Lec 4

Introduction to Analytical Chemistry

Introduction

Analytical chemistry is the science of obtaining, processing, and communicating information about the composition and structure of matter. In other words, it is the art and science of determining what matter is and how much of it exists.Analytical chemistry is science that concerned with the separation, identification, and determination of the relative amounts of the components making up a sample.

Applications of Analytical Chemistry

Analytical chemistry used in many fields:

· In ***medicine***, analytical chemistry is the basis for clinical laboratory tests which help physicians diagnosis disease and chart progress in recovery.

· In ***industry***, analytical chemistry provides the means of testing raw materials and for assuring the quality of finished products whose chemical composition is critical. Many household products, fuels, paints, pharmaceuticals, etc. are analysed by the procedures developed by analytical chemists before being sold to the consumer.

· ***Enviermental quality*** is often evaluated by testing for suspected contaminants using the techniques of analytical chemistry.

· ***Forensic analysis*** - analysis related to criminology; DNA finger printing, finger print detection; blood analysis.

· ***Bioanalytical chemistry and analysis*** - detection and/or analysis of biologicalvcomponents (i.e., proteins, DNA, RNA, carbohydrates, metabolites, etc.).

Classification of analysis

Qualitative analysis: An analysis in which we determine the identity of the constituent species in a sample.

Quantitative analysis: An analysis in which we determine how much of a constituent species is present in a sample.

Sample analysis

Analytes: The constituents of interest in a sample.

Matrix: All other constituents in a sample except for the analytes.

Classifying Analytical Techniques

Classical techniques

Mass, volume, and charge are the most common signals for classical techniques, and the corresponding techniques are:

1- Gravimetric techniques.

2- Volumetric techniques.

3- Coulometeric techniques.

Instrumental techniques

1- Spectroscopic methods - measuring the interaction between the analyte and electromagnetic radiation (or the production of radiation by an analyte).

2- Electroanalytic methods - measure an electrical property (i.e., potential, current,

resistance, amperes, etc.) chemically related to the amount of analyte.

Basic Tools and Operations of Analytical Chemistry

Basic Equipment

Measurements are made using appropriate equipment or instruments. The array of

equipment and instrumentation used in analytical chemistry is impressive, ranging from the simple and inexpensive, to the complex and costly.

Equipments for Measuring Mass (Analytical Balance)

An object's mass is measured using a **balance.** The most common type of balance is the ***mechanical balances*** which are replaced by the electronic balances.

Electronic balance

Equipment for Measuring Volume

Volumetric flask is designed to contain a specified volume of solution at a stated temperature, usually 20 °C.

Pipette is used to deliver a specified volume of solution. Several different styles of pipets are available.

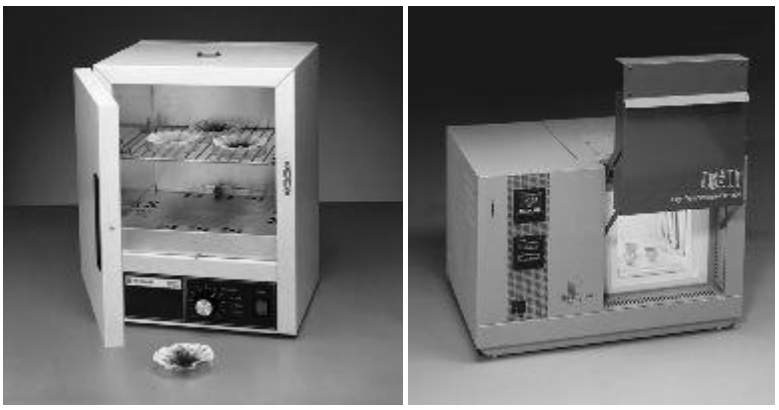
Figure 2.5
Common types of pipets and syringes: (a) transfer pipet; (b) measuring pipet; (c) digital pipet; (d) syringe.
Photos courtesy of Fisher Scientific.

Burette is volumetric glassware used to deliver variable, but known volumes of solution. A burette is a long, narrow tube with graduated markings, and a stopcock for dispensing the solution.

Equipment for Drying

Many materials need to be dried prior to their analysis to remove residual moisture.

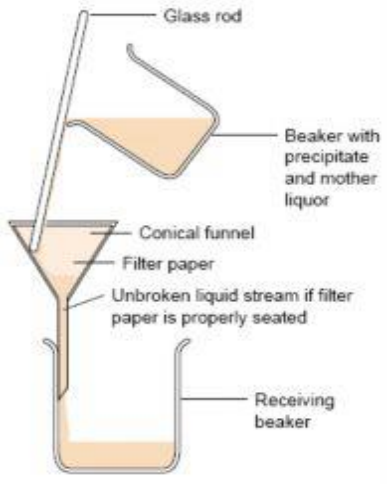
Depending on the material, heating to a temperature of 110–140 °C is usually sufficient. The processes can be accomplished using a ***laboratory oven*** capable of providing the required temperature



Conventional laboratory oven used for drying materials.Example of a muffle furnace used for heating samples tomaximum temperatures of 1100–1700 °C.

Filtration

In *gravimetric analysis*, the mass of product from a reaction is measured to determine how much unknown was present. Precipitates from gravimetric analyses are collected by filtration



Filtering a precipitate.

The conical funnel is supported by a metal ring attached to a ring stand, neither of which is shown.