Lab: Molar heat of vaporization and fusion of water

MOLAR HEAT OF VAPORIZATION AND HEAT OF FUSION OF WATER: Heat of vaporization is the heat needed to change a certain quantity of matter from the liquid state to the gaseous state without a change in temperature. Heat of fusion is the heat needed to change a certain quantity of matter from the solid state to the liquid state without a change in temperature. While a phase change is taking place the temperature remains the same because all the energy is being used to change the state. In this experiment we are going to determine experimentally the heat of vaporization of water (amount of heat to change 1 mole of water to steam) and the heat of fusion of water (amount of heat to change 1 mole of ice to water).

MATERIALS: Thermocup, thermometer, water, burner, hot plate, 250 mL flask and delivery tube.

PROCEDURE:
HEAT OF VAPORIZATION: Plug in your hot plate immediately. Weigh and record the mass of your thermocup. Place exactly 100 mL (100g) of water in a thermocup and determine its temperature (Ti). Weigh and record the mass of the thermocup and water (Mi). Add 50 mL of distilled water to the flask, connect the delivery tube, and start to heat the flask (See diagram for arrangement of the apparatus). When the water is boiling briskly, use the burner to heat the delivery tube in area "C". The steam should be coming out without any drops of water. Bring the thermocup with the thermometer in it up so that tube "B" is below the surface. Allow the steam to condense until the temperature has increased approximately 10°C. Remove the thermocup, stir and record the highest temperature reached (Tf). Weigh and record the mass of the thermocup with the original water plus the condensed water (Mf).

HEAT OF FUSION: Place exactly 100 mL of water (100 g) of water in a thermocup and determine its temperature (Ti). Weigh and record the mass of the thermocup and water (Mi). Add a couple pieces of crushed ice that has been patted dry with a paper towel. Stir, allowing the ice to melt and record the lowest temperature reached (Tf). Weigh and record the mass of the thermocup with the original water plus the water gained by the melted ice (Mf).

DATA TABLE:

Mass of Thermocup	_____.
Mass of Thermocup + 100 mL of water	_____.
Temperature of water before steam	_____.
Temperature of water after steam	_____.
Mass of Thermocup + water + steam	_____.
Mass of Thermocup + 100 ml of water	_____.
Temperature of water before ice	_____.
Temperature of water after ice	_____.
Mass of Thermocup + water + ice	_____.

CALCULATIONS:
1. Calculate the absolute temperature change |Tf-Ti|.
   a. water (Hv) b. steam (Hv) c. water (Hf) d. ice (Hf)
2. Calculate the Mass of steam condensed (Mf-Mi) then change to moles.
3. Calculate the Mass of ice melted (Mf-Mi) then change to moles.
4. Calculate the Molar Heat of Vaporization (Hv) and Molar Heat of fusion (Hf).
   a. Hv = (Heat gained by water - heat lost by the steam) / moles of steam.
      =[(mass water x ΔT x .00418kJ/g°C)-(mass steam x ΔT x .00418kJ/g°C)]/moles steam
   b. Hf = (Heat lost by water - heat gained by ice) / moles of ice.
      =[(mass water x ΔT x .00418 kJ/g°C)-(mass ice x ΔT x .00418 kJ/g°C)]/moles ice
5. Calculate the % error, using the following equation:
   % error = (accepted value – experimental value)/ accepted value x 100.
   The accepted value for Hv is 40.76 kJ/mole. The accepted value for Hf is 6.009 kJ/mole.