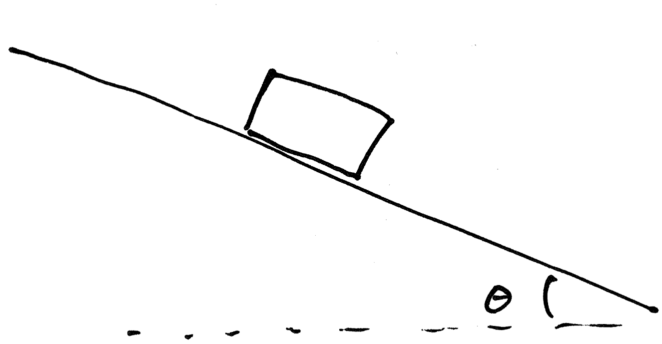
FORCE DIAGRAMS

~~EXCER~~

EXERCISE #1

5 MIN

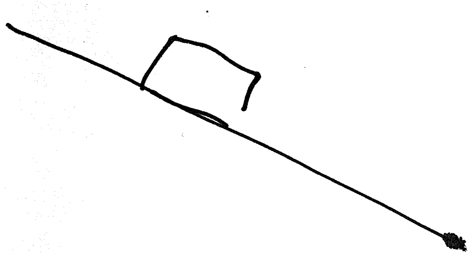
DRAW FORCE DIAGRAM



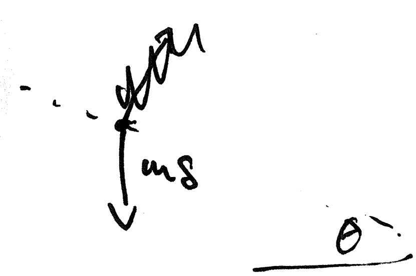
WHAT I DO

0. PRACTICE
1. DRAW PHYSICAL SITUATION
2. IDENTIFY GRAVITATIONAL FORCE
3. NORMAL FORCE

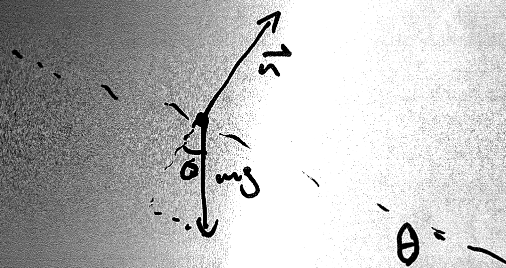
1.



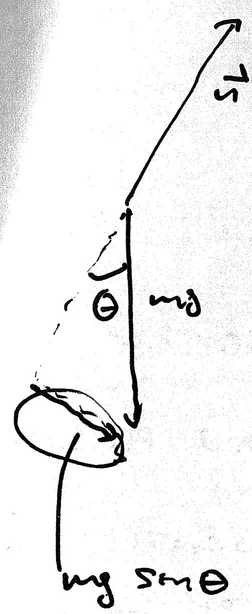
2.



3.



