PRACTICE PAPER 01 FOR G.C.E A/L STUDENTS – 2024

CONDUCTED BY TAMIL STUDENTS OF FACULTY OF ENGINEERING
UNIVERSITRY OF MORATUWA

10 – COMBINED MATHEMATICS

ANSWERS (MARKING SCHEME)

Pure Mathematics

Part A

1. $\tan 6\theta = \tan(4\theta + 2\theta)$

$= \dfrac{\tan 4\theta + \tan 2\theta}{1 - \tan 4\theta . \tan 2\theta}$ $\boxed{5}$

$= \dfrac{\frac{2\tan 2\theta}{1-\tan^2 2\theta} + \tan 2\theta}{1 - \frac{2\tan 2\theta}{1-\tan^2 2\theta}\tan 2\theta}$ $\boxed{5}$

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

$= \dfrac{3\tan 2\theta - \tan^3 2\theta}{1 - 3\tan^2 2\theta}$ $\boxed{5}$

$= \dfrac{3p - p^3}{1 - 3p^2}$

$6\theta = \frac{3\pi}{4} \Rightarrow \theta = \frac{\pi}{8}$

$\tan\left(6.\frac{\pi}{8}\right) = \dfrac{3.\tan \pi/4 \quad - \tan^3 \pi/4}{1 - 3\tan^2 \pi/4}$ $\boxed{5}$

$\tan\left(\frac{3\pi}{4}\right) = \frac{3-1}{1-3}$

$= -1$ $\boxed{5}$

2. $\cos\theta(2\sin\theta - \tan^2\theta . \operatorname{cosec}\theta) = \sec^2\theta . \cos 2\theta$

$\cos\theta\left(2\sin\theta - \frac{\sin^2\theta}{\cos^2\theta} \times \frac{1}{\sin\theta}\right) = \frac{1}{\cos^2\theta}(\cos^2\theta - \sin^2\theta)$ $\boxed{5}$

$\cos\theta\left(2\sin\theta - \frac{\sin\theta}{\cos^2\theta}\right) = 1 - \frac{\sin^2\theta}{\cos^2\theta}$

$2\sin\theta . \cos^3\theta - \sin\theta . \cos\theta = \cos^2\theta - \sin^2\theta$

$\sin\theta . \cos\theta\,(2\cos^2\theta - 1) = \cos^2\theta - \sin^2\theta \quad \cos 2\theta\,(\sin\theta . \cos\theta - 1) = 0$ $\boxed{5}$

$\sin 2\theta \neq 2$, so $\cos 2\theta = 0$

$\cos 2\theta = \cos\frac{\pi}{2}$ $\boxed{5}$

$2\theta = 2n\pi \pm \frac{\pi}{2}$; $n \in Z^+$ $\boxed{5}$

$\theta = n\pi \pm \frac{\pi}{4}$, $\theta = \frac{\pi}{4}, \frac{3\pi}{4}$ $\boxed{5}$

3. $\dfrac{1 - \cos[\sin^{-1}(\tan x)]}{\tan^2 x} = \dfrac{1}{1 + \sqrt{1 - \tan x}}$

assume that, $\sin^{-1}(\tan x) = \alpha, \left(0 < \alpha \leq \frac{\pi}{2}, \ 0 < \sin\alpha \leq 1\right)$

$\sin\alpha = \tan x$

$\cos^2\alpha = 1 - \sin^2\alpha$

$\cos\alpha = \sqrt{1 - \tan^2 x}, \quad (\cos\alpha > 0)$ $\boxed{5}$

$\text{L.H.S} = \dfrac{1 - \cos\alpha}{\tan^2 x}$

$= \dfrac{1 - \sqrt{1 - \tan^2 x}}{\tan^2 x}$

$= \dfrac{(1 - \sqrt{1 - \tan^2 x})(1 + \sqrt{1 - \tan^2 x})}{\tan^2 x.(1 + \sqrt{1 - \tan^2 x})}$ $\boxed{5}$

$= \dfrac{1 - (1 - \tan^2 x)}{\tan^2 x.(1 + \sqrt{1 - \tan^2 x})}$

$$= \frac{\tan^2 x}{\tan^2 x.\left(1+\sqrt{1-\tan^2 x}\right)}$$

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

$$\frac{1-\cos\left[\sin^{-1}(\tan x)\right]}{\tan^2 x} = 1$$

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

$\tan x \rightarrow \sin 2y$ $\boxed{5}$

$$\frac{1}{1+\sqrt{1-\sin^2 2y}} = 1$$

$$\frac{1}{1+\cos 2y} = 1$$

$$\frac{1}{2\cos^2 y} = 1$$ $\boxed{5}$

$\cos^2 y = \frac{1}{2}, \quad \cos y = \pm\frac{1}{\sqrt{2}}$

but, $0 < y \leq \frac{\pi}{4}$ because, $(0 < \sin 2y \leq 1,)$

$\cos y = \frac{1}{\sqrt{2}}, \quad \sin y = \frac{1}{\sqrt{2}}$

$\tan x = 2\sin y \cos y$

$= 2 \times \frac{1}{\sqrt{2}} \times \frac{1}{\sqrt{2}} = 1$ $\boxed{5}$

4. $\frac{\cot\theta - 1 + \operatorname{cosec}\theta}{\cot\theta + 1 - \operatorname{cosec}\theta} = \frac{1}{\operatorname{cosec}\theta - \cot\theta}$

