Prepare M/50 Solution of Oxalic Acid. With its help, Determine 50 the Molarity & Strength of the Given Solution of Potassium Permanganate ($KMnO_4$)

Chemical Equations

Molecular equations

$$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$$

$$\begin{matrix}COOH\\|\\COOH\end{matrix} . 2H_2O + [O] \xrightarrow{60—70°C} 2CO_2 + 3H_2O] \times 5$$

$$2KMnO_4 + 2H_2SO_4 + 5 \begin{matrix}COOH\\|\\COOH\end{matrix} . 2H_2O \longrightarrow K_2SO_4 + 2MnSO_4 + 18H_2O + 10CO_2$$

Ionic equations

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O] \times 2$$

$$C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-] \times 5$$

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

Indicator

$KMnO_4$ is a self-indicator.

End Point

Colourless to permanent pink colour ($KMnO_4$ in burette).

Procedure

1. Weigh 1.260 g of oxalic acid crystals and dissove them in water to prepare 500 ml of M/50 oxalic acid solution using a 500 ml measuring flask. Rinse the pipette with the M/50 oxalic acid solution and pipette out 20 ml of it in a washed titration flask.
2. Rinse and fill the burette with M/100 $KMnO_4$ solution.
3. Add one test-tube (~ 20 ml) full of dilute sulphuric acid (~ 2 M) to the solution in titration flask.
4. Note the initial reading of the burette.
5. Now add $KMnO_4$ solution from the burette till a permanent light pink colour is imparted to the solution in the titration flask on addition of last single drop of $KMnO_4$ solution.

6. Note the final reading of the burette.
7. Repeat the above steps 4-5 times to get a set of three concordant readings.

Observations

Weight of watch glass =……. g
Weight of watch glass + Mohr's salt =……..g
Weight of Mohr's salt = 1.260 g
Volume of Mohr's salt solution prepared = 500 ml
Volume of Mohr's salt solution taken for each titration = 20.0 ml
Molarity of $KMnO_4$ solution =M/50

S. No.	*Initial reading of the burette*	*Final reading of the burette*	*Volume of the $KMnO_4$ solution used*
1.	—	—	— ml
2.	—	—	— ml
3.	—	—	— ml
4.	—	—	— ml

Concordant volume = x ml (say).

Calculations

(a) Molarity of the $KMnO_4$ solution
From the overall balanced chemical equation it is clear that 2 moles of $KMnO_4$ react with 5 moles of oxalic acid.

$$\therefore \quad \frac{M_{KMnO_4} \times V_{KMnO_4}}{M_{\text{oxalic acid}} \times V_{\text{oxalic acid}}} = \frac{2}{5}$$

where, M_{KMnO_4} = Molarity of $KMnO_4$ solution

V_{KMnO_4} = Volume of $KMnO_4$ solution

$M_{\text{oxalic acid}}$ = Molarity of Mohr's salt solution

$V_{\text{oxalic acid}}$ = Volume of Mohr's salt solution

$$\frac{M_{KMnO_4} \times x}{1/50 \times 20} = \frac{2}{5}$$

$$M_{KMnO_4} = \frac{2}{5} \times \frac{2}{5x} = \frac{4}{25x}.$$

(*b*) *Strength of the $KMnO_4$ solution*

Strength (in g/1) = Molarity × Molar mass

$$= \frac{4}{25x} \times 158$$

Instructions for the Preparation of Solutions

Provide the following :

1. Oxalic acid crystals
2. $KMnO_4$ solution (1.26 g/litre)
3. 4N H_2SO_4.