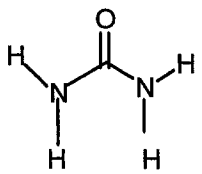
PHYSICAL PROPERTIES OF ORGANIC COMPOUNDS

Common physical properties used to identify organic compounds include the melting point of solids and the boiling point and density of liquids. In this experiment you will:

1. Determine the semi-microscale boiling point of a liquid, find its density and identify the liquid from a list of possible compounds.
2. Compare the melting points obtained for pure samples and mixtures.
3. Find a group of students with a solid identical to yours and, using experimental evidence, confirm that your solid is identical to theirs.

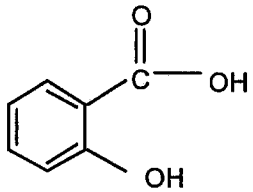
A substance can exist in either of three states; solid, liquid, or gas. The state depends on both temperature and pressure. Covalently bonded molecules are held together by weak intermolecular forces. As the temperature is raised, the molecules can be separated from each other. The stronger these forces are, the higher the melting and boiling point of the substance.

We will determine the melting points of urea and salicylic acid.



UREA

mp = 132 - 133 ^{o}C



SALICYLIC ACID

mp = 156 - 158 ^{o}C

Both of these compounds are solids at room temperature. Since the melting point of salicylic acid is greater, we expect that the intermolecular forces between salicylic acid molecules are stronger than those present in urea.

The melting point of a pure compound is a range of temperatures over which the solid softens and then completely liquifies. The melting point of a pure compound is sharp. The presence of impurities alters the melting point. This experiment will allow you the opportunity to find the melting points of pure substances and mixtures to determine the effect impurities have on melting points.

We will also determine the boiling point and density of an organic liquid. Both of these intensive physical properties can be used to identify the liquid. The boiling point will be determined using a semi-microscale procedure which is described in the procedure section of the laboratory experiment. We will measure the mass and the volume of the liquid at room temperature and report its density in grams/mL.

PROCEDURE:

Unknown Liquid Density

1. Weigh a clean **dry** empty 10 mL graduated cylinder to the nearest 0.01 gram. Record the mass.
2. Add the unknown liquid to the graduated cylinder so the liquid level reaches the **5.0 mL** mark. We will determine the boiling point of this same liquid in the next procedure.
3. Weigh the graduated cylinder and the unknown liquid. Record the total mass.
4. The mass of the liquid is the difference between the mass of the empty graduated cylinder and the cylinder with liquid.
5. DISPOSAL: Return the liquid to the labeled vial.

Unknown Liquid Boiling Point **(WORK IN THE HOOD)**

1. Obtain a small test tube and add **1-2 mL** of the same unknown liquid used above. Put into the test tube a capillary tube. (CLOSED SIDE UP)
2. Pour approximately 100 mL of water into a 150 mL beaker. Add a boiling chip to the beaker. Set up on a ring stand.
3. Place the test tube into the water and secure it with a clamp.
   Using a thermometer clamp, **suspend** your thermometer in the water. Do not allow the thermometer bulb to rest on the bottom of the beaker.
4. Begin heating the beaker with a bunsen burner.
5. As the temperature increases, the unknown liquid will begin to boil and bubbles will escape from the capillary tube. Continue heating until a "rapid" stream of bubbles is observed. When the stream of bubbles is observed, STOP heating.
6. Allow the system to cool. Shortly after the "last" bubble rises to the top of the test tube, the unknown liquid will rise in the capillary tube. Record the temperature. This is the boiling point of the liquid.
7. DISPOSAL: Return the liquid to the labeled vial.

CAUTION: These organic liquids are highly flammable.

From your density data and the boiling point of the liquid, identify the liquid using the choices listed.

Liquids	Boiling points	Density
chloroform	61.3 ^{o}C	1.50 g/mL
hexane	68.95 ^{o}C	0.6603 g/mL
ethanol	78.5 ^{o}C	0.7893 g/mL
1-propanol	97.4 ^{o}C	0.8035 g/mL
ethylene glycol	198 ^{o}C	1.1088 g/mL

Melting Point of Knowns and a Mixtures of the Knowns.

1. Choose a sample of urea (melting point; 132 - 133 ^{o}C)
   OR salicylic acid (melting point; 156 - 158 ^{o}C)
2. Obtain a sample of a **50:50 mixture** of these two compounds.
3. Place a small portion of each of the solids in different melting point capillary tubes. Tamp the solids down as shown by your instructor.
4. After receiving directions from your instructor, use the melting point apparatus to determine the melting point of each of your solid samples.
5. Find a way to tabulate your results so they can be shared with the class.
6. While performing this part of the experiment try to answer the question: **HOW DOES THE MELTING POINT OF A PURE COMPOUND DIFFER FROM THE MELTING POINT OF A MIXTURE?**
7. DISPOSAL: Put the capillary tube into the glass recycle box.

Melting Point of an Unknown

1. Select an unknown solid and record the number on the vial.
2. If necessary, crush the sample. Determine its melting point.
3. Find a way to tabulate your results so they can be shared with the class.
4. Find a group of students who have a solid which you **believe** is identical to yours. Place small amounts of both of the samples on a piece of weighing paper. Fold the paper and roll a stirring rod over the folded paper to crush and thoroughly mix the samples. Obtain a mixed melting point of the mixture.

Name_____Section _____

I. Liquid Unknown No:_____

A. Density Determination:

Weight of graduated cylinder _____g

Weight of graduated cylinder and liquid _____g

Weight of liquid _____g

Volume of liquid _____mL

Density _____g/mL

B. Boiling Point of Liquid: _____^{o}C

Name of Liquid: _____

II. Melting point of _____ _____^{o}C
Urea **OR** Salicylic Acid

Melting point of the **50:50 mixture** _____^{o}C

How does the melting point of the pure compound compare to that of the mixture?

Did the samples behave differently as they melted?

III. Unknown Number _____ Melting Point Observed _____^{o}C

Unknown Number used by the group you selected as possibly having the same solid as yours:_____What was their reported melting point? _____^{o}C

Mixed melting point _____^{o}C

Were you able to confirm that the two unknowns were identical?_____
WHY OR WHY NOT?