

MEMORY BASED QUESTIONS

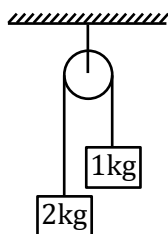
(HELD ON THURSDAY 02nd APRIL 2026)

TIME : 3:00 PM TO 6:00 PM

PHYSICS

TEST PAPER WITH SOLUTION

1. For given atwood machine. Find displacement (in m) of centre of mass after 2 sec of release.



- (1) $\frac{20}{9}$ (Downward) (2) $\frac{20}{9}$ (upward)
 (3) $\frac{10}{9}$ (Downward) (4) $\frac{10}{9}$ (upward)

Ans. (1)

Sol. $a = \frac{(m_2 - m_1)}{m_1 + m_2} g = \frac{(2 - 1)}{3} \times 10 = \frac{10}{3} \text{ m/s}^2$

$$a_{\text{cm}} = \frac{(1)(10/3) - (2)(10/3)}{3} = \frac{-10}{9} \text{ m/s}^2 (\downarrow)$$

$$S_{\text{cm}} = u_{\text{cm}} t + \frac{1}{2} a_{\text{cm}} t^2$$

$$= 0 + \frac{1}{2} \left(\frac{10}{9} \right) (4) = \frac{20}{9} \text{ m (downward)}$$

$$S_{\text{COM}} = \frac{20}{9} \text{ (Downward)}$$

2. At any instant, if $\vec{B} = -2 \times 10^{-7} \hat{j} \text{ T}$ and C is along +x axis then $\vec{E}$ at this instant is :-

- (1) $60 \hat{k} \text{ V/m}$ (2) $45 \hat{k} \text{ V/m}$
 (3) $90 \hat{k} \text{ V/m}$ (4) $30 \hat{k} \text{ V/m}$

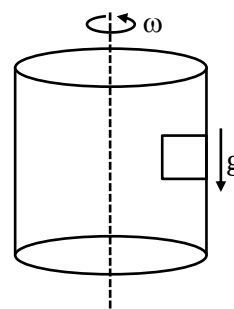
Ans. (1)

Sol. $\vec{E} = \vec{B} \times \vec{C}$

$$= -2 \times 10^{-7} \hat{j} \times 3 \times 10^8 \hat{i}$$

$$\vec{E} = 60 \hat{k} \text{ V/m}$$

3. A hollow cylinder of radius 1m is rotating with angular velocity $\omega = 10 \text{ rad/sec}$. Find minimum coefficient of friction μ so that block remains at rest w.r.t. cylinder.



(1) 0.1

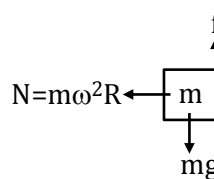
(2) 0.2

(3) 0.15

(4) 0.25

Ans. (1)

Sol.



$$f_{\text{max}} = mg$$

$$\mu_{\text{min}} N = mg$$

$$\mu_{\text{min}} \times m\omega^2 R = mg$$

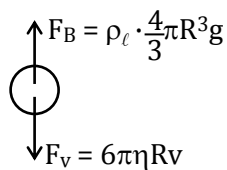
$$\mu_{\text{min}} = \frac{g}{\omega^2 R} = \frac{10}{10^2 \times 1} = 0.1$$

4. An air bubble of radius 1 mm is rising up with constant speed of 0.5 cm/s in a liquid of density ρ_{liq} 2000 kg/m³. Find coefficient of viscosity η in poise.

- (1) $\frac{70}{9}$ poise
(2) 20 poise
(3) $\frac{80}{9}$ poise
(4) 50 poise

Ans. (3)

Sol.



For constant speed

$$F_B = F_v$$

$$\Rightarrow \rho_l \frac{4}{3} \pi R^3 g = 6\pi \eta R v$$

$$\frac{2}{9} \frac{\rho_l R^2 g}{v} = \eta$$

$$\Rightarrow \frac{2}{9} \times \frac{2000 \times 10^{-6} \times 10}{5 \times 10^{-3}} = \eta$$

$$\Rightarrow \eta = \frac{8}{9} \text{ Pa.s}$$

$$\Rightarrow \eta = \frac{80}{9} \text{ Poise}$$

5. Work function for an object is 2.3 eV. If maximum kinetic energy of ejected electrons is 0.18 eV. Find wavelength λ of incident photon on object.

- (1) 200 nm (2) 500 nm
(3) 250 nm (4) 300 nm

Ans. (2)

$$\text{Sol. } KE_{\text{max}} = E_{\text{incident photon}} - \phi$$

$$2.3 = E - 0.18$$

$$E = 2.3 + 0.18 = 2.48 \text{ eV}$$

$$\Rightarrow \frac{1240 \text{ eV} \cdot \text{nm}}{\lambda(\text{nm})}$$

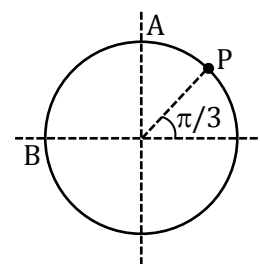
$$\lambda = \frac{1240}{2.48} = 500 \text{ nm}$$

6. Position of a particle is given by $x = A \sin\left(50t + \frac{\pi}{3}\right)$. If speed and acceleration becomes '0' for the first time at t_1 and t_2 sec respectively, then find t_1 & t_2 (in sec) :-

- (1) $\frac{\pi}{300}, \frac{\pi}{75}$ (2) $\frac{\pi}{300}, \frac{\pi}{150}$
(3) $\frac{\pi}{150}, \frac{\pi}{75}$ (4) $\frac{\pi}{150}, \frac{\pi}{300}$

Ans. (1)

Sol. Phase of the motion of particle is as follows :



$V = 0$, when particle cross A.

$$\therefore t_1 = \frac{\pi}{6\omega} = \frac{\pi}{300}$$

$a = 0$, when particle cross B.

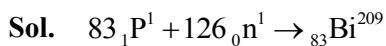
$$\therefore t_2 = \frac{2\pi}{3\omega} = \frac{\pi}{75}$$

7. Find $\left(\frac{BE}{A}\right)$ of ${}_{83}\text{Bi}^{209}$.

Given : $M_{\text{Bi}} = 208.9804$ amu, $m_p = 1.007276$ amu, $m_n = 1.008665$ amu, $1 \text{ amu} = 931 \text{ MeV}$

- (1) 5.8908729 MeV/A
(2) 3.0008729 MeV/A
(3) 4.2506229 MeV/A
(4) 7.6408729 MeV/A

Ans. (4)



$$\Delta m = 83m_p + 126m_n - M_{\text{Bi}}$$

$$= 83 \times 1.007276 + 126 \times 1.008665 - 208.9804$$

$$= 1.715298 \text{ amu}$$

$$BE = 1.715298 \times 931 \text{ MeV}$$

$$\frac{BE}{A} = \frac{1.715298 \times 931}{209} \text{ MeV}$$

$$\frac{BE}{A} = 7.6408729 \text{ MeV/A}$$

8. A screw gauge has pitch of 0.1 mm and 100 division on its circular scale. When it's both jaws touches, fifth division of its circular scale is coincide with zero. When a sphere is placed between jaws, then reading of linear scale is 5 mm and 50th division of circular scale coincides with zero of main scale. Find diameter of the sphere.

- (1) 5.55 mm
(2) 5.45 mm
(3) 5.056 mm
(4) 5.045 mm

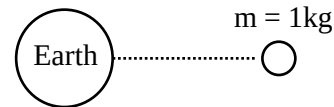
Ans. (4)

Sol. Least count : $\frac{0.1}{100} \text{ mm} = 0.001 \frac{\text{mm}}{\text{division}}$

$$\text{Reading} = \text{MSD} + (\text{CSD}) \times \text{LC} - \text{zero error}$$

$$= 5 \text{ mm} + 50 \times 0.001 - 5 \times 0.001 = 5.045 \text{ mm}$$

9. Find speed of 1 kg object when it reaches close to earth's surface from long distance after it is released from rest as shown in diagram. [Given $R_e = 6400 \text{ km}$, $g_s = 9.8 \text{ m/s}^2$]



- (1) 12.5 km/s
(2) 11.2 km/s
(3) 9.8 km/s
(4) 2.4 km/s

Ans. (2)

Sol. M.E.C

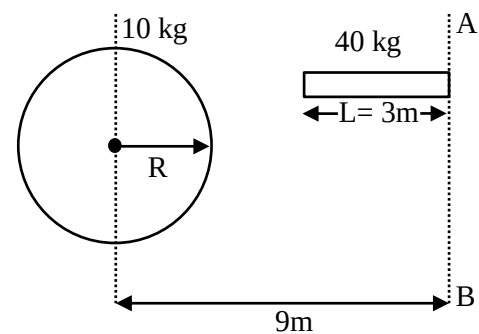
$$K_i + U_i = K_f + U_f$$

$$\Rightarrow 0 - \frac{GM_e m}{\infty} = \frac{1}{2}mv^2 - \frac{GMm}{R_e}$$

$$V = \sqrt{\frac{2GM}{R_e}} = \sqrt{2gR_e} = \sqrt{2 \times 9.8 \times 6400 \times 1000}$$

$$= 11.2 \text{ km/s}$$

10.



