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24-Jan-2026_Shift-II_JEE Main-2026_Session-I(Jan)

MATHEMATICS **Max Marks: 100**

SECTION-I
(SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

1. Let the length of the latus rectum of an ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1,(a>b)$, be 30. If its eccentricity is the maximum value of the function $f(t)=-\frac{3}{4}+2t-t^2$, then (a^2+b^2) is equal to

1. 276 2. 256 3. 516 4. 496

Key: 4

Sol: $\frac{2b^2}{a}=30$

$b^2=15a$

max value of $f(t)$ $f(t)=\frac{-3}{4}+2t-t^2$ is 'e'

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

$$=\frac{-3}{4}+1=\frac{1}{4}$$

$e=\frac{1}{4}$

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

$=a^2\left(1-\frac{1}{16}\right)$

$15a=a^2.\frac{15}{16}$

$a=16$

$a^2+b^2=256+240$

$=496$

2. Let a_1, a_2, a_3, a_4 be an A.P. of four terms such that each term of the A.P. and its common difference are integers. If $a_1 + a_2 + a_3 + a_4 = 48$ and $a_1 a_2 a_3 a_4 + l^4 = 361,$ then the largest term of the A.P. is equal to

1. 24 2. 27 3. 23 4. 21

Key: 2

Sol: Given a_1, a_2, a_3, a_4 AP as $a-3d\ a-3d, a-d, a+d, a+d, a+3d$

Given $a_1 + a_2 + a_3 + a_4 = 48$

$4a = 48$

$a = 12$

Given $a_1 a_2 a_3 a_4 + l^4 = 361$

$\left(a^1 - 9d^2\right)\left(a^2 - d^2\right) + l^4 = 361$

$\left(144 - 9d^2\right)\left(144 - d^2\right) + l^4 = 361$

$25d^4 - 1440d^2 + 144^2 = 361$

$\left(5d^2 - 144\right) = 19^2$

$5d^2 - 144 = 19\ \&\ -19$

$d^2 = \frac{163}{5}$ & $\frac{125}{5} = 25$

$d = \frac{\sqrt{163}}{5}$ & $\frac{125}{5} = 25$

$d = \sqrt{\frac{163}{5}}$ & 5

Largest term 12+15=27

3. Let $f(x) = \int \frac{7x^{10} + 9x^8}{\left(1 + x^2 + 2x^9\right)} dx, x > 0,\ \lim_{x \to 0} f(x) = 0 \quad f(1) = \frac{1}{4}$

If $A = \begin{bmatrix} 0 & 0 & 1 \\ \frac{1}{4} & f'(1) & 1 \\ \alpha^2 & 4 & 1 \end{bmatrix}$ and B = adj(adj A) be such that $|B| = 81,$ then α^2 is equal to

1. 3 2. 2 3) 4 4. 1

Key: 3

SOL: $f(x) = \int \frac{7x^{10} + 9x^8}{\left(1 + x^2 + 2x^9\right)^2} dx$

$= \int \frac{7x^{10} + 9x^8}{x^{18}\left(\frac{1}{x^9} + \frac{1}{x^7} + 2\right)^2} dx$

$$= \int \frac{\frac{7}{x^8} + \frac{9}{x^{10}}}{\left(\frac{1}{x^9} + \frac{1}{x^7} + 2\right)^2} dx$$

$$\frac{1}{x^9} + \frac{1}{x^7} + 2 = t$$

$$\left(-\frac{9}{x^{10}} - \frac{7}{x^8}\right) dx = dt$$

$$-\int \frac{dt}{t^2} = \frac{1}{t} + C$$

$$= \frac{1}{\left(\frac{1}{x^9} + \frac{1}{x^7} + 2\right)} + C$$

$$f(x) = \frac{x^9}{1 + x^2 + 2x^9} + C$$

$$f(x) = \frac{1}{4} \qquad \frac{1}{4} = \frac{1}{4} + C$$

$$C = 0$$

$$f(x) = \frac{x^9}{1 + x^2 + 2x^9}$$

$$A = \begin{bmatrix} 0 & 0 & 1 \\ \frac{1}{4} & 1 & 1 \\ \alpha & 4 & 1 \end{bmatrix}$$

$$|A| = 1\left(1 - \alpha^2\right)$$

$$B = adj(adjA$$

$$|B| = |adj(adjA)|$$

$$|B| = |adj(adjA)|$$

$$|B| = |A|^4$$

$$3^4 = \left(1 - \alpha^2\right)^4$$

$$1 - \alpha^2 = \pm 3$$

$$\alpha^2 = 4, -2$$

$$\alpha^2 = 4$$

4. The smallest positive integral value of a, for which all the roots of $x^4 - ax^2 + 9 = 0$ are real and distinct, is equal to

1) 9 2) 3 3) 4 4)7

Key: 4

Sol: $f(x)=x^4-ax^2+9$

$x^2=t$

$g(t)=t^2-at+9$

$g(t)$ roots must be +ve

1) $\Delta>0$

2) $\frac{-b}{2a}>0$

1) $a^2-49>0$

$a^2-36>0$

$a\in(-\infty,-6)\cup(6,\infty)$

2) $\frac{a}{2.1}>0$

$a>0$

5. $\left(\frac{1}{3}+\frac{4}{7}\right)+\left(\frac{1}{3^2}+\frac{1}{3}\times\frac{4}{7}+\frac{4^2}{7^2}\right)+\left(\frac{1}{3^3}+\frac{1}{3^2}\times\frac{4}{7}+\frac{1}{3}\times\frac{4^2}{7^2}+\frac{4^3}{7^3}\right)+\ldots$ upto infinite terms, is equal to

1) $\frac{5}{2}$ 2) $\frac{6}{5}$ 3) $\frac{4}{3}$ 4) $\frac{7}{4}$

Key: 1

Sol: $\left(\frac{1}{3}+\frac{4}{3}\right)+\left(\frac{1}{3^2}+\frac{1}{3}\times\frac{4}{7}+\frac{4^2}{7^2}\right)+\left(\frac{1}{3^2}+\frac{1}{3^2}\times\frac{4}{7}+\frac{1}{3}\times\frac{4^2}{7^2}+\frac{4^3}{7^3}\right)$

$a=\frac{1}{3},b=\frac{4}{7}$

$S=(a+b)+\left(a^2+ab+b^2\right)+\left(a^3+a^2b+ab^2+b^3\right)$

$=\frac{1}{(a-b)}\left[a^2-b^2+a^3-b^3+a^4-b^4+----\infty\right]$

$=\frac{a^2+a^3+---\infty}{a-b}-\frac{b^2+b^3+--\infty}{a-b}=\frac{a^2}{(a-b)(1-a)}-\frac{b^2}{(a-b)(1-b)}$

$=\frac{\frac{1}{9}}{\left(\frac{1}{3}-\frac{4}{7}\right)\left(1-\frac{1}{3}\right)}-\frac{\frac{16}{49}}{\left(\frac{1}{3}-\frac{4}{7}\right)\left(1-\frac{4}{7}\right)}$

6. Let the angles made with the positive x-axis by two straight lines drawn from the point P(2, 3) and meeting the line x +y=6 at distance $\sqrt{\frac{2}{3}}$ from the point P be θ_1 and θ_2. Then the value of $(\theta_1+\theta_2)$ is:

1) $\frac{\pi}{12}$ 2) $\frac{\pi}{6}$ 3) $\frac{\pi}{2}$ 4) $\frac{\pi}{3}$

Key: 3

Sol: $\frac{|5-6|}{\sqrt{2}}=\frac{1}{\sqrt{2}}$

$\Delta PLA,\ \cos\theta=\frac{\frac{1}{\sqrt{2}}}{\frac{\sqrt{2}}{\sqrt{3}}}=\frac{\sqrt{3}}{2}$

$\theta=\frac{\pi}{6}$

$\angle APB=\frac{\pi}{3}$

ΔPAB is an equilatend

$\tan 60^0=\left|\frac{m+1}{1-m}\right|$

$\sqrt{3}=\frac{|m+1|}{|1-m|}$

$3\left(1+m^2-2m\right)=m^2+1+2m$

$2m^2-8m+2=0$

$m^2-4m+1=0$

$m_1+m_2=4$

$m_1m_2=1$

$\tan\left(\theta_1+\theta_2\right)=\frac{m_1+m_2}{1-m_1m_2}$

$\tan\left(\theta_1+\theta_2\right)=\frac{4}{1-1}=\frac{1}{0}$

$\theta_1+\theta_2=\frac{\pi}{2}$

7. Let f be a function suck that $3f\left(x\right)+2f\left(\frac{m}{19x}\right)=5x,\ x\neq 0,$ where $m=\sum_{i=1}^{9}\left(i\right)^2$. Then $f\left(5\right)-f\left(2\right)$ is equal to

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

Key: 2

Sol: Give $3f\left(x\right)+2f\left(\frac{m}{19x}\right)=5x$

Given $m=\sum_{i=1}^{9} i^2 = 1^2+2^2+.....9^2 = \frac{9.10.19}{6} = 19\times 15$

$3f\left(x\right)+2f\left(\frac{15}{x}\right)=5x$

$\left(x\ by\ \frac{15}{x}\right)\ 3f\left(\frac{15}{x}\right)+2f\left(x\right)=\frac{75}{x}$

$9f\left(x\right)+6f\left(\frac{15}{3}\right)=15x$

$6f\left(\frac{15}{x}\right)+4f\left(x\right)=\frac{150}{x}$

$5f\left(x\right)=15x-\frac{150}{x}$

$f\left(x\right)=3x-\frac{30}{x}$

$f\left(5\right)-f\left(2\right)=\left(15-\frac{30}{5}\right)-\left(6-\frac{30}{2}\right)=\left(15-6\right)-\left(6-15\right)=9-9=18$

