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இணைந்த கணிதம்

பகுதி I

(1) $n=1$ எனின்

$L.H.S = 3\times 1 - 1 = 2$

$R.H.S = \frac{1}{2}\times 4 = 2$

$L.H.S = R.H.S$

$\therefore n=1$ இற்கு முடிவு உண்மையாகும் — 5

$n = p \in \mathbb{Z}^+$ இற்கு முடிவு உண்மை எனக்

$$\sum_{r=1}^{p}(3r-1) = \frac{p}{2}(3p+1) \quad\text{— 5}$$

$n=p+1$ எனின்

$$L.H.S = \sum_{r=1}^{p+1}(3r-1)$$

$$= \sum_{r=1}^{p}(3r-1) + 3(p+1) - 1 \quad 5$$

$$= \frac{p}{2}(3p+1) + (3p+2)$$

$$= \frac{1}{2}(3p^2+7p+4)$$

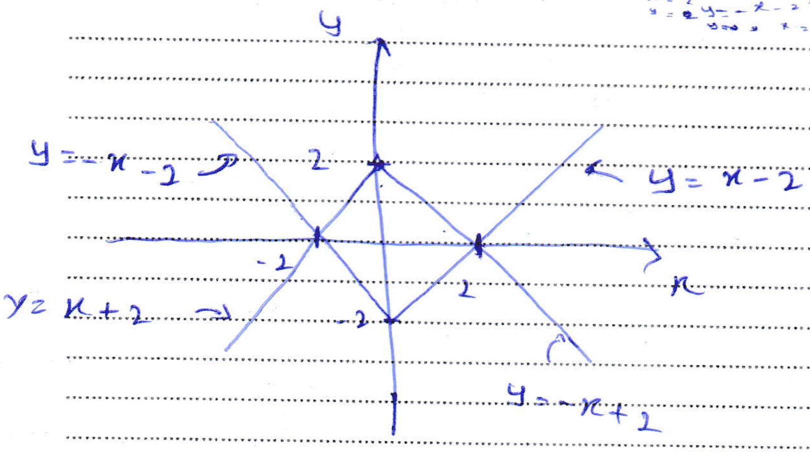
$$= \frac{1}{2}(p+1)(3p+4) \quad 5$$

$$= R.H.S$$

$\therefore n=p+1$ இற்கு முடிவு உண்மையாகும்

$\therefore n$ இன் எல்லா நேர் நிறை எண்களுக்கும் கணிதத் தொகுத்தறிவுக் கோட்பாட்டின் படி முடிவு உண்மையாகும் — 5

2. ஒரே வரிப்படத்தில் $y = -|x| + 2$, $y = |x - 2|$ ஆகியவற்றின் வரைபுகளை வரைக. இதிலிருந்து $|x - 1| + |x| \geq 1$ எனும் சமனிலியைத் தீர்க்க.



$|x-1| + |x| \geq 1$

$\cancel{1 + |x-1| \geq -|x| + 2}$

$x \to \frac{2x}{2}$

$\cancel{|2x-1| + |2x| \geq 1}$

$\left|\frac{x}{2} - 1\right| + \left|\frac{x}{2}\right| \geq 1$

$\left|\frac{x-2}{2}\right| + \frac{1}{2}|x| \geq 1$

$\frac{1}{2}|x-2| + \frac{1}{2}|x| \geq 1$

$|x-2| + |x| \geq 2$

$|x-2| \geq -|x| + 2$

தீர்வு

$x \leq -2$ or $x \geq 2$

[பக் 3 ஐப் பார்க்க.

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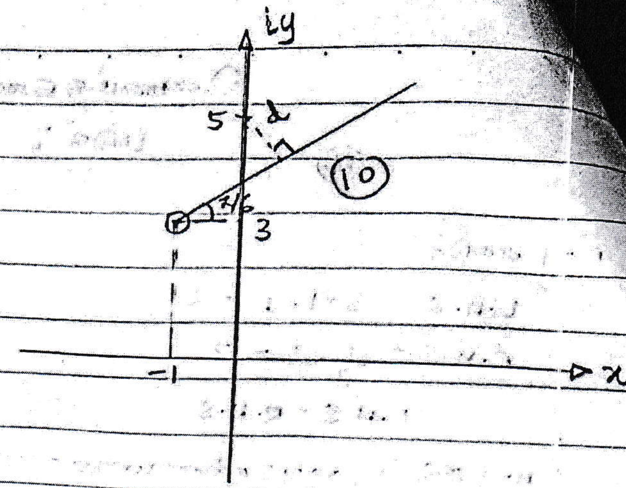
(3) $\text{Arg}(z-3i+1) = \frac{\pi}{6}$

$\text{Arg}\{z-(-1,3)\} = \frac{\pi}{6}$



$\text{Arg}(\bar{z}+3i+1) = -\frac{\pi}{6}$

$\text{Arg}(\overline{\bar{z}+3i+1}) = \frac{\pi}{6}$ —— (5)

$\text{Arg}(z-3i+1) = \frac{\pi}{6}$

$|z-5i| = |z-(0,5)|$

$\tan\frac{\pi}{6} = \frac{a}{1}$

$a = \frac{1}{\sqrt{3}}$ —— (5)

$\cos\frac{\pi}{6} = \frac{d}{2-a}$

$\frac{\sqrt{3}}{2} = \frac{d}{2-\frac{1}{\sqrt{3}}}$

$d = \frac{2\sqrt{3}-1}{2}$ அலகுகள் —— (5)

(4) T - 3 , A - 1, E - 1, N - 2, I - 1, O - 1

வரிசைமாற்றங்களின் எண்ணிக்கை $= \frac{9!}{3!\,2!} = 30240$ வழிகள் —— (5)

(i) $\boxed{\text{A E I O}}$ T - 3 N - 2 (5)

1

வரிசைமாற்றங்களின் எண்ணிக்கை $= \frac{6!}{3!\,2!} = 60$ வழிகள் —— (5)

(5)

(ii) $\boxed{\text{N}}$ T-3 A-1 E-1 I-1 O-1 $\boxed{\text{N}}$

வரிசைமாற்றங்களின் எண்ணிக்கை $= \frac{7!}{3!} = 840$ வழிகள் —— (5)

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(5) $$L.H.S = \lim_{x\to 3} \frac{\tan(\pi(x-3))}{\sqrt{x^2-5}-2}$$

$$= \lim_{x\to 3} \frac{\sin[\pi(x-3)](\sqrt{x^2-5}+2)}{\cos[\pi(x-3)](\sqrt{x^2-5}-2)(\sqrt{x^2-5}+2)}$$ (5)

$$= \lim_{x\to 3} \frac{\sqrt{x^2-5}+2}{\cos[\pi(x-3)]} \cdot \lim_{x\to \frac{\pi}{3}} \frac{\sin[\pi(x-3)]}{x^2-9}$$ (5)

$$= \frac{4}{1} \cdot \lim_{x\to 3} \frac{\sin[\pi(x-3)]}{\pi(x-3)} \cdot \lim_{x\to 3} \frac{\pi}{x+3}$$ (5) (5)

$$= 4 \times 1 \times \frac{\pi}{6}$$

$$= \frac{2\pi}{3}$$ (5)

$= R.H.S.$

(6) $$V = \int_0^1 \pi y^2\, dx$$

$$= \int_0^1 \pi\left(\frac{8x+1}{4x^2+9}\right) dx$$ (5)

$$= \pi \int_0^1 \frac{8x}{4x^2+9} + \frac{1}{4x^2+9}$$

(5)

$$= \pi\left\{\left[\ln|4x^2+9|\right]_0^1 + \frac{1}{4}\cdot\frac{2}{3}\left[\tan^{-1}\left(\frac{2x}{3}\right)\right]_0^1\right\}$$ (5)

$$= \pi\left\{\ln 13 - \ln 9 + \frac{1}{6}\tan^{-1}\left(\frac{2}{3}\right) - \frac{1}{6}\times 0\right\}$$ — (5)

$$= \pi\left\{\ln\left(\frac{13}{9}\right) + \frac{1}{6}\tan^{-1}\left(\frac{2}{3}\right)\right\}$$ — (5) //

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$$\frac{x^2}{16} - \frac{y^2}{25} = 1$$

$$\frac{1}{16}\cdot 2x - \frac{1}{25}\cdot 2y\cdot\frac{dy}{dx} = 0$$

$$\frac{x}{8} = \frac{2y}{25}\cdot\frac{dy}{dx}$$

$$\frac{dy}{dx} = \frac{25x}{16y} \quad (5)$$

$P(4\sec\theta, 5\tan\theta)$ න්:

$$\frac{dy}{dx} = \frac{25\times 4\sec\theta}{16\times 5\tan\theta}$$

$$\sqrt{2} = \frac{5\sec\theta}{4\tan\theta} \quad (5)$$

$$\sqrt{2} = \frac{5}{\cos\theta\cdot 4\sin\theta}\cdot\cos\theta$$

$$\sin\theta = \frac{5}{4\sqrt{2}}$$

$$\theta = \sin^{-1}\left(\frac{5}{4\sqrt{2}}\right) \quad (5)$$

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$$(y - 5\tan\theta) = \sqrt{2}(x - 4\sec\theta)$$

$$y - 5\cdot\frac{5}{\sqrt{7}} = \sqrt{2}\left(x - 4\cdot\frac{4\sqrt{2}}{\sqrt{7}}\right) \quad (5)$$

$$\sqrt{7}y - 25 = \sqrt{14}x - 32$$

$$\sqrt{14}x - \sqrt{7}y - 7 = 0$$

$$\sqrt{2}x - y - \sqrt{7} = 0 \quad (5)$$

$$l_1 \equiv 2x + y - 5 = 0$$

$$x = \alpha, \quad y = 5 - 2\alpha$$

$11x - 2y + 3 = 0$

$2\sqrt{5}$

$(\alpha, 5-2\alpha)$

$$d = 2\sqrt{5} = \frac{|11\alpha - 2(5-2\alpha) + 3|}{\sqrt{121+4}} \quad (5)$$

$$2\sqrt{5}\cdot 5\sqrt{5} = |15\alpha - 7|$$

$$50 = |15\alpha - 7|$$

$(+) \Rightarrow \quad 15\alpha - 7 = 50$

$$\alpha = \frac{57}{15} \quad (5)$$

$(-) \Rightarrow \quad -50 = 15\alpha - 7$

$$\alpha = -\frac{43}{15} \quad (5)$$

$$\left(\frac{57}{15}, \frac{-39}{15}\right) \quad (5)$$

$$\left(\frac{-43}{15}, \frac{161}{15}\right) \quad (5)$$

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$S \equiv x^2+y^2+2gx+2fy+c=0$ எனின்

மையம் $\equiv (-g,-f)$

மையம் y அச்சு மீது கிடப்பதால்

$-g=0$

$g=0$ —— (5)

வட்டம் $x+y+1=0$ ஐத் தொடுவதால்

$$\frac{|0-f+1|}{\sqrt{2}} = \sqrt{2} \text{ —— (5)}$$

$|1-f| = 2$

$1-f = \pm 2$

$f=(-1)\ ,\ f=3$ —— (5)

$\sqrt{g^2+f^2-c} = \sqrt{2}$

$f^2-c=2$

$f=(-1)$	$f=3$
$c=(-1)$	$c=7$

$\therefore$ வட்டங்கள் $x^2+y^2-2y-1=0$ —— (5)

$x^2+y^2+6y+7=0$ —— (5)

$y = \sqrt{3}\sin x - \cos x + 3$

$= 2\left\{\frac{\sqrt{3}}{2}\sin x - \frac{1}{2}\cos x\right\}+3$

$= 2\left\{\sin x \cdot \cos\frac{\pi}{6} - \cos x \sin\frac{\pi}{6}\right\}+3$

$= 2\sin\left(x-\frac{\pi}{6}\right)+3$ —— (5)

y உயர்வு ஆக $\sin\left(x-\frac{\pi}{6}\right)$ உயர்வு ஆகவேண்டும்

$\sin\left(x-\frac{\pi}{6}\right)$ உயர்வு $=1$ —— (5)

y உயர்வு $= 2\times 1+3$

$=5$ —— (5)

$$K = \frac{\sqrt{3}\sin x - \cos x + 4}{\cos x - \sqrt{3}\sin x + 5}$$

$$= \frac{(\sqrt{3}\sin x - \cos x + 3)+1}{-(\sqrt{3}\sin x - \cos x + 3)+8} \text{ (5)}$$

$$K \text{ உயர்வு} = \frac{5+1}{-5+8}$$

$= \frac{6}{3}$

$=2$ —— (5)

RATHNA

(11) (a) $x^2 + ax + b = 0 \quad (\alpha, \beta)$

$\gamma = \alpha^2$ (5) $\quad \delta = \beta^2$ (5)

$y = x^2$

$x = \pm\sqrt{y}$ (5)

$\therefore \gamma, \delta$ ஐ மூலங்களாக உடைய இருபடிச்சமன்பாடு

$(\pm\sqrt{y})^2 + a(\pm\sqrt{y}) + b = 0$ (5)

$y \pm a\sqrt{y} + b = 0$

$y + b = \mp a\sqrt{y}$

$y^2 + 2by + b^2 = a^2 y$ (5) $\qquad \boxed{30}$

$y^2 + (2b - a^2) y + b^2 = 0$

$x^2 + (2b - a)x + b^2 = 0$ // (5)

(b) $x^2 + (4+k)x - (25+k) = 0 \quad (\alpha, -\alpha^2)$

$\alpha - \alpha^2 = -(4+k)$

$\alpha^2 - \alpha = 4 + k$ — ① (5)

$\alpha(-\alpha^2) = -(25+k)$ (5)

$\alpha^3 = 25 + k$

$\alpha^3 = 21 + 4 + k$

① $\Rightarrow \alpha^3 = 21 + \alpha^2 - \alpha$

$\alpha^3 - \alpha^2 + \alpha - 21 = 0$ (5)

$\therefore \alpha$ ஆனது $x^3 - x^2 + x - 21 = 0$ இன் மூலமாகும் (5)

