Standardisation of $KMnO_4$ solution by standard Oxalic acid solution

Principle

$KMnO_4$ being a powerful oxidant can quantitatively oxidises oxalate ion ($C_2O_4^{2-}$) to CO_2.

$$MnO_4^- + 8H^+ + 5e \rightleftharpoons Mn^{2+} + 4H_2O \; ; \; E^\circ = 1.51V$$

$$2CO_2 + 2e \rightleftharpoons C_2O_4^{2-} \; ; \; E^\circ = -0.49V$$

So,

$$2MnO_4^- + 16H^+ + 5C_2O_4^{2-} \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

Equivalent weight of oxalic acid $= \frac{MW}{2}$

$= \frac{126}{2}$

$= 63$

[Oxalic acid $\rightarrow$ $\begin{matrix} COOH \\ COOH \end{matrix} \cdot 2H_2O$]

To prepare 250 ml (N/10) oxalic acid solution, the weight of oxalic acid to be taken $= \frac{63 \times 250}{1000 \times 10}$ gm

$= 1.575$ gm

Procedure

Preparation of standard (N/10) oxalic acid solution

Weight of the bottle with Oxalic acid (W_1 gm)	Weight of the bottle after transfer (W_2 gm)	Weight taken ($W_1 - W_2 = W$ gm)

$$\text{Strength of oxalic acid} = \frac{\text{weight taken}}{\text{weight required}} \left(\frac{N}{10}\right)$$

$$= \frac{W_1 - W_2}{1.575} \left(\frac{N}{10}\right)$$

$$= \frac{W}{1.575} \left(\frac{N}{10}\right)$$

$$= f \left(\frac{N}{10}\right), \quad f = \text{factor}$$

~~Titration of oxalic acid solution ($H_2C_2O_4$) with $KMnO_4$ solution~~

Titration of $KMnO_4$ solution with standard Oxalic acid solution

25 ml of standard oxalic acid solution is pipetted out into a 250ml conical flask. To it 100ml 2N H_2SO_4 solution is added. The mixture is heated on an asbestos board to about 70°-80°C and titrated in hot condition with $KMnO_4$ solution running from a burette dropwise.

Disappearence of pink colour is slow at the begining, then becomes rapid as Mn^{2+} formed autocatalyses the reaction. The end point is marked by the just appearence of pale pink colour by a drop of $KMnO_4$.

The burette reading is noted with the upper meniscus, as it is deep coloured.

Table: Titration of $KMnO_4$ by standard oxalic acid solution

No. of Titrations	Vol. of oxalic acid (ml)	Initial burette reading (ml)	Final burette reading (ml)	Difference in (ml)	Mean Volume (ml)
1. 2. 3.	25				V

Calculation

$$V_1 S_1 = V_2 S_2$$

$$\text{or, } 25 \times f\left(\frac{N}{10}\right) = V \times S_2$$

$$\text{or, } S_2 = \frac{25 \times f}{V}\left(\frac{N}{10}\right)$$

NOTE

2 N H_2SO_4

50 ml Conc. H_2SO_4 + 850 ml water = 900 ml 2N H_2SO_4