Worksheet: Phases of matter

Name: _____ Group

Note: This lab uses things that are both HOT and COLD. Use gloves and goggles throughout the lab.

1. Fill the beaker with 400 ml of ice water and ~100 g of ice (record the mass of ice). Place the water on the electric heater with the volume scale easily visible and place a thermometer in the ice water. Turn the electric heater on and record the temperature and volume of the liquid every 100 s. As the ice melts, the water heats up and 100 ml evalporates.

   - Graph temperature vs time between the time when the all the ice has melted and when the water starts to boil.

   - Find the slope of water temperature vs time between 0°C and 100°C:

     k = _____ _____

   - The energy required for each ml of water to rise 1°C in temperature is 1 calorie or 4.184 Joules. You can use this to determine the power (energy per time) of the hot plate:

     $P = 4.184 \frac{\mathrm{J}}{\mathrm{g\ C}} \cdot k \cdot V_{\mathrm{H2O}} =$ _____ J/s

Time	Temp	Volume

   - From the power of the hot plate and the time it took to melt ice or boil water, calculate the energy required to melt ice or boil water:

     Melt 100 gm of ice t = _____ E = P t = _____

     Boil 100 gm of water t = _____ E = P t = _____

2. Measurement of volume change for N_2 liquid to gas transition

Note that liquid nitrogen is a cryogenic liquid with boiling temperature of 77 K (-196 °C) and can "burn" or damage your eyes. Where gloves and goggles.

- Fill the plastic tub with 2 liters of water. Place the stand for the inverted soda bottle in the container.

- Fill the plastic bottle completely plug with your thumb and quickly invert it onto the stand with top under water.

- Thread the loose end of the red hose into the bottle.

- Your instructor will fill a glass tube with >2 ml of liquid nitrogen. Hold the tube upright with the cap loosely screw on and the clothes pin pinching the red tube. Let the liquid boil until it reaches the blue line. Tighten the cap and remove the clothes pin. As the liquid N_2 boils, the gaseous N_2 will push water from the plastic bottle. Measure the volume of liquid displaced.

Calculate the ratio of the volume of nitrogen gas to that of a liquid.