தொண்டைமானாறு வெளிக்கள நிலையம் நடாத்தும்
2ம் தவணைப் பரீட்சை
Field Work Centre, Thondaimanaru
2nd Term Examination

Grade - 12 (2022) **இணைந்த கணிதம்** Marking Scheme

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

$f(1) = 3$

$\Rightarrow a+b-3+4 = 3$ (5)

$\Rightarrow a+b = 2$ —— (1)

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

$f'(1) = 2$

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

$f'(x) = 3ax^2 + 2bx - 3$

$f'(1) = 3a + 2b - 3$

$2 = 3a + 2b - 3$ (5)

$3a + 2b = 5$ —— (2)

(1), (2) $\Rightarrow a = 1,\ b = 1$ (5) $\boxed{25}$

2. $\frac{2}{x} > 3 - \frac{1}{x^2}$

$3 - \frac{1}{x^2} - \frac{2}{x} < 0$ (5)

$\frac{3x^2 - 2x - 1}{x^2} < 0$

$\frac{(3x+1)(x-1)}{x^2} < 0$ (5)

$(3x+1)(x-1) < 0$ and $x \neq 0$

	$x < -\frac{1}{3}$	$-\frac{1}{3} < x < 1$	$x > 1$
$3x+1$	$(-)$	$(+)$	$(+)$
$x-1$	$(-)$	$(-)$	$(+)$
$(3x+1)(x-1)$	$(+)$	$(-)$	$(+)$

(10)

$-\frac{1}{3} < x < 1$ and $x \neq 0$ (5)

$-\frac{1}{3} < x < 0$ or $0 < x < 1$ $\boxed{25}$

3. $\frac{1}{x+x^3} = \frac{1}{x(x^2+1)} = \frac{A}{x} + \frac{Bx+C}{x^2+1}$ (5)

$1 \equiv A(x^2+1) + (Bx+C)x$

x^2// $0 = A + B$

x// $0 = C$

x^0// $1 = A + C$

$A = 1,\ B = -1,\ C = 0$ (5)

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

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

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

$= \frac{1}{x} + \frac{3}{x} - \frac{3x}{x^2+1}$

$= \frac{4}{x} - \frac{3x}{x^2+1}$ (5) $\boxed{25}$

4. $\log_3 x - 4\log_{3x} 3 = 2$

$\log_3 x - 4\frac{1}{\log_3 3x} = 2$ (5)

$\log_3 x - \frac{4}{\log_3 3 + \log_3 x} = 2$

$\log_3 x - \frac{4}{1 + \log_3 x} = 2$ (5)

$t - \frac{4}{1+t} = 2$ இங்கே $t = \log_3 x$

$t^2 + t - 4 = 2 + 2t$

$\Rightarrow t^2 - t - 6 = 0$

$\Rightarrow (t-3)(t+2) = 0$

$\Rightarrow t = 3$ or $t = -2$ (5)

$\Rightarrow \log_3 x = 3$ or $\log_3 x = -2$

$\Rightarrow x = 3^3 = 27$ (5) or $x = 3^{-2} = \frac{1}{9}$ (5)

$\boxed{25}$

5. $\lim_{x \to 0} \frac{\sin^2 3x}{\sqrt{1+x^2} - 1}$

$= \lim_{x \to 0} \frac{\sin^2 3x \, (\sqrt{1+x^2} + 1)}{1+x^2-1}$ (5)

$= \lim_{x \to 0} \frac{\sin^2 3x}{x^2} \cdot (\sqrt{1+x^2} + 1)$ (5)

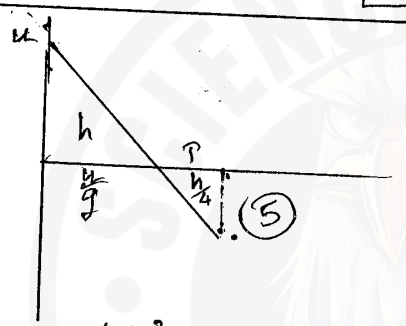
$= 9\left(\lim_{3x \to 0} \frac{\sin 3x}{3x}\right)^2 \cdot \lim_{x \to 0} (\sqrt{1+x^2}+1)$ (5) (5)

$= 9 \times 1^2 \times 2$

$= 18.$ (5)

