21 Jan 2nd Shift

Q-1

Solve

$1+d\ ,\ 1+7d\ ;\ 1+43d$ are in GP

$(1+7d)^2 = (1+d)(1+43d)$

$1+49d^2+14d = 1+44d+43d^2$

$6d^2-30d=0$

$d=5$

$S_{20} = \frac{20}{2}\left[2\times1+(20-1)\times5\right]$

$= 10\left[2+95\right]$

$\boxed{S_{20} = 970}$

Q-2

$f: R \to (0, \infty)$

$$\lim_{x \to \infty} \frac{f(7x)}{f(x)} = 1$$

$\because$ $f(x)$ is increasing

$\therefore$ $f(x) < f(5x) < f(7x)$

$$\therefore \frac{f(x)}{f(x)} < \frac{f(5x)}{f(x)} < \frac{f(7x)}{f(x)}$$

$$1 < \lim_{x \to \infty} \frac{f(5x)}{f(x)} < 1$$

$$\therefore \left[\frac{f(5x)}{f(x)} - 1\right]$$

$$\Rightarrow 1 - 1 = 0$$

Q-3

Let probability of tail is $\frac{1}{3}$

$\Rightarrow$ Probability of getting head $= \frac{2}{3}$

$\therefore$ Probability of getting 2 tails and 1 head

$= \left(\frac{1}{3} \times \frac{2}{3} \times \frac{1}{3}\right) \times 3$

$= \frac{2}{27} \times 3$

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

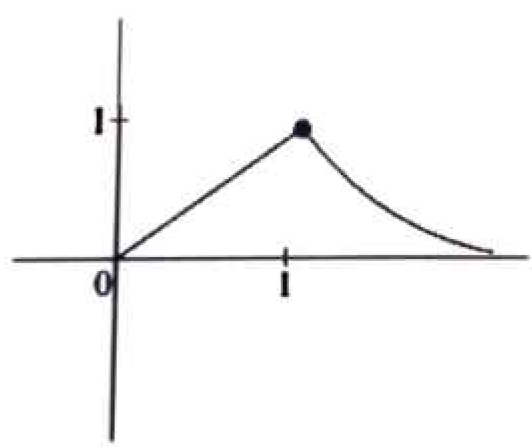
Q-4

$f : (0, \infty) \rightarrow R$

$f(x) = e^{-|\log_e x|}$

$$f(x) = \frac{1}{e^{|\ln x|}} = \begin{cases} \frac{1}{e^{-\ln x}}; 0 < x < 1 \\ \frac{1}{e^{\ln x}}; x \geq 1 \end{cases}$$

$$= \begin{cases} \frac{1}{\frac{1}{x}} = x; 0 < x < 1 \\ \frac{1}{x}, x \geq 1 \end{cases}$$



$\mathrm{m} = 0$ (No point at which function is not continuous)

$\mathrm{n} = 1$ (Not differentiable)

$\boxed{\therefore \mathrm{m} + \mathrm{n} = 1}$

Q-5

Let $A = \begin{bmatrix} x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \\ x_3 & y_3 & z_3 \end{bmatrix}$

Given $A \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \\ 2 \end{bmatrix}$ --- (1)

$\therefore \begin{bmatrix} x_1 + z_1 \\ x_2 + z_2 \\ x_3 + z_3 \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \\ 2 \end{bmatrix}$

$\therefore$

$\therefore \quad x_1 + z_1 = 2$ --- (2)

$x_2 + z_2 = 0$ --- (3)

$x_3 + z_3 = 0$ --- (4)

Given $A \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} -4 \\ 0 \\ 4 \end{bmatrix}$

$\therefore \begin{bmatrix} -x_1 + z_1 \\ -x_2 + z_2 \\ -x_3 + z_3 \end{bmatrix} = \begin{bmatrix} 4 \\ 0 \\ 4 \end{bmatrix}$

$\Rightarrow \quad -x_1 + z_1 = -4$ --- (5)

$-x_1 + x_2 = 0$ -- (6)

$-x_3 + z_3 = 4$

P.T.O

Given

$$A\begin{bmatrix}0\\1\\0\end{bmatrix}=\begin{bmatrix}0\\2\\0\end{bmatrix}$$

$$\therefore \begin{bmatrix}y_1\\y_2\\y_3\end{bmatrix}=\begin{bmatrix}0\\2\\0\end{bmatrix}$$

$\therefore\ y_1=0,\ y_2=2,\ y_3=0$

$\therefore$ form (2), (3), (4), (5), (6) and (7)

$x_1=3x,\ x_2'=0,\ x_3=-1$

$y_1=0,\ y_2=2,\ y_3=0$

$z_1=-1,\ z_2=0,\ z_3=3$

$$\therefore A=\begin{bmatrix}3&0&-1\\0&2&0\\-1&0&3\end{bmatrix}$$

$$\therefore \text{Now } (A-3I)\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}-1\\2\\3\end{bmatrix}$$

$$\therefore \begin{bmatrix}0&0&-1\\0&-1&0\\-1&0&0\end{bmatrix}\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}-1\\2\\3\end{bmatrix}$$

P.T.O

$$\begin{bmatrix} -z \\ -y \\ -x \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

$$[z = -1],\ [y = -2],\ [x = -3]$$

$\boxed{\text{Unique solution}}$

Q-6

$$L_2 = \frac{x+4}{3} = \frac{y-4}{2} = \frac{z-3}{0}$$

$$\therefore \text{ S.D } = \frac{\begin{vmatrix} x_2-x_1 & y_2-y_1 & z_2-z_1 \\ 2 & -3 & 2 \\ 3 & 2 & 0 \end{vmatrix}}{\left|\vec{n_1}\times\vec{n_2}\right|}$$

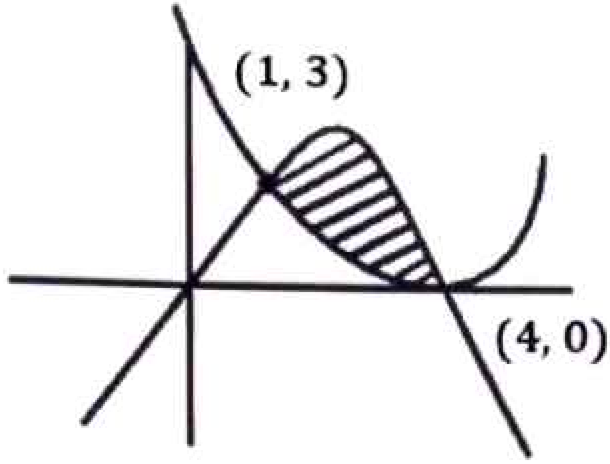
$$= \frac{\begin{vmatrix} 5 & -5 & -7 \\ 2 & -3 & 2 \\ 3 & 2 & 0 \end{vmatrix}}{\left|\vec{n_1}\times\vec{n_2}\right|}$$

$$= \frac{141}{|-4\hat{i}+6\hat{j}+13\hat{k}|}$$

$$= \frac{141}{\sqrt{16+36+169}}$$

$$\boxed{= \frac{141}{\sqrt{221}}}$$

Q-7



$$\text{Area} = \left|\int_1^4 \left[\left(4x - x^2\right) - \frac{(x-4)^2}{3}\right]\right| dx$$

$$= \left|\frac{4x^2}{2} - \frac{x^3}{3} - \frac{(x-4)^3}{9}\right|_1^4$$

$$= \left|\left(\frac{64}{2} - \frac{64}{3} - \frac{4}{2} + \frac{1}{3} - \frac{27}{9}\right)\right|$$

$$\boxed{\Rightarrow (27 - 21) = 6}$$

Q-8

After giving 2 apples to each child 15 apples left now 15 apples can be distributed in ${}^{15+3-1}C_2 = {}^{17}C_2$ ways

$$= \frac{17 \times 16}{2}$$

$$\boxed{= 136}$$

Q-9

$$f(x) = \int_{-x}^{x} |t| - t^2 e^{-t^2} dt$$

$$g(x) = \int_{0}^{x^2} t^{\frac{1}{2}} e^{-t} dt$$

$$f(x) = 2\int_{0}^{x} (t - t^2)\, e^{-t^2} dt$$

$$f(x) = 2\left[\int_{0}^{x} t^{-t^2} dt - \int_{0}^{x} t^2 e^{-t^2} dt\right]$$

$$g(x) = \int_{0}^{x^2} \sqrt{t} e^{-t} dt \quad \sqrt{t} = y \Rightarrow \frac{dt}{2\sqrt{t}} = dy$$

