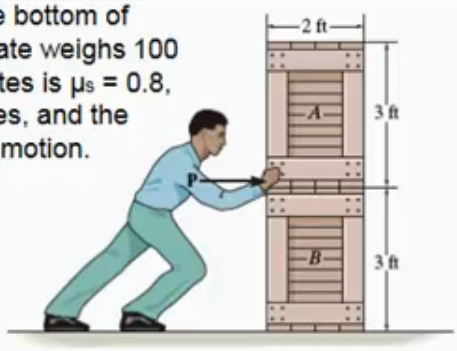
Problem 9.1

Impending Motion--Tip or Slip

The man (weight: 150 lb.) pushes horizontally on the bottom of crate A, which is stacked on top of crate B. Each crate weighs 100 lb. If the coefficient of static friction between the crates is $\mu_s = 0.8$, and between the bottom of the crate, the man's shoes, and the floor $\mu_s' = 0.3$, determine if he can cause impending motion.



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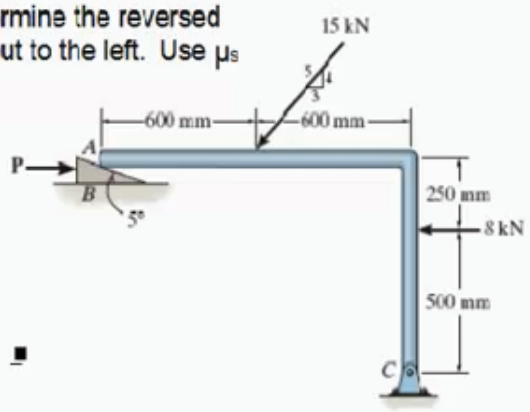
Problem 9.2

Wedge Pullout Analysis

The wedge is used to level the member. Determine the reversed horizontal force P required to pull the wedge out to the left. Use μ_s = 0.15 at both contact surfaces.



Problem 9.3

The uniform pole has a weight W and length L. Determine the distance d it can be placed from the smooth wall and not slip. The coefficient of the static friction between the floor and the pole is μ_s.

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W = 30; % lb
L = 26; % ft
mu = 0.3;
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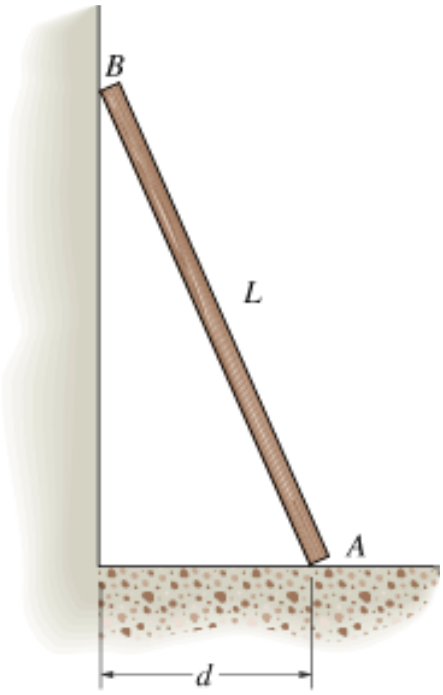

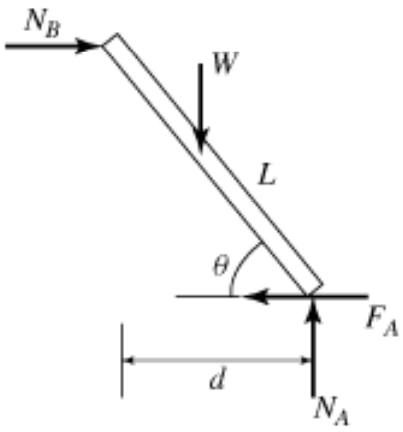

Problem 9.4

The drum has weight W and rests on the floor for which the coefficient of static friction is μ_s. Determine the smallest magnitude of the force P that will cause impending motion of the drum.