$\text{L.H.S} = \frac{\cot\theta - 1 + \operatorname{cosec}\theta}{\cot\theta + 1 - \operatorname{cosec}\theta} \times \frac{(\cot\theta - \operatorname{cosec}\theta)}{(\cot\theta - \operatorname{cosec}\theta)}$ $\boxed{10}$

$= \frac{\cot^2 x - \operatorname{cosec}^2 x - (\cot\theta - \operatorname{cosec}\theta)}{(\cot\theta + 1 - \operatorname{cosec}\theta)(\cot\theta - \operatorname{cosec}\theta)}$ $\boxed{5}$

$= \frac{-1 - (\cot\theta - \operatorname{cosec}\theta)}{(\cot\theta + 1 - \operatorname{cosec}\theta)(\cot\theta - \operatorname{cosec}\theta)}$ $\boxed{5}$

$= \frac{-(\cot\theta + 1 - \operatorname{cosec}\theta)}{(\cot\theta + 1 - \operatorname{cosec}\theta)(\cot\theta - \operatorname{cosec}\theta)}$

$= \frac{1}{\operatorname{cosec}\theta - \cot\theta}$ $\boxed{5}$

5. $\cos^{-1}\left(\frac{y^2-1}{y^2+1}\right) + \sin^{-1}\left(\frac{-2y}{1+y^2}\right) - \tan^{-1}\left(\frac{2y}{1-y^2}\right) = \frac{\pi}{13}$ $\boxed{5}$

assume that, $y \rightarrow \tan\theta$

$\cos^{-1}\left(\frac{\tan^2\theta - 1}{\tan^2\theta + 1}\right) + \sin^{-1}\left(\frac{-2\tan\theta}{1+\tan^2\theta}\right) - \tan^{-1}\left(\frac{2\tan\theta}{1-\tan^2\theta}\right) = \frac{\pi}{13}$

$\cos^{-1}(-\cos 2\theta) + \sin^{-1}(-\sin 2\theta) - \tan^{-1}(\tan 2\theta) = \frac{\pi}{13}$ $\boxed{10}$

$\pi - 2\theta - 2\theta - 2\theta = \frac{\pi}{13}$

$6\theta = \frac{12}{13}\pi$ $\boxed{5}$

$\theta = \frac{2}{13}\pi$

$y = \tan\left(\frac{2}{13}\pi\right)$ $\boxed{5}$

6. $a = b.\text{Cos } C + c.\text{Cos } B$

$b.\text{Cos } C = a - c.\text{Cos } B$

$\text{Cos } C = \frac{a}{b} - \frac{c}{b}\text{Cos } B$ 5

$= \alpha - \beta \text{ Cos } B$

$\alpha + \beta = 2$

$\frac{a}{b} + \frac{c}{b} = 2$ 5

$a + c = 2b$

So it lies in an arithmetic progression.

Here, $\alpha = \frac{a}{b}$ and $\beta = \frac{c}{b}$

$\beta - \alpha = \frac{4}{5}$

$\frac{c-a}{b} = \frac{4}{5}$ 5

$c - a = 4$

Common difference = 2

$a = 3,\ b = 5,\ c = 7$

$\text{Cos } C = \frac{3}{5} - \frac{7}{5} \times \frac{11}{14}$ 5

$= \frac{6-11}{10}$

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

$C = \frac{2\pi}{3},\ 0 < C < \pi$ 5

So it is an Obtuse angled Triangle.

7. $\frac{(n+2)\pi}{3} = \alpha$

$(n+2)\pi = 3\alpha \longrightarrow$ (i) 5

(i) $\rightarrow (n+2)\pi + \alpha = 3\alpha + \alpha$

$\tan 4\alpha = \tan \alpha$

and, $3\alpha - \alpha = (n+2)\pi - \alpha$ 5

$\tan 2\alpha = -\tan \alpha$

So, $\tan 4\alpha = -\tan 2\alpha$

$\tan 4\alpha + \tan 2\alpha = 0$

$\frac{2\tan 2\alpha}{1-\tan^2 2\alpha} = -\tan 2\alpha$ 5

assume that, $\tan 2\alpha \rightarrow t$

$\frac{2t}{1-t^2} = -t$

$t^3 - t = 2t$ 5

$t(t^2 - 3) = 0$

$\alpha > 0$, $\tan 2\alpha > 0 \longrightarrow t > 0$

So, $t^2 = 3$

$t = \pm\sqrt{3}$,

$t = \sqrt{3} = \tan 2\alpha$ 5

$2\alpha = \frac{\pi}{3} \longrightarrow \alpha = \frac{\pi}{6}$

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Part B

8. (a) $\sin(A+B) = \sin A\cos B + \sin B\cos A$ $\boxed{5}$

$A \longrightarrow A\ ,\ B \longrightarrow (-B)$

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

$= \sin A\cos B - \cos A\sin B$

$A = \frac{\pi}{3}, B = \frac{\pi}{4}$ $\boxed{5}$

$\sin\left(\frac{\pi}{3} - \frac{\pi}{4}\right) = \sin\frac{\pi}{3}\cos\frac{\pi}{4} - \cos\frac{\pi}{3}\sin\frac{\pi}{4}$

