Homework #9

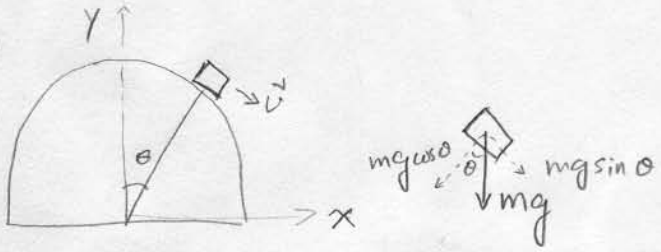
1. Energy conservation:

$mgh_1 = mgh$ h is the maximum height

$h_1 = h$

$h = 1.2m$

2.



suppose when it reaches angel θ, it will fall off the mound. Then there is no normal force at that moment.

Energy conservation: $mgR = mgR\cos\theta + \frac{1}{2}mv^2$

$v^2 = 2gR(1-\cos\theta) \Rightarrow v = \sqrt{2gR(1-\cos\theta)}$

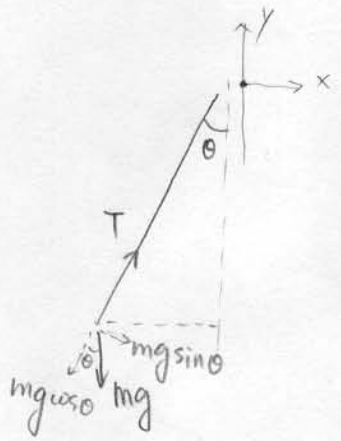
Newton's 2nd law: $mg\cos\theta = m\frac{v^2}{R}$

$mg\cos\theta = m\frac{2gR(1-\cos\theta)}{R} \Rightarrow \cos\theta = 2-2\cos\theta$

$3\cos\theta = 2 \Rightarrow \cos\theta = \frac{2}{3}$

$\theta = \cos^{-1}\frac{2}{3}$

3.



Energy conservation:

$-mg\cos35^\circ = -mgR\cos\theta + \frac{1}{2}mv^2$

$\frac{1}{2}mv^2 = mgR(\cos\theta - \cos35^\circ)$

$v^2 = 2gR(\cos\theta - \cos35^\circ)$

Newton's 2nd law:

$T - mg\cos\theta = m\frac{v^2}{R} = m\frac{2gR(\cos\theta - \cos35^\circ)}{R}$

$T = mg\cos\theta + 2mg(\cos\theta - \cos35^\circ)$

$= mg(3\cos\theta - 2\cos35^\circ)$

$T \le 700N \Rightarrow \theta \ge 24.2^\circ$

Vine breaks. when $\theta = 24.2^\circ$, it breaks