#### **Holt Physics**

# **Problem 6B**

#### FORCE AND MOMENTUM

#### PROBLEM

A student with a mass of 55 kg rides a bicycle with a mass of 11 kg. A net force of 125 N to the east accelerates the bicycle and student during a time interval of 3.0 s. What is the final velocity of the bicycle and student? Assume the student and bicycle are initially at rest.

#### SOLUTION

Given: 
$$m_s = 55 \text{ kg}$$
  
 $m_b = 11 \text{ kg}$   
 $F = 125 \text{ N to the cast}$   
 $\Delta t = 3.0 \text{ s}$   
 $\mathbf{v_i} = 0 \text{ cm/s}$   
Unknown:  $\mathbf{v_i} = ?$ 

Use the impulse-momentum theorem to solve for  $v_f$ .

$$\mathbf{F}\Delta t = \Delta \mathbf{p} = m\mathbf{v}_1 - m\mathbf{v}_1$$

$$\mathbf{v}_1 = \frac{\mathbf{F}\Delta t + m\mathbf{v}_1}{m}$$

$$m = m_s + m_b = 55 \text{ kg} + 11 \text{ kg} = 66 \text{ kg}$$

$$\mathbf{v}_1 = \frac{(125 \text{ N})(3.0 \text{ s}) - (66 \text{ kg})(0 \text{ m/s})}{66 \text{ kg}}$$

$$\mathbf{v}_1 = \frac{(125 \text{ N})(3.0 \text{ s})}{66 \text{ kg}}$$

$$\mathbf{v}_2 = \frac{(125 \text{ N})(3.0 \text{ s})}{66 \text{ kg}}$$

#### ADDITIONAL PRACTICE

- A net force of 10.0 N to the right pushes a 3.0 kg book across a table. If the force acts on the book for 5.0 s, what is the book's final velocity? Assume the book to be initially at rest.
- 2. A 60.0 g egg dropped from a window is caught by a student. If the student exerts a net force of -1.5 N over a period of 0.25 s to bring the egg to a stop, what is the egg's initial speed?
- 3. A child riding a sled is pulled down a snowy hill by a force of 75 N. If the child and sled have a combined mass of 55 kg, what is their speed after 7.5 s? Assume the child and sled are initially at rest.
- 4. A billiard ball with a mass of 0.195 kg and a velocity of 0.850 m/s to the right is deflected by the cushioned edge of the billiard table. The cushion exerts a force of 3.50 N to the left for 0.0750 s. What is the ball's final velocity?

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