Physical Pharmacy

Non-electrolytes 1

Non-electrolytes

- Material substances can be mixed together to form a variety of pharmaceutical mixtures (or dispersions) such as **true solutions, colloidal dispersions, and coarse dispersions.**

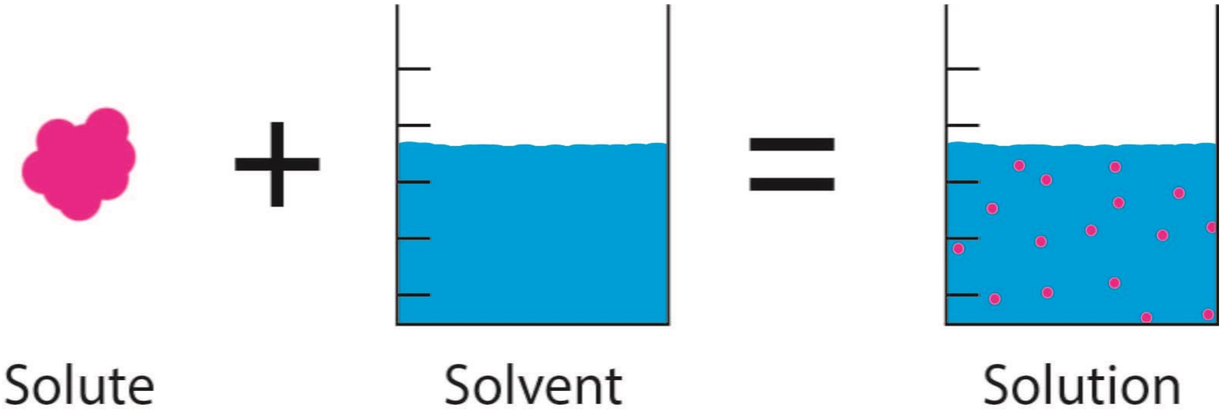
- The difference between the three types is in the diameter of the solute particles (dispersed phase).

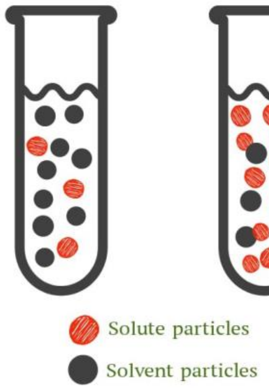
- A true solution is defined as a mixture of two or more components that form a homogeneous molecular dispersion, in other words, a one-phase system.

DR CUBE

Types of Solutions

- A solution can be classified according to the states in which the solute and solvent occur, and because three states of matter (gas, liquid, and crystalline solid) exist, nine types of homogeneous mixtures of solute and solvent are possible.





DR CUBE

Types of Solutions

Table 5-1 Types of Solutions

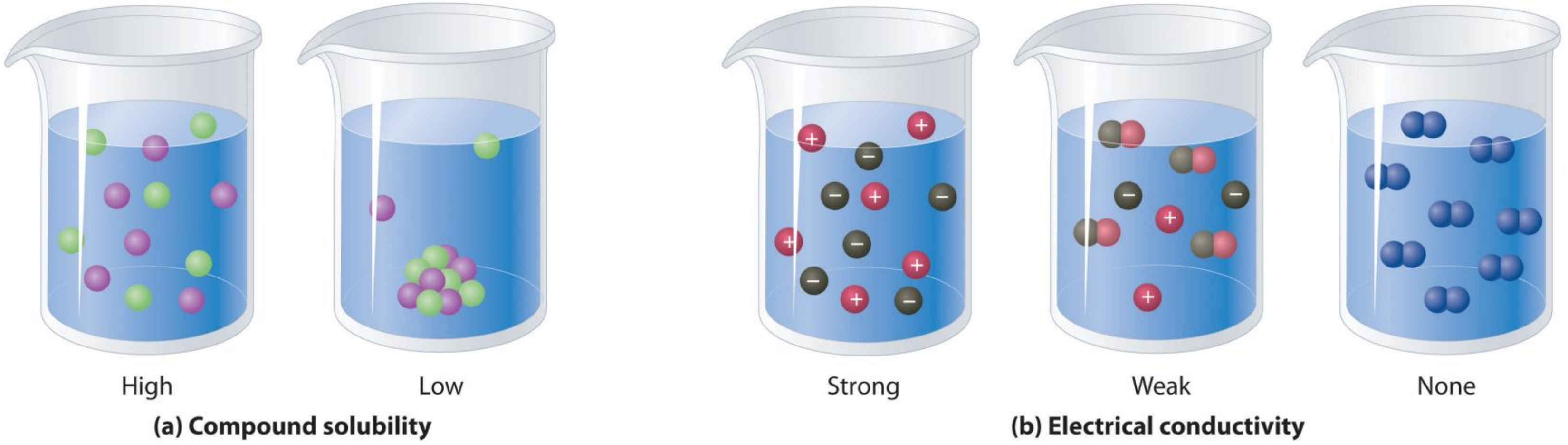
Solute	Solvent	Example
Gas	Gas	Air
Liquid	Gas	Water in oxygen
Solid	Gas	Iodine vapor in air
Gas	Liquid	Carbonated water
Liquid	Liquid	Alcohol in water
Solid	Liquid	Aqueous sodium chloride solution
Gas	Solid	Hydrogen in palladium
Liquid	Solid	Mineral oil in paraffin
Solid	Solid	Gold-silver mixture, mixture of alums

