

01) $f(n) = n^3 + 11n$

$n=1$ ஆக $f(1) = 12$

$\therefore n=1$ ஆக $f(n)$ ஆனது 6 இன்ஸ் வகுபடும். (5)

$n=p$ ஆக $f(n)$ ஆனது 6 இன்ஸ் வகுபடும் எனத் $p \in \mathbb{Z}^+$.

$p^3 + 11p = 6k$ (5)

$n=p+1$ ஆக $f(p+1) = (p+1)^3 + 11(p+1)$

$\Rightarrow = 6(k+2) + 3p$

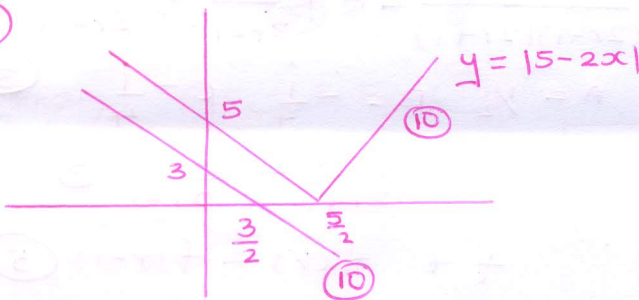
$(p+1)$ (5)

$= 6(k+2+k')$ (5)

ஆகவே (5)

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02)

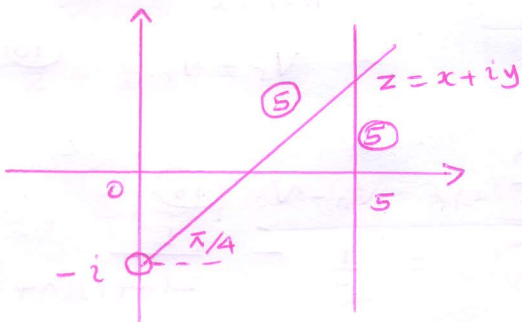


கீழ் x இன் எல்லாப் பெறுமானங்களிலும் 2-ன் மையாகும். (5)

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03) $z = x + iy$

$\Rightarrow x = 5$ (5)



$x = 5, y = 4$ (5)

$z = 5 + 4i$ (5)

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04) (5) $\frac{8!}{2!} = 20160$ (5)

(5) $7! = 5040$ (5)

720 (5)

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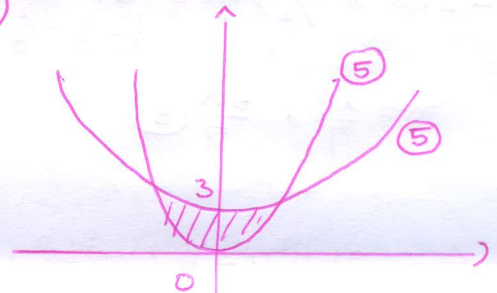
05) $\lim_{x \rightarrow 0} \frac{(1 - \cos x)(1 + \cos x + \cos^2 x)(\sqrt{x^2 + 9} + 3)}{x^2}$ (10)

$= \left(\lim_{x \rightarrow 0} \frac{\sin x}{x} \right)^2 \lim_{x \rightarrow 0} \frac{(1 + \cos x + \cos^2 x)(\sqrt{x^2 + 9} + 3)}{(1 + \cos x)}$ (10)

$= 1^2 \cdot \frac{3 \cdot 6}{2} = 9$ (5)

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06)



$A = \int_{-1}^1 (2x^2 + 3) dx - \int_{-1}^1 5x^2 dx$ (5)

$= 3 \left[x - \frac{x^3}{3} \right]_{-1}^1$ (5)

$= 4$ (5)

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07) $x^2 + xy + y^2 = k$ — (1)

$2x + x \frac{dy}{dx} + y + 2y \frac{dy}{dx} = 0$ (10)

$\frac{dy}{dx} = -\frac{(2x+y)}{x+y}$ (5)

$x = -2y$ (5)

$\Rightarrow 3y^2 = k$ (5)

