LEC.2

Classification of analytical Chemistry Weight and concentration Units , Methods of expressing of concentrations

Analytical chemistry the introduction of chemical methods to solve problems. In today's world, analytical chemistry is a very important part of science as it solves so many problems for people and helps them in their daily life.

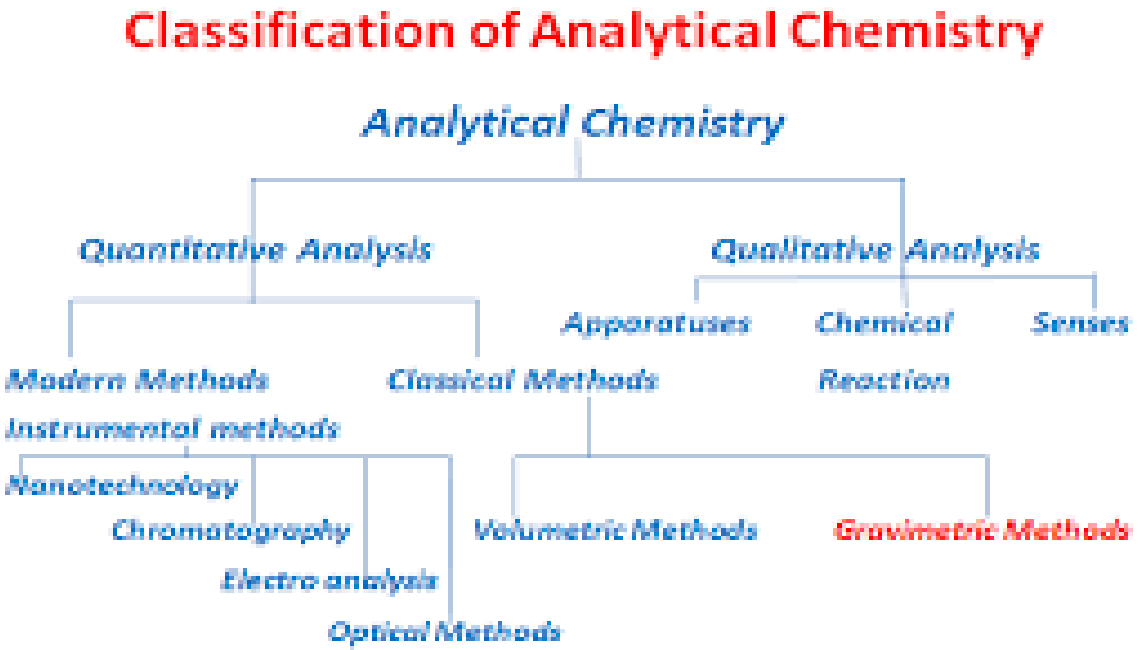
Analytical Chemistry has been split into two categories: qualitative analysis and quantitative analysis which are used widely by chemists.

Qualitative Analysis

This area deals with the identification of an unknown substance or classifying a known substance into one of its constituent parts. It involves separation techniques including filtration, distillation, etc., followed by some form on property measurements such as colorimetry (eosin), polarography (redox potential), and chromatography(separating mixtures). The main aim is to identify unknown compounds using properties like melting point, boiling point, and solubility.

Quantitative analysis

The process of measuring and determining the quantity of an element or chemical in a given sample. There are five major types, which include gravimetric analysis, titrimetric analysis (which includes volumetric analysis), colorimetry, potentiometry, and chromatography.

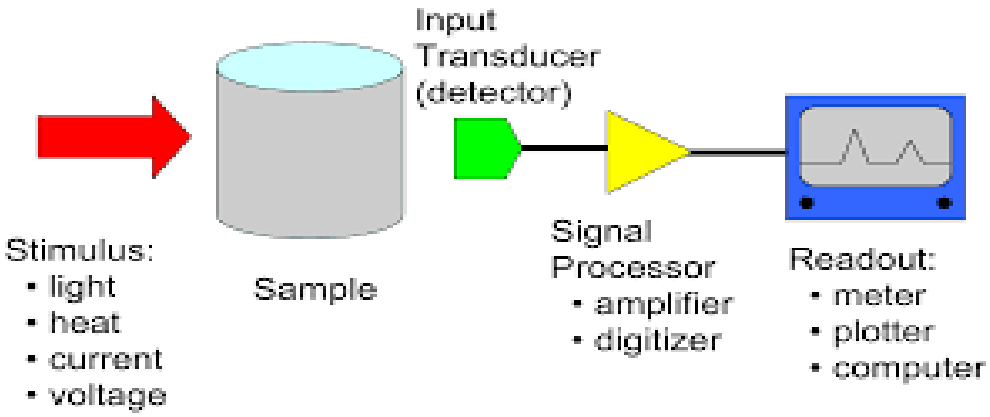


1. Classical Analysis System

Generally, this depends on the chemical reaction, such as volumetric analysis and gravimetric analysis. And it uses simple equipment such as burettes, balances, flame and furnace. It is used to estimate high concentrations .

Instrumental Analysis

This form of study requires equipment that focuses on the physical that physico-chemical properties of the analyte, such as the absorption or emission of electromagnetic radiation (spectroscopic analytical methods) or the electrical properties of the analyte such as electrical or electrical conductivity (electrochemical analysis methods) and finally the methods of chromatographic separation.

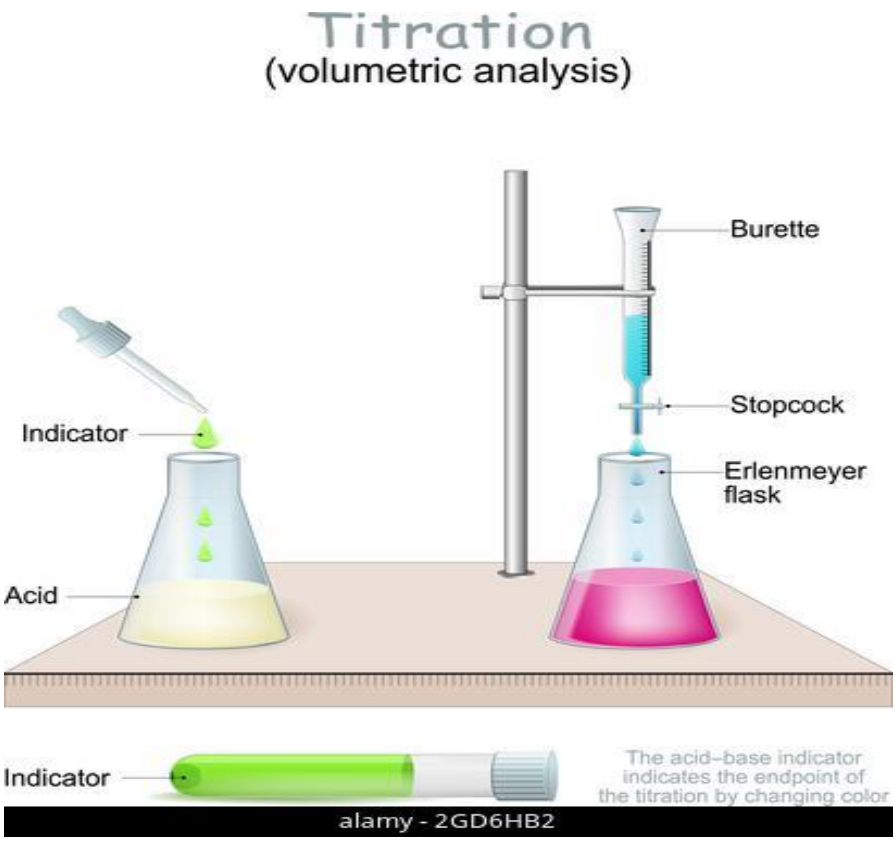


Gravimetric Analysis

Gravimetric analysis involves determining the amount of material present by weighting the sample before or after some transformation. A common example used in scholarly education is the determination of the amount of water in a hydrate by heating the sample to remove the water such that the difference in weight is due to the loss of water.

Volumetric Analysis

Titration involves the accumulation of reagent to the solution to be analyzed until a certain equivalence point is reached. The amount of substance in the analyzed solution can often be determined. For those who have studied chemistry, titration of acids and bases is best known, which includes a color-changing index. There are many other types of titration, such as potentiometric titration. These headings can use different types of metrics to reach a certain point of equivalence .



