PHARM.D • YEAR 1

Pharmaceutical Inorganic Chemistry

CHAPTER 4

Redox Titrations

PPT CHAPTER COVER



Redox Titration: Core Principle

Definition:

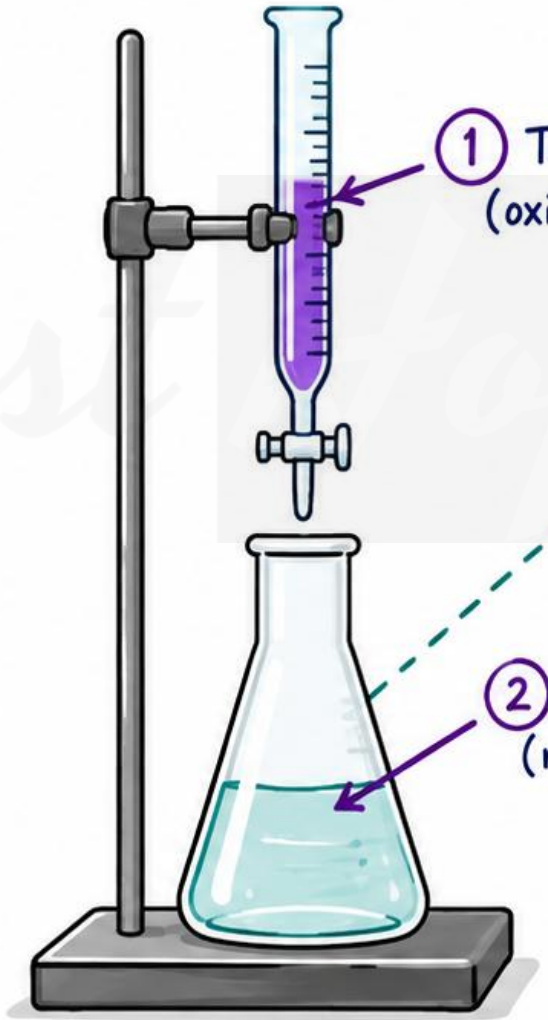
Redox titration is a volumetric method that determines concentration by an oxidation–reduction reaction between an oxidizing agent and a reducing agent.

Core Principle:

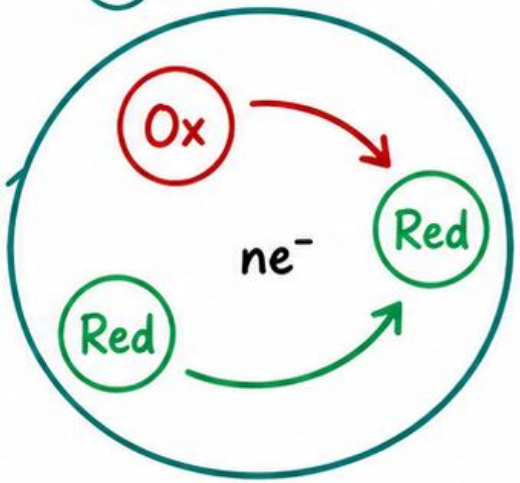
- The oxidizing agent in the titrant reacts quantitatively with the reducing agent in the analyte in a known redox reaction.

⇒ Equivalent moles of oxidant = Equivalent moles of reductant at the endpoint.

