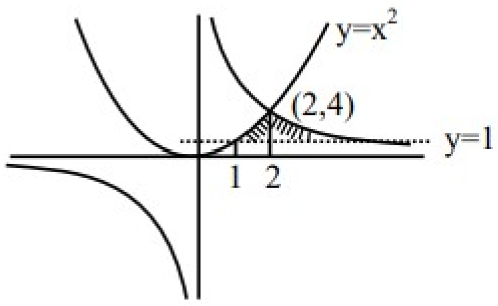
1 - JEE Main Maths 28-Jan 2026 Shift -1

Q1 Solution:
(3)



$A = \int_1^2 \left(x^2 - 1\right) dx + \int_2^8 \left(\frac{8}{x} - 1\right) dx$

$A = 8\log_e 4 - \frac{14}{3} = 16\log_e 2 - \frac{14}{3}$

$= \frac{2}{3}\left(24\log_e 2 - 7\right)$

Q2 Solution:
(1)

$\frac{\tan A - \tan B}{(1 + \tan A \tan B)\tan A} + \frac{1 + \cot^2 A}{1 + \cot^2 C} = 1$

Put $\tan A = x,\ \tan B = y,\ \tan C = z$

$\therefore \frac{x - y}{(1 + xy)x} + \frac{\left(x^2 + 1\right)z^2}{x^2\left(z^2 + 1\right)} = 1$

$\therefore x\left(x - y\right)\left(z^2 + 1\right) + z^2\left(1 + x^2\right)\left(1 + xy\right) = \left(1 + xy\right)x^2\left(1 + z^2\right)$

after solving we get

$z^2 = xy \qquad \because 1 + x^2 \neq 0$

$\therefore \tan^2 C = \tan A \cdot \tan B$

$\therefore \tan A,\ \tan C,\ \tan B$ are in G.P.

Q3 Solution:
(1)

$x^3 + ax^2 + bx + c = \left(x^2 + 2\right)\left(x + \frac{c}{2}\right)$

$x^2 : a = \frac{c}{2}$

$x :\ b = 2$

$b = 2,\ a = \frac{c}{2},\ c \in \left\{2, 4, \ldots, 20\right\}$

Number of polynomials in S will be 10 .

Q4 Solution:
(1)

$$T_k = (-1)^{k+1} . \frac{k(k+1)}{\lfloor k} = (-1)^{k+1}\left(\frac{k(k-1)+2k}{\lfloor k}\right)$$

$$\therefore \text{ sum } = \sum_{k=1}^{\infty} \frac{(-1)^{k+1}}{\lfloor k-2} + \sum_{k=1}^{\infty} \frac{2(-1)^{k+1}}{\lfloor k-1}$$

$$= \left(\frac{1}{\lfloor -1} - \frac{1}{\lfloor 0} + \frac{1}{\lfloor 1} - \frac{1}{\lfloor 2} + \frac{1}{\lfloor 3} ...\right) + \left(\frac{2}{\lfloor 0} - \frac{2}{\lfloor 1} + \frac{2}{\lfloor 2} - \frac{2}{\lfloor 3} ...\right)$$

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

Q5 Solution:

(4)

$B = (I + A)^{-1}, \; A + C = I$

$\Rightarrow B(I + A) = (I + A)B = I$

$\Rightarrow B + BA = B + AB$

$\Rightarrow B + B(I - C) = B + (I - C)B$

$\Rightarrow 2B - BC = 2B - CB$

$\Rightarrow BC = CB$

$$\therefore CB\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 1 & -5 \\ -1 & 2 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 12 \\ -6 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 1 & -5 \\ -1 & 2 \end{bmatrix}^{-1}\begin{bmatrix} 12 \\ -6 \end{bmatrix} = \frac{-1}{3}\begin{bmatrix} 2 & 5 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} 32 \\ -6 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 2 \\ -2 \end{bmatrix}$$

$\therefore \quad x_1 + x_2 = 0$

Q6 Solution:

(2)

Equation of circle C_2 is

$x^2 + y^2 - 5x - 5y = 0$

Its centre is $\left(\frac{5}{2}, \frac{5}{2}\right)$

[IMAGE 265]

$m_{AB} = -1$

$\therefore$ Slope of required chord $= 1$

$\therefore$ Equation of required chord is $x - y + 1 = 0$

$\therefore a = -1, \; b = 2$

$\therefore a - b = -2$

Q7 Solution:
(2)

$S = \{1, 2, 3, \ldots, 9\}$

$x = {}^9C_1 \cdot {}^8C_7 \times \frac{9!}{2} = \frac{9 \times 8 \times 9!}{2}$

$y = {}^9C_2 \cdot {}^7C_5 \times \frac{9!}{2!2!} = \frac{9 \times 8}{2} \times \frac{7 \times 6}{2} \times \frac{9!}{2!2!}$

$\Rightarrow \frac{x}{y} = \frac{4}{21}$

$\Rightarrow 21x = 4y$

Q8 Solution:
(3)

[IMAGE 266]

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

$L_1: \frac{x - 1}{3} = \frac{y - 2}{4} = \frac{z - a}{b} = \lambda$

$L_2: \frac{x - 1}{1} = \frac{y - 2}{4} = \frac{z - a}{c} = \mu$

Let $A(3\lambda + 1,\ 4\lambda + 2,\ b\lambda + a)$

It lies on L

$\therefore \frac{3\lambda}{1} = \frac{4\lambda + 2}{2} = \frac{b\lambda + a - 1}{1}$

$\Rightarrow \lambda = 1$ and $a + b - 1 = 3$

$\Rightarrow A(4, 6, 4),\ a + b = 4 \ \ldots(1)$

Let $B\left(\mu + 1,\ 4\mu + 2,\ c\mu + a\right)$

It also lies on L

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

$\Rightarrow 2\mu = 4\mu + 2$

$\Rightarrow \mu = -1$

$a - c - 1 = -1$

$\Rightarrow a = c \ \ldots(2),\ B(0, -2, 0)$

Also $PA = PB,\ P(1, 2, a),\ A(4, 6, 4)$

$\Rightarrow 9 + 16 + (a - 4)^2 = 1 + 16 + a^2$

$\Rightarrow 16 + 8 = 8a$

$\Rightarrow a = 3 \quad \therefore c = 3,\ b = 1$

$\therefore a + b + c = 7$

Q9 Solution:
(4)

$$\Rightarrow \lim_{x \to 0} \frac{\ln\left(\sec\left(ex\right)\right) + \ln\left(\sec\left(e^2x\right)\right) + \cdots + ln\left(\sec\left(e^{10}x\right)\right)}{e^{2\cos x}\left(\frac{e^{2-2\cos x}-1}{2-2\cos x}\right)\left(\frac{2-2\cos x}{x^2}\right)x^2}$$

$$\Rightarrow \lim_{x \to 0} \frac{ln\left(\sec\left(ex\right)\right) + ln\left(\sec\left(e^2x\right)\right) + \cdots + ln\left(\sec\left(e^{10}x\right)\right)}{e^2x^2}$$