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W = 100; % lb
mu = 0.5;
a = 3; % ft
b = 4; % ft
c = 3; d = 4;
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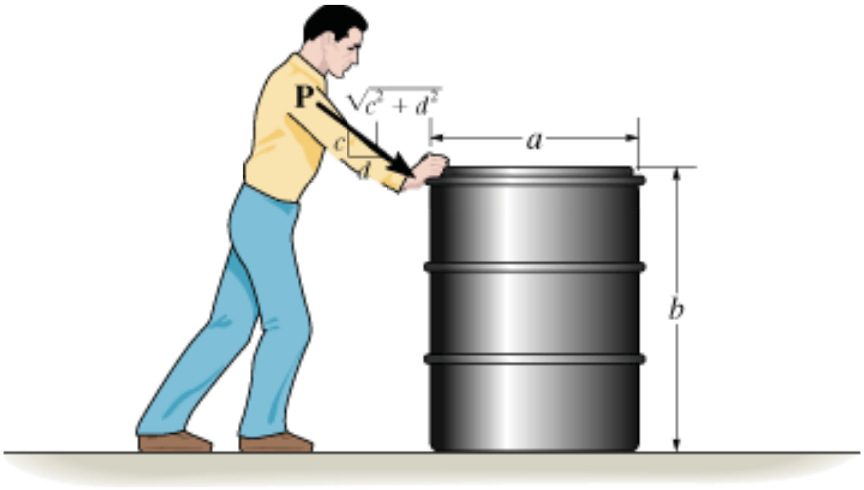
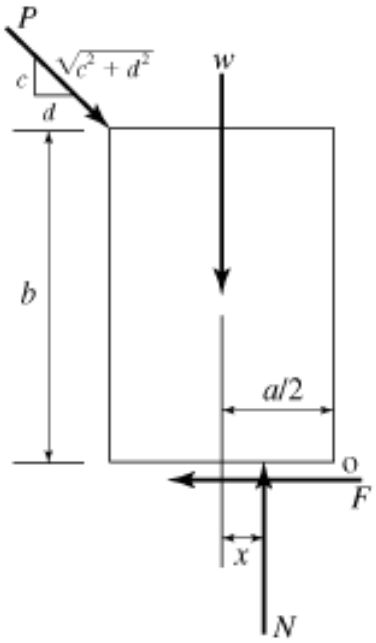
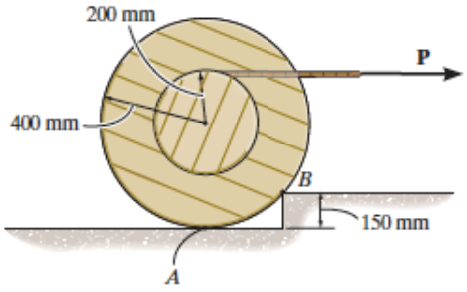
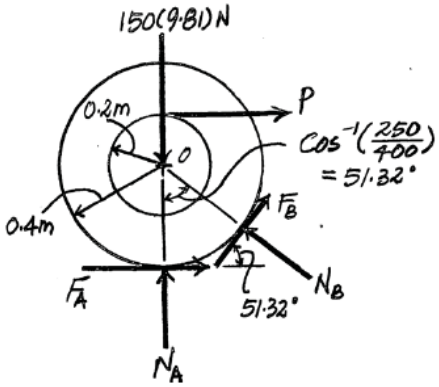




Problem 9.5

If the coefficients of static friction at contact points A and B are $\mu_s = 0.4$ and $\mu'_s = 0.2$ respectively, determine the smallest force P that will cause the 150-kg spool to have impending motion.





Free - Body Diagram. There are two possible modes of impending motion for the spool. The first mode is as the spool slips at A and B and is on the verge of rotating. The second mode is as point A of the spool just loses contact with the ground and the spool is on the verge of rolling about point B without slipping. We will assume that the first mode of motion occurs. Thus, $F_A = \mu_s N_A = 0.4 N_A$ and $F_B = \mu'_s N_B = 0.2 N_B$.

Equations of Equilibrium. Referring to the free-body diagram of the spool shown in Fig. a,

$$\overset{+}{\rightarrow} \Sigma F_x = 0; \qquad 0.4N_A + 0.2N_B \cos 51.32° - N_B \sin 51.32° + P = 0$$

$$+\uparrow \Sigma F_y = 0; \qquad N_A + 0.2N_B \sin 51.32° + N_B \cos 51.32° - 150(9.81) = 0$$

$$\left(+\Sigma M_O = 0; \qquad 0.4N_A(0.4) + 0.2N_B(0.4) - P(0.2) = 0\right.$$

Solving,

$$P = 844\,\text{N} \qquad \textbf{Ans.}$$

$$N_A = 315.31\,\text{N} \qquad N_B = 1480.17\,\text{N}$$

Since the result of $\mathbf{N}_A$ is a positive quantity, point A will remain in contact with the ground. Thus, the above assumption is correct.