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

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

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

$A \longrightarrow \frac{\pi}{2}\ ,\ B \longrightarrow A$

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

$= \cos A$

$\text{L.H.S} = \sin(A+B)\sin(A-B)$

$= (\sin A\cos B + \sin B\cos A) \times (\sin A\cos B - \sin B\cos A)$ $\boxed{5}$

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

$= \sin^2 A\,(1 - \sin^2 B) - \sin^2 B\,(1 - \sin^2 A)$ $\boxed{5}$

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

$= \text{R.H.S}$

$\text{L.H.S} = \cos 10^\circ . \cos 30^\circ . \cos 50^\circ . \cos 70^\circ$ $\boxed{5}$

$= \sin 80^\circ . \sin 60^\circ . \sin 40^\circ . \sin 20^\circ$

$= \frac{\sqrt{3}}{2}\sin 20^\circ\,[\sin(60^\circ + 20^\circ)\sin(60^\circ - 20^\circ)]$

$= \frac{\sqrt{3}}{2}\sin 20^\circ\,(\sin^2 60^\circ - \sin^2 20^\circ)$ $\boxed{5}$

$= \frac{\sqrt{3}}{2} \times \sin 20^\circ\left(\frac{3}{4} - \sin^2 20^\circ\right)$

$= \frac{\sqrt{3}}{2} \times \frac{(3\sin 20^\circ - 4\sin^3 20^\circ)}{4}$ $\boxed{5}$

$= \frac{\sqrt{3}}{8}\sin 60^\circ$ $\boxed{5}$

$= \frac{\sqrt{3}}{8} \times \frac{\sqrt{3}}{2}$

$= \frac{3}{16}$

$= \text{R.H.S}$

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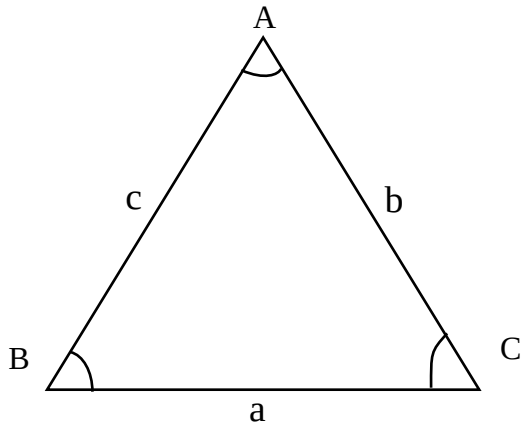
(b)

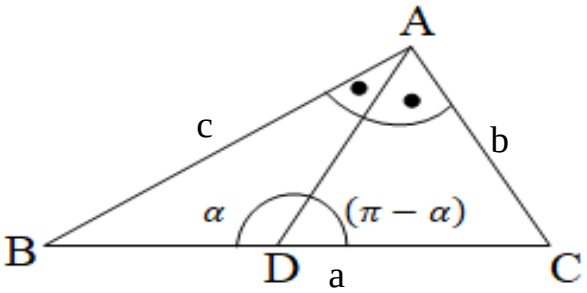


Sine rule:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$ 5

Cosine rule:

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



Δ ABD Sine rule:

$$\frac{BD}{\sin\left(\frac{A}{2}\right)} = \frac{c}{\sin\alpha} \longrightarrow (1)$$ 5

Δ ADC Sine rule:

$$\frac{DC}{\sin\left(\frac{A}{2}\right)} = \frac{b}{\sin(\pi-\alpha)}$$

$$\frac{DC}{\sin\left(\frac{A}{2}\right)} = \frac{b}{\sin\alpha} \longrightarrow (2)$$ 5

$$(1) + (2) \longrightarrow \frac{BD+DC}{\sin\left(\frac{A}{2}\right)} = \frac{c+b}{\sin\alpha}$$ 5

$(BD + DC = BC = a)$

$$\frac{a}{b+c} = \frac{\sin\left(\frac{A}{2}\right)}{\sin\alpha}$$ 5

$$\frac{a}{b+c} = \frac{BD}{c}$$

$$BD = \frac{ca}{b+c}$$

Δ ABC Sine rule:

$$\frac{a}{\sin A} = \frac{b}{\sin B} \longrightarrow (3)$$ 5

Δ ABD Sine rule:

$$\frac{AD}{\sin B} = \frac{BD}{\sin\left(\frac{A}{2}\right)} \longrightarrow (4)$$ 5

$(3),(4) \rightarrow \dfrac{a}{\sin A} = \dfrac{b}{AD\sin\left(\frac{A}{2}\right)} \times BD$

