(HELD ON SATURDAY 04th APRIL 2026) **TIME : 9:00 AM TO 12:00 NOON**

MATHEMATICS | TEST PAPER WITH SOLUTION

SECTION-A

1. Let $[\cdot]$ denote the greatest integer function. If the domain of the function $f(x) = \cos^{-1}\left(\frac{4x+2[x]}{3}\right)$ is $[\alpha, \beta]$, then $12(\alpha+\beta)$ is equal to :

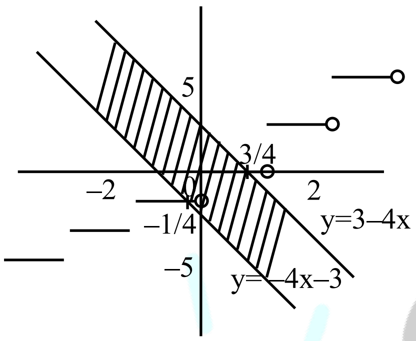
(1) 6 (2) 8

(3) 9 (4) 4

Ans. **(1)**

Sol. $-1 \le \frac{4x+2[x]}{3} \le 1$

$-3-4x \le 2[x] \le 3-4x$



$x \in \left[\frac{-1}{4}, \frac{3}{4}\right]$

$12(\alpha+\beta) = 6$

2. If the set of all solutions of $|x^2+x-9| = |x| + |x^2-9|$ is $[\alpha, \beta] \cup [\gamma, \infty)$, then $(\alpha^2+\beta^2+\gamma^2)$ is equal to :

(1) 9 (2) 18

(3) 36 (4) 72

Ans. **(2)**

Sol. $|a| + |b| = |a+b|$

$\Rightarrow a \cdot b \ge 0$

$\Rightarrow x(x^2-9) \ge 0$

$x \in [-3, 0] \cup [3, \infty]$

$\alpha^2+\beta^2+\gamma^2 = 18$

3. Let z be a complex number such that $|z+2| = |z-2|$ and $\arg\left(\frac{z+3}{z-i}\right) = \frac{\pi}{4}$. Then $|z|^2$ is equal to :

(1) 9 (2) 4

(3) 5 (4) 1

Ans. **(1)**

Sol. $|z+2| = |z-2|$

$\Rightarrow z = 0 + iy \qquad y \in R$

$\arg\left(\frac{3+iy}{iy-i}\right) = \frac{\pi}{4}$

$\Rightarrow \arg\left(\frac{y}{y-1} + \frac{3i}{1-y}\right) = \frac{\pi}{4}$

$\Rightarrow \frac{y}{y-1} = \frac{3}{1-y} > 0$

$\Rightarrow z = -3i$

$|z|^2 = 9$

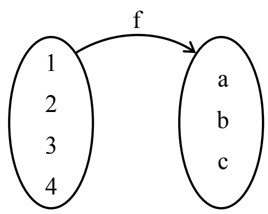
4. The number of functions $f : \{1, 2, 3, 4\} \to \{a, b, c\}$, which are not onto, is :

(1) 48 (2) 45

(3) 51 (4) 35

Ans. **(2)**

Sol.



No. of into function

$= {}^3C_1\, 2^4 - {}^3C_2\, 1 + 0$

$= 3 \times 16 - 3 \times 1$

$= 45$

5. Let

$S=\left\{A=\begin{bmatrix} a & b \\ c & d \end{bmatrix} : a,b,c,d \in \{0,1,2,3,4\} \text{ and } A^2-4A+3I=0\right\}$

be a set of 2 × 2 matrices. Then the number of matrices in S, for which the sum of the diagonal elements is equal to 4, is:

(1) 20 (2) 17

(3) 21 (4) 19

Ans. **(4)**

Sol. a, b, c, d ∈ {0, 1, 2, 3, 4}

$a + d = 4$ $ad - bc = 3$

Case-I $a = 0$ $d = 4$

$0 - bc = 3$

No solution

Case-II $a = 1$ $d = 3$

$3 - bc = 3$

$bc = 0$ ⇒ 9 ways

Case-III $a = 2$ $d = 2$

$4 - bc = 3$

$bc = 1$ ⇒ 1 ways

Case-IV $a = 3$ $d = 1$

$bc = 0$ ⇒ 9 way

Case-V $a = 4$ $d = 0$ ⇒No Solution

Total 19 matrix

6. Let $A=\begin{bmatrix} 1 & 1 & 2 \\ -2 & 0 & 1 \\ 1 & 3 & 5 \end{bmatrix}$. Then the sum of all elements of the matrix $\text{adj}(\text{adj}\,(2(\text{adj}A)^{-1}))$ is equal to :

(1) 3 (2) 4

(3) –4 (4) –3

Ans. **(4)**

Sol. $|A| = -4$

As $(\text{adj}A)^{-1} = \frac{A}{|A|} = \frac{-A}{4}$

$B = 2(\text{adj}A)^{-1} = \frac{-A}{2}$

$|B| = \left|\frac{-A}{2}\right|$

$= \frac{-1}{8}|A| = \frac{1}{2}$

$\text{adj}(\text{adj}B) = |B|^{n-2}B = |B|B$

$= \frac{B}{2} = \frac{-A}{4}$

Sum of element $= \frac{-12}{4} = -3$

7. The first term of an A.P. of 30 non-negative terms is $\frac{10}{3}$. If the sum of this A.P. is the cube of its last term, then its common difference is :

(1) $\frac{5}{87}$ (2) $\frac{25}{83}$

(3) $\frac{15}{29}$ (4) $\frac{5}{29}$

Ans. **(1)**

Sol. $a = \frac{10}{3} : S_{30} = (T_{30})^3$

$\frac{30}{2}\left[2\times\frac{10}{3}+29d\right] = \left[\frac{10}{3}+29d\right]^3$

$15\left(\frac{20}{3}+29d\right) = \left(\frac{10}{3}+29d\right)^3$

$15\left(\frac{10}{3}+\frac{10}{3}+29d\right) = \left(\frac{10}{3}+29d\right)^3$

By observation $\frac{10}{3}+29d = 5$

$29d = 5 - \frac{10}{3} = \frac{5}{3}$

$d = \frac{5}{87}$

8. The number of ways, of forming a queue of 4 boys and 3 girls such that all the girls are not together, is:

(1) 5040 (2) 3050

(3) 3410 (4) 4320

Ans. **(4)**

Sol. No. of ways to arrange 7 students = 7!

Cases where all girls are together

$B_1B_2B_3B_4\ \boxed{G_1G_2G_3} = 5!\ 3!$

Ans. = 7! – 5!3!

= 7! – 6!

= 6 × 6!

= 6 × 720

= 4320

9. Let the smallest value of $k \in \mathbb{N}$, for which the coefficient of x^3 in $(1 + x)^3 + (1 + x)^4 + (1 + x)^5 + \ldots + (1 + x)^{99} + (1 + kx)^{100}$, $x \neq 0$, is $\left(43n + \frac{101}{4}\right)\left({}^{100}C_3\right)$ for some $n \in \mathbb{N}$, be p. Then the value of $p + n$ is:

(1) 10 (2) 11

(3) 12 (4) 13

Ans. **(2)**

Sol. $${}^{3}C_3 + {}^{4}C_3 + {}^{5}C_3 + \ldots + {}^{99}C_3 + {}^{100}C_3K^3 = \left(43n + \frac{101}{4}\right){}^{100}C_3$$

$$\Rightarrow {}^{4}C_4 + {}^{4}C_3 + {}^{5}C_3 + \ldots + {}^{99}C_3 + {}^{100}C_3K^3 = \left(43n + \frac{101}{4}\right){}^{100}C_3$$

$$= {}^{100}C_4 + {}^{100}C_3K^3 = \left(43n + \frac{101}{4}\right){}^{100}C_3$$

$$\frac{{}^{100}C_4}{{}^{100}C_3} + K^3 = 43n + \frac{101}{4}$$

$$\frac{97}{4} + K^3 = 43n + \frac{101}{4}$$

$K^3 = 43n + 1$

$n = 5$

$K^3 = 216$

$K = 6 = P$

$P + n = 11$

10. Suppose that the mean and median of the non-negative numbers 21, 8, 17, a, 51, 103, b, 13, 67, (a > b), are 40 and 21, respectively. If the mean deviation about the median is 26, then 2a is equal to :

(1) 109 (2) 117

(3) 161 (4) 131

Ans. **(4)**

Sol. 8, 13, b, 17, 21, 51, a, 67, 103

$$\text{mean} = 40 = \frac{280 + a + b}{9}$$

$a + b = 80$

mean deviation about median

$$= \frac{13 + 8 + 4 + 30 + 46 + 82 + (a - 21) + (21 - b)}{9} = 26$$

$a - b = 51$

$\Rightarrow 2a = 131$

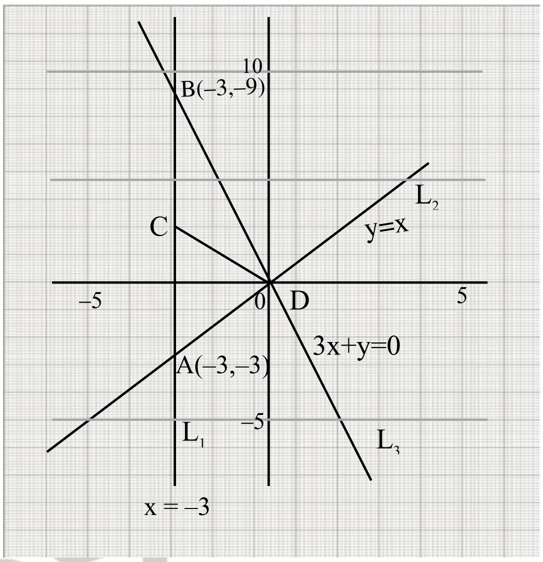
11. Let the line L_1 : $x + 3 = 0$ intersect the lines L_2 : $x - y = 0$ and L_3 : $3x + y = 0$ at the points A and B, respectively. Let the bisector of the obtuse angle between the lines L_2 and L_3 intersect the line L_1 at the point C. Then $BC^2 : AC^2$ is equal to :

(1) 5 : 1 (2) 1 : 5

(3) 2 : 3 (4) 3 : 2

Ans. **(1)**

Sol.



$$\frac{BC^2}{AC^2} = \left(\frac{OB}{OA}\right)^2 = \frac{9 + 81}{9 + 9}$$

$= 5$

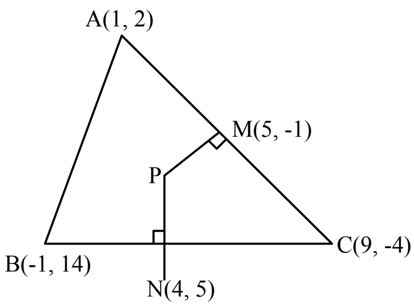
12. Let the vertex A of a triangle ABC be (1, 2), and the mid-point of the side AB be (5, –1). If the centroid of this triangle is (3, 4) and its circumcenter is (α, β), then $21(\alpha + \beta)$ is equal to:

(1) 309 (2) 403

(3) 497 (4) 524

Ans. **(3)**

Sol.



equation of PM : $4x - 3y = 23$

equation of PM : $5x - 9y = -25$

$P\left(\frac{94}{7}, \frac{215}{21}\right)$

$21(\alpha + \beta) = 497$

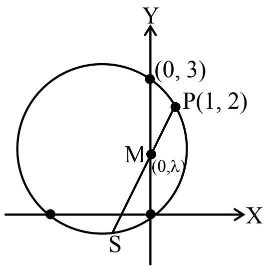
13. Suppose the two chords, drawn from the point (1, 2) on the circle $x^2 + y^2 + x - 3y = 0$ are bisected by the y-axis. If the other ends of these chords are R and S, and the mid point of the line segment RS is (α, β), then $6(\alpha + \beta)$ is equal to :

(1) 1 (2) 3

(3) 4 (4) 6

Ans. (2)

Sol.



chord PS bisected by y –axis

at point $M(0, \lambda)$

$\therefore S(-1, 2\lambda - 2)$

Which satisfy equation of circle

$\Rightarrow (-1)^2 + (2\lambda - 2)^2 - 1 - 3(2\lambda - 2) = 0$

$\Rightarrow \lambda = 1 \quad \& \quad \lambda = \dfrac{5}{2}$

Therefore two such chord PS & PR will exist

When $\lambda = 1 \quad \Rightarrow S(-1, 0)$

When $\lambda = \dfrac{5}{2} \qquad R(-1,3)$

$\therefore$ Mid point of R & S will be $\left(-1, \dfrac{3}{2}\right)$

$\therefore \alpha = -1, \; \beta = \dfrac{3}{2}$

$\therefore 6(\alpha + \beta) = 3$

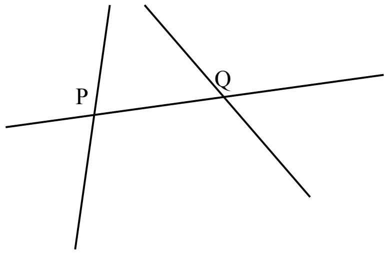
14. A line with direction ratios 1, –1, 2 intersects the lines $\dfrac{x}{2} = \dfrac{y}{3} = \dfrac{z+1}{3}$ and $\dfrac{x+1}{-1} = \dfrac{y-2}{1} = \dfrac{z}{4}$ at the points P and Q, respectively. If the length of the line segment PQ is α, then $225\alpha^2$ is equal to:

(1) 1024 (2) 1014

(3) 1104 (4) 1204

Ans. (2)

Sol.



$P(2\lambda, 3\lambda, 3\lambda - 1)$ and $Q(-\mu - 1, \mu + 2, 4\mu)$

D.R of PQ $2\lambda + \mu + 1, 3\lambda - \mu - 2, 3\lambda - 4\mu - 1$,

$$\frac{2\lambda + \mu + 1}{1} = \frac{3\lambda - \mu - 2}{-1} = \frac{3\lambda - 4\mu - 1}{2}$$

Solving $\lambda = \dfrac{1}{5}$ and $\mu = \dfrac{-8}{15}$

$$P\left(\frac{2}{5}, \frac{3}{5}, \frac{-2}{5}\right) \& Q\left(\frac{-7}{15}, \frac{22}{15}, \frac{-32}{15}\right)$$

$$PQ^2 = \left(\frac{13}{15}\right)^2 + \left(\frac{13}{15}\right)^2 + \left(\frac{26}{15}\right)^2$$

$$\alpha^2 = \frac{1014}{225} \quad \therefore 225\alpha^2 = 1014$$

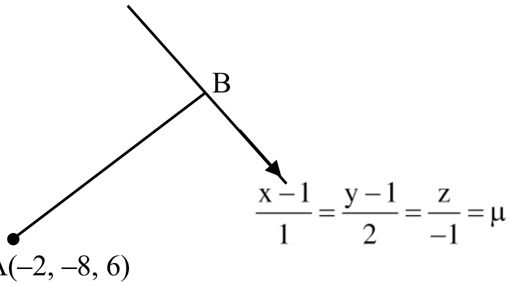
15. The square of the distance of the point (–2, –8, 6) from the line $\dfrac{x-1}{1} = \dfrac{y-1}{2} = \dfrac{z}{-1}$ along the line $\dfrac{x+5}{1} = \dfrac{y+5}{-1} = \dfrac{z}{2}$ is equal to:

(1) 3 (2) 6

(3) 8 (4) 12

Ans. (2)

Sol.



DR or AB is 1, –1, 2

$\therefore$ Line AB is $\dfrac{x+2}{1} = \dfrac{y+8}{-1} = \dfrac{z-6}{2} = \lambda$

B is $(\lambda-2, -\lambda-8, 2\lambda+6)$

B is $(\mu+1, 2\mu+1, -\mu)$

Solving point B is (–3, –7, 4)

$AB = \sqrt{(-1)^2 + (1)^2 + (2)^2} = \sqrt{6}$

$AB^2 = 6$

16. If $y = \tan^{-1}\left(\frac{3\cos x - 4\sin x}{4\cos x + 3\sin x}\right) + 2\tan^{-1}\left(\frac{x}{1+\sqrt{1-x^2}}\right)$,

then $\frac{dy}{dx}$ at $x = \frac{\sqrt{3}}{2}$ is equal to :

(1) 3 (2) –1

(3) 1 (4) 2

Ans. **(3)**

Sol. $y = \tan^{-1}\left(\frac{\frac{3}{4} - \tan x}{1 + \frac{3}{4}\tan x}\right) + 2\tan^{-1}\left(\frac{x}{1+\sqrt{1-x^2}}\right)$

For $2\tan^{-1}\left(\frac{x}{1+\sqrt{1-x^2}}\right)$

put $x = \sin\theta$

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

Hence

$y = \tan^{-1}\left(\frac{3}{4}\right) - \tan^{-1}(\tan x) + \sin^{-1}x$

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

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

$\frac{dy}{dx} = -1 + 2 = 1$

17. Let f be a real polynomial of degree n such that $f(x) = f'(x)\,f''(x)$, for all $x \in \mathbb{R}$. If $f(0) = 0$, then 36 $\left(f'(2) + f''(2) + \int_0^2 f(x)dx\right)$ is equal to :

(1) 42 (2) 46

(3) 56 (4) 66

Ans. **(3)**

Sol. Let degree of polynomial be 'n'

$n = n - 1 + n - 2 \Rightarrow n = 3$

$f(x) = ax^3 + bx^2 + cx$

$(ax^3 + bx^2 + cx) = (3ax^2 + 2bx + c)(6ax + 2b)$

$x^3 : a = 18a^2 \Rightarrow a = \frac{1}{18}$

$x^2 : b = 6ab + 12ab$

$x : c = 4b^2 + 6ac \Rightarrow \frac{2C}{3} = 4b^2 \Rightarrow b^2 = \frac{c}{6}$

const : $bc = 0 \Rightarrow b = c = 0$

$\int_0^2 f(x)dx + f'(2) + f''(2)$

$\int_0^2 ax^3dx + 12a + 12a = 4a + 24a = 28a = \frac{28}{18} = \frac{14}{9}$

$36\left(\frac{14}{9}\right) = 56$

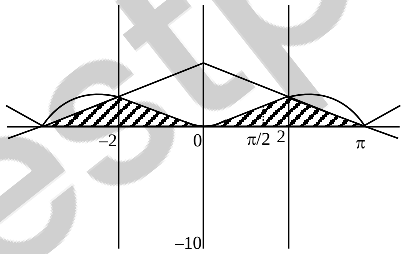
18. The area of the region $\{(x,y): y \le \pi - |x|,\ y \le |x \sin x|,\ y \ge 0\}$ is :

(1) $1 + \frac{\pi^2}{8}$ (2) $2 + \frac{\pi^2}{4}$

(3) $\frac{\pi^2}{8} - 1$ (4) $4 + \frac{\pi^2}{2}$

Ans. **(2)**

Sol.



Area ; $2\left(\int_0^{\pi/2} x\sin x\,dx + \int_{\pi/2}^{\pi}(\pi - x)dx\right)$

$= 2(-x\cos x + \sin x)_0^{\pi/2} + 2\left(\left.\frac{(\pi-x)^2}{2}\right|_{\pi}^{\pi/2}\right)$

$= 2 + \frac{\pi^2}{4}$

19. Let $\int_{-2}^{2}(|\sin x| + [x\sin x])dx = 2(3 - \cos 2) + \beta$, where [·] is the greatest integer function . Then $\beta \sin\left(\frac{\beta}{2}\right)$ equals.

(1) 1 (2) 2

(3) 4 (4) 8

Ans. **(2)**

Sol. $\int_{-2}^{2}(|\sin x|+[x\sin x])dx$

$\Rightarrow 2\int_{0}^{2}(|\sin x|+[x\sin x])dx$

$\Rightarrow 2\left[\int_{0}^{2}\sin x dx+\int_{0}^{2}[x\sin x]dx\right]$

$2\left([-\cos x]_0^2+\int_0^{\alpha}0dx+\int_{\alpha}^{2}2dx\right)$

2(3 – cos2 – 2 – α)

2 (3 –cos2) – 2α

where α is Root of x sinx = 1

Now comparing β = –2α

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

$$-\frac{\beta}{2}\sin\left(\frac{-\beta}{2}\right)=1$$

$$\beta\sin\left(\frac{\beta}{2}\right)=2$$

20. Let y = y(x) be the solution of the differential equation $\frac{dy}{dx}=(1+x+x^2)(1-y+y^2)$, $y(0)=\frac{1}{2}$. Then (2y(1)–1) is equal to

(1) $\sqrt{3}\tan\left(\frac{11\sqrt{3}}{6}\right)$ (2) $\frac{\sqrt{3}}{2}\tan\left(\frac{11\sqrt{3}}{12}\right)$

(3) $\sqrt{3}\tan\left(\frac{11\sqrt{3}}{12}\right)$ (4) $\frac{\sqrt{3}}{2}\tan\left(\frac{11\sqrt{3}}{6}\right)$

Ans. **(3)**

Ans. $\frac{dy}{y^2-y+1}=(x^2+x+1)dx$

$$\frac{dy}{\left(y-\frac{1}{2}\right)^2+\left(\frac{\sqrt{3}}{2}\right)^2}=(x^2+x+1)dx$$

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

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

$$y(0)=\frac{1}{2}\Rightarrow 0=0+0+0+C\Rightarrow C=0$$

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

put x = 1

$$\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2y-1}{\sqrt{3}}\right)=\frac{1}{3}+\frac{1}{2}+1=\frac{2+3+6}{6}=\frac{11}{6}$$

$$\tan^{-1}\left(\frac{2y-1}{\sqrt{3}}\right)=\frac{11\sqrt{3}}{12}$$

$$\frac{2y-1}{\sqrt{3}}=\tan\left(\frac{11\sqrt{3}}{12}\right)$$

$$\Rightarrow 2y(1)-1=\sqrt{3}\tan\left(\frac{11\sqrt{3}}{12}\right)$$

SECTION-B

21. A coin is tossed 8 times. If the probability that exactly 4 heads appear in the first six tosses and exactly 3 heads appear in the last five tosses is p, then 96p is equal to _______.

Ans. **(9)**

Sol. $x_1x_2x_3x_4x_5x_6x_7x_8$

Exactly 4 heads in first six Tosses.

$(x_1x_2x_3x_4x_5x_6)$

Exactly 3 heads in last 5 Tosses.

i.e. $(x_4\ x_5\ x_6\ x_7\ x_8)$

Common tosses $(x_4x_5x_6)$

Let k be number of heads on $(x_4x_5x_6)$

k = 1 ∴ ways to overlap = $^3C_1$

$^3C_3\times{}^3C_1\times{}^2C_2=3$ ways

k = 2

$^3C_2\times{}^3C_2\times{}^2C_1=18$

k = 3

$^3C_1\times 1=3$

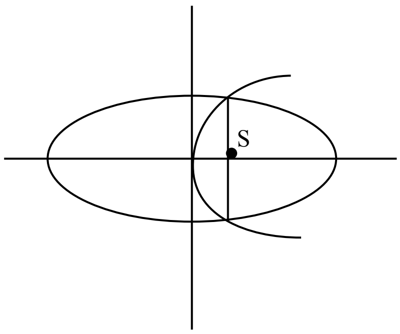
Total ways $24\left(\frac{1}{2}\right)^8$

$$96\times\frac{24}{28}=\frac{6\times 24}{16}=9$$

22. Consider the parabola P : $y^2 = 4kx$ and the ellipse E : $\frac{x^2}{a^2}+\frac{y^2}{b^2} = 1$. Let the line segment joining the points of intersection of P and E, be their latus rectums. If the eccentricity of E is e, then $e^2 + 2\sqrt{2}$ is equal to ______.

Ans. (3)

Sol.



Focus of parabola (k, 0)
Focus of Ellipse (ae, 0)
k = ae ....(1)

Also $4k = 2\frac{b^2}{a}$ ....(2)

$4ae = \frac{2b^2}{a}$

$\Rightarrow 4a^2e = 2b^2$

$4a^2e = 2a^2(1 - e^2)$

$2e = 1 - e^2$

$e^2 + 2e + 1 = 2$

$(e + 1)^2 = 2$

$e + 1 = \sqrt{2} \ \therefore\ e = \sqrt{2} - 1$

$e^2 + 2\sqrt{2} = 3$

23. If $A = \frac{\sin 3^\circ}{\cos 9^\circ}+\frac{\sin 9^\circ}{\cos 27^\circ}+\frac{\sin 27^\circ}{\cos 81^\circ}$ and B = tan81° – tan3°, then $\frac{B}{A}$ is equal to ______.

Ans. (2)

Sol. Consider $E = \frac{\sin\theta}{\cos 3\theta} \Rightarrow E = \frac{2\sin\theta\cos\theta}{2\cos 3\theta\cos\theta}$

$\Rightarrow E = \frac{\sin 2\theta}{2\cos 3\theta\cos\theta} \Rightarrow E = \frac{\sin(3\theta-\theta)}{2\cos 3\theta\cos\theta}$

$\Rightarrow E = \frac{1}{2}[\tan 3\theta - \tan\theta]$

$A = \frac{1}{2}[\tan 9^\circ - \tan 3^\circ + \tan 27^\circ - \tan 9^\circ + \tan 81^\circ - \tan 27^\circ]$

$\therefore A = \frac{1}{2}[\tan 81^\circ - \tan 3^\circ]$

$\therefore \frac{B}{A} = 2$

24. Let $\vec{a}_k = (\tan\theta_k)\hat{i} + \hat{j}$ and $\vec{b}_k = \hat{i} - (\cos\theta_k)\hat{j}$, where $\theta_k = \frac{2^{k-1}\pi}{2^n+1}$, for some $n \in \mathbb{N}$, n > 5. Then the value of $\frac{\sum_{k=1}^{n}|\vec{a}_k|^2}{\sum_{k=1}^{n}|\vec{b}_k|^2}$ is ______.

Ans. (3)

Sol. $|a_k|^2 = 1 + \tan^2\theta_k = \sec^2\theta_k$

$|b_k|^2 = 1 + \cot^2\theta_k = \text{cosec}^2\theta_k$

Since, $\cot\theta - \tan\theta = 2\cot 2\theta$

$\therefore -\text{cosec}^2\theta - \sec^2\theta = -4\,\text{cosec}^2 2\theta$

$\sec^2\theta = 4\text{cosec}^2 2\theta - \text{cosec}^2\theta$

$\Sigma \sec^2\theta_k = 4\Sigma\,\text{cosec}^2 2\theta_k - \Sigma\,\text{cosec}^2\theta_k$

Now

$\Sigma\,\text{cosec}^2 2\theta_k = \Sigma\,\text{cosec}^2\theta_k$

since

$\sum_{k=1}^{n}\text{cosec}^2\frac{2^k\pi}{2^n+1} = \sum_{k=1}^{n}\text{cosec}^2\frac{2^{k-1}\pi}{2^n+1}$

because $\text{cosec}\frac{2^n\pi}{2^n+1} = \text{cosec}\frac{\pi}{2^n+1}$

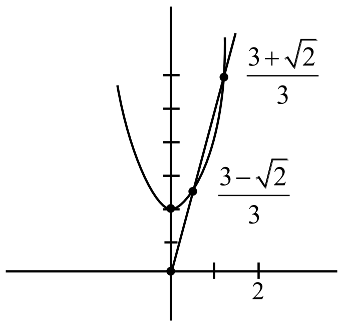
$\therefore \Sigma\sec^2\theta_k = 3\Sigma\,\text{cosec}^2\theta_k$

$\frac{\sum \sec^2\theta_k}{\sum \text{cosec}^2\theta_k} = 3$

25. The number of points, at which the fucntion $f(x) = \max\{6x, 2 + 3x^2\} + |x - 1|\cos\left|x^2 - \frac{1}{4}\right|, x \in (-\pi, \pi)$, is not differentiable, is _____.

Ans. (3)

Sol. $2 + 3x^2 = 6x \Rightarrow 3x^2 - 6x + 2 = 0$



$x = \frac{6\pm\sqrt{12}}{6} = \frac{3\pm\sqrt{2}}{3}$

$|x-1|\cos\left|x^2 - \frac{1}{4}\right|$ is differentiable at x = 1

Total number of points where $f(x)$ is non-Differentiable is 3

(HELD ON SATURDAY 04th APRIL 2026) **TIME : 9:00 AM TO 12:00 NOON**

PHYSICS	TEST PAPER WITH SOLUTION

SECTION-A

26. In a screw gauge when the circular scale is given five complete rotations it moves linearly by 2.5 mm. If the circular scale has 100 divisions, the least count of screw gauge is ___________ mm.

(1) 1×10^{-2}

(2) 1×10^{-3}

(3) 5×10^{-2}

(4) 5×10^{-3}

Ans. (4)

Sol. Pitch $\Rightarrow \dfrac{2.5\text{mm}}{5} = 0.5\text{mm} = 5\times10^{-4}\text{m}$

$$\text{L.C.} \Rightarrow \frac{\text{Pitch}}{\text{No. of divisions}} = \frac{5\times10^{-4}}{100}\text{m}$$

$= 5 \times 10^{-6}$ m

$= 5 \times 10^{-3}$ mm

27. The increase in the pressure required to decrease the volume (ΔV) of water is 6.3×10^7 N/m^2. The percentage decrease in the volume is _________.

(Bulk modulus of water = 2.1×10^9 N/m^2.)

(1) 2 % (2) 3 %

(3) 6 % (4) 4 %

Ans. (2)

Sol. Bulk modulus $\beta = \dfrac{-\Delta P}{\left(\dfrac{\Delta V}{V}\right)}$

$$100\times\frac{\Delta V}{V} = \frac{-\Delta P}{\beta}\times100 = -\frac{6.3\times10^7}{2.1\times10^9}\times100 = -3\%$$

Percentage decrease = 3%

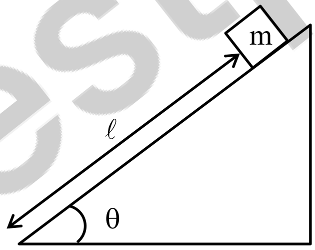
28. The time taken by a block of mass m to slide down from the highest point to the lowest point on a rough inclined plane is 50 % more compared to the time taken by the same block on identical inclined smooth plane. Both inclined planes are at 45° with the horizontal. The coefficient of kinetic friction between the rough inclined surface and block is _______.

(1) 3/4 (2) 2/3

(3) 5/9 (4) 4/9

Ans. (3)

Sol.



For Rough incline plane

$a = g(\sin\theta - \mu\cos\theta)$

$$t_1 = \sqrt{\frac{2\ell}{g(\sin\theta-\mu\cos\theta)}}$$

For smooth incline plane

$$t_2 = \sqrt{\frac{2\ell}{g\sin\theta}} \quad \& \ t_1 = 1.5t_2$$

$$\sqrt{\frac{2\ell}{g(\sin\theta-\mu\cos\theta)}} = \frac{3}{2}\times\sqrt{\frac{2\ell}{g\sin\theta}}$$

$$(\sin\theta-\mu\cos\theta) = \frac{4}{9}\sin\theta$$

$$\frac{5}{9}\sin\theta = \mu\cos\theta \Rightarrow \frac{5}{9}\tan\theta$$

$$\mu = \frac{5}{9}\tan45^\circ = \frac{5}{9}$$

29. Two nuclei of mass number 3 combine with another nucleus of mass number 4 to yield a nucleus of mass number 10. If the binding energy per nucleon for the mass number 3, 4 and 10 are 5.6 MeV, 7.4 MeV and 6.1 MeV, respectively, then in the process, ΔMc^2 = ______ MeV.

(1) 6.9 (2) 7.9

(3) 2.2 (4) 4.3

Ans. **(3)**

Sol. $\Delta mc^2 = [2 \times 3 \times 5.6 + 4 \times (7.4) - 6.1 \times 10]$

$= 2.2$ MeV

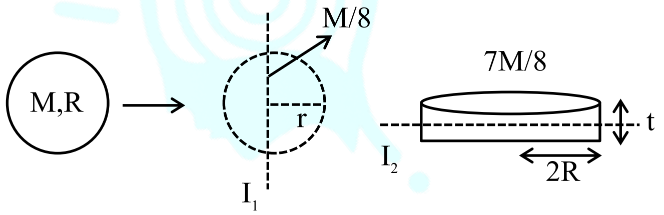
30. A solid sphere of mas M and radius R is divided into two unequal parts. The smaller part having mass M/8 is converted into a sphere of radius r and the larger part is converted into a circular disc of thickness t and radius 2R. If I_1 is moment of inertia of a sphere having radius r about an axis through its centre and I_2 is the moment of inertia of a disc about its diameter, the ratio of their moment of inertia I_2/I_1 = _______.

(1) 35 (2) 70

(3) 140 (4) 210

Ans. **(2)**

Sol.



$$I_1 = \frac{2}{5}\left(\frac{M}{8}\right)r^2$$

$$I_2 = \frac{\frac{7M}{8}\times(2R)^2}{4}$$

$$M = \rho \times \frac{4\pi}{3} \times R^3$$

$$\frac{M}{8} = \rho \times \frac{4\pi}{3} \times |r|^3$$

$$r = \frac{R}{2}$$

$$\frac{I_1}{I_2} = \frac{\frac{2}{5}\left(\frac{M}{8}\right)\left(\frac{R}{2}\right)^2}{\frac{7M}{8\times 4}\times(2R)^2} = \frac{2}{5}\times\frac{1}{4\times 7} = \frac{1}{70}$$

$$\frac{I_2}{I_1} = \frac{70}{1}$$

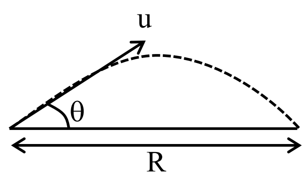
31. The two projectiles are projected with the same initial velocities at the 15° and 30° with respect to the horizontal. The ratio of their ranges is 1 : x. The value of x is

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

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

Ans. **(2)**

Sol.



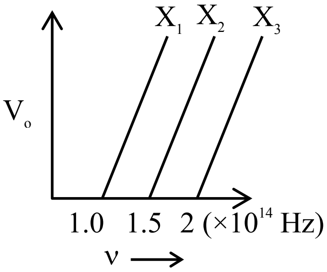
$$R_1 = \frac{u^2 \sin 2\times 15°}{g}$$

$$R_2 = \frac{u^2 \sin 2\times 30°}{g}$$

$$\frac{R_1}{R_2} = \frac{\sin 30°}{\sin 60°} = \frac{1}{\sqrt{3}} = \frac{1}{x}$$

$$x = \sqrt{3}$$

32. The graph shows variation of stopping potential V_o with the frequency ν of the incident radiation for three photosensitive metals X_1, X_2 and X_3. Which metal will give out electrons with greater kinetic energy, for the same wavelength of incident radiation?



(1) X_1

(2) X_2

(3) X_3

(4) All the metals will give out photo electrons with same kinetic energies.

Ans. (1)

Sol. $h\nu = \phi + ev_0$

$$v_0 = \frac{h\nu}{e} - \frac{\phi}{e} \Rightarrow 0 \Rightarrow \frac{h\nu}{e} = \frac{\phi}{e}$$

$$\left\langle \begin{matrix} \phi_1 : \phi_2 : \phi_3 \\ \nu_1 : \nu_2 : \nu_3 \\ 1 : 1.5 : 2 \end{matrix} \right\rangle$$

As metal (1) having minimum value of work function

So x_1 will having maximum kinetic energy

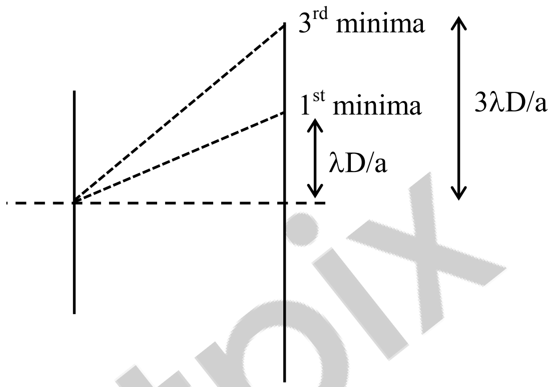
33. A slit of width a is illuminated by light of wavelength λ. The linear separation between 1st and 3rd minima in the diffraction pattern produced on a screen placed at a distance D from the slit system is __________.

(1) $\frac{D\lambda}{a}$ (2) $1.5\frac{D\lambda}{a}$

(3) $2\frac{D\lambda}{a}$ (4) $3\frac{D\lambda}{a}$

Ans. (3)

Sol.



Separation between 3rd & 1st minima

$= \frac{2D\lambda}{a}$

34. A string A of length 0.314 m of Young's modulus 2×10^{10} N/m^2 is connected to another string B of length and Young's modulus both twice of those of A. This series combination of strings is then suspended from a rigid support and its free end is fixed to a load of mass 0.8 kg. The net change in length of the combination is _______ mm.

(radius of both the strings is 0.2 mm and acceleration due to gravity = 10 m/s^2)

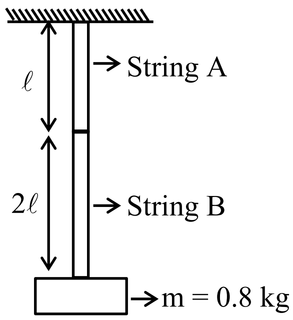
(Mass of both strings is to be neglected as compared to the mass of load)

(1) 3 (2) 2

(3) 1.9 (4) 1

Ans. (2)

Sol.



$\Delta \ell \Rightarrow \Delta \ell_1 + \Delta \ell_2$

$$\Rightarrow \frac{mg\ell}{AY} + \frac{mg(2\ell)}{A(2Y)} = \frac{2mg\ell}{AY}$$

$$= \frac{2 \times 0.8 \times 10 \times (0.314)}{3.14 \times (2 \times 10^{-4})^2 \times 2 \times 10^{10}} = 2 \text{ mm}$$

35. One gas of n_1 mole of molecules at temperature T_1, volume V_1, and pressure P_1, and another gas of n_2 mole of molecules at temperature T_2, volume V_2, and pressure P_2, are mixed resulting in pressure P and volume V of the mixture. The temperature of the mixture is ________.

(1) $(T_1 + T_2)/2$

(2) $T_1 T_2 PV/(T_2 P_1 V_1 + T_1 P_2 V_2)$

(3) $(T_2 P_1 V_1 + T_1 P_2 V_2)(T_1 T_2 PV)$

(4) $|T_1 - T_2|/2$

Ans. **(2)**

Sol. $n = n_1 + n_2$

$\therefore PV = nRT \qquad \Rightarrow n = \frac{PV}{RT}$

$$\frac{P(V)}{T_{Final}} = \frac{P_1 V_1}{T_1} + \frac{P_2 V_2}{T_2}$$

$$\frac{PV}{R\,T_f} = \frac{P_1 V_1}{R T_1} + \frac{P_2 V_2}{R T_2}$$

$$T_f = \frac{PV}{P_1 V_1 / T_1 + P_2 V_2 / T_2}$$

36. An ideal gas undergoes a process maintaining relation between pressure (P) and volume (V) as $P = P_o\left(1 + \left(\frac{V_o}{V}\right)^2\right)^{-1}$, where P_o and V_o are constants. If two samples A and B (two moles each) with initial volume V_o and $3V_o$ respectively undergo above mentioned process and attain same pressure, then the difference at the temperatures of these samples, $T_B - T_A$ is _______

(R = gas constant)

(1) $\frac{9P_oV_o}{8R}$ (2) $\frac{11P_oV_o}{10R}$

(3) $\frac{7P_oV_o}{6R}$ (4) $\frac{13P_oV_o}{11R}$

Ans. **(2)**

Sol. For $V = V_0$, $P = \frac{P_0}{2}$

$$\frac{P_0}{2} \times V_0 = 2 \times R\,T_A$$

$$T_A = \frac{P_0 V_0}{4R}$$

for $V = 3V_0 \qquad P = \frac{9P_0}{10}$

$$\frac{9P_0}{10} \times 3V_0 = 2 \times RT_B$$

$$T_B = \frac{27P_0V_0}{20R}$$

So, $T_B - T_A$

$$= \frac{11P_0V_0}{10R}$$

37. A voltmeter with internal resistance of x Ω can be used to measure upto 20 V. In order to increase its measuring range to 30 V, the required modification is to ________.

(1) connect resistor of $\frac{x}{2}\Omega$, in series with voltmeter.

(2) connect resistor of $\frac{x}{2}\Omega$, in parallel to voltmeter.

(3) connect resistor of x Ω, in series with voltmeter.

(4) connect resistor of 2x Ω, in parallel to voltmeter.

Ans. **(1)**

Sol. Since maximum current through voltmeter remains same

So, $\frac{20}{x} = \frac{30}{x+R}$

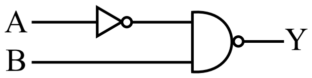
$20x + 20R = 30x$

$20R = 10\,x$

$R = \frac{x}{2}$

This extra resistance must be connected in series.

38. Two 4 bits binary numbers, A = 1101 and B = 1010 are given in the inputs of a logic circuit shown in figure below. The output (Y) will be :



(1) Y = 1101 (2) Y = 0010

(3) Y = 0111 (4) Y = 1000

Ans. **(1)**

Sol. $Y = \overline{A.\overline{B}} = A + \overline{B}$

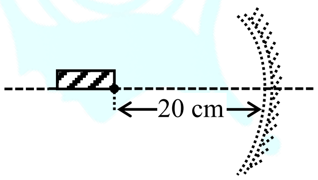
A = 1101

B = 1010

$\overline{B} = 0101$

$A + \overline{B} = 1101$

39. A rod of length 10 cm lies along the principle axis of a concave mirror of focal length 10 cm as shown in figure. The length of the image is ________ cm.



(1) 2.5 (2) 5

(3) 7.5 (4) 7

Ans. **(2)**

Sol. For A $\quad u = -20$ cm, $f = -10$ cm

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \quad \therefore v = \frac{u \times f}{u - f} = -20\text{cm}$

For B $\quad u = -30$ cm, $f = -10$ cm

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

$v = \frac{uf}{u-f} = -15\text{cm}$

Length of image = 20 – 15 = 5 cm

40. A parallel plate air capacitor is connected to a battery. The plates are pulled apart at uniform speed v. If x is the separation between the plates at any instant, then the time rate of change of electrostatic energy of the capacitor is proportional to x^{α}, where α is _______.

(1) –2 (2) 1

(3) –1 (4) 2

Ans. **(1)**

Sol. Capacitance = $C = \frac{\varepsilon_0 A}{x}$

Energy stored = $U = \frac{1}{2}Cv^2$

$U = \frac{1}{2}\frac{\varepsilon_0 A}{x}v^2$

$\frac{dU}{dt} = \frac{1}{2}\varepsilon_0 A v^2\left(-\frac{1}{x^2}\right)\frac{dx}{dt}$

$\frac{dU}{dt} \propto \frac{1}{x^2}$

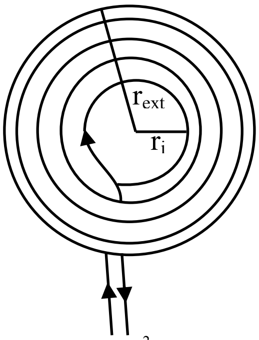
41. An insulated wire is wound so that it forms a flat coil with N = 200 turns. The radius of the innermost turn is r_1 = 3 cm, and of the outermost turn r_2 = 6 cm. If 20 mA current flow in it then the magnetic moment will be $\alpha \times 10^{-2}$ A.m^2. The value of α is _______.

(1) 4.4 (2) 2.64

(3) 3.25 (4) 1.2

Ans. **(2)**

Sol.



$dM = (dI)\pi r^2 = (IdN)\pi r^2$

$$M = \int_i^f I\left(\frac{N}{r_{ex} - r_i}\right)dr\,\pi r^2$$

$$M = \frac{I\pi N}{r_{ex} - r_i}\left[\frac{r^3}{3}\right]_{ri}^{r_{ex}}$$

$$M = \frac{I\pi N}{3(r_{ex} - r_{in})}(r_{ex}^{\ 3} - r_i^{\ 3})$$

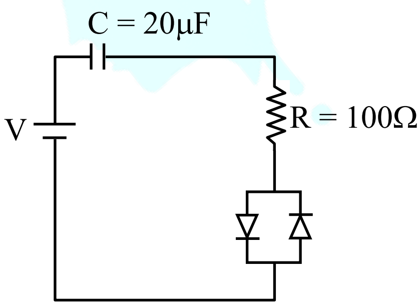
$$M = \frac{20\times10^{-3}\times3.14\times200[6^3 - 3^3]10^{-6}}{3[3]\times10^{-2}}$$

$$M = \frac{2373.84\times10^{-6}}{9\times10^{-2}}$$

$M = 263.76 \times 10^{-4}$

$M = 2.64 \times 10^{-2}\ Am^2$

42. Consider a circuit consisting of a capacitor (20 μF), resistor (100 Ω) and two identical diodes as shown in figure. The resistance of diode under forward biasing condition is 10 Ω. The time constant of the circuit is $\alpha \times 10^{-3}$ s. The value of α is ______________.



(1) 2.2 (2) 2.0

(3) 2.1 (4) 2.4

Ans. (1)

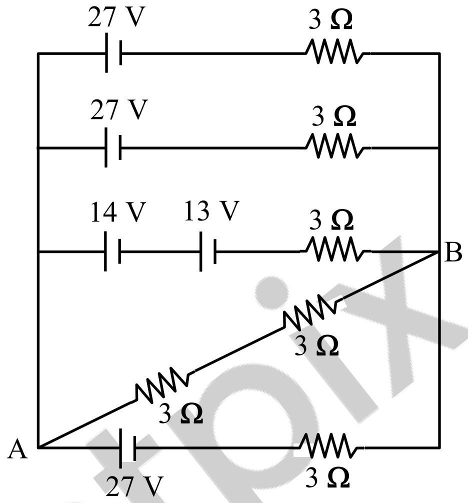
Sol. $\tau = RC$

$\tau = (110) \times 20 \times 10^{-6}$ sec

$\tau = 2200 \times 10^{-6}$ sec

$\tau = 2.2 \times 10^{-3}$ sec

43. The voltage and the current between A and B points shown in the circuit are ________.

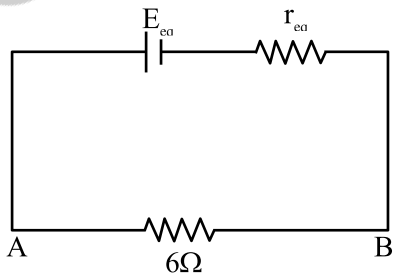


(1) 24 V, 12 A (2) 24 V, 4 A

(3) 18 V, 12 A (4) 27 V, 4 A

Ans. (2)

Sol. This circuit can be



Here : $$E_{eq} = \frac{\frac{27}{3}+\frac{27}{3}+\frac{27}{3}+\frac{27}{3}}{\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{3}}$$

$E_{eq} = 27$ V

$r_{eq} = \frac{3}{4}\Omega$

$$i_{AB} = \frac{27}{6+\frac{3}{4}} = 4A$$

$V_{AB} = 4 \times 6 = 24$ Volt

44. A telescope with objective diameter R is used to observe a distant star emitting light of wavelength 500 nm, at a resolution of 5×10^{-7} radian. The value of R is _______ cm.

(1) 61 (2) 122

(3) 244 (4) 305

Ans. **(2)**

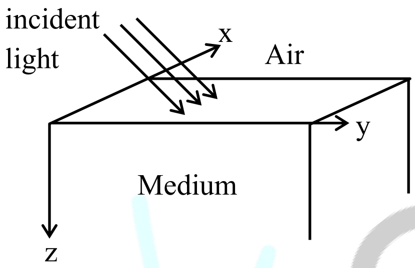
Sol. $\theta = 5 \times 10^{-7}$ radian

$\lambda = 500 \times 10^{-9}$ m

$$\theta = \frac{1.22\lambda}{R}$$

$$R = \frac{1.22\lambda}{\theta} = 1.22\text{m} = 122\text{cm}$$

45. An unpolarized light is incident on the plane interface of air-dielectric medium shown in figure. If the incident angle is equal to Brewster angle, identify the expression representing reflected wave.



(1) $(E_x\hat{i} + E_y\hat{j})\sin(kx - kz - \omega t)$

(2) $(E_x\hat{i} + E_z\hat{k})\sin(kx + ky - \omega t)$

(3) $(E_x\hat{j} + E_y\hat{k})\sin(ky + kz - \omega t)$

(4) $(E_x\hat{i} + E_y\hat{j} + E_z\hat{k})\sin(kx + ky - kz - \omega t)$

Ans. **(1)**

Sol. Is the light is propagating along the positive z-axis and its is reflected from plane then correct phase for reflected light is kx – kz – ωt and for electric field as the light incident on Brewster angle so the reflected light should be perfectly plane polarized that's why polarization direction should be y-axis so electric field of reflected light contain no z-component.

SECTION-B

46. A 1 kg block subjected to two simultaneous forces $(2\hat{i} + 3\hat{j} + 4\hat{k})$ N and $(3\hat{i} - \hat{j} - 2\hat{k})$N is moved a distance of 25 m along $(3\hat{i} - 4\hat{j})$ direction. The work done in this process is ________ J.

Ans. **(35)**

Sol. $\vec{F}_{Net} = 5\hat{i} + 2\hat{j} + 2\hat{k}$

$\vec{S} = 15\hat{i} - 20\hat{j}$

$W = \vec{F}\cdot\vec{S} = 75 - 40 = 35J$

47. The surface tension of a soap solution is 3.5×10^{-2}N/m. The work required to increase the radius of a soap bubble from 1 cm to 2 cm is $\alpha \times 10^{-6}$J. The value of α is ______. (π = 22/7)

Ans. **(264)**

Sol. $\text{W.D.} = 2T\left[4\pi R_2^2 - 4\pi R_1^2\right]$

$= 2 \times 3.5 \times 10^{-2} \times 4 \times \frac{22}{7}\left[2^2 - 1^2\right] \times 10^{-4}$

$= 2 \times 132 \times 10^{-6}$

$= 264 \times 10^{-6}\ J = \alpha \times 10^{-6}\ J$

$\alpha = 264$

48. The velocity of a particle executing simple harmonic motion along x-axis is described as $v^2 = 50 - x^2$, where x represents displacement. If the time period of motion is $\frac{x}{7}$s, the value of x is __________.

Ans. **(44)**

Sol. $V^2 = \omega^2 A^2 - \omega^2 x^2$

Comparing ω = 1

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{1} = 2\pi = \frac{x}{7}$$

$x = 14\pi$

$x = 43.98 \approx 44$

49. A body of mass 2 kg begins to move under the influence of time dependent force $\vec{F} = (2t\hat{i} + 6t^2\hat{j})$ N, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and y-axis respectively. The power produced by the force at t = 2 s is ______ W.

Ans. **(200)**

Sol. $\vec{a} = \frac{\vec{F}}{m} = t\hat{i} + 3t^2\hat{j}$

$\vec{v} = \int_0^2 \vec{a} \cdot dt = \left[\frac{t^2}{2}\hat{i} + \frac{3t^3}{3}\hat{j}\right]_0^2$

$= (2\hat{i} + 8\hat{j})\text{m/s}$

$\vec{F}_{t=2} = (4\hat{i} + 24\hat{j})\text{N}$

$P = \vec{F} \cdot \vec{v} = 8 + 192 = 200\text{W}$

50. An inductor of 10 mH, capacitor of 0.1 μF and a resistor of 100 Ω are connected in series aross an a.c power supply 220 V, 70 Hz. The power factor of the given circuit is 0.5. The difference in the inductive reactance and capacitance reactance is $\sqrt{3}\,\alpha\,\Omega$. The value of α is _______.

Ans. **(100)**

Sol. $\cos\phi = 0.5 = \frac{1}{2}$

$\phi = 60°$

$\tan\phi = \frac{|x_L - x_C|}{R}$

$\tan 60° = \sqrt{3} = \frac{x_L - x_C}{R}$

$|x_L - x_L| = R\sqrt{3} = 100\sqrt{3} = \sqrt{3}\alpha$

$\alpha = 100$

(HELD ON SATURDAY 04th APRIL 2026) **TIME : 9:00 AM TO 12:00 NOON**

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

51. Number of moles and number of molecules in 1.4187 L of SO_2 at STP respectively are

(1) 0.1266; 3.812×10^{22}

(2) 0.0633; 3.812×10^{22}

(3) 0.1266; 7.6238×10^{22}

(4) 0.0633; 7.6238×10^{22}

Ans. (2)

Sol. moles $= \dfrac{\text{V lit}}{22.7\text{ lit}} \Rightarrow \dfrac{1.4187\text{ lit}}{22.7\text{ lit}} \Rightarrow 0.0633$

no. of molecules = moles $\times 6.023 \times 10^{23}$

$\Rightarrow 0.0633 \times 6.032 \times 10^{3}$

$= 3.812 \times 10^{22}$

52. What is the ratio of wave number of first line (lowest energy line) of Balmer series of H atomic spectrum to first line of its Brackett series?

(1) 5:1

(2) 5:0.81

(3) 5:1.75

(4) 5:27

Ans. (2)

Sol. $\bar{V}_1 = R_H(z)^2\left[\dfrac{1}{2^2}-\dfrac{1}{3^2}\right] \Rightarrow$ Ist line of Balmer series

$\bar{V}_2 = R_H(z)^2\left[\dfrac{1}{4^2}-\dfrac{1}{5^2}\right] \Rightarrow$ Ist line of Brackett series

$\dfrac{\bar{V}_1}{\bar{V}_2} = \dfrac{500}{81} \Rightarrow \boxed{5:0.81}$

53. Which of the following is correct set of 4 quantum number of 19th electron in Chromium (Atomic number = 24) in accordance with Aufbau principle?

(1) $n = 3,\ \ell = 2,\ m = +2,\ s = +\dfrac{1}{2}$

(2) $n = 3,\ \ell = 2,\ m = -2,\ s = +\dfrac{1}{2}$

(3) $n = 4,\ \ell = 1,\ m = 0,\ s = +\dfrac{1}{2}$

(4) $n = 4,\ \ell = 0,\ m = 0,\ s = +\dfrac{1}{2}$

Ans. (4)

Sol. Cr $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$

$\Rightarrow$ 19th e^- belongs to 4s subshell

$n = 4\ ;\ \ell = 0\ ;\ m = 0\ ;\ m_s = +\dfrac{1}{2}$ or $-\dfrac{1}{2}$

54. Given below are two statements:

Statement I : For an ideal gas, heat capacity at constant volume is always greater than the heat capacity at constant pressure.

Statement II : In a constant volume process, no work is produced and all the heat withdrawn goes into the chaotic motion and is reflected by a temperature increase of the ideal gas.

In the light of the above statements, choose the ***correct*** answer from the options given below

(1) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false

(4) Statement I is false but Statement II is true

Ans. (4)

Sol. From first law of thermodynamics

$\Delta U = q + w$

constant volume w = 0

$\Delta U = q$

Also $C_P = C_V + R$

C_P = heat capacity at constant pressure

C_V = Heat capacity at constant volume.

R = constant

55. At T(K), the equilibrium constant of

$A_2(g) + B_2(g) \rightleftharpoons C(g)$ is 2.7×10^{-5}.

What is the equilibrium constant for

$\frac{1}{3}A_2(g) + \frac{1}{3}B_2(g) \rightleftharpoons \frac{1}{3}C(g)$ at the same temperature?

(1) $(2.7 \times 10^{-5})^3$ (2) 6×10^{-2}

(3) $\sqrt{2.7 \times 10^{-5}}$ (4) 3×10^{-2}

Ans. **(4)**

Sol. $A_2(g) + B_2(g) \rightleftharpoons (g)\quad K_{eq} = 2.7 \times 10^{-5}$

$\frac{1}{3}A_2(g) + \frac{1}{3}B_e(g) \rightleftharpoons \frac{1}{3}C(g) K^1_{eq} = (K_{eq})^{1/3}$

$K^1_{eq} = (2.7 \times 10^{-5})^{1/3}$

$= 3 \times 10^{-2}$

56. In order to oxidise a mixture of 1 mole each of FeC_2O_4, $Fe_2(C_2O_4)_3$, $FeSO_4$ and $Fe_2(SO_4)_3$ in acidic medium, the number of moles of $KMnO_4$ required is :

(1) 3 (2) 2

(3) 5 (4) 7

Ans. **(2)**

Sol. Meq of KM_nO_4 = meq of FeC_2O_4 + meq of $Fe_2(C_2O_4)$ + meq of $FeSO_4$

moles $\times 5 = 1 \times 3 + 1 \times 6 + 1 \times 1$

moles $= \frac{10}{5} = 2$

57. Consider the first order reaction $R \rightarrow P$.

The fraction of molecules decomposed in the given first order reaction can be expressed as

(1) $1 - e^{k_1 t}$ (2) $1 + e^{k_1 t}$

(3) $1 + e^{-k_1 t}$ (4) $1 - e^{-k_1 t}$

Ans. **(4)**

Sol. I^{st} order of $R\mu^H$

$a - x = ae^{-K_1 t}$

$\frac{x}{a} = 1 - e^{-K_1 t}$

58. A monoatomic anion (A^-) has 45 neutrons and 36 electrons. Atomic mass, group in the periodic table and physical state at room temperature of the element (A) respectively are :

(1) 80, 17, liquid (2) 81, 16, solid

(3) 80, 16, gas (4) 81, 15, gas

Ans. **(1)**

Sol. X = Br ; Atomic mass = 80

Period 4

Br_2 exist as liquid.

59. Given below are two statements :

Statement I : The covalency of oxygen is generally two but it can exceed upto four. The oxidation state of oxygen in SO_2 is –2 and in OF_2 it is +2.

Statement II : The anomalous behaviour of oxygen when compared to the other elements of group 16 is due to its small size and high electronegativity .

In the light of the above statements, choose the ***correct*** answer from the options given below :

(1) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false

(4) Statement I is false but Statement II is true

Ans. **(1)**

Sol. Oxygen can have covalency 4

In SO_2 ; O.S. of O = –2

In OF_2 ; O.S. of O = +2

Anamolous behaviour of oxygen is due to high EN and small size.

60. The **correct** statements among the following are,

A. Mo(VI) and W(VI) are less stable than Cr(VI).

B. Ce^{4+} and Tb^{4+} are oxidant while Eu^{2+} and Yb^{2+} are reductant.

C. Cm and Am have seven unpaired electrons.

D. Actinoid contraction is greater from element to element than lanthanoid contraction.

Choose the correct answer from the options given below :

(1) A and B Only (2) C and D Only

(3) B and D Only (4) A and C Only

Ans. **(3)**

Sol. (A) Mo(VI) & W(VI) more stable than Cr(VI)

(B) In lanthanoids +3 oxidation state is more stable hance +4 ions act as oxidising agents and +2 ions act as reducing agents.

(C) Cm – [Rn] $5f^7\ 6d^1 7S^2$ = 8 unpaired electrons

Am – [Rn] $5f^7\ 6S^2$ = 7 unpaired electrons

(D) Actinoid contraction is more than lanthanoid contraction

61. **Correct** statements from the following are

A. Potassium dichromate is an oxidising agent and it oxidises $FeSO_4$ to $Fe_2(SO_4)_3$ in acidic medium.

B. Sodium dichromate can be used as primary standard in volumetric estimation.

C. CrO_4^{2-} and $Cr_2O_7^{2-}$ are interconvertible in aqueous solution by varying the pH of the solution.

D. Cr–O–Cr bond angle in $Cr_2O_7^{2-}$ is 126°.

Choose the correct answer from the options given below :

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

(3) A and C only (4) B and D only

Ans. **(2)**

Sol. **(A)** $MnO_4^- + Fe^{+2} + H^+ \longrightarrow Fe^{+3} + Mn^{+2} + H_2O$

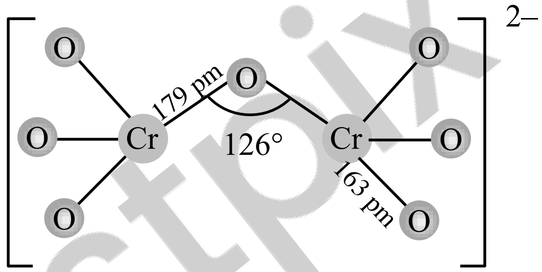
(B) $Na_2Cr_2O_7$ generally not used as a primary standard in volumetric analysis because it is deliquescent.

(C) In acidic medium $Cr_2O_7^{2-}$ exists and it get converted into CrO_4^{2-} in basic medium.

$$2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$$

$$Cr_2O_7^{2-} + 2OH^- \longrightarrow 2CrO_4^{2-} + H_2O$$

(D) $K_2Cr_2O_7$ is a good oxidising agent and bond angle of Cr–O–Cr bond in $Cr_2O_7^{2-}$ is 126°



Dichromate ion

62. Match the **List-I** with **List-II**

List-I Complex ion		List-II Calculated spin only magnetic moment (BM)	
A.	$[Cr(H_2O)_6]^{2+}$	I.	3.87
B.	$[Co(H_2O)_6]^{2+}$	II.	5.92
C.	$[Cu(H_2O)_6]^{2+}$	III.	4.90
D.	$[Mn(H_2O)_6]^{2+}$	IV.	1.73

Choose the ***correct*** answer from the options given below:

(1) A-I, B-III, C-IV, D-II

(2) A-II, B-I, C-III, D-IV

(3) A-IV, B-II, C-I, D-III

(4) A-III, B-I, C-IV, D-II

Ans. **(4)**

Sol. $[Cr(H_2O)_6]^{2+} \rightarrow$ 4 unpaired e^- ; 4.90 BM(III)

$[Co(H_2O)_6]^{2+} \rightarrow$ 0 unpaired e^- ; 3.87 BM(I)

$[Cu(H_2O)_6]^{2+} \rightarrow$ 1 unpaired e^- ; 1.73 BM(IV)

$[Mn(H_2O)_6]^{2+} \rightarrow$ 5 unpaired e^- ; 5.92 BM(II)

63. Increasing order of electron withdrawing power of following functional groups is :

a. –CN

b. –COOH

c. $-NO_2$

d. –I

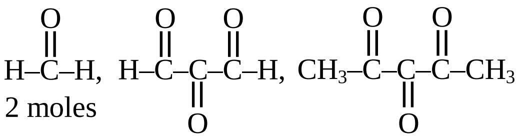
(1) c < b < d < a (2) c < a < b < d

(3) d < b < a < c (4) a < b < c < d

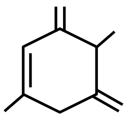
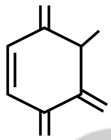
Ans. (3)

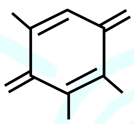
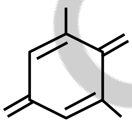
Sol. Theory based

64. An alkene (X) on ozonolysis followed by reduction gives following products.



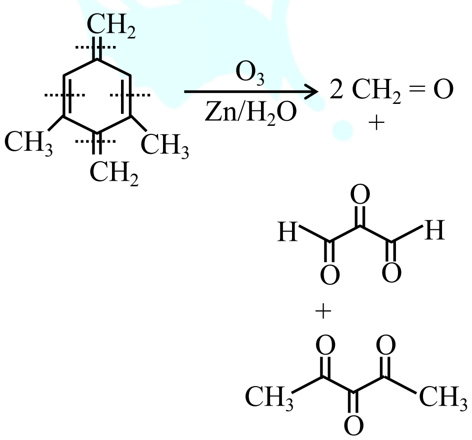
The alkene (X) is :

(1)  (2) 

(3)  (4) 

Ans. (4)

Sol.



65. Match the **List-I** with **List-II**

List_I Name of reaction		List-II Reagent or catalyst used	
A.	Finkelstein reaction	I.	SbF_3
B.	Swarts reaction	II.	Na, dry ether
C.	Sandmeyer's reaction	III.	NaI
D.	Fitting reaction	IV.	Cu_2Cl_2

Choose the ***correct*** answer from the options given below :

(1) A-I, B-IV, C-III, D-III

(2) A-III, B-I, C-IV, D-II

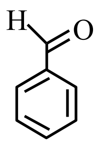
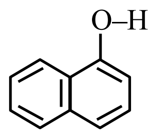
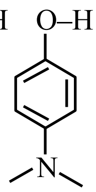
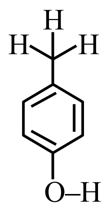
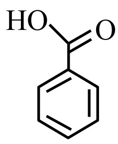
(3) A-IV, B-II, C-I, D-III

(4) A-I, B-III, C-II D-IV

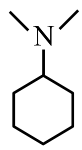
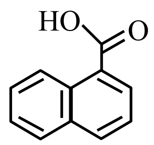
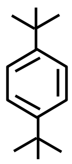
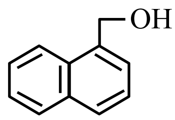
Ans. (2)

Sol. Theory based

66. Amongst the following, the total number of compounds soluble in aqueous NaOH at room temperature is:

(I) (II) (III) (IV) (V)

(VI) (VII) (VIII) (IX)

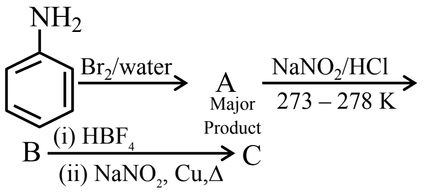
(1) 5 (2) 4 (3) 6 (4) 3

Ans. (1)

Sol. II, III, IV, V, VII

Compounds which are more acidic than H_2O can soluble in NaOH.

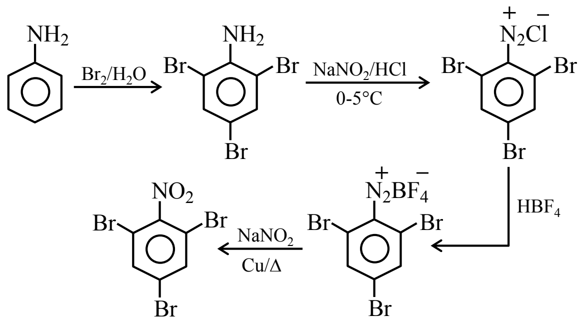
67. Product C of the following reaction sequence will be



(1) 1-Bromo-4-nitrobenzene
(2) 1,3,5-Tribromo-2-nitrobenzene
(3) 4-Bromo-1-nitrobenzene
(4) 1,3,5-Tribromobenzene

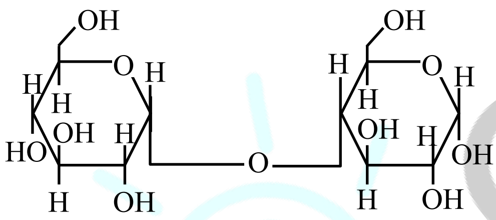
Ans. **(2)**

Sol.



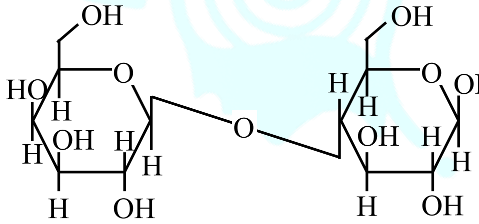
1,3,5-Tribromo -2-nitrobenzene

68. **Statement-I :** The structure of Maltose is given below :



Maltose is a non reducing sugar

Statement-II : The structure of Lactose is given below



Lactose is a reducing sugar

In the light of the above statements, choose the *correct* answer from the options given below

(1) Both Statement I and Statement II are true
(2) Both Statement I and Statement II are false
(3) Statement I is true but Statement II is false
(4) Statement I is false but Statement II is true

Ans. **(4)**

Sol. Maltose and lactose both have hemiacetal linkage. So both are reducing sugars.

69. Match the **LIST-I** with **LIST-II** :

	List-I Name of amino acid		**List-II One letter symbol/type)**
A	Arginine	I.	D / Non-essential
B	Aspartic acid	II.	R / Essential
C	Lysine	III.	E / Non-essential
D	Glutamic acid	IV.	K/Essential

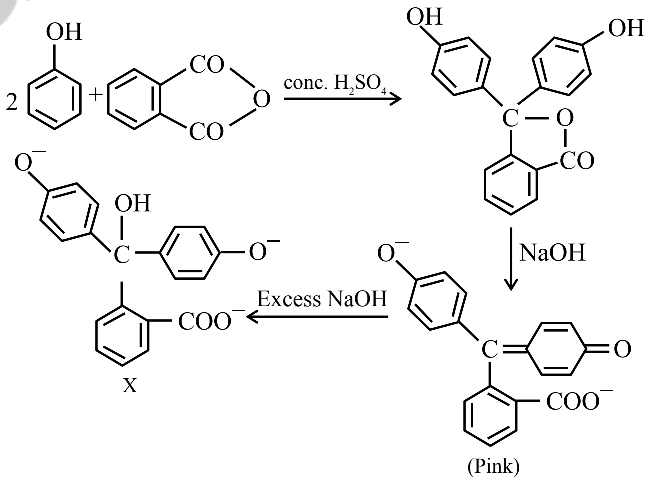
Choose the *correct* answer from the options given below :

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

Ans. **(1)**

Sol. Arginine (R) and Lysine (K) are essential amino acid. Aspartic acid (D) and Glutamic acid (E) are non-essential amino acid.

70. Identify the colour of compound 'X' in the sequence of the reaction.



(1) Violet (2) Green
(3) Red (4) Colourless

Ans. **(4)**

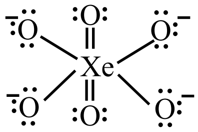
Sol. Phenolphthalein indicator turns colourless in excess NaOH.

SECTION-B

71. According to Lewis theory, the total number of σ bond-pairs and lone pair of electrons around the central atom of XeO_6^{4-} ion is ____.

Ans. **(6)**

Sol.



$\sigma = 6$

Lone pairs = 0

72. Consider the following sequence of reactions to give the major product (X)

 $\xrightarrow[\text{(ii) } Cl_2/FeCl_3 \quad \text{(iii) } K_2Cr_2O_7/H_2SO_4]{\text{(i) } CH_3Cl \text{ / anhydrous } AlCl_3}$ (X) Major Product

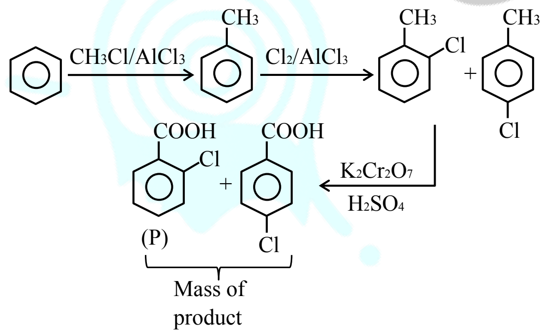
P g of the major product (X) formed is reacted with $NaHCO_3$soluion to liberate a gas which occupied 11.2 dm^3 at STP.

P = ____. g.

(Given molar mass in g mol^{-1} H : 1, C : 12, O : 16, Cl : 35.5)

Ans. **(78)**

Sol.



Moles of P = $\dfrac{11.2}{22.4}$ = 0.5 mole

$M_{C_7H_5O_2Cl}$ = 156.5 gm

$W_{P(C_7H_5O_2Cl)} = \dfrac{156.5}{2} = 78.25 \approx 78 \text{grams}$

73. 2.0 g of a bromo hydrocarbon (X) was subjected to Carius analysis, gave 3.36 g of AgBr. The percentage of carbon in the compound (X) is 26.7%. Total number of carbon atoms in the empirical formula for compound (X) is ____.

(Given molar mass in g mol^{-1} H : 1, C : 12, Br : 80, Ag : 108)

Ans. **(5)**

Sol. $n_{Br} = \dfrac{3.36}{(108+80)}$

r = no. of Br atoms in organic compound

$n_{\text{organic compound}} = \dfrac{3.36}{(108+80)\times x} = \dfrac{2}{M}$

$M = \dfrac{2\times 188\times x}{3.36}$

M = ½ × x

(x is integer)

$W_C = \dfrac{112\times x\times 26.7}{100} = 30 \times x$

$n_C = \dfrac{30\times x}{12} = 2.5 \times x$

take x = 2, $n_C = 5$

(Empirical formula is C_5H_4Br)

74. The pH a solution obtained by mixing 5 mL of 0.1 M NH_4OH solution with 250 mL of 0.1 M NH_4Cl solution is _____ × 10^{-2}. (Nearest integer)

Given : pK_b (NH_4OH) = 4.74

log 2 = 0.30

log 3 = 0.48

log 5 = 0.70

Ans. **(756)**

Sol. On mixing final volume = 255 ml

$[NH_4OH] = \dfrac{5\times 0.1}{255}, [NH_4Cl] = \dfrac{250\times 0.1}{255}$

$p^{OH} = pk_b + \log\dfrac{[NH_4Cl]}{NH_4OH}$

$p^{OH} = 4.74 + \log\dfrac{250\times 0.1}{5\times 0.1}$

$P^H = 14 - P^{OH} = 14 - 6.44$

75. A non-volatile, non-electrolyte solid solute when dissolved in 40 g of a solvent, the vapour pressure of the solvent decreased from 760 mm Hg to 750 mm Hg. If the same solution boils at 320 K, then the number of moles of the solvent present in the solution is _____. (Nearest integer)

[Given : boiling point of the pure solvent = 319.5 K, K_b of the solvent = 0.3 K kg mol^{-1}]

Ans. **(5)**

Sol. $\frac{P° - Ps}{Ps} = \text{i. molality} \times \frac{(\text{M.solvent})}{1000}$

$\Delta T_b = \text{i. } K_b\text{. molality} \Rightarrow \text{molality} = \frac{0.5}{0.3}$

$(\text{Molecular Mass}) = \frac{600}{75}\text{g}$

$\text{Moles} = \frac{40}{600/75} = 5$