தேசிய வெளிக்கள நிலையம் தொண்டைமானாறு
முதலாம் தவணைப் பரீட்சை - 2023
National Field Work Centre, Thondaimanaru.
1st Term Examination - 2023

Grade - 12 (2024) Combined Mathematics Marking Scheme

1. $\dfrac{3x^2}{(x-1)(x+2)} = A + \dfrac{B}{x-1} + \dfrac{C}{x+2}$ (5)

$3x^2 = A(x-1)(x+2) + B(x+2) + C(x-1)$ (5)

Comparing coefficients of powers of x:

$x^2 : 3 = A$

$x : 0 = A + B + C$ (5)

$x^0 : 0 = -2A + 2B - C$

$A = 3$, $B = 1$, $C = -4$ (5)

$\dfrac{3x^2}{(x-1)(x+2)} = 3 + \dfrac{1}{x-1} - \dfrac{4}{x+2}$ (5)

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2. $\dfrac{x+1}{x} < \dfrac{2}{x}$

$\dfrac{x+1}{x} - \dfrac{2}{x} < 0$

$\dfrac{x-1}{x} < 0$ (5)

	$x<0$	$0<x<1$	$x>1$
$x-1$	(−)	(−)	(+)
x	(−)	(+)	(+)
$\frac{x-1}{x}$	(+)	(−)	(+)

(5)

$0 < x < 1$ (5)

$\dfrac{x+1}{x} \geq \dfrac{2}{x}$

$\Leftrightarrow x < 0$ (5) or $x \geq 1$ (5)

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3. $f(x) = ax^4 + bx^3 + x^2 + 2$

$f(x) = (x^2-1)\phi(x) + x + 5$ (5)

$f(x) = (x-1)(x+1)\phi(x) + x + 5$

$f(1) = a + b + 1 + 2 = 0 + 1 + 5$ (5)

$\Rightarrow a + b = 3$ —— (1)

$f(-1) = a - b + 1 + 2 = 0 - 1 + 5$ (5)

$\Rightarrow a - b = 1$ —— (2)

(1), (2) $\Rightarrow a = 2,\ b = 1$ (5) (5)

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4. $\dfrac{\log_a bc}{1+\log_a bc} + \dfrac{\log_b ca}{1+\log_b ca} + \dfrac{\log_c ab}{1+\log_c ab}$

$= \dfrac{\log_a bc}{\log_a a + \log_a bc} + \dfrac{\log_b ca}{\log_b b + \log_b ca} + \dfrac{\log_c ab}{\log_c c + \log_c ab}$ (5)

$= \dfrac{\log_a bc}{\log_a abc} + \dfrac{\log_b ca}{\log_b abc} + \dfrac{\log_c ab}{\log_c abc}$ (5)

$= \log_{abc} bc + \log_{abc} ca + \log_{abc} ab$ (5)

$= \log_{abc}(abc)^2$ (5)

$= 2$ (5)

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5. $5^{2x+1} - 26\times 5^x + 5 = 0$

$5(5^x)^2 - 26\cdot 5^x + 5 = 0$ (5)

$5t^2 - 26t + 5 = 0$, where $t = 5^x$ (5)

$(5t-1)(t-5) = 0$ (5)

$t = \frac{1}{5}$ or $t = 5$ (5)

$5^x = 5^{-1}$ or $5^x = 5^1$

$x = -1$ or $x = 1$ (5)

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6. $\dfrac{1-\cos 2A}{1+\cos 2A}$

$= \dfrac{1-(1-2\sin^2 A)}{1+(2\cos^2 A - 1)}$ (5)

$= \dfrac{2\sin^2 A}{2\cos^2 A}$

$= \tan^2 A$ (5)

$\tan^2\frac{\pi}{12} = \dfrac{1-\cos\frac{\pi}{6}}{1+\cos\frac{\pi}{6}}$ (5)

$= \dfrac{1-\sqrt{3}/2}{1+\sqrt{3}/2}$ (5)

