(1

9-23-13

CH 5

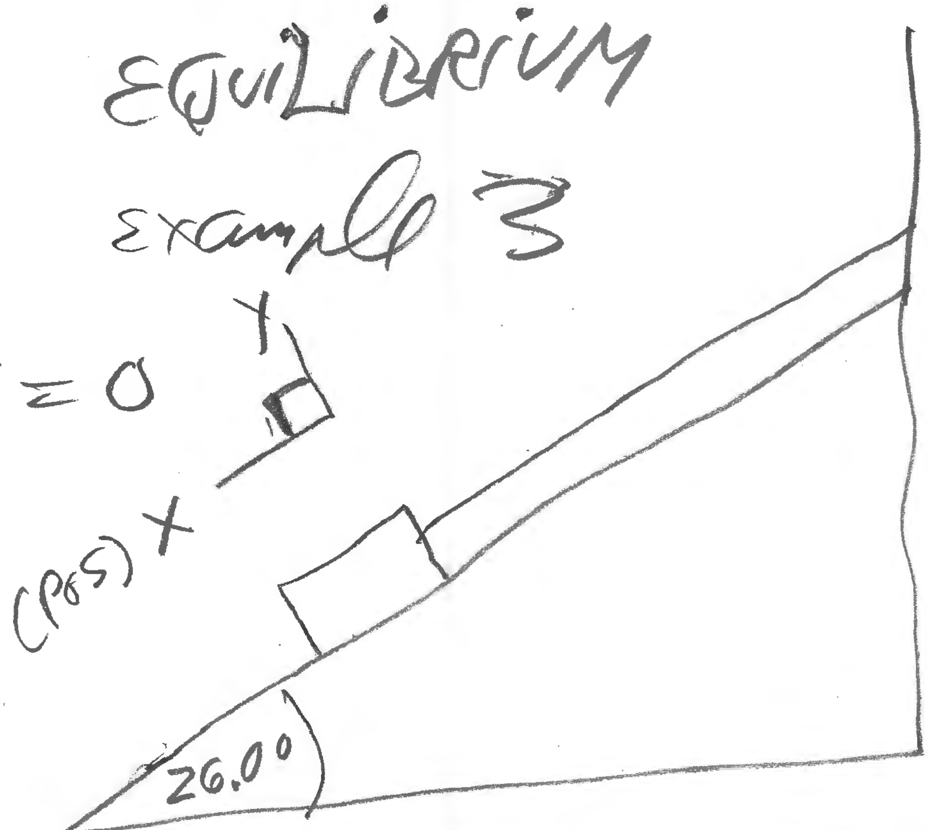
- EQUILIBRIUM problems (at rest) OR (straight line, constant speed)
- DYNAMIC problems