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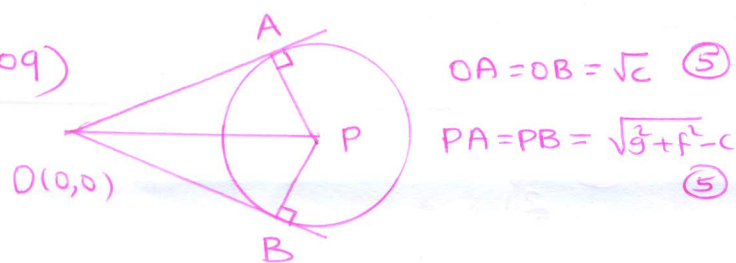
08) $2x + 3y - 5 + k(3x - 4y - 3) = 0$ (10)

$\Rightarrow k = -\frac{5}{3}$ (5)

$\therefore$ கூண்பாக $9x - 20y = 0$ (10)

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09)



$$OA = OB = \sqrt{c} \quad (5)$$

$$PA = PB = \sqrt{g^2 + f^2 - c} \quad (5)$$

$$\text{Area of } \triangle OAP = 2 \Delta OAP \quad (5)$$

$$= 2 \times \frac{1}{2} \times OA \times AP \quad (5)$$

$$= \sqrt{c} \sqrt{g^2 + f^2 - c} \quad (5) \quad [25]$$

$$10) 2 \cos \frac{5\pi}{2} \cos \frac{\pi}{2} = 2 \sin \pi \cos \frac{\pi}{2} \quad (5)$$

$$\cos \frac{\pi}{2} = 0 \quad \text{or} \quad \cos \frac{5\pi}{2} = \sin \pi \quad (5)$$

$$\cos \frac{\pi}{2} = \cos \frac{\pi}{2} \quad \text{or} \quad \cos \frac{5\pi}{2} = \cos \left(\frac{\pi}{2} - \pi \right) \quad (5)$$

$$\frac{\pi}{2} = 2n\pi \pm \frac{\pi}{2}, n \in \mathbb{Z} \quad \text{or} \quad \frac{5\pi}{2} = 2n\pi \pm \left(\frac{\pi}{2} - \pi \right) \quad (5)$$

$$n = \frac{\pi}{\pi}, \frac{5\pi}{\pi} \quad (5) \quad [25]$$

$$11) a) \Delta_1 = 36a^2b^2 - 4(2b^2 - a^2)2(a^2 + b^2) < 0 \quad (10)$$

$$\Rightarrow 4(2a^4 + 7a^2b^2 - 4b^4) < 0 \quad (5)$$

$$\Rightarrow 4(2a^2 - b^2)(a^2 + 4b^2) < 0 \quad (5)$$

$$\Rightarrow 2a^2 - b^2 < 0 \quad (5)$$

$$\Rightarrow \Delta_2 = 4(b^2 - 2a^2) > 0 \quad (10)$$

$$\Rightarrow \alpha^2 + 2b\alpha + 2a = 0 \quad \text{and}$$

பின்வரும் சமன்பாடுகளின் மூலம்
 $\alpha + \beta = -\frac{2b}{a} \quad (5)$

$$\alpha\beta = 2 \quad (5)$$

$$\alpha(\alpha+1) + \beta(\beta+1) = (\alpha+\beta)^2 - 2\alpha\beta + (\alpha+\beta) \quad (5)$$

$$= \frac{1}{a^2} (4b^2 - 2ab - 4a) \quad (5)$$

$$\alpha(\alpha+1)\beta(\beta+1) = \alpha\beta(\alpha\beta + \alpha + \beta + 1) \quad (5)$$

$$= \frac{2}{a} (3a - 2b) \quad (5)$$

2. சமன்பாடு

$$x^2 - \frac{1}{a^2} (4b^2 - 2ab - 4a)x + \frac{2}{a} (3a - 2b) = 0 \quad (5)$$

[35]

$$b) f(2) = 1 \Rightarrow 8a + 2b + c = 1 \quad (5)$$

$$f(-1) = 2 \Rightarrow -a - b + c = 2 \quad (5)$$

$$f(-3) = -4 \Rightarrow -27a - 3b + c = -4 \quad (5)$$

$$a = \frac{1}{3}, b = -\frac{4}{3}, c = 1 \quad (15)$$

$$f'(x) = 0 \Rightarrow x^3 - 4x + 3 = 0 \quad (5)$$

$$(x-1)(x^2 + x - 3) = 0 \quad (5)$$

$$x = 1 \quad \text{or} \quad x = \frac{-1 \pm \sqrt{13}}{2} \quad (5) \quad [65]$$

