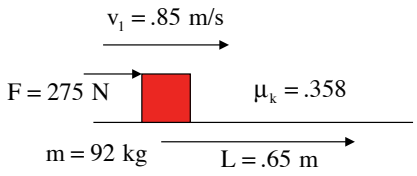
Problem 5.18



A crate is pushed as shown to the right.

a.) What is the magnitude and direction of the net force?

Summing the forces yields:

$$\begin{aligned} F_{net} &= F - f_k \\ &= (275\text{ N}) - \mu_k mg \\ &= (275\text{ N}) - (.358)(92\text{ kg})\left(9.8\text{ m/s}^2\right) \\ \Rightarrow\ F_{net} &= -47.8\text{ N} \end{aligned}$$

In other words, friction is dominating, the net force is pulling energy out of the system and the body is slowing down.

Also note that the force is in the horizontal.

b.) What is the net work done on the body over the entire motion "L?"

The easiest way to do this is dot the net force into the displacement:

$$\begin{aligned} W_{net} &= \vec{F}_{net} \bullet \vec{d} \\ &= \left|\vec{F}_{net}\right| \bullet \left|\vec{d}\right| \cos 180^\circ \\ &= -(47.8\text{ N})(.65\text{ m}) \\ &= -31.1\text{ J} \end{aligned}$$

c.) What's the crate's final speed?

With the net work already calculated, using the Work/Energy Theorem yields:

$$\begin{aligned} W_{net} &= \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 \\ \Rightarrow\ v_2 &= \sqrt{\frac{2}{m}\left(\frac{1}{2}mv_1^2 + W_{net}\right)} \\ &= \sqrt{\frac{2}{(92\text{ kg})}\left(\frac{1}{2}(92\text{ kg})(.85\text{ m/s})^2 + (-31.1\text{ kg})\right)} \\ &= .66\text{ m/s} \end{aligned}$$