AMERICAN INTERNATIONAL UNIVERSITY – BANGLADESH
Department of Natural Science (Chemistry)
Faculty of Science & Technology
Programs: B.Sc. Eng'g (EEE/CSE/IPE)

CHEM 1101: CHEMISTRY

Chemistry Lab Report

Semester: Spring **Session:** 2022-2023

NO EXPERIMENT, NO REPORT

Experiment No: 5

Name of the Experiment: STANDARDIZATION OF SODIUM THIOSULPHATE ($Na_2S_2O_3$) SOLUTION WITH STANDARD POTASSIUM DICHROMATE ($K_2Cr_2O_7$) SOLUTION

Date of Performance: 21-03-2023, *Date of Submission:*

Course-Teacher: DR. MOHAMMAD ANISUR RAHMAN JAMIL

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 A4-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: MD. SHOHANUR RAHMAN SHOHAN
ID No: 22-46013-1, *Section:* M, *Group:* 08

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Faculty comments: ....., *Signature:* .....
Date: .....

Objectives:

To know the strength of $Na_2S_2O_3$ solution (being a solution made from secondary standard substance) against standard $K_2Cr_2O_7$ solution by oxidation-reduction titration.

Theory:

Method: Redox titration.

A redox titration is based on an oxidation-reduction reaction between the analyte and titrant. This one use a potentiometer or a redox indicator to determine the endpoint. Frequently either the reactants or the tritant have a color intense enough that an additional indicator is not needed.

$Na_2S_2O_3.5H_2O$ is a secondary standard substance, a reducing agent, white solid (mol. wt. 248, gram equivalent wt 248) and colorless in water solution

$K_2Cr_2O_7$ is a primary standard substance an oxidizing agent, orange solid (mol. wt 294, gram equiv. wt. 49) and orange color in water solution.

Reaction:

The balanced reactions of $K_2Cr_2O_7$ in presence of HCl and KI (white solid, a reducing agent) and of $Na_2S_2O_3$ with I_2 are as follows:

1. $K_2Cr_2O_7 + 14HCl + 6KI = 8KCl + 2CrCl_3 + 7H_2O + 3I_2$
2. $2Na_2S_2O_3 + I_2 = Na_2S_2O_6 + 2NaI$

Redox Half Reactions:

For 1: a) $6I^-_{(aq)} \longrightarrow 3I_{2(aq)} + 6e^-$ (oxid. Half Reaction)

b) $Cr_2O_7^{2-}{}_{(aq)} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+}_{(aq)} + 7H_2O$ (red. half. reaction)

For 2: a) $2S_2O_3^{2-}{}_{(aq)} \longrightarrow S_4O_6^{2-} + 2e^-$ (oxid. half reaction)

b) $I_{2(aq)} + 2e^- \rightarrow 2I^-_{(aq)}$ (red. half reaction).

Indicator: starch solution

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 specially 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 α-d-glucose. In the presence of starch, iodine from I_5^- chains inside the amolyse helix and color turns dark blue.

$NaHCO_3$ (white solid) used to remove excess of HCl acid in the solution and to create layer of CO_2 in the conical flask to reduce loss of valatile I_2.

Required Chemicals:

Name of the Chemicals	Chemical Formula
1. 12% potassium iodine solution	KI
2. Sodium bicarbonate	$NaHCO_3$
3. Conc. Hydrochloric acid	HCl
4. Potassium dichromate	$K_2Cr_2O_7$
5. Sodium thiosulphate	$Na_2S_2O_3$
6. Starch	$(C_6H_{10}O_5)_n$

Apparatus:

1. Burette (50 ml)
2. Pippte (10 ml)
3. Conical Flask (250 ml)
4. Volumetric Flask (100 ml)
5. watch glass
6. Pippte Filler
7. Dropper
8. Clamp
9. stand
10. Measuring Cylinder
11. Wash Bottle.

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Department of Chemistry

Experiment 5

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

EXPERIMENT NO. 5: STANDARDIZATION OF SODIUM THIOSULPHATE ($Na_2S_2O_3$) SOLUTION WITH STANDARD POTASSIUM DICHROMATE ($K_2Cr_2O_7$) SOLUTION.

OBJECTIVE: To know the strength of $Na_2S_2O_3$ solution (being a solution made from secondary standard substance) against standard $K_2Cr_2O_7$ solution by oxidation-reduction titration.

THEORY:

(i) *Method*: Redox titration

(ii) *Reaction*:

1. $K_2Cr_2O_7 + 14HCl + 6KI = 8KCl + 2CrCl_3 + 7H_2O + 3I_2$
2. $2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$

(iii) *Indicator*: Starch solution

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. $NaHCO_3$,
3. Conc. HCl acid,
4. Standard $K_2Cr_2O_7$ solution
5. $Na_2S_2O_3$ solution,
6. Starch solution

PREPARATION OF APPROX. 0.1N POTASSIUM DICHROMATE SOLUTION.

Transfer approx. 0.49 gram of pure $K_2Cr_2O_7$ into a 100 mL measuring flask and then dissolve it with distilled water up to the mark.

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

$$= \frac{0.456 \times 0.1}{0.49}$$

$$= 0.09306N$$

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(Expt. 5 contd.)

PROCEDURE:

Take 4 mL of 12% KI solution in a conical flask and dilute to about 50 mL. Add about one gm of $NaHCO_3$ and shake the flask until the salt dissolves. Add 4 mL conc. HCl acid and then add 10 ml standard $K_2Cr_2O_7$ solution by means of a pipette in the same flask. Shake the flask and cover it with a watch glass, allow the solution to stand for about five minutes in the dark (inside the desk or dark chamber). Rinse the watch glass and dilute the solution about 100mL. Titrate the liberated iodine with sodium thiosulphate solution from a burette until the brown color fades (light yellow). Add about 1 mL starch solution and continue titration by adding sodium thiosulphate solution from the burette until one drop of the sodium thiosulphate solution changes the color of the solution from deep blue to light green. This is the end point. Repeat the whole experiment 2-3 times. Calculate the strength of sodium thiosulphate solution.

EXPERIMENTAL DATA:

Table: *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 reading) (in mL)*			*Mean (in mL)*
		Initial	*Final*	*Difference*	
1	10	0	10.6	10.6	10.1
2	10	10.6	20.2	9.6	
3	10				

CALCULATIONS:

Strength of supplied $Na_2S_2O_3$ solution:

$$V_{Na2S2O3} \times N_{Na2S2O3} = V_{K2Cr2O7} \times N_{K2Cr2O7}$$

$10.01 \times N_{Na_2S_2O_3} = 10 \times 0.09306$

$N_{Na_2S_2O_3} = 0.09211\ N$

RESULTS:

The strength of supplied $Na_2S_2O_3$ solution is = 0.09 N

Students should know

- What are redox reaction, oxidizing agent and reducing agent?
- What is the difference between acid-base and redox indicator?
- 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 $K_2Cr_2O_7$ and $Na_2S_2O_3$.
- What is the function of starch?
- Can you calculate the normality and molarity of $K_2Cr_2O_7$ and $Na_2S_2O_3$?

Text: M. Mahbubul Huque and A. Jabber Mian, "Practical Chemistry", 2nd ed. (1972)

Discussion:

Precautions Taken:

1. The apparatus were washed with distilled water.
2. Conc. HCl was carefully added at the time of titration
3. $Na_2S_2O_3$ was carefully added dropwise.
4. The iodine solution was shaken continusly.

Possible Errors:

1. While taking reading from burrette there might have been paralox error.
2. The starch solution might be added early in the titration.
3. Might have added more than 46 ml distilled water while making the solution.