Using L'H rule

$$\Rightarrow \lim_{x \to 0} \frac{e\tan\left(ex\right) + e^2\tan\left(e^2x\right) + \cdots + e^{10}\tan\left(e^{10}x\right)}{2e^2x}$$

$$= \frac{1}{2e^2}\left[e^2 + e^4 + e^6 + \cdots + e^{20}\right]$$

$$= \frac{1}{2} \cdot \frac{e^2\left(\left(e^2\right)^{10} - 1\right)}{e^2\left(e^2 - 1\right)}$$

$$= \frac{1}{2} \cdot \frac{\left(e^{20} - 1\right)}{\left(e^2 - 1\right)}$$

Q10 Solution:

(4)

$$\left|\vec{a} - \vec{b}\right|^2 + \left|\vec{b} - \vec{c}\right|^2 + \left|\vec{c} - \vec{a}\right|^2 = 9$$

$$\Rightarrow \vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a} = -\frac{3}{2}$$

$$\Rightarrow \vec{a} + \vec{b} + \vec{c} = 0 \Rightarrow \vec{b} + \vec{c} = -\vec{a}$$

$$\left|2\vec{a} + k\left(\vec{b} + \vec{c}\right)\right| = 3$$

$$\left|\vec{a}\left(2 - k\right)\right| = 3$$

$k = 5$ or -1

Positive value of k is 5

Q11 Solution:

(4)

Let common difference of A.P.'s are d_1 & d_2

$\therefore d_1 = 13 + d_2$

$b_1 + 30d_2 = -277 \quad \ldots(1)$

$b_1 + 42d_2 = -385 \quad \ldots(2)$

By $(2) - (1)$

$12d_2 = -108$

$d_2 = -9$

$\therefore d_1 = 4$

Now $a_{78} = 327$

$\Rightarrow a_1 + 77d_1 = 327$

$\Rightarrow a_1 + 308 = 327$

$a_1 = 19$

Q12 Solution:
(3)

$\frac{\beta - \alpha}{\alpha\beta} = \frac{1}{3}, \ \alpha + \beta = \frac{\lambda + 3}{\lambda}, \ \alpha\beta = \frac{3}{\lambda}$

$\beta - \alpha = \frac{\alpha\beta}{3} = \frac{1}{\lambda}$

on squaring

$\alpha^2 + \beta^2 - 2\alpha\beta = \frac{1}{\lambda^2} \ ...\left(1\right)$

$\alpha^2 + \beta^2 + 2\alpha\beta = \frac{(\lambda + 3)^2}{\lambda^2} \ ...\left(2\right)$

(2) - (1) $\quad 4\alpha\beta = \frac{(\lambda + 3)^2 - 1}{\lambda^2}$

$\frac{12}{\lambda} = \frac{\lambda^2 + 6\lambda + 8}{\lambda^2}$

$\Rightarrow \lambda^2 - 6\lambda + 8\lambda = 0$

$\Rightarrow \lambda = 0, 2, 4$

Sum of possible values of λ is 6

Q13 Solution:
(4)

Probability $= \frac{{}^1C_0 \cdot {}^9C_3}{\sum_{k=0}^{10} {}^kC_0 \cdot {}^{10-k}C_3}$

$= \frac{{}^9C_3}{{}^{10}C_3 + {}^9C_3 + {}^8C_3 + \cdots + {}^3C_3}$

$= \frac{{}^9C_3}{{}^{11}C_4}$

$= \frac{14}{55}$

Q14 Solution:
(3)

$x\frac{dy}{dx} - \sin 2y = x^3\left(2 - x^3\right)\cos^2 y$

$\sec^2 y\frac{dy}{dx} - 2\tan y \cdot \frac{1}{x} = x^2\left(2 - x^3\right)$

$\tan y = t \Rightarrow \sec^2 y\frac{dy}{dx} = \frac{dt}{dx}$

$\frac{dt}{dx} - \frac{2t}{x} = x^2\left(2 - x^3\right)$ (LDE)

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

$\therefore \frac{t}{x^2} = \int \frac{1}{x^2}x^2\left(2 - x^3\right)dx + C$

$\frac{\tan y}{x^2} = 2x - \frac{x^4}{4} + C$

$y\left(2\right) = 0 \Rightarrow 0 = 4 - 4 + C \Rightarrow C = 0$

$\tan y = 2x^3 - \frac{1}{4}x^6$

$x = 1 \Rightarrow \tan y = 2 - \frac{1}{4} = \frac{7}{4}$

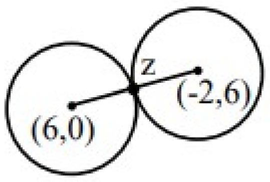
Q15 Solution:
(2)

Center of first circle $C_1(6,0)$, $r_1 = 5$

Center of second circle $C_2(-2,6)$, $r_2 = 5$

$\because C_1C_2 = r_1 + r_2$

$\therefore$ common point Z is mid point of C_1 & C_2



$\therefore z = 2 + 3i$

$\therefore z^2 = 4z - 13$

$\therefore z^3 = 3z - 52$

$\therefore z^3 + 3z^2 - 15z + 141 = 50$

Q16 Solution:
(2)

$g(2) = 13$

$f(g(2)) = f(13)$

Now $4g(f(x)) = 3x^2 - 32x + 72$

$4\left[3f^2(x) + 2f(x) - 3\right] = 3x^2 - 32x + 72$

Let $f(x) = t$

$12t^2 + 8t - (3x^2 - 32x + 84) = 0$

$$f\left(x\right) = \frac{-8 \pm \sqrt{64 + 48(3x^2 - 32x + 84)}}{24}$$

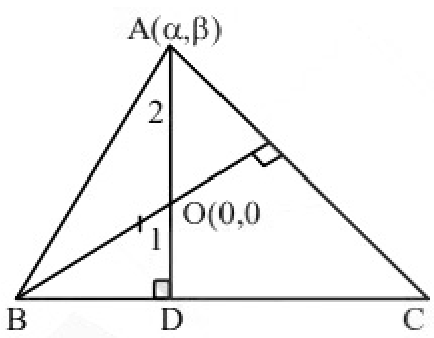
$$f\left(x\right) = \frac{-8 \pm 4(3x - 16)}{24}$$

$\because f(0) = -3 \quad \therefore$ we take +ve sign

$$\therefore f\left(x\right) = \frac{-8 + 4(3x - 16)}{24}$$

$$\therefore f\left(13\right) = \frac{-8 + 4 \cdot 23}{24} = \frac{84}{24} = \frac{7}{2}$$

Q17 Solution:
(3)



$\because\ m_{BC} \cdot m_{AD} = -1$

$\Rightarrow \left(-\frac{1}{2\sqrt{2}}\right)\left(\frac{\beta}{\alpha}\right) = -1$

$\Rightarrow \beta = 2\sqrt{2}\alpha\ \ ...(1)$

$\because OD = \left|\frac{-4}{\sqrt{1+8}}\right| = \frac{4}{3} \Rightarrow AO = \frac{8}{3}$

