

CHAPTER 12 Energy and Energy Resources

SECTION

3

Conservation of Energy

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How does friction affect energy conversions?
- What is the law of conservation of energy?
- What happens to energy in a closed system?

TN Tennessee Science Standards

GLE 0607.Inq.5

GLE 0607.10.2

GLE 0607.10.3

Where Does Energy Go?

Most roller coasters use a chain to pull the cars up to the top of the first hill. As the cars go up and down the rest of the hills, their potential energy and kinetic energy keep changing. Since no additional energy is put into the cars, they never go as high as the first hill. Is energy lost? No, it just changes into other forms of energy.

When a roller coaster's energy is changing, some of its energy is lowered by friction. **Friction** is a force that is present when two objects touch each other. There is friction between the cars' wheels and the track. There is also friction between the cars and the air around them. Friction slows the motion of a roller coaster. ✓

Energy Conversions in a Roller Coaster

a The PE is _____

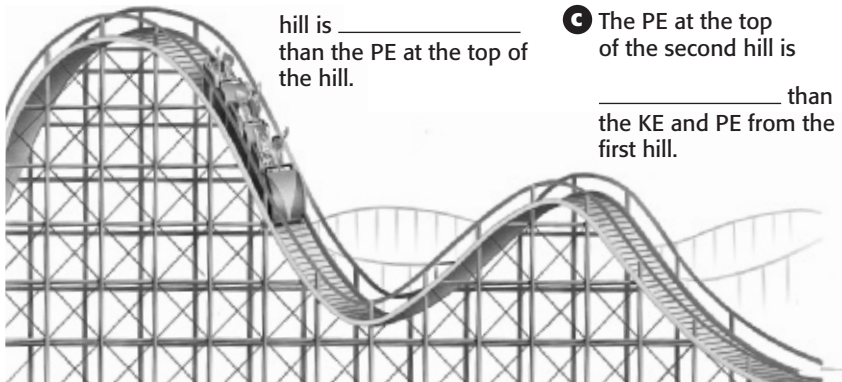
at the top of the first hill.

b Because of friction, the KE at the bottom of the first

hill is _____ than the PE at the top of the hill.

c The PE at the top of the second hill is

_____ than the KE and PE from the first hill.



Not all of the cars' potential energy (PE) changes into kinetic energy (KE) as the cars go down the first hill. When the cars move up hill 2, not all of its KE is converted into PE at the top of hill 2. Some of it is changed into thermal energy because of friction.

STUDY TIP

In your science notebook, list the energy conversions in this section and note why energy is not conserved in the conversion.

READING CHECK

1. Identify What causes the energy of a roller coaster to be lowered when the coaster's energy changes form?

TAKE A LOOK

2. Complete Fill in the blanks in the figure with the following terms (they can be used more than once): greater, less, largest, smallest.

SECTION 3 Conservation of Energy *continued***TN TENNESSEE
STANDARDS CHECK****GLE 0607.10.2** Analyze various types of energy transformations.**3. Identify** Into what form of energy does friction convert mechanical energy?

_____**What Happens to Energy in a Closed System?**

A *closed system* is a group of objects that move energy only to each other. On a roller coaster, a closed system would be the track, the cars, and the air around the cars.

Some of the mechanical energy (kinetic energy plus potential energy) of the cars changes into thermal energy. This happens because of friction. Mechanical energy is also converted into sound energy. You hear this energy when you are near the roller coaster. The rest of the potential energy changes into kinetic energy. This is seen by the roller coaster racing down the track.

If you add up all of this energy, it equals the cars' potential energy at the top of the first hill. The energy at the top of the hill is the same as the energy that is converted to other forms. So, energy is conserved and not lost in a closed system.

LAW OF CONSERVATION OF ENERGY

Energy is always conserved. This is always true, so it is called a law. In the **law of conservation of energy**, energy cannot be created or destroyed. In a closed system, energy can change from one form to another, but the total energy is always the same. It doesn't matter how many or what kinds of energy conversions take place. The energy conversions that happen in a light bulb are shown in the figure below. ✓

✓ READING CHECK**4. Describe** What is the law of conservation of energy?

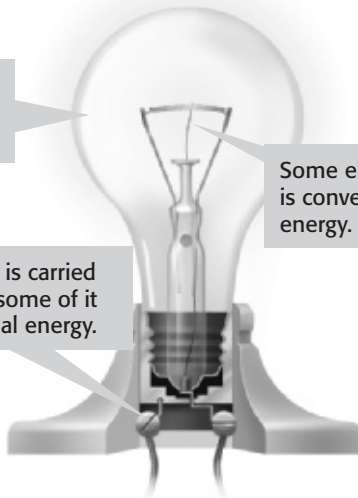
_____**Critical Thinking****5. Explain** Why is the light bulb *not* a closed system?

_____**Energy Conservation in a Light Bulb**

Some energy is converted into thermal energy, which makes the bulb feel warm.

Some electrical energy is converted into light energy.

