^2-\frac{31}{2}x+21\right)=0$$

$$2x^3-9x^2-31x+42=0$$

Q. 32 If $x_0=2, x_4=18, x_7=51$. Then the value of x_{11} will be ?

Option 1:
69

Option 2:
123

Option 3:
138

Option 4:
121

Correct Answer:
123

Solution:

Deduction -

The process of deducing particular results from a general result.

-

$x_0 = 2,$

$x_4 = 16 + 2$

$x_7 = 49 + 2$

.

.

$x_n = n^2 + 2$

So,

$x_{11} = 11^2 + 2$

$= 123$

The correct option is 2.

Q. 33 What is the number of circular permutations of 7 objects out of 12 available objects?

Option 1:
${}^{12}P_7$

Option 2:
$\frac{{}^{12}P_7}{7}$

Option 3:
6!

Option 4:
$12P_7/14$

Correct Answer:
$\frac{{}^{12}P_7}{7}$

Solution:

Rule for Circular Permutations -

Number of circular permutations of n different things taken r at a time when clockwise and anticlockwise order are taken as different is $\frac{{}^{n}p_r}{r}$.

- wherein

Where $r \geq 0 \ \ and \ \ r \leq n$

$$\frac{^{12}P_7}{7}$$

Q. 34 Find the equation whose roots are reciprocal of the roots of the equation $ax^2 + bx + 2 = 0$

Option 1:
$2x^2 + ax + b = 0$

Option 2:
$y^2 + by + a = 0$

Option 3:
$2x^2 + bx + a = 0$

Option 4:
None of these

Correct Answer:
$2x^2 + bx + a = 0$

Solution:
As we learned

Transformation of equation -

To find equation whose roots are symmetrical functions of α and β , Where α & β are roots of some other equation.

- wherein

Take any of the roots to be equal to y & calculate α or β accordingly in terms of y & satisfy the given equation to get the required equation.

Let the root of the required equation be y; so,

$$y = \frac{1}{\alpha} \rightarrow \alpha = \frac{1}{y}$$

now, $a\alpha^2 + b\alpha + 2 = 0$

$\rightarrow \frac{a}{y^2}+\frac{b}{y}+2=0$

$\rightarrow 2y^2+by+a=0$

Q. 35 Find the value of k & l, such that $2x^2-3x-5=0$ and $kx^2+2lx-7=0$ have both roots common.

Option 1:
$k=\frac{14}{5}, l=\frac{21}{10}$

Option 2:
$k=l=\frac{7}{2}$

Option 3:
$k=\frac{14}{5}, l=\frac{-21}{10}$

Option 4:
Can't Decide

Correct Answer:
$k=\frac{14}{5}, l=\frac{-21}{10}$

Solution:
As we learned

Condition for both roots common -

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

- wherein

$ax^2+bx+c=0$ &

$a'x^2+b'x+c'=0$

are the 2 equations

$\frac{2}{k}=\frac{-3}{2l}=\frac{-5}{-7}$

$\rightarrow k=\frac{14}{5}, l=\frac{-21}{10}$

Q. 36 Find $\sqrt{7-24i}$

Option 1:
$\pm(4-3i)$

Option 2:
$(4+3i)$

Option 3:
$-(4+3i)$

Option 4:
None of these

Correct Answer:
$\pm(4-3i)$

Solution:
As we learned

Square Root of a Complex Number -

$\sqrt{z}=a+ib \text{ where } z=x+iy \text{ is calcuated by equating real and imaginary parts of } :$
$x+iy=(a+ib)^2$

-

Let, $\sqrt{7-24i}=a+ib$

$\Rightarrow 7-24i=\left(a^2-b^2\right)+i\,(2ab)$

$\Rightarrow a^2-b^2=7 \;;\; 2ab=-2y$

So, $\left(a^2+b^2\right)=\sqrt{\left(a^2-b^2\right)+(2ab)^2}$

$=\sqrt{49+576}$

$=25$

So, $2a^2 = 32 \quad and \quad 2b^2 = 18$

$\Rightarrow a = \pm 4 \quad and \quad b = \pm 3$

$\Rightarrow a + ib = 4 - 3i \ or \ -4 + 3i$

(acceptable values as ab<0)

Q. 37 FInd the coeff. of $x^7 + x^8 \ in \ \frac{1}{(1-x)^3}$

Option 1:
81

Option 2:
64

Option 3:
100

Option 4:
none of these

Correct Answer:
81

Solution:
As we have learned

Properties of Binomial Theorem -

$$(1-x)^{-n} = 1 + nx + \frac{n(n+1)}{2!}x^2 + \frac{n(n+1)(n+2)}{3!}x^3 + - - -$$

