

Properties of Reservoir Fluids (PGE 362)

Gasses

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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.

$$P_t = P_1 + P_2 + P_3 + P_4 + \dots\dots\dots$$

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

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

Partial Pressure

$$PV = nRT$$

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

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

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

$$P_k = y_k P$$

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 **$6.02214129(27) \times 10^{23}$** elementary entities of the substance. It is one of the base units in the International System of Units.

<u>1 mole element</u>	<u>Number of Atoms</u>
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 ₂ O	= 6.02×10^{23} molecules

Mole - Examples

Ex1: How many moles of Ca are in 28.07 g of Ca?

Solution

(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) = $1 \times 28.07 / 40.1 = 0.7$ moles

Ex2: How many g of $(\text{NH}_4)_2 \text{SO}_4$ are in 0.05 moles of $(\text{NH}_4)_2 \text{SO}_4$?

Solution

(1) mole of $(\text{NH}_4)_2 \text{SO}_4$ = (132.134) g of $(\text{NH}_4)_2 \text{SO}_4$

(0.05) mole of $(\text{NH}_4)_2 \text{SO}_4$ = (x) g of $(\text{NH}_4)_2 \text{SO}_4$

Number of g of $(\text{NH}_4)_2 \text{SO}_4$ in 0.05 moles of $(\text{NH}_4)_2 \text{SO}_4$
= $132.134 \times 0.05 / 1 = 6.6067$ 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, CH₄, occupies 4.50 L at STP. How many moles of methane are present?

Solution

$$1 \text{ mole} = 22.4 \text{ L}$$

$$x \text{ mole} = 4.5 \text{ L}$$

$$x = 1 * 4.5 / 22.4$$

$$x = 0.201 \text{ moles CH}_4 .$$

Mole % and Volume %

➤Based on [Avogadro's Law](#), volume% and mole% are equivalent.

➤ $V_i \propto n_i$ or $V_i = k n_i$

➤ $volume\% = \frac{V_i}{\sum V_i} = \frac{k n_i}{\sum k n_i} \times 100 = \frac{n_i}{\sum n_i} \times 100 = mole\%$

Component	Mole fraction, y_i
C ₁	0.850
C ₂	0.090
C ₃	0.040
n-C ₄	0.020
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	1.000