

Chapter 20 Electricity

## Section 20.1 Electric Charge and Static Electricity

(pages 600–603)

*This section explains how electric charge is created and how positive and negative charges affect each other. It also discusses the different ways that electric charge can be transferred.*

### Reading Strategy (page 600)

**Identifying Main Ideas** Copy the table on a separate sheet of paper. As you read, write the main ideas. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

Characteristics of Electric Charge	
Topic	Main Idea
Electric Charge	An excess or shortage of electrons produces a net electric charge.
Electric Forces	
Electric Fields	
Static Electricity	

### Electric Charge (pages 600–601)

- What are the two types of electric charge?  
 a. \_\_\_\_\_ b. \_\_\_\_\_
- Is the following sentence true or false? In an atom, negatively charged electrons surround a positively charged nucleus.  
 \_\_\_\_\_
- Is the following sentence true or false? If a neutral atom gains one or more electrons, it becomes a positively charged ion.  
 \_\_\_\_\_
- What is the SI unit of electric charge? \_\_\_\_\_

### Electric Forces (page 601)

- Circle the letter of each sentence that is true about electric force.
  - Like charges attract and opposite charges repel.
  - Electric force is the attraction or repulsion between electrically charged objects.
  - Electric force is inversely proportional to the amount of charge.
  - Electric force is inversely proportional to the square of the distance between two charges.

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- Which are stronger inside an atom, electric forces or gravitational forces? \_\_\_\_\_
- Is the following sentence true or false? Electric forces cause friction and other contact forces. \_\_\_\_\_

### Electric Fields (page 602)

- A charge's electric field is the effect the charge has on \_\_\_\_\_ in the space around it.
- Circle the letters of the factors that the strength of an electric field depends on.
  - the direction of the field
  - whether the charge is positive or negative
  - the amount of charge that produces the field
  - the distance from the charge
- Is the following sentence true or false? The field of a negative charge points away from the charge. \_\_\_\_\_

### Static Electricity and Charging (pages 602–603)

- Static electricity is the study of the \_\_\_\_\_.
- Is the following sentence true or false? Charge can be transferred by friction, by contact, and by induction. \_\_\_\_\_
- What is the law of conservation of charge? \_\_\_\_\_  
\_\_\_\_\_
- Rubbing a balloon on your hair is an example of charging by \_\_\_\_\_.
- A charge transfer between objects that touch each other is called \_\_\_\_\_.
- Circle the letter of each sentence that is true about charging.
  - When you rub a balloon on your hair, your hair loses electrons and becomes positively charged.
  - The sphere of a Van de Graaff generator transfers all of its charge to you when you touch it.
  - Induction occurs when charge is transferred without contact between materials.
  - Static charges cannot move.

### Static Discharge (page 603)

- Is the following sentence true or false? Static discharge occurs when a pathway through which charges can move forms suddenly. \_\_\_\_\_
- How does lightning occur? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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## Section 20.2 Electric Current and Ohm's Law

(pages 604–607)

*This section discusses electric current, resistance, and voltage. It also uses Ohm's Law to explain how voltage, current, and resistance are related.*

### Reading Strategy (page 604)

**Predicting** Before you read, write a prediction of what electric current is in the table below. After you read, if your prediction was incorrect or incomplete, write what electric current actually is. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

Electric Current	
Electric Current Probably Means	Electric Current Actually Means

### Electric Current (page 604)

1. What is electric current? \_\_\_\_\_  
\_\_\_\_\_
2. Complete the following table about electric current.

Electric Current		
Type of Current	How Charge Flows	Examples
Direct		
Alternating	Two directions	

3. Electrons flow in the wire from a(n) \_\_\_\_\_ terminal to a(n) \_\_\_\_\_ terminal.

### Conductors and Insulators (page 605)

4. What is an electrical conductor? \_\_\_\_\_  
\_\_\_\_\_
5. What is an electrical insulator? \_\_\_\_\_  
\_\_\_\_\_
6. Is the following sentence true or false? Metals are good conductors because they do not have freely moving electrons.  
\_\_\_\_\_

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Match each material to the category of a conductor or insulator.

Material	Category
_____ 7. Copper	a. conductor
_____ 8. Plastic	b. insulator
_____ 9. Rubber	
_____ 10. Silver	
_____ 11. Wood	

### Resistance (page 605)

12. Explain why the current is reduced as electrons move through a conductor. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
13. Circle the letter of each factor that affects a material's resistance.  
 a. its length                      b. its temperature  
 c. its velocity                      d. its thickness
14. What is a superconductor? \_\_\_\_\_  
 \_\_\_\_\_

### Voltage (page 606)

Match each term to its definition.

Definition	Term
_____ 15. A device that converts chemical energy to electrical energy	a. flow of charge
_____ 16. Requires a complete loop	b. voltage
_____ 17. The difference in electrical potential energy between two places in an electric field	c. battery

18. Is the following sentence true or false? Three common voltage sources are batteries, solar cells, and generators. \_\_\_\_\_

### Ohm's Law (page 607)

19. Is the following sentence true or false? According to Ohm's law, the voltage in a circuit equals the product of the energy and the resistance. \_\_\_\_\_
20. Doubling the voltage in a circuit doubles the current if \_\_\_\_\_ is held constant.
21. Is the following sentence true or false? Doubling the resistance in a circuit will halve the current if voltage is held constant.  
 \_\_\_\_\_

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## Section 20.3 Electric Circuits

(pages 609–613)

*This section describes circuit diagrams and types of circuits. It also explains calculation of electric power and electric energy and discusses electrical safety.*

### Reading Strategy (page 609)

**Relating Text and Visuals** As you read about household circuits, complete the table by listing three things the diagram in Figure 13 helps you understand about circuits. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

Understanding a Circuit Diagram
<b>What Can Be Seen in the Circuit Diagram?</b>
Wire bringing current from outside

### Circuit Diagrams (pages 609–610)

- Circuit diagrams use \_\_\_\_\_ to represent parts of a circuit, including a source of electrical energy and devices that are run by the electrical energy.

