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23-Jan-2026_Shift-I_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.

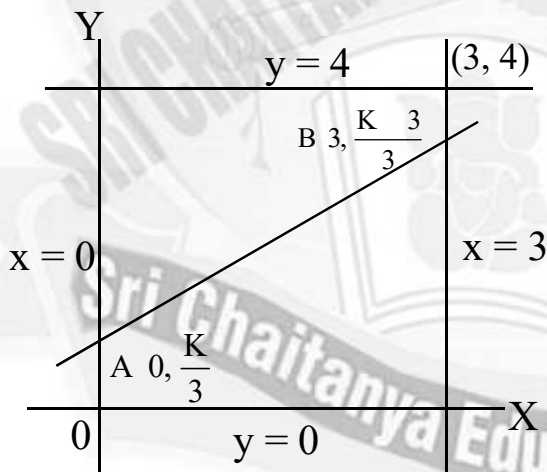
1. A rectangle is formed by the line $x = 0$, $y = 0$, $x = 3$ and $y = 4$. Let the line L be the perpendicular to $3x + y + 6 = 0$ and divide the area of the rectangle into two equal parts.

Then the distance of the point $\left(\frac{1}{2}, 5\right)$ from the line L is equal to :

- 1) $2\sqrt{10}$ 2) $3\sqrt{10}$ 3) $\sqrt{10}$ 4) $2\sqrt{5}$

Key : 1

Sol : $\frac{K}{3} \quad 4 \quad \frac{3}{3} \quad \frac{K}{3}$



$$\frac{2K}{3} \quad 3 \quad K \quad \frac{9}{2}$$

$$x \quad 3y \quad \frac{9}{2} \quad 0$$

Perpendicular distance = $\frac{1}{2} \quad 15 \quad \frac{9}{2} \quad \frac{20}{\sqrt{10}} \quad 2\sqrt{10}$

2. The value of $\frac{{}^{100}C_{50}}{51} \frac{{}^{100}C_{51}}{52} \dots \frac{{}^{100}C_{100}}{101}$ is :
- 1) $\frac{2^{101}}{101}$ 2) $\frac{2^{100}}{101}$ 3) $\frac{2^{100}}{100}$ 4) $\frac{2^{101}}{100}$

Key : 2

Sol :
$$\sum_{r=50}^{100} \frac{{}^{100}C_r}{r+1} = \frac{1}{{}^{101}C_{50}} \sum_{r=50}^{100} \frac{{}^{101}C_r}{r} = \frac{1}{{}^{101}C_{51}} \sum_{r=51}^{101} \frac{{}^{101}C_r}{r} = \frac{2^{101}}{101} - \frac{2^{100}}{101}$$

3. Let M and m respectively be the maximum and minimum values of the function $f(x) = 4 \sin^4 \frac{7x}{2} + \sin^4 11x - 2 \sin^6 \frac{3x}{2} + \sin^6 9x$, $x \in \mathbb{R}$. Then $M - 2m$ is equal to :
- 1) 5 2) 6 3) 3 4) 4

Key : 1

Sol :
$$f(x) = 4 \cos^4 \frac{7x}{2} + \sin^4 11x - 2 \cos^6 \frac{3x}{2} + \sin^6 9x$$

$$= 4 \left(1 - 2 \sin^2 \frac{7x}{2}\right)^2 + \sin^4 11x - 2 \left(1 - 3 \sin^2 \frac{3x}{2}\right)^2 + \sin^6 9x$$

$$= 4 \left(1 - 2 \sin^2 2\right)^2 + \frac{3}{2} \sin^4 2 - 2 \left(1 - \frac{3}{2} \sin^2 2\right)^2 + \frac{1}{2} \sin^4 2$$

$$= 2, \frac{3}{2}, \frac{2}{5}$$

4. Let $\vec{a} = \hat{i} + \hat{j} + 2\hat{k}$, $\vec{b} = \hat{i} + \hat{j} + 3\hat{k}$, $\vec{c} = a\hat{i} + b\hat{j} + c\hat{k}$ and $\vec{d} = c\hat{i} + a\hat{j} + b\hat{k}$. Then $\vec{a} \cdot \vec{b} \cdot \vec{d}$ is equal to:
- 1) 2 2) -4 3) 4 4) -2

Key : 4

Sol :
$$\vec{a} = \hat{i} + \hat{j} + 2\hat{k}, \vec{b} = \hat{i} + \hat{j} + 3\hat{k}, \vec{c} = a\hat{i} + b\hat{j} + c\hat{k}$$

$$\vec{d} = c\hat{i} + a\hat{j} + b\hat{k}$$

$$\vec{a} \cdot \vec{b} \cdot \vec{d} = (2\hat{i} + 2\hat{j} + 5\hat{k}) \cdot (c\hat{i} + a\hat{j} + b\hat{k}) = 4c + 4a + 10b = 2$$

5. Let $S = \{z : |2z - 3 - i| = 7\}$ be a set of complex numbers. Then

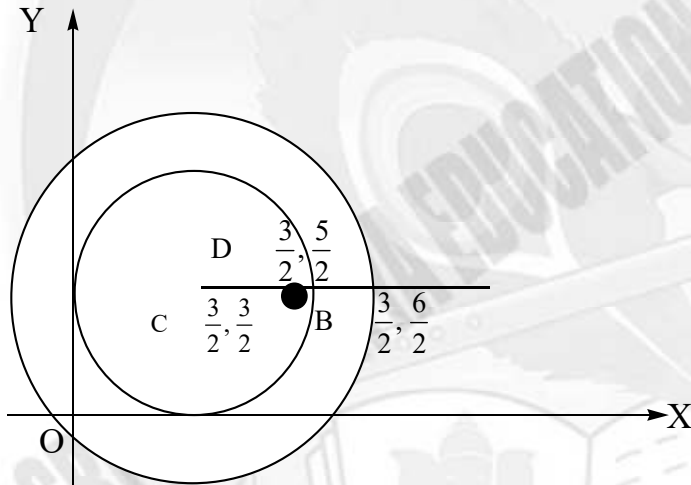
$\min_{z \in S} \left| z - \frac{1}{2} - 5 - 3i \right|$ is equal to :

- 1) $\frac{3}{2}$ 2) $\frac{5}{2}$ 3) 2 4) $\frac{1}{2}$

Key : 1

Sol : $\frac{3}{2} \left| z - 3 - \frac{1}{2}i \right| = \frac{7}{2}$

C $\frac{3}{2}, \frac{3}{2}$



minimum distance = $BD = 1 + \frac{1}{2}$

6. If α and β are the roots of the equation

$$2\sqrt{3} \sqrt{x-3} + x - 6\sqrt{x-9} - 9 - 2\sqrt{3} = 0, \quad x > 0, \text{ then } \sqrt{\alpha} + \sqrt{\beta} \text{ is}$$

equal to :

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

Key : 4

Sol : $x = 1$ and $x = 25$ satisfy the equation

$$1, 25, \sqrt{\alpha} + \sqrt{\beta} = 10$$

7. Let the mean and variance of 8 numbers 10, 7, 1, x, y, 9, 2, 16 be $\frac{7}{2}$ and $\frac{293}{4}$, respectively. Then the mean of 4 numbers x, y, x + y + 1, |x - y| is :
- 1) 12 2) 10 3) 9 4) 11

Key : 4

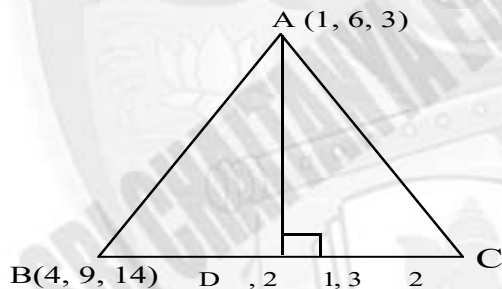
Sol : $\frac{x + y + 19}{4} = \frac{7}{2}$, $\frac{x^2 + y^2 + 193}{8} = \frac{293}{4}$

Mean of x, y, x + y + 1, |x - y| = $\frac{20 + 12 + 7 + 5}{4} = \frac{44}{4} = 11$

8. The vertices B and C of a triangle ABC lie on the line $\frac{x}{1} + \frac{y}{2} + \frac{z}{3} = 2$. The coordinates of A and B are (1, 6, 3) and (4, 9, 14) respectively and C is at a distance of 10 units from B. The area (in sq. units) of $\triangle ABC$ is
- 1) $5\sqrt{13}$ 2) $10\sqrt{13}$ 3) $15\sqrt{13}$ 4) $20\sqrt{13}$

Key : 1

Sol :



AD is perpendicular to BC. Then

$AD = \sqrt{13}$

Area of triangle ABC = $\frac{1}{2} \times \sqrt{13} \times 10 = 5\sqrt{13}$

9. Let A = {2, 1, 0, 1, 2, 3, 4}. Let R be a relation on A defined by xRy if and only if $2x = y + 2$. Let l be number of elements in R. Let 'm' and 'n' be the minimum number of elements required to be added in R to make it reflexive and symmetric relations respectively. Then l + m + n is equal to :
- 1) 33 2) 32 3) 34 4) 35

