3S INSTITUTE

JEE ADVANCED | JEE MAIN | NEET | OLYMPIADS | MHT-CET | FOUNDATION

11-April-2023 (Evening Batch) : JEE Main Paper

MATHEMATICS

Section - A (Single Correct Answer)

1. B

Sol. Put x = 0

$$\begin{vmatrix} 1 & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \lambda^2 \end{vmatrix} = \frac{9}{8}\times 81$$

$$\lambda^3 = \frac{9^3}{8} \quad \therefore \lambda = \frac{9}{2}$$

$$\therefore \frac{\lambda}{3} = \frac{3}{2}$$

$\therefore$ Required equation is :

$$x^2 - x\left(\frac{9}{2}+\frac{3}{2}\right)x + \frac{27}{4} = 0$$

$4x^2 - 24x + 27 = 0$

2. D

Sol. Line : $\frac{x-5}{3} = \frac{y-3}{4} = \frac{z-4}{2} = \lambda$

$R(3\lambda+5,\ 4\lambda+3,\ 2\lambda+4)$

$\therefore 3\lambda+5-4\lambda-3+2\lambda+4=4$

$\lambda+6=4 \ \therefore \lambda=-2$

$\therefore R \equiv (-1,\ -5,\ 0)$

Line : $\frac{x+1}{2} = \frac{y+5}{2} = \frac{z-0}{1} = \mu$

Point $T = (2\mu-1,\ 2\mu-5,\ \mu)$

It lies on plane

$2\mu-1+2(2\mu-5)+3\mu+2=0$

$\mu=1$

$\therefore T(1,\ -3,\ 1)$

$\therefore RT = 3$

3. C

Sol. T_{1011} from beginning = T_{1010+1}

$$= {}^{2022}C_{1010}\left(\frac{4x}{5}\right)^{1012}\left(\frac{-5}{2x}\right)^{1010}$$

T_{1011} from end

$$= {}^{2022}C_{1010}\left(\frac{-5}{2x}\right)^{1012}\left(\frac{4x}{5}\right)^{1010}$$

Given : ${}^{2022}C_{1010}\left(\frac{-5}{2x}\right)^{1012}\left(\frac{4x}{5}\right)^{1010}$

$$= 2^{10}\cdot {}^{2020}C_{1010}\left(\frac{-5}{2x}\right)^{1010}\left(\frac{4x}{5}\right)^{1012}$$

$$\left(\frac{-5}{2x}\right)^2 = 2^{10}\left(\frac{4x}{5}\right)^2$$

$$x^4 = \frac{5^4}{2^{16}}$$

$$|x| = \frac{5}{16}$$

4. C

Sol. Minimum $\{x^2,\ \{x\}\} = x^2\ ;\ x\in[0,\ 1)$

$[x - \log_e x] = 1\ ;\ x\in[1,\ 2)$

$$\therefore f(x) = \begin{cases} e^{x^2}; & x\in[0,\ 1) \\ e; & x\in[1,\ 2) \end{cases}$$

$$\int_0^2 xf(x)\,dx = \int_0^1 xe^{x^2}dx + \int_1^2 ex\,dx$$

$$= \frac{1}{2}(e-1) + \frac{1}{2}(4-1)e$$

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

5. C

Sol. $I.F = e^{\int \frac{5dx}{x(x^5+1)}} = e^{\int \frac{5x^{-6}dx}{(x^{-5}+1)}}$

Put, $1 + x^{-5} = t \Rightarrow -5x^{-6}\,dx = dt$

$$\Rightarrow e^{\int \frac{-dt}{t}} = \frac{1}{t} = \frac{x^5}{1+x^5}$$

$$y \cdot \frac{x^5}{1+x^5} = \int \frac{x^5}{(1+x^5)} \times \frac{(1+x^5)^2}{x^7} dx$$

$$y \cdot \frac{x^5}{1+x^5} = \frac{x^4}{4} - \frac{1}{x} + c$$

Given that : $x = 1 \Rightarrow y = 2$

$$2 \cdot \frac{1}{2} = \frac{1}{4} - 1 + c$$

$$c = \frac{7}{4}$$

$$y \cdot \frac{x^5}{1+x^5} = \frac{x^4}{4} - \frac{1}{x} + \frac{7}{4}$$

Now put, $x = 2$

$$y \cdot \left(\frac{32}{33}\right) = \frac{21}{4}$$

$$y = \frac{693}{128}$$

6. A

Sol. $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ are coplanar points.

$\vec{b} - \vec{a}, \vec{c} - \vec{a}, \vec{d} - \vec{a}$ are coplanar vectors.

