Al-Mustaqbal University

College of Science

Qualitative Analytical Chemistry

First Year Students / 1st Lecture

General Introduction

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By

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Basic Concept of Analytical Chemistry

Meaning:

The word analytical comes from the Ancient Greek **ana-** "up, and **lysis** "a loosening"). Collectively it means breaking-up" or "an untying.

Definition:

The branch of chemistry which deals with the analysis of matter, its identification, and its components. Thus, the process of chemical analysis are of two type;

(1) Qualitative Analysis (2) Quantitative Analysis

Classifications of Chemical Analysis

SO

Analytical Chemistry

I. Determination (Quantitative Analysis): Amount of constituents in matter.

ii. Identification (Qualitative analysis): Type of constituents of matter

Unknown (Analyte)

AAS-700

Cd → **Types/What is there (Qualitative Analysis) [Identification]**

0.5ppm → **Amount/How much is there(Quantitative Analysis) [Determination]**

Suppose we have water (H_2O), we qualitatively determine its constituents, i.e., H_2 and O_2 ; and quantitatively, it contains 2H (2g) and O (16 g).

Note

Analytes – components of a sample that are to be determined

Classifications of Analytical Techniques

There are two types of techniques

(1) Classical technique (2) Instrumental techniques

1). The classical techniques are qualitative as well as quantitative. ***The qualitative analysis*** is based on identifying and determining the analyte based on some properties specific to the analyte like boiling point, melting point, optical activities or refractive index, solubilities, and color.

E.g., the Boling point of water is 100°C, the melting point of sugar is 186 °C, the the refractive index of water is 1.333, test color of K is purple or the color of litmus.

Reference: Chemical Analysis, Qualitative and Quantitative By Henry Minchin Noad

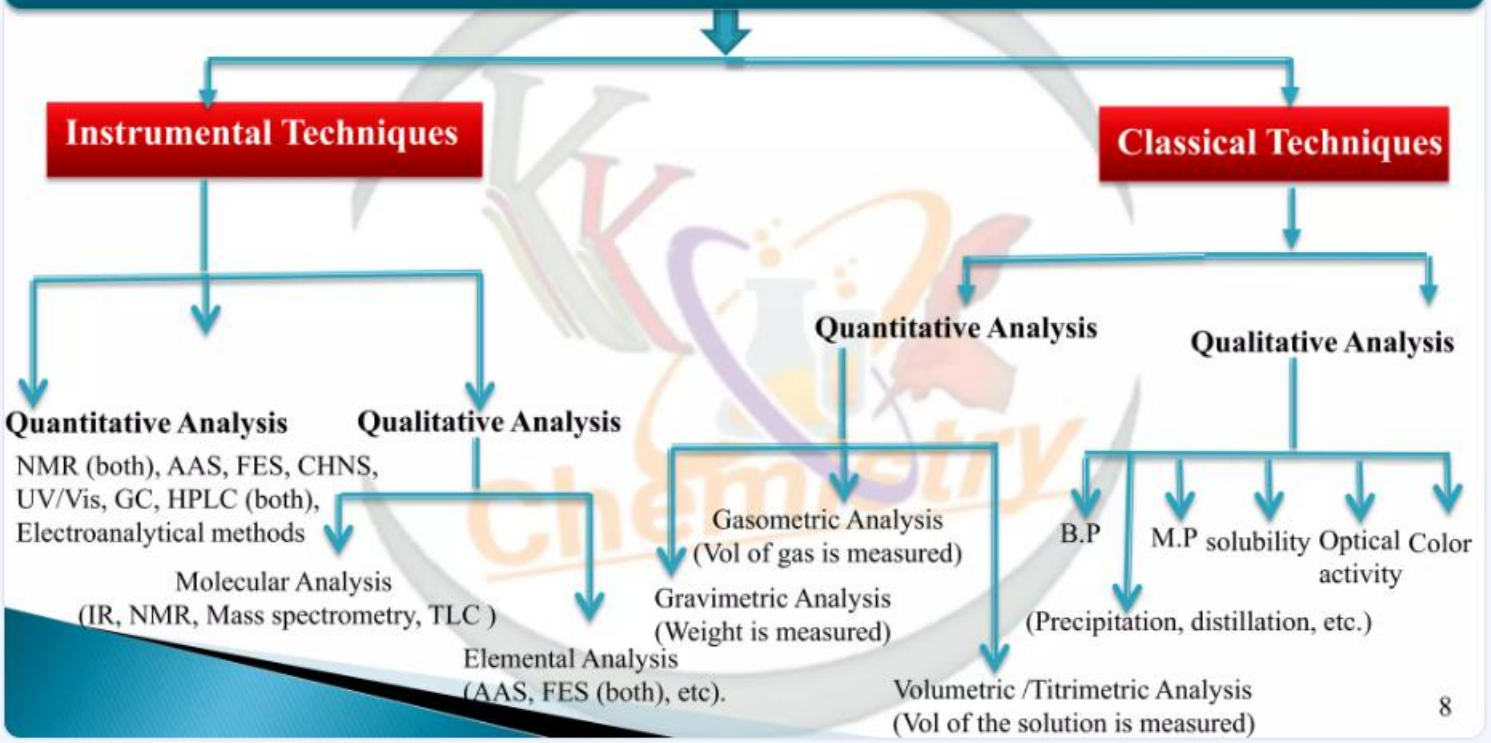
paper indicating the acidity or basicity of a compound. When sulphuretted hydrogen (H_2S) is passed through a solution containing Arsenic, a yellowish precipitate is formed indicating the presence of arsenic. If the precipitate is brown, is brown, it indicates Tin.