$f(x) = x^3 - x^2 + x - 21 = 0$

$f(3) = 27 - 9 + 3 - 21$

$= 0$ (5)

$\therefore (x-3)$ ஆனது $f(x)$ இன் ஒரு காரணியாகும் (5)

$x^3 - x^2 + x - 21 \equiv (x-3)(x^2 + Ax + 7)$ — 5

$\underline{x^2}$: $-1 = -3 + A$ — 5

$A = 2$ — 5

$x^3 - x^2 + x - 21 \equiv (x-3)(x^2 + 2x + 7)$ — 5

$g(x) = x^2 + 2x + 7 = 0$

$\Delta = \sqrt{4 - 28} = (-24)$

$\Delta < 0$

$\therefore g(x)$ ஆனது சிக்கற்தீர்வுகளை கொண்டிருக்கும் — 5

$\therefore f(x)$ ஆனது ஒரேயொரு மெய்மூலத்தை கொண்டிருக்கும் — 5

$\therefore \alpha = 3$ // — 5

$x^2 + (4+k)x - (25+k) = 0$ இன் மூலம் α என்பதால்,

$\alpha^2 + (4+k)\alpha - (25+k) = 0$ 5

$9 + (4+k)3 - 25 - k = 0$

$k = 2$ // 5

$\boxed{75}$

(c) $f(x) = ax^4 + bx^3 + cx^2 + x - 10$

$f(1) = 0$, $f(2) = 0$, $f(-1) = 48$

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$f(1) = a + b + c + 1 - 10 = 0$

$a + b + c = 9$ — ① 5

$f(2) = 16a + 8b + 4c + 2 - 10 = 0$

$8a + 4b + 2c = 4$ — ② 5

$f(-1) = a - b + c - 1 - 10 = 48$

$a - b + c = 59$ — ③ 5

①, ②, ③ $\Rightarrow$

$\left.\begin{array}{l} a = 6 \\ b = (-25) \\ c = 28 \end{array}\right\}$ 5

$$f(x) = 6x^4 - 25x^3 + 28x^2 + x - 10$$

$$f(-\tfrac{1}{2}) = 6\left(\tfrac{-1}{2}\right)^4 - 25\left(\tfrac{-1}{2}\right)^3 + 28\left(\tfrac{-1}{2}\right)^2 - \tfrac{1}{2} - 10 \quad \text{—— } 5$$

$$= 0$$

$\therefore f(x)$ இற்கு $(2x+1)$ ஒரு காரணியாகும் $\boxed{45}$

$$\therefore f(x) = (x-1)(x-2)(2x+1)(3x-5) \quad \text{—— } 5$$

(12) (a) $(a+b)^n = {}^nC_0\, a^n + {}^nC_1 \cdot a^{n-1} \cdot b + \dots\dots + {}^nC_r \cdot a^{n-r} \cdot b^r + \dots\dots + {}^nC_n \cdot b^n$ —— 5

இங்கு ${}^nC_r = \dfrac{n!}{(n-r)!\, r!}$ —— 5

$$\left(ax^2 + \frac{1}{bx}\right)^{11} \Rightarrow T_{r+1} = {}^{11}C_r \cdot (ax^2)^{11-r} \cdot \left(\frac{1}{bx}\right)^r$$

$$T_{r+1} = {}^{11}C_r \cdot a^{11-r} \cdot b^{-r} \cdot x^{22-3r} \quad \text{—— } 10$$

x^7 இனை கொண்ட உறுப்புக்கு $22 - 3r = 7$

$3r = 15$

$r = 5$ —— 5

$\therefore x^7$ இன் குணகம் $= {}^{11}C_5 \cdot a^6 \cdot b^{-5}$ —— (1) —— 5

$$\left(ax - \frac{1}{bx^2}\right)^{11} \Rightarrow T_{r+1} = {}^{11}C_r \cdot (ax)^{11-r} \left(\frac{1}{bx^2}\right)^r$$

$$= {}^{11}C_r \cdot a^{11-r} \cdot b^{-r} \cdot x^{11-3r} \quad \text{—— } 10$$

x^{-7} இனை கொண்ட உறுப்புக்கு

$11 - 3r = -7$

$3r = 18$

$r = 6$ —— 5

$\therefore x^{-7}$ இன் குணகம் $= {}^{11}C_6 \cdot a^5 \cdot b^{-6}$ —— (2)

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$①, ② \Rightarrow \quad {}^{11}C_5 \cdot a^6 \cdot b^{-5} = {}^{11}C_6 \cdot a^5 \cdot b^{-6}$

$$\frac{11!}{5!\,6!} a^6 \cdot b^{-5} = \frac{11!}{6!\,5!} \cdot a^5 b^{-6} \quad \text{—— (5)}$$

$$ab = 1 \;//$$

—— (5)

60

(b) $$U_r = \frac{r}{1+r^2+r^4}$$

$$U_r = \frac{1}{2}\left\{ f(r) - \frac{1}{1+r+r^2} \right\}$$

$$\frac{r}{1+r^2+r^4} = \frac{1}{2}\left\{ f(r) - \frac{1}{1+r+r^2} \right\} \quad \text{—— (5)}$$

$$\frac{r}{(r^2-r+1)(r^2+r+1)} + \frac{1}{2(1+r+r^2)} = \frac{1}{2} f(r) \quad \text{—— (5)}$$

$$\frac{2r + r^2 - r + 1}{2(r^2-r+1)(r^2+r+1)} = \frac{1}{2} f(r)$$

$$f(r) = \frac{(r^2+r+1)}{(r^2-r+1)(r^2+r+1)} \quad \text{—— (5)}$$

$$f(r) = \frac{1}{r^2-r+1} \;// \quad \text{—— (5)}$$

$$f(r+1) = \frac{1}{(r+1)^2-(r+1)+1} = \frac{1}{r^2+2r+1-r} = \frac{1}{r^2+r+1} \;//$$

—— (5)

$$\therefore U_r = \frac{1}{2}\left\{ \frac{1}{r^2-r+1} - \frac{1}{1+r+r^2} \right\}$$

$$U_r = \frac{1}{2}\left\{ f(r) - f(r+1) \right\} \quad \text{—— (5)}$$

$r=1 \qquad u_1 = \frac{1}{2}\{f(1) - f(2)\}$

$r=2 \qquad u_2 = \frac{1}{2}\{f(2) - f(3)\}$ (10)

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$r=n-1 \qquad u_{n-1} = \frac{1}{2}\{f(n-1) - f(n)\}$

$r=n \qquad u_n = \frac{1}{2}\{f(n) - f(n+1)\}$ (10)

$$\sum_{r=1}^{n} u_r = \frac{1}{2}\{f(1) - f(n+1)\} \text{ ——— (10)}$$

$$= \frac{1}{2}\left\{\frac{1}{1-1+1} - \frac{1}{n^2+n+1}\right\}$$

$$= \frac{1}{2}\left\{1 - \frac{1}{n^2+n+1}\right\}$$

$$= \frac{n^2+n+1-1}{2(n^2+n+1)}$$

$$= \frac{n(n+1)}{2(n^2+n+1)} \text{ ——— (5)}$$

$$\sum_{r=1}^{\infty} u_r = \lim_{n\to\infty} \frac{n(n+1)}{2(n^2+n+1)} = \lim_{n\to\infty} \frac{\cancel{n^2}(1+\frac{1}{n})}{2\cancel{n^2}(1+\frac{1}{n}+\frac{1}{n^2})}$$

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

$$= \frac{1}{2} \text{ ——— (5)}$$

$\therefore$ தொடர் ஒருங்கும். ——— (5)

$$\sum_{r=3}^{\infty} u_r = \sum_{r=1}^{\infty} u_r - u_1 - u_2 \text{ ——— (5)}$$

$$= \frac{1}{2} - \frac{1}{3} - \frac{2}{21}$$

$$= \frac{1}{14} \text{ ——— (5)}$$

$\boxed{90}$

$$\sum_{r=3}^{\infty} 2u_r = 2\left(\frac{1}{14}\right) = \frac{1}{7} \text{ ——— (5)}$$

13. (a) $A = \begin{pmatrix} a & 1 \\ -1 & b \end{pmatrix}$

$$A^2 = \begin{pmatrix} a & 1 \\ -1 & b \end{pmatrix} \begin{pmatrix} a & 1 \\ -1 & b \end{pmatrix}$$

$$A^2 = \begin{pmatrix} a^2-1 & a+b \\ -a-b & -1+b^2 \end{pmatrix}$$

$$\Rightarrow \quad A^2 - 5A - 7I = 0$$

$$\begin{pmatrix} a^2-1 & a+b \\ -a-b & -1+b^2 \end{pmatrix} - 5\begin{pmatrix} a & 1 \\ -1 & b \end{pmatrix} - 7\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$$

$$\begin{pmatrix} a^2-5a+6 & a+b-5 \\ 5-a-b & b^2-5b+6 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$$

$\Rightarrow a^2-5a+6=0$ $\qquad\qquad$ $b^2-5b+6=0$

$(a-3)(a-2)=0$ $\qquad\qquad$ $(b-2)(b-3)=0$

$a=3, \ a=2$ $\qquad\qquad$ $b=2, \ b=3$

$a>b$ ആകയാൽ $\quad a=3, \ b=2 \quad \Rightarrow A = \begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix}$

$$A^2 - 5A + 7I = 0$$

$$A^{-1}(A^2 - 5A + 7I) = 0$$

$$A - 5I + 7A^{-1} = 0$$

$$7A^{-1} = 5I - A$$

$$7A^{-1} = 5\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} - \begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix}$$

$$A^{-1} = \frac{1}{7}\begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix}$$

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$A^3 = A^2 \cdot A$

$= \begin{pmatrix} 8 & 5 \\ -5 & 3 \end{pmatrix} \begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix}$

$= \begin{pmatrix} 19 & 18 \\ -18 & 1 \end{pmatrix}$

$18A - 35I = 18\begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix} - 35\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

$= \begin{pmatrix} 19 & 18 \\ -18 & 1 \end{pmatrix}$

$\therefore \quad A^3 = 18A - 35I$ //

$\Rightarrow$

$35I = 18A - A^3$

$35I = A(18I - A^2)$

$I = \frac{A}{35}(18I - A^2)$

$\therefore (18I - A^2)^{-1} = \frac{A}{35}$

Alternative

$A^2 - 5A + 7I = 0$

$A^2 - 5A = -7I$

$A(A^2 - 5A) = -7A$

$A^3 - 5A^2 = -7A$

$A^3 - 5(-7I + 5A) = -7A$

$A^3 + 35I - 25A = -7A$

$A^3 = 18A - 35I$

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(b) $w = -2 + i \quad , \quad w = 2 - i$

$w^2 = (-2+i)^2$
$= 4 - 4i + i^2$
$= 4 - 4i - 1$
$= 3 - 4i$

$w^2 = (2-i)^2$
$= 4 - 4i + i^2$
$= 4 - 4i - 1$
$= 3 - 4i$

$(z+i)^2 = 3 - 4i = w^2$
$z + i = w$
$z + i = -2 + i \qquad z + i = 2 - i$
$z_1 = (-2) \qquad z_2 = 2 - 2i$

$\therefore w_1 = -2 \quad , \quad w_2 = 2 - 2i$

$w_1 - w_2 = -4 + 2i$

$|w_1 - w_2| = \sqrt{16+4} = \sqrt{20}$
$= 2\sqrt{5}$

$w_1 + w_2 = -2i$
$= 2\,[0 - i]$
$= 2\left[\cos(-\pi/2) + i\sin(-\pi/2)\right]$

$\text{Arg}(w_1 + w_2) = -\pi/2$ //

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$$z = \sqrt{5} + 2i$$
$$= 3\left[\frac{\sqrt{5}}{3} + \frac{2i}{3}\right]$$
$$= r\,[\cos\theta + i\sin\theta]$$

$r = 3 \qquad \tan\theta = 2/\sqrt{5}$

$$z^3 = 3^3[\cos\theta + i\sin\theta]^3$$
$$= 27\,[\cos 3\theta + i\sin 3\theta] \quad \text{—} (1)$$

$$\bar{z} = 3\,[\cos\theta - i\sin\theta]$$
$$\bar{z}^3 = 3^3[\cos\theta - i\sin\theta]^3$$
$$= 27\,[\cos 3\theta - i\sin 3\theta] \quad \text{—} (2)$$

