Name _____ Date _____ Class _____

Assess Your Understanding

Electric Charge and Static Electricity

How Do Charges Interact?

got it?

○ **I get it!** Now I know that the way electric charges interact depends on _____

_____

○ **I need extra help with** _____

_____

How Does Charge Build Up?

1a. DESCRIBE What happens to an object's atoms when the object becomes positively charged?

_____

_____

b. CHALLENGE Explain how you could use a piece of silk and a glass rod to attract a stream of tap water.

_____

_____

_____

_____

got it?

○ **I get it!** Now I know the four methods of building up static electricity are _____

_____

_____

_____

○ **I need extra help with** _____

_____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Name _____ Date _____ Class _____

Key Concept Summaries

Electric Charge and Static Electricity

How Do Charges Interact?

Atoms contain charged particles called electrons and protons. The charge on a proton is positive (+). The charge on an electron is negative (–). If two electrons or two protons come close together, they push each other apart. If a proton and an electron come close together, they attract one another because they have opposite electric charges.

Charges that are the same repel each other.
Charges that are different attract each other.
The interaction between electric charges is called electricity. The force between charged objects is called **electric force.** An **electric field** is a region around a charged object where the object's electric force is exerted on other charged objects. Electric fields and forces get weaker the farther away they are from the charge.

How Does Charge Build Up?

The buildup of charges on an object is called **static electricity.** In static electricity, charges build up on an object, but they do not flow continuously.

Charges are neither created nor destroyed. This is a rule known as the law of **conservation of charge.** An object can't become charged by destroying or creating its own electrons. If one object loses electrons, another object must pick them up.
There are four methods by which charges can redistribute themselves to build up static electricity: by friction, by conduction, by induction, and by polarization.

Charging by **friction** is the transfer of electrons from one uncharged object to another by rubbing the objects together. Charging by **conduction** is the transfer of electrons from one object to another by direct contact. Electrons can react to the electric field of a charged object without touching the object itself. This happens in charging by **induction** and **polarization.** The loss of static electricity as electric charges transfer from one object to another is called **static discharge.** Static discharge often produces a spark. Lightning bolts are an example of static discharge.

On a separate sheet of paper, explain how negative charges at the bottoms of storm clouds can cause lightning to strike earth.

Name _____ Date _____ Class _____

Lesson Quiz

Electric Charge and Static Electricity

Write the letter of the correct answer on the line at the left.

1. ___ Atoms contain charged particles called
   A protons, neutrons, and electrons
   B protons and electrons
   C protons and neutrons
   D electrons and neutrons

2. ___ A region around a charged object where the object's electric force is exerted on other charged objects is an electric
   A field
   B outlet
   C socket
   D power plant

3. ___ In static electricity, charges
   A flow continuously
   B flow intermittently
   C build up in an atom
   D build up on an object

4. ___ Charges can redistribute themselves by friction, conduction, polarization, or
   A reduction
   B production
   C induction
   D superconduction

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ Charges that are different repel each other.

6. _____ An electric field gets stronger the closer it is to the charge.

7. _____ Charges do not transfer between objects in polarization or conduction.

8. _____ Lightning is an example of static discharge.

9. _____ Electric current is the buildup of charges on an object.

10. _____ Most objects have some overall charge.

Name _____ Date _____ Class _____

Assess Your Understanding

Electric Current

How Is Electric Current Made?

1a. REVIEW What is the unit of current?

_____

b. PREDICT What could break the circuit between your home and an electric power plant?

_____

_____

got it?

○ **I get it!** Now I know that electric current is made of _____

_____

_____

○ **I need extra help with** _____

_____

How Do Conductors Differ From Insulators?

got it?

○ **I get it!** Now I know that conductors and insulators are different because of _____

_____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Assess Your Understanding

Electric Current

What Affects Current Flow?

2a. **LIST** List the four factors that determine the resistance of an object.

_____

_____

b. **CHALLENGE** Battery A supplies 500 charges. Each charge has 2 J of energy. Battery B supplies 50 charges, each of which has 4 J of energy. Which battery supplies more total energy? Which has a higher voltage?

_____

got it?

○ **I get it!** Now I know that current is affected by _____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Key Concept Summaries

Electric Current

How Is Electric Current Made?

When electric charges are made to flow through a material, they produce an electric current. **Electric current** is the continuous flow of electric charges through a material. The amount of charge that passes through a wire in a given period of time is the rate of electric current. The unit for the rate of current is the ampere (amp or A).

