Problem 8-1

The horizontal force is **P**. Determine the normal and frictional forces acting on the crate of weight W. The friction coefficients are μ_k and μ_s.

Given:

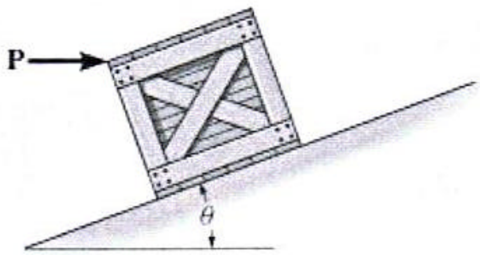
$W = 300 \text{ lb}$

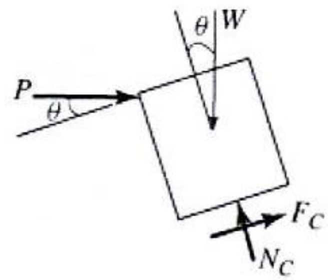
$P = 80 \text{ lb}$

$\mu_s = 0.3$

$\mu_k = 0.2$

$\theta = 20 \text{ deg}$





Solution:

Assume no slipping:

$\nearrow^{+}$ $\Sigma F_x = 0;$ $\quad P\cos(\theta) - W\sin(\theta) + F_c = 0$

$F_c = -P\cos(\theta) + W\sin(\theta)$ $\qquad F_c = 27.4 \text{ lb}$

$\nwarrow^{+}$ $\Sigma F_y = 0;$ $\quad N_c - W\cos(\theta) - P\sin(\theta) = 0$

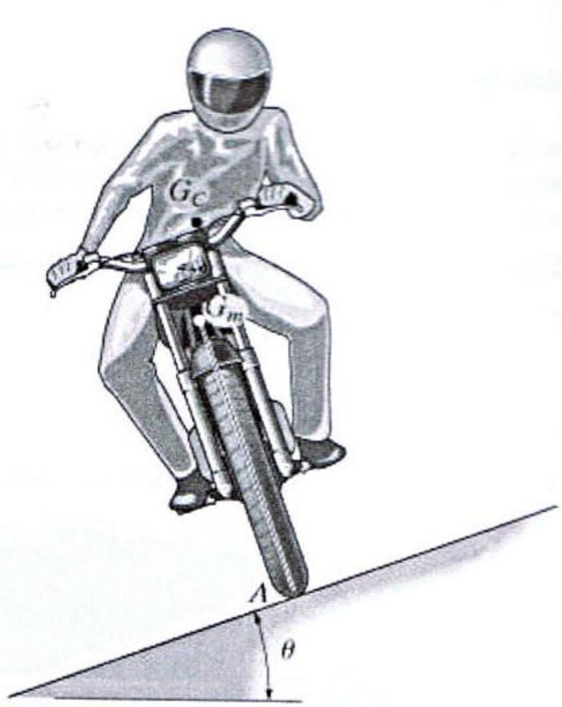
$N_c = W\cos(\theta) + P\cdot\sin(\theta)$ $\qquad N_c = 309 \text{ lb}$

Check $\quad F_{cmax} = \mu_s N_c$ $\qquad F_{cmax} = 92.8 \text{ lb}$

$F_{cmax} > F_c$

Problem 8-9

The motorcyclist travels with constant velocity along a straight, horizontal, banked road. If he aligns his bike so that the tires are perpendicular to the road at A, determine the frictional force at A. The man has a mass M_C and a mass center at G_C, and the motorcycle has a mass M_m and a mass center at G_m. If the coefficient of static friction at A is μ_A, will the bike slip?



Given:

$M_C = 60$ kg

$M_m = 120$ kg

$\mu_A = 0.4$

$\theta = 20$ deg

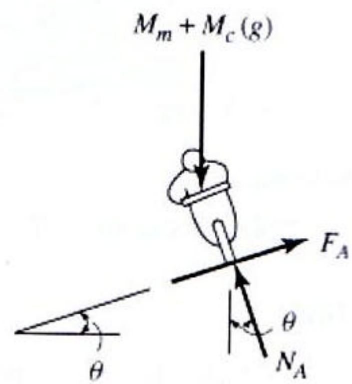
$g = 9.81 \dfrac{\text{m}}{\text{s}^2}$

Solution: Assume no slipping

$\Sigma F_y = 0;$ $N_A - (M_m + M_C) g \cos(\theta) = 0$

$N_A = (M_m + M_C)\, g \cos(\theta)$

$N_A = 1659$ N



$\Sigma F_x = 0;$ $F_A - (M_m + M_C)\, g \sin(\theta)$

$F_A = (M_m + M_C)\, g \sin(\theta)$

$F_A = 604$ N

$F_{Amax} = \mu_A N_A$

check: if $F_A < F_{Amax}$ → $604 < 664$ N
then our no-slip assumption is good.

Problem 8-35

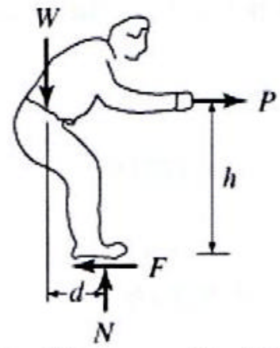
The man has a weight W, and the coefficient of static friction between his shoes and the floor is μ_s. Determine where he should position his center of gravity G at d in order to exert the maximum horizontal force on the door. What is this force?

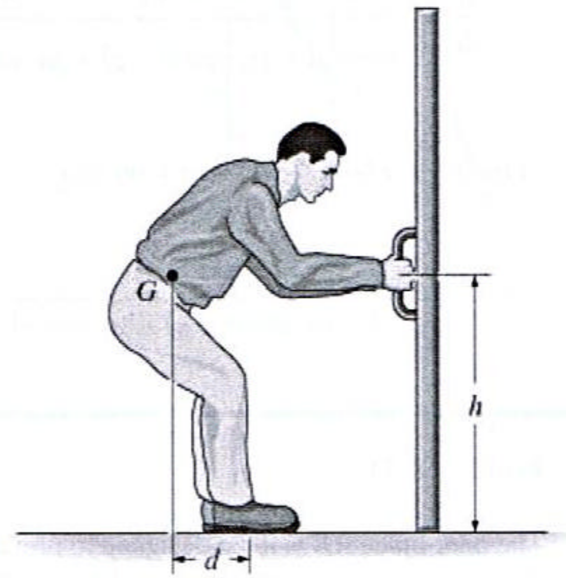
Given:

$W = 200 \text{ lb}$

$\mu_s = 0.5$

$h = 3 \text{ ft}$





Solution:

$N - W = 0 \qquad N = W \qquad N = 200.00 \text{ lb}$

$F_{max} = \mu_s N \qquad F_{max} = 100 \text{ lb}$

$\xrightarrow{+} \Sigma F_x = 0; \qquad P - F_{max} = 0$

$P = F_{max} \qquad P = 100 \text{ lb}$

$\curvearrowleft + \Sigma M_O = 0; \qquad W\, d - P\, h = 0 \quad d = P \dfrac{h}{W} \qquad d = 1.50 \text{ ft}$