

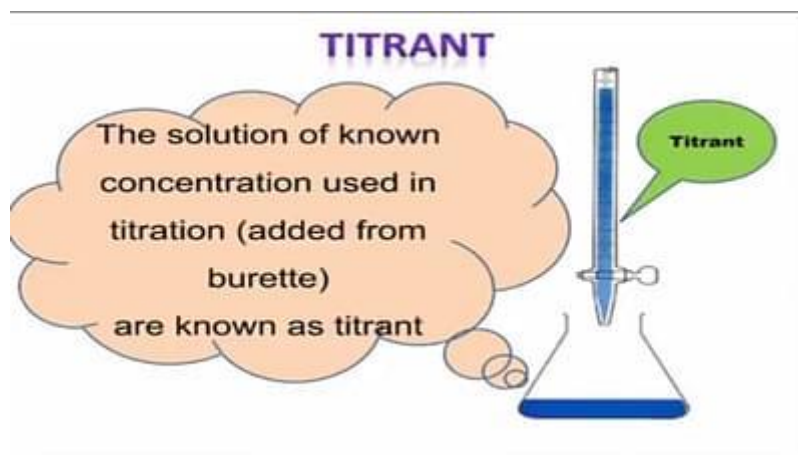
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Volumetric analysis

is a quantitative analytical method used to measure volume of a solution whose concentration is known. It is applied to the concentration of an analyte or known solution. Volumetric analysis was first used for determining the proportion of nitrogen mixed with other elements in organic compounds.

What is Volumetric Analysis?

Volumetric Analysis is the method in which the concentration of a substance in a solution is estimated by adding the same number of compounds of another substance present in a solution of known concentration. Volumetric Analysis is also known as Titration.





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Titrant

The titrant is the component whose solution is used to determine the concentration of an unknown solution. The component whose concentration is to be estimated is known as titrate. Titrimetric analysis is another name for volumetric analysis.

Types of Titration

Titration is a category of volumetric analysis. Volumetric analysis methods involve titrations. However, the term titration is used when volumetric analysis is used to determine concentration of an unknown component in a solution.



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There are three different types of titration:

1. Simple Titration

Simple titration is used to determine the concentration of an unknown solution using the concentration of another known solution.

Simple titration can be further divided into four categories:

- Acid-base
- Redox
- Precipitation
- Complexometric

2. Back Titration

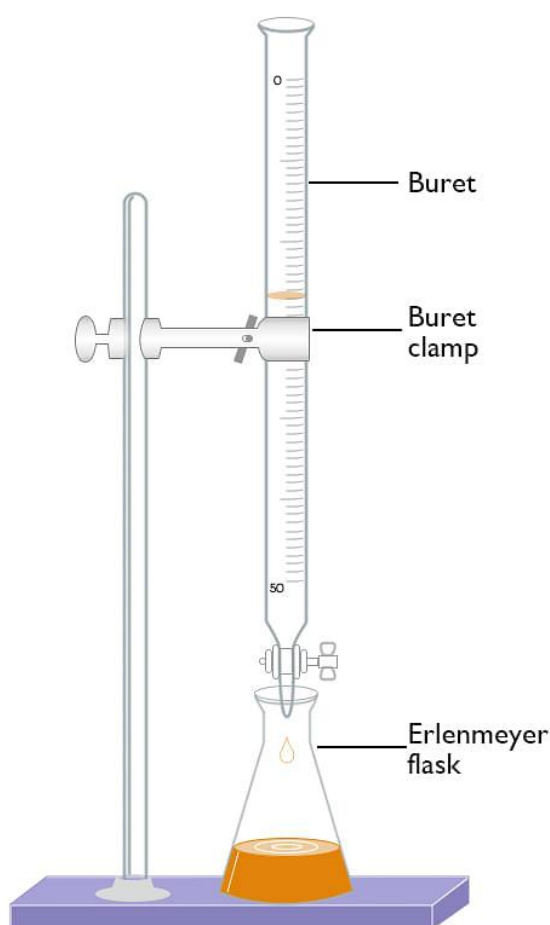
Back titration determines the concentration of an analyte by reacting it with a known amount of excess reagent, whereas a direct titration examines the concentration of an unknown chemical directly. Excess reagents are not added in back titrations. Back titration is also known as indirect titration.