Key : 1

Sol : $R = \{ (2, 2), (2, 1), (2, 0), (2, 2), (2, 3), (2, 4)$

$(1, 2), (1, 1), (1, 0), (1, 1), (1, 2), (1, 3), (1, 4), (0, 2), (0, 1), (0, 0), (0, 1), (0, 2), (1, 1), (1, 1), (2, 1, 0) \}$

$l = 23$

For reflexive add $\{(1, 1), (2, 2), (3, 3), (4, 4)\}$

$m = 4, n = 6$

$l + m + n = 33$

10. Among the statements:

$$\text{I: If } \begin{vmatrix} 1 & \cos & \cos \\ \cos & 1 & \cos \\ \cos & \cos & 1 \end{vmatrix} = 0 \quad \begin{vmatrix} 0 & \cos & \cos \\ \cos & 1 & \cos \\ \cos & \cos & 0 \end{vmatrix},$$

then $\cos^2 = \cos^2 = \cos^2 = \frac{3}{2}$, and

$$\text{II: If } \begin{vmatrix} x^2 & x & x & 1 & x & 2 \\ 2x^2 & 3x & 1 & 3x & 3x & 3 \\ x^2 & 2x & 3 & 2x & 1 & 2x & 1 \end{vmatrix} = px - q, \text{ then } p^2 = 196q^2$$

1) Both are false 2) Only II is true 3) Only I is true 4) Both are true

Key : 1

Sol : I) $\cos^2 = \cos^2 = \cos^2 = 1$

II) $q = 12, p = 24$

11. Let the domain of the function $f(x) = \log_3 \log_5 \log_7 (9x - x^2 - 13)$ be the interval

(m, n) . Let the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ have eccentricity $\frac{n}{3}$ and the length of the latus

rectum $\frac{8m}{3}$. Then $b^2 - a^2$ is equal to:

1) 7 2) 11 3) 5 4) 9

Key : 1

Sol : $\log_5 \log_7 (9x - x^2 - 13) = 0$

$$x^2 - 9x + 20 = 0$$

$$x = 4, 5, m = 4, n = 5$$

$$e = \frac{5}{3}, \frac{2b^2}{a} = \frac{8m}{3}, \frac{32}{3}$$

$$b = 4, a = 3$$

$$b^2 - a^2 = 7$$

12. Let $f(x) = \int_0^x \frac{2x^2 \cdot e^x}{\sqrt{1-x} \cdot x^{3/2}} dx$. If $f(0) = 0$, then $f\left(\frac{1}{2}\right)$ is equal to :

- 1) $\sqrt{3}e - 1$ 2) $\sqrt{2}e - 1$ 3) $\sqrt{2}e + 1$ 4) $\sqrt{3}e + 1$

Key : 4

Sol : $f(x) = \int_0^x \frac{2x^2 \cdot e^x}{\sqrt{1-x} \cdot x^{3/2}} dx = e^x \int_0^x \frac{1}{\sqrt{1-x} \cdot x^{3/2}} dx$

$$f(x) = e^x \left[\frac{1}{\sqrt{1-x}} - \frac{1}{\sqrt{x}} \right]$$

$$f\left(\frac{1}{2}\right) = e^{\frac{1}{2}} \left[\sqrt{3} - 1 \right] = \sqrt{3}e - 1$$

13. The value of the integral $\int_{\frac{\pi}{24}}^{\frac{5\pi}{24}} \frac{dx}{1 + \sqrt[3]{\tan 2x}}$ is :

- 1) $\frac{1}{18}$ 2) $\frac{1}{6}$ 3) $\frac{1}{3}$ 4) $\frac{1}{12}$

Key : 4

Sol : Using King's rule $I = \int_{\frac{\pi}{24}}^{\frac{5\pi}{24}} \frac{dx}{1 + \sqrt[3]{\cot 2x}}$

$$2I = \frac{4}{24} \quad I = \frac{1}{12}$$

14. Let $f(x) = \frac{ax^2 + 2ax + 3}{4x^2 + 4x + 3}$, $x = \frac{3}{2}$, $\frac{1}{2}$
 $b, x = \frac{3}{2}, \frac{1}{2}$

Be continuous at $x = \frac{3}{2}$. If $f\left(\frac{3}{2}\right) = \frac{7}{5}$, then 'x' is equal to :

- 1) 1.4 2) 0 3) 1 4) 2

Key : 1

Sol : $\lim_{x \rightarrow \frac{3}{2}} f(x) = f\left(\frac{3}{2}\right)$

$b \lim_{x \rightarrow \frac{3}{2}} \frac{ax^2 + 2ax + 3}{4x^2 + 4x + 3}$

Numerator must be zero at $x = \frac{3}{2}$

$a \left(\frac{3}{2}\right)^2 + 2a \left(\frac{3}{2}\right) + 3 = 0$

$a = 4, b = \frac{1}{2}$

$f(x) = \frac{2x + 1}{2x + 1} \cdot x = \frac{3}{2}$
 $\frac{1}{2} \cdot x = \frac{3}{2}$

$f\left(\frac{3}{2}\right) = \frac{7}{5}$

The value of $f(x)$ can never be $\frac{3}{2}$ because $\frac{2x + 1}{2x + 1} = \frac{3}{2}$

Leads to $4x + 2 = 6x + 3$
 $f(x) = \frac{3}{x + 1}$

15. Let the line $y - x = 1$ intersect the ellipse $\frac{x^2}{2} + \frac{y^2}{1} = 1$ at the points A and B. Then the angle made by the line segment AB at the center of the ellipse is :

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

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

Key : 2

Sol : $y = x + 1$ substitute in $\frac{x^2}{2} - \frac{y^2}{1} = 1$ then $A = (0, 1)$, $B = \left(\frac{4}{3}, \frac{1}{3}\right)$

$$m_1 = \frac{1}{0}, m_2 = \frac{1}{4}, \tan^{-1} \frac{1}{4}$$

$$\text{required angle} = \frac{\pi}{2} - \tan^{-1} \frac{1}{4}$$

16. Let $y = y(x)$ be the solution of the differential equation

$$x^4 dy - 4x^3 y dx + 2 \sin x = 0, x = \frac{\pi}{2}, y = \frac{1}{3}$$

Then $y\left(\frac{\pi}{3}\right)$ is equal to :

- 1) 81 2) 72 3) 92 4) 64

Key : 1

Sol : $\frac{dy}{dx} + \frac{4x^3 y}{x^4} = -\frac{2 \sin x}{x^4}$

$$\text{I.F} = e^{\int \frac{4x^3}{x^4} dx} = x^4$$

$$x^4 \cdot y = \int \frac{-2(\sin x)x^4}{x^4} \cdot dx$$

$$x^4 \cdot y = 2 \cos x + c$$

$$x^4 \cdot y = 2 \cos x + c \text{ at } x = \frac{\pi}{2}, y = 0 \therefore c = 0$$

$$f\left(\frac{\pi}{3}\right) = 81$$

17. A building construction work can be completed by two masons A and B together in 22.5 days. Mason A alone can complete the construction work in 24 days less than mason B alone. The mason A alone will complete the construction work in :

- 1) 24 days 2) 36 days 3) 42 days 4) 30 days

Key : 2

Sol : work = time \times efficiency using that rule we get 36 days

18. Number of solutions of $\sqrt{3} \cos 2\theta + 8 \cos \theta + 3\sqrt{3} = 0$, $\theta \in (0, 2\pi)$ is :
- 1) 4 2) 3 3) 0 4) 5

Key : 4

Sol : $\sqrt{3} \cos 2\theta + 8 \cos \theta + 3\sqrt{3} = 0$ ($-\pi, \pi$)

$$\cos \theta = -\frac{1}{\sqrt{3}} \text{ or } -\sqrt{3} \text{ (rejected)}$$

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

θ has five solutions

19. Let the direction cosines of two lines satisfy the equations : $4l + m - n = 0$ and $2mn + 10nl + 3lm = 0$. Then the cosine of the acute angle between these lines is :

- 1) $\frac{10}{3\sqrt{38}}$ 2) $\frac{20}{3\sqrt{38}}$ 3) $\frac{10}{\sqrt{38}}$ 4) $\frac{10}{7\sqrt{38}}$

Key : 1

Sol : $4l + m - n = 0$

$$2mn + 10nl + 3lm = 0$$

Solve above to we get dir's are 1, -8, -4 and 2, -5, 3

$$\cos \theta = \frac{10}{3\sqrt{38}}$$

20. The sum of all possible values of $n \in \mathbb{N}$, so that the coefficients of x , x^2 and x^3 in the expansion of $(1 + x^2)^2 (1 + x)^n$, are the arithmetic progression is :

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

Key : 1

Sol : $(1 + x^2)^2 \cdot (1 + x)^n$ the coefficients of x, x^2, x^3 are $n_{C_1}, n_{C_2} + 2, 2(n_{C_1}) + n_{C_3}$ are in AP

After simplification we get $(n - 2)(n - 3)(n - 4) = 0$

$$n = 2, 3, 4$$

Their sum is 9

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 attempted and -1 in all other cases.

21. Let $|A| = 6$, where A is a 3×3 matrix.

If $|\text{adj } 3\text{adj } A^2 \cdot \text{adj } 2A| = 2^m \cdot 3^n$, $m, n \in \mathbb{N}$. then $m + n$ is equal to

Key : 62

Sol : $|A| = 6$
 $n = 3$

$$|\text{Adj}(3\text{adj}(A^2 \cdot \text{Adj}2A))| = 2^m 3^n$$

$$3^6 |A|^8 |\text{Adj}2A|^4$$

$$2^{40} \cdot 3^{22} = 2^m \cdot 3^n$$

$$m + n = 62$$

22. Let number of 4 letter words, with or without meaning, which can be formed using the letters PQR PQRSTUVP, is

Key : 1422

Sol : PPP RR QQ S T U V

Four letter words are

$$3 \text{ same } 1 \text{ different} \rightarrow 1_{C_1} \cdot 6_{C_1} \cdot \frac{4!}{3!} = 24$$

$$2 \text{ same } 2 \text{ same} \rightarrow 3_{C_2} \cdot \frac{4!}{2!2!} = 18$$

$$2 \text{ same } 2 \text{ different} \rightarrow 3_{C_1} \cdot 6_{C_2} \cdot \frac{4!}{2!} = 540$$

$$\text{All different} \rightarrow 7_{C_4} \cdot 4! = 840$$

$$24 + 18 + 540 + 840 = 1422$$

23. From the first 100 natural numbers, two numbers first a and then b are selected randomly without replacement. If the probability that $a - b \geq 10$ is $\frac{m}{n}$, $\text{gcd } m, n = 1$, then $m + n$ is equal to

Key : 311

Sol : $a - b \geq 10$

a and b are chosen from 1,2,3.....100

$$\text{the probability is } \frac{4095}{100 \times 99} = \frac{91}{220}$$

$$220 + 99 = 311$$

24. Let the area of the region bounded by the curve

$y = \max(\sin x, \cos x)$, lines $x = 0$, $x = \frac{3\pi}{2}$, and the x-axis be A. Then $A - A^2$ is equal to

Key : 3

$$\text{Sol : } \int_0^{\frac{\pi}{4}} \cos x dx + \int_{\frac{\pi}{4}}^{\frac{5\pi}{4}} \sin x dx + \int_{\frac{5\pi}{4}}^{\pi} -\sin x dx + \int_{\pi}^{\frac{3\pi}{2}} -\cos x dx = 3$$

25. Let 'f' be a twice differentiable non-negative function such that

$f(x)^2 = 25 + \int_0^x (f(t)^2 + f'(t)^2) dt$. Then the mean of $f(\log_e 1), f(\log_e 2), \dots, f(\log_e 625)$ is equal to

Key : 1565

$$\text{Sol : } f(x)^2 = 25 + \int_0^x (f(t)^2 + f'(t)^2) dt$$

Differentiate both sides we get

$$f(x) = f'(x)$$

After simplification $y = e^x \cdot e^c$

$$f(0) = 5$$

$$f(x) = 5 \cdot e^x$$

$$\text{Mean} = \frac{f(\log 1) + f(\log 2) + \dots + f(\log 625)}{625} = 1565$$

PHYSICS

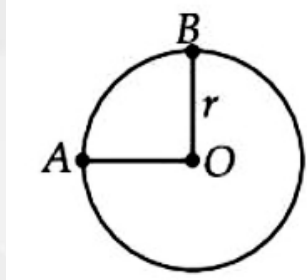
Max Marks: 100

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 Wire of uniform resistance $\lambda\Omega/m$ is bent into a circle of radius r and another piece of wire with length $2r$ is connected between points A and B (AOB) as shown in figure. The equivalent resistance between point A and B is _____ Ω



- 1) $2\pi\lambda r$ 2) $\frac{3\pi\lambda r}{8}$ 3) $\frac{6\pi\lambda r}{3\pi+16}$ 4) $(\pi+1)2r\lambda$

Key : 3

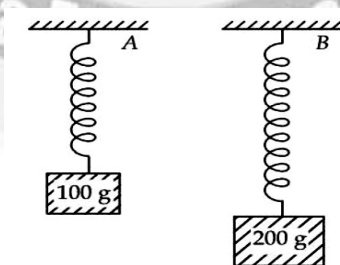
Sol : $R_1 = \lambda \frac{3}{4} \times 2\pi r = \frac{3\lambda\pi r}{2}$ $R_2 = \lambda \frac{2\pi r}{4} = \frac{\lambda\pi r}{2}$

$R_3 = \lambda 2r$ $R_{CH} = \frac{6\pi\lambda r}{16+3\pi}$

$$\frac{1}{R_e} = \frac{1}{\lambda 2r} + \frac{2}{\lambda\pi r} + \frac{2}{2\lambda\pi r} = \frac{1}{\lambda r} \left[\frac{1}{2} + \frac{2}{\pi} + \frac{2}{3\pi} \right]$$

$$= \frac{\lambda}{\lambda r} \left(\frac{3\pi+12+4}{6\pi} \right) \quad R_{eff} = \frac{6\pi\lambda r}{3\pi+16}$$

27. Two blocks with masses 100g and 200g are attached to the ends of springs A and B as shown in figure. The energy stored in A is E. The energy stored in B, when spring constants k_A, k_B of A and B respectively satisfy the relation $4k_A = 3k_B$ is



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

Key : 2

Sol : Assume they are released from natural length

$$E = \frac{1}{2} m A^2 \omega^2 \quad K A = m g = \frac{1}{2} K A^2$$

$$E = \frac{1}{2} K \cdot \left(\frac{m g}{k} \right)^2 = \frac{1}{2} \frac{(m g)^2}{K}$$

$$\frac{E_1}{E_2} = \frac{m_1^2}{m_2^2} \times \frac{k_2}{k_1} = \left(\frac{100}{200} \right)^2 \times \frac{K_B}{K_A} = \frac{1}{4} \times \frac{4}{3} = \frac{1}{3}$$

$$E_2 = 3E$$

28. Four persons measure the length of a rod as 20.00 cm, 19.75 cm, 17.01 cm and 18.25 cm.

The relative error in the measurement of average length of the rod is:

- 1) 0.06 2) 0.08 3) 0.24 4) 0.18

Key : 1

Sol : $20.00 + 19.75 + 17.01 + 18.25 = 75.01$

$$x_m = 18.75$$

$$\Delta x_1 = -1.2475, \quad \Delta x_2 = -0.9975, \quad \Delta x_3 = 1.7425$$

$$\Delta x_2 = 0.5025$$

$$\Delta x_m = 1.1225$$

$$\frac{\Delta x}{x} = 0.0598 \quad = 0.06$$

29. Given Below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R) Consider a ferromagnetic material:

Assertion (A) : The individual atoms in a ferromagnetic material possess a magnetic dipole moment and interact with one another in such a way that they spontaneously align themselves forming domains.

Reason (R) : At high enough temperature, the domain structure of ferromagnetic material disintegrate. Thus magnetization will disappear at high enough temperature known as Curie temperature.

In the light of the above statement choose the correct answer from the options given below:

- 1) Both (A) and (R) are true but (R) is not the correct explanation of (A)
 2) (A) is true but (R) is false
 3) Both (A) and (R) are true and (R) is the correct explanation of (A)
 4) (A) is false but (R) is true

Key : 1

Sol : In ferromagnetic materials magnetic domains exist above Curie temperature and disappear

30. In a perfectly inelastic collision, two spheres made of the same material with masses 15kg and 25kg moving in opposite directions with speeds of 10 m/s and 30 m/s respectively, strike each other and stick together. The rise in temperature (in °C), if all the heat produced during the collision is retained by these spheres is:

(specific heat of sphere material 31 cal/kg. °C and 1 cal = 4.2J)

- 1) 1.95 2) 1.44 3) 1.75 4) 1.15

Key : 2

Sol : $15 \times 10 - 25 \times 30 = 40 \times v$ (linear momentum conservation)

$$150 - 750 = 40v$$

$$\Delta E = \frac{1}{2} m u_1^2 + \frac{1}{2} m_2 u_2^2 - \frac{1}{2} (m_1 + m_2) v^2$$

$$\Delta E = 12000 - (40 \times 225) = 12000 - 9000 = 3000$$

$$\Delta E = 7500$$

$$\Delta = ms(\Delta T)$$

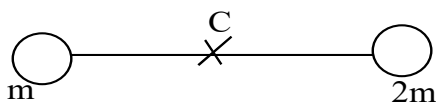
$$\Delta T = \frac{7500}{40 \times 31 \times 4.2} = 1.44$$

31. Two small balls with masses m and $2m$ are attached to both ends of a rigid rod of length d and negligible mass. If angular momentum of this system is L about an axis (A) passing through its centre of mass and perpendicular to the rod then angular velocity of the system about A is:

- 1) $\frac{3}{2} \frac{L}{md^2}$ 2) $\frac{4}{3} \frac{L}{md^2}$ 3) $\frac{2L}{5md^2}$ 4) $\frac{2L}{md^2}$

Key : 1

Sol : $x_n = \frac{m(0) + 2md}{3m} = \frac{2d}{3}$



$$I = m \left(\frac{2d}{3} \right)^2 + 2m \times \left(\frac{d}{3} \right)^2$$

$$md^2 \frac{4}{9} + 2 \frac{md^2}{9} = md^2 \left(\frac{6}{9} \right) = \frac{2md^2}{3}$$

$$L = \frac{2md^2}{3} \omega$$

32. A 20m long uniform copper wire held horizontally is allowed to fall under the gravity ($g = 10 \text{ m/s}^2$) through a uniform horizontal magnetic field of 0.5 Gauss perpendicular to the length of the wire. The induced EMF across the wire when it travels a vertical distance of 200 m is _____ mV

- 1) $2\sqrt{10}$ 2) $0.2\sqrt{10}$ 3) $20\sqrt{10}$ 4) $200\sqrt{10}$

Key : 3

Sol : $v = \sqrt{2gh}$; $e = Bvl$

$$e = 0.5 \times 10^{-4} \times \sqrt{2 \times 10 \times 200} \times 20 = \frac{1}{2} \times 10 \times \frac{20\sqrt{10} \times 20}{10000} \text{ volts}$$

$$= \frac{2\sqrt{10}}{100} = \frac{\sqrt{10}}{100} \times \frac{10^3}{10^3} = 20\sqrt{10} \text{ mV}$$

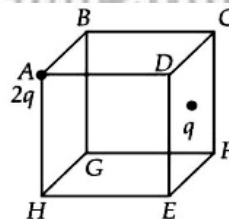
33. A thin prism with angle 5° of refractive index 1.72 is combined with another prism of refractive index 1.9 to produce dispersion without deviation. The angle of second prism is _____

- 1) 5° 2) 6° 3) 4° 4) 4.5°

Key : 3

Sol : $A_2 = \frac{(\mu_1 - 1)A_1}{(\mu_2 - 1)} = \frac{5(0.72)}{0.9} = 4^\circ$

34. Two point charges $2q$ and q are placed at vertex A and centre of face CDEF of the cube as shown in figure. The electric flux passing through the cube is:



- 1) $\frac{3q}{2\epsilon_0}$ 2) $\frac{3q}{\epsilon_0}$ 3) $\frac{3q}{4\epsilon_0}$ 4) $\frac{q}{\epsilon_0}$

Key : 3

$$\text{Sol : } \phi = \frac{1}{\epsilon_0} \left(\frac{2q}{8} + \frac{q}{2} \right) = \frac{3q}{4\epsilon_0}$$

35. In a screw gauge, the zero of the circular scale lies 3 divisions above the horizontal pitch line when their metallic studs are brought in contact. Using this instrument thickness of a sheet is measure If pitch scale reading is 1mm and the circular scale reading is 51 then the correct thickness of the sheet is _____ mm.

[Assume least count is 0.01mm]

- 1) 1.50 2) 1.48 3) 1.51 4) 1.54

Key : 4

Sol : Error is negative $e = -3 \times L.C$

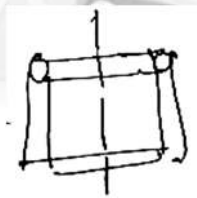
$$\text{Reducing} = (1 + 51 \times 0.01 + 3 \times 0.01) \text{mm} = 1.54 \text{mm}$$

36. The moment of inertia of a square loop made of four uniform solid cylinders, each having radius R and length L ($R < L$) about an axis passing through the mid points of opposite sides is (Take the mass of the entire loop as M)

- 1) $\frac{3}{8}MR^2 + \frac{7}{12}ML^2$ 2) $\frac{3}{8}MR^2 + \frac{1}{6}ML^2$
 3) $\frac{3}{4}MR^2 + \frac{7}{12}ML^2$ 4) $\frac{3}{4}MR^2 + \frac{1}{6}ML^2$

Key : 2

$$\text{Sol : } I = \left[\frac{m_1 L^2}{12} + \frac{m_1 R^2}{4} \right] \times 2 + \left[\frac{m_1 R^2}{2} + m_1 \left(\frac{L}{2} \right)^2 \right] \times 2 \quad \text{and} \quad m_1 = \frac{M}{4}$$

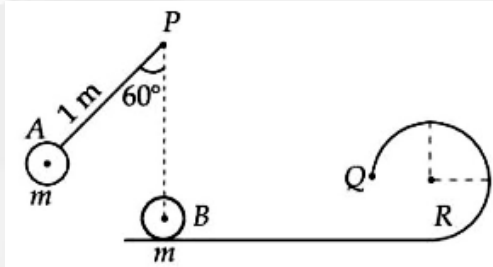


$$\frac{m_1 L^2}{12} \times 2 + \frac{m_1 R^2}{4} + \frac{m_1 R^2}{4} \times 2 + \frac{m_1 R^2}{2} \times 2 \quad m_1 L^2 \left[\frac{1}{6} + \frac{1}{2} \right] + m_1 R^2 \left[\frac{1}{2} + 1 \right]$$

$$m_1 L^2 \left(\frac{2+6}{12} \right) + \frac{3}{2} m_1 R^2$$

$$\frac{ML^2}{6} + \frac{3MR^2}{8}$$

37. A small bob A of mass m is attached to a massless rigid rod of length 1 m pivoted at point P and kept at an angle of 60° with vertical as shown in figure. At distance of 1 m below point P, an identical bob B is kept at rest on a smooth horizontal surface that extends to a circular track of radius R as shown in figure. If bob B just manages to complete the circular path of radius R upto a point Q after being hit elastically by bob A, then radius R is ____ m.



- 1) $\frac{1}{5}$ 2) $\frac{2-\sqrt{3}}{5}$ 3) $\frac{2+\sqrt{3}}{5}$ 4) $\frac{3}{5}$

Key : 1

Sol : $u = \sqrt{2gl(1 - \cos 60^\circ)}$

$$\sqrt{10 \times 1} = \sqrt{10}$$

$$\sqrt{10} = \sqrt{5gR}$$

$$10 = 5gR$$

$$R = \frac{10}{5g} = \frac{1}{5}$$

38. Match list – I with List-II

List-I

a) $\int E \cdot dl = -\frac{d}{dt} \int B \cdot da$

B) $\int B \cdot dl = \mu_0 \left(I + \epsilon_0 \frac{d\phi_E}{dt} \right)$

C) $\int E \cdot da = \frac{1}{\epsilon_0} \int_v \rho dv$

D) $\int B \cdot dl = \mu_0 I$

List-II

I) Ampere's circuital law

II) Faraday's law of electromagnetic induction

III) Ampere – Maxwell law

IV) Gauss's law of electrostatics

Choose the correct answer from the options given below:

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

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

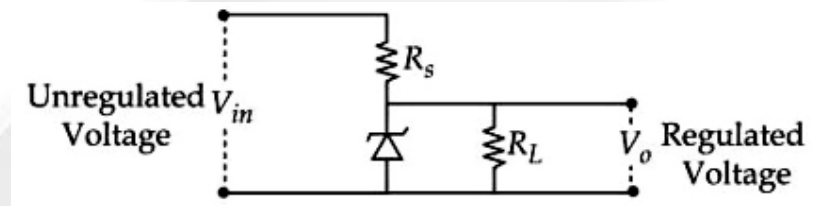
3) A-II, B-III, C-I, D-IV

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

Key: 1 or 2

Sol : Conceptual

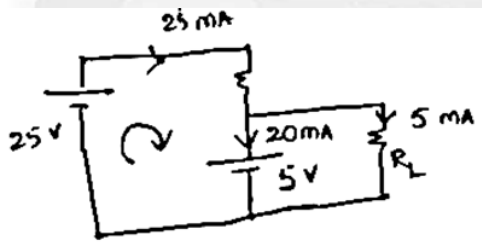
39. The following diagram shows a Zener diode as a voltage regulator. The Zener diode is rated at $V_z = 5V$ and the desired current in load is 5 mA. The unregulated voltage source can supply upto 25V. Considering the Zener diode can withstand four times of the load current, the value of resistor R_s (Shown in circuit) should be _____ Ω .



- 1) 4000 2) 1000 3) 100 4) 10

Key : 1

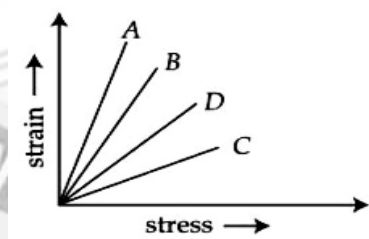
Sol :



$$25 - 25R_s - 5 = 0$$

$$R_s = \frac{20}{25} k\Omega = \frac{4}{5} = 0.8 k\Omega = 800\Omega ; R_s > 800\Omega$$

40. The strain-stress plot for materials A, B, C and D is shown in the figure. Which material has the largest Young's modulus?



