

## Bond Types and Physical Properties

### PA State Standards:

- 3.4.10.A Explain concepts about the structure and properties of matter.
- 3.7.10.B Apply appropriate instruments and apparatus to examine a variety of objects and processes.
- 1.2.11.A Read and understand the central content of informational texts and documents in all academic areas.

### Introduction:

The physical properties of compounds are determined by a variety of factors, and one of the most important is the type of bond holding the molecules together. There are many tests that can be performed to determine whether a molecule contains covalent or ionic bonds, and three of these tests will be utilized in this lab. The compounds will be tested for their solubility and conductivity in water, and their melting points will also be determined. Covalent compounds usually do not conduct electricity in water and have relatively low melting points. Ionic compounds are usually conductive in water and have very high melting points. Using data collected from these tests, bonds can be classified as covalent or ionic.

### Guiding Questions:

Please answer the following questions before beginning the lab.

1. A compound has a melting point of 92 °C, does not dissolve in water, and does not conduct electricity in water. What type of compound is this?
  
2. A compound has a very high melting point, does dissolve in water, and conducts electricity in water. What type of compound is this?

### Equipment/Materials:

Acetylsalicylic acid	Disposable pipet	Stirring rod
Capillary tubes	Dropping Tube	Urea
Calcium carbonate	Magnesium sulfate	Wash bottle of DI water
Conductivity apparatus	Mel-Temps	Well plate
Deionized water	Naphthalene	Zinc oxide
Dextrose	Scoopula	
Digital Thermometer	Sodium chloride	

### Safety:

- Goggles should be worn in the lab.
- The parts on the top of the Mel-Temp are **HOT** while it is turned on. Do not touch these parts or place your eye on the eyepiece – you will get burned!
- Capillary tubes and dropping tubes break very easily, handle them with caution.

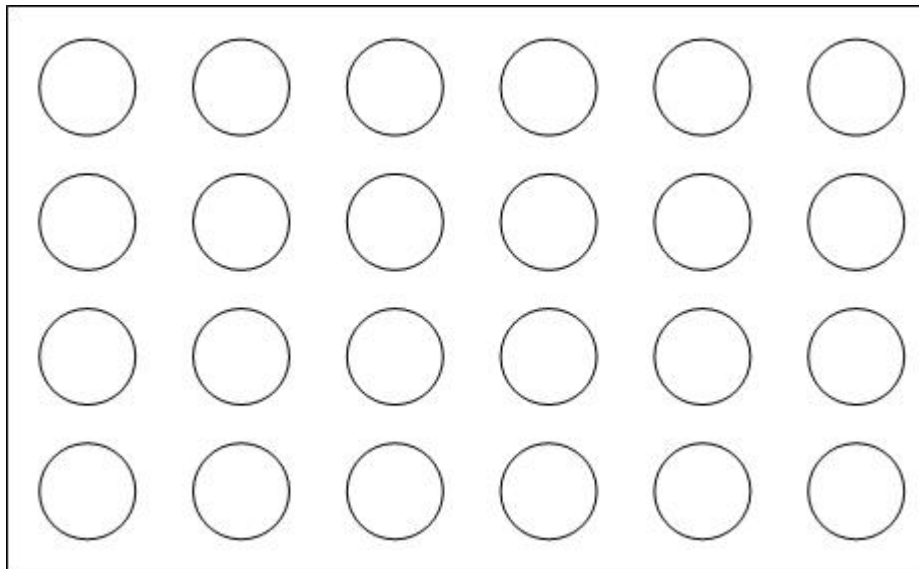
### Procedure:

**Part 1: Melting Point**

1. Obtain two capillary melting point tubes and two compounds. (The instructor will determine which 2 compounds will be tested by each group. The class will share data to fill in the data table.)
2. Push the open end of the tube into the compound. Some of the sample will now be in the top of the tube.
3. Hold the closed end of the capillary tube over a dropping tube; the dropping tube should be held perpendicular to the table and a couple of inches above the table surface. Drop the capillary tube into the dropping tube; the capillary tube will bounce on the table, packing the powder into the bottom. Repeat if necessary.
4. Place the capillary melting point tube in the Mel-Temp apparatus chamber. Be sure to indicate the location (left or right) of each tube in the data table. The mel-temp may be turned on to see the sample location, but the dial should be at zero until both samples have been inserted.
5. Move the dial to a setting of two to two and a half; the temperature should slowly rise. The samples should be observed continuously, so that the melting points of the samples are not missed. Heat slowly to acquire the most accurate results. Record the melting range for each sample, which begins when the sample first starts to melt and ends once the sample has completely melted. Increase the setting of the dial slowly only if the temperature stops rising.
6. If the temperature reaches 160°C, turn off the Mel-Temp and record the melting point of the chemical as >160 °C.
7. This section of the lab will take the longest time to complete; the Mel-Temp can be monitored by one partner while the other completes parts 2 and 3.

**Part 2: Solubility in Water**

1. Use a scoopula to place a small amount of each chemical into separate wells in the well plate. Only use enough of each chemical to cover about half the bottom of the well. Be sure to record where each sample is located by labeling the diagram below. Be sure to clean the scoopula between samples.



2. Use a plastic pipet to add enough deionized water to almost fill the well to each sample.
3. Stir each sample using the stirring rod. Be sure to clean the stirring rod between samples. Record the observations regarding the solubility of each of the substances in water in the data table. Do **NOT** discard the samples, as they are needed for the next section of the lab.

**Part 3: Conductivity**

1. Place the two copper leads from the conductivity meter into a sample and record your observations in the data table. There are two lights on the meter, a red light and a green light. To determine the amount of conductivity in each sample, use the key on the back of the meter.
2. Rinse the copper leads with deionized water from the wash bottle. Test the other samples, rinsing between each.
3. Discard all solutions by washing them down the drain with lots of water. Clean all the wells in the well plate.

**Data:**

<b>Substance</b>	<b>Melting Point</b>	<b>Solubility in Water</b>	<b>Conductivity</b>	<b>Type of Bonds</b>
<b>Acetylsalicylic acid</b>				
<b>Calcium carbonate</b>				
<b>Dextrose</b>				
<b>Magnesium sulfate</b>				
<b>Naphthalene</b>				
<b>Sodium chloride</b>				
<b>Urea</b>				
<b>Zinc oxide</b>				

**Questions:**

- Using the data above, determine the type of bond in each chemical and record the result in the data table.
- Which test(s) is/are the most definitive for determining what type of bonds are present in a given chemical?
- Which test(s) is/are the least definitive?
- Which type of compound (covalent or ionic) conducts electricity in water? Explain this result.
- Would you expect acetylsalicylic acid to conduct electricity based on the type of bonding in the molecule? Did it conduct electricity when you tested it? Explain your results.
- What is deionized water? Why is it important to use deionized water for this experiment?
- Why are some of the covalent compounds soluble in water while others are not?