So, $[\vec{b} - \vec{a}\ \vec{c} - \vec{a}\ \vec{d} - \vec{a}] = 0$

$$(\vec{b} - \vec{a}) \cdot ((\vec{c} - \vec{a}) \times (\vec{d} - \vec{a})) = 0$$

$$[\vec{b}\ \vec{c}\ \vec{d}] - [\vec{b}\ \vec{c}\ \vec{a}] - [\vec{b}\ \vec{a}\ \vec{d}] - [\vec{a}\ \vec{c}\ \vec{d}] = 0$$

$$\Rightarrow [\vec{a}\ \vec{b}\ \vec{c}] = [\vec{c}\ \vec{d}\ \vec{b}] + [\vec{b}\ \vec{d}\ \vec{a}] + [\vec{d}\ \vec{c}\ \vec{a}]$$

7. D

Sol. $I = \int_0^{\frac{\pi}{4}} f(\sin 2x)\sin x\,dx + \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} f(\sin 2x)\sin x\,dx$

$$+\alpha \int_0^{\frac{\pi}{4}} f(\cos 2x)\cos x\,dx = 0$$

Apply king in first part and put $x - \frac{\pi}{4} = t$ in second part.

$$I = \int_0^{\frac{\pi}{4}} f(\cos 2x)\sin\left(\frac{\pi}{4} - x\right)dx + \int_0^{\frac{\pi}{4}} f(\cos 2t)\sin\left(\frac{\pi}{4} + t\right)dt$$

$$+\alpha \int_0^{\frac{\pi}{4}} f(\cos 2x)\cos x\,dx = 0$$

$$I = \int_0^{\frac{\pi}{4}} f(\cos 2x)\left[2\sin\frac{\pi}{4} \cdot \cos x + \alpha\cos x\right]dx = 0$$

$$I = (\alpha + \sqrt{2})\int_0^{\frac{\pi}{4}} f(\cos 2x)\cos x\,dx = 0$$

$$\therefore \alpha = -\sqrt{2}$$

8. A

Sol. $7x + 11y + \alpha z = 13$ ....(i)

$5x + 4y + 7z = \beta$ ....(ii)

$175x + 194y + 57z = 361$....(iii)

(i) × 10 + (ii) × 21 – (iii)

$$z(10\alpha + 147 - 57) = 130 + 21\beta - 361$$

$$\therefore 10\alpha + 90 = 0$$

$$\alpha = -9$$

$$130 - 361 + 21\beta = 0$$

$$\beta = 11$$

$$\alpha + \beta + 2 = 4$$

9. C

Sol. $[x]^2 - 3[x] - 10 > 0$

$[x] < -2$ or $[x] > 5$

10. B

Sol. $\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 8 & 0 & -2 \\ 4 & -3 & -2 \end{vmatrix} = \hat{i}(-6) + 8\hat{j} - 24\hat{k}$

Normal of the plane $= 3\hat{i} - 4\hat{j} + 12\hat{k}$

Plane : 3x – 4y + 12z = 3

Distance from A(3, 4, α)

$$\left|\frac{9-16+12\alpha-3}{13}\right| = 2$$

$\alpha = 3$

$\alpha = -8$ (rejected)

Distance from B(2, 3, a)

$$\left|\frac{6-12+12a-3}{13}\right| = 3$$

a = 4

11. D

Sol. Converse of $((\sim p)\wedge q)\Rightarrow r$

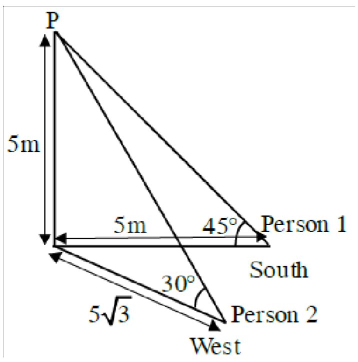
$\equiv r \Rightarrow (\sim p \wedge q)$

$\equiv \sim r \vee (\sim p \wedge q)$

$\equiv \sim r \vee (p \vee \sim q) \equiv (p \vee \sim q) \Rightarrow \sim r$

12. A

Sol.



Distance = 10 (By Pythagoras theorem)

13. A

Sol. $$\frac{5\left(\frac{a}{5}\right)+3\left(\frac{b}{3}\right)+2\left(\frac{c}{2}\right)+d}{11} \geq \left(\frac{a^5b^3c^2d}{5^5 3^3 2^2}\right)^{1/11}$$

$$1 \geq \left(\frac{a^5b^3c^2d}{5^5 3^3 2^2}\right)^{1/11}$$

$\beta = 90$

14. C

Sol. $(x-2)^2 + y^2 = r^2$

Solving with ellipse, we get

$$(x-2)^2 + \frac{36-x^2}{4} = r^2$$

$3x^2 - 16x + 52 - 4r^2 = 0$

$$D = 0 \Rightarrow 4r^2 = \frac{92}{3}$$

15. D

Sol. $x + y = 18 \{\because \text{mean} = 5\}$ ....(i)

$$10 = \frac{1+4+16+25+x^2+y^2}{6} - 25$$

$x^2 + y^2 = 164$ ....(ii)

