

Sample Lab Report: Molar Volume Of Hydrogen

Background: Gasses are a special phase of matter that can be described if one knows the pressure, temperature, and volume of the system filled by the gas. We will employ various techniques of measuring these variables. Since we will be collecting gas over water we will need to use Dalton's law of partial pressures to assure a proper reading of gas pressure.

Purpose: To verify Avagadro's law – "All gasses will occupy 22.4 Liters volume when one mole is present in the sample and the pressure and temperature are held at STP

Hypothesis: The hydrogen gas collected in this experiment when converted to conditions of STP (0 degrees C and 1 atm) will be close to 22.4 L/mol

Procedure: 5 mls of 2 M. HCl were poured into the bottom of a 10 ml graduated cylinder. Water was decanted on top of the HCl carefully so not to mix the HCl and added so that the cylinder was completely filled with liquid. A one cm strip of magnesium was affixed to the tapered end of a cork with a hole it it and this cork was placed on top of the graduated cylinder. The cylinder was quickly inverted and the end placed under water in a 400 ml beaker filled with water. The reaction was initiated by the diffusion of the HCl to the metal and gas was captured in the inverted cylinder. When the reaction ceased, the levels of water in the cylinder and beaker were equalized and the volume of gas determined. The experiment was repeated once.

Data:

| | Trial one | Trial 2 | Average |
|--|-------------|-------------|--|
| Length of Mg ribbon | 1 cm | 1 cm | 1 cm |
| Mass of Mg | 0.00789 g | 0.00789 g | 0.00789 g (3.25×10^{-4} moles) |
| Volume of H ₂ gas produced | 8.4 ml | 8.5 ml | 8.45 ml (0.00845 L) |
| Temperature | 23 °C | 23 °C | 23 °C |
| Barometric pressure | 735 mm Hg | 735 mm Hg | 735 mm Hg |
| Partial pressure of H ₂ O | 21.1 mmHg | 21.1 mmHg | 21.1 mmHg |
| Pressure of H ₂ gas produced (Barometric – H ₂ O pressure) | 713.9 mm Hg | 713.9 mm Hg | 713.9 mm Hg |

Calculations: (from handout)

- 1) Calculate the theoretical number of moles H₂ gas produced.

$\text{Mg} + 2 \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ according to the balanced reaction, the amount of hydrogen gas should equal the amount of moles of magnesium in the reaction.

$$0.00789 \text{ g} / 24.32 \text{ g/mol} = 3.25 \times 10^{-4} \text{ moles Mg and thus H}_2$$

- 2) Calculate the partial pressure of H₂ gas. Use Dalton's law of Partial pressure. Check chart at 23 °C
Barometric = total pressure (735 mmHg) $735 \text{ mm Hg}_{\text{total}} - 21.1 \text{ mmHg H}_2\text{O} = 713 \text{ mmHg H}_2$

- 3) Used combined gas law to convert gas volumes to those at STP.

$$P_1 V_1 / T_1 = P_2 V_2 / T_2 \quad \rightarrow \quad \text{let STP be 2}^{\text{nd}} \text{ conditions} \quad V_2 = P_1 V_1 T_2 / T_1 P_2$$

$$V_{\text{STP}} = (713.9 \text{ mmHg})(0.00845 \text{ L})(273 \text{ K}) / (296 \text{ K})(760 \text{ mmHg}) = 0.00732 \text{ L}$$

- 4) Divide volume at STP by the number of moles to get an experimentally determined molar volume at STP. $0.00732 \text{ L} / 3.25 \times 10^{-4} \text{ moles} = 22.5 \text{ L/mole}$

Chemistry Molar Volume Of Hydrogen Lab Answers

**Eugene LeMay, Jr., Herbert Beall, Karen
M. Robblee, Douglas C.
Brower, Prentice-Hall Staff**

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Laboratory Chemistry L. Neal Carmichael,David F. Haines,1990-10 **Chem C&A Chemla&Min Wksh** McGraw-Hill
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