LAB #9
THE COOLING AND HEATING CURVE OF A PURE SUBSTANCE.

INTRODUCTION: In this lab you will plot a curve that will give you the relationship of kinetic energy slope to potential energy phase change plateau of a substance that is cooling. You will also plot a graph of the substance while it is being heated. Some important theory and terminology that should be discussed in your lab write up is:

a) While heating or cooling the solid or liquid, the kinetic energy change can be measured by the thermometer and will be expressed as a slope on your graph.
b) As you heat or cool the substance during a *PHASE CHANGE* there will be a potential energy change, which cannot be measured by a thermometer. This will manifest as a plateau on the graph. In this lab there will be only one plateau, the melting/freezing equilibrium phase change.
c) You will be able to determine the freezing/melting point on your graph; this will correspond to the temperature at which the plateau occurs.

SAFETY

a) You will be heating a boiling water bath, burns can occur therefore be alert and focused during this lab.
b) Wear goggles and aprons during this lab.
c) Handle the thermometers carefully; NEVER push the ends of a thermometer with your palm. Always secure the thermometer as they can roll and break.

MATERIALS

a) BHT 6.0 grams OR Lauric Acid 6.9 grams.
b) Disposable borosilicate test tube, 600 mL beaker.
c) Ring stand, ring, wire pad, burner and lighter.
d) Tongs, thermometer with stopper, 2 clamps.

PROCEDURE:

1) Fill a 600 ml beaker about 2/3 full of warm water (from back sink).
   Begin heating the water to boiling, avoid having it splatter and you may have to occasionally add some water to the beaker to maintain the water level. This is called a *WATER BATH*; it will give you a <u>constant 100.0 C^o</u> as liquid water will never go above its boiling point.
2) Obtain a disposable borosilicate test tube.
3) Carefully add 6.0 grams of solid BHT or Lauric Acid to the tube. Filling will be more efficient if you make a funnel out of a piece of weighting paper. The solid naphtelene may fill the tube; however it will occupy a smaller volume after it has melted.

4) Place the tube into a clamp, avoid over tightening the clap screw or you may break the test tube. Carefully place the tube into the water bath, allow it to melt completely into a clear liquid, it is normal for the melt to have an odor similar to your detergent! NOTE- the water bath does not have to be at the boiling point before you place the test tube in, however it must reach boiling during the melting process.
5) After the BHT or Lauric Acid has completely melted, insert the thermometer. Be certain to clamp the stopper on the thermometer securely, see figure #1. The thermometer should never touch the glass of the test tube, or your readings will be inaccurate. Some of the naphtelene may solidify on the thermometer therefore you will have to allow that to melt before going to step 6.
6) After the solid has melted from the thermometer, remove the clamped test tube from the water bath and extinguish the burner. Allow the clamp to stay on the ring stand away from the water bath. And allow it to cool while recording the temp at 30.0 sec intervals (20.0 sec intervals will give you a better graph). ***HAVE PATIENCE,*** this can take a some time and you may be at the same temperature during the freezing/melting plateau for many temperature readings. You can stop after you record five consecutive (in a row) readings that drop after the plateau. You should have about 25 readings total. These readings will be plotted as your cooling curve. Relight your burner now to maintain the water bath temperature.
7) At this point the thermometer is frozen ("stuck") into the solid. Do not try to remove it, simply place the test tube with the captive thermometer back in the water bath and immediately begin to take your 30.0 sec interval temperature readings as you heat it to melting. You can stop after you record five readings greater that the temperature of the plateau. Turn off your burner now. The readings from the melting will be plotted as the heating curve.
8) While the BHT or Lauric Acid is still melted as a clear liquid, remove the thermometer, immediately wipe it to dryness with paper towels, and return the thermometer ASAP to your instructor.
9) Allow the test tube to cool, when it has solidified to a white solid, dispose of it in the solid waste pail. **NEVER DUMP MOLTEN BHT or LAURIC ACIDINTO THE SINK!**
10) Allow your equipment to cool before returning it.