Name _____ Date: _____

Period _____

Identifying and Comparing Properties of Ionic and Covalent Compounds in Order to Classify Unknown Compounds.

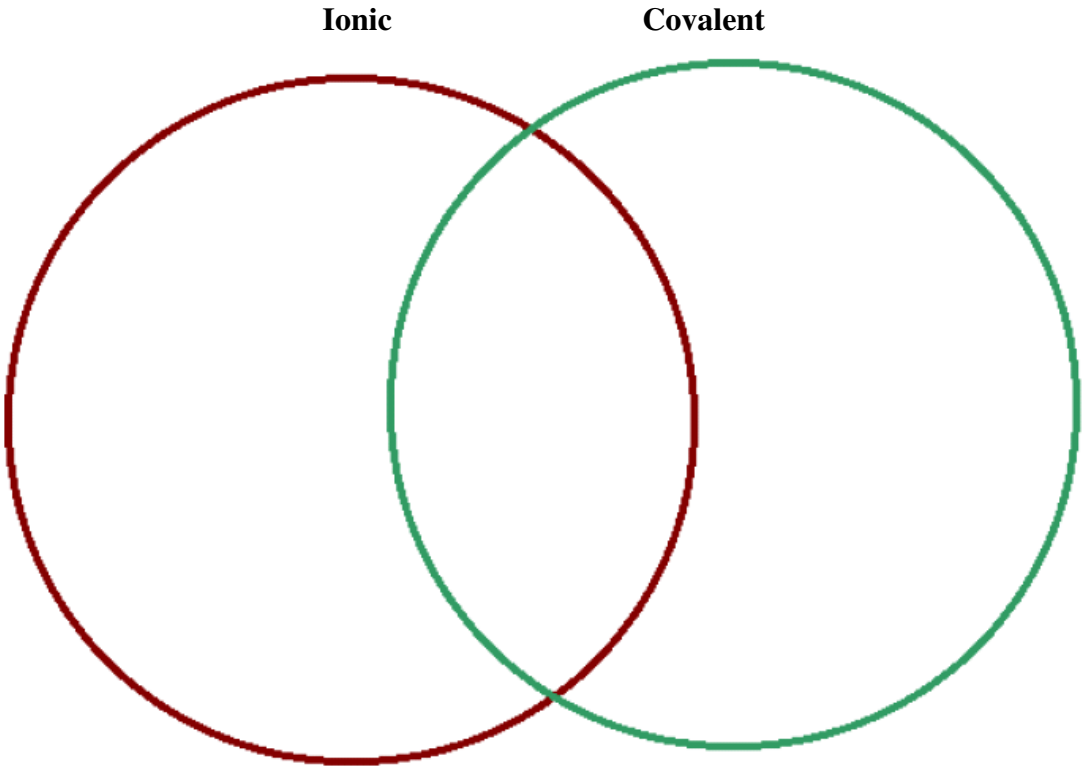
Pre-Lab

Please complete the chart prior to coming into the lab. Be sure to include MSDS information, as well as the structure. Most structures can be found by visiting http://www.chemfinder.com/.

Name of Compound	Chemical Formula	Cas #	Melting Point, °C	Boiling Point, °C	Solubility	Conductivity	Physical State	Physical Appearance	Safety Precautions, MSDS	Structure	Ionic or Covalent Compound
Sodium Chloride											
Lithium Chloride											
Potassium Iodide											
Baking Soda											
Sugar											
Benzoic Acid											
Methanol											
Starch											
Vinegar											
Cyclohexane											
Napthalene											

Name: _____ Date: _____

Using the template below, and the data from your table diagram the trends found in ionic and covalent compounds.



Please Define the Following Terms:

1) Solubility _____

2) Ionic Bond _____

3) Covalent Bond _____

4) Conductivity _____

5) Polar Covalent Bond _____

Name: _____ **Date:** _____

Please answer the following questions in preparation for the lab you will be performing:

1. Ionic compounds are generally made up of what kind of elements?_____

   _____

2. Covalent compounds are generally made up of what kind of elements?_____

   _____

3. Write the formula and predict whether each of the following is principally ionic or covalent by circling (I) or (C).

   sodium iodide _____ I or C carbon tetrachloride _____ I or C

   ammonia _____ I or C carbon dioxide _____ I or C

   potassium nitrate _____ I or C calcium chloride_____ I or C

4. Based upon the compounds you researched, and your venn diagram, are there any patterns with respect to the property of solubility? _____

   Explain. _____

5. Based upon the compounds you researched, are there any patterns with respect to melting point? _____

   Explain._____

6. Based upon the compounds you researched, are there any patterns with respect to conductivity?_____

   Explain. _____

7. Millenium falcon is a compound made from 2 elements, Millenium (Mi) and falcon (Fa). Millenium has a configuration similar to the alkali metals and falcon has a configuration similar to oxygen. Predict the following:

   a. solubility in water _____ b. conductivity_____

   c. melting point _____ d. formula _____

8. Water (H_2o) is:

    a. Polar
    b. Nonpolar

    Explain why you chose the answer above:
    _____
    _____
    _____

9. Cyclohexane is:

    c. Polar
    d. Nonpolar

    Explain why you chose the answer above:
    _____
    _____
    _____

10. Based on the following answers in #8 and #9, explain what is meant by “like dissolves like”. (Use words like polar, non-polar, water, and cyclohexane in your answer below)

Identifying and Comparing Properties of Ionic and Covalent Compounds in Order to Classify Unknown Compounds.

PART A. Solubility in Water and Cyclohexane

Materials:

- Fume hood
- 3 50 mL beakers
- Glass stirring rod
- Deionized water
- Cyclohexane
- Unknown Sample A
- Unknown Sample B
- Unknown Sample C
- Spatula

Safety:

- **These procedures should be performed under a fume hood for cyclohexane.**
- **Cyclohexane must be kept away from all sources of heat and open flame.**
- **Safety goggles must be worn at all times**
- **Lab aprons should be worn at all times.**
- **Cyclohexane must be disposed of in organic material collection container provided by instructor.**
- **Unknown Sample A should not be inhaled and all unknown containers should be kept closed at when not being used**

Procedure:

1. Under a fume hood, fill three beakers (50 mL or greater) with approximately 20 mL cyclohexane each. Label each beaker with identity of Unknown sample that you will be placing into the beaker (A,B, or C)
2. Place a small scoop (tip of spatula smaller than a pea size) of Unknown Sample A into beaker containing cyclohexane and CAREFULLY stir with glass stirring rod. Material should be stirred for approximately 1-3 min.
3. Repeat procedure #2 for unknown B and unknown C.
4. Record observations.
5. Dump cyclohexane into collection container provided by your teacher. **(DO NOT DUMP DOWN THE DRAIN).**
6. Thoroughly wash each beaker with soap and water and **THOROUGHLY** rinse with deionized water.
7. Fill each beaker with 20 mL deionized water.
8. Place a small scoop of Unknown sample A into beaker containing deionized water. Stir with glass stirring rod. Material should be stirred for approximately 1-3 min.
9. Repeat procedure #8 for unknown B and unknown C.
10. Record observations.
11. SAVE SOLUTIONS FOR PART B OF LAB.

Record you data here in a chart form:

PART B: Conductivity Test for Ions in Solution

Materials:

- Electric conductivity apparatus (can be commercial or home- made) – **WARNING: If the conductivity tester to be used is powered by a 120-V source then this test should only be performed only by a teacher and should be performed very carefully as to avoid electric shock.**
- (3) beakers 50 mL or greater
- Spatula
- Glass stirring rod
- Unknown sample A
- Unknown sample B
- Unknown Sample C

SAFETY:

- **Safety goggles must be worn at all times**
- **Lab aprons should be worn at all times.**
- **Unknown Sample A should not be inhaled and all unknown containers should be kept closed at when not being used.**

Procedure:

1. Using the solutions prepared in part A of the lab, add 20 mL more deionized water.
2. Add a small scoop (pea sized) unknown sample A to labeled beaker and stir with glass stirring rod.
3. Add a small scoop (pea sized) of Unknown Sample B to beaker and stir with glass stirring rod.
4. Add a small scoop (pea sized) of unknown Sample C to beaker and stir with glass stirring rod.
5. Make sure the bare wires of the conductivity tester are clean. Rinse with deionized water before performing test.
6. If using a home-made conductivity tester, 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 LED goes on than the solution is conducting electricity. If the LED stays dark than the solution is not conducting electricity.
7. **CAUTION**: **Exposed wires on conductivity tester must be cleaned with deionized water before performing <u>next</u> conductivity test.**
8. If at first none of the solutions are conducting electricity then add another small scoop of the unknown to the solution.

Record you data here in a chart form:

PART C: Melting Time for Unknowns

Materials:

- Hot plate
- Aluminum Foil
- Spatula
- Unknown sample A
- Unknown sample B
- Unknown sample C

SAFETY:

- **Safety goggles must be worn at all times**
- **Lab aprons should be worn at all times.**
- **Unknown Sample A should not be inhaled and all unknown containers should be kept closed at when not being used.**
- **Do not touch the surface of the hot plate at any time, it is very hot! Do not place any chemical substance directly on the hotplate!**
- **Any remaining Unknown A should only be disposed of in a container labeled by your teacher.**
- **All experiments with Unknown A should be conducted in the fume hood.**

Procedure:

1. Place hot plate in fume hood. Plug in and turn on the hot plat to "500 V" and wait approximately 5 minutes until the hot plate has heated up. **Do not touch the surface of the hot plate at any time, it is very hot! Do not place any chemical substance directly on the hotplate!**
2. While you are waiting, construct 3 mini "boat like" devices to hold each unknown sample using aluminum foil. The aluminum foil needs to be flat on the bottom with 1/2" sides to prevent any compound from spilling on the hot plate surface.
3. Once you have constructed 3 "boat like" devices, scoop a pea size amount of Unknown A onto the first aluminum boat. Repeat for Unknown B and C, each unknown having their own boat.
4. Once all three aluminum boats have separate unknowns on them and your hot plate is heated up, place the three boats onto the hot plate at the same time.
5. Record the starting time and observe each unknown for a minimum of 10 minutes.
6. Record **any physical changes** you observe and the time it takes for the change to occur.
7. Record the final appearance of each unknown after 10 minutes as well.
8. After 10 minutes, turn the hot plate off. After an additional 10 minutes of cooling, remove the aluminum boats and substances. They all can be placed in the trash for safe disposal.

Record you data here in a chart form:

Name: _____ **Date:** _____

Part A - Solubility in Water and Cyclohexane

1. Is an ionic compound considered to be a polar or non polar compound? Explain why.

2. What type of solvent will dissolve an ionic compound? Explain why.

3. What type of solvent will dissolve a non-polar covalent compound? Explain Why.

4. Is water a polar solvent or a non polar solvent?

5. Is cyclohexane a polar solvent or a non-polar solvent?

6. Propose a hypothesis as to what type of compounds (ionic or covalent) Unknown A, Unknown B, and Unknown C are based on the results obtained in your solubility experiment.

7. Explain the reasoning behind your hypothesis for each of your unknown samples in question #6.

Name: _____ **Date: _____**

Part B - Conductivity:

1. Describe the electrical conductivity of each of your unknowns in solution.

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

3. What must be true of a solution that does not conduct electricity?

4. Propose a hypothesis as to what type of compounds (ionic or covalent) Unknown A, Unknown B, and Unknown C are based on the results obtained in your conductivity experiment.

5. Explain the reasoning behind your hypothesis for each unknown sample in question #4.

Part C - Melting time:

1. Did you notice any patterns in your pre-lab data with respect to the melting point? (As the melting point increased…)

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

3. Write down the unknowns and the time it to melt or change their physical appearance.

4. Which known substance(s) had a higher melting point?

5. Which unknown had a longer time to melting (thus a higher melting point?)

6. What would a longer melting time for a substance indicate?

7. Why would a substance have higher melting point?

8. What information would the melting point give you in terms of the bonding of a compound?

9. All ionic compounds exist in only one state at room temperature. From what you learned in this investigation, what is that state and why do you think they do not exist in the other states at room temperature?

Fill out the chart below based on the answer to the POGIL questions provided above.

Unknown Substance	***Ionic?***	***Covalent?***	***Why?*** ***(base answers on data obtained from experimental tests)***
Unknown A			
Unknown B			
Unknown C			
Unknown D (extension)			

Name: _____ **Date: _____**

Closing Questions

1. Based on the results from your testing of your unknowns, did you see any patterns in the data collected? Summarize your results.

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

3. When comparing melting points between ionic and covalent substances
    a. No trends or generalities can be found.
    b. Ionic compounds melt at lower temperatures than covalent compounds.
    c. Ionic compounds melt at higher temperatures than covalent compounds.
    d. Impossible to compare because covalent compounds burn before they melt.

4. Describe the observations you used to identify your unknown powder.

5. Why might the results not prove conclusively the identity (ionic or covalently bonded) of the unknown?

6. What could be done to improve the precision and accuracy of your investigation?

7. The human body is mainly composed of nonionic compounds, such as water, carbohydrates, lipids, and proteins. Why then are people such good conductors of electricity?

8. Magnesium carbonate, an ionic compound, is sometimes used as a thermal insulator in buildings. Why would you expect ionic compounds to be good thermal insulators?