# HEATING AND COOLING CURVES
# OF STEARIC ACID USING THERMOMETER LAB

**Purpose:**

- To understand that a phase change is a physical change.
- To practice techniques of heating materials using the Bunsen burner.
- To study the effects of heating and cooling a pure substance through a change of phase.
- To construct heating and cooling curves of a pure substance using experimental data.
- To determine the freezing and melting point temperatures of the pure substance.

**Discussion:**

In this laboratory investigation you will take Stearic Acid and determine its freezing point and melting point experimentally.

When the data collection is completed, your graph should reflect pictorially what happens to a pure substance as its temperature is raised and lowered over a temperature interval that includes its freezing and melting points. The graph will also show how the freezing and melting points of a pure substance are related.

**Safety:** Goggles and Aprons

**Equipment:**

Sample test tube containing Stearic Acid
Goggles
Apron
Beaker – 400 mL
Thermometer
Ring stand
Iron ring
Wire gauze
Test tube clamp
Test tube rack
Bunsen burner
Stop watch/timer with second hand

**Material:**

Steric Acid Test Tube
Water

**STEP ONE:** ***Preparation for cooling curve:***

Before any data can be taken the Stearic Acid test tube must be prepared. It is given to you by the teacher in the solid phase. ***Therefore, it is below its freezing point***. We must first melt the sample in a hot water bath to prepare it for the cooling curve data.

1. Prepare a hot water bath using a ring stand, iron ring, wire gauze, Bunsen burner and a 400 mL beaker. Fill 400 mL beaker half –way. **YOU WILL PRESERVE THIS BATH!**

2. Remove rubber stopper and support sample test tube in the hot water bath using your test tube holder. Now, the sample will begin to melt and turn to a liquid.

3. While the sample is melting, place the thermometer into the test tube **CAREFULLY!** Look for a temperature reading of about $80^{o}$C. Continue melting until a temperature of $95^{o}$C is reached.

4. Now the sample is ready for the cooling curve experiment.

**STEP TWO :** ***The Cooling Curve:***

1. Remove test tube sample from the hot water bath and place in into a test tube rack. This is time = 0. Record initial temperature in appropriate place on data table.

2. Continuously stir the sample with the thermometer and make temperature readings every 30 seconds. Record your temperature readings on your data table. Continue this process until a temperature of $30^{o}$C is reached. **BE CAREFULL STIRRING!** At some point the thermometer will cease to move. (The substance is now frozen.)

**STEP THREE:** ***The Heating Curve:***

1. Using the bath from the preparation exercise, (make sure the temperature of the bath is no higher than $90^{o}$C), place the sample test tube (thermometer in it) into the bath. This time = 0 for the heating curve. Record temperature initial in you data table.

2. Continue making temperature readings every 30 seconds. Once the thermometer is free to move, make sure to stir constantly. Continue to make readings until a temperature of $90^{o}$C is achieved. (SIMMER water bath.)

3. Let sample cool 2 to 3 minutes. Remove the thermometer and return the sample to the teacher. **DO NOT DISPOSE OF THE SAMPLE!**