If moment of inertia of rod about axis AB is equal to moment of inertia of solid sphere about an axis parallel to AB which is at 9m from AB axis as

shown in the figure. If $R = \sqrt{\frac{\alpha}{2}}$ then find $\alpha = ?$

Ans. $\alpha = 60$

Sol. $\frac{2}{5}M_1R^2 = \frac{M_2L^2}{3}$

$$\frac{2}{5} \times 10 \times R^2 = \frac{40}{3} \times 9$$

$$R = \sqrt{30} = \sqrt{\frac{\alpha}{2}}$$

$$\alpha = 60$$

11. Surface tension of soap bubble is 0.03 N/m. The work done in increasing the diameter of bubble from 2 cm to 6 cm is $\alpha\pi \times 10^{-4}$ J. Find the value of α .

Ans. (1.92)

Sol. $W = \Delta U = 2T [4\pi R_2^2 - 4\pi R_1^2]$

$$W = 2 \times 3 \times 10^{-2} \times 4\pi [9 \times 10^{-4} - 1 \times 10^{-4}]$$

$$W = 1.92 \pi \times 10^{-4} \text{ J}$$

$$\alpha = 1.92$$

12. A paper is placed in front of lens at a distance 30 cm, such that paper gets burn in minimum time. Radius of curvature of bi-convex lens is 60 cm. If refractive index of lens is $\mu = \frac{\alpha}{10}$ then value of α is

Ans. (20)

Sol. To burn in minimum time distance of paper must be at focus.

$$\text{So } f = 30 \text{ cm}$$

$$\frac{1}{30} = (\mu - 1) \left(\frac{1}{60} - \frac{1}{-60} \right)$$

$$\frac{1}{30} = \frac{\mu - 1}{30}$$

$$\mu = 2$$

$$\boxed{\alpha = 20}$$

13. Consider Bohr's model of a H-atom. If magnetic field at centre due to electron in 2nd orbit is B_1 and magnetic field due to electron in 4th orbit is B_2 .

$$\text{Find } \frac{B_1}{B_2}$$

Ans. (64)

Sol. $B = \frac{\mu_0 I}{2\pi r}$

$$I = \frac{ev}{2\pi r}$$

$$B \propto \frac{V}{r^2}$$

$$V \propto \frac{Z}{n}$$

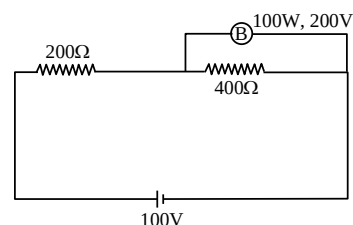
$$r \propto \frac{n^2}{Z}$$

$$B \propto \frac{\left(\frac{Z}{n}\right)}{\left(\frac{n^2}{Z}\right)^2}$$

$$B \propto \frac{Z^3}{n^5}$$

$$\frac{B_1}{B_2} = \frac{n_2^5}{n_1^5} = \frac{4^5}{2^5} = 64$$

14.



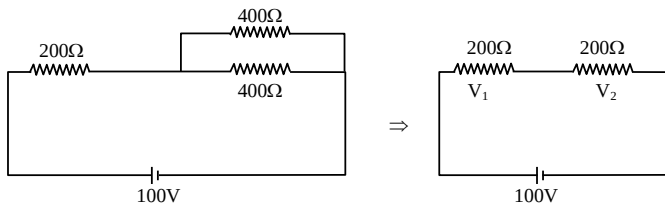
Find potential difference across bulb as shown in the figure.

Ans. (50)

Sol. For resistance of bulb

$$R = \frac{V^2}{P} = \frac{200 \times 200}{100} = 400\Omega$$

Now circuit will look like this



V_1 & V_2 will be same as resistances are same

$$V_1 = V_2 = 50V$$

$$V_{\text{bulb}} = V_2 = 50V$$

- 15.** Force on a charge $q = 10^{-9}$ C in uniform electric and magnetic field is $\vec{F} = (2 \times 10^{-10} \hat{i} + 3 \times 10^{-10} \hat{j})$ N. Find velocity (in m/s) of charge if value of electric field is $0.4 \hat{j}$ V/m and magnetic field is $2 \times 10^{-3} \hat{k}$ T.

$$(1) \vec{V} = 50 \hat{i} + 100 \hat{j}$$

$$(2) \vec{V} = 100 \hat{i} + 100 \hat{j}$$

$$(3) \vec{V} = 50 \hat{i} + 50 \hat{j}$$

$$(4) \vec{V} = 50 \hat{i} + 10 \hat{j}$$

Ans. (1)

$$\text{Sol. } \vec{F} = q\vec{E} + q(\vec{V} \times \vec{B})$$

$$(2 \times 10^{-10} \hat{i} + 3 \times 10^{-10} \hat{j}) = 0.4 \times 10^{-9} \hat{j} + 10^{-9} \{v_x \hat{i} +$$

$$v_y \hat{j} + v_z \hat{k}\} \times (2 \times 10^{-3}) \hat{k}$$

$$(2 \times 10^{-10} \hat{i}) + (3 \times 10^{-10} \hat{j}) = 4 \times 10^{-10} \hat{j} - 2v_x \times 10^{-12}$$

$$\hat{j} + 2v_y \times 10^{-12} \hat{i}$$

On comparing

$$3 \times 10^{-10} = 4 \times 10^{-10} - 2v_x \times 10^{-12}$$

$$2v_x \times 10^{-12} = 1 \times 10^{-10}$$

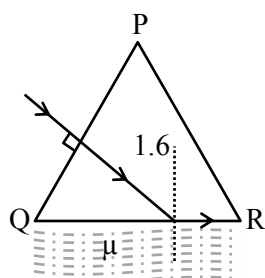
$$v_x \Rightarrow \frac{10^2}{2} \Rightarrow 50$$

$$2 \times 10^{-10} = 2v_y \times 10^{-12}$$

$$v_y = \frac{200}{2} = 100$$

$$\vec{V} = 50 \hat{i} + 100 \hat{j}$$

16. There is thin layer of refractive index μ below base of equilateral prism. The path of a ray is shown in figure. Find out μ .



- (1) 1.38
(2) 1.52
(3) 1.414
(4) 1.23

Ans. (1)

Sol. For surface QR

$$i = 60^\circ$$

$$1.6 \sin 60^\circ = \mu \sin 90^\circ$$

$$\mu = 1.6 \times \frac{\sqrt{3}}{2} = 0.8 \times \sqrt{3} = 1.38$$

17. If $G \rightarrow$ Gravitational constant and h is Plank's constant then dimension of G is :

- (1) $[M^{-2}L^{+1}T^{-1}h^{+2}]$
(2) $[M^{-2}L^{+1}T^{-1}h^{+1}]$
(3) $[M^{-1}L^{+1}T^{-1}h^{+3}]$
(4) $[M^{-2}L^{+1}T^{-1}]$

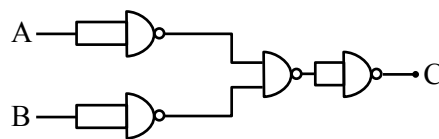
Ans. (2)

Sol. Energy = $\frac{hc}{\lambda} = \frac{GM_1M_2}{r}$

$$[ML^2T^{-2}] = [h] [T^{-1}] = [G] [M^2L^{-1}]$$

$$[G] = [M^{-2}L^{+1}T^{-1}h^{+1}]$$

18. For given logic gate circuit an equivalent gate will be



- (1) OR gate
(2) AND gate
(3) NAND gate
(4) NOR gate

Ans. (2)

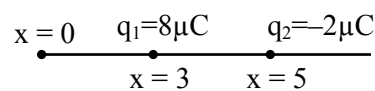
Sol. $Y_1 = \overline{A \cdot A} = \overline{A}$

$$Y_2 = \overline{B \cdot B} = \overline{B}$$

$$Y_3 = \overline{\overline{A} \cdot \overline{B}} = A + B$$

$$C = \overline{(A + B) \cdot (A + B)} = \overline{A + B} = A \cdot B$$

19. Find the ratio of electric flux passing through two spheres centred at origin having radius 4m and 6m respectively :



- (1) 2.36
(2) 1.33
(3) 5.72
(4) 6.83

Ans. (2)

Sol. For sphere with radius 4m and center origin

$$\phi_1 = \frac{q_{en}}{\epsilon_0} = \frac{8\mu C}{\epsilon_0}$$

for sphere of radius 6m

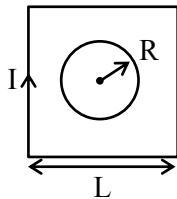
$$\phi_2 = \frac{q_{en}}{\epsilon_0} = \frac{(8-2)\mu C}{\epsilon_0} = \frac{6\mu C}{\epsilon_0}$$

$$\frac{\phi_1}{\phi_2} = \frac{8}{6} = \frac{4}{3} = 1.33$$

$$\frac{\phi_1}{\phi_2} = 1.33$$

20. Side of square is L and $R \ll L$.

Find mutual inductance of system shown in figure.



