PHARM.D • YEAR 1

Pharmaceutical Inorganic Chemistry

CHAPTER 7

Complexometric Titrations

PPT CHAPTER COVER



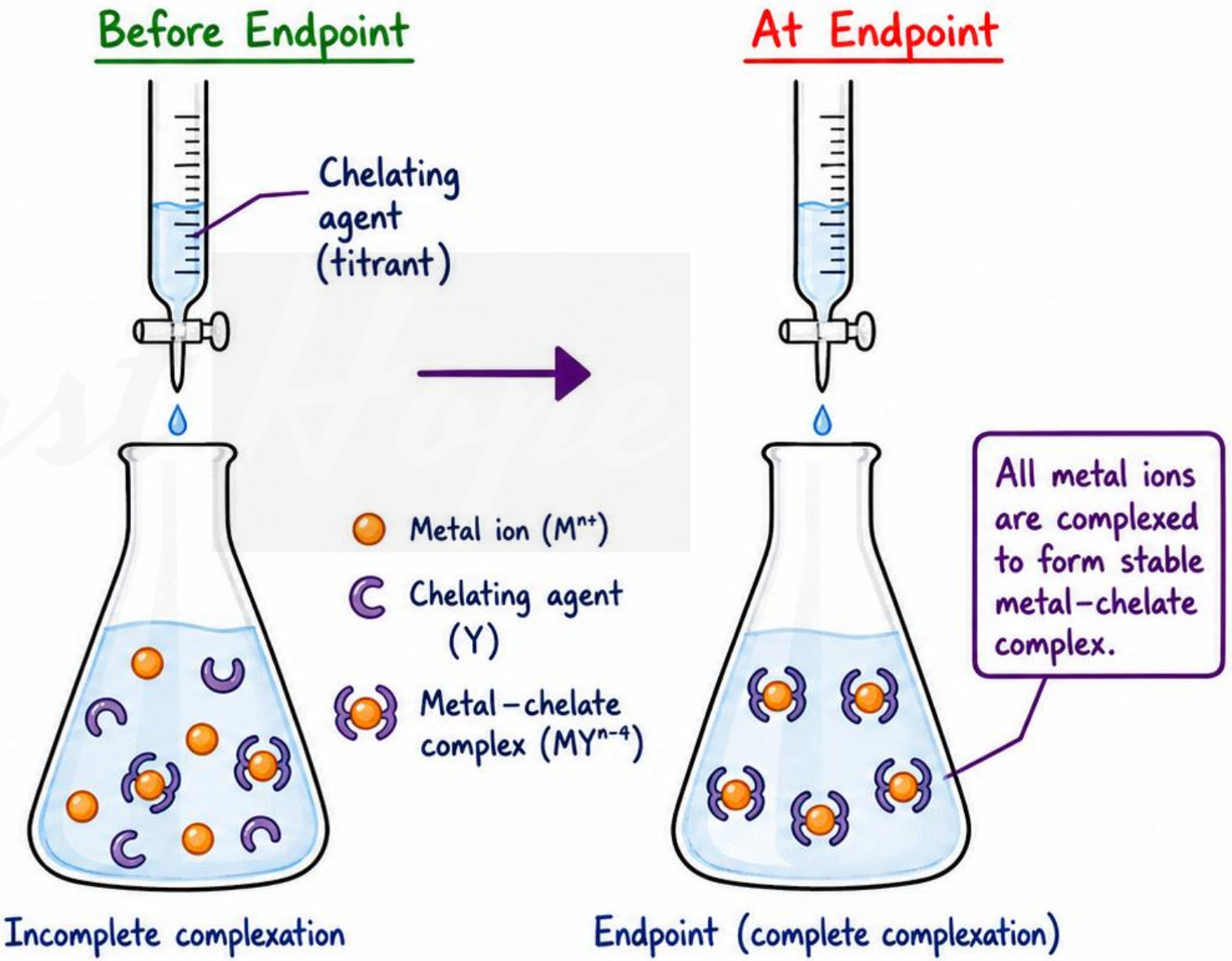
Complexometric Titration: Core Principle

Core Principle

- Complexometric titration is a volumetric analysis technique used to determine the concentration of metal ions by forming a complex with a chelating agent (titrant).

How it Works

1. Metal ions in the sample react with a chelating agent (titrant).
2. A stable metal–chelate complex is formed.
3. At the endpoint, all metal ions are complexed; the titrant volume is used for concentration calculation.