$\boxed{25}$

6



(5)

$\frac{h}{\frac{h}{4}} = \frac{\left(\frac{u}{g}\right)^2}{T^2}$ (10)

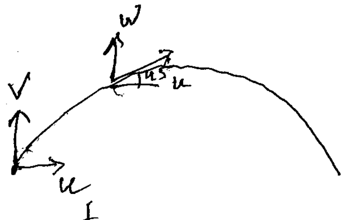
$4T^2 = \left(\frac{u}{g}\right)^2$

$T = \frac{u}{2g}$ (5)

Total Time $= \frac{u}{g} + \frac{u}{2g} = \frac{3u}{2g}$ (5)

$\boxed{25}$

(7)



$\uparrow$ $v = u + at$

$w = V - 2g$ (5)

$\frac{w}{u} = \tan 45$ (5)

$w = u$

$u = V - 2g$

$\frac{V}{u} = \tan\frac{\pi}{3} = \sqrt{3}$ (5)

$V = \sqrt{3}u$

$u = (\sqrt{3}+1)g$ (5)

$V = \sqrt{3}g(\sqrt{3}+1)$ (5)

$\boxed{25}$

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

$\underline{a} \cdot \underline{b} + \underline{a} \cdot \underline{c} = \underline{b} \cdot \underline{a} - \underline{b} \cdot \underline{c}$ (10)

$\underline{a} \cdot \underline{c} + \underline{b} \cdot \underline{c} = 0$

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

$\Rightarrow (\underline{a} + \underline{b}) \perp \underline{c}$ (5)

(9) $R = 2P\cos\frac{\theta}{2}$ (10)

$\uparrow$ $R = \sqrt{3 \cdot P \cdot P}$

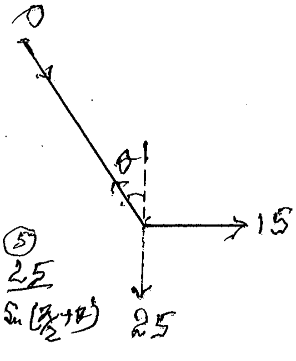
$= \sqrt{3}P$ (5)

$\therefore 2P\cos\frac{\theta}{2} = \sqrt{3}P$

$\cos\frac{\theta}{2} = \frac{\sqrt{3}}{2} = \cos\frac{\pi}{6}$ (5)

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

(10)



$\frac{T}{\sin\frac{\pi}{2}} = \frac{15}{\sin(\pi-\theta)} = \frac{25}{\sin(\frac{\pi}{2}+\theta)}$ (5) (5) (5)

$T = \frac{15}{\sin\theta} = \frac{25}{\cos\theta}$

$\tan\theta = \frac{3}{5}$ (5)

$T = 5\sqrt{34}$ (5)

11] a) $x^2 - px + q = 0 \quad (q \neq 0)$

$\left.\begin{array}{l}\alpha+\beta = p \\ \alpha\beta = q\end{array}\right\}$ (5)

$\alpha^3+\beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$ (5)

$= p^3 - 3qp$ (5)

$\alpha^3\beta^3 = (\alpha\beta)^3 = q^3$ (5)

The equation whose roots are α^3, β^3 is

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

$x^2 - (p^3-3pq)x + q^3 = 0$ (5) —— (*)

$\boxed{30}$

$xy = q^3+1$

$x = \dfrac{q^3+1}{y}$ (5) —— (**)

(*), (**) ⇒

$\left(\dfrac{q^3+1}{y}\right)^2 - (p^3-3pq)\left(\dfrac{q^3+1}{y}\right) + q^3 = 0$ (5)

$q^3y^2 - p(p^2-3q)(q^3+1)y + (q^3+1)^2 = 0$ (5) —— (***)

$y = \dfrac{q^3+1}{x} = \dfrac{\alpha^3\beta^3+1}{x}$ (5)

$x=\alpha^3 \Rightarrow y = \dfrac{\alpha^3\beta^3+1}{\alpha^3}$
$= \beta^3 + \dfrac{1}{\alpha^3}$ (5)

$x=\beta^3 \Rightarrow y = \dfrac{\alpha^3\beta^3+1}{\beta^3}$
$= \alpha^3 + \dfrac{1}{\beta^3}$

∴ The roots of (***) are

$\left(\alpha^3+\dfrac{1}{\beta^3}\right), \left(\beta^3+\dfrac{1}{\alpha^3}\right)$ (5)

$\boxed{30}$

b] $3x^2 - 2(a+b)x + ab = 0$

$\Delta = \{-2(a+b)\}^2 - 4(3)(ab)$ (10)

$= 4\{(a+b)^2 - 3ab\}$

$= 4\{a^2 - ab + b^2\}$ (5)

$= 4\left\{\left(a-\dfrac{b}{2}\right)^2 + \dfrac{3b^2}{4}\right\}$ (10)

≥ 0

∴ roots are real (5) $\boxed{30}$

c] $g(x) = x^3 + ax^2 + bx + 1$

$g(2) = 3g(1)$ (5)

$8+4a+2b+1 = 3\{1+a+b+1\}$ (5)

$b - a = 3$ (5) —— (1)

$g(x) = (x-1)(x-2)\phi(x) + kx + 5$ (10)

$g(1) = k+5$ (5)

$1+a+b+1 = k+5$

$a+b = k+3$ (5) —— (2)

$g(2) = 2k+5$ (5)

$8+4a+2b+1 = 2k+5$

$2a+b = k-2$ (5) —— (3)

(2) − (3) ⇒ $-a = 5$

$a = -5$ (5)

$b = -2$ (5)

$k = -10$ (5)

$\boxed{60}$

12] a) Let $f(x) = \sin x$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} \quad (5)$$

$$= \lim_{h \to 0} \frac{\sin(x+h) - \sin x}{h} \quad (5)$$

$$= \lim_{h \to 0} \frac{2\cos(x+\frac{h}{2})\sin\frac{h}{2}}{h} \quad (10)$$

$$= \lim_{\frac{h}{2} \to 0} \frac{\sin\frac{h}{2}}{\frac{h}{2}} \quad (5) \quad \lim_{h \to 0} \cos(x+\tfrac{h}{2})$$

$$= 1 \times \cos x \quad (5)$$

$$= \cos x$$

$\boxed{30}$

b) (i) $y = \dfrac{x^2 - x + 1}{x^2 + x + 1}$

$$\frac{dy}{dx} = \frac{(x^2+x+1)(2x-1) - (x^2-x+1)(2x+1)}{(x^2+x+1)^2} \quad (10)$$

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

$$= \frac{4x^2 - (2x^2+2)}{(x^2+x+1)^2}$$

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

(ii) $y = \dfrac{1 - e^x}{1 + e^x}$

$$\frac{dy}{dx} = \frac{(1+e^x)(-e^x) - (1-e^x)e^x}{(1+e^x)^2} \quad (10)$$

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

$\boxed{35}$

c) $y = x^2 \cos x$ —— (*)

$$\frac{dy}{dx} = x^2(-\sin x) + \cos x \cdot 2x \quad (10) \text{ —— (1)}$$

$$\frac{d^2y}{dx^2} = -\{x^2\cos x + \sin x \cdot 2x\} + 2\{x(-\sin x) + \cos x\} \quad (20)$$

$$= -x^2\cos x - 4x\sin x + 2\cos x \quad (5) \text{ —— (2)}$$

$(2) \times x^2 - (1) \times 4x \Rightarrow$

$$x^2\frac{d^2y}{dx^2} - 4x\frac{dy}{dx} = -x^4\cos x - 4x^3\sin x + 2x^2\cos x + 4x^3\sin x - 8x^2\cos x$$

$$= -x^4\cos x - 6x^2\cos x \quad (5)$$

$$= -x^2\cos x\{x^2+6\} \quad (5)$$

$$= -y(x^2+6) \quad (\text{by } *)$$

$$\Rightarrow x^2\frac{d^2y}{dx^2} - 4x\frac{dy}{dx} + (x^2+6)y = 0 \quad (5)$$

$\boxed{50}$

d) $x = e^t$ $\qquad y = \tan t$

$$\frac{dx}{dt} = e^t = x \quad (5) \qquad \frac{dy}{dt} = \sec^2 t \quad (5)$$

$$= 1 + \tan^2 t$$

$$= 1 + y^2 \quad (5)$$

$$\frac{dy}{dx} = \frac{dy}{dt} \cdot \frac{dt}{dx} = \frac{1+y^2}{x} \quad (5)$$

$$x\frac{dy}{dx} = 1 + y^2 \quad (5)$$

$$x\frac{d^2y}{dx^2} + \frac{dy}{dx} \cdot 1 = 0 + 2y\frac{dy}{dx} \quad (5)$$

$$x\frac{d^2y}{dx^2} + (1-2y)\frac{dy}{dx} = 0 \quad (5)$$

$\boxed{35}$

13. (a)