$$12) u_r = \frac{2r^2 - 1}{(2r-1)(2r+1)} \quad (5)$$

$$\frac{2r^2 - 1}{(2r-1)(2r+1)} = A + \frac{B}{2r-1} + \frac{C}{2r+1} \quad (15)$$

$$A = \frac{1}{2}, B = -\frac{1}{4}, C = \frac{1}{4} \quad (30)$$

$$u_r = \frac{1}{2} + \frac{1/4}{2r-1} - \frac{1/4}{2r+1} \quad (5) \quad [55]$$

$$\frac{1}{2} + f(r) - f(r-1) \quad (5)$$

$$\Rightarrow \sum_{r=1}^n u_r = \frac{1}{2}n + f(n) - f(0) \quad (15)$$

$$= \frac{1}{4} \left[2n-1 + \frac{1}{2n+1} \right] \quad (10)$$

[30]

$$\lim_{n \rightarrow \infty} = \infty \quad (5) \quad \text{ஒருங்கிணைந்த} \quad (5) \quad [10]$$

$$b) u_r = \frac{1}{n-r+2} \left[\frac{1}{n-r+1} - \frac{1}{n-r+3} \right] \quad (10)$$

$$= v_r - v_{r-1} \quad (10) \quad v_r = \frac{1}{2(n-r+1)(n-r+2)} \quad (5)$$

$$\sum_{r=1}^n u_r = v_n - v_0 \quad (15)$$

$$= \frac{1}{4} - \frac{1}{2(n+1)(n+2)} \quad (5)$$

$$\sum_{r=1}^n \frac{1}{r(r+1)(r+2)} = \frac{1}{4} - \frac{1}{2(2n+1)(2n+2)} \quad (10)$$

$$13) A^2 = \begin{pmatrix} 8 & 5 \\ -5 & 3 \end{pmatrix} \quad (5)$$

$$A^2 - 5A = \begin{pmatrix} -7 & 0 \\ 0 & -7 \end{pmatrix} \quad (10)$$

$$= -7I \quad (5)$$

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$$A^3 = A(5A - 7I) \quad (5)$$

$$= 5(5A - 7I) - 7A \quad (10)$$

$$35I = A(18I - A^2) \quad (10)$$

$$(18I - A^2)^{-1} = \frac{1}{35} A \quad (10)$$

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$$b) \left| \frac{z_1 - z_3}{z_2 - z_3} \right| = \sqrt{\left(\frac{1}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2} \quad (10)$$

$$\frac{|z_1 - z_3|}{|z_2 - z_3|} = 1 \quad (5)$$

$$P_1 P_2 = P_2 P_3 \quad (5)$$

$$\text{கிடைமுகம் } P_1 P_2 = P_2 P_3 \quad (15)$$

$$\therefore \text{ சமபக்க } \Delta \quad (5)$$

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$$c) z = x + iy$$

$$w = \frac{2(1-i)}{2} + \frac{10z(3-i)}{10} \quad (10)$$

$$= (1+3x+y) + i(3y-x-1) \quad (10)$$

$$\Rightarrow 3y = x \quad (10)$$

$$|z(3-i)| = 10 \quad (5)$$

$$x^2 + y^2 = 10 \quad (10)$$

$$\Rightarrow x = 3, -3 \quad (10)$$

$$z = \pm(3+i)$$

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$$14) a) f'(n) = \frac{(n^2-1)^2}{(n^2-1)^2} \quad (10)$$