Match each symbol to what it indicates on a circuit diagram.

Symbol	What Symbol Indicates
_____ 2. +	a. The direction of current
_____ 3. -	b. A negative terminal
_____ 4. →	c. A positive terminal

### Series Circuits (page 610)

- Is the following sentence true or false? In a series circuit, if one element stops functioning, then none of the elements can operate.  
\_\_\_\_\_

- Explain why the bulbs shine less brightly when more bulbs are added to a series circuit. \_\_\_\_\_  
\_\_\_\_\_

### Parallel Circuits (page 610)

- Is the following sentence true or false? Circuits in a home are rarely wired in parallel. \_\_\_\_\_
- If one element stops functioning in a parallel circuit, the rest of the elements \_\_\_\_\_.

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**Power and Energy Calculations (pages 611–612)**

9. The rate at which electrical energy is converted to another form of energy is called \_\_\_\_\_.
10. The SI unit of electric power is the joule per second, or \_\_\_\_\_, which is abbreviated \_\_\_\_\_.
11. Is the following sentence true or false? Electric power is calculated by multiplying current times voltage. \_\_\_\_\_
12. Write the formula for calculating electrical energy.  
\_\_\_\_\_
13. The unit of energy usually used by electric power companies is the \_\_\_\_\_.

**Electrical Safety (pages 612–613)**

14. Circle the letters of what could happen if the current in a wire exceeds the circuit’s safety limit.
  - a. The wire could overheat.
  - b. The wire could get cooler.
  - c. A fire could start.
  - d. A fuse could blow.
15. Explain how a fuse prevents current overload in a circuit. \_\_\_\_\_  
\_\_\_\_\_
16. A switch that opens to prevent overloads when current in a circuit is too high is called a(n) \_\_\_\_\_.
17. Explain why touching an electrical device with wet hands is dangerous. \_\_\_\_\_  
\_\_\_\_\_
18. Is the following sentence true or false? A ground-fault circuit interrupter shuts down the circuit if the current flowing through the circuit and current returning to ground are equal.  
\_\_\_\_\_
19. The transfer of excess charge through a conductor to Earth is called \_\_\_\_\_.
20. Complete the following table about equipment used to prevent electrical accidents.

Equipment to Prevent Current Overload	Equipment to Protect People from Shock	Equipment to Prevent Short Circuits
a. Circuit breaker	b. c. Grounding wire d.	e.

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## Section 20.4 Electronic Devices

(pages 618–622)

*This section discusses how various electronic devices operate and what they are used for.*

### Reading Strategy (page 618)

**Summarizing** Copy the table on a separate sheet of paper. As you read, complete the table to summarize what you learned about solid-state components. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

Solid-State Components		
Solid-State Component	Description	Uses
Diode		
Transistor		
Integrated Circuit		

### Electronic Signals (pages 618–619)

*Match each term to its definition.*

- | Definition   | Term                 |
|--|----------------------|
| _____ 1. Information sent as patterns in the controlled flow of electrons through a circuit              | a. electronics       |
| _____ 2. The science of using electric current to process or transmit information                        | b. analog signal     |
| _____ 3. A smoothly varying signal produced by continuously changing the voltage or current in a circuit | c. electronic signal |
| _____ 4. A signal that encodes information as a string of 1's and 0's                                    | d. digital signal    |
| 5. Which type of signal is usually used by an AM radio station?  |                      |
| _____  |                      |

6. Is the following sentence true or false? Analog signals are more reliable than digital signals. \_\_\_\_\_

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**Vacuum Tubes (page 619)**

7. Circle the letter of each item that is true about vacuum tubes.
  - a. can change alternating current to direct current
  - b. never burn out
  - c. can increase the strength of a signal
  - d. can turn a current on or off
8. Is the following sentence true or false? An image is produced in a CRT when phosphors glow red, green, and blue in response to electron beams. \_\_\_\_\_

**Semiconductors (page 621)**

9. What is a semiconductor? \_\_\_\_\_  
\_\_\_\_\_
10. Name the two types of semiconductors.
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
11. Circle the letter of each sentence that is true about a p-type semiconductor.
  - a. It can be made by adding a trace amount of boron to a silicon.
  - b. Electrons are attracted to positively charged holes at each boron atom.
  - c. As the electrons jump from hole to hole, it looks like a flow of positive charge.
  - d. Boron atoms provide weakly bound electrons that can flow.
12. Is the following sentence true or false? In an n-type semiconductor, weakly bound electrons can conduct a current. \_\_\_\_\_

**Solid-State Components (pages 621–622)**

*Match each term to its definition.*

Term	Definition
_____ 13. diode	a. A solid-state component with three layers of semiconductors
_____ 14. transistor	b. A thin slice of silicon that contains many solid-state components
_____ 15. integrated circuit	c. A solid-state component that combines an n-type and p-type semiconductor

16. A chip or microchip is another name for a(n) \_\_\_\_\_.

**Communications Technology (page 622)**

17. Why is it useful for communication devices to use microchips? \_\_\_\_\_  
\_\_\_\_\_
18. A mobile phone can store data such as phone numbers because \_\_\_\_\_  
\_\_\_\_\_