56. (a) By a force analysis in the style of Chapter 6, we find the normal force $N = mg\cos\theta$ (where $mg = 267$ N) which means $f_k = \mu_k mg\cos\theta$. Thus, Eq. 8-29 yields

$$\Delta E_{\text{th}} = f_k d = \mu_k mgd\cos\theta = (0.10)(267)(6.1)\cos 20^\circ = 1.5 \times 10^2 \text{ J} .$$

(b) The potential energy change is $\Delta U = mg(-d\sin\theta) = (267)(-6.1\sin 20^\circ) = -5.6\times 10^2$ J. The initial kinetic energy is

$$K_i = \frac{1}{2}mv_i^2 = \frac{1}{2}\left(\frac{267\,\text{N}}{9.8\,\text{m/s}^2}\right)(0.457\,\text{m/s})^2 = 2.8 \text{ J} .$$

Therefore, using Eq. 8-31 (with $W = 0$), the final kinetic energy is

$$K_f = K_i - \Delta U - \Delta E_{\text{th}} = 2.8 - \left(-5.6 \times 10^2\right) - 1.5 \times 10^2 = 4.1 \times 10^2 \text{ J} .$$

Consequently, the final speed is $v_f = \sqrt{2K_f/m} = 5.5$ m/s