Ionic and Covalent Compound Lab

Purpose: In this lab, you will examine the properties of ionic compounds and covalent molecules. The properties you will observe are: volatility, melting point, solubility in water, and electrical conductivity.

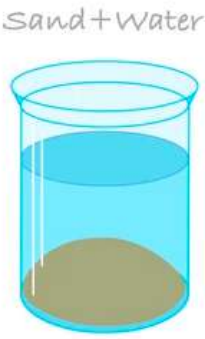
Materials:
Chemicals to be tested:
Sodium Chloride ($NaCl$)
Baking Soda Solution ($NaHCO_3$)
Rubbing Alcohol (C_3H_8O)
Sugar Solution ($C_{12}H_{22}O_{11}$)

Part 1: Solubility in Water

Solubility describes how easily something dissolves. High solubility in water means that the substance dissolves readily in water. A soluble liquid will form a homogeneous solution with water (i.e. the whole thing will look the same color). Low solubility in water means that the substance does not fully dissolve.

Check your understanding of solubility by completing the chart below. Then, follow the procedures to test the solubility of ionic and covalent compounds.

Substance	Soluble, or Insoluble?
Oil in water 	
Gatorade powder in water 	

Part 1 Materials:

- Chemicals to be tested:

Sodium Chloride (NaCl)
Baking Soda ($NaHCO_3$)
Rubbing Alcohol (C_3H_8O)
Sugar ($C_{12}H_{22}O_{11}$)

- 4 test tubes
- Metal spatula
- 1 graduated cylinder
- Digital scale
- 1 funnel
- Water/ wet paper towel to clean spatula in between trials

Part 1 Procedures:

1. Label a cup for each chemical to be tested (e.g. “NaCl”).
2. Put a plastic cup on your scale. Press “zero” or “tare.” The scale should read 0. Make sure the units are set to grams (g).
3. Using a metal spatula, add 5 grams of NaCl into the cup.
4. Use a funnel to pour the 5g of NaCl into a test tube.
5. Repeat steps 1-3 for baking soda, rubbing alcohol, and sugar.
6. Use a graduated cylinder to add 20 mL of water to each test tube.
7. Stir each test tube with the spatula. Rinse the spatula in water between each trial to avoid cross-contamination.
8. Swirl the test tube to mix it further.
9. In data table 1, record how likely the substance is to dissolve in water. Record high or low solubility.

Data Table 1: Solubility

Compound	**Ionic or Covalent?**	**How well did the substance dissolve in water? (record your observations)**	**High Solubility or Low Solubility?**

Analysis Question 1

1. Which type of compound is more soluble in water—ionic, or covalent? Use your observations to support your answer.	

Part 2: Volatility

Volatility describes how easily a substance will vaporize (turn into a gas). Highly volatile substances tend to have a stronger smell. In this section, you will determine whether ionic compounds or covalent molecules are more volatile.

Part 2 Materials:

- Chemicals to be tested:***(reuse your prepared test tubes from part 1!)***

Sodium Chloride Solution ($NaCl$)
Baking Soda Solution ($NaHCO_3$)
Rubbing Alcohol Solution (C_3H_8O)
Sugar Solution ($C_{12}H_{22}O_{11}$)

Part 2 Procedures

1. Using your prepared test tubes from part 1, carefully waft each sample towards your nose to smell each compound. (do not snort!)
2. Record how strong of a smell you observe in data table 2.
3. Record whether there is high or low volatility. (if you can detect an odor, assume the compound has a high volatility.)

Data Table 2: Volatility

Compound	Ionic or Covalent?	How strong of a smell? (weak, medium, strong)	High Volatility or Low Volatility?

