Chemical Bonding Lab

Chemical compounds are combinations of atoms held together by chemical bonds. These chemical bonds are of two basic types—ionic and covalent. Ionic bonds result when one or more electrons from one atom or group of atoms is transferred to another atom. Positive and negative ions are created through the transfer. In covalent compounds no electrons are transferred; instead electrons are shared by the bonded atoms.

The physical properties of a substance, such as melting point, solubility, and conductivity, can be used to predict the type of bond that binds the atoms of the compound. In this experiment, you will conduct tests on the properties and compile data enabling you to classify compounds as ionic or covalent.

OBJECTIVES

Compare the melting points of various compounds.
Determine the solubilities of solid compounds in water and in ethanol.
Determine the conductivity of water solutions of the soluble solids.
Classify the compounds into groups of ionic and covalent compounds.
Summarize the properties of ionic and covalent substance.

Please Note: While you will be conducting this lab with a partner, all of your responses must be done on an individual basis. Any copying of responses, charts… between partners with results in a grade of ZERO, for both partners, with no possibility of redoing your lab. So please be sure to do all of YOUR OWN work on the lab report.

PRELAB — Complete the following questions before beginning the lab. You will also include this information (typed) at the beginning of your lab report.

1. Define the Following Terms:
   a. Ionic Bond
   b. Covalent Bond
   c. Solubility
   d. Conductivity
2. Ionic compounds are generally made up of what kind of elements?
3. Covalent compounds are generally made up of what kind of elements?
4. Classify the properties to be tested (description, melting point, solubility, and electrical conductivity) as chemical or physical properties.
MATERIALS

- Bunsen burner
- conductivity tester
- iron ring
- ring stand
- aluminum foil square
- test tubes (6)
- small beakers (3)
- ethanol
- deionized water (in bottles)
- NaCl
- Sucrose (C\textsubscript{12}H\textsubscript{22}O\textsubscript{11})
- Unknown A
- Unknown B
- Unknown C
- Unknown D

Always wear safety goggles to protect your eyes... If you get a chemical in your eyes, immediately flush the chemical out at the eyewash station while calling to your teacher. Know the location of the emergency lab shower and eyewash station and the procedures for using them.

Do not touch any chemicals. If you get a chemical on your skin or clothing, wash the chemical off at the sink while calling to your teacher. Make sure you carefully read the labels and follow the precautions on all containers of chemicals that you use. If there are no precautions stated on the label, ask your teacher what precautions to follow. Do not taste any chemicals or items used in the laboratory. Never return leftovers to their original container; take only small amounts to avoid wasting supplies.

Do not heat glassware that is broken, chipped, or cracked. Use tongs or a hot mitt to handle heated glassware and other equipment because hot glassware does not always look hot. When using a flame, confine long hair and loose clothing. If your clothing catches on fire, WALK to the emergency lab shower and use it to put out the fire.

Procedures

Part I: Melting Point

1. Place a folded square of aluminum foil on an iron ring attached to a ring stand. Position the ring so that it is just above the tip of a Bunsen burner flame, as shown in Figure 1. Light the burner for a moment to check that you have the correct height.

2. Place a small amount of each compound in separate locations on the square of aluminum foil. Do not allow the samples of crystals to touch. Draw and label a diagram that shows the position of each compound.
3. For this experiment, it is not necessary to have exact values for the melting point. The foil will continue to get hotter as it is heated, so the order of melting will give relative melting points. Light the burner and observe. Note the substance that melts first by writing a 1 in your data table. Record the order in which the substances melt (2,3,4…)

4. After 2 min, record a “DNM” for each substance that did not melt.

| Note: If the substance melts easily, it has a low melting point. If the substance does not melt easily, it has a high melting point. |

Part II: Solubility

Dissolves in Water
1. Fill a test tube three-fourths full with water.
2. Place a match-head sized sample of one compound into the test tube.
3. Cap test tube and invert it slowly for 45 - 60 seconds and observe.
4. Record your data as either dissolves or does not dissolve in water.
5. Clean out your test tube with water and a test tube brush.
6. Repeat steps 1-5 with remaining substances.

Dissolves in Ethanol
Repeat steps 1 – 6 above, but substitute ethanol for the water. Be sure that the test tube is CLEAN and DRY for each substance before adding the ethanol.

Part III: Conductivity

1. Prepare a solution for each compound by adding 20 mL of deionized water to a small scoop (the size of 2 peas) of the compound in a labeled beaker and stir with glass stirring rod.

2. CAUTION: Exposed wires on conductivity tester must be cleaned with deionized water before performing next conductivity test. Rinse with deionized water before performing test.

3. Quickly touch the 2 wires together, the light bulb should light, indicating that the tester is working.

4. Hold the battery end of the tester and dip exposed ends of red and black wire into each beaker filled with solution. Do not touch sides of beaker. Wires should be approximately 2 cm apart and should not touch. If the light goes on than the solution is conducting electricity. If the light stays dark than the solution is not conducting electricity.

5. If at first none of the solutions are conducting electricity then add another small scoop of the compound to the solution.

6. Record your data.
DATA
Create one, typed data table to display the ALL characteristics of ALL compounds. Include the following characteristics:

- Description
- Melting point value
- Solubility in water
- Solubility in ethanol
- Conductivity

Be sure to include all parts of a data table.

Questions: Answer in complete sentences where appropriate. All answers MUST BE TYPED!

1. Group the substances into two groups according to their properties.

2. List the general properties of each group.

3. Based on the properties of each compound, label each substance as being either an ionic or covalent compound.

4. Write a statement to summarize the properties of ionic compounds and another statement to summarize the properties of covalent compounds.

5. Sodium chloride and lithium chloride are typical ionic compounds, while sugar represents a typical nonionic compound. In general, how would these two types of compounds compare in their melting points?

6. What must be true of a solution if the solution conducts electricity? How can the conductivity of a solution be increased?

7. Explain why tap water will conduct electricity but distilled water will not.

8. The human body is mainly composed of nonionic compounds, such as water, carbohydrates, lipids, and proteins which do not conduct electricity. With this in mind, explain why you would electrocute yourself if you took a bath with your hair dryer, even if you took a bath is perfectly pure distilled water. Why are people such good conductors of electricity?

9. Based on the results from the solubility tests, explain what is meant by “like dissolves like”. (Use words like polar, non-polar, water, and ethanol in your answer below)

10. What is the relationship between electronegativity and bond type? Put another way, how could you predict whether a compound would be ionic or covalent if given a list of the elements’ electronegativities?
11. List the physical properties you would predict the following compounds to have:
   • methane - CH4
   • acetic acid - HC2H3O2
   • copper(II) sulfate - CuSO4

12. Using your data, which physical property best separates the compounds into ionic or molecular? Give reasons for your answer.

13. Using your data, which physical property is least helpful in separating the compounds into ionic or molecular? Give reasons for your answer.