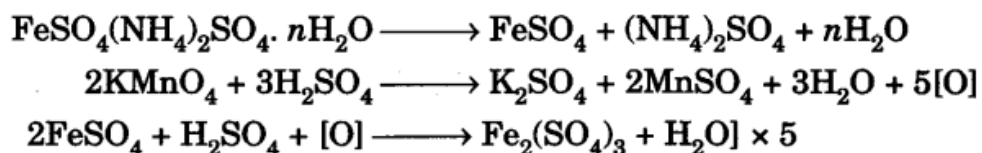


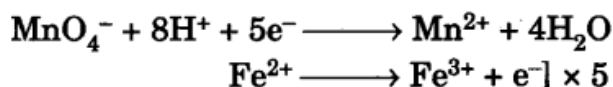
Determine the Equivalent Mass & Number of Molecules of Water of Crystallisation in a Sample of Mohr's salt, $\text{FeSO}_4(\text{NH}_4)_2 \text{SO}_4 \cdot n\text{H}_2\text{O}$. Provided KMnO_4

Chemical Equations

Molecular equations



Ionic equations



Theory

Prepare a solution of Mohr's salt with known strength (g/litre). Molarity of ferrous ammonium sulphate can be determined by directly titrating it against standard (M/100) KMnO_4 solution.

Molecular mass = strength/molarity.

Substituting the value of strength and value of molarity as calculated above, the molecular mass of Mohr's salt can be calculated. Suppose it comes out to be M.

Theoretical molecular mass of Mohr's salt, $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot n\text{H}_2\text{O}$

$$= 284 + 18n$$

$$\therefore 284 + 18n = M$$

whence, n can be calculated.

In case of Mohr's salt equivalent mass is equal to its molecular mass. Therefore, Equivalent mass of Mohr's salt = M.

Indicator

KMnO_4 is a self-indicator.

End Point

Colourless to permanent pink colour (KMnO_4 in burette).

Procedure

1. Weigh exactly 4.90 g of Mohr's salt and dissolve in water to prepare exactly 250 ml of solution, using a 250 ml measuring flask. Rinse the pipette with the prepared

Mohr's

salt solution and pipette out 20.0 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 (~ 4 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

Volume of Mohr's salt solution taken for each titration = 20.0 ml

Molarity of KMnO_4 solution = M/100

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

Molarity of the standard KMnO_4 solution = $\frac{M}{100}$

x ml of $\frac{M}{100}$ KMnO_4 react with 20.0 ml of the given Mohr's salt solution.

From the chemical equations, it is clear that one mole of KMnO_4 reacts with 5 moles Mohr's salt.

$$\therefore \frac{M_{\text{Mohr's salt}} \times V_{\text{Mohr's salt}}}{M_{\text{KMnO}_4} \times V_{\text{KMnO}_4}} = \frac{5}{1}$$

$$\frac{M_{\text{Mohr's salt}} \times 20.0}{1/100 \times x} = \frac{5}{1}$$

$$M_{\text{Mohr's salt}} = \frac{5 \times x \times 1}{20 \times 100} = \frac{x}{400}$$

$$\text{Molecular mass of Mohr's salt} = \frac{\text{Strength in g/litre}}{\text{Molarity}}$$

$$= \frac{19.6}{x/400} = M \text{ (say)}$$

(a) Calculation of no. of molecules of water of crystallisation

Theoretically, molecular mass of Mohr's salt, $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot n\text{H}_2\text{O}$
 $= 284 + 18n$

Equating this with the experimentally determined molecular mass, we get

$$M = 284 + 18n$$

$$n = \frac{M - 284}{18}$$

(b) Calculation of equivalent mass of Mohr's salt

Since oxidation of Mohr's salt involves one electron per molecule, therefore, equivalent mass of Mohr's salt is equal to its molecular mass.

$$\text{Equivalent mass} = \frac{\text{Molecular mass}}{1} = \frac{M}{1} = M$$

Instructions for the Preparation of Solutions

Provide the following:

1. Mohr's salt
2. KMnO_4 solution (1.58 g/litre)
3. 4N H_2SO_4 .