Military Institute of Science and Technology (MIST)

Chemistry Sessional (CHEM-102), Final Exam, 2023

Total Marks: 40 **Time: 2 hr 30 min**

Question: Estimate the Content of Copper (Cu) in a Copper Sulphate penta hydrate ($CuSO_4.5H_2O$) Solution by Iodometric Method with Standard Sodium Thiosulphate pentahydrate ($Na_2S_2O_3\,5H_2O$) Solution.

1. Theory:
2. Apparatus:
3. Chemicals: Copper Sulphate Pentahydrate ($CuSO_4.5H_2O$), Potassium dichromate ($K_2Cr_2O_7$), Sodium Thiosulphate Pentahydrate ($Na_2S_2O_3.5H_2O$), Potassium Iodide (KI), Sodium bi-carbonate ($NaHCO_3$), Sulfuric Acid (H_2SO_4), Ammonium Thiocyanate (NH_4SCN) and Starch $[C_6(H_2O)_5]_n$

4. Experimental Outline:

(a) Standardize Sodium Thiosulphate ($Na_2S_2O_3.5H_2O$) solution with standard ($K_2Cr_2O_7$) solution:

- Firstly, weigh out and prepare $K_2Cr_2O_7$ (~ 0.1 N) solution.
- Take 10 mL of iodate-free KI solution into a conical flask and dilute upto 100 mL with distilled water.
- Add 2 g of $NaHCO_3$ and shake until the salts dissolve.
- Add 10 mL of 3 N H_2SO_4 slowly while gently rotating the flask in order to mix the liquids.
- Add 10 mL of standard $K_2Cr_2O_7$ solution, mix the solutions well, and wash the sides of the flask with a little distilled water.
- Cover the flask with a watch glass and keep it in the dark place for 5 minutes to complete the reaction.
- Rinse the watch glass with distilled water and add it to the conical flask.
- Titrate the liberated iodine with $Na_2S_2O_3.5H_2O$ solution until most of the iodine is reacted as indicated by fading of brown colour or appearance of yellowish-green colour.
- Add 1 mL starch indicator solution with the above solution, intense blue colour appears.
- Continue the addition of the $Na_2S_2O_3.5H_2O$ solution dropwise until one drop changes the colour to light green or the blue colour disappears. Repeat the experiment three times and note the reading.

Experimental Data: Table for the volume of $Na_2S_2O_3.5H_2O$

Number of Observation	Volume of $K_2Cr_2O_7$ Solution	Volume of $Na_2S_2O_3\,5H_2O$				Remarks
		IBR (mL)	FBR (mL)	Diff (mL)	Mean	

The Strength of $Na_2S_2O_3.5H_2O$ Solution is ----------Y (N)

(b) Determine the content of copper (Cu) in $CuSO_4.5H_2O$ solution:

- Pipette out 10 mL of copper sulphate solution into a conical flask and add about 80 mL of distilled water.
- Add 2 g of $NaHCO_3$ and shake well.
- Add 10 mL 3 N H_2SO_4 in to the reaction mixture.
- Take 10 mL 12% KI solution into the conical flask, cover with watch glass and keep in dark place for 5 minutes to complete the reaction.
- Rinse the watch glass with distilled water and add it to the conical flask.
- Titrate with standardized $Na_2S_2O_3.5H_2O$ solution, until the brown colour starts to fade.
- Add 1 mL of starch indicator with the above solution and intense blue colour appear.
- Add 5 mL 10 % NH_4SCN solution.
- Continue the titration until off-white colour appears at the end point.

Experimental Data: Table for the volume of $Na_2S_2O_3.5H_2O$

Number of Observation	Volume of $CuSO_4.5H_2O$ Solution	Volume of $Na_2S_2O_3.5H_2O$				Remarks
		IBR (mL)	FBR (mL)	Diff (mL)	Mean	

5. Calculation:
6. Result:
7. % of error:
8. Discussion: