Table of Contents

Analytical Chemistry:

Is a branch of chemistry that deals with the analysis of substances (analytes) present in the sample **qualitatively** and **quantitatively**. In order to accomplish this analysis we must know the physical and chemical properties of these substances. In other words analytical chemistry deals with the separation, Identification and determination of substances in a sample. It also includes coverage of chemical equilibrium and statistical treatment of data.

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Definitions:-

Sample is anything that comes to mind in the air, water, soil, food and living organisms such as a piece of rock or a piece of meat or some water from the tank of the house or from a river or a lack or a sea or some tissue or blood from humans or animals or some vegetables .... etc. The sample is taken to the laboratory and analyzed for its substances (analytes) after pretreatment and the final step is the calculations of the percentage of each substance in the sample. An **analyte** is a constituent of a sample that is analyzed for, and its concentration is determined.

Common Analytical issues

Perhaps the most common analytical problem is a quantitative analysis. Examples of typical quantitative analyses include the elemental analysis of a newly synthesized compound, measuring the concentration of glucose in blood, or determining the difference between the bulk and surface concentrations of Cr in steel. Much of the analytical work in clinical, pharmaceutical, environmental, and industrial labs involves developing new quantitative methods for trace amounts of chemical species in complex samples. Most of the examples in this text are quantitative analyses.

Another important area of analytical chemistry, which receives some attention in this text, is the development of new methods for characterizing physical and chemical properties. Determinations of chemical structure, equilibrium constants, particle size, and surface structure are examples of a characterization analysis.

The purpose of a qualitative, quantitative, or characterization analysis is to solve a problem associated with a particular sample. The purpose of a fundamental analysis, on the other hand, is to improve our understanding of the theory behind an analytical method. Extending and improving the theory on which an analytical method is based, studying an analytical method's limitations, and designing and modifying existing analytical method are examples of fundamental studies in analytical chemistry.

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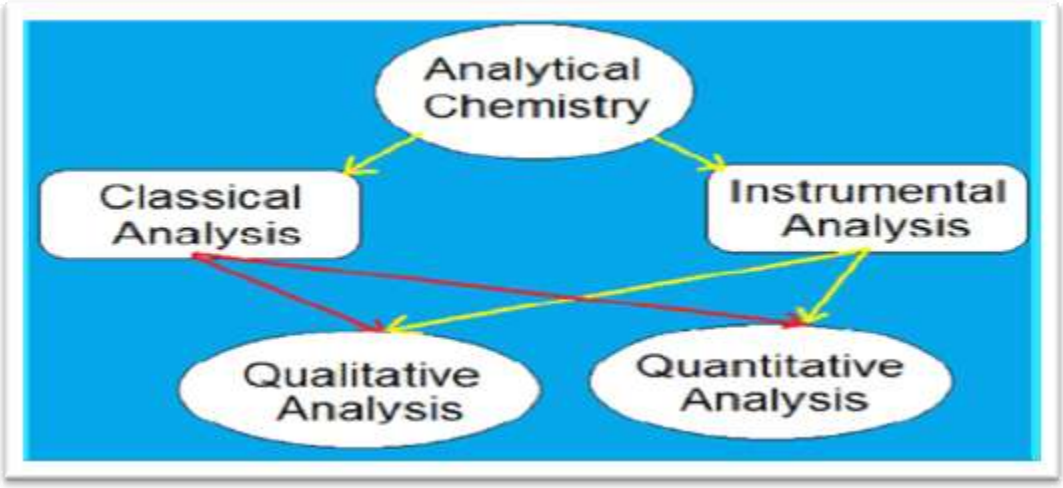

Qualitative Analysis

This analysis detects (identify) the type of all or some of the substances present in the sample (elements or ions or compounds). In other words it gives an answer to the question:

What substances are present in a sample?

These substances can be detected either by a chemical reaction For example, when you add silver nitrate solution to the sample solution a white precipitate formation indicates the presence of chloride ion in the sample.

Figure (1) Silver nitrate solution

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There are also many reagents that give distinctive colors with some of the substances and can be used in the detection of these substances. The flame also can be used for the detection of some common metals.

Qualitative Instrumental Analysis:

Currently there are many instruments that are separate and distinguish substances (organic or inorganic) in the sample, such as gas chromatography – mass spectrometry (GC – MS) , High performance liquid chromatography - mass spectrometry (HPLC – MS) , infrared spectra (IR) and induced coupled plasma – mass spectrometry (ICP – MS) or ICP – AES (Atomic Emission Spectrometry).

