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Analytical Chemistry: Branches, Methods and Applications

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Analytical chemistry is the science of separating, identifying, and quantifying chemical components of a matter. In other words, it is the quantitative and qualitative analysis of a given sample. Qualitative analysis involves identifying the chemical composition of a sample and **quantitative analysis** determines the quantity of different components present in the sample. The use of **mass spectrometry** to measure charged particles and determine the composition of a substance is an example of analytical chemistry. Analytical chemistry is used majorly in the field of medicine to determine levels of essential **nutrients** and toxic waste present in the body as well as to check the quality of pharmaceutical products.

Read Also: [Some Basic Concepts of Chemistry](#)

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What is Analytical Chemistry? [\[Click Here for Sample Questions\]](#)

Analytical chemistry is a discipline of chemistry concerned with the qualitative and quantitative examination of various substances. It deals with the separation, identification, and quantitative analysis of chemical constituents of a substance. When analytical chemistry is used to make biological measurements, it is known as **bio analytical chemistry**.

Analytical chemistry employs both traditional and contemporary methods and involves the use of modern scientific instruments to perform analysis.

The three main steps involved in analytical chemistry are:

- The **separation** procedure separates the appropriate chemical species from a **mixture** for analysis.
- Identification** of the analyte material is accomplished using qualitative analytical method.
- Quantitative analysis is performed to determine the **analyte concentration** in a given combination.

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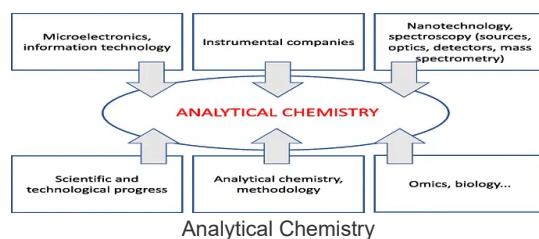
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Branches of Analytical Chemistry [\[Click Here for Sample Questions\]](#)

Analytical chemistry is divided into two branches: quantitative and qualitative. These two branches are explained in detail below:

Quantitative Evaluation

It is a method of calculating absolute or relative quantity of a sample or a blend when one or more substances are present in it. Quantitative experimental procedures include gravimetric analysis and volumetric analysis.

- **Gravimetric analysis**, also known as quantitative estimate by **weight**, is the technique of isolating and weighing an element or a combination of an **element** in its most pure form. The fundamental goal of gravimetric analysis is to turn an element or radical into a stable, pure compound that can be easily transformed into a form that can be weighed. Weight of an element is determined using the compound's formula and the **atomic weights of elements** that make up the compound. Precipitation, volatilization, or electroanalytical techniques can be used to separate the element or its compound.
- **Volumetric analysis**, also known as titrimetric analysis, is a method in which volume of a reagent reacting stoichiometrically with the analyte is measured. Volumetric methods were equivalent to gravimetric methods in **accuracy and precision**.

Qualitative Research

The term "quality" refers to the characteristics of a substance. Qualitative analysis is concerned with determining the quality of a chemical, regardless of its quantity or **concentration**. To put it another way, qualitative analysis determines the quality of a substance rather than the quantity of that substance.

For example, a chemist has a sample of an unknown chemical. He needs to know the kind of chemicals that are present in that sample first and therefore he will use 'qualitative' method to sort that out. After that, he will move on to quantitative approaches. He will then arrive at a stage in the experiment where he can accurately measure the correct amount of different chemicals present in the sample.

Read Also:

[Conductometric Titration](#)

[Redox Titration](#)

[Precipitation Titration](#)

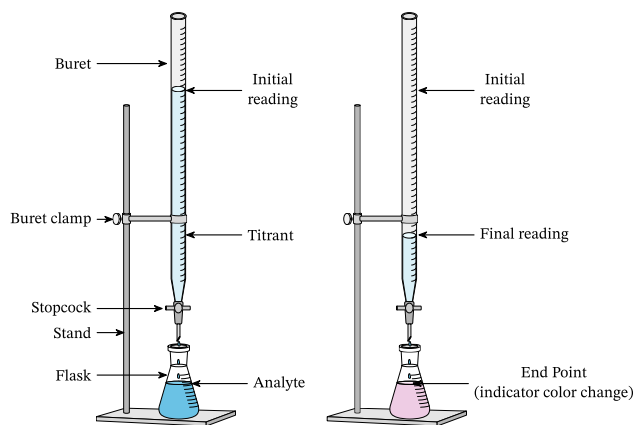
Methods used in Analytical Chemistry [\[Click Here for Sample Questions\]](#)

