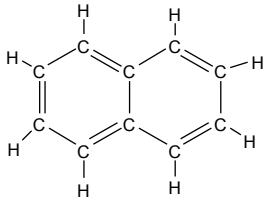
WKS--Demo *Name*_____

Freezing Point of Naphthalene *Date*_____ *Period*_____

Naphthalene
(The main ingredient in mothballs)



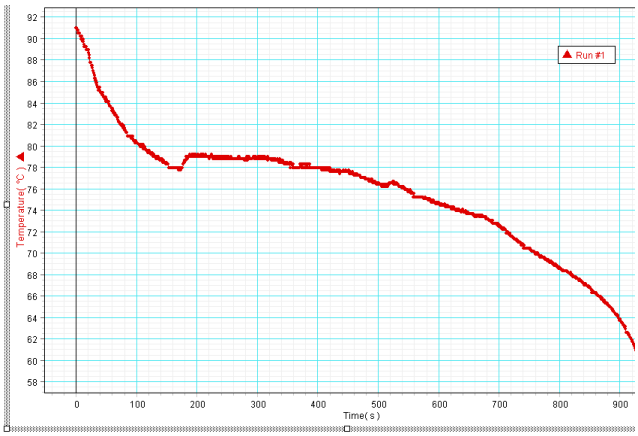
Purpose: To identify the freezing point of **naphthalene** by obtaining its cooling curve.

Procedure: **SAFETY GOGGLES MUST BE WORN!!!**

a) Obtain a test tube containing liquid naphthalene. BE CAREFUL!!! It is HOT!
b) Carefully secure the test tube to a ring stand.
c) Place a digital thermometer in the liquid naphthalene and allow the computer to collect temperature readings.

Part A: Cooling Curve of Naphthalene

Based on the graph of experimental temperature data for naphthalene (at right), answer the following questions:



1) Label on the graph when the naphthalene was all **liquid**, when the **first crystals** of solid were observed, and when only **solid** was visible.
2) Based on the graph, what is the experimental freezing point of naphthalene?_____
3) What must be the melting point of naphthalene (based on graph)? _____ How did you make your decision?

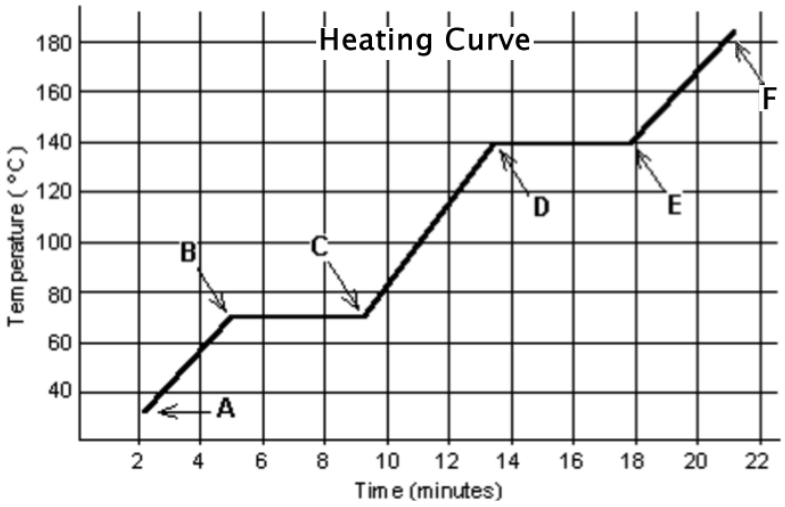
4) Describe what is happening to the molecules at each of these three stages. (Describe any changes in the motion of the molecules and/or any change in the bonding between the molecules.)
   a. Over the range near the beginning when the temperature decreases rapidly:
   b. Over the range when the temperature reaches a plateau (temperature barely changes):
   c. Over the range near the end when the temperature decreases rapidly again:

5) The plateau is where your substance changed from a liquid to a solid (it froze). Why does the temperature remain relatively constant (does not continue to decrease even though it is "cooling" in the air) when it is changing from a liquid to a solid?
   HINTS: Must this phase change be exothermic or endothermic?(Hint—the temperature is not decreasing as it normally would.) Are bonds being made or broken during this phase change? Thus, must energy be absorbed or released when these bonds are being made/broken?

6) If you were to heat up your solid substance slowly, the curve would be the opposite of your cooling curve. The temperature would increase, plateau while melting, and increase again once all the solid has melted. Why does the temperature remain constant while melting and doesn't continue to rise as your heat it? *(Think again about bonding and energy changes.)*

Part B: The Heating Curve of an unknown substance

The graph to the right was drawn from data collected as a substance (*not* water) was heated at a constant rate. Use the graph to answer the following questions.



7) At **point A**, the substance exists in a solid state. On the graph, label where this substance exists as (1) a solid, (2) a liquid and (3) a gas.
8) What is the melting pt. of the substance? ____
9) What is the boiling pt. of the substance? ____
10) What is its condensation pt?_____
11) What is its freezing pt?_____
12) Describe the arrangement and motion of molecules at C and then describe how the arrangement and/or motion of molecules changes as one moves to D on the graph.

13) A beaker of water is heated to boiling by a Bunsen burner. Would adding another burner raise the boiling point of water? Explain.

14) Give an advantage of cooking broccoli with steam instead of cooking it in boiling water? *(One advantage is fewer nutrients are lost (dissolved away) when cooked with steam rather than with boiling water. Come up with a different advantage.)*

15) When it gets below freezing outside, citrus fruit farmers often spray their fruit trees with water. This helps to protect the fruit because the fruit will not get as cold if sprayed. Explain why the fruit do not get as cold? *(There are really two reasons for this. One reason is that a layer of ice forms on the fruit. This layer of ice will insulate the fruit from the cold temperatures. You need to come up with the other reason.)*