$$f'(n) = 0 \Rightarrow n = \frac{1}{4}, 4 \quad (10)$$

$$n=1, n=-1 \quad 15. \text{ அ. ப. ச. த. } (5)$$

$$x < -1 \quad -1 < x < \frac{1}{4} \quad \frac{1}{4} < x < 1$$

$$+ \quad + \quad -$$

$$1 < n < 4$$

$$4 < n$$

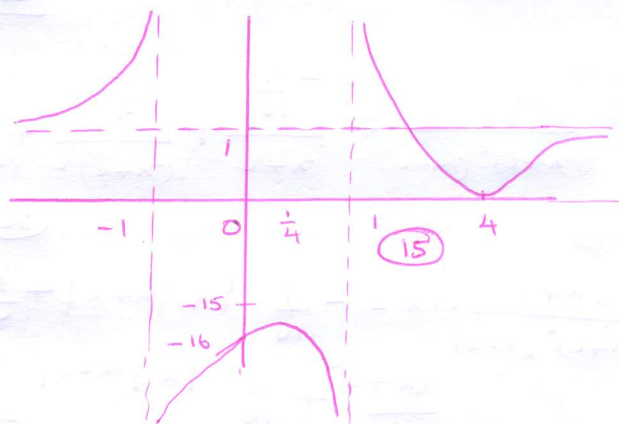
(25)

$$2.4 \left(\frac{1}{4}, -15\right) \quad (5)$$

$$8.4 (4, 0) \quad (5)$$

$$(0, -16), (4, 0) \quad (10)$$

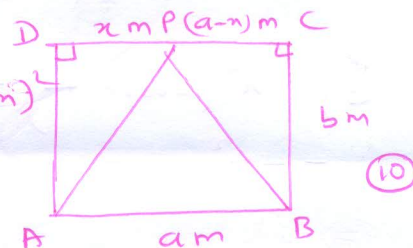
$$x \rightarrow \pm \infty \quad f(x) \rightarrow 1 \quad (5)$$



b)

$$y = (b^2 + n^2) + (a-n)^2 + b^2 \quad (10)$$

$$\frac{dy}{dn} = 4(n - \frac{a}{2}) \quad (15)$$



$$\frac{dy}{dn} = 0 \Rightarrow n = \frac{a}{2} \quad (10)$$

$$0 < n < \frac{a}{2} \quad \frac{a}{2} < n < a$$

(10)

$$n = \frac{a}{2} \text{ இ } y \text{ குறைவு } (5)$$

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$$15) a) \frac{dt}{de} = \frac{1+t^2}{2} \quad (5) \quad t: 0 \rightarrow 1 \quad (5)$$

$$I = \int_0^1 \frac{1}{4-t^2} dt \quad (10)$$

$$= \int_0^1 \left(\frac{1/4}{2-t} + \frac{1/4}{2+t} \right) dt \quad (5)$$

$$= \frac{1}{4} \ln \left| \frac{t+2}{t-2} \right|_0^1 \quad (10)$$

$$= \frac{1}{4} \ln 3 \quad (5)$$

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$$\frac{dp}{dw} = \frac{16}{(3+5 \cos w)^2} + \frac{3}{(3+5 \cos w)} \quad (20)$$

$$16 \int_0^{\frac{\pi}{2}} \frac{1}{(3+5 \cos w)^2} dw + 3 \int_0^{\frac{\pi}{2}} \frac{1}{3+5 \cos w} dw$$

$$= \left(\frac{5 \sin w}{3+5 \cos w} \right)_0^{\frac{\pi}{2}} \quad (5)$$

$$\int_0^{\frac{\pi}{2}} \frac{1}{(3+5 \cos w)^2} dw = \frac{5}{48} - \frac{7}{64} \ln 3 \quad (10)$$

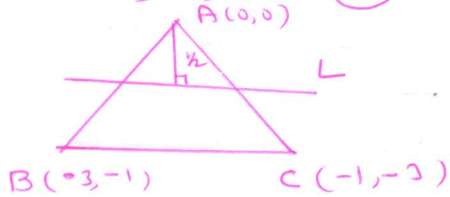
$$b) \frac{3n+1}{(n+2)^2(n-2)} = \frac{-\frac{7}{16}}{n+2} + \frac{\frac{5}{4}}{(n+2)^2} + \frac{\frac{7}{16}}{(n-2)} \quad (30)$$

$$\int \frac{3n+1}{(n+2)^2(n-2)} dn = -\frac{7}{16} \ln |n+2| + \frac{5}{4} \cdot \frac{(n+2)^{-1}}{-1} + \frac{7}{16} \ln |n-2| + k \quad (20)$$

