

Chapter 9 Part 3

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Gas laws and stoichiometry

- Gas data may also be used for the purposes of stoichiometry
- Primarily, the ideal gas law will be used to find the amount of moles based on the pressure, volume, and temperature of the gas

Stoichiometry involving gases

Ammonium sulfate is used as nitrogen and sulfur fertilizer. It is produced by reacting ammonia with sulfuric acid. What volume (in liters) of ammonia at 288.15 K and 1.15 atm is required to produce 150.0 g of ammonium sulfate (132.14 g/mol)?



Stoichiometry involving gases

An air bag is inflated with nitrogen, N_2 , using the rapid reaction of sodium azide, NaN_3 , and iron(III) oxide, Fe_2O_3 , which is initiated by a spark. The overall reaction is



How many grams of sodium azide would be required to provide 75.0 L of nitrogen gas at 25.00 °C and 748 mmHg?

Dalton's Law of Partial Pressures

- States that the pressure of a gas mixture is equal to the sum of the partial pressures of the individual gases

$$P_{\text{total}} = P_A + P_B + P_C$$

- P_{total} is the total pressure in the system
- P_A , P_B , and P_C are the partial pressures of gases A, B, and C respectively

Partial pressures and mole fractions

- The degree to which any one gas contributes to the partial pressure is directly related to the amount of that gas present in the mixture

$$\chi_A P_{\text{total}} = P_A$$

- χ_A is the mole fraction of gas A
- P_A is the partial pressure of gas A
- P_{total} is the total pressure of the system

Partial pressures

A 1.00 L sample of dry air at STP contains 0.925 g N_2 , plus other gases including oxygen, argon, and carbon dioxide. (A) How many moles of air are in the sample? (B) What is the mole fraction of N_2 in the mixture? (C) What is the partial pressure (in atm) of N_2 in the air sample?

Partial pressures

A 200. mL flask contains 3.22×10^{-5} mol O_2 and 1.40×10^{-4} mol He at 15.00°C . (A) What is the total pressure? (B) What are the partial pressures of oxygen and helium in the flask?

Collecting gas over water

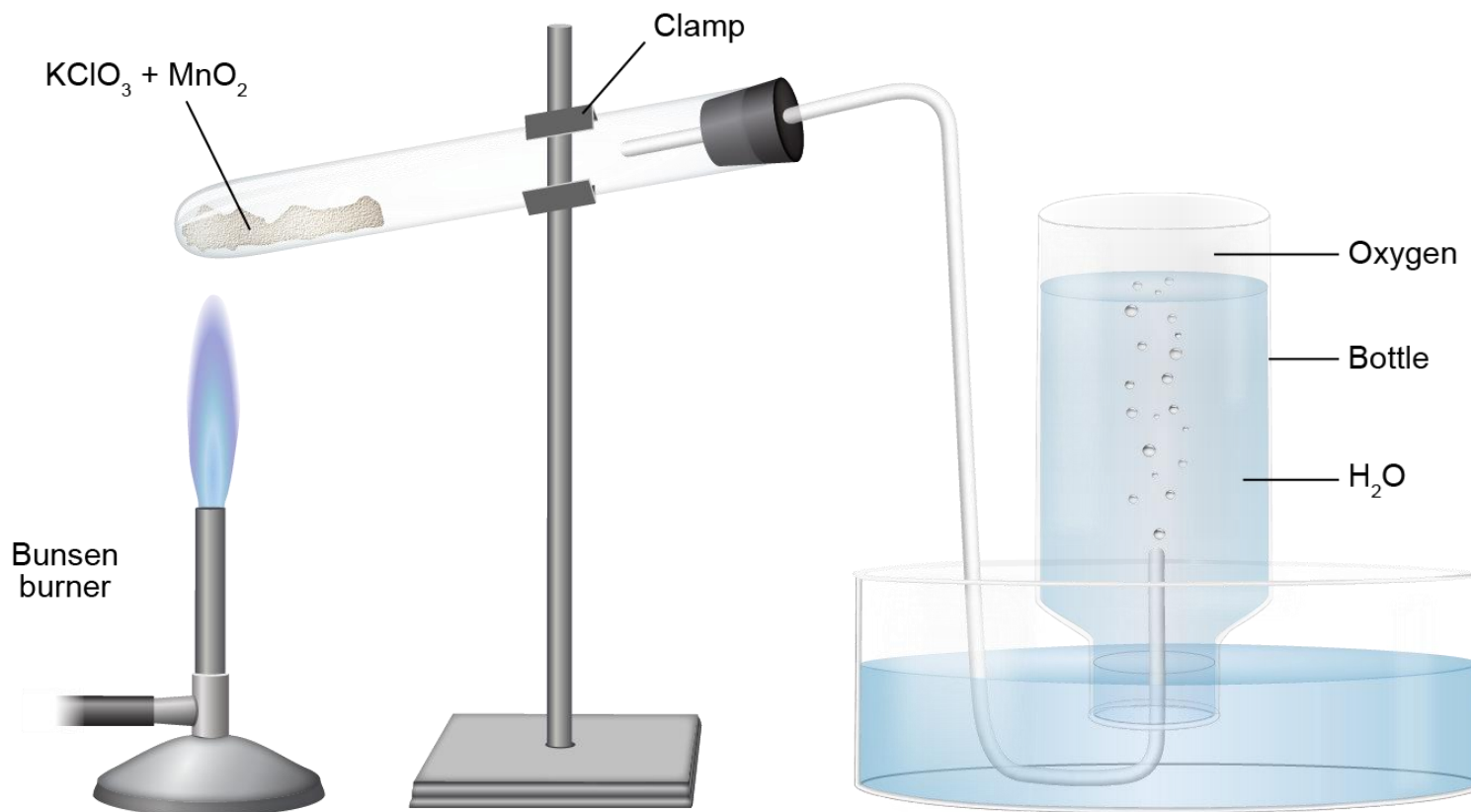
$$P_{\text{total}} = P_{\text{gas}} + P_{\text{water}}$$

- P_{total} is the total pressure
- P_{gas} is the partial pressure of the gas being collected
- P_{water} is the vapor pressure of water

Vapor Pressure Values for Water

Temperature (°C)	Vapor Pressure (torr)
0	4.579
10	9.209
20	17.535
30	31.824
40	55.324
50	92.51
60	149.38
70	233.7
80	355.1
90	525.76
100	760.00

Collecting gas over water



Collecting gas over water

A sample of hydrogen gas (H_2) is collected over water. The 0.156 L of collected gas has a pressure of 16.5 mmHg at 292.15 K. If the vapor pressure of water at 292.15 K is 16.5 mmHg, (A) what is the partial pressure of the hydrogen gas in atm? (B) What is the mass (in g) of the collected hydrogen gas?