EDTA Chelation and the 1:1 Ratio

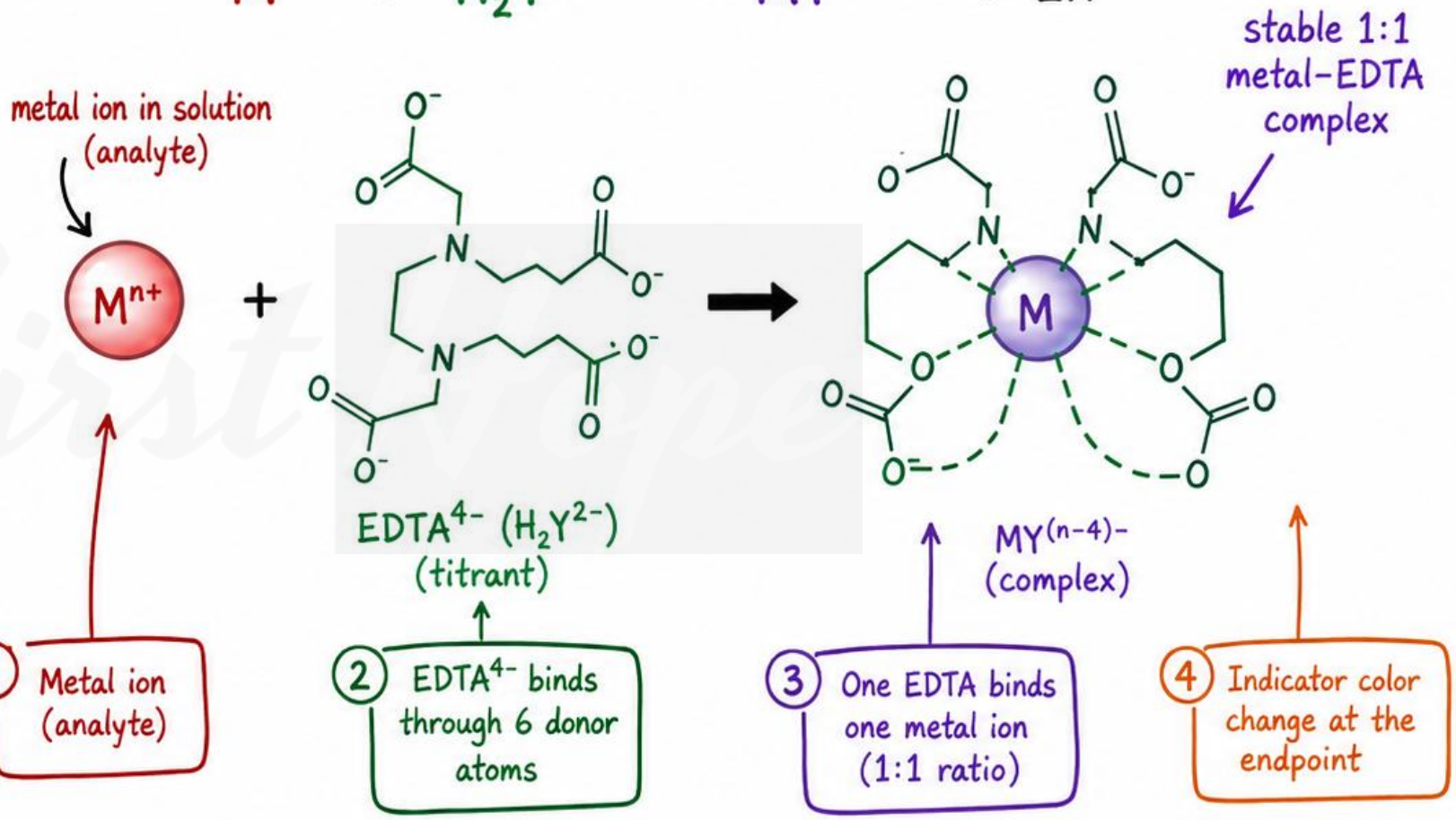
1. Key Points

- EDTA is a chelating agent with multiple donor atoms that binds metal ions to form stable complexes.
- EDTA almost always forms a 1:1 complex with a metal ion, regardless of the metal charge.
- At the endpoint, all metal ions are complexed and the indicator changes color.

FACT-CHECK NOTE:

EDTA usually forms a 1:1 complex with a metal ion, regardless of the metal charge; never divide EDTA moles by two for Mg^{2+} or Ca^{2+}.

$$M^{n+} + H_2Y^{2-} \longrightarrow MY^{(n-4)-} + 2H^+$$



★ Because EDTA forms a 1:1 complex with a metal ion, moles of EDTA used at the endpoint = moles of metal ion in the sample.

