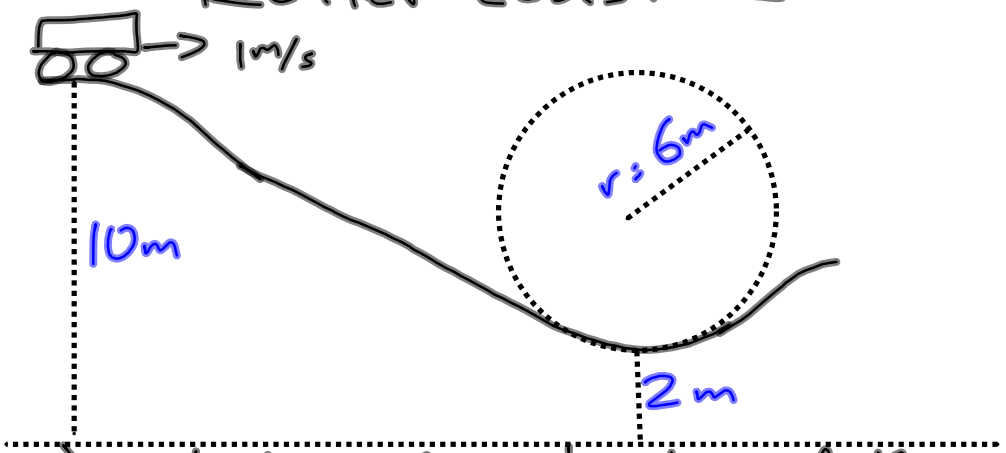
Roller coasters



1) What is the velocity of the cart when it is 2m off the ground

$$\Sigma E_1 = \Sigma E_2$$

$$U_{g1} + K_1 = U_{g2} + K_2 \qquad K = \frac{1}{2}mv^2$$

$$U_{g1} - U_{g2} + K_1 = K_2$$

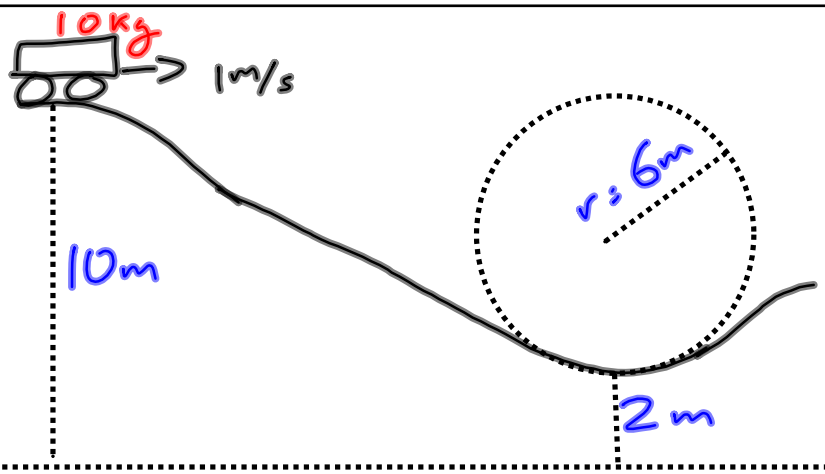
$$\Delta U_g + K_1 = K_2$$

$$m \cdot g \cdot \Delta h + \frac{1}{2} m v_1^2 = \frac{1}{2} m v_2^2$$

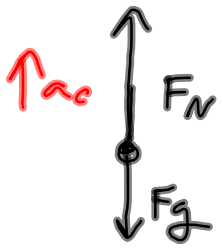
$$\sqrt{2g\Delta h + v_1^2} = \sqrt{v_2^2}$$

$$\sqrt{2(10\,m/s^2)(8m) + (1\,m/s)^2} = v_2$$

$$12.69\,m/s = v_2$$



2) What is the Normal force at 2m?



$a_x = \frac{\Sigma F_x}{m}$ $\quad$ $a_y = \frac{\Sigma F_y}{m}$

$0 = \frac{0}{m}$ $\quad$ $a_c = \frac{F_N - F_g}{m}$

$a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$ $\quad$ $m \cdot \frac{v^2}{r} = \frac{F_N - F_g}{m} \cdot m$

$$\frac{mv^2}{r} + F_g = F_N$$

$$\frac{(10kg)(12.69 m/s)^2}{(6m)} + (10kg \cdot 10 m/s^2) = F_N$$

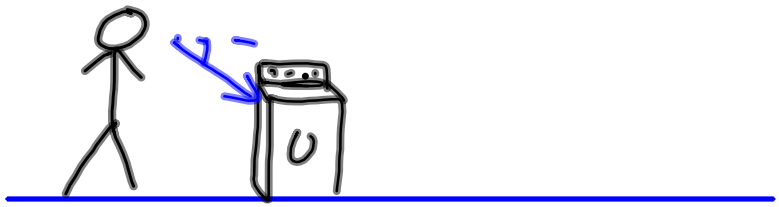
$$F_N = 369 \frac{kgm}{s^2}$$

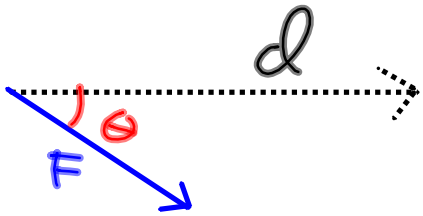
Work

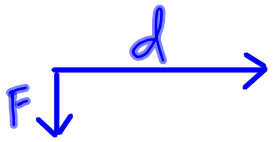
Energy Transferred by a force over a certain distance

$W = \vec{d} \cdot \vec{F}$ Dot Product

$W = d\,F\cos(\theta)$







$W = d \cdot F\cos(90)$

$= 0$

$W = d \cdot F\cos(\theta)$

$W = d \cdot F$

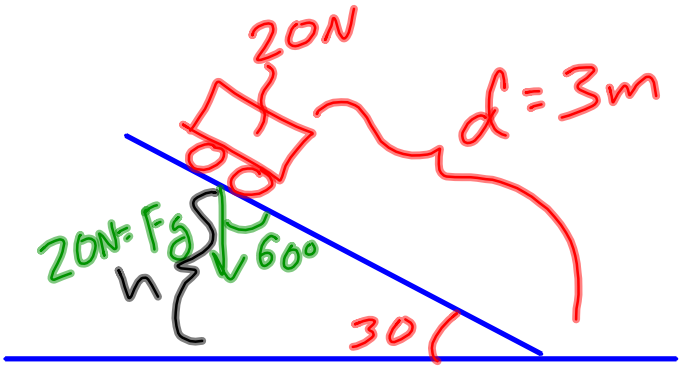
Work and Energy

$W = d \cdot F\cos(\theta)$

$[m]\left[\frac{kg\,m}{s^2}\right]$

$W = \Delta E$

$W: \left[\frac{kg\,m^2}{s^2}\right] = [J]$



$h = d \sin 30$

Work in terms of Force

What is the work done by gravity?

$W = d \cdot F_g \cos(\theta)$

$= 3m\,(20N)\cos(60)$

$= 30\ J$

Work in terms of ΔE

$\Delta U_g = mg\Delta h$

$= 20N \cdot 3m \sin(30)$