ALMUSTAQBAL UNIVERSITY

Department of Fuel and Energy Technologies Engineering

Analytical chemistry

First class / first term

Lecture Two

By

Asst. lect. SAFA FALLAH

Chemistry is the study of matter, including its composition and structure, its physical properties, and its reactivity. There are many ways to study chemistry, but, traditionally divide it into five fields: Organic, inorganic, physical, analytical, and biochemistry.

Analytical chemistry is a field of science consisting of a set of powerful ideas and methods that are useful in all fields of science, analytical chemistry concerned with determining the composition of substances. It comprises of two branches:

- ***Qualitative analysis***: deals with the determination of the identity of chemical constituents in samples.
- ***Quantitative analysis***: deals with the determination of the amounts (concentration or composition) of various substances in samples. There are many methods of determining these amounts, all based on chemical or physical properties of atoms, molecules and ions.

In general chemical analysis methods can be classification to:

- ***Gravimetric methods*** determine the mass of the analyte or some compound chemically related to it. This method is base on the measurement of the reaction product by precipitation.

- ***Volumetric method***, the method is based on determining the volume of a solution of known strength that required reacting with specific amount of the sample such as acid-base titration.

- ***Electroanalytical methods*** involve the measurement of such electrical properties as voltage, current, resistance, and quantity of electrical charge.

- ***Spectroscopic methods*** are based on measurement of the interaction between electromagnetic radiation and analyte atoms or molecules or on the production of such radiation by analytes. Finally, there is a group of

Lecture Two

miscellaneous methods that includes the measurement of such quantities as mass-to-charge ratio of molecules by mass spectrometry, rate of radioactive decay, heat of reaction, and rate of reaction, sample thermal conductivity, optical activity, and refractive index.

Fundamental Concepts

Atomic weight of element: The mass of a single atom in grams is much too small a number for convenience, and chemists therefore use a unit called an **atomic mass unit** (***amu***) also known as a *dalton* (Da). One **amu** is defined as exactly one-twelfth the mass of carbon isotope ^{12}C and equal to 1.66054×10^{-24} g.

Example: prove that carbon weighing 1.0×10^{-3} g contains 5.01×10^{19} carbon atom?

$$1.0 \times 10^{-3}\ g \times \frac{1\ amu}{1.6605 \times 10^{-24}\ g} \times \frac{1\ C\ atom}{12.011\ amu} = 5.01 \times 10^{19}\ C\ atoms$$

Molecular weight (Mwt): is the average mass of a substance's molecules. Numerically, is equal to the sum of the atomic weights of all atoms in the molecule.

$$molecular\ weight = \text{sum of atomic weight}$$

M.wt of water (H_2O) =2(1.008) +1(16.00) =18.02

M.wt of hydrogen (H_2) = 2(1.008) = 2.016

These weights are all relative to the mass of ^{12}C atom as 12.000 with (SI) system of units' .Molecular weight is expressed by g/mole

H.W: Calculate the M.wt. of $C_7H_{14}O_2$, $C_2H_5N_2SO_4$, Na_2CO_3, P_2O_5

Mole (mol): its Avogadro number (6.022137×10^{23}) of species, so one mole of something consists of 6.022137×10^{23} units of that substance.