$$g(x) = 2\int_{0}^{x} y^2 \cdot e^{-y^2} dy$$

$$f(x) + g(x) = 2\left(\frac{1-e^{-x^2}}{2}\right)$$

$$= 1 - e^{-x^2}$$

$$\Rightarrow 9\left(f\left(\sqrt{\log_e 9}\right) + g\left(\sqrt{\log_e 9}\right)\right) = 9 \times \left(1 - \frac{1}{9}\right)$$

$$\boxed{= 9 \times \frac{8}{9} = 8}$$

Q-10

$$\frac{dT}{dt} = -k(T-80)$$

$$\int_{160}^{T} \frac{dT}{(T-80)} = \int_{0}^{t} -Kdt$$

$$[\ln|T-80|]_{160}^{T} = -kt$$

$$\ln|T-80| - \ln 80 = -kt$$

$$\ln\left|\frac{T-80}{80}\right| = -kt$$

$$T = 80 + 80e^{-kt}$$

$$120 = 80 + 80e^{-k.15}$$

$$\frac{40}{80} = e^{-k15} = \frac{1}{2}$$

$$\therefore T(45) = 80 + 80e^{-k.45}$$

$$= 80 + 80\left(e^{-k.15}\right)^3$$

$$= 80 + 80 \times \frac{1}{8}$$

$$\boxed{= 90}$$

Q-11

$$^6C_m + 2\left(^6C_{m+1}\right) + {}^6C_{m+2} > {}^8C_3$$

$$^7C_{m+1} + {}^7C_{m+2} > {}^8C_3$$

$$^8C_{m+2} >^8 C_3$$

$$\therefore m = 2$$

And $^{n-1}P_3 : {}^nP_4 = 1 : 8$

$$\frac{(n-1)(n-2)(n-3)}{n(n-1)(n-2)(n-3)} = \frac{1}{8}$$

$$\therefore n = 8$$

$$\therefore {}^nP_{m+1} + {}^{n+1}C_m = {}^8P_3 + {}^9C_2$$

$$= 8 \times 7 \times 6 + \frac{9\times 8}{2}$$

$$\boxed{= 372}$$

Q-12

$$\text{mean } = \frac{a+b+68+44+48+60}{6} = 55$$

$$a+b+220 = 55 \times 6 \Rightarrow 330$$

$$a+b = 110$$

$$\text{variance } = \frac{\sum x_i^2}{n} - (\bar{x})^2 = 194$$

$$\frac{a^2+b^2+(68)^2+(44)^2+(48)^2+(60)^2}{6} - (55)^2 = 194$$

$$a^2+b^2+4624+1936+2304+3600 = 6 \times (3205+194)$$

$$a^2+b^2 = 6850$$

Now $(a+b)^2 = (110)^2$

$$a^2+b^2+2ab = 12100$$

$$6850+2ab = 12100$$

$$2ab = 12100-6850$$

$$2ab = 5250$$

$$ab = 2625$$

$$\Rightarrow (110-b)b = 2625 \quad (\because a = 110-b)$$

$$b^2-110b+2625 = 0$$

$$b = 35, 75$$

but $a > b$

$$a+b = 110$$

So $b = 35$ and $a = 75$

Now

$$\Rightarrow a+3b$$

$$\Rightarrow 75+3(35)$$

$$\boxed{\Rightarrow 180}$$

Q-13

$$a = \sin^{-1}(\sin 5) = 5 - 2\pi$$

and $b = \cos^{-1}(\cos 5) = 2\pi - 5$

$$\therefore a^2 + b^2 = (5 - 2\pi)^2 + (2\pi - 5)^2$$

$$\boxed{= 8\pi^2 - 40\pi + 50}$$

Q-14

$$f(x) = e^{x^3-3x+1}$$

$$f'(x) = e^{x^3-3x+1} \cdot (3x^2 - 3)$$

$$= e^{x^3-3x+1} \cdot 3(x-1)(x+1)$$

For $f'(x) \geq 0$

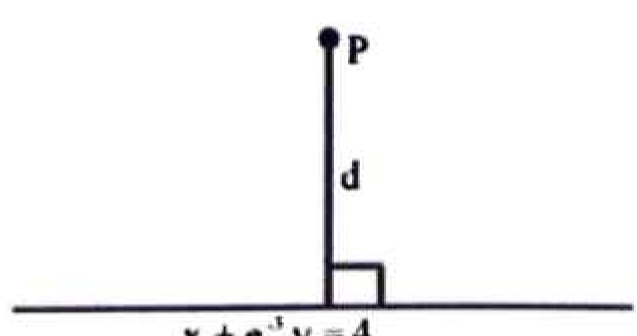
$\therefore f(x)$ is increasing function.

$$\therefore a = e^{-\infty} = 0 = f(-\infty)$$

$$b = e^{-1+3+1} = e^3 = f(-1)$$

$$P(2\,b + 4, a + 2)$$

$$\therefore P\left(2e^3 + 4, 2\right)$$



$$\boxed{d = \frac{(2e^3+4)+2e^{-3}-4}{\sqrt{1+e^{-6}}} \doteq 2\sqrt{1+e^6}}$$

Q 15

$$z_1 + z_2 = 5$$

$$z_1^3 + z_2^3 = 20 + 15i$$

$$|z_1^4 + z_2^4| = ?$$

$$z_1^3 + z_2^3 = (z_1 + z_2)^3 - 3z_1z_2(z_1 + z_2)$$

$$z_1^3 + z_2^3 = 125 - 15z_1z_2$$

$$20 + 15i = 125 - 15z_1z_2$$

$$z_1z_2 = 7 - i$$

Now

$$(z_1 + z_2)^2 = 5^2$$

$$z_1^2 + z_2^2 + 2z_1z_2 = 25$$

$$z_1^2 + z_2^2 = 25 - 2(7 - i)$$

$$= 11 + 2i$$

$$(z_1^2 + z_2^2)^2 = (11 + 2i)^2$$

$$z_1^4 + z_2^4 + 2(7 - i)^2 = 117 + 44i$$

$$z_1^4 + z_2^4 = 21 + 72i$$

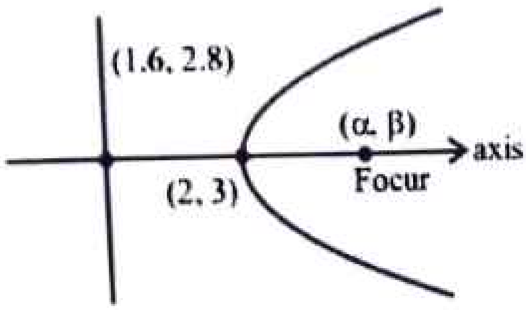
$$|z_1^4 + z_2^4| = \sqrt{(21)^2 + (72)^2}$$

$$= \sqrt{441 + 5184}$$

$$= \sqrt{5625}$$

$$\boxed{= 75}$$

Q-16



Slope of axis $= \frac{1}{2}$

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

$\Rightarrow 2y - 6 = x - 2$

$\Rightarrow 2y - x - 4 = 0$

$2x + y - 6 = 0$

$4x + 2y - 12 = 0$

$\alpha + 1.6 = 4 \Rightarrow \alpha = 2.4$

$\beta + 2.8 = 6 \Rightarrow \beta = 3.2$

Ellipse passes through $(2.4, 3.2)$

$$\Rightarrow \frac{\left(\frac{24}{10}\right)^2}{a^2} + \frac{\left(\frac{32}{10}\right)^2}{b^2} = 1 \quad \ldots.(1)$$