(i) $\dfrac{\sin A+\sin 2A}{1+\cos A+\cos 2A}$

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

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

$=\tan A$ (5) $\boxed{20}$

(ii) $\tan\left(\frac{\pi}{4}+\frac{A}{2}\right)+\tan\left(\frac{\pi}{4}-\frac{A}{2}\right)$

$=\dfrac{1+\tan\frac{A}{2}}{1-\tan\frac{A}{2}}+\dfrac{1-\tan A/2}{1+\tan A/2}$ (10)

$=\dfrac{(1+\tan A/2)^2+(1-\tan A/2)^2}{1-\tan^2 A/2}$ (5)

$=\dfrac{2(1+\tan^2 A/2)}{1-\tan^2 A/2}$ (5)

$=2\sec A$ (5) $\boxed{25}$

(iii) $\cos^2\frac{\pi}{16}+\cos^2\frac{3\pi}{16}+\cos^2\frac{5\pi}{16}+\cos^2\frac{7\pi}{16}$

$=\frac{1}{2}\left(1+\cos\frac{\pi}{8}\right)+\frac{1}{2}\left(1+\cos\frac{3\pi}{8}\right)+\frac{1}{2}\left(1+\cos\frac{5\pi}{8}\right)+\frac{1}{2}\left(1+\cos\frac{7\pi}{8}\right)$ (10)

$=\frac{1}{2}\left\{4+\cos\frac{\pi}{8}+\cos\frac{3\pi}{8}+\cos\left(\pi-\frac{3\pi}{8}\right)+\cos\left(\pi-\frac{\pi}{8}\right)\right\}$ (5)

$=\frac{1}{2}\left\{4+\cos\frac{\pi}{8}+\cos\frac{3\pi}{8}-\cos\frac{3\pi}{8}-\cos\frac{\pi}{8}\right\}$ (5)

$=\frac{1}{2}(4)$ (5)

$=2$ $\boxed{25}$

(b) (i) Let $\theta=\tan^{-1}2$

Then $\tan\theta=2$

$\sin(2\tan^{-1}2)+\cos(2\tan^{-1}2)$ (5)

$=\sin 2\theta+\cos 2\theta$

$=\dfrac{2\tan\theta}{1+\tan^2\theta}+\dfrac{1-\tan^2\theta}{1+\tan^2\theta}$ (5) (5)

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

$=\dfrac{1}{5}$ (5) $\boxed{25}$

(ii) $2\tan^{-1}(\sin x)=\tan^{-1}(2\sec x)$

Let $\alpha=\tan^{-1}(\sin x)$ and $\beta=\tan^{-1}(2\sec x)$

Then $\tan\alpha=\sin x$ and $\tan\beta=2\sec x$ (5)

$2\alpha=\beta$

$\tan 2\alpha=\tan\beta$

$\dfrac{2\tan\alpha}{1-\tan^2\alpha}=\tan\beta$ (5)

$\dfrac{2\sin x}{1-\sin^2 x}=2\sec x$ (5)

$\cancel{2}\sin x=\cancel{2}\sec x\cos^2 x$ (5)

$\sin x=\cos x$

$\tan x=1=\tan\frac{\pi}{4}$ (5)

$x=n\pi+\frac{\pi}{4}$; $n\in\mathbb{Z}$ (5) $\boxed{30}$

(c) $\alpha=\cos^{-1}x,\ \beta=\cos^{-1}y,\ \gamma=\cos^{-1}z$

$\alpha+\beta+\gamma=\pi$

$\alpha+\beta=\pi-\gamma$

$\cos(\alpha+\beta)=\cos(\pi-\gamma)$

$\cos\alpha\cos\beta-\sin\alpha\sin\beta=-\cos\gamma$ (5)

$xy-\sqrt{1-x^2}\sqrt{1-y^2}=-z$ (10)

$(xy+z)^2=(1-x^2)(1-y^2)$

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

$\Rightarrow x^2+y^2+z^2+2xyz=1$ (5) $\boxed{25}$

14.

