JEE–MAIN EXAMINATION – APRIL 2026
MEMORY BASED QUESTIONS

(HELD ON MONDAY 06th APRIL 2026) **TIME : 9:00 AM TO 12:00 NOON**

PHYSICS	TEST PAPER WITH SOLUTION

1. Potential energy of a particle is given as $u = \frac{A\sqrt{x}}{B+x}$.

Find dimension of A and B :-

(1) $M^3L^{3/2}T^{-2}, L$ (2) $ML^{5/2}T^{-1}, L^2$

(3) $ML^{5/2}T^{-2}, L$ (4) $ML^{7/2}T^{-3}, L$

Ans. (3)

Sol. $[B] = [x] = L$

$[U] = \left[\frac{A\sqrt{x}}{B+x}\right] \Rightarrow ML^2T^{-2} = \frac{[A]L^{1/2}}{L}$

$[A] = ML^{5/2}T^{-2}$

2. In AC circuit supply voltage $(V_{rms}) = 1000V$, $R = 80\ \Omega$, $X_L = 80\Omega$ & source frequency f = 50 Hz. Find the power factor.

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

(3) $\frac{1}{\sqrt{5}}$ (4) $\frac{1}{\sqrt{6}}$

Ans. (1)

Sol. Power factor, $\cos\phi = \frac{R}{Z}$

z $= \sqrt{R^2 + X_L{}^2} = 80\sqrt{2}\Omega$

$\cos\phi = \frac{80}{80\sqrt{2}}$

$\cos\phi = \frac{1}{\sqrt{2}}$

3. Electric field due to half Ring at center is 100 N/C. Find charge on Ring. Radius of Ring is 10cm.

(1) $\frac{\pi}{9}\times10^{-9}C$ (2) $\frac{\pi}{27}\times10^{-9}C$

(3) $\frac{\pi}{18}\times10^{-9}C$ (4) $\frac{\pi}{36}\times10^{-9}C$

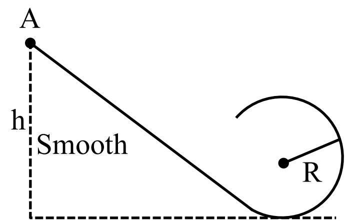
Ans. (3)

Sol. $E = \frac{2k\lambda}{r}$

$\Rightarrow 100 = \frac{2\times9\times10^9\times q}{\pi\times10\times10^{-2}\times10\times10^{-2}}$

$q = \frac{\pi}{18}\times10^{-9}C$

4. A particle is released from point A of track as shown in figure find h so that normal reaction at highest point is 3 times the weight of block :-



(1) h = 4 R (2) h = 3 R

(3) h = 2.5 R (4) h = 6 R

Ans. (1)

Sol. at highest point

$mg + N = \frac{mv^r}{R}$

$4\ mg = \frac{mv^r}{R}$

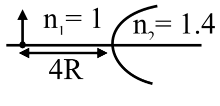
$v = \sqrt{4gR}$

Now energy conservation

$mg\ (h - 2R) = \frac{1}{2} m \times 4gR$

(h = 4R)

5. Find tranverse magnification due to curved boundary between two mediums.



(1) –1.5 (2) –1.67

(3) +1.2 (4) –0.8

Ans. (2)

Sol. $m = \frac{n_1}{n_2}\frac{v}{u}$

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$

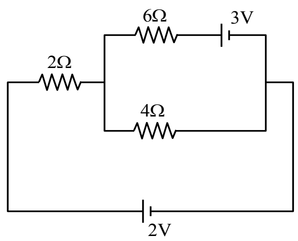
$$\frac{1.4}{v} + \frac{1}{4R} = \frac{1.4 - 1}{R}$$

$$\frac{1.4}{v} = \frac{4}{10R} - \frac{1}{4R}$$

$$v = \frac{56R}{6} = +\frac{28}{3}R$$

$$m = \frac{1}{1.4}\cdot\frac{28R/3}{(-4R)} = -1.67$$

6. Find heat dissipate in 6Ω resistance in 100 seconds.

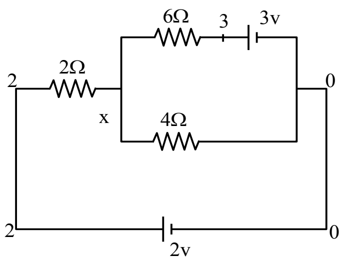


(1) 31 J (2) 35 J

(3) 40 J (4) 28 J

Ans. **(1)**

Sol.



$$\frac{x-2}{2} + \frac{x-0}{4} + \frac{x-3}{6} = 0$$

$$\frac{6x - 12 + 3x + 2x - 6}{12} = 0$$

$11x - 18 = 0 \Rightarrow x = \frac{18}{11}$ volt

$$V_{6\Omega} = 3 - \frac{18}{11} = \frac{33-18}{11} = \frac{15}{11}$$

Heat in 6Ω in 100 sec $= \left(\frac{v^2}{R}\right)\times 100 = \frac{\left(\frac{15}{11}\right)^2 \times 100}{6}$

$= 30.99 = 31$ J

7. In YDSE a glass slab of thickness 8μm is introduced in front of a slit. If central maxima shifts to the position of 4th minima, then find refractive index of glass slab (λ = 500 nm):-

(1) μ = 1.11 (2) μ = 1.22

(3) μ = 1.32 (4) μ = .22

Ans. **(2)**

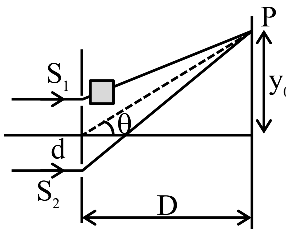
Sol. $S_2P - [S_1P + (\mu - 1)t] = n\lambda$

$n = 0$ (CBF)

$d\sin\theta - (\mu - 1)t = 0$

$$\frac{dy_0}{D} = (\mu - 1)t$$

Shift $= y_0 = (\mu - 1)t\frac{D}{d}$



Minima : $y_n = \left(n + \frac{1}{2}\right)\frac{D\lambda}{d}$

n = 3 is 4th minima

$$y_1 = \left(3 + \frac{1}{2}\right)\frac{D\lambda}{d} = \frac{7}{2}\frac{D\lambda}{d}$$

$y_0 = y_1$

$$(\mu - 1)t\frac{D}{d} = \frac{7}{2}\frac{D\lambda}{d} \Rightarrow (\mu - 1) = \frac{7\lambda}{2t} = \frac{7}{2}\times\frac{500\times10^{-9}}{8\times10^{-6}}$$

$\Rightarrow \mu - 1 = 3.5 \times 62.5 \times 10^{-3} = 0.218 = 0.22$

$\Rightarrow \mu = 1.22$

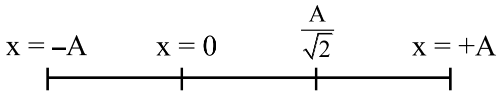
8. A particle is performing SHM of amplitude A. Find the time required for particle to go from mean position to $\frac{A}{\sqrt{2}}$. Time period of SHM is 5 secs :-

(1) $\frac{5}{4}$ sec. (2) $\frac{5}{12}$ sec.

(3) $\frac{5}{8}$ sec. (4) $\frac{5}{6}$ sec.

Ans. **(3)**

Sol.



$x = 0 \rightarrow \theta = 0°$

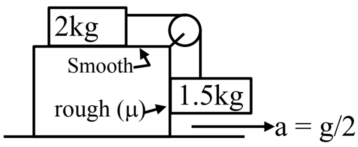
$x = \frac{A}{\sqrt{2}} \rightarrow \theta = \frac{\pi}{4}$

$\therefore$ phase covered $= \frac{\pi}{4}$

$\text{time} = \frac{\text{phase}}{w} = \frac{\pi}{4w} = \frac{\pi}{4} \times \frac{T}{2\pi} = \frac{T}{8}$

$\therefore\ t = \frac{5}{8}$ secs.