8. The letters of the word "UDAYPUR" are written in all possible ways with or without meaning and these words are arranged as in a dictionary. The rank of the word "UDAYPUR" is

1) 1579 2) 1580 3) 1581 4) 1578

Key: 2

UDAYPUR

Sol: $A----\frac{6!}{2!}$

$D----\frac{6!}{2!}$

$P----\frac{6!}{2!}$

$R----\frac{6!}{2!}$

$UA------5!$

$UDAP-----3!$

$UDAR-----3!$

$UDAU-----3!$

$UDAYPRU---1$

$UDAYPUR---1$

$4\times\frac{6!}{2!}+5!+3\times 3!+2$

$440+120+18+2=1580$

9. The largest value of n, for which 40^n divides 60!, is

1.14 2. 13 3) 11 4) 12

Key: 1

Sol: $40^n = 2^{3n}5^n$

$E_2(6!) = \left[\frac{60}{2}\right] ..... + \left[\frac{60}{2^5}\right] = 56$

$E_2(60!) = \left[\frac{60}{2}\right] ..... + \left[\frac{60}{2^5}\right] = 14$

$60! = 2^{56}.5^{14} = 2^{14}\left(2^3.5\right)^{14}$

$\therefore$ max value of n is 14

10. Let $a = 2i - 5j + 5k$ and $b = i - j + 3k$. If C isa vector such that $2\left(a \times c\right) + 3\left(b \times c\right) = 0$ $\left(a - b\right).c = -97$, then $\left|c \times k\right|^2$ is equal to

1) 205 2) 218 3) 233 4) 193

Key: 2

Sol: GT $2\left(a \times c\right) + 3\left(b \times c\right) = 0$

$\left(2a + 3b\right) \times 5c = 0$

$\therefore c = \lambda\left(2a + 3b\right)$

$= \lambda\left(7i - 13j + 19k\right)$

$\left(a - b\right).c = -97$ $\therefore C = -7i + 13j + 19k$

$\lambda\left(7 + 52 + 38\right) = -97$ $\therefore \left|c \times k\right|^2 = 218$

11. If the domain of the function $f(x) = \sin^{-1}\left(\frac{1}{x^2 - 2x - 2}\right)$, is $(-\infty, \alpha] \cup [\beta, \gamma] \cup [\delta, \infty)$, then $\alpha + \beta + \gamma + \delta$ is equal to

1) 4 2) 5 3) 3 4) 2

Key: 1

Sol: $-1 \le \frac{1}{x^2 - 2x - 2} \le 1$

$1 + \frac{1}{x^2 - 2x - 2} \ge 0$

$\frac{x^2 - 2x - 1}{x^2 - 2x - 2} \ge 0$

$\frac{\left(x - 1 - \sqrt{2}\right)\left(x - 1 + \sqrt{2}\right)}{\left(x - 1 - \sqrt{3}\right)\left(x - 1 + \sqrt{3}\right)} \ge 0$

$x \in \left(-\infty, 1-\sqrt{3}\right) \cup \left[1-\sqrt{2}, 1+\sqrt{2}\right] \cup \left(1+\sqrt{3}, \infty\right)$

$$\frac{1}{x^2-2x-2}-1 \le 0$$

$$1-\frac{1}{x^2-2x-2} \ge 0$$

$$\frac{x^2-2x-3}{x^2-2x-2} \ge 0$$

$$\frac{(x+1)(x-3)}{\left(x-1-\sqrt{3}\right)\left(x-1+\sqrt{3}\right)} \ge 0$$

$x \in (-\infty, -1] \cup \left(-\sqrt{3}, \sqrt{3}\right) \cup [3, \infty)$

$\therefore$ Domain is $(-\infty, -1] \cup \left[1-\sqrt{2}, 1+\sqrt{2}\right] \cup [3, \therefore \infty)$

$\therefore \alpha+\beta+\gamma+\delta = 4$

12. Let $P = \left[p_{ij}\right]$ and $Q = \left[q_{ij}\right]$ be two square matrices of order 3 such that $q_{ij} = 2^{(i+j-1)}\ p_{ij}$ and $\det(Q) = 2^{10}$ Then the value of $\det\left(adj\left(adjP\right)\right)$ is:

1) 81 2) 124 3) 32 4) 16

Key: 4

Sol: $|Q| = 2^{10} \quad and \quad q_{ij} = 2^{i+j-1}\ p_{ij}$

$$\begin{vmatrix} 2p_{11} & 2^2 p_{12} & 2^3 p_{13} \\ 2^2 p_{21} & 2^3 p_{22} & 2^2 p_{23} \\ 2^3 p_{37} & 2^4 p_{32} & 2^5 p_{33} \end{vmatrix} = 2^{10}$$

$$2^9 \begin{vmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & 2p_{32} & p_{33} \end{vmatrix} = 2^{10}$$

$|p| = 2$

$\left|adj\left(adjp\right)\right| = |p|^{(n-1)^2} = 2^4$

13. Let $a = 2i - j - k$, $b = i + 3j - k$ and $c = 2i + j + 3k$. Let v be the vector in the plane of the vectors a and b, such that the length of its projection on the vector C is $\frac{1}{\sqrt{14}}$. Then $|v|$ is equal to

1) 13 2) $\frac{\sqrt{21}}{2}$ 3) 7 4) $\frac{\sqrt{35}}{2}$

Key: No Option

14. Let the image of parabola $x^2 = 4y$, in the line $x - y = 1$ be $(y + a)^2 = b(x - c)$, $a, b, c \in N$. Then $a + b + c$ is equal to

1) 12 2) 6 3) 8 4) 4

Key: 2

Sol: Let $p(2T, t^2)$ on $x^2 = 4y$

Image p in $x - y = 1$ is $Q(h, k)$

$\therefore h = t^2 + 1,\ k = 2t - 1$

By eliminating t

We get $(k + 1)^2 = 4(h - 1)$

$(y + 1)^2 = 4(x - 1)$

$a = 1,\ b = 4, c = 1$

$a + b + c = 6$

15. Let $X = \{x \in N : 1 \le x \le 19\}$ and for some $a, b \in R, Y = \{ax + b : x \in X\}$. If the mean and variance of the elements of Y are 30 and 750, respectively, then the sum of all possible values of b is

` 1) 100 2) 60 3) 80 4) 20

Key: 2

Sol: For X main $x = 10;\ \sigma^2 = 30$

Variance

For Y main is $ax + b = 30$

$\sigma_1^2 = 750$

$4a^2.30 = 750$

$a = \pm 5$

$\Rightarrow 10a + b = 30$

$\pm 50 + b = 30$

$\therefore b = -20, 80$

Sum $= 80 - 20$
$= 60$

16. Let $f(\alpha)$ denote the area of the region in the first quadrant bounded by $x = 0, x = 1, y^2 = x$ and $y = |ax - 5| - |1 - ax| + ax^2$. Then $(f(0) + f(1))$ is equal to

1) 14 2) 12 3) 7 4) 9

Key: 3

Sol: $f(0) = 4 - \int_0^1 \sqrt{x}\,dx = \frac{10}{3}$

$f(1) = \int_0^1 \{(x^2 + 4) - \sqrt{x}\}\,dx = \frac{11}{3}$

$f(0)+f(1)=\frac{10}{3}+\frac{11}{3}$

17. Let $y=y(x)$ be a differentiable function in the interval $(0,\infty)$ such that $y(1)=2,$ and $\lim\limits_{t\to x}\left(\frac{t^2y(x)-x^2y(t)}{x-t}\right)=3$ for each $x>0$. Then $2y(2)$ is equal to

1) 23 2) 18 3)27 4) 12

Key: 1

Sol: $\lim\limits_{t\to x}\frac{t^2y(x)-x^2y(t)}{x-t}=3$

$\lim\limits_{t\to x}\frac{t^2\frac{dy}{dx}-2xy(t)}{1}=3\Rightarrow x^2\frac{dy}{dx}-2xy=3$

$\frac{dy}{dx}-\frac{2}{x}y=\frac{3}{x^2}$

$I.F=e^{-\int\frac{2}{x}dx}=e^{-2\ln x}=e^{\ln x^{-2}}=\frac{1}{x^2}$

$y.\frac{1}{x^2}=\int\frac{3}{x^4}dx=-\frac{1}{x^3}+C$

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

$y(1)=2,\quad \therefore 2=C-1\Rightarrow C=3$

$\therefore y(x)=3x^2-\frac{1}{x}$

$y(2)=3(4)-\frac{1}{2}=12-\frac{1}{2}=\frac{23}{2}$

$2y(2)=23$

18. Consider the following three statements for the function $f:(0,\infty)\to R$ defined by $f(x)=|\log_e x|-|x-1|$:

(I) f is differentiable at all $x>0$ (II) f is increasing in $(0,1)$.

(III) f is decreasing in $(1,\infty)$.

Then.

1) Only (I) and (III) are TRUE. 2) Only (I) is TRUE.

3) Only (II) and (III) are TRUE. 4) All (I), (II) and (III) are TRUE.