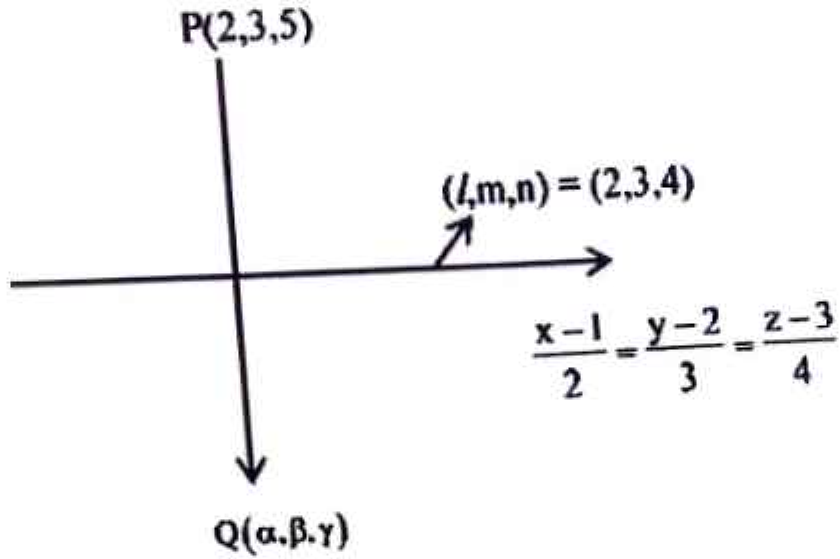
Also $1 - \frac{b^2}{a^2} = \frac{1}{2} = \frac{b^2}{a^2} = \frac{1}{2}$

$\Rightarrow a^2 = 2\,b^2$

Put in (1) $\Rightarrow b^2 = \frac{328}{25}$

$$\boxed{\Rightarrow \left(\frac{2b^2}{a}\right)^2 = \frac{4b^2}{a^2} \times b^2 = 4 \times \frac{1}{2} \times \frac{328}{25} = \frac{656}{25}}$$

Q-17



Direction Ratios of PQ

$$\alpha-2, \beta-3, \gamma-5$$

PQ $\perp$ line

$$2(\alpha-2)+3(\beta-3)+(\gamma-5)4=0$$

$$2\alpha-4+3\beta-9+4\gamma-20=0$$

$$\boxed{2\alpha+3\beta+4\gamma=20+9+4=33}$$

Q-18

Take $e^{\sin x} = t(t > 0)$

$\Rightarrow t - \frac{2}{t} = 2$

$\Rightarrow \frac{t^2-2}{t} = 2$

$\Rightarrow t^2 - 2t - 2 = 0$

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

$\Rightarrow (t - 1)^2 = 3$

$\Rightarrow t = 1 \pm \sqrt{3}$

$\Rightarrow t = 1 \pm 1.73$

$\Rightarrow t = 2.73$ or -0.73 (rejected as $t > 0$)

$\Rightarrow e^{\sin x} = 2.73$

$\Rightarrow \log_e e^{\sin x} = \log_e 2.73$

$\Rightarrow \sin x = \log_e 2.73 > 1$

So no solution.

Q-19

$$(y-2)=m(x-8)$$

$\Rightarrow$ x-intercept

$$\Rightarrow \left(\frac{-2}{\mathrm{m}}+8\right)$$

$\Rightarrow$ y-intercept

$$\Rightarrow (-8\,\mathrm{m}+2)$$

$$\Rightarrow \mathrm{OA}+\mathrm{OB}=\frac{-2}{\mathrm{m}}+8-8\,\mathrm{m}+2$$

$$\mathrm{f}'(\mathrm{m})=\frac{2}{\mathrm{m}^2}-8=0$$

$$\Rightarrow \mathrm{m}^2=\frac{1}{4}$$

$$\Rightarrow \mathrm{m}=\frac{-1}{2}$$

$$\Rightarrow \mathrm{f}\left(\frac{-1}{2}\right)=18$$

$\boxed{\Rightarrow \text{Minimum} = 18}$

Q-20

$A(a,b), B(3,4), C(-6,-8)$

2 : 1

C A B

(-6, -8) (a, b) (3, 4)

$\Rightarrow \mathrm{a}=0,\ \mathrm{b}=0 \Rightarrow \mathrm{P}(3,5)$

Distance from P measured along $\mathrm{x}-2\mathrm{y}-1=0$

$\Rightarrow x=3+r\cos\theta, y=5+r\sin\theta$

Where $\tan\theta=\frac{1}{2}$

$\mathrm{r}(2\cos\theta+3\sin\theta)=-17$

$$\boxed{\Rightarrow \mathrm{r}=\left|\frac{-17\sqrt{5}}{7}\right|=\frac{17\sqrt{5}}{7}}$$

Q-24

$$\lim_{x\to 0} \frac{ax^2\left(1+x+\frac{x^2}{2!}+\frac{x^3}{3!}+....\right)-b\left(x-\frac{x^2}{2}+\frac{x^3}{3}-....\right)+cx\left(1-x+\frac{x^2}{x!}-\frac{x^3}{3!}+....\right)}{x^3\cdot\frac{\sin x}{x}}$$

$$=\lim_{x\to\infty} \frac{(c-b)x+\left(\frac{b}{2}-c+a\right)x^2+\left(a-\frac{b}{3}+\frac{c}{2}\right)x^3+....}{x^3}=1$$

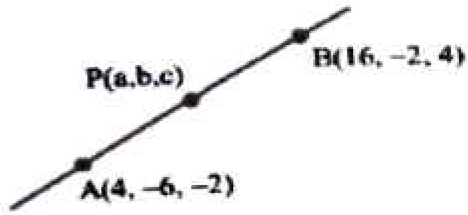
$$\mathrm{c}-\mathrm{b}=0, \quad \frac{\mathrm{b}}{2}-\mathrm{c}+\mathrm{a}=0$$

$$a-\frac{b}{3}+\frac{c}{2}=1 \quad a=\frac{3}{4} \quad b=c=\frac{3}{2}$$

$$a^2+b^2+c^2=\frac{9}{16}+\frac{9}{4}+\frac{9}{4}$$

$$\boxed{16\left(a^2+b^2+c^2\right)=81}$$

Q 22



Eq. of AB

$\frac{x-4}{12} = \frac{y+6}{4} = \frac{z+2}{6} = \alpha$

$a = 12\alpha + 4$

$b = 4\alpha - 6$

$c = 6\alpha - 2$

Distance $\mathbf{PA} = 21$

$\sqrt{(12\alpha + 4 - 4)^2 + (4\alpha - 6 + 6)^2 + (6\alpha - 2 + 2)^2} = 21$

$144\alpha^2 + 16\alpha^2 + 36\alpha^2 = 441$

$196\alpha^2 = 441$

$\alpha^2 = \frac{441}{196}$

$\alpha = \pm\frac{21}{14} \Rightarrow \pm\frac{3}{2}$ (a, b, c are non negative)

$\left(\alpha - \frac{8}{2}\right)$ (a, b, c)

$a = 12 \times \frac{3}{2} + 4 \Rightarrow 22$

$b = 4 \times \frac{3}{2} - 6 \Rightarrow 0$

$c = 6 \times \frac{3}{2} - 2 \Rightarrow 7$

$P(22, 0, 7), Q(4, -12, 3)$

$PQ = \sqrt{(18)^2 + (12)^2 + (4)^2}$

$= \sqrt{324 + 144 + 16}$

$\boxed{= 22}$

Q-23

$$\underbrace{\mathrm{adj}(\mathrm{adj}(\mathrm{adj}\ldots\ldots(\mathrm{a})))}_{\text{2024 times}}=|\mathrm{A}|^{(\mathrm{n}-1)^{2024}}$$

$$=|\mathrm{A}|^{2024}$$

$$=2^{2^{2024}}$$

$$2^{2024}=\left(2^{2}\right)2^{2022}=4(8)^{674}=4(9-1)^{674}$$

$$\Rightarrow 2^{2024}\equiv 4(\bmod 9)$$

$$\Rightarrow 2^{2024}\equiv 9\,\mathrm{m}+4,\ \mathrm{m}\leftarrow \text{even}$$

$$2^{9\,\mathrm{m}+4}\equiv 16\cdot\left(2^{3}\right)^{3\,\mathrm{m}}\equiv 16(\bmod 9)$$

$$\boxed{\equiv 7}$$

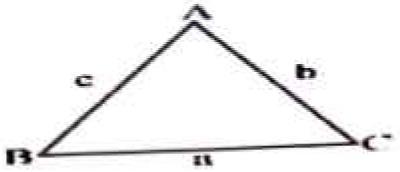
Q-24

$(a^2+b^2)x^2-2b(a+c)x+b^2+c^2=0$

$(ax-b)^2+(bx-c)^2=0$

$x=\frac{b}{a}, x=\frac{c}{b}$

Now



$|a-b|<c<(a+b)$

$b^2=ac$

$|a-c|<b<a+c$ $\qquad b^2=ac\times\frac{a}{a}$

$\left|1-\frac{c}{a}\right|<\frac{b}{a}<1+\frac{c}{a}$ $\qquad \frac{b^2}{a^2}=\frac{c}{a}$

