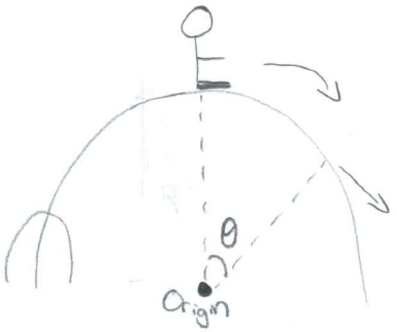
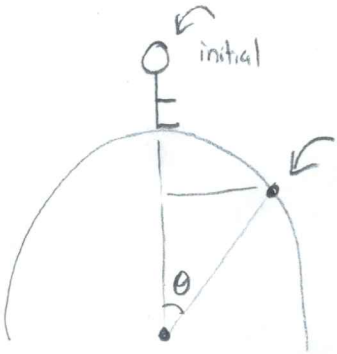
EX/



Find the angle from the vertical where Jack loses contact with the igloo (semicircle).

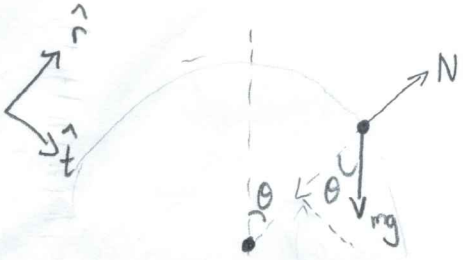


$h = R - R\cos\theta$

Energy $\Longleftrightarrow$ $0 = \Delta E_k + \Delta U_{gravity}$

$= \frac{1}{2}mv_f^2 - mg(R - R\cos\theta)$ ← mgh; $h = R - R\cos\theta$

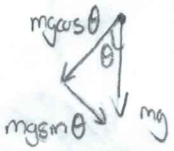
①



$F_{net\,\hat{r}} = \frac{mv^2}{R} = mg\cos\theta - N$ ← No contact, $N = 0$.

so $\frac{mv^2}{R} = mg\cos\theta$

so $v = \sqrt{gR\cos\theta}$ ②



Now sub ② into ① $v_f = \sqrt{gR\sin\theta}$

So $0 = \frac{1}{2}m\left(\sqrt{gR\cos\theta}\right)^2 - mgR + mgR\cos\theta$

$= \frac{1}{2}mgR\cos\theta - mgR + mgR\cos\theta$

$1 = \frac{1}{2}\cos\theta + \cos\theta$

$1 = \frac{3}{2}\cos\theta \Rightarrow \frac{2}{3} = \cos\theta$ $\boxed{\theta = \cos^{-1}\left(\frac{2}{3}\right)}$