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Quantitative & Qualitative Analysis Method Is Any Methods

Quantitative and qualitative analysis are the two main types of methods used in chemistry to determine the chemical makeup of a material. When comparing qualitative and quantitative research, the main distinction in chemistry is that while the former determines the presence or absence of specific chemical components, the latter measures how much of such components are present in a given sample.

Quantitative Analysis: -

Quantitative analysis is the branch of chemistry concerned with determining how much of each component there is in a given sample. The value can be written in a variety of units, including mass, volume, concentration, and relative abundance.

There are two methods in quantitative analysis which are:

• Chemical methods – Chemical methods include titration methods, gravimetric methods, combustion analysis techniques, and chemical reactions (for example, oxidation, reduction, precipitation, neutralization).

• Physical methods – Physical methods examine one or more of a sample's physical attributes. AES (Atomic emission spectroscopy), x-ray fluorescence spectroscopy, mass spectroscopy, Elements analysis (C, H, N, S) of organic compounds using a CHNS analyzer and atomic absorption spectrophotometer, and alkali and alkaline earth metals (K, Na, Ca, Mg) using a flame photometer. Other techniques are examples.

Quantitative chemistry: -

Quantitative chemistry is a very important branch of chemistry because it enables chemists to calculate known quantities of materials. For example, how much product can be made from a known starting material or how much of a given component is present in a sample.

Quantitative analysis (QA) is a set of techniques that use mathematical and statistical modeling, measurement, and research to understand behavior.

Quantitative analysis is any method used for determining the amount of a chemical in a sample. The amount is always expressed as a number with appropriate units.

Volumetric Analysis: -

Quantitative methods of analysis include volumetric analysis, which involves determining the concentration of a chemical in a solution by reacting a known volume of the solution with a solution of the material at a known concentration.

According to the law of chemical equivalence, substances react in the same ratio as their equivalent weight. This is the foundation of volumetric analysis. 'Titration' refers to the method used to do this kind of analysis.

Conditions for Volumetric Analysis

The reaction involved in volumetric analysis must satisfy the following requirements.

- **The reaction must be stoichiometric.**
- **Reaction should be fast.**
- **Reaction must be specific and there should be no side reaction.**
- **Reaction must show a sharp color change at the end of the reaction.**

Titration: -

Titration, also called titrimetric, is a method of chemical qualitative analysis that can be used to determine how much of a specific analyte is present in a sample. Titration, commonly known as volumetric analysis, is a vital procedure in the science of analytical chemistry.

Types of Titrations:-

1- Acid-Base Titration: -

An acid-base titration is an example of quantitative analysis. In this module you will learn about the core ideas or building blocks that are required for a deep understanding of quantitative chemistry.

Titration with acids and bases, also called acidimetry or alkalimetry, is a technique used in chemistry for making this determination. When an acid and a base are mixed in a solution, neutralization takes place. This is the primary mechanism upon which acid-base titrations depend. The concentration of an acid can be calculated using a standard base solution. Acidimetric is another name for this method.

The amount of H^+ ions (hydrogen ions) an acid dissociates into in water is a good indicator of how powerful or weak it is. Assuming the neutralization reaction proceeds to completion, the concentration of an acid solution can be calculated by titrating it with a strong base of known concentration. For the same reason, a strong base is needed throughout the titration procedure. Therefore, the strong base is the standard solution, and the acid solution is the titrate, in this case.

Acid is titrated with a base and base is titrated with an acid. The endpoint is usually detected by adding an indicator.

For Example:

$HA + BOH \rightarrow BA + H_2O$

where,

- **HA is acid and A is a negative ion**
- **BOH is base and B positive ion**

For example, an unknown molarity of HCl acts as the analyte. 50 mL of it is placed into a flask and a 0.1 M solution of NaOH will be the reagent. The endpoint is pH=7 so litmus, with a pKa of 6.5 is chosen. The color of the solution changes when 10 mL of 0.1 M NaOH is added.