In order to maintain an electric current, charges must be able to flow continuously in a loop. A complete, unbroken path that charges can flow through is called an **electric circuit.** All devices, from toasters to televisions, contain electric circuits.

How Do Conductors Differ From Insulators?

A **conductor** is a material through which charge can flow easily. Metals are good conductors. That is why current-carrying wires are usually made of metal. Wires are surrounded by **insulators,** materials like rubber that do not allow charges to flow. The difference between conductors and insulators comes from how strongly electrons are attached to atoms. **The atoms in conductors have loosely bound electrons that can move freely. Electrons in insulators cannot move freely among atoms.**

What Affects Current Flow?

Current flow is affected by the energy of the charges and the properties of the objects that the charges flow through. The *V* on a battery stands for volts, which is the unit of voltage. **Voltage** is the difference in electric potential energy *per charge* (electric potential) between two points in a circuit. This energy difference causes charges to flow. The amount of current in a circuit depends not only on voltage but also on resistance. **Resistance** is the measure of how difficult it is for charges to flow through an object. The greater the resistance, the less current there is for a given voltage. The unit of measure of resistance is the ohm (Ω). The four factors that determine the resistance of an object are diameter, length, material, and temperature. If more than one path for current is available, the current will flow through the path that has the least resistance.

On a separate sheet of paper, write a paragraph using the terms *electric current, voltage, resistance, ohm, ampere,* and *volt*. Underline the terms.

Name _____ Date _____ Class _____

Lesson Quiz

Electric Current

Write the letter of the correct answer on the line at the left.

1. ___ The unit for the rate of current is the
- A ampere
- B volt
- C ohm
- D joule

2. ___ All electrical devices contain electric
- A acid
- B gears
- C circuits
- D motors

3. ___ Potential electric current can be converted into
- A heat
- B matter
- C waste
- D food

4. ___ Which of the following does *not* determine the resistance of a wire?
- A temperature
- B diameter
- C length
- D color

Fill in the blank to complete each statement.

5. The amount of charge that passes through a wire in a given period of time is the rate of electric _____.

6. The electrons in conductors move about _____ freely than the electrons in insulators.

7. Charges flow through wires because of differences in electric _____.

8. _____ is the measure of how difficult it is for charges to flow through an object.

9. _____ is the difference in electric potential energy per charge between two points in a circuit.

10. Current flow is affected by the _____ of an object (such as the length of a wire) that the charge flows through.

Name _____ Date _____ Class _____

Assess Your Understanding

Electric Circuits

What Did Ohm Discover?

got it?

○ **I get it!** Now I know that Ohm's Law _____

_____

_____

○ **I need extra help with** _____

_____

What Is a Circuit Made Of?

1a. **CLASSIFY** A (series/parallel) circuit has only one path for current to flow through.

b. **ANSWER** How does an electric circuit work?

_____

_____

_____

_____

got it?

○ **I get it!** Now I know that electric circuits must contain _____

_____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Key Concept Summaries

Electric Circuits

What Did Ohm Discover?

In the 1800s, Georg Ohm found that the current, voltage, and resistance in a circuit are always related in the same way. Ohm concluded that conductors and most other devices have a constant resistance regardless of the applied voltage. Although changing the voltage in a circuit changes the current, it does not change the resistance.

Ohm created a law that describes how voltage, current, and resistance are related. **Ohm's law** says that resistance in a circuit is equal to voltage divided by current.

$$\text{Resistance} = \frac{\text{Voltage}}{\text{Current}}$$

You can rearrange Ohm's law to solve for voltage when you know current and resistance.

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

What Is a Circuit Made Of?

Everything that uses electricity contains a circuit. **All electric circuits have the same basic features: devices that are run by electrical energy, sources of electrical energy, and conducting wires.**

If all the parts of an electric circuit are connected one after another along one path, the circuit is called a **series circuit.** A series circuit has only one path for the current to take. So if a light bulb burns out in a series circuit, the other lights go out as well. Another disadvantage of a series circuit is that the light bulbs in the circuit become dimmer as more bulbs are added.

In a **parallel circuit,** different parts of the circuit are on separate branches. There are several paths for current to take. So, if a light burns out in a parallel circuit, charges can still move through the other branches. The other bulbs remain lit.

When you add a branch to a parallel circuit, the overall resistance decreases. Remember that for a given voltage, if resistance decreases current increases. The additional current travels along each new branch without affecting the original branches. So as you add branches to a parallel circuit, the brightness of the light bulbs does not change.

