Q-1

30 Jan fat se

Solve:-

$S_{20} = \frac{20}{2}[2a+19d] = 790$

$2a+19d = 79$ —(i)

$S_{10} = \frac{10}{2}[2a+9d] = 145$

$2a+9d = 29$ — (ii)

from(i) & (ii)

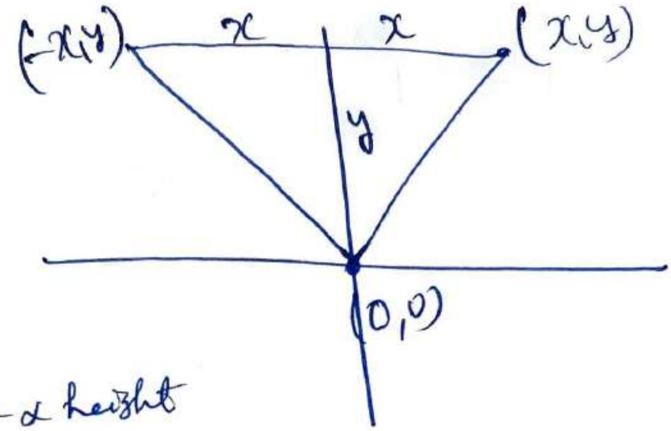
$a=-8$, $d=5$

$S_{15} - S_5 = \frac{15}{2}[-16+70] - \frac{5}{2}[-16+20]$

$\boxed{S_{15} - S_5 = 395}$

Q-2

Solve



Area $A = \frac{1}{2} \times \text{base} \times \text{height}$

$= \frac{1}{\cancel{2}} \times \cancel{2}x \times y$

$A = xy$

$A = x(-2x^2+54)$

$A = -2x^3+54x$

$\frac{dA}{dx} = -6x^2+54$

$\frac{dA}{dx} = 0$

$6x^2 = 54$

$x^2 = 9$

$x = \pm 3$

$A = -2(3)^3 + 54 \times 3$

$= -54 + 162$

$\boxed{A = 108}$

Q-3

Solve :-

$$\sec y\, dy = -\{(2-2x)\tan x + (2x-x^2)\}\{\, dx$$

$$\frac{dy}{dx} = -\int 2(x-1)\sin x\,dx + [(x^2-2x)\sin x - \int(2x-2)\sin x\,dx]$$

$$y(x) = (x^2-2x)\sin x + \lambda$$

$$y(0) = 0 + \lambda \Rightarrow 2 = \lambda$$

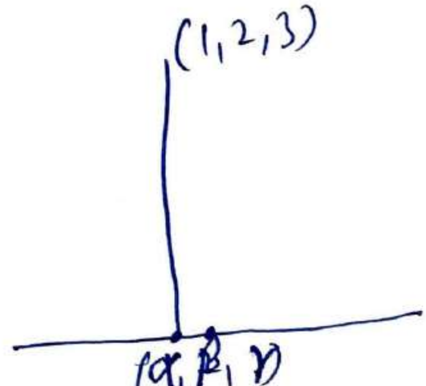
$$y(x) = (x^2-2x)\sin x + 2$$

$$y(2) = 2$$

Q-4 Let foot $P(5K-3,\ 2K+1,\ 3K-4)$

$$\frac{x+3}{5} = \frac{y-1}{2} = \frac{z+4}{3} = K$$

Direction cosines · Line: 5, 2, 3



Condition of perpendicular line

$$a a_1 + b b_1 + c c_1 = 0$$

$$5(5K-3) + 2(2K+1) + 3(3K-4) = 0$$

Then $K = \frac{43}{38}$

$$P(\alpha,\beta,\gamma) = 19\left(\frac{101}{38} + \frac{124}{38} + \left(\frac{-23}{38}\right)\right) = 101$$

$$\boxed{19(\alpha+\beta+\gamma) = 101}$$

Q-5

Let $f: \left[-\frac{\pi}{2}, \frac{\pi}{2}\right] \to R$

Solve

$$\lim_{x\to 0} \frac{x\int_0^x f(t)\,dt}{e^{x^2}-1} = \alpha$$

$$= \lim_{x\to 0} \frac{x\int_0^x f(t)\,dt}{\frac{e^{x^2}-1}{x^2}\cdot x^2} = \alpha$$

$$= \lim_{x\to 0} \frac{\int_0^x f(t)\,dt}{x}$$

$$\alpha = \frac{f(x)}{1}$$

$$\alpha = f(0)$$

$$\alpha = \frac{1}{2}$$

$$\boxed{8\alpha^2 = 8\cdot\frac{1}{4} = 2}$$

Q-16

$$f(x) = \cos^{-1}\left(\frac{2-|x|}{4}\right) + \{\log_e(3-x)\}^{-1}$$

$$-1 \le \frac{2-|x|}{4} \le 1$$

$$-4 \le 2-|x| \le 4$$

$$-6 \le -|x| \le 2$$

$$-2 \le |x| \le 6$$

$$|x| \le 6$$

$$\Rightarrow x \in [-6, 6] \quad \text{--- (1)}$$

Now $3-x \ne 1$

And $x \ne 2$ --- (2)

Now $3-x > 0$

$x < 3$ --- (3)

from (1), (2) and (3)

$$\Rightarrow x \in [-6, 3) - \{2\}$$

$\alpha = 6$

$\beta = 3$

$\gamma = 2$

$$\boxed{\alpha+\beta+\gamma = 6+3+2 = 11}$$

Solve

Q-7

$$g'\left(\tfrac{1}{2}\right) = g'\left(\tfrac{3}{2}\right)$$

$$f(x) = \tfrac{1}{2}\left[g(x) + g(2-x)\right]$$

$$f'(x) = \tfrac{1}{2}\left[g'(x) - g'(2-x)\right]$$

$$f'\left(\tfrac{1}{2}\right) = \tfrac{1}{2}\left[g'\left(\tfrac{1}{2}\right) - g'\left(\tfrac{3}{2}\right)\right] = 0$$

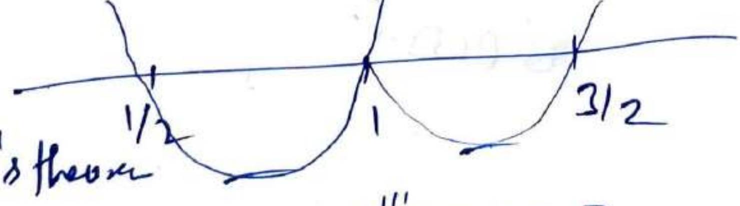
$$g'\left(\tfrac{1}{2}\right) - g'\left(\tfrac{3}{2}\right) = 0$$

$$f'\left(\tfrac{3}{2}\right) = \tfrac{1}{2}\left[g'\left(\tfrac{3}{2}\right) - g'\left(\tfrac{1}{2}\right)\right] = 0$$

$$x = 2 - x$$
$$2x = 2$$
$$x = 1$$

$$f'(1) = \tfrac{1}{2}\left[g'(1) - g'(1)\right] = 0$$

$$f'\left(\tfrac{1}{2}\right) = f'(1) = f'\left(\tfrac{3}{2}\right) = 0$$



by Rolle's theorem

$f''(c_1) = 0 \qquad f''(c_2) = 0$

$\boxed{f''(x) = 0 \text{ for atleast two } x \text{ in } (0,2)}$

Q-8

Solve :- $$\lim_{n\to\infty} \sum_{K=1}^{n} \frac{n^3}{(n^2+K^2)(n^2+3K^2)}$$

$$\lim_{n\to\infty} \frac{1}{n} \sum_{K=1}^{n} \frac{1}{\left(1+\frac{K^2}{n^2}\right)\left(1+\frac{3K^2}{n^2}\right)}$$

