Chapter 8 – Energy Flow and Systems

Section Review 8.1

1. In an experiment, you learn that the total energy at the end is a little less than it was at the beginning. Explain how this is possible. Use the *law of conservation of energy* in your answer and explain how energy can be "lost."

2. Draw an energy flow diagram that shows at least four energy conversions that occur as energy becomes light from the electric lights in your classroom.

Section Review 8.2

1. Which is greater, the power output of a human or that of an electric light bulb (100 W)? Explain.

2. What is *thermodynamics* and how does it relate to energy?

3. What is your efficiency if you eat 1 million joules of food energy to do 1,000 joules of work?

Section Review 8.3

1. Draw an energy flow diagram for a person who eats and then runs a race.

2. Describe at least three examples of energy and power in a natural system.

a.

b.

c.

Chapter 8 Review

Understanding Vocabulary

Select the correct term on page 210 to complete the sentences.

1. Light is a form of _____.

2. Energy stored in a candy bar is an example of _____.

3. Kinetic and potential energy are both forms of _____.

4. When work is done by heat transfer, the output work is always less than the amount of heat transferred. This is a statement of the _____.

5. _____ means there is a balance between energy "in" and energy "out," so the total energy of a system remains the same.

6. A(n) _____ is a way of describing the flow of energy between living things.

Reviewing Concepts

Section 8.1

1. Why can energy be thought of as "nature's money?"

2. Chemical energy is sometimes thought of as a form of potential energy. Explain this statement.

3. Explain what is meant by the "energy of pressure."

4. Is a stretched rubber band a form of potential or kinetic energy? Explain.

5. Why is work done against friction "lost" to a system?

Section 8.2

6. Describe the meaning of *power* and how it is calculated.

7. Name two units of power and an application for each.

a.

b.

8. List two different ways to describe power.

a.

b.

9. What is efficiency and how is it calculated?

10. Use the example of a car engine to explain the second law of thermodynamics.

11. Explain, in terms of work output, why the efficiency of living things is quite low.

12. Would the efficiency of a motorcycle be higher or lower than the efficiency of a bicycle? Explain your answer.

Section 8.3

13. Describe the energy conversions that occur with a swinging pendulum.

14. List two devices you use each day that have a high power rating, and two devices that have a relatively low power rating. Explain why these devices have high and low power ratings.

High: a. b.

Low: a. b.

Explain:

15. What is the primary energy input on Earth? What happens to that energy once it gets to Earth?

16. Why are herbivores more abundant than carnivores?

17. What are decomposers and what is their role in energy transfer?

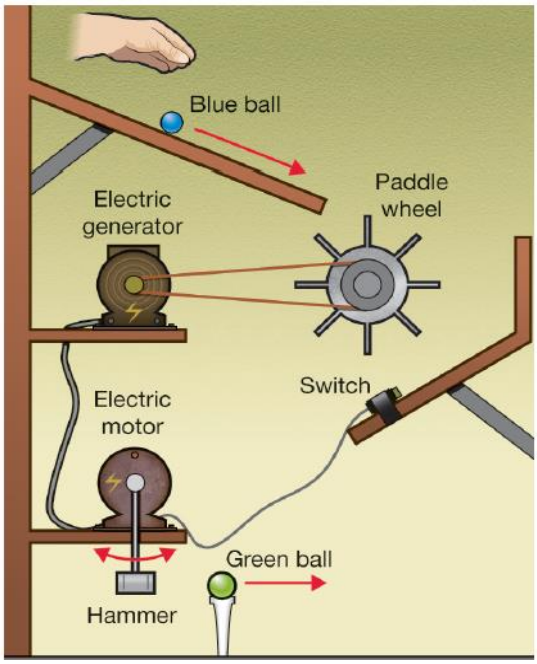
Solving Problems

Section 8.1

1. A 1-kg ball rolls down a 1-m-high hill and reaches a speed of 20 m/s at the bottom. Was the ball pushed? Explain your answer using calculations of potential and kinetic energy.

2. A ball at the top of a hill has 12.5 J of energy. After it rolls down the hill, it converts 11.6 J to kinetic energy. How much energy is "lost" to the system? Where did that energy go?

3. Use the diagram at right to answer questions a – d:



a. Where does the initial energy come from in the apparatus?

b. What forms of energy are involved in the operation of the apparatus?

c. Draw an energy flow diagram for this system.

d. Do you think the apparatus will work? _____ Why or why not?

