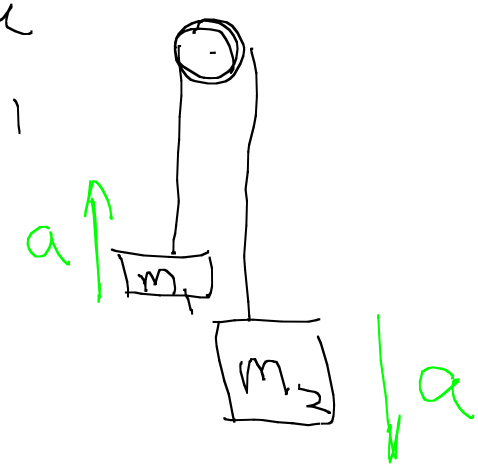
Phys 2110-3 9/29/10

Note Title 9/29/2010

Force problems

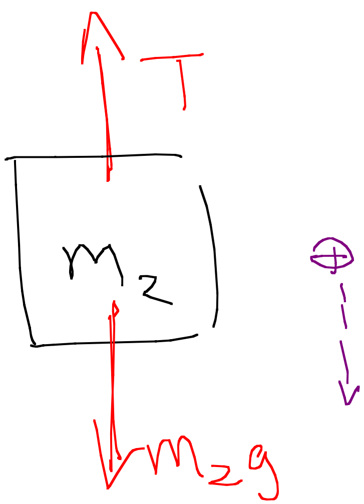
Assume $m_2 > m_1$



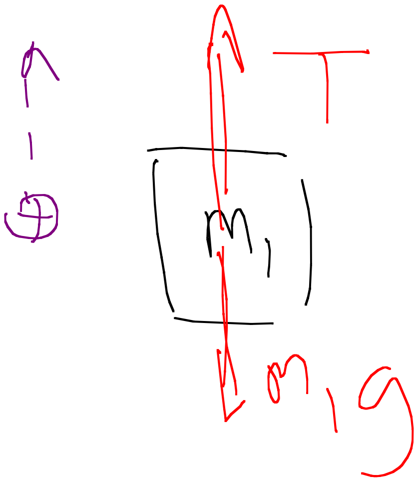
Another example

m_2 accel's down

m_1 accel's up



$$\boxed{m_2 g - T = m_2 a}$$



$$\boxed{T - m_1 g = m_1 a}$$

$$\boxed{m_2 g - T = m_2 a}$$

(Same T)
(Same a)

Add eqns, T cancels

$$m_2 g - m_1 g = m_1 a + m_2 a$$

$$g(m_2 - m_1) = (m_1 + m_2) a$$

$$a = g\frac{(m_2 - m_1)}{(m_2 + m_1)}$$

Cases:

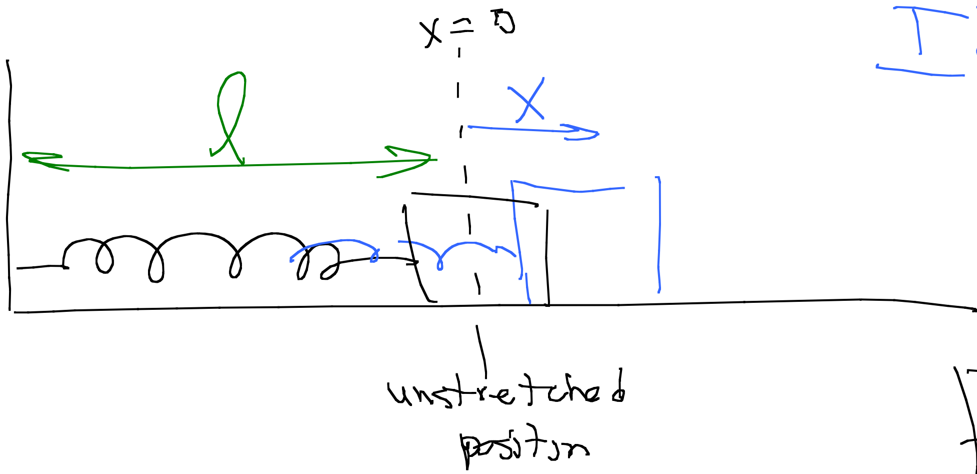
$m_1 = m_2$
$a = 0$

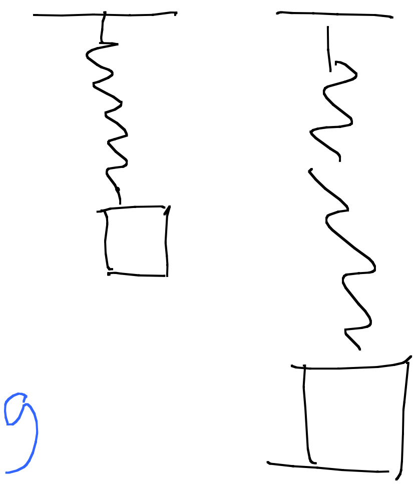
$m_1 = 0$
$a = g$

$m_2 = 0 \quad m_1 \neq 0$
$a = -g$

Spring Force

Spring exerts force which incr's with its length.





Ideal spring

$$|F_s| \propto |x|$$

$$F_{spr} = -kx$$

k = spring const / force const

Units

$$N = [k]\,m$$

$$[k] = \frac{N}{m} = kg/s^2$$

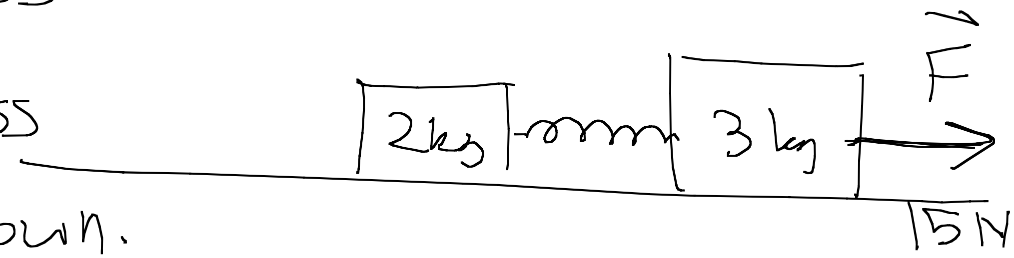
4.37 A 35-N force is applied to a spring with spring constant $k = 220\ \frac{N}{m}$. How much does the spring stretch?

$$|F_{spr}| = |kx|$$

$$\frac{F}{k} = |x| = \frac{35\,N}{220\,\frac{N}{m}} = 0.159\ m$$

$$= 15.9\,cm$$

4.51 A 2.0 kg mass and a 3.0 kg mass are on a fric'less surface as shown.

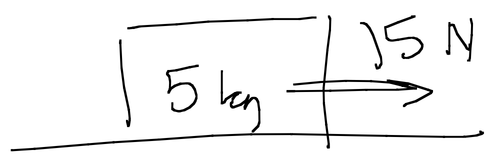


Conn'd by massless spring

$k = 140 \frac{N}{m}$. How much does spring stretch from its equilibr. position?

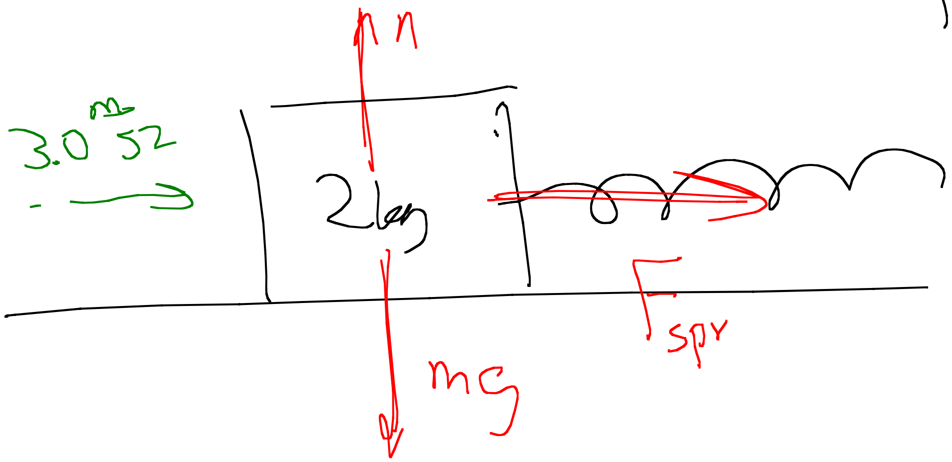
Assume they both together.

You can do this:



$a = 3.0 \frac{m}{s^2}$

Look at forces on 2 kg mass

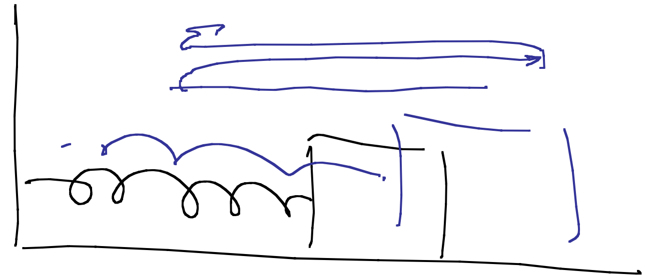


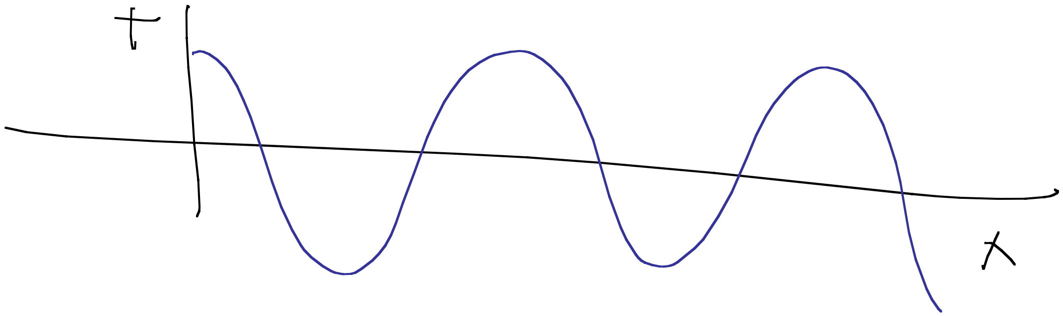
$$F_{spr} = (2\,kg)(3.0\,\tfrac{m}{s^2}) = 6\,N = |kx|$$

$$x = \frac{6\,N}{k} = \frac{6\,N}{140\,\frac{N}{m}} = 0.0429\,m$$

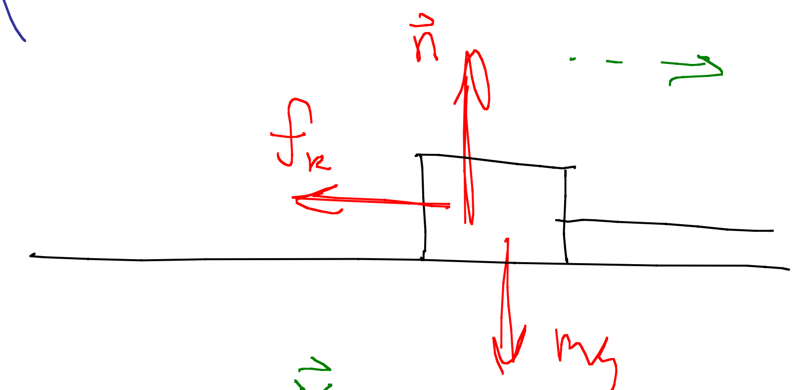
$$= 4.29\,cm$$

More interesting "Oscillations"





Friction



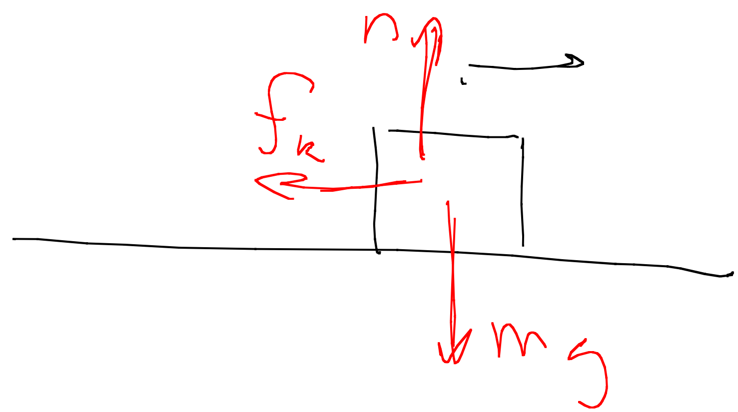
Kinetic friction

(Sliding friction)

Materials

Normal force

f_k is prop to normal



$$f_k = \mu_k n$$

μ_k coefficient of kinetic friction

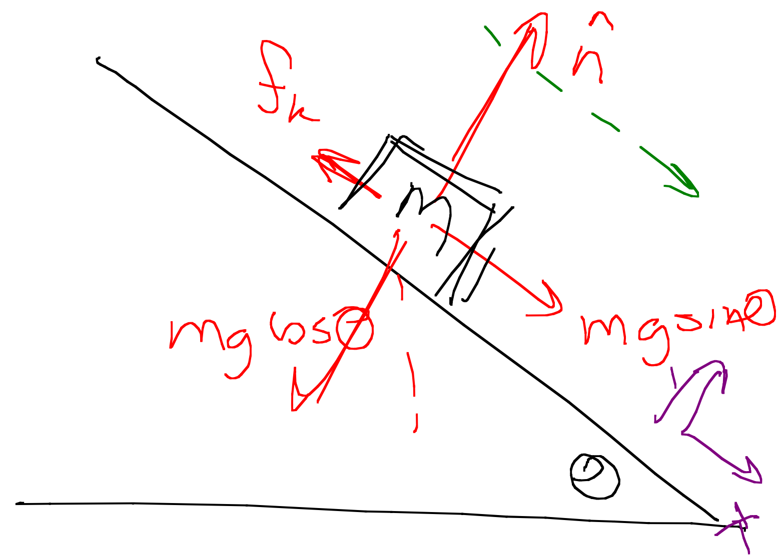
Units?

Units?

$N = (\quad) N$

No units!

$$n = mg\cos\theta \qquad \Sigma F_y = 0$$



$$F_{x_{net}} = mg\sin\theta - f_k$$

$$= mg\sin\theta - \mu_k n$$

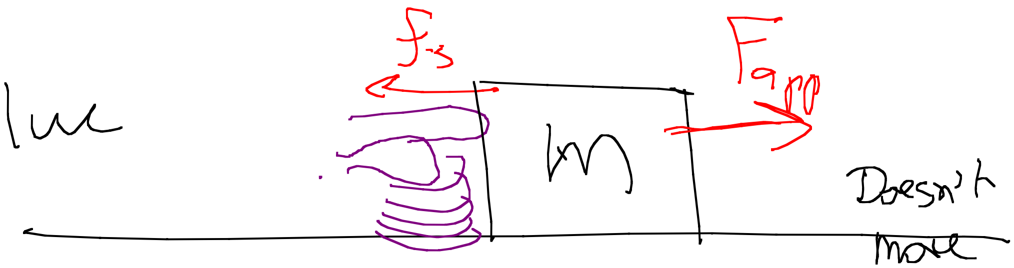
$$= mg\sin\theta - \mu_k(mg\cos\theta)$$

$$= \cancel{m}g(\sin\theta - \mu_k\cos\theta) = \cancel{m}a_x$$

$$a_x = g(\sin\theta - \mu_k\cos\theta)$$

Must get pos number here!

One other kind of friction:



f_s has some <u>max</u> value

f_s^{max}

$f_s = F_{appl}$

Depends materials

Also on normal force.