So $AD = \frac{8}{3} + \frac{4}{3} = 4$

$\Rightarrow \frac{|\alpha + 2\sqrt{2}\beta - 4|}{3} = 4 \Rightarrow \alpha = \frac{16}{9}$ or $-\frac{8}{9}$

$\{\because A(\alpha, \beta)$ & $(0,0)$ lie on same side of given line$\}$

$\therefore (\alpha, \beta) = \left(\frac{16}{9}, \frac{32\sqrt{2}}{9}\right)$ (Rejected)

so $(\alpha, \beta) = \left(-\frac{8}{9}, -\frac{16\sqrt{2}}{9}\right)$

$= [\,|\alpha + \sqrt{2}\beta|\,] = \left[\,\left|\frac{-8-32}{9}\right|\,\right] = 4$

Q18 Solution:

(1)

$\int \frac{dx}{\sin^5 x \cos^2 x} - 5\int \frac{dx}{\sin^5 x}$

$= \int \frac{\sec^2 x\, dx}{\sin^5 x} - 5\int \frac{dx}{\sin^5 x}$

By IBP

$= \frac{\tan x}{\sin^5 x} - \int \frac{5}{\sin^6 x} \cos x \tan x\, dx - 5\int \frac{dx}{\sin^5 x}$

$= \frac{\tan x}{\sin^5 x} + C$

$f(x) = \frac{\tan x}{\sin^5 x}$

$f\left(\frac{\pi}{6}\right) - f\left(\frac{\pi}{4}\right) = \frac{2^5}{\sqrt{3}} - (\sqrt{2})^5 = 4\sqrt{2} - \frac{32}{\sqrt{3}}$

$= \frac{32}{\sqrt{3}} - 4\sqrt{2}$

$= \frac{4}{\sqrt{3}}\left(8 - \sqrt{6}\right)$

Q19 Solution:

(4)

$\frac{2+3+5+10+11+13+15+21+a+b}{10} = 9$

$\frac{80+a+b}{10} = 9 \Rightarrow a + b = 10\ \ ...(1)$

$\frac{\sum x_i^2}{10} - \left(\frac{\sum x_i}{10}\right)^2 = 34.2$

$\frac{2^2+3^2+5^2+10^2+11^2+13^2+15^2+21^2+a^2+b^2}{10} - (9)^2 = 34.2$

$\frac{1094+a^2+b^2}{10} - 81 = 34.2$

$1094 + a^2 + b^2 - 810 = 342$

$a^2 + b^2 = 58\ \ ...(2)$

$a=7,\ b=3$ or $a=3,\ b=7$

Numbers $=2,3,5,7,10,11,13,15,21$

Mean $=\frac{7+10}{2}=8.5$

M.D. $=\frac{6.5+5.5+5.5+3.5+1.5+1.5+2.5+4.5+6.5+12.5}{10}$

$=\frac{50}{5}$

$=5$

Q20 Solution:
(2)

$\because f\left(x^2+1\right)=x^4+5x^2+2$

Put $x^2+1=t$

$\Rightarrow f\left(t\right)=(t-1)^2+5\left(t-1\right)+2$

$\Rightarrow f\left(t\right)=t^2+3t-2$

Now, $\int_0^3 f\left(t\right)dt=\int_0^3\left(t^2+3t-2\right)dt$

$=\left[\frac{t^3}{3}+\frac{3t^2}{2}-2t\right]_0^3$

$=\left[\frac{27}{3}+\frac{27}{2}-6\right]$

$=\frac{33}{2}$

Q21 Solution:
(90)

Let first three terms of G.P. are $\frac{A}{r},\ A,\ Ar$

$\frac{A}{r}\cdot A\cdot Ar=27$

$A^3=27\Rightarrow A=3$

$3\left(\frac{1}{r}+1+r\right)=3+3\left(r+\frac{1}{r}\right)$

We know, $r+\frac{1}{r}\geq 2$ or $r+\frac{1}{r}\leq -2$

$S\in\mathbb{R}-(-3,9)$

$a^2+b^2=9+81=90$

Q22 Solution:
(8)

$\frac{x^2}{8}-\frac{y^2}{8\cos^2\theta}=1,\quad e_1=\sqrt{1+\frac{8\cos^2\theta}{8}}$

$\ell_1=\frac{2b^2}{a}=\frac{2\left(8\cos^2\theta\right)}{2\sqrt{2}}$

$\frac{x^2}{6}+\frac{y^2}{6\cos^2\theta}=1,\quad e_2=\sqrt{1-\frac{6\cos^2\theta}{6}}=\sin\theta$

$\ell_2=\frac{2b^2}{a}=\frac{2\cdot 6\cos^2\theta}{\sqrt{6}}$

$e_1^2 = e_2^2\left(1 + \sec^2\theta\right)$

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

$1 + \cos^2\theta = \sin^2\theta + \tan^2\theta$

Solving we get $\theta = \frac{\pi}{4}$

$\ell_1 = 2\sqrt{2}$

$e_1 = \sqrt{\frac{3}{2}}$

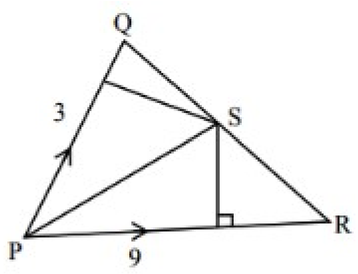
$\ell_2 = \sqrt{6}$

$e_2 = \frac{1}{\sqrt{2}}$

$\left(\frac{\ell_1\ell_2}{e_1e_2}\right)\tan^2\theta = 8$ (By putting values)

Q23 Solution:
(37)

$\overrightarrow{PS} = \hat{i} - 7\hat{j} + 2\hat{k}$



$\overrightarrow{PQ} = -2\hat{i} - \hat{j} + 2\hat{k}$

$\overrightarrow{PR} = a\hat{i} + b\hat{j} - 4\hat{k}$

$\overrightarrow{PS} = \lambda\overrightarrow{PR} + \overrightarrow{PQ}$

$\hat{i} - 7\hat{j} + 2\hat{k} \quad = \lambda\left(\frac{a\hat{i} + b\hat{j} - 4\hat{k}}{9} + \frac{-2\hat{i} - \hat{j} + 2\hat{k}}{3}\right)$

$\hat{i} - 7\hat{j} + 2\hat{k} \quad = \frac{\lambda}{9}\left(a\hat{i} + b\hat{j} - 4\hat{k}\right) \quad -2\hat{i} - \hat{j} + 2\hat{k}$

$\hat{i} - 7\hat{j} + 2\hat{k} \quad = \frac{\lambda}{9}\left(a\hat{i} + 6\hat{j} - 4\hat{k} - 6\hat{i} - 3\hat{j} + 6\hat{k}\right)$

$\hat{i} - 7\hat{j} + 2\hat{k} \quad = \frac{\lambda}{9}\left(a - 6\right)\hat{i} + \frac{\lambda}{9}\left(b - 3\right)\hat{j} + \frac{2\lambda}{9}\hat{k}$

