EXP 7: Determination of Ferrous ion (Fe^{2+}) in a supplied solution of Iron Salt by standard Potassium permanganate ($KMnO_4$) solution.

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Theory:

Method: Oxidation-reduction titration

Reaction:

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

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

Redox Half Reaction:

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

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

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

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

Indicator:

$KMnO_4$ Serves as its own indicator

Experimental Data:

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

Table-1: Standardization of supplied $KMnO_4$ solution by standard $Na_2C_2O_4$ solution.

No. of reading	Vol. of Oxalet solution (in mL)	Vol of $KMnO_4$ (burette reading) (in mL)			Mean (in mL)
		Initial	Final	Difference	
1	10	0.00	9.10	9.10	$\frac{9.10+9.20}{2} = 9.15$
2	10	9.10	18.30	9.20	

The strength of $Na_2C_2O_4$ solution $= \frac{\text{Weight taken (in gm)} \times 0.1}{0.67}$ (N)

$= \frac{0.99 \times 0.1}{0.67}$ N

$= 0.073$N

The strength of supplied $KMnO_4$ solution:

$V_{KMnO_4} \times N_{KMnO_4} = V_{No.\ Oxalet} \times N_{No.\ Oxalet}$

$\Rightarrow N_{KMnO_4} = \frac{10 \times 0.073}{9.15} = 0.079$N

(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	No. of Mohr salt solution (in mL)	No. of $KMnO_4$ (burette reading) (in mL)			Mean (in mL) (V)
		Initial	Final	Difference	
1	10	18.30	23.30	5.00	$\frac{5.00+4.90+5.10+4.90}{4}$ = 4.975
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

$= 0.05584 \times 4.975 \times 0.079$ gm

$= 0.022$ gm

Amount of iron in 500 ml of iron salt solution

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

$= 0.022 \times 50$ gm

$= 1.1$ gm

Observe value of Fe^{2+} (in 500 ml solution) = 1.1 gm

known value of Fe^{2+} (in 500 ml solution) =

$$= \frac{55.89 \times 8.90}{392.14} gm$$

$$= 1.27 gm$$

Results:

The amount of ferrous ions in 500 ml of iron salt solution is 1.1 gm

Percentage of error:

$$\frac{\text{known value} - \text{observed value}}{\text{known value}} \times 100 =$$

$$= \frac{1.27 - 1.1}{1.27} \times 100$$

$$= 0.1338 \times 100$$

$$= 13.38\%$$