(5) Molarity :- (M)

(from : Dr. A. K. Gupta, chemistry)

It is equal to the gram moles of solute dissolved in one litre of solution.

Thus,

$$\text{Molarity (M)} = \frac{\text{Gram moles of solute (n)}}{\text{Volume of solution in litre (V)}}$$

$$\text{Gram moles (n)} = \frac{\text{Given mass of solute (w)}}{\text{Molar mass of solute}}$$

$$\therefore \text{Molarity (M)} = \frac{\text{Given mass of solute (w)}}{\text{Molar mass of solute} \times \text{Volume of sol'n (V in L)}}$$

$$M = \frac{w\,(\text{in g})}{\text{Molar mass of solute (in g)} \times V\,(\text{in L})} = \frac{w\,(\text{in g}) \times 10^3}{\text{Molar mass of solute} \times V\,(\text{in ml})}$$

(6) Molality (m) :-

It is equal to the gram moles of solute dissolved in 1 kg of solvent.

Thus,

$$\text{Molality (m)} = \frac{\text{Gram moles of solute (n)}}{\text{Mass of solvent in kg}}$$

$$\text{Gram moles of solute (n)} = \frac{\text{Given mass of solute (w)}}{\text{Molar mass of solute}}$$

$$\therefore \text{Molality } (m) = \frac{\text{Mass of solute (w in g)}}{\text{Molar mass of solute} \times \text{Mass of solvent (in kg)}}$$

$$m = \frac{w \text{ (in g)} \times 10^3}{\text{Molar mass of solute} \times \text{Mass of solvent (in g)}}$$

Problems

(1) 49 gm H_2SO_4 are present in 100 ml aq. sol^n. What is the molarity of H_2SO_4 ?

Hints:- Molar mass of H_2SO_4 = 98 g.

(2) Calculate the molality (m) of 2.5 g of ethanoic acid in 75 g of benzene.

Hints: Molar mass of ~~Ethanoic~~ Ethanoic acid (CH_3COOH) = 60.

Mass of solvent = 75 g = 75×10^{-3} kg.

—x—

[Dr. A. K. Gupta chemistry]

(7) Formality :-

It is equal to the number of formula masses present in one litre of the solution.

Thus, $$\text{Formality} = \frac{\text{No. of formula masses of solute}}{\text{Volume of solution in L (V)}}$$

$$\text{formula mass} = \frac{\text{Mass of solute (w) in g}}{\text{formula mass of solute}}$$

$$\therefore \text{formality} = \frac{w(\text{in g})}{\text{formula mass of solute} \times V(\text{in L})}$$

$$F = \frac{w(\text{in g}) \times 10^3}{\text{formula mass of solute} \times V(\text{in ml})}$$

(8) Mole fraction (X) :-

Let us consider, in a solution

moles of solute $= n_A$

moles of solvent $= n_B$

Total moles $= n_A + n_B$

mole fraction of solute $(x_A) = \frac{n_A}{n_A + n_B}$

mole fraction of solvent $(x_B) = \frac{n_B}{n_A + n_B}$

(9). Mass fraction :-

Let us consider,

mass of solute $= w_A$

mass of solvent $= w_B$

Total mass $= w_A + w_B$

Mass fraction of solute $= \frac{w_A}{w_A + w_B}$

Mass fraction of solvent $= \frac{w_B}{w_A + w_B}$

(10). Concentration in parts per million :-

It is equal to the number of milligrams of the solute present in 1 litre of the solution. PPm is equal to grams of the solute present in 10^6 cc (1 million cc) of the solution.

Concentration in ppm $= \frac{\text{Mass of solute in mg}}{\text{Volume of solution in L(V)}}$

(11) Relationship between molarity and normality :-

$$\text{Normality} = \text{Molarity} \times n$$

~~(A) for monobasic acid~~ – ~~(HCl)~~

~~HCl,~~

(A) for HCl, NaOH, NaCl, $NaHCO_3$, NH_4OH, H_3PO_2, CH_3COOH, HCN, HBr etc. $n = 1$

(B) for H_2SO_4, H_3PO_3, Na_2SO_4, Na_2CO_3, $C_2H_2O_4$ (oxalic acid), $Ba(OH)_2$, $CaCl_2$, $Mg(HCO_3)_2$ etc. $n = 2$.

(C) for H_3PO_4, $AlCl_3$, Na_3PO_4 etc. $n = 3$.

note- n depends upon the reaction.

$$n = \frac{\text{molar mass}}{\text{Equivalent mass}}$$

(12) Normality Equation :-

$$N_1V_1 = N_2V_2$$

when two solution reacts completely.

(13) Molarity equation :-

$$M_1V_1 = M_2V_2$$

when two solution reacts completely.