$$Ox + ne^- \rightleftharpoons Red$$



3 Redox Reaction



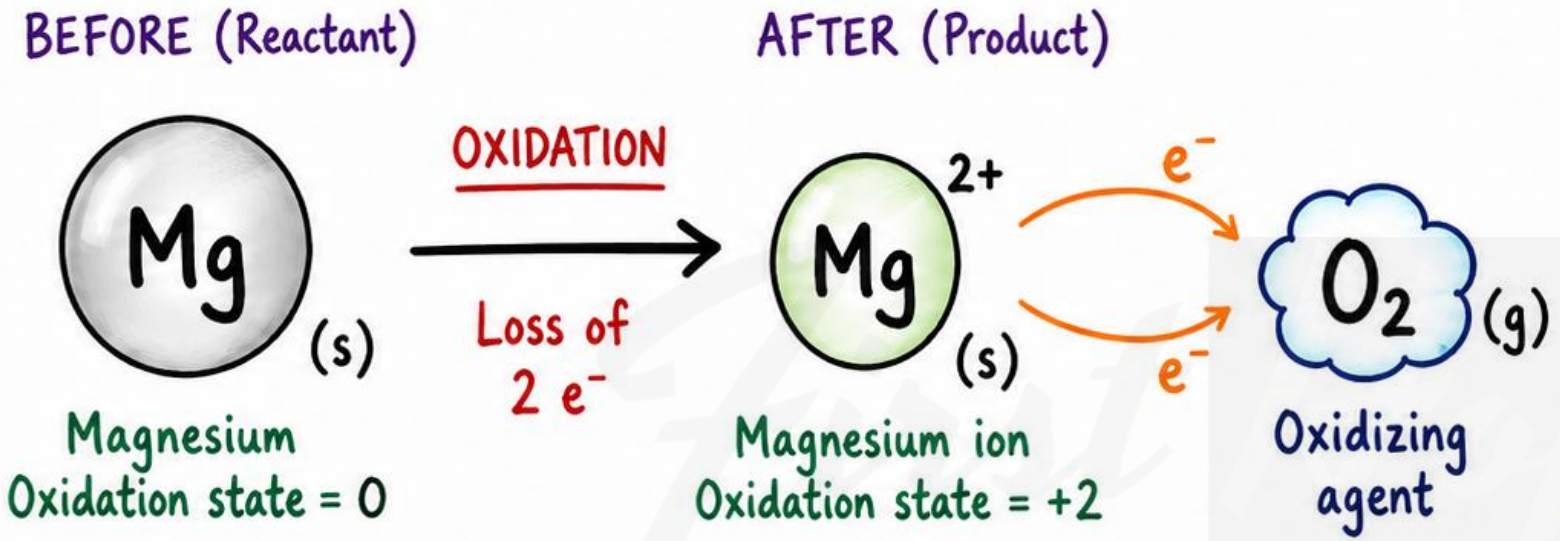
4 Endpoint

Stoichiometric completion of the redox reaction.

5 Calculation

Use equivalent relationship to find concentration.

Oxidation Means Electron Loss



$$2\,Mg\,(s) + O_2\,(g) \longrightarrow 2\,MgO\,(s)$$

$$Mg\,(s) \longrightarrow Mg^{2+}(s) + 2\,e^-$$

Magnesium loses two electrons ; oxidation state increases from 0 to +2.

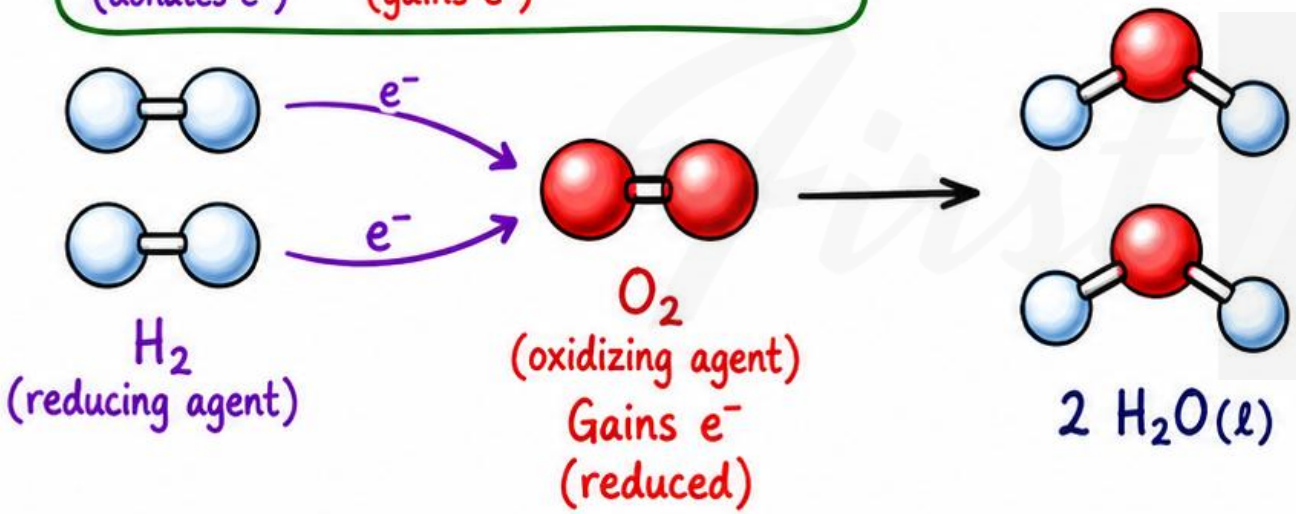
- **Meaning of Oxidation**
  - Oxidation is the loss of one or more electrons by a species, which increases its oxidation state.
- **Role of Oxidizing Agents**
  - Oxidizing agents gain electrons in a redox reaction, causing another species to lose electrons — i.e., become oxidized. They have high affinity for electrons and bring about oxidation of other substances.

