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Wednesday, October 31, 2018 12:20 PM

Announcements

- Extra credit opportunity at CBTF this week
- This is the last week of lecture and discussions for TAM 210
  - Next week's discussion will go over friction. TAM 210 students are encouraged to attend but not required for attendance
- Written Exam next Thursday (11/8)
- Quiz 4 viewing: Friday, Nov. 2, 2-5pm, 218 MEB.

❑ Upcoming deadlines:

- Friday (11/2)
  - PL HW

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Written Exam

Thursday, November 8, 7:00–8:50pm

- Both TAM 210 and 211 students are required to take it for grade.
- Bring student ID card.
- Arrive early – we will start on time!
- Closed book, closed notes. Calculators allowed.
- DRES accommodations must be made with DRES office before Monday (11/5), schedule the exam for Thursday (11/8).
- Conflict exam must be scheduled with the staff team via online excused absence form before Monday (11/5).
- Room assignment:
  - AL1 (12pm lecture), last name A-L: 100 Noyes Lab
  - AL1 (12pm lecture), last name M-Z: 2079 Natural History Building
  - AL2 (1pm lecture), last name A-L: 141 Loomis Lab
  - AL2 (1pm lecture), last name M-Z: 151 Loomis Lab

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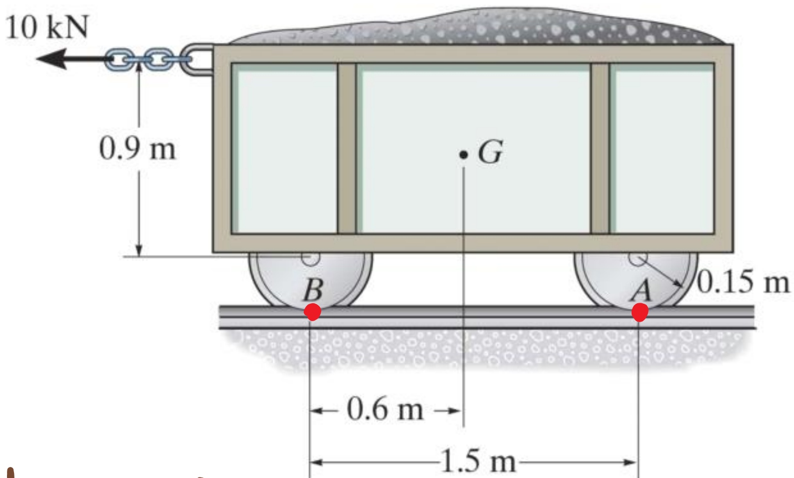
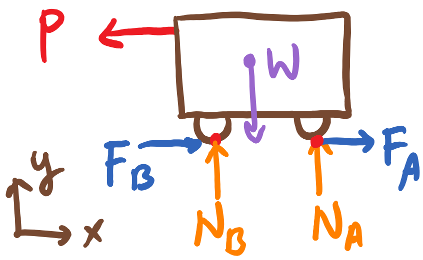
Example

The wheels of the 50-kN mine cart are locked, will then force applied be able to move the cart (the coefficient of static friction between the wheel and the track is $\mu_s = 0.4$)



FBD



EoE (solve for unknowns: N_A, N_B, F_A, F_B)

$\Sigma F_x = F_A + F_B - P = 0 \rightarrow P = (F_A + F_B)$: tutal friction $(F_A + F_B)$ is P

$\Sigma F_y = N_A + N_B - W = 0 \rightarrow W = N_A + N_B$

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$\Sigma M_B = N_A(1.5m) - W(0.6m) + P(1.05m) = 0$

$\rightarrow N_A = \dfrac{0.6W - 1.05P}{1.5} = 13\text{ kN}$, $N_B = 37\text{ kN}$

- Find maximum allowable static friction

$F_s = \mu_s N$ (max friction)

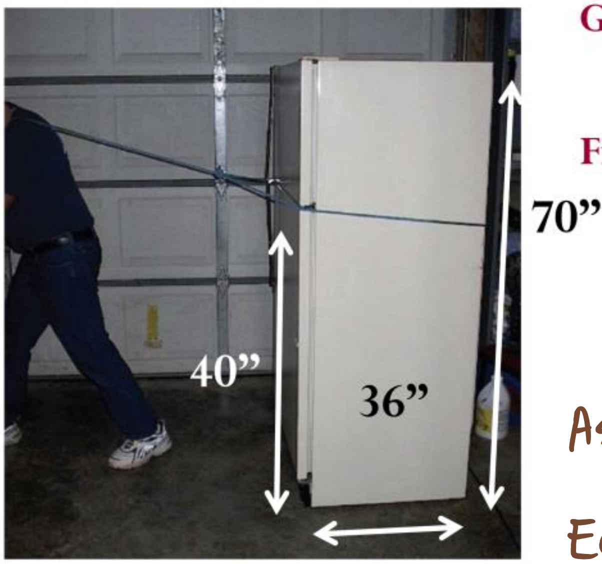
$= F_{AS} + F_{BS} = \mu_s N_A + \mu_s N_B = 0.4(13\text{ kN}) + 0.4(37\text{ kN})$

