



# *Oxidation reduction titration*

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1. **Red-ox reactions** are those reactions which involves change in the oxidation number or transfer of electrons between reactants.
2. Oxidation is a process which involves loss of electrons.

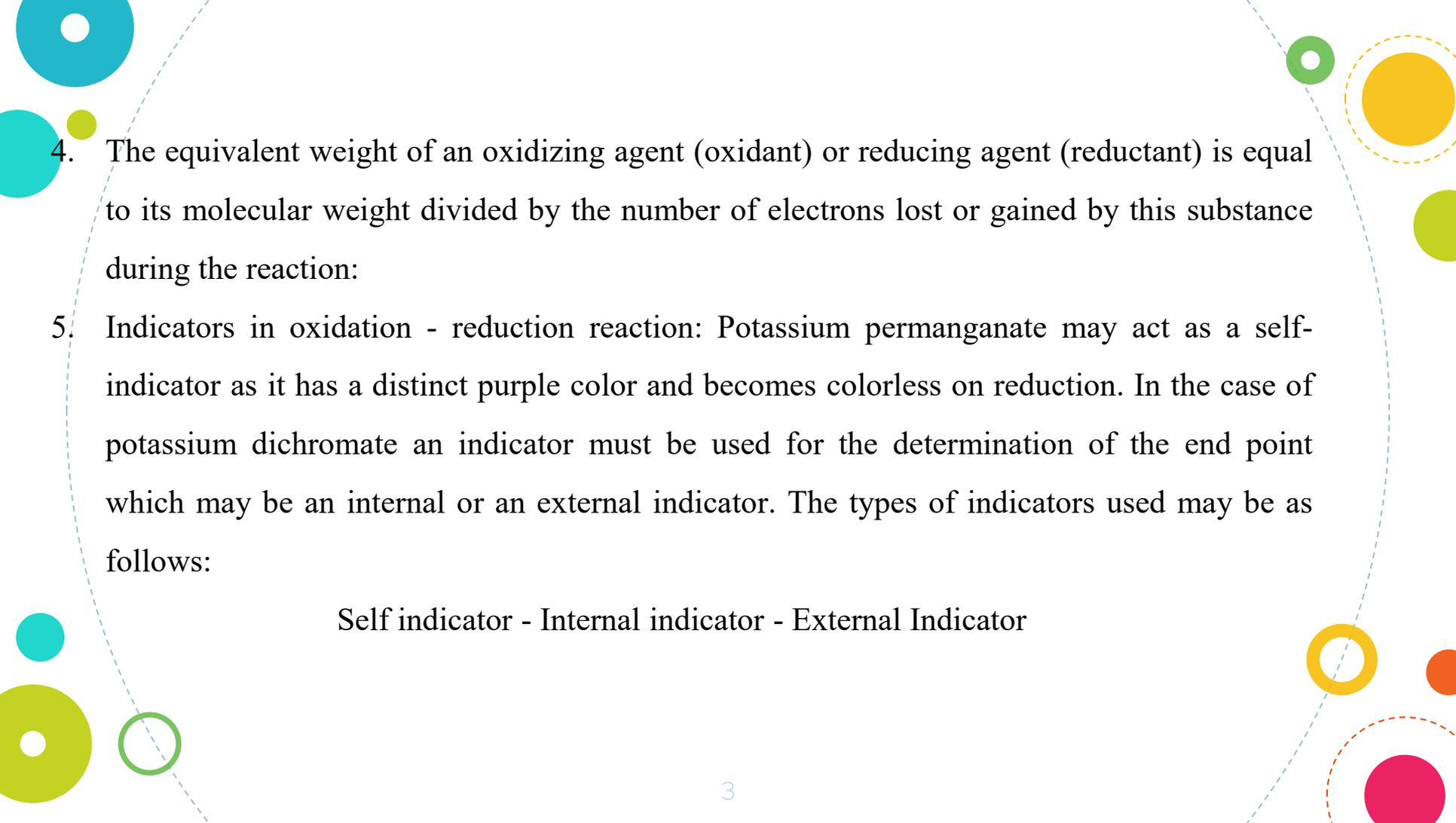


$$\text{The eq.wt.} = \frac{\text{MnO}_4^-}{5} = \frac{\text{KMnO}_4}{5}$$

3. Reduction is a process in which electrons are gained.



$$\text{The eq.wt.} = \frac{\text{Cr}_2\text{O}_7^{2-}}{6} = \frac{\text{K}_2\text{Cr}_2\text{O}_7}{6}$$