$\frac{2\lambda}{9} = 2$

$\lambda = 9, \ a - 6 = 1$

$a = 7$

$b - 3 = -7$

$b = -4$

$3a - 4b = (21 + 16) = 37$

Q24 Solution:
(210)

Let $I_r = \int_0^r x \mid \sin\pi x \mid dx \quad ...(1)$

Apply King Property

$= \int_0^r (r - x) \mid \sin\pi x \mid dx \quad ...(2)$

By (1) + (2)

$2I_r = \int_0^r r \mid \sin\pi x \mid dx \Rightarrow I_r = \frac{r}{2}\int_0^r \mid \sin\pi x \mid dx$

$I_1 = \frac{1}{2}\int_0^1 \mid \sin\pi x \mid dx = \frac{1}{2\pi}\int_0^\pi \mid \sin t \mid dt = \frac{1}{2\pi}(2)$

$I_2 = \frac{2}{2}\int_0^2 \mid \sin\pi x \mid dx = \frac{2}{2\pi}\int_0^{2\pi} \mid \sin t \mid dt = \frac{2}{2\pi}(4)$

$S = \sqrt{\pi \cdot \frac{1}{2\pi} \cdot 2} + \sqrt{\pi \cdot \frac{2}{2\pi} \cdot 4} + \sqrt{\pi \cdot \frac{3}{2\pi} \cdot 6} + \cdots + \sqrt{\pi \cdot \frac{20}{2\pi} \cdot (2 \cdot 20)}$

$= 1 + 2 + 3 + \cdots + 20$

$= \frac{20 \times 21}{2} = 210$

Q25 Solution:
(1)

Let $\theta = \frac{1}{2}\sin^{-1}\left(\frac{2}{3}\right)$, then $\frac{1}{2}\cos^{-1}\left(\frac{1}{3}\right) = \left(\frac{\pi}{4} - \theta\right)$

$k = \tan\theta + \cot\theta = \frac{1}{\sin\theta\cos\theta} = \frac{2}{\sin 2\theta}$

$k = \frac{2}{2/3} = 3$

$\sin^{-1}(3x - 1) = \sin^{-1}x - \cos^{-1}x$

$\sin^{-1}(3x - 1) = \frac{\pi}{2} - 2\cos^{-1}x$

$3x - 1 = \sin\left(\frac{\pi}{2} - 2\cos^{-1}x\right)$

$3x - 1 = 2x^2 - 1 \Rightarrow x = 0, \frac{3}{2}$ (rejected)

No. of solution $= 1$

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Q26 Solution:
(2)

$T = \frac{F/A}{\Delta\ell/\ell} \Rightarrow Y = \frac{F\ell}{A\Delta\ell}$

$\frac{Y_A}{Y_B} = \frac{\ell_A}{\ell_B}\left(\frac{A_B}{A_A}\right)$

$= \frac{6}{5.4}\left(\frac{4.5 \times 10^{-5}}{3 \times 10^{-5}}\right) = \frac{9}{5.4} = \frac{5}{3} \Rightarrow \frac{x}{3} = \frac{5}{3}$

$x = 5$

Q27 Solution:
(2)

$m \cdot \frac{dv}{dt} = mg - kv$

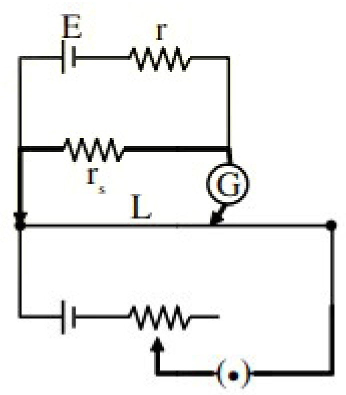
$$\int_0^v \frac{dv}{mg - kv} = \int_0^t \frac{dt}{m}$$

$$-\frac{1}{k} ln\left(\frac{mg - kv}{mg}\right) = \frac{t}{m}$$

$$v = \frac{mg}{k}\left(1 - e^{-kt/m}\right)$$

Q28 Solution:
(3)

Let E is emf and r is internal resistance of cell.



$$\frac{E \cdot 4}{r + 4} = 120K$$

$$\frac{E \cdot 12}{r + 12} = 180K$$

$$\Rightarrow \frac{1}{3} \cdot \frac{r + 12}{r + 4} = \frac{2}{3}$$

$$r + 12 = 2(r + 4)$$

$$\Rightarrow r = 4$$

Q29 Solution:
(1)

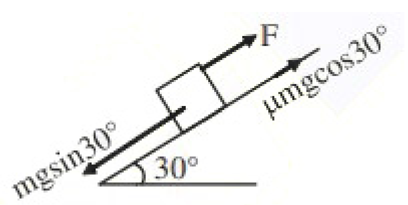
$$\omega = 2 \times 10^{15} \text{ rad/s}$$

$$k = 10^7 \text{ m}^{-1}$$

$$v = \frac{2\pi}{k} \cdot \frac{\omega}{2\pi} = \frac{\omega}{k} = \frac{2 \times 10^{15}}{10^7} = 2 \times 10^8 = \frac{c}{1.5}$$

$$\Rightarrow \mu = 1.5$$

Q30 Solution:
(1)



$$mg\sin 30° = F + \mu mg\cos 30°$$

$$F = 5 \times 10 \times \frac{1}{2} - \frac{\sqrt{3}}{2} \times 5 \times 10 \times \frac{\sqrt{3}}{2}$$

$$F = 25 - \frac{75}{2} = 25 - 37.5$$

$$F = -12.5 \text{ N}$$

$\therefore$ Force will be downward on incline of magnitude 12.5 N

Q31 Solution:

(1)

Increasing the slit width 'a' decreases the diffraction angle $\left(\theta = \lambda / a\right)$ and reduces the spreading of the wave. A narrower slit produces a more pronounced spherical wave (high curvature) while a wider slit leads to a flatter, less curved wave.

