Density of a gas
\[ d = \frac{m}{V} \]

\[ d = \frac{m}{V} = \frac{MV}{RT} \]

\[ \frac{p}{RT} = \frac{m}{V} \Rightarrow \frac{p}{RT} = \frac{m}{V} \cdot \frac{d}{M_m} \]

Density = \( \frac{p \cdot M_m}{RT} \)

\[ M_m = \frac{dRT}{p} \]

What is the density of \( \text{N}_2 \) at room conditions?

\[ T = 20^\circ C \quad P = 762 \text{ mm Hg} \]

\[ d = \frac{p \cdot M_m}{RT} = \left( \frac{762 \text{ mm Hg}}{760 \text{ mm Hg}} \right) \left( \frac{28.02 \text{ g/mol}}{62.01 \text{ g/mol}} \right) \left( \frac{293 \text{ K}}{298 \text{ K}} \right) = 1.17 \text{ g/L} \]

A colorless gas is determined to be composed of \( \text{S} \), \( \text{F}_2 \). The density of the gas is \( 6.16 \text{ g/L} \). At \( 23^\circ C \) and \( 1.024 \text{ atm} \), \( M_m \)? possible identity?

\[ M_m = \frac{dRT}{p} = \left( \frac{6.16 \text{ g/L}}{1.024 \text{ atm}} \right) \left( \frac{293 \text{ K}}{298 \text{ K}} \right) \]

\[ 1.46 \]

\[ -32 \]

\[ \frac{114 \text{ g/mol}}{19 \cdot 26} = 0.7 \]

\( \text{SF}_6 \)
Density of a gas
\[ d = \frac{m}{V} \frac{g}{L} \]
\[ n = \frac{\text{mass}}{\text{M}_m} \]

\[ PV = nRT \]
\[ \frac{P}{RT} = \frac{n}{V} \Rightarrow \frac{P}{RT} = \frac{m_0}{V_m} \]

Density = \[ \frac{P \cdot M_m}{RT} \]
\[ M_m = \frac{dRT}{P} \]

What is the density of \( \text{N}_2 \) at room conditions?
\( T = 298 \degree C \)
\( P = 762 \text{ mmHg} \)

\[ d = \frac{P \cdot M_m}{RT} = \frac{(762 \text{ mmHg})(28.02 \text{ g/mol})}{(62.4 \text{ g/mol})(298 \text{ K})} = 1.17 \text{ g/L} \]

A colorless gas is determined to be composed of \( S \) and \( F \). The density of the gas is 6.104 g/L at 23\(^\circ\)C and 1.024 atm. \( M_m = ? \) possible identity?

\[ M_m = \frac{dRT}{P} = \frac{(6.104 \text{ g/L})(0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(296 \text{ K})}{1.024 \text{ atm}} \]

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-32
\[ \frac{114 \text{ g}}{19} \rightarrow 6 \]
\( \text{SF}_6 \)
Dalton's Law of Partial Pressure

* USED WITH MIXTURES OF GASES

\[ P_T = P_1 + P_2 + P_3 + \ldots \]

The total \( P \) of a mixture of gases is the sum of the partial (individual) pressures of the gases in the mixture.

Mixtures of 2 gases in the same container at the same \( T \)

\[ P_T = \frac{(n_1 + n_2)RT}{V} \]

\( \Rightarrow \) mole fraction

\[ X_1 = \frac{n_1}{(n_1 + n_2)} \quad X_1 < 1 \]

\[ P_1 = X_1 P_T \quad P_2 = X_2 P_T \]

\[ P_i = X_i P_T \quad \text{for a mixture of } g \text{ gases} \]
M + 2H₂ → H₂ + MH₂

If 45.0 mL of H₂ is collected over water at 15°C (E₀ = 12.79 mm Hg at 0°C (5°C)) and room P (762 mm Hg), \( n_{H₂} = ? \), \( g_{H₂} = ? \)

\[ P_T = P_{H₂} + P_{H₂O} \]
\[ P_{H₂} = P_T - P_{H₂O} = \frac{762.0 \text{ mm Hg}}{12.79 \text{ mm Hg}} = 749.2 \text{ mm Hg} \]

\[ n_{H₂} = \frac{P_{H₂} V}{RT} = \frac{(749.2 \text{ mm Hg})(0.0450 \text{ L})}{(62.4 \text{ mm Hg} \cdot \text{L} \cdot \text{mol}^{-1} \cdot \text{K}^{-1})(288 \text{ K})} = 1.88 \times 10^{-3} \text{ mol H₂} \]

\[ \times 2.02 g/\text{mol} \]
\[ 3.79 \times 10^{-3} \text{ g H₂} \]

10g Ar, 10g Ne, 10g He are added to an empty 5.00 L container kept at 3.00 atm. \( P \) of each gas?

\[
\text{Ar:} 10g \Rightarrow 0.25 \text{ mole} \\
\text{Ne:} 10g \Rightarrow 0.50 \text{ mole} \\
\text{He:} 10g \Rightarrow 2.50 \text{ mole} \\
\]

\[ P_{\text{Ar}} = \left( \frac{0.25}{3.05} \right) 3.00 \text{ atm} = 0.23 \text{ atm} \]

\[ P_{\text{Ne}} = \left( \frac{0.50}{3.05} \right) 3.00 \text{ atm} = 0.46 \text{ atm} \]

\[ P_{\text{He}} = \left( \frac{2.50}{3.05} \right) 3.00 \text{ atm} = 2.31 \text{ atm} \]