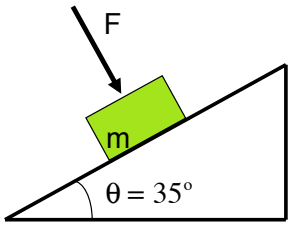
Problem 4.47

What is the minimum force F needed to hold the block motionless?



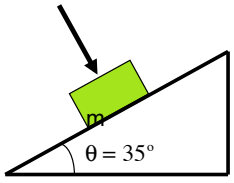
m = 3 kg

$\mu_S = .3$

The f.b.d. is shown below. The line of acceleration would be along the incline, so I'll put the axes are at an angle. The only off-axis force is gravity, which has to be broken up into the components shown. With all that, the sum of forces yields:

m = 3 kg

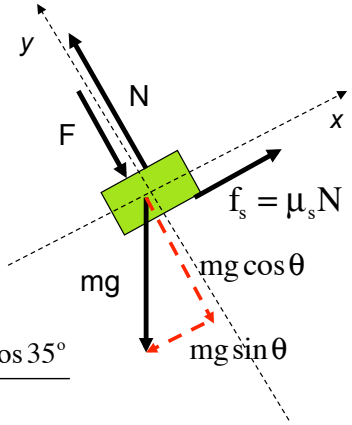
$\mu_S = .3$



$$\sum F_y:$$

$$N - F - mg\cos\theta = m\cancel{a_y}^{0}$$

$$\Rightarrow \quad N = F + mg\cos\theta$$



$$\sum F_x:$$

$$(\mu_s N) - mg\sin\theta = m\cancel{a_x}^{0}$$

$$\Rightarrow \quad (\mu_s(F + mg\cos\theta)) - mg\sin\theta = 0$$

$$\Rightarrow \quad F = \frac{mg\sin\theta - \mu_s mg\cos\theta}{\mu_s}$$

$$\Rightarrow \quad F = \frac{(3\text{kg})(9.8\text{m/s}^2)\sin 35^\circ - (.3)(3\text{kg})(9.8\text{m/s}^2)\cos 35^\circ}{.3}$$

$$\Rightarrow \quad F = 32.1 \text{ nts}$$