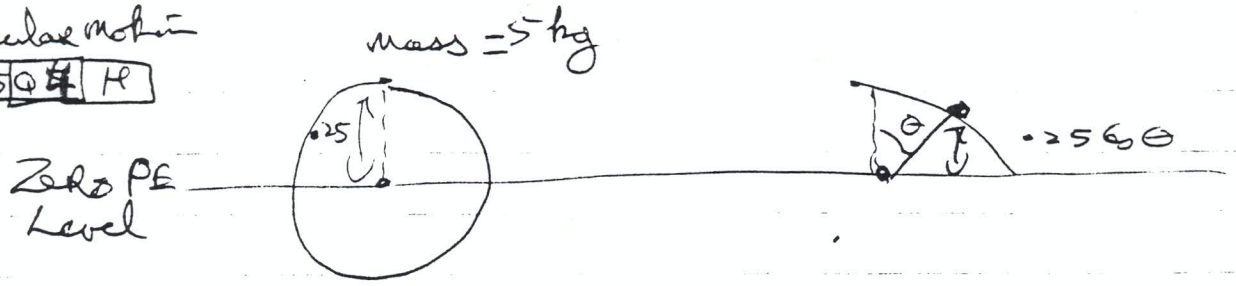
Circular motion

| 1975 | Q4 | H |
|---|---|---|




Initial

$E_A = mg(.25) + \frac{1}{2}mv^2$

$E_A = 5g(.25)$

$E_A = 12.25$ Joules

Typical

$E_B = mg(-.25\cos\theta) + \frac{1}{2}mv^2$

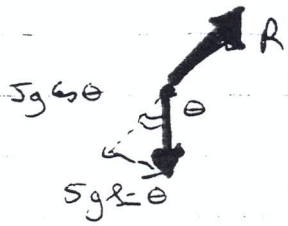
$E_A = 5g(-.25\cos\theta) + \frac{1}{2}(5)v^2$

$E_B = 12.25\cos\theta + 2.5v^2$

Conservation of energy: $E_A = E_B$

$\Rightarrow \boxed{12.25 = 12.25\cos\theta + 2.5v^2}$ (1)

Forces: (Resolve Radially etc)




$5g\cos\theta - R = \frac{mv^2}{r}$.

$\Rightarrow 5g\cos\theta - R = \frac{5v^2}{.25}$

$\Rightarrow \boxed{49\cos\theta - R = 20v^2}$ (2)

Particle leaves sphere when $R = 0$.

(2) $\Rightarrow 20v^2 = 49\cos\theta$. $\Rightarrow v^2 = \frac{49}{20}\cos\theta$.

$\therefore$ (1) $\Rightarrow$ $12.25 = 12.25\cos\theta + 2.5\left(\frac{49}{20}\cos\theta\right)$

$\Rightarrow 12.25 = 12.25\cos\theta + 6.125\cos\theta$

$\Rightarrow 12.25 = 18.375\cos\theta$

$\Rightarrow \frac{12.25}{18.375} = \cos\theta$

$\Rightarrow .6666 = \cos\theta$

$\boxed{\theta = 48^\circ 11'}$.

// Strictly speaking question asks for R in terms of $\theta$ alone so should combine (1) and (2) to get.

$12.25 = 12.25\cos\theta + 2.5\left(\frac{49\cos\theta - R}{20}\right)$

to satisfy examiner. //