Nonelectrolytes

- The solutes (whether gases, liquids, or solids) are divided into two main classes: nonelectrolytes and electrolytes.

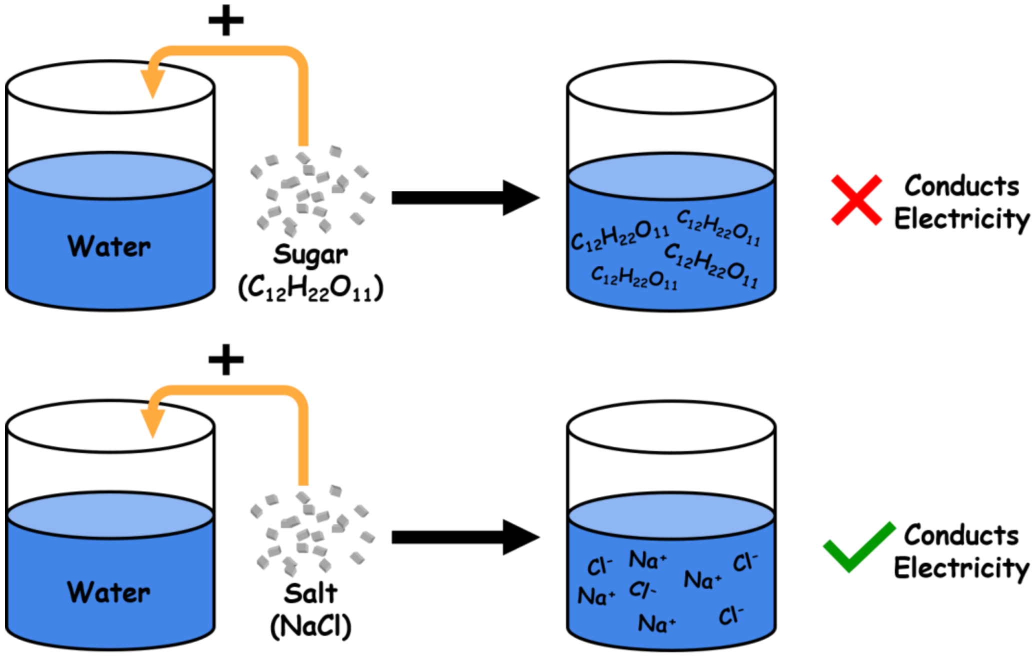
- Nonelectrolytes are substances that do not ionize when dissolved in water and therefore do not conduct an electric current through the solution

- Examples of nonelectrolytes are **sucrose, glycerin, naphthalene, and urea.**



Electrolytes

- **Electrolytes** are substances that form ions in solution, conduct electric current.
- **Examples** of electrolytes are sodium chloride, hydrochloric acid, sodium sulfate, ephedrine, and phenobarbital.



DR CUBE

Electrolytes

- Electrolytes may be subdivided further into:-

a. **Strong electrolytes**
b. **Weak electrolytes , depending on whether the substance is completely or only partly ionized in water.**

- Hydrochloric acid and sodium chloride ,sodium sulfate are strong electrolytes

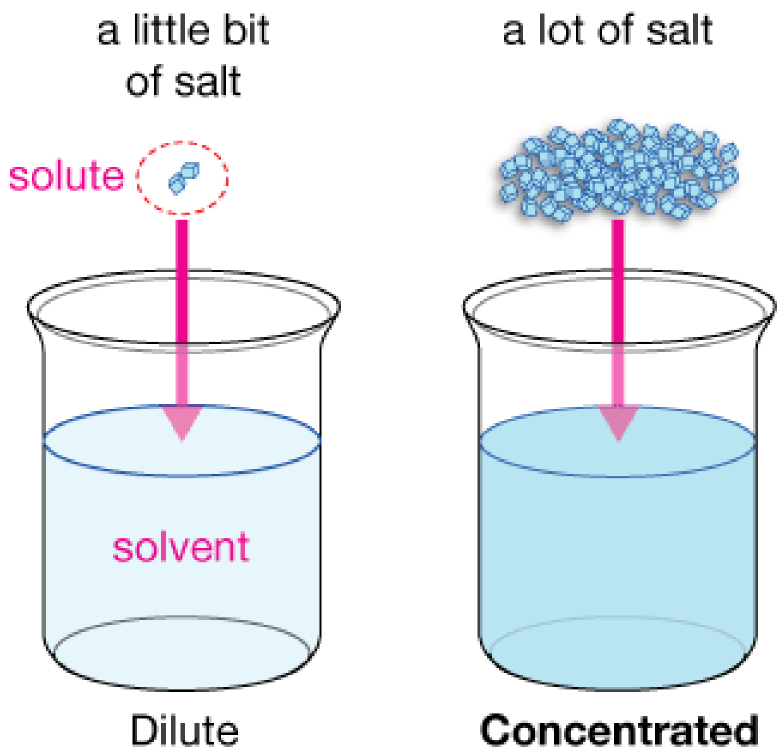
$$\mathbf{NaCl \longrightarrow Na^{+} + Cl^{-}}$$

- Whereas acetic acid ,ephedrine and phenobarbital are weak electrolytes.

$$\mathbf{CH3COOH \longleftrightarrow CH3COO^{-} + H3O^{+}}$$

Concentration Expressions

- The concentration of a solution can be expressed either in terms of the quantity of solute in a definite volume of solution or as the quantity of solute in a definite mass of solvent or solution



DR CUBE

Concentration Expressions

Table 5-2 Concentration Expressions

Expression	Symbol	Definition
Molarity	M,c	Moles (gram molecular weights) of solute in 1 liter of solution
Normality	N	Gram equivalent weights of solute in 1 liter of solution
Molality	m	Moles of solute in 1000 g of solvent
Mole fraction	X,N	Ratio of the moles of one constituent (e.g., the solute) of a solution to the total moles of all constituents (solute and solvent)

DR CUBE

Concentration Expressions

Table 5-2 Concentration Expressions

Expression	Symbol	Definition
Mole percent		Moles of one constituent in 100 moles of the solution; mole percent is obtained by multiplying mole fraction by 100
Percent by weight	% w/w	Grams of solute in 100 g of solution
Percent by volume	%V/V	Milliliters of solute in 100 mL of solution
Percent weight-in-volume	%W/V	Grams of solute in 100 mL of solution
Milligram percent	–	Milligrams of solute in 100 mL of solution

Molarity and Normality

- **Molarity (M,c)**:- no. of moles (g Mwt) of solute in one liter of solution

$$\mathrm{M} = \frac{Wt}{Mwt}\ x\ \frac{1000}{Vol\ of\ solution}$$

- **Normality(N):-** no. of gram equivalent wt of solute in one liter of solution

$$\mathrm{N} = \frac{Wt}{eqwt}\ x\ \frac{1000}{Vol\ of\ solution}$$

- Molar and normal solutions are popular in chemistry because they can be brought to a convenient volume

DR CUBE

Molarity and Normality

Both molarity and normality have the disadvantage :

1. Changing their value with temperature because of the expansion or contraction of liquids and should not be used when one wishes to study the properties of solutions at various temperatures.

2. The volume of the solvent in a molar or a normal solution is not usually known, and it varies for different solutions of the same concentration, depending upon the solute and solvent involved which cause difficulty in the study of properties such as vapor pressure and osmotic pressure, which are related to the concentration of the solvent..