- (1) $\frac{\sqrt{2}\mu_0 R^2}{L}$
 (2) $\frac{4\sqrt{2}\mu_0 R^2}{L}$
 (3) $\frac{2\mu_0 R^2}{L}$
 (4) $\frac{2\sqrt{2}\mu_0 R^2}{L}$

Ans. (4)

Sol. Magnetic field due to square

$$B = 4 \times \frac{\mu_0 I}{4\pi \frac{L}{2}} \{2 \sin 45^\circ\}$$

$$= \frac{4\mu_0 I}{\pi L} \times \frac{1}{\sqrt{2}} = \frac{2\sqrt{2}\mu_0 I}{\pi L}$$

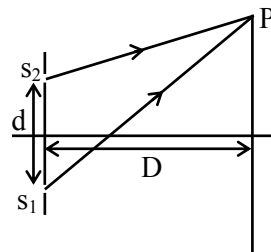
$$Q = B \times A_{\text{circle}}$$

$$Q = \frac{2\sqrt{2}\mu_0 I}{\pi L} \times \pi R^2$$

$$Q = \frac{2\sqrt{2}\mu_0 R^2}{L} I$$

$$\text{Inductance} = \frac{2\sqrt{2}\mu_0 R^2}{L}$$

21. As shown in the figure in YDSE experiment if intensity is $\frac{3}{4}$ th of maximum intensity at point P, and path difference at point 'P' is $\Delta x = \frac{\lambda}{\alpha}$. Find the value of " α ". (where λ is wavelength of light)



- (1) 4
 (2) 6
 (3) 5
 (4) 2

Ans. (2)

Sol. $I = 4I_0 \cos^2 \frac{\Delta\phi}{2}$

$$3I_0 = 4I_0 \cos^2 \frac{\Delta\phi}{2}$$

$$\cos \frac{\Delta\phi}{2} = \frac{\sqrt{3}}{2}$$

$$\frac{\Delta\phi}{2} = \frac{\pi}{6}$$

$$\frac{k\Delta x}{2} = \frac{\pi}{6}$$

$$\frac{2\pi}{\lambda} \times \frac{\Delta x}{2} = \frac{\pi}{6}$$

$$\Delta x = \frac{\lambda}{6} = \frac{\lambda}{\alpha}$$

$$\alpha = 6$$

22. An ideal gas of 5 mole has $C_p = 8 \text{ cal/mol}^\circ\text{C}$. If its temperature changes from 10°C to 20°C , then calculate change in its internal energy (in cal).

Ans. (300)

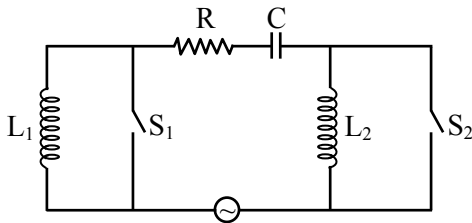
Sol. $C_p - C_v = R \Rightarrow C_v = (C_p - R)$

$$C_v = 6 \text{ cal/mol}^\circ\text{C}$$

$$\Delta U = nC_v \Delta T$$

$$= 5 \times 6 \times 10 = 300 \text{ cal}$$

23. If S_1 is closed and S_2 open, θ is 30° and if S_1 is open and S_2 closed then θ is 60° . Then find $3L_2 - L_1$ if $C = 100\mu\text{F}$.



(1) $\frac{2}{9}$

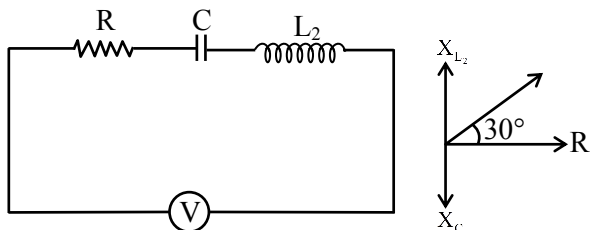
(2) $\frac{4}{9}$

(3) $\frac{9}{4}$

(4) $\frac{2}{7}$

Ans. (1)

Sol. For S_1 is closed and S_2 open

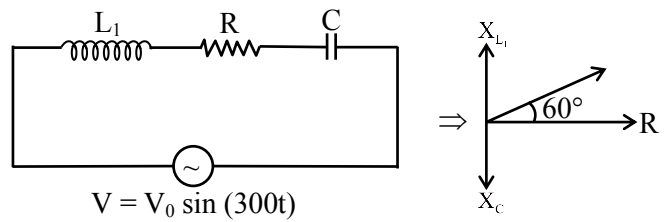


$$V = V_0 \sin(300t)$$

$$\frac{X_{L_2} - X_C}{R} = \tan(30^\circ) = \frac{1}{\sqrt{3}}$$

$$\sqrt{3}(X_{L_2} - X_C) = R \dots\dots(1)$$

For S_1 is open and S_2 is closed.



$$\frac{|X_{L_1} - X_C|}{R} = \tan 60^\circ = \sqrt{3}$$

$$\frac{|X_{L_1} - X_C|}{\sqrt{3}} = R \dots\dots(2)$$

from Eq. (1) and (2)

$$\sqrt{3}(X_{L_2} - X_C) = \frac{(X_{L_1} - X_C)}{\sqrt{3}}$$

$$3\left(\omega L_2 - \frac{1}{\omega C}\right) = \left[\omega L_1 - \frac{1}{\omega C}\right]$$

$$|3L_2 - L_1| = \frac{2}{\omega^2 C} = \frac{2}{9 \times 10^4 \times 100 \times 10^{-6}}$$

$$|3L_2 - L_1| = \frac{2}{9}$$

24. A small ball of mass 1 kg is released from height of 20 m on the sand. It penetrates 10 cm in sand and comes to rest. Find average force exerted by sand on ball. ($g = 10 \text{ m/s}^2$)

(1) 1000

(2) 1980

(3) 2010

(4) 2020

Ans. (3)

Sol. $(W.D.)_g + (W.D.)_{\text{sand}} = \Delta K$

$$mg\left(\frac{10}{100} + 20\right) - F_{\text{sand}}\left(\frac{10}{100}\right) = 0$$

$$F_{\text{sand}} = 2010$$

MEMORY BASED QUESTIONS

(HELD ON THURSDAY 02nd APRIL 2026)

TIME : 3:00 PM TO 6:00 PM

CHEMISTRY	TEST PAPER WITH SOLUTION												
1. For first order reaction; $2A(g) \rightarrow 4B(g) + C(g)$ Total pressure at $t = 30$ sec and $t = \infty$ are 300 torr and 600 torr respectively. Calculate pressure of C(g) at 30 sec (in torr). Ans. (20) Sol. $2A(g) \rightarrow 4B(g) + C(g)$ <table> <tr> <td></td> <td>p°</td> <td></td> <td></td> </tr> <tr> <td>$t = 30$ sec</td> <td>$p^\circ - 2x$</td> <td>$4x$</td> <td>x</td> </tr> <tr> <td>$t = \infty$</td> <td>–</td> <td>$2p^\circ$</td> <td>$p^\circ/2$</td> </tr> </table> $p_\infty = 2p^\circ + p^\circ/2 = 600$ $5p^\circ/2 = 600$ $P^\circ = 240 \text{ torr}$ At $t = 30$ sec, $p = 300 = p^\circ - 2x + 4x + x$ $300 = 240 + 3x$ $3x = 60$ $x = 20$ Pressure of C(g) = 20 torr. 2. 'x' be the osmotic pressure of solution formed by dissolving 1g of a protein ($M = 50,000$ g/mol) in 0.5 litre and 'y' be the osmotic pressure of solution formed by dissolving 2g of same protein in 1 litre at 300 K. If 'z' be the osmotic pressure of solution formed by mixing above two solutions. Then the value of 'x', 'y' and 'z' respectively are. {Use : $R = 0.083$ lit-bar/K-mol} (1) 9.96×10^{-4} bar, 9.96×10^{-4} bar, 4.48×10^{-4} bar (2) 9.96×10^{-4} bar, 19.2×10^{-4} bar, 9.96×10^{-4} bar (3) 19.2×10^{-4} bar, 19.2×10^{-4} bar, 19.2×10^{-4} bar (4) 9.96×10^{-4} bar, 9.96×10^{-4} bar, 9.96×10^{-4} bar Ans. (D) Sol. $'x' = \frac{1}{50,000 \times 0.5} \times R \times 300 = 9.96 \times 10^{-4} \text{ bar}$ $'y' = \frac{2}{50,000 \times 1} \times R \times 300 = 9.96 \times 10^{-4} \text{ bar}$ $'z' = \frac{'x' \times \frac{1}{2} + 'y' \times 1}{\frac{3}{2}} = 9.96 \times 10^{-4} \text{ bar}$		p°			$t = 30$ sec	$p^\circ - 2x$	$4x$	x	$t = \infty$	–	$2p^\circ$	$p^\circ/2$	3. Molarity of $H_2SO_4(aq.)$ solution is 4.9 M. If density of solution is 1.40 g/ml, then molality and mole fraction of solute in the solution is : (Molar mass of $H_2SO_4 = 98$ gm/mole) (1) $m = 5.33$, $x_{\text{solute}} = 0.072$ (2) $m = 5.33$, $x_{\text{solute}} = 0.087$ (3) $m = 5.21$, $x_{\text{solute}} = 0.072$ (4) $m = 5.21$, $x_{\text{solute}} = 0.087$ Ans. (2) Sol. $m = \frac{1000 \times M}{1000d - M.M_{H_2SO_4}}$ $= \frac{1000 \times 4.9}{1000 \times 1.40 - 4.9 \times 98}$ $\Rightarrow \frac{4900}{1400 - 480.2} \Rightarrow \frac{4900}{919.8} = 5.327 \text{ 'm'}$ Mole fraction x $= \frac{5.327}{5.327 + 55.56} = \frac{5.327}{60.887} = 0.087$ 4. A metal of work function 2.3 eV is irradiated with radiation of wave-length $y \times 10^2$ nm. $(KE)_{\text{max}}$ of ejected electron is 2.8×10^{-20} J, then calculate y. (in nearest integer) Ans. (5) Sol. $KE \text{ of electron} = 2.8 \times 10^{-20} \text{ J}$ $= \frac{2.8 \times 10^{-20}}{1.6 \times 10^{-19}} = 0.175 \text{ eV}$ $\therefore (KE)_{\text{max}} = \left[\frac{1240 \text{ eV.nm}}{\lambda \text{ (in nm)}} - \phi \right]$ $= 0.175 = \frac{1240}{\lambda} - 2.3$ $\lambda = \frac{1240}{2.475}$ $\lambda = 501.01 \text{ nm}$ $\lambda = 5.01 \times 10^2 \text{ nm}$
	p°												
$t = 30$ sec	$p^\circ - 2x$	$4x$	x										
$t = \infty$	–	$2p^\circ$	$p^\circ/2$										