Q32 Solution:
(4)

$w = \text{Area of parabola}$

$= \frac{2}{3}\left(\text{Area of rectangle } AC31A\right)$

$= \frac{2}{3}P_0\left(3 - 1\right) = \frac{4P_0}{3}$

When $V = 1$

$(1 - 2)^2 = 4aP_0$

$P_0 = \frac{1}{4a}$

$w = \frac{4}{3}P_0 = \frac{4}{3} \cdot \frac{1}{4a} = \frac{1}{3a}$

$w_{\text{gas}} = -\frac{1}{3a}$

Q33 Solution:
(2)

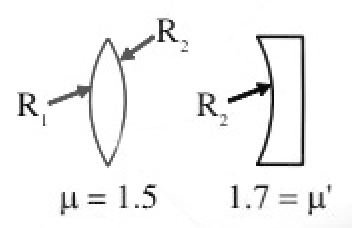
$\text{Reading} = \text{MSR} + \left(\text{VSR} \times \text{LC}\right) - \left(\text{zero error}\right)$

$= 15\text{mm} + (5 \times 0.1\text{mm}) - (4 \times 0.1\text{mm})$

$\text{Reading} = 15.1\text{mm}$

$\therefore \ell = 15.1\text{mm}$

Q34 Solution:
(2)



$|P_A| = |P_B|$

$0.5\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \frac{0.7}{R_2}$

$\frac{5}{R_1} = \frac{2}{R_2}$

$\frac{R_1}{R_2} = \frac{5}{2}$

Q35 Solution:
(4)

$\text{Time to reach ground} = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 5}{10}} = 1 \text{ sec}$

Five drops per second

Time between each drop $= 0.2$ sec

Time of fall for 4th drop is $1 - 0.6 = 0.4$ sec

Height of fall of 4th drop is $= \frac{1}{2} \times 10 \times (0.4)^2 = 0.8$ m

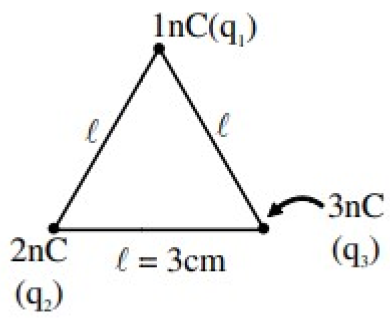
Height from ground $= 5 - 0.8 = 4.2$ m

Q36 Solution:
(1)

$\frac{\mu_0 I}{2R} = 16\mu\text{T}$

$\frac{\mu_0 I R^2}{2\left(x^2 + R^2\right)^{3/2}} = \frac{\mu_0 I R^2}{2 \times 8R^3} = 2\mu\text{T}$

Q37 Solution:
(1)

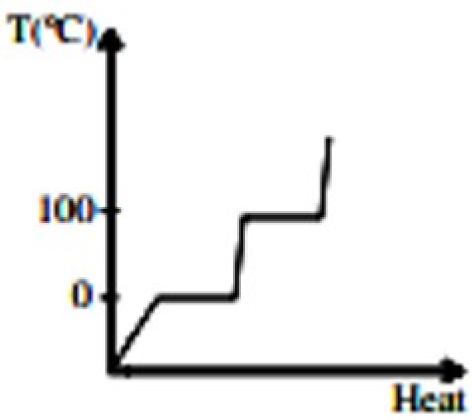


$W = \left(\frac{kq_1}{\ell} + \frac{kq_2}{\ell}\right) q_3$

$= \frac{9 \times 10^9}{3 \times 10^{-2}}\left(3 \times 10^{-9}\right) \times 3 \times 10^{-9}$

$= 27 \times 10^{-7}$ J $= 2.7\ \mu$J

Q38 Solution:
(2)



-20°C to 0°C: $q = ms_{\text{ice}} \Delta T$ At 0°C, phase change takes place.

0°C to 100°C: $q = ms_{\text{water}} \Delta T$ At 100°C, phase change takes place.

Q39 Solution:
(1)

In series, $i_1 = \frac{2E}{6 + 2r}$

In parallel, $i_2 = \frac{E}{6 + \frac{r}{2}}$

$i_1 = i_2 \Rightarrow \frac{2E}{6 + 2r} = \frac{E}{6 + \frac{r}{2}}$

$12 + r = 6 + 2r$

$r = 6\Omega$

Q40 Solution:
(1)

$12 - 0.3 \times 10^3 I - 0.7 = 0$

$\frac{11.3}{0.3 \times 10^3} = I$

$37.66 \times 10^{-3}\ \text{A} = I$

Current through diode D_1, $I_1 = \frac{I}{2}$

$I_1 = 18.83\ \text{mA}$

Q41 Solution:
(2)

$10 \times 3.36 \times 10^5 + 10 \times 2100 \times 10 + 10 \times 4200 \times \left(T - 0\right)$

$= 100 \times 4200 \times (25 - T)$

$\Rightarrow T = 15°\text{C}$

$\Delta T = 25 - 15 = 10°\text{C}$

Q42 Solution:
(4)

Surface area $x \propto A^{2/3}$

$X_i = 8^{2/3} K = 4K$

$X_f = (8 + 10 + 9)^{2/3} K = 9K$

% increase in surface area of nucleus

$x_i = \frac{9K - 4K}{4K} \times 100 = 125\%$

Q43 Solution:
(1)

$\alpha = \frac{\tau}{I}$

$I = \frac{1}{4}mR^2 + mR^2 + \frac{1}{4}mR^2 + m(2R)^2 + \frac{m(3R)^2}{12} + m\left(\frac{R}{2}\right)^2$

$= \left(\frac{3}{2} + 4 + 1\right)mR^2 = \frac{13}{2}mR^2 = \frac{13}{2} \times 600 \times 10^2 = 39 \times 10^4$

$\alpha = \frac{43 \times 10^5}{39 \times 10^4}\ \text{rad/s}^2 \quad = \frac{430}{39}\ \text{rad/s}^2 \approx 11\ \text{rad/s}^2$

Q44 Solution:
(1)

$i_{\text{rms}}^2 = \frac{\int_0^T \left(\frac{i_0^2 t^2}{T^2}\right) dt}{\int_0^T dt} = \frac{i_0^2}{T^3} \cdot \frac{T^3}{3} = \frac{i_0^2}{3}$

$i_{\text{rms}} = \frac{i_0}{\sqrt{3}}$

Q45 Solution:
(1)

$$F_{\text{net}} = \frac{\mu_0}{2\pi} I_0 \left(\frac{I_1}{d_1} + \frac{I_2}{d_2} \right) \ell$$

$$F_{\text{net}} = 2 \times 10^{-7} \times \left(\frac{3}{3} + \frac{2}{2} \right) \times \frac{15 \times 10^{-2}}{10^{-2}}$$

$$= 4 \times 15 \times 10^{-7}$$

$$F_{\text{net}} = 6 \times 10^{-6} \text{ N}$$

Q46 Solution:
(3)

$$\frac{1}{f_{\text{air}}} = \left(\frac{1.5 - 1}{1} \right) \left(\frac{1}{R_1} + \frac{1}{R_2} \right)$$

$$\frac{1}{f_{\text{water}}} = \left(\frac{1.5 - \frac{4}{3}}{\frac{4}{3}} \right) \left(\frac{1}{R_1} + \frac{1}{R_2} \right)$$

$$\Rightarrow \frac{f_{\text{water}}}{f_{\text{air}}} = \frac{0.5}{0.5/4} = 4$$

$$\Rightarrow f_{\text{water}} - f_{\text{air}} = 3f$$

Q47 Solution:
(2)

$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2m \cdot KE}}$$

$$\frac{\lambda_d}{\lambda_\alpha} = \sqrt{\frac{m_\alpha \cdot KE_\alpha}{m_d \cdot KE_d}} = \sqrt{\frac{4m \cdot 2E}{2m \cdot E}} = 2:1$$

Q48 Solution:
(265)