$\dfrac{\sin A}{a}=\dfrac{\sin B}{b}=\dfrac{\sin C}{c}$ (5) $\boxed{5}$

proof: $\boxed{20}$

3

(i)

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = k$$

$(b+c)\sin\frac{A}{2}$

$= (k\sin B + k\sin C)\sin\frac{A}{2}$ (5)

$= k \cdot 2\sin\left(\frac{B+C}{2}\right)\cos\left(\frac{B-C}{2}\right)\sin\frac{A}{2}$ (5)

$= k \cdot 2\cos A/2 \cos\left(\frac{B-C}{2}\right)\sin\frac{A}{2}$ (5)

$= \cos\left(\frac{B-C}{2}\right) \cdot k\sin A$ (5)

$= \cos\left(\frac{B-C}{2}\right) a$ (5)

$= a\cos\left(\frac{B-C}{2}\right)$

$\boxed{25}$

(ii) $(b^2-c^2)\cot A$

$= (k^2\sin^2 B - k^2\sin^2 C)\frac{\cos A}{\sin A}$ (5)

$= k^2\left[\frac{1}{2}(1-\cos 2B) - \frac{1}{2}(1-\cos 2C)\right] \cdot \frac{\cos A}{\sin A}$ (10)

$= k^2 \frac{1}{2}(\cos 2C - \cos 2B)\frac{\cos A}{\sin A}$

$= \frac{k^2}{2} 2\sin(C+B)\sin(B-C)\frac{\cos A}{\sin A}$ (5)

$= k^2 \frac{\cancel{\sin(A)}\sin(B-C)\cos(\pi-(B+C))}{\cancel{\sin A}}$ (5)

$= -k^2 \cos(B+C)\sin(B-C)$ (5)

$= -\frac{k^2}{2}\left[\sin 2B - \sin 2C\right]$ (5)

$= \frac{k^2}{2}\left[\sin 2C - \sin 2B\right]$ — (1)

similarly

(5) $(c^2-a^2)\cot B = \frac{k^2}{2}\left[\sin 2A - \sin 2C\right]$ — (2)

(5) $(a^2-b^2)\cot C = \frac{k^2}{2}\left[\sin 2B - \sin 2A\right]$ — (3)

(1) + (2) + (3) $\Rightarrow$

$(b^2-c^2)\cot A + (c^2-a^2)\cot B + (a^2-b^2)\cot C = 0$ (5)

$\boxed{50}$

$\cos A = \frac{b^2+c^2-a^2}{2bc}$ (5)

$\frac{\cos A}{a} + \frac{\cos B}{b} + \frac{\cos C}{c}$

$= \frac{b^2+c^2-a^2}{2bca} + \frac{c^2+a^2-b^2}{2cab} + \frac{a^2+b^2-c^2}{2abc}$ (10)

$= \frac{a^2+b^2+c^2}{2abc}$ (5)

$\boxed{20}$

$\frac{\cos A}{a} + \frac{\cos B}{b} + \frac{\cos C}{c} = k\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)$

$\frac{a^2+b^2+c^2}{\cancel{2abc}} = k\left(\frac{bc+ca+ab}{\cancel{abc}}\right)$ — (1) (5)

$(a-b)^2 + (b-c)^2 + (c-a)^2 \geq 0$ (5)

$a^2 - 2ab + b^2 + c^2 - 2bc + c^2 + c^2 - 2ca + a^2 \geq 0$

$\Rightarrow a^2+b^2+c^2 \geq ab+bc+ca$ (5) — (2)

