



Exp 07 - Eudiometer

Using a eudiometer to measure gas volumes and pressure as we explore stoichiometry in the gas state.

Preparation *(complete this pre-lab work before coming to lab)*

Read Exp07 Gas Stoichiometry (<http://chemskills.com/labs>)

Start the experiment as a new project in your lab book:

- Identify the experiment objective(s)
- Organize your procedures as short bullet lists of steps
- Prepare a data table in your lab book to record your observations

Intended Learning Outcomes

- * Convert between pressure in units of torr, mmHg and atm.
- * Read measurements from and explain the operation of a barometer and a manometer.
- * Use Boyle's law, Charles' law & Avogadro's law to solve before and after problems.
- * Know all gas laws involving temperature require Kelvin temperatures.
- * Explain the simple gas laws using KMT.
- * Use molar volume to convert between volumes and moles of a gas—at STP (only).
- * Know the ideal gas law and the ideal gas constant (0.0821 L-atm/mol-K).
- * Use the ideal gas law to convert between volumes and moles of a gas—when not at STP.
- * Know liquids and solids produce a vapor pressure that depends only on that substances temperature.
- * Use Dalton's law to relate the partial pressures of component gases to the total pressure of a gas mixture.
- * Find the mole fraction of a gas in a mixture from it's moles to total moles or it's partial pressure to total pressure.
- * Use the mole fraction to determine moles or partial pressure of a gas from total moles or total pressure.

Report *(prepare a report on your experiment to be submitted in the following lab meeting)*

Prepare a report for this experiment according to class cover sheet. Reports should clearly begin with your experimental objectives and include separate sections for (1) presenting the data you collected, (2) presenting your analysis of that data (showing all calculations), and (3) concisely reporting the conclusions you arrived at (answers to your experiment objectives).

Attach your prelab quiz and include any post lab questions with answers for this experiment.



Analysis *(calculations needed in your report analysis)*

1. The pressure of the laboratory (P_{LAB}) will be determined by a nautical barometer. These devices use inches of mercury as unit of measurement. Convert this number into mmHg. You'll need the following conversion factors: 1 inch = 2.54 cm (exactly); 1 cm = 10^{-2} m (exactly); and 1 mm = 10^{-3} m (exactly). Use dimensional analysis.
2. For the Zinc experiment, you measured the difference in pressure between the lab and the eudiometer by measuring the difference in level of the liquid inside and outside the eudiometer. That difference, recorded in cm of the acid solution, needs to be converted into mmHg. You'll need the conversion factor $0.722 \text{ mmHg} = 1 \text{ cm of acid solution}$ (this is a measured value).
3. Find the pressure of the mixture of gases inside the eudiometer (P_{MIX}). You know the pressure in the lab (P_{LAB}) and you know the difference in pressure between the lab and the eudiometer (P_{LAB}). Now that both pressures are in mmHg, subtract the difference from the lab pressure to calculate the pressure of the gas mixture.
4. Dalton's law of partial pressures states the total pressure inside the eudiometer is equal to the sum of pressures exerted by each gas in the mixture. The pressure of water vapor in the eudiometer can be found in the table on the front page of the experiment, it requires you to know the temperature of that water. The only other gas in the mixture is the hydrogen gas you prepared. Calculate the partial pressure of hydrogen in the eudiometer (P_{HYDROGEN}).
5. The volume of gas produced in the experiment can be read directly from the eudiometer. That value will be in mL. Convert this value to L of gas.
6. You now know the volume of gas produced (C5), the pressure of that gas (C4) and the temperature of the gas (assume it's the same as the water in which it was produced). Use the ideal gas law to calculate the number of moles of gas produced.
7. Using the balanced equation for the chemical reaction and the moles of hydrogen gas produced, calculate how many moles of zinc was consumed in this reaction.
8. Divide the grams of zinc you used by the number moles of zinc you calculated to find out the molar mass of zinc. In your conclusions section, report this number and the percent error between this and the known molar mass of zinc.

Repeat the calculations C2-C7 above to determine the number of moles of magnesium consumed in your second experiment.

Using the moles of magnesium from C14, calculate the mass of your unknown piece of magnesium. Report the unknown number and final mass in your conclusions.

Post-Lab Questions *(append these questions with answer to your experiment report)*

1. Which pressure is higher, the pressure of the hydrogen gas or the barometric pressure of the lab? How did you know?
2. A sample of 0.2047803 moles gas in a 750 mL tank is found to be under 1020 mm Hg pressure. How many degrees Celsius is the temperature of the sample?
3. If 268.5 grams of aluminum sulfide reacts with excess water at STP, how many liters of hydrogen sulfide gas is produced?



4. If 40.5 grams of propane burns in excess oxygen at 298K and 1.25 atm, how many liters of carbon dioxide gas is produced?

