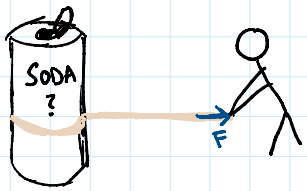
20-R-KIN DK27-28

June 4, 2020 2:01 PM

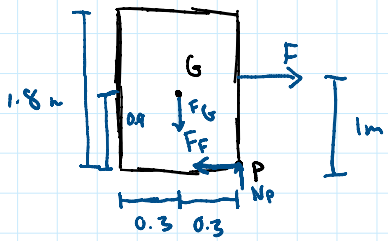
CH17-DK-27 Beginner General Plane Motion Video

Inspiration: Hibbeler pg. 485

Scrap Second part → incorrect



Movers are trying to set up an art gallery. They attempt to drag a human-size statue of a soda can with mass $m = 120\ kg$ by tying a rope around it. Determine the force required before the statue slips and before it tips if the coefficient of static friction and kinetic friction is found to be $\mu_s = 0.4$ and $\mu_k = 0.3$ respectively. Determine the angular acceleration of the statue if a force of 400 N is applied. The can has a height of 1.8 m and the rope is tied 1 m off the ground. Assume the statue to be a solid cylinder with radius r=0.3 m and constant density



a)

P is the point of tipping when it does tip

No tip $= \vec{\alpha} = \vec{0}$

$\sum F_x = F - F_F = F - \mu_s N_P = m a_{Gx}$

$\sum F_y = N_P - mg = m a_{Gy} = 0$

$\sum M_P = mg(0.3) - F(1) = I_P \alpha$

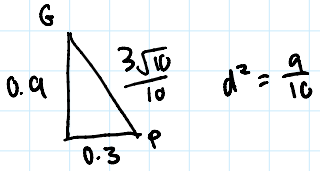
$F_F \leq \mu_s mg$

$\sum F_y$: $N_P = mg = 120(9.81) = 1177.2$

$\sum F_x = 0$: $F - 0.4(1177.2) = 0$ (Before it slips) → $F = 470.88\ N$

$(120)(9.81)(0.3) = F(1)$ → $F = 353.16$

b)



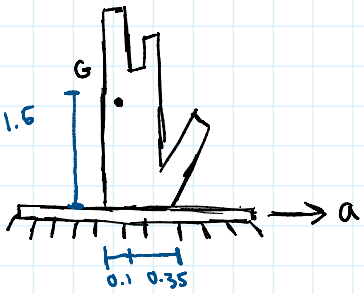
$\sum M_P = (120)(9.81)(0.3) - 400(1) = \left[\frac{1}{12}(120)(3(0.3)^2 + 1.8^2) + (120)\left(\frac{9}{10}\right)\right]\alpha$

$-46.84 = 143.1\,\alpha$ → $\alpha = -0.327323\ rad/s^2$

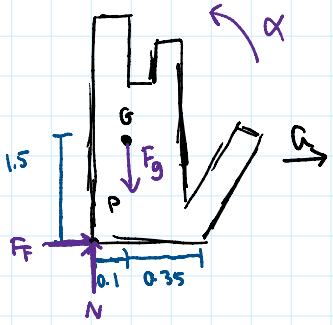
CH17-DK-28 Beginner General Plane Motion Homework

CHECK TO Complete

Scrap Second part



Your friend is once again trying to move his mom's modern art sculpture by dragging a rug underneath it. What is the maximum acceleration of the rug without causing the sculpture to slip? without causing it to tip? What will be the angular acceleration of the statue if the rug is pulled with an acceleration of $3\ m/s^2$? The statue has a mass of 80 kg and has a radius of gyration $k_G = 0.8$. The coefficient of static and kinetic friction is determined to be $\mu_s = 0.25$ and $\mu_k = 0.2$



$\Sigma F_x = F_F = -ma_{Gx}$ $\quad \Sigma F_y = N - mg = 0$ $\quad \Sigma M_G = F_F(1.5) - N(0.1) = I_G\alpha$

Slipping: $F_F \leq \mu_s mg \rightarrow F_F \leq 196.2\ N$

Tipping: $F_F(1.5) - N(0.1) = 0$ $\quad F_F = \frac{(80)(9.81)(0.1)}{1.5} = 52.32$

$196.2 = m a_{Gx}$ $\quad \boxed{a_{Gx} = 2.4525}$ for slipping

$\frac{52.32}{80} = a_{Gx}$ $\quad \boxed{a_{Gx} = 0.654}$ for tipping

$F_F = (80)(3) = 240$

No tip: $\vec{\alpha} = \vec{0}$ $\quad$ No slip: $F_F \leq \mu_s N$

$\Sigma F_x = F_F = ma_{Gx}$ $\quad \Sigma F_y = N - mg = ma_{Gy} = 0$ $\quad \Sigma M_G = F_F(1.5) - N(0.1) = I_G\alpha$

$N = mg$

$F_F \leq 0.25(80)(9.81)$

$F_F \leq 196.2\ N$ $\quad F_F = ma_{Gx}$ $\quad 196.2 = 80\, a_{Gx}$ $\quad \boxed{a_{Gx} = 2.4525}\ m/s^2$ for slipping

$\Sigma M_G = F_F(1.5) - N(0.1) = 0$ $\quad F_F(1.5) = (80)(9.81)(0.1)$ $\quad F_F = 52.32$

$52.32 = 80\, a_{Gx}$ $\quad \boxed{a_{Gx} = 0.654}\ m/s^2$ for tipping $\quad$ The object will tip before slipping

$\Sigma F_F = 80(3) = 240$