By solving (i) and (ii)

x = 8, y = 10

$$\text{M.D.}(\bar{x}) = \frac{\sum|x_i - \bar{x}|}{6} = \frac{8}{3}$$

16. B

Sol. ${}^{n+2}C_{r-1} : {}^{n+2}C_r : {}^{n+2}C_{r+1} = 1 : 3 : 5$

$$\frac{{}^{n+2}C_{r-1}}{{}^{n+2}C_r} = \frac{1}{3}$$

n = 4r – 3 ....(i)

$$\frac{{}^{n+2}C_r}{{}^{n+2}C_{r+1}} = \frac{3}{5}$$

8r – 1 = 3n ....(ii)

From, (i) and (ii)

r = 2 and n = 5

Required sum = 63

17. A

Sol. 4 × 4! + 1 × 3! + 1 = 103

18. B

Sol. Let $a = x_1 + iy_1$, $z = x + iy$

Now $\text{Re}(a+\bar{z}) > \text{Im}(\bar{a}+z)$

$\therefore x_1 + x > -y_1 + y$

$x_1 = 2, y_1 = 10, x = -12, y = 0$

Given inequality is not valid for these values.

S1 is false.

Now $\text{Re}(a+\bar{z}) < \text{Im}(\bar{a}+z)$

$x_1 + x < -y_1 + y$

$x_1 = -2, y_1 = -10, x = 12, y = 0$

Given inequality is not valid for these values.

S2 is false.

19. B

Sol. Let $a_1 = 1 \Rightarrow$ 5 choices of b_2

$a_1 = 3 \Rightarrow$ 4 choices of b_2

$a_1 = 4 \Rightarrow$ 4 choices of b_2

$a_1 = 6 \Rightarrow$ 2 choices of b_2

$a_1 = 9 \Rightarrow$ 1 choices of b_2

For (a_1, b_2) 16 ways.

Similarly, $b_1 = 2 \Rightarrow$ 4 choices of a_2

$b_1 = 4 \Rightarrow$ 3 choices of a_2

$b_1 = 5 \Rightarrow$ 2 choices of a_2

$b_1 = 8 \Rightarrow$ 1 choices of a_2

Required elements in R = 160

20. B

Sol. $f(x) = \begin{cases} x+1, & x<0 \\ 1-x, & 0 \le x < 1 \\ x-1, & 1 \le x \end{cases}$

$g(x) = \begin{cases} x+1, & x<0 \\ 1, & x \ge 0 \end{cases}$

$g(f(x)) = \begin{cases} x+2, & x<-1 \\ 1, & x \ge -1 \end{cases}$

$\therefore g(f(x))$ is continuous everywhere

g(f(x)) is not differentiable at x = –1

Differentiable everywhere else

Section - B (Numerical Value)

21. 2

Sol. Let $e^{2x} = t$

$\Rightarrow t^4 - t^3 - 3t^2 - t + 1 = 0$

$\Rightarrow t^2 + \frac{1}{t^2} - \left(t + \frac{1}{t}\right) - 3 = 0$

$\Rightarrow \left(t+\frac{1}{t}\right)^2 - \left(t+\frac{1}{t}\right) - 5 = 0$

$\Rightarrow t + \frac{1}{t} = \frac{1+\sqrt{21}}{2}$

Two real values of t.

22. 27

Sol. $64x^2 + 5Nx + 1 = 0$

$D = 25N^2 - 256 < 0$

$\Rightarrow N^2 < \frac{256}{25} \Rightarrow N < \frac{16}{5}$

$\therefore N = 1, 2, 3$

$\therefore$ Probability $= \frac{1}{4} + \frac{3}{4} \times \frac{1}{4} + \frac{3}{4} \times \frac{3}{4} \times \frac{1}{4} = \frac{37}{64}$

$\therefore q - p = 27$

23. 285

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

$\vec{b} \cdot (\vec{a} \times \vec{c}) = 27,\ \vec{a} \cdot \vec{b} = 0$

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

Let θ be angle between $\vec{b}, \vec{a} \times \vec{c}$

Then $|\vec{b}| \cdot |\vec{a} \times \vec{c}| \sin\theta = 3\sqrt{14}$

$|\vec{b}| \cdot |\vec{a} \times \vec{c}| \cos\theta = 27$

$\Rightarrow \sin\theta = \frac{\sqrt{14}}{\sqrt{95}}$

$\Rightarrow |\vec{a} \times \vec{c}| = \sqrt{3} \times \sqrt{95}$

24. 1680

Sol. $\left(\frac{z^2 + 8iz - 15}{z^2 - 3iz - 2}\right) \in R$

$\Rightarrow 1 + \frac{(11iz - 13)}{(z^2 - 3iz - 2)} \in R$

Put $z = \alpha - \frac{13}{11}i$

$\Rightarrow z = \alpha - \frac{13}{11}i$

Put z = x + iy

$\Rightarrow (x^2 - y^2 + 2xyi - 3ix + 3y - 2) \in$ Imaginary

$\Rightarrow \text{Re}(x^2 - y^2 + 3y - 2 + (2xy - 3x)i) = 0$

$\Rightarrow x^2 - y^2 + 3y - 2 = 0$

$x^2 = y^2 - 3y + 2$

$x^2 = (y-1)(y-2) \;\therefore\; z = \alpha - \frac{13}{11}i$

Put $x = \alpha,\ y = \frac{-13}{11}$

$\alpha^2 = \left(\frac{-13}{11} - 1\right)\left(\frac{-13}{11} - 2\right)$

$\alpha^2 = \frac{(24 \times 35)}{121}$

$242\alpha^2 = 48 \times 35 = 1680$

25. 2

Sol. $10 = 1 + \frac{4}{k} + \frac{8}{k^2} + \frac{13}{k^3} + \frac{19}{k^4} + \ldots\ldots$ upto ∞

