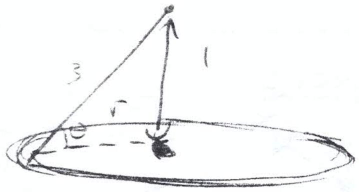
1988 Q6

88 Q6

Geometry:

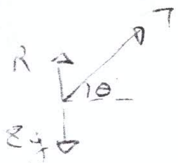


Pythag $\Rightarrow r = \sqrt{8}$.

$\tan\theta = \frac{1}{\sqrt{8}}$.

mass 8

Forces:



accel Radially in $\frac{v^2}{\sqrt{8}}$, $\updownarrow$ 0.

NII: $\updownarrow$ $R - 8g + T\sin\theta = 0$.

$\Rightarrow R - 8g + \frac{T\,1}{3} = 0$.

Radially in: $T\cos\theta = 8\frac{v^2}{\sqrt{8}}$

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

$\Rightarrow \boxed{T = 3v^2}$

(i)

(ii). $R + \frac{T}{3} = 8g$.

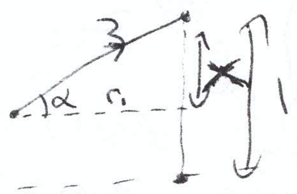
$\Rightarrow R + v^2 = 8g$.

$\left.\begin{array}{l} R \geq 0 \\ R \text{ positive} \end{array}\right] \Rightarrow$ $v^2 \leq 8g$

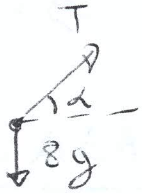
$\Rightarrow$ $v \leq \sqrt{8g}$.

(iii) New geometry

$\boxed{v = 9.1g}$



New forces:



NII: $\updownarrow$ $T\sin\alpha = 8g$

Radially inwards: $T\cos\alpha = \frac{8v^2}{r_1} \Rightarrow T\cos\alpha = \frac{8(9.1g)}{r_1}$ (2)

Geometry: $x^2 + r_1^2 = 3^2 \Rightarrow r_1 = \sqrt{9-x^2}$. $\left[\begin{array}{l} \text{Also } \cos\alpha = \frac{\sqrt{9-x^2}}{3} \\ \text{and } \sin\alpha = \frac{x}{3}. \end{array}\right.$

$\therefore$ (1) $\Rightarrow T\frac{x}{3} = 8g \Rightarrow \frac{T}{3} = 8g$.

(2) $\Rightarrow T\frac{\sqrt{9-x^2}}{3} = \frac{8(9.1g)}{\sqrt{9-x^2}}$

from (1) subst. $\Rightarrow$. $\frac{8g}{x}\sqrt{9-x^2} = \frac{8(9.1)g}{\sqrt{9-x^2}}$

$\Rightarrow$ $9 - x^2 = 9.1x \Rightarrow x^2 + 9.1x - 9 = 0$

$\Rightarrow (x - .9)(x + 10) = 0$

$\Rightarrow x = .9$

rise height $= \boxed{.1}$