13

12. Boat A has a mass of 10kg and a velocity of 3m/s. Boat B has a mass of 15kg and a velocity of -1m/s. The two boats collide and bounce away from one another. After the bounce, boat B has a velocity of 1.4m/s.

a. What is the velocity of boat A after the bounce?

$-0.6\,m/s$

b. What impulse is experienced by boat A during the collision?

$F\Delta t = \Delta p = p_{final} - p_{initial} = (-0.6\,m/s)(10kg) - (10kg)(3\,m/s) = -36\,kg\,m/s$

c. What impact force is felt by boat B?

$F(0.1s) = -36\,kg\,m/s \quad F = 360N$

d. What impulse is experienced by boat B?

$36\,kg\,m/s$

e. What impact force is felt by boat A?

$F = -360N$

f. What is the coefficient of restitution for this collision?

$e = \frac{V_f' - V_A'}{V_A - V_B} = \frac{1.4\,m/s - (-0.6\,m/s)}{(3\,m/s) - (-1\,m/s)} = \frac{2\,m/s}{4\,m/s} = 0.5$

g. Is the collision elastic or inelastic?

$e < 1$

14. A softball of mass 0.220 kg that is moving with a speed of $8.5\,m/s$ collides head-on and elastically with another ball initially at rest. Afterward the incoming softball bounces backward with a speed of $3.7\,m/s$. Calculate (*a*) the velocity of the target ball after the collision, and (*b*) the mass of the target ball.

14. Let A represent the moving softball, and let B represent the ball initially at rest. The initial direction of the softball is the positive direction. We have $v_A = 8.5\,m/s$, $v_B = 0$, and $v_A' = -3.7\,m/s$.

(*a*) Use Eq. 7-7 to obtain a relationship between the velocities.

$$v_A - v_B = -(v_A' - v_B') \rightarrow v_B' = v_A - v_B + v_A' = 8.5\,m/s - 0 - 3.7\,m/s = \boxed{4.8\,m/s}$$

(*b*) Use momentum conservation to solve for the mass of the target ball.

$$m_A v_A + m_B v_B = m_A v_A' + m_B v_B' \rightarrow$$

$$m_B = m_A \frac{(v_A - v_A')}{(v_B' - v_B)} = (0.220\text{ kg}) \frac{(8.5\,m/s - -3.7\,m/s)}{4.8\,m/s} = \boxed{0.56\text{ kg}}$$