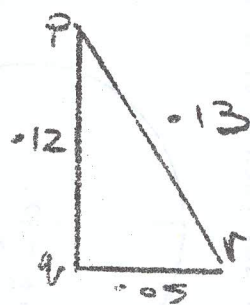


CIRCULAR MOTION (11) 1982 WS.

(a) Geometry -



$$|Pr| + |Pq| = 18$$

$$\text{Let } |Pr| = x$$

$$|Pq| = 18 - x$$

Pythagoras \Rightarrow

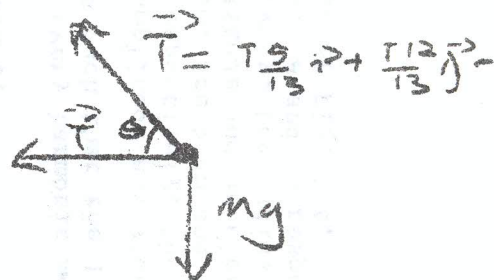
$$(\frac{12}{13})^2 + (18-x)^2 = x^2$$

$$\Rightarrow x = 13$$

$$\Rightarrow 18-x = 0.5$$

Forces

$$\tan \theta = \frac{12}{5}$$



NII:

$$\frac{T \cdot 5}{13} + T = m\omega^2 r$$

$$\Rightarrow \frac{18T}{13} = m\omega^2 (0.05)$$

(1)

$$\frac{T \cdot 12}{13} - mg = 0$$

$$\frac{T \cdot 12}{13} = mg$$

$$\Rightarrow T = \frac{13mg}{12}$$

(2)

Sub from (2) into (1)

$$\Rightarrow$$

$$\frac{18}{13} \left(\frac{13mg}{12} \right) = m\omega^2 (0.05)$$

$$\Rightarrow$$

$$\frac{3}{2}g = \omega^2 (0.05)$$

$$\omega^2 = 30g$$

$$\Rightarrow \omega = \sqrt{30g} = \sqrt{294} \text{ rad/s}$$

qed.

(b) Energy -

Initial

$$E_I = \frac{1}{2}mu^2 + 0$$

Typical

$$E_B = \frac{1}{2}mV^2 + mgh$$

$$= \frac{1}{2}mV^2 + mg[a - a \cos 60]$$

$$= \frac{1}{2}mV^2 + mg \frac{a}{2}$$

Zero

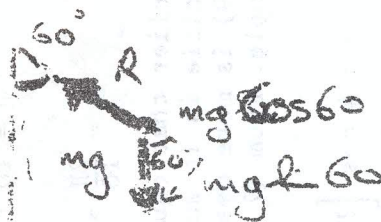
PCE $\Rightarrow E_I = E_B$

$$\Rightarrow \frac{1}{2}mu^2 = \frac{1}{2}mV^2 + mg \frac{a}{2}$$

$$\Rightarrow$$

$$mu^2 = mV^2 + mga \quad (1)$$

Forces: Typical position:



Radially NII \Rightarrow

$$R - mg \cos 60 = \frac{mV^2}{a}$$

$$\Rightarrow R - \frac{mg}{2} = \frac{mV^2}{a} \quad (2)$$

Need to eliminate mV^2 from (1) and (2).

$$\Rightarrow R - \frac{mg}{2} = \frac{mu^2 - mga}{a}$$

$$\Rightarrow R - \frac{mg}{2} = \frac{mu^2}{a} - mg \Rightarrow R = \frac{mu^2}{a} - mg + \frac{mg}{2}$$

$$\Rightarrow R = m \left(\frac{u^2}{a} - \frac{g}{2} \right)$$

qed.