9. Find μ so that blocks are at rest :

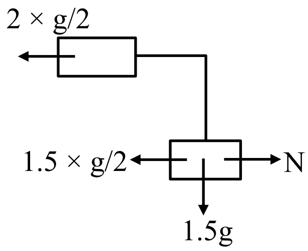


(1) $\frac{1}{3}$ (2) $\frac{2}{3}$

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

Ans. **(2)**

Sol. w.r.t bigger block

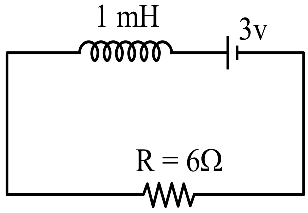


$f = \mu N = \mu \times \frac{1.5g}{2}$

$1.5g = g + \mu + \frac{1.5g}{2} \quad \Rightarrow 0.5 = \mu \times \frac{1.5}{2}$

$\left(\mu = \frac{2}{3}\right)$

10. For the given circuit, find ratio of instantaneous voltage across inductor when current is 2mA & when current is 4mA.



(1) 1.5 (2) 1

(3) 2 (4) 1.25

Ans. **(2)**

Sol. At i = 2mA

$\Delta V_R = iR = 2 \times 10^{-3} \times 6 = 0.012$ V

$\Delta V_{ind} = 3 - 0.012 = 2.988$ V

At I = 4mA

$\Delta V_{ind} = iR = 4 \times 10^{-3} \times 6 = 0.024$

$\Delta V_{ind} = 3 - 0.024 = 2.976$

$\text{Ratio} = \frac{2.988}{2.976} = 1.00403$

11. A sphere of mass 5 kg and radius 4 cm is rotating about fixed axis about diameter with 1200 r.p.m. To stop it in 10 sec, a torque is applied. Find magnitude of torque required and revolution made before it stops. Respectively :-

(1) 0.08 N-m and 50 Rev.

(2) 0.04 N-m and 100 Rev.

(3) 0.016 N-m and 200 Rev.

(4) 0.2 N-m and 100 Rev.

Ans. **(2)**

Sol. $w_i = 1200 \text{ rpm} = 1200 \times \frac{2\pi}{60} = 40\ \pi$ rad /sec

$\rightarrow w_f = w_i + \alpha t \Rightarrow 0 = 40p + \alpha(10)$

$\alpha = -4\pi$ rad/sec^2

$\rightarrow I = \frac{2}{5} MR^2 = \frac{2}{5}(5)\ (0.04)^2 = 2 \times 0.0016$

$I = 0.0032$ Kg-m^2

$\rightarrow \tau = I\alpha = 0.0032 \times 4\pi$

$\tau = 0.04$ N-m

$\rightarrow w_f^2 = w_i^2 + 2\alpha\phi$ &

$0 = (40\pi)^2 + 2(4\pi)\theta$

$\theta = \frac{1600\pi^2}{8\pi} = 200\pi$

No. of revolution $= \frac{\theta}{2\pi} = \frac{200\pi}{2\pi}$

No. of revolution = 100

12. Intensity of two sources is same and path difference at point A and B are $\frac{\lambda}{6}$ and $\frac{\lambda}{3}$ respectively. Ratio of intensity at A & B will be.

(1) 3 (2) 4

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

Ans. **(1)**

Sol. $\Delta\phi)_A = \frac{2\pi}{\lambda}\times\frac{\lambda}{6} = \frac{\pi}{3}$

$\therefore\ I)_A = I + I + 2\ 2\sqrt{I}.\sqrt{I}.\cos\left(\frac{\pi}{3}\right)$

$= 2\ I + 2I\ \frac{1}{2} = 3I$

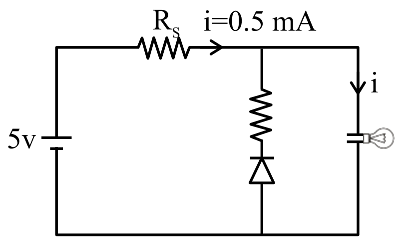
$\Delta\phi)_B = \frac{2\pi}{\lambda}\times\frac{\lambda}{3} = \frac{2\pi}{3}$

$\therefore\ I)_A = I + I + 2\ 2\sqrt{I}.\sqrt{I}.\cos\left(\frac{2\pi}{3}\right)$

$= 2\ I - I = I$

$\therefore\ \frac{I_A}{I_B} = \frac{3I}{I} = 3$

13. Find minimum R_S so that LED light does not get damaged (power rating of LED is 2 mW):-



(1) 1Ω (2) 2Ω

(3) 3Ω (4) 4Ω

Ans. **(2)**

Sol. Diode in reverse bias so no crrent in it.

$P_{bulb} = 2 \times 10^{-3} = V_{bulb}$

$v_{bulb} = 4V$

So $5V = V_{RS} + V_{bulb}$

$V_{rs} = 5 - 4 = 1$

$1 = 0.5\ R_s \Rightarrow R_s = 2\Omega$

14. The dimension of a solid cylinder is measured as given

Mass = 19.42 ± 0.02 kg

Diameter = 20.20 ± 0.02 cm

Length = 10.10 ± 0.02

Find out % error in density.

(1) 0.5% (2) 0.3%

(3) 0.4% (4) 0.7%

Ans. **(1)**

Sol. $\rho = \frac{4M}{\pi d^2 \ell}$

$\frac{d\rho}{\rho} = \frac{dM}{M} + \frac{d\ell}{\ell} + \frac{2dd}{d}$

$\frac{d\rho}{\rho} = \left(\frac{0.02}{19.42} + \frac{0.02}{10.10} + \frac{2\times0.02}{20.20}\right)\times 100 = 0.5\%$

15. Electric field in space is given by $\vec{E} = 2x\hat{i} + 3y^2\hat{j} + 4\hat{k}$. A charge q = 3C is taken from $r_i(0, -1, -3)$ to $r_f(5, 1, 2)$. Find magnitude of ΔU

Ans. **(47)**

Sol. $\Delta U = -w_{electrostatic} = -\int 2xdx - \int 3y^2dy - \int 4dz$

$= \left(-x^2 - y^3 - 4z\right)_{(0,-1,-3)}^{(5,1,2)}$

$= -[25 + 2 + 20]$

$= -47\ J$

16. Bulk's modulus of an ideal gas for isothermal process initially is B. Gas is compressed from volume V_0 to $\frac{V_0}{3}$ isothermally. Find the work done by gas.

(1) $BV_0 \ell n3$

(2) $\frac{BV_0}{3}\ell n3$

(3) $BV_0 \ell n\left(\frac{1}{3}\right)$

(4) $3BV_0 \ell n\left(\frac{1}{2}\right)$

Ans. **(3)**

Sol. For isothermal process initially $B = P_0$.

$$W = nRT\ell n\left(\frac{V_2}{V_1}\right)$$

$$= P_0V_0\ell n\left(\frac{1}{3}\right)$$

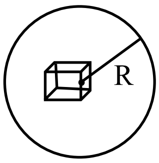
$$W = BV_0\ell n\left(\frac{1}{3}\right)$$

17. A cube of side 1mm is placed at centre of circular coil of radius 10cm. current flowing in coil is 2A. Find magnetic field energy stored in cube. ($\pi = 3.14$)

(1) 1.57×10^{-14} J
(2) 6.28×10^{-14} J
(3) 12.56×10^{-14} J
(4) 9.42×10^{-14} J

Ans. **(2)**

Sol. Magnetic field at centre $B = \left(\frac{\mu_0}{4\pi}\right)\frac{2\pi i}{R}$



$$= \frac{10^{-7} \times 2 \times \pi \times 2}{10 \times 10^{-2}}$$

So energy stored

$$U = \frac{B^2}{2\mu_0} \times V$$

$$= \frac{10^{-14} \times 4 \times \pi^2 \times 4 \times 100}{2 \times 4\pi \times 10^{-7}} \times \left(1 \times 10^{-9}\right)$$

$$= 2\pi \times 10^{-14}\,\text{J}$$

$= 6.28 \times 10^{-14}$ J

18. Unpolarised light with intensity I_0, incident on polariser. Find angle between axis of polarises and analyser so that intensity of emergent light becomes $\frac{3I_0}{8}$:-

(1) 60°
(2) 30°
(3) 90°
(4) 0°

Ans. **(2)**

Sol. $\underset{\text{(Unpolarised)}}{I_0} \rightarrow \underset{\text{(Polarised)}}{\frac{I_0}{2}} \xrightarrow{\text{Analyser}}$