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4. The equivalent weight of an oxidizing agent (oxidant) or reducing agent (reductant) is equal to its molecular weight divided by the number of electrons lost or gained by this substance during the reaction:
5. Indicators in oxidation - reduction reaction: Potassium permanganate may act as a self-indicator as it has a distinct purple color and becomes colorless on reduction. In the case of potassium dichromate an indicator must be used for the determination of the end point which may be an internal or an external indicator. The types of indicators used may be as follows:

Self indicator - Internal indicator - External Indicator

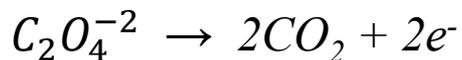
# (I) Standardization of potassium permanganate with oxalic acid:

## Theory:

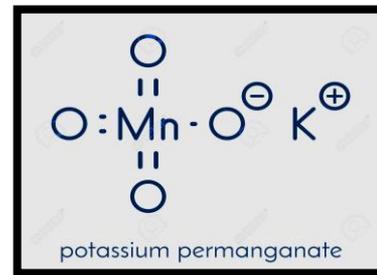
Oxalic acid is oxidized by potassium permanganate, in acid solution to carbon dioxide and water.



The reaction is complete at a temperature of about 60-90°C



$$\text{eq.wt. of oxalic acid} = \frac{M.wt.}{2} = 63$$



## *Oxidation with potassium permanganate:*

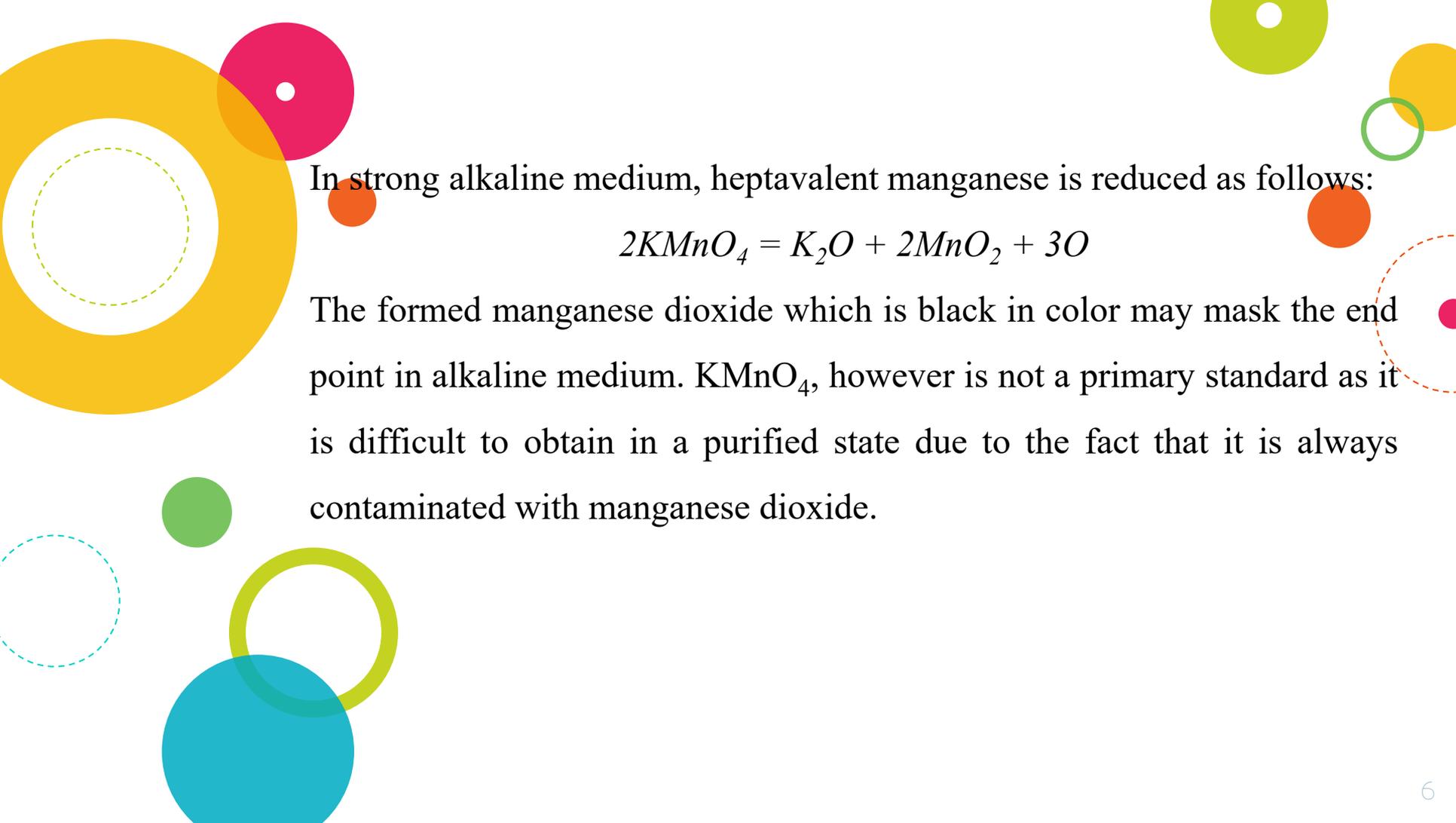
$\text{KMnO}_4$  is a strong oxidizing agent in acid medium



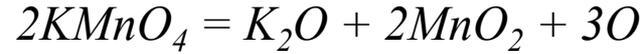
HCl, could not be used instead of  $\text{H}_2\text{SO}_4$  as it is readily oxidized to chlorine in presence of permanganate.