CH 5 is Example driven

EQUILIBRIUM

example 3

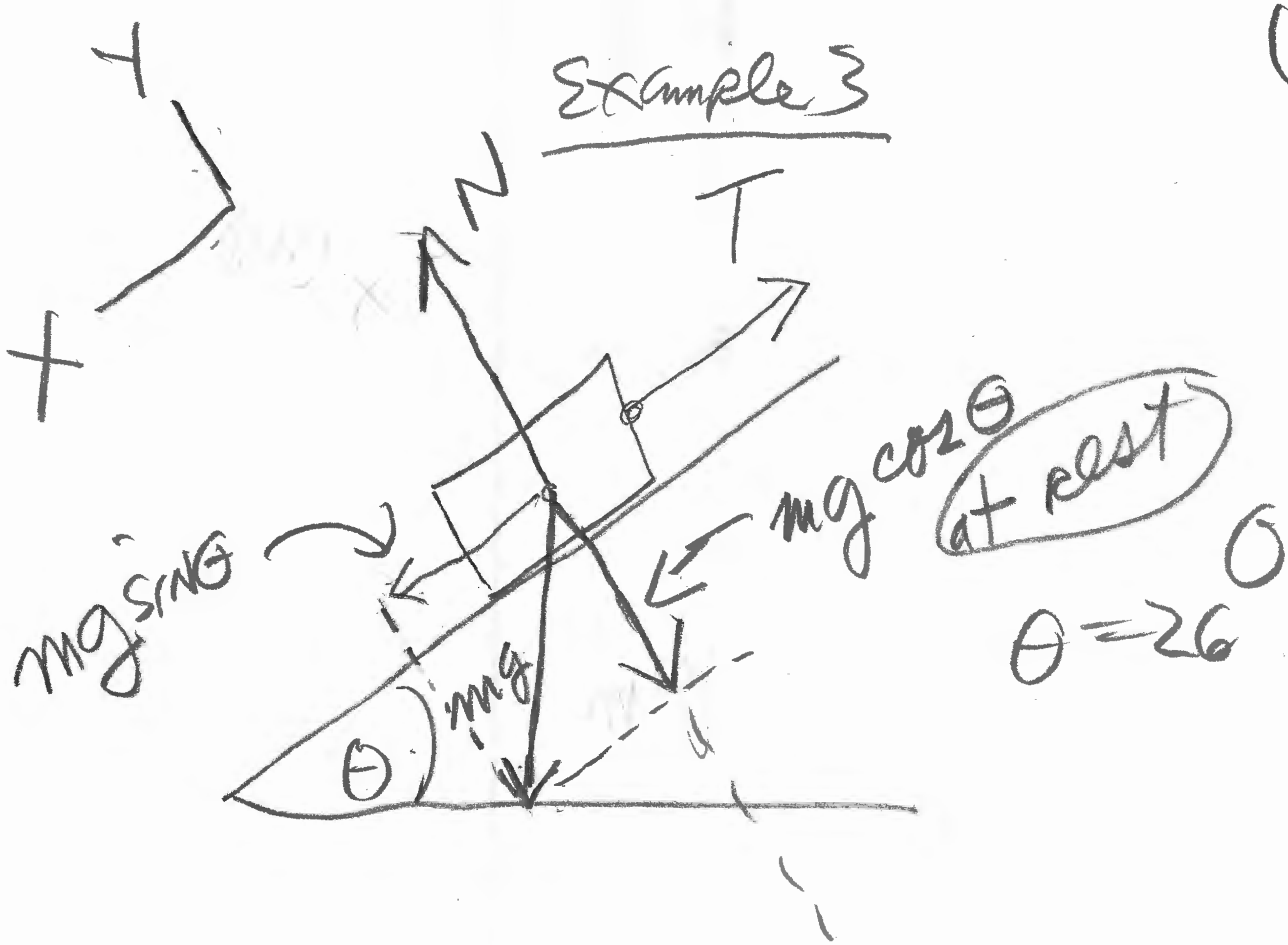
$\vec{a} = 0$



$\sum F_x = ma_x = pos - neg$

$\sum F_y = ma_y = pos - neg$

Example 3



$ma_x = 0 = pos - neg$

$0 = mg\sin\theta - T$

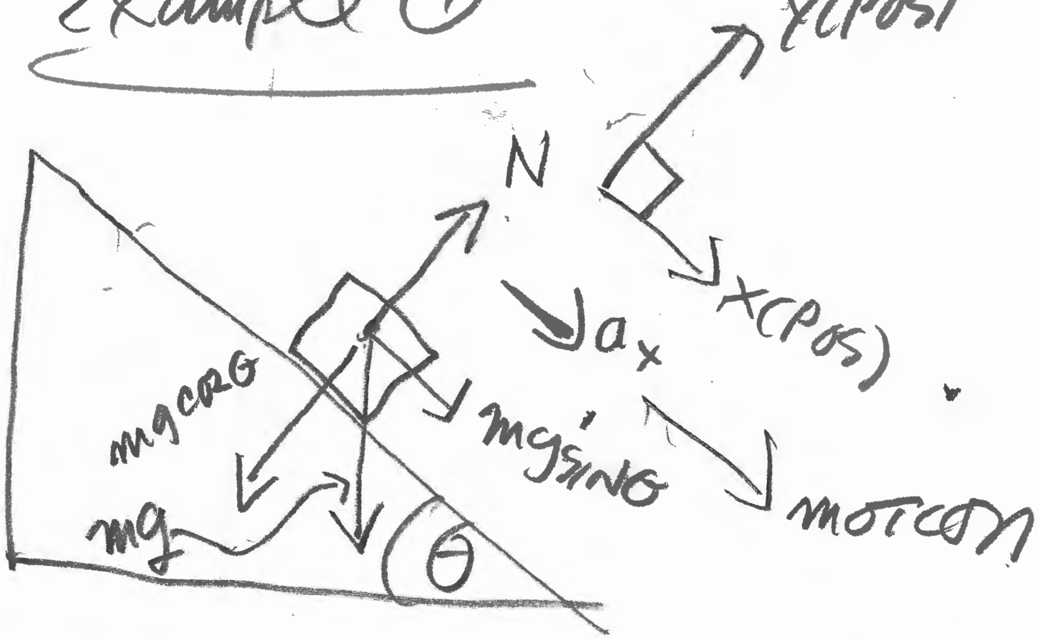
$$\boxed{T = mg\sin\theta}$$

$ma_y = 0 = pos - neg$

$0 = N - mg\cos\theta$

$N = mg\cos\theta$, usually true even if it slid down incline.