$F_s = 20\text{ kN}$

- Compare F_s to $F_A + F_B$: $20\text{kN} > 10\text{ kN}$

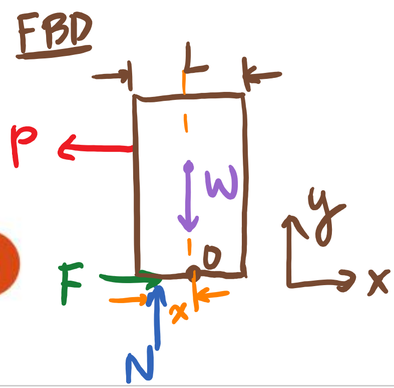
$\rightarrow$ The cart will remain at equilibrium

Slip vs. Tip



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.



Slip

Assume: $F = F_s = \mu_s N$

EoE

$$\Sigma F_x = -P + F = 0$$
$$= -P + \mu_s N = 0$$
$$\Sigma F_y = -W + N = 0$$
$$N = W$$

$$P_{slip} = \mu_s N = \mu_s W$$
$$= 0.4(250\text{ lb})$$
$$\boxed{P_{slip} = 100\text{ lb}}$$

Tip

Assume: $x = \frac{L}{2}$.

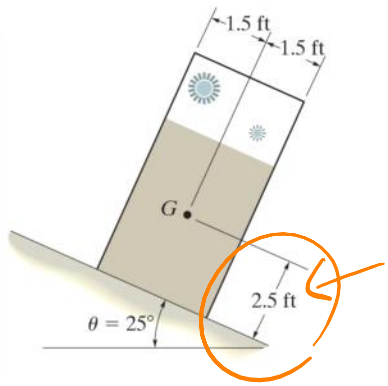
EoE

$$\Sigma M_O = P(40\text{in}) - N\left(\frac{L}{2}\right) = 0$$
$$\rightarrow P = \frac{N\left(\frac{L}{2}\right)}{40\text{in}} = \frac{W\left(\frac{L}{2}\right)}{40\text{in}}$$
$$\rightarrow \boxed{P_{tip} = 112.5\text{ lb}}$$

$P_{slip} < P_{tip}$

• the fridge will slip first.

It is observed that when the bed of the dump truck is raised to an angle of the vending machines will begin to slide off the bed. Determine the static coefficient of friction between a vending machine and the surface of the truck bed.



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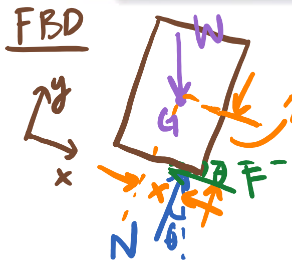

EoE

$\Sigma F_x = -F + W\sin\theta = 0$

$\Sigma F_y = N - W\cos\theta = 0$

$\Sigma M_G = Nx - F(2.5\text{ ft}) = 0$

x: distance from the center.

• slide: impending motion that assumes friction is at max: $F_s = \mu_s N$

$\Sigma F_x = -\mu_s N + W\sin\theta = 0 \rightarrow \mu_s = \frac{W\sin\theta}{N} = \mu_s = \frac{W\sin\theta}{W\cos\theta}$

$\Sigma F_y \rightarrow N = W\cos\theta$

$\mu_s = \tan\theta$

$\theta = 25°$

Q: What θ is required for the vending machine to fall over?

~ don't assume $F = F_s = \mu_s N$, do assume $x = \frac{L}{2}$, the largest distance from the center.

$\Sigma M_G = N\left(\frac{L}{2}\right) - F(2.5\text{ ft}) = 0$)

largest distance from the ...

$\Sigma M_G = N\left(\frac{L}{2}\right) - F(2.5 \text{ ft}) = 0$

$\Sigma F_x \rightarrow F = W\sin\theta$

$\Sigma F_y \rightarrow N = W\cos\theta$

$$\frac{W\cos\theta\left(\frac{L}{2}\right) = W\sin\theta(2.5)}{W\cos\theta}$$

$$\rightarrow \frac{L}{2} = \tan\theta\,(2.5)$$

$$\theta = \tan^{-1}\left(\frac{L}{5}\right)$$