AP Chemistry 30 Lab 1: What's In the Bottle?

Essential Skills

- Determine the type of bonding in unknown solids (ionic, molecular and metallic) using physical and chemical properties of the substances.
- Develop a classification system for solid bonding types from laboratory data, and use it to categorize unknowns.

Context

There is a problem in the chemical storeroom! High humidity has caused the labels on some of the chemical bottles to fall off. The labels are lying all over the shelves, and it is your job, as a savvy AP chemistry student, to design a method that will help to identify all the solids as ionic, non-polar or polar covalent or metallic.

Lab Outline

- To conduct the lab, you may work in groups of three; however, students must hand in individual lab reports. This work is expected to be done independently so that all discussion and explanation are done in each student's own words. Labs that are too similar to another student's will be given a mark of zero.
- Please refer to the lab report guidelines and rubric to ensure you meet all requirements.
- On the first day of the lab, you will complete the pre-lab questions and begin your background information. On the second day, you will perform the practice procedure using known compounds and develop your classification system. On the third day, you will perform your testing on two unknown chemicals.

Pre-Lab

Use Table 1 to answer the pre-lab questions. Please answer both questions in your lab report under pre-lab questions, on a separate piece of paper.

Table 1: Properties and Bond Types of Solid Compounds

Compound	Observations	MP (°C)	Solubility in 25°C Water	Types of Elements	Bond Type
Potassium Chloride (KCl)	White solid	993	Yes	Metal/non-metal	Ionic
Sucrose ($C_{12}H_{22}O_{11}$)	White solid	186	Yes	Two non-metals	Polar covalent
Iodine (I_2)	Dark grey solid	114	Slightly	Two non-metals	Non-polar covalent
Zinc (Zn)	Grey, shiny solid	1535	No	Metals	Metallic

1. Compare the type of bond with regard to the properties below using Table 1. Identify and explain any relationships.

a. Melting point
b. Solubility in 25°C water

2. Predict the properties of each substance below based on Table 1. Copy this data table into your answers.

Compound	Bond Type	Relative Melting Point (high or low)	Solubility in 25°C Water
Benzene (C_6H_6)			
Bromobenzene (C_6H_5Br)			
Sodium chloride (NaCl)			
Iron (Fe)			

3. Read the full lab handout. Make a data table for Part 1 of the procedure.

Background Information

Prior to testing, provide an explanation about the general properties of each type of solid. Include an explanation of the difference between polar and non-polar covalent compounds. Be sure to write in your own words and cite all sources in APA format. Include pictures if they contribute to your explanation.

Materials

Known Solids

- Potassium chloride (KCl)
- Naphthalene ($C_{10}H_8$)
- Dextrose ($C_6H_{12}O_6$)
- Tin (Sn)

Possible Unknown Solids

- Magnesium oxide (MgO)
- Potassium nitrate (KNO_3)
- Copper (Cu)
- Benzoic acid (C_6H_5COOH)
- Urea ($(NH_2)_2CO$)
- Sodium acetate ($NaC_2H_3O_2$)
- Aluminum (Al)
- Iodine (I_2)
- Sodium hydrogen carbonate ($NaHCO_3$)
- Paraffin ($C_{20}H_{42}$)
- Zinc (Zn)
- Copper(II) sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$)
- Magnesium (Mg)
- Sodium carbonate (Na_2CO_3)
- Sodium chloride (NaCl)
- Calcium carbonate ($CaCO_3$)
- Sucrose ($C_{12}H_{22}O_{11}$)
- Salicylic acid ($C_6H_4(OH)COOH$)

Materials for Testing

- 95% ethanol
- Multimeter
- 0.1 M hydrochloric acid
- Universal indicator
- pH paper
- Magnifying lens
- Hexanes
- 0.1 M sodium hydroxide solution
- Magnet
- Thermometer
- Well plate
- Small beakers

Procedure

Part 1

1. Obtain small quantities of the four known materials.
2. Before you begin, classify each as ionic, metallic, polar covalent or non-polar covalent.
3. Analyze and interpret the physical and chemical properties by conducting the following tests: *Colour, solubility in distilled water, conductivity of the solid, conductivity in distilled water, solubility in ethanol, solubility in hexanes, reaction with 0.1 M HCl, reaction with 0.1 M NaOH and magnetism*
4. Record all results in a data tab;e. Use these results to develop a classification system, using at least five tests, for unknown compounds. Detail and explain your classification system in your analysis section.

Part 2

Use your classification system to determine the type of bonding present in two unknown compounds. Be sure to indicate the letters of your unknowns. Use a table to indicate your results. Explain your conclusions in your analysis section.

The materials and procedure used in this section of the lab are the information needed in the experimental section of your lab report.

Post-Lab Questions

1. When solids were place in water, were all the results the same? What type of solids conduct electricity in water? Use your investigation to explain what happened.
2. This lab should be conducted with deionized water instead of distilled water. Explain why.
3. What further testing could you do to more specifically identify an ionic compound? Give and explain at least two examples.