Example 6



$$\sum F_x = ma_x = pos - neg$$

$$ma_x = mg\sin\theta - 0$$

$$ma_x = mg\sin\theta$$

$$\boxed{a_x = g\sin\theta}$$

$$\sum F_y = ma_y = pos - neg$$

$$ma_y = N - mg\cos\theta = 0$$

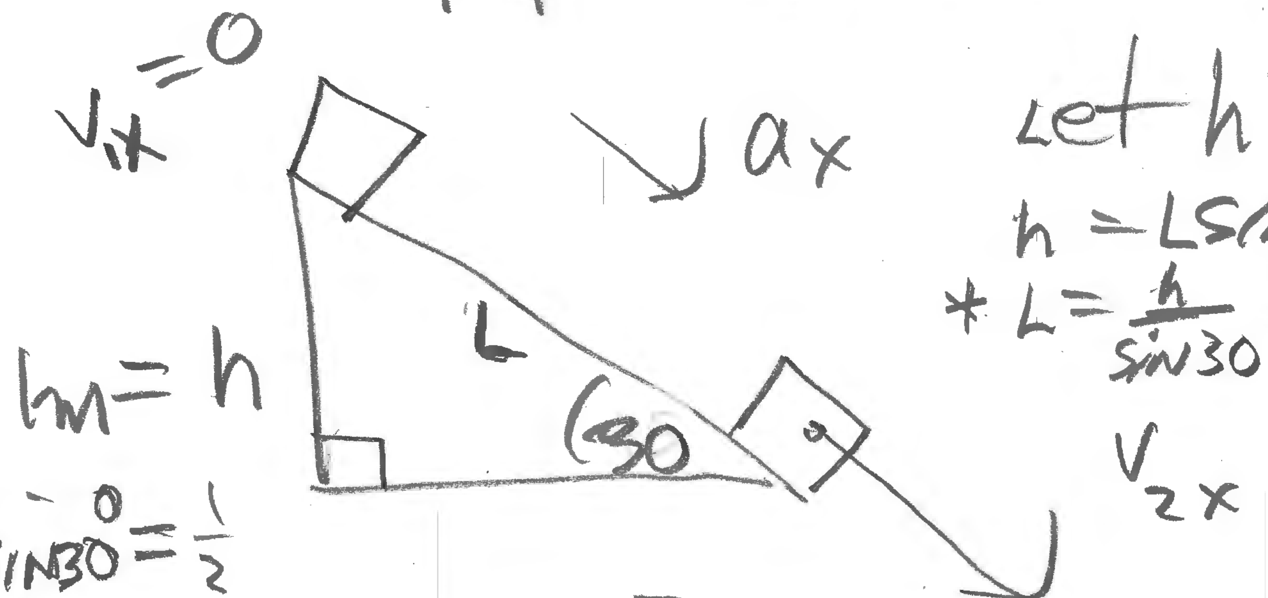
$a_y = 0$ because box moves along x.

$$\boxed{N = mg\cos\theta}$$

Let box start from rest at top.

Let $\theta = 30^\circ$.

What is speed at bottom?



