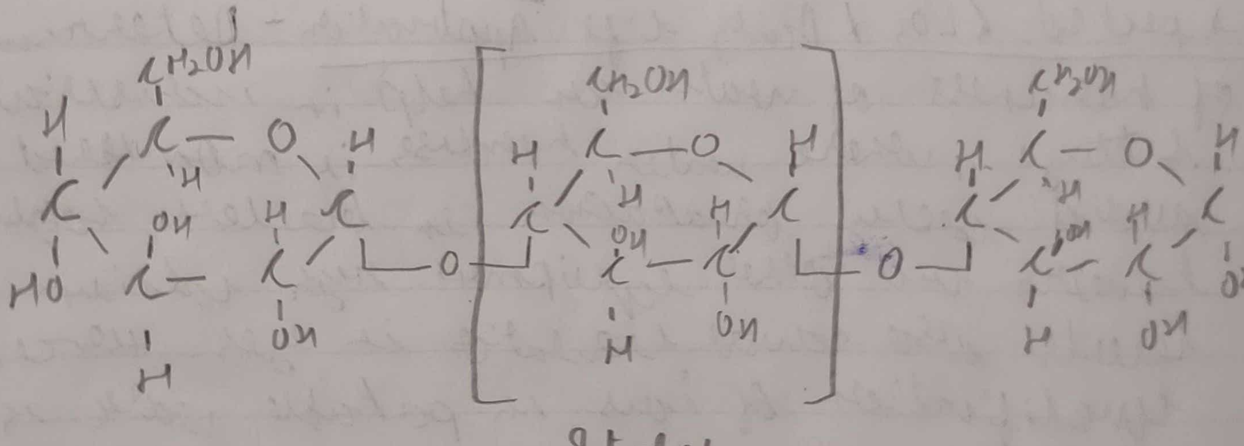
Experiment - 3

Experiment - To determine the copper content of a given sample of copper ore solution using 0.1 N sodium thiosulphate iodometrically.

Apparatus - Pipette, burette, beakers, conical flask, funnel, burette stand and clamp

Chemicals - Copper sulphate ($CuSO_4$), sodium bicarbonate ($NaHCO_3$), acetic acid (CH_3COOH), Potassium iodide (KI), starch solution and sodium thiosulphate ($Na_2S_2O_3$)

Chemical Structure -



Starch

Chemical Equations - $2CuSO_4 + 4KI \xrightarrow{H^+} 2CuI_2 + 2K_2SO_4$

$$2CuI_2 \rightarrow Cu_2I_2\downarrow + I_2$$

$$2Na_2S_2O_3 + I_2 \rightarrow 1\ Na_2S_4O_6 + 2NaI$$

Date

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Apparatus- Pipette, burette, beaker, conical flask, funnel, burette stand & clamp

Chemicals- copper sulphate ($CuSO_4$), solid sodium bicarbonate ($NaHCO_3$), acetic acid (CH_3COOH), potassium iodide (KI), starch solution and sodium thiosulphate.

Theory- Estimation of copper in the copper ore is based on the fact that copper can quantitatively liberate iodide from potassium iodide solution in an acidic medium. The liberated iodide soln can be titrated against a given standard sodium thiosulphate solution using starch as an indicator

Chemical Equation-

$$2CuSO_4 + 4KI \xrightarrow{H^+} 2CuI_2 + 2K_2SO_4$$

$$2CuI_2 \rightarrow Cu_2I_2 + I_2$$

$$2Na_2SO_3 + I_2 \rightarrow 2Na_2S_4O_6 + 2NaI$$

End point is the appearance of white color due to precipitation of Cu_2I_2. As Cu_2I_2 is soluble in mineral acids but insoluble in weak organic acids, the strongly acidic medium is neutralised

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Indicator - Starch solution.

End point → Starch (pale yellow to deep blue)

Sodium thiosulphate (Deep blue to permanent white)

Observations - Volume of copper ore solution taken for each titration = 10ml

S. No.	Burette Reading (ml)		Volume of 0.1 N $Na_2S_2O_3$ sol (ml)
1	0	9.5	9.5
2	0	9.5	9.5
3	0	9.5	9.5
4	0	9.5	9.5

Mean volume of $Na_2S_2O_3$ used (V_2) = 9.5ml

Calculations - Volume of copper ore solution used for each titration (V_1) = 10ml

Normality of sodium thiosulphate solⁿ = 0.1N

Let volume of $Na_2S_2O_3$ used = V_2 ml = 9.5 ml

using normality eqⁿ

$$N_1 V_1 = N_2 V_2$$

with $NaHCO_3$ till a faint permanent precipitates of basic carbonate is formed which are dissolved with a ~~few~~ few drops of acetic acid.

Procedure - 1. Pipette out 10 ml of the copper ore sol^n into a titration flask.

2. Add small amount of some solid $NaHCO_3$ to the ore sol^n in small doses till there is no ~~effect~~ effervescence the sol^n turns milky at this stage.

3. Add dilute acetic acid dropwise, just sufficient to remove the milkiness. To the clear blue solution add 5 ml of 10% KI sol^n. Color of sol^n changes to dark brown due to the formation of KI_3

4. Add about 35 ml of distilled water to dilute the contents of the flask. Wait for atleast 3 min. Titrate the sol^n against standard sodium thiosulphate sol^n till the color turns to pale / light yellow.

5. Add about 2 ml of 1% freshly prepared starch sol^n. Color of the solution turns to deep ~~of~~ blue.

6. Continue the titration with more sodium thiosulphate sol^n till the color changes from ~~the~~ blue to permanent white.

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10 ml of N_1 copper ore soln = V_2 ml of 0.1 N $Na_2S_2O_3$ soln.

N_1 (Normality of copper soln) $= \frac{0.1 \times V_2}{10}$

$= \frac{0.1 \times 9.5}{10} = 0.095 N$

Equivalent weight of copper = 63.50g

Amount of copper in the given ore = $N_1 \times 63.5$ gm/L

$= 0.095 \times 63.5$

$= 6.0325$ gm/L

<u>Result</u>- The amount of copper present in copper ore solution is 6.0325 gm/L

7. Keep the contents of the flask ~~for~~ for some time on the table shelf. It shouldn't turn blue again. If this happens, add a few more drops of $Na_2S_2O_3$ soln to get permanent white color again.

8. Repeat the experiment to get at least five correct readings till atleast two concordant readings are obtained.

<u>General calculations</u> - Volume of copper ore Soln used for each titration $(V_1) = 10$ ml

Normality of $Na_2S_2O_3 = 0.1$ N
Let volume of $Na_2S_2O_3$ used $= V_2$ ml

Applying normality eq. = (copper ore) $N_1V_1 = N_2V_2$ ($Na_2S_2O_3$)

10 ml of N_1 copper ore sol = V_2 ml of 0.1 Na_2SO_3

$$N_1 = \frac{0.1 \times V_2}{10}$$

Amount of copper in given ore $= N_1 \times 63.5$ gm/L

<u>Result</u> - The amount of the copper present in copper ore soln is 6.0325 gm/L

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Precautions - 1. The white color at the end point should be permanent.

2. The copper ore soln should be neutralised before titration.

3. The contents of the titration flask should be diluted to observe better change of color at the end point.

4. After mixing the initial soln, wait for atleast 3 min before starting the titration.

5. General precaution of volumetric titrations should be followed.

Daily Life Applications - As both excess and lower levels of copper can have adverse effect, eg. excess of copper in body can cause "Wilson Disease".

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