$AD \cdot \dfrac{a}{2\sin\left(\frac{A}{2}\right)\cos\left(\frac{A}{2}\right)} = \dfrac{b}{\sin\left(\frac{A}{2}\right)} \cdot \dfrac{ca}{b+c}$ 5

$AD = \dfrac{2bc\cos\left(\frac{A}{2}\right)}{b+c}$

<u>Δ ABC cosine rule:</u>

$\cos A = \dfrac{b^2+c^2-a^2}{2bc}$

$\cos B = \dfrac{a^2+c^2-b^2}{2ac}$

$\cos C = \dfrac{a^2+b^2-c^2}{2ab}$

$\dfrac{2\cos A}{a} + \dfrac{\cos B}{b} + \dfrac{2\cos C}{c} = \dfrac{a}{bc} + \dfrac{b}{ca}$ 5

$\dfrac{2}{a}\left(\dfrac{c^2+b^2-a^2}{2bc}\right) + \dfrac{1}{b}\left(\dfrac{c^2+a^2-b^2}{2ac}\right) + \dfrac{2}{c}\left(\dfrac{b^2+a^2-c^2}{2ab}\right) = \dfrac{a}{bc} + \dfrac{b}{ca}$

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

$a^2 = b^2+c^2$

This agrees with pythagoras theorem so this is a right angled triangle. 5

(c) Assume that, $\sin^{-1} x = \theta$

$x = \sin\theta$ 5

$x = \cos\left(\dfrac{\pi}{2} - \theta\right)$

So, $\cos^{-1} x = \dfrac{\pi}{2} - \theta$ 5

$= \dfrac{\pi}{2} - \sin^{-1} x$

$\cos^{-1} x + \sin^{-1} x = \dfrac{\pi}{2}$

$\cos(2\cos^{-1} x + \sin^{-1} x) = \dfrac{-2\sqrt{6}}{5}$

$\cos[\cos^{-1} x + (\cos^{-1} x + \sin^{-1} x)] = \dfrac{-2\sqrt{6}}{5}$

$\cos\left(\cos^{-1} x + \frac{\pi}{2}\right) = \frac{-2\sqrt{6}}{5}$ 5

$-\sin(\cos^{-1} x) = \dfrac{-2\sqrt{6}}{5}$

$\sin(\cos^{-1} x) = \dfrac{2\sqrt{6}}{5} \longrightarrow R1$ 5

$\cos^{-1} x = a \rightarrow \cos a = x \quad (0 \le \cos^{-1} x \le \pi \ , 0 \le a)$

$\sin^2 a + \cos^2 a = 1$

$\sin^2 a = 1 - x^2$

$\sin a = \sqrt{1-x^2} \quad (0 \le \sin a)$ 5

$a = \sin^{-1}\left(\sqrt{1-x^2}\right)$

$\cos^{-1} x = \sin^{-1}\left(\sqrt{1-x^2}\right)$

$\sin(\cos^{-1} x) = \sqrt{1-x^2}$ $\boxed{5}$

$R1 \rightarrow \sin(\cos^{-1} x) = \frac{2\sqrt{6}}{5}$

$\sqrt{1-x^2} = \frac{2\sqrt{6}}{5}$ $\boxed{5}$

$1 - x^2 = \frac{24}{25}$

$x^2 = \frac{1}{25}$

$x = \frac{1}{5} \quad (x > 0)$ $\boxed{5}$

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Applied Mathematics
Part A

1. By the conservation of energy,

$$\frac{1}{2}m\left(\sqrt{\frac{ga}{2}}\right)^2 + mga = mga\cos\theta + \frac{1}{2}mV^2 \quad \boxed{10}$$

$$\frac{mga}{4} + mga = mga\cos\theta + \frac{1}{2}mV^2$$

$$F = ma$$

$$R + mg\cos\theta = \frac{mV^2}{a} \quad \boxed{5}$$

$$R + mg\cos\theta = mg\left(\frac{5}{2} - 2\cos\theta\right)$$

$$R = mg\left(\frac{5}{2} - 3\cos\theta\right)$$

$$R = mg$$

$$\cancel{mg} = \cancel{mg}\left(\frac{5}{2} - 3\cos\theta\right)$$

$$3\cos\theta = \frac{3}{2}$$

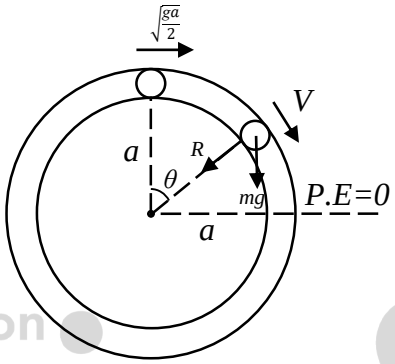
$$\cos\theta = \frac{1}{2} \quad \boxed{5}$$

