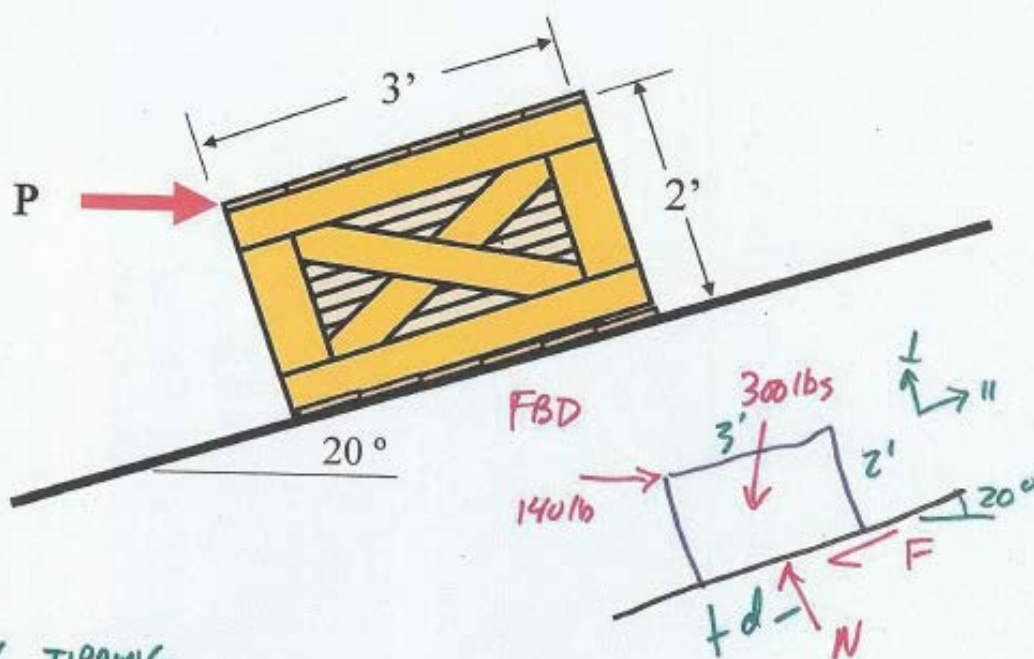


Problem 1 – Friction I

If the horizontal force $P = 140$ lbs, determine the normal and frictional forces acting on the 300 lb crate. Take $\mu_s = 0.3$ and $\mu_k = 0.2$. Consider sliding and tipping.



1) CHECK TIPPING

$$\sum M_B = 0 = 140 \text{ lb} \cos 20^\circ (2') + 300 \text{ lb} \cos 20^\circ (1.5') - 300 \text{ lb} \sin 20^\circ (1') - N \cdot d$$

$$Nd = 583.8 \text{ lb} \cdot \text{ft}$$

$$\sum F_{\perp} = 0 = -300 \cos 20^\circ + N - 140 \sin 20^\circ \quad N = 329.8 \text{ lb}$$

$$d = \frac{583.8}{329.8} \Rightarrow d = 1.77' \quad 0 < d < 3'$$

\therefore NO TIPPING

2) CHECK SLIDING

$$\sum F_{\parallel} = 0 = -F - 300 \sin 20^\circ + 140 \cos 20^\circ$$

$$F = 20.95 \text{ lb} \leftarrow$$

$$F_{\text{MAX}} = \mu_s N = 0.3(330) = 99 \text{ lb}$$

$$F < F_{\text{MAX}}$$

$$20.95 < 99$$

\therefore NO SLIDING