(iii) Equating the two values of T gives:

$$\frac{Mgl}{h} = M\omega^2 l$$

$$\Rightarrow \frac{g}{h} = \omega^2$$

$$\Rightarrow h = \frac{g}{\omega^2}$$

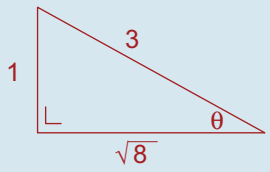
(iv) $h \geqslant 0.25$

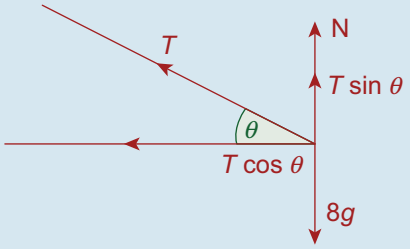
$$\Rightarrow \frac{g}{\omega^2} \geqslant 0.25$$

$$\Rightarrow \omega^2 \leqslant \frac{g}{0.25}$$

$$\Rightarrow \omega \leqslant 6.3 \text{ rads/sec}$$

Q. 11.





$\uparrow = \downarrow$

$$N + \frac{T}{3} = 8g \quad ...①$$

(i) **NZL:** $\leftarrow \frac{T\sqrt{8}}{3} = \frac{mv^2}{r}$

$$\Rightarrow \frac{T\sqrt{8}}{3} = \frac{8v^2}{\sqrt{8}}$$

$$\Rightarrow T = 3v^2$$

(ii) From ①

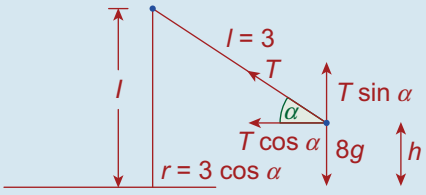
For contact with table $N > 0$

$$N = 8g - T\sin\theta$$

$$\Rightarrow 8g > 3v^2\frac{1}{3}$$

$$\Rightarrow v < \sqrt{8g}$$

(iii)



$v = \sqrt{9.1g}$

$\uparrow = \downarrow$

$$T\sin\alpha = 8g$$

$$\Rightarrow T = \frac{8g}{\sin\alpha} \quad ...①$$

② **NZL:** $\sum F = ma$

$$\leftarrow T\cos\alpha = \frac{mv^2}{r}$$

From ① $\frac{8g}{\sin\alpha}\cos\alpha = \frac{8(9.1g)}{3\cos\alpha}$

$$\Rightarrow 3\cos^2\alpha = 9.1\sin\alpha$$

$$\Rightarrow 3(1 - \sin^2\alpha) = 9.1\sin\alpha$$

$$\Rightarrow 3\sin^2\alpha + 9.1\sin\alpha - 3 = 0$$

$$\Rightarrow 30\sin^2\alpha + 91\sin\alpha - 30 = 0$$

$$\Rightarrow (3\sin\alpha + 10)(10\sin\alpha - 3) = 0$$

$$\Rightarrow \sin\alpha = \frac{3}{10}$$

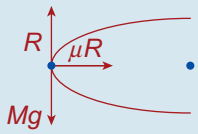
From diagram, $h = 1 - l\sin\alpha$

$$= 1 - 3\left(\frac{3}{10}\right)$$

$$\Rightarrow h = \frac{1}{10} \text{ m}$$

Exercise 11C

Q. 1.



1: $R = mg$

2: $\mu R = \frac{mv^2}{r}$

$$\Rightarrow \mu mg = \frac{m(21)^2}{50}$$

$$\Rightarrow \mu = 0.9$$

Q. 2. (i) 1: $R = mg$

2: $\mu R = \frac{mv^2}{r}$

$$\Rightarrow \frac{2}{3}(mg) = \frac{mv^2}{24}$$

$$\Rightarrow v^2 = 16g$$

$$\Rightarrow v = 4\sqrt{g} = 12.52 \text{ m/s}$$

(ii) 1: $R = mg$

2: $\mu R = \frac{mv^2}{r}$

$$\Rightarrow \mu(mg) = \frac{m(7)^2}{24}$$

$$\Rightarrow \mu = \frac{5}{24}$$