-

$$\frac{1}{(1-x)^3} = {}^2c_0 + {}^3c_1 + {}^4c_2 + \ldots$$

$${}^9c_7x^7 + {}^{10}c_8x^8 = \frac{9 \times 8}{2} + \frac{10 \times 9}{2} = 9/2 \times 18 = 81$$

Q. 38 If a_1 and a_2 are two values of a for which the unit vector $a\hat{i} + b\hat{j} + \frac{1}{2}\hat{k}$ is linearly dependent with $\hat{i} + 2\hat{j}$ and $\hat{j} - 2\hat{k}$ then $\frac{1}{a_1} + \frac{1}{a_2}$ is equal to

Option 1:
1

Option 2:
1/8

Option 3:
-16/11

Option 4:
-11/16

Correct Answer:
-16/11

Solution:
As we have learnt

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

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

-

$$a\hat{i}+b\hat{j}+\frac{1}{2}\hat{k}=l\left(\hat{i}+2\hat{j}\right)+m\left(\hat{j}-2\hat{k}\right)$$

a=l ,b=2l+m, and m=-1/4

$a\hat{i}+b\hat{j}+\frac{1}{2}\hat{k}$ is a unit vector

$$a^2+b^2=\frac{3}{4}$$

$$5a^2-a-\frac{11}{16}=0$$

a_1 and a_2 are roots of the above equation

$$\frac{1}{a_1}+\frac{1}{a_2}=\frac{a_1+a_2}{a_1a_2}=\frac{-16}{11}$$

Q. 39 Find the shortest distance between the lines $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$ and $\frac{x-2}{3}=\frac{y-4}{4}=\frac{z-5}{5}$

Option 1:

$\frac{2}{\sqrt{6}}$

Option 2:

$\frac{3}{\sqrt{6}}$

Option 3:

$\frac{1}{\sqrt{6}}$

Option 4:

None

Correct Answer:

None

Solution:

As we ahve learnt

Shortest distance between two skew lines (Cartesian form) -

Shortest distance between $\frac{x-x_1}{a_1}=\frac{y-y_1}{b_1}=\frac{z-z_1}{c_1}$ and $\frac{x-x_2}{a_2}=\frac{y-y_2}{b_2}=\frac{z-z_2}{c_2}$ is given by

$$\left|\frac{\left(\vec{b}\times\vec{b_1}\right)\cdot\left(\vec{a}-\vec{a_1}\right)}{\left|\vec{b}\times\vec{b_1}\right|}\right|$$ Where

$\vec{a}=x_1\hat{i}+y_1\hat{j}+z_1\hat{k}$

$\vec{a_1}=x_2\hat{i}+y_2\hat{j}+z_2\hat{k}$

$\vec{b}=a_1\hat{i}+b_1\hat{j}+c_1\hat{k}$

$\vec{b_1}=a_2\hat{i}+b_2\hat{j}+c_2\hat{k}$

-

Lines $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$, $\frac{x-2}{3}=\frac{y-4}{4}=\frac{z-5}{5}$

$$d=\frac{\begin{vmatrix} x_2-x_1 & y_2-y_1 & z_2-z_1 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & m_2 \end{vmatrix}}{\sqrt{(l_1m_2-l_2m_1)^2+(m_1n_2-m_2n_1)^2+(l_1n_2-l_2n_1)^2}}$$

$$=\frac{1}{\sqrt{6}}$$

Q. 40 If $a=i+j+k, b=4i+3j+4k$ and $c=i+\alpha j+\beta k$ are linearly dependent vectors and $|c|=\sqrt{3}$, then

Option 1:
$\alpha=1,\beta=-1$

Option 2:
$\alpha=1,\beta=\pm1$

Option 3:
$\alpha=-1,\beta=\pm1$

Option 4:
$\alpha=\pm1,\beta=1$

Correct Answer:
$\alpha=\pm1,\beta=1$

Solution:
As we learn

Linear combination of vectors -

Any vector $\vec{r}$, copalant with non-collinear vectors $\vec{A}$ and $\vec{B}$ can be expressed as linear combination of vectors. $\vec{r}=m\vec{a}+n\vec{b}$

- wherein

m, n are scalar.

The given vectors are linearly dependent hence, there exist scalars x,y,z not all zero, such that x**a**+y**b**+z**c**=0

i.e., $x(i+j+k)+y(4i+3j+4k)+z(i+\alpha j+\beta k)=0,$

i.e., $(x+4y+z)i+(x+3y+\alpha z)j+(x+4y+\beta z)k=0,$

$\Rightarrow x+4y+z=0, x+3y+\alpha z=0, x+4y+\beta z=0,$

For non-trivial solution, $\begin{vmatrix}1 & 4 & 1\\ 1 & 3 & \alpha\\ 1 & 4 & \beta\end{vmatrix}=0\Rightarrow\beta=1$

