EXPERIMENT
Reaction Analysis of a Single Replacement Reaction

INTRODUCTION:

    Avogadro's hypothesis states that equal volumes of all gases contain equal numbers of molecules under the same conditions of temperature and pressure. It follows from this hypothesis that all gas samples containing the same number of molecules will occupy the same volume under the same conditions of temperature and pressure. A special name is given to the volume occupied by 1 mole samples of gases at STP. This volume is called the molar volume. In this experiment, you will make use of the molar volume.

    The hydrogen gas is the product that is of interest to you in this experiment. You will make an experimental determination of the number of moles of hydrogen molecules produced and the volume occupied by these molecules. The number of moles of hydrogen will be determined indirectly. The volume of hydrogen gas produced will be measured directly on the scale of a gas measuring tube or eudiometer. The Combined Gas Laws will be used to correct this volume, measured under laboratory conditions, to the volume the sample of gas would occupy at STP. The collected data (number of moles and volume at STP) will be used to calculate the molar volume of the hydrogen gas.

OBJECTIVES: To determine the volume of hydrogen using experimental data, known mathematical relationships, and a balanced chemical equation.

MATERIALS: magnesium ribbon (Mg)   3M hydrochloric acid

EQUIPMENT:

gas measuring tube	400 ml beaker	metric ruler
1000 ml beaker	ring stand	10 ml graduated cylinder
Buret clamp	safety goggles	thread
lab apron	thermometer	one-hole rubber stopper
wood splint	Bunsen burner	

TIME: 2 or 3 lab periods

PRE LAB:
1. Write a balanced chemical reaction for this experiment based on the information provided in the procedure.
2. Determine the mass of Magnesium necessary to produce approximately 40.00mL of H_2 gas at STP.
3. Design a data table based on the information provided in the procedure and put it at the end of the procedure. Make sure you include an average of the 3 trials in your table.

PROCEDURE:

1. Obtain a 10cm piece of magnesium ribbon.
    - Ø   Record the length in your data table.
    - Ø   Mass the piece of magnesium ribbon on the electronic balance. Record the mass of magnesium ribbon.
    - Ø   Determine the length of magnesium necessary to obtain the volume results you arrived at in your Pre-Lab work and cut 3 pieces to the correct length.
    - Ø   Mass one of the pieces of magnesium on the analytical electronic balance and record the mass.

2. Add about 300 ml of tap water at room temperature to a 400 ml beaker. Place the beaker of water on the base of a ring stand.

3. Obtain a piece of thread about 15 cm long.

    - Ø   Tie one end of the thread around the piece of magnesium ribbon, leaving about 10 cm free.
    - Ø   Bend the magnesium so that it will fit easily into the gas measuring tube.

4. Obtain about 10 ml of 3M hydrochloric acid (HC1). (Pour approximately the correct amount into a small beaker) **Caution**: Handle the acid with care.
    - Ø   Measure out exactly 10.00ml of the 3M HCl. (instrument:
    - Ø   Carefully pour the HCl into the gas measuring tube.
    - Ø   Tilt the gas measuring tube slightly. Using a beaker, <u>slowly</u> fill the gas measuring tube with deionized water at room temperature. Try to avoid mixing the acid and water as much as possible.

5. Lower the piece of magnesium ribbon 4 or 5 cm into the gas measuring tube. Drape the thread over the edge of the tube and insert the one hole rubber stopper, holding the magnesium in place.

6. Place your finger over the hole in the rubber stopper and invert the gas measuring tube. Lower the stoppered end of the tube into the beaker of water. Clamp the tube in place so that the stoppered end is a few centimeters above the bottom of the beaker. Record your visual observations in the data table.

7. Let the apparatus stand about five minutes after the magnesium has completely reacted.

    - Ø   Tap the sides of the gas measuring tube to dislodge any bubbles that may have become attached to the sides of the tube.
    - Ø   Move the tube up or down (to equalize pressure) until the water level in the tube is the same as that in the beaker (or as close as possible). On the scale of the gas measuring tube read the volume of the gases in the tube.
    - Ø   Record this volume as in your data table.

8. Test for the presence of H_2 gas to confirm its presence.

9. In the data table, record the room temperature in Kelvin and the barometric pressure in mmHg.

10. Repeat the procedure with the other 2 pieces of magnesium ribbon to obtain 3 trials

Data Table:

Post Lab:

1. Calculate the theoretical yield of H_2 gas for each trial and the average of all 3 trials. Make sure you adjust your calculations from STP to the reaction conditions first using the Combined Gas Law

2. Calculate the % yield for each trial

3. Calculate the % error based on the average values of the 3 trials.

4. Hydrogen gas is one product of this reaction. What is the other product? What happens to it?

5. Which factor was not taken into account in the calculations of the theoretical yield?