$= \dfrac{2-\sqrt{3}}{2+\sqrt{3}}$

$= \dfrac{(2-\sqrt{3})^2}{4-3}$

$\tan^2\frac{\pi}{12} = (2-\sqrt{3})^2$

$\tan\frac{\pi}{12} = 2-\sqrt{3}$ $[\because \tan\frac{\pi}{12} > 0]$ (5)

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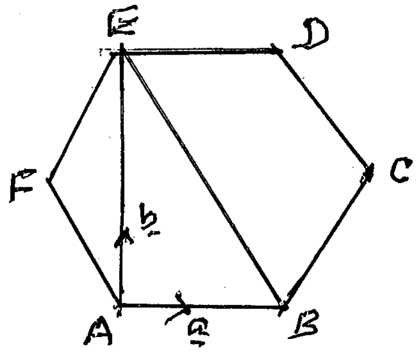
7.



$\overrightarrow{BE} = \overrightarrow{BA} + \overrightarrow{AE}$

$= -\underline{a} + \underline{b}$ (5)

$\overrightarrow{AD} = \underline{a} + \underline{b}$ (5)

$\overrightarrow{BC} = \frac{1}{2}\overrightarrow{AD} = \frac{1}{2}(\underline{a}+\underline{b})$ (5)

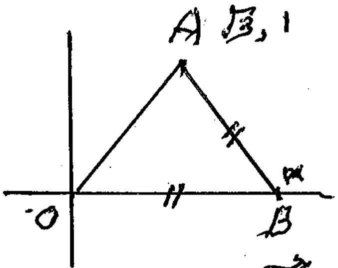
$\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$ (5)

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

$= \frac{3}{2}\underline{a} + \frac{1}{2}\underline{b}$

$= \frac{1}{2}(3\underline{a}+\underline{b})$ (5)

8.



$\overrightarrow{OA} = \sqrt{3}\underline{i} + \underline{j}$, $\overrightarrow{OB} = \alpha\underline{i}$

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$ (5)

$= -\sqrt{3}\underline{i} - \underline{j} + \alpha\underline{i}$

$= (\alpha - \sqrt{3})\underline{i} - \underline{j}$ (5)

$AB = OB$

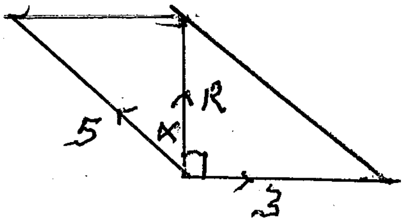
$|\overrightarrow{AB}|^2 = |\overrightarrow{OB}|^2$ (5)

$(\alpha-\sqrt{3})^2 + 1^2 = \alpha^2$ (5)

$-2\sqrt{3}\alpha + 4 = 0$

$\alpha = \frac{2}{\sqrt{3}}$ (5)

9.



$\theta = \frac{\pi}{2} + \sin^{-1}\frac{3}{5}$

$= \frac{\pi}{2} + \alpha$

$\sin\alpha = \frac{3}{5}$ (5)

$R^2 = 5^2 + 3^2 + 2\cdot5\cdot3\cos\left(\frac{\pi}{2}+\alpha\right)$ (5)

$= 25 + 9 - 30\sin\alpha$

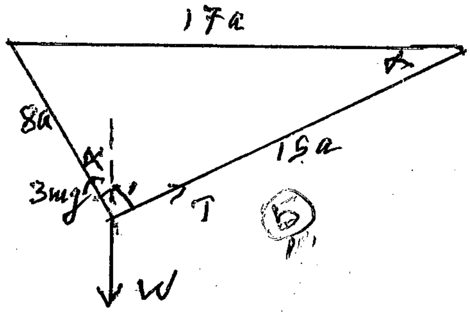
$= 34 - 30\cdot\frac{3}{5}$ (5)

$= 16$

$R = 4$ (5)

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

10.