Parts of a Complexometric Titration

Definition:

A volumetric technique to determine metal ion concentration by forming a complex with a chelating agent (titrant).

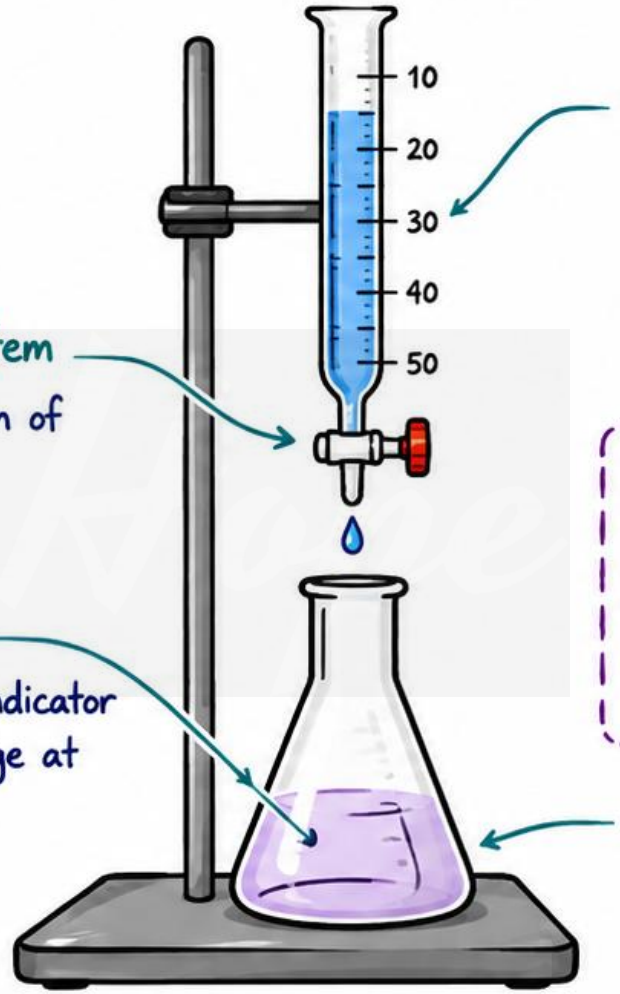
Principle:

The chelating agent (Y^{4-}) reacts stoichiometrically with metal ion (M^{n+}) to form a stable complex.

$$M^{n+} + Y^{4-} \longrightarrow [MY]^{n-4}$$

Endpoint:

Indicated by a color change of a metallochromic indicator at the equivalence point.



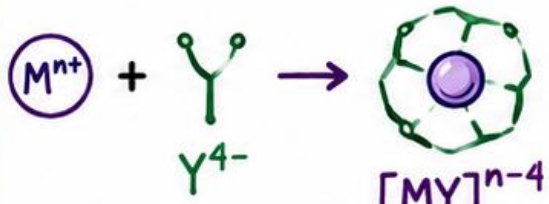
1) Burette (titrant)
Chelating agent solution (e.g., EDTA)

3) Delivery system
Controls addition of titrant.

4) Indicator
Metallochromic indicator gives color change at endpoint.