$$f_s^{max} = \mu_s n$$

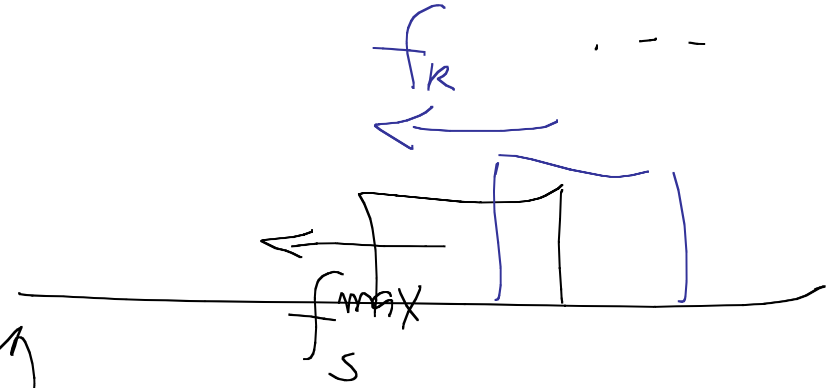
μ_s = coeff. of static friction

Compare

Requires more force to start it moving

$$f_s^{max} > f_k$$

$$\mu_s > \mu_k$$

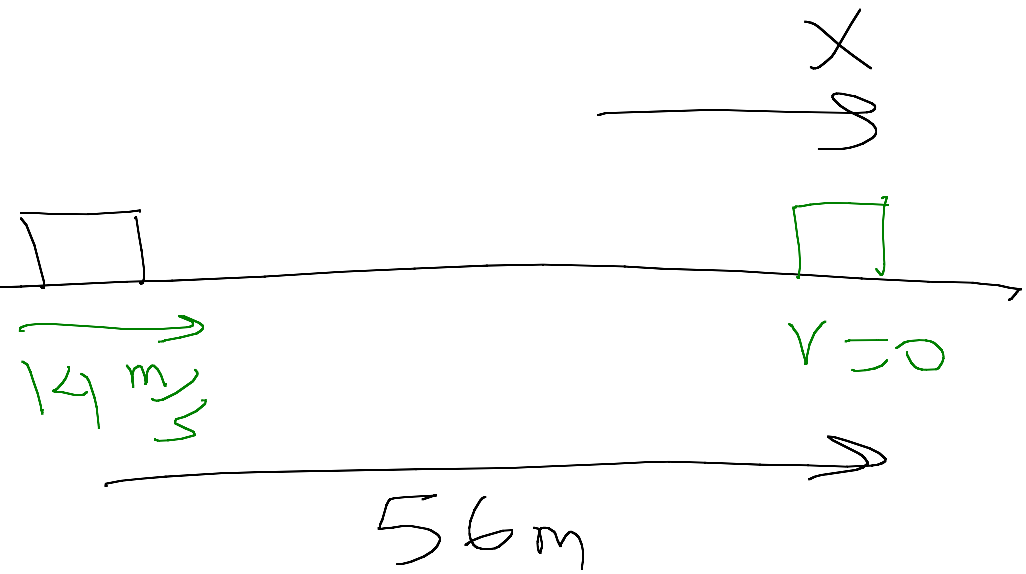


5.29 A hockey puck is given an initial speed of 14 m/s. If it comes to rest in 56 m what is coeff of kinetic friction?

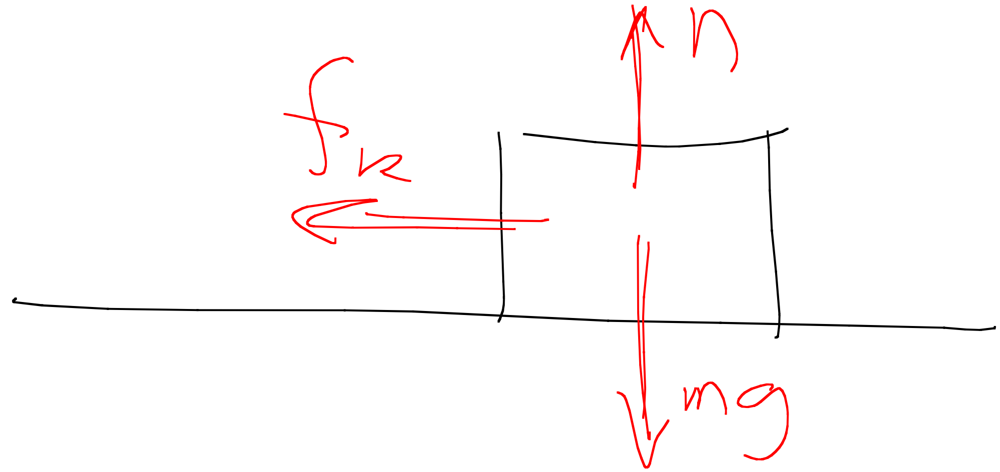
$$v^2 = v_0^2 + 2ax$$

$$0 \quad (14)^2 + 2a(56\,m)$$

$$a = -1.75 \frac{m}{s^2}$$



forces



$$f_k = -\mu_k n = -\mu \cancel{m} g$$

$$= ma = \cancel{m}\left(-1.75\,\frac{m}{s^2}\right)$$

$$\mu_k g = \left(1.75\,\frac{m}{s^2}\right)$$

$$\boxed{\mu_k = 0.179}$$