(5)

Using Sine Rule

$\frac{T}{\sin(\pi-\alpha)} = \frac{W}{\sin\frac{\pi}{2}} = \frac{3mg}{\sin(90+\alpha)}$ (10)

$\frac{T}{\sin\alpha} = W = \frac{3mg}{\cos\alpha}$

$T = 3mg\tan\alpha = \frac{8}{5}mg$ (5)

$W = 3mg\,\frac{17}{15}$

$= \frac{17}{5}mg$ (5)

11.(a) $0<k<3$, $f(x) = (3-k)x^2 - kx + 1$

(i) Discriminant $\Delta = k^2 - 4(3-k)(1)$ (10)

$= k^2 + 4k - 12$ (5)

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

$\Delta \geq 0$ (5)

$\Leftrightarrow (k+6)(k-2) \geq 0$

$\Leftrightarrow k \leq -6$ or $k \geq 2$ (5)

since $0 < k < 3$

$\therefore 2 \leq k < 3$ (5)

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(ii) $\alpha + \beta = \frac{k}{3-k}$ (5)

$\alpha\beta = \frac{1}{3-k}$ (5)

Since α and β are real

$2 \leq k < 3$

$\alpha+\beta = \frac{k}{3-k} > 0$ [$\because 2 \leq k < 3$] (5)

$\alpha\beta = \frac{1}{3-k} > 0$ [$\because 2 \leq k < 3$] (5)

$\therefore$ α and β are both positive (5)

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$(\alpha+2) + (\beta+2)$

$= (\alpha+\beta) + 4$ (5)

$= \frac{k}{3-k} + 4$ (5)

$= \frac{3(4-k)}{3-k}$

$(\alpha+2)(\beta+2)$

$= \alpha\beta + 2(\alpha+\beta) + 4$ (5)

$= \frac{1}{3-k} + \frac{2k}{3-k} + 4$ (5)

$= \frac{13-2k}{3-k}$

The equation whose roots are

$\alpha+2$ and $\beta+2$ is $(x-(\alpha+2))(x-(\beta+2)) = 0$ (5)

$x^2 - [(\alpha+2)+(\beta+2)]x + (\alpha+2)(\beta+2) = 0$ (5)

$x^2 - \frac{3(4-k)}{3-k}x + \frac{13-2k}{3-k} = 0$

$(3-k)x^2 - 3(4-k)x + 13 - 2k = 0$ (5)

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(b) $x + \frac{1}{x} = t$

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

$x^2 + 2 + \frac{1}{x^2} = t^2$

$x^2 + \frac{1}{x^2} = t^2 - 2$ —— (1) (5)

$6x^4 + 5x^3 - 38x^2 + 5x + 6 = 0$

$6x^2 + 5x - 38 + \frac{5}{x} + \frac{6}{x^2} = 0$ (5)

$6(x^2 + \frac{1}{x^2}) + 5(x + \frac{1}{x}) - 38 = 0$ (5)

$6(t^2 - 2) + 5t - 38 = 0$ [$\because$ by (1)] (5)

$6t^2 + 5t - 50 = 0$ (5)

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$6t^2 + 5t - 50 = 0$

$(3t+10)(2t-5) = 0$

$t = -\frac{10}{3}$ or $t = \frac{5}{2}$ (5)

$t = -\frac{10}{3} \Rightarrow x + \frac{1}{x} = -\frac{10}{3}$

$\Rightarrow 3x^2 + 10x + 3 = 0$ (5)

$\Rightarrow (3x+1)(x+3) = 0$

$\Rightarrow x = -\frac{1}{3}$ or $x = -3$. (5)

$t = \frac{5}{2} \Rightarrow x + \frac{1}{x} = \frac{5}{2}$

$\Rightarrow 2x^2 - 5x + 2 = 0$ (5)

$\Rightarrow (2x-1)(x-2) = 0$

$\Rightarrow x = \frac{1}{2}$ or $x = 2$. (5)

25

12.(a) $f(x) = 2x^2 + 8x + 13$

$= 2(x^2 + 4x + \frac{13}{2})$ (5)

$= 2\{(x+2)^2 - 4 + \frac{13}{2}\}$

$= 2(x+2)^2 + 5$ (5)

$= a(x+b)^2 + c$,

where $a = 2$, $b = 2$, $c = 5$ (10)

