Experiment 3

Melting Temperature of a Pure Substance

Name _____ Per ___

Purpose: To find the melting point of paradichlorobenzene (motha crystals) and make an hypothesis (third step of the *Scientific Method*).

The method used in Experiment 2 to determine the order in which materials melt as the temperature is raised is a satisfactory experimental technique but not a convenient one. Chemical stockrooms contain several hundred different chemicals and if we were to follow this method, we would have to place each on the lid. A more practical method is to measure separately the temperature of melting (the melting point) of each of the substances. Then these characteristic temperatures can be filed for comparison with the measured melting points of any other sample at any later time.
Until now we have been dealing only with the relative order of melting points. Now let us look at the melting of one substance more closely.
The solid, paradichlorobenzene, will be heated slightly above its melting temperature. Temperature data will be obtained by noting the temperature at designated time intervals as the liquid cools and solidifies. The solid will then be reheated and melted, and again temperature data will be obtained at designated time intervals during the heating.

DO NOT REMOVE THE THERMOMETER FROM THE TEST TUBE OF CRYSTALS!!!

Use your locker thermometer to take water temperatures.

NEVER HEAT A CLAMP!!!

Clamp the test tube at the top end to prevent heating the clamp.

PROCEDURE:

Part I. Cooling Behavior

a. On the back, prepare a table to record the time and temperature as the sample is cooled. It should go from 0 to 480 seconds in 30 second intervals.

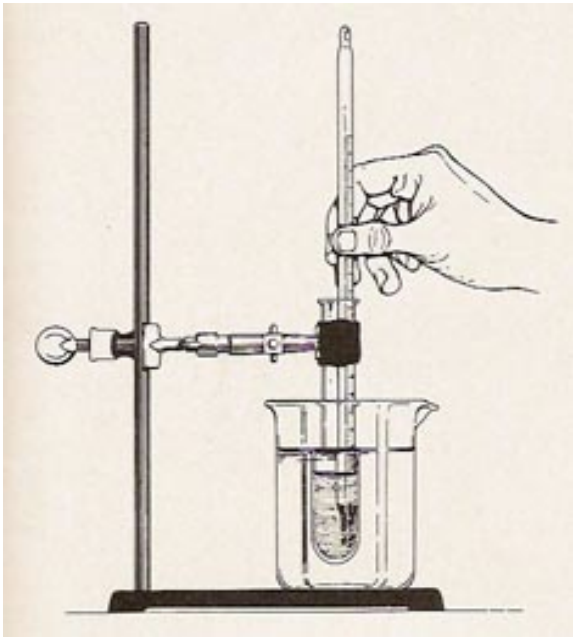
Time in seconds	Temp ^{o} C
0	.
30	.
60	.
Etc.	Etc.

b. Fill a 250 mL beaker 1/2 full of tap water. Place it on a ringstand upon an iron ring with wire gauze and with a burner bring the water to a boil (100^{o}C). With the clamp, hold the sample of crystals in the boiling water until the crystals are completely melted.

c. Secure the burner.

d. Raise the test tube out of the boiling water bath and attach the clamp to the ringstand as shown in Fig. 3-3.

Fig. 3-3 Fig. 3-2



e. Empty the boiling water from the beaker, and re-fill it with COLD tap water 3/4 full.

f. Place the beaker, three-fourths full of COLD water, on the ringstand as shown in Fig 3-2 above **without the sample tube in it.**

g. Prepare for action. One partner will do the timing and record the temperature every 30 seconds for about ten minutes. The other partner will call off the temperatures and observations.

h. On signal by the recorder, immerse the test tube into the cold water bath as in Fig3-2 above. Record the temperature of the sample each 30 seconds, noting when solidification (it gets cloudy) starts and completes.

Temp when solidification begins _____ ^{o}C. Temp when solidification ends _____ ^{o}C

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Part II. Warming Behavior

The observer and recorder should exchange duties at this point.

a. On the back, prepare another table to record the time and temperature as the sample is warmed. It should go from 0 to 480 seconds in 30 second intervals..

