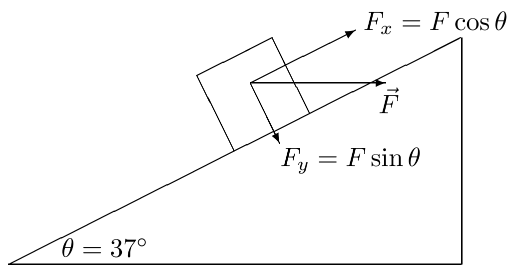
77. The coordinate system we wish to use is shown in Fig. 5-18 in the textbook, so we resolve this horizontal force into appropriate components.




(a) Applying Newton's second law to the $x$ (directed uphill) and $y$ (directed away from the incline surface) axes, we obtain

$$\begin{aligned} F\cos\theta - f_k - mg\sin\theta &= ma \\ N - F\sin\theta - mg\cos\theta &= 0 \ . \end{aligned}$$

Using $f_k = \mu_k N$, these equations lead to

$$a = \frac{F}{m}(\cos\theta - \mu_k \sin\theta) - g(\sin\theta + \mu_k\cos\theta)$$

which yields $a = -2.1 \text{ m/s}^2$ for $\mu_k = 0.30$, $F = 50$ N and $m = 5.0$ kg.

(b) With $v_0 = +4.0$ m/s and $v = 0$, Eq. 2-16 gives

$$\Delta x = -\frac{4.0^2}{2(-2.1)} = 3.9 \text{ m} \ .$$

(c) We expect $\mu_s \geq \mu_k$; otherwise, an object started into motion would immediately start decelerating (before it gained any speed)! In the minimal expectation case, where $\mu_s = 0.30$, the maximum possible (downhill) static friction is, using Eq. 6-1,

$$f_{s,\text{max}} = \mu_s N = \mu_s(F\sin\theta + mg\cos\theta)$$

which turns out to be 21 N. But in order to have no acceleration along the $x$ axis, we must have

$$f_s = F\cos\theta - mg\sin\theta = 10 \text{ N}$$

(the fact that this is positive reinforces our suspicion that $\vec{f_s}$ points downhill). Since the $f_s$ needed to remain at rest is less than $f_{s,\text{max}}$ then it stays at that location.