$\left|1-\frac{c}{a}\right|<x<1+\frac{c}{a}$ $\qquad x^2=\frac{c}{a}$

$|1-x^2|<x<1+x^2$

Case I: $x<1+x^2$

always +ve

Case II: $|1-x^2|<x$

$-x<1-x^2<x$

Now

$1-x^2<x$

$x^2+x-1>0$

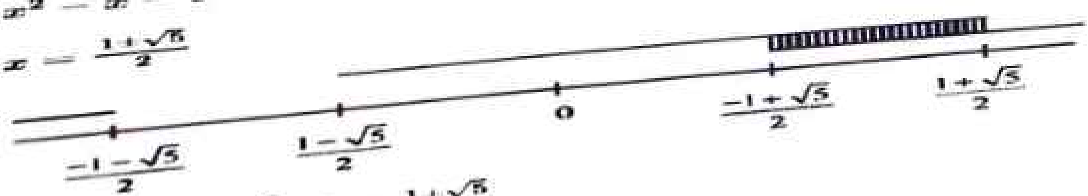
$x=\frac{-1\pm\sqrt{5}}{2}$

Now

$-x<1-x^2$

$x^2-x-1<0$

$x=\frac{1\pm\sqrt{5}}{2}$



$\Rightarrow \alpha=\frac{-1+\sqrt{5}}{2}, \beta=\frac{1+\sqrt{5}}{2}$

Now

$12(\alpha^2+\beta^2)=12\left(\left(\frac{-1+\sqrt{5}}{2}\right)^2+\left(\frac{1+\sqrt{5}}{2}\right)^2\right)$

$=12\left(\frac{(-1+\sqrt{5})^2+(1+\sqrt{5})^2}{4}\right)$

$\boxed{=36}$

Q-25

$$(x+3)^{n-1}+(x+3)^{n-2}(x+2)+$$

$$(x+3)^{n-3}(x+2)^2+\ldots\ldots+(x+2)^{n-1}$$

$$\sum \alpha_r = 4^{n-1}+4^{n-2}\times 3+4^{n-3}\times 3^2\ldots\ldots+3^{n-1}$$

$$=4^{n-1}\left[1+\frac{3}{4}+\left(\frac{3}{4}\right)^2\ldots\ldots+\left(\frac{3}{4}\right)^{n-1}\right]$$

$$=4^{n-1}\times\frac{1-\left(\frac{3}{4}\right)^n}{1-\frac{3}{4}}$$

$$=4^n-3^n=\beta^n-\gamma^n$$

$$\beta=4,\gamma=3$$

$$\boxed{\beta^2+\gamma^2=16+9=25}$$

Q-26

$$(\vec{a}+\vec{b})\times\vec{c} = 2(\vec{a}\times\vec{b}) + 24\hat{j} - 6\hat{k}$$

$$(5\hat{i}+\hat{j}+4\hat{k})\times\vec{c} = 2(7\hat{i}-7\hat{j}-7\hat{k}) + 24\hat{j} - 6\hat{k}$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 5 & 1 & 4 \\ x & y & z \end{vmatrix} = 14\hat{i} + 10\hat{j} - 20\hat{k}$$

$$\Rightarrow \hat{\mathrm{i}}(\mathrm{z}-4\mathrm{y}) - \hat{\mathrm{j}}(5\mathrm{z}-4\mathrm{x}) + \hat{\mathrm{k}}(5\mathrm{y}-\mathrm{x}) = 14\hat{\mathrm{i}} + 10\hat{\mathrm{j}} - 20\hat{\mathrm{k}}$$

$$z - 4y = 14, 4x - 5z = 10, 5y - x = -20$$

$$(\mathrm{a}-\mathrm{b}+\mathrm{i})\cdot\vec{\mathrm{c}} = -3$$

$$(2\hat{i}+3\hat{j}-2\hat{k})\cdot\vec{c} = -3$$

$$2\mathrm{x} + 3\mathrm{y} - 2\mathrm{z} = -3$$

$$\therefore \mathrm{x} = 5, \mathrm{y} = -3, \mathrm{z} = 2$$

$$\boxed{|\vec{\mathrm{c}}|^2 = 25 + 9 + 4 = 38}$$

Q-21

$$\left|\frac{120}{\pi^3}\int_0^{\pi}\frac{x^2\sin x\cos x}{\sin^4 x+\cos^4 x}dx\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\int_0^{\pi/2}\frac{\sin x\cos x}{\sin^4 x+\cos^4 x}\left(x^2-(\pi-x)^2\right)dx\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\int_0^{\pi/2}\frac{\sin x\cdot\cos x}{\sin^4 x+\cos^4 x}\left(2\pi x-\pi^2\right)dx\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\left[2\pi\int_0^{\pi/2}\frac{x\sin x\cdot\cos x}{\sin^4 x+\cos^4 x}dx-\pi^2\int_0^{\pi/2}\frac{\sin x\cdot\cos x}{\sin^4 x+\cos^4 x}dx\right]\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\left[2\pi\times\frac{\pi^{\pi/2}}{4}\int_0^{\pi/2}\frac{\sin x\cdot\cos x}{\sin^4 x+\cos 4}dx-\pi^2\int_0^{\pi/2}\frac{\sin x\cdot\cos x}{\sin^4 x+\cos^4 x}dx\right]\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\left[\frac{-\pi^2}{2}\int_0^{\pi/2}\frac{\sin x\cdot\cos x}{\sin^4 x+\cos^4 x}dx\right]\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\left[\frac{-\pi^2}{2}\int_0^{\pi/2}\frac{\sin x\cdot\cos x}{1-2\sin^2 x\cos^2 x}dx\right]\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\left[\frac{-\pi^2}{2}\int_0^{\pi/2}\frac{\frac{1}{2}\sin^2 x}{1-\frac{1}{2}\sin^2 2x}dx\right]\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\left[\frac{-\pi^2}{2}\int_0^{\pi/2}\frac{\sin 2x}{2-\sin^2 2x}dx\right]\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\left[\frac{-\pi^2}{2}\int_0^{\pi/2}\frac{\sin 2x}{1+\cos^2 2x}dx\right]\right|$$

take $\cos 2x = t, -2\sin 2x dx = dt$

$$\Rightarrow\left|\frac{120}{\pi^3}\left[\frac{-\pi^2}{2}\int_1^{-1}\frac{-\frac{1}{2}dt}{1+t^2}\right]\right|$$

