Lab: Molar Volume of Hydrogen Gas

PROBLEM: What is the molar volume of hydrogen gas?

PREDICTION:

MATERIALS			
Goggles	500 mL Graduated Cylinder	lce	Water
Celsius thermometer	Barometer	Magnesium strip	Plastic pipette
3.0 – M HCl	25 mL Graduated Cylinder	Plastic wrap	Rubber band
			Pin

PROCEDURE:

- 1. Fill large graduated cylinder with snow/ice and water. Place Celsius thermometer inside. Add more snow until the temperature is 0°C.
- 2. Measure the atmospheric pressure in the laboratory. Record the temperature and pressure in data table.
- **3.** Obtain a magnesium strip. Trim the cut edges so they are straight across. Measure the length of the strip to the nearest 0.01 cm and record in data table.
- **4.** Use the plastic pipette to dispense 7.0 mL of 3.0 M HCl into the bottom of the empty 25 mL graduated cylinder. Insert the pipette into the cylinder so that you avoid getting any HCl on the sides of the cylinder.
- 5. Rinse out the pipette and use it to fill the rest of the graduated cylinder with tap water. Drip the water down the inside surface of the cylinder to prevent mixing the acid with the water. The water should overfill the cylinder top slightly to form a smooth curved surface.
- 6. Carefully set the magnesium strip on the surface of the water. It should float. Quickly, cover the cylinder with a square of plastic wrap, stretching it tight and securing it with a rubber band. Make sure there are no air bubbles. (See Illustration 1)
- 7. With a pin, poke a tiny hole in the plastic over the cylinder. Holding the cylinder by the base, immediately invert it into the ice water. Hold the graduated cylinder like this until the reaction has completed. (*See Illustration 2*)
- **8.** The magnesium will react with the acid, producing hydrogen gas that collects in the cylinder. When the reaction is complete, chill the gas by submerging the cylinder completely in the ice water for about 1 minute. Tipping it slightly to an angle if necessary.
- **9.** Read the volume of the hydrogen gas in the cylinder by lifting it vertically until the liquid level inside the cylinder matches the level of the water in the basin. This equalizes the gas pressure in the cylinder with the atmospheric pressure outside the cylinder. Record this volume in the data table.
- 10. Repeat for three trials total.

DISPOSAL

✓ The remaining acid in the graduated cylinder may be rinsed down the drain with plenty of water.



CALCULATIONS – Please organize this section carefully and **SHOW WORK FOR ALL TRIALS**. Remember: these values should also be entered in your data table.

- ✓ Write a balanced chemical equation for the reaction you have observed.
- ✓ Find the mass of the magnesium using dimensional analysis. (1 cm Mg = 0.00734 g Mg)
- Use the balanced equation to identify the number of moles of hydrogen produced per mole of magnesium (mole to mole ratio).
- ✓ Calculate then number of moles of Magnesium used for each trial.
- ✓ Use the **Mg** : **H** mole ratio to calculate the number of moles of hydrogen gas produced.
- ✓ Find the volume of hydrogen at standard pressure produced in each trial, using the following formula

$Volume = measured volume (L) x \frac{Atmospheric pressure (mm Hg)}{760 mm Hg}$

✓ Based on your data, calculate the molar volume of hydrogen gas produced in lab. This is your experimental molar volume.

 $Experimental Molar Volume = \left(\frac{Liters Hydrogen Gas}{Experimental moles Hydrogen Gas}\right)$

✓ Calculate % Error for each trial.

$$\% Error = \frac{|Experimental - Actual|}{Actual} \times 100$$

ANALYSIS AND CONCLUSION – Please write an analysis and conclusion that is appropriate for this lab. Consult the lab writing criteria at the front of your laboratory notebook for further guidance.

QUESTION ANALYSIS What is the molar volume of hydrogen gas? _____ What do your calculations tell you? Written in question format Describe sources of error _____ Exactly how did they affect results? PREDICTION/HYPOTHESIS ____ How can you improve this procedure to minimize ____ What will happen error? _____ Why it will happen How could you change this procedure to Written in complete sentences minimize error? Easy to read CONCLUSION PROCEDURE Restate hypothesis _____ Correct/refuted Written in own words _____ What evidence supports your conclusions? Numbered step by step _____ Practical applications of this laboratory Easy to read I could complete this lab, following these _____ Additional questions asked or that can be studied directions, if I didn't know what I was doing. Illustration 1 OVERALL _____ Illustration 2 _____ Legible Illustration 3 Organized MATERIALS LIST **EXTRA CREDIT** _____ Neatly organized I wish this lab report were mine SAFETY PRECAUTIONS DATA Lab written in third – person style ____ Data table neatly organized ____ Data is not crowded Comments: _____ Volume of H₂ gas Length of Mg strip Observations UNITS!!! ____ Straight edge CALCULATIONS Balanced chemical equation Mass of Mg strip Grader signature Moles of Mg used in reaction

- _____ Moles of H₂(g) produced in reaction
- _____ Standardized volume of H₂ (g)
- _____ Experimental Molar Volume
- _____ % Error
- _____ Work shown for all 3 trials and entered in data
- table

Total

/41