Revised August 2008

AP LAB 6a: Molar Mass of a Volatile Liquid

Aim To calculate the Molar Mass of a volatile liquid

Apparatus 125 mL conical flask, aluminum foil, 1000 mL beaker, hotplate, electronic balance, clamp and stand, measuring cylinders, thermometer, rubber band

Chemicals Unknown volatile liquid, water

Method

Conduct the whole experiment inside the fume hood

1. Weigh a clean 125 mL conical flask, a small piece of aluminum foil and a rubber band to the nearest 0.001 g.

2. Approximately two-thirds fill a 1000 mL beaker with water, add a few boiling granules and heat it to boiling on a hot plate. Reduce the heat so the water is gently simmering at a temperature just below 100.0 $^{\circ}$C.

3. Add about 6.00 mL of the unknown liquid to the flask and cover it using the foil and the rubber band. Ensure the foil is pressed tightly against the glass on the neck of the flask. Using a pin, pierce a small hole in the foil to allow a limited exchange of gases between the room and the flask.

4. Submerge the flask into the water and clamp it down. Put the flask as far into the water as you can without getting the foil wet. Watch the liquid level inside the flask. The liquid will vaporize quickly. When the last bit of liquid inside the flask has evaporated leave the flask in the water for another minute before removing it. Record the temperature of the water.

5. Quickly cool the flask in an ice bath and then thoroughly dry the exterior of the flask.

6. Record the mass of the dry flask with the condensed vapor.

7. Discard the condensed liquid into the waste beaker at the rear of the fume hood and determine the total volume of the flask by filling it to the rim with water and transferring the water to a measuring cylinder.

8. Record the barometric pressure in the room.

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Results

Mass of empty flask, foil and rubber band (g)	
Temperature of boiling water (K)	
Mass of flask, foil, rubber band + condensed vapor (g)	
Volume of flask (L)	
Barometric pressure (mmHg)	
Gas constant, R (mmHg L mol^{-1} K^{-1})	62.4

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Conclusion/Calculation

When heated in a water bath the volatile liquid will boil, expel air from the flask and fill it with the liquids vapor. On cooling, the vapor condenses back to the liquid allowing the mass of the vapor to be calculated. By recording the pressure, temperature and the volume, and by knowing a value of the gas constant, the ideal gas equation can be used to calculate the molar mass of the volatile liquid.

1. Use your data to calculate the Molar Mass of the liquid used in the experiment.

2. The following data was obtained in another, similar experiment. Calculate the Molecular Mass of the liquid.

Volume of test tube = 7.89 mL
Pressure = 0.9863 atm
Temperature = 97.0 ^{o}C
Mass of volatile liquid = 0.0341 g

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3. Suggest how the calculated molecular mass would be affected by the following experimental errors.

     (i)   20 mL of liquid was placed into the flask rather than the recommended 6 mL.

     (ii)   The flask was left overnight to cool rather than being cooled quickly.

     (iii)   A large part of the flask was not immersed in the water bath meaning it was not at the temperature of the water bath.