$|c|^2=3\Rightarrow 1+\alpha^2+\beta^2=3\Rightarrow\alpha^2=2-\beta^2=2-1=1;\therefore\alpha=\pm1$

Trick : $|c|=\sqrt{1+\alpha^2+\beta^2}=\sqrt{3}\Rightarrow\alpha^2+\beta^2=2$

$\because$ a, b,c are linearly dependent,

hence $\begin{vmatrix}1 & 1 & 1\\ 4 & 3 & 4\\ 1 & \alpha & \beta\end{vmatrix}=0\Rightarrow\beta=1.$

$\therefore\alpha^2=1\Rightarrow\alpha=\pm1$

Q. 41 $\lim\limits_{x\to 1}\dfrac{x^2+4x-5}{\sin(x^2-1)}$ is equal to:

Option 1:
0

Option 2:
1

Option 3:
2

Option 4:
3

Correct Answer:
3

Solution:
As we learned

L - Hospital Rule -

$In\ the\ form\ of\ \ \frac{0}{0}\ and\ \frac{\infty}{\infty}\ \ we\ differentiate\ \frac{N^r}{D^r}\ separately.$

$$\Rightarrow \lim_{x\to a}\ \frac{f(x)}{g(x)} = \lim_{x\to a}\ \frac{f'(x)}{g'(x)}$$

- wherein

$$\lim_{x\to a}\ \frac{\frac{d}{dx}f(x)}{\frac{d}{dx}g(x)}$$

$Where\ \ f(x)\ \ and\ \ g(x) = 0$

$$\lim_{x\to 1}\ \frac{x^2+4x-5}{\sin(x^2-1)}$$

$$= \lim_{x\to 1}\ \frac{2x+4}{\cos(x^2-1).2x}\ [By\ L'H\ \ Rule]$$

$$= \frac{6}{1*2} = 3$$

Q. 42 Find length of subtangent to $y^2 = x\ at\ (4,-2)$ on it.

Option 1:
$\sqrt{17}$

Option 2:
6

Option 3:
8

Option 4:
10

Correct Answer:
8

Solution:
As we learned

Length of sub Tangent -

$$L_{ST} = \frac{y}{y'}$$

- wherein

$$Where \;\; y' = \frac{dy}{dx}$$

$$2y\, y^1 = 1 \Rightarrow y^1 = \frac{-1}{4} \; at \; (4, -2)$$

$$So, L_{ST} = \left|\frac{y}{y^1}\right| = \left|\frac{-2}{\frac{-1}{4}}\right| = 8$$

Q. 43 Particular solution of D.E $e^{\frac{dy}{dx}} = x + 2$ when x=-1, y=2

Option 1:
$(x+2)\ln(x+2) - x + 1$

Option 2:
$(x+2)\ln(x+2) + 2$

Option 3:
$x\ln(x+2) - 2\ln(x+2) + 2$

Option 4:
None of these

Correct Answer:
$(x+2)\ln(x+2) - x + 1$

Solution:
As we learnt

Particular Solution -

The solutions, obtained by giving particular values to the arbitrary constants in the general solution, are called particular solutions

-

$$e^{\frac{dy}{dx}} = x + 2 \Rightarrow \frac{dy}{dx} = \ln|x+2|$$

$$\int dy = \int \ln|x+2|\, dx$$

$$y = (x+2)\ln(x+2) - x + C$$

$$2 = (-1+2)\ln(-1+2) - (-1) + C$$

$2 = 1 * 0 + 1 + C$

$C = 1$

$y = (x + 2) \ln (x + 2) - x + 1$

Q. 44 f(x) is a pohynomial function such that f(1)=3, f(3)=7, g(1)=-3, g(3)=-5, then $\pounds$ alteast one $C\epsilon(1,3)$ such that $\frac{f'(c)}{g'(c)}$

Option 1:
-1

Option 2:
-2

Option 3:
2

Option 4:
1

Correct Answer:
-2

Solution:
As we learned

cauchy's Theorem -

$$\frac{f'(c)}{g'(c)} = \frac{f(b) - f(a)}{g(b) - g(a)}$$

for some $C \ \epsilon \ (a, b)$

- wherein

$f(x) \ and \ g(x)$ diffrentialable $[a, b]$

$$\frac{f'(c)}{g'(c)} = \frac{f(3) - f(1)}{g(3) - g(1)}$$

$$= \frac{7 - 3}{-5 + 3}$$

= -2

Q. 45 If $\int \sqrt{1-x^2}dx = A[sin^{-1}(x) + g(x)] + C$, then $g(x) = ?$

Option 1:
$x\sqrt{x^2-1}$

Option 2:
$x(x^2-1)$

Option 3:
$x\sqrt{x^2+1}$

Option 4:
$x\sqrt{1-x^2}$

Correct Answer:
$x\sqrt{1-x^2}$

Solution:
As we have learnt,

Special type of indefinite integration -

Integrals of the form :

(i) $f(\sqrt{a^2-x^2})$, (ii) $f(\sqrt{x^2-a^2})$

(iii) $f(\sqrt{a^2+x^2})$, (iv) $f(a^2+x^2)$

(v) $f\left(\sqrt{\frac{a-x}{a+x}}\right)$, (vi) $f\left(\sqrt{\frac{a+x}{a-x}}\right)$

(vii) $f\left(\sqrt{\frac{x-a}{b-x}}\right)$, (viii) $f\left(\sqrt{(x-a)(x-b)}\right)$

- wherein

Working rule :

for (i) put $x = a\sin\Theta$ or $a\cos\Theta$

for (ii) Put $x = a\sec\Theta$ or $a\,cosec\Theta$

for (iii) and (iv) Put $x = a\tan\Theta$ or $a\cot\Theta$

for (v) and (vi) Put $x = a\cos 2\Theta$

for (vii) and (viii) Put $x = a\cos^2\Theta + b\sin^2\Theta$

$$\int \sqrt{1-x^2}$$

put

$$x = \sin(u) \Rightarrow dx = \cos(u)du$$
$$u = \sin^{-1}(x)$$

$$= \int \cos(u)\sqrt{1-\sin^2(u)}du = \int \cos^2(u)du$$

$$= \int \frac{\cos(2u)+1}{2}du = \frac{1}{2}\int \cos(2u)du + \frac{1}{2}\int 1du$$

$$= \frac{\sin(2u)}{4} + \frac{u}{2} + C$$

Undo substitution,

$u = \sin^{-1}(x)$ and $\sin(2\sin^{-1}x) = 2x\sqrt{1-x^2}$

$$= \frac{\sin^{-1}x + x\sqrt{1-x^2}}{2} + C$$

Q. 46 $\sim (P \Leftrightarrow q) \equiv$

Option 1:
$\sim (p \Rightarrow q) \vee \sim (q \Rightarrow p)$

Option 2:
$(p \Rightarrow q) \wedge (q \Rightarrow p)$

Option 3:
$(\sim p \Rightarrow q) \vee (\sim q \Rightarrow p)$

Option 4:
$(p \Leftrightarrow q) \wedge (p \Rightarrow q)$

Correct Answer:
$\sim (p \Rightarrow q) \vee \sim (q \Rightarrow p)$

Solution:
As we have learned

Negation of Biconditional Statement -

Negation of $p \leftrightarrow q$ is disjunction of negation of implication $p \rightarrow q$ and the negation of implication $q \rightarrow p$

-

$$\sim (p \Leftrightarrow q)$$

$$\equiv \sim (p \Rightarrow q \wedge q \Rightarrow p) \equiv \sim (p \Rightarrow q) \vee \sim (q \Rightarrow p)$$

Q. 47 A Fair six-sided die is rolled 6 times what is the probability of getting all outcomes as unique:

Option 1:
$6/6^6$

Option 2:
$3^6/6^6$

Option 3:
$6!/6^6$

Option 4:
$5!/6^6$

Correct Answer:
$6!/6^6$

Solution:
As we have learned

Probability of occurrence of an event -

Let S be the sample space then the probability of occurrence of an event E is denoted by P(E) and it is defined as

$$P(E) = \frac{n(E)}{n(S)}$$

$$P(E) \leq 1$$

$$P(E) = \lim_{n \to \infty} \left(\frac{r}{n}\right)$$

- wherein

Where n repeated experiment and E occurs r times.

For all outcomes to be unique, we have 6 chance for first then 5 chance for the second, 4 chance for third and so on

required probability

$$\mathrm{P}(R)=\frac{6!}{6^6}$$

Q. 48 Four persons can hit a target correctly with probabilities $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ and $\frac{1}{8}$ respectively. If all hit at the target independently, then the probability that the target would be hit,is:

Option 1:
$\frac{25}{192}$

Option 2:
$\frac{7}{32}$

Option 3:
$\frac{1}{192}$

Option 4:
$\frac{25}{32}$

Correct Answer:
$\frac{25}{32}$

Solution:
P (target is hit)

$= 1 - P$ (No one hit the target)

$$= 1-\left(\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}\times\frac{7}{8}\right)$$

$$=\frac{25}{32}$$

Q. 49 Find the domain of the function $f(x)=\frac{2}{\log_{10}(1-x)}+\sqrt{x+3}$

Option 1:
$[-3,0)\cup(0,1)$

Option 2:
$[-2,1)\cup(1,\infty)$

Option 3:
$[-2,0)\cup(0,\infty)$

Option 4:
none

Correct Answer:
$[-3,0)\cup(0,1)$

Solution:
As we have learned

Domain of function -

All posible values of x for f(x) to be defined is known as domain.

-

$$f(x)=\frac{2}{log_{10}(1-x)}+\sqrt{x+3}$$

$\log_a x$ defined when $x>0$, If $a>0$ & $a\neq 1$

also, $\log_a 1=0$, Thus $\log_{10}(1-x)$ exist when

$1-x>0$ and $1-x\neq 1$

$x<1$ and $x\neq 0$

now , we have $\sqrt{x+3}, so\ \ x+3\geq 0$

$f(x)$ holds true when $-3\leq x<1$ *and* $x\neq 0$

$x\epsilon[-3,0)\cup(0,1)$

Q. 50 If the curves, $x^2-6x+y^2+8=0\ and\ x^2-8y+y^2+16-k=0,(k>0)$ touch each other at a point, then the largest value of k is_____.

Option 1:
15

Option 2:
30

Option 3:

51

Option 4:

36

Correct Answer:

36

Solution:

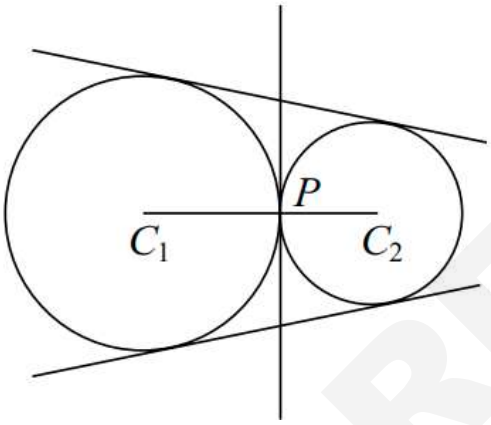
Intersection of Two Circle -

CASE 2

When two circles touch each other externally

$|\mathbf{C_1C_2}| = \mathbf{r_1} + \mathbf{r_2},$

i.e, the distance between the centres is equal to the sum of radii, then two circles touch externally.



In this case, two direct common tangents are real and distinct while the transverse tangents are coincident.

In this case, point of contact P divides C_1 and C_2 internally in the ratio r_1:r_2.

$$\frac{C_1P}{C_2P} = \frac{r_1}{r_2}$$

$$\text{Coordinate of point P is } \left(\frac{r_1x_2 + r_2x_1}{r_1 + r_2}, \frac{r_1y_2 + r_2y_1}{r_1 + r_2}\right)$$

$$\text{The equation of tangent at point } P \text{ is } S_1 - S_2 = 0, \text{ where } S_1 = 0 \text{ and } S_2 = 0 \text{ are equations of circles.}$$

-

Two circles touch each other if $C_1C_2 = |r_1 \pm r_2|$

Distance between C2(3, 0) and C1(0, 4) is either $\sqrt{k} + 1$ or $|\sqrt{k} - 1|$

Also $C_1C_2 = \sqrt{4^2 + 3^2} = 5$

$\Rightarrow \sqrt{k}+1=5 \text{ or } |\sqrt{k}-1|=5 \quad \Rightarrow k=16 \text{ or } k=36$

Maximum value of K is 36

Correct Option 4

Q. 51 Two normals at t_1 and t_2 meet again the parabola $y^2 = 4ax$ then the relation between t_1 and t_2 is

Option 1:
$t_1 t_2 = 1$

Option 2:
$t_1 - t_2 = 2$

Option 3:
$t_1 t_2 = 2$

Option 4:
$t_1 + t_2 = 2$

Correct Answer:
$t_1 t_2 = 2$

Solution:

Normal at t1 meets the parabola again at t2 -

Normal at t_1 meets the parabola again at t_2

$$\text{Equation of Normal at P} \equiv \left(at_1^2, 2at_1\right) \text{ to the parabola } y^2 = 4ax \text{ is}$$

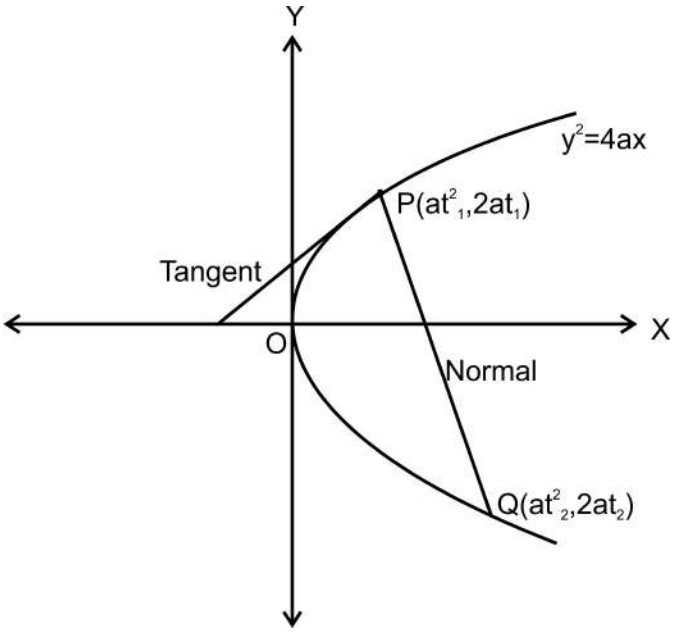
$$y = -t_1 x + 2at_1 + at_1^3$$

$$\text{It meets the parabola again at Q} \equiv \left(at_2^2, 2at_2\right)$$

$$\therefore 2at_2 = -at_1 t_2^2 + 2at_1 + at_1^3$$

$$\Rightarrow 2a\left(t_2 - t_1\right)\left[2 + at_1\left(t_2^2 - t_1^2\right) = 0\right.$$
$$\Rightarrow a\left(t_2 - t_1\right)\left[2 + t_1\left(t_2 + t_1\right)\right] = 0$$
$$\therefore a\left(t_2 - t_1\right) = 0$$
$$\therefore 2 + t_1\left(t_1 + t_2\right) = 0$$

$$t_2 = -t_1 - \frac{2}{t_1}$$



-

Since the normal at t_1 meets the parabola at t, so $t = -t_1 - \frac{2}{t_1}$.

Similarly, $t = -t_1 - \frac{2}{t_1}$

$$\text{Thus, } -t_1 - \frac{2}{t_1} = -t_2 - \frac{2}{t_2}$$
$$\Rightarrow \quad (t_1 - t_2) = \left(\frac{2}{t_1} - \frac{2}{t_2}\right) = \frac{2(t_1 - t_2)}{t_1 t_2}$$
$$\Rightarrow \quad t_1 t_2 = 2$$

Q. 52 Given the following two constraints, which solution is a feasible solution for a maximization problem?

Constraint1: $4x_1 + 3x_2 \leq 18$

Constraint 2: $x_1 - x_2 \leq 3$

Option 1:
$x_1, x_2 = (1, 5)$

Option 2:
$x_1, x_2 = (4, 1)$

Option 3:
$x_1, x_2 = (4, 0)$

Option 4:

$x_1, x_2 = (2, 1)$

Correct Answer:

$x_1, x_2 = (2, 1)$

Solution:

Different Types of Linear Programming Problems -

-

As we learnt in

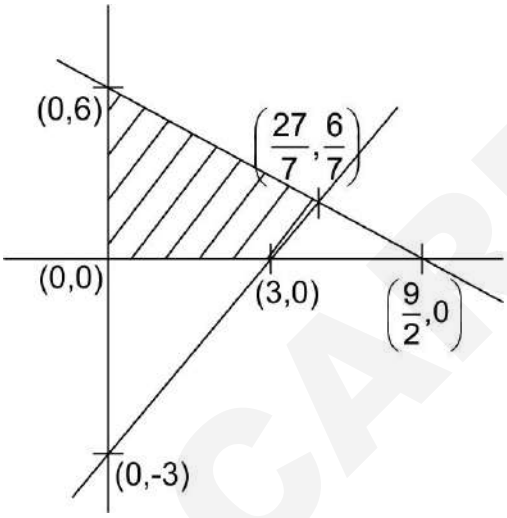
Corner Point Method -

This method of solving an LPP graphically is based on the principle of extreme points theorem.

-

$4x_1 + 3x_2 \leq 18$

$x_1 - x_2 \leq 3$



From figure only (2, 1) lies in region.

Q. 53 The value of α for which system of equation is inconsistent

$\alpha x + \alpha y + z = \alpha - 1$

$x + \alpha y + z = \alpha - 1$

$\alpha x + y + \alpha z = \alpha - 1$

Option 1:
1

Option 2:
-1

Option 3:
-1/2

Option 4:
Both a and b

Correct Answer:
-1/2

Solution:
As we have learnt

Inconsistent system of linear equation -

If the system of equations has no solutions

System of linear eq. is insonsistent. So system has no solution

$$\begin{vmatrix} \alpha & \alpha & 1 \\ 1 & \alpha & \alpha \\ \alpha & 1 & \alpha \end{vmatrix} = 0$$

$R_1 = R_1 + R_2 + R_3$ and take common $(1+2\alpha)$

$$\begin{bmatrix} 1+2\alpha & \alpha & 1 \\ 1+2\alpha & \alpha & \alpha \\ 1+2\alpha & 1 & \alpha \end{bmatrix} = (1+2\alpha) \begin{bmatrix} 1 & \alpha & 1 \\ 1 & \alpha & \alpha \\ 1 & 1 & \alpha \end{bmatrix} = 0$$

$R^1 \to R_1 - R_2$ and $R^2 \to R_2 - R_3$

we get,

$(1+2\alpha)(\alpha-1)^2 = 0$

- $\alpha = -1/2, 1$

$\alpha \neq -1$

Q. 54 Find the sum of first 15 terms of series $1 + 3 + 7 + 13 + ...$

Correct Answer:
1135

Solution:
Difference of consecutive terms: 2, 4, 6, ...which is an Ap

So we can use Method of Difference to nth term first, and then apply summation to nth term to get the sum

$$S_n = 1 + 3 + 7 + 13 + ... + T_n \quad ....(i)$$
$$S_n = \quad 1 + 3 + 7 + ... + T_{n-1} + T_n \quad ...(ii)$$

Equation (i)-(ii)

$$0 = 1 + (2 + 4 + 6.....(n-1)\ terms) - T_n$$
$$T_n = 1 + 2(\frac{n(n-1)}{2})$$
$$T_n = n^2 - n + 1$$
$$S_n = \sum_{1}^{15} T_n$$
$$S_n = \frac{n(n+1)(2n+1)}{6} - \frac{n(n+1)}{2} + n$$
$$S_n = \frac{1}{3}\left(n^3 + 2n\right)$$
$$S_{15} = 1135$$

Q. 55 What is the ways of selecting atleast one fruit from 5 identical mangoes, 3 identical guavas and 7 identical bananas?

Option 1:
192

Option 2:
15

Option 3:
191

Option 4:
None of these

Correct Answer:
191

Solution:

The theorem of Combinations -

The number of ways of selecting at least one item from a collection of m objects of one kind, n objects of another kind and p other kind is (m + 1) (n + 1) (p + 1) -1.

-

(5 + 1) (3 + 1) (7 + 1) -1=191

Q. 56 The sum of four numbers of an AP is 16 and the sum of their square is 84. Find the numbers.

Option 1:
2,4,6,8

Option 2:
1,3,5,7

Option 3:
2,5,8,11

Option 4:
3,4,5,6

Correct Answer:
1,3,5,7

Solution:
As we have learnt,

Selection of terms -

If we have to take 4 terms in an AP, whose sum is known,

we take them as a - 3d, a - d, a + d, a + 3d

- wherein

Extension : If we have to take 2r terms in an AP, we take them as

a -(2r -1)d,a - (2r -3)d, - - - - - - a - d, a+d, - - - - - - a+ (2r - 1)d.

Lets Assume number in an AP be $a-3d, a-d, a+d, a+3d$

$\Rightarrow a-3d+a-d+a+d+a+3d=16 \quad (given)$

$4a=16$

$a=4$

numbers become,

$4-3d, 4-d, 4+d, 4+3d$

$(4-3d)^2+(4-d)^2+(4+d)^2+(4+3d)^2=84$

$16+9d^2-24d+16+d^2-8d+16+d^2+8d+16+9d^2+24d=84$

$64+20d^2=84$

$20d^2=20$

$d=1$

So, the numbers are,

$a-3d=4-3=1$ $\quad$ $a+d=4+1=5$

$a-d=4-1=3$ $\quad$ $a+3d=4+3=7$

Q. 57 Find the equation of straight line parallel to $2\hat{i}-\hat{j}+3\hat{k}$ and passing through the point (5,-2,4)

Option 1:
$(5+2\lambda)\,\hat{i}-(2+\lambda)\,\hat{j}+(4+3\lambda)\,\hat{k}$

Option 2:
$\lambda\hat{i}-2\hat{j}+3\lambda\hat{k}$

Option 3:
$(5+3\lambda)\,\hat{i}-(2+3\lambda)\,\hat{j}+(4-\lambda)\,\hat{k}$

Option 4:
$(5+\lambda)\,\hat{i}-(2+\lambda)\,\hat{j}+(4+3\lambda)\,\hat{k}$

Correct Answer:
$(5+2\lambda)\,\hat{i}-(2+\lambda)\,\hat{j}+(4+3\lambda)\,\hat{k}$

Solution:
As we have learnt

Vector equation of a line -

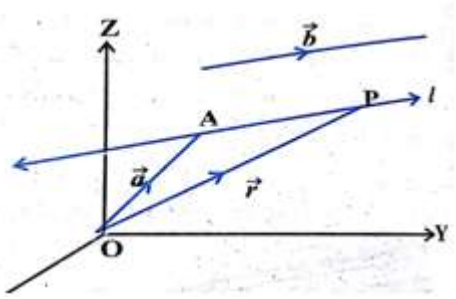
The equation of a line passing through $A\,(\bar{a})$and parallel to vector $\vec{B}$ is given by

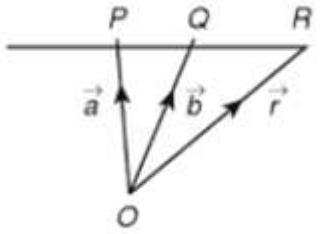
$\vec{r}=\vec{a}+\lambda\vec{b}$.

The equation of a line passing through two points $A\,(\vec{a})\ and\,B\left(\vec{b}\right)$ is given by

$\vec{r}=\vec{a}+\lambda\left(\vec{b}-\vec{a}\right)$

- wherein





Let, P=(5,-2,4) then $OP = 5\hat{i} - 2\hat{j} + 4\hat{k} = a$

$b = 2\hat{i} - \hat{j} + 3\hat{k}$

So, equation of straight line

$r = a + \lambda b$

$r = \left(5\hat{i} - 2\hat{j} + 4\hat{k}\right) + \lambda(2\hat{i} - \hat{j} + 3\hat{k})$

$r = (5 + 2\lambda)\,\hat{i} - (2 + \lambda)\hat{j} + \hat{k}\,(4 + 3\lambda)$

Q. 58 Solution of the D.E

$$y\frac{dx}{dy} + x = xy\sin(y)$$ is

Option 1:

$\ln(xy) - \cos(y) = c$

Option 2:

$\ln(x + y) - \cos(y) = c$

Option 3:

$\ln(xy) + \cos(y) = c$

Option 4:

$\ln(x + y) + \cos(y) = c$

Correct Answer:

$\ln(xy) + \cos(y) = c$

Solution:
As we learnt

General form of Variable Separation -

$$d\left(\log xy\right)=\frac{ydx+xdy}{xy}$$

-

Since,

$$y\frac{dx}{dy}+x=xy\sin(y)$$
$$\frac{ydx+xdy}{dy}=xy\sin(y)$$
$$\frac{ydx+xdy}{xy}=\sin(y)dy$$

Since, $d\left(\log xy\right)=\frac{ydx+xdy}{xy}$

So,

$$d\left[\ln(xy)\right]=\sin(y)dy$$

Integrate both sides

$$\ln(xy)=-\cos(y)+C$$

$$\ln(xy)+\cos(y)=c$$

Q. 59 If $\lim_{x\to 0}\frac{[(a-n)nx-\tan x]\sin nx}{x^2}=0,$ where n is a non-zero real number, then a is equal to

Option 1:
0

Option 2:
$\frac{n+1}{n}$

Option 3:
n

Option 4:

$n+\frac{1}{n}$

Correct Answer:

$n+\frac{1}{n}$

Solution:
As we learned

Condition for Trigonometric limit -

$\lim_{x\to 0}\ [\frac{sinx}{x}]=0$

$\lim_{x\to 0}\ [\frac{tanx}{x}]=1$

$[\lim_{x\to 0}\ \frac{sinx}{x}]=[\lim_{x\to 0}\ \frac{tanx}{x}]=1$

- wherein

Where [.] is greater integer function

$\lim_{x\to 0}\frac{[(a-n)nx-\tan x]\sin nx}{x^2}=0,$

$\lim_{x\to 0}\frac{n\cdot\sin nx}{nx}\cdot\lim_{x\to 0}\left((a-n)n-\frac{tanx}{x}\right)=0$

$\Rightarrow n[(a-n)n-1]=0\Rightarrow(a-n)n=1\Rightarrow a=n+\frac{1}{n}$

Q. 60 If the probability of dangerous fire is 0.01 and the probability of having a smoke is 0.1. If 90 % of dangerous fire makes smoke the probability of dangerous fire when there is smoke is

Option 1:
0.09

Option 2:
0.11

Option 3:
0.91

Option 4:
0.9

Correct Answer:
0.09

Solution:
As we have learned

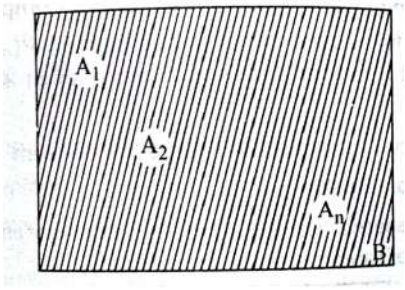
BAYE'S Theorem -

If E_1, E_2, E_3.....E_n be n mutually exclusive and exhaustive events and A is an event that occurs together with either E_1, E_2, E_3.....E_n from a portion of the sample space S and A be an event than

$$P\left(\frac{E_k}{A}\right)=\frac{P\left(E_k\right)\cdot P\left(\frac{A}{E_k}\right)}{P\left(E_1\right)\cdot P\left(\frac{A}{E_1}\right)+P\left(E_2\right)\cdot P\left(\frac{A}{E_2}\right)+\cdots P\left(E_k\right)\cdot P\left(\frac{A}{E_k}\right)}$$

where S = $E_1 \cup E_2 \cup \cdots E_k$ and S is sample space.

- wherein



$$P(Fire|Smoke)=\frac{P(fire)P(Smoke|Fire)}{P(Smoke)}=\frac{0.01\times 0.9}{0.1}=0.09$$