Section 5

Electric Power

Reading Preview

Key Concepts

- How do you calculate electric power?
- What factors are used to determine how people pay for electrical energy?

Key Term

- power

Target Reading Skill

Asking Questions Before you read, preview the red headings. In a graphic organizer like the one below, ask a *what* or *how* question for each heading. As you read, write the answer to your questions.

Electric Power

Question	Answer
What is electric power?	Electric power is . . .

Lab zone **Discover Activity**

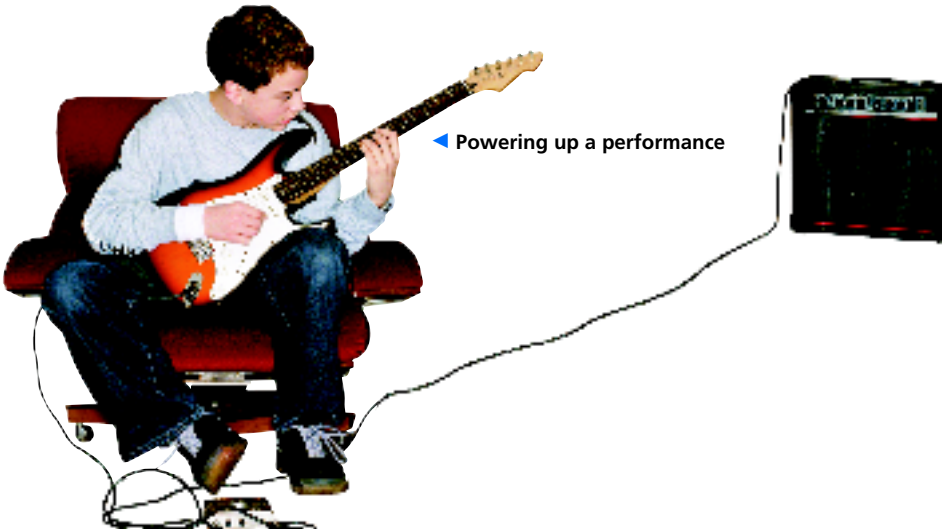
How Can You Make a Bulb Burn More Brightly?

1. Attach a light bulb in its socket to a hand generator as shown.
2. Slowly crank the generator. Observe the brightness of the bulb.
3. Crank the generator a little faster and again observe the bulb.
4. Crank the generator quickly and observe the bulb once more.

Think It Over

Posing Questions How does the speed at which you crank the generator affect the brightness of the bulb? What questions do you need to ask to explain how the rate of generating electrical energy is related to the brightness of the bulb?

Your band is auditioning for the school dance. The drummer pounds away on his snares and cymbals. The lead guitar lays down some rockin' riffs. Deep-toned plucks from your electric bass guitar maintain the beat. The judges enjoy what they hear but say they couldn't hear your bass guitar very well. "Turn up the power of your amplfier," one of them suggests. You know that means increase the volume, but what does that have to do with power?

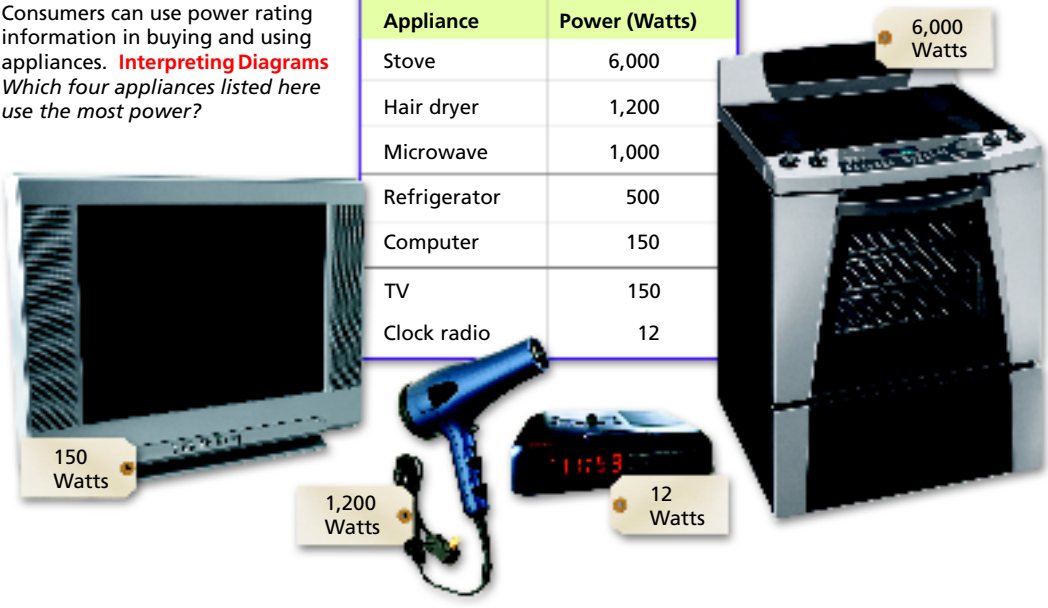


◀ **Powering up a performance**

FIGURE 21
Power Ratings
Consumers can use power rating information in buying and using appliances. **Interpreting Diagrams** *Which four appliances listed here use the most power?*

Power Ratings for Appliances

Appliance	Power (Watts)
Stove	6,000
Hair dryer	1,200
Microwave	1,000
Refrigerator	500
Computer	150
TV	150
Clock radio	12



Electric Power

An electrical appliance transforms electrical energy into another form. This energy transformation enables the appliance to perform its function. Hair dryers transform electrical energy to thermal energy to dry your hair. An amplifier that a guitar player uses transforms electrical energy into sound. A washing machine transforms electrical energy to mechanical energy to wash your clothes. The rate at which energy is transformed from one form to another is known as **power.** The unit of power is the watt (W).

Power Ratings You are already familiar with different amounts of electric power. The power rating of a bright light bulb, for example, might be 100 W. The power rating of a dimmer bulb might be 60 W. The bright bulb transforms (or uses) electrical energy at a faster rate than the dimmer bulb.

The appliances in your home vary greatly in their power ratings. New appliances are sold with labels that show the power rating for each product. Look at the table in Figure 21 to see some typical power ratings. Do any of these ratings surprise you?

Lab zone Skills Activity

Observing

Study the back or bottom of some electrical appliances around your home. Make a chart of their power ratings. Do you see any relationship between the power rating and whether or not the appliance produces heat?

Calculating Power The power of a light bulb or appliance depends on two factors: voltage and current. **You can calculate power by multiplying voltage by current.**

$$\text{Power} = \text{Voltage} \times \text{Current}$$

The units are watts (W) = volts (V) × amperes (A). Using the symbols P for power, V for voltage, and I for current, this equation can be rewritten

$$P = VI$$

Reading Checkpoint **How can you calculate power if you know the voltage and current?**

Go Online SCILINKS NSTA
For: Links on electric power
Visit: www.SciLinks.org
Web Code: scn-1425

Math Sample Problem

Calculating Power

A household light bulb has about 0.5 amps of current in it. Since the standard household voltage is 120 volts, what is the power rating for this bulb?

1 Read and Understand

What information are you given?

Current = 0.5 A

Voltage = 120 V

2 Plan and Solve

What quantity are you trying to calculate?

The power of the light bulb = ?

What formula contains the given quantities and the unknown quantity?

Power = Voltage × Current

Perform the calculation.

Power = 120 V × 0.5 A

Power = 60 W

3 Look Back and Check

Does your answer make sense?

The answer is reasonable, because 60 W is a common rating for household light bulbs.

Math Practice

1. A flashlight bulb uses two 1.5-V batteries in series to create a current of 0.5 A. What is the power rating of the bulb?
2. A hair dryer has a power rating of 1,200 W and uses a standard voltage of 120 V. What is the current through the hair dryer?

FIGURE 22
Paying for Electricity
Electric bills are based on the amount of time various appliances are used. For any type of appliance, energy guides help consumers make the most efficient purchase.

Paying for Electrical Energy The electric bill that comes to your home charges for energy use, not power. Energy use depends on both power and time. Different appliances transform electrical energy at different rates. And you use some appliances more than others. **The total amount of energy used by an appliance is equal to the power of the appliance multiplied by the amount of time the appliance is used.**

$$\text{Energy} = \text{Power} \times \text{Time}$$

Electric power is usually measured in thousands of watts, or kilowatts (kW), and time is measured in hours. The unit of electrical energy is the kilowatt-hour (kWh).

$$\text{Kilowatt-hours} = \text{Kilowatts} \times \text{Hours}$$

Ten 100-watt light bulbs turned on for one hour use 1,000 watt-hours, or 1 kilowatt-hour, of energy.

The amount of electrical energy used in your home is measured by a meter. As more lights and appliances are turned on, you can observe a dial on the meter turning more rapidly. The electric company uses the meter to keep track of the number of kilowatt-hours used. You pay a few cents for each kilowatt-hour.

Reading Checkpoint **How can you calculate power if you know the voltage and current?**

Section 5 Assessment

Target Reading Skill **Asking Questions** Use the answers to the questions about headings to help you answer the questions below.

Reviewing Key Concepts

1. **a.** **Defining** What is electric power?
   b. **Calculating** What formula can you use to calculate power?
   c. **Making Generalizations** Is it correct to say the bigger the electrical device, the more power it uses? Use Figure 21 to explain your answer.
2. **a.** **Reviewing** When utility companies calculate a consumer's electric bill, do they consider power or energy use? Explain.
   b. **Explaining** If the power rating of an appliance is known, how can you find the amount of energy it uses?
   c. **Interpreting Tables** Which appliance in Figure 21 has the greatest power rating? How can some appliances with lower power ratings cost more to use over a month?

Math Practice

3. **Calculating Power** An electric water heater that uses 40 kW runs for 5.0 hours. What is its power?
4. **Calculating Power** What is the power of the same water heater if it was run for 20 hours?