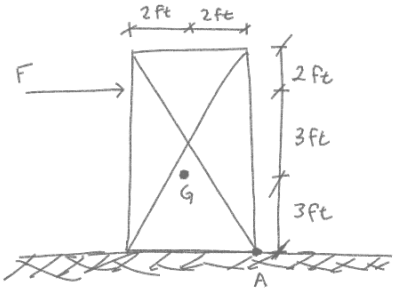
Statics
Friction
Example #2

Determine the maximum force, F, that can be applied to the crate without causing movement of the crate. The crate weighs 300 lbs and has a center of gravity located at point G. The coefficient of static friction between the crate and the floor is μ = 0.35. Use the following figure for other given information:



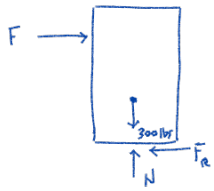
WHEN THINKING ABOUT THIS SITUATION, THERE IS MORE THAN ONE WAY THE CRATE CAN MOVE

1. THE CRATE CAN SLIDE
2. OR THE CRATE WILL TIP ABOUT POINT A

SO, BOTH OF THESE CASES NEED TO BE CHECKED AND THE MOST CONSERVATIVE FORCE WILL BE SELECTED

CASE #1: CRATE SLIDES

FBD



EQUATIONS OF EQUILIBRIUM TO SOLVE FOR UNKNOWNS

$\uparrow \Sigma F_y = 0 = N - 300\,lbs$

$N = 300\,lbs \uparrow$

$\rightarrow \Sigma F_x = 0 = F - F_R$

WE ALSO KNOW $F_R = \mu N$

$F - \mu N = 0$

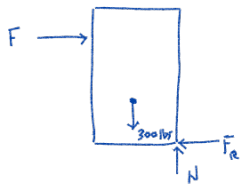
$F - 0.35(300\,lbs) = 0$

$F = 105\,lbs$

$\boxed{F_{SLIDE} = 105\,lbs}$

CASE #2: CRATE TIPS

FBD



* WHEN CHECKING FOR TIPPING THE NORMAL AND FRICTION FORCES ARE APPLIED TO THE CORNER WHERE THE OBJECT IS BEING TIPPED. THIS IS BECAUSE WHEN AN OBJECT IS TIPPED THE ONLY PART OF THAT OBJECT THAT IS TOUCHING THE SUPPORTING SURFACE IS THE CORNER *

$\circlearrowleft \Sigma M_A = 0 = F[6\,ft] - 300\,lbs[2\,ft]$

$F = \frac{300\,lbs[2\,ft]}{6\,ft} = 100\,lbs$ $\boxed{F_{TIP} = 100\,lbs}$

$F_{TIP} < F_{SLIDE}$ THEREFORE, F_{TIP} CONTROLS; $\boxed{F_{MAX} = 100\,lbs,\ \text{CRATE WILL TIP FIRST}}$