Honors Chemistry Lab 15: Ionic and Covalent Compounds

Introduction: Ionic compounds (or salts) are formed when metals transfer electrons to nonmetals. The loss of electrons by the metal atom transforms it into a positive ion, or *cation*. The gain of electrons by the nonmetal atom transforms it into a negative ion, or *anion*. The cation and anion are attracted to each other because of their opposite charges. A salt is really a network of cations and anions that are stacked in a specific crystalline structure due to their mutual attractions. In a covalent compound, atoms share electrons. Covalent bonds are usually formed between nonmetal atoms, which have more valence electrons than they are energetically capable of losing. Nonmetal atoms have reasonably high ionization energies, so it's hard to get an electron from one. When two nonmetal atoms meet they do not tend to completely transfer electrons (as a metal would do to a nonmetal); instead, they tend to share. One pair of electrons makes a covalent bond, and since both atoms "want" that pair of electrons, they stick together as long as the pair is shared. Both types of chemical bonds exist because of atoms trying to satisfy the octet rule. The octet rule says that atoms gain, lose, or share electrons in an attempt to achieve the same electron configuration as one of the noble gases (which usually have 8 valence electrons – hence the word "octet"). Noble gases have the most stable arrangements of electrons; this explains why they so seldom participate in chemical reactions. The purpose of this lab is to determine some properties of ionic and covalent bonds and to compare their melting temperatures and electrical conductivity in solutions. You will use the observed properties to make conclusions regarding some unknown compounds. Remember our motto!

Materials

Aluminum foil
Ring stand
Iron ring
Bunsen burner
Sodium chloride, NaCl
Table sugar, $C_{12}H_{22}O_{11}$
Unknown Compound #1
Matches/Flint striker
9-Volt battery
Wire with alligator clips
Small_light_source
Unknown Compound #2
Unknown Compound #3
Unknown Compound #4

PART ONE: Relative Melting Point Determination

1. Cut a square of aluminum foil that is about 5" by 5". It does not need to be perfect.
2. Set up a ring stand with an iron ring attached. Place the aluminum square on the iron ring, as shown at right in **Figure 1**.
3. Obtain a small pea-sized sample of NaCl. Place the sample on the aluminum foil, about 1 inch from the center of the square.
4. Obtain a small pea-sized sample of table sugar. Place the sample on the aluminum foil, about 1 inch from the center of the square, but in the opposite direction from the salt.
5. Your square of aluminum foil should look like **Figure 2**.
6. Light the Bunsen burner and adjust the flame height so that the tip of the flame is just an inch or so below the height of the aluminum foil. Raise or lower the iron ring if you need to (*before* you put the burner under it, of course).
7. Move the Bunsen burner so that the flame is directly below the center of the aluminum square. Observe as the two compounds heat up. If one of the samples begins to burn, do not panic. A small sample should burn out quickly.
8. Which compound melts first? Find a suitable place on your report to record qualitative data that describes each compound as it burns/melts.
9. Make predictions regarding the relative melting points of covalent and ionic compounds in your Conclusion section.

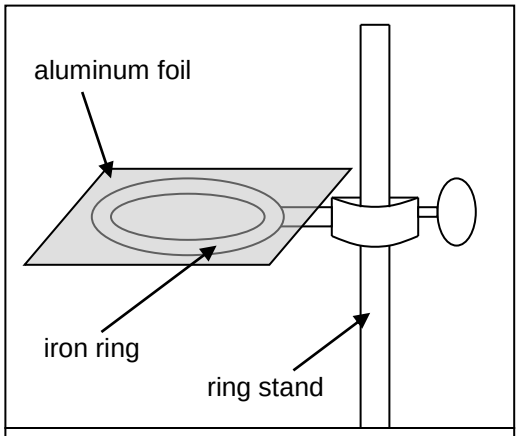


Figure 1.