$9 = \frac{4}{k} + \frac{8}{k^2} + \frac{13}{k^3} + \frac{19}{k^4} + \ldots\ldots$ upto ∞

$\frac{9}{k} = \frac{4}{k^2} + \frac{8}{k^3} + \frac{13}{k^4} + \ldots\ldots$ upto ∞

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$S = 9\left(1 - \frac{1}{k}\right) = \frac{4}{k} + \frac{4}{k^2} + \frac{5}{k^3} + \frac{6}{k^4} + \ldots..$ upto ∞

$\frac{S}{k} = \frac{4}{k^2} + \frac{4}{k^3} + \frac{5}{k^4} + \ldots\ldots$ upto ∞

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$\left(1 - \frac{1}{k}\right)S = \frac{4}{k} + \frac{1}{k^3} + \frac{1}{k^4} + \frac{1}{k^5} + \ldots..\infty$

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

$9(k-1)^2 = 4k(k-1) + 1$

$k = 2$

26. 360

Sol. $f(1) + f(2) + 1 = f(4)k, 6$

$f(1) + f(2) \le 5$

Case (i) $f(1) = 1 \Rightarrow f(2) = 1, 2, 3, 4 \Rightarrow$ 4 mappings

Case (ii) $f(1) = 2 \Rightarrow f(2) = 1, 2, 3 \Rightarrow$ 4 mappings

Case (iii) $f(1) = 3 \Rightarrow f(2) = 1, 2 \Rightarrow$ 2 mappings

Case (iv) $f(1) = 4 \Rightarrow f(2) = 1 \Rightarrow$ 1 mapping

f(5) & f(6) both have 6 mappings each

Number of functions = $(4 + 3 + 2 + 1) \times 6 \times 6 = 360$

27. 116

Sol. $\because P(3, \alpha)$ lies on $y^2 = 12x$

$\Rightarrow \alpha = \pm 6$

But, $\left.\frac{dy}{dx}\right|_{(3,\,\alpha)} = \frac{6}{\alpha} = 1 \Rightarrow \alpha = 6 (\alpha = -6 \text{ reject})$

Now, hyperbola $\frac{x^2}{9} - \frac{y^2}{36} = 1$, normal at $Q(\alpha - 1,\ \alpha + 2)$ is $\frac{9x}{5} + \frac{36y}{8} = 45$

$\Rightarrow 2x + 5y - 50 = 0$

Now, distance of (6, –4) from $2x + 5y - 50 = 0$ is equal to

$\left|\frac{2(6) - 5(4) - 50}{\sqrt{2^2 + 5^2}}\right| = \frac{58}{\sqrt{29}}$

$\Rightarrow$ Square of distance = 116

28. 11

Sol. $\ell : x = \frac{y-1}{2} = \frac{z-3}{\lambda},\ \lambda \in \mathbb{R}$

DR's of line $\ell(1,\ 2,\ \lambda)$

DR's of normal vector of plane P : $x + 2y + 3z = 4$

Now, angle between line ℓ and plane P is given by

$\sin\theta = \left|\frac{1 + 4 + 3\lambda}{\sqrt{5 + \lambda^2} \cdot \sqrt{14}}\right| = \frac{3}{\sqrt{14}}\left(\text{given } \cos\theta = \sqrt{\frac{5}{14}}\right)$

$\Rightarrow \lambda = \frac{2}{3}$

Let variable point on line ℓ is $\left(t,\ 2t+1,\ \frac{2}{3}t+3\right)$

lies on plane P.

$\Rightarrow t=-1$

$\Rightarrow \left(-1,\ -1,\ \frac{7}{3}\right)=(\alpha,\ \beta,\ \gamma)$

$\Rightarrow \alpha+2\beta+6\gamma=11$

29. 348

Sol. Point of intersection of $\ell_1:3y-2y=3$

$\ell_2:x-y+1=0$ is $P\equiv(0,\ 1)$

Which lies on $\ell_3:\alpha x+\beta y+17=0,$

$\Rightarrow \beta=-17$

Consider a random point $Q\equiv(-1,\ 0)$

on $\ell_2:x-y+1=0,$ image of Q about

$\ell_2:x-y+1=0$ is $Q'\equiv\left(\frac{-17}{13},\ \frac{6}{13}\right)$ which is

calculated by formulae

$$\frac{x-(-1)}{2}=\frac{y-0}{-3}=-2\left(\frac{-2+3}{13}\right)$$

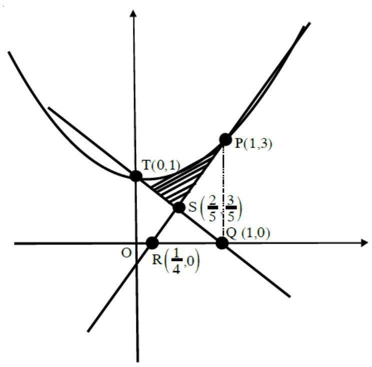
Now, Q' lies on $\ell_3:\alpha x+\beta y+17=0$

$\Rightarrow \alpha=7$

Now, $\alpha^2+\beta^2-\alpha-\beta=348$

30. 16

Sol.