2. Analytical Chemistry in Modern Research

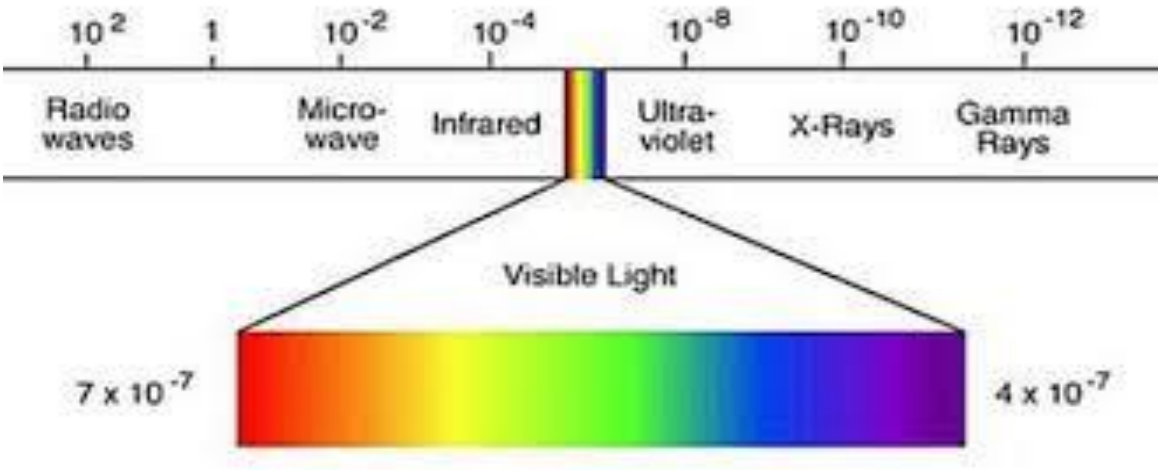
Analytical chemistry can be applied in different aspects including, biological analysis, clinical and environmental investigation and material study. Research in analytical chemistry is largely determined by performance like sensitivity, detection limit, selectivity, speed and cost.

Optical and mass spectrometry are the most common and universal among the main branches of contemporary analytical atomic spectrometry .

Several developments improve the analysis of biological systems. Examples DNA sequencing, and related research in the fields of genetic fingerprinting and DNA micro-disks; proteomics, analysis of protein concentrations and changes, in particular the effects of different stresses , at different stages of development or in different parts of the body, metabolomics, dealing with metabolites; transcripts, including mRNA and related fields; lipidomics - lipids and related areas; peptidomics - peptides and related fields; and metallurgy, which deals with metal concentrations, in particular their binding to proteins and other molecules .

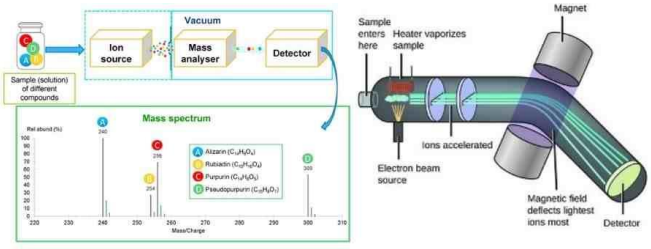
3. Spectroscopy

Spectroscopy consists of many different applications such as atomic absorption spectroscopy, atomic emission spectroscopy, ultraviolet-visible spectroscopy, X-ray fluorescence spectroscopy, infrared spectroscopy, Raman spectroscopy, nuclear magnetic resonance spectroscopy, photoemission spectroscopy and so on .

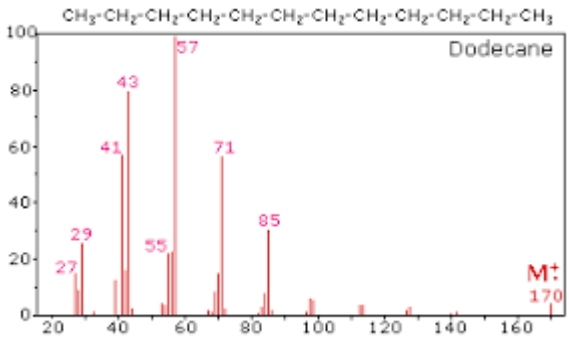


4. Mass Spectrometry

This is an analytical method of characterizing matter, based on the determination of atomic or molecular masses of individual species present in a sample. The instruments employed for carrying out mass spectrometry can be classified into different categories according to the mass separation technique used . This technique is found in many industrial control processes as well as for regulation compliance