$I = I' \cos^2\theta$

$$\frac{3I_0}{8} = \frac{I_0}{2}\cos^2\theta$$

$$\cos\theta = \frac{\sqrt{3}}{2}$$

$\theta = 30°$

19. Shortest wavelength of Lyman is x, then difference of wavelengths of 1st Balmer and 2nd Balmer line is terms of x will be :-

(1) $\left(\frac{28}{15}\right)x$
(2) $\left(\frac{26}{15}\right)x$
(3) $\left(\frac{13}{15}\right)x$
(4) $\left(\frac{11}{15}\right)x$

Ans. **(A)**

Sol. $\lambda = \dfrac{91.2\text{nm}}{z^2\left(\dfrac{1}{n_1^2}-\dfrac{1}{n_2^2}\right)}$

H-atom 1st lyman x = 91.2 nm

1st Balmer $\lambda_1 = \dfrac{91.2}{\left(\dfrac{1}{4}-\dfrac{1}{9}\right)} = \dfrac{36x}{5}$

2nd Balmer $\lambda_2 = \dfrac{91.2}{\left(\dfrac{1}{4}-\dfrac{1}{16}\right)} = \dfrac{16}{3}x$

$\lambda_1 - \lambda_2 = \left(\dfrac{36}{5}-\dfrac{6}{3}\right)x = \dfrac{28}{15}x$

20. A small drop of mass 1 gm starts falling from rest from a height of 1 km. When it reaches the ground with speed of 5 m/s, magnitude of work done by resistance force is $x \times 10^{-3}$ J. Find x :-

(1) 845 (2) 247.5

(3) 987.5 (4) None

Ans. **(3)**

Sol. $w_g + w_{res} = \Delta k$

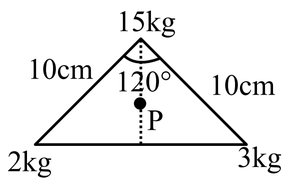
$mgh + w_{res} = \dfrac{1}{2}mv^2$

$\therefore\ w_{res} = \dfrac{1}{2}mv^2 - mgh$

$= 10^{-3}\left(\dfrac{25}{2}-10^4\right)$

$= 987.5 \times 10^{-3}$ J

21. If P is the midpoint of median. Find distance of COM from P.



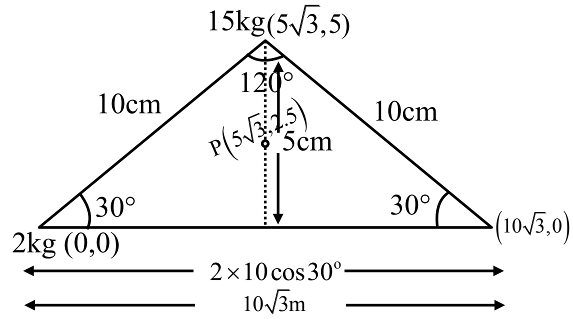
(1) 6.18

(2) 5.18

(3) 6.88

(4) 1.32

Ans. **(4)**



Sol.

$X_{cm} = \dfrac{2\times0+15\times5\sqrt{3}+3\times10\sqrt{3}}{20} = \dfrac{21\sqrt{3}}{4}$

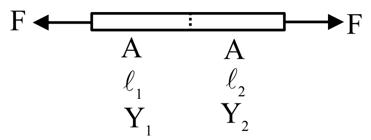
$Y_{cm} = \dfrac{0\times2+15\times5+3\times0}{20} = \dfrac{15}{4}$

Distance = $\sqrt{\left(5.25\sqrt{3}-5\sqrt{3}\right)^2+\left(3.75-2.5\right)^2}$

$= \sqrt{(0.25\sqrt{3})^2+(1.25)^2} \quad = \sqrt{1.75}$

= 1.32

22. Two wires are joint together and is elongated with force as shown in figure.



If $\dfrac{Y_1}{Y_2} = \dfrac{20}{11}$. Find out $\dfrac{\ell_1}{\ell_2}$ so that they have same elongation.

(1) $\dfrac{11}{20}$

(2) $\dfrac{20}{11}$

(3) $\dfrac{11}{10}$

(4) $\dfrac{10}{11}$

Ans. **(2)**

Sol. $\Delta\ell = \dfrac{T\ell}{YA}$

$\ell \propto Y$

$\dfrac{\ell_1}{\ell_2} = \dfrac{Y_1}{Y_2} = \dfrac{20}{11}$

23. Find the ratio of momentum of photons of 1st & 2nd line of Balmer series of hydrogen atom.

(1) $\frac{10}{20}$ (2) $\frac{11}{27}$

(3) $\frac{15}{20}$ (4) $\frac{20}{27}$

Ans. (4)

Sol. $p = \frac{h}{\lambda}$

$$\frac{1}{\lambda_1} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = R\left(\frac{1}{4} - \frac{1}{9}\right)$$

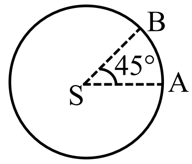
$$\frac{1}{\lambda_1} = R\frac{5}{36}$$

$$\frac{1}{\lambda_2} = R\left(\frac{1}{2^2} - \frac{1}{4^2}\right) = R\left(\frac{1}{4} - \frac{1}{16}\right)$$

$$\frac{1}{\lambda_2} = \frac{3R}{16}$$

$$\frac{p_1}{p_2} = \frac{\lambda_2}{\lambda_1} = \frac{\frac{16}{3R}}{\frac{36}{5R}} = \frac{20}{27}$$

24. A point source is kept at center of sphere. The intensity of light at point A is I, then intensity at point B is :



(1) I/2

(2) 2I

(3) I

(4) I/3m

Ans. (3)

Sol. Distance is same

So intensityis also same

$$I = \frac{P}{4\pi R^2}$$

JEE–MAIN EXAMINATION – APRIL 2026
MEMORY BASED QUESTIONS

(HELD ON MONDAY 06th APRIL 2026) **TIME : 9:00 AM TO 12:00 NOON**

CHEMISTRY | TEST PAPER WITH SOLUTION

1. Hydrolysis of sucrose follows 1st order kinetics to produce glucose and fructose. If $(t_{1/2})$ for decomposition of sucrose is 3 hr. Find % of sucrose left after 6 hr.

Ans. **(25)**

Sol. Sucrose + $H_2O \rightarrow$ glucose + fructose

$t_{1/2} = 3$ hr

For 1st order $t_{75\%} = 2 \times t_{1/2}$

So t = 6 hr, 75% of sucrose decomposed

So 25% of sucrose remains after 6 hr.

2. If at infinite dilution, molar conductivities of $BaCl_2$, HCl and H_2SO_4, are x_1, x_2, x_3 S cm^2mol^{-1} respectively. Find solubility product of $BaSO_4$.

Given K_{BaSO_4} (Specific conductance) = x S cm^{-1}

(1) $\left(\dfrac{x}{x_1+x_3-2x_2}\right)^2 \times 10^6$

(2) $\left(\dfrac{x_1+x_3-2x_2}{x}\right)^2 \times 10^6$

(3) $\left(\dfrac{x}{x_1+x_3-x_2}\right)^2 \times 10^3$

(4) $\left(\dfrac{x}{x_1+x_3-x_2}\right)^2 \times 10^6$

Ans. **(1)**

Sol. Using Kohlrausch's Law

$$\mathring{\Lambda}_{M_{BaSO_4}} = x_1 + x_3 - 2x_2$$

$$\mathring{\Lambda}_{M} = \frac{\kappa \times 1000}{S} \Rightarrow$$

$$S = \frac{x}{x_1+x_3-2x_2} \times 10^3\ 'M'$$

$$\Rightarrow K_{Sp} = S^2$$

3. For given four processes compare magnitude of work

Process	Work
(I) Isothermal multistep → Expansion	W_1
(II) Isothermal single-step → Expansion	W_2
(III) Isothermal single-step → Compression	W_3
(II) Isothermal multi-step → Compression	W_4

Which of the following is correct option

(1) $|W_1| > |W_2| > |W_3| > |W_4|$

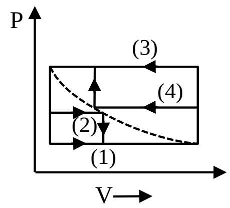
(2) $|W_1| < |W_2| < |W_3| < |W_4|$

(3) $|W_1| < |W_3| < |W_2| < |W_4|$

(4) $|W_2| < |W_1| < |W_4| < |W_3|$

Ans. **(4)**

Sol.



|W| = Area under the P–V cuve

4. A solution contain 0.25 moles of non-volatile solute dissolved in one mole of solvent. Then calculate % of vapour pressure of solution relative to vapour pressure of pure solvent?

