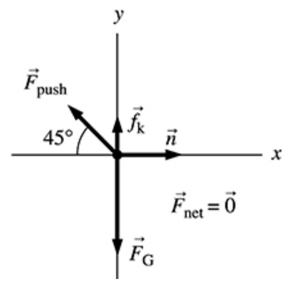
6.51. Model: The box will be treated as a particle. Because the box slides down a vertical wood wall, we will also use the model of kinetic friction.

Visualize:

Pictorial representation



Solve: The normal force due to the wall, which is perpendicular to the wall, is here to the right. The box slides down the wall at constant speed, so $\vec{a} = \vec{0}$ and the box is in dynamic equilibrium. Thus, $\vec{F}_{net} = \vec{0}$. Newton's second law for this equilibrium situation is

$$(F_{net})_x = 0 \text{ N} = n - F_{push}\cos 45°$$

$$(F_{net})_y = 0 \text{ N} = f_k + F_{push}\sin 45° - F_G = f_k + F_{push}\sin 45° - mg$$

The friction force is $f_k = \mu_k n$. Using the x-equation to get an expression for n, we see that $f_k = \mu_k F_{push}\cos 45°$. Substituting this into the y-equation and using Table 6.1 to find $\mu_k = 0.20$ gives,

$$\mu_k F_{push}\cos 45° + F_{push}\sin 45° - mg = 0 \text{ N}$$

$$\Rightarrow F_{push} = \frac{mg}{\mu_k \cos 45° + \sin 45°} = \frac{(2.0 \text{ kg})(9.80 \text{ m/s}^2)}{0.20\cos 45° + \sin 45°} = 23 \text{ N}$$