On a separate sheet of paper, make a Venn diagram that compares and contrasts a series and parallel circuit, each made up of a battery, wires, and light bulbs.

Name _____ Date _____ Class _____

Lesson Quiz

Electric Circuits

Write the letter of the correct answer on the line at the left.

1. ___ When more branches are added to a parallel circuit,
   - A resistance increases
   - B voltage increases
   - C resistance decreases
   - D voltage decreases

2. ___ Batteries and power plants are examples of
   - A energy sources
   - B energy conduction
   - C energy transformation
   - D energy conservation

3. ___ The path of current in a circuit is completed by
   - A a transformer
   - B an energy source
   - C conducting wires
   - D an electrical device

4. ___ Resistance in a circuit is equal to voltage divided by
   - A joules
   - B current
   - C power
   - D amperage

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ Electrical energy in a circuit gets transformed into other forms of energy, such as mechanical energy.

6. _____ Isaac Newton formulated Ohm's law.

7. _____ Opening a switch breaks an electric device.

8. _____ All electric circuits have the same basic features.

9. _____ Energy is always lost in a circuit.

10. _____ Most conductors have a(n) inconstant resistance regardless of the applied voltage.

Name _____ Date _____ Class _____

Assess Your Understanding

Electric Power and Safety

How Do You Calculate Electric Power and Safety?

1a. **REVIEW** The power of an appliance can be found by multiplying _____ by _____.

b. **CALCULATE** How much energy does an 850 W toaster consume if it is used for 1.5 hours over the course of a month?

_____

_____

got it?

○ **I get it!** Now I know that electric power and energy depend on _____

_____

○ **I need extra help with** _____

_____

How Can Electric Shocks Be Prevented?

got it?

○ **I get it!** Now I know that electric safety devices _____

_____

_____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Key Concept Summaries

Electric Power and Safety

How Do You Calculate Electric Power and Safety?

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 is calculated by multiplying voltage by current.

Power = Voltage × Current

The units are watts (W) = volts (V) × amperes (A). An electric bill charges for the month's energy use, not power. Power tells you how much energy an appliance uses in a certain period of time. **The total amount of energy used is equal to the power of the appliance multiplied by the amount of time the appliance is used.**

Energy = Power × Time

Electric power is usually measured in thousands of watts, or kilowatts (kW). To go from watts to kilowatts, you divide by 1,000. Time is measured in hours. A common unit of electrical energy is the kilowatt-hour (kWh).

Kilowatt-hours = Kilowatts × Hours

How Can Electric Shocks Be Prevented?

A **short circuit** is a connection that allows current to take the path of least resistance. Touching a frayed wire causes a short circuit, since current can flow through the person rather than through the wire.

Electric shocks can be prevented with devices that redirect current or break circuits. Ground wires connect the circuits in a building directly to Earth, giving charges an alternate path in the event of a short circuit. The **third prong** on electric plugs connects the metal parts of appliances to the building's ground wire. Any circuit connected to Earth in this way is **grounded.**

Overheated circuits can result in fires, so circuits in homes contain devices that prevent circuits from overheating. **Fuses** are devices that melt if they get too hot. This breaks the circuit. **Circuit breakers** are switches that will bend away from circuits as they heat up. Unlike fuses, circuit breakers can be reset.

On a separate sheet of paper, explain how to calculate power. Then write a paragraph explaining how shocks can be prevented.

Name _____ Date _____ Class _____

Lesson Quiz

Electric Power and Safety

Write the letter of the correct answer on the line at the left.

1. ___ The power of a light bulb or appliance depends on

A kilowatts and hours

B voltage and current

C fuses and circuit breakers

D transformation of energy

2. ___ The unit of power is the

A watt

B volt

C ampere

D kilowatt

3. ___ The amount of current running through a clock radio that uses a standard wall outlet (120 volts) and has a power rating of 12 watts is

A 0.1 amps

B 1.0 amps

C 10 amps

D 100 amps

4. ___ An electric bill charges for the month's

A wattage

B amperage

C energy use

D voltage

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ You can calculate current by multiplying power by voltage.

6. _____ Electric power is usually measured in watts.

7. _____ The equation Energy = Power × Current can be used to find the amount of energy used by an appliance.

8. _____ A short circuit allows current to take the path of greatest resistance.

9. _____ Fuses and circuit gauges prevent circuits in a home from overheating.

10. _____ A circuit connected to Earth with a three-pronged plug is resistant.