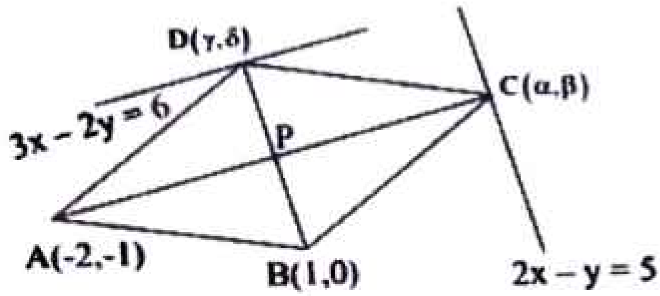
$$\Rightarrow\left|\frac{120}{\pi^3}\left[\frac{-\pi^2}{2}\int_{-1}^{1}\frac{\frac{1}{2}dt}{1+t^2}\right]\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\times\left[\frac{-\pi^2}{4}\left(\tan^{-1}(t)\right)_{-1}^{1}\right]\right|$$

$$\Rightarrow\left|\frac{120}{\pi^3}\times\left[\frac{-\pi^2}{4}\times\frac{\pi}{2}\right]\right|$$

$$\boxed{\Rightarrow 15}$$

Q-28



$$P \equiv \left(\frac{\alpha-2}{2}, \frac{\beta-1}{2}\right) \equiv \left(\frac{\gamma+1}{2}, \frac{\delta}{2}\right)$$

$$\frac{\alpha-2}{2} = \frac{\gamma+1}{2} \text{ and } \frac{\beta-1}{2} = \frac{\delta}{2}$$

$$\Rightarrow \alpha - \gamma = 3 \quad \ldots.(1)$$

$$\beta - \delta = 1 \quad \ldots.(2)$$

Also, (γ, δ) lies on $3x - 2y = 6$

$$3\gamma - 2\delta = 6 \quad \ldots.(3)$$

and (α, β) lies on $2x - y = 5$

$$\Rightarrow 2\alpha - \beta = 5 \quad \ldots.(4)$$

Solving (1), (2), (3), (4)

$$\alpha = -3, \beta = -11, \gamma = -6, \delta = -12$$

$$\boxed{|\alpha + \beta + \gamma + \delta| = 32}$$

~~Q.28~~ 29

$$\sec^2 x\frac{dx}{dy} + e^{2y}\tan^2 x + \tan x = 0$$

$$\left(\text{Put } \tan x = t \Rightarrow \sec^2 x\frac{dx}{dy} = \frac{dt}{dy}\right)$$

$$\frac{dt}{dy} + e^{2y} \times t^2 + t = 0$$

$$\frac{dt}{dy} + t = -t^2 \cdot e^{2y}$$

$$\frac{1}{t^2}\frac{dt}{dy} + \frac{1}{t} = -e^{2y}$$

$$\left(\text{Put } \frac{1}{t} = u \frac{-1}{t^2}\frac{dt}{dy} = \frac{du}{dy}\right)$$

$$\frac{-du}{dy} + u = -e^{2y}$$

$$\frac{du}{dy} - u = e^{2y}$$

$$\text{I.F.} = e^{-\int dy} = e^{-y}$$

$$ue^{-y} = \int e^{-y} \times e^{2y} dy$$

$$\frac{1}{\tan x} \times e^{-y} = e^{y} + c$$

$$x = \frac{\pi}{4}, y = 0, c = 0$$

$$x = \frac{\pi}{6}, y = \alpha$$

$$\sqrt{3}e^{-\alpha} = e^{\alpha} + 0$$

$$e^{2\alpha} = \sqrt{3}$$

$$\boxed{e^{8\alpha} = 9}$$

Q-30

$$A = \{1, 2, 3 \ldots 100\}$$

$$R \Rightarrow 2x = 3y \Rightarrow y = \frac{2x}{3}$$

$$R = \{(3,2), (6,4), (9,6) \ldots (99,66)\}$$

$$n(R) = 33$$

$$R \subset R_1$$

Now

$$R_1 = \{(3,2), (6,4), (9,6) \ldots (99,66), (2,3), (4,6), (6,9) \ldots (66,99)\}$$

$\Rightarrow$ minimum number of elements in $R_1 = 66$

JEE Main Solution

Physics Date - 31/01/24 shift - II

Ans-31

$$|\vec{A}+\vec{B}| = \sqrt{R^2+R^2+2R^2\cos\theta}$$

$$= \sqrt{2R^2(1+\cos\theta)}$$

$$= \sqrt{2R^2 \cdot 2\cos^2\frac{\theta}{2}}$$

$$\boxed{|\vec{A}+\vec{B}| = 2R\cos\frac{\theta}{2}}$$

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

Ans-32

$$\vec{F} = (6t\hat{i} + 6t^2\hat{j})$$

$$\vec{a} = \frac{\vec{F}}{m} = \frac{6t\hat{i}}{2} + \frac{6t^2\hat{j}}{2} = (3t\hat{i} + 3t^2\hat{j})$$

$$\frac{d\vec{v}}{dt} = (3t\hat{i} + 3t^2\hat{j})$$

$$\vec{v} = 3\frac{t^2}{2}\hat{i} + \frac{3t^3}{3}\hat{j} = \frac{3t^2}{2}\hat{i} + t^3\hat{j}$$

$$P = \vec{F}\cdot\vec{v} = (6t\hat{i} + 6t^2\hat{j})\cdot\left(\frac{3t^2}{2}\hat{i} + t^3\hat{j}\right)$$

$$= (9t^3 + 6t^5)\,W$$

$$\boxed{P = (9t^3 + 6t^5)W}$$

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

$\boxed{\text{Ans-33}}$

$$V = 20 \sin 200\pi t$$

$$I = 10 \sin \left(200\pi t + \frac{\pi}{3}\right)$$

$$P_{av} = V_{rms} I_{rms} \cos\phi$$

$$= \frac{V_0 I_0}{2} \cos\phi = \frac{20\times10}{2} \times \cos\frac{\pi}{3}$$

$$= \frac{200}{4} = 50W$$

$$\boxed{P = 50W}$$

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

$\boxed{\text{Ans-34}}$

$$\frac{\Delta l}{l} = \frac{0.2}{20} = \frac{1}{100}$$

$$\%\text{ error in } \frac{\Delta l}{l} = 1\%$$

$$\frac{\Delta T}{T} = \frac{1}{40}$$

$$\%\text{ error in } \frac{\Delta T}{T} = \frac{1}{40} \times 100 = 2.5\%$$

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

$$g = 4\pi^2 \frac{l}{T^2}$$

$$\%\text{ error in } g = \%\text{ error in } l + 2\times\%\text{ error in } T$$

$$= 1 + 2\times 2.5$$

$$= 6\%$$

$\boxed{\text{option (2) is correct}}$

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

$$F^{*} = \frac{K q_1 q_2}{r^2}$$

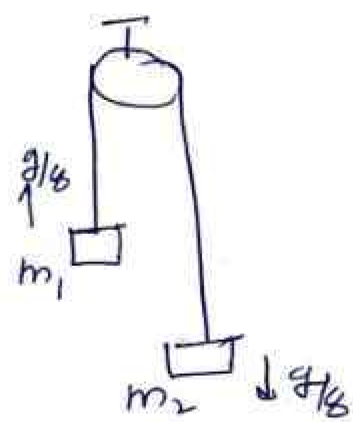
$$F' = \frac{K q_1 q_2}{K\left(\frac{r}{5}\right)^2} = \frac{K\cdot q_1 q_2}{\cancel{5}\cdot\frac{r^2}{\cancel{25}\,5}}$$

$$F' = 5\,\frac{K q_1 q_2}{r^2} = 5F$$

$$\boxed{F' = 5F}$$

$\boxed{\text{option (2) is Correct}}$

$\boxed{\text{Ans - 36}}$



$$m_2 g - T = m_2 \frac{g}{8}$$

$$T = m_2 \frac{7g}{8}$$

$$T - m_1 g = m_1 \frac{g}{8}$$

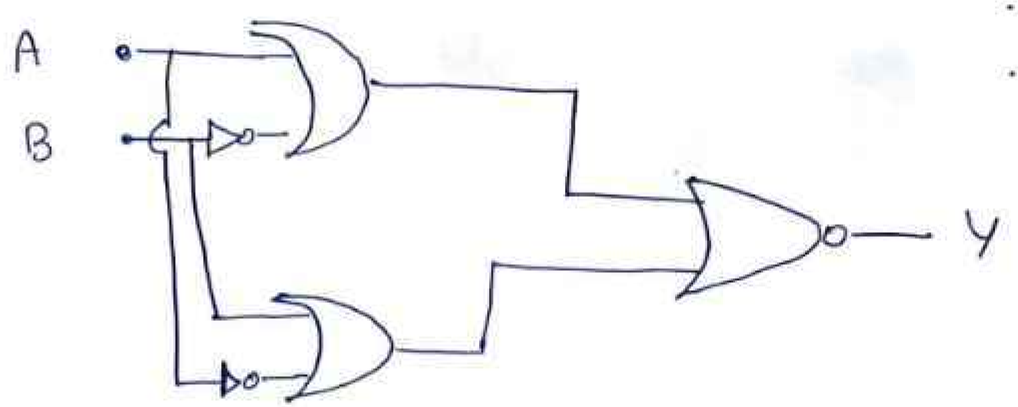
$$T = m_1 \frac{9g}{8}$$

$$m_2 \frac{7g}{8} = m_1 \frac{9g}{8}$$

$$\boxed{\frac{m_2}{m_1} = \frac{9}{7}}$$

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

Ans-37



Truth Table

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

option (1) is correct

Ans-38 For first case

$$\frac{x}{4\cancel{0}} = \frac{25}{6\cancel{0}} \qquad x = \frac{100}{6} = \frac{50}{3}\ \Omega$$