4. IDENTIFY USEFUL COMPONENS



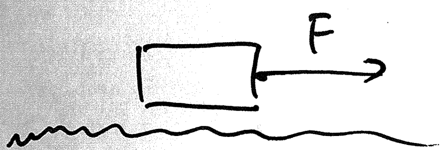
4.5 DEFINE GOOD COORDINATES

5. WRITE DOWN MOTION i.e. $\sum \vec{F}_x = ma_x$

$$\cancel{m}a_x = \cancel{m}g\sin\theta$$

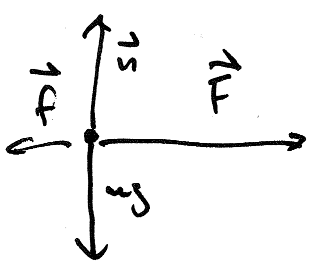
$$a_x = g\sin\theta$$

- KINETIC FRICTION



FIND ACCELERATION

FREE BODY DIAGRAM



$$|\vec{f}| = \mu_k |\vec{n}|$$

- MOTION IN x DIRECTION ONLY

$$\sum F_x = (|\vec{F}| - |\vec{f}|)\hat{i}$$

$$\sum F_x = \underline{F - \mu n} = m a_x$$

$$a_x = \frac{F - \mu n}{m}$$

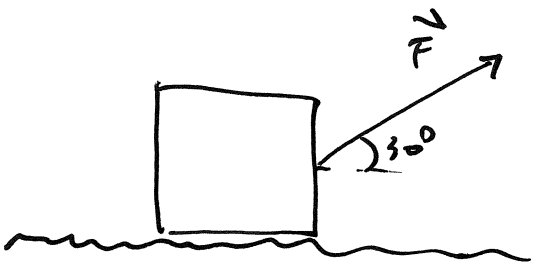
$a_y = 0$

$$\sum F_y = 0 = \vec{n} - mg \rightarrow n = mg$$

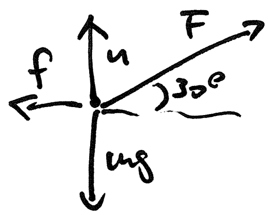
$$= \frac{F - \mu mg}{m}$$

-

$$a_x = \frac{F}{m} - \mu_k g$$



ACCELERATION?



$$\sum F_x = F\cos\theta - f = ma_x$$

$$\sum F_y = F\sin\theta + n - mg = ma_y = 0$$

$$ma_x = F\cos\theta - f = F\cos\theta - \mu_k n$$

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

$$ma_x = F\cos\theta - \mu_k [mg - F\sin\theta]$$

$$= \cancel{F[\cos\theta + \mu_k \sin\theta]}$$

$$ma_x = F[\cos\theta + \mu_k \sin\theta] - \mu_k mg$$

$$a_x = \frac{F}{m}[\cos\theta + \mu_k \sin\theta] - \mu_k g$$

$\theta = 30°$

$$a_x = \frac{F}{m}\left[\frac{\sqrt{3}}{2} + \mu_k \frac{1}{2}\right] - \mu_k g$$

AT $\theta = 0$

$$a_x = \frac{F}{m} - \mu_k g$$

$a_x(\theta = 30) > a_x$

IF FORCE IS THE SAME

$\cos\theta + \mu_k \sin\theta > 1$

$1(1 + \mu_k \tan\theta) > \frac{1}{\cos\theta}$

$\mu_k \sin\theta > 1 - \cos\theta$

$$\mu_k > \frac{1 - \cos\theta}{\sin\theta}$$

(F $a_x = 0$

$$\frac{F}{m}\left[\cos\theta + \mu_k \sin\theta\right] = \mu_k g$$

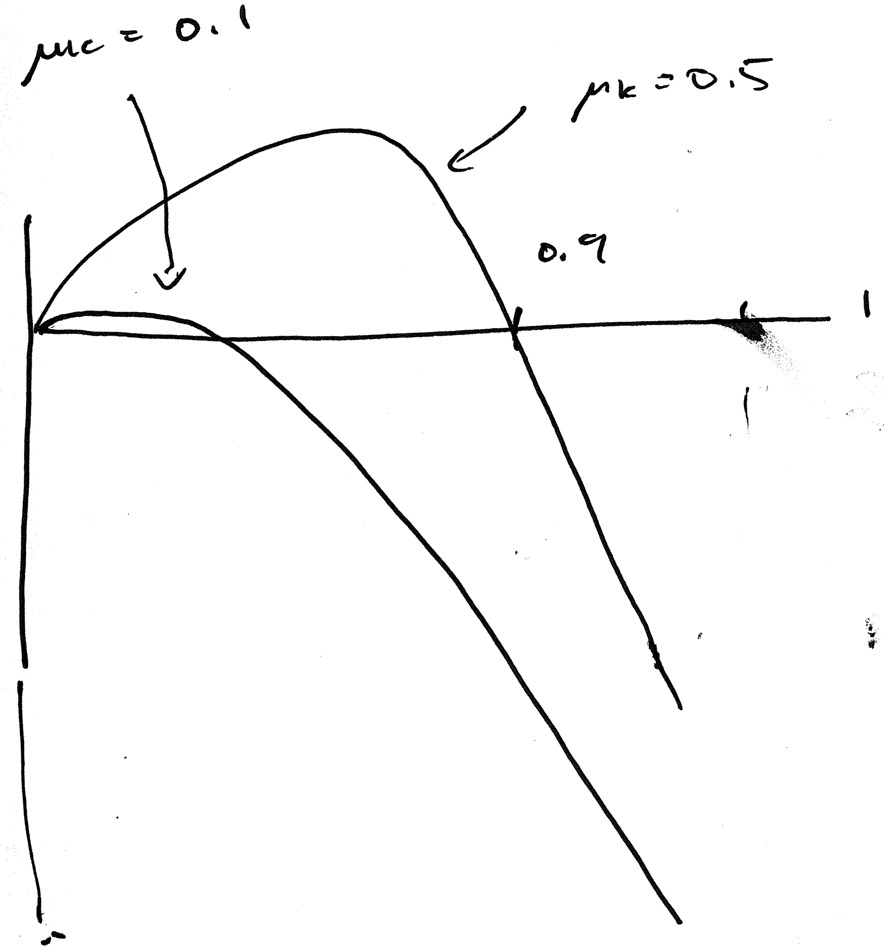
$$F = \frac{\mu_k m g}{\cos\theta + \mu_k \sin\theta}$$

