$KMnO_4$-Based Titrations

2026

Titrations involving **potassium permanganate ($KMnO_4$)** are a class of **redox titrations** known as **permanganometry**. $KMnO_4$ acts as a **strong oxidizing agent**, especially in **acidic medium**, and has the advantage of being **self-indicating** due to its intense purple color.

Why $KMnO_4$ Is Not a Primary Standard ?

1. Instability on Storage

- $KMnO_4$ **slowly decomposes** over time, especially in the presence of light and heat.
- It reacts with traces of organic matter or dust in the air or even in distilled water, which alters its concentration. Its solution does **not remain stable for long periods**.

2. Impurities in the Solid

- Commercial $KMnO_4$ may contain **MnO_2 (manganese dioxide)** or other manganese oxides as impurities.
- Intensly coloured and difficult to prepare a standard solution.
- Cannot acidify with HCl as it evolves Cl_2 gas.

$KMnO_4$ as an Oxidizing Agent:

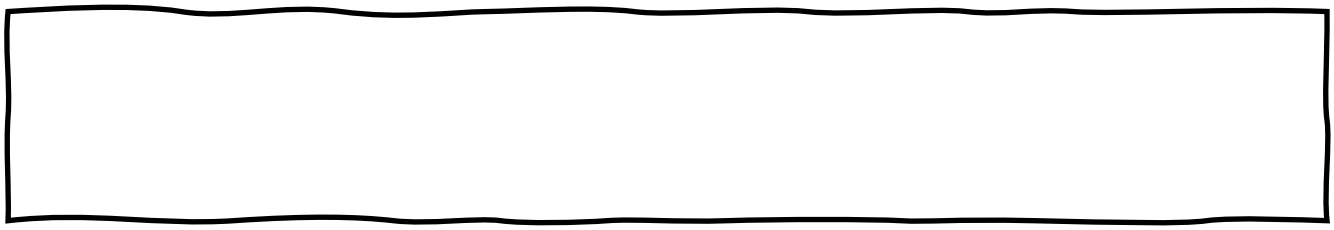
- **Medium**: Acidic (usually H_2SO_4) – required to prevent any side reactions.
- **Color**: Purple (MnO_4^-) → Colorless (Mn^{2+})
- **Self-indicator**: Endpoint is the first **permanent pink** color.

Half-Equation in Acidic Medium:

Detailed Exam Related Examples of Titrations

1. $KMnO_4$ vs Fe^{2+}

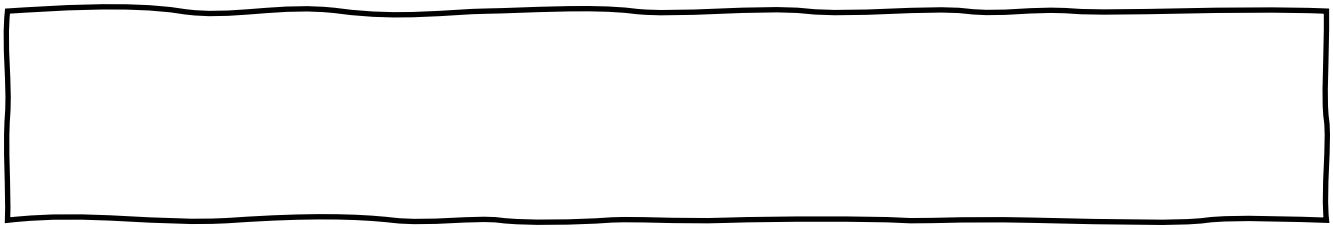
- **Medium**: Dilute H_2SO_4
- **Purpose**: Determine Fe^{2+} concentration.
- **Equation**:



- **Endpoint**: Pale green to **permanent pink**.

2. $KMnO_4$ vs Oxalic Acid

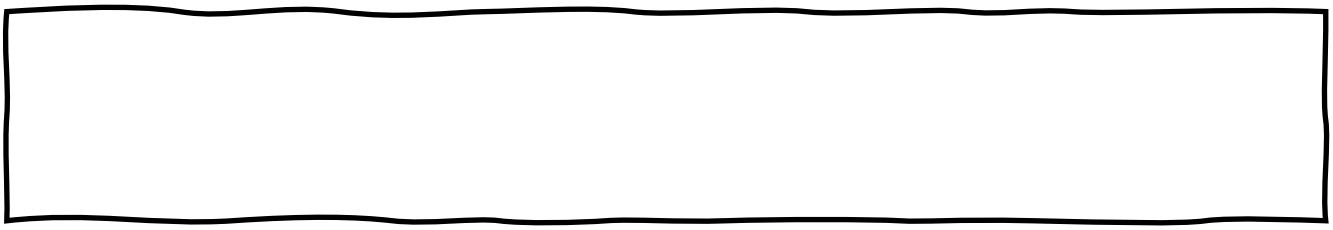
- **Medium**: Warm dilute H_2SO_4 (60–70 °C)
- **Equation**:



- **Slow at room temperature**, needs warming.
- **Endpoint**: Colorless to **permanent pink**.