For second case

$$\frac{\frac{5\cancel{0}^{2}}{3}}{\cancel{21} \times x} = \frac{25}{\cancel{21}(100-x)}$$

$$200 - 2x = 3x$$

$\boxed{x = 40\ \text{cm}}$

option (3) is correct

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

Heating effect of current

$$H_1 = I^2 R t$$

If current is reduced by 20 %

$$H_2 = 0.64 I^2 R t$$

% decrease in heating or illumination $= \dfrac{I^2Rt(1-0.64)}{I^2Rt} \times 100$

$$= 36 \%$$

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

$\boxed{\text{Ans-40}}$

$$E = \frac{B - x^2}{At}$$

Dimension of $B = [L^2]$

$$[ML^2T^{-2}] = \frac{[L^2]}{A[T]}$$

$$A = \frac{1}{[MT^{-1}]} = [M^{-1}T^1]$$

$$AB = [L^2M^{-1}T^1]$$

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

$\boxed{\text{Ans-41}}$ $U = nC_vT$

For 8 moles of argon

$$U_1 = 8 \times \frac{3R}{2} T = 12RT$$

For 6 moles of oxygen

$$U_2 = \cancel{6}^{3} \times \frac{5R}{\cancel{2}} \times T = 15RT$$

Total Energy $U = U_1 + U_2 = 12RT + 15RT$

$$\boxed{\text{Ans} = 27RT}$$

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

$\boxed{\text{Ans-42}}$ $\vec{B} = 2 \times 10^{-3} \hat{j}\ T$

$$\vec{A} = -20 \times 10 \times 10^{-4} \hat{i}$$

$$\vec{M} = i\vec{A} = -5 \times 2 \times 10^{-2} \hat{i}$$

$$= -10^{-1} \hat{i}$$

$$\vec{\tau} = \vec{M} \times \vec{B}$$

$$= -10^{-1} \hat{i} \times 2 \times 10^{-3} \hat{j}$$

$$\vec{\tau} = -2 \times 10^{-4} \hat{k}\ N\text{-}m$$

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

$\boxed{\text{Ans- 43}}$ New frequency $f' = \frac{1.5 f_0}{2} = 0.75 f_0$

$$f' < f_0$$

New frequency is less than the thresold frequency. Hence no photoelectron will be emitted.

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

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

$\boxed{\text{Ans- 44}}$ speed of sound in oxygen at STP

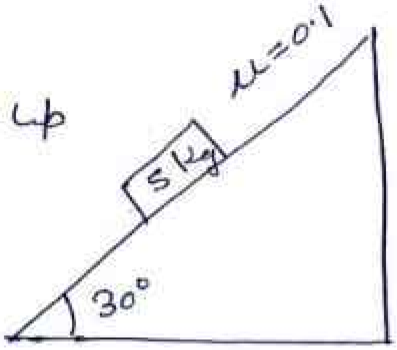
$$= \sqrt{\frac{\gamma RT}{M}} = \sqrt{\frac{1.4 \times 8.3 \times 273}{32 \times 10^{-3}}}$$

$$\approx 314 \text{ m/sec}$$

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

$\boxed{\text{Ans- 45}}$

Force for moving up



$$\vec{F_1} = 5g \sin 30 + \mu\, 5g \cos 30$$

Force for moving down

$$\vec{F_2} = 5g \sin 30 - \mu\, 5g \cos 30$$

$\vec{F_2}$ - just prevent the block from sliding down

$$\vec{F_1} - \vec{F_2} = 2\mu\, 5g \cos 30$$

$$= \cancel{2} \times 0.1 \times 5 \times 10 \times \frac{\sqrt{3}}{\cancel{2}}$$

$$= 5\sqrt{3}\ N$$

$\boxed{\text{Wrong choices given}}$ $\boxed{\text{Drop}}$

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

$$V = \frac{2}{9} \frac{(\sigma - \rho) r^2 g}{\eta}$$

since density of fluid is negligible $\rho = 0$

$$V = \frac{2\sigma r^2 g}{\eta}$$

$$\sigma = \frac{M}{\frac{4}{3}\pi r^3}$$

$$= \frac{2M \cancel{r^2} g}{\frac{4}{3}\pi r^{\cancel{3}}}$$

$$V \propto \frac{M}{r}$$

$$\frac{V_1}{V_2} = \frac{\frac{1}{r}}{\frac{1}{2r}}$$

$$2V_2 = V_1$$

$$\boxed{V_2 = \frac{V}{2}}$$

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

$\boxed{\text{Ans - 47}}$

$$r \propto A^{\frac{1}{3}}$$

$$\left(\frac{r_1}{r_2}\right)^3 = \frac{A_1}{A_2}$$

$$\left(\frac{r}{\frac{r}{2}}\right)^3 = \frac{192}{A_2}$$

$$A_2 = \frac{192}{8} = 24$$

$$\boxed{A_2 = 24}$$

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

$\boxed{\text{Ans-48}}$ Statement I → Electromagnetic waves carry energy as they travel through space and energy is equally shared by electric and magnetic field - correct

Statement II - when electromagnetic waves strike a surface, a pressure exerted on the surface - correct

$\boxed{\text{Both statement I and II are correct}}$

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

$\boxed{\text{Ans-49}}$

$$M_m = \frac{M_P}{144}$$

$$r_m = \frac{r_P}{16}$$

$$\sqrt{\frac{2GM_P}{r_P}} = V$$

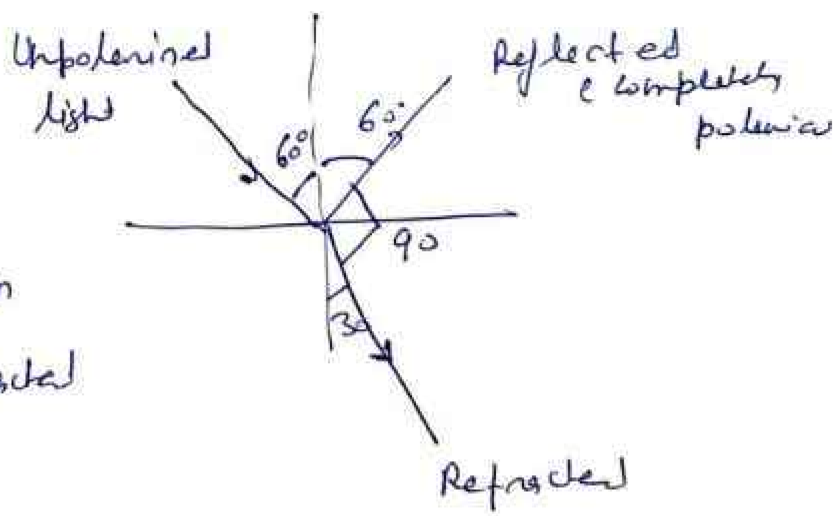
$$V_m = \sqrt{\frac{2GM_m}{r_m}} = \sqrt{\frac{2G\frac{M_P}{144}}{\frac{r_P}{16}}}$$

$$= \frac{1}{3}\sqrt{\frac{2GM_P}{r_P}} = \frac{V}{3}$$

$$\boxed{V_m = \frac{V}{3}}$$

$\boxed{\text{option (2) is correct}}$

$\boxed{\text{Ans-50}}$



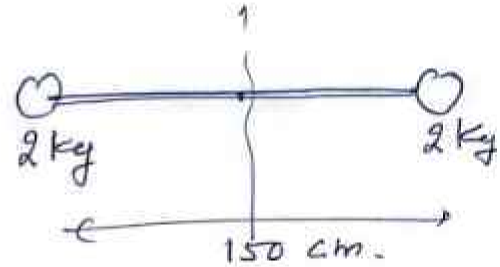
From Brewster's law angle between Reflected and Refracted light is 90°

$$\text{angle of Refraction} = 180 - (90+60)$$
$$= 30^\circ$$

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

$\boxed{\text{Ans - 51}}$ $M = 2\,kg$

$r = 50\,cm$



$$I_1 = I_2 = \frac{2}{5} M r^2$$

$$= \frac{2}{5} \times 2 \times 0.5 \times 0.5$$

$$= \frac{1}{5}\ kg\text{-}m^2$$

about the centre of Rod for Ist sphere

$$= I_1 + M\left(\frac{d}{2}\right)^2$$

$$= \frac{1}{5} + 2 \times 0.75 \times 0.75$$

$$= \frac{1}{5} + \frac{3}{4} \times \frac{3}{\cancel{4}_2} \times \cancel{2}$$

$$= \frac{1}{5} + \frac{9}{8}$$

$$\frac{8 + 45}{40} = \frac{53}{40}\ kg\text{-}m^2$$

For both $= \frac{53}{40} \times 2 = \frac{53}{20}\ kg\text{-}m^2$

$$\boxed{x = 53}$$

$\boxed{\text{Ans - 52}}$ K and K are in parallel eq $= 2K$

2K and K in series

$$= \frac{2K \times K}{2K + K} = \frac{2}{3}K$$

K and $\frac{2K}{3}$ in parallel $= K + \frac{2K}{3} = \frac{5K}{3}$

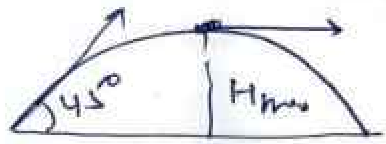
$$T = 2\pi\sqrt{\frac{M}{\frac{5K}{3}}} = 2\pi\sqrt{\frac{3M}{5K}} = \pi\sqrt{\frac{12M}{5K}}$$

$$\boxed{\alpha = 12}$$

$\boxed{\text{Ans- 53}}$

At heighest point

momentum $= mu\cos 45$



angular Momentum

$$= mu\cos 45 \times H_{max}$$

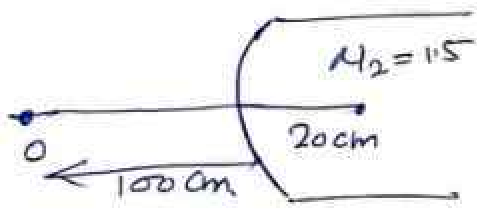
$$= mu\cos 45 \times \frac{u^2 \sin^2 45}{2g}$$

$$= \frac{mu^3}{2\cdot 2\cdot \sqrt{2}\, g} = \frac{\sqrt{2}\, mu^3}{8g}$$

on comparing $\boxed{x = 8}$

$\boxed{\text{Ans- 54}}$

$$\frac{\mu_2}{V} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$



$$\frac{1.5}{V} - \frac{1}{(-100)} = \frac{0.5}{20}$$

$$\frac{1.5}{V} + \frac{1}{100} = \frac{1}{40}$$

$$\frac{1.5}{V} = \frac{1}{40} - \frac{1}{100}$$

$$\frac{1.5}{V} = \frac{5-2}{200} = \frac{3}{200}$$

$$\boxed{V = 100 \text{ cm}}$$

Image from the object $= 100 + 100 = 200\text{cm}$

$\boxed{\text{Ans} = 200}$

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

$$V = \frac{KPr\cos\theta}{r^3} = \frac{KP\cos\theta}{r^2}$$

For First dipole

$$P_1 = 2q \times 4l = 8ql$$

It's direction is opposite

$$V_1 = -\frac{K(8ql)\cos 60}{r^2} = -\frac{4Kql}{r^2}$$

For second dipole

$$P_2 = q \times 2l = 2ql$$

$$V_2 = \frac{K.(2ql)\cos 60}{r^2} = \frac{Kql}{r^2}$$

$$V_P = V_1 + V_2 = -\frac{3Kql}{r^2} = -27\left[\frac{ql}{r^2}\right] \times 10^9 V$$

$$\boxed{\alpha = 27}$$

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

$$4g - T = 4a$$
$$T - 2g = 2a$$
$$2g = 6a$$

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

$$T = 4g - \frac{4g}{3}$$
$$= \frac{8g}{3} = \frac{80}{3} N$$

$$\frac{\Delta l}{l} = \frac{\frac{T}{\pi r^2}}{\cancel{4}\ 4}$$

$$= \frac{\cancel{8}0}{3\pi \times \cancel{16} \times \cancel{10^{-10}}\ \cancel{4}\ \cancel{2} \times 10^{11}}$$

$$= \frac{1}{12\pi}$$

$$\boxed{\alpha = 12}$$

$\boxed{\text{Ans 57}}$

Volume $\propto$ Mass number

$$V_1 = KA_1$$

$$V_2 = KA_2$$

$$\frac{V_2}{V_1} = \frac{A_2}{A_1} = 4$$

$\boxed{\text{Ans} - 4}$

$\boxed{\text{Ans} - 58}$

$$N_P = N_Q = 100$$

$$r_P = r_Q = \pi \text{ cm}$$

$$I_P = 1A \qquad I_Q = 2A$$

$$B_P = \frac{\mu_0 I_P N_P}{2 r_P} = \frac{\mu_0 \times 1 \times 100}{2\pi \times 10^{-2}}$$

$$= 2 \times 10^{-7} \times 100 \times 10^{2}$$

$$= 2 \times 10^{-3}\ T$$

$$B_Q = \frac{\mu_0 I_Q N_Q}{2 \times r_Q} = \frac{\mu_0 \times 2 \times 100}{2\pi \times 10^{-2}}$$