2) Conical flask (analyte)
Solution containing metal ion (M^{n+}) + indicator

5) Reaction in solution

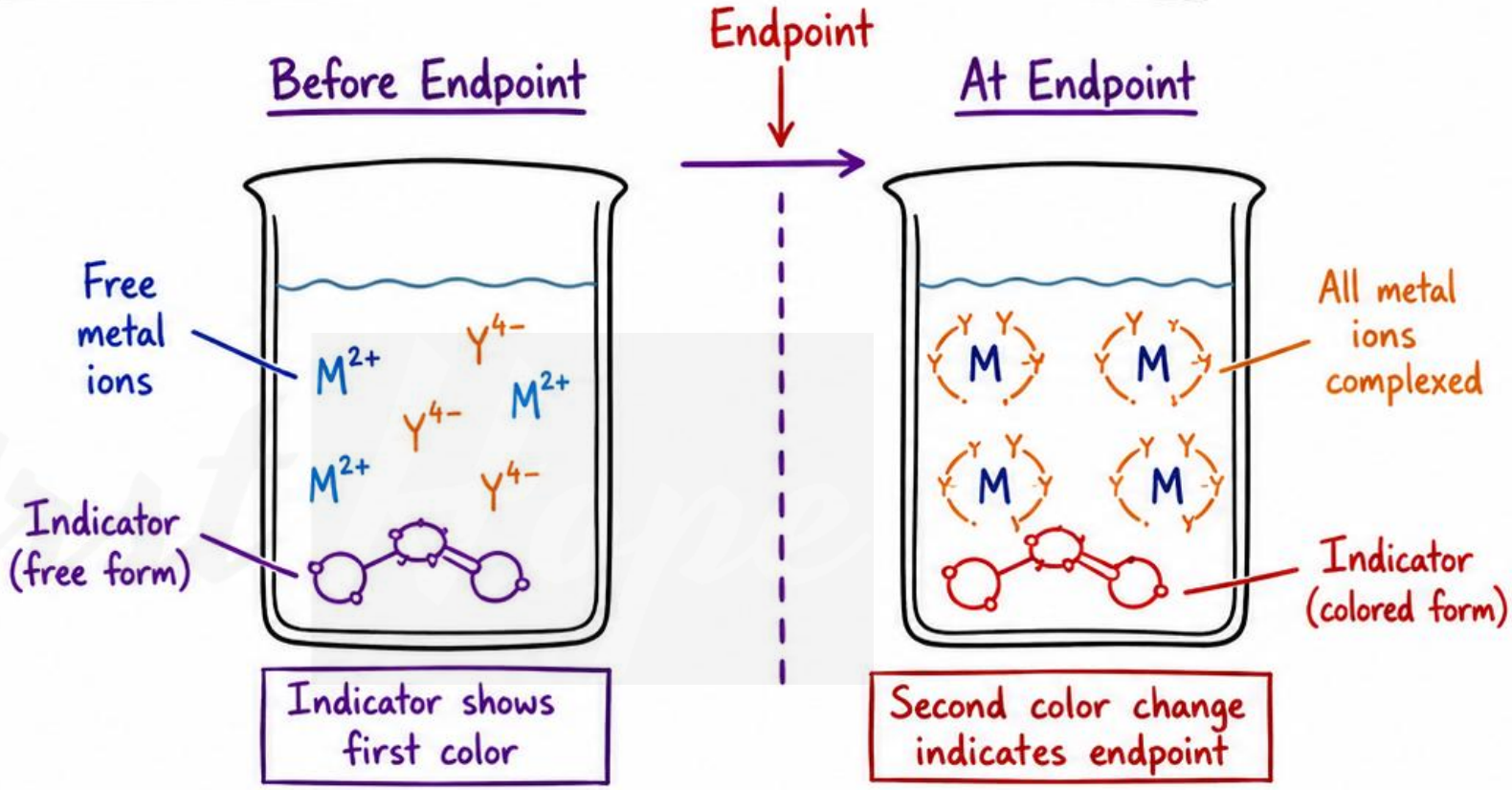


Takeaway: A complexometric titration uses a chelating agent (titrant), an analyte with metal ions, a suitable indicator, and standard apparatus to determine metal ion concentration accurately.

How the Endpoint Is Detected

- Endpoint = the point when all metal ions are complexed with the chelating agent.

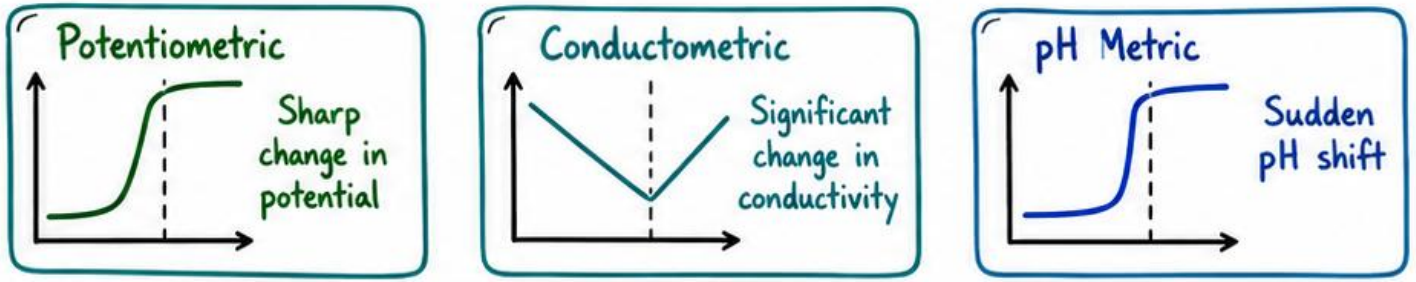
KEY POINT:
A distinct, sharp change in the measured signal marks the endpoint.



Detected by:

- Second color change (indicatory)
- Sharp change in potential (potentiometric)
- Significant change in conductivity (conductometric)
- Sudden pH shift

Instrumental Detection



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