Homework Solutions
9/25/2007

Conceptual

3. Many possible examples. When two vehicles collide inelastically, kinetic energy is converted to heat and sound.

4. No, it is not possible for both to be at rest after the collision because then momentum would have been lost. If there is momentum before a collision, there must be momentum after a collision.

5. No, the momentum of the object is transferred to the earth (which gave it momentum to begin with!).

6. C, because the skater will have the largest change in velocity and therefore the largest change in momentum.

7. No, the momentum you receive is equal and opposite the momentum of the earth that you are pushing off of.

8. No, the particle with the larger velocity will have the larger kinetic energy. Their momenta will only be equal if they have equal masses.

Problems

18.

$$F_g = mg$$

$$730N = m\left(9.8\frac{m}{s^2}\right)$$

$$m = 74.49kg$$

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

$$0 + 0 = (74.49kg)v_1' + (1.2kg)\left(5.0\frac{m}{s}\right)$$

$$-6.0kg\frac{m}{s} = (74.49kg)v_1'$$

$$v_1' = -0.0805\frac{m}{s}$$

$$v = \frac{\Delta x}{t}$$

$$t = \frac{\Delta x}{v} = \frac{5.0m}{0.0805\frac{m}{s}} = 62s$$

27. a.

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2)v'$$

$$(2.00 \bullet 10^4 kg)\left(3.00\frac{m}{s}\right) + (4.00 \bullet 10^4 kg)\left(1.2\frac{m}{s}\right) = (6.00 \bullet 10^4 kg)v'$$

$$60{,}000kg\frac{m}{s} + 48{,}000kg\frac{m}{s} = (6.00 \bullet 10^4 kg)v'$$

$$v' = 1.8\frac{m}{s}$$

b.

$$KE = \frac{1}{2}mv^2$$

$$KE_i = \frac{1}{2}(2.00 \bullet 10^4 kg)\left(3.00\frac{m}{s}\right)^2 + \frac{1}{2}(4.00 \bullet 10^4 kg)\left(1.20\frac{m}{s}\right)^2$$

$$KE_i = 90{,}000J + 28{,}800J = 118{,}800J$$

$$KE_f = \frac{1}{2}(6.00 \bullet 10^4 kg)\left(1.8\frac{m}{s}\right)^2 = 97{,}200J$$

$$KE_{lost} = 118{,}800J - 97{,}200J = 21{,}600J$$

30.

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

$$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \bullet -1.00m}{-9.80\frac{m}{s}}} = 0.452s$$

$$v = \frac{\Delta x}{t} = \frac{2.00m}{0.452s} = 4.42\frac{m}{s}$$

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2)v'$$

$$v_1 = \frac{(m_1 + m_2)v'}{m_1} = \frac{(.008kg + 0.250kg)\left(4.42\frac{m}{s}\right)}{0.008kg} = 143\frac{m}{s}$$

48.

$$TE_i = TE_f$$

$$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$$

$$mgh_i = \frac{1}{2}mv_f^2$$

$$v = \sqrt{2gh} = \sqrt{2\left(9.81\frac{m}{s^2}\right)(5.00m)} = 9.90\frac{m}{s}$$

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

$$v_1 + v_1' = v_2 + v_2'$$

$$v_2 = 0 \frac{m}{s}$$

$$v_1 + v_1' = v_2'$$

$$m_1 v_1 = m_1 v_1' + m_2 v_2'$$

$$v_2' = \frac{m_1 v_1 - m_1 v_1'}{m_2}$$

$$v_1 + v_1' = \frac{m_1 v_1 - m_1 v_1'}{m_2}$$

$$v_1 + v_1' = \frac{m_1}{m_2} v_1 - \frac{m_1}{m_2} v_1'$$

$$v_1 + \frac{m_1}{m_2} v_1' = \frac{m_1}{m_2} v_1 - v_1'$$

$$v_1' \left(1 + \frac{m_1}{m_2} \right) = \frac{m_1}{m_2} v_1 - v_1$$

$$v_1' = \frac{\frac{m_1}{m_2} v_1 - v_1}{\left(1 + \frac{m_1}{m_2} \right)} = -3.30 \frac{m}{s}$$

$$\frac{1}{2} m v_i^2 + m g h_i = \frac{1}{2} m v_f^2 + m g h_f$$

$$\frac{1}{2} m v_i^2 = m g h_f$$

$$h_f = \frac{v_i^{\,2}}{2g} = \frac{\left(-3.30\frac{m}{s}\right)^2}{2 \bullet 9.80\frac{m}{s^2}} = 0.556m$$