Let $\frac{K^2}{n^2} = x^2$

$$\int_0^1 \frac{1}{(1+x^2)(1+3x^2)}\,dx$$

$$\frac{1}{(1+x^2)(1+3x^2)} = \frac{Ax+B}{(1+x^2)} + \frac{Cx+D}{1+3x^2}$$

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

$$= \frac{1}{2}\left[\frac{\sqrt{3}\,\pi}{3} - \frac{\pi}{4}\right]$$

$$= \frac{1}{2}\left[\frac{4\sqrt{3}\pi - 3\pi}{12}\right]$$

$$\boxed{= \frac{13\pi}{8(4\sqrt{3}+3)}}$$

(9)

Q-

$$f(x) = \begin{vmatrix} 2\cos^4 x & 2\sin^4 x & 3+2\sin^4 2x \\ 3+2\cos^4 x & 2\sin^4 x & \sin^2 2x \\ 2\cos^4 x & 3+2\sin^4 x & \sin^2 2x \end{vmatrix}$$

$R_2 \to R_2 - R_1$ $R_3 \to R_3 - R_1$

$$f(x) = \begin{vmatrix} 2\cos^4 x & 2\sin^4 x & 3+\sin^2 2x \\ 3 & 0 & -3 \\ 0 & 3 & -3 \end{vmatrix}$$

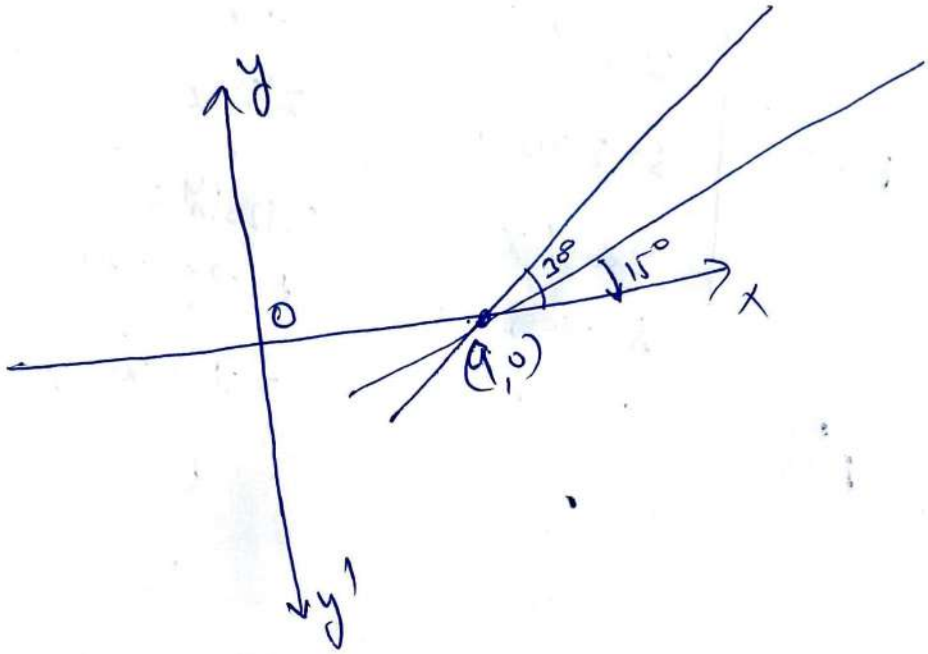
$$f'(x) = \begin{vmatrix} 2\times 4\cos^3 x(-\sin x) & 2\times 4\sin^3 x(\cos x) & 2\sin 2x \cos 2x \cdot 2 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix}$$

$$f'(0) = 0 + 0 + 0 = 0$$

$$\boxed{\frac{1}{5} f'(0) = 0}$$

Q-10

Ans



$$(y-0) = \tan 15^\circ (x-9)$$

$$y = (2-\sqrt{3})(x-9)$$

$$\frac{y}{2-\sqrt{3}} = x-9$$

$$\boxed{\frac{y}{\sqrt{3}-2} + x = 9}$$

Q-4

Solve

Minor axis of ellipse $= 2b$

focus lenght $= 2ae$

$2b = \frac{1}{\cancel{2}} \times \cancel{2}ae$

$2b = ae$

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

$\frac{\cancel{a^2}e^2}{4} = \cancel{a^2}(1-e^2)$

$e^2 = \frac{4}{5}$

$\boxed{e = \frac{2}{\sqrt{5}}}$

Q-13

Solve

If two circle intersect at two distinct pnt

$\Rightarrow |r_1 - r_2| < C_1C_2 < r_1 + r_2$

$|r - 2| < \sqrt{9+16} < r+2$

$|r-2| < 5$ and $r+2 > 5$

$-5 < r-2 < 5$ and $r > 3$

$r < 7$ and $r > 3$

$\boxed{3 < r < 7}$

Q-14

Solve :-

$$\begin{bmatrix} 1 & 1 & 1 & 4\mu \\ 1 & 2 & 2\lambda & 10\mu \\ 1 & 3 & 4\lambda^2 & \mu^2+15 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 1 & 1 & 4\mu \\ 0 & 1 & 2\lambda-1 & 6\mu \\ 0 & 2 & 4\lambda^2-1 & \mu^2-4\mu+15 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 1 & 1 & 4\mu \\ 0 & 1 & 2\lambda-1 & 6\mu \\ 0 & 0 & 4\lambda^2-4\lambda+1 & \mu^2-16\mu+15 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 1 & 1 & 4\mu \\ 0 & 1 & 2\lambda-1 & 6\mu \\ 0 & 0 & (2\lambda-1)^2 & (\mu-15)(\mu-1) \end{bmatrix}$$

$\boxed{\text{The system is inconsistent if } \lambda = \frac{1}{2} \text{ and } \mu \neq 1}$ wrong

Rank [A] $\neq$ Rank [A:B]

Q-15

Solve

$z = x + iy$

$z^2 + i\bar{z} = 0$

$z^2 = -i\bar{z}$

$|z^2| = |\bar{z}| \Rightarrow |z| = 1$

$\boxed{|z^2| = 1 \ , \ z^2 = 1}$

Q-16

Solve :- $2\sin^3 x + 2\sin x \cdot \cos^2 x + 4\sin x - 4 = 0$

$2\sin^3 x + 2\sin x(1 - \sin^2 x) + 4\sin x - 4 = 0$

$6\sin x - 4 = 0$

$\sin x = \frac{4}{6} = \frac{2}{3}$

has excatly 3 Solution

So $n = 5$

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

$x = \frac{-5 \pm \sqrt{17}}{2}$

Required interval $(-\infty, 0)$

Q-11

Soln.:

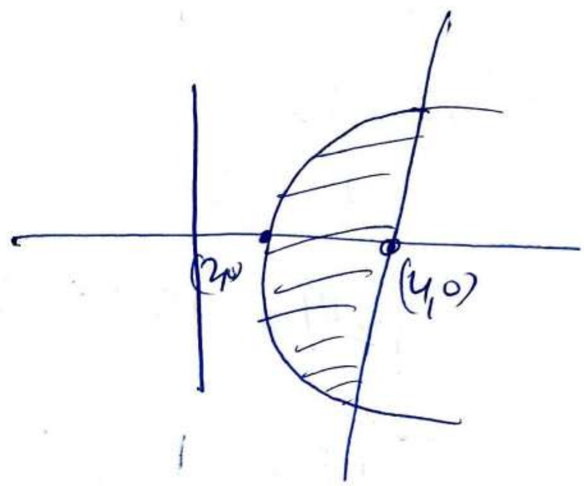
$$y^2 = 4(x-2)$$

$$y = 2x - 8$$

$$y^2 = 2(y+8) - 8$$

$$y^2 - 2y - 8 = 0$$

$$y = 4, \quad y = -2$$



$$= \int_{-2}^{4} \left(\frac{y+8}{2} - \frac{y^2+8}{4} \right) dy$$

$$= \int_{-2}^{4} \frac{y}{2}\, dy - \int_{-2}^{4} \frac{y^2}{4}\, dy + \int_{-2}^{4} 2\, dy$$

$$= \left[\frac{y^2}{4}\right]_{-2}^{4} - \frac{1}{4}\left[\frac{y^3}{3}\right]_{-2}^{4} + 2\left[y\right]_{-2}^{4}$$

$$= 9$$

Q-10

Solve

If $x=0$, $y=6,7,8,9,10$

If $x=1$, $y=7,8,9,10$

If $x=2$, $y=8,9,10$

If $x=3$, $y=9,10$

If $x=4$, $y=10$

If $x=5$, $y=$ no possible value

Total possible ways

$=(5+4+3+2+1)\times 2=30$

$$\boxed{\text{Required Probability} = \frac{30}{11\times 11} = \frac{30}{121}}$$

Q-19

Solve

Class	frequency	Cumulative frequency
0-4	3	3
4-8	9	12
8-12	10	22
12-16	8	30
16-20	6	36
	N = 36	

$$M = l + \left(\frac{\frac{N}{2} - c}{f}\right) h$$

$$M = 8 + \left(\frac{18 - 12}{10}\right) \times 4$$

$$M = 10.4$$

$$20M = 208$$

Q-20

Solve:-

Area of parallelogram $= |\vec{AC} \times \vec{BD}|$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 5 & -1 & 7 \\ 1 & 2 & 3 \end{vmatrix}$$

$$= \frac{1}{2} |-17\hat{i} - 8\hat{j} + 11\hat{k}|$$

$$= \frac{1}{2}\sqrt{474}$$

Q-21

Solve !-

$$f(x) = \begin{cases} \frac{1}{x} & x \geq 2 \\ ax^2+2b & -2 < x < 2 \\ -\frac{1}{x} & x \leq -2 \end{cases}$$

differentiable at $x = 2$

$2ax = -\frac{1}{x^2}$ at $x=2$

$a = -\frac{1}{16}$

Continuous at $x = 2$

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

$b = 3/8$

$$\boxed{48(a+b) = 48\left(-\frac{1}{16} + \frac{3}{8}\right) = 15}$$

Q-22

Solve -

$f : A \to P(A)$

$a \notin f(a)$

That mean a will connect with subset contain element 'a'.

every element of set (A) contain 2^6 subsets

Hence total subset (total 7 elements)

$2^6 \times 2^6 \times 2^6 \times 2^6 \times 2^6 \times 2^6 \times 2^6$

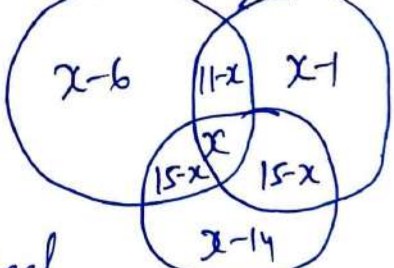
$= 2^{42}$

$\boxed{\therefore\ m+n = 2+42 = 44}$

Q-23

Solve -

$n(M) = 20$



$11 - x \geq 0$

$x \leq 11$

$x = 11$ does not satisfied the data

$x = 10$

Maximum Number of students passed in all Three subjects $= 10$

(26)

Solve :-

Given

$$a_n = a_{n+1} + a_{n+2}$$

$$2 \cdot ar^{n-1} = ar^n + ar^{n+1}$$

$$\frac{2}{r} = 1 + r$$

$$r^2 + r - 2 = 0$$

$$r = -2 \qquad r \neq 1$$

$$S_{20} - S_{18} = T_{19} + T_{20}$$

$$= ar^{18}(1+r)$$

$$a = \frac{1}{8}, \; r = -2$$

$$\boxed{T_{19} + T_{20} = -2^{15}}$$

(21)

Solve :-

$45x + 5y + 3 = 0$

slope $\Rightarrow -9 = 27r_4 + \frac{9r_2}{2}$

$6r_4 + r_2 + 2 = 0$

$$\lim_{x \to 3} \frac{\int_3^x 8t^2\,dt}{\frac{3r_2x}{2} - r_2x^2 - r_4x^3 - 3x}$$

$$\lim_{x \to 3} \frac{\frac{8}{3}[x^3 - 27]}{\frac{3r_2x}{2} - r_2x^2 - r_4x^3 - 3x}$$

L'H Rule

$$\lim_{x \to 3} \frac{8x^2}{\frac{3r_2}{2} - 6r_2 - 27r_4 - 3}$$

$$= \frac{144}{3r_2 - 12r_2 - 54r_4 - 6}$$

$$= \frac{144}{-9(r_2 + 6r_4) - 6}$$

$$= \lim_{x \to 3} \frac{144}{18 - 6}$$

$= 12$

Q-24

Solve:

$$9\int_0^9 \left[\sqrt{\frac{10x}{x+1}}\right]$$

$$= 9\left[\int_0^{1/9} 0\,dx + \int_{1/9}^{2/3} 1\,dx + \int_{2/3}^{9} 2\,dx\right]$$

$$= 9\left[0 + [x]_{1/9}^{2/3} + [2x]_{2/3}^{9}\right.$$

$$= 9\times\left[\frac{2}{3}-\frac{1}{9}\right] + 2\left[9-\frac{2}{3}\right]$$

$$= 9\times\left(\frac{6-1}{9} + 2\cdot\frac{25}{3}\right)$$

$$= 9\left(\frac{5}{9}+\frac{50}{3}\right)$$

$$\boxed{= 155}$$

JEE Main - 2024 Solutions

Physics, 30/01/24, shift-1

Ans-31

coefficient of Viscosity = $[ML^{-1}T^{-1}]$

surface tension = $[ML^{0}T^{-2}]$

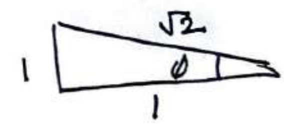
Angular Momentum = $[ML^{2}T^{-1}]$

Rotational K.E. = $[ML^{2}T^{-2}]$

option (3) is Correct

Ans-32

$E = (25 \sin 1000t)\ V$ $\qquad \cos\phi = \frac{1}{\sqrt{2}}$



$\tan\phi = \frac{X_L}{R}$

$X_L = R$ $\qquad \tan\phi = 1$

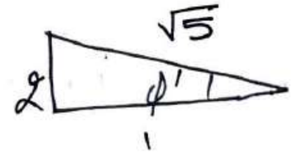
Now in second Case $E = 20 \sin 2000t$

frequency doubled so X_L doubled

$X_L' = 2X_L = 2R$

$\tan\phi' = \frac{X_L}{R} = \frac{2R}{R} = 2$

$$\boxed{\cos\phi = \frac{1}{\sqrt{5}}}$$



option (3) is Correct

Ans-33

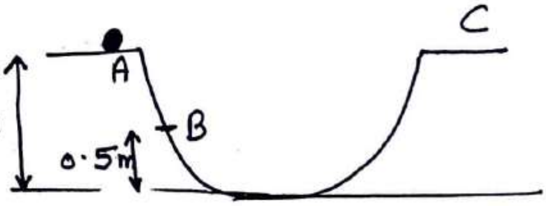
We know ratio of KE and PE doesnot depend on orbit It remains same only in every orbit

Generally $PE = 2KE$

$$\text{Ratio} = \frac{KE}{PE} = \frac{1}{2}$$

$\boxed{\text{option (3) is correct}}$

Ans-34



Since track is friction less, Energy remains conserved.

Change in PE = Change in K.E.

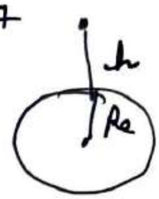
$$\cancel{m} \times 10 \times 0.5 = \frac{1}{2}\cancel{m} v^2 - 0$$

$v^2 = 10$, $v = \sqrt{10}$ m/sec

$\boxed{\text{option (3) is correct}}$

Ans- 35

Gravitational Potential at a point h above the earth surface



$$V = -\frac{GM_e}{(R_e+h)} = -5.12\times10^{7}$$

$$\frac{GM_e}{R_e+h} = 5.12\times10^{7}$$

$$g = \frac{GM_e}{(R_e+h)^2} = 6.4$$

$$(R_e+h) = 8\times10^{6}\ m$$

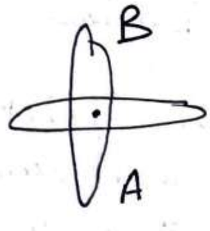
$$6.4\times10^{6} + h = 8\times10^{6}$$

$$h = (8-6.4)\times10^{6}$$

$$= 1.6\times10^{6}\ m = 1600\ km$$

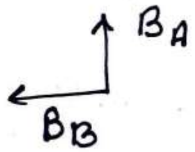
option (3) is correct

Ans- 36



Magnetic field at centre

$$= \frac{\mu_0 I}{2R} = \frac{\mu_0 I}{2a}$$



It is same for Both =

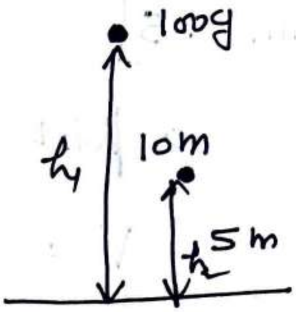
$$B_B = B_A = \frac{\mu_0 I}{2a}$$

Net field will be vector sum

$$B = \sqrt{B_A^2 + B_B^2} = B\sqrt{2} = \frac{\mu_0 I\sqrt{2}}{\cancel{\sqrt{2}}\,\cancel{2}\, a}$$

option (3) is correct

Ans-37



Impulse = change in momentum

$= m(V+u)$

$= m(\sqrt{2gh_2} + \sqrt{2gh_1})$

$= \frac{100}{1000}\left(\sqrt{2\times 9.8\times 10} + \sqrt{2\times 5\times 9.8}\right)$

$= \frac{100}{1000}(14 + 7\sqrt{2})$

$= 0.1\times 7(2+\sqrt{2}) = 0.7(2+1.4)$

$= 0.7\times 3.41$

$= 2.39$ kg m/sec

option (4) is correct

Ans-38

Angular Momentum about the point of projection at maximum height

$= m\,u\cos 30\times H_{max}$ (P. distance)

$H = \frac{u^2\sin^2 30}{2g}$

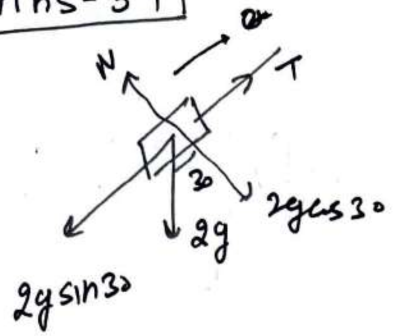
$= \frac{u^2}{8g}$

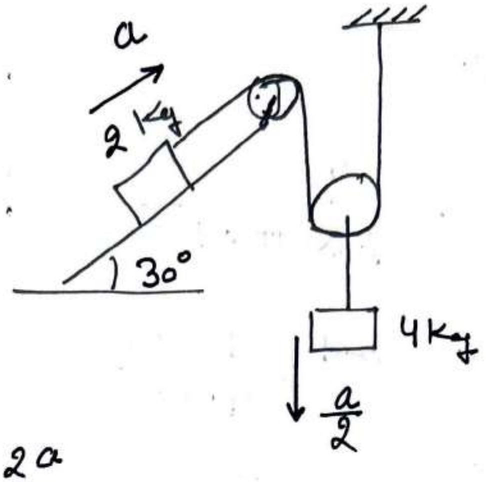
$= mu\left(\frac{\sqrt{3}}{2}\right)\times\frac{u^2}{8g}$

$= \frac{\sqrt{3}\,mu^3}{16g}$

option(4) is correct

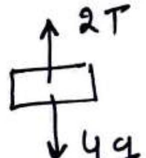
$\boxed{\text{Ans-39}}$





$$T - 2g \sin 30 = 2a$$

$$T - g = 2a \quad -(1)$$



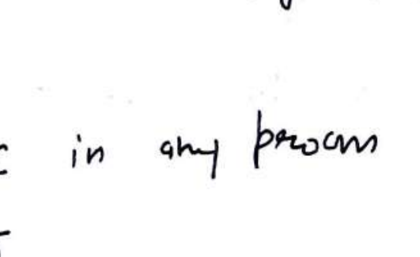
$$4g - 2T = 4 \cdot \frac{a}{2} = 2a \quad -(2)$$

$(1) \times (2) + (2)$ (1) multiplied with 2 and added to (2)

$$2g = 6a \quad , \quad \boxed{a = \frac{g}{3}}$$

$\boxed{\text{option (4) is correct}}$

$\boxed{\text{Ans-40}}$ From Polytropic process



$$PV^n = C$$

$$\log P + n \log V = 0$$

$$\log P = -n \log V$$

General expression for C in any process

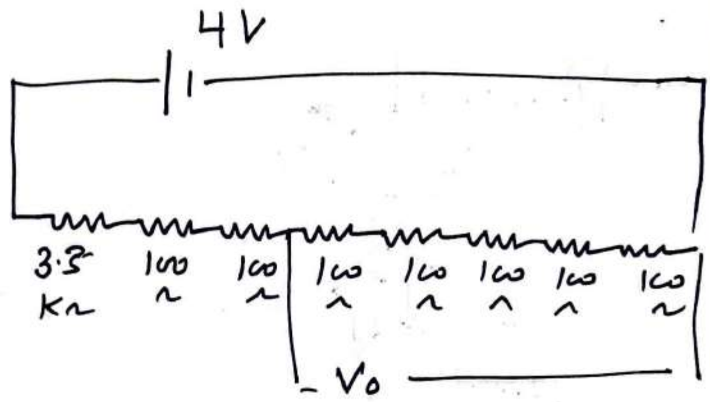
$$C = \frac{R}{4-1} + \frac{R}{1-n}$$

For B isothermal $\quad C_B = \infty \quad$ as $n = 1$

For adiabatic process A $\quad n = 4 \quad C_A = 0$

$\boxed{\text{option (2) \& (3) both correct}}$

Ans-41



$$i = \frac{4}{3.3\times1000 + 700}$$

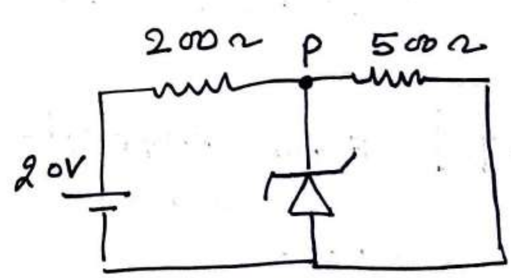
$$= \frac{4}{4000}$$

$$= 10^{-3}\ A$$

$$V_0 = 10^{-3} \times 500 = 0.5V$$

$\boxed{\text{option (1) is Correct}}$

Ans-42



Breakdown voltage for Zenor is 10V hence point P can have maximum potential = 10V

current in 200Ω resistor $= \frac{20-10}{200} = \frac{10}{200}$

$= 0.05A$

$= 50mA$

Current in 500 Ω resistor $= \frac{10-0}{500} = 20mA$

Current through Zener diode

$= 50-20 = 30mA$

$\boxed{\text{option (4) is Correct}}$

$\boxed{\text{Ans-43}}$ Young's Modulus is property of material and depends on nature of material. So by changing length and area, It will not change and remains same.

$\boxed{\text{option (3) is correct}}$

$\boxed{\text{Ans -44}}$ $V_p = 220V$, $N_p = 100$ $N_s = 10$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} \quad , \quad \frac{220}{V_s} = \frac{100}{10}$$

$$V_s = 22\ V$$

current in both resistor

$$= \frac{22}{22}\ mA$$

$$= 1\ mA$$

Voltage across $7k\Omega$ resistor

$$V_o = 1mA \times 7k\Omega = 7V$$

$\boxed{\text{Ans = 7V}}$ $\boxed{\text{option (2) is correct}}$

$\boxed{\text{Ans - 45}}$ $V_{rms} = \sqrt{\dfrac{3RT}{M}}$

For H_2 $\sqrt{\dfrac{3\cancel{R}T}{\cancel{2}\times\cancel{10^{-3}}}} = \sqrt{\dfrac{3\cancel{R}\times 320}{\cancel{32}\times \cancel{10^{-3}}}}$ 16

$$\boxed{T = 20K}$$

$\boxed{\text{option (1) is correct}}$

$\boxed{\text{Ans - 46}}$

$V = 220V$

$I = 2.75\ A$

$R_t = \dfrac{V}{I} = \dfrac{220}{2.75}$

$R = 60\Omega$ at $T = 27^\circ C$

$R_t = R(1+\alpha \Delta T)$

$\dfrac{R_t}{R} = 1+\alpha\Delta T$

$\dfrac{22\cancel{0}}{2.75\times 6\cancel{0}} - 1 = \alpha.\Delta T$

$\dfrac{22}{16.50} - 1 = \alpha\Delta T$

$\dfrac{\cancel{5.5}}{\cancel{16.5}} = \alpha\Delta T$ 3

$\boxed{\text{option (3) is correct}}$

$\Delta T = \dfrac{10000}{6} = 1667$

$T_t - 27 = 1667$

$$\boxed{T_t = 1694\ ^\circ C}$$

$\boxed{\text{Ans-47}}$ $\vec{E} = E_0 \cos(\omega t - kz)\,\hat{i}$

This equation shows $\vec{E}$ in x direction and wave is travelling in z direction. Hence magnetic field should be in +ve y direction.

$$B_0 = \frac{E_0}{c}$$

$$\boxed{\vec{B} = \frac{E_0}{c} \cos(\omega t - kz)\,\hat{j}}$$

$\boxed{\text{option (3) is correct}}$

$\boxed{\text{Ans-48}}$

$\lambda = 400 \times 10^{-9}\,m = 4 \times 10^{-7}\,m$

$a = 0.2\,mm = 2 \times 10^{-4}\,m$

$D = 100\,cm = 1\,m$

$$\beta = \frac{D\lambda}{a} = \frac{1 \times 4 \times 10^{-7}}{2 \times 10^{-4}}$$

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

$$\boxed{\beta = 2\,mm}$$

$\boxed{\text{option (1) is correct}}$

$\boxed{\text{Ans - 49}}$ For dipole electrostatic potential

$$V = \frac{K \cdot P\cos\theta}{r^2}$$

here V is proportional to $\frac{1}{r^2}$

$\boxed{\text{option (1) is correct}}$

$\boxed{\text{Ans - 50}}$ $W_0 = 3\ eV = 3 \times 1.6 \times 10^{-19}\ J$

$$W_0 = \frac{hc}{\lambda}$$

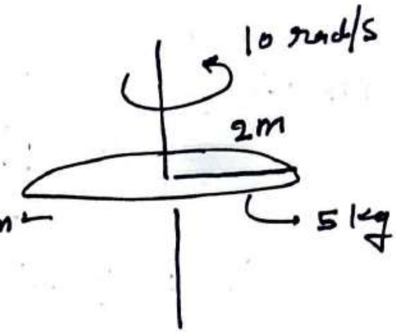
$$\lambda = \frac{6.63 \times \cancel{10^{-34}} \times \cancel{3} \times \cancel{10^{8}}}{\cancel{3} \times 1.6 \times \cancel{10^{-19}}} \quad 10^{-7}$$

$$= \frac{6.63 \times 10^{-7}}{1.6}$$

$$\boxed{\lambda = 414\ nm}$$

$\boxed{\text{option (1) is correct}}$

$\boxed{\text{Ans - 51}}$



Initially $I_1 = \frac{1}{2} m r^2$

$= \frac{1}{\cancel{2}} \times 5 \times \cancel{4}^2 = 10 \text{ kg-m}^2$

$\omega_1 = 10$ rad/sec

$E_1 = \frac{1}{2} I_1 \omega_1^2 = \frac{1}{2} \times 10 \times (10)^2 = 500\,J$

after placing another disc on First disc

$I_2 = \frac{1}{\cancel{2}} (5+5)(2)^{\cancel{2}} = 20 \text{ kg-m}^2$

$I_1 \omega_1 = I_2 \omega_2 \qquad 10 \times 10 = 20 \times \omega_2$

$\omega_2 = 5$ rad/sec

$E_2 = \frac{1}{2} \times I_2 \times \omega_2^2 = \frac{1}{\cancel{2}} \times \overset{10}{\cancel{20}} \times 5^2 = 250\,J$

Energy dissipated $= (500 - 250) = 250\,J$

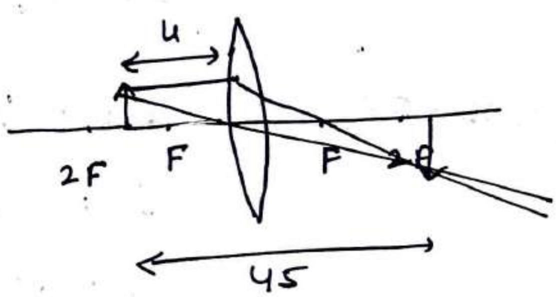
$\boxed{\text{Ans} = 250}$

$\boxed{\text{Ans-52}}$ object distance

$= -u$

Image distance

$= (45-u)$



$\frac{v}{u} = -2$

$\frac{45-u}{-u} = -2$

$u = 15$ cm $\quad v = 30$ cm

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

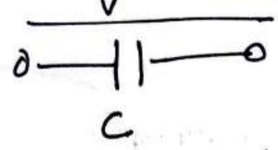
$= \frac{1}{30} + \frac{1}{15}$

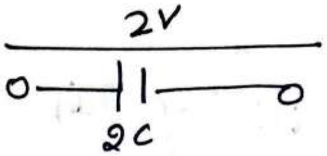
$\frac{1+2}{30}$

$\boxed{f = 10\text{ cm}}$

Ans - 53

Initially





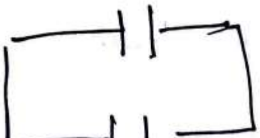
$U_1 = \frac{1}{2} CV^2 = E$

$U_2 = \frac{1}{\cancel{2}} \times \cancel{2}C \times (2V)^2$

$= 4CV^2$

Total energy Initially $= \frac{1}{2} CV^2 + 4CV^2$

$= \frac{9}{2} CV^2 = 9E$



after Connection

common $V = \dfrac{CV + 4CV}{3C} = \frac{5}{3} V$

Final energy $= \frac{1}{2}(C + 2C)\left(\frac{5}{3}V\right)^2$

$= \frac{1}{2} \times \cancel{3}C \times \frac{25V^2}{\cancel{9}\,3}$

$= \frac{25}{3} E$

Loss of energy $= 9E - \frac{25}{3}E = \frac{2}{3}E$

$\boxed{x = 2}$

Ans - 54

$B_H = 3.5 \times 10^{-5}\ T$

$I = \sqrt{2}\ A$

$l = 1m$

$F = IlB\sin\theta$

$= \sqrt{2} \times 1 \times 3.5 \times 10^{-5} \sin 45$

$\boxed{F = 35 \times 10^{-6}\ N/m}$

$\boxed{\text{Ans} = 35}$

$\boxed{\text{Ans - 55}}$

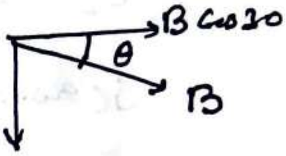
$l = 0.8\,m$

$W = \dfrac{2\pi \times 1200}{60} = 40\pi$ rad/sec

$B = 0.5 \times 10^{-4}\ T$

$\theta = 30^\circ$

EMF in case of rotation



$\mathcal{E} = \frac{1}{2} B l^2 \omega$

$= \frac{1}{2} \times 0.5 \times 10^{-4} \sin 30 \times (0.8)^2 \times 40\pi$

B sin30
(vertical component contribute for $\mathcal{E}$)

