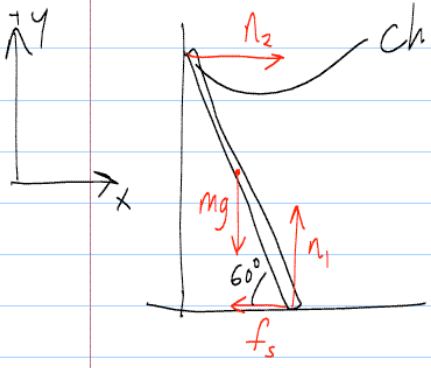
PHY131 - Class 19 - Mon. Nov. 21, 2011

Choose



choose pivot to be where ladder touches wall.

Balance x, y:

	x	y
n_2	n_2	0
mg	0	$-mg$
n_1	0	$+n_1$
f_s	$-\mu_s n_1$	0

Ladder is "just about to slip"

$\Rightarrow f_s = f_{s,max} = \mu_s n_1$

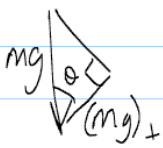
$(F_{Net})_x = 0 = n_2 - \mu_s n_1$

$(F_{Net})_y = -mg + n_1 = 0 \quad \Rightarrow n_1 = mg$

$n_2 = \mu_s n_1 = \mu_s mg$

Balance torques.

gravity: $\theta = 60°$

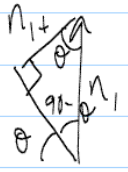


$r = L/2$

$F_\perp = mg\cos\theta$

$\tau_g = -\frac{L}{2} mg\cos\theta$

- Torque due to n_2 is zero, since it acts at pivot.

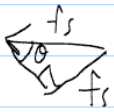


$r = L$

$n_{1\perp} = n_1\cos\theta$

$\tau_{n_1} = +n_1\cos\theta\, L$

$\mu_s n_1$



$f_{s\perp} = f_s\sin\theta$

$r = L$

$\tau_{f_s} = -\mu_s n_1 \sin\theta\, L$

$$\tau_{Net} = 0 = -mg\cos\theta \frac{L}{2} + n_1 \cos\theta L - \mu_s n_1 \sin\theta L$$

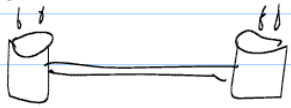
Solve for μ_s, set $n_1 = mg$.

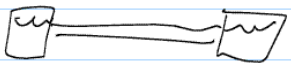
$$\mu_s mg \sin\theta L = mg\cos\theta L - mg\cos\theta \frac{L}{2}$$

$$\mu_s \cancel{mg} \sin\theta \cancel{L} = \cancel{mg}\cos\theta \frac{\cancel{L}}{2}$$

$$\mu_s = \frac{\cos\theta}{2\sin\theta} = \frac{1}{2\tan\theta} = \frac{1}{2\tan 60^\circ}$$

$$\boxed{\mu_s = 0.29}$$

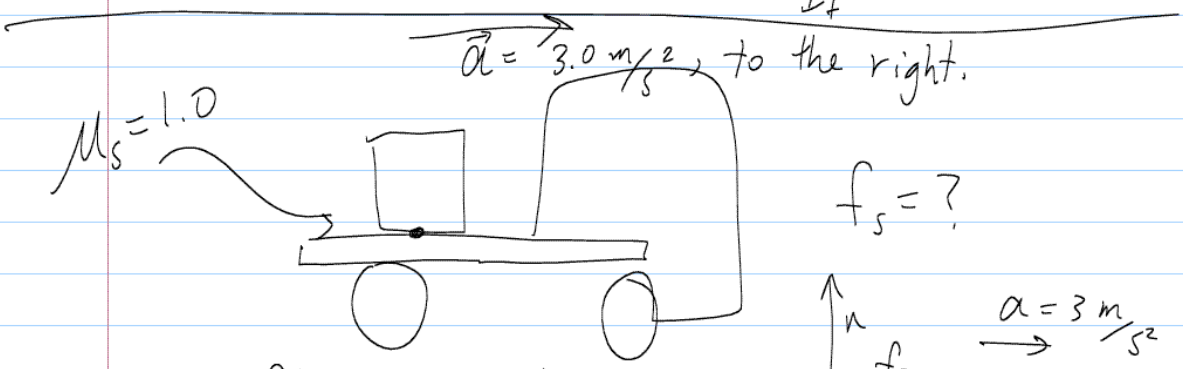
Before:  empty buckets, spin at ω_i

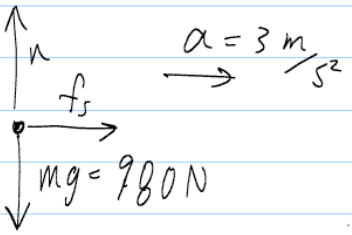
After:  m_f is greater. I_f is greater.

$L_f = L_i$

$I_f \omega_f = I_i \omega_i$

$\omega_f = \frac{I_i}{I_f} \omega_i < \omega_i$





fbd. of box:

$a_y = 0$ $\quad (F_{Net})_y = 0 = n - mg = 0$

$n = mg = 980\ N.$

$f_s \leq \mu_s n \leq 980\ N.$

$a_x = +3.0\ m/s^2$ $\quad (F_{Net})_x = ma_x = f_s$

$$f_s = m a_x = (100\,kg)(3.0)$$
$$= 300\,N.$$