Ministry of higher education and scientific research
AL-Mustaqbal University college
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Analytical chemistry

Lecture 3

Electroanalytical method of analysis
(Potentiometric analysis)

By

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Electroanalytical methods

Are a class of techniques in analytical chemistry which study an analyte by measuring the potential **(Volts**) and/or current **(Amperes**) in an electrochemical cell containing the analyte.

These methods can be broken down into several categories depending on which aspects of the cell are controlled and which are measured.

The three main categories are:

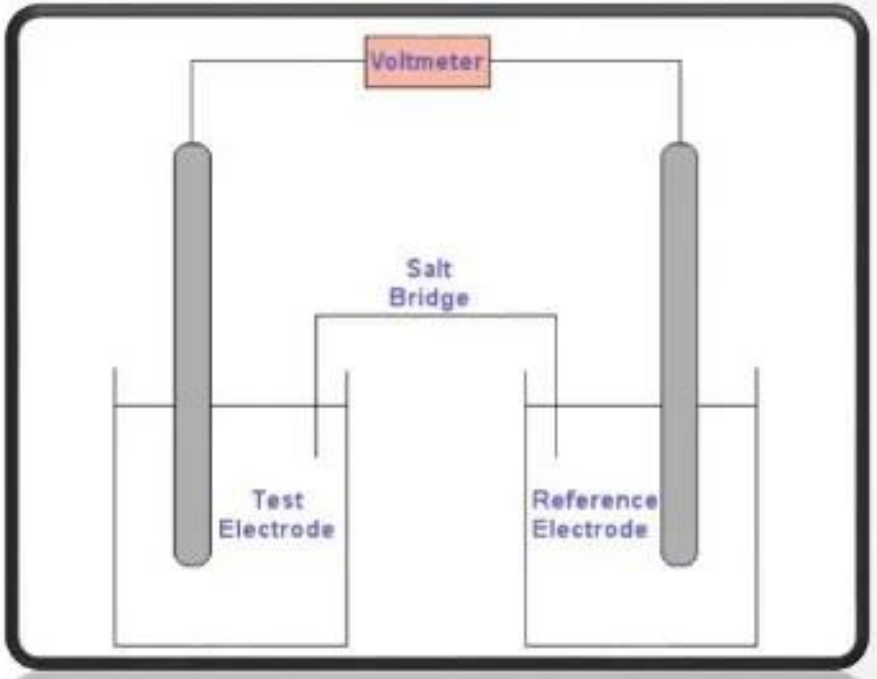
1. **Potentiometry** :the difference in electrode potentials is measured.
2. **Coulometry :**the cell's current is measured over time,
3. **Voltammetry :**the cell's current is measured while actively altering the cell's potential.

1-Potentiometric analysis

- What is potentiometric analysis?
- What are the types of potentiometric analysis?
- What is potentiometric measurement?
- Which electrodes are used in potentiometry?