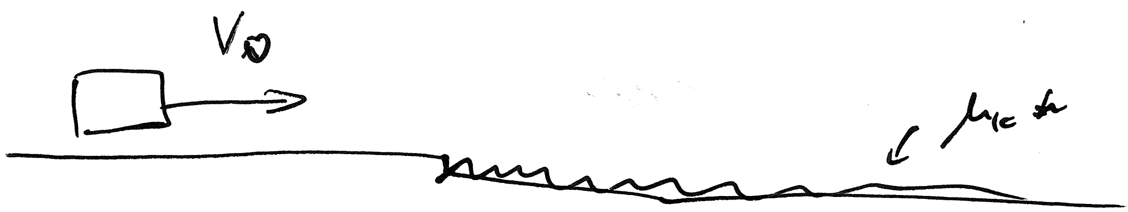
$\theta = 0$

$F = \mu_k m g$

OK.

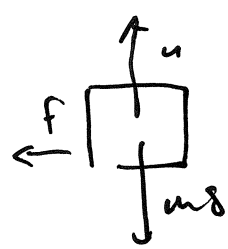
IF $\cos\theta + \mu_k \sin\theta < 1$ YOU REQUIRE LESS TORQ





AT BOUNDARY $\underline{\underline{V_0}}$

AFTER BOUNDARY



$$ma = -\mu N \hat{i}$$

$$\vec{a}_x = -\frac{\mu N}{m}\hat{i}$$

$$V_x(t) = -\frac{\mu N}{m}t + V_0$$

AT t_f $\quad V(t_f) = 0 = -\frac{\mu N}{m}t_f + V_0$

$$t_f = \frac{m V_0}{\mu N}$$

$$P(T) = -\frac{\mu N}{2m} t^2 + V_0 t$$

$$P(T_E) = -\frac{\mu N}{2m}\left(\frac{m V_0}{\mu N}\right)^2 + V_0\left(\frac{m V_0}{\mu N}\right)$$

$$= -\frac{\cancel{\mu N}}{2\cancel{m}} \frac{\overset{m}{\cancel{m^2}} V_0^2}{\underset{\mu N}{\cancel{\mu^2 N^2}}} + \frac{m V_0^2}{\mu N}$$

$$P(T_E) = \frac{1}{2} \frac{m V_0^2}{\mu N}$$

DISTANCE × FORCE = ENERGY

$$\frac{1}{2}\frac{m V_0^2}{\cancel{\mu N}} \times \cancel{\mu N} = \underline{\frac{1}{2} m V_0^2}$$ (INITIAL ENERGY DISSIPATED INTO FRICTION)