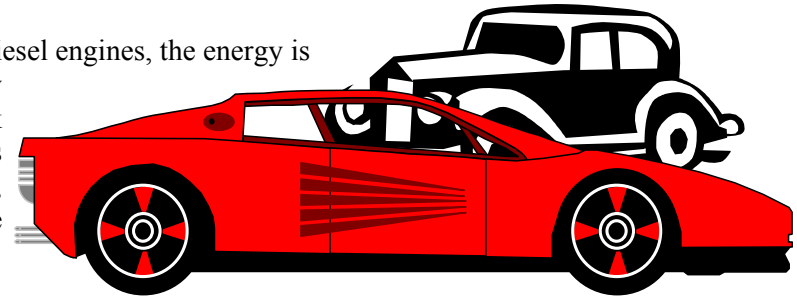
Forcing Electrons to Move



The energy to run most cars from gasoline. Except in diesel engines, the energy is released from the gasoline by exploding it with a tiny spark from a spark plug. The energy to make the spark comes from the car's battery. The battery in the car is called a "wet cell." It contains sulfuric acid [$H_2SO_4(aq)$], a liquid electrolyte. The electricity is generated by the following chemical reaction:

$$PbO_2 + Pb + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O$$

Car batteries can last for several years. This is because they get recharged. As the engine spins, a moving magnet in the alternator pushes electrons in a direction opposite to the way they normally flow from the battery. These electrons reverse the chemical reaction that generated electricity in the battery. A cell that uses electricity to produce a chemical reaction in this way is called an electrolytic cell. When the car battery is generating electricity it is an electrochemical cell. When it is being recharged, it is an electrolytic cell.

Answer the questions below based on the reading above and on your knowledge of chemistry.

1. Write the chemical reaction that occurs when a car battery generates electricity. _____

   _____

   a. Write the half reactions: _____

      _____

   b. What is oxidized, and what is reduced? _____

2. Write the chemical reaction that occurs when a car battery is recharged. _____

   a. Write the half reactions: _____

      _____

   b. What is oxidized, and what is reduced? _____

3. Aluminum is found in the mineral bauxite (Al_2O_3). To get pure aluminum, the aluminum needs to be separated from oxygen.

   a. Imagine bauxite forms by the following reaction: $4Al + 3O_2 \rightarrow 2Al_2O_3$. Write the half reactions. _____

      _____

   b. During the formation of bauxite from its elements, what is oxidized, and what is reduced? Does this make sense considering that aluminum is a metal? Explain. _____

      _____

   c. Write the reaction for the purification of aluminum from bauxite. _____

☞ Continue on the next page.

d. Write the half reactions for the purification of aluminum. During the purification, what is oxidized, and what is reduced? _____

e. Considering that aluminum is a metal, suggest a method to purify it. Explain. _____

4. Iron is often protected from rusting by a process called galvanizing. When a metal is galvanized, it is coated with zinc. One way to coat iron with zinc is through a single replacement reaction: $Fe + Zn(NO_3)_2 \rightarrow Fe(NO_3)_3 + Zn$. Since the reaction occurs at the surface of the iron, the iron becomes plated with zinc.

   a. Write the half reactions for this reaction. What was oxidized, and what was reduced? _____

   b. Consult the activity series on Chart J. How likely is this reaction to occur? Explain. _____

   c. Suggest a method to plate iron with zinc. _____

5. What is an electrolytic cell? What are some of its functions? _____

6. What type of cell is represented by the following reaction: $Cu + AgNO_3 \rightarrow Ag + Cu(NO_3)_2$? Write the half reactions associated with it. Identify the oxidation and reduction half reactions. _____