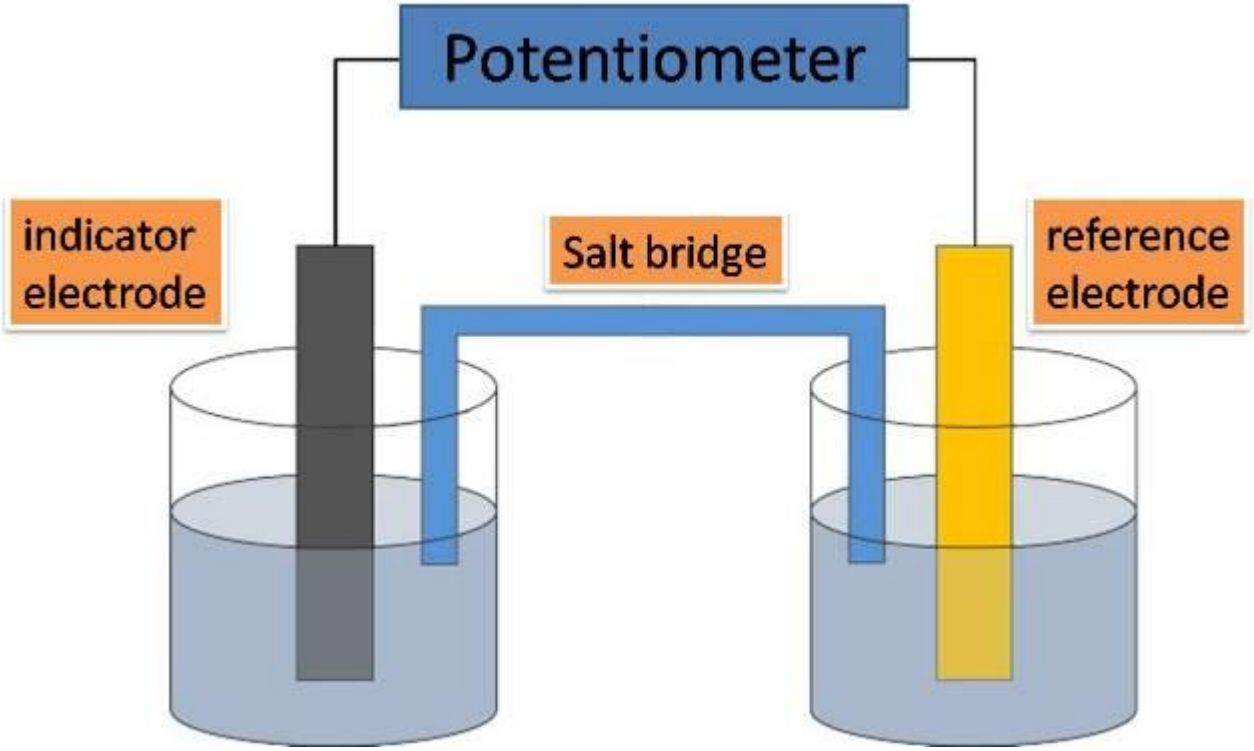
Potentiometry

An electroanalytical method, used to determine solution concentration by potential measurement



What is a Potentiometric Titration?

Potentiometric Titration principle of Potentiometry Principle.
When the pair of electrodes are placed in the sample solution or analyte, it shows the potential difference between two electrodes by the addition of the titrant or by the change in the concentration of ions.



Potentiometric Titration is done via the usage of two electrodes – an indicator electrode and a reference electrode (generally a hydrogen electrode or a silver chloride electrode).

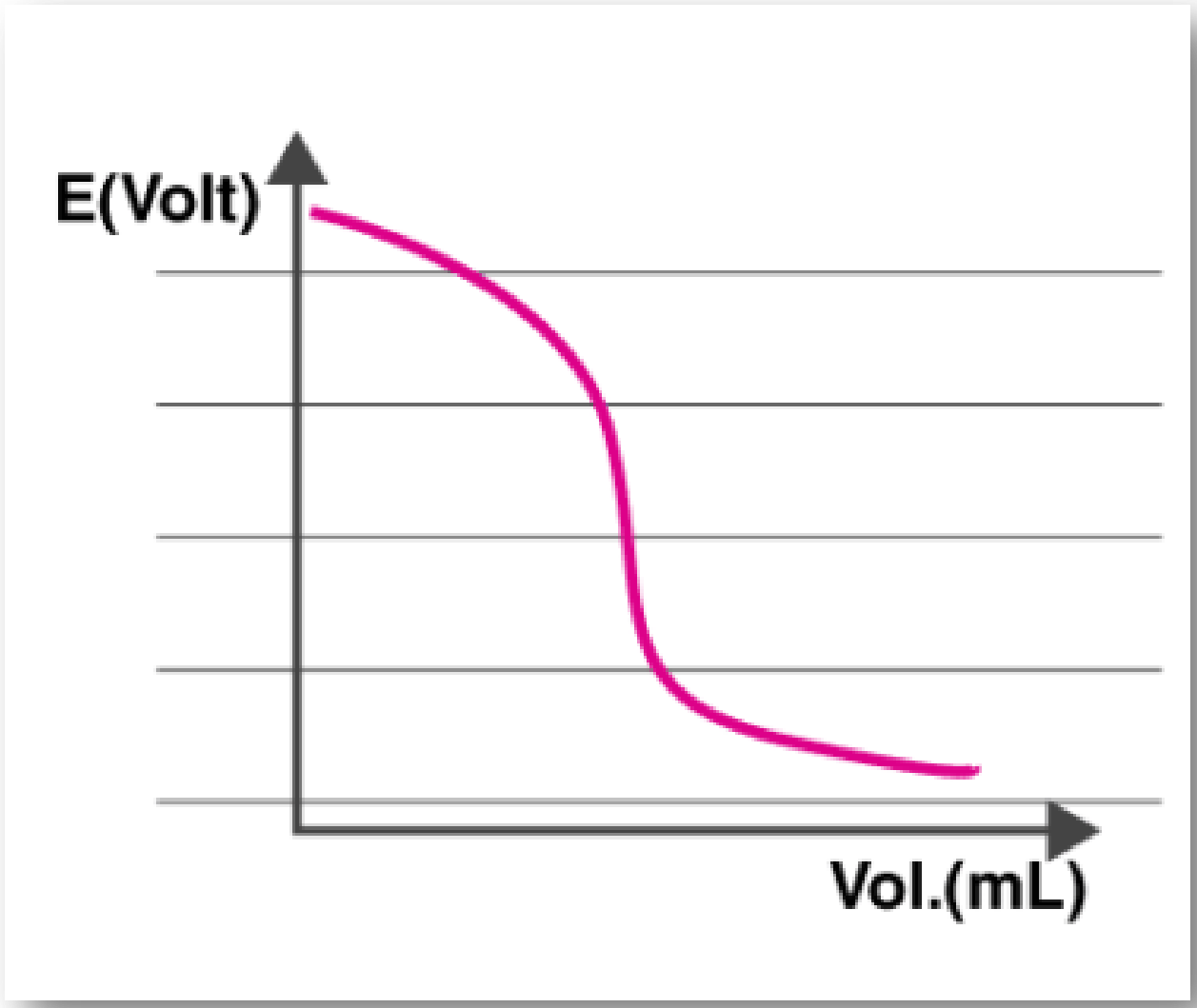
Potentiometric Titration Method

Potentiometric Titration is done via the usage of two electrodes – an indicator electrode and a reference electrode (generally a hydrogen electrode or a silver chloride electrode). One half-cell is formed with the indicator electrode and the ions of the analyte, which is generally an electrolyte solution. The other half-cell is formed by the reference electrode.

The overall cell potential can be calculated using the formula given below.

$$E_{cell} = E_{ind} - E_{ref} + E_{sol}$$

Where the potential drop between the indicator and reference electrodes over the electrolyte solution is given by **E**sol


E(Volt)
Vol.(mL)

Types of potentiometric analysis

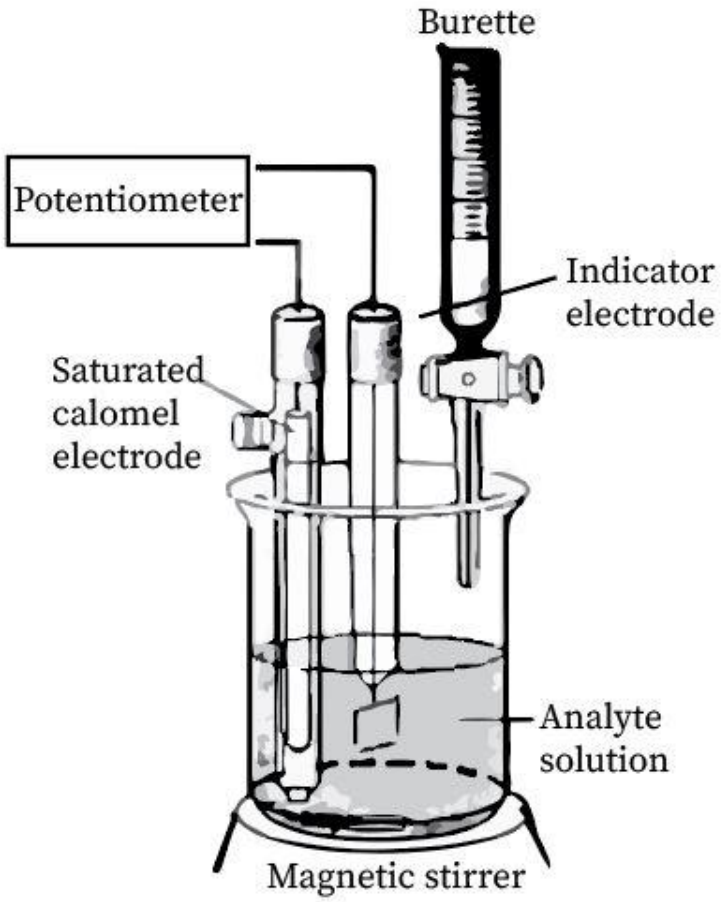
The potentiometric titration involve measurement of E_{cell} with the addition of titrant.