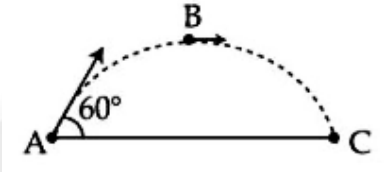
- 1) C 2) B 3) D 4) A

Key : 1

$$\text{Sol : } Y = \frac{\text{Stress}}{\text{Strain}} = \frac{1}{\text{slope}}$$

C-least slope

41. An object is projected with kinetic energy K from a point A at an angle 60° with the horizontal. The ratio of the difference in kinetic energies at point B and C to that at point A (See figure), in the absence of air friction is:



- 1) 1:2 2) 1:4 3) 3:4 4) 2:3

Key : 3

Sol : At A $KE_A = \frac{1}{2}mv^2 = K$

At B $KE_B = \frac{K}{4}$

At C $KE_C = \frac{1}{2}mv^2 = K$

$$\frac{K_B - K_C}{K_A} = \frac{\frac{K}{4} - K}{K} = \frac{3}{4}$$

42. A simple pendulum of straight length 30cm performs 20 oscillations in 10s. The length of the string required for the pendulum to perform 40 oscillations in the same time duration is _____ cm [Assume that the mass of the pendulum remains same]

- 1) 15 2) 120 3) 7.5 4) 0.75

Key : 3

Sol : $T = 2\pi\sqrt{\frac{l}{g}}$

$$f \propto \frac{1}{\sqrt{l}}$$

$$\frac{f_2}{f_1} = \sqrt{\frac{l_1}{l_2}}$$

$$\frac{4}{2} = \sqrt{\frac{30}{l_2}}$$

$$l_2 = 7.5 \text{ cm}$$

43. Consider light travelling from a medium A to medium B separated by a plane interface, If the light undergoes total internal reflection during its travel from medium A to B and the speed of light in media A and B are $2.4 \times 10^8 \text{ m/s}$ and $27 \times 10^8 \text{ m/s}$, respectively then the value of critical angle is:

- 1) $\sin^{-1}\left(\frac{9}{8}\right)$ 2) $\cot^{-1}\left(\frac{3}{\sqrt{13}}\right)$ 3) $\cos^{-1}\left(\frac{8}{9}\right)$ 4) $\tan^{-1}\left(\frac{8}{\sqrt{17}}\right)$

Key : 4

$$\text{Sol : } \mu_A = \frac{c}{V_A} = \frac{3 \times 10^8}{2.4 \times 10^8} = \frac{10}{8}$$

$$\mu_B = \frac{c}{V_B} = \frac{3 \times 10^8}{2.7 \times 10^8} = \frac{10}{9}$$

$$\mu_A > \mu_B$$

$$\mu_A \sin i = \mu_B \sin r$$

$$\frac{10}{8} \sin i = \frac{10}{9} \sin 90^\circ$$

$$\sin i = \frac{8}{9}$$

$$i = \tan^{-1}\left(\frac{8}{\sqrt{17}}\right)$$

44. In hydrogen atom spectrum ($R \rightarrow$ Rydberg's constant)

- A) The maximum wavelength of the radiation of Lyman series is $\frac{4}{3R}$
 B) The Balmer series lies in the visible region of the spectrum
 C) The minimum wavelength of the radiation of Paschen series $\frac{9}{R}$
 D) The minimum wavelength of Lyman series is $\frac{5}{4R}$

Choose the correct answer from the options given below:

- 1) A, B and C Only 2) A, B Only
 3) B, D Only 4) A, B and D Only

Key : 1

$$\text{Sol : } \frac{1}{\lambda} = Rz^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$\text{A: } n_1 = 1; n_2 = 2$$

$$\lambda_{\max} = \frac{4}{3R}$$

B : Correct

$$\text{C : } n_1 = 3, n_2 = \alpha$$

$$\lambda \text{ minimum} = \frac{9}{R}$$

$$\text{D : } n_1 = 1; n_2 = \alpha$$

$$\lambda \text{ minimum} = R$$

45. The de Broglie wavelength of an oxygen molecule at 27°C is $x \times 10^{-12} \text{m}$. The value of x is (take Planck's constant = $6.63 \times 10^{-34} \text{J.s}$ Boltzmann constant = $1.38 \times 10^{-23} \text{J/K}$. mass of oxygen molecule = $5.31 \times 10^{-26} \text{kg}$)

1)20

2)24

3)26

4)30

Key : 3

$$\text{Sol : } \lambda = \frac{h}{p} = \frac{h}{\sqrt{3mkT}}$$

$$\lambda = 26 \times 10^{-12}$$

$$x = 26$$

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. The equation the electric field of an electromagnetic wave propagating through free space is given by : $E = \sqrt{377} \sin(6.27 \times 10^3 t - 2.09 \times 10^{-5} x) \text{N/C}$

The average power of the electromagnetic wave is $\left(\frac{1}{\alpha}\right) \text{W/m}^2$. The value of α is ____

$$\left(\text{Take } \sqrt{\frac{\mu_0}{\epsilon_0}} = 377 \text{ in SI units} \right)$$

Key : 2

$$\text{Sol : } I_{\text{ave}} = \frac{E_0^2}{2Z} = \frac{(\sqrt{377})^2}{2 \times 377} = \frac{1}{2}$$

$$\alpha = 2$$

47. In two separate Young's double – slit experimental set-ups and two monochromatic light sources of different wavelength are used to get fringes of equal width. The ratios of the slits separations and that of the wavelengths of light used are 2:1 and 1:2 respectively. The corresponding ratio of the distance between the slits and the respective screens (D_1 / D_2) is ____

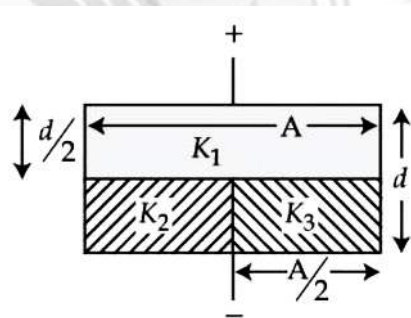
Key : 4

$$\text{Sol : } \beta_1 = \beta_2$$

$$\frac{D_1 \lambda_1}{d_1} = \frac{D_2 \lambda_2}{d_2}$$

$$\frac{D_1}{D_2} = \frac{d_1}{d_2} \times \frac{\lambda_2}{\lambda_1} = 4$$

48. The space between the plates of a parallel plate capacitor of capacitance C (without any dielectric) is now filled with three dielectric slabs of dielectric constants $K_1 = 2, K_2 = 3$ and $K_3 = 5$ (as shown in figure). If new capacitance is $\frac{n}{3}C$ then the value of n is ____



Key : 8

$$\text{Sol : } C = \frac{\epsilon_0 A}{d}$$

$$C_1 = \frac{2\epsilon_0 A}{d/2} = 4C$$

$$C_2 = 3C$$

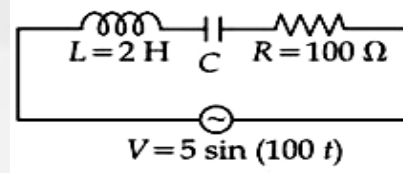
$$C_3 = 5C$$

$$C_p = 3C + 5C = 8C$$

$$C_{eff} = \frac{4C \times 8C}{12C} = \frac{8C}{3} = \frac{n}{3}C$$

$$n = 8$$

49. Using a variable frequency a.c. voltage source the maximum current measured in the given LCR circuit is 50 mA for $V = 5 \sin(100t)$. The values of L and R are shown in the figure. The capacitance of the capacitor (C) used is _____ μF .



Key : 50

Sol : Maximum current is possible in resonance condition

$$x_L = x_C$$

$$L\omega = \frac{1}{c\omega} \Rightarrow c = \frac{1}{\omega^2 L}$$

$$c = \frac{1}{(100)^2 (2)} = 50 \mu F$$

50. A Simple Pendulum made of mass 10g and a metallic wire of length 10cm is suspended vertically in a uniform magnetic field of 2T. The magnetic field direction is perpendicular to the plane of oscillations of the pendulum. If the pendulum is released from an angle of 60° with vertical, then maximum induced EMF between the point of suspension and point of oscillations is _____ mV. (Take $g = 10 \text{ m/s}^2$)

Key : 100

Sol : $mgh = \frac{1}{2}mv^2$

$$mgl[1 - \cos 60^\circ] = \frac{1}{2}mv^2$$

$$V = 1 \text{ m/s}$$

$$\text{Emf} = \frac{1}{2}Bl^2\omega$$

$$\frac{1}{2}Blv = \frac{1}{2} \times 2 \times 0.1 \times 1 = 100 \text{ mV}$$

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. The statements that are incorrect about the nickel (II) complex of dimethylglyoxime are:

- A) It is red in colour.
- B) It has a high solubility in water at pH = 9.
- C) The Ni ion has two unpaired d-electrons.
- D) The N – Ni – N bond angle is almost close to 90°
- E) The complex contains four five-membered metallacycles (metal containing rings)

Choose the correct answer from the options given below :

- 1) A, D and B only
- 2) C and D only
- 3) C and E only
- 4) B, C and E only

Key : 4

Sol : Ni DMG₂ shows dsp hybridization, dia magnetic and produces red coloured ppt. in ammonical solution P^H 9 . It shows square planar structure and bond angle is 90° .

