



## AMERICAN INTERNATIONAL UNIVERSITY - BANGLADESH

Department of Natural Science (Chemistry)

Faculty of Science &amp; Technology

Programs: B.Sc. Eng'g (EEE/CSE/IPE)

CHEM 1101: CHEMISTRY

## Chemistry Lab Report

Semester: Summer

Session: 2021-2022

NO EXPERIMENT, NO REPORT

Experiment No: 06

Name of the Experiment: Estimation of Copper (Cu) contained in a supplied solution of copper salt by Iodometric method.

Date of Performance: 19-07-22, Date of Submission: 26-07-22

Course-Teacher: Dr. Saiful Islam

## Instructions:

1. A lab report consists of three parts: a cover page, body of the report and a data and results sheet (lab-sheet).
2. This is the cover page of a report and students will collect and preserve the lab-sheet of a particular experiment to be performed.
3. Body of the report includes-(1) Objective of the Experiment, (2) Theory, (3) Name of the Chemicals, (4) Name of the Apparatus, (5) Percentage of Error (if necessary) and (6) Discussion (I. Precautions taken, II. Possible errors).
4. Use A<sub>4</sub>-size off-set paper, write on one side of the paper by hand keeping suitable margin.
5. Staple the lab-sheet at the end of the report and cover page on the top.
6. Submit the report in time to avoid deduction of marks.
7. Students working in a group will write and submit the report individually.
8. Copying of the report from others is strictly prohibited.

Name of the Student: Khondoker Md. Sabit Hasan  
ID No: 21-45306-2, Section: M, Group: 9

## FOR FACULTY USE ONLY

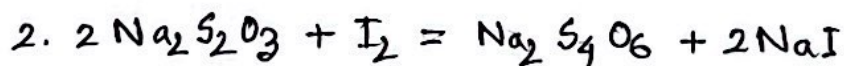
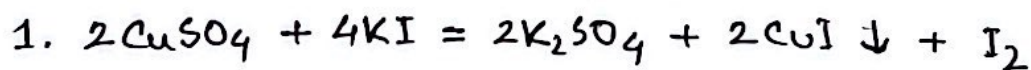
Faculty comments: Signature: Date:

Objective: To determine the amount of  $\text{Cu}^{+2}$  ions in a supplied solution of copper salt by iodometric method.

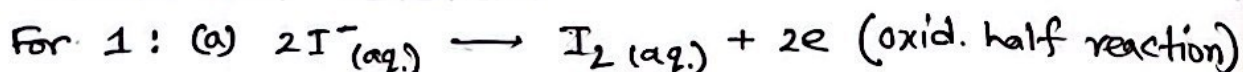
Theory:

(i) Method: Redox titration (also called oxidation-reduction titration) is a type of titration based on a redox reaction between the analyte (substance subjected to analysis) and titrant (standard solution taken in burette). Redox titration may involve the use of a redox indicator and/or a potentiometer.

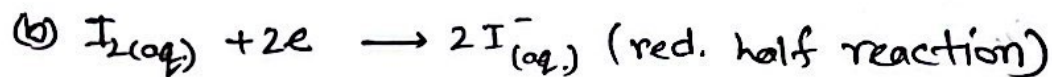
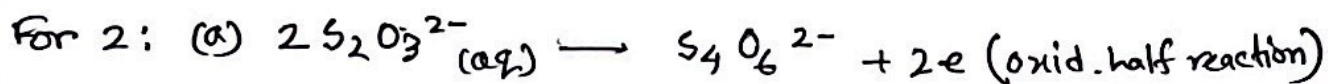
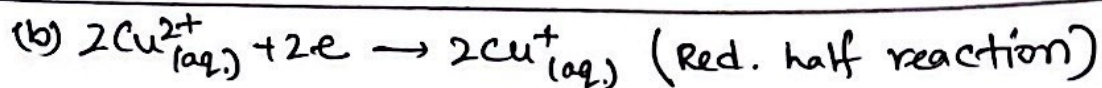
(ii) Reaction:  $\text{K}_2\text{Cr}_2\text{O}_7$  is a primary standard substance, an oxidizing agent, orange solid and orange color in water solution.  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  is a secondary standard substance, a reducing agent, white solid and colorless in water solution.  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  is an inorganic compound (also called blue vitriol, an oxidizing agent, blue colored) and blue in water solution. The balanced reactions of  $\text{CuSO}_4$  in presence of  $\text{NH}_4\text{OH}$ ,  $\text{CH}_3\text{COOH}$  and  $\text{KI}$  (white solid, a reducing agent) and  $\text{Na}_2\text{S}_2\text{O}_3$  with  $\text{I}_2$  are as follows:



For redox half reaction,







(iii) Indicator: Starch solution is used in this titration involving iodine because it forms an intense blue complex with even a trace of iodine. But starch is not a redox indicator; it responds specifically to the presence of  $I_2$ , not to a change in redox potential. The active fraction of starch is amylose, a polymer of the sugar  $\alpha$ -D glucose. In the presence of starch, iodine forms  $I_5^{-}$  chains inside the amylose helix and the color turns dark blue.

### Apparatus:

Burette (50ml), pipette (10ml), conical flask (250ml), volumetric flask (100 ml), watch glass, pipette filler, dropper, stand and clamp etc.

### Required Chemicals:

1. Potassium iodide (KI).
2. Sodium bicarbonate ( $NaHCO_3$ ).
3. Conc. Hydrochloric acid (HCl).
4. Potassium dichromate ( $K_2Cr_2O_7$ )
5. Sodium thiosulphate ( $Na_2S_2O_3 \cdot 5H_2O$ )
6. starch ( $C_6H_{10}O_5$ )<sub>n</sub>
7. Copper sulphate ( $CuSO_4 \cdot 5H_2O$ )
8. Ammonium hydroxide ( $NH_4OH$ , 6M)
9. Conc. Acetic acid ( $CH_3COOH$ )
10. Ammonium thiocyanate ( $NH_4SCN$ )

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# Experiment 6

CHEM 1101: CHEMISTRY (EEE/CoE/CSE/IPE)

## EXPERIMENT NO. 6: ESTIMATION OF COPPER (Cu) CONTAINED IN A SUPPLIED SOLUTION OF COPPER SALT BY IODOMETRIC METHOD.

**OBJECTIVE:** To determine the amount of  $\text{Cu}^{+2}$  ions in a supplied solution of copper salt by iodometric method.

### **THEORY:**

- (i) Method: Redox titration
- (ii) Reaction:
  1.  $2\text{CuSO}_4 + 4\text{KI} = 2\text{K}_2\text{SO}_4 + 2\text{CuI} \downarrow + \text{I}_2$
  2.  $2\text{Na}_2\text{S}_2\text{O}_3 + \text{I}_2 = \text{Na}_2\text{S}_4\text{O}_6 + 2\text{NaI}$
- (iii) Indicator: Starch

### **APPARATUS:**

Burette (50mL), pipette (10mL), conical flask (250mL), volumetric flask (100mL), watch glass, pipette filler, dropper, Stand and clamp etc.

### **REQUIRED CHEMICALS:**

- |  |   |   |
|--|---|---|
| (1) 12% KI solution,                                     | (2) Copper salt solution                  | (3) $\text{NaHCO}_3$ solid,                     |
| (4) 6M $\text{NH}_4\text{OH}$                            | (5) Conc. HCl acid,                       | (6) Conc. $\text{CH}_3\text{COOH}$              |
| (7) Standard $\text{K}_2\text{Cr}_2\text{O}_7$ solution, | (8) 10% $\text{NH}_4\text{SCN}$ solution, | (9) $\text{Na}_2\text{S}_2\text{O}_3$ solution, |
| (10) Starch solution,                                    |   |   |

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

**Table-1:** Standardization of supplied  $\text{Na}_2\text{S}_2\text{O}_3$  solution against standard  $\text{K}_2\text{Cr}_2\text{O}_7$  solution by oxidation-reduction titration.

