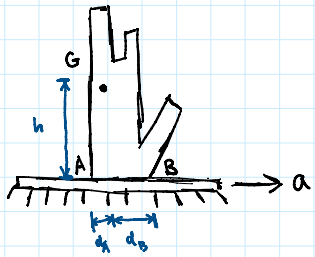
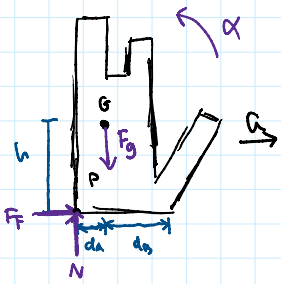
20-R-KIN-DK-28 Beginner General Plane Motion



Your friend is once again trying to move their mom's modern art sculpture by dragging a rug underneath it. Will the statue tip or slip first? Determine the magnitude of the acceleration needed for both tipping and slipping. The statue has a mass of ***m = 80 kg*** and has a radius of gyration ***k_G = 0.8 m***. The coefficient of static and kinetic friction is determined to be ***mu_s = 0.25*** and ***mu_k = 0.2*** respectively. Assume there is no friction between the rug and the ground.
The center of gravity G is found at a height ***h = 1.5 m*** and is a horizontal distance ***d_A = 0.1 m*** from point A. Point B is a horizontal distance ***d_B = 0.35 m*** away from the center of gravity.



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

$\sum F_x = F_F = m a_{Gx}$ $\sum F_y = N - mg = m a_{Gy} = 0$ $\sum M_G = F_F(1.5) - N(0.1) = I_G \alpha$

$N = mg$

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

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

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

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