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Apparatus Used for Volumetric Analysis

The apparatus used for Volumetric Analysis are:

- Burette, pipette, measuring flasks, and measuring cylinders.
- Flasks for general titration, beaker, tile, glass rod, funnel, weighing bottle, and wash bottle.
- Weighing machine with a chemical balance





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Experimental Setup

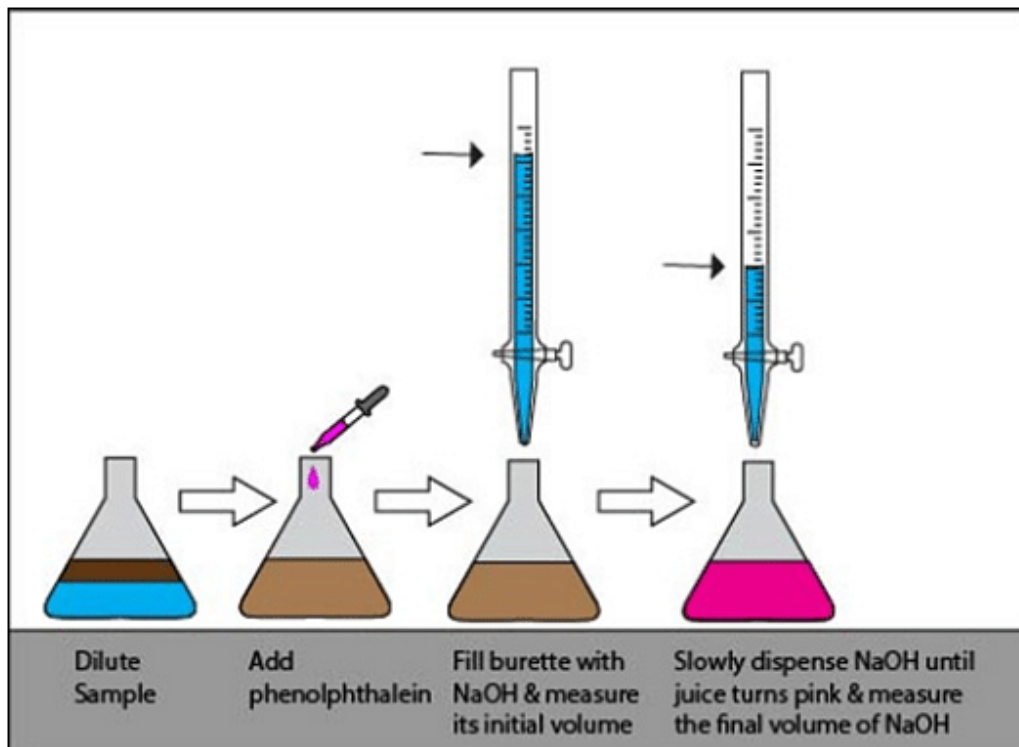
Principles of Volumetric Analysis

The principles of Volumetric Analysis includes:

- An unknown number of chemicals must be present in the solution which needs to be examined.
- To show the end-point, a reagent with an unknown concentration reacts with the chemical of an unknown amount in the presence of an indicator (usually phenolphthalein). The end-point is the point at which the reaction is finished.
- The reaction between the solution and the reagent is completed by titration which is used to measure the volumes.
- The amount of reagent and solution is shown by the volume and concentration of reagent used in the titration.
- The mole fraction of the equation determines the amount of an unknown chemical in the specific volume of solution.

LEC.2 Procedure for Volumetric Analysis

A typical titration begins with a calibrated burette or pipette containing the titrant and a beaker or flask with a precise volume of the analyte and a small amount of indicator placed beneath it.



Titration Procedure



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Volumetric Analysis Formulae and Important Terms

Important terms of volumetric analysis are:

- **Normality:** number of solute gram-equivalents /volume of solution(liters)
- **Molarity:** moles of solute/volume of solution
- **Endpoint:** It's when the reaction between the two solutions is almost finished.
- **Indicator:** A material that shows the achievement of a result. The colour of the indicator changes at the termination point.
- **Standard solution:** A standard solution is a solution that has a known concentration.

To calculate the analyte concentration, the following formula is used:

$$C_a = C_t \times V_t \times M / V_a$$

- Where,
- C_t = Titrant concentration
- V_t = Volume of the titrant used
- M = Mole ratio (Analyte)
- V_a = Volume (Analyte)



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Definitions and terms

A volumetric method is one in which the analysis is completed by measuring the volume of a solution of known concentration needed to react completely with the substance being determined

A titration is a process for determining the amount of a substance by measurement of the quantity of a reagent (the titrant) required to react completely with the substance

A standard solution is a reagent of exactly known composition used in a titration

A primary standard is a highly purified chemical compound
Standardization :Is a process where by the concentration of a standard solution is determined by titrating with a primary standard solution

Requirement of a primary standard :

- 1- It must be of the highest purity
- 2- It should be stable and not attacked by atmosphere
- 3- It should not be hygroscopic
- 4- It should be available and not too expensive
- 5- It should have equivalent to minimize weighing errors



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The end point of a titration :Is the point at which physical changes associated with the equivalence point can be observed

An indicator : is a chemical compound that exhibits a change in color as a result of concentration changes occurring near the equivalence point.