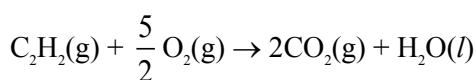
5. A hydrocarbon has mass ratio of C and H in 12 : 1. Each molecule of hydrocarbon has 2 carbon atoms. Calculate mass of CO_2 (in gm) produced, when 3.38 gm hydrocarbon undergoes combustion.

- (1) 11.44
(2) 22.88
(3) 3.28
(4) 6.44

Ans. (1)

Sol. Molecular formula of hydrocarbon is C_2H_2

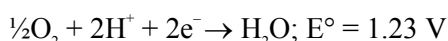
$$\text{Moles of } \text{C}_2\text{H}_2 = \frac{3.38}{26}$$



$$\text{Moles of } \text{CO}_2 \text{ produced} = \left(\frac{3.38}{26} \times 2 \right)$$

$$\text{Mass of } \text{CO}_2 \text{ produced} = \left(\frac{3.38}{26} \times 2 \right) \times 44 = 11.44$$

6. A cell is formed using below half-cell reactions and cell is working with 80% efficiency. Work obtained is utilised for isothermal expansion of gas against external pressure of 1 kPa. Find ΔV (in m^3)



Ans. (560)

Sol. $\Delta G^\circ = -6 \times 96500 \times 1.21 \text{ J}$

$$W = \frac{80}{100} \times \Delta G^\circ = -P\Delta V$$

$$0.8 \times 6 \times 96500 \times 1.21 = 1 \times 10^3 (\Delta V)$$

$$\Delta V = 560.472 \text{ m}^3$$

7. For process $X \rightarrow Y$ work done by the gas is 10 J and heat absorb in the process is 2 J. For reverse process heat evolved is 6 J. Find work done for reverse process.

- (1) Work done on the gas is 14 J.
(2) Work done by the gas is 2 J.
(3) Work done on the gas is 20 J.
(4) Work done by the gas is 12 J.

Ans. (1)

Sol. For process $X \rightarrow Y$

$$w = -10 \text{ J}$$

$$q = +2 \text{ J}$$

$$\Delta U = q + w$$

$$\Delta U_{X \rightarrow Y} = 2 - 10 = -8 \text{ J}$$

For reverse process :

$$\Delta U_{Y \rightarrow X} = 8 \text{ J}$$

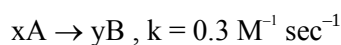
$$q = -6 \text{ J}$$

$$\Delta U = q + w$$

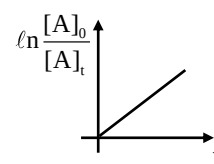
$$8 = -6 + w$$

$$w = 14 \text{ J}$$

8. For a reaction



- (i) If the concentration of A is made 4 times then rate of reaction becomes 16 times.
(ii) The decomposition of N_2O_5 is an example of this type of reaction
(iii) The order of reaction is 2
(iv) A plot of $\ln \frac{[\text{A}]_0}{[\text{A}]_t}$ vs t is straight line



- (v) The half life of the reaction is independent of the concentration of the reactant.

Which of the following option has correct set of statement :-

- (1) (i), (ii), (v) (2) (i), (iii)
(3) (iii), (iv), (v) (4) (i), (iii), (v)

Ans. (2)

Sol. Rate of constant (k) = $0.3 \text{ M}^{-1} \text{ sec}^{-1}$

$$\therefore 1 - n = -1 \text{ [unit of } k = \text{M}^{1-n} \text{ sec}^{-1}]$$

$$n = 2 \Rightarrow 2^{\text{nd}} \text{ order reaction}$$

$$\text{rate} = k[A]^2$$

(i) If concentration of A is 4 times then reaction will become 16 times.

(ii) Decomposition of N_2O_5 is example of 1st order reaction

(iii) Order of reaction is 2

(iv) Graph of $\ln \frac{[A]_0}{[A]_t}$ vs t is straight line for 1st

order not for 2nd order reaction.

(v) Half-life of the reaction is independent of the concentration of the reactant for 1st order, not for 2nd order reaction.

So statement (i), (iii) are correct

So option (2) is correct option

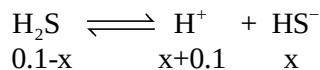
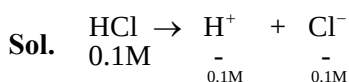
9. 0.1 mole of H_2S is added in 1 litre of 0.1 HCl solution. Calculate concentration of HS^- .

$$[\text{Given } K_{a1} = 8.3 \times 10^{-8} \text{ \& } K_{a2} = 10^{-13}]$$

$$(1) 8.3 \times 10^{-8} \text{ M} \quad (2) 10^{-13} \text{ M}$$

$$(3) 0.1 \text{ M} \quad (4) 0.05 \text{ M}$$

Ans. (1)



(Due to common ion effect x is very less)

$$K_{a1} = \frac{[\text{H}^+][\text{HS}^-]}{[\text{H}_2\text{S}]}$$

$$K_{a1} = \frac{0.1 \times [\text{HS}^-]}{0.1}$$

$$[\text{HS}^-] = K_{a1} = 8.3 \times 10^{-8}$$

10. 20 ml of 0.2 M HA ($K_a = 5 \times 10^{-4}$) is titrated with 10 ml of 0.2 M NaOH solution. Calculate initial & final value of pH of solution? [Given $\log 5 = 0.7$]

$$(1) 2, 3.3$$

$$(2) 1.65, 2$$

$$(3) 3.3, 2$$

$$(4) 2, 3.6$$

Ans. (A)

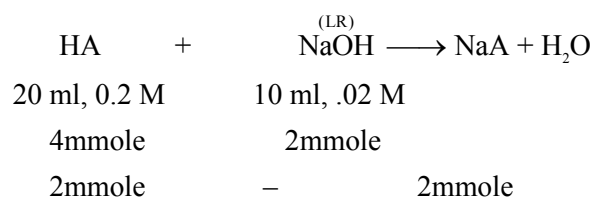
Sol. For 0.2M, 20ml HA solution,

$$\text{pH of weak acid} = \frac{1}{2}[\text{p}K_a - \log c]$$

$$= \frac{1}{2}[4 - \log 5 - \log 0.2]$$

$$= \frac{1}{2}[4 - \log 5 + \log 5]$$

$$= 2$$



$[\text{HA} + \text{NaA}] \Rightarrow$ acidic buffer

$$\text{pH} = \text{p}K_a + \log \frac{\text{salt}}{\text{acid}}$$

$$\text{pH} = 3.3 + \log \frac{2}{2}$$

$$\text{pH} = 3.3$$

so, option (1) is correct

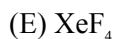
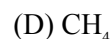
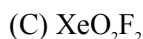
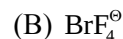
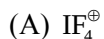
11. How many of the following are paramagnetic :

Lu^{3+} , Yb^{2+} , Gd^{2+} , Ce^{4+} , La^{3+} , Zn^{2+} , Cu^{2+} , Mn^{2+} , Sc^{3+} and Ti^{4+}

Ans. (3)

Sol. Paramagnetic species are : Gd^{2+} , Cu^{2+} and Mn^{2+}

12. Which of the following are iso-structural with SF_4 ?



Correct option is _____

$$(1) \text{A, B \& E}$$

$$(2) \text{A, C \& E}$$

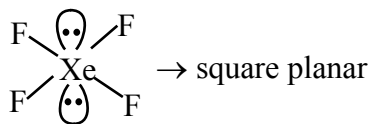
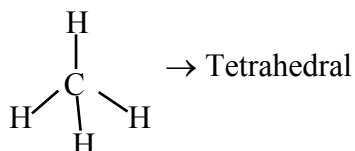
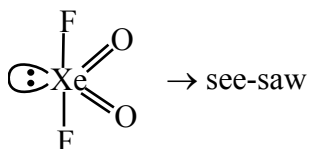
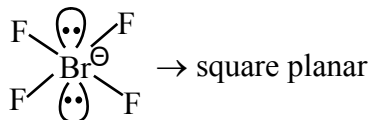
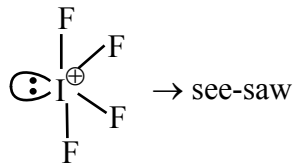
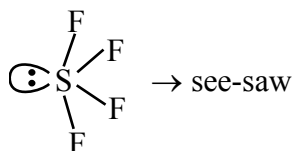
$$(3) \text{A \& C only}$$

$$(4) \text{B \& E only}$$

Ans. (3)

Sol. Species

Structure / Shape



13. The correct set that contains all kinds of oxides (Basic, acidic, amphoteric and neutral) is :-

- (1) Na_2O , N_2O , Al_2O_3 & CO
- (2) Al_2O_3 , As_2O_3 , CO , & NO
- (3) K_2O , Cl_2O_7 , As_2O_3 & NO
- (4) Na_2O , K_2O , Al_2O_3 & As_2O_3

Ans. (3)

Sol. Basic Oxides : Na_2O , K_2O

Acidic Oxides : Cl_2O_7

Neutral Oxides : N_2O , NO & CO

Amphoteric Oxides : Al_2O_3 , As_2O_3

14. Statement 1 : The correct order of 2nd ionization energy for boron family elements is : $\text{B} > \text{Al} > \text{Ga}$.
Statement 2 : The correct order of 1st ionization energy for carbon family elements is : $\text{Si} > \text{Ge} < \text{Pb} < \text{Sn}$.

Choose the correct option :

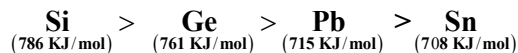
- (1) Both statement 1 and statement 2 are correct
- (2) Statement 1 is correct and statement 2 is incorrect
- (3) Statement 1 is incorrect and statement 2 is correct.
- (4) Both statement 1 and statement 2 are incorrect

Ans. (4)

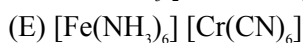
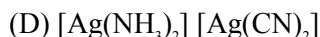
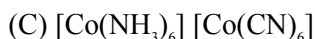
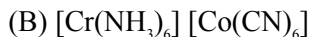
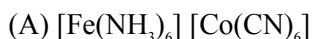
Sol. Order of II ionization energy for boron family elements is :



Order of I ionization energy for carbon family elements is :



15. Which of the following compounds shows coordination isomerism.



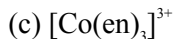
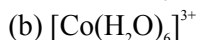
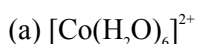
(1) A, B & C only (2) A, B & D only

(3) A, B C & E only (4) D only

Ans. (3)

Sol. Compound, $[\text{Ag}(\text{NH}_3)_2] [\text{Ag}(\text{CN})_2]$ cannot show coordination isomerism.

16. Arrange the following complexes in increasing order of C.F.S.E. (Δ_0)



(1) $b > c > a$ (2) $c > a > b$

(3) $c > b > a$ (4) $a > b > c$

Ans. (C)

Sol. C.F.S.E. is proportional to charge on central metal ion.

For same charge on central atom ; C.F.S.E. is proportional to strength of ligand.

17. Which of the ions show positive Borax Bead test and has the largest ionization energy :



Ans. (B)

Sol. Zn^{2+} does not show Borax Bead Test.

Among remaining ions; Fe^{3+} has maximum ionization energy.

18. Identify code of amino acid and iodine derivative hormone in given option

Code	Hormone
(1) Y	Insuline
(2) T	Thyroxine
(3) Y	Thyroxine
(4) T	Insuline

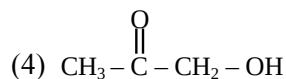
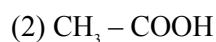
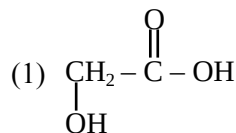
Ans. (3)

Sol. Thyroxine is derivative of Tyrosine and single letter symbol of Tyrosine amino acid is Y.

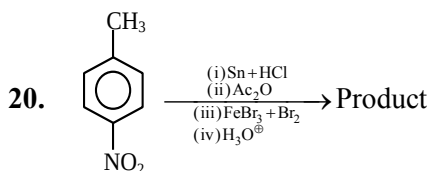
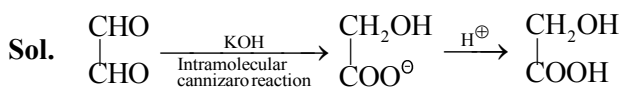
19. Organic compound + $\text{KOH} \xrightarrow{\text{H}^+}$ gives product (X)

(having same molar ratio of C : H : O)

'P'. Identify product 'P'

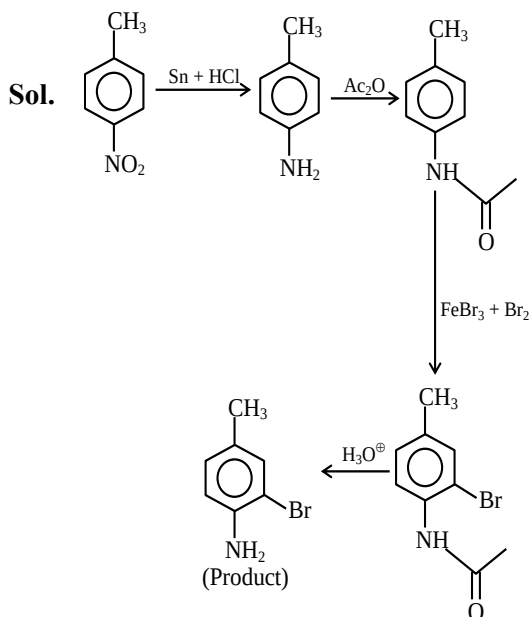


Ans. (1)



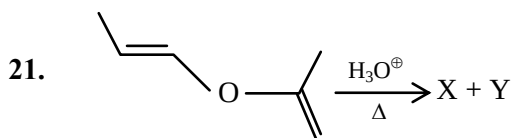
What will be mass of AgBr obtained when 1 gm of product treated with AgNO_3 in Carius method.

Ans. (1)



Molar mass of product = 186

$$\text{Mass of AgBr} = \frac{1}{186} \times 188 \approx 1$$

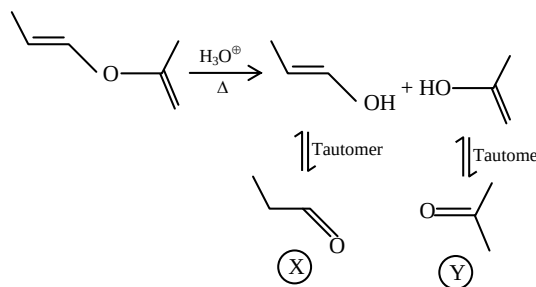


Correct statement about product X and Y?

- (a) They can be differentiated by NaHCO_3 test.
 - (b) They both give 2,4-DNP test
 - (c) They both have same molecular mass.
 - (d) They both react with same rate with HCN
- (1) Statement a and b are correct
 (2) Statement b and c are correct
 (3) Statement c and d are correct
 (4) Statement a and d are correct

Ans. (2)

Sol.



A will give positive Fehling's test

Molar mass of [X] ($\text{C}_3\text{H}_6\text{O}$) = 58

Molar mass of [Y] ($\text{C}_3\text{H}_6\text{O}$) = 58

22. Identify correct statement(s)

(i) Ar-Cl and R-Cl show similar chemical properties.

(ii) Rate of $\text{S}_{\text{N}}1$ $\text{C}_6\text{H}_5\text{CH}_2\text{-Cl} < \text{C}_6\text{H}_5\text{-CH(Cl)-C}_6\text{H}_5$

(iii) Alcohol is more polar than water so alcoholic KOH shows elimination reaction.

(iv) Vinyl alcohol is an alkene whereas allyl alcohol is an alkene.

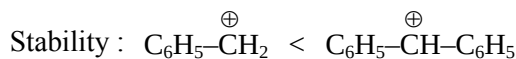
(v) Alcohol with SOCl_2 gives alkyl halide but phenol does not give.

- (1) i, ii, iii statements are correct
 (2) i, iii, iv statements are correct
 (3) ii and v statements are correct
 (4) ii and iv statements are correct

Ans. (3)

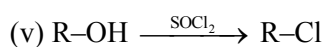
Sol. (i) Ar-Cl and R-Cl show different chemical properties

(ii) Rate of $\text{S}_{\text{N}}1 \propto$ stability of first formed carbocation

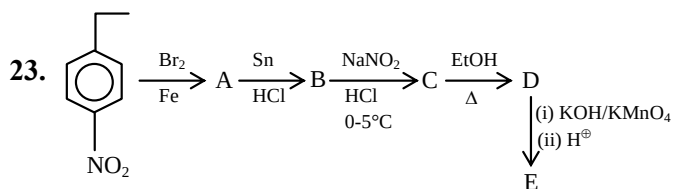


(iii) Water is more polar than alcohol

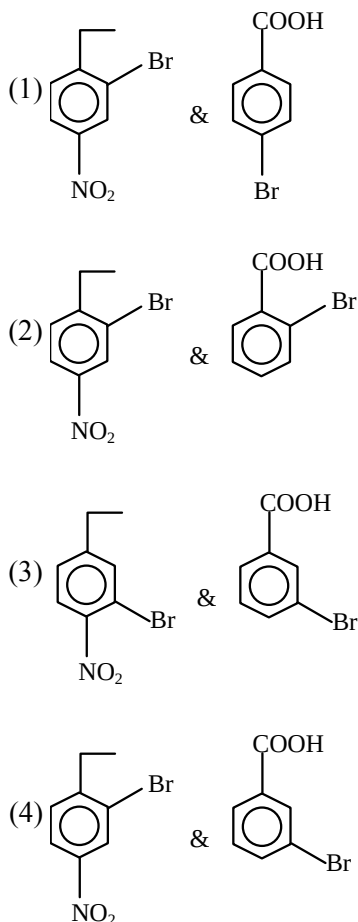
(iv) vinyl alcohol, allyl alcohol, both are unsaturated alcohols



Phenol does not give Ph-Cl with SOCl_2 .

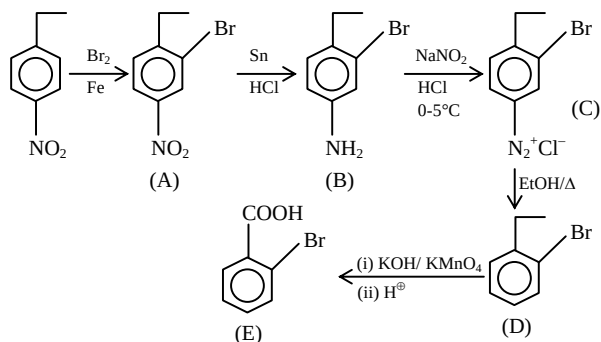


Identify A and E

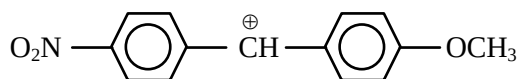


Ans. (2)

Sol.

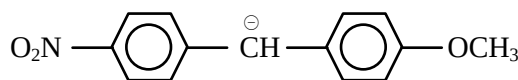


24. Statement I :



carbocation stable by $\oplus R$ effect of $-\text{OCH}_3$ group.

Statement II :



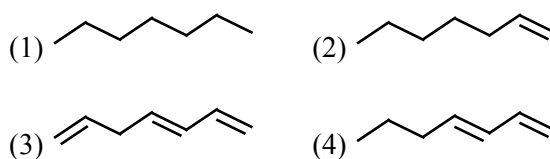
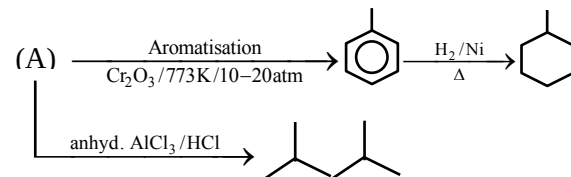
carbanion stable by $\ominus R$ effect of $-\text{NO}_2$ group.

- (1) Both statement 1 and statement 2 are correct
- (2) Statement 1 is correct and statement 2 is incorrect
- (3) Statement 1 is incorrect and statement 2 is correct.
- (4) Both statement 1 and statement 2 are incorrect

Ans. (1)

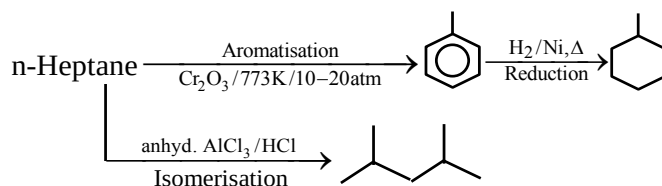
Sol. Both statements are correct

25. (A) is hydrocarbon



Ans. (1)

Sol.



JEE–MAIN EXAMINATION – APRIL 2026

MEMORY BASED QUESTIONS

(HELD ON THURSDAY 02nd APRIL 2026)

TIME : 3:00 PM TO 6:00 PM

MATHEMATICS	TEST PAPER WITH SOLUTION
1. Let $x_1, x_2, x_3, \dots, x_n$ be 'n' observations such that $\sum_{i=1}^{n-1} x_i = 48$ and $\sum_{i=1}^{n-1} x_i^2 = 496$. If mean and variance of the distribution are 8 and 16 respectively then value of n is :- (1) 7 (2) 9 (3) 8 (4) 12 Ans. (1) Sol. $x_1 + x_2 + \dots + x_{n-1} + x_n = 8n$ $48 + x_n = 8n$ $\Rightarrow x_n = 8n - 48 \quad \dots(1)$ $\Rightarrow 16 = \frac{496 + x_n^2}{n} - (8)^2$ $\Rightarrow 80n = 496 + x_n^2$ $\Rightarrow x_n^2 = 80n - 496 \quad \dots(2)$ $\Rightarrow (8n - 48)^2 = 80n - 496$ $\Rightarrow 64(n - 6)^2 = 8(10n - 62)$ $\Rightarrow 8(n - 6)^2 = 10n - 62$ $\Rightarrow 4(n - 6)^2 = 5n - 31$ $\Rightarrow 4(n^2 - 36 - 12n) = 5n - 31$ $\Rightarrow 4n^2 + 144 - 48n = 5n - 31$ $\Rightarrow 4n^2 - 53n + 175 = 0$ $\Rightarrow 4n^2 - 28n - 25n + 175 = 0$ $\Rightarrow 4n(n - 7) - 25(n - 7) = 0$ $n = 7$	2. Let $f(x)$ be a polynomial of degree 5 having extreme values at $x = 1$ and $x = -1$. If $\lim_{x \rightarrow 0} \frac{f(x)}{x^3} = -5$, then the value of $f(2) - f(-2)$ is (1) 110 (2) 112 (3) 115 (4) 118 Ans. (2) Sol. Given $f(x)$ is a polynomial of degree 5 Also, $f'(1) = 0$; $f'(-1) = 0$. Also $\therefore \lim_{x \rightarrow 0} \frac{f(x)}{x^3} = -5$ (fixed and finite) $\therefore f(0) = 0; f'(0) = 0; f''(0) = 0$ $\frac{f'''(0)}{6} = -5 \Rightarrow f'''(0) = -30$ Hence, let $f'(x) = (ax + b)(x - 0)(x - 1)(x + 1)$ $\Rightarrow f'(x) = ax^4 + bx^3 - ax^2 - bx$ $f''(x) = 4ax^3 + 3bx^2 - 2ax - b$ $\therefore f''(0) = 0 \Rightarrow b = 0$ $f'''(x) = 12ax^2 + 6bx - 2a$ $\therefore f'''(0) = -2a = -30$ $\Rightarrow a = 15$ $\therefore f'(x) = 15x.x.(x - 1)(x + 1)$ $\Rightarrow f'(x) = 15x^4 - 15x^2$ $\Rightarrow f(x) = 3x^5 - 5x^3 + C$ $\therefore f(0) = 0 \Rightarrow C = 0$ $\therefore f(x) = 3x^5 - 5x^3$ $\therefore f(2) - f(-2) = 112$

3. Let $\overrightarrow{PS} = \hat{i} + \hat{j}$ and $\overrightarrow{PQ} = -\hat{j} + \hat{k}$. If $\overrightarrow{PS}$ must be rotated by an angle α such that $\overrightarrow{PS}$ is perpendicular to $\overrightarrow{PQ}$ then $\left(\sin^2 \frac{5\alpha}{2} - \sin^2 \frac{\alpha}{2}\right)$ equals

- (1) $\frac{1}{2}$ (2) 1 (3) $\frac{\sqrt{3}}{2}$ (4) 0

Ans. (3)

Sol. $\overrightarrow{PS} = \hat{i} + \hat{j}$ $\theta = (\overrightarrow{PS} \wedge \overrightarrow{PQ})$

$\overrightarrow{PQ} = -\hat{j} + \hat{k}$

$\cos \theta = \frac{\overrightarrow{PS} \cdot \overrightarrow{PQ}}{|\overrightarrow{PS}| |\overrightarrow{PQ}|} = -\frac{1}{2} \Rightarrow \theta = \frac{2\pi}{3}$

$\alpha = 30^\circ$

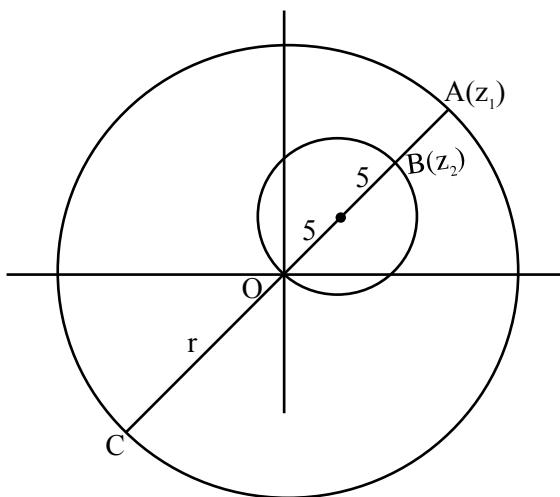
$\sin^2 75^\circ - \sin^2 15^\circ = \sin^2 60^\circ = \frac{\sqrt{3}}{2}$

4. If z_1 lies on curve $|z| = r$ and z_2 lies on curve $|z - 3 - 4i| = 5$ if minimum of $|z_1 - z_2| = 2$, then the maximum of $|z_1 - z_2|$ is

- (1) 12 (2) 18 (3) 20 (4) 22

Ans. (4)

Sol.



