

LAB
2

Laboratory
Activity

Investigating Covalent and Ionic Bonds

All substances are made of atoms. Some of the physical and chemical properties of a substance are determined by the chemical bonds that hold its atoms together. In this experiment you will investigate the properties of compounds formed by two types of chemical bonds—covalent bonds and ionic bonds.

The atoms of covalent compounds are held together by covalent bonds. A covalent bond forms when two atoms share electrons. In other substances, atoms transfer electrons and form ions. An ion is an atom that has gained or lost electrons. In ionic compounds, the ions are held together by ionic bonds.

Solutions of ionic compounds can conduct an electric current. These solutions of covalent compounds conduct an electric current. A measure of how well a solution can carry an electric current is called conductivity.

Strategy

You will determine the conductivity of several solutions.

You will classify the compounds that were dissolved in the solutions as ionic compounds or covalent compounds.

Materials



9-V battery and battery clip
10-cm × 10-cm cardboard sheet
masking tape
4 alligator clips
1000-Ω resistor
LED (light-emitting diode)
2 20-cm lengths of insulated copper wire
24-well microplate

7 plastic pipettes
sulfuric acid solution, $\text{H}_2\text{SO}_4(aq)$
sodium chloride solution, $\text{NaCl}(aq)$
sodium hydroxide solution, $\text{NaOH}(aq)$
silver nitrate solution, $\text{AgNO}_3(aq)$
glucose solution, $\text{C}_6\text{H}_{12}\text{O}_6(aq)$
glycerol solution, $\text{C}_3\text{H}_8\text{O}_3(aq)$
distilled water

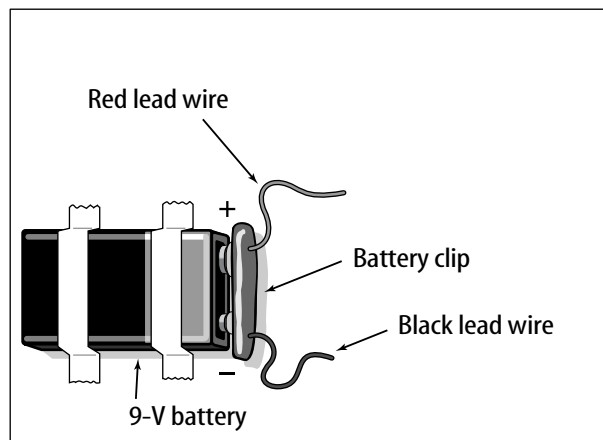
CAUTION: Sulfuric acid and sodium hydroxide can cause burns. Silver nitrate can cause stains. Avoid inhaling any vapors from the solutions. Avoid any contact between the solutions and your skin or clothing.

Procedure

Part A—Constructing a Conductivity Tester

1. Attach the 9-V battery clip to the 9-V battery. Use tape to attach the battery securely to the cardboard sheet, as shown in Figure 1.
2. Attach an alligator clip to one of the lead wires of the 1000-Ω resistor. Connect the same alligator clip to the red lead wire of the battery clip. Tape the resistor and alligator clip to the cardboard sheet as shown in Figure 2.

Figure 1



Laboratory Activity 2 (continued)

- Attach an alligator clip to the *long* lead wire of the light-emitting diode (LED). Connect this alligator clip to the second wire of the 1000- Ω resistor. Tape the alligator clip to the cardboard sheet.
- Attach an alligator clip to the *short* lead wire of the LED. Connect this alligator clip to one end of the insulated copper wires. Tape the alligator clip to the cardboard sheet as shown in Figure 3.
- Attach the last alligator clip to one end of the second insulated copper wire. Connect the alligator clip to the *black* lead wire of the battery clip. Tape the alligator clip to the cardboard sheet as shown in Figure 4.
- Check to be certain that the alligator clips, resistor, and battery are securely taped to the cardboard sheet and that the clips are not touching one another.
- Have your teacher check your conductivity tester.
- Touch the two ends of the two insulated copper wires, and observe that the LED glows.