Analysis Question 2

2. Which type of compound–ionic or covalent– has a higher volatility?	

Part 3: Conductivity

Conductivity measures a substance's ability to carry an electric current. In this section, you will determine whether ionic or covalent compounds are more conductive. We will determine each substance's conductivity by connecting it to a multimeter and measuring the resistance in Ohms. (Ohms measure the amount of resistance in a circuit. The higher the resistance, the more the circuit slows down the electricity, much as a clog would slow down water flowing through a pipe. So, **a larger number of Ohms means a lower conductivity.**

Part 3 Materials:

- Chemicals to be tested ***(can reuse from Parts 1 and 2)***

Sodium Chloride (NaCl)
Baking Soda Solution ($NaHCO_3$)
Rubbing Alcohol (C_3H_8O)
Sugar Solution ($C_{12}H_{22}O_{11}$)
4 labeled cups from part 1

- Multimeter
- water/ wet paper towel to clean leads between trials

Part 3 Procedures:

1. Pour each solution into its labeled cup (ex. NaCl solution from test tube into NaCl plastic cup.
2. Plug the red lead of the multimeter into the positive port, and the black lead of the multimeter into the negative port. (this may be already done for you!)
3. Turn on the multimeter and turn its dial to 200 M Ohms (Ω)
4. Swirl your solution to make sure it is well mixed (i.e. the salt has not all settled at the bottom of your test tube)
5. Touch both of the multimeter leads to your solution. Make sure the leads do not touch each other.
6. Record the resistance in Ohms (Ω) in data table 3.
7. Clean the leads with water before repeating the experiment with the next solution to avoid cross-contamination.

Data Table 3: Resistance in Ohms (Ω)

Compound	**Ionic or Covalent?**	**Resistance in Ohms (Ω)**	**Conductive, or Not Conductive?**

Analysis Question 3

3. Which type of compound–ionic or covalent– is more conductive? Use data from this section to support your answer.	

Part 4: Melting Point

Melting point is the temperature at which a given solid will melt to become a liquid. If a compound has a HIGH melting point, it requires high temperatures and a lot of energy to melt. This means the substance has strong chemical bonds. If a compound has a LOW melting point, it melts at a low temperature and does not require very much energy to melt. This means that it has weak chemical bonds.

In today's lab, some of our samples have melting points that are higher temperatures than our thermometers can measure! So, we will measure the amount of time it takes each substance to melt instead. If a compound takes a long time to melt, assume it has a high melting point. If a compound melts quickly, assume it has a low melting point.

Part 4 Materials:

- salt (NaCl) and sugar ($C_{12}H_{22}O_{11}$)
- 2 new clean test tubes
- Tongs
- Bunsen burner
- timer

Part 4 Procedures:

1. Place 1 gram of salt (NaCl) into a clean, dry test tube. Place 1 gram of sugar ($C_{12}H_{22}O_{11}$) into a second test tube.

***Get a solid sample of the compounds from your teacher- do not use the liquid solutions that you used for parts 1-3.**

2. Hold your test tube with tongs. Heat the sample using a Bunsen burner.
3. In table 4, record the time in seconds when the substance starts to melt.
4. Record the time in seconds when the substance is fully melted.
5. Average these two values. The longer it takes the compound to melt, the higher the melting point. (If the compound hasn't started to melt in 1 minute, the compound has a high melting point.)

Data Table 4

Compound	**Ionic or Covalent?**	**Time (s) when substance started melting**	**Time (s) when substance is fully melted**	**Average time (s)** *(add start time and end time together, and divide by 2)*	**HIGH or LOW melting point?**
Salt (NaCl)					
Sugar ($C_{12}H_{22}O_{11}$)					

Analysis Questions 4 and 5

4. Which has a HIGHER melting point– ionic compounds or covalent molecules?	
5. Which bond type is stronger– ionic bonds, or covalent bonds? How can you tell based on your data from this section?	

Clean Up Instructions:

- Pour any leftover solutions you have down the sink.
- Wash out your test tubes with soap and water. Put them upside down in your rack to dry.
- Make sure that your bin looks like it did when you received it! It should have:
    - 4 clean test tubes in a test tube rack
    - 1 graduated cylinder
    - 1 clean metal spatula
    - 1 plastic cup

–Extension (complete if you have time!)--

1. Describe three sources of error in this lab. (i.e. reasons why the data you collected is not perfect)

2. How could you alter your procedures next time to avoid or minimize these sources of error?

Exit Ticket–Summary

1. What are 4 characteristics of ionic compounds?

2. What are 4 characteristics of covalent molecules?