MLC
1995 Q6 [UCM]

(a)

$\sum F = m\omega^2 r$ $\longrightarrow$ $T\sin\theta = m[\omega^2 r]$ [5]

$T\frac{r}{l} = m\omega^2 r$. [5]

$\Rightarrow T = ml\omega^2$.

$\updownarrow \sum F = 0$ $\quad T\cos\theta - mg = 0$ [5]

$T\frac{h}{l} = mg$

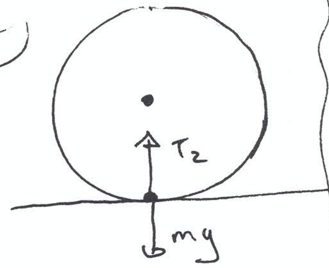
$\therefore ml\omega^2 \frac{h}{l} = mg$

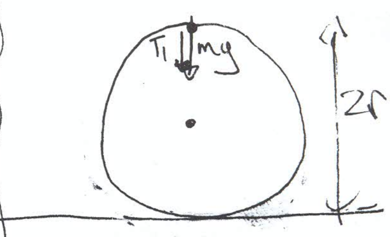
$\therefore \omega^2 = \frac{g}{h}$ [5]

$\therefore$ Period $= \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{h}{g}}$. [5]

[OR derivation done in notes]

(b)





$v = v_2$

$h = 0$ . . .

Forces: Radially in $\sum F = \frac{mv^2}{r}$

$$T_2 - mg = \frac{m v_1^2}{r} \quad (1)$$

[5]

$v = v_1$

$h = 2r$

Forces: Radially in $\sum F = \frac{mv^2}{r}$

$$T_1 + mg = \frac{m v_2^2}{r} \quad (2)$$

[5]

Energy:

$\mathcal{E}_2 : \frac{m v_2^2}{2} + mg(0)$ [5]

$\mathcal{E}_1 : \frac{m v_1^2}{2} + mg(2r)$ [5]

PCE $\Rightarrow \mathcal{E}_1 = \mathcal{E}_2$

$$\therefore \frac{m v_2^2}{2} = \frac{m v_1^2}{2} + 2mgr \quad (3)$$

Need to simplify (1)(2)(3) to eliminate v_1, v_2 to get answer required.

(1) $\Rightarrow m v_1^2 = r[T_2 - mg]$

(2) $\Rightarrow m v_2^2 = r[T_1 + mg]$

$\therefore$ (3) $\Rightarrow$

$\frac{1}{2} r[T_2 - mg] = \frac{1}{2} r[T_1 + mg] + 2mgr$

$\Rightarrow T_2 - mg = T_1 + mg + 4mg$

$$\Rightarrow \boxed{T_2 = T_1 + 6mg}$$

[5] q.e.d.