It consist of two five member rings and two six member rings.

52. Identify the molecule (X) with maximum number of lone pairs of electrons (obtained using Lewis dot structure) among HNO₃, H₂SO₄, NF₃ and O₃. Choose the correct bond angle made by the central atom of the molecule (X).

- 1) 120°
- 2) 102°
- 3) 107°
- 4) 116°

Key : 2

Sol : HNO₃ contains 7 lone pairs

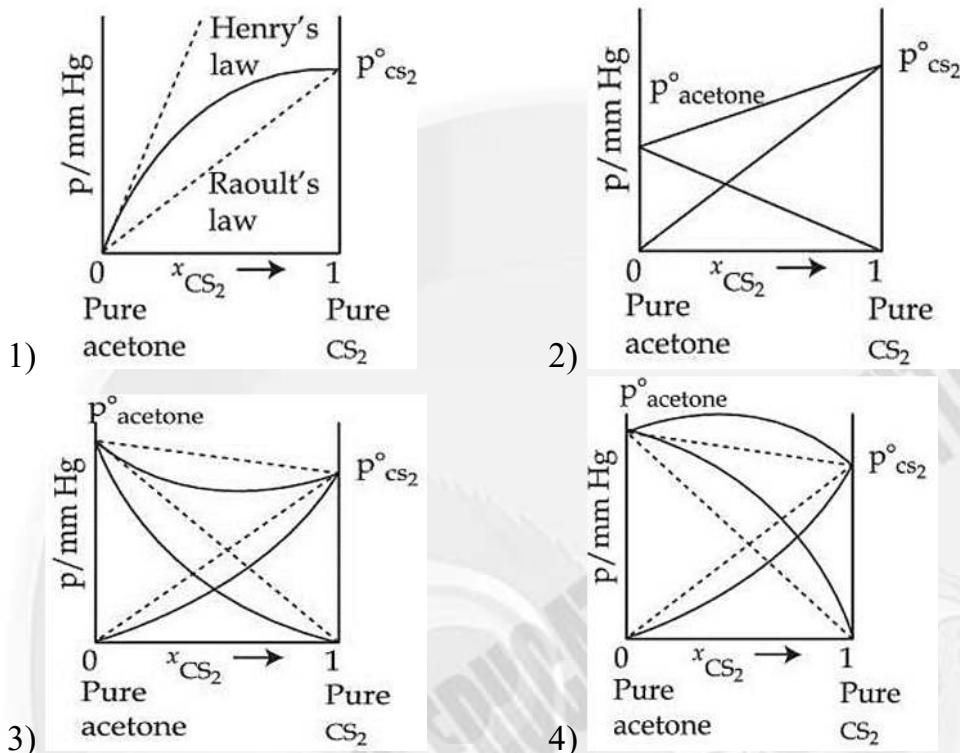
H₂SO₄ contains 8 lone pairs

NF₃ contains 10 lone pairs

O₃ contains 6 lone pairs

Based on above data NF₃ contains more no. of lone pairs and bond angle nearly equals to 102° .

53. Which of the following graphs accurately represents the plot of partial pressure of CS_2 vs its mole fraction in a mixture of acetone and CS_2 at constant temperature?



Key : 1

Sol : CS_2 CH_3COCH_3

(non polar) (polar)

non ideal solution

Henry's law behaviour at low mole fraction.

54. Given below are two statements:

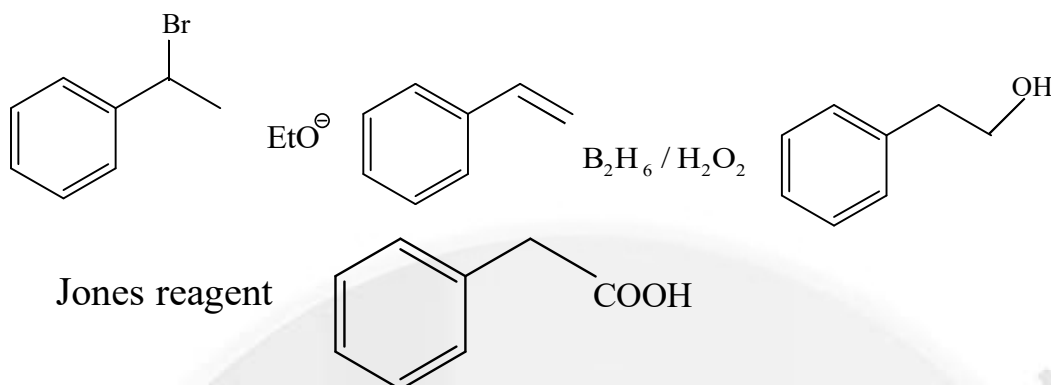
Statement – I : Sublimation is used for the separation and purification of compounds with low melting point.

Statement – II : The boiling point of a liquid increases as the external pressure is reduced. 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) Both Statement – I and Statement – II are true
- 3) Statement – I is false but Statement – II is true
- 4) Statement – I is true but Statement – II is false

Key : 2

Sol :



57. Given :

(A) $n = 5, m_l = 1$ (B) $n = 3, l = 2, m_l = 1, m_s = \frac{1}{2}$

The maximum number of electron(s) in an atom that can have the quantum numbers as given in (A) and (B) respectively are :

- 1) 26 and 1 2) 2 and 4 3) 8 and 1 4) 4 and 1

Key : 3

Sol : Part – A : $n = 5, m = -1$

$m = -1$ allowed l values are $l = 1, 2, 3, 4$

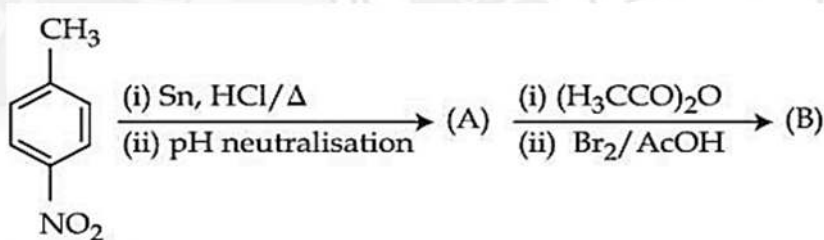
No. of orbitals = 4

Maximum of no. of electrons = $4 \times 2 = 8$

Part – B : $n = 3, l = 2, m = -1, s = +\frac{1}{2}$

Maximum no. of electrons = 1

58. Consider the following sequences of reactions:



4- nitrotoluene

Assuming that the reaction proceeds to completion then 137 mg of 4-nitrotoluene will produce mg of B.

(Given molar mass in g mol^{-1} H : 1, C : 12, N : 14, O : 16, Br : 80)

- 1) 208 2) 301 3) 228 4) 146

Key : 3

Sol : mole $\frac{137 \cdot 10^3}{137} = 0.001 \text{ mol}$

Mole of product = 0.001 mole.

Mass of product = 0.001 \cdot 228 gr = 0.228 = 228 gr.

59. Consider the general reaction given below at 400 K



The value of K_p and K_c are studied under the same condition of temperature but variation in x and y.

I) $K_p = 85.87$ and $K_c = 2.586$ appropriate units

II) $K_p = 0.862$ and $K_c = 28.62$ appropriate units

The values of x and y in (i) and (ii) respectively are :

1) (i) 3, 1 (ii) 3, 1 2) (i) 4, 1 (ii) 4, 1

3) (i) 1, 3 (ii) 2, 1 4) (i) 1, 2 (ii) 2, 1

Key : 4

Sol : A B

$$K_p = K_c (RT)^n$$

At 400k $RT = 0.082 \cdot 400 = 32.8$ nearly 33

Case (i) $\frac{K_p}{K_c} = \frac{85.87}{2.586} = 33$

$$n = 1$$

Case 2 : $\frac{K_p}{K_c} = \frac{0.862}{28.62} = 0.03$

$$n = 1$$

60. The correct statements from the following are:

- A) Ionic radii of trivalent cations of group 13 elements decreases down the group.
- B) Electro negativity of group 13 elements decreases down the group
- C) Among the group 13 elements, Boron has highest first ionisation enthalpy
- D) The trichloride and triiodide of group 13 elements are covalent in nature.

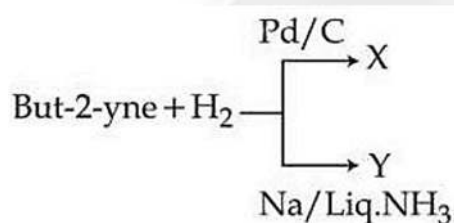
Choose the correct answer from the options given below :

- 1) C and D only 2) B and D only 3) A and D only 4) A and C only

Key : 1

Sol : Order of ionic radii : $B^3 < Al^3 < Ga^3 < In^3 < Tl^3$ Electro negativity : $B > Tl > In > Ga > Al$ Ionization enthalpy : $B > Tl > Ga > Al > In$ MX_3 shows covalent nature.

