20-R-KIN-DK-44

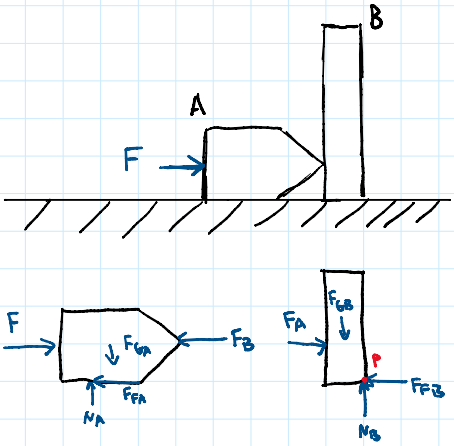
July 22, 2020 9:40 AM

20-R-KIN-DK-44 Beginner Multibody Kinetics

Inspiration: None

Need better wording

Determine the applied force F required on wedge A in order to cause block B to either slip or tip first if the coefficient of static and kinetic friction are given as ***mu_s = 0.3*** and ***mu_k = 0.2*** respectively. Wedge A contacts block B at a height ***h_A = 0.1 m*** and block B has a width ***w_B = 0.05 m*** and height ***h_B = 0.45 m***. Both A and B have a mass of ***m = 0.5 kg***.



$\sum F_{Ax}: ma_{GAx} = F - F_{FA} - F_B$

$\sum F_{Ay}: ma_{GAy} = N_A - F_{GA} = 0 \quad N_A = F_{GA} = mg = 0.5(9.81) = 4.905$

Force needed for A to slip: $0 = F - F_{FA} - F_B \quad F = 0.3(4.905) + F_B$

$F_B = F_A$ Reaction forces

$\sum F_{Bx}: ma_{GBx} = F_A - F_{FB}$

$\sum F_{By}: ma_{GBy} = N_B - F_{GB} = 0 \quad N_B = F_{GB} = mg = 0.5(9.81) = 4.905$

$\sum M_P: F_{GB}\frac{w_B}{2} - F_A h_A = I_P \alpha$

Force needed for B to slip: $F_A - F_{FB} = 0 \quad F_A = 0.3(4.905) = 1.4715$

Force needed for B to tip: $4.905\left(\frac{0.05}{2}\right) - F_A(0.1) = 0 \quad F_A = 1.22625$

Block B will tip first with $F_A = 1.22625$ N $\quad F_B = 1.22625$ N

$F = 0.3(4.905) + 1.22625 = \boxed{2.69775 \text{ N}}$