



16.3 Voltage, Current, and Resistance

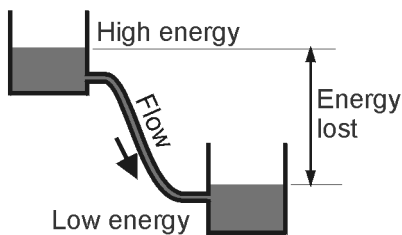
READ



Electricity is one of the most fascinating topics in physical science. It's also one of the most useful to understand, since we all use electricity daily. This skill sheet reviews some of the important terms in the study of electricity. In the reading section, you'll find questions that check your understanding. If you're not sure of the answer, go back and read that section again. In the practice section, you will have an opportunity to show that you know how voltage, current, and resistance are related in real-world situations.

What is voltage?

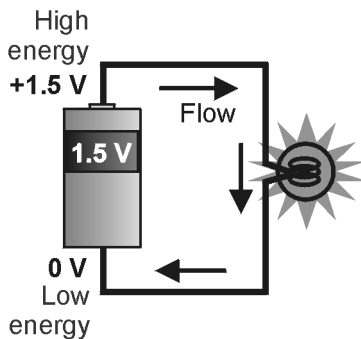
Water flows from high energy (height) to lower energy.



You know that water will flow from a higher tank through a hose into a lower tank. The water in the higher tank has greater potential energy than the water in the lower tank. A similar thing happens with the flow of charges in an electric circuit.

Charges flow in a circuit when there is a difference in energy level from one end of the battery (or any other energy source) to the other. This energy difference is measured in volts. The energy difference causes the charges to move from a higher to a lower voltage in a closed circuit.

Electric charge flows from high energy (voltage) to lower energy.



Think of voltage as the amount of “push” the electrical source supplies to the circuit. A meter is used to measure the amount of energy difference or “push” in a circuit. The meter reads the voltage difference (in volts) between the positive and the negative ends of the power source (the battery). This voltage difference supplies the energy to make charges flow in a circuit.

1. What is the difference between placing a 1.5-volt battery in a circuit and placing a 9-volt battery in a circuit?

What is current?

Current describes the flow of electric charges. Current is the actual measure of how many charges are flowing through the circuit in a certain amount of time. Current is measured in units called *amperes*.

Just as the rate of water flowing out of a faucet can be fast or slow, electrical current can move at different rates. The type, length, and thickness of wire all effect how much current flows in a circuit. Resistors slow the flow of current. Adding voltage causes the current to speed up.

2. What could you do to a closed circuit consisting of a battery, a light bulb, and a switch that would *increase* the amount of current? Explain your answer.
3. What could you do to a closed circuit consisting of a battery, a light bulb, and a switch that would *decrease* the amount of current? Explain your answer.



What is resistance?

Resistance is the measure of how easily charges flow through a circuit. High resistance means it is difficult for charges to flow. Low resistance means it is easy for charges to flow. Electrical resistance is measured in units called *ohms* (abbreviated with the symbol Ω).

Resistors are items that reduce the flow of charge in a circuit. They act like “speed bumps” in a circuit. A light bulb is an example of a resistor.

- Describe one thing that you could do to the wire used in a circuit to *decrease* the amount of resistance presented by the wire.

How are voltage, current, and resistance related?

When the voltage (push) increases, the current (flow of charges) will also increase, and when the voltage decreases, the current likewise decreases. These two variables, voltage and current, are said to be directly proportional.

When the resistance in an electric circuit increases, the flow of charges (current) decreases. These two variables, resistance and current, are said to be inversely proportional. When one goes up, the other goes down, and vice versa.

The law that relates these three variables is called Ohm’s Law. The formula is:

$$\text{Current (amps)} = \frac{\text{Voltage (volts)}}{\text{Resistance (ohms, } \Omega \text{)}}$$

- In your own words, state the relationship between resistance and current, as well as the relationship between voltage and current.

EXAMPLE

- In a circuit, how many amps of current flow through a resistor such as a 6-ohm light bulb when using four 1.5-volt batteries as an energy supply?

Solution:

$$\text{Current} = \frac{4 \times 1.5 \text{ volts}}{6 \text{ ohms}} = \frac{6 \text{ volts}}{6 \text{ ohms}}$$

$$\text{Current} = 1 \text{ amp}$$



PRACTICE



Now you will have the opportunity to demonstrate your understanding of the relationship between current, voltage and resistance. Answer each of the following questions and show your work.

1. How many amps of current flow through a circuit that includes a 9-volt battery and a bulb with a resistance of 6 ohms?
2. How many amps of current flow through a circuit that includes a 9-volt battery and a bulb with a resistance of 12 ohms?
3. How much voltage would be necessary to generate 10 amps of current in a circuit that has 5 ohms of resistance?
4. How many ohms of resistance must be present in a circuit that has 120 volts and a current of 10 amps?