$y = 2x^2 + 1$

Tangent at (1, 3)

$y = 4x - 1$

$A=\int_0^1 (2x^2+1)\,dx-$ area of $(\Delta QOT)-$ area of (ΔPQR) + area of (ΔQRS)

$$A=\left(\frac{2}{3}+1\right)-\frac{1}{2}-\frac{9}{8}+\frac{9}{40}=\frac{16}{60}$$

PHYSICS

Section - A (Single Correct Answer)

31. B

Sol. $v\propto r^2$

$$\frac{v_1}{v_2}=\left(\frac{r}{R}\right)^2$$

$$8\cdot\frac{4}{3}\pi r^3=\frac{4}{3}\pi R^3$$

$R = 2r$

$$\frac{10}{v_2}=\left(\frac{1}{2}\right)^2$$

$v_2 = 40$ cm/s

32. B

Sol. $f=f_0\left(\frac{c+v_0}{c+v_s}\right)$

$$f=400\left(\frac{360+40}{360+20}\right)$$

$f = 421$ Hz

33. B

Sol. $\vec{E}=6.6\hat{j}$

$v = 20$ MHz

$\vec{c}=3\times10^8\hat{i}$

$$|\vec{B}|=\frac{|\vec{E}|}{c}=2.2\times10^{-8}T$$

$\hat{E}\times\hat{B}=\hat{c}$

$\vec{B}=2.2\times10^{-8}\hat{k}T$

34. C

Sol. $\phi=\frac{q_{in}}{\epsilon_0}$

$$=\frac{Q}{\epsilon_0}=\frac{CV}{\epsilon_0}$$

35. B

Sol. $[ML^{-3}] = [MLT^{-2}]^a[LT^{-1}]^b[T]^c$

$= [M^aL^{a+b}T^{-2a-b+c}]$

a = 1,

a + b = – 3,

⇒ b = – 4,

also – 2a – b + c = 0

c = – 2

36. B

Sol. Conceptual

37. A

Sol. $V = \frac{GM}{2R^3}(3R^2 - r^2)$ at $r = R \Rightarrow V = \left(\frac{GM}{R}\right)$

at $r = 0,\ V_0 = \frac{3GM}{2R} = \left(\frac{3V}{2}\right)$

38. B

Sol. $v = 10\sqrt{x} \Rightarrow v^2 = 100x$

$2v\frac{dv}{dx} = 100 \Rightarrow a = 50\ m/s^2$

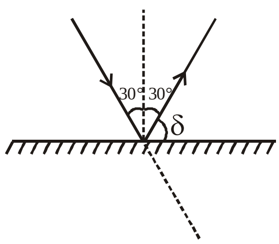
F = 25 N

39. A

Sol. At t = 2 particle is at maximum height moving with velocity V = 40 cos 30° = $20\sqrt{3}\ ms^{-1}$

40. B

Sol.



δ = 180° – 60 = 120°

41. C

Sol. $v_{orbit} = \sqrt{\frac{GM}{R}} = \sqrt{gR};$

$v_{escape} = \sqrt{\frac{2GM}{R}} = \sqrt{2gR}$

$\Delta v = (\sqrt{2} - 1)\sqrt{gR} = 8(\sqrt{2} - 1)$ km/s

42. A

Sol. $\lambda \propto \frac{1}{\sqrt{m}} \Rightarrow \frac{\lambda_p}{\lambda_e} = \sqrt{\frac{m_e}{m_p}} = 1:43$

43. B

Sol. T = constant ⇒ U = constant

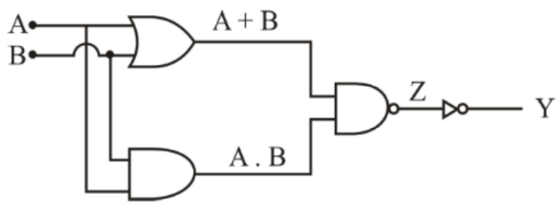
44. C

Sol.

$$E_n = \frac{-13.6Z^2}{n^2} = \frac{-13.6 \times 4}{4} = -13.6\ eV$$

45. A

Sol.



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

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

Y = A. B

∴ It is an AND Gate

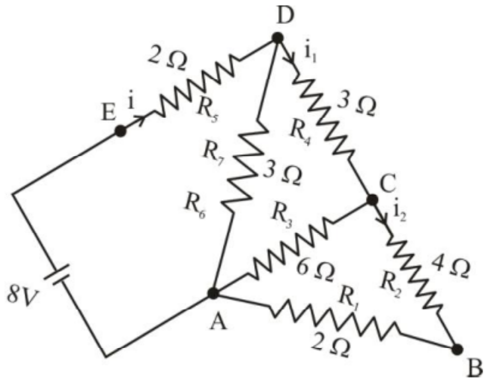
46. A

Sol.

$$V_{rms} = \sqrt{\frac{3k_BT}{m}} = \sqrt{\frac{3 \times 1.4 \times 10^{-23} \times 300}{4.6 \times 10^{-26}}} = 523\ m/s$$

47. D

Sol.



$R_{eq} = 4\ \Omega$

$$i = \frac{8}{4} = 2A$$

$$i_1 = \frac{2 \times 3}{3+6} = \frac{2}{3}A$$

$$i_2 = \frac{2/3}{2} = \frac{1}{3}A$$

48. BONUS

Sol. $\vec{B} - \vec{A} = 2\hat{j}$

$$\vec{B} = 2\hat{i} + 5\hat{j} + 2\hat{k}$$

$$|\vec{B}| = \sqrt{33}$$

49. C

Sol. Conceptual

50. B

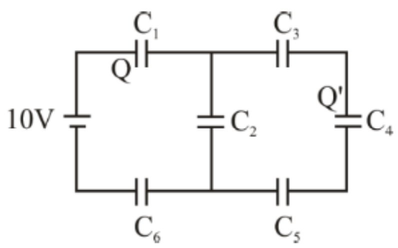
Sol. $\vec{F} = q(\vec{v} \times \vec{B})$ as angle between $\vec{v}$ and $\vec{B}$ is 0°

F = 0

Section - B (Numerical Value)

51. 4

Sol.



$$C_{eq} = 0.5\ \mu F$$

Q = 0.5 × 10 = 5 μC

$$Q' = \frac{5\mu C \times 0.8}{0.8 + 0.2} = 4\mu C$$

52. 3

Sol. $KE = \frac{L^2}{2I} \Rightarrow \frac{KE_{final}}{KE_{initial}} = \frac{I_{initial}}{I_{final}} \Rightarrow \frac{KE_{final}}{E} = \frac{1}{3}$

$$\Rightarrow KE_{final} = \frac{E}{3}$$

53. 2

Sol. $\frac{v_1}{v_2} = \frac{m_2}{m_1} = \frac{A_2}{A_1} = \frac{2}{1}$

54. 5

Sol. V = I × 10

$$1.5 = \left(\frac{3}{10+2r}\right) \times 10$$

r = 5 Ω

55. 300

Sol. F – 5g sin30° = 5a ⇒ F = 5 + 25 = 30N

V_{10} = u + at ⇒ v_{10} = 0 + 1(10) = 10 m/s

P_{10} = Fv = 300 W

56. 625

Sol. $I = \frac{V}{R} = \frac{5}{2}A$

$$E = \frac{1}{2}LI^2 = \frac{1}{2} \times 2 \times \left(\frac{5}{2}\right)^2$$

E = 625 × 10^{-2} J

57. 150

Sol. ΔV = (v × B)d

ΔV = (2 × 1/2) 0.15

ΔV = 150 mV

58. 80

Sol. $f = \frac{1}{2L}\sqrt{\frac{T}{\mu}} = \frac{1}{2L}\sqrt{\frac{Y A \Delta L}{\rho A L}}$

f = 80 Hz

59. 264

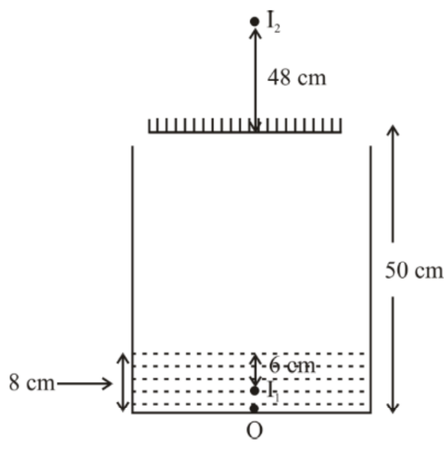
Sol. W = T·(ΔA)

$$W = T\left(8\pi\left(r_2^2 - r_1^2\right)\right)$$

W = 264 × 10^{-4} J

60. 98

Sol.



Apparent depth of $O = \frac{d}{\mu} = 6$

Distance between O and I_2 = 48 + 50 = 98 cm

CHEMISTRY

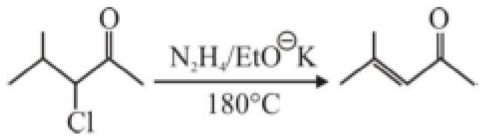
Section - A (Single Correct Answer)

61. A

Sol. BeH_2 is hypovalent.