The quantitative analysis is based on the quantity of the analyte. Like determining the volume of the analyte (volumetric and gasometric analysis) and weight of the analyte (gravimetric analysis.

(2) Instrumental methods can be both qualitative and quantitative. ***The qualitative analysis*** likewise relies on detecting and determining the analyte based on certain characteristics. Elements (C, H, N, S) of organic compounds using a CHNS analyzer, heavy metals using an atomic absorption spectrophotometer, and alkali and alkaline earth metals (K, Na, Ca, Mg) using a flame photometer.

At the molecular level, infrared (IR) spectroscopy, Nuclear magnetic resonance (NMR) spectroscopy, mass spectrometry, and thin-layer chromatography are used to examine substances.. These techniques tell us the nature of a compound. Some of these techniques can also be used for quantitative purposes as well.

Classifications of Analytical Techniques (Summary)



Classical Quantitative Analysis

Volumetric /Titrimetric Analysis

The term ***titrimetric/volumetric analysis*** refers to quantitative chemical analysis carried out by determining the volume of a solution of accurately known concentration which is required to react quantitatively with a measured volume of a solution to be determined.

The solution of known concentration is called a **standard solution.** As these analyses are based on the measurement of volume for the determination of the analyte and are called volumetric analysis.

In this technique, the reacting substances are taken in the solution form where the concentration of one is known (standard solution/titrant) and is always taken in the burette. The concentration of the other (analyte/titrand) can be found by titrating with the titrant using the following equation.