Let $h = 1m$

$h = L\sin\theta$

$* \; L = \frac{h}{\sin 30} = \boxed{2m}$

$* \; \sin 30^\circ = \frac{1}{2}$

$$V_{2x}^2 = V_{1x}^2 + 2 \cdot a_x \cdot \Delta X$$

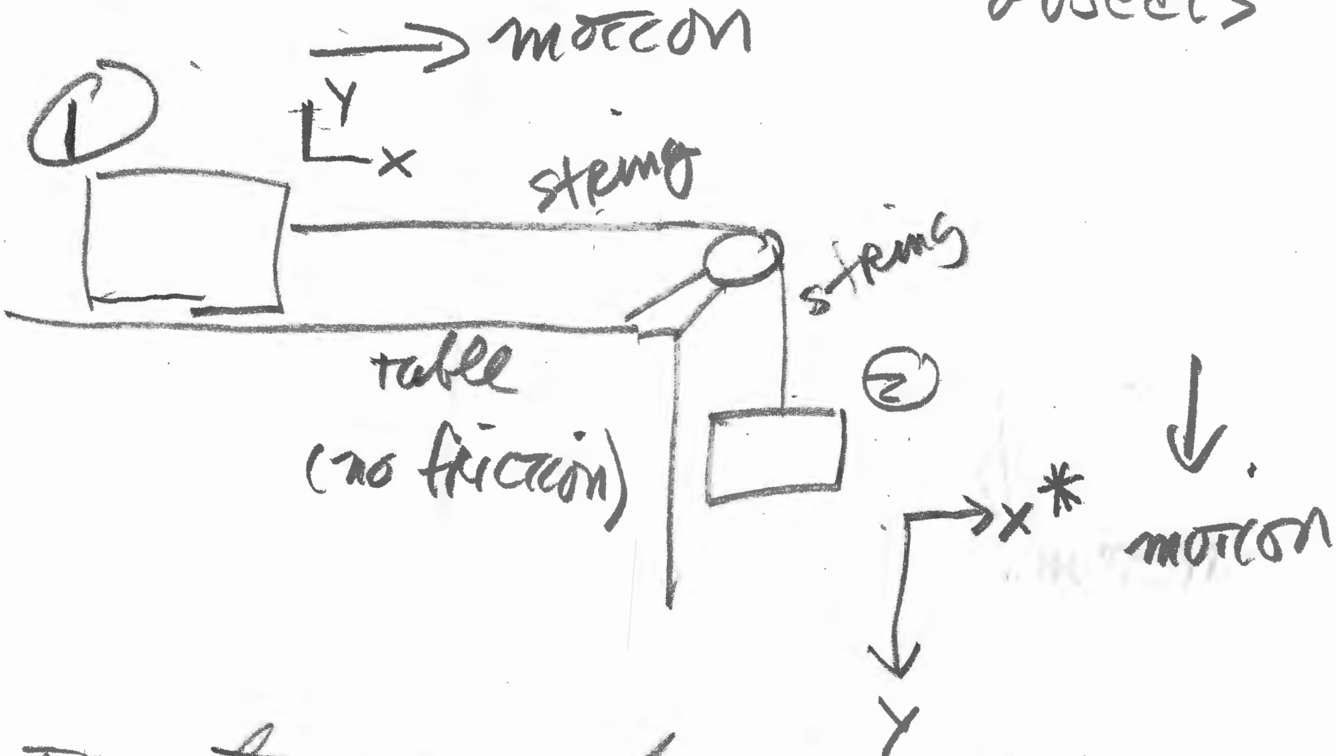
$$= 0^2 + 2 \cdot g\sin 30 \cdot (2m)$$

$$V_{2x}^2 = 2 \cdot (9.8) \cdot \frac{1}{2} \cdot 2 = 19.6 \frac{m^2}{s^2}$$

$$\boxed{V_{2x} = 4.4 \, m/s}$$

Example 7

connected objects

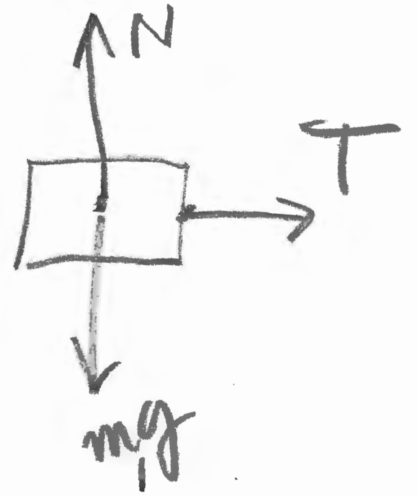


Isolate each object

(1.) $\sum F_x = m_1 a_x = \text{pos} - \text{neg}$

$m_1 a_x = T - 0$

$\boxed{m_1 a_x = T}$



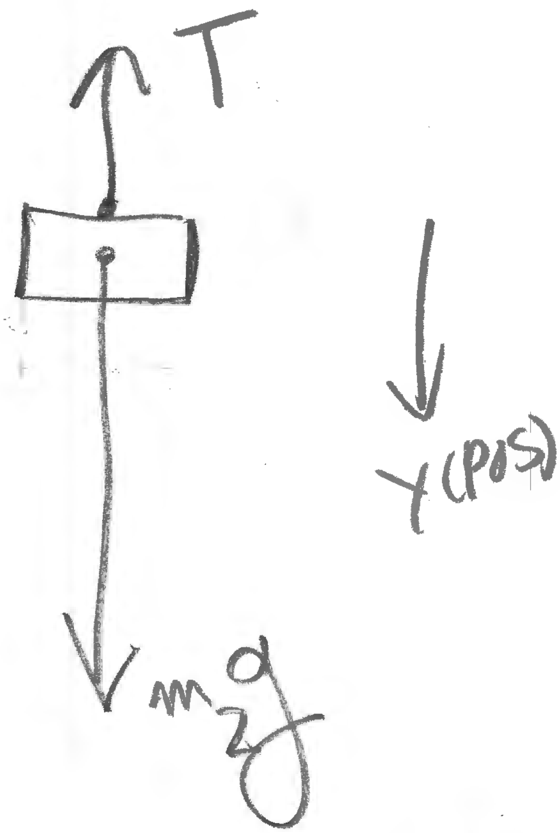
$\sum F_y = m_1 a_y = 0 = \text{pos} - \text{neg}$

$0 = N - m_1 g$

$\boxed{N_1 = m_1 g}$

* x for (2) NOT needed

2.



$\sum F_y$ = pos − neg