$(1) + (2) \Rightarrow \quad z^3 + \bar{z}^3 = 54\cos 3\theta$

$(1) - (2) \Rightarrow \quad z^3 - \bar{z}^3 = 54 i\sin 3\theta$

$$\tan 3\theta = \frac{3\tan\theta - \tan^3\theta}{1 - 3\tan^2\theta}$$

$$= \frac{3\left(\frac{2}{\sqrt{5}}\right) - \left(\frac{2}{\sqrt{5}}\right)^3}{1 - 3\left(\frac{2}{\sqrt{5}}\right)^2}$$

$$= \frac{\frac{6}{\sqrt{5}} - \frac{8}{5\sqrt{5}}}{1 - \frac{12}{5}}$$

$$\tan 3\theta = \frac{22}{-7\sqrt{5}}$$

No : Date: / /

$\Rightarrow \quad 5x(z^3+\bar{z}^3) = i(z^3-\bar{z}^3)$

$5x(54\cos 3\theta) = i(54 i \sin 3\theta)$

$5x(54\cos 3\theta) = 54(\sin 3\theta) i^2$

$5x = \tan 3\theta(-1)$

$x = -\dfrac{\tan 3\theta}{5}$

$x = \left(\dfrac{22}{-7\sqrt{5}}\right)\left(-\dfrac{1}{5}\right)$

$= \dfrac{22}{35\sqrt{5}}$

No_______

4 (a) $f(x) = \dfrac{x+2}{(x-1)^2}$

$f'(x) = \dfrac{(x-1)^2 \cdot 1 - (x+2)\,2(x-1)\cdot 1}{(x-1)^4}$ —— 5

$= \dfrac{(x-1)[x-1-2x-4]}{(x-1)^4}$ —— 5

$= \dfrac{-(x+5)}{(x-1)^3}$

நிலைக்குத்து அணுகுகோடு $\Rightarrow x = 1$ —— 5

$f'(x) = 0$ இல் திரும்பற்புள்ளிகள் பெறப்படும் —— 5

$x = (-5)$ —— 5

$y = \dfrac{-3}{36} = -\dfrac{1}{12}$ —— 5

x இன் வீச்சு	$x < -5$	$-5 < x < 1$	$x > 1$
$f'(x)$ இன் குறி	$-$	$+$	$-$

5

$\vee$

$\therefore x = (-5)$ இல் இழிவு பெறப்படும் 5

இழிவுப்புள்ளி $= \left(-5, -\frac{1}{12}\right)$ 5

$x = 0 \Rightarrow y = 2$

$y = 0 \Rightarrow x = (-2)$ 5

$f''(x) = \dfrac{2(x+8)}{(x-1)^4}$

$f''(x) = 0$ இல் விபத்திப்புள்ளிகள் பெறப்படும் —— 5

$x = (-8)$ $y = \dfrac{-6}{81} = \dfrac{-2}{27}$

விபத்திப்புள்ளி $= \left(-8, \frac{-2}{27}\right)$

5

Date

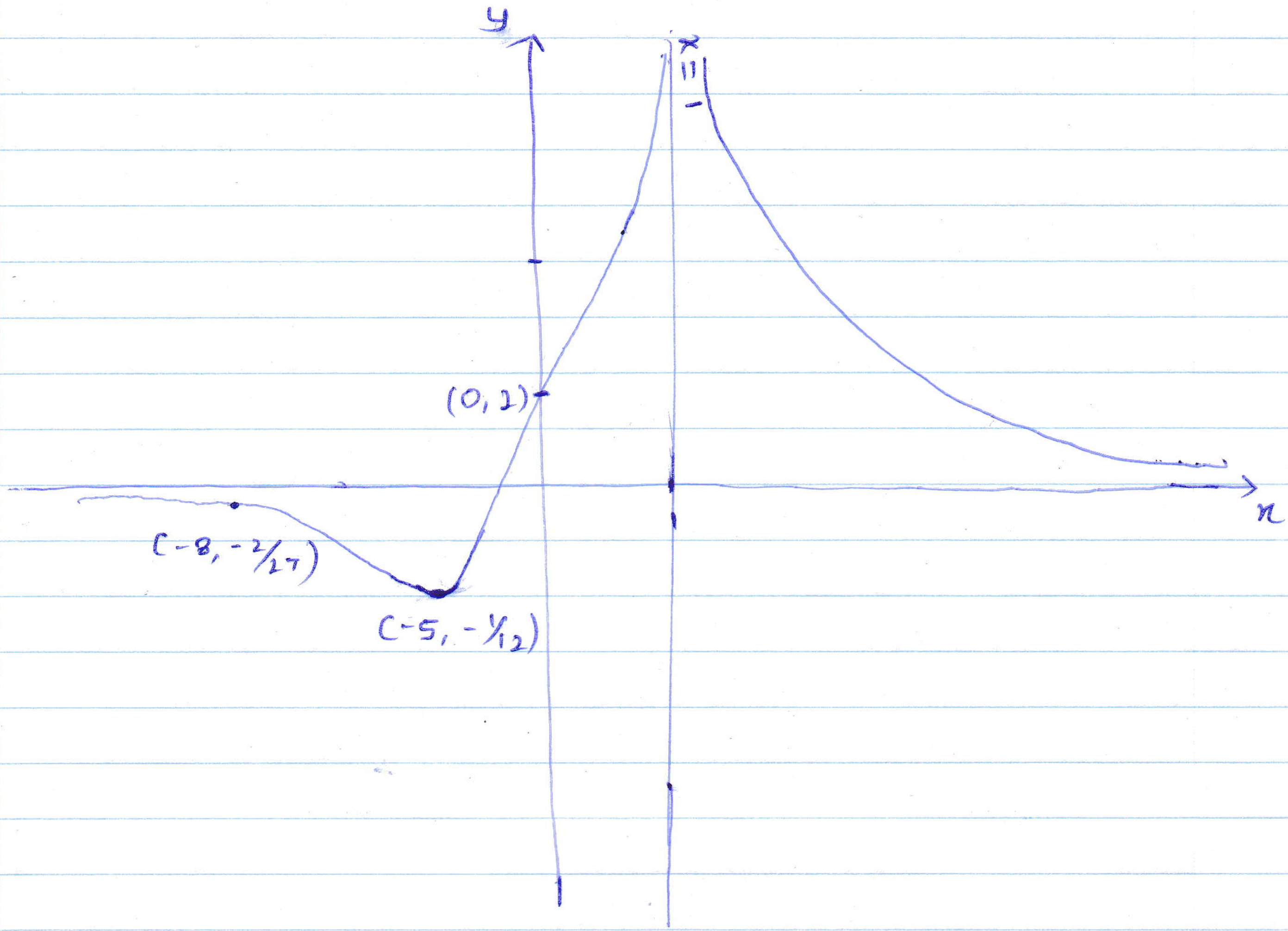
x இன் பெறுமானம்	$x < -8$	$-8 < x < 1$	$x > 1$
$f''(x)$ இன் குறி	$-$	$+$	$+$
	கீழ்நோக்கி குழிவு	மேல்நோக்கி குழிவு	மேல்நோக்கி குழிவு

(10)

$$\lim_{x \to \pm\infty} f(x) = \lim_{x \to \pm\infty} \frac{x+2}{(x-1)^2} = 0$$

$\therefore$ கிடை அணுகுகோடு $y = 0$ (5)

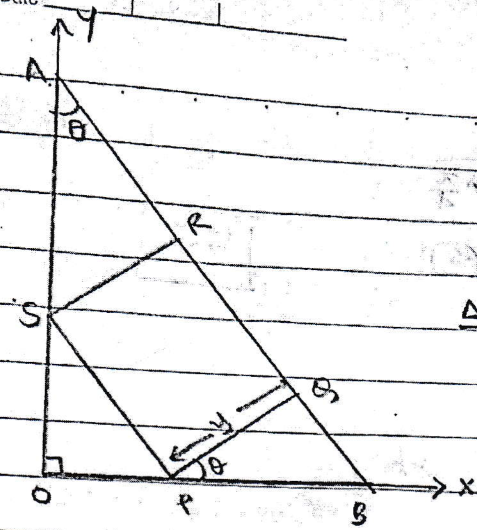
3



$(2'+2\lambda)V_1 =$
$V_1 = (2$

Date   No.

b)



$QR = y$

$SR = y$

$\underline{\Delta ASR}$ $\quad \tan\theta = \dfrac{SR}{AR}$

$AR = SR\cot\theta$

$AR = y\cot\theta$ —— (5)

$\underline{\Delta PQB}$ $\quad \tan\theta = \dfrac{QB}{y}$

$QB = y\tan\theta$ —— (5)

$AB = AR + QR + QB$

$K = y\cot\theta + y + y\tan\theta$ —— (5)

$0 = y(-\mathrm{Cosec}^2\theta) + \cot\theta\dfrac{dy}{d\theta} + \dfrac{dy}{d\theta} + y.\sec^2\theta + \tan\theta\cdot\dfrac{dy}{d\theta}$ —— (5)

$\dfrac{dy}{d\theta}(1 + \tan\theta + \cot\theta) = y(\mathrm{Cosec}^2\theta - \sec^2\theta)$

$\dfrac{dy}{d\theta} = \dfrac{y(\mathrm{Cosec}^2\theta - \sec^2\theta)}{1 + \tan\theta + \cot\theta}$ —— (5)

$\dfrac{dy}{d\theta} = 0$ இல் உயர்வு இழிவு பெறுமானம் —— (5)

$\mathrm{Cosec}^2\theta - \sec^2\theta = 0$ $\quad [\because y \neq 0]$

$\tan^2\theta = 1$

$\tan\theta = 1$

$\theta = \dfrac{\pi}{4}$ —— (5)

θ இன் வீச்சு	$0 < \theta < \frac{\pi}{4}$	$\frac{\pi}{2} > \theta > \frac{\pi}{4}$
$\frac{dy}{d\theta}$ இன் குறி	$+$	$-$

$\therefore \theta = \frac{\pi}{4}$ இல் y உயர்வானது

(5)

$\wedge$ (10)

$1+\cot\frac{\pi}{4}+\tan\frac{\pi}{4}$

$= \frac{1}{3}$ —— 5

$\boxed{55}$

15 (a) $\frac{1}{x^2-1} \equiv \frac{A}{x-1} + \frac{B}{x+1}$

$1 \equiv A(x+1) + B(x-1)$

$x:\quad 0 = A+B$

மாறிலி $\quad 1 = A-B$ $\Big\}$ 5

$\Rightarrow A = \frac{1}{2}, \quad B = -\frac{1}{2}$

5 $\quad$ 5

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

$= \frac{1}{2}\ln|x-1| - \frac{1}{2}\ln|x+1| + c$

5 $\quad$ 5

$\int \frac{1}{x^2-1}\,dx = \frac{1}{2}\ln\left|\frac{x-1}{x+1}\right| + c$, c - ஒரு மாறிலி —— ①

5 $\quad$ 5

$x \to x+1$ எனப்பிரதியிட —— 5

$\int \frac{1}{x(x+2)}\,dx \equiv \frac{1}{2}\ln\left|\frac{x}{x+2}\right| + c$; c - ஒரு மாறிலி —— ②

5

① + ② $\Rightarrow \int \frac{1}{x^2-1}\,dx + \int \frac{1}{x(x+2)}\,dx = \frac{1}{2}\ln\left|\frac{x-1}{x+1}\right| + \frac{1}{2}\ln\left|\frac{x}{x+2}\right| + c_1$

5

$\int \frac{x^2+2x+x^2-1}{x(x-1)(x+1)(x+2)} = \frac{1}{2}\ln\left|\frac{x-1}{x+1}\cdot\frac{x}{x+2}\right| + c_1$

5

$\int \frac{2x^2+2x-1}{x(x-1)(x+1)(x+2)} = \frac{1}{2}\ln\left|\frac{x(x-1)}{(x+1)(x+2)}\right| + c_1$

c_1 - ஒரு மாறிலி

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$① - ② \Rightarrow \int \frac{1}{x^2-1}dx - \int \frac{1}{x(x+2)}dx = \frac{1}{2}\ln\left|\frac{x-1}{x+1}\right| - \frac{1}{2}\ln\left|\frac{x}{x+2}\right| + C_2$ (5)

$$\int \frac{x^2+2x-x^2+1}{x(x-1)(x+1)(x+2)}dx = \frac{1}{2}\ln\left|\frac{(x-1)}{(x+1)}\cdot\frac{(x+2)}{x}\right| + C_2$$ (5)

$$\int \frac{2x+1}{x(x-1)(x+1)(x+2)}dx = \frac{1}{2}\ln\left|\frac{(x-1)(x+2)}{x(x+1)}\right| + C_2$$ (5) $\boxed{70}$

C_2 - ஒரு மாறிலி

(b) (i) $\int_0^1 e^{\tan^{-1}x}\left(\frac{1+x+x^2}{1+x^2}\right)dx$

$\tan^{-1}x = t$ என்க $\qquad x \to 0 \Rightarrow t \to 0$

$x \to 1 \Rightarrow t \to \frac{\pi}{4}$ (5)

$\frac{dt}{dx} = \frac{1}{1+x^2}$ $\qquad \tan t = x$ (5)

$dx = (1+x^2)\,dt$ (5)

$$\int_0^{\pi/4} \frac{e^t(1+\tan t+\tan^2 t)\cancel{(1+\tan^2 t)}\,dt}{\cancel{(1+\tan^2 t)}}$$ (5)

$$= \int_0^{\pi/4} e^t(\sec^2 t + \tan t)\,dt$$

$$= \left[e^t \cdot \tan t\right]_0^{\pi/4}$$ (5)

$$= e^{\pi/4}\cdot 1 - e^0\cdot 0$$ $\boxed{30}$

$$= e^{\pi/4} \quad //$$ (5)

(b) (ii) $$\int_{\pi/6}^{\pi/3} \ln(\tan\theta)\,d\theta = \frac{1}{2}\int_{\pi/6}^{\pi/3}\left\{\ln(\tan\theta) + \ln\left(\tan\left(\frac{\pi}{2}-\theta\right)\right)\right\} d\theta .$$ (5)

$$= \frac{1}{2}\int_{\pi/6}^{\pi/3} \ln(\tan\theta . \cot\theta)$$

$$= \frac{1}{2}\int_{\pi/6}^{\pi/3} \ln 1\, d\theta$$ (5)

$$= 0$$

$\ln \tan\theta = u$ ගනිමු

$$e^{u} = \tan\theta .$$

$$\sec^2\theta = e^{u} . \frac{du}{d\theta} .$$ (5)

$$d\theta = \frac{e^{u} du}{\sec^2\theta} = \frac{e^{u} . du}{1+\tan^2\theta} = \frac{e^{u} . du}{1+e^{2u}}$$ (5)

$$\left.\begin{aligned} \theta \to \frac{\pi}{6} &\Rightarrow u \to \ln\left(\frac{1}{\sqrt{3}}\right) \\ \theta \to \frac{\pi}{3} &\Rightarrow u \to \ln(\sqrt{3}) \end{aligned}\right\}$$ (5)

$$\int_{\ln\left(\frac{1}{\sqrt{3}}\right)}^{\ln\sqrt{3}} . u . \frac{e^{u} du}{1+e^{2u}} = 0 \;//$$ (5)

(c) $$\int_0^1 x \ln(1+x^2) . dx$$

$$\frac{dv}{dx} \quad u$$

$$= \left[\ln(1+x^2) . \frac{x^2}{2}\right]_0^1 - \int_0^1 \frac{x^2}{\cancel{2}} . \frac{1}{1+x^2} . \cancel{2}x\, dx$$ (5) (5)

$$= \left(\frac{\ln 2}{2} - 0\right) - \int_0^1 \frac{(x^3+x) - x}{(1+x^2)} dx$$

$$= \frac{\ln 2}{2} - \int_0^1 . x - \frac{x}{1+x^2} dx$$

$$= \frac{\ln 2}{2} - \left[\frac{x^2}{2} - \frac{1}{2}\ln|1+x^2|\right]_0^1 \quad \text{—— (5)}$$

$$= \frac{\ln 2}{2} - \left\{\frac{1}{2} - \frac{\ln 2}{2} + \frac{\ln 1}{2}\right]$$

$$= \ln 2 - \frac{1}{2} \;// \quad \text{—— (5)}$$

$\boxed{50}$

$P, Q \equiv (a, -a)$ $\qquad S \equiv x^2+y^2-2x+4y+1=0$

$$\sqrt{S_p} = 3$$

$$\sqrt{a^2+a^2-2a-4a+1} = 3 \quad (10)$$

$$2a^2-6a+1 = 9 \quad (5)$$

$$2a^2-6a-8=0$$

$$a^2-3a-4=0 \quad (5)$$

$$a=4, \quad a=(-1) \quad (5)$$

(5)

P, Q இன் ஆள்கூறுகள்

$P \equiv (4,-4)$ (5), $Q \equiv (-1,1)$ (5)

$S_1 \equiv x^2+y^2+2gx+2fy+c=0$ எனக் —— (5)

$(4,-4)$ $\quad 16+16+8g-8f+c=0$ (5)

$$8g-8f+c=-32 \quad \text{—— ① (5)}$$

$(-1,1)$ $\quad 1+1-2g+2f+c=0$ (5)

$$-2g+2f+c=-2 \quad \text{—— ② (5)}$$

$$①, ② \Rightarrow \quad c=(-8) \quad \text{—— (5)}$$

$$10g-10f=-30 \quad \text{—— (5)}$$

$$g-f=-3$$

$$f=g+3 \quad \text{—— (5)}$$

∴ வட்டங்களின் பொதுச்சமன்பாடு

$$x^2+y^2+2gx+2(g+3)y-8=0 \quad \text{—— (10)}$$

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$S \equiv x^2+y^2+2gx+2fy+c=0$ எனக

மையம் $\equiv (-g, -f)$

மையம் y அச்சு மீது கிடப்பதால்

$-g=0$

$g=0$ —— (5)

வட்டம் $x+y+1=0$ ஐத் தொடுவதால்

$\frac{|0-f+1|}{\sqrt{2}} = \sqrt{2}$ —— (5)

$|1-f| = 2$

$1-f = \pm 2$

$f=(-1), \ f=3$ —— (5)

$\sqrt{g^2+f^2-c} = \sqrt{2}$

$f^2-c=2$

$f=(-1)$	$f=3$
$c=(-1)$	$c=7$

∴ வட்டங்கள் $x^2+y^2-2y-1=0$ —— (5)

$x^2+y^2+6y+7=0$ —— (5)

$y = \sqrt{3}\sin x - \cos x + 3$

$= 2\left\{\frac{\sqrt{3}}{2}\sin x - \frac{1}{2}\cos x\right\} + 3$

$= 2\left\{\sin x \cdot \cos\frac{\pi}{6} - \cos x \sin\frac{\pi}{6}\right\} + 3$

$= 2\sin\left(x-\frac{\pi}{6}\right) + 3$ —— (5)

$y_{\text{உயர்வு}}$ ஆக $\sin\left(x-\frac{\pi}{6}\right)$ உயர்வு ஆகவேண்டும்

$\sin\left(x-\frac{\pi}{6}\right)_{\text{உயர்வு}} = 1$ —— (5)

$y_{\text{உயர்வு}} = 2\times1+3$

$=5$ —— (5)

$K = \frac{\sqrt{3}\sin x - \cos x + 4}{\cos x - \sqrt{3}\sin x + 5}$

$= \frac{(\sqrt{3}\sin x - \cos x + 3)+1}{-(\sqrt{3}\sin x - \cos x + 3)+8}$ (5)

$K_{\text{உயர்வு}} = \frac{5+1}{-5+8}$

$= \frac{6}{3}$

$=2$ —— (5)

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$$\frac{x^2}{16} - \frac{y^2}{25} = 1$$

$$\frac{1}{16} \cdot 2x - \frac{1}{25} \cdot 2y \cdot \frac{dy}{dx} = 0$$

$$\frac{x}{8} = \frac{2y}{25} \cdot \frac{dy}{dx}$$

$$\frac{dy}{dx} = \frac{25x}{16y} \text{ ——— } (5)$$

$P(4\sec\theta, 5\tan\theta)$ හි

$$\frac{dy}{dx} = \frac{25 \times 4\sec\theta}{16 \times 5\tan\theta}$$

$$\sqrt{2} = \frac{5\sec\theta}{4\tan\theta} \text{ ——— } (5)$$

$$\sqrt{2} = \frac{5}{\cos\theta \cdot 4\sin\theta} \cdot \cos\theta$$

$$\sin\theta = \frac{5}{4\sqrt{2}}$$

$$\theta = \sin^{-1}\left(\frac{5}{4\sqrt{2}}\right) \text{ ——— } (5)$$

ස්පර්ශකය

$$(y - 5\tan\theta) = \sqrt{2}(x - 4\sec\theta)$$

$$y - 5 \cdot \frac{5}{\sqrt{7}} = \sqrt{2}\left(x - 4 \cdot \frac{4\sqrt{2}}{\sqrt{7}}\right) \quad (5)$$

$$\sqrt{7}y - 25 = \sqrt{14}x - 32$$

$$\sqrt{14}x - \sqrt{7}y - 7 = 0$$

$$\sqrt{2}x - y - \sqrt{7} = 0 \text{ ——— } (5)$$

$$l_1 \equiv 2x + y - 5 = 0$$

$$x = \alpha, \quad y = 5 - 2\alpha$$

$11x - 2y + 3 = 0$

$2\sqrt{5}$

$(\alpha, 5 - 2\alpha)$

$$d = 2\sqrt{5} = \frac{|11\alpha - 2(5 - 2\alpha) + 3|}{\sqrt{121 + 4}} \quad (5)$$

$$2\sqrt{5} \cdot 5\sqrt{5} = |15\alpha - 7|$$

$$50 = |15\alpha - 7|$$

$(+) \Rightarrow \quad 15\alpha - 7 = 50$

$$\alpha = \frac{57}{15} \quad (5)$$

$(-) \Rightarrow \quad -50 = 15\alpha - 7$

$$\alpha = -\frac{43}{15} \quad (5)$$

$$\left(\frac{57}{15}, \frac{-39}{15}\right) \quad (5)$$

$$\left(\frac{-43}{15}, \frac{161}{15}\right) \quad (5)$$

பொதுநாணின் சமன்பாடு

$S - S_1 = 0$ (10)

$(2g+2)x + (2g+6-4)y - 9 = 0$ (10)

$(2g+2)x + (2g+2)y - 9 = 0$ (10)

S இன் மையம் $\equiv (1,-2)$ (5)

S இன் மையம் பொதுநாணின் மீது இருப்பதால்

$2g+2-4g-4-9=0$ (5)

$2g = -11$

$g = -\frac{11}{2}$ (5)

$S_1 = x^2+y^2-11x+2\left(-\frac{11}{2}+3\right)y-8=0$ (5)

$S_1 = x^2+y^2-11x-5y-8=0$ // (10) $\boxed{150}$

(17)

(a) $L.H.S = \frac{\sin^3 x}{1+\cos x} + \frac{\cos^3 x}{1-\sin x}$

$= \frac{(1-\cos^2 x)\cdot\sin x}{1+\cos x}$ (5) $+ \frac{(1-\sin^2 x)\cos x}{1-\sin x}$ (5)

$= \frac{(1-\cos x)\cancel{(1+\cos x)}\sin x}{\cancel{(1+\cos x)}} + \frac{\cancel{(1-\sin x)}(1+\sin x)\cos x}{\cancel{(1-\sin x)}}$

$= \sin x - \cancel{\sin x\cos x} + \cos x + \cancel{\cos x\sin x}$

$= \sin x + \cos x$

$= \sqrt{2}\left(\cos x\cdot\frac{1}{\sqrt{2}} + \sin x\cdot\frac{1}{\sqrt{2}}\right)$ (5)

$= \sqrt{2}\left(\cos x\cos\frac{\pi}{4} + \sin x\sin\frac{\pi}{4}\right)$ (5)

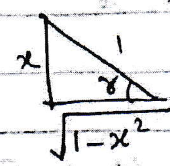
$= \sqrt{2}\cos\left(x-\frac{\pi}{4}\right)$ (5)

$= \sqrt{2}\cos\left(\frac{\pi}{4}-x\right)$ // $\boxed{25}$

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

$\tan^{-1}\left(\frac{1}{2}\right) = \alpha$ [illegible] $\qquad \tan^{-1}\left(\frac{1}{3}\right) = \beta \qquad \sin^{-1}(x) = \gamma$

$\tan\alpha = \frac{1}{2}$ (5) $\qquad \tan\beta = \frac{1}{3}$ (5) $\qquad \sin\gamma = x$ (5)



$\alpha - \beta = \gamma$

$\tan(\alpha - \beta) = \tan\gamma$ (5)

$\frac{\tan\alpha - \tan\beta}{1 + \tan\alpha\tan\beta} = \pm \frac{x}{\sqrt{1-x^2}}$ (5)

$\frac{\frac{1}{2} - \frac{1}{3}}{1 + \frac{1}{2}\cdot\frac{1}{3}} = \pm \frac{x}{\sqrt{1-x^2}}$ (5)

ΔADC [illegible] sin [illegible]

$\frac{\sin(90-\theta)}{b} =$

$\left(\frac{1}{7}\right)^2 = \frac{x^2}{1-x^2}$

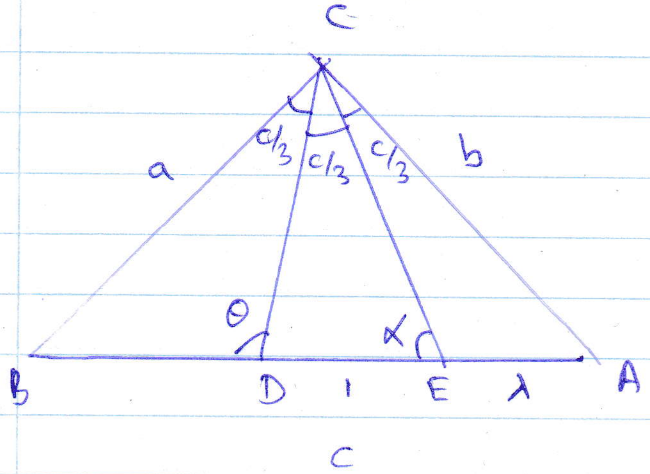
$1 - x^2 = 49x^2$

$50x^2 = 1$

$x^2 = \frac{1}{50}$ (5)

$x = \pm\frac{1}{5\sqrt{2}}$ (5) $\Rightarrow x = \frac{1}{5\sqrt{2}}$ (5) //

$\boxed{45}$



ΔADC இல் sin விதிப்படி

$$\frac{b}{\sin(180-\theta)} = \frac{AD}{\sin\frac{2C}{3}} \quad -(1)$$

Δ CDB இல் sin விதிப்படி

$$\frac{a}{\sin\theta} = \frac{BD}{\sin C/3} \quad -(2)$$

$(1)/(2) \Rightarrow \quad \frac{b}{a} = \frac{\sin C/3}{\sin 2C/3} \quad (\because AD = BD)$

$$= \frac{1}{2\cos C/3}$$

$$\cos C/3 = a/2b \quad //$$

ΔBCE இல் Sin விதிப்படி

$$\frac{\sin\frac{2C}{3}}{(\lambda+2)x} = \frac{\sin\alpha}{a} \quad (5) \qquad \text{———} (3)$$

ΔACE இல் Sin விதிப்படி

$$\frac{\sin\frac{C}{3}}{\lambda x} = \frac{\sin(180-\alpha)}{b}$$

$$\frac{\sin C/3}{\lambda x} = \frac{\sin\alpha}{b} \quad (5) \qquad \text{———} (4)$$

$$\frac{(3)}{(4)} \Rightarrow \frac{\sin\frac{2C}{3}\cdot\lambda}{\sin\frac{C}{3}\cdot(\lambda+2)} = \frac{b}{a}$$

$$\frac{2\cancel{\sin\frac{C}{3}}\cdot\cos\frac{C}{3}\cdot\lambda}{2(\lambda+2)\cancel{\sin\frac{C}{3}}} = \frac{b}{a} \quad (5)$$

$$\cos\frac{C}{3} = \frac{(\lambda+2)b}{2\lambda a} \;// \quad (5)$$

$$\lambda = 1 \Rightarrow \cos\frac{C}{3} = \frac{3b}{2a} \quad (5) \qquad \frac{3b}{2a} = \frac{a}{2b}$$

$$a = \sqrt{3}b \;// \quad (5)$$

$$\cos\frac{C}{3} = \frac{\sqrt{3}b}{2b} = \frac{\sqrt{3}}{2} \quad (5)$$

$$\frac{C}{3} = \frac{\pi}{6}$$

$$C = \frac{\pi}{2} \;// \quad (5)$$

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$\lambda = 2$

$$\cos\frac{c}{3} = \frac{4b}{4a} = \frac{b}{a} \quad 5$$

$$\frac{b}{a} = \frac{a}{2b}$$

$$2b^2 = a^2 \Rightarrow a = \sqrt{2}b \quad 5$$

$$\cos\frac{c}{3} = \frac{\sqrt{2}b}{2b} = \frac{1}{\sqrt{2}} \quad 5$$

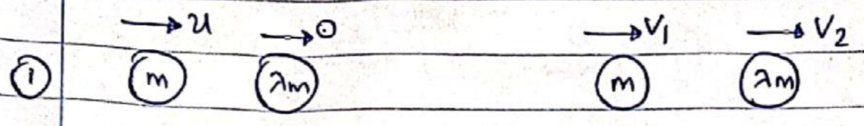
$$\frac{c}{3} = \frac{\pi}{4}$$

$$c = \frac{3\pi}{4} \quad // \quad 5$$

$\boxed{80}$

பகுதி - A

(1)