Nitric acid is stronger than  $\text{KMnO}_4$



In strong alkaline medium, heptavalent manganese is reduced as follows:



The formed manganese dioxide which is black in color may mask the end point in alkaline medium.  $KMnO_4$ , however is not a primary standard as it is difficult to obtain in a purified state due to the fact that it is always contaminated with manganese dioxide.

### Materials:

Oxalic acid solution 0.1N.

Dilute sulphuric acid 2N.

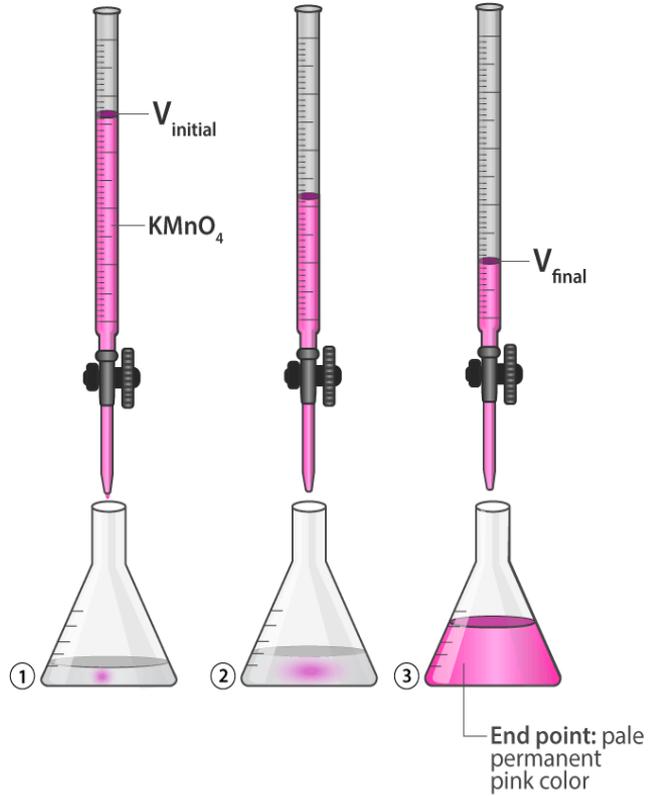
Potassium permanganate solution of unknown normality.

### Procedure:

1. Transfer 10 ml of oxalic acid solution to the conical flask and add equivalent amount (10 ml) of dilute sulphuric acid (2N).
2. Warm the solution gently until the temp. of the solution reaches 60-80°C then add the permanganate solution slowly from the burette till the solution acquires a light rose color. Keep the solution hot during the titration. If a brown ppt is formed during the titration, this may be due to one of the following reasons:
  - a. The temp. of the solution may be below 60°C.
  - b. The addition of permanganate solution was carried out rapidly.
  - c. The amount of sulphuric acid is insufficient.
3. Repeat the experiment three times and take the mean value of your reading.

## TITRATION OF OXALIC ACID VS $\text{KMnO}_4$

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## Calculations:

meq. of oxalic acid = meq. of permanganate at the end point.

$$N \times V (\text{oxalic acid}) = N' \times V' (\text{KMnO}_4)$$

From this relation deduce the normality of  $\text{KMnO}_4$

$$\text{Strength of KMnO}_4 = N' \times \text{eq. wt. KMnO}_4 \quad \text{gm/L}$$

1. Oxidation is a process which involves loss of electrons.



$$\text{The eq.wt.} = \frac{\text{MnO}_4^-}{5} = \frac{\text{KMnO}_4}{5}$$



$$-1 = (4 \times -2) + X$$

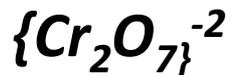
$$X = -1 + 8$$

$$X = 7$$

. Reduction is a process in which electrons are gained.



$$\text{The eq. wt.} = \frac{\text{Cr}_2\text{O}_7^{-2}}{6} = \frac{\text{K}_2\text{Cr}_2\text{O}_7}{6}$$



$$-2 = (7 \times -2) + 2X$$

$$X = (-2 + 14) / 2$$

$$X = 6$$