

# Experiment 8

## Molecular Weight of a Volatile Compound

# Purpose and Goals

- To determine the molecular weight of an unknown volatile compound using the ideal gas law
- Use a method developed by J.R. Dumas to determine the vapor density of the unknown

# Ideal Gas Law

$$PV = nRT$$

# Molecular Weight

- The number of moles is expressed as  $w/MW$

$$n = \frac{w}{MW}$$

- Final equation

$$MW = \frac{RT}{PV} w$$

# !!!CAUTION!!!

- All unknown compounds are flammable
- Run experiment under a hood because the vapor may be toxic

# Procedure

- This experiment should be done individually
- An unknown compound and its elemental percentage analysis will be provided
- Weigh and record a clean, dry Erlenmeyer flask to 0.1 g
- Collect the flask, 10cm<sup>2</sup> aluminum foil, and 15cm Al wire. Weigh and record to .001 g

# Procedure

- Heat the water bath until boiling
- Boil until **NO** vapor is coming from the pinhole, then turn off burner
- Allow to cool 5°C or more, remove from the bath and place on a clean towel

# Procedure

- Dry and weigh (.001g) the flask assembly after it is allowed to reach room temperature
- Record the weight once it stays constant
- Record the Barometric pressure
- Unroll the Al foil and inspect for water droplets
- If droplets are present the experiment must be done again

# Calculations

- Weight of the condensed liquid (same as weight of vapor)
- Volume of vapor = Volume of flask  
$$= \frac{\text{weight of water}}{\text{density of water}}$$
- Molecular wt. of unknown liquid using equation 1

$$PV = \frac{w}{MW} RT$$

# Sample calculation

$$\begin{aligned} MW &= \frac{RT}{PV} w \\ &= \frac{(0.0821 \frac{L \cdot atm}{mole \cdot K}) * 372.78 K}{.989 atm * .2610 L} (1.012 g) \\ &= 120 \frac{g}{mole} \end{aligned}$$

# Calculations cont.

- Empirical formula from the elemental percentage analysis
- From Empirical formula find the empirical formula weight

# Empirical vs. Molecular

- Compare the E. formula weight to your approximate Mol. Wt. & identify the Mol. Formula
- Molecular formula  $\text{C}_6\text{H}_6$
- Empirical formula  $\text{CH}$

# Calculations cont.

- From the Molecular Formula calculate the Molecular Weight
- Percent error from the true Molecular wt. and your calculated molecular weight