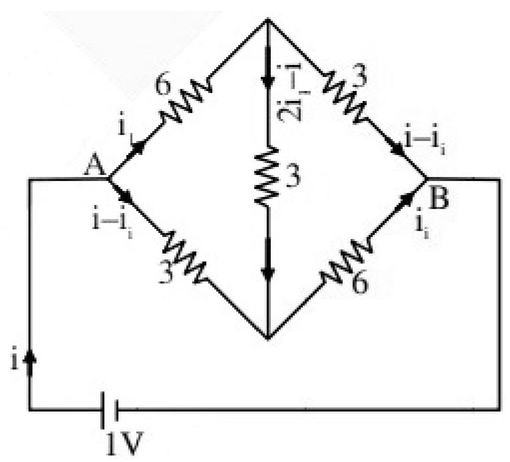
Let radius of gyration is k

$$\Rightarrow mk^2 = \frac{2}{3} mR^2 + md^2$$

$$k^2 = \frac{2}{3} \times 10^2 + 15^2 = 265$$

$$\left(\sqrt{n} \right)^2 = 265 \Rightarrow n = 265$$

Q49 Solution:
(21)



$$6i_1 + 3\left(2i_1 - i \right) = 3\left(i - i_1 \right)$$

$$\Rightarrow 15i_1 = 6i \Rightarrow i_1 = \frac{2}{5} i \;\; \ldots \left(1 \right)$$

$3\left(i - i_1\right) + 6i_1 = 1$

$3i + 3i_1 = 1$

$\left(3 + \frac{6}{5}\right)i = 1$

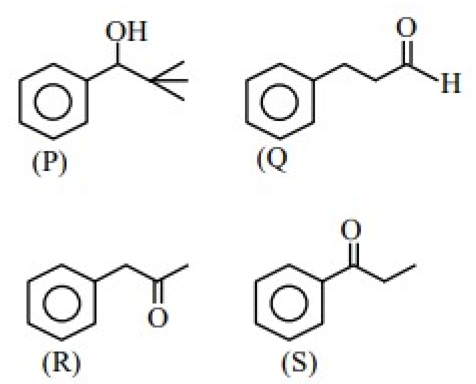
$\Rightarrow i = \frac{5}{21}\text{ A} = \frac{1\text{ V}}{R_{eq}} \Rightarrow R_{eq} = \frac{21}{5}\,\Omega$

Q50 Solution:
(2)

Potential energy is maximum at extreme position. The particle starting at mean position reaches extreme position in time $\frac{T}{4}$.

3 - JEE Main Chemistry 28-Jan 2026 Shift -1

Q51 Solution:
(3)

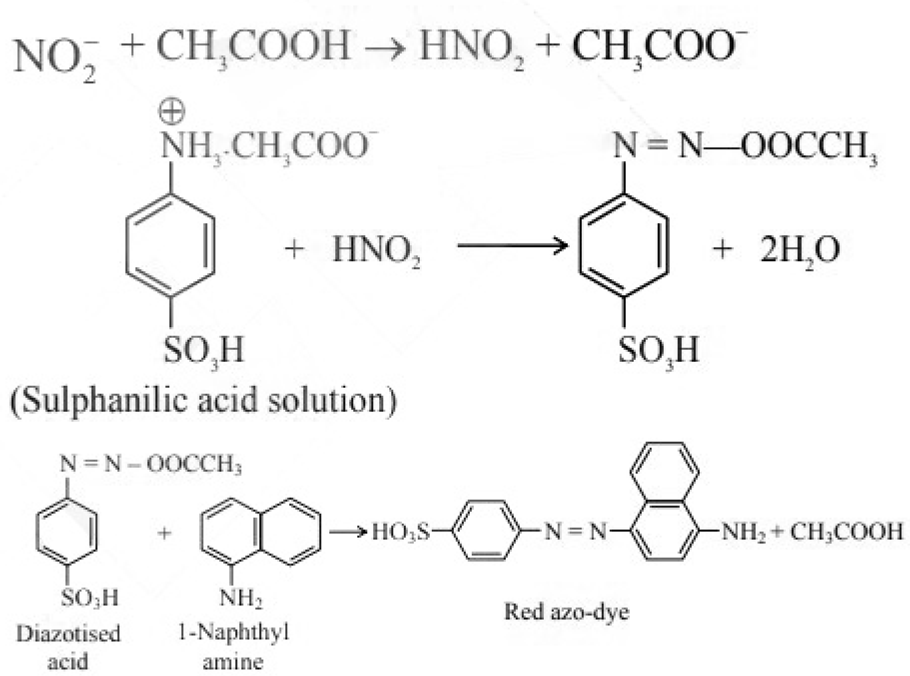


(A) Q, R, S all three give 2, 4 DNP test as they have Aldehyde/ketone group

(C) Q & R gives sooty flame

(E) Q gives Tollens reagent test

Q52 Solution:
(3)



Q53 Solution:
(2)

For isothermal reversible process $\Delta U = \Delta H = 0$

$w_{iso} = -p_1 V_1 \ln\frac{P_1}{P_2}$

$w_{iso} = -0.5 \times 10^6 \times 20 \times 10^{-3} \ln\frac{0.5}{0.2}$

$w_{iso} = -0.5 \times 10^6 \times 20 \times 10^{-3} \times 2.303 \times \left(0.6989 - 0.3010\right)$

$w \approx -9.1\text{kJ}$

$q = -w = 9.1\text{kJ}$

Q54 Solution:
(1)

$CH_2 = CH^- \quad CH_3 > CH_2^- \quad CH \equiv C^-$

Stability $\propto \% S$

Order of stability

$CH \equiv C^- > CH_2 = CH^- > CH_3 - CH_2^-$

Q55 Solution:
(2)

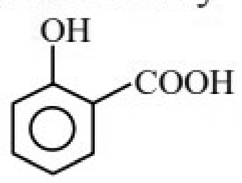
Sc^{3+}, Ti^{4+} and Zn^{2+} are colourless

Th^{4+} cannot act as a reducing agent.

Q56 Solution:
(3)

$(X) \xrightarrow[(2)H_3O^{\oplus}]{(1)CO_2/NaOH} Y_{Major}$

76.6%C
6.38% H
Vapour Density 47

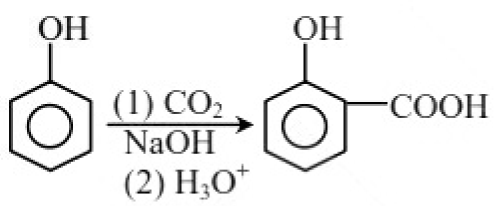
Y = 

Salicylic acid

Gives colour with $FeCl_3$

Soluble in $NaHCO_3$

Soluble in NaOH

Compound (X) is 

Kolbe Schmitt reaction

Q57 Solution:
(3)

At spherical node

$\psi_r = 0$

Q58 Solution:
(4)

