Conceptual Physics/ PEP   Name: _____ Date: _____

Chapter 4 – Conservation Laws

Section Review 4.1

1. List three action and reaction pairs in the picture at right, on page 82 in text.

    a.

    b.

    c.

2. Why don't action and reaction forces cancel?

3. Use impulse to explain how force is related to changes in momentum.

4. Explain the law of conservation of momentum and how it relates to Newton's third law.

Section Review 4.2

1. What are the units of energy and what do they mean?

2. What is *work* in physics and what is the relationship between work and energy?

3. How can you increase an object's potential or kinetic energy?

4. What happens to the kinetic and potential energy of a ball as it falls toward the ground?

5. Explain what it means to say that energy is "conserved."

Section Review 4.3
1. List three examples of elastic collisions and three examples of inelastic collisions not already mentioned in this chapter.

      a.

      b.

      c.

      a.

      b.

      c.

2. Are momentum and kinetic energy conserved in all collisions? Explain.

3. What is the definition of *impulse*?

4. Why will an egg break if it is dropped on the ground but not if it is dropped on a pillow?

Chapter 4 Review

Understanding Vocabulary

Refer to the Word Bank on page 98, and select the correct term to complete the below sentences.

1. _____ is calculated by multiplying a force and the time needed for the force to act.

2. According to _____ for every action force, there is a reaction force equal in strength and opposite in direction.

3. The mass of an object multiplied by its velocity equals its _____.

4. The _____ states that energy can never be created or destroyed, just changed from one form to another.

5. Energy due to position is known as _____.

6. When two objects collide and stick together or change shape, it is called a(n) _____.

Reviewing Concepts

Section 4.1

1. State Newton's third law in your own words.

2. Action and reaction forces always have the _____ strength and act in _____ directions.

3. You and a friend are sitting across from each other on chairs with wheels. You push off each other and move in opposite direction. Explain the following:

   a. How does the force you feel compare to the force your friend feels?

   b. If your mass is greater than your friend's mass, how do your accelerations compare?

4. A book rests on a table. The force of gravity pulls down on the book. What prevents the book from accelerating downward?

5. Provide three examples of Newton's third law in everyday life. List the action and reaction forces in each example.

    a.

    b.

    c.

6. What two things does an object require to have momentum?

    a.

    b.

7. Consider an airplane at rest and a person walking through the airport.

    a. Which has greater mass?

    b. Which has greater velocity?

    c. Which has greater momentum? Explain.

8. Explain the two different ways to calculate *impulse*.

    a.

    b.

9. Is the unit used to represent impulse the same as the unit for momentum? Explain.

10. State the law of conservation of momentum in your own words.

11. You and your little cousin are standing on in-line skates. You push on each other and both move backwards.

        a. Which of you moves back at a greater speed? Use the law of conservation of momentum to explain your answer.

        b. How does your impulse compare to your cousin's impulse?

12. When you jump, you move upward with a certain amount of momentum. Earth moves downward with an equal amount of momentum. Why don't you notice the Earth's motion?

Section 4.2
13. What is anything with energy able to do?

14. The *joule* is an abbreviation for what combination of units?

15. When work is done, _____ is transferred.

16. How can you increase the gravitational potential energy of an object?

17. Explain why a bicycle at rest at the top of a hill has energy.

18. Which two quantities are needed to determine an object's kinetic energy?

    a.

    b.

19. What happens to a car's kinetic energy if its speed doubles? What if the speed triples?

20. A ball is thrown up into the air. Explain what happens to its potential and kinetic energies as it moves up and then back down.

21. Explain what it means to say energy is conserved as a ball falls toward the ground.

22. Will we ever run out of energy on Earth? Might we run out of certain forms of energy? Explain.

Section 4.3
23. Distinguish between *elastic* and *inelastic* collisions.

24. Classify each collision as elastic or inelastic.

       a. A dog catches a tennis ball in his mouth.

       b. A ping-pong ball bounces off a table.

       c. You jump on a trampoline.

       d. A light bulb is knocked onto the floor and breaks.

25. Is momentum conserved during elastic collisions? Is it conserved during inelastic collisions? Explain.

26. Why does bouncing nearly always cause a greater force than simply stopping during a collision?

27. Cars that crumple in a collision are safer than cars that bounce when they collide. Explain why this is so.

28. What is the secret to catching a water balloon without breaking it? Explain using what you know of physics.

Solving Problems

Section 4.1

1. You throw a basketball by exerting a force of 20 N. According to Newton's third law, there is another 20-N force created in the opposite direction. If there are two equal forces in opposite directions, how does the ball accelerate?

2. What is the momentum of a 2-kg ball traveling at 4 m/s?

3. How fast does a 1,000-kg car have to move to have a momentum of 50,000 kg·m/s?

4. Idil's momentum is 110 kg·m/s when she walks at 2 m/s. What's her mass?

5. Which has more momentum: a 5,000-kg truck moving at 10 m/s or a sports car with a mass of only 1,200 kg moving at 50 m/s?

6. Two hockey players on ice skates push off each other. One has a mass of 60 kg. the other has a mass of 80 kg.

    a. If the 80-kg player moves back with a velocity 3 m/s, what is his momentum?

    b. What is the 60-kg player's momentum?

    c. What is the 60-kg player's velocity?