$$= 4 \times 10^{-3}\ T$$

$$B = \sqrt{B_P^2 + B_Q^2} = \sqrt{20} \times 10^{-3}\ T$$

$$= \sqrt{20}\ mT$$

$$\boxed{x = 20}$$

$\boxed{\text{Ans- 59}}$

$$\phi = 5t^2 - 36t + 1$$

$$|e| = -\frac{d\phi}{dt} = 10t - 36$$

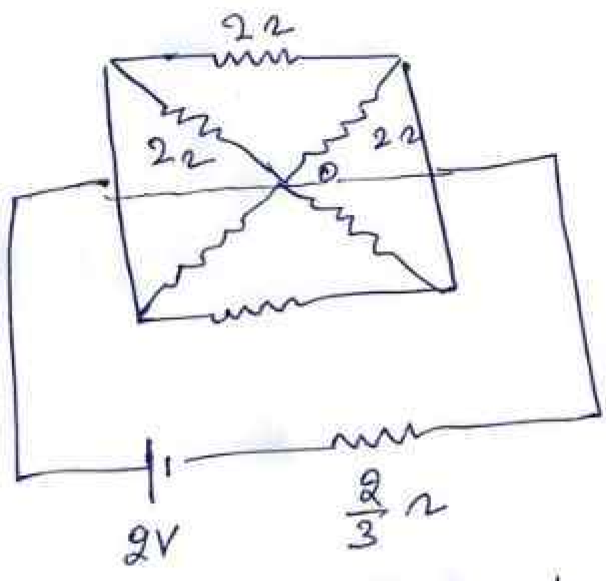
at $t = 2$ sec

$e = 16$ V

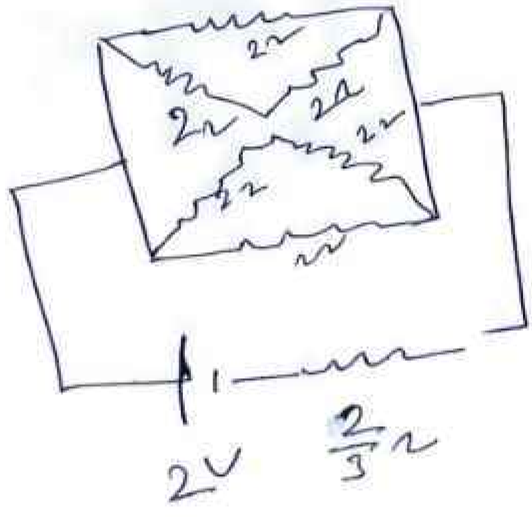
$$I = \frac{e}{R} = \frac{16}{8} = 2A$$

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

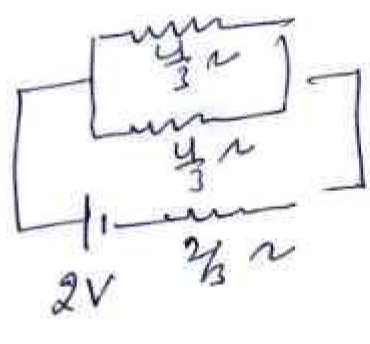
$\boxed{\text{Ans-60}}$



circuit is symmetrical about O hence this point can be separated



eq. resistance



$V = 2V$

$R_{eq} = \frac{2}{3} + \frac{2}{3} = \frac{4}{3}\Omega$

$I = \frac{V}{R} = \frac{2}{\frac{4}{3}} = \frac{3}{2} A$

$P = VI = 2 \times \frac{3}{2}$

$\boxed{P = 3W}$

A-1 Correct option is 4

A 2 Let the mass of $MgCO_3$ is x gm and $CaCO_3$ is $(2.21-x)$ gm

$$\overset{(2.21-x)\,gm}{CaCO_3} \xrightarrow{\Delta} CaO + CO_2 \quad -(1)$$

$$\overset{x\,gm}{MgCO_3} \xrightarrow{\Delta} MgO + CO_2 \quad -(2)$$

By Eq(1). mole of CaO = mole of $CaCO_3$

Mass of CaO $= \frac{(2.21-x)}{100}\times 56$ gm

Similarly.

mass of MgO $= \frac{x}{84}\times 40$ gm

By the question,

mass of CaO + mass of MgO = 1.152

$$56\frac{(2.21-x)}{100} + \frac{x\times 40}{84} = 1.152$$

$$56\times 84(2.21-x) + 4000x = 1152\times 84$$

$$10396 - 4704x + 4000x = 9677$$

$$10396 - 9677 = 704x$$

$$719 = 704x$$

$$x = \frac{719}{704} \Rightarrow \boxed{x = 1.02\,gm}$$

mass of $MgCO_3 = 1.02$ gm

mass of $CaCO_3 = 2.21 - 1.02$
$= 1.19$ gm

Correct option is (3)

A-3 Correct option is (3)

A-4 Correct option is (1)

A-4 Correct option is (1)

A-5 Correct option is (1)

A-6 Correct option is (2) ∵ Group-13 elements have vacant orbitals in which it can holds the L.P. of water

A-7 Correct option is (1)

A-8 Correct option is (3)

A-9 Correct option is (3)

A-10 Correct option is (4)

A-11 Correct option is (1)

A-12 Correct option is (2)

A-13 *Correct option is (3)

A-14 Correct option is (1)

A-15

$$\overset{1}{A} \rightleftharpoons \overset{0}{B} + \overset{0}{\frac{C}{2}}$$

$$1-\alpha \qquad \alpha \qquad \frac{\alpha}{2}$$

Total mole at equilibrium $= 1+\frac{\alpha}{2} = \frac{2+\alpha}{2}$

$P_A = \frac{1-\alpha}{2+\alpha} \times 2P$ $\qquad P_C = \frac{\alpha/2}{(2+\alpha)/2} \times P = \left(\frac{\alpha}{2+\alpha}\right) \times P$

$P_B = \frac{\alpha}{2+\alpha} \times 2P$

Correct option is (2)

$$K_P = \frac{P_B \times P_C^{1/2}}{P_A}$$

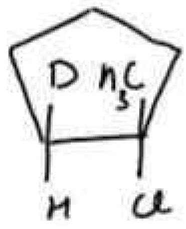
$$K_P = \frac{\left(\frac{\alpha}{2+\alpha}\right)\left(\frac{\alpha}{2+\alpha}\right)^{1/2} \times \cancel{2} \times P^{3/2}}{\frac{1-\alpha}{2+\alpha} \times \cancel{2} P}$$

$$\boxed{K_P = \frac{\alpha^{3/2} P^{1/2}}{(2+\alpha)^{1/2}(1-\alpha)}}$$

A-16 Statement "A" and "C" are Correct

A-17 Correct option is (3).

A-18 Correct option is 4.



A-19 Correct option is (4)

A-20 Correct option is (1)

A-21 only Four are conductors.

A-22 $W = -2.303\, nRT \log \frac{V_2}{V_1}$

$W = -2.303 \times 5 \times 8.314 \times 300 \log \frac{\cancel{100}}{\cancel{10}}$

$= -2.303 \times 1500 \times 8.314\, J$

$\boxed{W = -28,720\, J}$ on comparing with $-x$

$\boxed{x = 28,720\, J}$

A-23

$\mu = q \times d$

$1.2 \times 10^{-18}\, esu.cm = q \times 10^{-8}\, cm$

$q = \frac{1.2 \times \cancel{10^{-18}}\, esu.\cancel{cm}}{\cancel{10^{-8}}\, \cancel{cm}} \Rightarrow \boxed{q = 1.2 \times 10^{-10}\, esu.}$

$q = 0.0000000012 \times 10^{-1}\, esu.$

on comparing with $x \times 10^{-1}$ esu, then

$\boxed{x = 0.0000000012}$

A-24 $K_2Cr_2O_7 + KCl + H_2SO_4 (conc) \longrightarrow 2KHSO_4 + CrO_2Cl_2 + H_2O$

A-25 For 1st order Reaction,

$K = \frac{0.693}{t_{1/2}} = \frac{0.693}{120}\, min^{-1}$

$K = \frac{2.303}{t} \log \frac{100}{10} = \frac{0.693}{120}$

$t = \frac{2.30\cancel{3} \times 120}{\ldots} \log 10 = \frac{120}{\ldots} \times 1$

$$t = \frac{\cancel{2.303} \times 120}{\cancel{2.303} \times 0.3010} \log 10 = \frac{120}{0.3010} \times 1$$

$$\boxed{t = 398.67 \text{ min.}}$$

A-26

$$[X] + Cl-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[\Delta]{\text{anhy } AlCl_3} [X]\begin{matrix} \overset{O}{\overset{\|}{C}}-CH_3 + HCl \\ \underset{O}{\underset{\|}{C}}-CH_3 + HCl \end{matrix}$$

M.m = 108

$108 - 2 + 43 \times 2 = 192\,u$

It means compound [X] - contains 2 - amine group

A-27 Total 5 vitamins among the following can be added to human body. i.e; vitamin - A, D, E, K & B_1
∵ they are all water insoluble.

A-28

$$2MnO_4^- \underbrace{+ 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2}_{\text{oxidation = ON inc by } 2\times 5} + 8H_2O$$

Reduction = O.N decr by 5 × 2

Acc to equation, $2MnO_4^{-1}$ is needed 16 H^+ ions
∴ $1\,MnO_4^-$ " " 8 H^+ ions.

A-29 mass of solution $= V \times d$
$= 1\,l \times 1.54$ g/ml
$= 1540$ gm

mass of H_3PO_4 (solute) $= \frac{7\cancel{0}}{\cancel{100}} \times 154\cancel{0} = 1078$ gm.

$$\boxed{\text{molarity} = \frac{w}{m \times V(L)} = \frac{1078}{98} = 11\,M}$$

A-30

$$\overset{4}{C}H_3-\overset{3}{C}H_2-\overset{2}{C}H-\overset{1}{C}H_3 + Cl_2 \xrightarrow[\text{at } C-1]{(1)} CH_3-CH_2-\underset{CH_3}{\overset{H}{C^*}}-CH_2-Cl$$

$\overset{4}{C}H_3 - \overset{3}{C}H_2 - \overset{2}{C}H(CH_3) - \overset{1}{C}H_3 + Cl_2 \longrightarrow$

(2) at C-2 $\longrightarrow CH_3 - CH_2 - C(Cl)(CH_3) - CH_3$

(3) at C-3 $\longrightarrow CH_3 - C(Cl)(H) - CH(CH_3) - CH_3$

(4) at C-4 $\longrightarrow Cl - CH_2 - CH_2 - CH(CH_3) - CH_3$

Total structural isomeric Products are 4 but including stereoisomers being chirality in the Product at C-1 & C-3

total isomeric Products are 6.