**Aim:** To estimate the amount of Fe (II) ions present in the unknown solution of Mohr's salt by titrating it with $K_2Cr_2O_7$ ($\sim N/40$) using internal indicator.

**Requirements:**

**Apparatus:** Burette, pipette, conical flask, standard flask, beaker, spatula, wash bottle, weighing bottle.

**Chemicals:** Mohr's salt solution, $K_2Cr_2O_7$ solution ($\sim \frac{N}{40}$) o-phosphoric acid, dilute sulphuric acid Diphenyl amine indicator and Mohr's salt (solid).

**Theory:**

Change in O.S = 6

$$\overset{+12}{Cr_2O_7^{2-}} + 14H^+ \longrightarrow \overset{+6}{2Cr^{3+}} + 7H_2O \quad \times 1$$

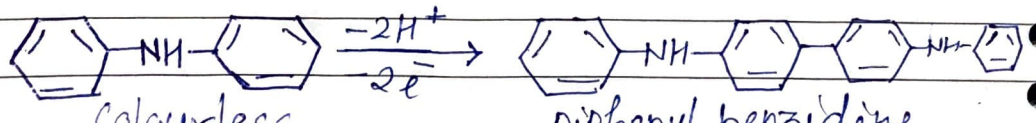
$$Fe^{2+} \longrightarrow Fe^{3+} \quad \times 6$$

Change in O.S = 1

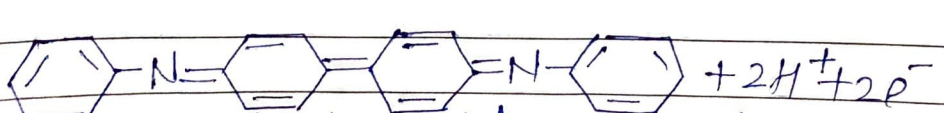
$$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

Yellowish Orange Colour → Green

**Indicator:**




Colourless → Diphenyl benzidine (colourless) Benzenoid form




Violet colour ← Diphenyl benzidine violet (Quinonoid form)

## Preparation of $\left(\frac{N}{40}\right)$ Mohr's salt Solution (100mL)

$$\text{Normality} = \frac{\text{wt.} \times 1000}{\text{Eq.wt} \times V(mL)}$$

$$\frac{1}{40} = \frac{\text{wt.} \times 1000}{392.14 \times 100}$$

$$\text{wt.} = \frac{392.14}{400}$$

$$\boxed{\text{wt.} = 0.98\,g}$$

Equivalent wt. of $K_2Cr_2O_7$:

$$Cr_2O_7^{2-} + 14H^+ \longrightarrow 2Cr^{3+} + 7H_2O$$

Change in O.S = 6

Molecular wt. of $K_2Cr_2O_7 = 294.21$

$$\text{Equivalent wt. of } K_2Cr_2O_7 = \frac{\text{Molecular wt.}}{\text{change in O.S.}} = \frac{294.21}{6}$$

$$\boxed{\text{Equivalent wt. of } K_2Cr_2O_7 = 49.03}$$

Role of Phosphoric Acid:

1. $H_3PO_4 \longrightarrow H^+ + H_2PO_4^-$

   $H_2PO_4^- \longrightarrow H^+ + HPO_4^{2-}$

   $HPO_4^- + Fe^{3+} \longrightarrow [Fe(HPO_4)]^+$

2. $H_3PO_4$ also prevents the premature oxidation of the indicator.

## Procedure:

1. **Preparation of Standard Solution of Mohr's salt:**
Prepare a standard solution of Mohr's salt $\frac{N}{40}$ by dissolving 0.98g of Mohr's salt in ~10mL of dil. $H_2SO_4$ & then dilute with water to make 100mL of solution.

2. **Standardisation of Potassium Dichromate:**
Pipette out 10mL of standard Mohr's salt in a conical flask. Add 10mL dil $H_2SO_4$ in the Mohr's salt solution & then add 2mL $H_3PO_4$ and diphenyl amine (2-3 drops), respectively. Titrate with $K_2Cr_2O_7$ solution till a permanent blue colour is obtained. Repeat the titration to get three concordant values.

## Observation Table:

| Sr.No. | Volume of Mohr's salt (mL) | Burette Reading (mL) | | Volume of $K_2Cr_2O_7$ used (mL) |
|---|---|---|---|---|
| | | Initial | Final | |
| 1. | 10.0 | 0.0 | 9.1 | |
| 2. | 10.0 | 9.1 | 19.4 | 10.3 mL |
| 3. | 10.0 | 19.4 | 29.7 | |
| 4. | 10.0 | 29.7 | 40.0 | |

Concordant volume = 10.3 mL

$N_1V_1 = N_2V_2$

$K_2Cr_2O_7$ = Standard Mohr's salt solution

$N_1 \times 10.3 = \frac{1}{40} \times 10$

$$N_1 = \frac{1}{41.2} N$$

Normality of $K_2Cr_2O_7$ solution = $\frac{1}{41.2} N$

3. Titration of unknown Mohr's salt solution with standard $K_2Cr_2O_7$ solution:

Pipette out the unknown Mohr's salt solution (10mL) in a conical flask. Add dil. $H_2SO_4$ (10mL) & then add 2mL $H_3PO_4$ and 2-3 drops diphenyl amine (2-3 drops) indicator. Titrate with standard $K_2Cr_2O_7$ solution till a permanent blue colour is obtained. Repeat the titration to get three concordant values.

Observation Table 2:

| Sr.No. | Volume of Mohr's Salt (mL) | Burette Reading (mL) Initial | Final | Volume of $K_2Cr_2O_7$ Used (mL) |
|---|---|---|---|---|
| 1. | 10.0 | 0.0 | 11.5 | |
| 2. | 10.0 | 11.5 | 23.5 | 12.0 mL |
| 3. | 10.0 | 23.5 | 35.5 | |
| 4. | 10.0 | 35.5 | 47.5 | |

Concordant Volume = 12 mL

$N_1V_1' = N_2V_2$

Standard $K_2Cr_2O_7$ = Unknown Mohr's Salt Solution

$\frac{1}{41.3} \times 12 = N_2 \times 10$

$N_2 = \frac{12}{413}$

$N_2 = 0.029\ N$

Normality of unknown Mohr's salt solution = 0.029N

Calculations:

Strength of Mohr's salt solution = Normality × Equivalent wt. of Mohr's salt

Strength in g/L = 0.029 X 392.14

= 11.393g/L

Amount of Mohr's salt present = 11.393g/L

Amount of Fe(II):

$(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O \longrightarrow Fe^{2+}$

1 mole. 1 mole.

392.14 g 56.

Amount of Fe(II) in 1g Mohr's salt = $\frac{56}{392.14}$

∴ Amount of Fe(II) present in 11.393g of Mohr's salt

$= \frac{56}{392.14} \times 11.393$

**Amount of Fe(II) = 1.626g**

Result: Amount of Fe(II) present = .....