(1), (2) $\Rightarrow$

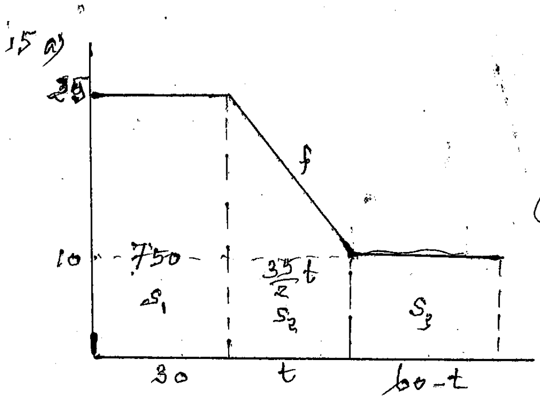
$2k(ab+bc+ca) \geq ab+bc+ca$ (5)

$\Rightarrow k \geq \frac{1}{2}$ (5)

$k_{min} = \frac{1}{2}$ (5)

$\boxed{30}$

15 a)



$S_1 = 25 \times 30 = 750$ (5)

$S_2 = \frac{1}{2}(25+10)\cdot t = \frac{35}{2}t$ (5)

$S_3 = 10(60-t)$ (5)

$S_1 + S_2 + S_3 = 1410$

$750 + \frac{35}{2}t + 10(60-t) = 1410$ (10)

I $t = 8$ (5)

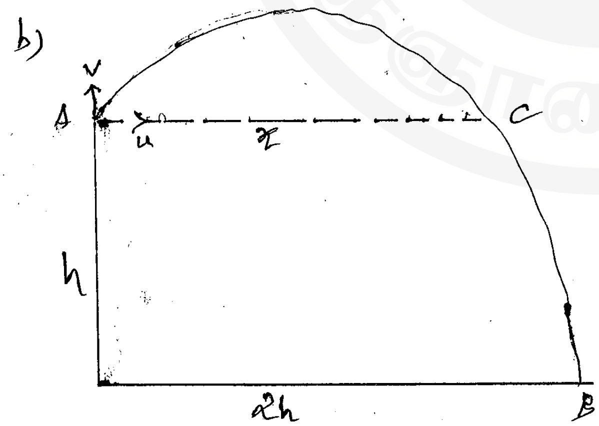
II $f = \frac{25-10}{t} = \frac{15}{8}\ ms^{-2}$ (10)

III $S_2 = \frac{35}{2}t$
$= 140$ (5)

IV $S_3 = 10(60-t)$
$= 520$ (5)

$\boxed{80}$

b)



$\frac{v}{u} = \frac{3}{4}$ (5)

A → B $s = ut + \frac{1}{2}at^2$

$2h = ut$ —— (1) (10)

↑ $-h = vt - \frac{1}{2}gt^2$ (10)

$-h = v\cdot\frac{2h}{u} - \frac{1}{2}g\cdot\frac{4h^2}{u^2}$

$-1 = 2\frac{v}{u} - 2g\frac{h}{u^2}$

$-1 = 2\cdot\frac{3}{4} - \frac{2gh}{u^2}$

$u = \sqrt{\frac{2gh}{5}}$ (10)

$v = \frac{3}{4}\sqrt{\frac{2gh}{5}}$ (10)

II A → C $s = ut + \frac{1}{2}gt^2$

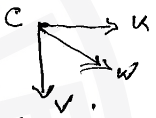
↑ $0 = vt - \frac{1}{2}gt^2$ (10)

$t = \frac{2v}{g}$

→ $x = u\cdot\frac{2v}{g}$ (10)

$= \frac{3}{5}h$

III



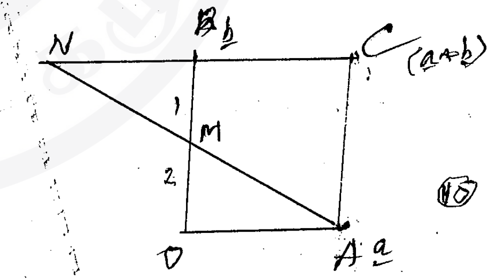
$w^2 = u^2 + v^2$

$w = \frac{5}{4}\sqrt{\frac{2gh}{5}}$

$= \frac{\sqrt{10gh}}{4}$ (5)

$\boxed{70}$

(16)



(10)

$\vec{AM} = \vec{AO} + \vec{OM}$

$= -\underline{a} + \frac{2}{3}\underline{b}$ (10)

$\vec{CB} = -\underline{a}$

$\vec{CN} = \lambda(-\underline{a})$ (10)

$\vec{AN} = \mu(-\underline{a} + \frac{2}{3}\underline{b})$ (10)

