Medical chemistry- year1

Method of ExpressingConcentration

Lecture no(7) part 2

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Normality

Number of gram equivalent of solute (Substance)dissolved in one litre (1000 ml) of solution is called as Normality.
Normality is indicated by (N).

$$N = \frac{Eq}{V\ (L)}$$

$$\text{Normality (N)} = \frac{\textit{No of gram equivalents}}{\textit{Volume of solution in litres}}$$

We have,

$$\text{no of g.eqv.} = \frac{\text{Mass in g}}{\text{Eqv. mass}}$$

equivalent weight

By substitution,

$$\text{Normality} = \frac{\text{Mass of solute in g}}{\text{Eqv. mass} \times \text{Vol. of solution in L}}$$

$$Eq = \text{Equivalent Weight} = \frac{\text{Gram equivalent Weight of Solute}}{\text{No. of replaceable } H^+ \text{, } OH^- \text{; e-}}$$

example :

How many equivalents are in 1.60 L of 0.5 N H_3PO_4 ?

$$N = \frac{\text{\# of equivalents}}{\text{Liter of solution}} = 0.50\ N = \frac{\text{“X” equiv.}}{1.60\ L}$$

$$\text{“X”} = 0.80 \text{ equivalents}$$

example :

What is N of 80.0g NaOH dissolved in 1.5 L of solution ?

$$80.0\text{g NaOH} \times \frac{1 \text{ equiv. NaOH}}{40.0\text{g}} = 2.0 \text{ equiv.}$$

$$N = \frac{\#\text{ of equivalents}}{\text{Liter of solution}} = \frac{2.0 \text{ equiv.}}{1.5 \text{ L}} = 1.33 \text{ N}$$

Dilutions with Normality:

What if you wished to dilute a more concentrated Normal solution to a specific concentration. How would you do it ?

$$N_i \; V_i \quad = \quad N_f \; V_f$$

Dilutions example :

A lab requires 500 mL of 0.20 N Sulfuric acid. You have a significant volume of 4.0 N H_2SO_4.

Solution :

$$\boxed{N_iV_i = N_fV_f}$$

$$0.20\ N \times 0.500\ L = 4.0\ N \times \text{“X”}$$

$$\text{“X”} = 0.025\ L$$

Dilute 25 mL of 4.0 N Sulfuric acid to 500 mL.

Mole fraction (x)

Mole fraction(x) : of any component in a solution is the number of moles of the component divided by total number of moles making up a solution.it is denoted by (x).

$$\text{Mole fraction } (X) = \frac{\text{Moles of component}}{\text{Total number of moles making up the solution}}$$

$$X_A + X_B = 1$$

Sum of mole fractions is always equal to 1

For example, a solution is prepared by dissolving 1 mole of ethyl alcohol $C_2H_5\text{-}OH$ in 3 moles of water (H_2O), where n_A and n_B represent the number of moles of ethyl alcohol and water respectively.

Then,

Mole fraction of ethyl alcohol $= X_A = \dfrac{n_A}{n_A + n_B}$

$$= \frac{1}{1+3} = \frac{1}{4} = 0.25$$

Mole fraction of water $= X_B = \dfrac{n_B}{n_A + n_B} = \dfrac{3}{1+3}$

$$= \frac{3}{4} = 0.75$$

Result: Mole fraction of ethyl alcohol $X_A = 0.25$

Mole fraction of water $X_B = 0.75$

Sum of mole fractions is always equal to 1.

Mole fraction of ethyl alcohol = 0.25

Mole fraction of water = 0.75

Sum of mole fractions = 1.0

Percentage (%)

- Sometimes the concentration is expressed in terms of per cent (parts per hundred) also. Per cent Composition of a solution can be expressed as:

1. Per cent W/W = Weight of solute/ Weight of solution X 100
2. Per cent V/V = Volume of solute/ Volume of solution X 100
3. Per cent W/V= Weight of solute/ Volume of solution X 100

- 1 %= 1gm of KCl ----------- in 100 ml of water
- 10 % = 10 gm of KCl ----------- in 100 ml of water
- 100 % = 100 gm of KCl ----------- in 100 ml of water

%by weight(%w/w)

What is the % w/w of a solution if 3.00 grams of NaCl are dissolved in 17.00 g of water?

$$\%w/w = \frac{\text{mass of solute}}{\text{total mass of solution}} \times 100\%$$

- mass of solute = 3.00 g
- mass of solution = 3.00 g + 17.00 g = 20.00 g
- (3.00 g / 20.00 g) x 100% = 15.0% w/w

%by volume(%v/v)

What is the % v/v of a solution if 20.0 mL of alcohol are dissolved in 50.0 mL of solution?

$$\%v/v = \frac{\text{volume of solute}}{\text{total volume of solution}} \times 100\%$$

- volume of solute = 20.0 mL
- volume of solution = 50.0 mL
- (20.0 mL / 50.0 mL) x 100% = 40.0%

Parts per million

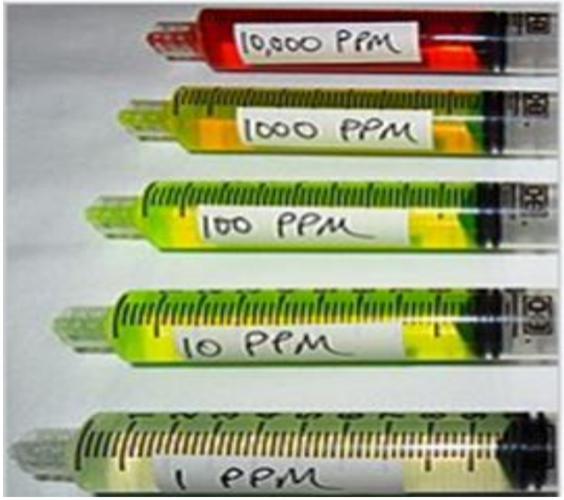
Parts per million is frequently employed to express the concentration of very dilute solutions and is express as PPM

A part per million (ppm) is one part of solute per million parts of solution. In terms of defining equations, we can write:

m/m = $$\text{ppm (m/m)} = \frac{\text{mass solute}}{\text{mass solution}} \times 10^6$$

v/v = $$\text{ppm (v/v)} = \frac{\text{volume solute}}{\text{volume solution}} \times 10^6$$

m/v = $$\text{ppm (m/v)} = \frac{\text{mass solute(g)}}{\text{volume solution (mL)}} \times 10^6$$



Formality

The concentration unit, formal, is similar to the more familiar molar concentration in that it is calculated as the number of moles of a substance in a liter of solution.

Formal concentrations are notated with the symbol (**F**)

$$\text{Formal concentration (F)} = \frac{\text{no. of moles (mole)}}{\text{total volume (L)}}$$

$$\text{NO .of moles (n)} = \frac{\text{mass (g)}}{\text{molar mass(g/mole)}}$$

$$\text{Formal concentration (F)} = \frac{\text{mass (g)}}{\text{molar mass*total volume (L)}}$$

Thank you