EXP 5: Estimation of Copper (Cu) contained in a supplied solution of copper salt by iodometric method.

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Theory:

Methods: Oxidation-Reduction Titration

Reactions:

1. $K_2Cr_2O_7 + 14HCl + 6KI = 8KCl + 2CrCl_3 + 7H_2O + 3I_2$

2. $2CuSO_4 + 4KI = 2K_2SO_4 + 2CuI\downarrow + I_2$

3. $2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$

Half Reactions:

For 1: (a) $6I^- \rightarrow 3I_2 + 6e$

(b) $Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{3+} + 7H_2O$

For 2: (a) $2I^- \rightarrow I_2 + 2e$

(b) $2Cu^{2+} + 2e \rightarrow 2Cu^+$

For 3: (a) $2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2e$

(b) $I_2 + 2e \rightarrow 2I^-$

Indicator:

Starch is a indicator which specify the presence of I_2 but it is not a redox indicator.

Experimental Data:

(A) Standardize sodium thiosulphate solution as Expt. No. 4:

Table-1: Standardization of supplied $Na_2S_2O_3$ solution against standard $K_2Cr_2O_7$ solution by oxidation-reduction titration.

No. of reading	Vol. of $K_2Cr_2O_7$ (in mL)	Vol of $Na_2S_2O_3$ (burette) (in mL)			Mean (in mL)
		Initial	Final	Difference	
1	10	0.00	10.30	10.30	$\frac{10.30+10.20}{2}$
2	10	10.30	20.50	10.20	$= 10.25$

The strength of $K_2Cr_2O_7$ solution $= \frac{\text{Weight taken (in gm)} \times 0.1}{0.49}$ (N)

$= \frac{0.65 \times 0.1}{0.49}$ N

$= 0.13$ N

The strength of supplied $Na_2S_2O_3$ solution (S):

$V_{thio} \times N_{thio} = V_{dichromate} \times N_{dichromate}$

$\Rightarrow 10.25 \times N_{thio} = 10 \times 0.13$

$\Rightarrow N_{thio} = \frac{10 \times 0.13}{10.25}$

$\Rightarrow N_{thio} = 0.127$

(B) Estimation of Cu^{2+} ions:

Table2: Determination of the amount of copper in a supplied solution of blue vitriol by iodometric method.

No. of reading	Vol. of Copper Sulphate solution (V)	Vol of $Na_2S_2O_3$ (burette) (in ml)			Mean (in ml) (V)
		Initial	Final	Difference	
1	10	0.00	3.50	3.50	3.50+3.30+3.90+3.35 / 4 = 3.3875
2	10	3.50	6.80	3.30	
3	10	6.80	10.20	3.40	
4	10	10.20	13.55	3.35	

Calculations: $2CuSO_4 \equiv I_2 \equiv 2Na_2S_2O_3$

1 ml 1N $Na_2S_2O_3 \equiv 0.06354$ gm of Cu^{2+}

Amount of copper ions in 10 ml of copper salt solution

$= 0.06354 \times V \times 5$ gm

$= 0.06354 \times 3.3875 \times 0.127$ gm

$= 0.027$ gm

Amount of copper ions in 500 ml of copper salt solution

$= 0.06354 \times V \times 50$ gm

$= 0.06354 \times 3.3875 \times 0.127 \times 50$ gm

$= 1.367$ gm

Observe value of Cu^{2+} (in 500 ml solution)

$= 1.367$ gm

Known value of Cu^{2+} (in 500 ml solution)

$$= \frac{63.54 \times \text{amount Cu-salt taken}}{249.68}$$

$$= \frac{63.54 \times 4.25}{249.68} = 1.082 \text{ gm}$$

Results: The amount of copper ions in 500 ml of copper salt solution is 1.367 gm

Percentage of Error:

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

$$= \frac{1.082 - 1.367}{1.082} \times 100$$

$$= -0.2634 \times 100$$

$$= -26.34\%$$