Announcements

- WA#2 has been regraded – thanks for the feedback
- CBTF Quiz 5 this week
- MATLAB Lecture: Thursday, 5-6PM, location TBD
- Homework grade update

18% = PL + ME + WA.

- Upcoming deadlines:
- Wednesday (11/1)
  - PL HW18 – EXTENDED!
- Thursday (11/2)
  - ME HW19
- Friday (11/3)
  - WA#3

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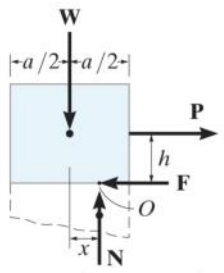
Recap: Dry friction



All forces in the same direction as F_{fric}

1.) Equilibrium: $F_{fric} = P$

2.) Pending motion: $F_{fric} = F_s = \mu_s N$.

3.) In motion: $F_{fric} = \mu_k N$

μ_s: coefficient of static friction

μ_k: coefficient of kinetic friction

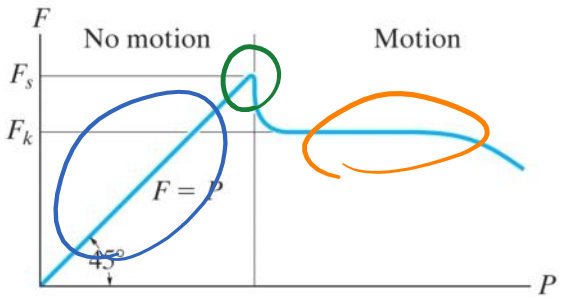


Table 8–1 Typical Values for μ_s	
Contact Materials	Coefficient of Static Friction (μ_s)
Metal on ice	0.03–0.05
Wood on wood	0.30–0.70
Leather on wood	0.20–0.50
Leather on metal	0.30–0.60
Aluminum on aluminum	1.10–1.70

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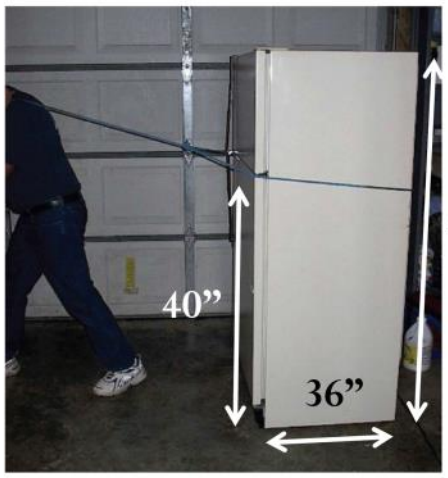
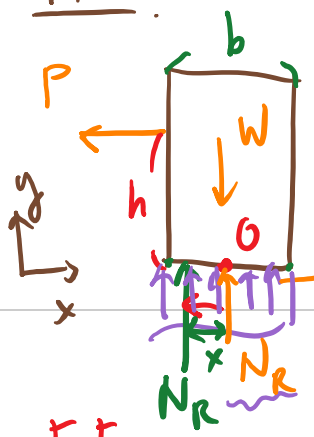


Given: Fridge weight = 250 lb and $\mu_s = 0.4$

Find: The maximum horizontal force P that can be applied at without causing movement of the crate.

FBD



EoE

$\Sigma M_O = Ph \neq 0$

non-zero moment about O

~ N_R is going to shift its position to counter the moment from P.

→ shift left to create negative moment.

$\Sigma M_O = Ph - N_R x = 0.$

$\Rightarrow \boxed{x = \frac{Ph}{N_R}}$ $\quad 0 < x < \frac{b}{2}$

x cannot go past the edge of the fridge

① Slipping

Assume: $F_{fric} = F_s = \mu_s N$

$\Sigma F_x = F_{fric} - P = 0$

$P = F_{fric} = \mu_s N$

$\Sigma F_y = N - W = 0$

$N = W$

$\boxed{P_{slip} = \mu_s W}$

force require to slide the fridge

② Tipping

Assume: $x = \frac{b}{2}$

$\Sigma F_x = F_{fric} - P = 0$

$\Sigma F_y = N - W = 0$

$\Sigma M_O = Ph - N\left(\frac{b}{2}\right) = 0$

$\boxed{P_{tip} = \frac{Nb}{2h} = \frac{Wb}{2h}}$

force required to tip the fridge

⇒ Compare the two and pick the smaller value, which will occur first when you slowly increase P from zero.

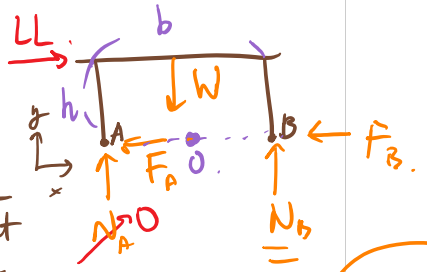
$P_{slip} = 100\,lb > P_{tip} = 64.3\,lb$

⇒ fridge will tip first

How much horizontal force does Liz Lemon need to show people that she is angry? Can she do it? (The 96"L x 42"W x 30"H table and its contents weigh 150 lb)

~ For the tipping case, assume all the normal force will be concentrated at B to counter the positive moment from LL about O.

FBD



$\Sigma M_o = -(LL)(h) + N_B(\frac{b}{2}) - N_A(\frac{b}{2})$ ($N_A \to 0$)

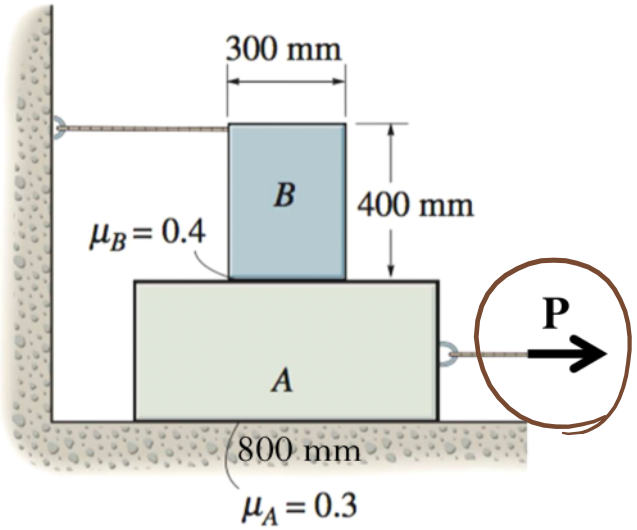
$= 0$

$\Sigma F_y = N_B - W = 0 \Rightarrow N_B = W$

Force required to flip the table: $LL = \frac{N_B b}{2h} = \frac{Wb}{2h} = \frac{W(42\text{in})}{2(30\text{in})} = 105\text{ lb}$

Monday, October 30, 2017 11:13 AM

Blocks A and B have the same height and a mass of 7 kg and 10 kg, respectively. Determine the largest vertical force P which can be applied to the cord attached to the middle of B without causing motion.



Motion

Translation (slide)

Assume: $F_s = \mu_s N$

Rotation (tip)

Assume: $x = 150\text{mm}$

FBD