Chapter Test Review

Teacher Notes and Answers
Momentum and Collisions

CHAPTER TEST REVIEW

1. a

   Given

   a: $m = 275$ kg

   $\mathbf{v} = 0.55$ m/s

   b: $m = 2.7$ kg

   $\mathbf{v} = 7.5$ m/s

   c: $m = 91$ kg

   $\mathbf{v} = 1.4$ m/s

   d: $m = 1.8$ kg

   $\mathbf{v} = 6.7$ m/s

   Solution

   $\mathbf{p} = mv$

   $\mathbf{p_a} = (275 \text{ kg})(0.55 \text{ m/s}) = 1.5 \times 10^2 \text{ kg} \bullet \text{m/s}$

   $\mathbf{p_b} = (2.7 \text{ kg})(7.5 \text{ m/s}) = 2.0 \times 10^1 \text{ kg} \bullet \text{m/s}$

   $\mathbf{p_c} = (91 \text{ kg})(1.4 \text{ m/s}) = 1.3 \times 10^2 \text{ kg} \bullet \text{m/s}$

   $\mathbf{p_d} = (1.8 \text{ kg})(6.7 \text{ m/s}) = 1.2 \times 10^1 \text{ kg} \bullet \text{m/s}$

   $\mathbf{p_a} > \mathbf{p_c} > \mathbf{p_b} > \mathbf{p_d}$

2. a

3. d

   Given

   $m = 2.0$ kg

   $\mathbf{v_i} = 40$ m/s

   $\mathbf{v_f} = -60$ m/s

   Solution

   $\Delta\mathbf{p} = m(\mathbf{v_f} - \mathbf{v_i}) =$
   `(0.2 kg)(-60 m/s - 40 m/s) =`
   `-20 kg`$\bullet$`m/s`

4. b

5. a

6. b

7. b

8. d

9. b

10. The first pitch is harder to stop. The first pitch has greater momentum because it has a greater velocity.

11. Yes, a spaceship traveling with constant velocity could experience a change in momentum if its mass changed, for example, by burning fuel.

12. 10.5 m/s

13. Stopping a falling egg requires changing the momentum of the egg from its value at the time of first impact to zero. If the egg hits the concrete, the time interval over which this happens is very small, so the force is large. If the egg lands on grass, the time interval over which the momentum changes is larger, so the force on the egg is smaller.

14. Producing sound requires energy. Because the system of objects loses some energy as sound is produced in the collision, the total kinetic energy cannot be conserved, so the collision cannot be perfectly elastic.

15. 30 m/s to the west

    Given

    $m_1 = 2680$ kg

    $\mathbf{v_1} = 15$ m/s to the west

    $m_2 = 1340$ kg

    Solution

    $m_1\mathbf{v_1} = m_2\mathbf{v_2}$

    $\mathbf{v_2} = \dfrac{m_1\mathbf{v_1}}{m_2} = \dfrac{(2.68 \times 10^3 \text{ kg})(15 \text{ m/s})}{(1.34 \times 10^3 \text{ kg})}$

    $= 3.0 \times 10^1$ m/s

16. $-1.8 \text{ kg} \bullet \text{m/s}$

    Given

    $m = 6.0 \times 10^{-2}$ kg

    $\mathbf{v_i} = 12$ m/s

    $\mathbf{v_f} = -18$ m/s

    Solution

    $\Delta\mathbf{p} = m(\mathbf{v_f} - \mathbf{v_i}) =$

    $(6.0 \times 10^{-2} \text{ kg})(-18 \text{ m/s} - 12 \text{ m/s})$

    $= -1.8 \text{ kg} \bullet \text{m/s}$

17. 77 s; 5.8×10^2 m

 Given

 $m = 1.8 \times 10^5$ kg

 $\mathbf{v_i} = 15$ m/s

 $\mathbf{v_f} = 0$ m/s

 $\mathbf{F} = -3.5 \times 10^4$ N

 Solution

 $\mathbf{F}\Delta t = \Delta \mathbf{p}$

 $\Delta t = \dfrac{\Delta \mathbf{p}}{\mathbf{F}} = \dfrac{m(\mathbf{v_f} - \mathbf{v_i})}{\mathbf{F}} =$

 $\dfrac{(1.8 \times 10^5 \text{ kg})(0 \text{ m/s} - 15 \text{ m/s})}{-3.5 \times 10^4 \text{ N}}$

 $= 77$ s

 $\Delta x = \dfrac{1}{2}(\mathbf{v_i} + \mathbf{v_f})\Delta t =$

 $\dfrac{1}{2}(15 \text{ m/s} + 0 \text{ m/s})(77 \text{ s}) =$

 5.8×10^2 m

18. 0.33 m/s

 Given

 $m_1 = 85$ kg

 $m_2 = 2.0$ kg

 $\mathbf{v_{1,i}} = \mathbf{v_{2,i}} = 0$ m/s

 $\mathbf{v_{2,f}} = -14$ m/s

 Solution

 $m_1\mathbf{v_{1,i}} + m_2\mathbf{v_{2,i}} = m_1\mathbf{v_{1,f}} + m_2\mathbf{v_{2,f}} = 0$

 $m_1\mathbf{v_{1,f}} = m_2\mathbf{v_{2,f}}$

 $\mathbf{v_{1,f}} = -\dfrac{m_2\mathbf{v_{2,f}}}{m_1} = -\dfrac{(2.0 \text{ kg})(-14 \text{ m/s})}{85 \text{ kg}}$

 $= 0.33$ m/s

19. 0.20 m/s

 Given

 $m_1 = 0.10$ kg

 $m_2 = 0.15$ kg

 $\mathbf{v_{2,i}} = 0$ m/s

 $\mathbf{v_{1,f}} = -0.045$ m/s

 $\mathbf{v_{2,f}} = 0.16$ m/s

 Solution

 $m_1\mathbf{v_{1,i}} + m_2\mathbf{v_{2,i}} = m_1\mathbf{v_{1,f}} + m_2\mathbf{v_{2,f}}$

 $\mathbf{v_{1,i}} = \dfrac{m_1\mathbf{v_{1,f}} + m_2\mathbf{v_{2,f}} - m_2\mathbf{v_{2,i}}}{m_1}$

 $\mathbf{v_{1,i}} = [(0.10 \text{ kg})(-0.045 \text{ m/s}) + (0.15 \text{ kg})(0.16 \text{ m/s})$

 $- (0.15 \text{ kg})(0 \text{ m/s})] \div 0.10 \text{ kg} = 0.20 \text{ m/s}$

20. 10 m/s to the north

 Given

 $m_1 = 90$ kg

 $m_2 = 120$ kg

 $\mathbf{v_{2,i}} = 4$ m/s to the south $= -4$ m/s

 $m_1\mathbf{v_{1,i}} + m_2\mathbf{v_{2,i}} = (m_1 + m_2)\mathbf{v_f}$

 $\mathbf{v_f} = 2$ m/s to the north $= 2$ m/s

 $\mathbf{v_{2,f}} = 2.0$ m/s to the north $= 2$ m/s

 $\mathbf{v_{1,i}} = \dfrac{(m_1 + m_2)\mathbf{v_f} - m_2\mathbf{v_{2,i}}}{m_1} =$

 Solution

 $\dfrac{(90 \text{ kg} + 120 \text{ kg})(2 \text{ m/s}) - (120 \text{ kg})(-4 \text{ m/s})}{90 \text{ kg}} =$

 1×10^1 m/s

 $\mathbf{v_{1,i}} = 10$ m/s to the north

Name:_____ Class:_____ Date:_____