Figure (2) Qualitative Instrumental Analysis

Quantitative Analysis: This analysis gives knowledge of the amount of all or some of the substances present in the sample and uses two types of analysis depending on the concentration of the substance in the sample, namely **classical chemical analysis** and **instrumental analysis.**

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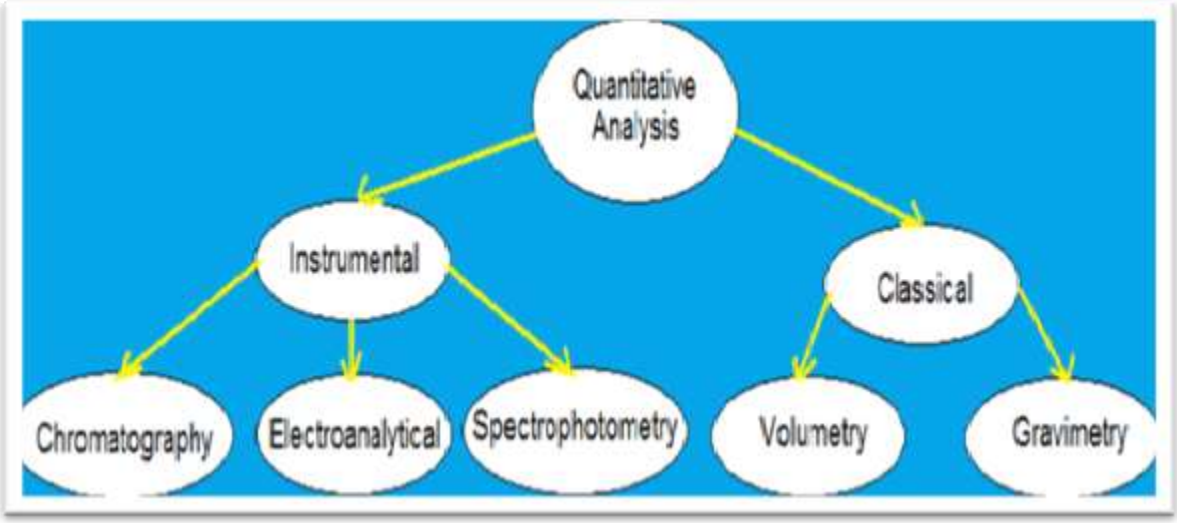

Classical chemical analysis:

Which depends on the chemical reaction, such as volumetric analysis and gravimetric analysis, as we shall see later in lectures. And it uses simple equipment such as burettes, balances, flame, furnace. And is used to estimate high concentrations (more than 0.001 M).

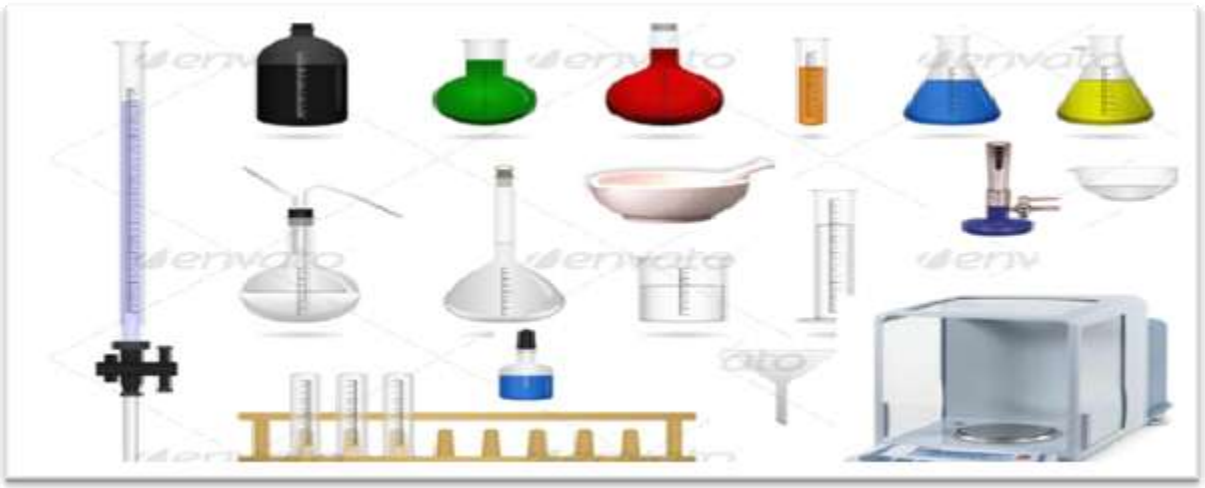

Figure (3) Chemical instruments used in Lab.

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Instrumental Analysis:

This type of analysis uses instruments and depends on the physical and physico-chemical properties of the substance being analyzed (analyte) such as absorption or emission of electromagnetic radiation (spectroscopic methods of analysis) or electrical properties of the substance being analyzed such as voltage or current intensity or electrical conductivity ..... etc. (electrochemical methods of analysis) and finally the methods of separation such chromatography.

Figure (4) FTIR Instrumental Analysis

HomeWork:

Compare between Qualitative and Quantitative analytical chemistry.

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