There are four types of titration that fall under the category of potentiometric titration, namely:

1. **Acid-base titration.**
2. **Redox titration.**
3. **Complexometric titration.**
4. **Precipitation titration**.

1-Potentiometric acid–base titration

This type of potentiometric titration is used to determine the concentration of a given acid/base by neutralizing it exactly using a standard solution of base/acid whose concentration is known.



2-Potentiometric Redox titration

- Oxidation reduction (or redox) reactions involve the transfer of an electron (or H, or hydride group) from a donor to an acceptor.

- This type of potentiometric titration involves an analyte and titrant that undergo a redox reaction.

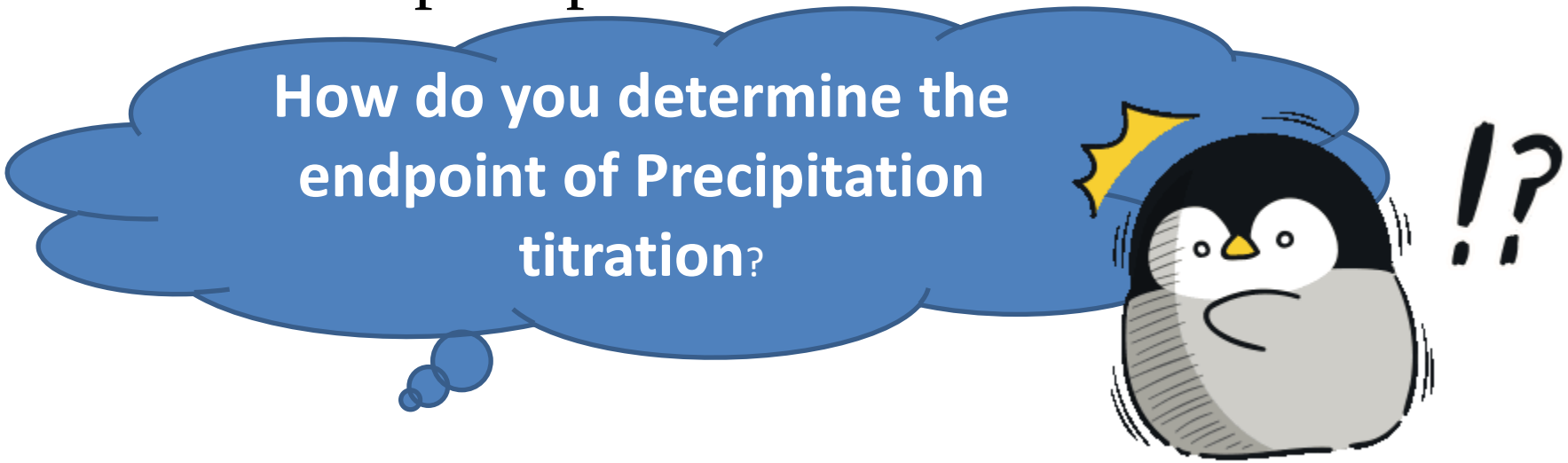
- An example of this type of titration would be the treatment of an iodine solution with a reducing agent which produces iodide ion (a starch indicator is used to get the endpoint).

3-Potentiometric Complexometric titration

- In this type of potentiometric titration concentration of metal ions are determined in the analyte.
- This type of titration can also be referred to as chelatometry. In this method, a coloured complex is formed, indicating the end point of the titration.
- This method is used to determine a mixture of metal ions in a given solution.

4-Potentiometric Precipitation titration

- This type of titration involves a reaction between the given analyte and the titrant wherein an insoluble precipitate is formed.
- The end-point of this titration is noted when the addition of the titrant no longer forms a precipitate.



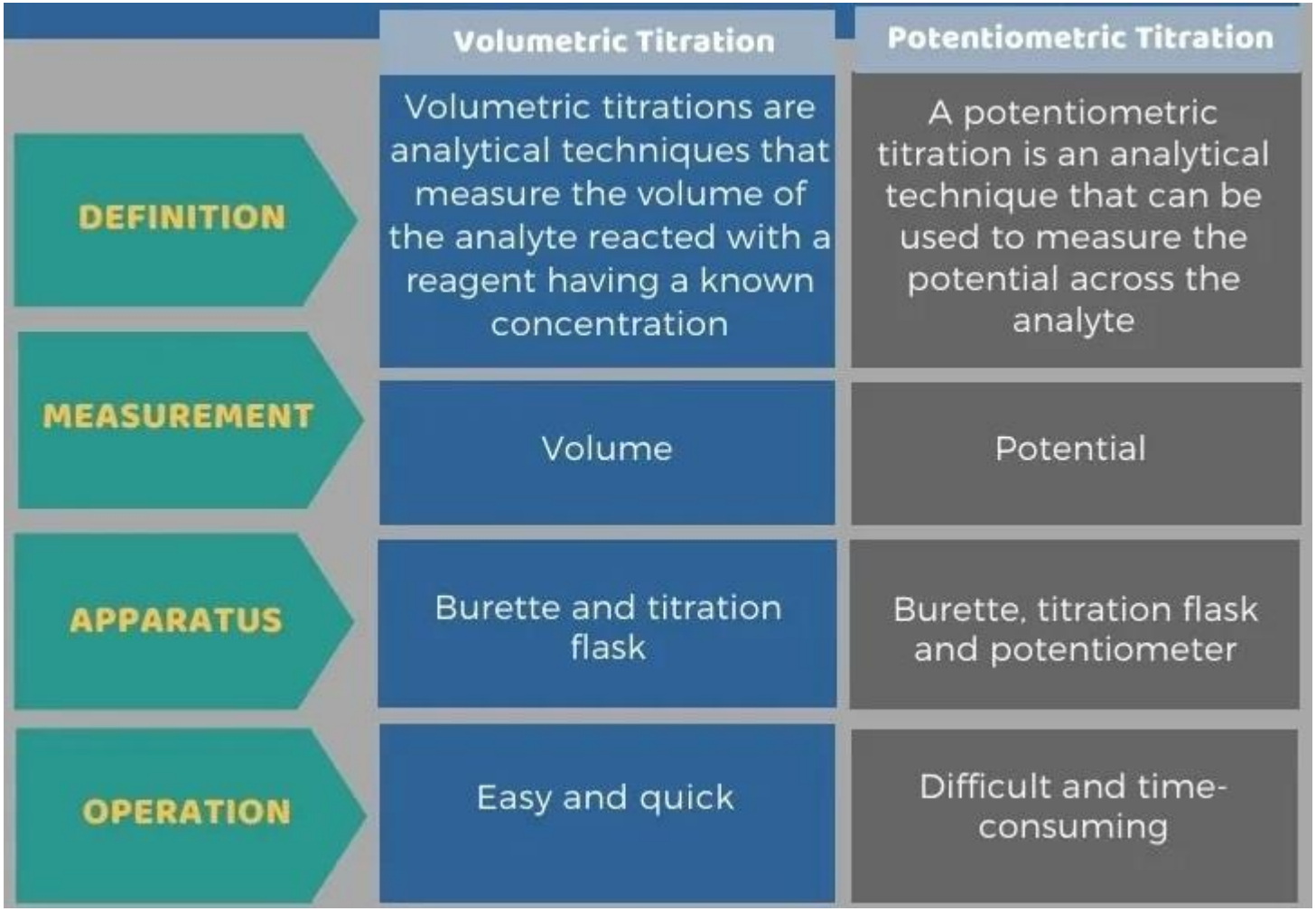
Applications of potentiometric titrations:

1) It is used in clinical chemistry for the analysis of metals.
2) It is used for the analysis of cyanide, ammonia etc., in water or wastewater.
3) It is used in agriculture for the detection of different elements in soils, fertilizers etc.
4) It is used in detergent manufacturing, food processing etc.

What is the Difference Between Volumetric and Potentiometric Titration?

- Titrations are chemical techniques used to identify the amount of an unknown compound present in a given mixture.
- The key difference between volumetric and potentiometric titration is that volumetric titration measures the volume of analyte reacted with the reagent, whereas potentiometric titration measures the potential across the analyte.
- Moreover, volumetric titrations are easy and quick when compared to potentiometric titrations.

Volumetric VS potentiometric titration



What is the main advantage of potentiometric titration?

The main advantage of using this method of titration is it requires less quantity of substances and is an inexpensive method.


Thank You
For Your
Attention