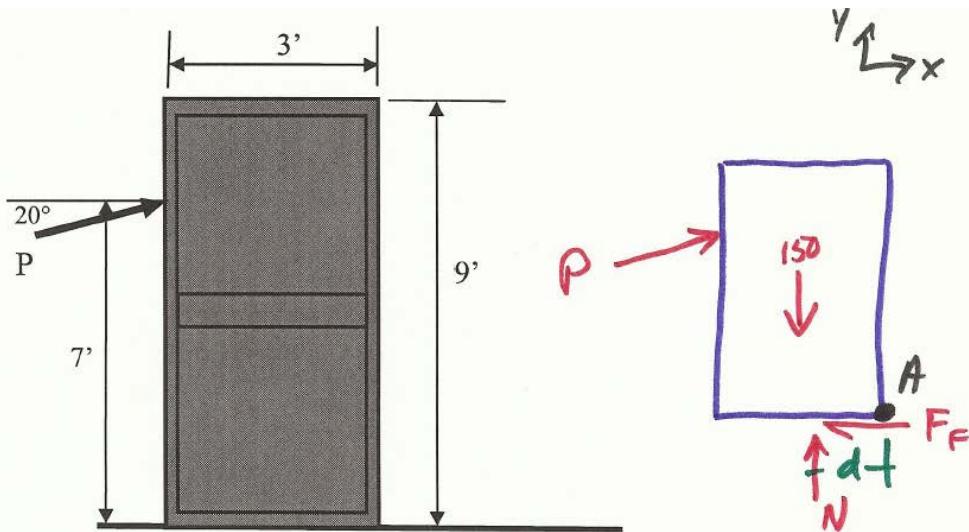


**Problem 8:** What is the minimum force,  $P$ , that will cause the 150 lb crate to move? The coefficient of static friction between the ground and the crate is 0.25. (You must consider both tipping and sliding)



**ASSUME SLIPPING**

$$F_F = F_{\max} = \mu_s N \rightarrow \sum F_x = 0 = P \cos 20 - 0.25 N$$

$$\uparrow \sum F_y = 0 = P \sin 20 - 150 + N$$

$$.94 P - .25 N = 0$$

$$.342 P + N = 150$$

**ASSUME TIPPING**

$$d=0 \quad \sum M_A = 0 = P \cos 20(7) + P \sin 20(3) - 150(1.5)$$

$$7.6P - 225 = 0$$

$$P = 29.6 \text{ TO TIP}$$

$$\therefore P_{\min} = 29.6 \text{ lbs}$$

*CHUSES TIPPING*

**ANSWER:**  $P_{\min} = 29.6 \text{ lbs}$