As electrical energy is carried through the wires, some of it changes into thermal energy.



SECTION 3 Conservation of Energy *continued*

Why Can't a Machine Run Forever Without Adding Energy?

Any time an energy conversion happens, some of the energy always changes into thermal energy. This thermal energy is in the form of friction. The energy from friction is not useful energy. It is not used to do work.

Think about a car. You put gas into a car. Not all of the chemical energy from the gas makes the car move. Some energy is wasted as thermal energy. This energy leaves through the radiator and the exhaust pipe.

It is impossible to create a machine that runs forever without adding more energy to it. This kind of machine is called a *perpetual motion machine*. A machine has to have a constant supply of energy because energy conversions always produce wasteful thermal energy. ✓

EFFICIENT ENERGY CONVERSIONS

If a car gets good gas mileage, it is energy efficient. The *energy efficiency* is found by comparing the amount of starting energy with the amount of useful energy produced. A car with high energy efficiency goes farther than other cars with the same amount of gasoline.

More efficient energy conversions waste less energy. For example, smooth, *aerodynamic* cars have less friction between the car and the air around it. They use less energy, so they are more efficient. If less energy is wasted, then less energy is needed to run the car.



Car A



Car B

The shape of newer cars lowers the friction between the car and the air passing over it.

**READING CHECK**

6. Describe Why can't there be a perpetual motion machine?

**READING CHECK**

7. Describe Which car is more aerodynamic in shape?

Section 3 Review

GLE 0807.Inq.5, GLE 0607.10.2, GLE 0607.10.3 

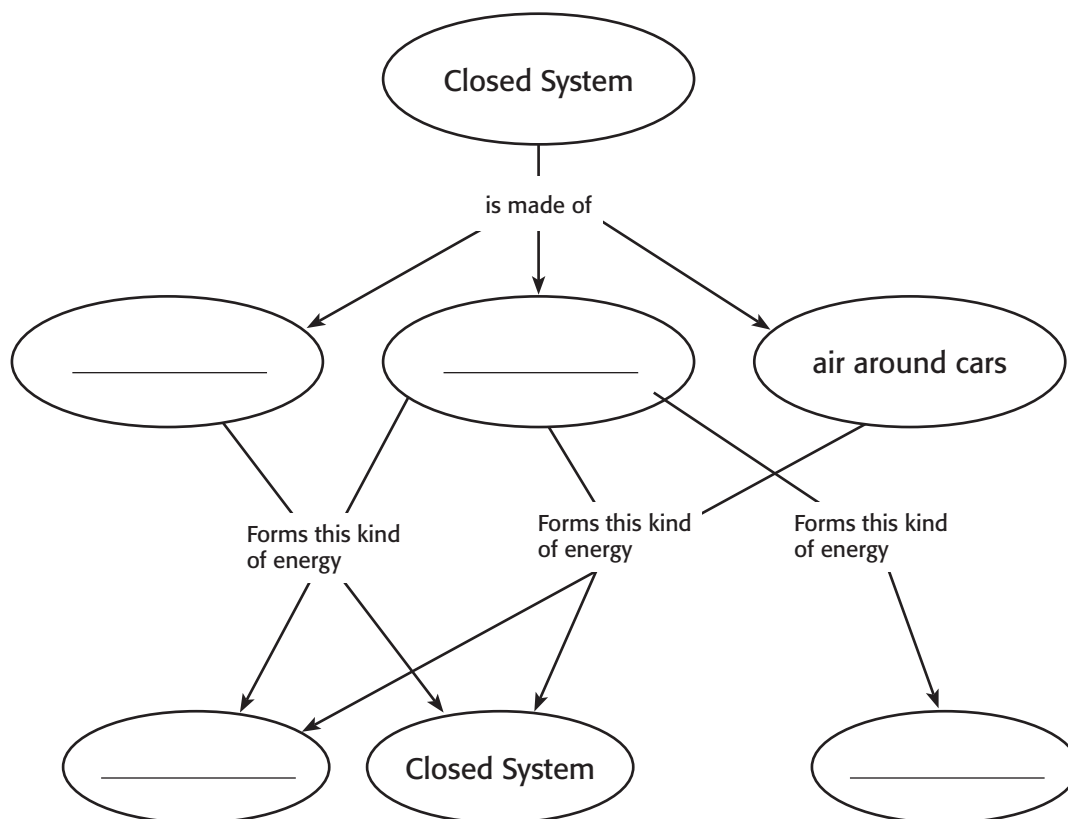
SECTION VOCABULARY

friction a force that opposes motion between two surfaces that are in contact

law of conservation of energy the law that states that energy cannot be created or destroyed but can be changed from one form to another

- 1. Explain** Suppose you drop a ball. It bounces a few times and then stops. Does the energy disappear? Explain your answer.

- 2. Identify** Fill in the following concept map for a closed system of a roller coaster. Include the parts of the closed system and the energy that is produced.



- 3. Identify** What causes thermal energy always formed in an energy conversion?
