The Given Solution has been Prepared By Dissolving 1.6 g Of An Alkali Metal Permanganate Per litre Of Solution. Determine Volumetrically the Atomic mass Of the Alkali metal. Prepare M/20 Mohr's Salt Solution For Titration

Chemical Equations

Molecular equations. Let A represent the alkali metal and $AMnO_4$ represent alkali metal permanganate,

$$2AMnO_4 + 3H_2SO_4 \longrightarrow A_2SO_4 + 2MnSO_4 + 5[O]$$
$$FeSO_4.(NH_4)_2SO_4.6H_2O \longrightarrow FeSO_4 + (NH_4)_2SO_4 + 6H_2O$$
$$2FeSO_4 + H_2SO_4 + [O] \longrightarrow Fe_2(SO_4)_3 + H_2O$$

Ionic equations

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$
$$Fe^{2+} \longrightarrow Fe^{3+} + e^-] \times 5$$

$$MnO_4^- + 8H^+ + 5Fe^{2+} \longrightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$$

Indicator

$AMnO_4$ will act as a self-indicator.

End Point

Colourless to permanent pink colour ($AMnO_4$ in burette).

Procedure

1. Weigh exactly 4.90 g of Mohr's salt on a watch glass and dissolve in water to prepare exactly 250 ml of its solution using a 250 ml measured flask. Rinse the pipette with
   the M/20 Mohr's salt solution and pipette out 20.0 ml of it in a washed titration flask.
2. Rinse and fill the burette with the given $AMnO_4$ solution.
3. Add one test-tube (~ 20 ml) full of dilute sulphuric acid (~ 4M) to the solution in titration flask.
4. Note the initial reading of the burette.
5. Now add AMn04 solution from the burette till a permanent light pink colour is just imparted to the solution in the titration flask.

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 = 4.90 g
Volume of solution prepared = 250 ml
Molarity of Mohr's salt solution = M/20
Volume of Mohr's salt solution taken for each titration = 20.0 ml

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

Prom the balanced chemical equation, it can be seen that 2 moles of $AMnO_4$ react with 10 moles of Mohr's salt.

$$\therefore \quad \frac{M_{AMnO_4} \times V_{AMnO_4}}{M_{Mohr's\ salt} \times V_{Mohr's\ salt}} = \frac{2}{10}$$

$$\frac{M_{AMnO_4} \times x}{\frac{1}{20} \times 20} = \frac{2}{10}$$

Molarity of $AMnO_4$, $\quad M_{AMnO_4} = \frac{2}{10} \times \frac{1}{x} = \frac{2}{10x}$

Strength of $AMnO_4$ = 1.6 g/litre.

Molecular mass of alkali metal permanganate

$$= \frac{\text{Strength}}{\text{Molarity}}$$

$$= \frac{1.6}{\frac{2}{10x}} = 8x \qquad \ldots(11.1)$$

But molecular mass of $AMnO_4$ = Atomic mass of A + Formula mass of MnO_4^-

$$= a + 119 \qquad \ldots(11.2)$$

From equations (11.1) and (11.2),

$$8x = a + 119$$

$$a = 8x - 119$$

Instructions for the Preparation of Solutions

Provide the following :

1. $KMnO_4$ solution (1.58 g/litre)
   Label it as $AMnO_4$ solution
2. Mohr's salt
3. 4N H_2SO_4.