Since $(x+2)^2 \geq 0$ (5)

$\therefore f(x) \geq 5$

$(f(x))_{min} = 5$ (5)

$\left(\frac{2}{1+f(x)}\right)_{max} = \frac{2}{1+(f(x))_{min}} = \frac{2}{1+5} = \frac{1}{3}$. (5)

(5)

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(b) $g(x) = 3x^3 + px^2 + qx + 7$

Since, when $g(x)$ is divided by $x+1$, the remainder is -9, we have $g(-1) = -9$ (5)

$-3 + p - q + 7 = -9$ (5)

$p - q = -13$ —— (1) (5)

Since, when $g(x)$ is divided by x^2-3x+2, the remainder is $2x+r$, we have

$$g(x) = (x^2-3x+2)\phi(x) + 2x + r \quad (10)$$

$$3x^3+px^2+qx+7 = (x-1)(x-2)\phi(x) + 2x + r \quad (5)$$

Substituting $x=1$, we have

$$3+p+q+7 = 2+r \quad (5)$$

$$p+q = r-8 \quad \text{—— (2)} \quad (5)$$

Substituting $x=2$, we have

$$24+4p+2q+7 = 4+r \quad (5)$$

$$4p+2q = r-27 \quad \text{—— (3)}$$

$$(3)-(2) \Rightarrow 3p+q = -19 \quad \text{—— (4)} \quad (5)$$

$$(1),(4) \Rightarrow p=-8,\ q=5 \quad (5)\ (5)$$

$$(2) \Rightarrow r=5 \quad (5)$$

$\boxed{65}$

$$g(x) = 3x^3-8x^2+5x+7$$

$$3x^3-8x^2+5x+7 \equiv (x^2+2)(Ax+B)+Cx+D \quad (5)$$

Comparing coefficients of powers of x:

$$\left.\begin{array}{ll} x^3: & 3 = A \\ x^2: & -8 = B \\ x: & 5 = 2A+C \\ x^0: & 7 = 2B+D \end{array}\right\} \begin{array}{l} A=3 \\ B=-8 \\ C=-1 \\ D=23 \end{array} \quad (10)$$

Quotient $= 3x-8$, (5) Remainder $= -x+23$ (5)

$\boxed{25}$

Aliter

$$\begin{array}{r|l} & \quad 3x-8 \\ \hline x^2+0x+2 & 3x^3-8x^2+5x+7 \\ & \underline{3x^3+0x^2+6x} \\ & \quad -8x^2-x+7 \\ & \quad \underline{-8x^2+0x-16} \\ & \qquad -x+23 \end{array} \quad (15)$$

Quotient $= 3x-8$, (5) Remainder $= -x+23$ (5)

$\boxed{25}$

$$g(x) = (x^2+2)(3x-8) - x + 23$$

$$g(-2x) = (4x^2+2)(-6x-8) - (-2x) + 23 \quad (5)$$

$$= (2x^2+1)(-12x-16) + 2x + 23 \quad (5)$$

Quotient $= -12x-16$, (5) Remainder $= 2x+23$ (5)

$\boxed{20}$

13.

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

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

$\boxed{10}$

(i) $\sin(A-B)$

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

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

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

$\cos(A-B)$

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

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

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

$\boxed{30}$

$$\sin 15^\circ = \sin(45^\circ-30^\circ) \quad (5)$$

$$= \sin 45^\circ\cos 30^\circ - \cos 45^\circ\sin 30^\circ \quad (5)$$

$$= \frac{1}{\sqrt{2}}\cdot\frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}}\cdot\frac{1}{2} \quad (5)$$