**OBSERVATIONS AND DATA:**

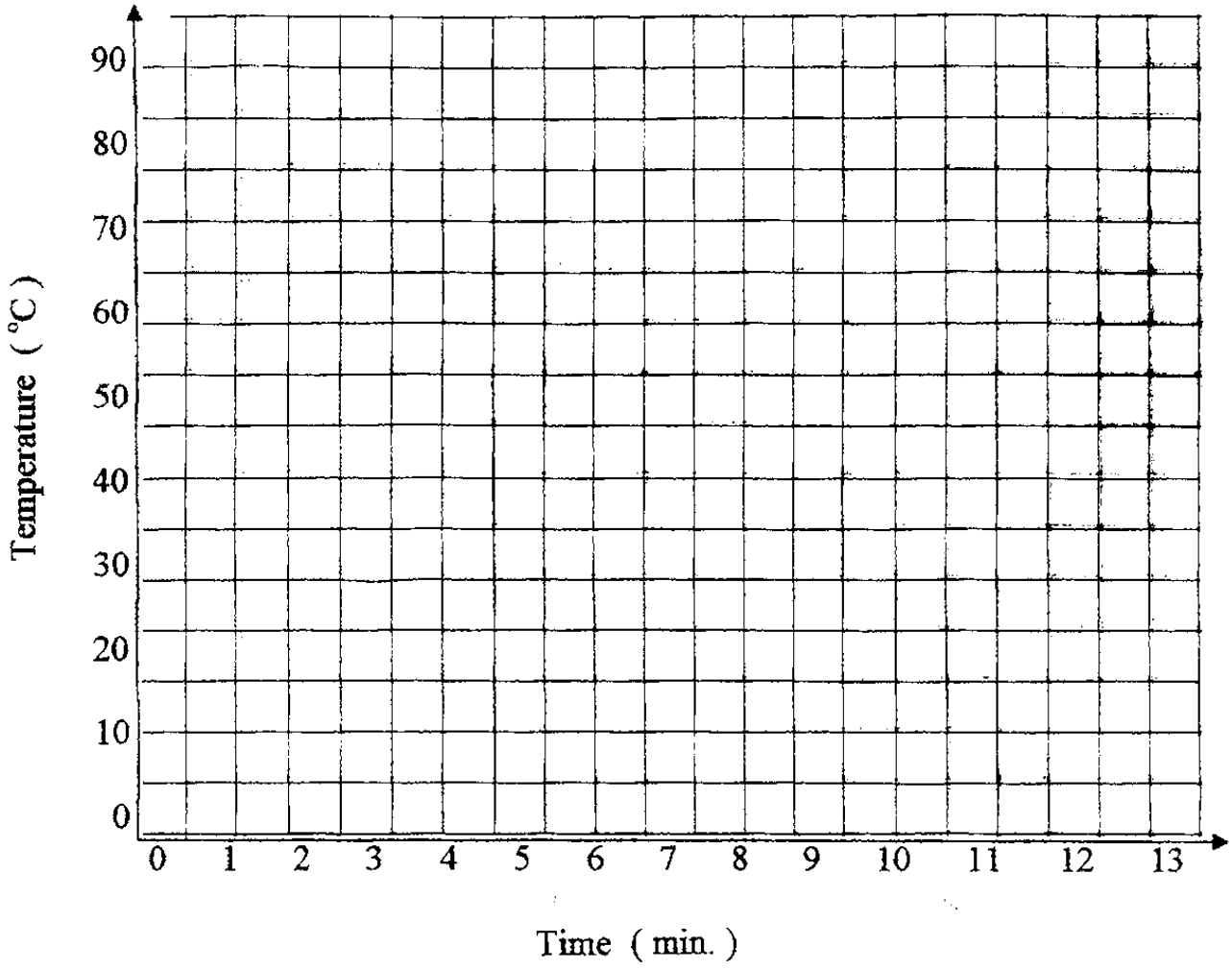
| Time (min) | Temp. ($C^o$) | |
|---|---|---|
| | Cooling (Part I) | Heating (Part II) |
| 0 | | |
| ½ | | |
| 1 | | |
| 1 ½ | | |
| 2 | | |
| 2 ½ | | |
| 3 | | |
| 3 ½ | | |
| 4 | | |
| 4 ½ | | |
| 5 | | |
| 5 ½ | | |
| 6 | | |
| 6 ½ | | |

| Time (min) | Temp. ($C^o$) | |
|---|---|---|
| | Cooling (Part I) | Heating (Part II) |
| 7 | | |
| 7½ | | |
| 8 | | |
| 8 ½ | | |
| 9 | | |
| 9 ½ | | |
| 10 | | |
| 10 ½ | | |
| 11 | | |
| 11½ | | |
| 12 | | |
| 12½ | | |
| 13 | | |
| 13 ½ | | |

**CALCULATIONS:**

Plot your data from this experiment on the set of axes in the graph below.

Use a blue pencil to plot cooling data and a red pencil to plot heating data.



**QUESTIONS:**

1. Referring to your graph, determine the freezing point of Stearic Acid. How does this temperature compare with the melting point temperature of the same substance as indicated on the graph?

2. Explain the diagonal parts of the cooling curve in terms of changes in kinetic and potential energy. Do the same for the horizontal portions of the cooling curve.

3. What phase changes are exothermic? Endothermic?

4. In which phase of a substance do its particles have the greatest average kinetic energy?