

AP Chemistry Lab

Molar Mass of a Gas

Pre Lab Questions

- 1) What is the ideal gas law equation?
- 2) What is the value of the Universal Gas Constant R?
- 3) Derive the formula for molar mass from the ideal gas law.
- 4) Derive the formula for gas density from the ideal gas law.
- 5) Does liquid water have a constant density at all temperatures? Explain.

Procedure

Find the volume of your flask:

- 1) Completely dry the empty Erlenmeyer flask.
- 2) Find its mass.
- 3) Fill the flask to almost full with water.
- 4) Place it on a balance and finish filling it. Make sure to not spill any of the water. I mean full!
- 5) Find the mass of the flask and the water.

Find the mass of a volatile liquid:

- 1) Follow all safety procedures with no exceptions! Work this lab up in your notebook.
- 2) Clean and dry a 250-mL Erlenmeyer flask. It must be perfectly dry! You can heat the flask gently to achieve a dry flask. Make sure to hold it with a clamp while doing this.
- 3) Cut a square of aluminum foil to cover the opening of the flask, attach it with a small rubber band, and place a very tiny hole in the center of the foil. Find the mass of your apparatus.
- 4) Prepare a hot water bath by half filling a 600 or 1000-mL beaker, adding a boiling stone, and placing it on a hot plate. Place a ring stand next to the hot plate.
- 5) Place 3 or 4 mL of the unknown liquid in the flask. You may open the cover to do this.
- 6) Evaporate the liquid by placing the flask in the hot water bath. Allow it to evaporate. Measure the barometric pressure and the temperature of the water.

7) Remove the flask and let it cool. Dry the outside of the flask and find the mass of it with the liquid that has just condensed inside the flask. If it is too hot to touch don't touch it!

8) Add 3-4 more mL's of the liquid and repeat steps 6 and 7 two more times.

Sample Data Tables

Raw Data

Measurements	Trial 1	Trial 2	Trial 3
Identification number of liquid			
Mass of flask and cover		NA	NA
Mass of flask, cover, and vapor			
Barometric pressure			
Temperature of water bath			
Mass of empty flask		NA	NA
Temperature of water in flask		NA	NA
Mass of flask completely full of water		NA	NA
Density of water at specific temperature		NA	NA

Calculations

	Trial 1	Trial 2	Trial 3
Volume of the water in flask in mL's			
Volume of the flask in liters			
Mass of vapor alone in flask			
Moles of vapor			
Molar mass of vapor			
Average molar mass of vapor	NA		NA
Density of vapor			
Average density of vapor	NA		NA

Post Lab Questions

- 1) You will be provided the identity of the unknown. What is it's molar mass?
- 2) Calculate the percent error for your molar mass.
- 3) What is the theoretical density of the vapor at STP?
- 4) Is your density close to the actual value? Why do you think it is off?
- 5) Imagine some water condensed on the outside of the flask when you weighed it with the cooled vapor. How would this change your value for the molar mass? Support this by making a fourth column in your data table and inventing the necessary number. Only one measured value will need to be changed.