$= 32\pi \times 10^{-5}\ V$

$\boxed{N = 32}$

$\boxed{\text{Ans - 56}}$

$S_n = u + \frac{a}{2}(2n-1)$

$S_{t+1} = u + \frac{a}{2}(2t+1)$

$V = u + a \times 1$

$V - u = a$, $\quad a = 50\ m/sec^2$

$V^2 - u^2 = 2 \times 50 \times 125$

$125 = 100 + 25(2t+1)$

$t = 0$

$(V-u)(V+u) = 2 \times 50 \times 125$

$V + u = 250$

$V - u = 50$

$V = 150$

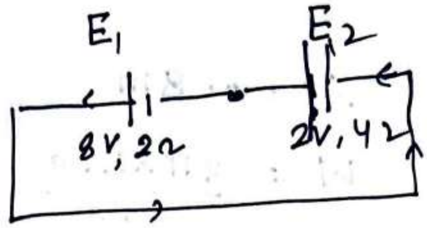
$u = 100$

$S_{(0+2)}$

$= 100 + 25(4-1)$

$\boxed{S_{t+2} = 175\ m}$

Ans- 57



$$I = \frac{8-2}{2+4} = 1A$$

E_2 is charging Potential difference across terminals

$$= V + Ir = 2 + 4 \times 1 = 6V$$

$\boxed{\text{Ans} = 6\ V}$

Ans- 58

$$\frac{V}{4l_1} = 30$$

$$\frac{330}{4 \times 30} = l_1 \qquad l_1 = \frac{11}{4}\ m$$

$$\frac{V}{4l_2} = 110 \qquad l_2 = \frac{3}{4}\ m$$

length of water column $= \frac{8}{4} = 2m = 200\,cm$

Volume $= 2\,cm^2 \times 200\,cm = 400\,cm^3$

mass = density × volume

$= 1 \times 400 = 400\,gm$

$\boxed{\text{Ans} = 400}$

$\boxed{\text{Ans - 59}}$ $E_n = -0.85\ eV$

$$-\frac{13.6}{n^2} = -0.85$$

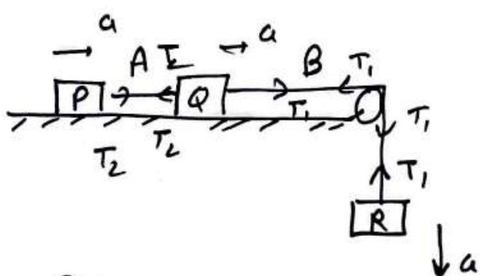
$$n^2 = 16 \quad , \quad n = 4$$

Maximum no. of allowed transitions

$$= \frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6$$

$\boxed{\text{Ans} = 6}$

$\boxed{\text{Ans - 60}}$



For R

$$3g - T_1 = 3a$$

Q $\quad T_1 - T_2 = 3a$

P $\quad T_2 = 3a$

$$3g = 9a$$

$$a = \frac{g}{3}$$

$$3g - T_1 = g$$

$$T_1 = 2g = 2\times 10 = 20\ N$$

$$\text{stress} = \frac{20}{0.005\times 10^{-4}} = 4\times 10^{+7}$$

$$Y = 2\times 10^{11}\ N/m^2$$

$$\text{strain} = \frac{4\times 10^{7}}{2\times 10^{11}} = 2\times 10^{-4}$$

$\boxed{\text{Ans} = 2}$

NTA - JEE SOLUTION [30Th Jan, 24, SHIFT-1]

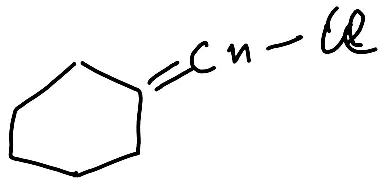
A-1 Correct option is (1) because if NaCN & Na_2S are not decomposed in Lassaigne extract then ~~it~~ it forms ppt with $AgNO_3$ solution.

A-2 La^{3+} and Ce^{4+} ions are diamagnetic because of no single electrons.

A-3 Correct option is (2) as sucrose does not give Fehling Test because it does not have hemiacetal

Correct option is (4)

A-4 $AlCl_3$ in aqueous and acidified solution forms a complex ion $[Al(H_2O)_6]Cl_3$ which has octahedral geometry.

A-5 Correct option is (2)  is vinyl halide

A-6 Correct option is (2) ∵ Reason is not correct explanation of statement (A).

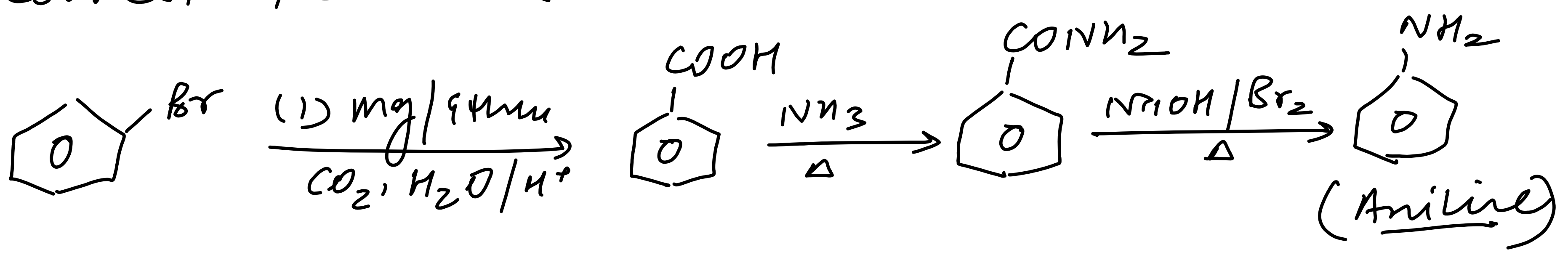
A-7 Correct option is (3)
Water - (Bent in shape), SF_4 - (Sea - Saw)
ClF_3 - (T - shape), BrF_5 - (Square Pyramidal)

A-8 Correct option is (1) because black ppt (Silvery) belongs to lead Sulphide.

A-9 Correct option is (4) because in hydrogen atom it has no electron(s) in 3rd-orbit so the energy of 3P, 3S & 3d are same & degenerate

A-10. Correct option is (3) Aniline

A-10. Correct option is (3) Aniline



A-11 Correct option is (2) because halide carbon is sp^3-hybridised

$$\underset{sp^2}{CH_2} = \underset{sp^2}{CH} - \underset{sp^3}{CH_2} - Cl$$

A-12 Correct option is (3) and structure is

$$\overset{5}{C}H_3 - \overset{4}{C}H(CH_3) - \overset{3}{C}H = \overset{2}{C}H - \overset{1}{C}HO \quad \begin{bmatrix} C_1 = \text{al} \\ C_2 = \text{ene} \\ C_4 = \text{methyl} \end{bmatrix}$$

A-13 Correct option is (4) because it is Aromatic and obeys Huckle's Rule for $n=0$, $(4\times0+2)\pi e^-$
$= \underline{2\pi e^-}$

A-14 Correct option is (1) Because on addition of napthalene to benzene, the v.P. and vaporisation, both are increased. Hence Freezing Point decreases

A-15 Correct option is (3)

$$CH_3-C\equiv CH + Na \xrightarrow[-H_2]{} CH_3-C\equiv \bar{C}\overset{+}{Na} \ (A)$$

$$\downarrow Br-CH_2-CH_2-CH_3 \ (B)$$

$$NaBr + CH_3-C\equiv C-CH_2-CH_2-CH_3$$

A-16 Correct option is (2).

A-17 Correct option is (3).

$$\begin{bmatrix} Cr^{2+} = 3d^4, 4s^0 \\ Mn^{+} = 3d^5, 4s^1 \\ Ni^{2+} = 3d^8, 4s^0 \end{bmatrix} \longrightarrow \text{This is actual arrangement}$$

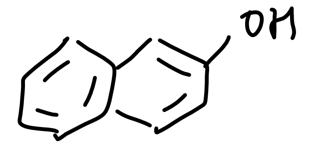
$$\left[\begin{array}{ll} Ni^{2+} & = 3d^{8}, 4s^{0} \\ V^{+} & = 3d^{3}, 4s^{1} \end{array}\right]$$

A-18 Correct option is (3). It belongs to Rosenmund's Reduction

A-19 Correct option is (4).