Time in seconds	Temp ^{o} C
0	.
30	.
60	.
Etc.	Etc.

b. Fill a 250 mL beaker three-fourths full of tap water and place it on the iron ring and gauze.

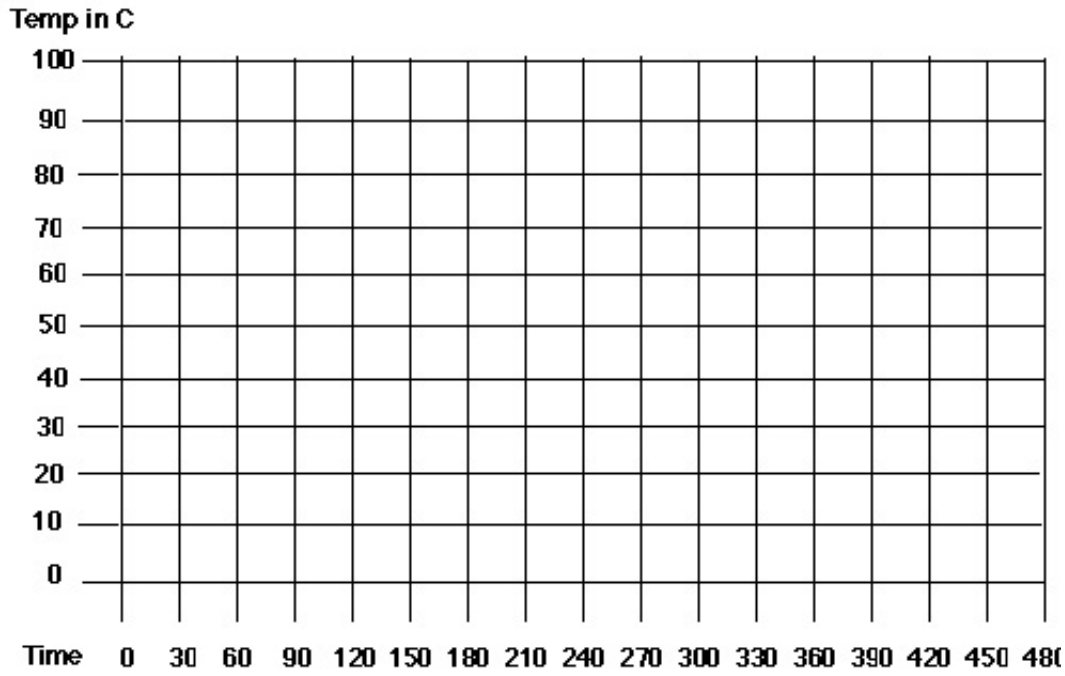
c. With the burner, heat the water bath to 70^{o}C, then remove the burner but leave it on.

d. With the burner, maintain the water temperature at 70^{o}C.

e. When ready, immerse the tube of solid crystals into the beaker of warm water and start recording the temperature of the sample every 30 seconds until a temperature of 65^{o}C is reached. (About ten minutes).

f. Note the temperature when melting STARTS and when it is COMPLETE. (It will become clear when it is melted).
Starting temp _____ ^{o}C. Completion temp _____ ^{o}C

On the next page, graph **BOTH** the cooling and warming curves on the **SAME** axes. Place Time (every 30 seconds from 0 to 480 sec) on the x axis, and Temperature (0^{o}C to 100^{o}C) on the y axis.



QUESTIONS:

1. What would be the effect of increasing the amount of crystals?

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2. Based upon your data, what are the melting and freezing points of the crystals.

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3. Within experimental error, do you believe that the melting and freezing points are the same?

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4. Make an hypothesis why all pure substances will have a definite melting and freezing point?

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CRITIQUE: Study your experimental results as shown in the graphs. Write a summary on the experiment including an interpretation of the shape of the heating and cooling curves..