$\vec{AN} = \vec{AC} + \vec{CN}$

$\mu(-\underline{a} + \frac{2}{3}\underline{b}) = \underline{b} + \lambda(-\underline{a})$ (10)

4

$(\lambda-\mu)\underline{a}+\left(\frac{2}{3}\mu-1\right)\underline{b}=\underline{0}$

$\lambda-\mu=0$ & $\frac{2}{3}\mu-1=0$

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

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

$AM:MN=2:1$ (10) $\boxed{70}$

b) $25(P^2+Q^2)=P^2+Q^2+2PQ\cos\theta$ (10)

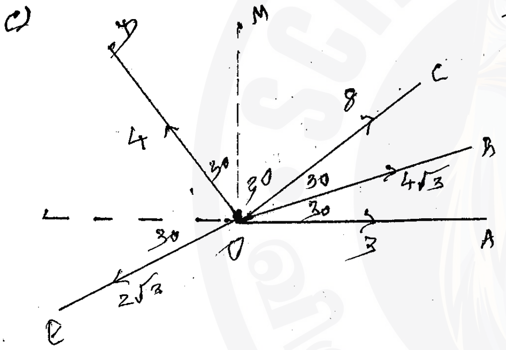
$9(P^2+Q^2)=P^2+Q^2+2PQ\sin\theta$ (10)

$2PQ\sin\theta=8(P^2+Q^2)$

$2PQ\cos\theta=24(P^2+Q^2)$

$\tan\theta=\frac{1}{3}$ (10) $\boxed{30}$

c)



(10)

$\overset{OA}{\rightarrow}$ $x=3+4\sqrt{3}\cos30+8\cos60-4\cos60-2\sqrt{3}\cos30$

$=8$ (10)

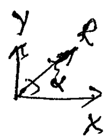
$OM\uparrow$ $y=4\sqrt{3}\sin30+8\cos30+4\cos30-2\sqrt{3}\sin30$

$=7\sqrt{3}$ (10)

$R^2=x^2+y^2$

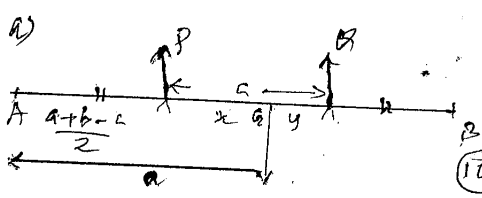
$R=\sqrt{211}$ (10)

$\tan\alpha=\frac{7\sqrt{3}}{8}$ (10)



$\boxed{50}$

17) a)



(10)

$x=a-\frac{a+b-c}{2}=\frac{a-b+c}{2}$ (10)

$y=b-\frac{a+b-c}{2}=\frac{b-a+c}{2}$ (10)

G↻ $Px-Qy=0$ (10)

$Px=Qy$

$P+Q=W$ (10)

$Px=(W-P)y$

$P(x+y)=Wy$

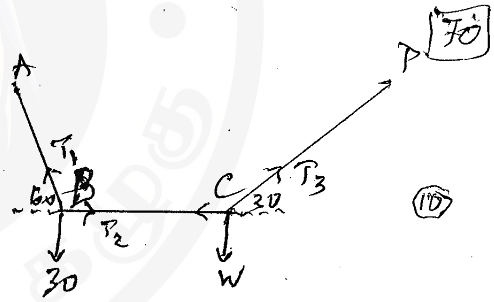
$P=\frac{Wy}{x+y}$ (5)

$=\frac{W}{2c}(b+c-a)$ (5)

$Q=\frac{W}{2c}(c+a-b)$ (10)

$\boxed{70}$

b)



(10)

$\frac{T_1}{\sin90}=\frac{T_2}{\sin(90+60)}=\frac{30}{\sin(180-60)}$ (30)

$=\frac{T_2}{\cos60}=\frac{30}{\sin60}$

$T_2=30\cot60$

$=10\sqrt{3}$ (10)

$\frac{T_2}{\sin(90+30)}=\frac{W}{\sin(\pi-30)}$ (20)

$\frac{T_2}{\cos30}=\frac{W}{\sin30}$ $\boxed{80}$

$W=10\sqrt{3}\tan30$

$=10$ (10)