தொகுதிக்கு $\vec{I} = \Delta mv$

$$0 = mv_1 + \lambda m v_2 - mu \quad \text{— (5)}$$

$$u = v_1 + \lambda v_2 \quad \text{— (1)} \quad \text{— (5)}$$

நியூட்டனின் பரிசோதனை விதிப்படி

$$v_2 - v_1 = \frac{1}{2}u$$

$$2v_2 - 2v_1 = u$$

$$2\lambda v_2 - 2\lambda v_1 = \lambda u \quad \text{— (2)} \quad \text{— (5)}$$

$$(1)\,2 - (2) \Rightarrow (2 + 2\lambda)v_1 = (2 - \lambda)u$$

$$v_1 = \frac{(2-\lambda)u}{2+2\lambda} \quad \text{— (5)}$$

A இன் வேகம் புறமாற்றப்படின்

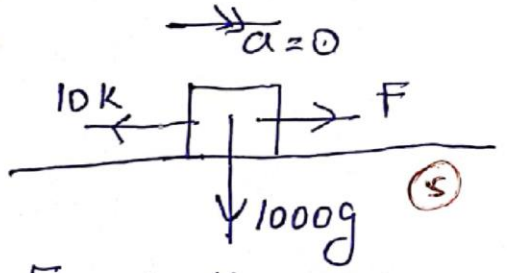
$$2 - \lambda < 0$$

$$\lambda > 2 \;//$$

— (5)

RATHNA

2)



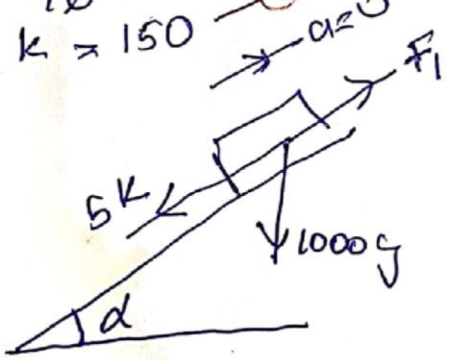
$F = 10\,K$

$\frac{1500\cancel{0}}{1\cancel{0}} = 10\,K$

$K = 150$ — (5)

$36\,kmh^{-1} = 36 \times \frac{5}{18}\,ms^{-1} = 10\,ms^{-1}$

$18\,kmh^{-1} = 5\,ms^{-1}$ — (5)



↗ $F = ma$

$F_1 - 5K - 1000g\sin\alpha = 1000 \times 0$ — (5)

$\frac{15000}{5} - 5 \times 150 - 1000 \times 10 \sin\alpha = 0$

$300\cancel{0} - \cancel{7}5\cancel{0} - 100\cancel{0}0\sin\alpha = 0$

$1000\sin\alpha = 225$

$\sin\alpha = \frac{225}{1000} = \frac{9}{40}$ — (5)

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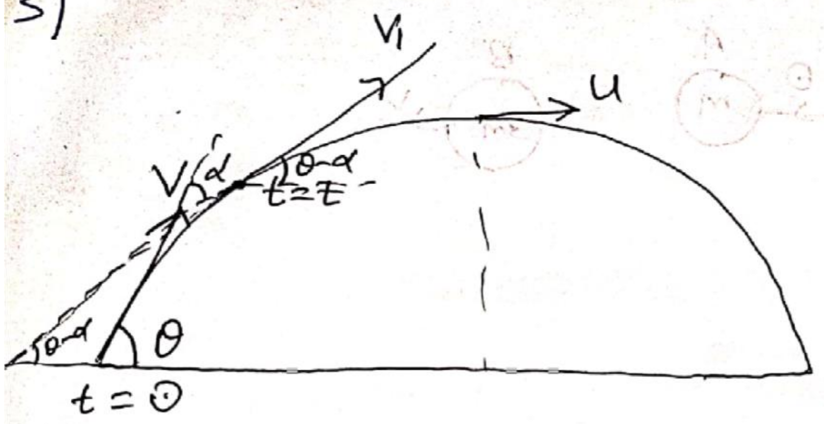
3)



$V\cos\theta = u$ — (5) $\quad V\cos\theta = V_1\cos(\theta-\alpha)$

$V_1\cos(\theta-\alpha) = u$ — (5)

$\uparrow \; V = u + at$

$V_1\sin(\theta-\alpha) = V\sin\theta - gt$ — (5)

$$gt = V\sin\theta - V_1\sin(\theta-\alpha)$$

$$= V\sin\theta - \frac{V\cos\theta}{\cos(\theta-\alpha)}\cdot\sin(\theta-\alpha)$$

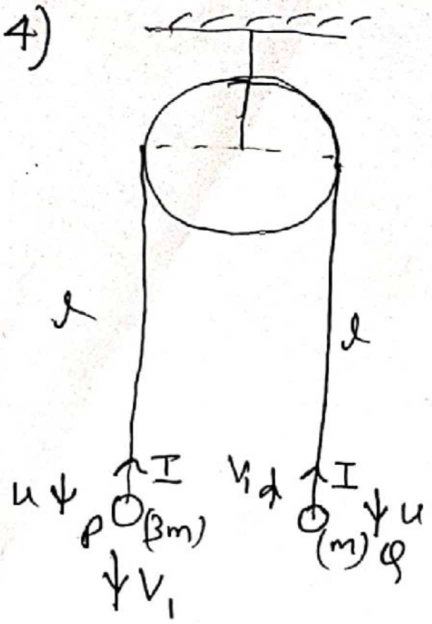
$$= V\left\{\frac{\sin\theta\cos(\theta-\alpha) - \cos\theta\sin(\theta-\alpha)}{\cos(\theta-\alpha)}\right\}$$

$$= \frac{V\sin\alpha}{\cos(\theta-\alpha)} \quad \text{— (5)}$$

$$= \frac{V\sin\alpha}{\frac{u}{V_1}} = \frac{VV_1\sin\alpha}{u} \quad \text{— (5)}$$

$$t = \frac{VV_1\sin\alpha}{ug}$$

4)



சக்தி காப்புவிதி.

$$0 + 0 = -3mg.l - mgl + \frac{1}{2}3mu^2 + \frac{1}{2}mu^2$$

$$0 = -6mgl - 2mgl + 4mu^2 \quad (5)$$

$$u^2 = 2gl$$

$$u = \sqrt{2gl} \quad (5)$$

P இற்கு $\downarrow I = \Delta mv$

$$-I = 3m(v_1 - u) \quad \text{——} (1) \quad (5)$$

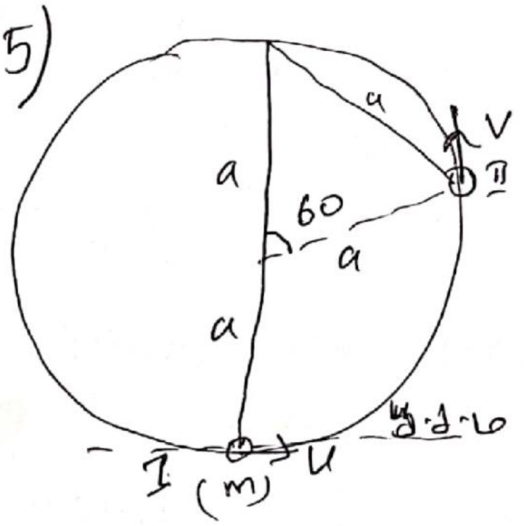
Q இற்கு $\uparrow I = \Delta mv$

$$I = m(v_1 - (-u)) \quad \text{——} (2) \quad (5)$$

$(1) + (2) \Rightarrow \quad 0 = 4v_1 - 2u \quad (5)$

$$v_1 = \frac{u}{2} = \sqrt{\frac{gl}{2}}$$

5)



$I \rightarrow II$ சக்திக்காப்பு விதி (15)

$$\frac{1}{2}mu^2 + \frac{1}{2}\frac{a^2}{a}3mg + 0 = \frac{1}{2}mv^2 + mg.(a + a\cos$$

$$u^2 + 3mga = v^2 + 2ga\left(1 + \frac{1}{2}\right)$$

$$u^2 + 3ga = v^2 + 3ga \quad (5)$$

$$v^2 = u^2 \quad (5)$$

$$v = u$$

6) $|\underline{a}| = \sqrt{4+k^2}$, $|b| = \sqrt{10}$ (5)

$\underline{a}\cdot\underline{b} = |\underline{a}||\underline{b}|\cos\theta$ (5)

$(2\underline{i}+k\underline{j})\cdot(3\underline{i}-\underline{j}) = \sqrt{4+k^2}\cdot\sqrt{10}\cdot\frac{3}{\sqrt{10}}$

$6-k = 3\cdot\sqrt{4+k^2}$ (5)

$(6-k)^2 = 9(4+k^2)$

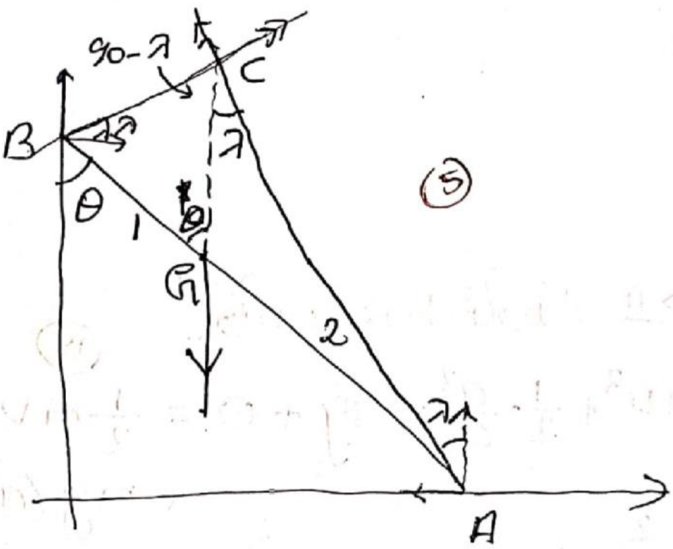
$36-12k+k^2 = 36+9k^2$

$8k^2+12k=0$

$k(2k+3)=0$

$k=0$ (5) or $k=-\frac{3}{2}$ (5)

7)



$3\cot\theta = 2\cot\lambda - \cot(90-\lambda)$ —— (10)

$= \frac{2}{\tan\lambda} - \tan\lambda$

$= \frac{2}{\mu} - \mu$

$\cot\theta = \frac{2-\mu^2}{3\mu}$ —— (5)

$\tan\theta = \frac{3\mu}{2-\mu^2}$ —— (5)

$\theta = \tan^{-1}\left(\frac{3\mu}{2-\mu^2}\right)$

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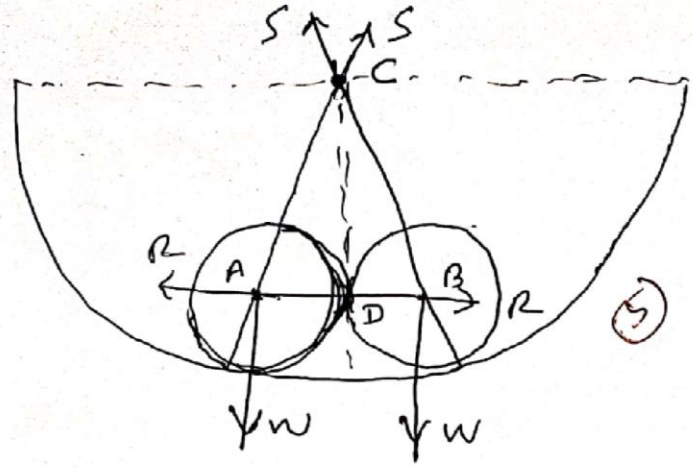
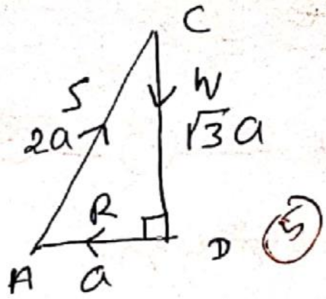
8)





$$\frac{R}{a} = \frac{S}{2a} = \frac{W}{\sqrt{3}a}$$ 5 5 5

$$R = \frac{W}{\sqrt{3}} = \frac{\sqrt{3}W}{3}$$

9) $P(A/B) = \dfrac{P(A\cap B)}{P(B)}$ — 5

$0.5 = \dfrac{0.1}{0.1+x}$ — 5

$0.05 + 0.5x = 0.1$

$0.5x = 0.05$

$x = \dfrac{0.05}{0.5}$

$x = 0.1$ — 5

$\dfrac{0.1}{0.05}$

$P(A\cup B) = P(A) + P(B) - P(A\cap B)$ — 5

$= 0.3 + 0.2 - 0.1$

$P(A\cup B) = 0.4$ — 5

10) $\dfrac{x+y+\cancel{40}\ 36}{10} = 4$

$x + y = 4$ —— (1) —— 5

ஆகாரம் 3 என்பதால்

$x = 1$, $y = 3$ —— 5

—— 5

1, 2, 3, 3, 3, 4, 5, 6, 6, 7

இடையம் $= \frac{1}{2}(n+1)$ ஆவது —— 5

$= \frac{1}{2} \times 11$ ''