$$\theta = \frac{\pi}{3}$$

$$v \longrightarrow u \ , \theta = \frac{\pi}{3}$$

$$u^2 = \left(\frac{5}{2} - 1\right)ga$$

$$u = \sqrt{\frac{3ga}{2}} \quad \boxed{5}$$



2. $F = ma$

$$\uparrow \ T\cos\theta = mg \quad \boxed{5}$$

$$\leftarrow \ T\sin\theta = mr\omega^2 \quad \boxed{5}$$

$$\tan\theta = \frac{r\omega^2}{g} \quad \boxed{5}$$

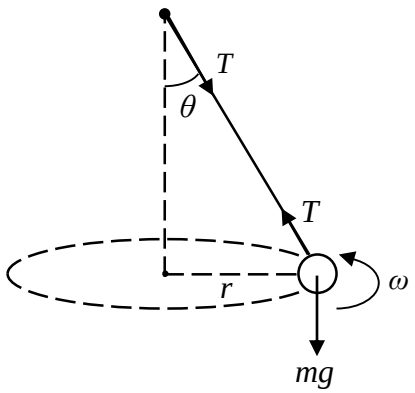
$$\frac{\pi}{4} < \theta$$

$$\tan\frac{\pi}{4} < \tan\theta \quad \boxed{5}$$

$$1 < \frac{r\omega^2}{g} \quad \boxed{5}$$

$$\frac{g}{r} < \omega^2$$

$$\omega > \sqrt{\frac{g}{r}}$$



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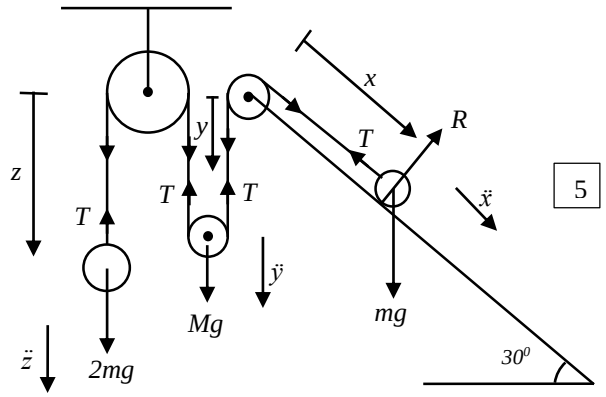
3. $\ddot{x} + 2\ddot{y} + \ddot{z} = 0$ [5]

$F = ma$

$\searrow mg\sin 30 - T = m\ddot{x}$

$\downarrow Mg - 2T = M\ddot{y}$

$\downarrow 2mg - T = 2m\ddot{z}$ [10]



[5]

$\frac{3mg}{2} = 2m\ddot{z} - m\ddot{x}$

$3g = 4\ddot{z} - 2\ddot{x}$

$3g = \frac{6g}{5} - 2\ddot{x}$

$2\ddot{x} = -\frac{9g}{5}$

$\ddot{x} = -\frac{9g}{10}$

$\ddot{y} = \frac{3g}{10}$

$mg - 2T = 2m\ddot{x}$

$Mg - mg = M\ddot{y} - 2m\ddot{x}$

$Mg - mg = \frac{3Mg}{10} + \frac{18mg}{10}$

$10M - 10m = 3M + 18m$

$M = 4m$ [5]

4. Length of string

$x + 2y =$ constant [5]

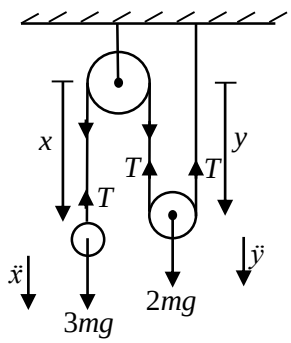
$\dot{x} + 2\dot{y} = 0$

$\ddot{x} + 2\ddot{y} = 0$

$F = ma$

$\downarrow 3mg - T = 3m\ddot{x}$ [5]

$\downarrow 2mg - 2T = 2m\ddot{y}$ [5]



[5]

$mg - T = m\ddot{y}$

$3mg - T - mg + T = 3m\ddot{x} - m\ddot{y}$

$2mg = 3m\ddot{x} - m\left(-\frac{\ddot{x}}{2}\right)$

$2g = 3\ddot{x} + \frac{\ddot{x}}{2}$

$4g = 7\ddot{x}$

$\ddot{x} = \frac{4}{7}g$ [5]

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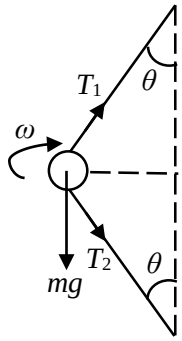
5. $\uparrow T_1 \cos\theta = T_2 \cos\theta + mg$ [5]

$(T_1 - T_2)\cos\theta = mg$

$\rightarrow T_1 \sin\theta + T_2 \sin\theta = m(l\sin\theta)\omega^2$ [5]



[5]

$(T_1 + T_2)\sin\theta = ml\sin\theta \times \omega^2$

$T_1 + T_2 = ml\omega^2$

$T_1 - T_2 = mg\sec\theta$

$2T_1 = ml\omega^2 + mg\sec\theta$

$T_1 = \frac{m}{2}(l\omega^2 + g\sec\theta)$ [5]

$T_2 = \frac{m}{2}(l\omega^2 - g\sec\theta)$ [5]

6. $\downarrow 5mg - T = 5m\ddot{x}$ [5]

$\downarrow 2mg - T_1 = 2m\ddot{y}$ [5]

$\downarrow mg + T_1 - 2T = m\ddot{y}$ [5]

$\xleftarrow{F=ma}$

$T = 3m(-\ddot{z})$

$F = ma$ [5]

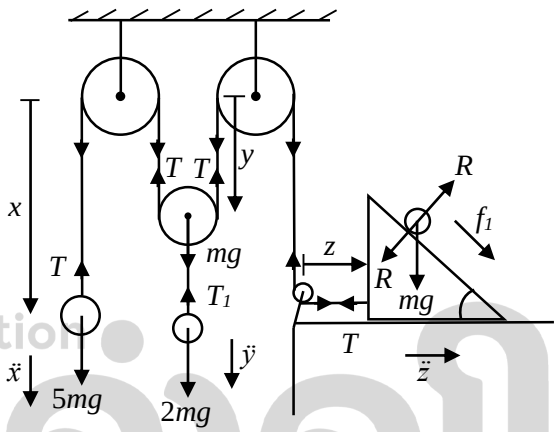
$mg\sin\theta = m(\ddot{z}\cos\theta + g\sin\theta)$

Length of string

$x + 2y + z =$ constant

$\dot{x} + 2\dot{y} + \dot{z} = 0$

$\ddot{x} + 2\ddot{y} + \ddot{z} = 0$



[5]

7. By the conservation of energy,

$\frac{1}{2}m\left(\sqrt{kga}\right)^2 - mga = \frac{1}{2}mV^2 - mga\cos\alpha$ [5]

$v^2 = kga - 2ga(1 - \cos\alpha)$

$\alpha = \pi \qquad v = u$

$u^2 = kga - 4ga$

$\downarrow F = ma$ [5]

$mg = \frac{mu^2}{a}$

$ga = kga - 4ga$

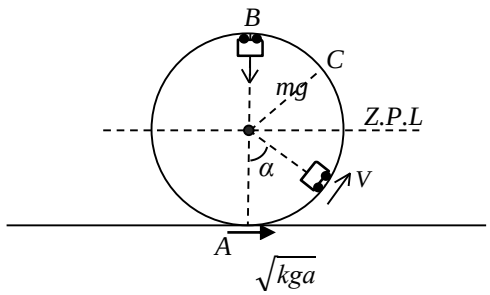
$k = 5$ [5]

$\alpha = \pi - \theta \qquad v = w$

$w^2 = 5ga - 2ga(1 - \cos(\pi - \theta))$ [5]

$w^2 = 3ga - 2ga\cos\theta$

$w^2 = ga(3 - 2\cos\theta)$ [5]



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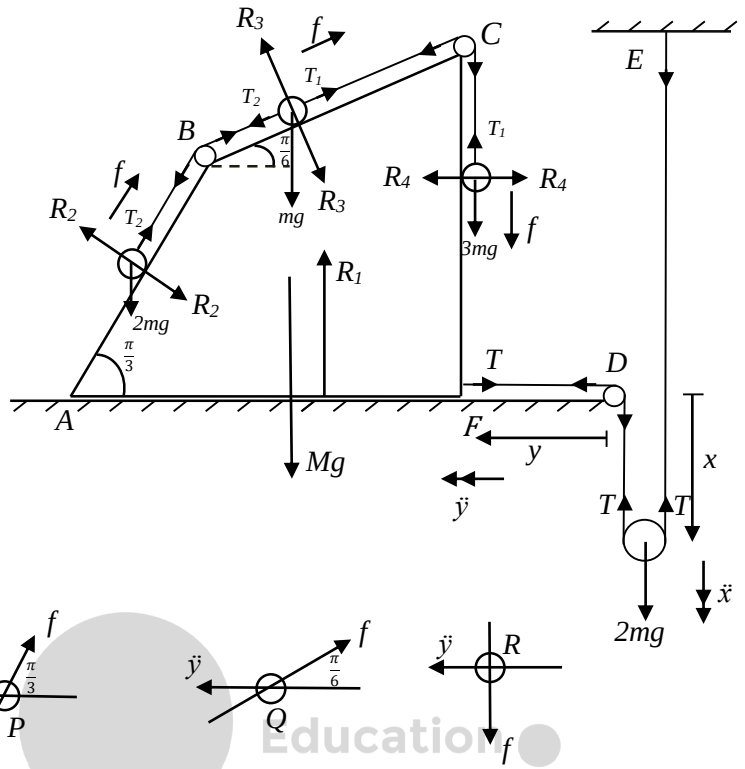
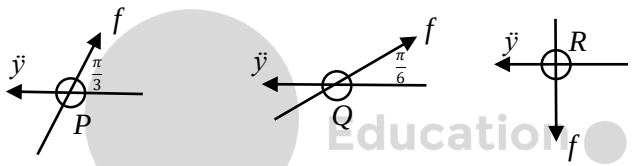
Part B

