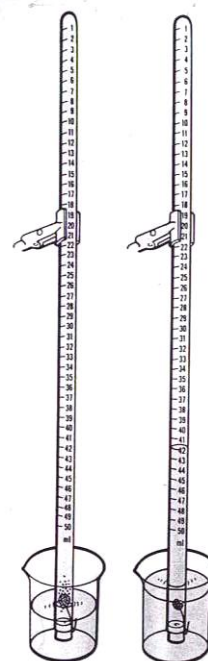## Lab 1: Volume of Hydrogen Gas
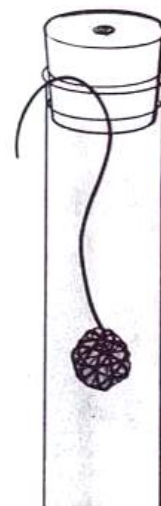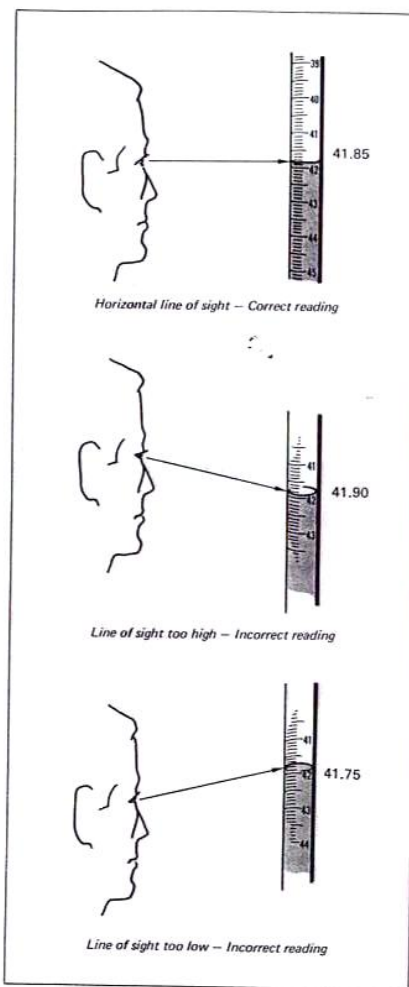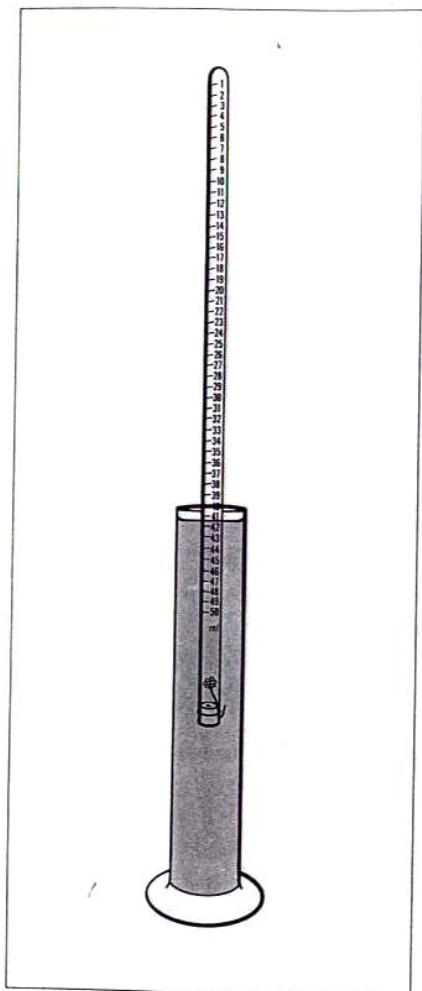
Purpose: to determine the volume of hydrogen gas formed when a sample of Mg reacts with 6 M HCl according to:

$Mg_{(s)}$ + 2 $HCl_{(aq)}$ → $MgCl_{2(aq)}$ + $H_{2(g)}$ and to compare the actual measured volume to the theoretical volume expected.
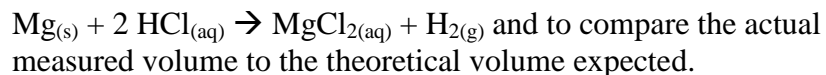
1.   Measure the length of the Mg ribbon in cm. Report your measurement in data table(see *b* in table)with two decimal places, meaning that you have to, as usual, estimate the last decimal place.

2.   Coil up the ribbon and trap it in a copper cage as shown in the diagram.

3.   Add about 700 mL of water to a large graduated cylinder.

4.   Slant the gas burette and pour in about 10 mL of 6M HCl.

5.   Carefully fill the rest of the tube with water (pour it slowly down the sides of the tube) without disturbing the acid at the bottom.

