Name Date

Section 9.2 Summary

The Power of Electricity

Textbook pages 320–329

Before You Read

What does the word power mean to you? Write a sentence using this word on the lines below. As you read about the power of electricity in this section, think about how the common meaning of power differs from the scientific meaning.

_____

_____

Mark the Text

Summarize

As you read this section, highlight the main point in each paragraph. Then write a short paragraph summarizing what you have learned.

Reading Check

1. What is the equation for calculating electrical power?

_____

_____

_____

What is electrical power?

Power is the rate of change in energy. The symbol for power is P. The units for measuring power are joules per second. A **joule** (J) is the unit for measuring energy. One joule per second is also called one **watt** (W).

Electrical power is the rate of change of electrical energy. In other words, electrical power is the amount of electrical energy that is changed into other forms of energy each second. For example, a 100 W light bulb changes 100 W of electrical energy into light and heat each second.

How is electrical power calculated?

You can calculate electrical power if you know the voltage and current in a circuit:

Power (in watts) = current (in amperes, symbol I)
× voltage (in volts, symbol V)
or $P = IV$

By rearranging the terms in this equation, you can find the current or the voltage of the circuit, too.

$$\text{Current} = \frac{\text{Power}}{\text{Voltage}} \text{ or } I = \frac{P}{V}$$

$$\text{Voltage} = \frac{\text{Power}}{\text{Current}} \text{ or } V = \frac{P}{I}$$

What is a power rating?

You have likely seen a light bulb with a power in watts marked on it, such as 40 W, 60 W, or 100 W. You may have noticed a similar power in watts on devices such as hair dryers, kettles, or MP3 players. These **power ratings** tell you how many joules of energy the device uses each second of operation. (Recall that 1 W is 1 J/s.)

How is amount of electrical energy calculated?

You can use a power rating to calculate the amount of electrical energy that a device uses. The mathematical equation that defines power is:

$$\textbf{Power (in watts)} = \frac{\text{energy (in joules)}}{\text{time (in seconds)}} \text{ or } P = \frac{E}{t}$$

By rearranging the terms in this equation, you can find the amount of electrical energy that a device uses by multiplying its power rating by the amount of time it was used:

$$\text{Energy (in joules, J)} = \text{Power (in watts, W)} \times \text{Time (in seconds, s)}$$
$$\text{or } E = Pt$$

What is a kilowatt-hour?

A joule is a small amount of energy. You use about one joule of energy to lift a medium-sized apple a distance of one metre. Electrical devices use fairly large amounts of energy, so a larger unit of energy is used to describe them. A **kilowatt-hour** (kW•h) is the same amount of energy as 1000 W used over a period of 1 h.

Reading Check

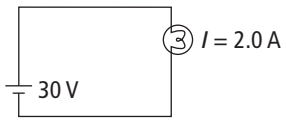
2. What is the equation for calculating energy use of an electrical device?

Name Date

Comprehension
Section 9.2

Power calculations

State the formula that you will be using for each question. Show all your work below. Write down your answer with the correct units.

1. The current in a clothes dryer is 20 A when it is plugged into a 240 V outlet. What is the power rating of this clothes dryer?	**2.** A countertop convection oven is plugged into an outlet that provides a potential difference of 120 V. What is the power rating of the oven if the current is 12 A?
3. A DVD player that is not being used still uses energy at a rate of 15 W. What current is passing through it if the DVD player is plugged into a 120 V electrical outlet?	**4.** Determine the amount of current flowing into a 210 W computer plugged into a 120 V outlet.
5. A flashlight bulb has 2.4 W of power when the current in the bulb is 0.8 A. What is the voltage drop across the bulb?	**6.** Calculate the power of the light bulb in the circuit shown below. 

Use with textbook pages 320–325.

Energy calculations

State the formula that you will be using for each question. Show all your work below. Write down your answer with the correct units.

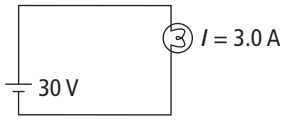
1. A microwave oven operates on 1200 W of power and is used for 30 minutes. How much electrical energy is used by the microwave oven?

2. A refrigerator operates on average for 12 hours a day. If the power rating of the fridge is 700 W, how much electrical energy does the fridge use in one day?

3. A kitchen light is left on for 6 h. If the amount of electrical energy used is 0.6 kW•h, what is the power rating of the light bulb?

4. A hair dryer that has a power rating of 1000 W uses 1.75 kW•h in one week. For how many hours (or minutes) is the hair dryer used daily on average?

5. How much energy did the light bulb in the circuit below use if it was left on for 2 hours?



Use with textbook pages 320–325.

Paying for electricity

Show all your work below.

1. Assume that the electric utility company charges $0.09 for every kW·h of energy. How much does it cost to:

(a) operate a dryer that uses 15 A of current at 240 V for 1.5 hours?

(b) operate six 100 W light bulbs for an average of 5 hours per day?

(c) operate a refrigerator for a week if it draws 2.0 A of current from a 120 V source that turns on for 15 minutes every hour?

2. If your computer uses 2.5 A at 120 V, how much will it cost to use the computer for 4 hours a day, seven days a week for two weeks? Assume that the cost of electricity is $0.09 for every kW·h of energy.

3. A clothes dryer has a power rating of 4000 W. How long did it take to dry a load of laundry if electric power costs $0.09/ kW·h and the cost of using the dryer was $0.54?

Use with textbook pages 320–325.

The power of electricity

Use the following table showing power ratings of some appliances to answer questions 1 to 3.

Appliance	Power (W)
stereo	250
toaster	1100
computer	350
colour TV	200
microwave	900

Match each Description on the left with the correct Appliance on the right. Each Appliance may be used more than once.

Description	Appliance
1. _____ consumes 1 kW•h of energy if it is left on for 4 h **2.** _____ uses the most energy if it operates for 20 min **3.** _____ has 7.5 A of current flowing through it when it is plugged into a 120 V outlet	**A.** stereo **B.** toaster **C.** computer **D.** colour TV **E.** microwave

Circle the letter of the best answer.

4. Which of the following are units for energy?

I.	watts (W)
II.	joules (J)
III.	kilowatt-hours (kW•h)

A. I and II only

B. I and III only

C. II and III only

D. I, II, and III

5. A calculator uses a 9 V battery and draws 0.2 A of current. What is its power rating?

A. 0.02 W

B. 1.8 W

C. 18 W

D. 45 W

6. The current flowing in an appliance connected to a 120 V source is 2 A. How much electrical energy does the appliance use in 6 h?

A. 1.44 kW•h

B. 40 kW•h

C. 240 kW•h

D. 1440 kW•h

7. An electric space heater draws 15 A from a 120 V source. If it is used for 6 hours, how much electrical energy does it use?

I.	10.8 kW•h
II.	648 000 kW•h
III.	38 880 000 J

A. I and II only

B. I and III only

C. II and III only

D. I, II, and III

8. A self-cleaning oven operates on 5400 W of power when cleaning itself. It takes 2 h to clean. At a cost of $0.09 per kW•h, how much does it cost to clean the oven?

A. $0.49

B. $0.97

C. $10.80

D. $970.00