The balanced neutralization reaction:

$$HCl\ (aq.) + NaOH\ (aq.) \rightarrow H_2O + Na^+ + Cl^- \quad (1)$$

Or just the net ionic equation

$$H^+ + OH^- \rightarrow H_2O \quad (2)$$

The following equation can then be derived

$$X = (0.1\ M\ \ NaOH)(10\ mL)\left(\frac{1\ L}{1000\ mL}\right)\left(\frac{1\ mol\ NaOH}{1\ mol\ OH^-}\right) \qquad (3)$$

H+ =X HCl (4)

X=0.0010 mol of HCl

The molarity is now easily solved for

$$\frac{0.0010\ mol\ HCl}{0.050\ L} = 0.020\ M\ HCl \qquad (5)$$

2- Redox Titration;-

Titration is an example of an oxidation-reduction reaction. This titration relies on electron transport among the reactive ions in aqueous solutions to produce the chemical reaction. Redox titration involves two solutions, one of which acts as a reducing agent and the other as an oxidizing agent. Examples of Redox Titration are:

1- **Permanganate Titration**
2- **Dichromate Titration**
3- **Isodiametric and Audiometric Titration**

Permanganate titration

Permanganate titration is a method used in analytical chemistry to determine the concentration of a substance by adding a solution of permanganate

Potassium permanganate serves as an oxidizing agent. The item is maintained in good condition through the use of dilute sulphuric acid.

The balanced equation for the reaction is:

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

This solution is colorless until the endpoint. In addition, potassium permanganate is utilized for the determination of oxalic acid, ferrous salts, hydrogen peroxide, oxalates, and various other substances.

3-Precipitation Titration: -

This titration method relies on the formation of a precipitate. During precipitation titration, two chemicals that react with each other are brought into contact. For

instance, when utilizing silver nitrate solution, one may employ either ammonium thiocyanate or sodium chloride solution. When it undergoes interaction, it results in the formation of a white precipitate composed of either silver thiocyanate or silver chloride. The chemical equation is as follows:

$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

The titration is commonly followed by Gravimetric Analysis to determine the concentration of ions in the precipitate

4-Complex Metric Titration: -

Complex metric titration is a technique used in analytical chemistry to determine the concentration of a metal ion in a solution. It involves the formation

The most significant occurrence in this titration is the development of an un dissociated compound. It encompasses more than just precipitation titrations. For example: The reaction can be represented as follows:

$Hg^{2+} + 2\ SCN^- \rightarrow Hg(SCN)_2$

Gravimetric Analysis:-

Gravimetric analysis is an analytical technique that is used to quantitatively determine an analyte by measuring the mass of a solid substance.

The requirements for gravimetric analysis are as follows:

For successful gravimetric analysis using the precipitation method, it is essential to meet the following fundamental condition.

1-The component that requires estimation should be completely precipitated.

2-The precipitate must be pure before it is weighed.

3-The precipitate should be appropriate for various handling tasks, such as filtering, washing, and weighing.

4-The selection of an insoluble precipitate of the constituent to be determined is the most fundamental requirement for gravimetric analysis. 5-This precipitate should have sufficient stability and be suitable for manipulation.

For example, to determine the chloride ion content in drinking water, Silver Nitrate ($AgNO_3$) will be added to the sample solution, resulting in the precipitation of silver chloride (AgCl), as below equation:

$Ag^+(aq.) + Cl^-(aq.) \rightarrow AgCl(s)$

Principle of Gravimetric Analysis:-

Gravimetric analysis is a method based on the principle that the mass of an ion in a pure compound can be determined by calculating the percentage of mass of the same ion in a known amount of an impure compound. The gravimetric analysis is performed according to the following steps:

1- **Preparing the solution**
2- **Filter and wash the sediment**
3- **Drying process**
4- **Ignition**
5- **Heating until a constant weight is reached**

Qualitative analysis :-

Qualitative chemical analysis, branch of chemistry that deals with the identification of elements or grouping of elements present in a sample. The techniques employed in qualitative analysis vary in complexity, depending on the nature of the sample.

Qualitative analysis in chemistry give details of the presence or nonappearance of different chemical components in an unknown sample. Qualitative analysis is also called subjective investigation. in the field of chemistry, it a part of science examine the substance piece or chemical composition of sample.

The seven methods to perform the qualitative analysis of a chemical compound lie hereunder: -

1. **Change in colour**
2. **Flame test**
3. **Distillation**
4. **Extraction**
5. **Precipitation**
6. **Chromatography**
7. **Spectroscopy**

What is the difference between quantitative and qualitative analysis in chemistry?

The main difference between qualitative and quantitative analysis chemistry is that qualitative analysis determines whether or not different chemical components are present in a sample, whereas quantitative analysis determines the amount of different chemical components present in a sample.

What is qualitative chemistry example?

The classical approach to qualitative analysis involves both a 'dry' test and a 'wet' test. A dry sample of a solid substance is heated in a flame. The colour of the flame typically indicates the presence of certain elements. For example, zinc gives off green light when subjected to a flame.