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:**

```
\[ F_{\text{net}} = \vec{0} \]
```

**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, \( F_{\text{net}} = \vec{0} \). Newton’s second law for this equilibrium situation is

\[
(F_{\text{net}})_x = 0 = n - F_{\text{push}} \cos 45^\circ
\]

\[
(F_{\text{net}})_y = 0 = -f_k + F_{\text{push}} \sin 45^\circ - F_G = -f_k + F_{\text{push}} \sin 45^\circ - mg
\]

The friction force is \( f_k = \mu_n n \). Using the \( x \)-equation to get an expression for \( n \), we see that \( f_k = \mu_k F_{\text{push}} \cos 45^\circ \).

Substituting this into the \( y \)-equation and using Table 6.1 to find \( \mu_k = 0.20 \) gives,

\[
\mu_k F_{\text{push}} \cos 45^\circ + F_{\text{push}} \sin 45^\circ - mg = 0 \text{ N}
\]

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