wc26lect

Announcements

- CBTF Quiz 5 this week
- MATLAB Lecture: Thursday, 5-6PM, location ~~TBD~~ MEB 218.
- 211 students **DO NOT** take 210 final, or you will get a **zero** on 211 final!!!

❑ Upcoming deadlines:

- Wednesday (11/1)
  - PL HW18 – Tonight
- Thursday (11/2)
  - ME HW19
- Friday (11/3)
  - WA#3

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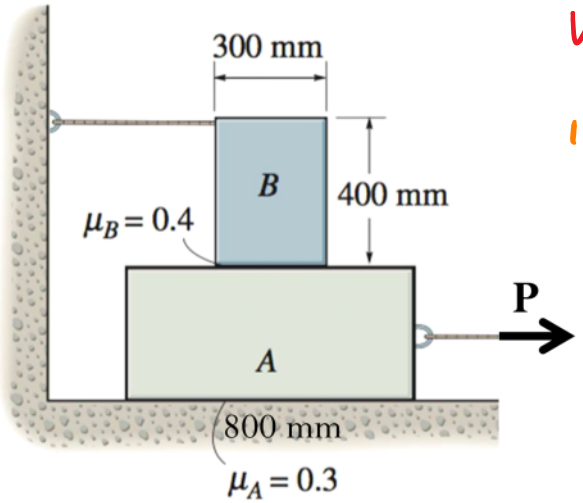
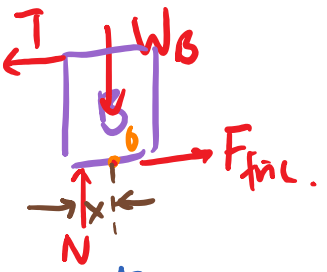
Blocks A and B have the same height and a mass of 7 kg and 10 kg, respectively. Determine the largest vertical force P which can be applied to the cord attached to the middle of B without causing motion.



When A slides out...

1.) B will slide off A

FBD



• Set $F_{fric} = F_s = \mu_s N$ for sliding

EoE

$\Sigma F_x = -T + F_{fric.} = 0$

$\Sigma F_y = N - W_B = 0 \Rightarrow N = W_B$

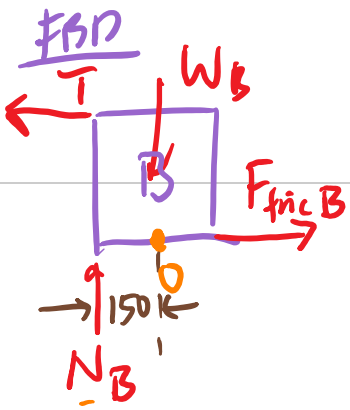
$\Sigma M_0 = T(400\text{mm}) - Nx = 0$

$\Rightarrow F_{fric} = \mu_s W_B = 39.24\,N$

for sliding case

2.) B will tip over.

FBD



• Set $x = 150\text{mm}$ for tipping.

EoE

① $\Sigma F_x = F_{fric} - T = 0 \rightarrow F_{fric} = T$

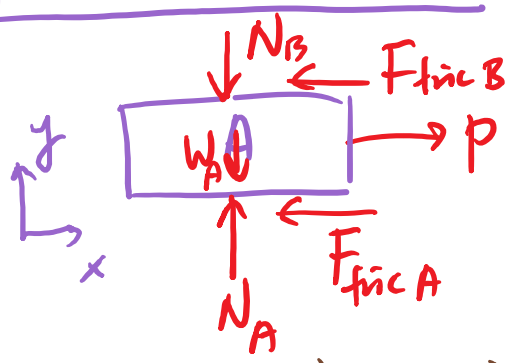
② $\Sigma F_y = N - W_B = 0$

③ $\Sigma M_0 = T(400\text{mm}) - N(150\text{mm}) = 0$

$\Rightarrow T = N\left(\frac{150}{400}\right) \overset{①,②}{\Longrightarrow} F_{fric} = W_B\left(\frac{150}{400}\right) = 36.79\text{N}$ for tipping case

~ Since the friction force on block B is smaller for the tipping case, it will occur first. Now solve for P...

FBD for block A



~ Use the F_{fricB} value derived previously, and pending motion will require F_{fricA} to be at the maximum static value, so $F_{fricA} = \mu_A N_A$

$\Sigma F_y = N_A - W_A - N_B = 0$

$\Sigma F_x = P - F_{fricB} - F_{fricA} = 0$

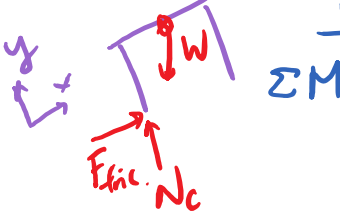
$P = F_{fricB} + F_{fricA} = 36.79\text{N} + (0.3)(166.77\text{N}) = 82.8\text{N}$

Wednesday, November 1, 2017 11:12 AM

The table weighs 50 lb and the coefficient of static friction between its legs and the inclined surface is 0.7. A force **P** parallel to the incline in applied to the table, what is the minimum magnitude to make the table move?

1.) Tipping case: the most effective way is to push down at B.