6.   Slip in the cage containing the Mg, hooking the handle outside of the burette as shown in the diagram, and stopper the burette. There should only be the tiniest bubble of air at the top. Otherwise, add more water.

7.   Cover the hole with your finger and invert the tube in the beaker of water as ***shown below***. Clamp it in place and the denser acid will fall through to eat your metal.

8.   Wait for all of the Mg metal to disappear, and then wait 5 more minutes to let the gas and tube to cool to room temperature.

9.   Lower or raise the gas burette until the level of water in the burette is the same as the level of water in the cylinder. This procedure allows you to measure the volume of gases at room pressure.

Horizontal line of sight – Correct reading

41.85

Line of sight too high – Incorrect reading

41.90

Line of sight too low – Incorrect reading

41.75

10. Read and record the gas volume from the gas burette. Use two decimal places. Report it in row (c)

11. Record the room temperature in row (d) and beaker water temp.in row (e).

12. To get (f), the partial pressure of water vapour, see the chart in Analysis #1.

13. Record the room pressure in row (g).

Data:

a. Mass(g) of a meter of Mg (obtain from lab instructor)	
b. Length of Mg (cm)used	
c. Volume of hydrogen + water vapour (mL)	$V_{H2+H2O} =$ mL
d. Room temperature (°C) today (written on the board)	$T_{room} =$ °C= K
e. Temperature of water from beaker (°C)	
f. Pressure of water vapour **(kPa)** at above water temperature (see chart analysis)	$P_{H2O} =$ kPa
g. Atmospheric Pressure of room (kPa) (written on the board)	$P_{room} =$ kPa

Analysis:

1. Calculate hydrogen's actual pressure:

$$P_{H2} = P_{room} - P_{H2O} \text{ (\textbf{based on Dalton's Law})}$$

for P_{H_2O} consult the following table:

Temp of water (°C)	Pressure (kPa)	Temp of water (°C)	Pressure (kPa)
18.0	2.07	22.0	2.64
19.0	2.20	23.0	2.80
20.0	2.33	24.0	2.99
21.0	2.48	25.0	3.16

2. Calculate hydrogen's actual contribution to the volume measured by multiplying by
The following values:

$$V_{H2} = \left(\frac{P_{H2}}{P_{room}} \right) \times V_{H2+H2O}$$

WET HYDROGEN

3. Calculate the mass(g) of magnesium used based on the length used. Don't round off!

4. Convert grams of magnesium to moles of magnesium. Use at least 24.3g/mole for molar mass of Mg. Don't round off!
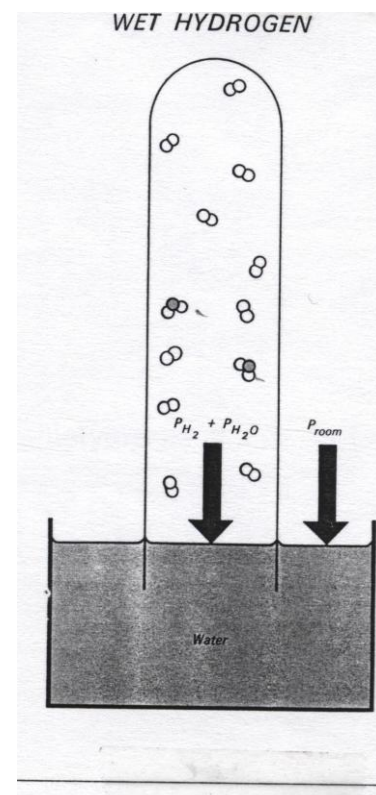
5. How many moles of hydrogen should have formed based on the number of moles of Mg actually used? Don't round off!

Use the mole ratios of :   Mg   + 2 HCl → $MgCl_2$ + H_2
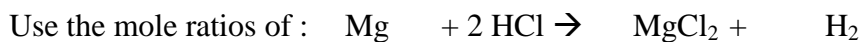
6. Now calculate V: $V_{\text{expected in liters}} = \dfrac{nRT_{room}}{P_{H_2}}$

   n = moles of hydrogen expected(from #5)
   R = 8.31kPa L/(K mole)
   T = room temperature in K
   P_{H_2} = pressure in kPa

7.   **Convert your expected volume in ml**, and determine percent yield:

   % yield $= \dfrac{V_{H2}}{V_{\exp ected}} \times 100\%$ Your answer should have two significant digits in all.

8.   If it had been hotter in the room, how would the volume of hydrogen have changed?

9.   If the pressure had been greater in the room, how would the volume of hydrogen have changed?

Conclusion: Write your own. Do not copy off lab partner. Several of you did that last year.
You and the person copied-off will get no marks.

Things to include in conclusion:

- What did you accomplish by doing this lab? (Reread the purpose of the experiment to find out.)
- Include two possible error sources.
- How is the % yield related to the measured volume and to the theoretical?

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