Name: _____ Date: _____

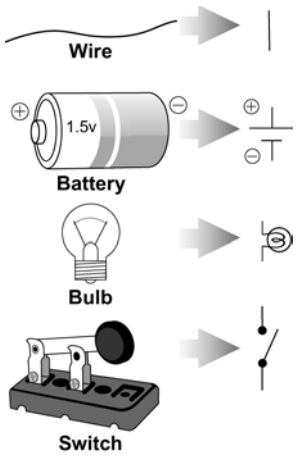
Ohm's Law

READ

A German physicist, Georg S. Ohm, developed this mathematical relationship, which is present in most circuits. This relationship is known as Ohm's law. This relationship states that if the voltage (energy) in a circuit increases, so does the current (flow of charges). If the resistance increases, the current flow decreases.

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

To work through this skill sheet, you will need the symbols used to depict circuits in diagrams. The symbols that are most commonly used for circuit diagrams are provided to the right.



If a circuit contains more than one battery, the total voltage is the sum of the individual voltages. A circuit containing two 6 V batteries has a total voltage of 12 V. [Note: The batteries must be connected positive to negative for the voltages to add.]

EXAMPLE

If a toaster produces 12 ohms of resistance in a 120-volt circuit, what is the amount of current in the circuit?

Given	**Solution**
The resistance (R) is 12 ohms. The voltage (V) is 120 volts.	$I = \frac{V}{R} = \frac{120 \text{ volts}}{12 \text{ ohms}} = 10 \text{ amps}$
Looking for The amount of current (I) in the circuit.	The current in the toaster circuit is 10 amps.
Relationships $I = \frac{V}{R}$	

If a problem asks you to calculate the voltage or resistance, you must rearrange the equation $I=V/R$ to solve for V or R. All three forms of the equation are listed below.

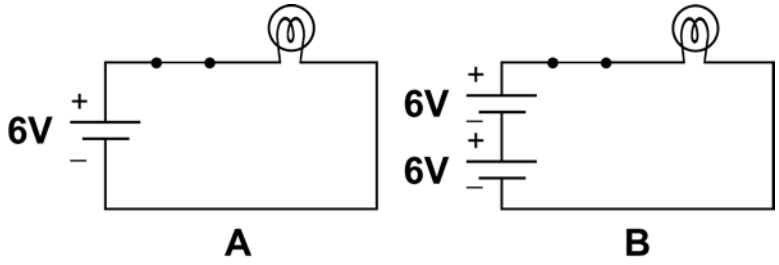
$$I = \frac{V}{R} \qquad V = IR \qquad R = \frac{V}{I}$$

PRACTICE

In this section, you will find some problems based on diagrams and others without diagrams. In all cases, show your work.

1. How much current is in a circuit that includes a 9-volt battery and a bulb with a resistance of 3 ohms?
2. How much current is in a circuit that includes a 9-volt battery and a bulb with a resistance of 12 ohms?
3. A circuit contains a 1.5 volt battery and a bulb with a resistance of 3 ohms. Calculate the current.

4. A circuit contains two 1.5 volt batteries and a bulb with a resistance of 3 ohms. Calculate the current.
5. What is the voltage of a circuit with 15 amps of current and toaster with 8 ohms of resistance?
6. A light bulb has a resistance of 4 ohms and a current of 2 A. What is the voltage across the bulb?
7. How much voltage would be necessary to generate 10 amps of current in a circuit that has 5 ohms of resistance?
8. How many ohms of resistance must be present in a circuit that has 120 volts and a current of 10 amps?
9. An alarm clock draws 0.5 A of current when connected to a 120 volt circuit. Calculate its resistance.
10. A portable CD player uses two 1.5 V batteries. If the current in the CD player is 2 A, what is its resistance?
11. You have a large flashlight that takes 4 D-cell batteries. If the current in the flashlight is 2 amps, what is the resistance of the light bulb? (Hint: A D-cell battery has 1.5 volts.)
12. Use the diagram below to answer the following problems.



    a. What is the total voltage in each circuit?
    b. How much current would be measured in each circuit if the light bulb has a resistance of 6 ohms?
    c. How much current would be measured in each circuit if the light bulb has a resistance of 12 ohms?
    d. Is the bulb brighter in circuit A or circuit B? Why?
13. What happens to the current in a circuit if a 1.5-volt battery is removed and is replaced by a 9-volt battery?
14. In your own words, state the relationship between resistance and current in a circuit.
15. In your own words, state the relationship between voltage and current in a circuit.
16. What could you do to a closed circuit consisting of 2 batteries, 2 light bulbs, and a switch to *increase* the current? Explain your answer.
17. What could you do to a closed circuit consisting of 2 batteries, 2 light bulbs, and a switch to *decrease* the current? Explain your answer.
18. You have four 1.5 V batteries, a 1 Ω bulb, a 2 Ω bulb, and a 3 Ω bulb. Draw a circuit you could build to create each of the following currents. There may be more than one possible answer for each.
    a. 1 ampere
    b. 2 amperes
    c. 3 amperes
    d. 6 amperes

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1. 3 amps
2. 0.75 amp
3. 0.5 amp
4. 1 amp
5. 120 volts
6. 8 volts
7. 50 volts
8. 12 ohms
9. 240 ohms
10. 1.5 ohms
11. 3 ohms
12. Answers are:
    a. Circuit A: 6 V; Circuit B: 12 V
    b. Circuit A: 1 A; Circuit B: 2 A
    c. Circuit A: 0.5 A; Circuit B: 1 A
    d. It is brighter in circuit B because there is a greater voltage and greater current (and more power is consumed since power equals current times voltage).
13. The current becomes 4 times as great.
14. If resistance increases, the current decreases. The two are inversely proportional.
15. If voltage increases, current increases. The two are directly proportional.
16. Remove one of the light bulbs. This decreases the resistance and increases the current.
17. Remove one of the batteries. This decreases the voltage and decreases the current.
18. Answers are:
    a. 2 batteries and a 3 ohm bulb (or 4 batteries and all 3 bulbs)
    b. 4 batteries and a 3 ohm bulb
    c. 2 batteries and a 1 ohm bulb (or 4 batteries and a 2 ohm bulb)
    d. 4 batteries and a 1 ohm bulb