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

$$= \frac{\sqrt{6}-\sqrt{2}}{4} \quad (5)$$

$$\cos 15^\circ = \cos(45^\circ-30^\circ) \quad (5)$$

$$= \cos 45^\circ\cos 30^\circ + \sin 45^\circ\sin 30^\circ \quad (5)$$

$$= \frac{1}{\sqrt{2}}\cdot\frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}}\cdot\frac{1}{2} \quad (5)$$

$$= \frac{\sqrt{3}+1}{2\sqrt{2}}$$

$$= \frac{\sqrt{6}+\sqrt{2}}{4} \quad (5)$$

$\boxed{40}$

(ii) $\sin 2A = \sin(A+A)$ (5)

$$= \sin A\cos A + \cos A\sin A \quad (5)$$

$$= 2\sin A\cos A$$

$$\cos 2A = \cos(A+A) \quad (5)$$

$$= \cos A\cos A - \sin A\sin A \quad (5)$$

$$= \cos^2 A - \sin^2 A$$

$$= 1-\sin^2 A - \sin^2 A \quad (5)$$

$$= 1 - 2\sin^2 A$$

$\boxed{25}$

$\frac{1-\cos 2A}{\sin 2A}$

$= \frac{1-(1-2\sin^2 A)}{2\sin A\cos A}$ 5 5

$= \frac{2\sin^2 A}{2\sin A\cos A}$ 5

$= \tan A$

$\boxed{15}$

$\tan 7\frac{1}{2}^\circ = \frac{1-\cos 15^\circ}{\sin 15^\circ}$ 5

$= \frac{1-\frac{\sqrt{6}+\sqrt{2}}{4}}{\frac{\sqrt{6}-\sqrt{2}}{4}}$ 5

$= \frac{4-(\sqrt{6}+\sqrt{2})}{\sqrt{6}-\sqrt{2}}$

$= \frac{[4-(\sqrt{6}+\sqrt{2})][\sqrt{6}+\sqrt{2}]}{[\sqrt{6}-\sqrt{2}][\sqrt{6}+\sqrt{2}]}$ 5

$= \frac{4\sqrt{6}+4\sqrt{2}-(6+2\sqrt{6}\sqrt{2}+2)}{6-2}$ 5

$= \frac{4\sqrt{6}+4\sqrt{2}-8-4\sqrt{3}}{4}$ 5

$= \sqrt{6}-\sqrt{3}+\sqrt{2}-2.$ 5

$\boxed{30}$

14.(a) (i) $\cot^4\theta + \cot^2\theta$

$= \cot^2\theta(\cot^2\theta+1)$ 5

$= (\mathrm{cosec}^2\theta - 1)\,\mathrm{cosec}^2\theta$ 5

$= \mathrm{cosec}^4\theta - \mathrm{cosec}^2\theta$ 5

$\boxed{15}$

(ii) $\frac{\sec\theta}{\sec\theta - 1} + \frac{\sec\theta}{\sec\theta+1}$

$= \frac{\sec\theta(\sec\theta+1)+\sec\theta(\sec\theta-1)}{(\sec\theta-1)(\sec\theta+1)}$ 5

$= \frac{2\sec^2\theta}{\sec^2\theta - 1}$ 5

$= \frac{2\sec^2\theta}{\tan^2\theta}$ 5

$= \frac{\frac{2}{\cos^2\theta}}{\frac{\sin^2\theta}{\cos^2\theta}}$ 5

$= \frac{2}{\sin^2\theta}$ 5

$= 2\,\mathrm{cosec}^2\theta$ 5

$\boxed{30}$

(b) (i) $\sin x + \sin 7x = \sin 4x$

$2\sin 4x \cos 3x = \sin 4x$ 5

$\sin 4x(2\cos 3x - 1) = 0$ 5

$\sin 4x = 0$ or $\cos 3x = \frac{1}{2}$ 5

$\sin 4x = \sin 0$ or $\cos 3x = \cos\frac{\pi}{3}$ 5

$4x = n\pi;\ n\in\mathbb{Z}$ or $3x = 2m\pi \pm \frac{\pi}{3},\ m\in\mathbb{Z}$

$x = \frac{n\pi}{4};\ n\in\mathbb{Z}$ or $x = \frac{2m\pi}{3} \pm \frac{\pi}{9};\ m\in\mathbb{Z}$

5 5

$\boxed{30}$

(ii) $3\sin 8\alpha - 4\sin^3 8\alpha = \sin 3\alpha$

$\Rightarrow \sin 24\alpha = \sin 3\alpha$ —— (1) 5

$\cos 3\alpha \cos 6\alpha \cos 12\alpha$

$= \frac{1}{2\sin 3\alpha}\ 2\sin 3\alpha \cos 3\alpha \cos 6\alpha \cos 12\alpha$ 5

$= \frac{1}{2\sin 3\alpha}\ \sin 6\alpha \cos 6\alpha \cos 12\alpha$ 5

$= \frac{1}{4\sin 3\alpha}\ \sin 12\alpha \cos 12\alpha$ 5

$= \frac{1}{8\sin 3\alpha}\ \sin 24\alpha$ 5

$= \frac{1}{8}$ [$\because$ by (1)] 5

$\boxed{30}$

(iii) $\sin x = k\sin(A-x)$

$\Rightarrow k = \frac{\sin x}{\sin(A-x)}$

$\frac{k-1}{k+1} = \frac{\frac{\sin x}{\sin(A-x)} - 1}{\frac{\sin x}{\sin(A-x)} + 1}$ 5

$= \frac{\sin x - \sin(A-x)}{\sin x + \sin(A-x)}$

$= \frac{2\cos\frac{A}{2}\sin\left(x-\frac{A}{2}\right)}{2\sin\frac{A}{2}\cos\left(x-\frac{A}{2}\right)}$ 5 5

$= \frac{\tan\left(x-\frac{A}{2}\right)}{\tan\frac{A}{2}}$ 5

$\tan\left(x-\frac{A}{2}\right) = \frac{k-1}{k+1}\tan\frac{A}{2}$ 5

$\boxed{25}$

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

$\Rightarrow \tan\left(x-\frac{\pi}{3}\right) = \frac{1}{3}\tan\frac{\pi}{3}$ [$\because$ $k=2$ and $A = \frac{2\pi}{3}$]

5

$\Rightarrow \tan\left(x-\frac{\pi}{3}\right) = \frac{1}{3}\sqrt{3}$ 5

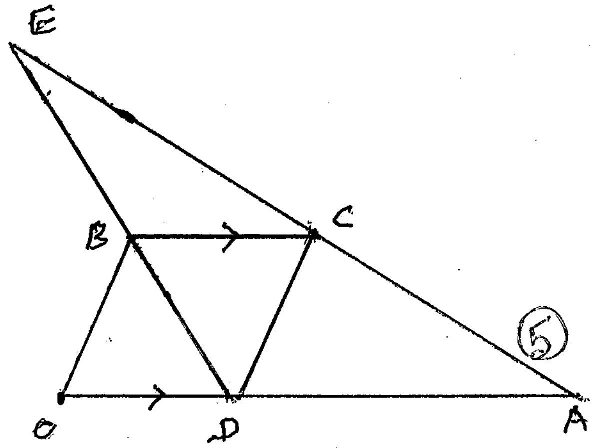
$\Rightarrow \tan\left(x-\frac{\pi}{3}\right) = \frac{1}{\sqrt{3}}$

$\Rightarrow x - \frac{\pi}{3} = \frac{\pi}{6}$ [$\because 0 < x < \pi$] 5

$\Rightarrow x = \frac{\pi}{2}$ 5

$\boxed{20}$

15 a) Theory [10]



(5)

I $\vec{OA} = 6\underline{i}$, $\vec{OB} = \underline{i}+\sqrt{3}\underline{j}$

$\vec{OD} = 2\underline{i}$

$\vec{BC} = 2\underline{i}$ (5)

$\vec{OC} = \vec{OB} + \vec{BC}$ (5)

$= \underline{i}+\sqrt{3}\underline{j} + 2\underline{i}$

$= 3\underline{i}+\sqrt{3}\underline{j}$ (5) 20

II $\vec{DB} = \vec{DO} + \vec{OB}$ (5)

$= -2\underline{i} + \underline{i}+\sqrt{3}\underline{j}$

$= -\underline{i}+\sqrt{3}\underline{j}$ (5)

$\vec{AC} = \vec{AO} + \vec{OC}$ (5)

