Methods of expressing Concentration.

There are many ways to express Concentration, like

1- Molarity	M
2- Molality	m
3- Normality	N
4- Formality	F
5- Part per thousand	ppt
6- part per million	ppm
7- part per billion	ppb
8- weight by weight	% (w/w)
9- weight by volume	% (w/v)
10- volume by volume	% (v/v)

1- Molarity (M):- Is defined as the number of moles of solute per liter of solution, also known as the molar concentration of a solution. The unite of molarity are M or mole/L or mmol/ml

$$1\text{- Molarity (M)} = \frac{\text{moles of solute}}{\text{volume of solution (solute + solvent)}}$$

$$2\text{- Moles of solute} = \frac{\text{weight of solute (g)}}{\text{Molecular weight (g/mol)}}$$

$$3\text{- Volume of solution (L)} = \frac{\text{moles of solute}}{\text{Molarity}}$$

4- Moles of solute = Molarity x volume of Solution (L)

5- mmoles of solute = Molarity * volume of solution (ml)

6- mmole = mole * 1000

An Easy Short_Cut

7- $M(\frac{mol}{L}) = \frac{m(g)}{m.wt \times V(L)}$

8- $M(\frac{mol}{L}) = \frac{m(g)}{m.wt} \times \frac{1000}{V(ml)}$

Question (1)

Find the number of grams of Na_2SO_4 (m.wt = 142 mg/mmol) required to prepare 500 ml of 0.1 molarity solution.

$n(mol) = M\frac{mol}{L} * V(L) \rightarrow$

$n(mol) = 0.1 \times 0.5 = 0.05$ mole

$m(g) = n(mole) * m.wt$

$m(g) = 0.05 \text{ mole} \times 142 \text{ g/mole} = 7.1 \text{ g}$

Short_cut

$M(\frac{mol}{L}) = \frac{m(g)}{m.wt\ g/mol \times V(L)} \rightarrow$

$m(g) = M \times m.wt \times V \rightarrow$

$m(g) = 0.1 \text{ mol/L} \times 142 \text{ g/mol} \times 0.5 \text{ L} = 7.1 \text{ g}$

Question 2

calculate the molarity of a solution resulting from dissolving 1.26 g of $AgNO_3$ (m.wt = 169.9) in a total volume of 250ml Solution.

$$n(mol) = \frac{m(g)}{m.wt\ g/mol} = \frac{1.26\ g}{169.9\ g/mol} = 7.42 \times 10^{-3}\ mol$$

$$M\left(\frac{mol}{L}\right) = \frac{n(mol)}{V(L)} = \frac{7.42 \times 10^{-3}\ mol}{0.25\ L} = 0.029\ mol/L$$

$$M\left(\frac{mol}{L}\right) = \frac{m(g)}{m.wt\ \frac{g}{mol} \times V(L)} = \frac{1.26\ g}{169.9\ g/mol \times 0.25\ L} = 0.029$$

$$M = \frac{m}{m.wt} \times \frac{1000}{V\,ml} \rightarrow M = \frac{1.26}{169.9} \times \frac{1000}{250} \rightarrow M = 0.029\ \frac{mol}{L}$$

Question 3

Find the molarity of potassium ion after mixing 100ml of 0.25 M KCl with 200ml of 0.1 M K_2SO_4.

mmol of K^+ = mmol K^+ from KCl + mmol K^+ from K_2SO_4

mmol K^+ = $0.25\ \frac{mmol}{ml} \times 100\,ml + (2 \times 0.1\ \frac{mmol}{ml}) \times 200\,ml$

mmol of K^+ = 25 + 40 →

mmol of potassium ion = 65 mmol

$$Molarity = \frac{n(mol)}{V(L)} = \frac{n(mmol)}{V(ml)} = \frac{65\ mmol}{300\,ml} = 0.216\,M$$

Question 4:- what is the Molar concentration of a solution if 0.28 g NaOH is dissolved in 500ml of water (m.wt = 40 g/mol) (Homework)

2- Molality :- Is defined as number of moles of Solute per weight of solvent in kilogram

$$\text{molality} = \frac{\text{moles of solute}}{\text{weight of solvent (kg)}}$$

Question 1

What is the molality of Solution made by dissolve 25 g of NaCl in to 2 liter of water. Assume the density of water (d = 1.0 g/ml) & (Na = 23)(Cl = 35.5)

Molar mass of NaCl = (1×23) + (1×35.5) = 58.5 $\frac{g}{mol}$

$$n(\text{mole}) \text{ of NaCl} = \frac{\text{weight}}{\text{m.wt}} = \frac{25\,g}{58.5\,g/mol} = 0.427\ mol$$

$$\text{density} = \frac{\text{mass}}{\text{volume}} \rightarrow \text{mass} = 2\,L \times 1\,kg/L = 2\,kg$$

∴ weigh of water in kg = 2 kg

$$\text{molality} = \frac{\text{moles of solute}}{\text{weigh of solvent (kg)}} = \frac{0.427\ mol\ NaCl}{2\ kg\ water}$$

⇒ molality = 0.213 m of NaCl.

Question (2)

What is the molality of a solution that Contains 8 grams of Sodium hydroxide and 500grams of water (m.wt) = 40 g/mol (Homework)