Preparation of Solutions (Concentrations)

Jeillan H. MSc.

Lab3

2022-2023

Concentration

What is concentration?

- Refers to the amount of a substance per defined space.
- Is the ratio of solute in a solution to either solvent or total solution.
- Is the amount of solute dissolved in a given amount of solvent.

$$\text{Concentration of a solution} = \frac{\text{amount of solute}}{\text{amount of solution}}$$

Types of concentration

- Molarity: number of moles per liter of solution
- Molality: number of moles per mass of solvent
- Normality: grams active solute liters of solution
- Percent solutions: amount of solute/amount of solution x 100%

Molarity

$$\text{Molarity (M)} = \frac{\boldsymbol{moles\ of\ solute}}{\boldsymbol{one\ liter\ of\ solution}}$$

$$\text{Moles} = \frac{weight\ (g)}{molecular\ weight\ g/mole}$$

An amount of 58.5 g of NaCl was dissolved in 1 liter of water. What is the molarity of this solution?

Note: MW of Na=23, MW of Cl=35.5

Answer: moles=$\frac{58.5\text{g}}{58.5\ \text{g/mole}}$=1 mole

M=1/1= 1M

❖ How many moles of NaOH are in 38ml of 0.50mol/L NaOH?

Molality

Molality (m)= $\frac{\boldsymbol{moles\ of\ solute}}{\boldsymbol{one\ Kg\ of\ solvent}}$

An amount of 75.0 g of NaCl is dissolved in 1 Kg of water. Find molality.

Mole=75.0/ 58.5= 1.28

m= $\frac{1.28}{1\ Kg\ H2O}$=1.28 m

10g of NaOH is dissolved in 500g of water. What is the molality of the solution ?

Na=23 O=16 H=1

Normality

- The normality of a solution is the gram equivalent weight of a solute per liter of solution.
- Common units of normality include N, eq/L, or meq/L.
- Normality is not the most common unit of concentration, nor is its use appropriate for all chemical solutions. Typical situations when you might use normality include acid-base chemistry, redox reactions, or precipitation reactions. For most other situations, molarity or molality are better options for units.
- **Equivalent weight** = **molar mass**/(**H+ or OH per mole**)
- Equivalent weight of **HCl** is 36.5/1=36.5 g
- Equivalent weight of **H_2SO_4** is 96/2=48 g
- Equivalent weight of **KOH** is 56/1=56 g

Find the N of 3M HCl

N= M*n (n= number of H^+ in acids or OH^- in bases)

N= 3*1= 3 N

Find the N of 6M H_2SO_4

N= 6*2= 12 N

Find the N of 2M NaOH

N=2*1= 2 N

The normality of a solution is NEVER less than its molarity!

What is the normality of asolution that contain 50g of H2SO4 dissolved in 15L?

H=1 S=32 O=16 .

Percent concentrations

- Percent solutions can take the form of weight/volume % (w/v %), for preparing (5%) NaCl. Dissolve (5) gram of sodium chloride in water and complete the volume to 100 ml.
- Weight/weight % (w/w %), for preparing (5%) NaCl. Dissolve (5) gram of sodium chloride in (95) gram of water.
- Volume/volume % (v/v %) for preparing (5%) from Ethanol. Dissolve (5) ml of Ethanol in (95) ml of water

$$\text{Mass/volume percent (m/v)} = \frac{\text{grams of solute}}{\text{milliliters of solution}} \times 100\%$$

$$\text{Mass percent (m/m)} = \frac{\text{mass of solute (g)}}{\text{mass of solute (g)} + \text{mass of solvent (g)}} \times 100\%$$

$$= \frac{\text{mass of solute (g)}}{\text{mass of solution (g)}} \times 100\%$$

$$\text{Volume percent (v/v)} = \frac{\text{volume of solute}}{\text{volume of solution}} \times 100\%$$

- Dissolve 10g of NaCl in 60 ml of water, find the percentage of NaCl in the solution?
- 15g of NaOH was dissolved in 225g of water, what is the mass percent of NaCL in the solution?
- 25ml of methanol is mixed with 150ml of water, what is the volume percent of methanol?

Dilution

- From more concentrated to less concentrated solution
- The newly calculated concentration always smaller than the original.
- There are:
  - C1*V1=C2*V2
  - M1*V1=M2*V2
  - N1*V1=N2*V2
- How many ml of a 2.50M of NaOH solution are required to make 525ml of a 0.150M NaOH solution?