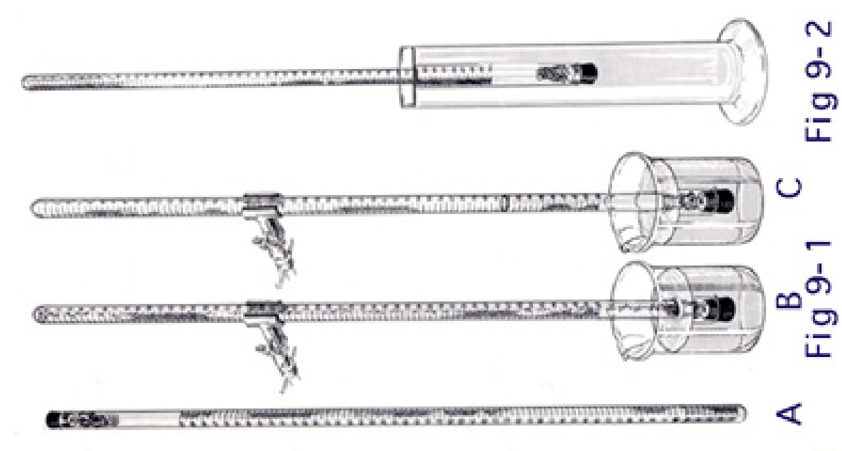
Experiment 9, Molar Volume of Hydrogen

Name ____ Per ___

Purpose: Find the volume of one mole of hydrogen gas.

Procedure: a. Obtain a piece of magnesium approximately 5 cm long. Carefully measure the length of the ribbon to nearest millimeter. One millimeter of Mg masses 0.0007g/mm so you may calculate the mass of the Mg used.

b. Fold the Mg and hang it from a 10 cm long piece of thread. c. Prepare a gas measuring tube as shown in Fig 9-1-A.



d. Place a 250 ml beaker about two-thirds full of tap water near the ring stand.

e. With GOGS ON, pour 10 ml of 6 M HCI (hydrochloric acid) into the gas measuring tube.

f. Slowly add enough tap water to the tube to fill it brim full.

g. Lower the Mg ribbon into the water in the tube about 3 cm and hold it in place by inserting the rubber stopper over the thread. It should be hanging by the thread. There sholuld be no air bubbles in the tube! Fig. 9-1-A.

h. Cover the stopper's hole with a finger and invert the tube into the beaker of water as shown in Fig. 9-1-B. Clamp it in place. The acid being more dense than water will diffuse down and react with the Mg to produce H_2 gas. Neat!

i. Note all observations here:

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j. After the reaction stops, Fig. 9-1-C, cover the hole with a finger and transfer the tube to a cylinder filled with water . See Fig. 9-2. Raise or lower the tube until the level of the liquid inside the tube is the same as the level of the water in the cylinder. This adjusts the H_2 gas pressure to room pressure. Read the volume of H_2 in the measuring tube from the bottom of the **meniscus** of the liquid in the tube.

The volume of H_2 is _____ ml.

k. Remove the tube from the water and pour the acid solution down the sink. Rinse out the tube and beaker.

l. Record the temperature of the water in the cylinder ______ ^{o}C.

m. Record the barometric room pressure _______ mm of Hg.

Calculations:

The Reaction: $Mg + 2HCl \dashrightarrow MgCl_2 + H_{2\,(g)}$

1. Find **Mass of Mg =** (length in mm)(0.0007g/mm) = _______ g.

2. ***Showing your method***, **find Mol of Mg = m/MM = (#1)/24.3 g/mol**.

Calculations:

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Find Mol of H_2 . It will be the **same** because of the **1/1** ratio in the equation.

Mol of H_2 = ______ mol.

3. Use this table to find the water vapor pressure at your measured temperature from part l above:

Temp, ^{o} C	Press, mm Hg	Temp, ^{o} C	Press, mm Hg
15	12.8	23	21.0
16	13.6	24	22.4
17	14.5	25	23.8
18	15.5	26	25.2
19	16.5	27	26.7
20	17.5	28	28.3
21	18.6	29	30.0
22	19.8	30	31.8

P_{water} = ______ mm.

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4. Calculation of the Pressure of Hydrogen (subtract the vapor pressure from the room pressure found in part m):

$$P_{hydrogen} = P_{room} - P_{water\ vapor}$$

$P_{hydrogen}$ = ______ mm.

5. Using the gas law equation:

$$PV/T = P'V'/T'$$

Find the volume (V') of H_2 at STP. (Remember T is in K). **K = C + 273**.

V = volume measured in the tube in part j above.

P = the pressure of the H_2 from part 4 above.

T = water temp in part k above + 273^{o} = _____ K.

P' = 760 mm (std pressure).

T' = 273K (std temp).

Solve for V' = the volume of H_2 corrected to STP .

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6. Find the Molar Volume for H_2:

(V' is found in #5 and mol of H_2 is found in #2):

$$MV = ml/mol = V'/mol\ of\ H_2$$

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MV = ________ ml/mol

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7. Change ml/mol to L/mol by dividing by 1000 ml/L. This is the molar volume in liters/mol:

L/mol = ______

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8. Find your error, which is the difference between the accepted value and your value. The accepted value is 22.4 L/mol.

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Error = ______ L/mol.

9. Find the percentage error:

%-age error = your error/22.4L/mol X 100%.

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% -age error = ________ %

We find that all gases have the same molar volume, 22.4 L/mol (at STP). Avogadro's Law states that equal volumes of all gases at the same temperature and pressure have the same number of molecules.

10. The grande critique of this lab: