Name:_____ Period:____

Lab 14:
The Cooling Curve & Heating Curve of Lauric Acid

Objective:

1. observe the freezing and melting behavior of lauric acid
2. construct a graph of the cooling curve for lauric acid
3. interpret the freezing point and melting point from a graph

Background:

In any pure substance, changes of physical state occur at constant, discrete temperatures that are uniquely characteristic of the substance. Changes in physical state include solids melting, liquids freezing or boiling, and gases condensing. In this experiment, you will closely examine what happens when a pure substance undergoes a change in physical state. Specifically, you will investigate the freezing behavior of a sample of an organic compound called lauric acid, $CH_3(CH_2)_{10}COOH$. You will observe what happens to the temperature of the lauric acid between the time that freezing begins and the time it is complete. You will deduce what would happen during a heating curve, and you will also consider what happens to the energy that is put into or removed from the lauric acid system during freezing or melting.

Materials:

Safety goggles	Test tube tongs
2 – 400 mL beaker	Hot plate
Thermometer	Large test tube with Lauric acid

Procedure:

1. Heat sample of lauric acid in a test tube until it is melted using a hot water bath.

2. Remove the test tube from the hot water bath and attach to the ring stand with a test tube clamp. Hold a thermometer in the center of the sample of lauric acid and record the temperature to the **nearest 0.1°C**. Lower the test tube into a beaker of cold water and record the temperature every **30** seconds making sure to *stir the sample continuously*. *As the acid begins to freeze, do not force stirring or the thermometer will break.*

3. Continue to record the temperature until the lauric acid has solidified and the temperature has fallen to 34°C or lower.
4. Write down what happens to the volume of liquid lauric acid as it turns to solid:_____

5. Place the same test tube with solid lauric acid in the 400 mL beaker of hot water. DO NOT reheat the water (it should be around 55°C). Record the temperature of the lauric acid in **Part B** of your data table (Time = 0) as soon as you place the test tube in the beaker of hot water. Read and record the temperature to the nearest **0.1°C every 15 seconds** until the solid lauric acid has changed completely to liquid.

6. When the thermometer is able to move, use it to stir the solid/liquid lauric acid. Continue stirring and record the temperature to the nearest **0.1°C every 15 seconds** until the temperature of the *sample reaches 60°C.*

7. Remove the thermometer and wipe it clean with paper towels. Then rinse it in the sink and dry with paper towels. Remove the test tube from the hot water and allow it to cool in the test tube rack.

8. Clean up your lab station. **DO NOT** throw away the test tube and the lauric acid.

9. Clean Up Approval: _____

Data Table A: Cooling Data

Time (sec)	Temp (°C)	Time (sec)	Temp (°C)	Time (sec)	Temp (°C)

Data Table B: Heating Data

Time (sec)	Temp (°C)	Time (sec)	Temp (°C)	Time (sec)	Temp (°C)

Results:

1. **Constructing your graph:** Make a line graph with your cooling and heating data. Use one color to represent cooling and a different color to represent heating, and include a color-coded key. Label the X axis as Time (seconds), and the Y axis as Temperature (°C). Make sure you use the maximum amount of graph space that you can, so spread out the numbered intervals. Lastly, put a title on your graph.

Conclusion:

1. At what temperature does lauric acid show visible signs of becoming solid (the freezing point)?

2. How *should* the freezing point temperature of lauric acid compare to the the melting point temperature of lauric acid?

3. Look at your graph; describe what occurs, *in terms of kinetic energy* in the section on your graph where the line is sloped for *both* the cooling curve and heating curve. What is this phase of matter?

4. Look at your graph; describe what occurs, *in terms of potential energy* in the section on your graph where the line is horizontal for *both* the cooling curve and heating curve. What is this phase of matter?

5. What happened to the volume of lauric acid as it became a solid? What does this indicate about the density of solid lauric acid compared to liquid lauric acid? What does this change indicate about the change in potential energy as the lauric acid freezes?

6. Predict the effect that increasing the amount of solid lauric acid would have on the melting point/heating curve and the freezing point/cooling.

7. If you used ice as the substance undergoing melting and freezing (phase change) instead of lauric acid in this experiment, how do you think your results would be different?

8. Calculate your percent error for this experiment. The accepted melting point for lauric acid is 44°C. **Show all work below.**