Overview of Chapter 14

- Solutions
- Concentrations:
  - Molarity
  - Molality
  - Mole fraction
- Colligative Properties
  - Freezing point depression
  - Boiling point elevation
- Osmosis

Today's questions to consider:

- How do we calculate concentrations?
- Why does a soda fizz when we open the lid?
- How do you calculate mole fraction?

Today's Topics

- Calculating concentrations
  - Molarity
  - Molality
  - Mole fraction
- Colligative Properties
- Raoult's Law

Concentration Units

Molarity, M

$$\text{M of solute} = \frac{\text{mol solute}}{\text{1 L solution (total volume)}}$$

Molality, m

$$\text{m of solute} = \frac{\text{mol solute}}{\text{1 kg solvent}}$$

Concentration Units

Molality (m):
0.100 m K_2CrO_4 =

19.4g K_2CrO_4
+
1.00 kg H_2O

Molarity (M):
0.100 M K_2CrO_4 =

19.4g K_2CrO_4
in
1.00 L total volume

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Concentration Units

Mole Fraction, X

For a mixture of A, B, and C:

$$X_A = \text{mol fraction A} = \frac{\text{mol A}}{\text{mol A} + \text{mol B} + \text{mol C}}$$

WEIGHT % = grams solute per 100 g solution

Concentration Calculations

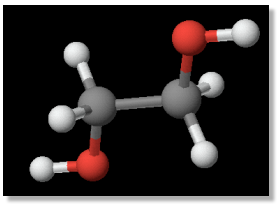
If we make dissolve 62.1 g (1.00 mol) of ethylene glycol in 250. g of H_2O, calculate the

mol fraction

molality

weight %

of ethylene glycol.



Concentration Calculations

Dissolve 62.1 g (1.00 mol) of ethylene glycol in 250. g of H_2O. Calculate X, m, and % of glycol.

250. g H_2O x (1 mol H_2O/18.0 g H_2O)
= 13.9 mol H_2O

Calculate mole fraction X:

$$X_{glycol} = \frac{1.00 \text{ mol glycol}}{1.00 \text{ mol glycol} + 13.9 \text{ mol } H_2O}$$

$$X_{glycol} = 0.0672$$

Concentration Calculations

Dissolve 62.1 g (1.00 mol) of ethylene glycol in 250. g of H_2O. Calculate X, m, and % of glycol.

Calculate molality:

$$\text{conc (molality)} = \frac{1.00 \text{ mol glycol}}{0.250 \text{ kg } H_2O} = 4.00 \text{ molal}$$

Calculate weight %:

$$\%\text{glycol} = \frac{62.1 \text{ g}}{62.1 \text{ g} + 250. \text{ g}} \times 100\% = 19.9\%$$

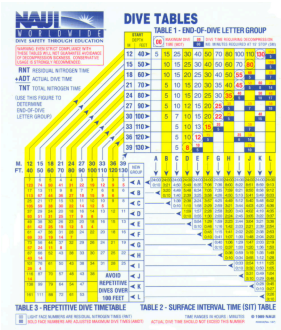
Dissolving Gases & Henry's Law

Gas solubility (in mol/L) = $k_H \cdot P_{gas}$

k_H for O_2 = 1.66×10^{-6} M / mmHg

When P_{gas} drops, solubility drops.

Scuba Diving



Colligative Properties

On adding a solute to a solvent, the props. of the solvent are modified.

- Vapor pressure decreases
- Melting point decreases
- Boiling point increases
- Osmosis is possible (osmotic pressure)

They depend only on the NUMBER of solute particles relative to solvent particles, not on the KIND of solute particles.