Density of a gas

$d = \frac{m}{V}$ $\frac{g}{L}$

$n = \frac{mass}{M_m}$

$PV = nRT$

$\frac{P}{RT} = \frac{n}{V} \Rightarrow \frac{P}{RT} = \frac{m}{V M_m}$ → d

$density = \frac{P \cdot M_m}{RT}$

$M_m = \frac{dRT}{P}$

What is the density of N_2 at room conditions?
T = 20°C P = 762 mm Hg

$d = \frac{P M_m}{RT} = \frac{(762\ mmHg)(28.02\ g/mol)}{(62.4\ \frac{mmHg \cdot L}{mol \cdot K})(293\ K)} = 1.17\ g/L$

A colorless gas is determined to be composed of S & F. The density of the gas is 6.164 g/L at 23°C and 1.024 atm. M_m = ? possible identity?

$M_m = \frac{dRT}{P} = \frac{(6.164\ g/L)(0.0821\ \frac{atm \cdot L}{mol \cdot K})(296\ K)}{1.024\ atm}$

146
−32
114 g ÷ 19 → 6

$M_m = 146\ g/mol$

SF_6

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Dalton's Law of Partial Pressures

* USED WITH MIXTURES OF GASES

$$P_T = P_1 + P_2 + P_3 + \cdots$$

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

mixture of 2 gases in the same container at the same T

$$P_1 = \frac{n_1 RT}{V} \qquad P_2 = \frac{n_2 RT}{V}$$

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

→ mole fraction

$$X_1 = \frac{n_1}{(n_1 + n_2)} \qquad X_1 < 1$$

$$P_1 = X_1 P_T \qquad P_2 = X_2 P_T$$

for a mixture of gases

$$P_i = X_i P_T$$

$$M + 2HX \longrightarrow H_2 + MX_2$$

If 45.0 mL of H_2 is collected over water at 15.0 °C (P_{vap} = 12.79 mmHg @ 15 °C) and room P (762 mmHg)

n_{H_2} = ? $g\ H_2$ = ?

$$P_T = P_{H_2} + P_{H_2O}$$

$$P_{H_2} = P_T - P_{H_2O} = 762.0\ \text{mmHg} - 12.79\ \text{mmHg} = 749.2\ \text{mmHg}$$

$$n_{H_2} = \frac{P_{H_2}V}{RT} = \frac{(749.2\ \text{mmHg})(0.0450\ \text{L})}{\left(62.4\ \frac{\text{mmHg}\cdot\text{L}}{\text{mol}\cdot\text{K}}\right)(288\ \text{K})} = 1.88\times10^{-3}\ \text{mol}\ H_2$$

$\times$ 2.02 g/mol

3.79×10^{-3} g H_2

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10 g Ar, 10 g Ne, 10 g He are added to an empty 5.0 L container kept at 3.00 atm. P of each gas?

Ar: 10 g ⇒ 0.25 mol

Ne 10 g ⇒ 0.50 mol

He 10 g ⇒ 2.50 mol

3.25 mol

$$P_{Ar} = \left(\frac{0.25}{3.25}\right) 3.00\ \text{atm} = 0.23\ \text{atm}$$

$$P_{Ne} = \left(\frac{0.50}{3.25}\right) 3.00\ \text{atm} = 0.46\ \text{atm}$$

$$P_{He} = \left(\frac{2.50}{3.25}\right) 3.00\ \text{atm} = 2.31\ \text{atm}$$