Key: 1

Sol: $f(x)=|\log_e x|-|x-1|+5$

$$f(x)=\begin{cases}\log_e x-(x-1)+5, & x\geq 1\\ -\log_e x+(x-1)+5, & 0<x\leq 1\end{cases}$$

$$f'(x)=\begin{cases}\frac{1}{x}-1, & x\geq 1\\ -\frac{1}{x}+1, & 0<x\leq 1\end{cases}$$

$f'(x)<0$ *for* $\in(1,\infty)$

$f'(x)<0$ *for* $\in(0,1)$

$\therefore$ $f(x)$ is decreasing in $(1,\infty)$ and also in $(0,1)$

$\therefore f(x)$ is differentiable in $(0,\infty)$

19. The sum of all values of α, for which the shortest distance between the lines $\frac{x+1}{\alpha}=\frac{y-2}{-1}=\frac{z-4}{-\alpha}$ *and* $\frac{x}{\alpha}=\frac{y-1}{2}=\frac{z-1}{2\alpha}$ is $\sqrt{2}$, is

1) -8 2) 8 3)-6 4) 6

Key: 3

Sol: $\frac{x+1}{\alpha}=\frac{y-2}{-1}=\frac{z-4}{-\alpha},\ \frac{x}{\alpha}=\frac{y-1}{2}=\frac{z-1}{2\alpha}$

$$SD=\frac{\begin{vmatrix}-1 & 1 & 3\\ \alpha & -1 & -\alpha\\ \alpha & 2 & 2\alpha\end{vmatrix}}{\begin{vmatrix}i & j & k\\ \alpha & -1 & -\alpha\\ \alpha & 2 & 2\alpha\end{vmatrix}}=\sqrt{2}$$

$$\Rightarrow\frac{-1(-2\alpha+2\alpha)+1(-\alpha^2-2\alpha^2)+3(2\alpha+\alpha)}{\left|i(-2\alpha+2\alpha)+j(-\alpha^2-2\alpha^2)+k(2\alpha+\alpha)\right|}=\sqrt{2}$$

$$\Rightarrow(-3\alpha^2+9\alpha)=\sqrt{2}\sqrt{9\alpha^4+9\alpha^2}$$

$$2(9\alpha^4+9\alpha^2)=9\alpha^2(-\alpha+3)^2$$

$$\Rightarrow 2(\alpha^2+1)=\alpha^2-6\alpha+9$$

$$\Rightarrow\alpha^2+6\alpha-7=0$$

$$\Rightarrow(\alpha+7)(\alpha-1)=0$$

$\alpha=-7,1$

Required Sum $=-6$

20. Let [t] denote the greatest integer less than or equal to t. If the function

$$f(x)=\begin{cases} b^2\sin\left(\frac{\pi}{2}\left[\frac{\pi}{2}(\cos x+\sin x)\cos x\right]\right), & x<0 \\ \frac{\sin x-\frac{1}{2}\sin 2x}{x^3}, & x>0 \\ a & x=0 \end{cases}$$

is continuous at $x=0$, then a^2+b^2 is equal to

1) $\frac{3}{4}$ 2) $\frac{9}{16}$ 3) $\frac{1}{2}$ 4) $\frac{5}{8}$

Key: 1

Sol: R.H.L: $\lim\limits_{x\to 0^+} f(x)=\lim\limits_{x\to 0^+}\frac{\sin x-\sin x\cos x}{x^3}$

$\lim\limits_{x\to 0^+}\left(\frac{\sin x}{x}\right)\left(\frac{1-\cos x}{x^2}\right)=\frac{1}{2}$

$\therefore f(0)=a$

L.H.L: $\lim\limits_{x\to 0^-} f(x)=\lim\limits_{x\to 0^-} b^2\sin\frac{\pi}{2}\left[\frac{\pi}{2}(\sin x+\cos x)\cos x\right]=b^2$

Since the function $f(x)$ is continuous at $x=0$ $\therefore$ L.H.L =R.H.L= $f(0)$

$\therefore b^2=a=\frac{1}{2}\Rightarrow a^2+b^2=\frac{1}{4}+\frac{1}{2}=\frac{3}{4}$

SECTION-II
(NUMERICAL VALUE TYPE

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

21. If $f(x)$ satisfies the relation $f(x)=e^x+\int_0^1\left(y+xe^x\right)f(y)dy$, then $e+f(0)$ is equal to

Key: $\overline{2}$

Sol: $f(x)=e^x+\int_0^1\left(y+xe^x\right)f(y)dy$

$=e^x+\int_0^1 yf(y)dy+xe^x\int_0^1 f(y)dy$

$f(x)=e^x+A+Bxe^x$

$$A=\int_0^1 yf(y)dy=\int_0^1 y\left(A+e^y+Bye^y\right)dy$$

$$=\left[A.\frac{y^2}{2}+ye^y-e^y+B\left(y^2e^y-2ye^y+2e^y\right)\right]_0^1$$

$$=\frac{A}{2}+(0-1)+B(e-2)$$

$$A=\frac{A}{2}+B(e-2)-1$$

$$\frac{A}{2}=B(e-2)-1\Rightarrow\frac{A}{2}+B(2-e)=-1$$

$$B=\int_0^1\left(e^y+A+Bye^y\right)dy$$

$$=\left[e^y+Ay+B\left(ye^y-e^y\right)\right]_0^1=e-1+A+B\left(0-(-1)\right)$$

$$B=e-1+A+B$$

$$A=1-e$$

$$f(x)=e^x+A+Bxe^x$$

$$f(0)=1+A\Rightarrow f(0)=1+1-e$$

$$e+f(0)=2$$

22. The number of elements in the set

$\left\{x\in\left[0,180^0\right]:\tan\left(x+100^0\right)=\tan\left(x+50^0\right)\tan x\tan\left(x-50^0\right)\right\}$ is_____

Key: 4

Sol: $\tan\left(x+100\right)=\tan\left(x+50^0\right)\tan x\tan\left(x-50\right)$

$$\Rightarrow\frac{\tan\left(x+100\right)}{\tan x}=\tan\left(x+50\right)\tan\left(x-50\right)$$

$$\Rightarrow\frac{\sin\left(x+100\right)\cos x}{\cos\left(x+100\right)\sin x}=\frac{\sin\left(x+50^0\right)\sin\left(x-50^0\right)}{\cos\left(x+50^0\right)\cos\left(x-50^0\right)}$$

Using Componendo and Dividendo, we get

$$2\sin\left(2x+100\right)\cos 2x+\sin 200=0$$

$$\Rightarrow\sin\left(4x+100\right)+\sin 100^0+\sin\left(200\right)=0$$

$$\Rightarrow\sin\left(4x+100\right)=-2\sin 150\ \sin 50$$

$$\sin\left(4x+100\right)=-\sin\left(50\right)=\sin\left(-50^0\right)$$

$4x+100 = n\pi+(-1)^n(-50)$

$x=\dfrac{n\pi+(-1)^{n+1}50 -100^0}{4}, n\in I$

$x=\dfrac{130}{4},\dfrac{210}{4},\dfrac{490}{4},\dfrac{570}{4}$ in $[0,180]$

Number of solutions =4

23. Let S be a set of 5 elements and P(S) denote the power set of S. Let E be an event of choosing an ordered pair (A, B) from the set P(S) x P(S) such that $A\cap B=\phi$. If the probability of the event E is $\dfrac{3^p}{2^q}$, where $p,q\in N$, then $p+q$ is equal to

Key: 15

Sol: Let $S=\{a,b,c,d,e\}$ The power set $P(S)$ contains $=2^5=32=2^{10}$ elements. An ordered pair (A,B) chosen from $P(S)\times P(S)$. The total number of possible pairs $=32\times 32$

For condition α each element $x\in S$ has exactly three mutually exclusive Possibilities.

i) $x\in A$ and $x\in B$

ii) $x\notin A$ and $x\in B$

iii) $x\notin A$ and $x\notin B$

Number of favourable pairs for the event $E=3^5$

The probability of even E =P(E) $=\dfrac{3^5}{2^{10}}=\dfrac{3^p}{2^q}$,

$\therefore p=5, q=10$

$\therefore p+q=15$

24. Let $z=(1+i)(1+2i)(1+3i).....(1+m)$, where $i=\sqrt{-1}$. If $|z|^2=44200$, then n is equal to __

Key: 5

Sol: $z=(1+i)(1+2i)(1+3i)...(1+ni)$

$|z|=\sqrt{1+1}\sqrt{1+4}\sqrt{1+9}....\sqrt{1+n^2}$

$|z|^2=2.5.10..\sqrt{n^2+1}$ .....(i)

But $|z|^2=44200=2^3.5^2.13.17$ (given) which can be written as

$=2.5.(2.5)(17)(2.13)$

$|z|^2=2.5.10.17.26.....(ii)$

Comparing (i) and (ii) we get $n^2+1=26$

$\therefore\ n=5$

25. Let (h, k) lie on the circle $C: x^2+y^2=4$ and the point $(2h+1, 3k+2)$ lie on an ellipse with eccentricity e. Then the value of $\frac{5}{e^2}$ is equal to

Key: 9

Sol: $x^2+y^2=4$

Let $P=(2\cos\theta, 2\sin\theta)$, where $h=2\cos\theta, k=2\sin\theta$ $Q=(2h+1, 3k+2)$

Coordination of $Q=(4\cos\theta+1, 6\sin\theta+2)$

Locus of Q is $\frac{(x-1)^2}{16}+\frac{(y-2)^2}{36}=1$

$e^2=1-\frac{16}{36}=\frac{5}{9}$

$\frac{5}{e^2}=9$

PHYSICS

Max Marks: 100

SECTION-I
(SINGLE CORRECT ANSWER TYPE)

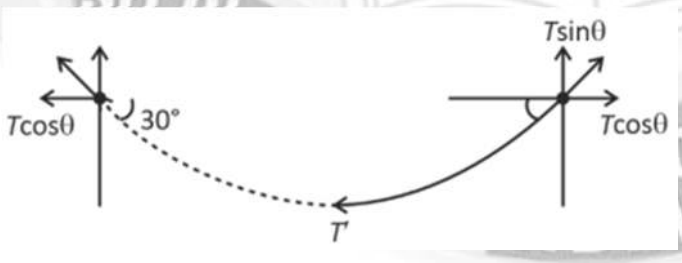
This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

26. A flexible chain of mass m hangs between two fixed points at the same level. The inclination of the chain with the horizontal at the two points of support is 30°. Considering the equilibrium of each half of the chain, the tension of the chain at the lowest point is___

1. $\sqrt{3}mg$ 2. mg 3. $\frac{\sqrt{3}}{2}mg$ 4. $\frac{1}{2}mg$

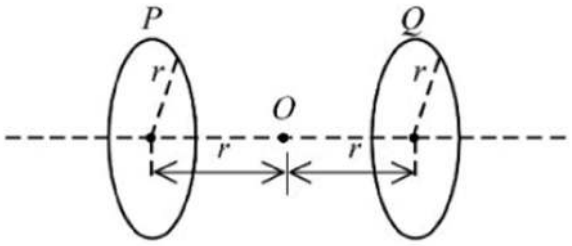
Key: 3



Sol:

$T\frac{\sqrt{3}}{2}=T^1$

$T^1=\frac{mg\sqrt{3}}{2}$

27. 

Two identical circular loops P and Q each of radius r are lying in parallel planes such that they have common axis. The current through P and Q are I and $4I$ respectively in clockwise direction as seen from O. The net magnetic field at O is:

1) $\frac{3\mu_O I}{4\sqrt{2}r}$ towards P 2) $\frac{3\mu_O I}{4\sqrt{2}r}$ towards Q

3) $\frac{\mu_O I}{4\sqrt{2}r}$ towards Q 4) $\frac{\mu_O I}{4\sqrt{2}r}$ towards P

Key: 2

Sol: $B_P = \frac{\mu_o i r^2}{2\left(r^2+x^2\right)3/2} = \frac{\mu_o i}{4\sqrt{2}r}$ toward P

$B_Q = \frac{\mu_o 4 i r^2}{2\left(r^2+x^2\right)3/2} = \frac{\mu_o 4i}{4\sqrt{2}r}$ toward Q

$B_{Net} = \frac{\mu_o 3i}{4\sqrt{2}r}$ toward Q

28. A cubical block of density $\rho_b = 600\text{kg/m}^3$ floats in a liquid of density $\rho_e = 900\text{kg/m}^3$. If the height of block is $H = 8.0\,\text{cm}$ then height of the submerged part is_____ cm.

1) 4.3 2) 5.3 3) 6.3 4) 7.3

Key: 2

Sol: $F_B = mg$

$\rho_e Vig = \rho_o \times V_{total} \times 8$

$\rho_e \times A \times hi = \rho_o \times A \times h_o$

$hi = \frac{\rho_o}{\rho_e} \times h_o = \frac{900}{600} \times 8cm = 5.3cm$

29. In the Young's double slit experiment the intensity produced by each one of the individual slits is I_O. The distance between two slits is $2\,\text{mm}$. The distance of screen from slits is $10\,\text{m}$. The wavelength of light is $6000\,\text{Å}$. The intensity of light on the screen in front of one of the slits is_____.

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

Key: 2

Sol: $I = 4I_o \cos^2 \frac{\Delta\phi}{2}$

$\Delta\phi = \frac{2\pi}{\lambda}\Delta x$

$\Delta x = \frac{dy}{D} = \frac{2mm \times 1mm \times 10^{-6}}{10}$

$\Delta\phi = \frac{2\pi}{3}$

$I = 4I_o \cos^2\left(\frac{2\pi}{3} \times \frac{1}{2}\right) = I_o$

30. The fifth harmonic of a closed organ pipe is found to be in unison with the first harmonic of an open pipe. The ratio of lengths of closed pipe to that of the open pipe is $5/x$. The value of x is_____.

1) 1 2) 3 3) 4 4) 2

Key: 4

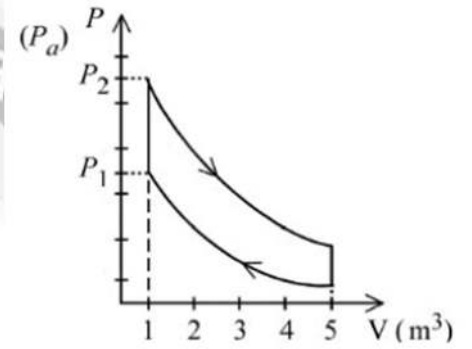
Sol: 5^{th} harmonic in closed $= \frac{5V}{4l_1}$

1^{st} harmonic in open $= \frac{V}{2l_2}$

$\frac{5V}{24l_1} = \frac{V}{xl_2}\frac{l_1}{l_2} = \frac{5}{2}$

$x = 2$

31. 10 mole of an ideal gas is undergoing the process shown in the figure. The heat involved in the process from P_1 to P_2 is α Joule ($P_1 = 21.7\,\text{Pa}$ and $P_2 = 30\,\text{Pa}, C_V = 21\,\text{J/K.mol}, R = 8.3\,\text{J/mol.K}$). The value of α is_____



1) 21 2) 24 3) 28 4) 15

Key: 1

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

$Q = \Delta U$

$$= nC_V \Delta T \times \frac{R}{R} = \frac{C_v}{R}\left[P_2V_2 - P_1V_1\right] = \frac{21}{8-3}\left[30\times 1 - 21.3\times 1\right] = 21$$

32. A point source is kept at the center of a spherically enclosed detector. If the volume of the detector increased by 8 times, the intensity will

1) decrease by 8 times 2) increase by 64 times

3) increase by 8 times 4) decrease by 4 times

Key: 4

Sol: Volume (New) $= \frac{4}{3}\pi r^{13}$

Volume (old) $= \frac{4}{3}\pi r^3$

New $= 8 \times old$

$$\frac{4}{3}\pi r^{13} = 8 \times \frac{4}{3}\pi r^3$$

$$r! = 2r$$

$$\frac{I_{old} = \frac{p}{4\pi r^2}}{I_{new} = \frac{p}{4\pi(2r)^2}}$$

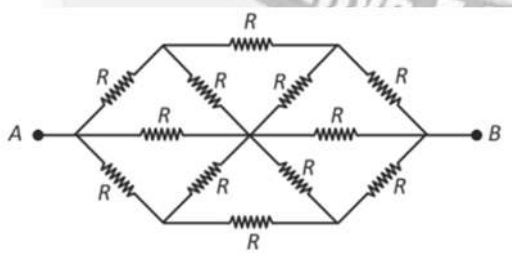
$$\frac{I_{old}}{I_{new}} = 4$$

$$I_{new} = \frac{I_{old}}{4}$$

33. A regular hexagon is formed by six wires each of resistance r Ω and the corners are joined to the centre by wires of same resistance. If the current enters at one corner and leaves at the opposite corner, the equivalent resistance of the hexagon between the two opposite corners will be

1) $\frac{3}{5}r$ 2) $\frac{4}{5}r$ 3) $\frac{3}{4}r$ 4) $\frac{5}{8}r$

Key: 2



Sol:

Resistance b/w A & B

$$R_{AB} = \frac{4r}{5}$$

34. Distance between an object and three times magnified real image is 40 cm. The focal length of the mirror used is_____cm.

1) -10 2) -15 3) -20 4) $-15/2$

Key: 2

Sol: $m=3=\frac{v}{u}=\frac{y}{x}$

$y=3x$

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

$\frac{1}{-y}+\frac{1}{-x}=\frac{1}{f}$

$\frac{1}{-3x}+\frac{1}{-x}=\frac{1}{f}$

$\frac{-4}{3x}=\frac{1}{f}$ $f=\frac{-3x}{4}=\frac{-3}{4}(20)=-15cms$

35. The binding energy for the following nuclear reactions are expressed in MeV.

$2He^3+{}_0n^1\rightarrow {}_2He^4+20MeV$

$2He^4+{}_0n^1\rightarrow {}_2He^5-0.9MeV$

If X_3, X_4, X_5 denote the stability of ${}_2He^3$, ${}_2He^4$, and ${}_2He^5$, respectively, then the correct order is:

1) $X_4<X_5<X_3$ 2) $X_4=X_5=X_3$ 3) $X_4>X_5>X_3$ 4) $X_4>X_5<X_3$

Key: 3

Sol: ${}_2\mu e^3+{}_0n^1\rightarrow {}_2\mu e^4+20Mev$

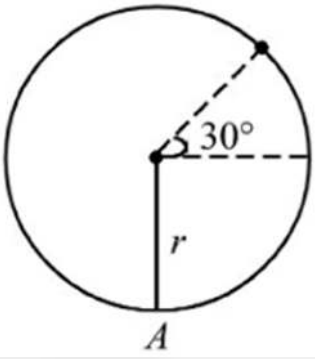
Energy is released, Hence ${}^4_2\mu e$ is more stable than ${}^3_2\mu e$

${}_2\mu e^4+{}_0n^1\rightarrow {}_2\mu e^5-0.9Mev$

Energy is observed< hence ${}^4_2\mu e$ is more stable than ${}^5_2\mu e$ $X_4>X_5>X_3$

${}^5_2\mu e$ is more stable composed to ${}^3_2He$ as more energy is released in first reason than the energy Absorbed in 2 nd reaction.

36. In case of vertical circular motion of a particle by a thread of length r if the tension in the thread is zero at an angle 30 shown in figure, the velocity at the bottom point (A) of the circular path is (g = gravitational acceleration)



1) $\sqrt{\frac{7}{2}gr}$ 2) $\sqrt{\frac{5}{2}gr}$ 3) $\sqrt{4gr}$ 4) $\sqrt{5gr}$

Key: 1

Sol: Let 'u' be the velocity at 'A'

$$T + mg\cos bo = \frac{mv^2}{r}$$

$$T = 0$$

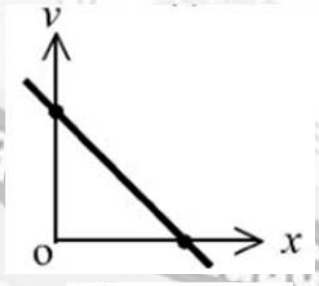
$$V^2 = \frac{rg}{2}$$

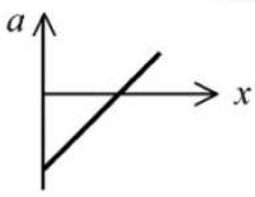
Energy conservation at A & B

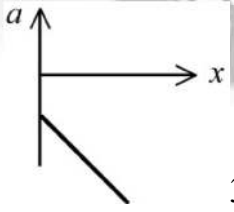
$$\frac{1}{2}mu^2 = mg\left(r + \frac{r}{2}\right) + \frac{1}{2}mv^2$$

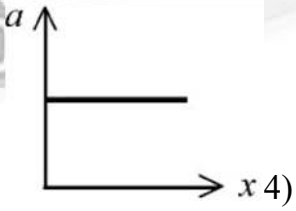
$$u^2 = 3gr + \frac{rg}{2} \qquad u = \sqrt{\frac{7gr}{2}}$$

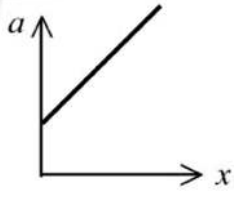
37. The velocity (v) – Distance (x) graph is shown in figure. Which graph represents acceleration (a) versus distance (x) variation of this system?



1) 

2) 

3) 

4) 

Key:

Sol: $v = v_0 - mx$

$$a=(v)\left(\frac{dv}{dx}\right)$$
$$=(v_0-mx)(-m)$$
$$=-mv_0+m^2x$$

38. In a vernier callipers, 50 vernier scale divisions are equal to 48 main scale divisions. If one main scale division $=0.05$ mm, then the least count of the vernier callipers is_____ mm.

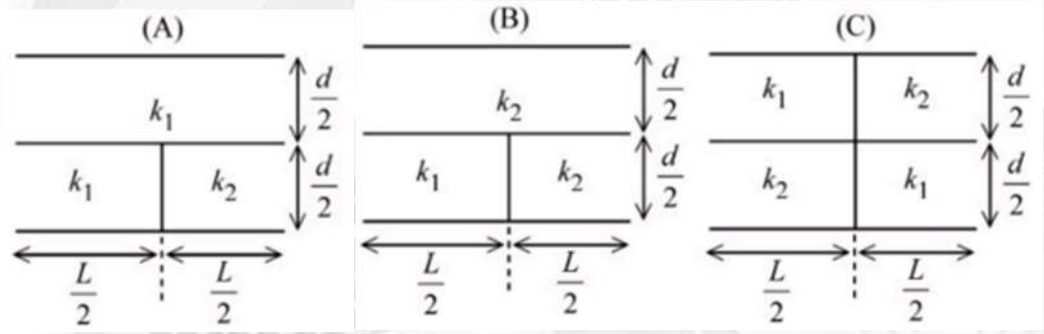
1) 0.02 2) 0.002 3) 0.005 4) 0.05

Key: 2

Sol: $50VSD=48MSD$

$$L.C=1MSD-1VSD$$
$$=1MSD-\frac{48}{50}MSD=\frac{2}{50}MSD=\frac{2}{50}\times 0.05mm=0.002mm$$

39. Three parallel plate capacitors each with area A and separation d are filled with two dielectric $(k_1 \text{ and } k_2)$ in the following fashion. Which of the following is true? $(k_1>k_2)$



1) $C_B>C_C>C_A$ 2) $C_C>C_B>C_A$ 3) $C_C>C_A>C_B$ 4) $C_A>C_C>C_B$

Key: 4

Sol: Ceq (A) $=\left(\frac{k_1}{2}+\frac{k_1k_2}{k_1+k_2}\right)\frac{\in oA}{d}$

Ceq(B) $=\left(\frac{k_2}{2}+\frac{k_1k_2}{k_1+k_2}\right)\frac{\in_o A}{d}$

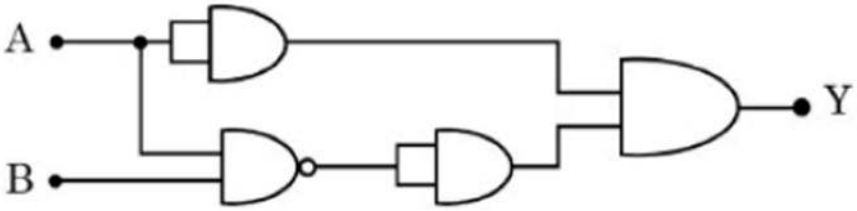
Ceq(C) $=\left(\frac{2k_1k_2}{k_1+k_2}\right)\frac{\in oA}{d}$

$$k_1>k_2$$

By substituting values for k_1 & k_2

$$C_A>C_C>C_B$$

40. Identify the correct truth table of the given logic circuit.



1)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

2)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

3)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	0

4)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

Key: 3

Sol: $Y=\left(\overline{AB}\right)A=\left(\overline{A}+\overline{B}\right)A=0+A.\overline{B}$

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	0

41. A moving coil galvanometer of resistance 100Ω shows a full scale deflection for a current of 1mA. The value of resistance required to convert this galvanometer into an ammeter, showing full scale deflection for a current of 5mA, is_____Ω

1) 10 2) 0.5 3) 2.5 4) 25

Key: 4

Sol: Shunt resistance required is

$$S=\frac{G}{\frac{new\,range}{old\,range}}-1=\frac{100}{\frac{5}{1}-1}=\frac{100}{4}$$

$$S=25\Omega$$

42. Five persons P_1, P_2, P_3, P_4 and P_5 recorded object distance (u) and image distance (v) using same convex lens having power $+5D$ as $(25,96),(30,62),(35,37),(45,35)$ and $(50,32)$ respectively. Identify correct statement

1) Readings recorded by P_3 person are incorrect

2) Readings recorded by P_4 and P_5 persons are incorrect

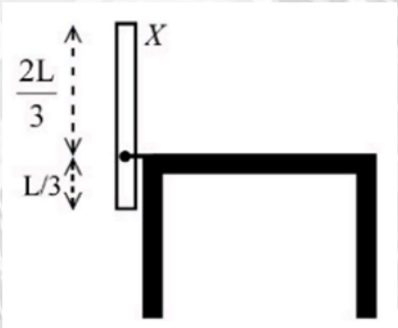
3) Readings recorded by P_3 and P_2 persons are incorrect

4) Readings recorded by all persons are correct

Key: 1

Sol: $D = \frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{96} + \frac{1}{25} = 0.0104 + 0.04 = 0.0504\,cm^{-1} = 5D$

43. A thin uniform rod (X) of mass M and length L is picoted at a height $\left(\frac{L}{3}\right)$ as shown in the figure. The rod is allowed to fall from a vertical position and lie horizontally on the table. The angular velocity of this rod when it hits the table top, is_____. (g = gravitational acceleration)



1) $\sqrt{\frac{3}{2}\frac{g}{L}}$ 2) $\frac{3}{\sqrt{2}}\sqrt{\frac{g}{L}}$ 3) $\sqrt{\frac{3g}{L}}$ 4) $\frac{1}{\sqrt{2}}\sqrt{\frac{g}{L}}$

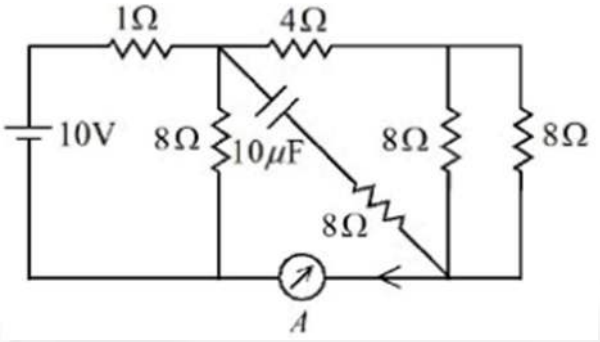
Key; 3

Sol: $mg\frac{L}{6} = \frac{1}{2}Iw^2$

$mg\frac{L}{6} = \frac{1}{2}\left\{\frac{mL^2}{12} + m\frac{L^2}{36}\right\}w^2$

$w = \sqrt{\frac{3g}{L}}$

44. The reading of the ammeter (A) in steady state in the following circuit (assuming negligible internal resistance of the ammeter) is_____A.



1) 2 2) 1 3) 1/2 4) 0

Key: 2

Sol: $I=\frac{10}{5}=2A$

Reading of ammeter $=1A$

45. When a light of a given wavelength falls on a metallic surface the stopping potential for photoelectrons is 3.2V. If a second light having wavelength twice of first light is used, the stopping potential drops to 0.7V. The wavelength of first light is_____m.

$\left(h=6.63\times10^{-34}\text{J.s,e}=1.6\times10^{-19}C,c=3\times10^{8}\text{m/s}\right)$

1) 3.1×10^{-7} 2) 2.5×10^{-7} 3) 2.9×10^{-8} 4) 2.2×10^{-8}

Key: 2

Sol: $=\left(\frac{k_2}{2}+\frac{k_1k_2}{k_1+k_2}\right)\frac{\in oA}{d}$

$e(0.7)=\frac{hc}{2\lambda}-\phi$

$2.5=\frac{hc}{e}\frac{1}{2\lambda}$

$\lambda=\frac{12400}{5}$

$\lambda=2480\,A^0$

$\lambda=2.48\times10^{-7}\,m$

SECTION-II
(NUMERICAL VALUE TYPE

This section contains **5 Numerical Value Type Questions**. The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example I,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

46. A soap bubble of surface tension 0.04N/m is blown to a diameter of 7 cm. If $(15000-x)\mu J$ of work is done in blowing it further to make its diameter14 cm, then the value of x is_____ $(\pi=22/7)$

Key: 11304

Sol: $w = 8\pi T\left\{r_2^2 - r_1^2\right\}$

$$w = 8 \times \frac{22}{7} \times 0.04 \times \frac{1}{4}\left\{\frac{14^2 - 7^2}{10^4}\right\}$$

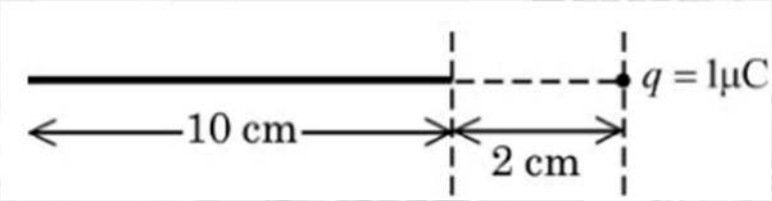
$$w = 8 \times \frac{22}{7} \times 147 \times 10^{-6}$$

$$w = 3696\,\mu J$$

$$(15000 - x)\,\mu J = 3696\,\mu J = 11304$$

47. A point charge $q = 1\mu C$ is located at a distance 2 cm from one end of a thin insulating wire of length 10 cm having a charge $Q = 24\,\mu C$, distributed uniformly along its length, as shown in figure. Force between q and wire is_____N.

$$\left(Use: \frac{1}{4\pi \in_o} = 9 \times 10^9\,\text{N.m}^2/\text{C}^2\right)$$



Key: 90

Sol: $F = 90N$

$= 90N$

48. In a meter bridge experiment to determine the value of unknown resistance, first the resistances 2Ω and 3Ω are connected in the left and right gaps of the bridge and the null point is obtained at a distance $l\,cm$ from the left. Now when an unknown resistance $x\Omega$ is connected in parallel to 3Ω resistance, the null point is shifted by 10 cm to the right of wire. The value of unknown resistance x is _____Ω.

Key: 6

Sol: $\frac{2}{3} = \frac{l}{100 - l}$

$l = 40cm$

$$\frac{\frac{2}{3x}}{3 + x} = \frac{50}{50} = 1$$

$x = 6\Omega$

49. A uniform solid cylinder of length L and radius R has moment of inertia about its axis equal to I_1. A small co-centric cylinder of length $L/2$ and radius $R/3$ carved from this cylinder has moment of inertia about its axis equals to I_2. The ratio I_1/I_2 is_____.

Key: 162

Sol: $I_1 = \frac{MR^2}{2}$

After removing $mass = \frac{m}{18}$

$Rad = \frac{R}{3}$ Use $m = v.d$

$I_2 = \frac{1}{2}\left(\frac{M}{18}\right)\left\{\frac{R}{3}\right\}^2$

$I_2 = \frac{MR^2}{324}$

$\frac{I_1}{I_2} = 162$

50. When $300\,\text{J}$ of heat given to an ideal gas with $C_P = \frac{7}{2}R$ its temperature raises from $20\ C$ to $50\ C$ keeping its volume constant. The mass of the gas is (approximately)_____ g. $\left(R = 8.314\,\text{J/mol.K}\right)$

Key:

Sol: $Q = nC_v\Delta T$

$300 = n\frac{5R}{2}\{50-20\}$

$300 = \frac{mass}{molar\,mass} \times \frac{5R}{2} \times 30$

$300 = \frac{mass}{molar\,mass} \times \frac{5}{2} \times 8.314 \times 30$

Molar mass is not given to calculate mass of gas

CHALLENGING QUESTIONS

OBJECTION : Add score

CHEMISTRY

Max Marks: 100

SECTION-I
(SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

51. At 298 K, the mole percentage of $N_2(g)$ in air is 80%. Water is in equilibrium with air at a pressure of 10 atm. What is the mole fraction of $N_2(g)$ in water at 298 K?

$\left(K_H \text{ for } N_2 \text{ is } 6.5\times10^7 Hg\right)$

1) 1.23×10^{-7} 2) 9.35×10^{-5} 3) 1.17×10^{-4} 4) 9.35×10^{-5}

Key: 2

Sol: $P = k\mu \times N_2$

$10 = 6.5\times10^7 Xair$

$10\times760 = 6.5\times10^7 Xair$

$Xair = \dfrac{10\times760}{6.5\times10^7}$ $XN_2 = 0.8Xair$

$\dfrac{0.8\times10\times760}{6.5\times10^7} = \dfrac{6080}{6.5}\times10^{-7} = 9.35\times10^{-5}$

52. A student has planned to prepare acetanilide from aniline using acetic anhydride. The student has started from 9.3 g of aniline. However, the student has managed to obtain 11 g of dry acetanilide.The % yield of this reaction is :-

1) 97.5% **2)** 72.5% 3) 81.5% 4) 59.5%

Key: 3

Sol: $\dfrac{9.3}{93} = 0.1$

$0.1\times135 = 13.5g$

$\text{Yield} = \dfrac{1}{13.5}\times100$

81.5%

53. The wavelength of spectral line obtained in the spectrum of Li^{2+} ion, when the transition takes place between two levels whose sum is 4 and difference is 2, is

1) 2.28 x 10^6 cm 2) 1.14 x 10^{-7} cm 3) 1.14 x 10^{-6} cm 4) 2.28 x 10^{-7} cm

Key: 3

Sol: $n_2 + n_1 = 4$

$n_2 - n_1 = 2$

$2n_2 = 6$

$n_2 = 3$

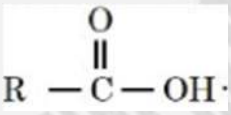
$n_1 = 1$

$$\frac{1}{\lambda} = R_H \times z^2\left(\frac{1}{1} - \frac{1}{9}\right)$$

$$\frac{1}{\lambda} = 10^7 \times 9\left(\frac{8}{9}\right)$$

$$\lambda = \frac{1}{8} \times 10^{-7} = 1.25 \times 10^{-8} A \ = 1.25 \times 10^{-6} cm$$

54. Given below are two statements:

Statement I: The dipole moment of R-CN is greater than R-NC and R-NC can undergo hydrolysis under acidic medium to produce  .

Statement-II: R-CN hydrolyses under acidic medium to produce a compound which on treatment with $SOCl_2$ followed by the addition of NH_3 gives another compound(x). This compound (x) on treatment with $NaOCl / NaOH$ gives a product, that on treatment with $CHCl_3/KOH/\Delta$ produces R-NC In the light of the above statements, choose the correct answer from the options given below

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

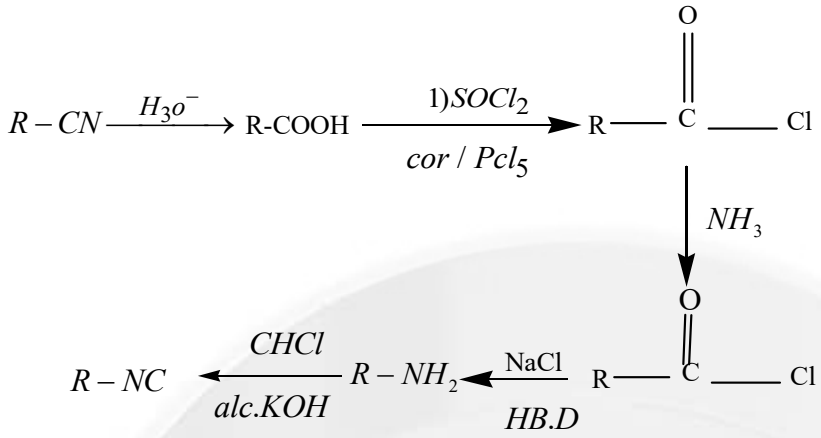
Key: 4

Sol: Statement-I

$$R - CN \xrightarrow[\Delta]{H_3O^-} R - \overset{O}{\overset{\|}{C}} - OH$$

$$R - NC \xrightarrow[\Delta]{H^{\oplus}} R - NH_2 + H - \overset{O}{\overset{\|}{C}} - OH$$

Statement-II



55. Pair of species among the following having same bond order as well as paramagnetic character will be

1) O_2^-, N_2^- 2) O_2^+, N_2^{2-} 3) O_2^-, N_2^+ 4) O_2^+, N_2^-

Key: 4

Sol:

15	15
2.5	2.5

paramagnetic

56. The wavelength of light absorbed for the following complexes are in the order

$\left[Co(NH_3)\right]^{3+}$; $\left[Co(H_2O)_6\right]^{3+}$; $\left[Co(CN)_6\right]^{3+}$; $\left[Co(NH_3)_5(H_2O)^{3+}\right]$; $[CF_6]^{3-}$

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

1. III <I<IV<II<V 2. III <I<II<IV<V
3. III < IV<I<II<V 4. III<I<IV<V<II

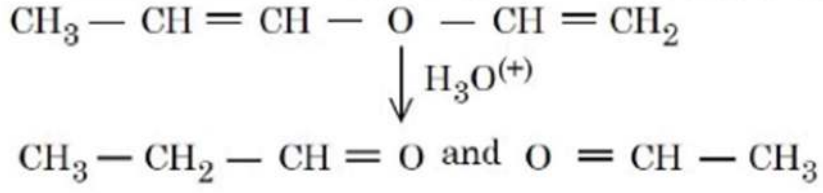
Key: 1

Sol: wave length of light absorbed is inversely proportional to ligand strength

Ligand strength: $CN^- > NH_3 > H_2^o > F^-$

Wavelength : $CN^- > NH_3 > H_2 > F^-$

57. The unsaturated ether on acidic hydrolysis produces carbonyl compounds as shown below:-



Based on this, predict the solution/reagent that will help to distinguish "P" and "Q" obtained in the following reaction:-

$$CH_3-CH=CH-O-\underset{\displaystyle CH_3}{\overset{|}{C}}=CH_2 \xrightarrow[\Delta]{H_3O^{(+)}} P + Q$$

1) 2, 4 - DNP reagent
2. Lucas reagent
3. Fehling solution
4. Saturated $NaHSO_3$ solution

Key: 3

Sol:
$$CH_3-CH=CH-OH \quad + \quad CH_2=CH-OH$$
$$CH_3-CH_2-CHO \qquad\qquad CH_3CHO$$
$$CH_3-CH_2-CHO + CH_3-c^{p}-CH_3$$
$$(p) \qquad\qquad (Q)$$

58. The heat of atomisation of methane and ethane are $'x'kJ\,mol^{-1}$ and $'y'\ kJmol^{-1}$ respectively. The longest wavelength (λ) of light capable of breaking the C-C bond can be expressed in SI unit as:

1) $N_A hc\left(y-\frac{6x}{4}\right)^{-1}$
2) $\frac{N_A hc}{250(y-6x)}$
3) $\frac{N_A hc}{250(4y-6x)}$
4) $\frac{hc}{1000}\left(\frac{y-6x}{4}\right)^{-1}$

Key: 3

Sol: $CH \xrightarrow{\Delta} C + AH, x\,kJmol^{-1}$

$C_2H_6 \xrightarrow{\Delta} 2C + 6H, y\,kJ\,mol^{-1}$

$\left[C + kH \xrightarrow{\Delta} (H4\right] \times 2, -x\,kJ\,mol^{-1}$

$1000x = 4 \times E_{C-H}$ $\qquad \therefore E_{C-H} = \frac{1000x}{4}$

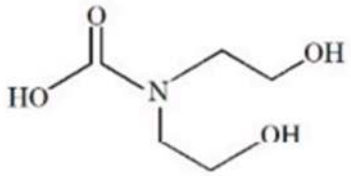
$1000y = 4 \times E_{C-C} + 6 \times E_{CH}$

$1000y = E_{C-C} + 6 \times \frac{1000}{4}x$

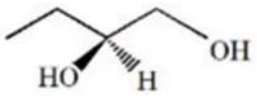
$N_A \frac{hc}{\lambda} = E_{c-c} = \left(1000y - \frac{6000}{4}x\right)$

$\lambda = \frac{N_A hc}{1000(y-6x/4)}$

59. From the following, how many compounds contain at least one secondary alcohol?

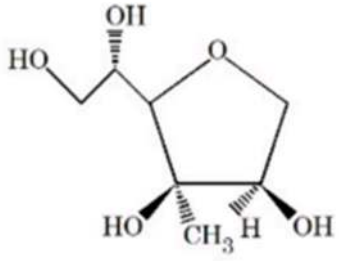


(I)

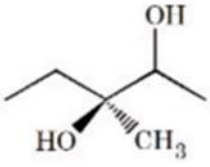


(II)

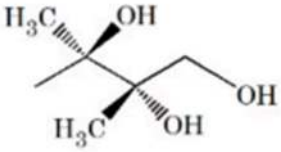
(III)



(IV)



(V)



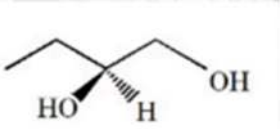
(VI)

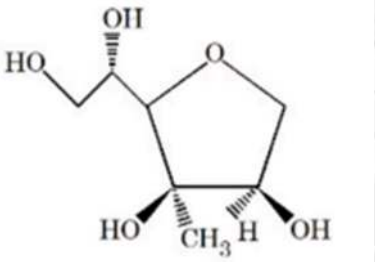
Choose the correct answer from the options given below:

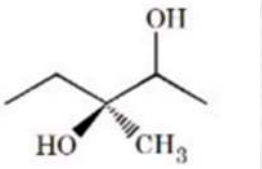
1. Three 2. Five 3. Four 4. Two

Key: 1

Sol: 2^0 -OH contains molecules are







So final answer is 3

60. The number of possible tripeptides formed involving alanine (ala), glycine (gly) and valine (val), where no amino acid has been used more than once is:

1. 6 2. 3 3. 8 4. 4

Key: 1

Sol:
$Gly - Ala - Val$
$Gly - Val - Ala$
$Ala - Gly - Val$
$Ala - Val - Gly$
$VAl - Gly - Ala$
$Val - Ala - Gly$

61. One mole of $Cl_2(g)$ was passed into 2 L of cold 2M KOH solution. After the reaction, the concentrations of Cl^-, ClO^- and OH^- are respectively (assume volume remains constant)

1. 0.75M, 0.75M, 1M 2. 0.5M, 0.5M, 1M

3. 1M, 1M, 1M 4. 0.5M, 0.5M, 0.5M

Key: 2

Sol: $e/2 + 20H^- \rightarrow Cl^- + clo^-$

$4mol \quad 1mol \quad 1mol$

$= 0.5M, 0.5M, 1M$

62. Two liquids A and B form an ideal solution at temperature T K. At T K, the vapour pressures of pure A and B are 55 and 15 kN m^2 respectively. What is the mole fraction of A in solution of A and B in equilibrium with a vapour in which the mole fraction of A is 0.8?

1. 0.340 2. 0.5217 3. 0.663 4) 0.480

Key: 2

Sol: $P\ A = 55kNm^{-2}$

$P\ _B = 15kNm^{-2}$

$Y_A = 0.8$

$P_A = P\ _A X_B = Y_A P_T$

$P_B = P\ _B X_B = Y_B P_T$

$\frac{P_A}{P_B} = \frac{P\ _A X_A}{P\ _B X_B} = \frac{Y_A}{Y_B} = \frac{0.8}{0.2}$

$\frac{X_A}{X_B} = \frac{0.8}{0.2} \times \frac{P\ _B}{P\ _A} = 4 \times \frac{15}{55} = \frac{60}{55} = \frac{12}{11}$

$\frac{X_A}{(1 - X_A)} = \frac{12}{11}$

$\frac{1}{X_A} - 1 = \frac{11}{12}$

$\frac{1}{X_A} = \frac{11+12}{12}$

$X_A = \frac{12}{23} = 0.5217$

63. Consider the following gaseous equilibrium in a closed container of volume 'V' at T(K).

$P_2(g) + Q_2(g) \qquad 2PQ(g)$

2 moles each of $P_{2(g)}, Q_{2(g)}$ and $PQ_{(g)}$ are present at equilibrium. Now one mole each of 'P_2' and 'Q_2' are added to the equilibrium keeping the temperature at T(K). The number of moles of P_2 and Q_2 and PQ at the new equilibrium, respectively, are

1. 1.66, 1.66, 1.66 2. 1.21, 2.24, 1.56 3. 2.67, 2.67, 2.67 4. 2.56, 1.62, 2.24

Key: 3

Sol: $P_2(9)+Q_2Q1 \rightarrow 2PQ(g)$

$$Keg=\frac{(PQ)}{\{P_2\}\{Q_2\}}$$

$(3-x)(3-x)(2-x)keg>Q$

Reaction forward

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

$P_2=3-x$

$$=3-\frac{1}{3}=8/3(3-x)^2=(2+2x)^2$$

$Q_2=3-x$

$$Q_2=3-\frac{1}{3}=8/3(3-x)=2+2x$$

$PQ=2+2x=2+2/3=8/3$

$\therefore x=1/3$

64. Choose the INCORRECT statement

1. Carbon cannot exceed its covalency more than four.
2. Among the isotopes of carbon, 13_C is a radioactive isotope.
3. CO_2 is the most acidic oxide among the dioxides of group of 14 elements.
4. Carbon exhibits negative oxidation states along with +4 and +2.

Key: 2

Sol: Among the isotopes of carbon

C^{14} is radioactive isotope

65. In the Group analysis of cations, Ba^{2+} & Ca^{2+} are precipitated respectively as

1. chromate & sulphide
2. sulphide & sulphide
3. carbonate & carbonate
4. hydroxide & carbonate

Key: 3

Sol: For Ba^{+2} and Ca^{+2} group reagent is $(NH_4)_2CO_3$ in the presence of NH_4OH and NH_4Cl Ba^{+2} and Ca^{+2} are precipitated as carbonates

$Ba^{+2}+Ca^{+2} \rightarrow BaCO_3$

$Ca^{+2}+CO^{+2} \rightarrow CaCO_3$

66. Find out the statements which are not true.

A. Resonating structures with more number of covalent bonds and lesser charge separation are more stable.

B. In electromeric effect, an unsaturated system shows +E effect with nucleophile and -E effect with electrophile.

C. Inductive effect is responsible for high melting point, boiling point and dipole moment of polar compounds.

D. The greater the number of alkyl groups attached to the doubly bonded carbon atoms, higher is the heat of hydrogenation.

E. Stability of carbanion increases with the increase in s - character of the carbon carrying the negative charge.

Choose the correct answer from the options given below:

1. A, C & D only 2. B, D & E only 3. B & D only 4.A, D & E only

Key: 3

Sol: Conceptual

67. The correct order of C, N, O and F in terms of second ionisation potential is

1. $F < N < C < O$ 2. $C < F < N < O$ 3. $C < O < N < F$ 4. $C < N < F < O$

Key: 4

Sol: Given elements, C,N,O,F

$$\begin{array}{cccc} C < & O < & N < & F \\ \downarrow & \downarrow & \downarrow & \downarrow \\ B & N & C & O \end{array}$$

Ionisation energy order of B,N,C,O is $B < C < O < N$ but they are formed from $C < N < F < O$

68. "X" is an oxoanion of the lightest element of group 7 (in the periodic table). The metal is in +6 oxidation state in "X". The color of the potassium salt of X is

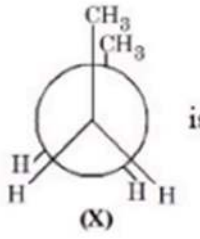
1. green 2. Purple 3. Orange 4. Yellow

Key: 1

Sol: Colour of potassium manganite $+6\left(k_2MnO_4\right)$ is green.

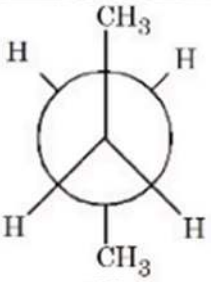
69. Given below are two statements:

Statement I: There are several conformers for n-butane. Out of those conformers,



(X)

is the least stable and most stable conformer is



(Y)

Statement II: As the dihedral angle increases, torsional strain decreases from (X) to (Y).

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

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

Key: 3

Sol: Statement –I is correct because of X is eclipsed confirmation suffers from highly eclipsed strain where as Y is anti confirmations there is no eclipsed strain and no steric strain because of groups of separated by 180^0

Statement –II is also correct because of as the dihydral angle changes potential energy is also changes potential energy depends on dihydral angle

70. Given below are two statements:

Statement I: Cross aldol condensation between two different aldehydes will always produce four different products.

Statement II: When semicarbazide reacts with a mixture of benzaldehyde and acetophenone under optimum pH, it forms a condensation product with acetophenone only.

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

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

Key: 4

SECTION-II
(NUMERICAL VALUE TYPE

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

71. Molar conductivity of a weak acid HQ of concentration 0.18 M was found to be 1/30 of the molar conductivity of another weak acid HZ with concentration of 0.02 M. If $\lambda_Q^0 -$ happened be equal with $\lambda_Z^0 -$, then the difference of the pK_a, values of the two weak acids $\left(pK_a(HQ) - pK_a(HZ)\right)$ is____

(Nearest integer). [Given: degree of dissociation $(\alpha) << 1$ for both weak acids λ^0: limiting molar conductivity of ions]

Key: 2

Sol: $\lambda_m(HQ) = \frac{1}{30} \times \lambda_m(HZ)$

$$\frac{\alpha_{HQ}}{\alpha_{HZ}} = \frac{\frac{\lambda_m(HQ)}{\lambda_m^{\infty}(HQ)}}{\frac{\lambda_m(HZ)}{\lambda_m^{\infty}(HZ)}} = \frac{1}{30}$$

$$\therefore x = \log\left[\frac{kg(HZ)}{ka(HQ)}\right]$$

$$= \log\left[\frac{0.02 \times \alpha HZ^2}{0.18 \times \alpha HQ^2}\right]$$

$$\therefore x = 2$$

72. The half –life of ^{65}Zn is 245 days After x days, 75% of original activity remained. The value of x in days is. (Nearest integer) (Given: log 3 = 0.4771 and log 2 = 0.3010)

Sol: $k = \left(\frac{l\,n2}{t1/2}\right) = \frac{l\,n2}{245} day - 1$

$$\ln\frac{[Ao]}{[At]} = kt$$

$$\frac{l\,n[Ao]}{0.75[A0]} = \left(\frac{l\,n2}{245}\right) t$$

$\therefore t = 102$ days

73. 0.25 g of an organic compound "A" containing carbon, hydrogen and oxygen was analysed using the combustion method. There was an increase in mass of $CaCl_2$ tube and potash tube at the end of the experiment. The amount was found to be 0.15 g and 0.1837 g, respectively. The percentage of oxygen in compound A is _ %. (Nearest integer)

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

Key: 73

Sol: $C_xH_yO_z + \left(x + \frac{y}{4} - \frac{z}{2}\right) o_2 \rightarrow xco_2 + y/2H_2O$

time $t = 0$ 0.25g 0.18g 0.15g

time $t=0$ $\%man\ of\ c=\frac{0.37}{44}\times\frac{12\times100}{0.25}=x=20.04$

$\%man of\ H=\frac{0.15}{18}\times\frac{2\times100}{0.25}=y=6.67$

$\%\ of$ oxygen $=100-(x+y)=73.32\%$

$=73.3\%$

74. Grignard reagent RMgBr (P) reacts with water and forms a gas (Q). One gram of Q occupies 1.4 dm^3 at STP. (P) on reaction with dry ice in dry ether followed by H_3O^+ forms a compound (Z). 0.1 mole of (Z) will weigh ____g. (Nearest integer)

Key: 6

Sol: $M_Q=\frac{22.4L/mol}{1.4L/g}=16g/mol$

A hydrocarbon gas with a molar mass of 16g/mol is methane (CH_4).

Therefore, the R group in the Grignard reagent is a methyl group

First, calculate the molar mass of acetic acid $(C_2H_4O_2)$:

MR=(2×12)+(4×1)+(2×16)=24+4+32=60 g/mol

Mass=moles×molar mass=0.1 mol×60 g/mol=6 g

75. A chromium complex with a formula $CrCl_3.6H_2O$ has has a spin only magnetic moment value of 3.87 BM and its solution conductivity corresponds to 1: 2 electrolyte. 2.75 g of the complex solution was initially passed through a cation exchanger. The solution obtained after the process was reacted with excess of $AgNO_3$. The amount of AgCl formed in the above process is g. (Nearest integer)

[Given: Molar mass in g mol^{-1} Cr: 52; Cl: 35.5, Ag:108, O:16, H:1]

Key:

Sol: $\left[Cr(H_2O)Cl\right]cl_2.H_2O+2AgNo_3\rightarrow 2AgCl$

Weight $=2.75gm$

No.of moles $=\frac{2.75}{266.5}=0.0103moles$ $0.0206moles$ Amount of Agcl formed

$=0.0206\times143.5$ $=2.96\approx3$.

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V PRAVAS REDDY
Appl. No. 250310253376

P SAI SURYA KARTHIK
Appl. No. 250310407861

YASH KUMAR
Appl. No. 250310204405*

P PRANAYA SAI MUKESH
Appl. No. 250310606114

ADITYA SINGH
Appl. No. 250310151728

JAY AGARWAL
Appl. No. 250310122371*

V ESWAR KARTHIK
Appl. No. 250310235425

SAKSHAM GARG
Appl. No. 250310025726*

RANVEER SINGH VIRDE
Appl. No. 250310790734

BELOW 100	BELOW 500	BELOW 10	BELOW 100	BELOW 1000	TOTAL QUALIFIED RANKS FOR JEE ADVANCED-2025
31	95	10	98	579	22,094

Sri Chaitanya Educational Institutions | Infinity Learn

41 Years of Excellence 1986-2026

LEADING BY MILES SRI CHAITANYA DOMINATES

JEE ADVANCED 2025

29 Ranks in Top 100 in All-India Open Category

4 Students in Top 11 in JEE-Advanced 2025, All India Open Category

16 RANK DEVDUTTA MAJHI HT. No. 255053116*	18 RANK DHARMANA GNANA RUTVIK SAI HT. No. 256055278	19 RANK VANGALA AJAY REDDY HT. No. 256131009	23 RANK AKSH GOGI HT. No. 252071075*	26 RANK P HEMA SAI SURYA KARTHIK HT. No. 256033006	27 RANK SARKARSAMUDRA HT. No. 252071105*
30 RANK OM PRAKASH BEHERA HT. No. 252021018*	32 RANK SUNKARA SAI RISHANTH REDDY HT. No. 256165327	34 RANK DHRUBA JYOTHI PANJA HT. No. 252048248*	35 RANK BHAVESH JAYANTHI HT. No. 251043080	36 RANK ADVAY MAYANK HT. No. 252104113*	37 RANK KARMANYA GUPTA HT. No. 252081477*
42 RANK MD ANAS HT. No. 252046210*	45 RANK RAMIT GOYAL HT. No. 257001113*	52 RANK MAULIK JAIN HT. No. 252079407*	54 RANK GARV HT. No. 252056188*	59 RANK LARISSA HT. No. 252079071*	60 RANK ARYAN BALABADRULA HT. No. 256132077
63 RANK SAMYAJYOTI BISWAS HT. No. 255056458*	64 RANK AARUSH ANAND HT. No. 251006178*	72 RANK RUSHMITH BANDARI HT. No. 256168048	78 RANK KORIKANA RASAGNYA HT. No. 256057046	87 RANK LAKSHYA SHARMA HT. No. 252070079*	91 RANK AVANEESH BANSAL HT. No. 251113130*	95 RANK KAVYA AGGARWAL HT. No. 252079121*

BELOW 100 ALL INDIA OPEN CATEGORY RANKS 29	BELOW 500 ALL INDIA OPEN CATEGORY RANKS 113	BELOW 1000 ALL INDIA OPEN CATEGORY RANKS 205	BELOW 1000 ALL INDIA CATEGORY RANKS COUNT 745	NUMBER OF QUALIFIED RANKS 4,212

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