3. $KMnO_4$ vs H_2O_2

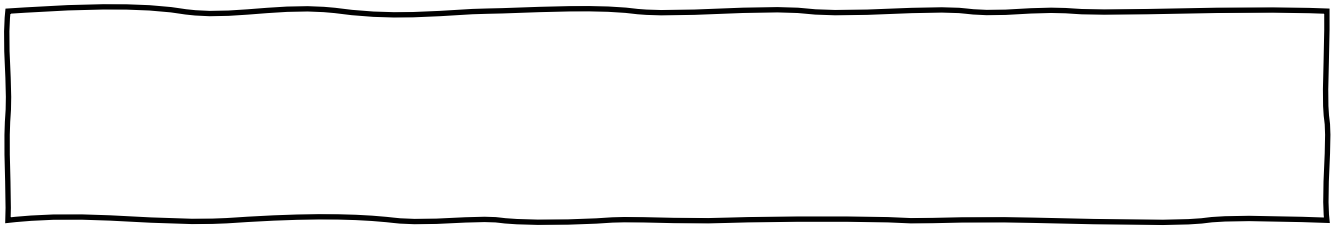
- **Equation**:



- Used for **determining hydrogen peroxide concentration**.
- **Endpoint**: Colorless to **permanent pink**.

4. $KMnO_4$ vs SO_3^{2-} (Sulfite)

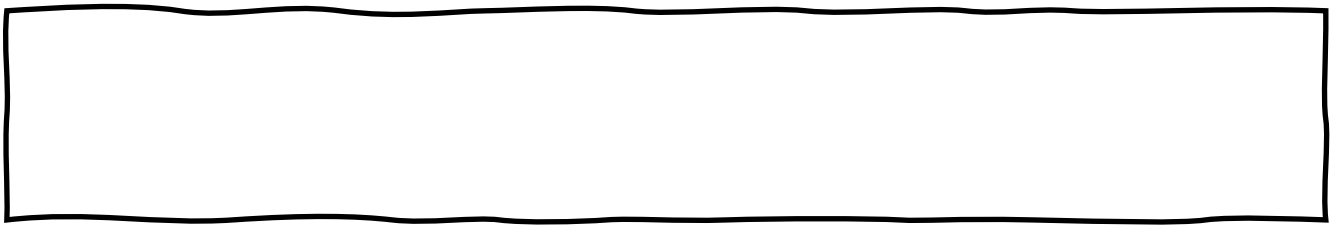
- **Equation**:



- **Used in**: Food preservative analysis.
- **Endpoint**: Colorless to **permanent pink**.

5. $KMnO_4$ vs NO_2^- (Nitrite)

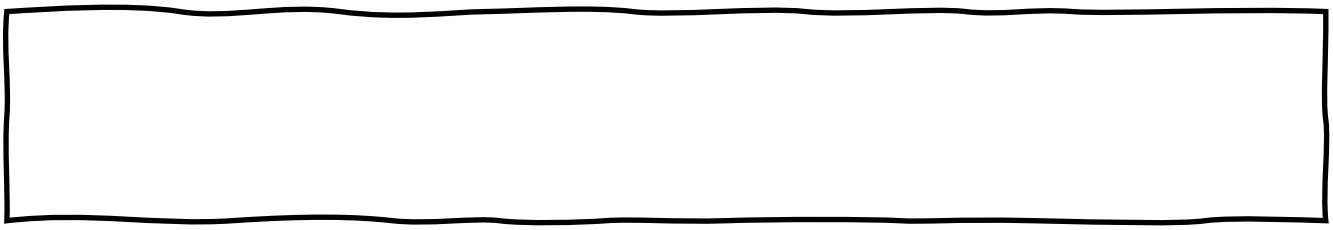
- **Equation**:



- **Used in**: Water and food quality analysis (e.g., curing meats).
- **Endpoint**: Colorless to **permanent pink**.

6. $KMnO_4$ vs S^{2-} (Sulfide)

- **Equation**



- **Used in**: Wastewater and ore analysis.
- **Endpoint**: Colorless to **permanent pink**.

Endpoint Detection

- **No indicator** needed.
- **Colorless to Pink** transition.
- Stop titration when a **faint pink persists** for ~30 seconds.
- Use a candel light (torch light) to record the burette reading