Balmer series line $\Rightarrow \bar{\nu} = R_H Z^2 \left[\frac{1}{2^2} - \frac{1}{n^2}\right]$

if $n = 3 \Rightarrow \bar{\nu} = R(1)^2 \left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5R}{36}$

if $n = 4 \Rightarrow \bar{\nu} = \frac{3R}{16}$

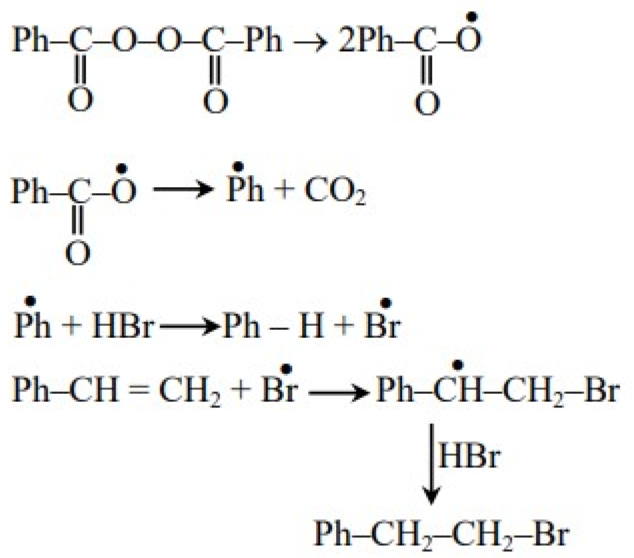
if $n = 5 \Rightarrow \bar{\nu} = \frac{21R}{100}$

Q59 Solution:
(2)

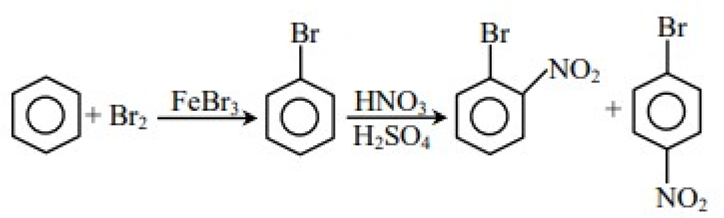
$$\text{Ph-CH=CH}_2 \xrightarrow[\text{HBr}]{(\text{PhCOO})_2} \text{Ph-CH}_2\text{-CH}_2\text{-Br}$$

Anti Markovnikov addition

- Reaction follows radical addition in presence of peroxide
- In absence of peroxide follows carbocation mechanism
- Benzene also formed



Q60 Solution:
(2)



B & C separate by

Fractional Distillation method

Due to their different boiling point.

Q61 Solution:
(1)

	HCl	+	B	→	BH^+	+	Cl^-
	0.02M		0.02M				
	$x$ml		$y$ml				
t_f	0		0.02y - 0.02x		0.02x		

$\text{pOH} = \text{p}K_b + \log\left[\frac{\text{Salt}}{\text{Base}}\right]$

$5 = 5.699 + \log\left[\frac{\text{Salt}}{\text{Base}}\right]$

$\frac{x}{y - x} = \frac{1}{5}$

$6x = y$

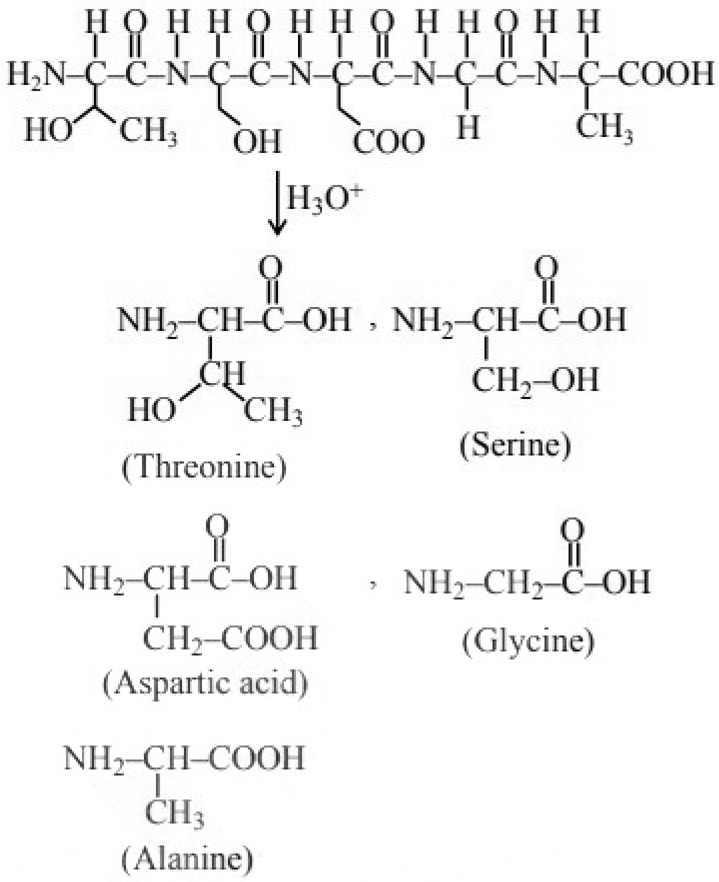
$7x = 100$

$x = \frac{100}{7}$ ml

and $y = \frac{600}{7}$ ml

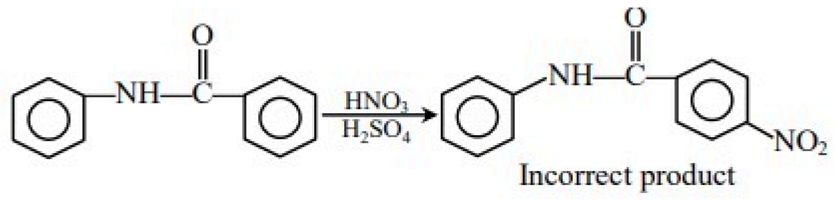
Q62 Solution:
(1)

Sol.

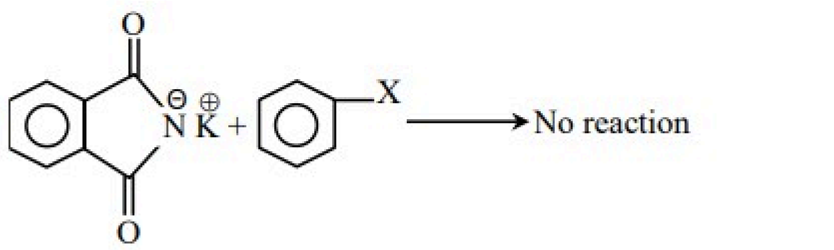


Q63 Solution:
(2)

(1)

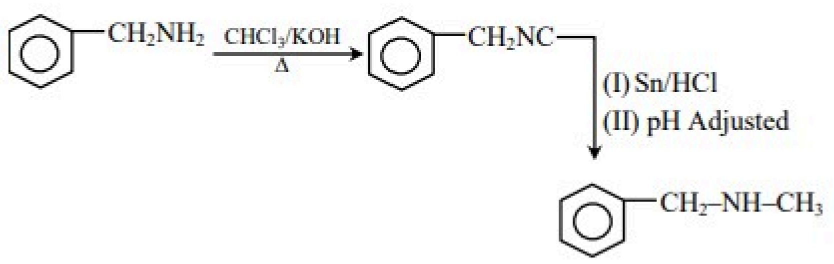


(2)