DR.CUBE

Molarity and Normality

Molality(m)

- Moles of solute in one Kilogram solvent
- Molal solutions are prepared by adding the proper weight of solvent to a carefully weighed quantity of the solute.
- The volume of the solvent can be calculated from the specific gravity, and the solvent can then be measured from a burette rather than weighed.
- So the molal solution is prepared in terms of weight units and does not have the disadvantages just discussed; therefore, molal concentration appears more frequently than molarity and normality in theoretical studies.

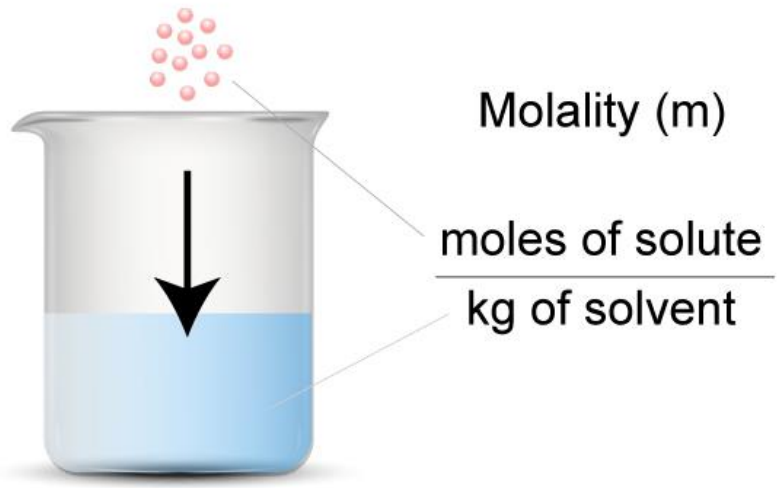
DR CUBE

Molarity and Normality

Molality(m)

$$\mathbf{M} = \frac{Wt}{Mwt} \, x \, \frac{1000}{Vol\ of\ solution}$$

- In aqueous solutions more dilute than 0.1 M, it usually may be assumed for practical purposes that molality and molarity are equivalent



Molarity and Normality

Mole Fraction (X)

- Ratio of the moles of one constituent (ex. Solute) of solution to the total moles of all constituents (solute and solution)

$$\mathbf{X1} = \frac{n1}{n1 + n2} \qquad \mathbf{X2} = \frac{n2}{n1 + n2}$$

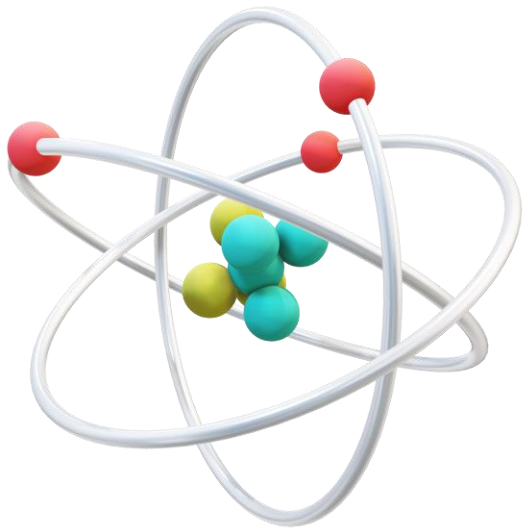
- This is for a system of two constituents.
- Were **X1** is the mole fraction of constituent 1(the subscript 1 is ordinarily used as the designation for the solvent)
- **X2** is the mole fraction of constituent 2 (usually the solute),and n1 and n2 are the numbers of moles of the respective constituents in the solution.

DR CUBE

Mole Fraction (X)

- The sum of the mole fractions of solute and solvent must equal unity , that is mean

$$X1 + X2 = 1$$



Mole percent

- Mole fraction is also expressed in percentage terms by multiplying X1 or X2 by 100.

Example :

In a solution containing 0.01 mole of solute and 0.04 mole of solvent, what will be the mole fraction of solute and of solvent and what will be their mole pecent?

Answer

The mole fraction of the solute is X2 = 0.01/(0.04 + 0.01) = 0.20.
Because the mole fractions of the two constituents must equal 1
The mole fraction of the solvent is 0.8.
The mole percent of the solute is 20%.
The mole percent of the solvent is 80%.

DR CUBE

Thank You !

https://t.me/Dr_Cube