$= -6\underline{i} + 3\underline{i}+\sqrt{3}\underline{j}$

$= -3\underline{i}+\sqrt{3}\underline{j}$ (5) 20

IV $\vec{DE} = \mu(-\underline{i}+\sqrt{3}\underline{j})$ (5)

$\vec{AE} = \lambda(-3\underline{i}+\sqrt{3}\underline{j})$ (5) 10

V $\vec{DE} = \vec{DA} + \vec{AE}$ (5)

$\mu(-\underline{i}+\sqrt{3}\underline{j}) = 4\underline{i} + \lambda(-3\underline{i}+\sqrt{3}\underline{j})$ (5)

$(3\lambda-\mu-4)\underline{i} + (\sqrt{3}\mu - \lambda\sqrt{3})\underline{j} = \underline{0}$

$3\lambda-\mu-4=0$ & $\sqrt{3}\mu-\lambda\sqrt{3}=0$ 10

$\lambda = 2$ (5) $\mu=\lambda$ (5)

DE = 2DB , AE = 2AC

AC : CE = 1 : 1 (5) , DB : BE = 1 : 1 (5)

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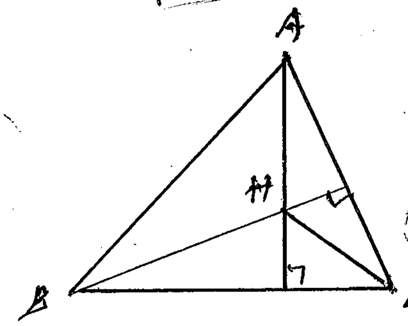
b) Def [10]



(5)

$\vec{HA} = \underline{a}$, $\vec{HB} = \underline{b}$, $\vec{HC} = \underline{c}$

HA ⊥ BC & HB ⊥ AC

$\vec{HA}\cdot\vec{BC} = 0$ (5)

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

$\underline{a}\cdot\underline{c} - \underline{a}\cdot\underline{b} = 0$ — (1) (5)

$\vec{HB}\cdot\vec{AC} = 0$

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

$\underline{b}\cdot\underline{c} - \underline{b}\cdot\underline{a} = 0$ (5) — (2)

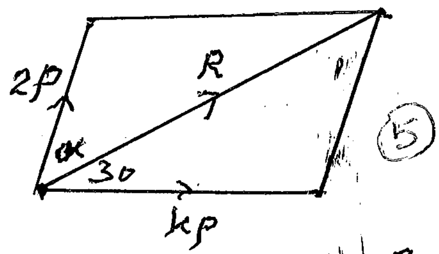
(1) + (2) ⇒ $\underline{a}\cdot\underline{c} - \underline{b}\cdot\underline{c} = 0$ (5)

$(\underline{a}-\underline{b})\cdot\underline{c} = 0$

$\vec{BA}\cdot\vec{HC} = 0$ (5) 40

BA ⊥ HC

16 (a) Theory [10]



(5)

$\frac{kP}{\sin\alpha} = \frac{2P}{\sin 30} = \frac{R}{\sin(\alpha+30)}$ 20

I $k=4$

$\frac{4P}{\sin\alpha} = \frac{4P}{1} = \frac{R}{\sin(\alpha+30)}$ (5)

$\sin\alpha = 1$ (5)

$\alpha = \frac{\pi}{2}$ (5) , $R = 2\sqrt{3}P$ (5) 25

II $k = 2\sqrt{3}$

$\frac{2\sqrt{3}P}{\sin\alpha} = 4P = \frac{R}{\sin(\alpha+30)}$ (5)

$\sin\alpha = \frac{\sqrt{3}}{2}$ (5)