$$c) x^2(-\cos n) - \int (-\cos n) 2n dn \quad (10)$$

$$= -x^2 \cos n + 2n \sin n + 2 \cos n + C \quad (15)$$

16) a) சிங்குத்தொலைவு (20)



$$L: x+y-c=0 \quad (15)$$

$$c = \pm \frac{1}{\sqrt{2}} \quad (10)$$

L 36 நாள் வரை (5)

$$c = -\frac{1}{\sqrt{2}} \quad (5)$$

$$L: x+y+\frac{1}{\sqrt{2}}=0 \quad (5)$$

b) திசை (30)

$$x^2+y^2-5x-6y-4+k(x^2+y^2-2x+1)=0 \quad (10)$$

$$\Rightarrow 5(1+k)x^2 + 5(2k-1)x + 5(2k-1)=0 \quad (15)$$

$$\Delta=0 \quad (10)$$

$$\Rightarrow k = \frac{1}{2} > -\frac{5}{2} \quad (10)$$

$$\text{சமன்பாடுகள்: } x^2+y^2-4x-4y+3=0 \quad (5)$$

$$x^2+y^2+4y-1=0 \quad (5)$$

$$17) a) \cos \alpha = \frac{9}{5} \quad (5)$$

$$\Rightarrow \tan\left(\frac{\pi}{4} + \frac{\alpha}{2}\right) + \tan\left(\frac{\pi}{4} - \frac{\alpha}{2}\right) \quad (5)$$

$$= \frac{1+\tan \frac{\alpha}{2}}{1-\tan \frac{\alpha}{2}} + \frac{1-\tan \frac{\alpha}{2}}{1+\tan \frac{\alpha}{2}} \quad (15)$$

$$= \frac{2}{\cos \alpha} \quad (10) = \frac{25}{9} \quad (5)$$

$$b) \sin 2A + \sin 2B + \sin 2C \quad (5)$$

$$= 2 \sin(A+B) \cos(A-B) + 2 \sin C \cos C \quad (5)$$

$$= 2 \sin C [\cos(A-B) - \cos(A+B)] \quad (10)$$

$$= 4 \sin A \sin B \sin C \quad (5)$$

$$\sin A = x, \sin B = y, \sin C = z \quad (5)$$

$$\sin 2A + \sin 2B + \sin 2C = 4 \sin A \sin B \sin C \quad (5)$$

$$\Rightarrow x\sqrt{1-y^2} + y\sqrt{1-x^2} + z\sqrt{1-z^2} = 2xyz \quad (5)$$

c) திசை (25)

$$(i) \frac{c-a}{c+a} = \frac{\sin C - \sin A}{\sin C + \sin A} \quad (5)$$

$$= \frac{\tan\left(\frac{C-A}{2}\right)}{\tan\left(\frac{C+A}{2}\right)} \quad (15)$$

$$(ii) \frac{\sin 3C}{b} = \frac{\sin C}{c} \quad (5)$$

$$3 - 4 \sin^2 C = \frac{b}{c} \quad (10)$$

$$\cos C = \sqrt{\frac{b+c}{4c}} \quad (5)$$

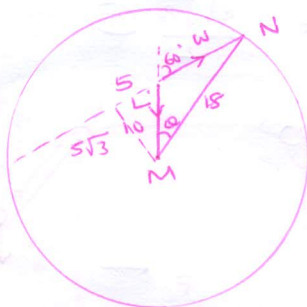
$$\sin \frac{A}{2} = \cos 2C \quad (5)$$

$$= 2\left(\frac{b+c}{4c}\right) - 1 \quad (5)$$

$$= \frac{b-c}{2c} \quad (5)$$

$$v = \sqrt{\frac{3ga}{2}} \quad (5)$$

02)



$$w = \sqrt{249} - 5$$

$$\sin \theta = \frac{\sqrt{3}w}{36} \quad (5)$$

$$T = \frac{12}{\sqrt{249 - 5}}$$

$$03) \quad t = \sqrt{\frac{2h}{g}} \quad (5)$$

$$v = \sqrt{2gh} \quad (5)$$

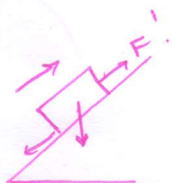
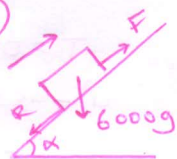
$$h_1 = e^2 h \quad (5)$$

$$S = h + 2(e^2 h + e^4 h + \dots) \quad (5)$$

$$= \left(\frac{1+e^2}{1-e^2} \right) h \quad (5)$$



(40)