In analytical chemistry, the methods used for qualitative and quantitative estimation of substances are broadly classified into two categories:

Traditional Techniques

There are a variety of traditional ways for determining if a chemical is present or absent in an analyte.

- The acid test for **gold** is an example of traditional method for determining whether the given substance is actually gold or not.
- The Kastle-Meyer test which uses **phenolphthalein** as an indicator to assess for the presence of haemoglobin in a given analyte is another example of a traditional qualitative analytical method.
- Flame tests may be performed to check for the presence of certain components in the analyte. This is done by exposing an analyte to a flame and watching the colour change of the flame.
- Gravimetric analysis is a traditional method of quantitative analysis that may be used to estimate the quantity of water in a hydrate by heating it and determining the weight of the water lost.
- Volumetric analysis (or **titration**) is a well-known classical approach of quantitative analysis. A reactant is introduced to the analyte until an equivalency point is reached in the titration technique.



Volumetric Analysis

Read More: [Thermochemistry](#)

Instrumental Approaches

Instrumental approaches refers to the use of scientific instruments to carry out different processes of analytical chemistry.

- The interaction between **electromagnetic radiation** and atoms or molecules in a sample is measured using **spectroscopy**.
- The method of mass spectroscopy is used to determine the ratio of a molecule mass to its charge by using electric and **magnetic fields**.
- Electrochemical analysis is a popular instrumental technique used in analytical chemistry. The analyte is put in an **electrochemical cell**, and the voltage or current flowing through it is determined using this technique.
- The field of analytical chemistry known as **calorimetry** studies the interaction between an analyte and energy in the form of heat. A calorimeter is a device that measures the heat produced by a chemical process.

Read Also:

Beer-Lambert Law	Coloumn Chromatography	Karl Fischer Titration
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Applications of Analytical Chemistry [\[Click Here for Sample Questions\]](#)

Analytical chemistry is used in a variety of applications in contemporary culture, including drug development, industrial process control, environmental monitoring, medical diagnostics, food production, and forensic surveys. It is also critical in a variety of study fields. The following are some of the important applications of analytical chemistry:

- **Analytical chemistry is used to determine the shelf life of various medications.**
- **It is used to detect adulterants in pharmaceuticals.**
- **It can be used to determine the quantity of minerals and nutrients required for plant development by testing the soil.**
- **It is used in chromatography as well.**
- Analytical chemistry may also be used to assess the quantity of pesticide residues and pollutants in any food sample.
- It can be used to measure cholesterol and glucose levels in a **blood** sample.
- Forensic science, clinical analysis, and even environmental analysis all rely on analytical chemistry.

Things to Remember

- Analytical chemistry is used to detect, identify, characterise, and quantify chemical substances.
- Analytical chemistry employs both traditional and instrumental approaches to perform analysis of a substance.
- It is frequently used in biology for pharmaceutical product research, development, and quality control.
- Analytical chemistry is essential in medical science because it aids in the measurement of key nutrients and hazardous waste levels in the body.
- Analytical Chemistry can be used in spectroscopy, **electrochemistry**, chromatography, separation and preconcentration methods etc.

Sample Questions

Ques. What is the purpose of analytical chemistry? (2 marks)

Ques. What role does analytical chemistry play in Agriculture? (3 Marks)

Ques. What is the relevance of analytical chemistry in everyday life? (3 Marks)

Ques. Where is analytical chemistry applied? (2 Marks)

Ques. What are the fundamental analytical chemistry tools? (3 Marks)

Ques. What is the difference between quantitative and qualitative analysis? (3 Marks)

Ques. What is Titration and its types? (5 Marks)

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Relation Between Molality and Molarity	Principle of UV Visible Spectroscopy	Electromagnetic Spectrum

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