Gases

(CH-3)

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Partial Pressure

- Pressure exerted by each individual gas within a mixed gas.
- Dalton's Law- The total pressure of a gas mixture is the sum of the partial pressures of the component gases.

$$P_t = P_1 + P_2 + P_3 + \ldots$$

$$\sum_{i=1}^{n} P_k = P$$

$$P_k = \frac{n_k}{n} P$$

Partial Pressure

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

$$P_k = \frac{n_k RT}{V}$$

$$\frac{P_k}{P} = \frac{n_k}{\sum n_k} = y_k$$

or

$$P_k = y_k \times P$$

Mole - Definition

- Is a unit of measurement used in chemistry to express amounts of a chemical substance, defined as the amount of any substance that contains as many elementary entities (e.g., atoms, molecules, ions, electrons) as there are atoms in 12 grams of pure carbon-12.

- This corresponds to the Avogadro constant, which has a value of $6.02214129(27)\times10^{23}$ elementary entities of the substance. It is one of the base units in the International System of Units.

1 mole element	Number of Atoms
1 mole C	= 6.02×10^{23} C atoms
1 mole S	= 6.02×10^{23} S atoms
1 mole Hg	= 6.02×10^{23} Hg atoms
……..	……
1 mole H_2O	= 6.02×10^{23} molecules

Mole - Examples

- How many moles of Ca are in 28.07 g of Ca?

- (1) mole of Ca = (40.1) g of Ca
- (x) mole of Ca = (28.07) g of Ca

- Number of moles of Ca in 28.07 g (x) = 1 x 28.07/40.1 = 0.7

- How many g of $(NH_4)_2\ SO_4$ are in 0.05 moles of $(NH_4)_2\ SO_4$?

- (1) mole of $(NH_4)_2\ SO_4$ = (132.134) g of $(NH_4)_2\ SO_4$
- (0.05) mole of $(NH_4)_2\ SO_4$ = (x) g of $(NH_4)_2\ SO_4$

- Number of g of $(NH_4)_2\ SO_4$ in 0.05 moles of $(NH_4)_2\ SO_4$
  = 132.134 x 0.05 / 1 = 6.6067 g

Mole - Unit Factor

- 1 *mol* = 6.02 × 10^{23} particles
- 1 *mol* = molar mass
- 1 *mol* = 22.4 L at STP for a gas

Ex: A sample of methane, CH_4, occupies 4.50 L at STP. How many moles of methane are present?

1 mol = 22.4 L

x mole = 4.5 L

x = 1 * 4.5/ 22.4

x = 0.201 moles CH_4 .

Mole % and Volume %

- Based on Avogadro's law volume% and mole% are equivalent.
- $V_i \propto n_i \quad \text{or} \quad V_i = k\, n_i$
- $$volume\% = \frac{V_i}{\sum V_i} \times 100 = \frac{k\, n_i}{\sum k\, n_i} \times 100$$
$$= \frac{n_i}{\sum n_i} \times 100 = mole\%$$

Component	Mole fraction, y_i
C_1	0.850
C_2	0.090
C_3	0.040
n-C_4	0.020
	1.000