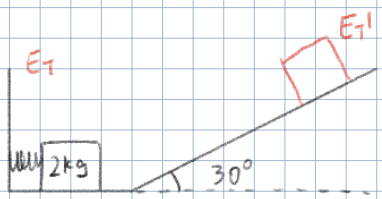
Example 1:

A toy car (1kg) is shot up a ramp by a spring as shown. The spring constant is 2N/cm and the spring gets compressed 40cm. How high up the ramp does the car get?



$K = \frac{2N}{1cm} = \frac{100cm}{1m} = 200N/m$

$x = 0.4m$

$E_T = E_T'$

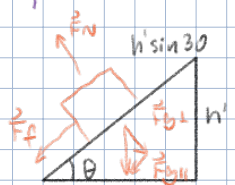
$E_s = E_g$

$\frac{1}{2}kx^2 = mgh'$

$\frac{1}{2}(200)(0.4)^2 = 2(9.81)h'$

$h' = 0.815m$

Addon: The ramp has $\mu = 0.1$ → h'



$E_T = E_T'$

$E_s = E_g + E_f$

$\frac{1}{2}kx^2 = mgh' + F_f d$

$\frac{1}{2}kx^2 = mgh + \mu mg\cos\theta \cdot h'\sin\theta$

$\frac{1}{2}(200)(0.4)^2 = 2(9.81)h' + 0.1(2)(9.81)(\cos 30)(\frac{h'}{\sin 30})$

$\frac{1}{2}(200)(0.4)^2 = h'(2(9.81) + 0.1(2)(9.81)(\frac{\cos 30}{\sin 30}))$

$h' = 0.695m$

Example 2:

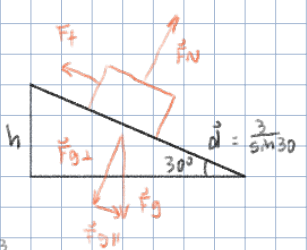
Two blocks are set up as shown. The 3kg block is shot by a spring (K = 2KN/m) which was compressed 30cm. The ramps have mu = 0.1

a) What is the velocity of the 3kg block before it strikes the 1kg block

$E_1 = E_1'$

$E_s + E_g = E_k + E_f$

$\frac{1}{2}kx^2 + mgh = \frac{1}{2}mv^2 + \vec{F}\vec{d}$



$\frac{1}{2}kx^2 + mgh = \frac{1}{2}mv^2 + \mu mg\cos\theta \frac{3}{\sin 30}$

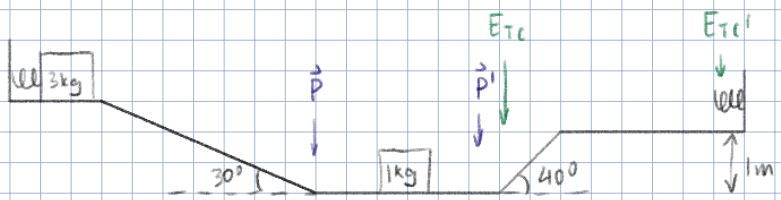
$v = \sqrt{\left[\frac{1}{2}kx^2 + mgh - \mu mg\cos\theta \frac{3}{\sin 30}\right]\frac{2}{m}}$

$= \sqrt{\left[\frac{1}{2}(2000)(0.3)^2 + 3(9.81)(3) - 0.1(3)(9.81)\cos 30 \frac{3}{\sin 30}\right]\frac{2}{3}}$

$= 10.42\ m/s$

b) If the collision is a TIC, what is the velocity of the blocks after collision?

c) When the blocks hit the 2nd spring, it compressed 20cm. What is its spring constant?



b)

$\vec{P} = \vec{P}'$

$m_3v_3 = m_4v_4'$

$3(10.4) = 4(V_4')$

$V_4' = 7.82 m/s$

c)

$E_{TC} = E_{TC}' \neq E_{TA}$

$E_K = E_g + E_s + E_f$

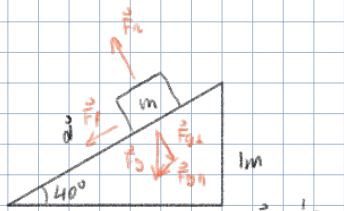
$\frac{1}{2}mv^2 = mgh + \frac{1}{2}kx^2 + \vec{F}\vec{d}$ (??)

$k = [\frac{1}{2}mv^2 - mgh - \vec{F}\vec{d}]\frac{2}{x^2}$

$= [\frac{1}{2}(4)(7.82)^2 - 4(9.81)(1) - \frac{0.1(4)(9.81)\cos 40}{\sin 40}]\frac{2}{0.2^2}$

$= 3916.59 N/m$

$= 3.92 kN/m$



$\vec{a} = \frac{1}{\sin 40}$

$\vec{F}_f = \mu\vec{F}_N = \mu mg\cos\theta$