

Electric Current



What are the two types of current?



The two types of current are direct current and alternating current.

Electric Current

The continuous flow of electric charge is an **electric current**.

- Charge flows only in one direction in **direct current** (DC). A flashlight and most other battery-operated devices use direct current.
- **Alternating current** (AC) is a flow of electric charge that regularly reverses its direction. Electric current in your home and school is mostly alternating current.

Electric Current

The SI unit of electric current is the ampere (A), or amp, which equals 1 coulomb per second.

Even though electrons flow in an electric current, scientists define current as the direction in which positive charges would flow.

Conductors and Insulators



What are some examples of conductors and insulators?



Metals such as copper and silver are good electrical conductors. Wood, plastic, rubber, and air are good electrical insulators.

Conductors and Insulators

An **electrical conductor** is a material through which charge can flow easily.

An **electrical insulator** is a material through which charge cannot flow easily.

Resistance



What factors affect electrical resistance?



A material's thickness, length, and temperature affect its resistance.

Resistance

Resistance is opposition to the flow of charges in a material.

- As electrons move through a conducting wire, they collide with electrons and ions. These collisions convert some kinetic energy into thermal energy, and the current is reduced.
- The SI unit of resistance is the ohm.

Resistance

Resistance is greater in a longer wire because the charges travel farther. As temperature increases, a metal's resistance increases because electrons collide more often.

A **superconductor** is a material that has almost zero resistance when it is cooled to low temperatures.

Voltage



What causes an electric current?



In order for charge to flow in a conducting wire, the wire must be connected in a complete loop that includes a source of electrical energy.

Voltage

Potential Difference

Water falls spontaneously from a higher to a lower height. Likewise, electric charges flow from a higher to a lower potential energy.

- **Potential difference** is the difference in electrical potential energy between two places in an electric field.
- Potential difference is measured in joules per coulomb, or volts. Because it is measured in volts, potential difference is also called **voltage**.

Ohm's Law



How are voltage, current, and resistance related?



Increasing the voltage increases the current. Keeping the same voltage and increasing the resistance decreases the current.

Ohm's Law

According to **Ohm's law**, the voltage (V) in a circuit equals the product of the current (I) and the resistance (R).

Ohm's Law

$$V = I \times R \text{ or } I = \frac{V}{R}$$

When the current is in amperes, and the resistance is in ohms, the voltage is in volts.

Ohm's Law

What is the voltage if the resistance is 3 ohms and the current is 3 amps?

$$V = I \times R = 3 \text{ amps} \times 3 \text{ ohms} = 9 \text{ volts}$$

Assessment Questions

1. Which of the following materials is a good conductor of electric current?
 - a. wood
 - b. glass
 - c. air
 - d. iron

ANS: D

Assessment Questions

2. If a piece of wire has a certain resistance, which wire made of the same material will have a lower resistance?
- a. a hotter wire
 - b. a thicker wire
 - c. a longer wire
 - d. a thinner wire

ANS: B

Assessment Questions

3. What does the voltage between two points in an electric field represent?
- a. the total kinetic energy
 - b. the difference in mechanical energy
 - c. the difference in potential energy
 - d. the electrical energy

ANS: C

Assessment Questions

4. A 9-volt battery drives an electric current through a circuit with 4-ohm resistance. What is the electric current running through the circuit?
- a. 0.44 A
 - b. 2.25 A
 - c. 5 A
 - d. 36 A

ANS: B

Assessment Questions

5. The two types of electric current are direct current and indirect current.

True

False

ANS: F, alternating