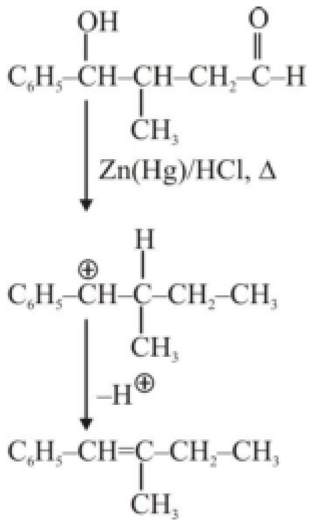
62. C

Sol. Wolff-Kishner reduction is not suitable for base sensitive group.



63. B

Sol.



64. A

Sol. Freons are chlorofluoro carbon.

65. A

Sol. $r = K[A]^1 [B]^1$

$0.1 = K(20)^1 (0.5)^1$ ...(i)

$0.40 = K(x)^1 (0.5)^1$ ...(ii)

$0.80 = K(40)^1 (y)^1$ ...(iii)

From (i) and (ii),

$x = 80$

From (i) and (iii),

$y = 2$

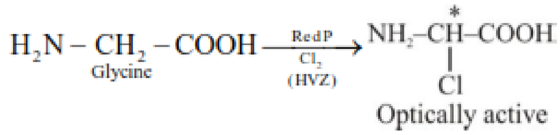
66. A

Sol. Since H_2O is strong field ligand compared to chloride and Co^{3+} ion is present.

$\therefore$ CFSE is higher for $[Co(NH_3)_5H_2O]^{+3}$, hence it will absorb at lower wavelength.

67. B

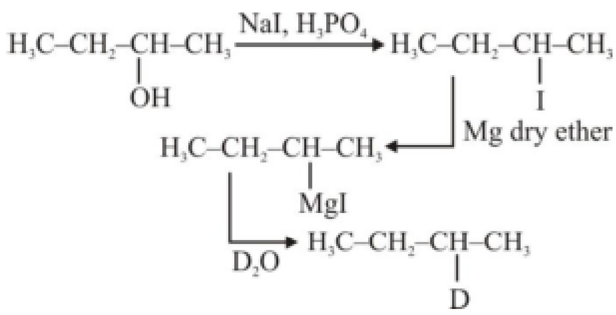
Sol.

(1) 

(2) Meso compound are optically inactive.

68. A

Sol.



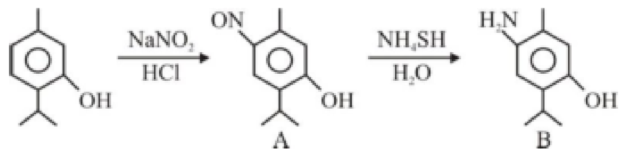
69. B

Sol. $S_1 \Rightarrow$ HDPE is formed by $TiCl_4$ & $Al(Et)_3$.

$S_2 \Rightarrow$ Nylon-6 is formed by caprolactam.

70. B

Sol.



71. A

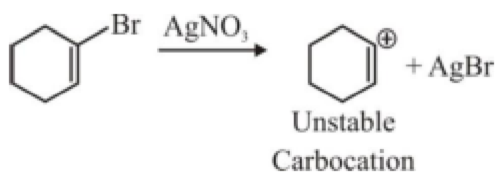
Sol. SO_2 and NH_3 are polar molecules. They are constituent particles of polar molecular solids.

72. A

Sol. $P_4 + 8SOCl_2 \rightarrow 4PCl_3 + 2S_2Cl_2 + 4SO_2$

73. A

Sol.



74. D

Sol. Solute (X) = 2 g

Solvent (H_2O) = 1 mole = 18 g

Total mass = 2 + 18 = 20 g

% mass of X = $\frac{2}{20}\times 100 = 10\%$

75. A

Sol. $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

Oxides on carbon reduction forms CO_2 while sulphide on carbon reduction gives CS_2.

CO_2 is more volatile compared to CS_2 therefore oxides are easy to reduce.

76. D

Sol. On moving down the group in alkali metals melting point decreases.

77. D

Sol. $\frac{P^0 - P_s}{P^0} = \frac{n}{N}$ (for dilute solution)

