MOLAR VOLUME OF A GAS

LAB PS 4
Adapted from Juniata College Science in Motion.

INTRODUCTION

In chemistry many of the materials worked with are gases. It is often easier to measure the volume of a sample of a gas than to determine its mass. A conversion factor is needed to convert the volume of a gas to moles of gas. In this experiment, known amounts of magnesium will be reacted with hydrochloric acid to generate hydrogen gas.

The moles of hydrogen generated and the volumes (at STP) will be plotted. From the graph, a value for molar volume will be determined.

PURPOSE

The purpose of this experiment is to determine the volume of one mole of a gas at STP (molar volume).

EQUIPMENT/MATERIALS

60 mL Leur-Lok syringe	250 mL beaker
Leur-Lok syringe valve	ruler
short piece of tubing	1 M HCl
magnesium ribbon	barometer/thermometer
vial cap	balance, 0.01 g

SAFETY

- Always wear an apron and goggles in the lab.
- When expelling liquid or gas from the syringe, make sure that the syringe is not pointed at another individual.

PROCEDURE

1. Record the mass of one meter of the ribbon on the Data Sheet. This value is needed to convert the length of magnesium ribbon to mass of magnesium.

2. Measure the actual length of the five cut pieces of magnesium ribbon, which should possess approximately 1.0, 2.0, 3.0, 4.0 and 5.0 cm lengths. Record the actual values in your data table. Place the smallest piece of magnesium in the vial cap.

3. **Hold the syringe <u>vertically</u>** and make sure that the plunger moves smoothly in the barrel of the syringe. Remove the plunger, close the valve connected to the syringe and fill the syringe with tap water. Float the vial cap with the magnesium on the water in the syringe, open the valve and let the water drain into a waste beaker. When all the water has drained from the syringe, replace the plunger and push it into the syringe as far as it will go.
   Note the reading on the syringe here: _____ mL.
4. Draw 5 mL of the hydrochloric acid into the syringe by placing the tubing into the 1 M HCl bottle and pulling the plunger up until the liquid is at the 5 mL line. Close the syringe valve. Record the volume after drawing up the acid as the Initial Volume in the Data Table.
5. **Turn the syringe <u>horizontal</u> and not pointed at anyone**, shake it so that the acid and magnesium react. Note: As the reaction takes place, the hydrogen gas produced will push the plunger up the barrel of the syringe.
6. When the reaction is done, record the Final Volume in the Data Table. Subtract the Initial Volume to find the "Actual H_2 Volume".
7. Invert the syringe. **Making sure that the syringe is not pointed at anyone,** carefully open the syringe valve. Drain the liquid into a waste beaker.
8. Repeat steps 1-7 with the each sample of magnesium ribbon.
9. Write and balance equation for this reaction.

DATA SHEET

Name _____

Name _____

Period _____ Class _____

Date _____

MOLAR VOLUME OF A GAS

DATA

Mass of 1.00 meter of magnesium ribbon _____ g

Mass per cm of magnesium _____ g/cm

Room Temperature _____ °C = _____ K

Barometric Pressure _____

DATA TABLE

Trial	Length Mg (cm)	Mass Mg (g)	Moles Mg	Moles H_2	Final Volume (mL)	Initial Volume (mL)	Actual H_2 Volume (mL)	Volume H_2, STP (L)	Molar Volume of H_2 (L/mole)
1									
2									
3									
4									
5									

CALCULATIONS

Complete for one of your trials: (assume that the HCl is in excess)

1. Show the calculation of:

    a. The mass of magnesium used

    b. The moles of magnesium used

    c. The moles of hydrogen formed

    d. The actual H_2 volume

2. Complete the following table:

Your experiment STP

P_1 = _____ P_2 = _____

V_1 = _____ V_2 = _____

T_1 = _____ T_2 = _____

3. Use the combined gas law to calculate the volume of hydrogen (liters) collected at STP.

4. Calculate the molar volume of hydrogen

QUESTIONS

1. What is the limiting reactant in this reaction?

2. What are some possible sources of error in this experiment?

3. What is your % error?