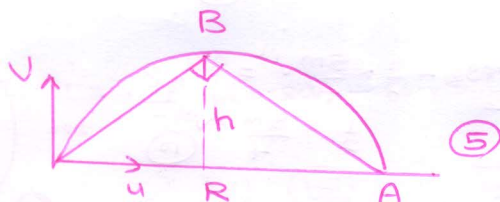
$$F = \frac{5P}{16} \quad (5) \quad F' = \frac{3P}{16} \quad (5)$$

$$F - R - 6000g \sin \alpha = 6000 \cdot 2 \quad (5)$$

$$F' - R - 6000g \sin \alpha = 0 \quad (5)$$

$$\Rightarrow P = 96 \text{ kW} \text{ (5)}$$

05)



$$h = \frac{v^2}{2g} \quad (5) \qquad R = \frac{2uv}{g} \quad (10)$$

$$\Rightarrow \frac{u}{v} = \frac{1}{2} \quad (5)$$

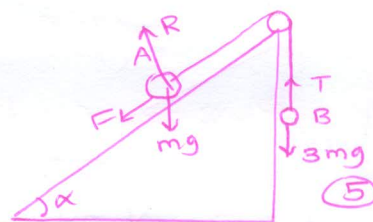
06) $(\underline{a} + \underline{b} + \underline{c}) \cdot (\underline{a} + \underline{b} + \underline{c}) = \underline{0}$ ⑤

$$a^2 + b^2 + c^2 + 2(\underline{a \cdot b} + \underline{b \cdot c} + \underline{c \cdot a}) = 0 \quad (10)$$

$$9^2 + 12^2 + 15^2 + 2(\underline{a} \cdot \underline{b} + \underline{b} \cdot \underline{c} + \underline{c} \cdot \underline{a}) = 0$$

$$\underline{a} \cdot \underline{b} + \underline{b} \cdot \underline{c} + \underline{c} \cdot \underline{a} = -225 \text{ (5)}$$

07)



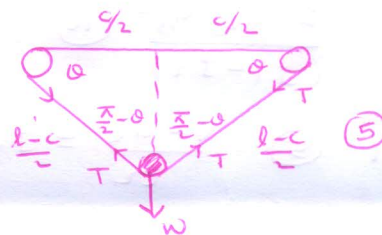
B// $T = 3mg$ (5)

$$A \parallel T = F + mg \sin \alpha \quad (5)$$

$$R = mg \cos \alpha \quad (5)$$

$$\mu = \frac{3 - \sin \alpha}{\cos \alpha} \quad (5)$$

08)



கிளையின் எதிர்ப்பு $\frac{w}{\sin 2\theta} = \frac{T}{\cos \theta}$ (5)

முதலாம் பிந்தான மறுதாக்கம் = $2\pi \cos \theta / L$ (5)
 $= W \left(\frac{l-c}{2(l-2c)} \right)^{\frac{1}{2}}$
 (10) 25

09) i) $P(A \cup B) = P(A) + P(B)$ (5)

$$p = \frac{1}{10} \quad (5)$$

$$ii) P(A \cap B) = 1 - \frac{1}{10} \quad (5)$$

$$P(A \cap B) = P(A) \cdot P(B) \quad (5)$$

$$p = \frac{1}{5} \quad (5)$$

10) $1 - P(DDD)$ (5)

$$= 1 - \frac{4}{10} \cdot \frac{3}{9} \cdot \frac{2}{8} \quad (10)$$

$$= \frac{29}{30} \text{ (10)}$$



$$k = \frac{6}{5} \quad (10)$$

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BO $> \frac{6}{5} a$ (5)