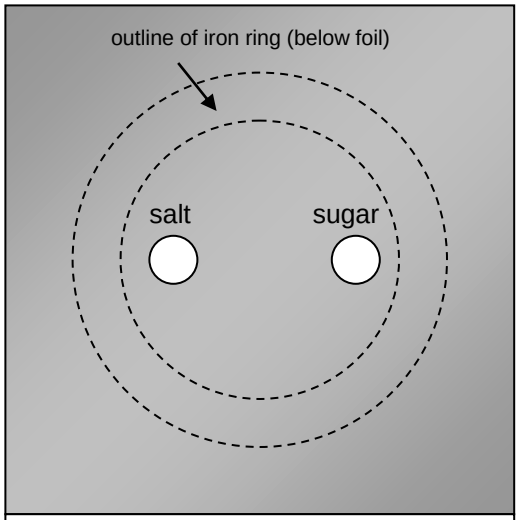
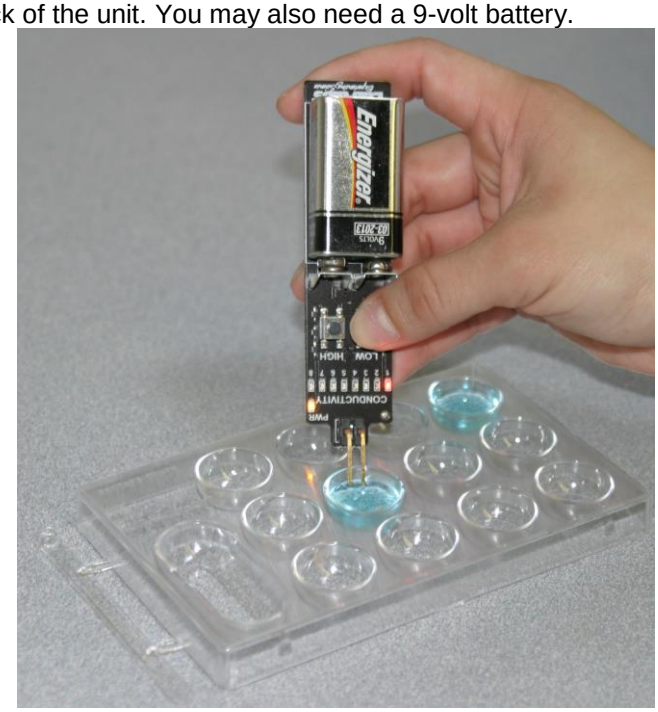


Figure 2.

10. Set up another sheet of aluminum foil and determine the relative melting points (low vs. high) of the four unknowns. Record your results in the **Data Section** table.

PART TWO: Conductivity in Solution

11. You will be using a conductivity indicator for this portion of the lab. These are located in drawer 7 and will have an LED array that indicates the level of conductivity, which is usually located on the back of the unit. You may also need a 9-volt battery.



12. To test for electrical conductivity, insert both electrodes into the solution. Please do not submerge the indicator, as this will corrode the unit. Please wipe off the electrodes each time.

13. Dissolve a small amount of NaCl in water on a spotting plate. Test the resulting solution for conductivity. Record your observations.

14. Dissolve a small amount of sucrose in water on a spotting plate. Test the resulting solution for conductivity. Record your observations.

15. Do ionic compounds conduct an electric current when dissolved? Do covalent compounds? Record your conclusions in your lab notebook.

16. Dissolve a small amount of the four unknowns in four different beakers or a spotting plate. Use the conductivity tester to establish whether each unknown conducts a current when dissolved. Record your findings in the

Data Section.

Data Section *(transcribe the data table on the next page)*

Q1. Did the table salt or table sugar melt first?

Q2. Did the table salt or table sugar conduct a current when dissolved?

Q3. Record the properties you observed for the four unknowns in the table below:

Unknown Number	Relative Melting Point (Low/High)	Conducts Electricity When Dissolved (yes/no)
1		
2		
3		
4		

Conclusion:

Q4. The formula for table salt is NaCl. Is table salt ionic or covalent?

Q5. The formula for table sugar is $C_{12}H_{22}O_{11}$. Is table sugar ionic or covalent?

Q6. Based on your tests with salt and sugar, compare the melting points of ionic compounds with those of covalent compounds.

Q7. Based on your tests with salt and sugar, compare the ability to conduct electricity in solution of ionic and covalent compounds.

Q8. A compound that conducts electricity when dissolved is called an ***electrolyte***. Write a short statement that identifies ionic and covalent compounds as electrolytes or non-electrolytes.

Q9. Identify each of the unknown solids as ionic or covalent, based on your observations:

Unknown 1: _____

Unknown 2: _____

Unknown 3: _____

Unknown 4: _____

Q10. In general, if the difference in electronegativity between two atoms is zero the bond formed is _____

Q11. If the electronegativity difference between two atoms is between 0.5 and 2.1 the bond formed is _____

Q12. If the electronegativity difference between two atoms is greater than 2.1, the bond is _____

Q13. In an ionic bond, the valence electrons are _____.

Q14. In a metallic bond the valence electrons form a _____