$$N_1V_1 = N_2V_2$$

N_1 = Normality of standard solution
V_1 = volume used of standard solutions

N_2 = Normality of an Unknown solution
V_2 = volume taken of an unknown solution

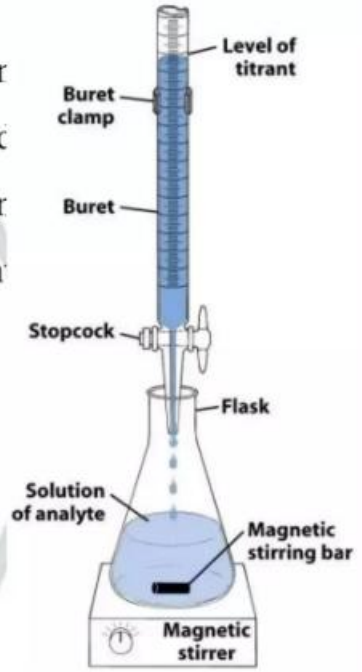


Figure 7-1
Quantitative Chemical Analysis, Seventh Edition
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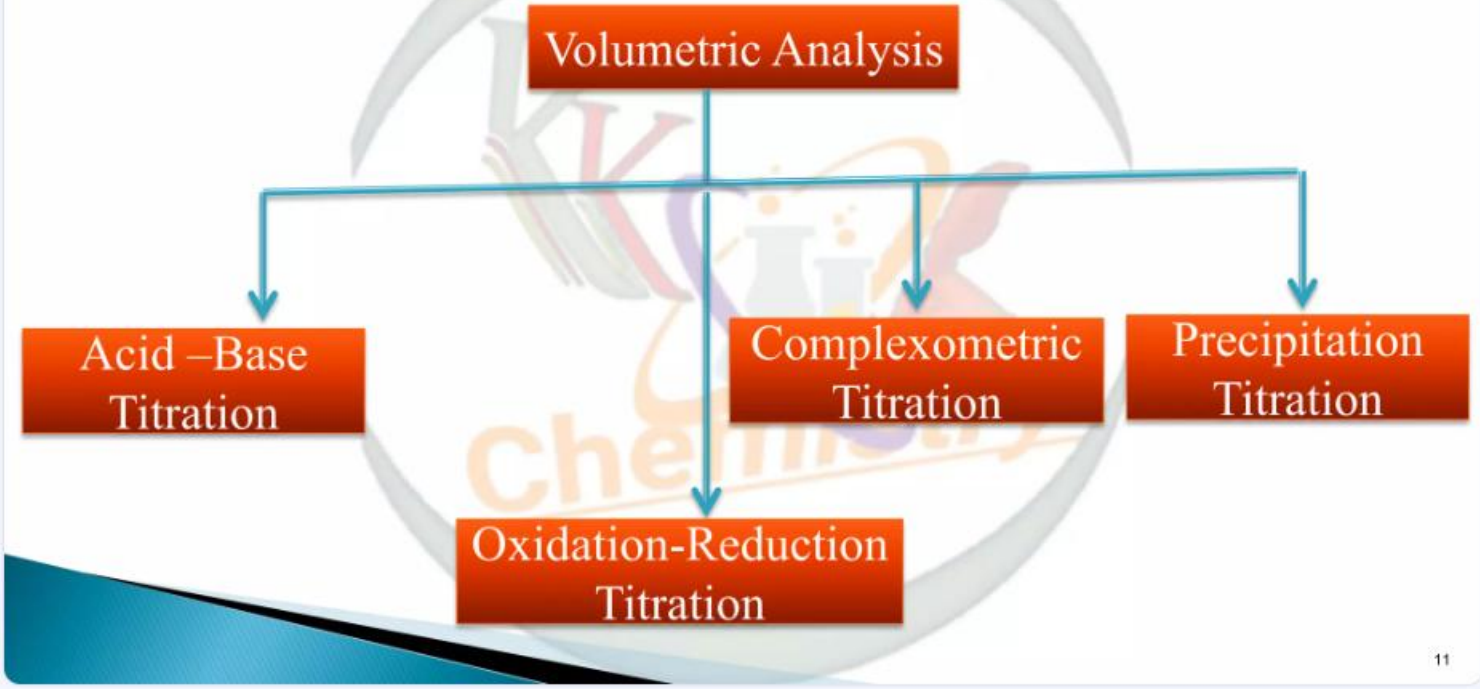
Classifications of Volumetric Analysis