Figure 2

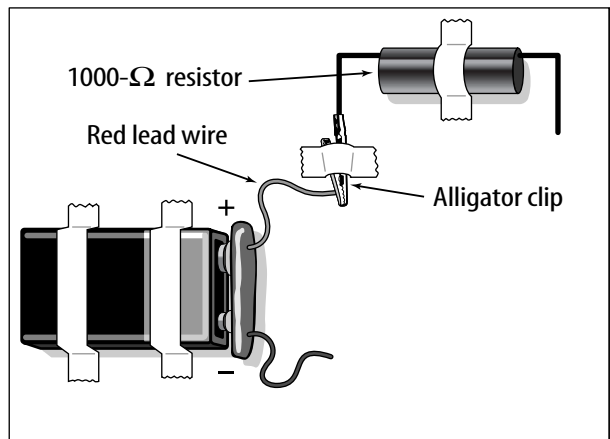


Figure 3

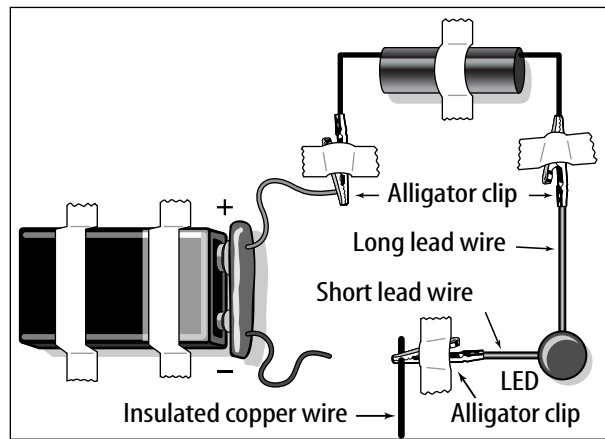
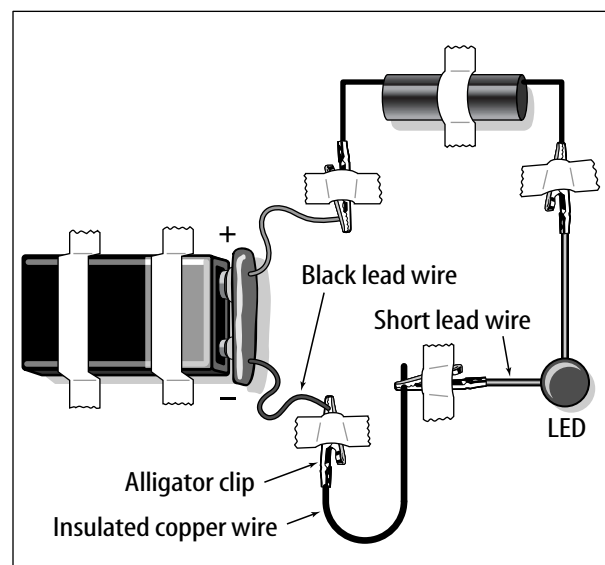


Figure 4

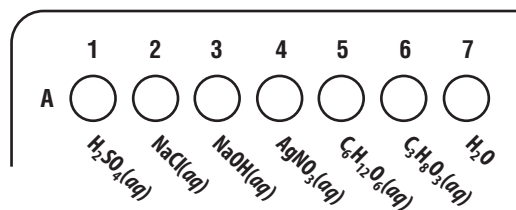


Laboratory Activity 2 (continued)

Part B—Testing the Conductivity of a Solution

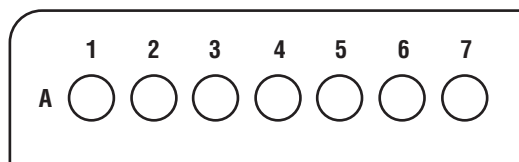
1. Wear an apron, gloves, and goggles for Part B of the experiment.
2. Place the microplate on a flat surface. Have the numbered columns of the microplate at the top and the lettered rows at the left.
3. Using a clean pipette, add a pipetteful of the sulfuric acid solution to well A1.
4. Using another clean pipette, add a pipetteful of the sodium chloride solution to well A2.
5. Repeat step 4 for each remaining solution. Use a clean pipette for each solution. Add the sodium hydroxide solution to well A3, the silver nitrate solution to well A4, the glucose solution to well A5, and the glycerol solution to well A6.
6. Using a clean pipette, add a pipetteful of distilled water to well A7. Figure 5 shows the contents of each of the wells A1 through A7.
7. Place the exposed ends of the two insulated copper wires into the solution in well A1, positioning the wires so they are at opposite sides of the well. Be sure that the exposed ends of the wires are completely submerged.
8. Observe the LED. Use the brightness of the LED as an indication of the conductivity of the solution. Rate the conductivity of the solution using the following symbols: + (good conductivity); – (fair conductivity); or 0 (no conductivity). Record your rating in the corresponding well of the microplate shown in Figure 6.
9. Remove the wires and dry the ends of the wires with a paper towel.
10. Repeat steps 6 through 9 for each remaining solution and the distilled water.

Figure 5



Data and Observations

Figure 6



Laboratory Activity 2 (continued)**Questions and Conclusions**

1. What is the conductivity of distilled water?

2. Why was the conductivity of the distilled water measured?

3. What characteristic is common to the compounds that produce solutions that can conduct electricity?

4. What characteristic is shared by the compounds that produce solutions that do not conduct an electric current?

5. How do the conductivities of solutions of ionic compounds and covalent compounds compare?

Strategy Check

_____ Can you determine the conductivity of solutions?

_____ Can you classify compounds in solutions as ionic or covalent?