(a)



10 Force

10 Acceleration



$\xleftarrow{}$ $F=ma$ for system

$$-T = M\ddot{y} + 2m\left(\ddot{y} - f\cos\frac{\pi}{3}\right) + m\left(\ddot{y} - f\cos\frac{\pi}{6}\right) + 3m\ddot{y}$$ 15

for particle P

$\swarrow$ $$2mg\sin\frac{\pi}{3} - T_2 = 2m\left(\ddot{y}\cos\frac{\pi}{3} - f\right)$$ 10

for particle Q

$\nearrow$ $$T_1 - T_2 - mg\sin\frac{\pi}{6} = m\left(f - \ddot{y}\cos\frac{\pi}{6}\right)$$ 10

for particle R

$\downarrow$ $3mg - T_1 = 3mf$ 5

Pulley S

$\downarrow$ $2mg - 2T = 2m\ddot{x}$ 5

Length of string

$2x + y =$ Constant

$2\ddot{x} + \ddot{y} = 0$

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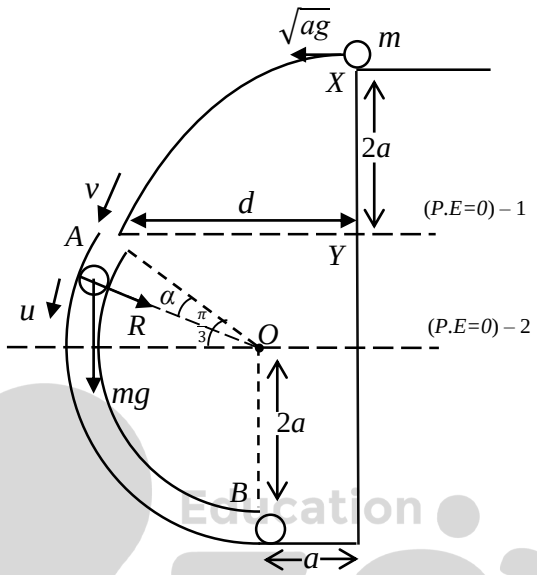
for particle P, relative to wedge

$\nearrow$ $S = ut + \frac{1}{2}at^2$

$a = 0 + \frac{1}{2}ft^2$ $\boxed{5}$

(b)



$X \longrightarrow A$

$S = ut + \frac{1}{2}at^2$

$2a = 0 + \frac{1}{2}gt^2$

$t^2 = \frac{4a}{g}$

$t = \pm 2\sqrt{\frac{a}{g}}$

But $t > 0$

$\therefore t = 2\sqrt{\frac{a}{g}}$ $\boxed{5}$

d be the horizontal range attained by particle P in time t.

$s = ut$

$d = \sqrt{ag} \times 2\sqrt{\frac{a}{g}}$ $\boxed{5}$

$d = 2a$

But $AX = 2a$

$\therefore d = AY$

Therefore particle P goes through end A. $\boxed{5}$

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By the law of conservation of energy to particle P at point A ,

$$\frac{1}{2}m\left(\sqrt{ag}\right)^2 + mg(2a) = \frac{1}{2}mV^2$$

$$V^2 = ag + 4ag$$

$$V^2 = 5ag$$

$$V = \sqrt{5ag} \qquad \boxed{5}$$

By the conservation of energy,

$$\frac{1}{2}mV^2 + mg(2a\cos 30) = \frac{1}{2}mu^2 + mg \times 2a\cos(30+\alpha) \qquad \boxed{10}$$

$$\frac{1}{2}m(5ag) + mg(2a)\left(\frac{\sqrt{3}}{2}\right) = \frac{1}{2}mu^2 + mg(2a)\left(\frac{\sqrt{3}}{2}\cos\alpha - \frac{1}{2}\sin\alpha\right)$$

$$5ag + 2\sqrt{3}ag = u^2 + 2ag\left(\sqrt{3}\cos\alpha - \sin\alpha\right)$$

$$u^2 = ag\left[5 + 2\sqrt{3} - 2\left(\sqrt{3}\cos\alpha - \sin\alpha\right)\right] \qquad \boxed{5}$$

$$F = ma$$

$$R + mg\cos(30+\alpha) = m\frac{u^2}{2a} \qquad \boxed{5}$$

$$R = \frac{mg}{2}\left[5 + 2\sqrt{3}\right]$$

$$R + mg\cos(30+\alpha) = \frac{5mg}{2} + \sqrt{3}mg - 2mg\cos(\alpha+30)$$

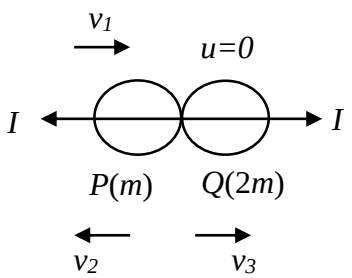
$$R = \frac{5mg}{2} + \sqrt{3}mg - 3mg\left(\frac{\sqrt{3}}{2}\cos\alpha - \frac{\sin\alpha}{2}\right)$$

