Almustaqbal University College

Medical Laboratories Techniques Department

First year students

Subject : General chemistry 1 - Lecture 1A

Lecturer: Assistant professor Dr. SADIQ . J. BAQIR

Chemistry

Chemistry is the science that study matter, its chemical and physical properties, the chemical and physical changes it undergoes, and the energy changes that accompany those processes.

Major Areas of Chemistry

1. **ORGANIC CHEMISTRY**

Involves the study of the structure, properties, and preparation of chemical compounds of diverse substances such as plastics, drugs, solvents, industrial chemicals that consist primarily of **Carbon and Hydrogen.**

2. **Inorganic chemistry**

Involves the study of the properties and behavior of inorganic compounds. It covers all chemical compounds other than organic compounds. It studies minerals, metals, catalysts, and most elements in the Periodic Table.

3. **PHYSICAL CHEMISTRY**

Deals with the study of the effect of chemical structure on the physical properties of a substance. , the rate of a chemical reaction, the interaction of molecules with radiation, and the calculation of structures and properties.

4. **BIOCHEMISTRY**

Is related to the study of chemical reactions that take place in living beings (animals, plants and micro organisms). It tries to explain them in chemical terms.

5. **ANALYTICAL CHEMISTRY**

Involves the analysis of substance to determine its **composition and the quantity** of its components . It is concerned with answering the questions:

• **What** chemical species are present in a sample ?(Qualitative Analysis)

• **How much** of each component is present ?(Quantitative Analysis).

It is done through volumetric , gravimetric or instrumental methods .

There is a huge overlap between Chemistry and Engineering, Biology, Medicine, Physics, Geology, and other fields. Chemistry really is **a CENTRAL SCIENCE**.

Properties of Solutions

A **solution** is a homogeneous mixture of two or more substances. It is composed of one or more ***solutes*****,** dissolved in a ***solvent***.

For example, when sugar (the solute) is added to water (the solvent), the sugar dissolves in the water to produce a solution.

For the cases where the solvent is water, the homogeneous mixture is refered to as an **aqueous solution.**

Types of solutions:

There are different types of solution includes;

1. **Gas solutions**

Air is an example of a gaseous mixture (solution) where oxygen and a number of trace gases are dissolved in the gaseous solvent, Nitrogen.

2. **Solid solutions**

Metallic item, such as rings, are homogeneous mixtures of two or more kinds of metal atoms in the solid state. These homogeneous mixtures are termed ***alloys***.

3. **Liquid solutions**

Although solid and gaseous solutions are important in many applications, liquid solutions are more important because so many important chemical reactions take place in liquid solutions.

Electrolytic solutions:

Are solutions formed from solutes that are soluble ***ionic*** compounds(electrolytes). They dissociate in solution to produce ions that behave as charge carriers. Solutions of electrolytes are good conductors of electricity.
For example, sodium chloride dissolving in water:

$$\underset{\text{Solid sodium chloride}}{NaCl(s)} + H_2O \rightarrow \underset{\text{dissolved sodium chloride}}{Na^+(aq) + Cl^-(aq)}$$

Nonelectrolytic Solutions:

Are solutions formed from non dissociating *molecular* solutes (non electrolytes), and these solutions are nonconducting.
For example, dissolving Glucose sugar in water:

$$\underset{\text{Solid glucose}}{C_6H_{12}O_6(s)} + H_2O \rightarrow \underset{\text{Dissolved glucose}}{C_6H_{12}O_6(aq)}$$

A **true solution**
is a homogeneous mixture with uniform properties throughout.
, the solute cannot be isolated from the solution by filtration through the filter paper. Furthermore, solute particles will not "settle out" after a time.

Degree of Solubility
The rule ***"like dissolves like"*** was described as the fundamental condition for solubility. Polar solutes are soluble in polar solvents, and nonpolar solutes are soluble in nonpolar solvents.

The *degree* of **solubility,** *indicates how much* solute can dissolve in a given volume of solvent, which is a quantitative measure of solubility.

Methods of expressing concentrations-

Concentration represents the amount of dissolved substance (solute) per unit amount of solvent ,It can be expressed by:.

1) physical units : mass-volume
2) chemical units : equivalent weight- Molecular weight(mole).

Expressing concentrations By Physical units :

A. Percent concentration %

It can be expressed in several ways such as :

① Weight percent (w/w) %

Weight percent ($\frac{w}{w}$) % = $\frac{weight\ of\ solute}{weight\ of\ solution}$ x 100 %

e.g : Nitric acid (70%) solution, means that it contains (70 g) of HNO_3 for each (100 g) of solution.

②volume percent (V/V)%

Volume percent ($\frac{V}{V}$)% = $\frac{volume\ of\ solute}{volume\ of\ solution}$ x 100%

It is commonly used to specify the concentration of a solution prepared by diluting a pure liquid with another liquid.(e.g : perfumes)

e.g: 5% aqueous solution of a perfume usually describe a solution prepared by diluting 5 mL of perfume with enough water to give 100 mL.

③weight/volume percent (w/v)%

weight/volume percent ($\frac{w}{V}$)% = $\frac{weight\ of\ solute(gm)}{volume\ of\ solution(mL)}$ x 100%

It is often employed to indicate the composition of dilute aqueous solution of solid dissolved in water. **e.g** : 5% aqueous potassium nitrate refers to a solution prepared by dissolving (5.0 g) of KNO_3 in sufficient amount of water to give (100 mL) of solution .

Example:

Describe the preparation of one liter of (10%) NaCl solution $(\frac{w}{v})\%$.

Solution:

weight/volume percent ($\frac{w}{V}$)% = $\frac{weight\ of\ solute(g)}{volume\ of\ solution(mL)}$ x 100%

10% = $\frac{weight\ of\ solute(g)}{1000\ mL}$ x 100%

Weight of solute (g) =$\frac{10\ x\ 1000}{100}$ = 100 g

Then (100 g) of NaCl is to be dissolved in a sufficient volume of water and the volume is to be completed to (1) liter to get 10% $solution\ of\ NaCl$

Example:

Calculate the $\left(\frac{w}{v}\right)\%$ concentration of the aqueous solution of sodium chloride prepared by dissolving 5 g of NaCl in water and completing the volume to 250 mL .

Answer:

($\frac{w}{v}$)% = $\frac{weight\ of\ solute(g)}{volume\ of\ solution(mL)}$ x 100%

$$\left(\frac{w}{v}\right)\% = \frac{5\ gm}{250\ mL} \text{ x } 100\% = 2\ \%$$

Practice exercises :

a.Calculate the (w/v)% of 0.2 L of solution containing 15 g KCl.

b. Calculate the mass (in g) of sodium hydroxide required to make 2.00 L of a 1 % (w/v)% solution.

c. Calculate the volume (in mL) of a 25 % (w/v)% solution containing 10 g NaCl.