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

2 equations and 2 unknowns:
T and $a = a_x = a_y$.
string does not stretch.

(1.) $m_1 a = T$

and

(2.) $m_2 a = m_2 g - T$

$$\boxed{m_1 a + m_2 a = m_2 g}$$

ADD to cancel T

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

let $m_2 = 1\,kg$

$m_1 = 10\,kg$

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

$$= \frac{(1\,kg)(9.8\,\frac{m}{s^2})}{11\,kg}$$

$$= 0.89\,m/s^2 \approx \frac{1}{11} g$$

Now, get T

(1) $m_1 a = T$

(2) $m_2 a = m_2 g - T \Rightarrow T = m_2 g - m_2 a$

$= m_2(g-a)$

Use (1) (convenient)

$T = (10\,kg)(0.89\,\frac{m}{s^2})$

$= 8.9\,(N)$

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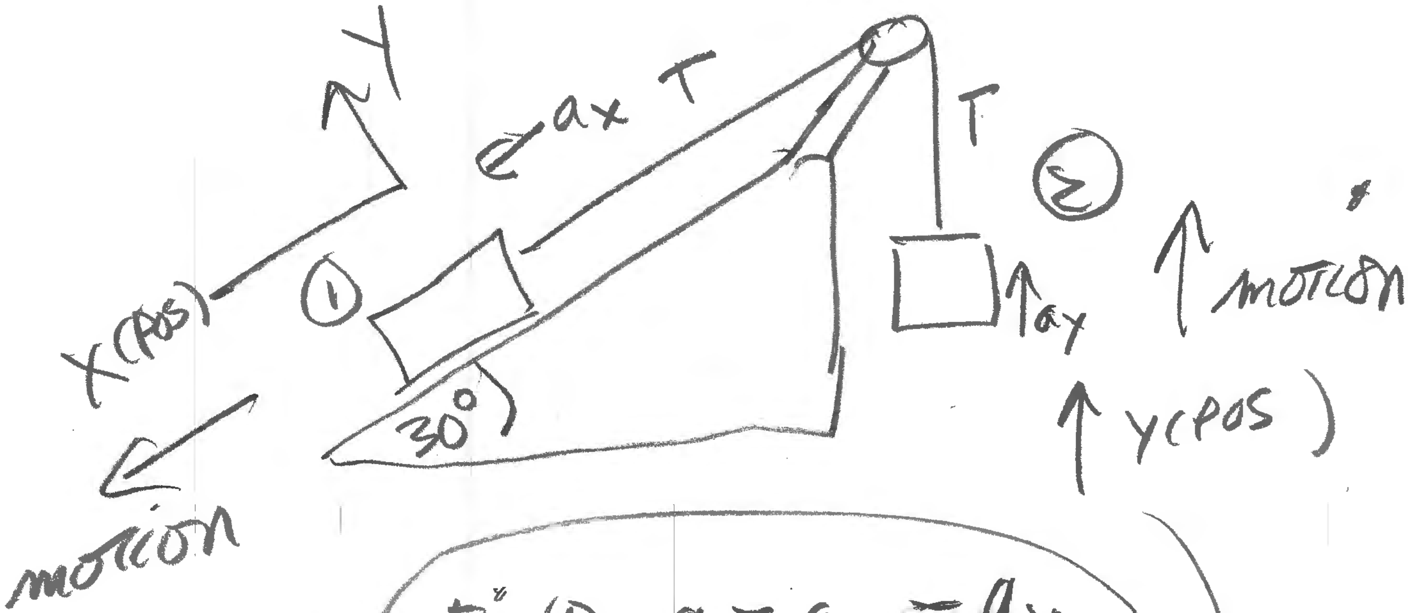
comment: TRY THIS

