



Analytical chemistry

is a branch of chemistry that deals with the quantitative and qualitative estimation of the elements or compounds that make up the substance to be analyzed. This branch is divided into several methods and techniques that can be used, **each of which has its uses and importance, including:**

- 1-Volumetric analysis and gravimetric analysis
- 2-Thermal analysis
- 3-Qualitative analysis
- 4-Spectrometric analysis
- 5-Instrumental analysis
- 6-Electrolysis.

Some of these methods can detect the presence of a compound or elements with high sensitivity that may reach a concentration of one part per million billion grams/liter.

The subject of analytical chemistry and its tasks

The methods of qualitative and quantitative analysis are very diverse. Therefore, a substance can be studied in different ways. The name analytical chemistry is given to the science that specializes in methods of analysis. In a broader sense, analytical chemistry is a science that is not limited to methods of analyzing the



composition of an analyte to be analyzed, but also includes methods of studying the multifaceted chemical aspects of the materials around us on Earth and the planets that we can observe.

Analytical chemistry helps solve many problems, including:

Clarifying the nature of the studied sample (analyte), proving whether the substance in question is of organic or inorganic origin.

Determining the forms of existence of independent components in the sample (for example, the presence of (S^{-2} , SO^{-23} , or SO^{-24}) and the degree of oxidation of elements (Fe^{+2} , Fe^{+3} , CR^{+3} , etc.).

Determining the composition and quantity of each of the main component (gold in the form of an innate metal, for example) and foreign impurities in it (copper and silver in a gold sample, for example), as well as the quantity of fine impurities (those present in very small quantities) and their local distribution in highly pure technical samples (such as boron in graphite, iron, semiconductors, etc.).

Determining the formula of an unknown compound (such as a metal, a newly synthetic substance, a pharmaceutical preparation extracted from a plant, etc.).

Detecting certain structural elements in the compound in question and then determining the structure of this compound (such as detecting certain hydroxyl or



carboxyl groups, double bonds, hydrocarbon moieties, or the like in the compound under study).

Basic concept of qualitative and quantitative analysis

The major types of analytical procedures used in chemistry to determine the chemical composition of a material qualitatively and quantitatively include qualitative and quantitative analysis.

Qualitative Analysis

Qualitative analysis in chemistry, is a branch of the subject that examines the chemical makeup of a material. It denotes the presence of several elements or groupings of elements in the sample, such as functional groups. As a result, a qualitative analysis of a sample can be utilized to establish whether or not a specific component is present. However, no information regarding the quantity of that chemical component is provided by this examination. Color, aroma, melting point, boiling point, reactivity, precipitation, and other characteristics of the sample are frequently evaluated in the analysis.

There are two forms of qualitative analysis:

organic qualitative analysis and inorganic qualitative analysis.



Organic qualitative analysis, for example, determines the sample's functional groups and chemical bonds, whereas inorganic qualitative analysis, for the most part, determines the ions present in the sample.

Examples:

Let's look at a few examples to see how a sample's qualitative analysis works:

1. Test for Iodine (An Organic Qualitative Analysis Technique) – The iodine test is used to determine whether or not starch is present. Sugar is a type of organic substance. The indication is liquid iodine in this case. To test, utilize a spot test (take a white tile and drop some drops of the samples to be examined on it.) Then, for each drop of sample, add a drop iodine solution. The presence of starch is indicated by a change in the color of the sample to a brown color.
2. Test with a flame (An Inorganic Qualitative Analysis Technique) – The existence of a certain metal or its ions can be determined via a flame test. The flame takes on varied hues depending on which metal atoms are present. The presence of some metal ions can be determined based on the flame color produced when a part of the sample is burned in the Bunsen burner. Zinc, for example, produces a green flame.



The following chemical procedures can be employed in the qualitative examination of a sample:

- Variation in color
- Extraction
- Precipitation
- Chromatography
- Spectroscopy

- **Variation in color**

In a chemical reaction, bonds of the reactant molecules will break and new bonds are made within the molecules of the product.

These chemical changes are not always visible to the naked eye, but some chemical reactions are characterized by a change in the color of reactants.

In a chemical reaction, two or more elements combine to interact and a different structure is formed, with a different composition and color in total.

For example, on heating, the green color of Ferrous Sulphate (FeSO₄) changes to the reddish-brown color of Ferric Oxide (Fe₂O₃)