FBD

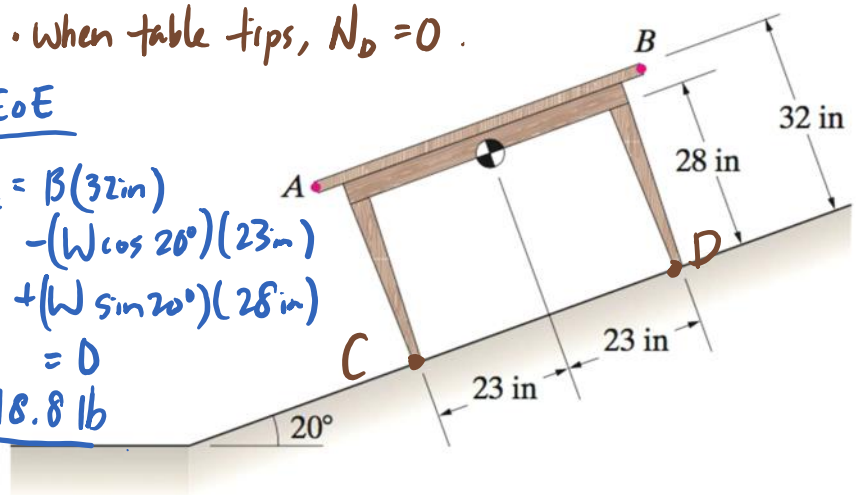


- When table tips, $N_D = 0$.

EoE

$$\Sigma M_C = B(32\text{in}) - (W\cos 20°)(23\text{in}) + (W\sin 20°)(28\text{in}) = 0$$

$$\Rightarrow B = 18.8\text{ lb}$$

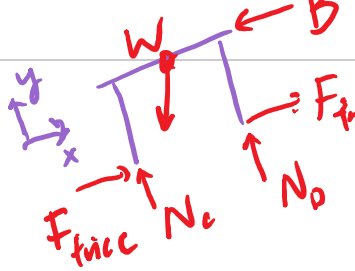


2.) Slipping Case: the most effective way is to push down the ramp at B as well.

- Impending motion: $F_{fric,C} = \mu_s N_C$

$F_{fric,D} = \mu_s N_D$.

FBD



EoE

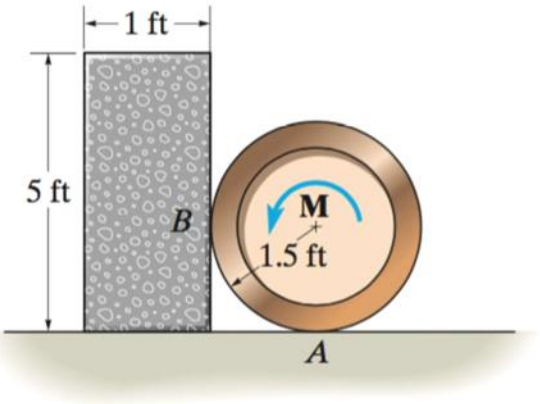
$$\Sigma F_x = F_{fric,C} + F_{fric,D} - W\sin 20° - B = 0$$

$$\Sigma F_y = N_C + N_D - W\cos 20° = 0$$

$$\Sigma M_C = W\sin 20°(28\text{in}) - W\cos 20°(23\text{in}) + N_D(46\text{in}) + B(32\text{in}) = 0$$

$$\Rightarrow B = 15.79\text{ lb} \qquad \Rightarrow B_{slip} < B_{tip} \rightarrow \boxed{B = 15.79\text{ lb}}$$

The wheel weighs 150-lb, the uniform concrete block has a weight of 300 lb. The coefficients of static friction are 0.2 at A, 0.3 at B, and 0.4 between the concrete block and the floor. Determine the smallest couple moment required to cause motion.



Cases to consider:

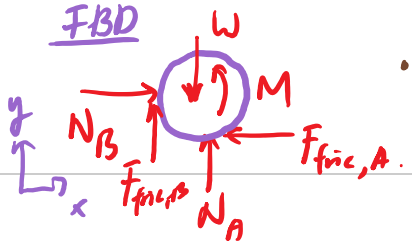
1.) Wheel rotate in place

2.) Wheel rotate to the left, block slides

3.) Wheel rotates to the left, block tips

- Analyze the wheel

FBD



EoE

- Impending motion: $F_{fric} = \mu_s N$

$\Sigma F_x = N_B - F_{fric,A} = 0$

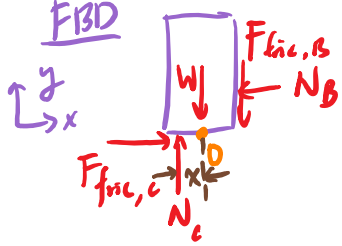
$\Sigma F_y = F_{fric,A} + N_A - W = 0$

$\Sigma M_A = M - N_B(1.5\,ft) - F_{fric,B} = 0$

$\Rightarrow N_B = 28.30\,lb,\ N_A = 141.5\,lb,\ M = 55.21\,lb\cdot ft.$

- Analyze the block

FBD



EoE

known from ↓

$\Sigma F_x = F_{fric,C} - N_B = 0$

$\Sigma F_y = F_{fric,B} - W + N_C = 0$

$\Sigma M_O = -F_{fric,B}(\frac{1}{2}\,ft) + N_B(1.5\,ft) - N_C x = 0$

$\Rightarrow F_{fric,C} = 28.30\,lb,\ N_C = 308.5\,lb,\ x = 0.1739\,ft.$

→ Since $F_{fric,C} < F_s$ and $x < \frac{1}{2}\,ft$, block will remain at equilibrium when the wheel goes into motion with $M = 55.21\,lb\cdot ft$