$$R = \frac{mg}{2}\left[5 + 2\sqrt{3} - 3\left(\sqrt{3}\cos\alpha - \sin\alpha\right)\right] \qquad \boxed{5}$$

let $u = v_1$ when $\alpha = 150$,

$$v_1{}^2 = ag\left[5 + 2\sqrt{3} - 2\left(\sqrt{3} \times \left(-\frac{\sqrt{3}}{2}\right) - \frac{1}{2}\right)\right]$$

$$v_1{}^2 = ag\left(9 + 2\sqrt{3}\right) \qquad \boxed{5}$$



$\xrightarrow[I=\Delta mv]{}$ for system

$$0 = 2mv_3 - mv_2 - mv_1$$

$$v_1 = 2v_3 - v_2 \qquad \boxed{5}$$

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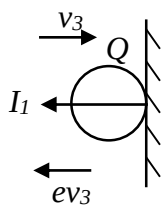
$v_1 e = v_2 + v_3$ 5

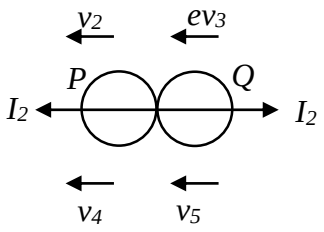
$v_2 = \left(\frac{2e-1}{3}\right) v_1 \quad , \quad v_3 = \left(\frac{1+e}{3}\right) v_1$

If $= \frac{1}{2}$,

$v_2 = 0$

$v_3 = \frac{v_1}{2}$





$\xleftarrow[I=\Delta mv]{}$

$0 = mv_4 + 2mv_5 - 2m\left(\frac{v_1}{4}\right)$ 5

$\frac{m_1}{2} = v_4 + 2v_5$

$\left(e = \frac{1}{2}\right)$ Newton's experimental law,

$\left(\frac{v_1}{4}\right)\frac{1}{2} = v_4 - v_5$ 5

$\frac{v_1}{4} = 2v_4 - 2v_5$

$\frac{3v_1}{4} = 3v_4$

$v_4 = \frac{v_1}{4}$ 5

By the conservation of energy,

$\frac{1}{2} m {v_4}^2 = \frac{1}{2} m(0) + mgh$

$h = \frac{{v_4}^2}{2g}$

$h = \frac{{v_1}^2}{32g} = \frac{1}{32}(a)\left(9 + 2\sqrt{3}\right)$

$h = \left(\frac{9 + 2\sqrt{3}}{32}\right) a$ 5

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எங்கள் குறிக்கோள்

எண்ணிம உலகத்தில் மாணவர்களிற்கென சிறந்ததொரு கற்றல் கட்டமைப்பை உருவாக்குதல்.

அனைத்தும் டிஜிட்டல் மயப்படுத்தப்பட்ட இந்த காலத்தில் பல்வேறு துறைகளும் கால ஓட்டத்துடன் இணைந்து டிஜிட்டல் தளத்தில் பல்கிப்பெருகி வருகின்றன. அந்த வகையில் கல்வித்துறையும் இதற்கு விதிவிலக்கல்ல. இணையவழி கல்வியின் மூலம் கலவித்துறை புதியதொரு பரிமாணத்தை எட்டியுள்ளது. குறிப்பாக கொரோனா பேரிடர் காலத்தில் நாடே முடக்கப்பட்டிருந்தது. இதனால் மாணவர்களிற்கும் பாடசாலை, கல்வி நிறுவனங்களிற்கு இடையிலான தொடர்பு துண்டிக்கப்பட்டது. அந்த இக்கட்டான சூழ்நிலையில் இணையவழி வகுப்புகள் மாணவர்களிற்கு வரப்பிரசாதமாக அமைந்தது என்பதே உண்மை.

இன்று தொழில்நுட்பம் மாணவர்களை தவறான பாதைக்கு இட்டு செல்வதாக ஓர் எண்ண ஓட்டம் மக்கள் மத்தியில் உள்ளது. தொழில்நுட்பம் என்பது ஒரு கருவி மட்டுமே அதை எவ்வாறு பயன்படுத்துகிறோம் என்பதில் அதன் ஆக்க மற்றும் அழிவு விளைவுகள் தீர்மானிக்கப்படுகிறது. உளியை கொண்டு சிலையை செதுக்க நினைத்தால் அவன் நிச்சயம் சிற்பி ஆகலாம். இங்கு பிரச்சினையாக காணப்படுவது மாணவர்களை வழிப்படுத்த தொழில்நுட்ப உலகில் ஓர் முறையான கட்டமைப்பு இல்லாமையே. அதை உருவாக்குவதே எங்கள் நோக்கம். அதை நோக்கியே எங்கள் பயணம் அமையும்.

எமது இணையத்தினூடக ஊடாக உங்களிற்கு தேவையான பரீட்சை வினாத்தாள்களை இலகுவான முறையில் தரவிறக்கம் செய்து கொள்ளமுடியும்.

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