46 ELECTROCHEMISTRY
EXPERIMENT

PURPOSE

To investigate the use of electrolytic cells to cause chemical changes.

BACKGROUND

It is common for manufactured products to be coated with a very thin layer of metal. For example, maybe you've eaten with silver-plated tableware. Your watchband, belt buckle, or jewelry may be gold-plated. All these plated items were produced using the electroplating process. *Electroplating* consists of depositing a thin layer of metal on another metal, either to protect the surface from corrosion or for a decorative effect. An electrolytic cell set up to electroplate a fork with a silver coating is shown in Figure 46.1. When the fork is being silver-plated, the anode metal is silver, the electrolytic solution is aqueous silver nitrate, and the cathode is the fork. The fork becomes silver-plated as a result of the reduction of Ag^+ ions, from the solution, at the cathode.

$$Ag^+(aq) + e^- \rightarrow Ag(s) \quad \text{reduction}$$

At the same time, the silver ions are replenished by oxidation of silver atoms at the anode.

$$Ag^+(s) \rightarrow Ag^+(aq) + e^- \quad \text{oxidation}$$

In this experiment, you will electroplate a metal object using a typical electrolytic cell. You will then remove the plating by reversing the direction of flow of electrons in the electrolytic cell.

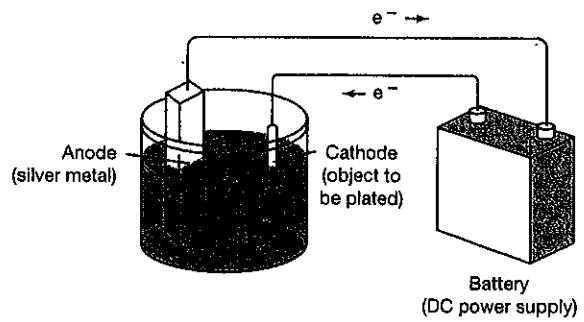

Figure 46.1

MATERIALS (PER PAIR)

safety goggles
1 250-mL beaker
1 100-mL graduated cylinder
2 copper wire lengths
4 alligator clips
1 6-volt battery
1*M* copper(II) sulfate, $CuSO_4$ T
copper strip, Cu, 0.25 mm thick, 1-cm × 5-cm
silver coin
steel wool
paper towels

SAFETY FIRST!

In this lab, observe all precautions, especially the ones listed below. If you see a safety icon beside a step in the procedure, refer to the list below for its meaning.

Caution: Wear your safety goggles. (All steps.)

Caution: Use a piece of paper to hold the steel wool or gloves to avoid getting metal slivers in your hand. (Steps 1 and 2.)

Note: Return or dispose of all materials according to the instructions of your teacher. (Step 6.)

PROCEDURE

As you perform the experiment, record your observations in Data Table 1.

1. Thoroughly clean a small silver object, such as a coin, with steel wool. Securely attach, with an alligator clip, a 25-cm length of copper wire to the object.
2. Polish a 1-cm × 5-cm strip of copper with steel wool. Use an alligator clip to attach a 25-cm length of copper wire to the strip.
3. Add 100 mL of 1*M* $CuSO_4$ to a 250-mL beaker and set up a system similar to that shown in Figure 46.2.
4. Use an alligator clip to connect the wire attached to the object to the negative terminal of a 6-volt battery. Use another alligator clip to connect the wire attached to the copper strip to the positive terminal. The object and the copper strip should not touch. Record your observations after 5 minutes have elapsed.
5. Reverse the connections and record your observations after 5 and 10 minutes.
6. Follow your teacher's instructions for proper disposal of the materials.

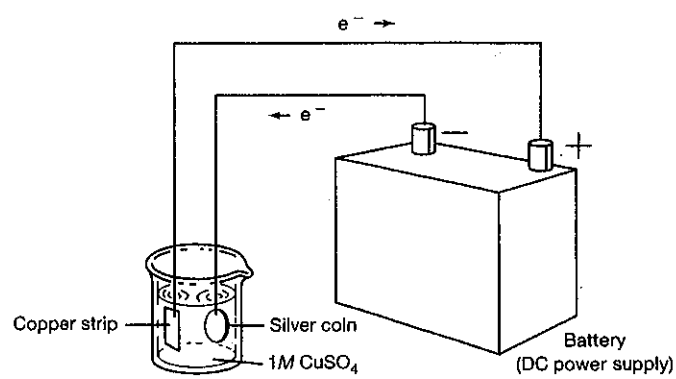

Figure 46.2

Name _____ Class _____ Date _____

OBSERVATIONS

DATA TABLE 1: OBSERVATIONS OF ELECTROPLATING	
Time of Observation	Condition of Coin
after 5 minutes of current flow	
5 minutes after reversal of curent flow	
10 minutes after reversal of current flow	

ANALYSES AND CONCLUSIONS

1. Write equations for the reactions that occur at the anode and at the cathode during electroplating.

2. What is oxidized in this experiment? At which electrode does oxidation occur?

3. What is reduced in this experiment? At which electrode does reduction take place?

4. To which battery terminal must an object be attached for it to become electroplated?

5. Sketch your electrochemical cell. Show the direction of ion movement and electron flow.