7. A 75-kg astronaut floating in space throws a 5-kg rock at 5 m/s. How fast does the astronaut move backwards?

8. A 2-kg ball is accelerated from rest to a speed of 8 m/s.

     a. What is the ball's change in momentum?

     b. What is the impulse?

     c. A constant force of 32 N is used to change the momentum. For how much time does the force act

9. A 1,000-kg car uses a braking force of 10,000 N to stop in 2 s.

     a. What impulse acts on the car?

     b. What is the change in momentum of the car?

     c. What was the initial speed of the car?

Section 4.2

10. A 5-kg can of paint is sitting on top of a 2-m-high step ladder. How much work did you do to move the can of paint to the top of the ladder? What is the potential energy of the can of paint?

11. How much work is done to move a 10,000-N car 20 m?

12. Which has more potential energy, a 5-kg rock lifted 2 m off the ground on Earth, or the same rock lifted 2 m on the Moon? Why?

13. At the end of a bike ride up a mountain, Chris was at an elevation of 500 m above where he started. If Chris's mass is 60 kg, by how much did his potential energy increase?

14. Alexis is riding her skateboard. If Alexis has a mass of 50 kg:

    a. What is her kinetic energy if she travels at 5 m/s?

    b. What is her kinetic energy if she travels at 10 m/s?

    c. Alexis's 50-kg dog Bruno gets on the skateboard with her. What is their total kinetic energy if they move at 5 m/s?

    d. Based on your calculations, does doubling the mass or doubling the speed have more of an effect on kinetic energy?

15. A 1-kg coconut falls out of a tree from a height of 12 m. Determine the coconut's potential and kinetic energy at each point shown in the figure on page 100. At point A, its speed is zero.

Section 4.3

16. A demolition derby is a car-crashing contest. Suppose an 800-kg car moving at 20 m/s crashes into the back of and sticks to a 1,200-kg car moving at 10 m/s in the same direction. Refer to the figure on page 100, and answer the below:

    a. Is this collision elastic or inelastic? Why?

    b. Calculate the momentum of each car before the collision.

c. What is the total momentum of the stuck-together cars after the collision? Why?

d. What is the speed of the stuck-together cars after the collision?

17. A 5-kg ball moving at 6 m/s collides with a 1-kg ball at rest. The balls bounce off each other and the second ball moves in the same direction as the first ball at 10 m/s. What is the velocity of the first ball after the collision? Refer to the figure on page 100.

18. Yanick and Nancy drive two identical 1,500-kg cars at 20 m/s. Yanick slams on the brakes and his car comes to a stop in 1 s. Nancy lightly applies the brakes and stops her car in 5 s.

a. How does the momentum change of Yanick's car compare to the momentum change of Nancy's car?

b. How does the impulse on Yanick's car compare to the impulse on Nancy's car?

c. How does the force of Yanick's brakes compare to the force of Nancy's brakes?

d. Calculate the stopping force for each car.

19. Your neighbor's car breaks down. You and a friend agree to push it two blocks to a repair shop while your neighbor steers. The two of you apply a net force of 800 N to the 1,000-kg car for 10 s.

a. What impulse is applied to the car?

b. At what speed is the car moving after 10 s? The car starts from rest.

Test Practice

Section 4.1
1. Newton's third law describes action and reaction forces which

a. are equal in strength.   b. are acting in the same direction.

c. are always applied to the same object.   d. always cancel each other out.

2. A person with a mass of 50 kg is in a canoe with a mass of 30 kg. The canoe is moving at 5 m/s. What is the momentum of the person and canoe?

a. 16 kg·m/s   b. 150 kg·m/s   c. 250 kg·m/s   d. 400 kg·m/s

3. Impulse is the product of

a. force and mass.   b. force and time.
c. mass and acceleration.   d. mass and velocity.

4. How much time should a 50-N force take to increase the speed of a 5-kg car from 10 m/s to 30 m/s?

a. 0.5 s   b. 1 s   c. 2 s   d. 3 s

Section 4.2
5. Joules are a unit of measurement for all of the following except

a. kinetic energy.   b. potential energy.   c. momentum.   d. work.

6. A 60-kg woman is on a ladder 2 m above the ground. What is her potential energy?

a. 60 J   b. 120 J   c. 588 J   d. 1,176 J

7. A 1-kg cat is perched in a tree 4 m off the ground. It jumps out of the tree. The cat's velocity halfway down is 10 m/s. What is the cat's kinetic energy halfway down?

      a. 5 J   b. 8 J   c. 50 J   d. 100 J

8. Take a look at the figure on page 102. At which point does the car on the ramp have the greatest potential energy?

      a. A   b. B   c. C   d. D

Section 4.3

9. In a collision between objects, kinetic energy is not lost when

      a. the objects change shape.   b. the objects stick together.

      c. the collision is inelastic.   d. the collision is elastic.

10. Refer to the figure on page 102. A 6,000-kg train car moving at 10 m/s strikes a second 4,000-kg parked train car. The cars stick together and move along the track. What is their velocity after the collision?

      a. 4 m/s   b. 6 m/s   c. 10 m/s   d. 15 m/s

11. Which of the following is an example of a nearly-elastic collision?

      a. marbles collide and bounce off each other.

      b. ice skaters collide and hold on to each other.

      c. trucks crash and stick together.

      d. a ceramic mug fall to the floor and breaks.

12. A 15-kg child ice skating at 1 meter per second collides with a skater at rest. The skaters grab onto each other and continue moving at 0.5 m/s. What is the mass of the second skater?

      a. 7.5 kg   b. 15 kg   c. 30 kg   d. 45 kg