Oxidation –Reduction Titrations

Prepration and Standarization of 0.1N $KMnO_4$ Solution

Aim: To determine the concentration Normality of Potassium Permanganate ($KMnO_4$) solution by titrating is against a 0.1N standard solution of oxalic acid ($H_2C_2O_4$) .

Titration of Potassium Permanganate with Oxalic Acid is a type of redox titration .

$KMnO_4$ is an oxidizing agent which works in acidic medium more strongly than alkaline medium .Its oxidizing action can be represented by following reaction in an acidic medium

$$MnO^-_4 + 8H^+ + 5e^- \longrightarrow Mn^{+2} + 4H_2O$$

In acidic medium ,the equivalent weight of Permanganate is equal to 1/5 of its molecular weight,that is $KMnO_4$ accepted 5 electrons.

Equivalent Weight of Permanganate$= \frac{158.03}{5}$ =31.61 gm

We use sulphuric acid (H_2SO_4) in this titration with $KMnO_4$ .The solution which contain MnO^-_4 ion in it is purple in color.While the solution containing Mn^{+2} ions is pink .Thus,Potassium Permanganate when reacts with a reducing agent it works as self indicator also.

In this experiment,Oxalic Acid acts as a reducing agent and $KMnO_4$ is taken in an acidic medium of H_2SO_4 . So, there is no need of indicator as Potassium Permanganate will act as self-indicator.

Oxidation Half reaction:

$$5H_2C_2O_4+5[O] \longrightarrow 5H_2O+10CO_2$$

$$C_2O_4-2e \longrightarrow 2CO_2$$

By multiplying the oxidation equation for oxalic acid by 5 and the equation for permanganate reduction by 2 and adding the two equations:

$$5C_2O_4 - 10e \longrightarrow 2CO_2$$

$$2MnO^-_4 + 16H^+ + 10e \longrightarrow 2Mn^{+2} + 4H_2O$$

$$5C_2O_4 + 2MnO^-_4 + 16H^+ \longrightarrow 2CO_2 + 2Mn^{+2} + 4H_2O$$

Overall Reaction:

$$2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$$

This is titration cannot be carried in the presence of acids like nitric acid or HCl because itself is an oxidising agent.

$$N \times V = N \times V$$

$H_2C_2O_4$ $KMnO_4$