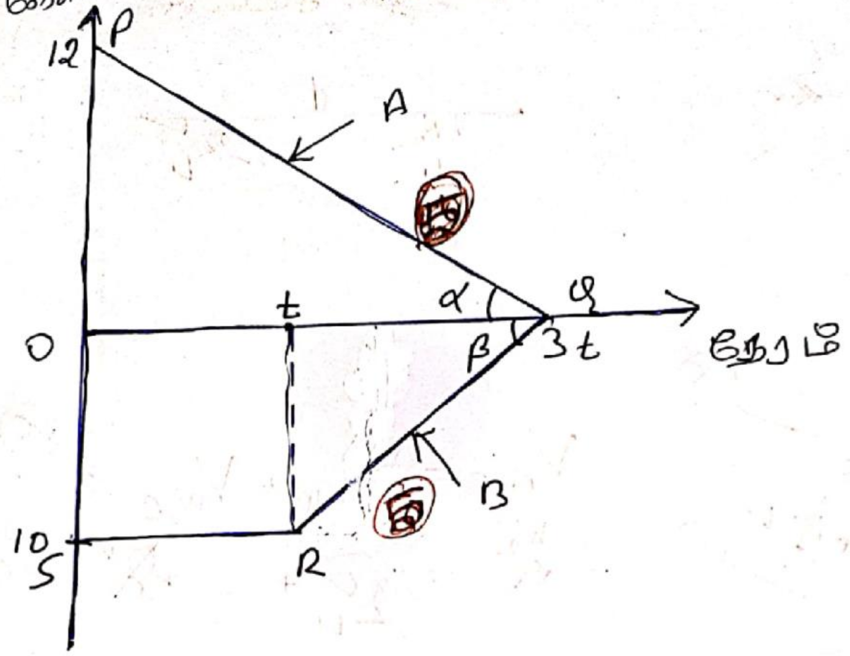
$= 5.5$ ''

$= \frac{3+4}{2}$

இடையம் $= 3.5$ —— 5

(11)

1. i) வேகம் (ms⁻¹)



ii) ΔOPQ + சரிவகம் $OQRS = 700$ — (5)

$$\frac{1}{2}\times 3t\times 12+\frac{1}{2}(t+3t)\times 10=700$$ — (5)

$$18t+20t=700$$

$$38t=700$$ — (5)

$$t=\frac{700}{38}=\frac{350}{19}$$ — (5)

$$t=\frac{350}{19}\,s$$

iii) $f_A=\tan\alpha$

$$=\frac{12}{3t}$$ — (5)

$$=\frac{4}{t}$$

$$=\frac{4\times 19}{350}$$

$$f_A=\frac{38}{175}\,ms^{-2}$$ — (5)

$f_B=\tan\beta$

$$=\frac{10}{2t}$$ — (5)

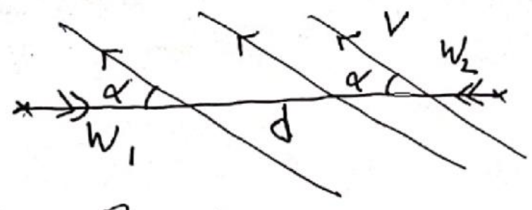
$$=\frac{5}{t}$$

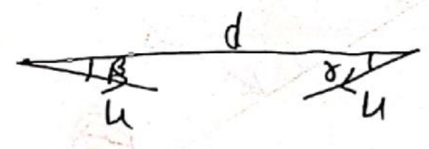
$$=\frac{5\times 19}{350}$$

$$f_B=\frac{19}{70}\,ms^{-2}$$ — (5)

$\boxed{50}$

1. b) புவியின் சட்டம் — காற்றின் சட்டம்

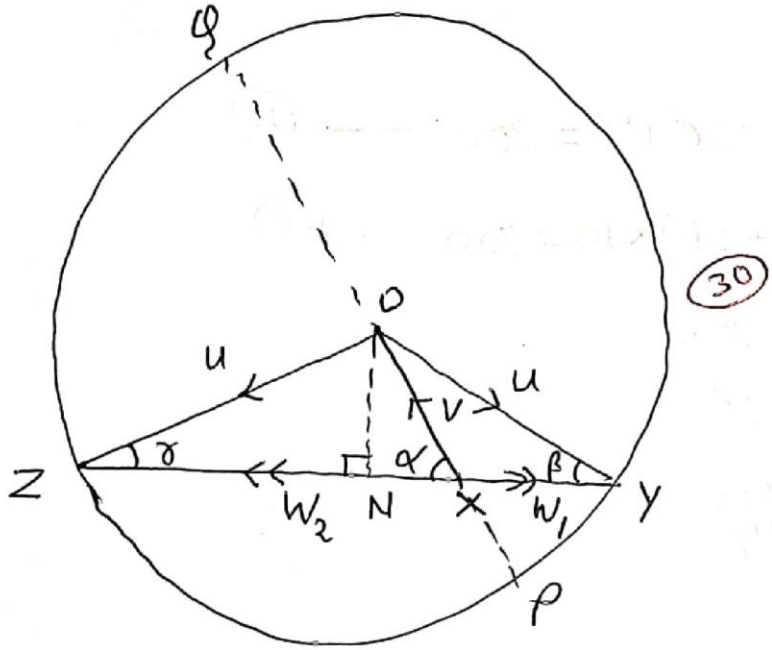




விமானம் - A
காற்று - W
புவி - E
5

$V_{A,E} = V_{A,W} + V_{W,E}$ 5 $\qquad$ $V_{A,E} = V_{A,W} + V_{W,E}$ 5

$\overrightarrow{W_1} = \underset{u}{\searrow}\beta + \alpha\nwarrow V$ 5 $\qquad$ $\overleftarrow{W_2} = \underset{u}{\swarrow}\gamma + \alpha\nwarrow V$ 5



30

55

$$T_1 - T_2 = \frac{d}{W_1} - \frac{d}{W_2} \quad 5$$

$$= d\left(\frac{W_2 - W_1}{W_1 \cdot W_2}\right) \quad 5$$

$$= \frac{d(XZ - XY)}{YX \cdot XZ} \quad 5$$

$$= \frac{d(ZN + NX - NY + NX)}{PX \cdot XQ} \quad 5$$

$$= \frac{2d\,NX}{PX \cdot XQ} \quad 5$$

$$T_1 - T_2 = \frac{2dv\cos\alpha}{(u-v)(u+v)} \quad 5$$

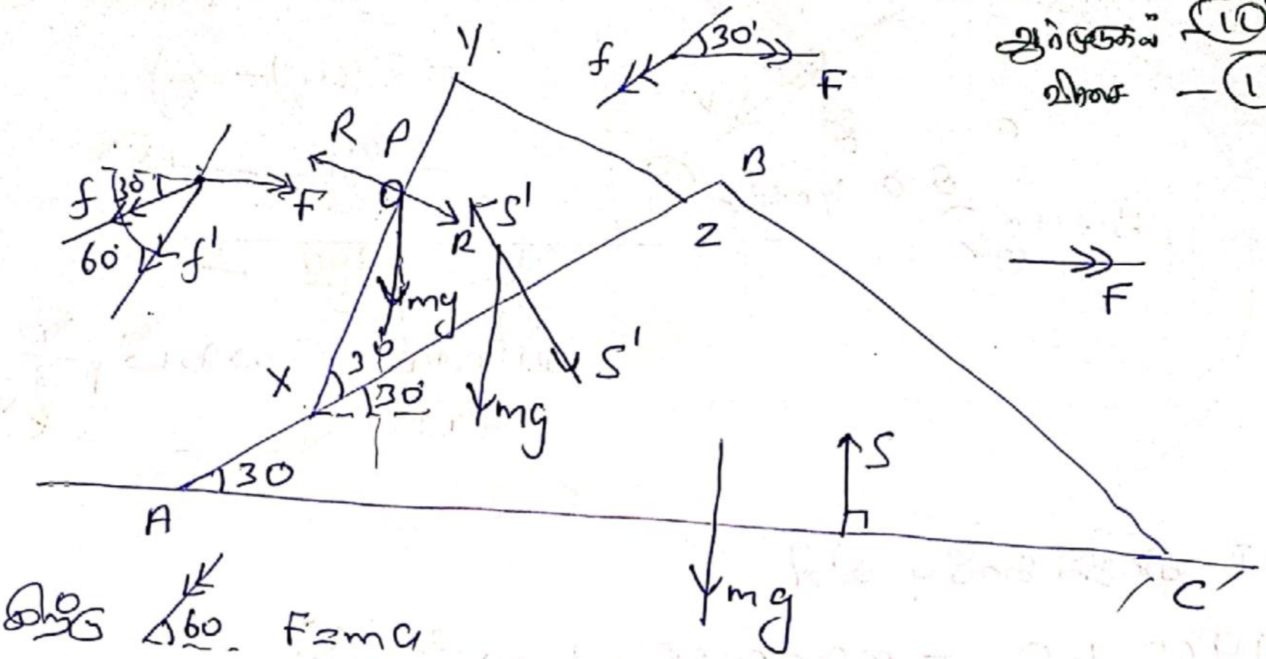
$$(u^2 - v^2) = \frac{2dv\cos\alpha}{T_1 - T_2} \quad 5$$

$$u^2 = v^2 + \frac{2dv\cos\alpha}{T_1 - T_2} \quad 5$$

$$u = \left(v^2 + \frac{2dv\cos\alpha}{T_1 - T_2}\right)^{1/2} \quad 5$$

$\boxed{45}$

12)(a)



ஆர்முடுகல் - (10)
விசை - (10)

P இற்கு ↙60 $F=ma$

~~$mg\cos 30^\circ = m(f' + f\cos 30^\circ - F\cos 60^\circ)$~~

$mg\cos 30^\circ = m(f' + f\cos 30^\circ - F\cos 60^\circ)$

$f' + f\cos 30^\circ - F\cos 60 = g\cos 30^\circ$ —— (1) —— 10/0

P, XYZ இற்கு ↙ $F=ma$

$2mg\cos 60 = m(f - F\cos 30^\circ)$ —— 10/0

$f - F\cos 30^\circ = 2g\cos 60$ —— (2)

தொகுதிக்கு → $F=ma$

$0 = mF + m(F - f\cos 30^\circ) + m(F - f\cos 30^\circ - f'\cos 60^\circ)$ —— 15/0

$3F - 2f\cos 30^\circ - f'\cos 30^\circ = 0$ —— (3)

$\boxed{55}$

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12) (b)(i)(Q)(D→A) $\uparrow v^2 = u^2 + 2as$.

$$v^2 = \left(4\sqrt{ag}\sin\frac{\pi}{3}\right)^2 - 2g \times 6a \quad — \boxed{5}$$

$$v^2 = \left(2 \times \sqrt{3ag}\right)^2 - 12ag$$

$$v^2 = 0 \quad — \boxed{5}$$

$$v = 0$$

$\uparrow v = u + at$.

$$0 = 4\sqrt{ag}\sin\left(\frac{\pi}{3}\right) - gt \quad — \boxed{5}$$

$$gt = 2\sqrt{3ag}.$$

$$t = 2\sqrt{\frac{3a}{g}} \quad — \boxed{5}$$

$\boxed{30}$

$\leftarrow s = ut + \frac{1}{2}at^2$.

$$s = 4\sqrt{ag}\cos\left(\frac{\pi}{3}\right) \times 2\sqrt{\frac{3a}{g}} + 0 \quad — \boxed{5}$$

$$s = 2\sqrt{ag} \times 2\sqrt{\frac{3a}{g}}.$$

$$s = 4a\sqrt{3} \quad — \boxed{5}$$

∴ புள்ளி A இல் Q ஆனது P ஐ கிடையாக மோதுகின்றது.

(ii) இரு துணிக்கைகளும் சர்வசமனானவை. பூரண மீள்தன்மை அடைகின்றமையால் P ஆனது Q இன் கிடைவேகத்துடன் இயங்கும். — $\boxed{10}$

ஆகவே, P இன் கிடை வேகம் $= 4\sqrt{ga} \times \cos\frac{\pi}{3}$.

$$= 4\sqrt{ga} \times \frac{1}{2}.$$

$\boxed{15}$

$$= 2\sqrt{ag}. \quad — \boxed{5}$$

(iii) பொறிமுறைச்சக்திக் காப்புக் கோட்பாட்டின்படி,

$$0 + \frac{1}{2}mu^2 = \frac{1}{2}mv_1^2 + mg\left(a + a\sin\frac{\pi}{6}\right).$$

$$u^2 = v_1^2 + 2ga \times \frac{3}{2}. \quad \boxed{15}$$

$$v_1^2 = 4ag - 3ag \qquad \boxed{20}$$

$$= ag$$

$$v_1 = \sqrt{ag} \quad \boxed{5}$$

(iv) $\uparrow v^2 = u^2 + 2as.$

$$0 = \left[v_1 \sin\left(\frac{\pi}{3}\right)\right]^2 - 2gh \quad \boxed{5}$$

$$2gh = \left(\sqrt{ag} \times \frac{\sqrt{3}}{2}\right)^2.$$

$$2gh = \frac{3ag}{4}. \qquad \boxed{30}$$

$$h = \frac{3a}{8} \quad \boxed{10}$$

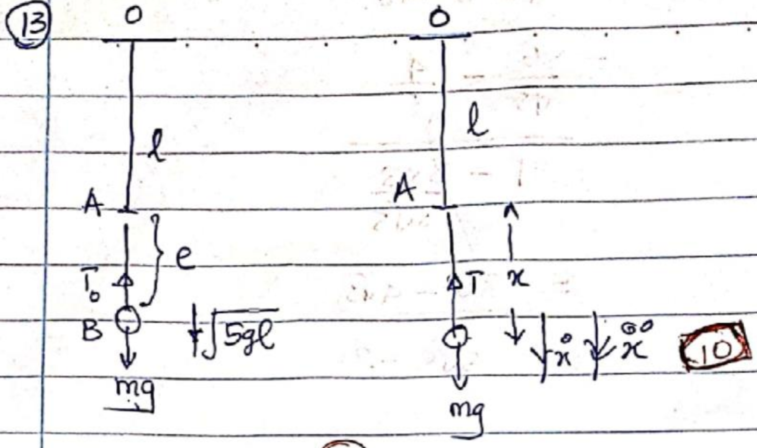
$$6a + a + a\sin\left(\frac{\pi}{6}\right) + \frac{3a}{8} = 7a + \frac{a}{2} + \frac{3a}{8}. \quad \boxed{5}$$

$$= \frac{56a + 4a + 3a}{8}$$

$$= \frac{63a}{8} \quad \boxed{10}$$

$$= \left(7\frac{7}{8}\right)a.$$

(13)



$T_0 = mg$ — ① (5)

$T_0 = 3mg\dfrac{e}{l}$ — ② — (5)

①, ② $\Rightarrow e = l/3$ — (5)

$\therefore OB = l + l/3$

$= \dfrac{4l}{3}$ — (5)

