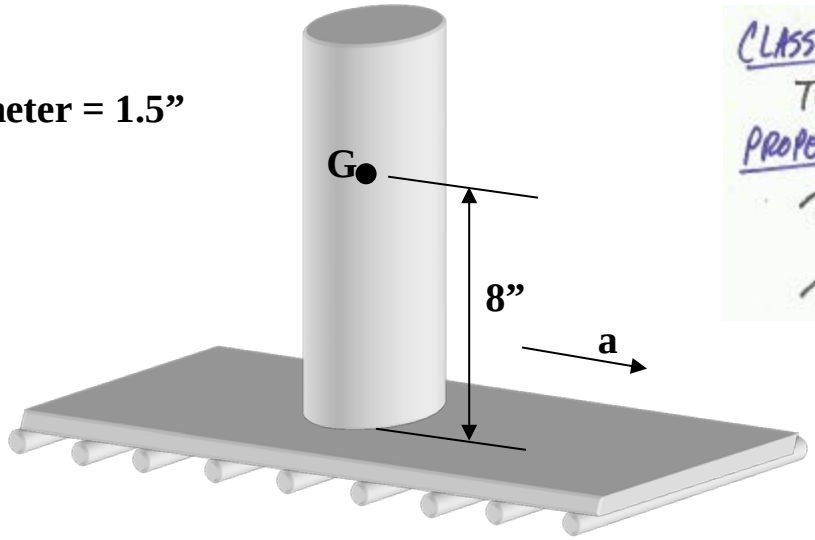
Force Acceleration I – Problem 2

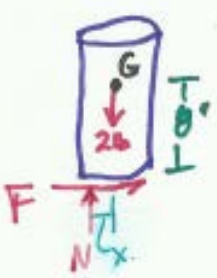
The 2 lb canister rests on the conveyor belt. If the coefficient of static friction is $\mu_s = 0.2$, determine the largest acceleration the conveyor belt can have without causing the can to slip or tip. The center of gravity is at G.



CLASSIFY MOTION
TRANSLATION

PROPERTIES
$m = \frac{2\text{ lb}}{g} = 0.0621$ slug
$\mu_s = 0.2$

FBD = KD



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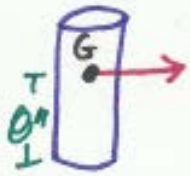

$\rightarrow \Sigma F_x = ma_{Gx} \Rightarrow F = ma_{Gx}$

$F = 0.0621\, a_{Gx}$

3 EQNS
4 UNKS
NEED HELP!

$\uparrow \Sigma F_y = ma_{Gy} \Rightarrow N - 2 = 0$

$N = 2$ lbs

$\circlearrowleft \Sigma M_G = I_G \alpha \Rightarrow \theta F - 2x = 0$ FRICTION

ASSUME SLIPPING

$F = \mu_s N = 0.2(2) = 0.4$ lb

$\theta F - 2x = 0 \Rightarrow \theta(.4) = 2x$ $x = 1.6" > 0.75"$ ∴ TIPS FIRST!

ASSUME TIPPING

$x = 0.75"$

$\theta F = 2x$ $\theta F = 2(.75)$

$F = 0.1875$

$F = 0.0621\, a_{Gx}$

$0.1875 = 0.0621\, a_{Gx}$

$a_{Gx_{MAX}} = 3.02\ ft/s^2$