கிடு கிழைகளும் கிறுகதமாக
ஒருத்தம் ⑤

15



$$\frac{2mg \left(\frac{3a}{2} - x - ka \right)}{ka} - \frac{mg \left(\frac{3a}{2} + x - a \right)}{a}$$

$$\Rightarrow \ddot{x} = -\frac{8g}{3a}x \quad (15)$$

$$(iii) \quad 2\ddot{x} = -2\omega^2 x \quad (10)$$

$$\ddot{x} = -\omega^2 x \quad (5)$$

$$\omega = \sqrt{\frac{89}{39}} \quad (5)$$

$$x = 0.29, \dot{x} = 0 \quad (10) \quad A = 0.29 \quad (5)$$

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(iv) $v \cdot \pi^2 = \frac{89}{3a} \left((0.2a)^2 - (0.05a)^2 \right)$ 10

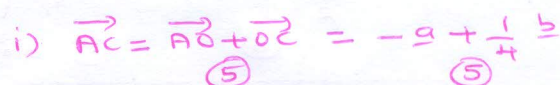
$$\Rightarrow a = \frac{1}{2} \quad (15)$$



$$= \sqrt{\frac{3a}{8g}} \cos^{-1} \left(\frac{1}{4} \right)$$

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15



$$\overrightarrow{AD} = \overrightarrow{AO} + \overrightarrow{OD} = \frac{4}{5} \left(-\frac{5}{5} + \frac{1}{5} \cdot 5 \right) = \frac{4}{5} \overrightarrow{AC}$$

A, C, D நேர்சொல் (5)

ii) $\overrightarrow{AP} = a(b-g)$ (5) $\overrightarrow{AQ} = \frac{1}{3}(b-g)$ (5)

$$\begin{aligned}\vec{PC} &= \vec{PA} + \vec{AC} \quad (5) \\ &= (\lambda - 1)\underline{a} + \left(\frac{1}{4} - \lambda\right)\underline{b} \quad (5)\end{aligned}$$

$$\begin{aligned}\vec{cg} &= \vec{co} + \vec{og} \quad (5) \\ &= -\frac{1}{3}\mathbf{i} + \left(\frac{1}{3} - \frac{1}{4}\right)\mathbf{j} \quad (5)\end{aligned}$$

P, C, G எந்தோட்டிநிதும் பின்

$$\frac{2-1}{-1/3} = \frac{1/4 - \lambda}{1/3 - 1/4} \Rightarrow \lambda + \mu = 1 \quad (10) \quad (5)$$

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$$Y = 4 \text{ (10)}$$

$$R = 2\sqrt{5} \text{ (5)}$$

30

$$\tan \alpha = \frac{y}{x} = 2 \quad (5)$$

① ↗ $4 \cdot x + 2 \cdot 12 = 5 \cdot 12 \Rightarrow x = 9$
 (10) (5)

பெரியவன் AB னை B க்குள்ளே 4 cm 5

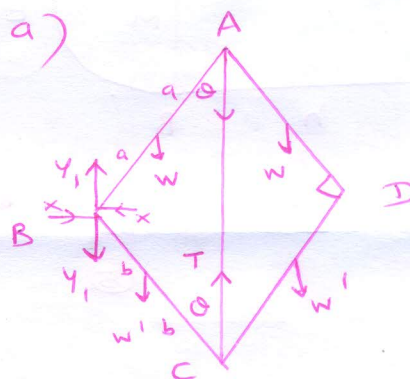
$$\text{Rat } E = \text{Rat } D + G \quad (5)$$

$$GJ = 4 \cdot 9 + 2 \cdot 12 \quad (10)$$

$$= 60 \text{ Ncm} \quad (5)$$

20

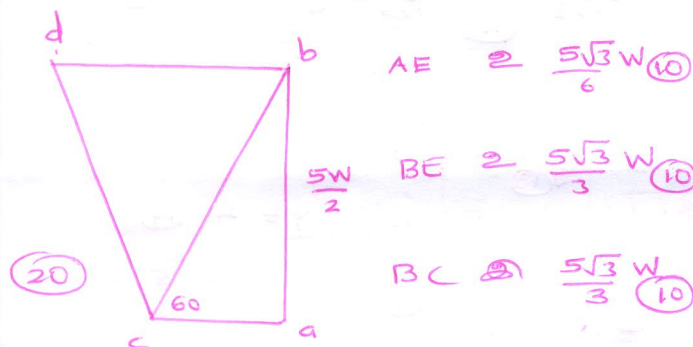
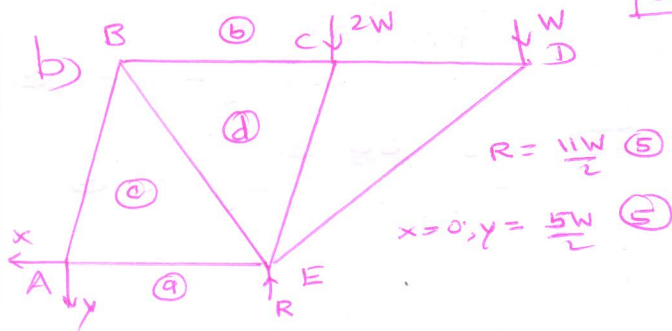
15) a)



10

A) AB, $y, 2a \sin \theta + x 2a \cos \theta = w a \sin \theta$ (15)
 C) $y, 2b \cos \theta - x 2b \sin \theta = -w^2 b \cos \theta$ (15)
 $x = \frac{(w+w')}{2} \sin \theta \cos \theta$ (5) $y = \frac{(w+w')}{2} \sin^2 \theta - \frac{w'}{2}$ (5)

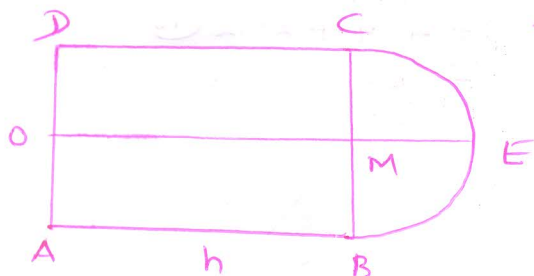
D) BCD, $T \cdot 2b \cos \theta = y, 4b \cos \theta + w' 3b \cos \theta + w' b \cos \theta$ (10)
 $\Rightarrow T = (w+w') \sin^2 \theta + w'$ (5)



4th தகவல் காணல் (25)

16) Theory

உத்தரவுகள்



கிடைத்தல் தகவல் OE வரவில்லை (5)

பொருள் தகவல் தகவல் M கிடைத்தல் (10)
 ABC) $h 2r g$ $-h/2$ (10)
 BEC $\pi (2r)^2 g$ $8\pi/3\pi$ (10)
 தகவல் $(4\pi r^2 + 2hr) g$ π (5)

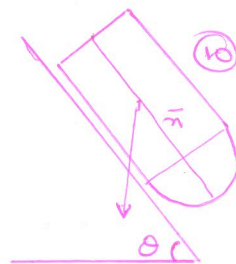
$(4\pi r^2 + 2hr) g \pi = \pi (2r)^2 g \cdot \frac{8r}{3\pi} +$

$h \cdot 2r g (-h/2)$ (10)

$\pi = \frac{32r^3 - 3h^2}{6(2\pi r + h)}$ (5)

$h = 2r$ க்கு

$\pi = \frac{32r^3 - 3(2r)^3}{6(2\pi r + 2r) 2r}$ (10)
 $= \frac{5r}{3(\pi + 1)}$ (5)



$\tan \theta < \frac{\pi}{2r}$ (10)

$= \frac{5}{6(\pi + 1)}$ (10)

$\theta_{max} = \tan^{-1} \left(\frac{5}{6(\pi + 1)} \right)$ (10)

17) தகவல் தகவல் தகவல்

$P(H) = \frac{1}{2}$ (5)

$P(T) = \frac{1}{2}$ (5)

$P(A|H) = \frac{6}{36} + \frac{5}{36}$ (10)
 $= \frac{11}{36}$ (5)

$P(A|T) = \frac{2}{11}$ (10)

$P(A) = P(H) \cdot P(A|H) + P(T) \cdot P(A|T)$ (20)

$= \frac{1}{2} \cdot \frac{11}{36} + \frac{1}{2} \cdot \frac{2}{11}$ (10)

$= \frac{193}{792}$ (10)

$P(H|A) = \frac{P(A|H) P(H)}{P(A)}$ (15)

$= \frac{\frac{11}{36} \cdot \frac{1}{2}}{\frac{193}{792}} = \frac{72}{193}$ (10)