Prepare M/20 Solution of Ferrous Ammonium Sulphate (Mohr's salt). Using this Solution Find out the Molarity & Strength of the Given $KMnO_4$ Solution

Chemical Equations

Molecular equations

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

$$2FeSO_4(NH_4)_2SO_4.6H_2O + H_2SO_4 + [O] \longrightarrow Fe_2(SO_4)_3 + 2(NH_4)_2SO_4 + 13H_2O] \times 5$$

$$2KMnO_4 + 8H_2SO_4 + 10FeSO_4(NH_4)_2.SO_4.6H_2O \longrightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 10(NH_4)_2SO_4 + 68H_2O$$

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

$KMnO_4$ is a self-indicator.

End Point

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

Procedure

1. Prepare 250 ml of M/20 Mohr's salt solution by dissolving 4.9 g of Mohr's salt in water 20 as described in experiment 11.3. 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 KMn04 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 = 4.90 g
Volume of Mohr's salt 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

(a) Molarity of the $KMnO_4$ solution.
From the overall balanced chemical equation, it is clear that 2 moles of $KMnO_4$ reacts with 10 moles of Mohr's salt.

$$\therefore \quad \frac{M_{KMnO_4} \times V_{KMnO_4}}{M_{\text{Mohr's salt}} \times V_{\text{Mohr's salt}}} = \frac{2}{10}$$

where, M_{KMnO_4} = Molarity of $KMnO_4$ solution
V_{KMnO_4} = Volume of $KMnO_4$ solution
$M_{\text{Mohr's salt}}$ = Molarity of Mohr's salt solution
$V_{\text{Mohr's salt}}$ = Volume of Mohr's salt solution

$$\frac{M_{KMnO_4} \times x}{\frac{1}{20} \times 20} = \frac{2}{10}$$

$$M_{KMnO_4} = \frac{2}{10} \times \frac{1}{x} = \frac{2}{10x}$$

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

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

$$= \frac{2}{10x} \times 158$$

Instructions for the Preparation of Solutions:

Provide the following:

1. Crystals of Mohr's salt
2. M/100 $KMnO_4$ solution (1.58 g/litre)
3. 4N H_2SO_4.