(1) 20 (2) 40

(3) 60 (4) 80

Ans. **(4)**

Sol. $P_S = P^0.X_A$

$$\frac{P_S}{P^0} = X_A = \frac{1}{1+0.25} = 0.80$$

% = 0.8 × 100 = 80

5. 1 mole of He and 1 mole A are taken in 10 L rigid container at 400 K and equilibrium A $\rightleftharpoons$ B is established. Calculate partial pressure of He and B at equilibrium if $K_C = 4$.
(1) 3.28 atm, 2.62 atm
(2) 2.6 atm, 3.28 atm
(3) 2.6 atm, 2.6 atm
(4) 3.28 atm, 3.28 atm

Ans. (1)

Sol.

$$A \rightleftharpoons B$$

$t = 0$ 1 mol –

t_{eq^m} $1 - x$ x

$$K_C = \frac{x/10}{\frac{1-x}{10}} = 4$$

$x = 0.8$

$$P_{He} = \frac{1 \times 0.0821 \times 400}{10} = 3.284 \text{ atm}$$

$$P_B = \frac{0.8 \times 0.0821 \times 400}{10} = 2.62 \text{ atm}$$

6. An oxide of iron contains 69.9% iron. Find its empirical formula.
(Given : Atomic masses Fe= 56, O =16)
(1) Fe_3O_4 (2) Fe_2O_3
(3) FeO_3 (4) FeO

Ans. (2)

Sol.

	Fe		**Oxygen**
Moles :	$\frac{69.9}{56}$		$\frac{30.1}{16}$
Molar Ratio :	1	:	1.5
Molar Ratio :	2	:	3

Answer : $\mathbf{Fe_2O_3}$

7. **Column-I** **Column-II**
(P) 2s (i) Radial node = 2
Angular node = 1
(Q) 3s (ii) Radial node = 0
Angular node = 2
(R) 4p (iii) Radial node = 1
Angular node = 0
(S) 3d (iv) Radial node = 2
Angular node = 0

Match the correct list -
(1) P-(iv), Q-(iii), R-(ii), S-(i)
(2) P-(iii), Q-(iv), R-(i), S-(ii)
(3) P-(i), Q-(ii), R-(iii), S-(iv)
(4) P-(ii), Q-(i), R-(iv), S-(iii)

Ans. (2)

Sol. Radial nodes = $n - \ell - 1$

Angular nodes = ℓ

8. For the reversible reaction at 300 K, $\Delta H^\circ = 28.4$ KJ/mole and equilibrium constant $K = 1.8 \times 10^{-7}$, then calculate magnitude of ΔS° in Joule/K-mole.
[Given log 2 = 0.3, $\ell n10 = 2.3$,
R = 8.314 J/Kmole, log 3 = 0.47]

Ans. (34 J/K-mole)

Sol. $\Delta G^\circ = -RT\ell n K_{eq^m}$

$$\Delta H^\circ - T\,\Delta S^\circ = -2.303\ RT \log K_{eq^m}$$

$$\Delta S^\circ = \frac{\Delta H^\circ}{T} + 2.303 R \log K_{eq^m} = \Delta S^\circ$$

$$= \frac{28.4 \times 10^3}{300} + 2.303 \times 8.314 \log[18 \times 10^{-8}]$$

$= -34.47$ J/K-mole

9. If minimum wavelength for H-atom in Lyman series is 'x', then maximum wavelength of Balmer series of He^+ ion in terms of 'x' will be

(1) $\frac{3}{4}x$

(2) x

(3) $\frac{9x}{5}$

(4) $\frac{5x}{9}$

Ans. (3)

$$\frac{1}{x} = R \times 1^2 \times \left(\frac{1}{1^2} - \frac{1}{\infty^2}\right) \text{ ....(1)}$$

$$\frac{1}{\lambda} = R \times 2^2 \times \left(\frac{1}{2^2} - \frac{1}{3^2}\right) \text{ ....(2)}$$

$$\frac{1}{\lambda} = R \times 4 \times \frac{5}{4 \times 9}$$

$$\frac{1}{\lambda} = \frac{1}{x} \times \frac{5}{9}$$

$$\lambda = \frac{9x}{5}$$

10. For the following configurations of tetrahedral complexes in List-I, match them with corresponding CFSE in List-II.

	List-I		List-II (Δ_t)
(A)	d^2	(P)	–0.6
(B)	d^4	(Q)	–0.8
(C)	d^6	(R)	–1.2
(D)	d^8	(S)	–0.4

(1) A-R ; B-S ; C-Q ; D-P

(2) A-R ; B-S ; C-P ; D-Q

(3) A-P ; B-S ; C-R ; D-Q

(4) A-S ; B-Q ; C-P ; D-R

Ans. (2)

Sol. $d^2 = -0.6 \times 2 = -1.2$

$d^4 = -1.2 + 0.8 = -0.4$

$d^6 = -1.8 + 1.2 = -0.6$

$d^8 = -2.4 + 1.6 = -0.8$

11. Consider the following orders of energy levels in 'd' subshell in a tetrahedral complex.

(A) $d_{xy} = d_{xz} > d_{x^2-y^2}$

(B) $d_{xy} = d_{yz} > d_{z^2}$

(C) $d_{x^2-y^2} > d_{z^2} > d_{xz}$

(D) $d_{x^2-y^2} = d_{z^2} > d_{xz}$

The correct order are :

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

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

Ans. (3)

Sol. In tetrahedral splitting , energy of t_2 orbitals ($d_{xy} = d_{xz} = d_{yz}$) is greater than that of e-orbitals ($d_{x^2-y^2} = d_{z^2}$)

12. **Statement-I :** Al is more electropositive than Tl because, $E^0_{Al^{3+}/A\ell}$ is negative & $E^0_{T\ell^{3+}/T\ell}$ is positive.

Statement-II : For B-atom ; sum of first three ionization energy is very high thus it forms covalent compounds.

(1) Both statement-I & statement-II are correct

(2) Both statement-I & statement-II are incorrect

(3) Statement-I is correct but statement-II is incorrect

(4) Statement-I is incorrect but statement-II is correct.

Ans. (1)

Sol. $E^0_{Al^{3+}Al} = -1.66$

$E^0_{T\ell^{3+}/T\ell} = 1.26$

13. Which of the following pair of specie(s) have different lewis strcuture

(A) SO_3^{2-}, CO_3^{2-} (B) O_2^{2-}, F_2

(C) CN^-, CO (D) NH_3, H_3O^+

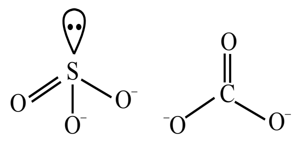
(E) MnO_4^-, CrO_4^{2-}

(1) (A) only (2) (A) & (B) only

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

Ans. (1)

Sol. Only SO_3^{2-} & CO_3^{2-} has different structure



14. Consider the statements

(A) In Zeigler –Natta catalyst, d-block central metal ion has spin magnetic moment of 2.84 BM

(B) In Zeigler –Natta catalyst, p-block element has + 3 oxidation state

(C) Basic vanadium oxide is used in production of H_2SO_4

(D) Catalyst used in wacker's process has central metal with d^8 configuration

(1) (A) , (B) & (C) are correct
(2) (B) & (D) are correct
(3) (C) & (D) are correct
(4) (B) , (C) & (D) are correct

Ans. **(2)**

Sol. Ziegler natta catalyst : $TiCl_3/TiCl_4 + Al(C_2H_5)_3$

V_2O_5 is amphoteric oxide used in production of H_2SO_4

$PdCl_2$ is used in Wacker's process.

15. Find correct order of increasing boiling point in the following given molecules :

(A) n-C_4H_9OH (B) n-$C_4H_9NH_2$
(C) n-C_4H_{10} (D) $C_2H_5NHC_2H_5$
(1) C < D < B < A (2) A < B < D < C
(3) D < C < A < B (4) B < C < D A

Ans. **(1)**

Sol. Boiling point $\propto$ Intermolecular attraction

$\propto$ Number of H-bonding

16. Match disease with the deficiency.

	Column-I		Column-I
(A)	Scurvy	(P)	Pyridoxine
(B)	Convulsions	(Q)	Vitamin-A
(C)	Cheilosis	(R)	Ascorbic acid
(D)	Xerophthalmia	(S)	Riboflavin

(1) A-R ; B-P ; C-S ; D-Q
(2) A-P ; B-R ; C-S ; D-Q
(3) A-S ; B-P ; C-R ; D-Q
(4) A-R ; B-S ; C-P ; D-Q

Ans. **(1)**

Sol. Vitamin–A $\rightarrow$ Xerophthalmia

Vitamin-C (Ascorbic acid) $\rightarrow$ Scurvy

Vitamin-B_2 (Cheilosis) $\rightarrow$ Cheilosis

Vitamin-B_6 (Pyridoxine) $\rightarrow$ Convulsions

17. Match with tab test of amino acids.

Column-I	**Column-II**
A $\rightarrow$ Glutamine	I $\rightarrow$ Hinsberg test
B $\rightarrow$ Lysine	II $\rightarrow$ Neutral $FeCl_3$
C $\rightarrow$ Tyrosine	III $\rightarrow$ Cerric ammonium nitrate
D $\rightarrow$ Serine	IV $\rightarrow$ Hoffmann Bromamide

(1) A – I, B-IV, C-III, D-II
(2) A – IV, B-I, C-II, D-III
(3) A – I, B-III, C-IV, D-II
(4) A – IV, B-II, C-I, D-III

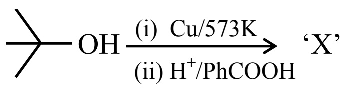
Ans. **(2)**

Sol. Glutamine has amide functional group inside chain. So it gives Hoffmann bromamide reaction.

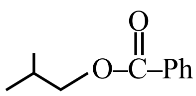
Lysine has 1° amine group. So it gives +ve Hinsberg test.

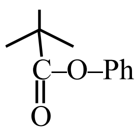
Tyrosine has phenolic OH. So it gives +ve test with neutral $FeCl_3$.

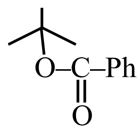
Serine has alcohlic OH group. So it gives +ve test with cerric ammonium nitrate.

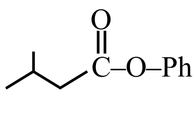
18. 

'X' may be :

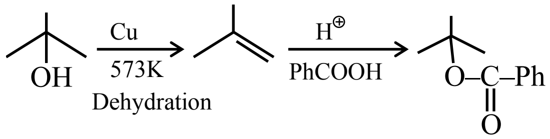
(1) 

(2) 

(3) 

(4) 

Ans. **(3)**

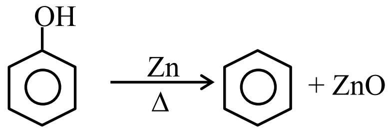
Sol. 

19. 4.7 g of phenol $\xrightarrow{Zn,\Delta}$ 'X'

If reaction goes to 60% yield of X. Find number of moles of 'X' …... $\times 10^{-2}$ are formed.

Ans. **(3)**

Sol.



Moles of phenol $= \dfrac{4.7}{94.0} = 0.05\,\text{mol}$

Reaction is 1 : 1 so 0.05 mole of phenol will give 0.05 mole of benzene on 100% yield

For 60% yield = 0.05 × 0.60

= 0.03 mol.

mol of 'X' = 3×10^{-2} mol

20. Given below are two statements :

Statement-I : 2,4-Diethylcyclohexanone and 2-methyl-6-propylcyclohexanone are metamers.

Statement-II : 2,2,6,6-Tetraethylcyclohexanone will show tautomerism.

Choose correct options :

(1) Statement-I and Statement-II both are correct.

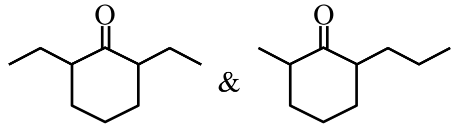
(2) Statement-I and Statement-II both are incorrect.

(3) Statement-I is correct but Statement-II is incorrect.

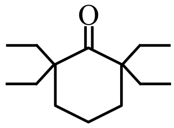
(4) Statement-I is incorrect but Statement-II is correct.

Ans. **(3)**

Sol.



are metamers



will not show tautomerism.

21. **Statement-I :** 3-Phenylprop-1-ene will react with HBr and give alkyl halide as major product having 1 chiral carbon atom.

Statement-II : Aryl chloride and Aryl cyanide both can be formed by gattermann and sandmeyer reaction.

(1) Both Statement I and Statement II are incorrect.

(2) Statement I is correct but Statement II is incorrect.

(3) Statement I is incorrect but Statement II is correct.

(4) Both Statement I and Statement II are correct.

Ans. **(2)**

Sol. $Ph - CH_2 - CH = CH_2 \xrightarrow{HBr} Ph - CH_2 - \overset{\oplus}{C}H - CH_3$

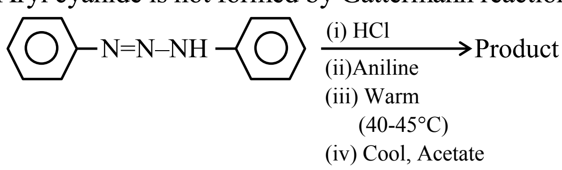
$\downarrow$ Hydride shift

$\underset{\text{Br}}{Ph - \overset{*}{C}H} - CH_2 - CH_3 \xleftarrow{Br^-} Ph - \overset{\oplus}{C}H - CH_2 - CH_3$

Chiral carbon

Aryl cyanide is not formed by Gattermann reaction.

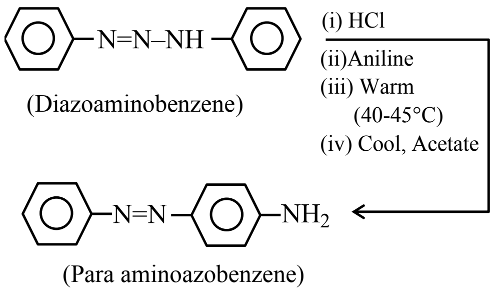
22.



Find percentage of nitrogen in the final product.

Ans. **(21.30%)**

Sol.



- HCl catalysed hydrolysis.
- Aniline acts as a solvent and reactant.
- The mixture is gently heated to facilitate rearrangement.
- After the reaction is complete, the mixture is cooled and treated with sodium acetate to neutralise excess acid and precipitate the final product.

Mass percentage of nitrogen in final product

$= \frac{42}{197} \times 100 = 21.30\ \%$

23. Given below are two statements :

Statement-I : Methane can be prepared by decarboxylation of sodium acetate, by Kolbe's electrolysis and by CH_3MgBr.

Statement-II : Methane can't be prepared by unsaturated hydrocarbon and by Wurtz reaction.

Choose correct options :

(1) Statement-I and Statement-II both are correct.

(2) Statement-I and Statement-II both are incorrect.

(3) Statement-I is correct but Statement-II is incorrect.

(4) Statement-I is incorrect but Statement-II is correct.

Ans. **(4)**

Sol. Methane can not be prepared by Kolbe's electrolysis process.

JEE–MAIN EXAMINATION – APRIL 2026
MEMORY BASED QUESTIONS

(HELD ON MONDAY 06th APRIL 2026) **TIME : 9:00 AM TO 12:00 NOON**

MATHEMATICS	TEST PAPER WITH SOLUTION

1. Find $I = \int_{-\pi/4}^{\pi/4} \frac{32\cos^4\theta}{1+e^{\sin\theta}} d\theta$

(1) $3\pi + 8$ (2) $3\pi + 4$

(3) $4\pi + 3$ (4) $8\pi + 3$

Ans. **(1)**

Sol. Apply (P-5)

$$I = \int_{-\pi/4}^{\pi/4} \frac{32\cos^4\theta}{1+e^{-\sin\theta}} d\theta$$

Add $2I = \int_{-\pi/4}^{\pi/4} 32\cos^4\theta\, d\theta = 2\int_0^{\pi/4} 32\cos^4\theta\, d\theta$

$$I = 32\int_0^{\pi/4} \cos^4\theta\, d\theta$$

$$= 8\int_0^{\pi/4} (2\cos^2\theta)^2 d\theta = 8\int_0^{\pi/4} (1+\cos 2\theta)^2 d\theta$$

$$= 8\int_0^{\pi/4} 1 + 2\cos 2\theta + \cos^2 2\theta\, d\theta$$

$$= 8\int_0^{\pi/4} 1 + 2\cos 2\theta + \frac{1+\cos 4\theta}{2} d\theta$$

$$= 8\left[\frac{3\theta}{2} + \frac{2\sin 2\theta}{2} + \frac{\sin 4\theta}{8}\right]_0^{\pi/4}$$

$$= 8\left[\left(\frac{3\pi}{8} + 1 + 0\right)\right] = 3\pi + 8$$

2. Let $S = \left\{\theta \in (-2\pi, 2\pi) : \cos\theta + 1 = \sqrt{3}\sin\theta\right\}$. Then $\sum_{\theta \in S} \theta$ is equal to

(1) $\frac{4\pi}{3}$ (2) $\frac{5\pi}{3}$

(3) $-\frac{4\pi}{3}$ (4) $-\frac{5\pi}{3}$

Ans. **(3)**

Sol. $\cos\theta + 1 = \sqrt{3}\sin\theta$

$$\frac{1-\tan^2\frac{\theta}{2}}{1+\tan^2\frac{\theta}{2}} + 1 = \sqrt{3}\left(\frac{2\tan\frac{\theta}{2}}{1+\tan^2\frac{\theta}{2}}\right)$$

$$2 = 2\sqrt{3}\tan\frac{\theta}{2}$$

$\Rightarrow \tan\frac{\theta}{2} = \frac{1}{\sqrt{3}}$ $\quad \theta \in (-2\pi, 2\pi)$, $\frac{\theta}{2} \in (-\pi, \pi)$

$$\frac{\theta}{2} = -\frac{5\pi}{6}, \frac{\pi}{6}$$

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

$$\text{Sum} = -\frac{-5\pi}{3} + \frac{\pi}{3} = \frac{-4\pi}{3}$$

3. a_1, a_2, a_3 ..... a_n are in A.P. and sum of first 10 terms is 160. g_1, g_2, g_3 .... g_n are in G.P. were $g_1 + g_2 = 8$ if the first term of A.P. is equal to common ratio of G.P. and first term of G.P. is equal to common difference of A.P. then sum of all possible values of g_1 is equal to :

(1) $\frac{34}{9}$ (2) $\frac{28}{9}$

(3) $\frac{23}{3}$ (4) $\frac{28}{5}$

Ans. **(1)**

Sol. A.P. $\frac{10}{2}[2a + 9d] = 160 \Rightarrow 2a + 9d = 32$ .... (1)

G.P. First term = A, Common ratio = R

$g_1 + g_2 = 8$

A + AR = 8 ... (2)

given a = R & A = d

from (1) $\Rightarrow$ 2R + 9A = 32

A + AR = 8

$A + A\left(\frac{32 - 9A}{2}\right) = 8$

$\Rightarrow 9A^2 - 34A + 16 = 0$

$\text{Sum} = \frac{34}{9}$

4. If $P\left(\frac{a}{3},0,a+c\right)$ is image of Q(1, 6, a) with respect to line $L:\frac{x}{1}=\frac{y-1}{2}=\frac{z-a+1}{b}$, where a > 0, b > 0. If S (α, β, γ) is at a distance of $2\sqrt{14}$ from foot of perpendicular of Q on L, then $\alpha^2+\beta^2+\gamma^2$ is

(1) 179 (2) 120

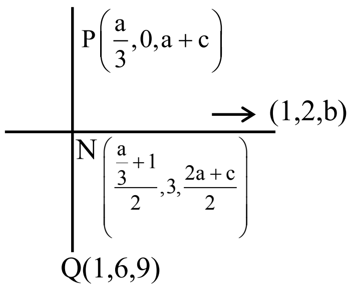
(3) 321 (4) 220

Ans. **(1)**

Sol. N will lie on line L

$$\frac{a+3}{6}=\frac{3-1}{2}=\frac{a+\frac{C}{2}-a+1}{b}$$

$$\Rightarrow a=3\ \&\ \frac{c}{2}+1=b$$



And $\overrightarrow{PQ}.(1,2,b)=0$

$$\left(\frac{a}{3}-1\right).1+(0-6).2+c.b=0$$

$-12+2b(b-1)=0$

$\Rightarrow b=3$ or $b=-2$ (reject)

$c=4$

$$L:\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}=\lambda$$

N (1, 3, 5)

Let S(λ, 2λ + 1, 3λ + 2)

$SN=2\sqrt{14}\Rightarrow(\lambda-1)^2+(2\lambda-2)^2+(3\lambda-3)^2=56$

$14(\lambda-1)^2+56\Rightarrow(\lambda-1)^2=4$

$\Rightarrow\lambda-1=\pm2$

$\lambda=3,-1$

S (3, 7, 11) or S (– 1, – 1, – 1)

$\alpha^2+\beta^2+\gamma^2=9+49+121$

$=130+49=179$

5. Consider the circle $x^2+y^2+2gx+2fy+25=0$ having centre on line $-2x+y=+4$ and radius 6 centre lie in I[st] quadrant. If the line x = 1 cuts the circle at A and B then AB^2 is

(1) 40 (2) 60

(3) 80 (4) 100

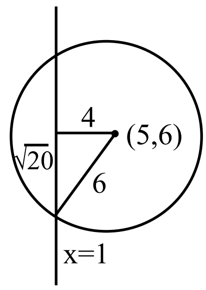
Ans. **(3)**

Sol. $x^2+y^2+2gx+2fy+25=0$

$2g-f=+4\ \&\ g^2+f^2-25=36$

solving $g=-5, f=-6$

$\Rightarrow x^2+y^2-10x-12y+25=0$



$AB=2\sqrt{20}$

$AB^2=80$

6. The value of $1^3-2^3+3^3-4^3+\text{-------}\ 15^3$ is equal to :

(1) 1852 (2) 1854

(3) 1856 (4) 1860

Ans. **(3)**

Sol. $S=1^3-2^3+3^3-4^3+\text{-----}\ 15^3$

$=(1^3+2^3+\text{------}15^3)-2\times2^3(1^3+2^3+\text{----}\ 7^3)$

$$=\left(\frac{15\times16}{2}\right)^2-16\left(\frac{7\times8}{2}\right)^2$$

$=1856$

7. Evaluate the limit $\lim\limits_{x\to0}\frac{x^2\sin^2x}{x^2-\sin^2x}$

(1) 2 (2) 3

(3) 4 (4) 6

Ans. **(2)**

Sol. $9\left(-\frac{80}{72}\right)=-10=\lim\limits_{x\to0}\frac{x^4}{\frac{1}{6}.2.x^4}=3$

8. If coefficients of middle terms in the expansion $(1 + \alpha x)^{26}$ & $(1 - \alpha x)^{28}$ are equal then α is :-

(1) $\frac{1}{4}$ (2) $\frac{8}{27}$

(3) $\frac{7}{27}$ (4) $\frac{9}{28}$

Ans. (3)

Sol. ${}^{26}C_{13}\,\alpha^{13} = {}^{28}C_{14}\,\alpha^{14}$

${}^{26}C_{13} = \frac{28}{14}\cdot {}^{27}C_{13}\,\alpha$

$$\alpha = \frac{{}^{26}C_{13}}{2.\,{}^{27}C_{13}} = \frac{\frac{26!}{13!13!}}{2.\frac{27!}{14!}} = \frac{7}{27}$$

9. Let $f : \{1,2,3,4\} \to \{1, e, e^2, e^3\}$ is a strictly increasing and bijective function and $g : \{1, e, e^2, e^3\} \to \left\{1,\frac{1}{2},\frac{1}{3},\frac{1}{4}\right\}$, strictly decreasing and bijective function. If $\phi(x) = \left[f^{-1}(g^{-1}(1/2))\right]^x$ then find $\int_0^1 (\phi(x) - x^2)dx$:

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

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

Ans. (1)

Sol. $f(x) = e^{x-1}$

$g(x) = \frac{1}{\log_e x + 1}$

$f^{-1}(g^{-1}(1/2)) = f^{-1}(e) = 2$

$\phi(x) = 2^x$

$$\therefore \int_0^1 (2^x - x^2)dx = \left(\frac{2^x}{\ln 2} - \frac{x^3}{3}\right)_0^1 = \frac{1}{\ln 2} - \frac{1}{3}$$

10. The number of four letter words which can be formed using two vowels and two consonants from the world INCONSEQUENTIAL

(words can be meaningful or meaning less) is :

(1) 4092 (2) 4050

(3) 4090 (4) 4080

Ans. (1)

Sol. (I, I), (E, E), 0, A, U (NNN), C, S, Q, T, L

V	C	
2A	2A	${}^2C_1 \times \frac{4!}{2!2!} = 12$
2A	2D	${}^2C_1 \times {}^6C_2 \times \frac{4!}{2!} = 360$
2D	2A	${}^5C_2 \times 1 \times \frac{4!}{2!} = 120$
2D	2D	${}^5C_2 \times {}^6C_2 \times 4! = 3600$

4092

11. If $\tan^{-1}(1-\alpha) + \tan^{-1}(1-\beta) = \frac{\pi}{4}$ & $\alpha = \frac{1}{\beta}$ then find $|\alpha + \beta|$:

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

(3) $\frac{5}{2}$ (4) 3

Ans. (3)

Sol. $\tan^{-1}(1-\alpha) = \frac{\pi}{4} - \tan^{-1}(1-\beta)$

$= \tan^{-1} 1 - \tan^{-1}(1 - \beta)$

$= \tan^{-1}\frac{1-(1-\beta)}{1+(1-\beta)}$

$\Rightarrow 1 - \alpha = \frac{\beta}{2-\beta}$

$\because \beta = \frac{1}{\alpha}$

$\Rightarrow 2\alpha^2 - 3\alpha - 2 = 0$

$\Rightarrow \alpha = -\frac{1}{2}$ & $\alpha = 2$

$\Rightarrow \beta = -2$ & $\beta = \frac{1}{2}$

$\therefore |\alpha + \beta| = \frac{5}{2}$

12. Let the set of all values of $K \in \mathbb{R}$ such that the equation, $z(\bar{z} + 2 + i) + K(2 + 3i) = 0$, $z \in C$ has atleast one solution, be the interval $[\alpha, \beta]$. Then $9(\alpha + \beta) =$

(1) –10 (2) –8

(3) $10\sqrt{13}$ (4) $8\sqrt{13}$

Ans. (1)

Sol. Let $z = x + iy$ where $x, y \in \mathbb{R}$.

$\therefore$ The equation becomes

$(x^2 + y^2 + 2x - y + 2k) + i(x + 2y + 3k) = 0 = 0 + i0$

$\therefore x^2 + y^2 + 2x - y + 2k = 0$ .....(1)

& $x + 2y + 3k = 0$ ....(2)

So, on putting $x = -(2y + 3k)$ from (2) in (1), we get

$5y^2 + (12k - 5)y + (9k^2 - 4k) = 0$

As y is real, so its

Discriminate ≥ 0

$\Rightarrow 36k^2 + 40k - 25 = 0$

$\therefore \dfrac{-40 - 20\sqrt{13}}{72} \leq k \leq \dfrac{-40 + 20\sqrt{13}}{72}$

So, $9(\alpha + \beta) = 9\left(-\dfrac{80}{72}\right) = -10$

13. If $x_1, x_2, x_3 \ldots\ldots\ldots\ldots x_{25}$ be 25 observations such that $\sum_{i=1}^{25}(x_i + 5)^2 = 2500$ and $\sum_{i=1}^{25}(x_i - 5)^2 = 1000$. Then the ratio of mean and standard deviation of the given observation, is

(1) $\dfrac{1}{3}$ (2) $\dfrac{1}{2}$

(3) $\dfrac{1}{4}$ (4) $\dfrac{1}{5}$

Ans. (2)

Sol. $\sum x_i^2 + 10\sum x_i + 625 = 2500$

$\sum x_i^2 - 10\sum x_i + 625 = 1000$

$\Rightarrow \sum x_i^2 = 1125$

$\sum x_i = 75$

Mean $\bar{x} = \dfrac{\sum x_i}{25} = \dfrac{75}{25} = 3$

Standard deviation = $\sqrt{\dfrac{\sum x_i^2}{25} - \left(\dfrac{\sum x_i}{25}\right)^2}$

$= \sqrt{\dfrac{1125}{25} - 9} = 6$

Ratio $\dfrac{1}{2}$

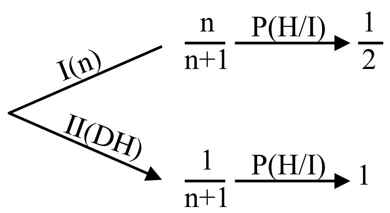
14. If there are (n + 1) coins of which n coins are fair and one is double headed coin. A coin is randomly selected and tossed, if probability that head occurs is $\dfrac{9}{16}$ then n is :

(1) 7 (2) 8

(3) 9 (4) 10

Ans. (1)

Sol.



$\therefore \dfrac{n}{n+1}.\dfrac{1}{2} + \dfrac{1}{n+1}.1 = \dfrac{9}{16}$

$\dfrac{n+2}{2(n+1)} = \dfrac{9}{16} \Rightarrow n = 7$

15. Given point $P\left(6,4\sqrt{3}\right)$ satisfy hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ where eccentricity is root of equation $9e^2-21e+10=0$. Then find the length of latus rectum of hyperbola $\frac{x^2}{a^2}-\frac{y^2}{2\left(1+b^2\right)}=1$.

(1) $\frac{56}{3}$ (2) $\frac{68}{3}$

(3) $\frac{52}{3}$ (4) $\frac{70}{3}$

Ans. (2)

Sol. $9e^2 – 15e – 6e + 10 = 0$

$3e(3e – 5) – 2 (3e – 5) = 0$

$$e=\frac{2}{3},\frac{5}{3};\boxed{e=\frac{5}{3}}$$

$$\frac{25}{9}=1+\frac{b^2}{a^2}\Rightarrow\frac{b^2}{a^2}=\frac{16}{9}$$

$$\frac{x^2}{a^2}-\frac{y^2}{b^2}=1\xrightarrow[(6,4\sqrt{3})]{}\frac{36}{a^2}-\frac{48}{b^2}=1$$

$$\frac{36}{9\lambda}-\frac{48}{16\lambda}=1\Rightarrow\frac{4}{\lambda}-\frac{3}{\lambda}=1\Rightarrow\lambda=1$$

$b^2 = 16,\ a^2 = 9$

$$\frac{x^2}{9}-\frac{y^2}{34}=1$$

$$\frac{2b^2}{a}=\frac{2\times34}{3}=\frac{68}{3}$$

16. Given two lines

$$L_1:\frac{x-1}{3}=\frac{y-2}{2}=\frac{z+1}{1}$$

$$L_2:\frac{x+2}{1}=\frac{y-1}{1}=\frac{z}{1}$$

Third lines L_3 is perpendicular to both lines L_1 & L_2. Find acute angle between lines L_3 & $\vec{v}=2\hat{i}-\hat{j}-\hat{k}$

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{4}$

(3) $\frac{\pi}{6}$ (4) $\frac{\pi}{3}$

Ans. (4)

Sol. DR of $L_3=\vec{a}$

$$\vec{a}=\begin{vmatrix}\hat{i}&\hat{j}&\hat{k}\\3&2&1\\1&1&1\end{vmatrix}=\hat{i}-2\hat{i}+\hat{k}$$

$$\cos\theta=\frac{\vec{a}.\vec{v}}{|\vec{a}||\vec{v}|}$$

$$=\left(\frac{2+2-1}{\sqrt{6}\sqrt{6}}\right)$$

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

$$\theta=\frac{\pi}{3}$$

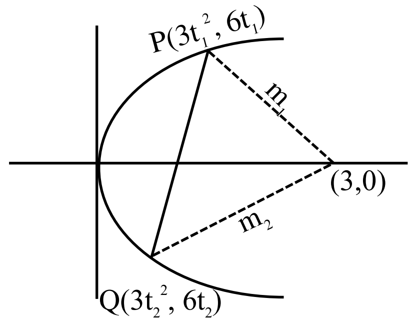
17. If ratio of 2-ordinates of points on the parabola $y^2 = 12x$ is 1 : 2 and length of chord joining these points is $3\sqrt{13}$, then find angle subtend by the chord at the focus of the parabola

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

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

Ans. (2)

Sol.



$$\frac{6t_1}{6t_2}=\frac{1}{2}$$

$t_2 = 2t_1$

$$m_1=\frac{6t_1}{3t_1^2-3}=\frac{2t_1}{t_1^2-1}=\text{not defined}$$

$$m_2=\frac{2t_2}{t_2^2-1}=\frac{4t_1}{4t_1^2-1}=\frac{4}{3}$$

$$9\times13=9\left(t_1^2-t_2^2\right)^2+36\left(t_1-t_2\right)^2$$

$$13=\left(t_1^2-4t_1^2\right)^2+4\left(t_1-2t_1\right)^2$$

$$13=9t_1^4+4t_1^2\Rightarrow t_1^2=1$$

$t_1=1,-1$ $\boxed{\tan\theta=3/4}$

18. If domain of $f(x)=\sin^{-1}\left(\frac{x+[x]}{3}\right)$ where $[\bullet]$ denotes greatest integer function, is $[\alpha, \beta)$ then $(\alpha^2+\beta^2)$ is :

(1) 5 (2) 7

(3) 3 (4) 9

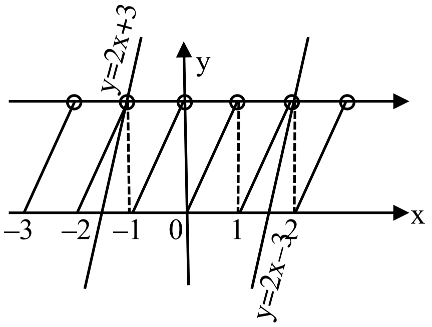
Ans. (1)

Sol. $-1 \le \frac{x+[x]}{3} \le 1$

$x + [x] \ge -3$ $\quad$ $x + [x] \le 3$

$2x - \{x\} \ge -3$ $\quad$ $2x - \{x\} \le 3$

$\{x\} \le 2x + 3$ $\quad$ $\{x\} \ge 2x - 3$



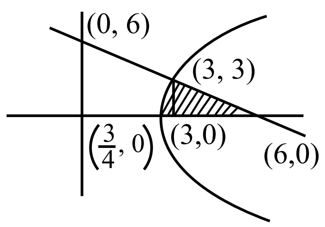
$x \in [-1, 2) \Rightarrow \alpha = -1, \beta = 2$

$\therefore \alpha^2 + \beta^2 = 5$

19. Find the area bounded by $0 \le y \le 6 - x$, $y^2 + 3 \le 4x$ & $x > 0$, is

Ans. (9)

Sol. $A = \int_0^3 \left(6 - y - \frac{y^2+3}{4}\right)dy = 9$



20. Solution of differential equation

$$\frac{dy}{dx} + \frac{y\left(x-\sqrt{x^2-1}\right)}{\left(x^2 - x\sqrt{x^2-1}\right)} = \frac{x}{x^2 - x\sqrt{x^2-1}}$$

Satisfy condition $y(1) = 1$, then find $\left[y\left(\sqrt{5}\right)\right]$.

(Here $[\cdot]$ denotes greatest integer function)

Ans. (3)

Sol. $\frac{dy}{dx} + \frac{y}{x} = \frac{1}{x - \sqrt{x^2-1}}$

$\frac{dy}{dx} + \frac{y}{x} = x + \sqrt{x^2-1}$

$I.f = e^{\ln x} = x$

$y.x = \int \left(x + \sqrt{x^2-1}\right)x\, dx$

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

Given $y(1) = 1$

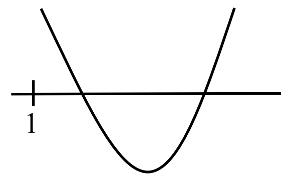
$1 = \frac{1}{2} + C \Rightarrow C = \frac{1}{2}$

$\left[y\left(\sqrt{5}\right)\right] = \left[\frac{\sqrt{5}}{2} + \frac{8}{3} + \frac{1}{2\sqrt{5}}\right] = 3$

21. Consider e_1 and e_2 be roots of the equal $x^2–ax+2=0$ set of exhaustive values of 'a' for which e_1 and e_2 are eccentricities of hyperbolas then $a \in [\alpha, \beta)$ and set of values of 'a' for which e_1 and e_2 are eccentricity of the parabola and ellipse is (γ, ∞) then $(\alpha^2 + \beta^2 + \gamma^2)$ equal :

Ans. (26)

Sol.



$f(x) = x^2 - ax + 2$

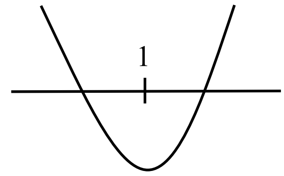
$f(1) = 3–a > 0 \Rightarrow a < 3$

$-\frac{b}{2a} > 1 \Rightarrow \frac{a}{2} > 1 \Rightarrow a > 2$

$D \ge 0 \Rightarrow a^2 - 8 \ge 0$

$a \in (-\infty, -2\sqrt{2}] \cup [2\sqrt{2}, \infty)$

$a \in [2\sqrt{2}, 3)$



$f(1) < 0$

$3 - a < 0$

$a \in (3, \infty)$

$\alpha = 2\sqrt{2},\ \beta = 3,\ \gamma = 3$

$\alpha^2 + \beta^2 + \gamma^2 = 8 + 9 + 9 = 26$

22. Given vectors

$\vec{a} = \hat{i} + \hat{j} + \hat{k}$ & $\vec{b} = \hat{j} - \hat{k}$. Another vector $\vec{c}$ satisfy equation $\vec{a}.\vec{c} = 3$ & $\vec{a} \times \vec{c} = \vec{b}$ then find $\vec{a}.(\vec{c} - 2\vec{b})$

Ans. (3)

Sol. $\vec{a} \times (\vec{a} \times \vec{c}) = \vec{a} \times \vec{b}$ -

$3\vec{a} - 3\vec{c} = \vec{a} \times \vec{b}$

$$\vec{c} = \frac{3\vec{a} - \vec{a} \times \vec{b}}{3}$$

$$\vec{a}.\left(\frac{3\vec{a} - \vec{a} \times \vec{b}}{3} - 2\vec{b}\right)$$

$\Rightarrow |\vec{a}|^2 - 2\vec{a}.\vec{b} = 3 - 2(0) = 3$

23. Given that quadratic equation $(k^2 - 15k + 27)\ x^2 + 9(k-1) + 18 = 0$ has one root twice of other. Then find length of latus rectum of parabola $y^2 = 6kx$

Ans. (12)

Sol. $(k^2 - 15k + 27)\ x^2 + 9\ (k - 1)\ x + 18 = 0 \begin{matrix} \nearrow \alpha \\ \searrow 2\alpha \end{matrix}$

$$\alpha + 2\alpha = -\frac{9(k-1)}{k^2 - 15k + 27} \Rightarrow \alpha = \frac{-3(k-1)}{k^2 - 15k + 27}$$

$$\alpha(2\alpha) = \frac{18}{k^2 - 15k + 27}$$

$$\Rightarrow 2\alpha^2 = \frac{18}{k^2 - 15k + 27} \Rightarrow \frac{2 \cdot 9(k-1)^2}{(k^2 - 15k + 27)^2} = \frac{18}{(k^2 - 15k + 27)}$$

$\Rightarrow (k-1)^2 = k^2 - 15k + 27 \Rightarrow k = 2$

$LR = 6k = 12$