$\alpha = \frac{\pi}{3}$ (5) , $R = 4P$ (5) 20

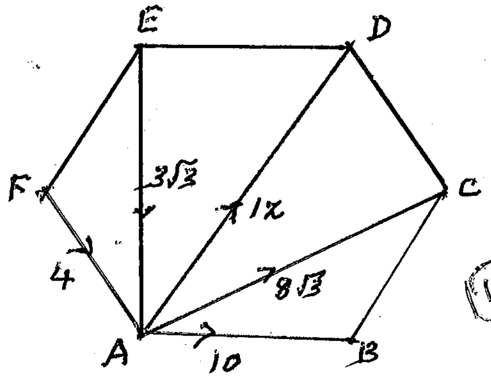
iii) $x = 6$

$$\frac{6P}{\sin\alpha} = 4P = \frac{R}{\sin(\alpha+30)} \quad (5)$$

$\sin\alpha = \frac{3}{2}$ its not possible. (5)

10

b)



10

$AB \rightarrow X = -10 + 8\sqrt{3}\cos 30 + 12\cos 60 + 4\cos 60$ (15)

$= -10 + 12 + 6 + 2$

$= 10$ (5)

$\uparrow AE \quad Y = -3\sqrt{3} + 12\cos 30 + 8\sqrt{3}\cos 60 - 4\cos 30$ (15)

$= -3\sqrt{3} + 6\sqrt{3} + 4\sqrt{3} - 2\sqrt{3}$

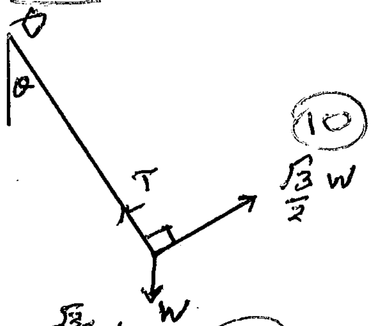
$= 5\sqrt{3}$ (5)

$R^2 = 10^2 + (5\sqrt{3})^2$ (5)

$R = 5\sqrt{7}$ (5) $\qquad \tan\theta = \frac{\sqrt{3}}{2}$ (5)

65

17 a) Theorem 10



10

$$\frac{W}{\sin 90} = \frac{T}{\sin(90+\theta)} = \frac{\frac{\sqrt{3}}{2}W}{\sin(\pi-\theta)} \quad (15)$$

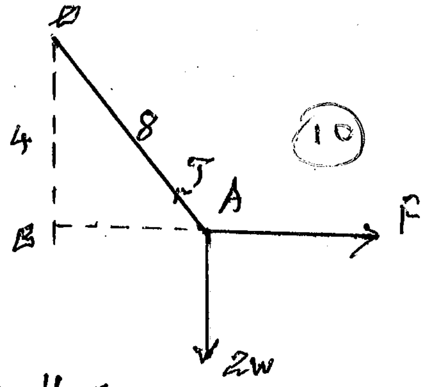
$W = \frac{T}{\cos\theta} = \frac{\sqrt{3}W}{2\sin\theta}$ (5)

$\sin\theta = \frac{\sqrt{3}}{2}$ (5) $\qquad T = \frac{W}{2}$ (5)

$\theta = 60^\circ$ (5)

45

b)



10

$F \parallel BA,\ 2W \parallel OB,\ T \parallel AO$

$\Rightarrow$ OAB Tr. of Force (15)

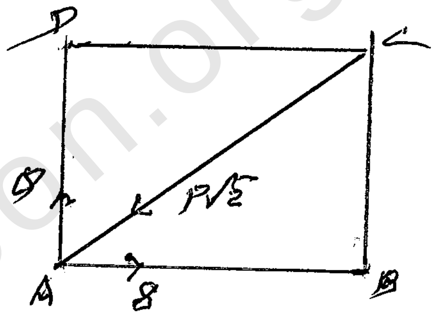
$$\frac{F}{BA} = \frac{2W}{OB} = \frac{T}{AO} \quad (10)$$

$$\frac{F}{4\sqrt{3}} = \frac{2W}{4} = \frac{T}{8}$$

$T = 4W$ (5), $\quad F = 2\sqrt{3}W$ (5)

45

c.



10

$\rightarrow \quad 8 - P\sqrt{2}\cos 45 = 0$ (15)

$P = 8$ (5)

$\uparrow \quad Q - P\sqrt{2}\sin 45 = 0$ (15)

$Q = P$

$= 8$ (5)

50