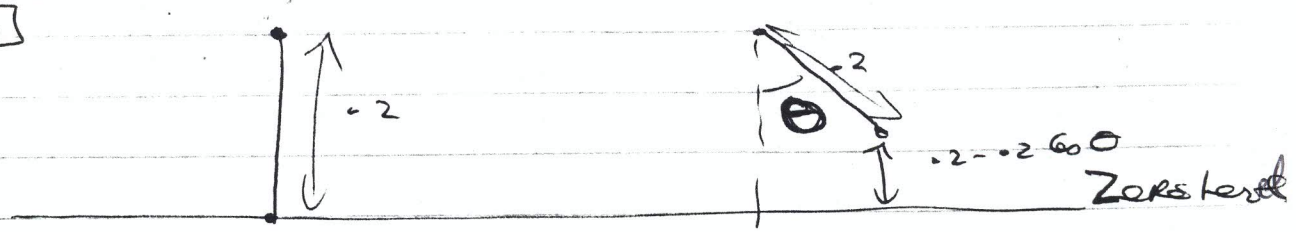
Circular motion

1973 Q5 H

Energy:-



Initial

$\mathcal{E}_A$: $mg(0) + \frac{1}{2}m(1-4)^2$

$\Rightarrow + \frac{1}{2}(10)(-4)^2$

$\Rightarrow \mathcal{E}_A$: 9.8 Joules

Typical:

$\mathcal{E}_B$: $10g(.2 - .2\cos\theta) + \frac{1}{2}(10)v^2$

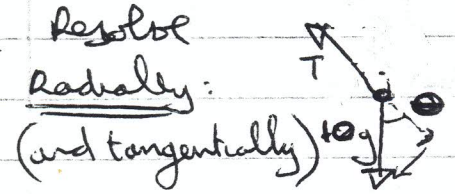
$\mathcal{E}_B$: $2g(1-\cos\theta) + 5v^2$

$\mathcal{E}_B$: $19.6(1-\cos\theta) + 5v^2$

Conservation of energy $\Rightarrow \mathcal{E}_A = \mathcal{E}_B$

$\Rightarrow$ $\boxed{9.8 = 19.6(1-\cos\theta) + 5v^2}$ (1)

Forces: Resolve Radially (and tangentially)



$\vec{T} = T\vec{i}$.

$\vec{w} = -10g\cos\theta\,\vec{i} - 10g\sin\theta\,\vec{j}$.

NII: Radially:

$T - 10g\cos\theta = \frac{mv^2}{r}$

$\Rightarrow$

$T - 10g\cos\theta = \frac{10v^2}{.2}$

$\Rightarrow$ $\boxed{T - 98\cos\theta = 50v^2}$ (2)

Find θ when $v = 0$:-

Eqn (1) $\Rightarrow$ $9.8 = 19.6(1-\cos\theta) + 5(0)^2$

$\Rightarrow$ $9.8 = 19.6(1-\cos\theta)$

$\Rightarrow$ $\frac{1}{2} = 1 - \cos\theta$

$\Rightarrow$ $\cos\theta = \frac{1}{2}$ $\Rightarrow$ $\boxed{\theta = 60^\circ}$

When $v = 0$ and $\theta = 60$,

Eqn (2) $\Rightarrow$ $T - 98\cos(60) = 50(0)^2$

$\Rightarrow$ $T - 98(\frac{1}{2}) = 0$

$\boxed{T = 49\,N}$ qed.