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Experiment - 7 : Determination of ferrous ion (Fe^{2+}) in a supplied solution of iron salt by standard potassium permanganate ($KMnO_4$) solution.

Experimental data :

Method : Oxidation - reduction titration

Reactions : 1. $2KMnO_4 + 5Na_2C_2O_4 + 8H_2SO_4 = 2MnSO_4 + 10CO_2 + 8H_2O$ $(+ K_2SO_4 + 5Na_2SO_4)$

2. $2KMnO_4 + 10FeSO_4 + 8H_2SO_4 = 2MnSO_4 + 5Fe_2(SO_4)_3 + K_2SO_4 + 8H_2O$

Redox Half Reactions :

For 1 : (a) $5C_2O_4^{2-} \longrightarrow 10CO_2 + 10e$ (Oxidation)

(b) $2MnO_4^- + 16H^+ + 10e = 2Mn^{++} + 8H_2O$ (Reduction)

For 2 : (a) $10Fe^{2+} \longrightarrow 10Fe^{3+} + 10e$ (Oxidation)

(b) $2MnO_4^- + 16H^+ + 10e = 2Mn^{++} + 8H_2O$ (Reduction)

(A) Standardize the $KMnO_4$ solution by standard $Na_2C_2O_4$ solution.

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Table-1 : Standardization of Supplied $KMnO_4$ Solution by Standard $Na_2C_2O_4$ Solution.

No of reading	Vol. of oxalate Solution (in mL)	Vol. of $KMnO_4$ (burette reading) (in mL)			Mean (in mL)
		Initial	Final	Different	
1	10	0.00	9.10	9.10	9.15
2	10	9.10	18.30	9.20	

weight taken (in gm) = 0.53 gm

The strangth of $Na_2C_2O_4$ Solution

$$= \frac{\text{Weight taken (in gm)} \times 0.1}{0.67} \text{ (N)}$$

$$= \frac{0.53 \times 0.1}{0.67} = 0.0791$$

$$= 0.08 \text{ (N)}$$

The strenght of supplied $KMnO_4$ Solution

$$V_{KMnO_4} \times N_{KMnO_4} = V_{Na\text{-oxalate}} \times N_{Na\text{-oxalate}}$$

$$\Rightarrow N_{KMnO_4} = \frac{10 \times 0.08}{9.15} \text{ (N)}$$

$$= 0.0874 \text{ (N)}$$

$$= 0.09 \text{ N}$$

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(B) Estimation of fe ions :

Table - 2 : Determination of the amount of iron in Mohr's salt solution using standard $KMnO_4$ solution.

No of reading	Vol of Mohr's Salt Solution (in mL)	Vol. of $KMnO_4$ (burnette reading) (in mL)			Mean (in mL) (V)
		Initial	Final	Difference	
1	10	18.30	23.30	5.00	4.975 = 4.98
2	10	23.30	28.20	4.90	
3	10	28.20	33.30	5.10	
4	10	33.30	38.20	4.90	

Calculations :

1 mL 1N $KMnO_4 \equiv 0.05584$ gm of fe^{2+}

Amount of iron in 10 mL of iron salt solution

$= 0.05584 \times V \times S$ gm

$= 0.05584 \times 4.98 \times 0.09$ gm

$= 0.0250$ gm

$= 0.03$ gm

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Amount of iron in 500mL of iron salt solution.

$= 0.05584 \times V \times 5 \times 50$ gm

$= 0.05584 \times 4.98 \times 0.09 \times 50$ gm

$= 1.2513$ gm

$= 1.25$ gm

Observe value of Fe^{2+} (in 500mL Solution)

$= 1.25$ gm

Known value of Fe^{2+} (in 500mL Solution)

$$= \frac{55.89 \times 8.55}{392.14} \text{ gm}$$

$= 1.2175$ gm

$= 1.22$ gm

Results: The amount of ferrous ions in 500 mL of iron salt solution is 1.25 gm

Percentage of Error:

$$\frac{\text{known value} - \text{Observed value}}{\text{known value}} \times 100$$

$$= \frac{1.22 - 1.25}{1.22} \times 100$$

$= -0.0245\%$

$= -2.45\%$