$\downarrow \underline{F} = m\underline{a}$

$mg - T = m\ddot{x}$ — (10)

$\Rightarrow mg - \dfrac{3mgx}{l} = m\ddot{x}$ (5)

$\Rightarrow \ddot{x} = g - 3g\dfrac{x}{l}$

$\ddot{x} = -\dfrac{3g}{l}(x - l/3)$ (5), $X = x - l/3$

$\dot{X} = \dot{x}$, $\ddot{X} = \ddot{x}$ (5)

இயக்கமையத்தில் $\ddot{X} = 0$ (5)

$\Rightarrow X = 0$

$\Rightarrow x = l/3$

$\therefore \ddot{X} = -\omega^2 X$; $\omega = \sqrt{3g/l}$ — (5) // $\boxed{65}$

A யிற்கு கீழே $l/3$ தூரத்தில் இயக்கமையம் இருக்கும். — (5)

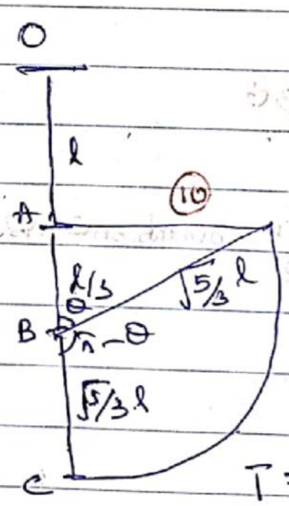
$X = 0$ இல் $\dot{X} = \sqrt{5gl}$ — (5)

$\therefore 5gl = \dfrac{3g}{l}(a^2 - 0)$ — (5)

$\dfrac{5l^2}{3} = a^2$

$\Rightarrow a = \sqrt{\dfrac{5}{3}}\, l$ — (5)

$\therefore$ வீச்சம் $= \sqrt{5/3}\, l$ // — (5)



$\cos\theta = \dfrac{l/3}{\sqrt{5/3}\, l} = \dfrac{1}{\sqrt{15}}$ (5)

இழைதளரும் வரைக்கும் இயங்கிய நேரம்

$X = -l/3$, $\dot{X} = V$ — (5)

$V^2 = \dfrac{3g}{l}\left(\dfrac{5l^2}{3} - l^2/9\right)$ — (5)

$= \dfrac{\cancel{3}g}{\cancel{l}} \times \dfrac{14l^{\cancel{2}}}{\cancel{9}_3}$ — (5)

$\therefore V = \sqrt{\dfrac{14gl}{3}}$ — (5)

(10) — $T = \left[\dfrac{\pi}{2} + \pi - \cos^{-1}\left(\dfrac{1}{\sqrt{15}}\right)\right]\sqrt{\dfrac{l}{3g}}$

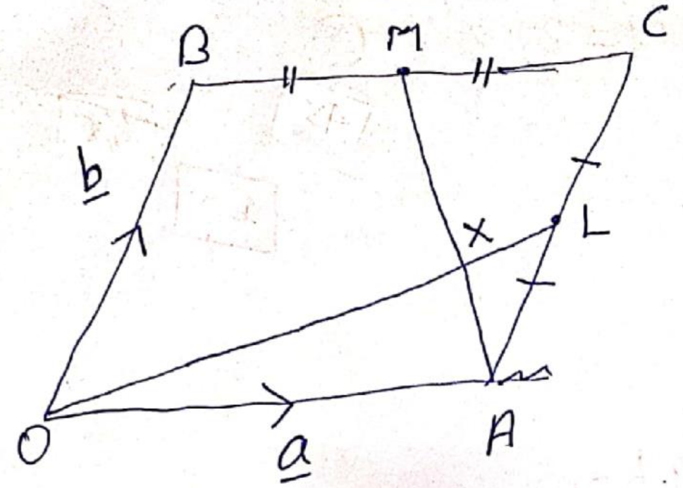
$= \left[\dfrac{3\pi}{2} - \cos^{-1}\left(\dfrac{1}{\sqrt{15}}\right)\right]\sqrt{l/3g}$ (5)

$\uparrow v^2 = u^2 + 2as$

$0 = \dfrac{14gl}{3} - 2gH \Rightarrow H = \dfrac{7l}{3}$ // — (5) (5)

$\boxed{85}$

4) (a)



i) $\overrightarrow{OL} = \overrightarrow{OA} + \overrightarrow{AL}$

$= \overrightarrow{OA} + \frac{1}{2}\overrightarrow{AC}$

$= \underline{a} + \frac{1}{2}\underline{b}$ — 5

$\overrightarrow{OL} = \frac{1}{2}(2\underline{a} + \underline{b})$

$\overrightarrow{AM} = \overrightarrow{AC} + \overrightarrow{CM}$

$= \overrightarrow{AC} + \frac{1}{2}\overrightarrow{CB}$

$= \underline{b} - \frac{1}{2}\underline{a}$ — 5

$= \frac{1}{2}(2\underline{b} - \underline{a})$

ii) $OX = \lambda OL$

$\overrightarrow{OX} = \lambda\overrightarrow{OL}$

$\overrightarrow{OX} = \frac{\lambda}{2}(2\underline{a} + \underline{b})$ — 5

$\overrightarrow{AX} = \mu\overrightarrow{AM}$

$= \frac{\mu}{2}(2\underline{b} - \underline{a})$ — 5

ΔOAX ගෙන්

$\overrightarrow{OX} = \overrightarrow{OA} + \overrightarrow{AX}$

$\frac{\lambda}{2}(2\underline{a} + \underline{b}) = \underline{a} + \frac{\mu}{2}(2\underline{b} - \underline{a})$ — 5

$(2\lambda + \mu - 2)\underline{a} + (\lambda - 2\mu)\underline{b} = 0$

$2\lambda + \mu - 2 = 0$ & $\lambda - 2\mu = 0$ — 5

$2\lambda + \mu = 2$ — (1)

$\lambda - 2\mu = 0$ — (2)

$5\lambda = 4$

$\lambda = \frac{4}{5}, \quad \mu = \frac{2}{5}$ — 5

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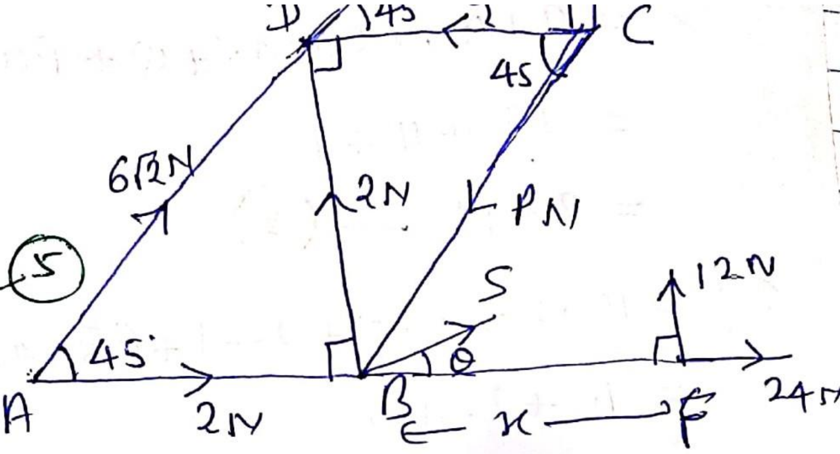
i)

$G_D \curvearrowright = 0$

$2 \times \frac{d}{\sqrt{2}} - P \times \cos 45 \cdot \frac{d}{\sqrt{2}} - 1 \cdot \frac{d}{\sqrt{2}} = 0$ — (5)



$2 - \frac{P}{\sqrt{2}} - 1 = 0$

$\frac{P}{\sqrt{2}} = 1 \Rightarrow P = \sqrt{2}N$ — (5)

$G_B \curvearrowright = 0$

$Q \cdot \frac{d}{\sqrt{2}} - 1 \cdot \frac{d}{\sqrt{2}} - 10\sqrt{2} \times \sin 45^\circ \frac{d}{\sqrt{2}} = 0$ — (5)

$Q - 1 - 10 = 0$

$Q = 11N$ — (5)

$\boxed{25}$

ii) $\rightarrow X = 0$ & $\uparrow Y = 0$ — (5)

$S\cos\theta + 2 + 10\sqrt{2}\cos 45^\circ - Q - P\cos 45^\circ = 0$ — (5)

$S \cdot \cos\theta + 2 + 10 - 11 - 1 = 0$

$S \cdot \cos\theta = 0$

$\cos\theta = 0 \quad (S \neq 0)$

$\theta = \pi/2$ — (5)

$\boxed{15}$

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$\uparrow 10\sqrt{2}\sin 45^\circ + 2 - 1 - P\sin 45^\circ + S\cdot\sin\theta = 0$ — 5

$10 + 1 - 1 + S\cdot\sin\theta = 0$

$S\cdot\sin\theta = -10$

$S\cdot\sin\frac{\pi}{2} = -10$

$S = -10N \qquad \downarrow S = 10N$ — 5

iii) $\overrightarrow{X} = 2 + 10\sqrt{2}\cos 45^\circ + Q + P\cos 45^\circ$ — 5

$= 12 + 11 + 1$

$= 24N$ — 5

$\uparrow Y = 10\sqrt{2}\sin 45^\circ + 2 - 1 + P\sin 45^\circ$ — 5

$= 10 + 2 - 1 + 1$

$= 12N$ — 5

$R = \sqrt{24^2 + 12^2}$

$= 12\sqrt{5}\,N$ — 5

$\tan\theta = \frac{12}{24}$

$= \frac{1}{2}$

$\theta = \tan^{-1}(1/2)$ — 5

B) $12\cdot x = Q\cdot\frac{l}{\sqrt{2}} - 1\times\frac{l}{\sqrt{2}} - 10\sqrt{2}\sin 45^\circ\cdot l/\sqrt{2}$ — 5

$12\cdot x = 11\cdot\frac{l}{\sqrt{2}} - \frac{l}{\sqrt{2}} - \frac{10l}{\sqrt{2}}$

$x = 0$ — 5

B හිදී හමුවෙයි — 5

55

$OX : XL = 4:1$, $AX : XM = 2:3$ — 5

40

iii) $OL \perp AM$

$\overrightarrow{OL} \cdot \overrightarrow{AM} = 0$ — 5

$\frac{2}{5}(2\underline{a}+\underline{b}) \cdot \frac{1}{5}(2\underline{b}-\underline{a}) = 0$

$4\underline{a}\cdot\underline{b} - 2\underline{a}\cdot\underline{a} + 2\underline{b}\cdot\underline{b} - \underline{a}\cdot\underline{b} = 0$

$3\underline{a}\cdot\underline{b} - 2|\underline{a}|^2 + 2|\underline{b}|^2 = 0$ — 5

$3|\underline{a}||\underline{b}|\cos(A\hat{O}B) = 2|\underline{a}|^2 - 2|\underline{b}|^2$

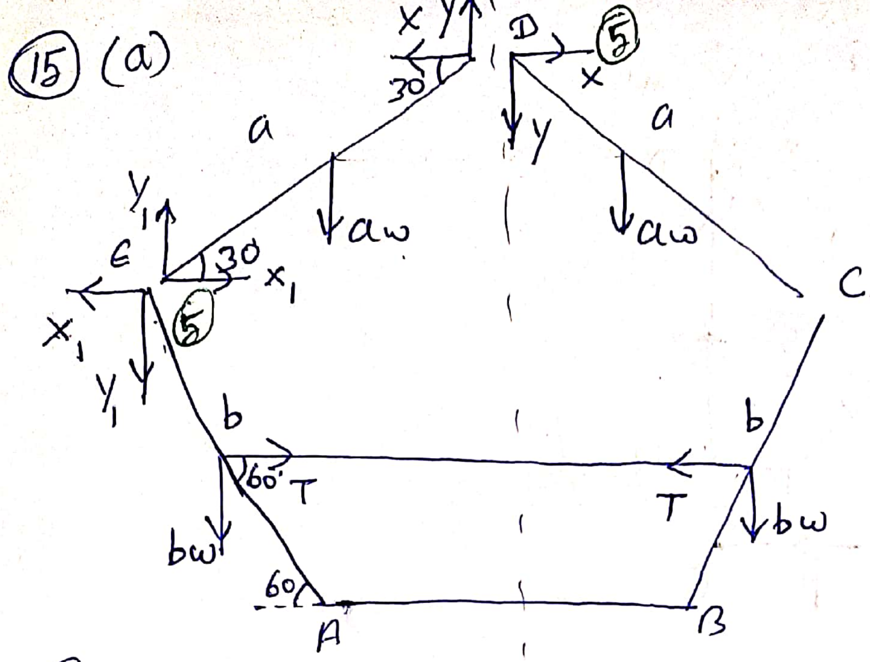
$\cos A\hat{O}B = \dfrac{2|\underline{a}|^2 - 2|\underline{b}|^2}{3|\underline{a}||\underline{b}|}$ — 5

$A\hat{O}B = \cos^{-1}\left(\dfrac{2|\underline{a}|^2 - 2|\underline{b}|^2}{3|\underline{a}||\underline{b}|}\right)$

15

$\frac{N}{24}$

(15) (a)



සමමිතියෙන් D සන්ධියේ ප්‍රතික්‍රියාවේ උපාංගය $Y = 0$ (5)

දණ්ඩ ED සඳහා E ↻

$$X \cdot a\sin 30^\circ - aw \cdot \frac{a}{2}\cos 30^\circ = 0 \quad \text{— (10)}$$

$$X = \frac{aw\sqrt{3}}{2} \quad \text{— (5)}$$

$\rightarrow$ $X_1 = X$

$$X_1 = \frac{aw\sqrt{3}}{2} \quad \text{— (5)}$$

$\uparrow$ $Y_1 = aw$ — (5)

දණ්ඩ AE සඳහා A ↻

$$T \cdot \frac{b}{2}\cos 30^\circ - bw \cdot \frac{b}{2}\sin 30^\circ - Y_1 \cdot b\cos 60^\circ - X_1 \cdot b\sin 60^\circ = 0 \quad \text{— (10)}$$

