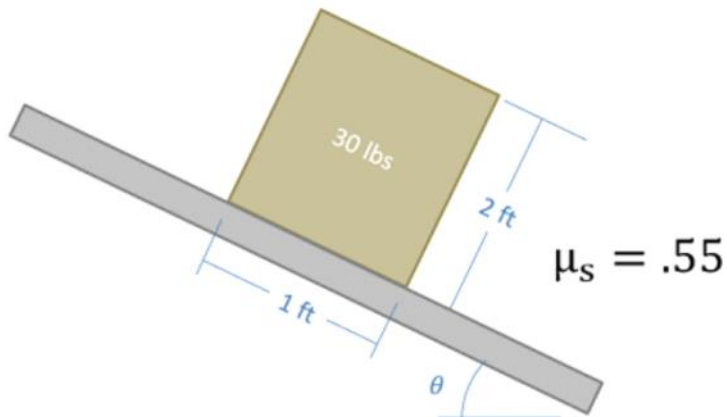
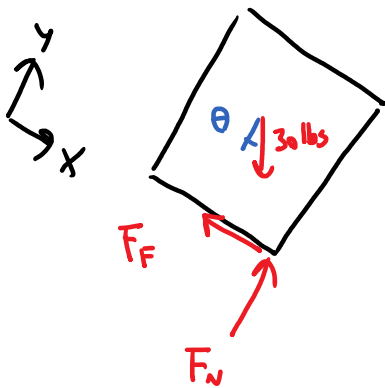


Problem 4

A 30 lb box with the dimensions shown below is placed on a surface and the angle of that surface is slowly increased until the box either tips over or begins sliding. What will occur first and what angle will this occur at? Assume the center of mass of the box is at the center point of the box.



Assume Slipping



$$F_F = .55 F_N$$

$$\sum F_x = 30 \sin(\theta) - .55 F_N = 0$$

$$\sum F_y = F_N - 30 \cos(\theta) = 0$$

$$F_N = 30 \cos(\theta)$$

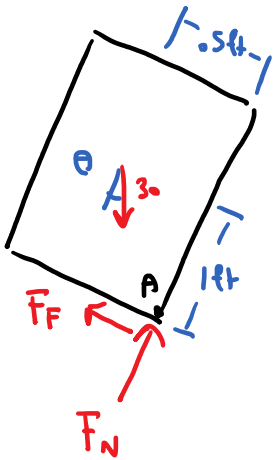
$$30 \sin(\theta) - .55 (30 \cos(\theta)) = 0$$

$$\cancel{30} \sin(\theta) = .55 (\cancel{30} \cos(\theta))$$

$$\frac{\sin(\theta)}{\cos(\theta)} = \tan(\theta) = .55$$

$$\theta = \underline{28.81^\circ}$$

Assume Tipping



$$\sum M_A = (30 \cos(\theta))(0.5) - (30 \sin(\theta))(1) = 0$$

$$15 \cos(\theta) = 30 \sin(\theta)$$

$$\cdot 5 = \frac{\sin(\theta)}{\cos(\theta)} = \tan(\theta)$$

$$\underline{\theta = 26.57^\circ}$$

θ_{tipping} is lower so that will occur first.

$$\theta_{\text{tipping}} = 26.57^\circ$$