No. of reading	Vol. of $\text{K}_2\text{Cr}_2\text{O}_7$ (in mL)	Vol. of $\text{Na}_2\text{S}_2\text{O}_3$ (burette reading) (in mL)			Mean (in mL)
		Initial	Final	Difference	
1	10	0	11.3	11.3	11.25
2	10	11.3	22.5	11.2	

$$\text{Strength of } \text{K}_2\text{Cr}_2\text{O}_7 \text{ solution} = \frac{\text{Weight taken (in gm)} \times 0.1}{0.49} \text{ (N)}$$

$$= \frac{0.49 \times 0.1}{0.49} = 0.1 \text{ (N)}$$

$$\text{Strength of supplied } \text{Na}_2\text{S}_2\text{O}_3 \text{ solution (S): } V_{\text{thio}} \times N_{\text{thio}} = V_{\text{dichromate}} \times N_{\text{dichromate}}$$

$$\Rightarrow 11.25 \times N_{\text{thio}} = 10 \times 0.1$$

$$\Rightarrow N_{\text{thio}} = 0.089 \text{ N}$$

May, 2022

Chemistry Lab Sheet



(Expt. 6 contd.)

**(B) Estimation of Cu ions:**

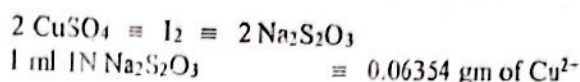
**PROCEDURE:** Pipette out 10 mL of copper salt solution into a conical flask. Add 3-4 drops of 6M  $\text{NH}_4\text{OH}$  until a faint permanent ppt remain and then add 6-8 drops of conc.  $\text{CH}_3\text{COOH}$ . Now add about 10 ml of 12% potassium iodide (KI) solution and titrate the liberated iodine against the standard sodium thiosulphate solution (standardized previously) until the brown color of iodine changes to light yellow. Add approx. 1 mL of starch solution, solution turns intense blue and continue titration till the blue color begins to fade. Now add few drops of 10% ammonium thiocyanate solution and continue titration until the blue color is just discharged (off-white). Calculate the amount of copper present in 500 mL of copper salt solution.

**EXPERIMENTAL DATA:**

**Table-2:** Determination of the amount of copper in a supplied solution of blue vitriol by iodometric method.

No. of reading	Vol. of Copper salt solution (in mL)	Vol. of $\text{Na}_2\text{S}_2\text{O}_3$ (burette reading) (in mL)			Mean (in mL) (V)
		Initial	Final	Difference	
1	10	<del>25</del>	—	—	4.83
2	10	25	30	5	
3	10	30	35	5	
4	10	35	39.5	4.5	

**CALCULATIONS:**



Amount of copper ions in 10 mL of copper salt solution  $= 0.06354 \times V \times S \text{ gm}$   
 $= 0.06354 \times 4.83 \times 0.089$   
 $= 0.0273 \text{ gm}$

Amount of copper ions in 500 mL of copper salt solution  $= 0.06354 \times V \times S \times 50 \text{ gm}$   
 $= 0.0273 \times 50 = 1.365 \text{ gm}$

Observe value of  $\text{Cu}^{2+}$  (in 500mL solution)  $= (0.06354 \times 4.83 \times 0.089) \times 50$   
 $= 0.0273 \times 50 = 1.365 \text{ gm}$

Known value of  $\text{Cu}^{2+}$  (in 500mL solution)  $= \frac{63.54 \times 4}{249.68} = 1.01794 \text{ gm}$

**RESULTS:**

Amount of copper ions in 500 mL of copper salt solution is 1.365 gm.

**PERCENTAGE OF ERROR:**

$$\frac{\text{Known value} - \text{Observed value}}{\text{Known value}} \times 100 = \frac{1.01794 - 1.365}{1.01794} \times 100 = -34.09\%$$

**Students should know**

- Why it is necessary to keep your experimental solution in the dark?
- Is it iodometric or iodimetric that you are performing?
- Tell molecular weight and gram equivalent weight of  $\text{K}_2\text{Cr}_2\text{O}_7$  and  $\text{Na}_2\text{S}_2\text{O}_3$ .
- What is the function of starch?
- What is the purpose of adding  $\text{NH}_4\text{SCN}$  solution?

**Text:** M. Mahbul Huque and A. Jabber Mian, "Practical Chemistry", 2<sup>nd</sup> ed (1972)

May, 2022

Chemistry Lab Sheet

## Discussion:

### (a) Precautions taken:

1. Avoid skin and eye contact with the chemicals.
2. Identify the safety equipment.
3. Wear clothing that covers torso and legs.

### (b) Possible errors:

1. Weight was not taken properly.
2. Error might be occurred while taking the burette reading
3. Using the equipment incorrectly.