check! $m_1 g \sin 30 \overset{?}{>} m_2 g$

$50\,(N) > 10\,(N)$

mass (1) moves DOWN

Extension

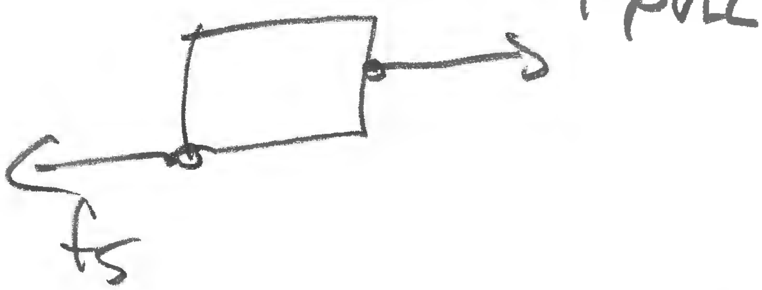


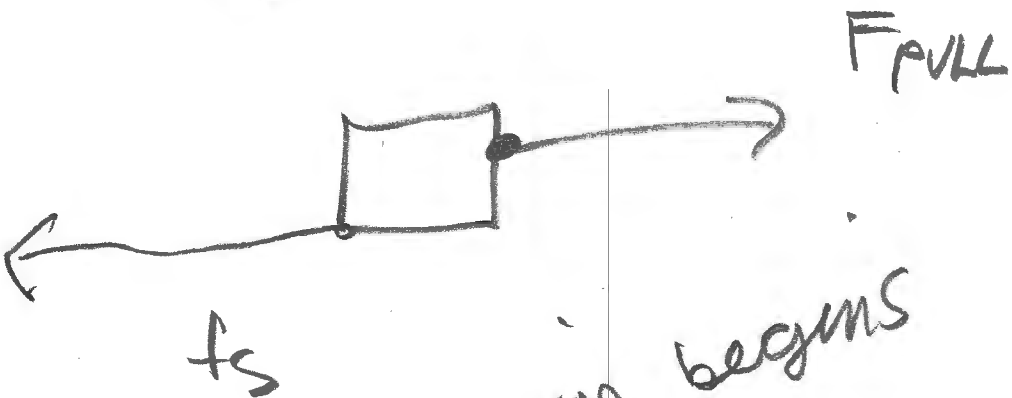
Find $a = a_x = a_y$

and T.

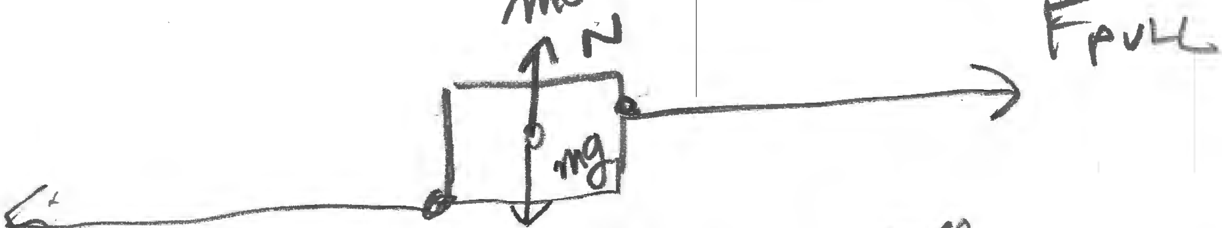
sec 5-3 : friction

at rest

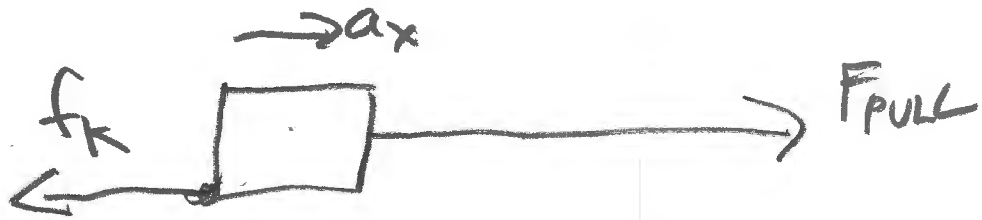




motion begins



$$f_{s\,max} = \mu_s \cdot N = \mu_s \cdot mg$$



$$f_k = \mu_k \cdot N$$