61. But-2-yne and hydrogen (one mole each) are separately treated with

i Pd/C and ii $Na/liq.NH_3$ to give the products X and Y respectively.

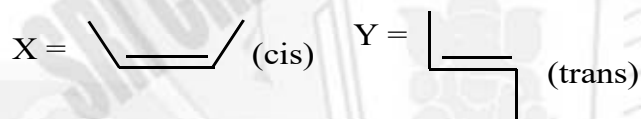
Identify the incorrect statements :

- A) X and Y are stereo isomers
 B) Dipole moment of X is zero
 C) Boiling point of X is higher than Y
 D) X and Y react with $O_3 / Zn \quad H_2O$ to give different products

Choose the correct answer from the options given below :

- 1) A and C only 2) B and C only 3) B and D only 4) A and B only

Key : 3

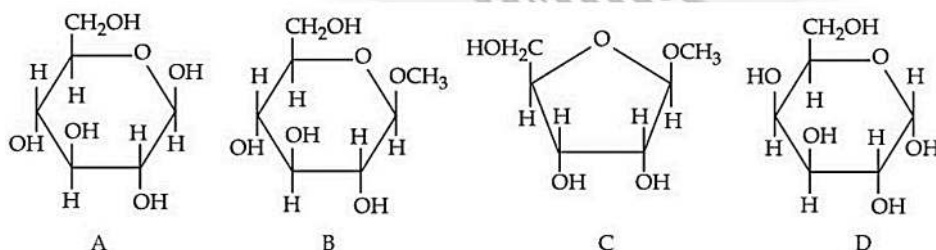


Sol :

X is having higher dipole moment than Y.

X, Y O_3 / Zn gives same product ethanol

62. From the given following (A to D) cyclic structures, those which will not react with Tollen's reagent are :



- 1) B and D 2) A and B 3) B and C 4) A and D

64. In the given electrochemical cell,

$\text{Ag s} | \text{AgCl s} | \text{FeCl}_2 \text{ aq}, \text{FeCl}_3 \text{ aq} | \text{Pt s}$ at 298 K, the cell potential E_{cell} will increase when :

- A) Concentration of Fe^{2+} is increased
- B) Concentration of Fe^{3+} is decreased
- C) Concentration of Fe^{2+} is decreased
- D) Concentration of Fe^{3+} is increased
- E) Concentration of Cl^- is increased

Choose the correct answer from the options given below :

- 1) A and E only
- 2) B only
- 3) C, D and E only
- 4) A and B only

Key : 3

Sol : $\text{Ag} | \text{Cl}^- | \text{Fe}^{3+} | \text{AgCl} | \text{Fe}^{2+}$

$$E = E^0 - \frac{0.059}{n} \log \frac{[\text{Fe}^{2+}]}{[\text{Cl}^-][\text{Fe}^{3+}]} \quad (n = 1)$$

65. Given below are two statements :

Statement – I : CoBr_4^{2-} ions will absorb light of lower energy than CoCl_4^{2-} ion.

Statement – II : In CoI_4^{2-} ion, the energy separation between the two set of d-orbitals is more than $[\text{CoCl}_4]^{2-}$ ion.

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) Both Statement – I and Statement – II are true
- 3) Both Statement – I and Statement – II are false
- 4) Statement – I is false but Statement – II is true

Key : 1

Sol : Order of ligand strength is $\text{Br}^- > \text{Cl}^-$

Ligand strength \propto complementary colour wavelength

1

absorbed wave length

Order of CFSE is CoCl_4^{2-} CoBr_4^{2-}

66. The correct trend in the first ionization enthalpies of the elements in the 3rd periodic table is :

- 1) $\text{S} < \text{Si} < \text{Al} < \text{P} < \text{Cl}$ 2) $\text{Al} < \text{Si} < \text{S} < \text{P} < \text{Cl}$
 3) $\text{Al} < \text{S} < \text{P} < \text{Si} < \text{Cl}$ 4) $\text{Si} < \text{S} < \text{Al} < \text{P} > \text{Cl}$

Key : 2**Sol :** Order of ionization energy is $\text{Al} < \text{Si} < \text{S} < \text{P} < \text{Cl}$

Phosphorus contains half filled P sub shell

67. A cup of water at 5°C (system) is placed in a microwave oven and the oven is turned on for one minute during which the water begins to boil. Which of the following option is true?

- 1) q ve, w ve, U ve 2) q ve, w 0, U ve
 3) q ve, w ve, U ve 4) q ve, w ve, U ve

Key : 1**Sol :** Cup of water 5°C

Heated in microwave oven. After 1 min. water begins to boil.

System = water

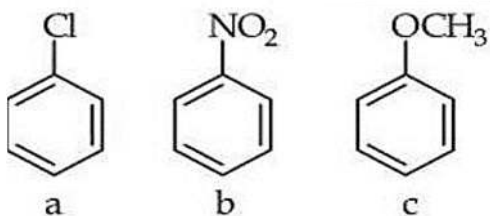
q = +ve

Temperature increases from 5°C to 100°C

U ve

W ve

68. Consider the following compounds

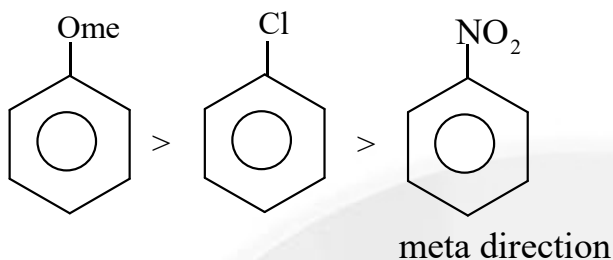


Arrange these compounds in the increasing order of reactivity with nitrating mixture.

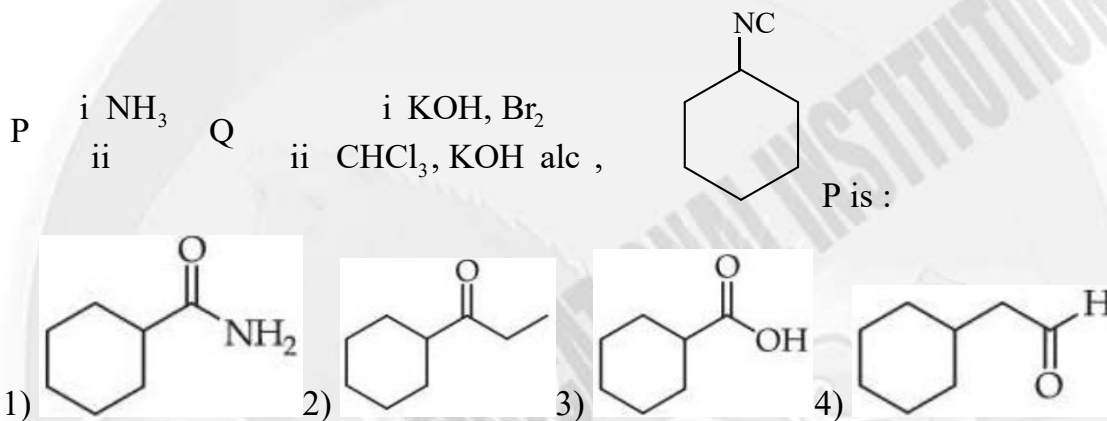
- 1) $c < b < a$ 2) $b < c < a$ 3) $b < a < c$ 4) $c < a < b$

Key : 3

Sol : Rate of EAS order

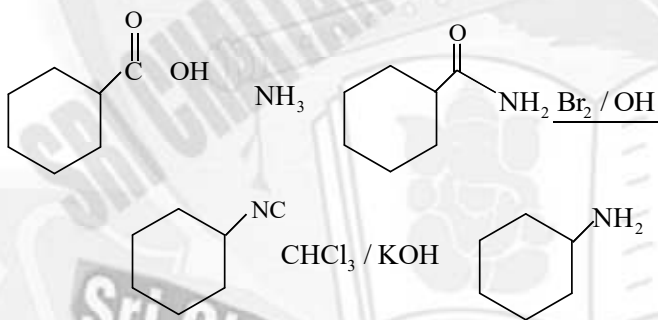


69. Compound 'P' undergoes the following sequence of reactions:



Key : 3

Sol :



70. Which of the following statements regarding the energy of the stationary state is true in the following one-electron systems?

- 1) $2.18 \times 10^{-18} \text{ J}$ for second orbit of He⁺ ion
- 2) $1.09 \times 10^{-18} \text{ J}$ for second orbit of H atom.
- 3) $2.18 \times 10^{-18} \text{ J}$ for third orbit of Li²⁺ ion.
- 4) $8.72 \times 10^{-18} \text{ J}$ for first orbit of He⁺ ion.

Key : 3

Sol : $E_n = \frac{2.18 \times 10^{-18}}{n^2} Z^2$ $Z = 3, n = 3$

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. x mg of pure HCl was used to make an aqueous solution 25.0 ml. of 0.1 M Ba OH₂ solution is used when the HCl solution was titrated against it. The numerical value of 'x' is 10^1 (nearest integer)
Given : molar mass of HCl and Ba OH₂ are 36.5 and 171.0 g mol⁻¹ respectively).

Key : 1825

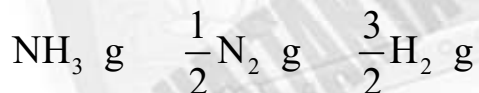


$$N_1 V_1 = N_2 V_2$$

$$\frac{W}{36.5} \times 1000 = 0.1 \times 25$$

$$wt = 182.5 \times 10^3 \text{ gm} = 182.5 \text{ milli. gram} = 1825 \times 10^1$$

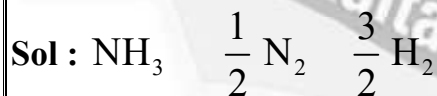
72. For the following gas phase equilibrium reaction at constant temperature.



If the total pressure is $\sqrt{3}$ atm and the pressure equilibrium constant K_p is 9 atm, then the degree of dissociation is given as $x \times 10^{2 \frac{1}{2}}$. The value of 'x' is

(nearest integer)

Key : 125



$$1 \quad 0 \quad 0$$

$$1 \quad \frac{1}{2} \quad \frac{3}{2}$$

$$\text{Total moles at equilibrium} \quad 1 \quad \frac{1}{2} \quad \frac{3}{2} \quad 1$$

$$PP_{\text{NH}_3} = \frac{1}{1} \sqrt{3}; PP_{\text{N}_2} = \frac{1}{2} \sqrt{3}$$

$$P_{H_2} = \frac{3}{2} \sqrt{3}$$

$$K_p = \frac{P_{N_2}^{\frac{1}{2}} P_{H_2}^{3/2}}{P_{NH_3}}$$

After substitution and simplification

$$K_p = \frac{3\sqrt{3}}{4} \frac{P}{1^2}$$

$$9 = \frac{3\sqrt{3}}{4} \frac{2\sqrt{3}}{1^2}$$

$$\frac{4}{5} = \sqrt{\frac{4}{5}}$$

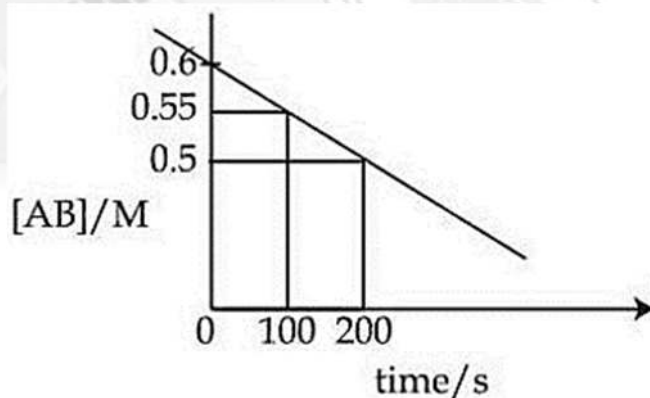
$$x \cdot 10^{-2} = 10^{-2}$$

$$x = 1$$

$$\frac{4}{5} = \frac{1}{x \cdot 10^{-2}}$$

$$x = 125$$

73. For the thermal decomposition of reactant AB(g), the following plot is constructed.



The half life of the reaction is 'x' min.

x = min. (nearest integer)

Key : 10

Sol : Given graph zero order

At $t = 0$ $(AB) = 0.6$

$t = 200$, $(AB) = 0.5$

Change = 0.1

$$K = \frac{0.1}{200} \times 5 \times 10^4$$

$$t_{\frac{1}{2}} = \frac{a_0}{2k} = \frac{0.6}{2 \times 5 \times 10^4} \times \frac{0.6}{10^3} = 600 \text{ sec.} = 10 \text{ min.}$$

74. The crystal field splitting energy of $\text{Co}(\text{oxalate})_3^{3-}$ complex is 'n' times that of the $\text{Cr}(\text{oxalate})_3^{3-}$ complex. Here 'n' is (Assume Δ_0 P)

Key : 2

Sol : C.F.S.E Δ_0 t_{2g}^x e_g^y Δ_0

First complex C.F.S.E value = $2.4 \Delta_0$

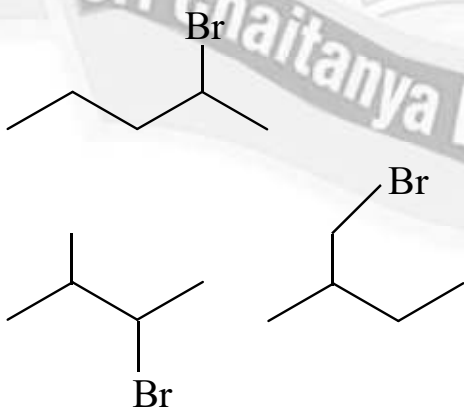
Second complex C.F.S.E value = $1.2 \Delta_0$

And the ratio equals to 2

75. Consider all the structural isomers with molecular formula $\text{C}_5\text{H}_{11}\text{Br}$ are separately treated with $\text{KOH}(\text{aq})$ to give respective substitution products, without any rearrangement. The number of products which can exhibit optical isomerism from these is

Key : 6

Sol :





TOPPERS ARE NOT BORN, THEY'RE MADE @ SRI CHAITANYA

SEIZES 3 RANKS IN TOP 10 IN JEE MAIN 2025 (ALL-INDIA OPEN CATEGORY)

1



**ALL INDIA RANK
OPEN CATEGORY**
Ajay Reddy Vangala
Appl. No. 25030265592
Class Secretary, Students' Forum, Graduate 06-XB

1



**ALL INDIA RANK
OPEN CATEGORY**
Devdutta Majhi
Appl. No. 2503001985*

10

All India Rank Open Category



**295
300
Marks**
Saksham Jindal
Appl. No. 250310236696*

Secured 31 ranks in Top 100 All INDIA Open Category

 12 RANK SAURAV Appl. No. 250310254844*	 22 RANK LAKSHYA SHARMA Appl. No. 25031034153*	 31 RANK BANDARI RUSHMITH Appl. No. 250310395238	 32 RANK BHAVESH JAYANTHI Appl. No. 250310299930	 33 RANK UJJWAL KESARI Appl. No. 250310008860*	 36 RANK PRADI SH GANDHI S Appl. No. 250310788252*
 39 RANK S SAI RISHANTH REDDY Appl. No. 250310565619	 41 RANK PRASANNA KS Appl. No. 250310326957	 43 RANK KOLLIBOINA NUNI SAI Appl. No. 250310460536	 44 RANK GORRE NITHIN REDDY Appl. No. 250310551436	 53 RANK U RAMA CHARANREDDY Appl. No. 250310260782	 56 RANK ARNAV NIGAM Appl. No. 25031026446
 60 RANK SAMUDRA SARKAR Appl. No. 250310179442*	 61 RANK SOHAN KALIDAS CHEEKAR Appl. No. 250310202114*	 64 RANK BUDUMURU VIKRAM RAJA Appl. No. 250310322700	 66 RANK SHAGANTI THRISHUL Appl. No. 250310500006	 70 RANK LAXIBHARGAV MENDE Appl. No. 250310246060	 71 RANK D CHETAN RAO Appl. No. 250310685984
 73 RANK V PRAVA S REDDY Appl. No. 250310253376	 75 RANK P SAI SURYA KARTHIK Appl. No. 250310407861	 76 RANK YASH KUMAR Appl. No. 250310204405*	 81 RANK P PRANAYA SAI MUKESH Appl. No. 250310606114	 89 RANK ADITYA SINGH Appl. No. 250310151728	 91 RANK JAY AGARWAL Appl. No. 250310122371*
 94 RANK V ESWAR KARTHIK Appl. No. 250310230425	 96 RANK SAKSHAM GARG Appl. No. 250310026726*	 97 RANK RANVEER SINGH VIRDE Appl. No. 250310790734			

BELOW 100
C.R.O. BY MARKS

31

BELOW 500
C.R.O. BY MARKS

95

BELOW 10
RANK COUNT

10

BELOW 100
RANK COUNT

98

BELOW 1000
RANK COUNT

579

TOTAL QUALIFIED RANKS
FOR JEE ADVANCED-2025

22,094



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

DEVDDUTTA MAJHI
HT. No. 255053116*

18
RANK

DHARMANA GNANA RUTVIK SAI
HT. No. 256053278

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. 252065188*

59
RANK

LARISSA
HT. No. 252079071*

60
RANK

ARYAN BALABADRULA
HT. No. 256132077

63
RANK

SAMYAJYOTI BISWAS
HT. No. 255353456*

64
RANK

AARUSH ANAND
HT. No. 251006179*

72
RANK

RUSHMITH BANDARI
HT. No. 256168948

78
RANK

KORIKANA BASAGNYA
HT. No. 256057046

87
RANK

LAKSHYA SHARMA
HT. No. 232070079*

91
RANK

AVANEESH BANSAL
HT. No. 25113130*

95
RANK

KAVYA AGGARWAL
HT. No. 232079121*

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**