EXPERIMENT NO. 3

Aim: To determine the strength of copper in the given copper sulphate ($CuSO_4.5H_2O$) solution Provided hypo solution (N/50) iodometrically.

Apparatus: Burette, pipette, conical flask, beakers and funnel etc.

Chemicals required: $CuSO_4.5H_2O$ solution, Hypo solution ($Na_2S_2O_3$), $K_2Cr_2O_7$ solution, H_2SO_4, KI, $NaHCO_3$, Acidic Acid and Starch.

Indicator – Starch (Internal indicator)

End Point - Blue to colourless

Theory: This Experiment comes under the iodometric titration which is used in the analysis of alloys, ores etc.
When an excess of KI is added to $CuSO_4$ solution then iodine is liberated. This liberated iodine is then treated against standard hypo solution using starch indicator near the end point.

Reactions involved:

$CuSO_4.5H2O + 4KI \rightarrow 2CuI_2 + 2K_2SO_4 + 5H_2O$

$2CuI_2 \rightarrow Cu_2I_2 + I_2$

$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

(Hypo sol.) (sodium tetrathionate)

Ionic Reactions –

$2Cu^{2+} + 2I^- \rightarrow Cu_2^{2+} + I_2 + 2e$

$2S_2O_3^{2-} + I_2 + 2e^- \rightarrow S_4O_6^{2-} + 2I^-$

Procedure:

Ist Titration – Standardization of hypo sol. By $K_2Cr_2O_7$ ($K_2Cr_2O_7$ Vs Hypo solution)

1. 50 ml of Hypo solution is filled in the burette.
2. 10 ml of $K_2Cr_2O_7$ is pipetted out in the conical flask.
3. 5 ml H_2SO_4 and 1 gm. KI is added to it.
4. The flask is covered with filter paper, and now kept in dark for 5 minutes. In dark to liberate Iodine, till the dark colour appear.
5. Now add 1 pinch of $NaHCO_3$ and titrated with the Hypo solution. 6. Add to 2-3 drop of starch is solution changes its colour to dark blue.

7. Again, titrate the solution with hypo solution, till the solution changes its colour to deep blue or light green.
8. Repeat to get three concordant readings.

IInd Titration - (Copper solution Vs Hypo solution)

1. 50 ml of Hypo solution is filled in the burette.
2. 10 ml of Copper solution is pipetted out in the conical flask.
3. Added Na_2CO_3 solution drop by drop till faint ppt forms. After that added acetic acid until ppt just dissolves.
4. Add 1gm. of KI in the conical flask.
5. The flask is covered now and kept in dark for 5 minutes.
6. Now hypo solution run in the conical flask.
7. When solution changes colour to pale yellow,
8. Now add 2ml of starch solution, this will form deep blue iodoform starch complex.
9. Again, titrate it with hypo solution until colour changes to milky white, which is the end point.
10. Repeat to get three concordant readings.

Observations:

1. $K_2Cr_2O_7$ Vs Hypo solution

Solution in burette – Hypo
Solution in flask - $K_2Cr_2O_7$
End Point – Blue to colourless.
Indicator – Starch

Observation Table:

Serial No.	Burette Reading		Volume (ml)
	Initial	Final	
1	0	4.2	4.2
2	4.2	8.4	4.2

2. **Hypo solution Vs Copper Solution**

Solution in burette – Hypo
Solution in flask - $CuSO_4$
End Point – Dark blue to milky White.
Indicator – Starch

Observation Table:

Serial No.	Burette Reading		Volume (ml)
	Initial	Final	
1	0	10.1	10.1
2	10.1	19.4	9.3
3	19.4	28.4	9.3

Calculations:

1. **Standardization of hypo solution (Hypo Solution Vs $K_2Cr_2O_7$)**

   $N_{HYPO} V_{HYPO} = N_{K2Cr2O7} V_{K2Cr2O7}$

   $N_{HYPO} 4.2 = 1/50 X 10$

   $N_{HYPO} = 0.047 N$

2. **Hypo solution Vs Copper Solution**

   $N_{Cu} V_{Cu} = N_{Hypo} V_{Hypo}$

   $N_{Cu} = (0.047 X 9.3) / 10$

   $N_{Cu} = 0.043 N$

Strength of Cu = N_{Cu} X Eq. Wt. Of Cu

= 0.043 X 63.5

= 2.730 g/L

Result:

The strength of Cu = 2.730 g/L

Applications:

1. It is used to determine the amount of various nutrients present in a particular food item.
2. It is used in the innovation of medical sciences.

Precautions:

1. Wash the apparatus before use.
2. Rinse the burette with the solution to be filled in it.
3. For the measurement of coloured solution measure the upper meniscus and for the lower meniscus for the colourless solution.

Structure:

Starch - Amylose