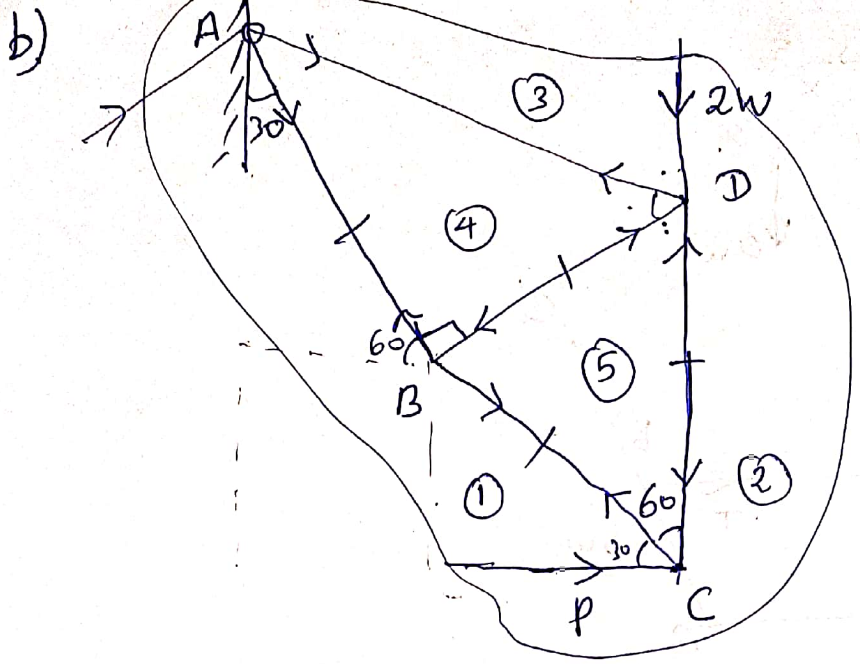
$$T \cdot \frac{\sqrt{3}}{4} - \frac{bw}{4} - \frac{aw}{2} - \frac{3aw}{4} = 0 \quad \text{— (5)}$$

$$T = \frac{(b+5a)w}{\sqrt{3}} \quad \text{— (5)}$$

$\boxed{60}$

b)

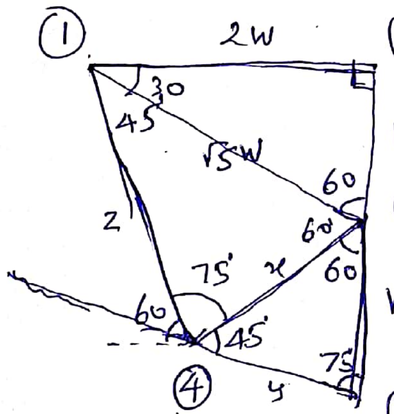
(b)



A) $P\cdot\left(x\frac{\sqrt{3}}{2}+\frac{x}{2}\right)-2W\left(\frac{\sqrt{3}}{2}x+\frac{x}{2}\right)=0$ — (5)

$P=2W$ — (5)

$\boxed{10}$



(30)

கோல்	தகைப்பு இழுவை	உதைப்பு	பருமன்
AB		✓ (5)	$\frac{\sqrt{6}(\sqrt{3}+1)W}{4}$ (5)
BC		✓ (5)	$\sqrt{3}W$ (5)
CD	✓ (5)		W (5)
AD		✓ (5)	$\frac{\sqrt{6}W}{2}$ (5)
BD	✓ (5)		$\frac{W(\sqrt{3}+1)}{2}$ (5)

$$\frac{x}{\sin 75^\circ}=\frac{y}{\sin 60}=\frac{W}{\sin 45^\circ}$$

$$y=\frac{\sqrt{6}W}{2}$$

$$x=\frac{W\sin 75^\circ}{\sin 45^\circ}$$

$$=W\left(\frac{\sqrt{3}+1}{2\cancel{\sqrt{2}}}\right)\times\cancel{\sqrt{2}}$$

$$x=\frac{W(\sqrt{3}+1)}{2}$$

$\boxed{80}$

$$\frac{z}{\sin 60}=\frac{x}{\sin 45^\circ}$$

$$z=\frac{W(\sqrt{3}+1)}{2}\times\frac{\sqrt{3}}{2}\times\sqrt{2}=\frac{\sqrt{6}(\sqrt{3}+1)W}{4}$$

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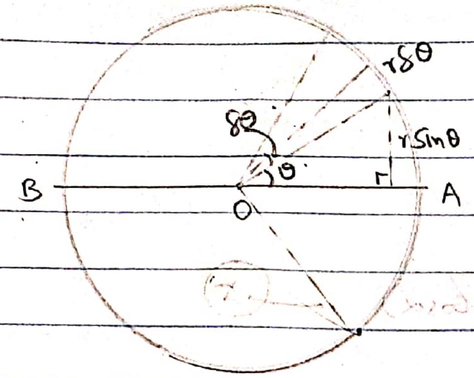
(16) (a)



(i) வளையத்தின் திணிவு $(\delta m) = 2\pi r \sin\theta \cdot r\,\delta\theta\,\rho$

ஓட்டின் திணிவு $(m) = \int_{\alpha}^{\pi} 2\pi r^2 \rho \sin\theta \, d\theta$ (5)

$$= 2\pi r^2 \rho \int_{\alpha}^{\pi} \sin\theta \, d\theta$$

$$= 2\pi r^2 \rho \; -\left[\cos\theta\right]_{\alpha}^{\pi} \quad (5)$$

$$= -2\pi r^2 \rho \left(\cos\pi - \cos\alpha\right)$$

$$= -2\pi r^2 \rho \left(-1 - \cos\alpha\right)$$

$$= 2\pi r^2 \rho \left(1 + \cos\alpha\right) \quad (5)$$

$\boxed{15}$

(ii) திணிவுமையம் $(\bar{x}, 0)$ எனின்

$$\bar{x} = \frac{\int_{\alpha}^{\pi} 2\pi r^2 \rho \sin\theta \cdot r\cos\theta \, d\theta}{2\pi r^2 \rho (1 + \cos\alpha)} \quad (10)$$

$$= \frac{\pi r^3 \rho \int_{\alpha}^{\pi} \sin 2\theta \, d\theta}{2\pi r^2 \rho (1 + \cos\alpha)} \quad (5)$$

$$= \frac{-\pi r^3 \rho \left[\cos 2\theta\right]_{\alpha}^{\pi}}{4\pi r^2 \rho (1 + \cos\alpha)} \quad (5)$$

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$$= -\frac{r}{4}\frac{(\cos 2\pi - \cos 2\alpha)}{(1+\cos\alpha)}$$

$$= \frac{-r(1-\cos 2\alpha)}{4(1+\cos\alpha)}$$

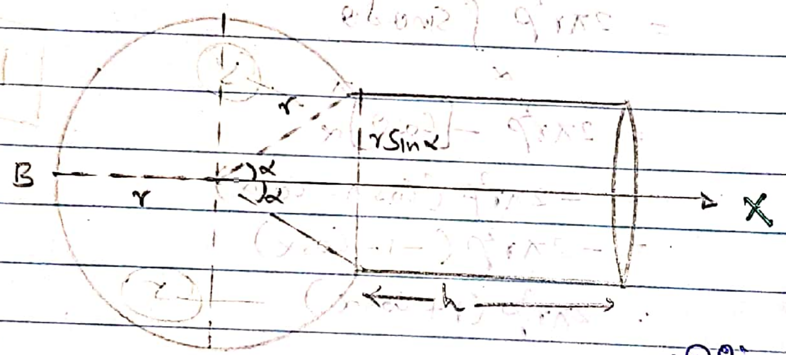
$$= \frac{-2r\sin^2\alpha}{4(1+\cos\alpha)}$$

$$= \frac{-r(1-\cos\alpha)(1+\cancel{\cos\alpha})}{\cancel{4}(1+\cancel{\cos\alpha})} \quad 5$$

$$= -\frac{r}{2}(1-\cos\alpha)$$

$\therefore$ OB இல் O இலிருந்து $\frac{r}{2}(1-\cos\alpha)$ தூரத்திலுள்ளது 5

$\boxed{30}$



$\cos\alpha = \frac{15}{17}$

$\sin\alpha = \frac{8}{17}$

உருவம்	திணிவு	சமச்சீரின் படி திணிவுமையம் OX அச்சில் இருக்கும் திணிவுமையத்தூரம் 5
கோளக்கூடு	$2\pi r^2\rho(1+\cos\alpha)$ 5	$-\frac{r}{2}(1-\cos\alpha)$ 5
உருளை	$2\pi rh\rho\sin\alpha$ 5	$r\cos\alpha + \frac{h}{2}$ 5
தொகுதி	$2\pi r\rho[r(1+\cos\alpha)+h]$ 5	$\bar{x}$

$$\bar{x} = \frac{\sum_{i=1}^{n} m_i x_i}{\sum_{i=1}^{n} m_i} \quad 10$$

$$= \frac{2\pi r^2\rho(1+\cos\alpha)\left(-\frac{r}{2}\right)(1-\cos\alpha) + 2\pi rh\rho\sin\alpha\left(r\cos\alpha+\frac{h}{2}\right)}{2\pi r\rho\left[r(1+\cos\alpha) + h\sin\alpha\right]} \quad 10$$

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$$\bar{x} = \frac{-r^2(1-\cos^2\alpha) + 2rh\sin\alpha\cos\alpha + h^2\sin\alpha}{2[r(1+\cos\alpha) + h\sin\alpha]}$$ 5

$$= \frac{\sin\alpha[-r^2\sin\alpha + 2rh\cos\alpha + h^2]}{2[r(1+\cos\alpha)+h\sin\alpha]}$$ 5

$$= \frac{\frac{8}{17}\left[-\frac{8r^2}{17} + \frac{30rh}{17} + h^2\right]}{2\left[r\left(1+\frac{15}{17}\right) + h\times\frac{8}{17}\right]}$$ 5

$$= \frac{8(17h^2 + 30rh - 8r^2)}{34(32r+8h)}$$ 5

$$\bar{x} = \frac{17h^2 + 30rh - 8r^2}{34(4r+h)}$$ 5

$\boxed{85}$

(c) உறுதிச்சமநிலை அடைய $\bar{x} < 0$ ஆக வேண்டும் 5

$$\frac{17h^2 + 30rh - 8r^2}{34(4r+h)} < 0$$ 5

$$17h^2 + 30rh - 8r^2 < 0$$

$$(17h - 4r)(h + 2r) < 0$$ 5

$$17h - 4r < 0 \quad , (h + 2r > 0)$$

$17h < 4r$ ஆகும் 5

$\boxed{20}$

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(a) பிரதம விருந்தினர் காரில் செல்தல் B_1 என்க
〃 வானில் 〃 B_2 என்க
〃 முச்சக்கரவண்டியில் B_3 என்க
〃 நிகழ்வு நேரத்திற்கு முன் வருதல் A என்க
〃 நிகழ்வு நேரத்திற்குப் பின் வருதல் B என்க.   5

$P(B_1) = 0.7$, $P(B_2) = 0.2$, $P(B_3) = 0.1$
$P(A/B_1) = 0.3$, $P(A/B_2) = 0.5$, $P(A/B_3) = 0.7$
$P(B/B_1) = 0.3$, $P(B/B_2) = 0.5$, $P(B/B_3) = 0.3$ 5

$P(A) = P(A/B_1) \cdot P(B_1) + P(A/B_2) \cdot P(B_2) + P(A/B_3) \cdot P(B_3)$ — 10
$= 0.3 \times 0.7 + 0.5 \times 0.2 + 0.7 \times 0.1$ — 5
$= 0.21 + 0.1 + 0.07$
$= 0.38$ — 5

$P(B) = P(B/B_1) \cdot P(B_1) + P(B/B_2) \cdot P(B_2) + P(B/B_3) \cdot P(B_3)$ — 10
$= 0.3 \times 0.7 + 0.5 \times 0.2 + 0.3 \times 0.1$ — 5
$= 0.21 + 0.1 + 0.03$
$= 0.34$ — 5

(i) $\dfrac{0.38}{0.38 + 0.34} = \dfrac{38}{72} = \dfrac{19}{36}$ — 5

(ii) $\dfrac{0.34}{0.38 + 0.34} = \dfrac{0.34}{0.72} = \dfrac{34}{72} = \dfrac{17}{38}$ — 5

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(b)

வகுப்பு	நடுப்பெறுமானம் x	மீடிறன் f	விலகல் u	u^2	fu	fu^2
10 - 20	15	1	-3	9	-3	9
20 - 30	25	2	-2	4	-4	8
30 - 40	35	4	-1	1	-4	4
40 - 50	$\boxed{45}$	5	0	0	0	0
50 - 60	55	4	1	1	4	4
60 - 70	65	3	2	4	6	12
70 - 80	75	1	3	9	3	9
		20			2	46

$$\bar{x} = A + \left(\frac{\Sigma fu}{\Sigma f}\right) c$$

$$= 45 + \frac{2}{20} \times 10$$

$$= 46$$

$$\delta x = c\sqrt{\frac{\Sigma fu^2}{\Sigma f} - \left(\frac{\Sigma fu}{\Sigma f}\right)^2}$$

$$= 10\sqrt{\frac{46}{20} - \left(\frac{2}{20}\right)^2}$$

$$= 10\sqrt{2.3 - 0.01}$$

$$= 10\sqrt{2.29}$$

$$= 15.133$$

$$= 15.1$$

$\boxed{60}$

$$y = ax + b$$

$$\bar{y} = a\bar{x} + b$$

$$S_y = a S_x$$

$$40a + b = 44 \quad \text{—— (1)}$$

$$25a + b = 32 \quad \text{—— (2)}$$

$$(1) - (2) \Rightarrow 15a = 12$$

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

$$b = 12$$

$$\bar{y} = a\bar{x} + b$$

$$= \frac{4}{5} \times 46 + 12$$

$$= 48.8$$

$$S_y = a \cdot S_x$$

$$= \frac{4}{5} \times 15.1$$

$$= 12.08$$

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$\boxed{30}$