

## Problem 9.19

A .01 kg slug is fired into a 5.00 kg block of wood. Just after embedding, the slug and block move with velocity magnitude .600 m/s. What's the slug's original speed.

You would be amazed at the number of students over the years who have looked at this problem, thought, “We have a velocity and want a velocity, so let's use *conservation of energy*.” WRONG!

An enormous amount of energy is lost as the slug deforms the block while burrowing into it. In fact, what *is* conserved is momentum (all the forces along the line of motion are internal—the slug on the block, the block on the slug, etc.). *Conservation of momentum* is the direction we want to go:

$$\sum p_{1,x} + \sum F_{\text{ext}} \Delta t_{\text{throughCollision}} = \sum p_{2,x}$$

$$\Rightarrow m_s v_o = (m_s + m_b) v_f$$

$$\Rightarrow (1.00 \times 10^{-2} \text{ kg}) v_o = ((1.00 \times 10^{-2} \text{ kg}) + (5.00 \text{ kg})) (6 \times 10^{-1} \text{ m/s})$$

$$\Rightarrow v_o = 301 \text{ m/s}$$