Section 8.2

4. Michelle weighs 75 kg. She climbs up a 3-m staircase in 3 s.

a. How many joules of work does she do?

b. What is her power in watts?

c. What is her power in horsepower?

d. If Michelle uses 10 Calories to do the work, what is her efficiency?

5. A motor pushes a car with a force of 35 N for a distance of 350 m in 6 s.

a. How much work has the motor accomplished?

b. How powerful is the motor in watts?

c. How powerful is the motor in horsepower?

6. How much power is required to do 55 J of work in 55 s?

7. The manufacturer of a machine says that it is 86% efficient. If you use 70 J of energy to run the machine, how much output work will it produce?

8. Carmen uses 800 J of energy on a jack that is 85% efficient to raise her car to change a flat tire.

a. How much energy is available to raise the car?

b. If the car weighs 13,600 N, how high off the ground can she raise the car?

9. Suppose you exert 200 N of force to push a heavy box across the floor at a constant speed of 2 m/s.

a. What is your power in watts?

b. What would happen to your power if you used the same force to push the box at a constant speed of 1 m/s?

Section 8.3

10. Suppose your job is to choose a motor for an escalator. The escalator must be able to lift 20 people at a time, each with a mass of 70 kg. The escalator must move between two floors, 5 m apart, in 5 s.

a. What energy is required to do this work?

b. What is the power rating of the required motor, in horsepower?

11. On page 211 in your text, there is an Energy flow diagram for model solar car. Fill in the joules of energy for each box in the blanks provided below. Compute the output work and total wasted energy. What is the overall efficiency of the model solar car?

Electrical energy: _____ J → Mechanical energy: _____ J → Mechanical energy: _____

→ Output work: _____ J

Friction and heat: _____ J

Test Practice

Section 8.1

1. The potential energy in a stretched spring is

a. radiant energy b. mechanical energy c. chemical energy d. energy of pressure

2. Microwaves are a form of _____ energy.

a. radiant b. mechanical c. chemical d. nuclear

3. The combustion of gasoline in a car and the splitting of uranium atoms both release _____ as output work.

a. radiant energy b. mechanical energy c. chemical energy d. energy of pressure.

4. A child on a sled is at rest at the top of a hill 10 m high. The child and sled combined have a mass of 20 kg. They sled down the hill and attain a speed of 12 m/s. How much energy was lost to friction when they slid down the hill and converted their potential energy to kinetic energy?

a. 520 J b. 1,240 J c. 1,440 J d. 1,960 J

Section 8.2

5. Joshua weighs 50 kg. He takes 4 s to carry a 10-kg suitcase up a flight of stairs 3 m high. What is his power?

a. 45 W b. 74 W c. 368 W d. 441 W

6. An arrow drawn back in a bow has a potential energy of 100 J. If the efficiency of the bow and arrow system is 75%, how much kinetic energy will the arrow have when it is launched?

a. 0 J b. 75 J c. 100 J d. 133 J

7. The second law of thermodynamics states that

a. energy cannot be created or destroyed, only converted from one form to another.

b. for every action, there is a reaction force, equal to the action force and opposite in direction.

c. when work is done by heat flowing, the output work must be less than the amount of heat flow.

d. the total momentum in a system of interacting objects cannot change as long as all forces act only between objects in the system.

8. Maria uses 30 Calories of energy to climb a hill. Her increase in potential energy is 9,800 J. What is her energy efficiency?

a. 6% b. 7% c. 8% d. 9%

Section 8.3

9. Look at the energy diagram on page 212 in your text. The diagram could represent

a. a car rolling down a ramp. b. a child on a swing.
c. a ball rolling across the floor. d. all of the above.

10. You are hired to design a crane to life a 500-kg weight to a height of 20 m in 40 s. Assuming the crane is 100% efficient, what is the minimum power rating you should choose for the motor?

a. 0.3 hp b. 1.3 hp c. 3.3 hp d. 13.1 hp

11. Which of the following systems can reach a steady state of energy flow?

a. radiant energy on Earth b. the water cycle
c. a food chain d. all of the above

12. Producers use photosynthesis to convert radiant energy from the Sun into

a. chemical energy. b. electrical energy. c. solar energy. d. mechanical energy.