# Electrical Power and Energy

Read from **Lessons 2 and 3** of the **Current Electricity** chapter at **The Physics Classroom**:

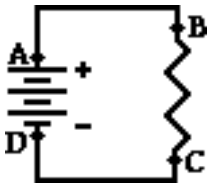
**http://www.physicsclassroom.com/Class/circuits/u9l2d.html**
**http://www.physicsclassroom.com/Class/circuits/u9l3d.html**

**MOP Connection:** Electric Circuits: sublevel 3

**Review:**

1. The electric potential at a given location in a circuit is the amount of _____ per _____ at that location. The location of highest potential within a circuit is at the _____ ( +, - ) terminal of the battery. As charge moves through the external circuit from the _____ ( +, - ) to the _____ ( +, - ) terminal, the charge loses potential energy. As charge moves through the battery, it gains potential energy. The difference in electric potential between any two locations within the circuit is known as the electric potential difference; it is sometimes called the _____ and represented by the symbol _____. The rate at which charge moves past any point along the circuit is known as the _____ and is expressed with the unit _____.

The diagram at the right depicts an electric circuit in a car. The rear defroster is connected to the 12-Volt car battery. Several points are labeled along the circuit. Use this diagram for questions #2-#6.




2. Charge flowing through this circuit possesses 0 J of potential energy at point ___.

3. The overall effect of this circuit is to convert ____ energy into ____ energy.
   a. electrical, chemical  b. chemical, mechanical
   c. thermal, electrical  d. chemical, thermal

4. The potential energy of the charge at point A is ___ the potential energy at B.
   a. greater than  b. less than  c. approximately equal to

5. The + charge gains potential energy as it moves between points ___ and ___.
   a. A and B  b. B and C  c. C and D  d. D and A  e. none of these

6. The + charge loses potential energy as it moves between points ___ and ___.
   a. A and B  b. B and C  c. C and D  d. D and A  e. none of these

7. The rate at which energy is delivered to a circuit by the energy source or the rate at which energy is consumed by an electrical device is known as the electric _____.
   a. current  b. potential  c. voltage  d. power

8. The unit of electric power is the _____.
   a. Ampere  b. Volt  c. Watt  d. Joule

9. Mechanical power (discussed in a previous unit) is the rate at which work is done on an object. Electrical power is the rate at which work is done on a charge (by the battery) or on an electrical device (by the charge). In terms of an equation, it is … . (Fill in the numerator and the denominator.)

$$\text{Power} = \frac{\qquad}{\qquad}$$

   a. A 60-Watt light bulb uses up _____ J of energy when left on for 1 hour (3600 s).
   b. A 60-Watt light bulb uses up _____ J of energy when left on for 4 hours.
   c. A 1500-Watt hair dryer uses up _____ J of energy when used for 5 min (300 s).
   d. A 120-Watt fan uses up _____ J of energy when left on for a day.

10. Substitution of other electrical equations ( $\mathbf{I = Q/t}$ and $\mathbf{\Delta V = I \cdot R}$ and $\mathbf{\Delta V = W/Q}$ ) into the power equation yields the following three equations.

$$\mathbf{P = I \cdot \Delta V} \qquad \mathbf{P = I^2 \cdot R} \qquad \mathbf{P = \Delta V^2 / R}$$

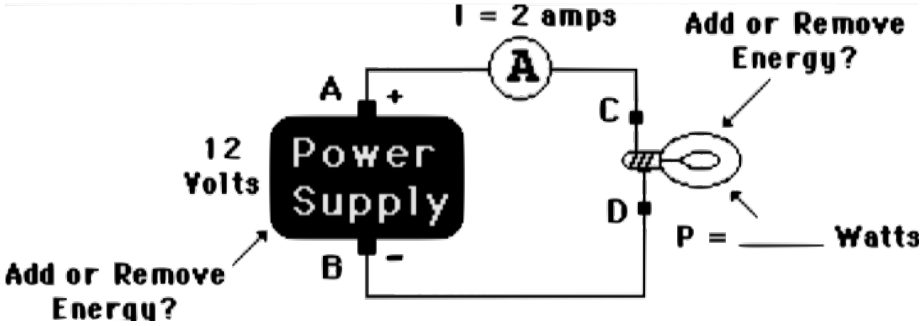
Use these equations to solve the following problems.

a. Calculate the resistance of a toaster oven if its power is 800 W when connected to a 110-V outlet.

b. Calculate the resistance of the 1000 W microwave oven that gets plugged into to a 110-V outlet.

c. The TI-84 calculator uses four 1.5-V batteries and has a power of 0.0008 W. What is the current?

11. The following two circuits consist of a power supply, an ammeter (for measuring current), and a light bulb. Use >, <, and = symbols to compare the electric potential at A to B and at C to D. Indicate whether the devices add energy to or remove energy from the charge. Finally, fill in all blanks.




$V_A > V_B$ (>)

$V_C > V_D$ (>)

$V_B = V_D$ (=)

12. **TRUE** or **FALSE**: A kilowatt-hour is a unit of power.

13. Alfredo deDarke often leaves household appliances on for *no good reason* (at least according to his parents). The deDarke family pays 15¢/kilowatt-hour (i.e., \$.15/kW•hr) for their electrical energy. Express your understanding of *dollar power* by filling in the following table.

| Power Rating (Watt) | Time (hrs) | Energy Used (kilowatt-hour) | Cost ($) |
|---|---|---|---|
| 60 Watt Bulb | 1 | 0.060 kW•hr | \$0.009 |
| 60 Watt Bulb | 4 | | |
| Ten 60 Watt Bulb | 24 | | |
| 60 Watt Bulb | | | \$10 |
| 7 Watt Night Light | 168 | | |
| 7 Watt Night Light | 8760 | | |

14. People often claim that an electrical appliance "uses up electricity." Explain what is actually being "used up" and what becomes of this *thing* that is being *used up*.