Aromatic halide does not give gabriel phthalimide reaction

(3)



(4) Hoffmann bromamide degradation

$$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow[4KOH]{Br_2} CH_3-CH_2-NH_2 \; +$$

$2KBr + K_2CO_3 + 2H_2O$

Q64 Solution:
(3)

Stability: $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Basicity: $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Reducing character: $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

Boiling point: $PH_3 < AsH_3 < NH_3 < SbH_3 < BiH_3$

Q65 Solution:
(1)

2 moles of A + 3 moles of B

⇓

$X_A = 2/5$, $X_B = 3/5$

$P_s = X_A P_A° + X_B P_B°$

$320 = P_A°\left(\frac{2}{5}\right) + P_B°\left(\frac{3}{5}\right)$

$2P_A° + 3P_B° = 1600 \quad ....(I)$

Now 1 mole of A & 1 mole of B is added

$X_A' = \frac{3}{7}, \; X_B' = \frac{4}{7}$

$P_s' = 328.6 = P_A°\left(\frac{3}{7}\right) + P_B°\left(\frac{4}{7}\right)$

$3P_A° + 4P_B° = 2300.2 \quad ....(II)$

Now eq (I) × 3 - eq (II) × 2

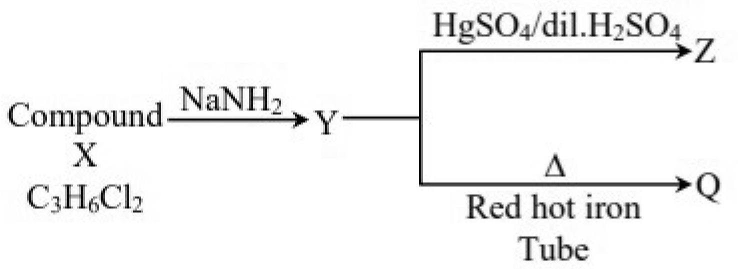
$6P_A° + 9P_B° = 4800$

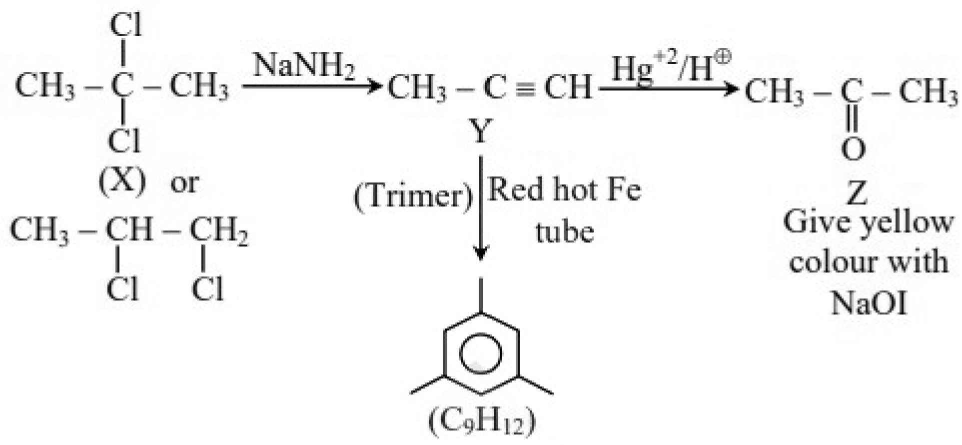
$6P_A° + 8P_B° = 4600.4$

$P_B° \simeq 200$ mm of Hg

$P_A° \simeq 500$ mm of Hg

Q66 Solution:
(1)





Q67 Solution:
(1)

$[Ni(CN)_4]^{2-} \rightarrow 3d^8 \rightarrow$ diamagnetic $\rightarrow dsp^2$

$[Ni(CO)_4] \rightarrow 3d^{10} \rightarrow$ diamagnetic $\rightarrow sp^3$

$[NiCl_4]^{2-} \rightarrow 3d^8 \rightarrow e^{2,2}t_2^{2,1,1} \rightarrow sp^3 \rightarrow$ paramagnetic

Q68 Solution:
(4)

In BF_4^-, SiF_4 and XeF_4 all bond lengths are identical

Molecules		B.O.
O_2^+	$\rightarrow$	2.5
O_2^-	$\rightarrow$	1.5
O_2^{2-}	$\rightarrow$	1
F_2	$\rightarrow$	1

Q69 Solution:
(4)

In a period moving from left to right atomic size decreases.

Q70 Solution:
(1)

$t = \frac{1}{k}\ln\frac{A_0}{A_t}$

$t_{1/8} = \frac{1}{k}\ln\frac{A_0}{A_0/8} = \frac{1}{k}\ln 8$

$t_{1/10} = \frac{1}{k}\ln\frac{A_0}{A_0/10} = \frac{1}{k}\ln 10$

$\frac{t_{1/8}}{t_{1/10}} = \frac{\ln 8}{\ln 10} = \frac{\log 8}{\log 10}$

$\frac{t_{1/8}}{t_{1/10}} = \log 8 = 3\log 2 = 0.9$

$\frac{t_{1/8}}{t_{1/10}} \times 10 = 9$

Q71 Solution:
(3)

$MnO_4^- + I^- \rightarrow MnO_2 + I_2$

$I_2 + S_2O_3^{2-} \rightarrow S_4O_6^{2-} + I^-$

gram eq of $KMnO_4$ = gram eq of $Na_2S_2O_3$

$0.2 \times \frac{500}{1000} \times 3 = 0.1 \times V \times 1$

$V = 3L$

Q72 Solution:
(4)

$C_xH_yBr_z \rightarrow CO_2$
1g 1.32g

$\% C = \frac{1.32 \times 12}{44 \times 1} \times 100 = 36\%$

$C_xH_yBr_z \rightarrow AgBr$
0.53g 0.75g

$\% Br = \frac{0.75 \times 80}{188 \times 0.53} \times 100 = 60.2\%$

$\% H = 100 - (36 + 60.2)$

$\% H \approx 4\%$

Q73 Solution:
(24)

$3BH_4^- + 4ClO_3^- \rightarrow 4Cl^- + 3H_2BO_3^- + 3H_2O$

n-factor = 8

moles = 3

$\therefore \quad n = 3 \times 8 = 24$

Q74 Solution:
(6)

Here

$X = 3$ (Two cis + one trans isomers)

$Y = 1$ (trans isomer)

$Z = 2$ (fac - mer isomer)

$\mathrm{X} + \mathrm{Y} + \mathrm{Z} = 3 + 1 + 2 = 6$

Q75 Solution:
(3)

$\mathrm{pH} = \frac{1}{2}\left[\mathrm{p}K_a - \log c\right]$

$\mathrm{pH} = \frac{1}{2}\left[4 - \log 10^{-2}\right]$

$\mathrm{pH} = 3$