$|z| = r$

$OA = r$

minimum $|z_1 - z_2| = 2$

$\Rightarrow r - 10 = 2 \Rightarrow r = 12$

maximum value of CB

$|z_1 - z_2| = r + 10 = 12 + 10 = 22$

5. Parabola $y = x^2 + px + q$ is passing through $(1, -1)$ and vertex of parabola is at minimum distance from x-axis then $p^2 + q^2$ is

- (1) 1 (2) 2 (3) 3 (4) 4

Ans. (4)

Sol. parabola passes through $(1, -1)$ so

$-1 = 1 + p + q$

$p + q = -2$

$q = -2 - p \quad \dots(1)$

Distance from x-axis

$\frac{-D}{4a} = \frac{-(p^2 - 4q)}{4(1)} = \frac{4q - p^2}{4}$

$= \frac{4(-2 - p) - p^2}{4} \quad \text{from (1)}$

$= \frac{-8 - 4p - p^2}{4} = \frac{-(p^2 + 4p + 8)}{4} = \frac{-((p+2)^2 + 4)}{4}$

Minimum at $p = -2 \Rightarrow q = 0$

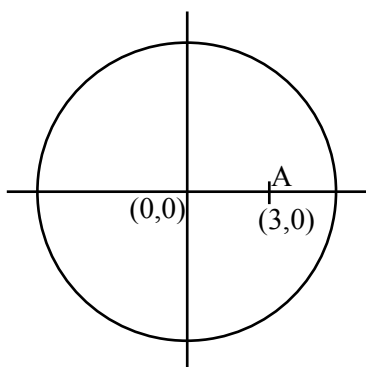
$p^2 + q^2 = 4 + 0 = 4$

6. Let 'C' be a circle with radius '6' units centred at origin. Let $A(3, 0)$ be a point. If B is a variable point in xy-plane such that circle drawn taking AB as diameter touches the circle C then eccentricity of the locus of point 'B' is

- (1) 2 (2) $\frac{1}{2}$ (3) 3 (4) $\frac{3}{4}$

Ans. (2)

Sol.



Let B(h, k)

Equation of circle with AB as diameter

$$(x-h)(x-3) + (y-k)(y-0) = 0$$

$$x^2 + y^2 - (h+3)x - ky + 3h = 0$$

$$\text{Centre } \left(\frac{h+3}{2}, \frac{k}{2} \right)$$

Circle touches internally

$$\therefore C_1 C_2 = |R - r|$$

$$\sqrt{\left(\frac{h+3}{2}\right)^2 + \left(\frac{k}{2}\right)^2} = \left| 6 - \frac{1}{2} \left(\sqrt{(h-3)^2 + k^2} \right) \right|$$

$$\sqrt{(x+3)^2 + y^2} + \sqrt{(x-3)^2 + y^2} = 12$$

$$2a = 12 \quad \therefore a = 6$$

(-3, 0) and (3, 0) are foci

$$2ae = 6$$

$$12e = 6$$

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

7. Find sum up to 8 terms of the series

$$\frac{1^3}{1} + \frac{1^3 + 2^3}{1+3} + \frac{1^3 + 2^3 + 3^3}{1+3+5} + \dots$$

$$(1) 84 \quad (2) 71$$

$$(3) 61 \quad (4) 100$$

Ans. (2)

$$\text{Sol. } T_r = \frac{1^3 + 2^3 + 3^3 + \dots + r^3}{1 + 3 + 5 + \dots + (2r-1)} = \frac{\left(\frac{r(r+1)}{2} \right)^2}{r^2}$$

$$= \frac{r^2 + 2r + 1}{4}$$

$$S_n = \sum_{r=1}^n T_r$$

$$S_n = \frac{1}{4} \sum (r^2 + 2r + 1)$$

$$= \frac{1}{4} \left[\frac{n(n+1)(2n+1)}{6} + 2 \frac{n(n+1)}{2} + n \right]$$

$$S_8 = \frac{1}{4} \left[\frac{8 \times 9 \times 17}{6} + 8 \times 9 + 8 \right]$$

$$= \frac{1}{4} [204 + 72 + 8] = 71$$

8. If the system of equations $x + 5y + 6z = 4$, $2x + 2y + 4z = 1$ and $x + y + az = b$ has infinite numbers of solutions then point (a,b) lies on-

$$(1) x - 2y = 1$$

$$(2) x - y = 3$$

$$(3) x + y = 2$$

$$(4) y - x = 3$$

Ans. (1)

$$\text{Sol. } x + 5y + 6z = 4$$

$$2x + 2y + 4z = 1$$

$$x + y + az = b$$

$$D = \begin{vmatrix} 1 & 5 & 6 \\ 2 & 2 & 4 \\ 1 & 1 & a \end{vmatrix} = 0$$

$$\Rightarrow \begin{vmatrix} 1 & 5 & 6 \\ 1 & 1 & 2 \\ 1 & 1 & a \end{vmatrix} = 0 \Rightarrow a = 2$$

$$D_z = \begin{vmatrix} 1 & 5 & 4 \\ 2 & 2 & 1 \\ 1 & 1 & b \end{vmatrix} = 0 \Rightarrow b = \frac{1}{2}$$

$$a - 2b = 1$$

9. The value of $\int_0^{20\pi} (\sin^4 x + \cos^4 x) \cdot dx$ is equal to

(1) 15π (2) $15\pi/2$

(3) 25π (4) $\frac{25\pi}{2}$

Ans. (1)

Sol. $I = \int_0^{20\pi} (1 - 2\sin^2 x \cos^2 x) \cdot dx$

$$= 20\pi - \frac{1}{2} \int_0^{20\pi} \sin^2 2x \, dx$$

$$20\pi - \frac{1}{2} (40) \int_0^{\frac{\pi}{2}} \sin^2 2x$$

$$20\pi - \frac{20}{2} \left(x - \frac{\sin 2x}{2} \right)_0^{\frac{\pi}{2}}$$

$$20\pi - 10 \left(\frac{\pi}{2} \right) = 15\pi$$

10. A regular polygon with n sides is given. P_n denotes no. of triangles formed by joining any three points of given regular polygon. If $P_{n+1} - P_n = 66$, then the sum of all prime divisors of n is

(1) 9 (2) 5 (3) 11 (4) 23

Ans. (2)

Sol. $P_n = {}^nC_3$

$$P_{n+1} - P_n = 66$$

$${}^{n+1}C_3 - {}^nC_3 = 66$$

$$\Rightarrow \frac{(n+1)n(n-1)}{6} - \frac{n(n-1)(n-2)}{6} = 66$$

$$\Rightarrow \frac{n(n-1)}{6} [n+1 - n+2] = 66$$

$$\Rightarrow n(n-1) = 132$$

$$n = 12$$

Prime divisors of 12 are 2 & 3

$$\text{sum} = 2 + 3 = 5$$

11. Let $A = \{2, 3, 4, 5, 6\}$ be a set. Consider R be a relation of $A \times A$ such that $(x, y) R(a, b)$ implies x divides 'a' and $y \leq b$ then total number of elements in R is :

(1) 24 (2) 120 (3) 720 (4) 144

Ans. (2)

Sol. For $x = 2$, $a = 2, 4, 6$

$x = 3$ $a = 3, 6$

$x = 4$ $a = 4$

$x = 5$ $a = 5$

$x = 6$ $a = 6$

Total case = 8

and no. of combination of y and b satisfying $y \leq b$
 $= 1 + 2 + 3 + 4 + 5 = 15$

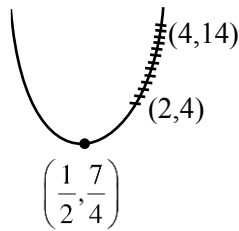
No. of relations satisfying $(x, y) R(a, b)$ is $8 \times 15 = 120$.

12. Find number of points of discontinuity of the function $f(x) = [x^2 - x + 2]$ in $x \in [2, 4]$ (where $[\cdot]$ denotes greatest integer function).

- (1) 9 (2) 11
(3) 8 (4) 10

Ans. (4)

Sol. In the interval $x \in [2, 4]$ range of $x^2 - x + 2$ is $[4, 14]$
GIF is discontinuous at integers



Checking at $x = 4$

$$f(4) = [4^2 - 4 + 2] = 14$$

$$f(4^-) = \lim_{h \rightarrow 0} [(4-h)^2 - (4-h) + 2]$$

$$= \lim_{h \rightarrow 0} [16 + h^2 - 8h - 4 + h + 2]$$

$$= \lim_{h \rightarrow 0} [14 + h(h-7)]$$

$$= 13$$

Discontinuous at $x = 4$ and 9 other points

Total 10 points.

13. If $I(x) = \int \frac{16x+24}{x^2+2x-15} dx$, $I(4) = 14\ln 3$ and $I(7) = \ln(2^\alpha \cdot 3^\beta)$, then $(\alpha + \beta)$ is equal to
(1) 39 (2) 33 (3) 36 (4) 42

Ans. (1)

Sol. $I(x) = \int \frac{8(2x+2)+8}{x^2+2x-15} dx$

$$I(x) = 8\ln|x^2+2x-15| + \ln\left|\frac{x-3}{x+5}\right| + C$$

$$I(4) = 14\ln 3 + C$$

$$C = 0$$

$$I(7) = 8\ln 48 - \ln 3$$

$$= \ln\left(\frac{(48)^8}{3}\right)$$

$$I(7) = \ln(2^{32} \times 3^7)$$

$$\alpha = 32, \beta = 7 \Rightarrow \alpha + \beta = 39$$

14. If the lines $x + (k-1)y + 3 = 0$ & $2x + k^2y - 4 = 0$ are perpendicular and their point of intersection is the centre of a circle which passes through origin. If chord $x - y + 2 = 0$ intersects this circle at A & B then $(AB)^2 = ?$

- (1) 18 (2) 20 (3) 9 (4) 36

Ans. (1)

Sol. $x + (k-1)y + 3 = 0$

$$2x + k^2y - 4 = 0$$

$$\left(\frac{1}{1-k}\right)\left(\frac{2}{k^2}\right) = 1$$

$$2 = k^2 - k^3$$

$$k^3 - k^2 + 2 = 0$$

$$k = -1$$

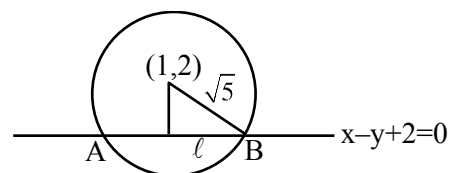
Solving :

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

$$2x + y - 4 = 0$$

$$-5y + 10 = 0$$

$$y = 2$$



$$x = 1$$

Centre (1, 2)

$$r = \sqrt{5}$$

$$\text{So circle is } (x-1)^2 + (y-2)^2 = 5$$

$$\text{Chord } x - y + 2 = 0$$

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

$$l = \sqrt{5 - \frac{1}{2}} = \frac{3}{\sqrt{2}}$$

$$AB = \frac{6}{\sqrt{2}} \therefore AB^2 = 18$$

15. Let $x(y)$ be the solution of the given differential equation $2y^2 \frac{dx}{dy} - 2xy + x^2 = 0$. If $x(e) = e$, then

$$\frac{3x(e^2)}{e^2} \text{ equals.}$$

- (1) 1 (2) 2
(3) 3 (4) 4

Ans. (2)

Sol. $2y(ydx - xdy) + x^2 dy = 0$

$$-2yx^2 d\left(\frac{y}{x}\right) + x^2 dy = 0$$

$$-2y d\left(\frac{y}{x}\right) + dy = 0$$

$$\frac{-2y}{x} + \log_e y = C$$

Given $x(e) = e$

$$\Rightarrow C = -1$$

$$\frac{-2y}{x} + \log_e y = -1$$

$$\frac{2y}{x} - \log_e y = 1$$

$$\frac{2e^2}{x} - 2 = 1 \Rightarrow \frac{2e^2}{x} = 3 \Rightarrow x = \frac{2e^2}{3}$$

$$x(e^2) = \frac{2e^2}{3}$$

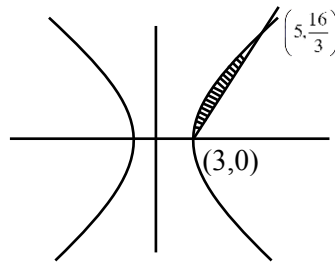
16. If the area bounded by two curves $\frac{x^2}{9} - \frac{y^2}{16} = 1$ and

$$8x - 3y = 24 \text{ is } A - 6 \log_e 3, \text{ then } A \text{ is equal to}$$

- (1) 5 (2) 6
(3) 7 (4) 8

Ans. (4)

Sol.



$$16x^2 - 9y^2 = 144$$

$$16x^2 - (8x - 24)^2 = 144$$

$$16x^2 - 64(x - 3)^2 = 144 \Rightarrow x^2 - 4(x - 3)^2 = 9$$

$$3x^2 - 24x + 45 \Rightarrow x^2 - 8x + 15 = 0$$

$$x = 3, 5$$

$$\text{Area} = \int_3^5 \sqrt{\frac{16x^2 - 144}{9}} - \frac{1}{2} \cdot 2 \cdot \frac{16}{3}$$

$$= \frac{4}{3} \int_3^5 \sqrt{x^2 - 9} - \frac{16}{3}$$

$$= \frac{4}{3} \left(\frac{x}{2} \sqrt{x^2 - 9} - \frac{9}{2} \log_e (x + \sqrt{x^2 - 9}) \right)_3^5 - \frac{16}{3}$$

$$= \frac{4}{3} \left(\frac{5}{2} \cdot 4 - \frac{9}{2} \log_e 9 - \frac{3}{2} \cdot 0 + \frac{9}{2} \log_e 3 \right) - \frac{16}{3}$$

$$\text{Area} = 8 - 6 \log_e 3 = A - 6 \log_e 3$$

$$\Rightarrow A = 8$$

SECTION B

1. Let $P = \{\theta \in [0, 4\pi], \tan^2 \theta \neq 1\}$

$$S = \{a \in \mathbb{Z} : (\cos^2 \theta - \sin^2 \theta) \sec 2\theta = a^2, \theta \in P\}$$

then $n(S)$ equals

Ans. (2.00)

Sol. $a^2 = \cos 2\theta \cdot \sec 2\theta = 1 \Rightarrow a = 1, -1$

$$n(S) = 2$$

2. If ${}^{30}C_{30-r} + 3 \cdot {}^{30}C_{31-2r} + 3 \cdot {}^{30}C_{32-r} + {}^{30}C_{33-r} = {}^nC_r$

then value of n is

Ans. (33)

Sol. ${}^3C_3 \cdot {}^{30}C_{30-r} + {}^3C_2 \cdot {}^{30}C_{31-2r} + {}^3C_1 \cdot {}^{30}C_{32-r} + {}^3C_0 \cdot {}^{30}C_{33-r}$

$$= {}^{33}C_{33-r} \equiv {}^nC_r \equiv {}^nC_{n-r}$$

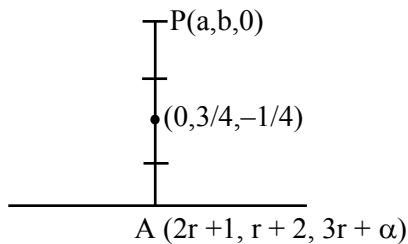
$$\Rightarrow n = 33$$

3. If foot of the perpendicular from a point $P(a, b, 0)$ on the line $\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-\alpha}{3}$ is A and mid-point of AP is $(0, 3/4, -1/4)$, then the value of $(a^2 + b^2 + \alpha^2)$ is -

Ans. (1)

Sol. $\frac{2r+1+a}{2} = 0 \Rightarrow 2r+a = -1$

$\frac{r+2+b}{2} = \frac{3}{4} \Rightarrow r+b = -\frac{1}{2}$



$\frac{3r+\alpha}{2} = \frac{-1}{4} \Rightarrow 3r+\alpha = -\frac{1}{2}$

$2 \cdot a + 1 \cdot (b - 3/4) + 3 \cdot \frac{1}{4} = 0 \Rightarrow a + b = 0$

$\Rightarrow 2(-1 - 2r) + (-r - 1/2) = 0$

$\Rightarrow -3/2 = 3r = 1 \Rightarrow r = -1/2, a = 0, b = 0, \alpha = 1$

$\therefore a^2 + b^2 + \alpha^2 = 1$

4. If matrices $A = \begin{bmatrix} 2 & -2 \\ 4 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 3 \\ 3 & 9 \end{bmatrix}$ are such that $PA = B$ and $AQ = B$ then $\text{tr}(2(P + Q))$ is -

Ans. (10)

Sol. $A^{-1} = \frac{1}{4} \begin{bmatrix} -2 & 2 \\ -4 & 2 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix}$

$P = BA^{-1} = \frac{1}{2} \begin{bmatrix} 1 & 3 \\ 3 & 9 \end{bmatrix} \begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} -7 & 4 \\ -21 & 12 \end{bmatrix}$

$Q = A^{-1}B = \frac{1}{2} \begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix} \begin{bmatrix} 1 & 3 \\ 3 & 9 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 2 & 6 \\ 1 & 3 \end{bmatrix}$

$\therefore \text{tr}(2(P + Q)) = 10$

5. Ram is tossing a coin if head comes then 10 points will be given and if tail comes then 5 points will be given. If the probability of getting exactly 30 points is $\frac{m}{n}$ then $(m + n)$ equals (Where m & n are co-prime numbers).

Ans. (107)

Sol. $P = (6 \text{ tail}) + (4 \text{ tail} + 1 \text{ head}) + (2 \text{ tail} + 2 \text{ head}) + (3 \text{ head})$

$P = \left(\frac{1}{2}\right)^6 + \frac{5!}{1!4!} \left(\frac{1}{2}\right)^5 + \frac{4!}{2!2!} \left(\frac{1}{2}\right)^4 + \left(\frac{1}{2}\right)^3$

$P = \frac{1}{64} + \frac{5}{32} + \frac{3}{8} + \frac{1}{8}$

$P = \frac{1+10+24+8}{64} = \frac{43}{64} = \frac{m}{n}$

$m + n = 107$