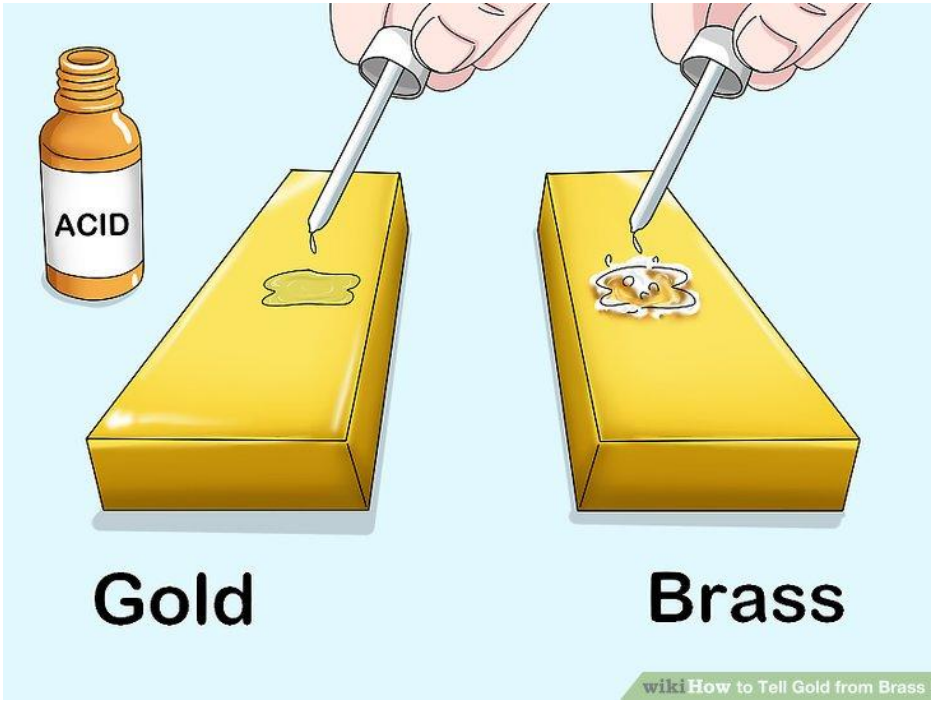


1. Classical Methods

There exist many classical methods of checking for the presence or absence of a particular compound in a given analyte.
These examples are of classical method of qualitative analysis:

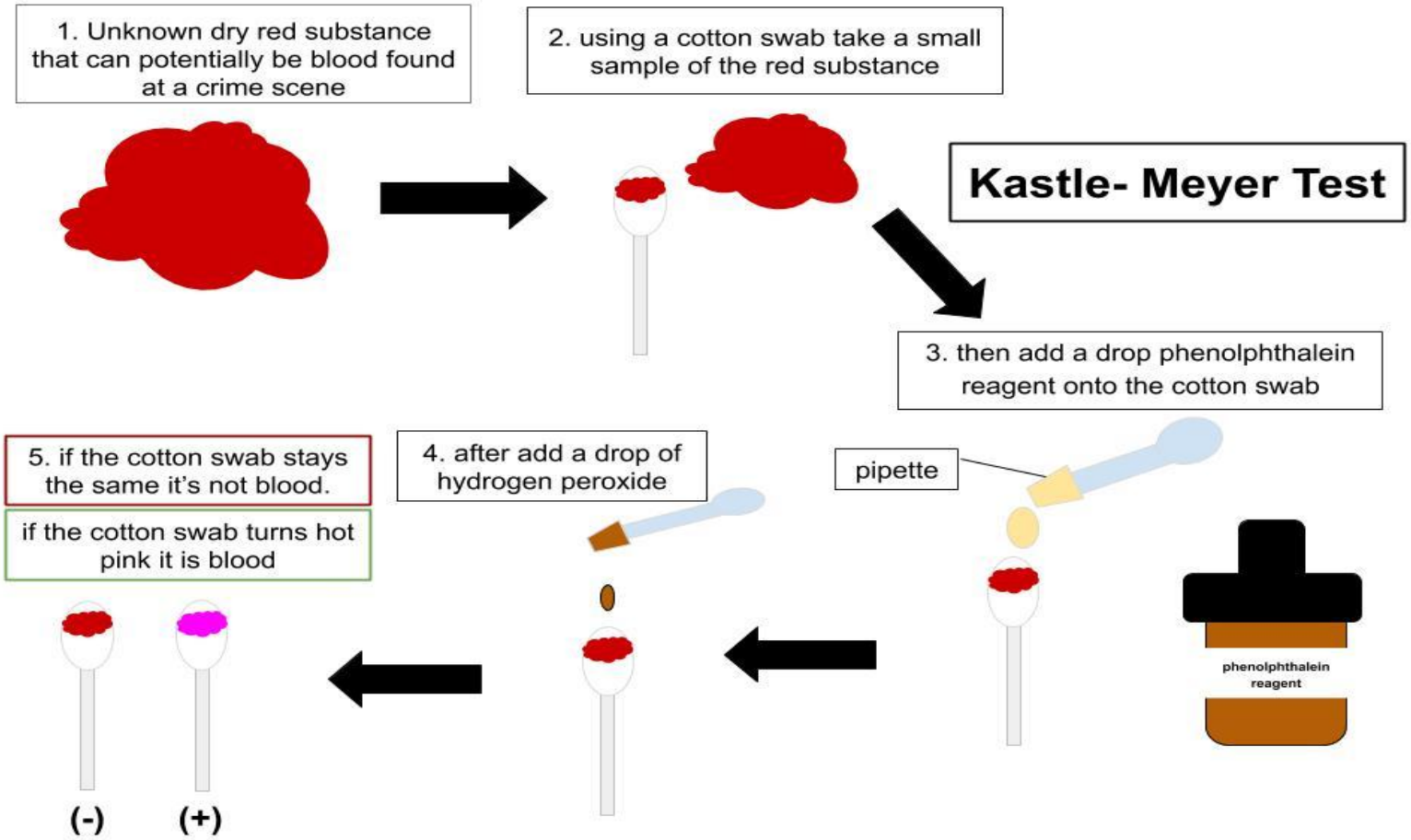
1. The acid test for gold:

The mark is tested by applying nitric acid, which dissolves the mark of any item that is not gold



2- The Kastle-Meyer test :

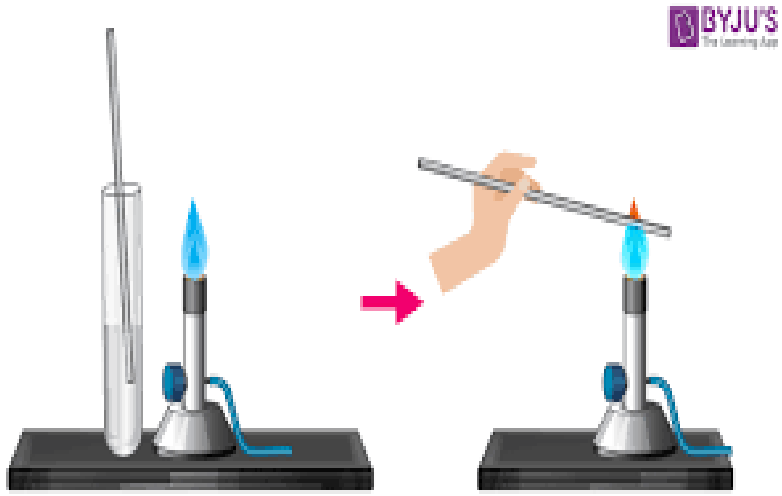
The test identifies the heme component of hemoglobin, which in the presence of hydrogen peroxide catalyzes the oxidation of the indicator phenolophthalin, turning it pink.



3-Flame tests:

These can be used to check for the presence of specific elements in an analyte by exposing it to a flame and observing the change in the color of the flame.

A flame test is a **qualitative analysis** used by the chemist to identify the metal and metalloid ion in the sample. Not all metal ions emit color when heated in the gas burner.



Flame Tests

Metals change the colour of a flame when they are heated in it, this produces a flame of a distinct colour. The colour of this flame can help us identify common metals.

Chemistry teach