$A = CrO_3$, $B = CrO_2Cl_2$

A-20 Correct option is (3).

$A = \dfrac{NaNO_2 / HCl}{(0-5)^\circ C}$ $B =$ 

A-21

$$Mg(OH)_2 \rightleftharpoons \underset{(s)\ mol/l}{Mg^{2+}} + \underset{(2s)\ mol/l}{2OH^{-1}}$$

$K_{sp} = [Mg^{2+}][OH^-]^2 = (s + 0.1)4s^2 = 4s^3 + 0.4s^2 = 10^{-11}$

compare to s^2. s^3 is negligible. $0.4s^2 = 10^{-11}$

$s^2 = \dfrac{10}{4} \times 10^{-11} = 2.5 \times 10^{-11}$

$s = 5 \times 10^{-6}\ m = [OH^-]$

$pOH = -\log[OH^-] = -\log[5 \times 10^{-6}] = -\log 5 + 6 = 0.6990 + 6 = \underline{5.3010}$

$pH = 14 - pOH = 14 - 5.3 = 8.7 \simeq 9$

A-22 Total molecular orbitals are 8 from 2s & 2p in diatomic molecule

A-23

$$M = \frac{w \times 1000}{m \times V(ml)}$$

$$0.35 = \frac{w \times \cancel{1000}^{\,4}}{82.02 \times \cancel{250}} \Rightarrow w = \frac{0.35 \times 82.02}{4}$$

$$\boxed{W = 7.17\ gm}$$

A-24

Volume of Silver deposit $= \pi r^2 h$

$= 0.05 m^2 \times 0.05 cm$

$= 0.05 \times 10^4 cm^2 \times 0.05 cm$

$= 25\ cm^3$

$= 25\ cm^3$

mass of silver deposit $= V \times d$

$= 25\ cm^3 \times 7.9\ gm\ cm^{-3}$

$= 197.5\ gm.$

mole of silver $= \frac{w}{m} = \frac{197.5}{108} = 1.8287$

No. of atom of silver $= 1.8287 \times 6.023 \times 10^{23}$

$= \underline{11.01 \times 10^{23}}$

on comparing with

$\_\_\_ \times 10^{23} \Rightarrow$ will be 11.1

A-25 No. of Nitrogen atom in semicarbazide is 3

A-27

$$\overbrace{2MnO_4^{-1} + 2I^- + H_2O \longrightarrow 2MnO_2}^{\text{Red}\ \ O.N.\ \text{dec by (6)} \times 1} + I_2 + OH^-$$

oxidation ∵ O.N. inc. by (2) ×3

now, it will be,

$$2MnO_4^{-1} + 6I^- + 4H_2O \longrightarrow 2MnO_2 + 3I_2 + 8OH^-$$

Compare with,

$$2MnO_4^{-1} + b.I^- + C.H_2O \longrightarrow x.MnO_2 + y.I_2 + z.OH^-$$

$b = 6,\ C = 4,\ x = 2,\ y = 3,\ z = 8$

A-28 Retardation factor $= \frac{\text{distance travelled by org compound}}{\text{distance travelled by solvent}}$

$= \frac{3.5}{5} = 0.7 = 7 \times 10^{-1}$

comparing with $= - \times 10^{-1}$

Answer will be 7.

A 29 Rate constant for 1st order

$$K = \frac{2.303}{10} \log \frac{0.04}{0.02} \Rightarrow \frac{2.303}{10} \log \frac{4}{2} \Rightarrow \frac{2.303}{10} [2 \times 0.3010 - 0.4771]$$

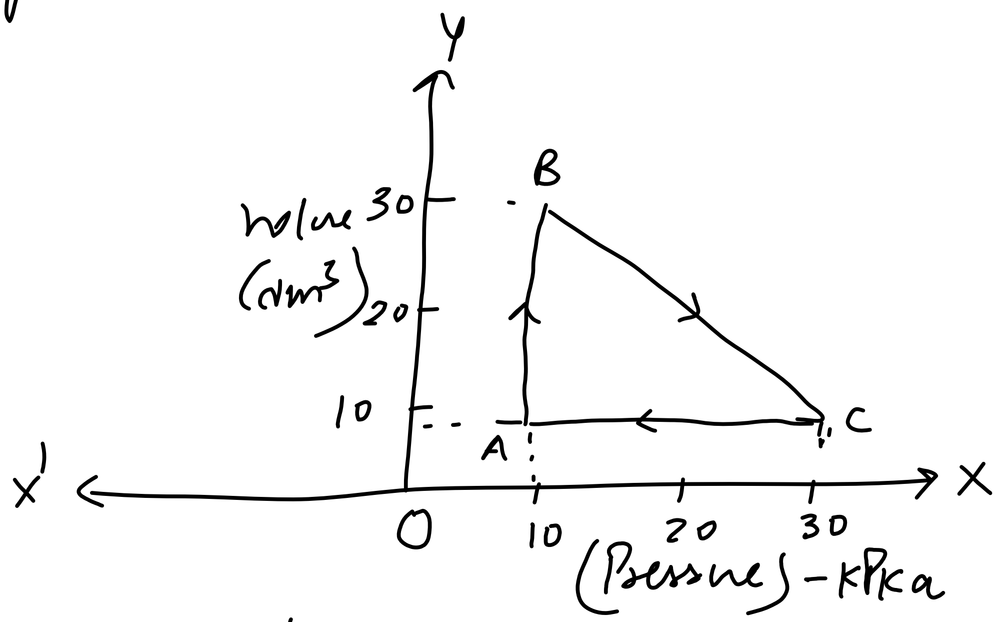
$$K = \frac{2.303}{10}\log\frac{0.04}{0.03} \Rightarrow \frac{2.303}{10}\log\frac{4}{3} \Rightarrow \frac{2.303}{10}\left[2\times 0.3010 - 0.4771\right]$$

$$K = \frac{2.303}{10}\left[0.6020 - 0.4771\right] = \frac{2.303\times 0.1249}{10} = 0.02876$$

$$t_{1/2} = \frac{0.693}{K} = \frac{0.693}{0.02876} = 24.09\ \underline{sec}$$

A-30 The atomic number is 111 and it belongs to 7th Period and group-11th.

A-26 work done by $A \rightarrow B$



$$W_{AB} = -P_{ext}(V_2 - V_1)$$

$$= -10(30-10)$$

$$= -200$$

work done by $B \rightarrow C$

$$W_{BC} = -20\times(10-30)$$

$$= +400$$

work done by $C \rightarrow A$

$W_{CA} = 0$ $\because$ vol does not change.

Hence, total work is done $= W_{AB} + W_{BC} + W_{CA}$

$$= -200 + 400 + 0$$

$$\boxed{W_{total} = 200}$$