Reduction Means Electron Gain

Example 1

$2\ H_2(g) + O_2(g) \longrightarrow 2\ H_2O(\ell)$

Reducing agent (donates e^-) — Oxidizing agent (gains e^-)



Example 2

$2\ O_2(g) + 4\ e^- \longrightarrow 2\ O^{2-}(s)$

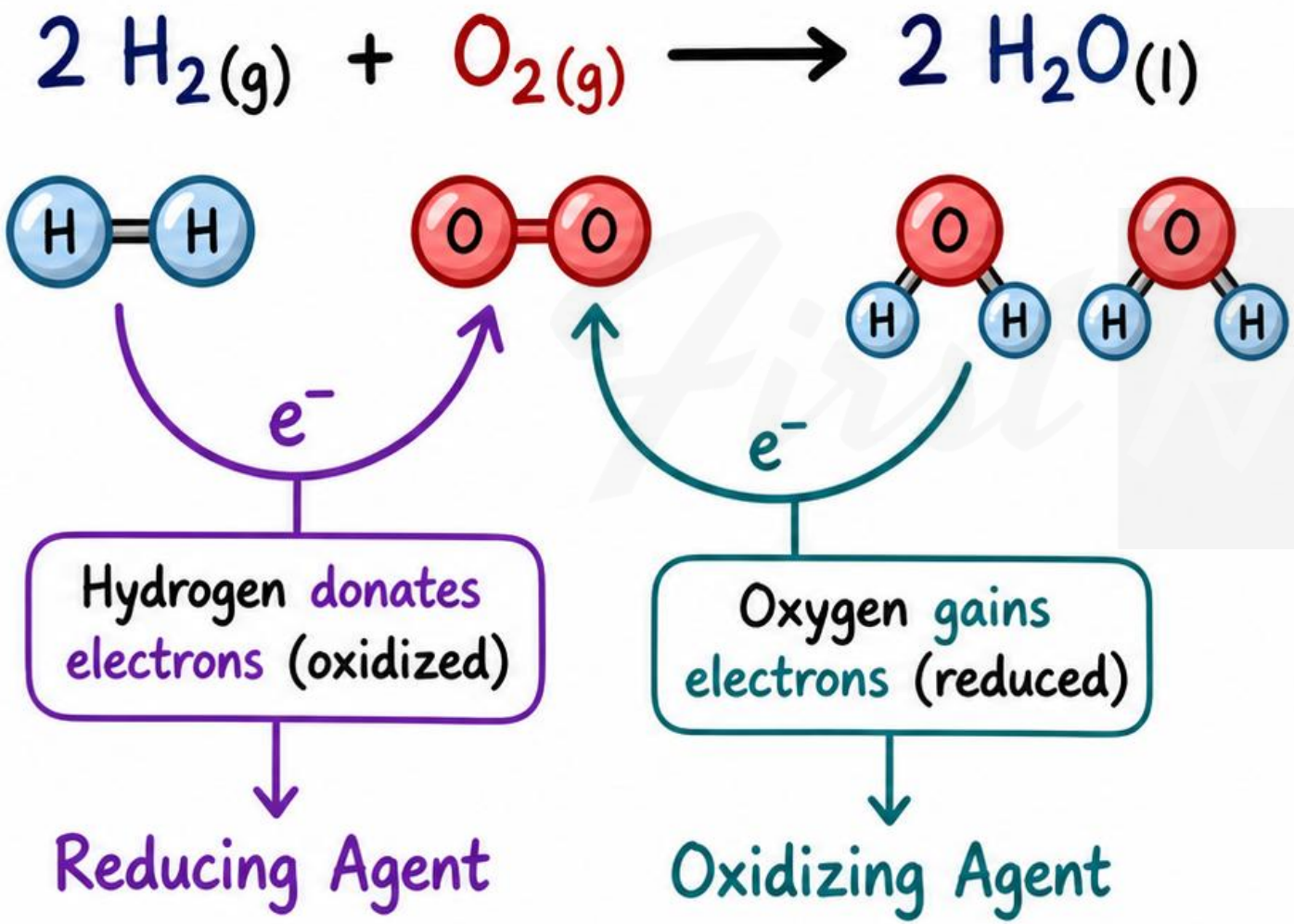
Oxygen gains 2 e^-; oxidation state: $0 \rightarrow -2$



(oxide ion)

1. **Reduction:** Gain of one or more electrons, causing a decrease in oxidation state (often linked to addition of H or removal of O).
2. **Reducing agent:** Donates electrons to another species, enabling its reduction.
3. In the reaction $2\ H_2 + O_2 \rightarrow 2\ H_2O$, O_2 is the oxidizing agent (gains e^-) and H_2 is the reducing agent (donates e^-).

Oxidizing and Reducing Agents



- Oxidizing agent: accepts electrons and causes the oxidation of another species; it is reduced in the process.
- In $2\ H_{2(g)} + O_{2(g)} \longrightarrow 2\ H_2O_{(l)}$, oxygen ($O_2$) accepts electrons from hydrogen and is reduced.
- Reducing agent: donates electrons and causes the reduction of another species; it is oxidized in the process.
- In $2\ H_{2(g)} + O_{2(g)} \longrightarrow 2\ H_2O_{(l)}$, hydrogen ($H_2$) donates electrons to oxygen and is oxidized.

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