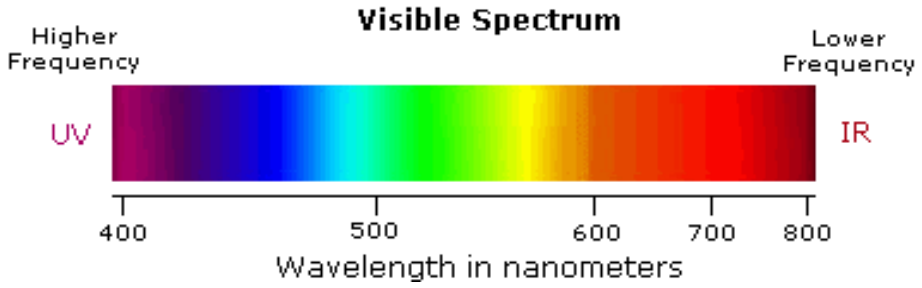


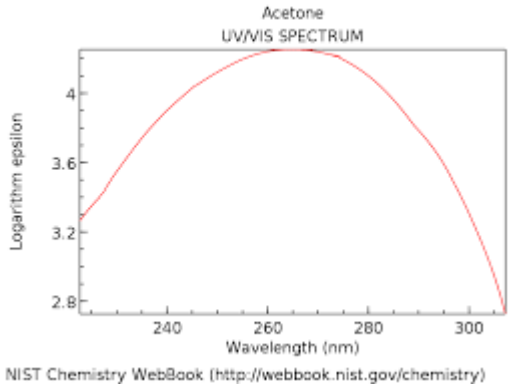
Mass Spectrometry

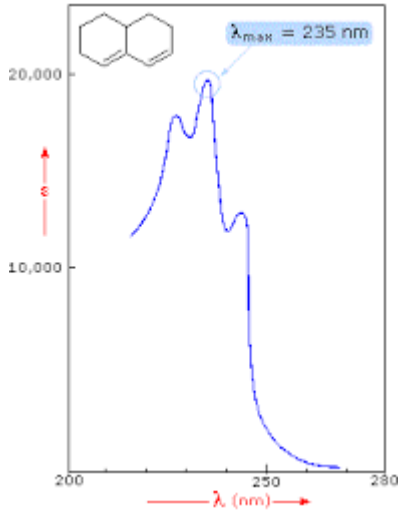


5. Ultraviolet and Visible Absorption Spectroscopy

The absorption of electromagnetic radiation material between the near-ultraviolet and the very near-infrared range (between 180 and 1100 nm) had been studied in detail . This part of the electromagnetic spectrum, called UV / visible because it involves perceptible radiation from the human eye, usually provides little structural information but is very useful for quantitative measurements . The concentration of the analyte in the solution can be determined by measuring the absorbance at a certain wavelength and applying the Lambert-Beer law. The method is known as colorimetry, which is considered a workplace in many laboratories .

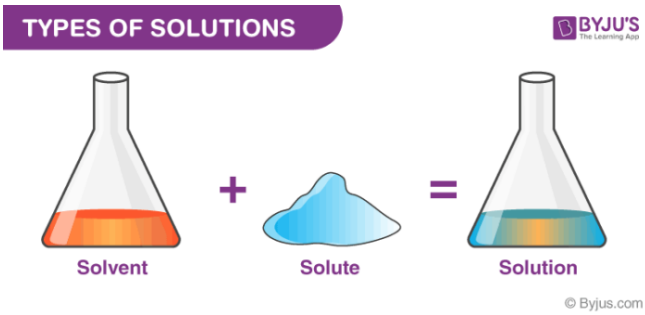






Solutions

are homogeneous mixtures containing one or more **solutes** in a **solvent**. The solvent that makes up most of the solution, whereas a solute is the substance that is dissolved inside the solvent.



Relative Concentration Units

Concentrations are often expressed in terms of relative unites (e.g. percentages) with three different types of percentage concentrations commonly used:

1. **Mass Percent**: The mass percent is used to express the concentration of a solution when the mass of a solute and the mass of a solution is given:

$$\text{Mass Percent} = \frac{\text{Mass of Solute}}{\text{Mass of Solution}} \times 100\% \quad (1)$$

2. **Volume Percent**: The volume percent is used to express the concentration of a solution when the volume of a solute and the volume of a solution is given:

$$\text{Volume Percent} = \frac{\text{Volume of Solute}}{\text{Volume of Solution}} \times 100\%$$

3. **Mass/Volume Percent:** a percentage concentration is mass/volume percent, which measures the mass or weight of solute in grams (e.g., in grams) vs. the volume of solution (e.g., in mL).

Mass/Volume Percent=Mass of Solute (g)Volume of Solution (mL)×100%

Concentration of Solutions

We can calculate the concentration of solutions by various methods. Let's study each method and determine the formulas for this method.

Mass/Weight Percentage or Percentage by Mass/Weight

$$Mass\ Percentage = \frac{Mass\ of\ Solute}{Mass\ of\ Solution} \times 100$$

$$= \frac{Mass\ of\ Solute}{Mass\ of\ Solute + Mass\ of\ Solvent} \times 100$$

$$= \frac{Mass\ of\ Solute}{Volume\ of\ Solution + Density\ of\ Solution} \times 100$$