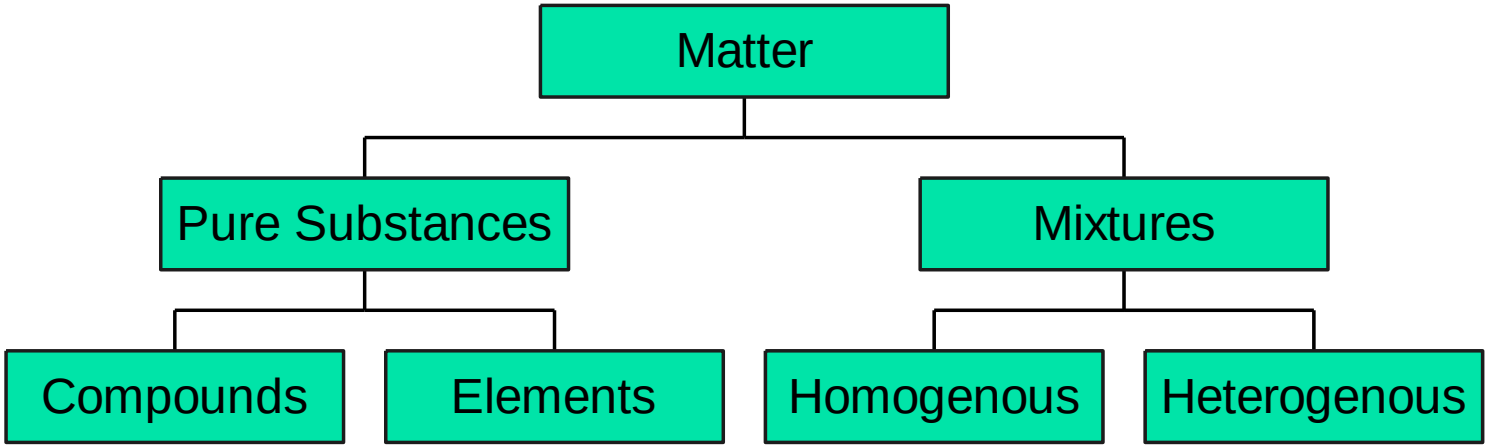
Unit 3

Solutions

&

Solubility

Classification of Matter



Mixtures

- Homogenous
- Heterogeneous

Homogenous Mixture

- A uniform mixture of only one phase
- Examples:
  - Table salt (NaCl) in water solutions
  - Gold (Alloy)
  - Air e.g O_2 in N_2(Gaseous Solution)
  - Vinegar (Acetic acid in water)

What is a solution made up of?

- A solute and a solvent
- Solute: A substance that is dissolved in a solvent eg. Sodium chloride in water
- Solvent: The medium in which a solute is dissolved, often the liquid component of a solution or the component that is present in a larger quantity.

Classification of Solutions

Solute in Solvent	Example
Gas in Gas	Oxygen in Nitrogen (Air)
Gas in Liquid	Oxygen in water
Gas in Solid	Oxygen in Ice Pumice/Sponge
Liquid in Gas	Water vapor in air
Liquid in Liquid	Ethanol in water
Liquid in Solid	Mercury in Silver (Amalgam)
Solid in Liquid	Sugar in water
Solid in Solid	Tin in Copper (Bronze)

Electrolytes & Non Electrolytes

- Electrolytes: They are substances which dissolve in water and conduct electricity in their aqueous solution.
  - Examples KCl, $MgSO_4$, HCl, KOH etc.
- Non Electrolytes:They do not conduct electricity in aqueous solution
  - Examples Sugar, Urea, honey, glycerol

What is the condition for solubility?

- Like Dissolves Like
  - Electrolytes dissolve in polar solvents
    - Meaning ionic compounds dissolve in polar solvents
    - E.g.
  - Non-Polar compounds dissolve in Non-Polar solvents
    - Meaning organic compounds dissolve in organic solvents
    - E.g

Thermodynamic view point

- If an electrolyte is to dissolve in polar solvent like water the “Energy of Hydration” should be greater than the Lattice Energy.

Why do some organic compounds dissolve in water?

- Can you explain why sugar, honey, glucose, urea, glycerol etc dissolves in water
- Why does not petrol, kerosene, olive oil etc. dissolve in water?
- How could you explain this phenomenon?

What are the force operating during dissolution of salts

- London’s Forces or Van Der Waals Forces (They are extremely weak and present in molecular compounds)
- Dipole dipole interaction(Polar com.)
- Hydrogen bonds

Solvation

- All ionic compounds dissolve in water due to solvation or hydration
- All molecules capable of forming hydrogen bonds with water dissolve in water
- The process of stabilizing the ion or molecule by a hydration shell leading to electrical neutrality is called solvation.

Hydration

- Water is a polar liquid
- ∴ It is a dipole and has dipole moment
- Electrolytes break up into ions in aqueous solution
- The +ve ions are surrounded by –ve end of the dipole of water there by electrically stabilizing the ion
- Similarly the –ve ions are also stabilized
- This process is known as hydration/Solvation

Why is water known as a Universal solvent?

- Water dissolves so many more substances than any other liquid.
- All forms of life including animals and plants depend upon water for sustaining life
- ∴ Naturally water is a universal solvent

Solution Concentration

6.3

What is concentration

- It is the ratio of:
- Quantity of Solute to Quantity of Solvent

Different expressions of Concentrations

- Percentage Concentration
- Parts Per Million (For Very low conc..)
- Molar Concentrations

Percentage Concentration

- % = (Volume/Volume) x 100
- % = (Weight/Volume) x 100
- % = (Weight/Weight) x 100

Molar Concentrations

- Molarity may be defined as number of moles of the solute dissolved in one liter of the solution
- Unit is "M" or mol L^{-1} or mol/L
- $M = (m_B/Mm_B) \times (1000/V_A)$
- $C = \frac{n}{v}$

Parts per Million

- If the quantity of chlorine a disinfectant in swimming pool water is 1 ppm this is what it means
- 1gram on chlorine is present in 10^6 g of pool water
- i.e. the number of grams (parts) of the pollutant per 10^6grams (parts) of the solvent
- 1mg/L is also 1 ppm

Molarity and volume calc.

- $C_1V_I = C_2V_2$
- The above equation is used for dilution of solutions
- C_1 is higher concentration and V_1 is the volume of that reagent
- C_2 is the diluted concentration and V_2 is its volume