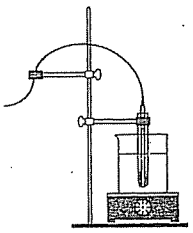
Heating and Cooling Curves

Discussion: In this experiment, you will observe the effects of cooling and heating a pure substance. First, a pure substance will be cooled; temperature readings will be made at regular intervals until the substance changes to its solid phase and cools to a temperature below its freezing point. Second, the substance will be heated; temperature readings will be made until the substance is in its liquid phase at a temperature above its melting point. The data collected will be used to construct a graph consisting of a cooling curve and heating curve. The graph also will show how the freezing and melting points of a pure substance are related.

Purpose: To study the effects of heating and cooling a pure substance through a change of phase. Also, to construct heating and cooling curves of a pure substance and to determine the freezing and melting point of the substance.

Materials: Test tube with lauric acid , hot plate
Temperature probe
2 -250ml beakers, Safety glasses, Ice water



Procedure:

1. Fill two 250 mL beakers 1/2 full of water. Place one beaker on the hot plate and place ice in the other beaker.
2. Obtain a test tube of melted lauric acid and place the temperature probe into the test tube. The lauric acid should be at 60°C.
3. When the temperature stabilizes, press COLLECT and immerse the test tube into the beaker of ice water making sure the entire sample is under water. Stir the test tube continuously with the temperature probe.
4. Continue until the temperature reaches 25°C, and then click STOP.
   Highlight the flat section of the graph with the cursor.
   Select Analyze - statistics
   Find the mean and record as the freezing point.
   Go to File and Select Print Graph
   SELECT STORE LATEST RUN FROM THE EXPERIMENT MENU
5. Check the water of your hot water bath and make sure it is no higher than 65°C - 70°C. When it is turn off heat
6. Start the computer BY PRESSING COLLECT and immerse the test tube in the warm water bath
7. As soon as the probe is free to move, it should be used to stir the solid-liquid mixture. Continue stirring until the temperature of the sample reaches 50°C and the entire solid has melted.
8. Click on Stop - Go to Data menu and Select hide data set run 1 -Select Analyze - Autoscale- Highlight flat portion select analyze again - Statistics (make Sure on latest run) find mean record as melting point - Print Graph
9. Remove probe and clean it with very hot water. Return the test tube to your teacher. (do not pour lauric acid down the drain)

Questions for Discussion:

1. Referring to your graph, determine the freezing point of lauric acid. How does this temperature compare with the melting point temperature of the same substance as indicated on the graph?
2. Explain the diagonal and horizontal parts of the cooling curve in terms of changes in kinetic and potential energy.
3. List the phase changes and classify them as endothermic or exothermic.
4. In which phase of a substance do its particles have the greatest kinetic energy

1) As ice melts at standard pressure, its temperature remains at 0°C until it has completely melted. Its potential energy

A) decreases B) remains the same C) increases

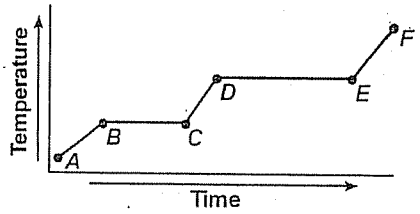
2) In which process does a solid change directly into a vapor?

A) solidification B) deposition C) condensation D) sublimation

3) Which phase change results in the release of energy?

A) $H_2O(\ell) \longrightarrow H_2O(g)$ B) $H_2O(g) \longrightarrow H_2O(\ell)$ C) $H_2O(s) \longrightarrow H_2O(\ell)$ D) $H_2O(s) \longrightarrow H_2O(g)$

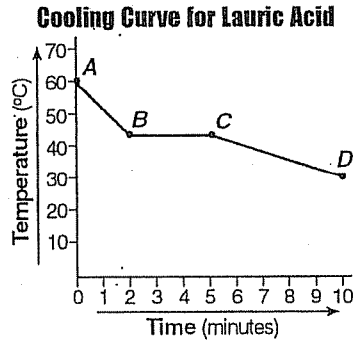
4) The graph below represents the uniform heating of a substance, starting with the substance as a solid below its melting point.



Which line segment represents an increase in potential energy and *no* change in average kinetic energy?

A) *CD* B) *BC* C) *AB* D) *EF*

5) Given the graph below that represents the uniform cooling of a sample of lauric acid starting as a liquid above freezing point.



(a) Which line segment represents a phase change, only?

(b) What is the melting point of lauric acid?

(c) At which point do the particles of lauric acid have the *highest* average kinetic energy?

(d) Name the phase change that takes place during this 10-minute cooling time.