$$\frac{0.2}{54.2} = \frac{n\times 18}{100}$$

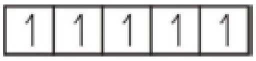
$$n = \frac{100}{271\times 18}$$

$$w = \frac{100\times 180}{271\times 18};\ w = 3.69g$$

78. D

Sol. $[Fe(H_2O)_6]^{3+}$

$Fe^{3+} \Rightarrow [Ar]3d^5 4s^0$

No pairing 

∴ Unpaired e^- = 5

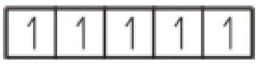
$$\mu = \sqrt{n(n+2)}$$

$$= \sqrt{5(5+2)}$$

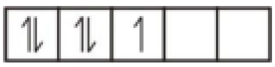
$$\mu = \sqrt{35} = 5.92 \text{ B.M.}$$

$[Fe(CN)_6]^{-3}$

$Fe^{3+} \Rightarrow [Ar]3d^5 4s^0$



Pairing occur due to strong field ligand CN^-



∴ Unpaired $e^- \Rightarrow 1$

$$\mu = \sqrt{n(n+2)}$$

$$= \sqrt{1(1+2)} = \sqrt{3} = 1.732 \text{ B.M.}$$

79. A

Sol. $Mg(NH_4)PO_4 \Rightarrow$ White

$K_3[Co(NO_2)_6] \Rightarrow$ Yellow

$MnO(OH)_2 \Rightarrow$ Brown

$Fe_4[Fe(CN)_6]_3 \Rightarrow$ Blue

80. B

Sol. $[NiBr_2Cl_2]^{2-} \rightarrow$ This complex species is tetrahedral as $Br^{\ominus}$ & $Cl^{\ominus}$ are weak field ligands.

$[PtBr_2Cl_2]^{2-} \rightarrow$ As Pt belongs to 5d series. This complex species is square planar.

Both the complex species are optically inactive.

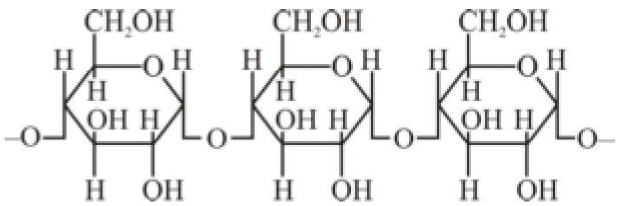
$[NiBr_2Cl_2]^{2-}$, being tetrahedral does not show Geometrical Isomerism.

$[PtBr_2Cl_2]^{2-}$ shows two Geometrical Isomers.

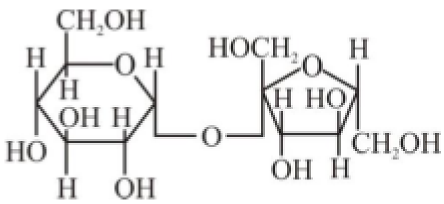
Section - B (Numerical Value)

81. 3

Sol. Amylose :



Sucrose :



Both Amylose and Sucrose does not give Benedict's test.

82. 1

Sol.

	$H_{2(g)}$	+ $I_{2(g)}$	$\rightleftharpoons$ $2HI_{(g)}$
t = 0	4.5	4.5	–
t_{eq}	3	3	3

$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{(3)^2}{3\times 3} = \frac{9}{3} = 1$$

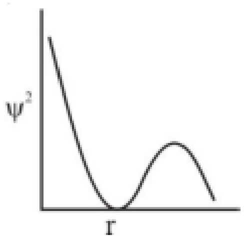
83. 3

Sol. B, C and D are correct.

(NCERT - Surface Chemistry)

84. 3

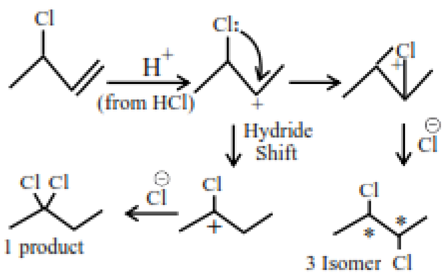
Sol. A, D and E statements are correct.



For 2s orbital, the probability density first decreases and then increases.
At any distance from nucleus the probability density of finding electron is never zero and it always have some finite value.

85. 4

Sol.



Total Possible Isomeric product = 1+ 3 = 4.

86. 6

Sol. $Mg(NO_3)_2 \cdot 6H_2O$ is a hydrated salt whereas $Ba(NO_3)_2$ is a anhydrous salt.

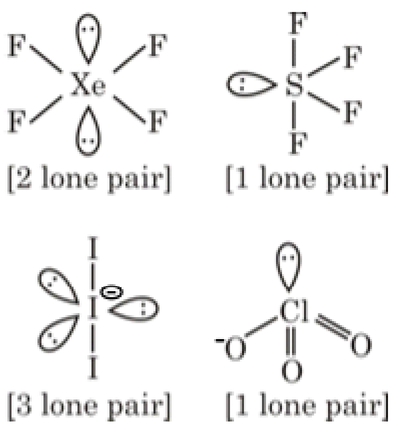
∴ $x + y = 6$

87. 4

Sol. Extensive ⇒ Mole, Volume, Gibbs free energy.
Intensive ⇒ Molar mass, Molar heat capacity, Molarity, E^{θ} cell.

88. 3

Sol.



89. 224

Sol. $Mg + 2HCl \rightarrow MgCl_2 + H_2 \uparrow$

w = 2.4 g

$N = \frac{2.4}{24} = 0.1$ mole

1 mole of gas at STP ⇒ 22.4 lit.

∴ 0.1 mole of gas = 0.1×22.4

$= 2.24$ lit. $= 224 \times 10^{-2}$ litre

90. 4

Sol. Given statements A, B, C and D are correct.

❒ ❒ ❒