10/7/05

CHM 123 - Lecture (Friday 10:30 am)

- Labs will meet next week on Wednesday, 10/12/05 and Friday, 10/14/05.

Avogadro's Law:

Molar volume (V_m): volume per mole of molecules.

$$V_m = \frac{V}{n}$$

Gases @ same T & P, a given # of gas molecules will occupy the same volume, irrespective of the gas.

$$V = V_m n$$

$$V \propto n$$

For an ideal gas @ $\underbrace{0^\circ C \text{ \& } 1 atm}_{STP}$, $V_m = 22.4 \text{ L/mol}$

1 mol of any gas occupies 22.4 L under STP ($0^\circ C$ & 1 atm)

STP: standard temp. & pressure.

- $PV = \text{constant}$ — Boyle's Law
- $\frac{V}{T} = \text{constant}$ — Charles's Law
- $\frac{V}{n} = \text{constant}$ — Avogadro's Law

Combining the 3 laws,

$$\boxed{PV = nRT}$$

Ideal gas law, where R = universal gas constant.

$R = 0.08206 \text{ L atm/mol K}$.

Example:
At what temperature does 29.8g of O_2 have a pressure of 2atm in a 10.0L tank?

Sol: $PV = nRT$

$$T = \frac{PV}{nR}$$

$$n = (29.8\,g)\frac{(1\,mol)}{(32\,g)}$$

$$T = \frac{(2\,atm)(10.0\,L)(32\,g)(mol)(K)}{(29.8\,g)(1\,mol)(0.08206\,L\,atm)}$$

temp = 262 K

$PV = nRT$

density = $d = \frac{m}{V} = \frac{nM}{V}$ (# moles x molar mass)

Volume = $\frac{nRT}{P}$ so, $\frac{1}{V} = \frac{P}{nRT}$

substituting,

$$d = \not{n}M\left(\frac{P}{\not{n}RT}\right) = \frac{PM}{RT} = \frac{m}{V}$$

Relationship b/w density, temp, P, V, mass & molar mass

Mixtures of gases and partial pressure

Partial pressure of a gas = pressure that gas would exert if it were alone in a container.

Total pressure of mixture : sum of all partial pressures.

$$P_{Tot} = P_1 + P_2 + P_3 + \cdots$$

$PV = nRT$, $P = \frac{nRT}{V}$, $P_{Tot} = \frac{n_{tot}RT}{V}$ or $P_A = \frac{n_A RT}{V}$

(P_A: pressure of gas A)