



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: Summer

Session: 2021-2022

NO EXPERIMENT, NO REPORT

Experiment No: 02

Name of the Experiment: Standardization of Hydrochloric Acid (HCl) solution with standard Sodium Hydroxide (NaOH) solution.

Date of Performance: 07-06-22

Date of Submission: 14-06-22

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 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: Khondoker Md. Sabit Hossain

ID No: 21-45306-2

Section: M, Group: 9

FOR FACULTY USE ONLY

Faculty comments:

Signature:

Date:

Objective: To know the strength of HCl solution (being a solution made from secondary standard substance) against a previously standard solution by acid-base titration.

Theory:

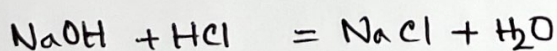
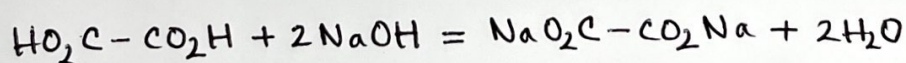
(i) Method:

An acid-base titration is a method in chemistry that allows quantitative analysis of the concentration of an unknown acid or base solution.

Quantitative analysis is concerned with the determination of concentration or the amount of a known substance quantitatively by volumetric Analysis (Titration).

(ii) Reactions:

HCl is a secondary standard substance, a strong acid, colorless gas and available in water solution. NaOH is a secondary standard substance, a strong base, white solid and colorless in water solution. $C_2H_2O_4 \cdot 2H_2O$ is a primary standard substance, a weak acid, white solid and colorless in water solution. The balance reactions between NaOH and $C_2H_2O_4 \cdot 2H_2O$; NaOH and HCl are as follows:



(iii) Indicator:

Since the first reaction is a combination of weak acid and strong base, the choice of indicator is

phenolphthalein ($C_{20}H_{14}O_4$). Second reaction is a combination of strong acid and strong base, so the choice of indicator is methyl orange ($C_{14}H_{14}N_3NaO_3S$).

Apparatus;

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

Required chemicals;

1. Sodium hydroxide. $[NaOH]$
2. Oxalic acid. $[C_2H_2O_4 \cdot 2H_2O]$
3. Hydrochloric acid. $[HCl]$
4. Phenolphthalein. $[C_{20}H_{14}O_4]$
5. Methyl orange. $[C_{14}H_{14}N_3NaO_3S]$

Name: Khondoker Md. Sabit Hasan ID No: 21-45306-2 Section (Group): M (9)

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Experiment 2

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

EXPERIMENT NO. 2: STANDARDIZATION OF HYDROCHLORIC ACID (HCl) SOLUTION WITH STANDARD SODIUM HYDROXIDE (NaOH) SOLUTION.

OBJECTIVE: To know the strength of HCl solution (being a solution made from secondary standard substance) against a previously standard solution by acid-base titration.

THEORY:

- (i) *Method:* Acid-base titration
- (ii) *Reactions:* 1. $\text{HO}_2\text{C}-\text{CO}_2\text{H} + 2\text{NaOH} = \text{NaO}_2\text{C}-\text{CO}_2\text{Na} + 2\text{H}_2\text{O}$
2. $\text{NaOH} + \text{HCl} = \text{NaCl} + \text{H}_2\text{O}$
- (iii) *Indicators:* Phenolphthalein, Methyl orange

APPARATUS:

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

REQUIRED CHEMICALS:

1. Supplied NaOH solution
2. Standard oxalic acid solution
3. HCl acid solution
4. Phenolphthalein indicator
5. Methyl orange indicator

(A) Standardize the supplied NaOH solution as in Experiment No. 1

$$\text{Strength of oxalic acid solution} = \frac{\text{Weight taken (in gm)} \times 0.1}{0.63} (\text{N}) = \frac{0.67 \times 0.1}{0.63} = 0.106 \text{ N}$$

Table-1: Standardization of supplied NaOH solution against standard oxalic acid solution by acid-base titration.

No. of reading	Vol. of NaOH (in mL)	Vol. of Oxalic acid (burette reading) (in mL)			Mean (in mL)
		Initial	Final	Difference	
1	10	0	9.5	9.5	9.167
2	10	9.5	18.5	9	
3	10	18.5	27.5	9	

Strength of supplied NaOH solution:

$$V_{\text{NaOH}} \times N_{\text{NaOH}} = V_{\text{Oxalic acid}} \times N_{\text{Oxalic acid}}$$

$$\Rightarrow 10 \times N_{\text{NaOH}} = 9.167 \times 0.106$$

$$\Rightarrow N_{\text{NaOH}} = 0.09717 \text{ N}$$

May, 2022

Chemistry Lab Sheet

Name: _____ ID No: _____ Section (Group): _____

(Expt. 2 contd.)

(B) Preparation of approximately 0.1N hydrochloric acid solution:

Take 10 ml conc. HCl in a 1000 ml measuring flask and add distilled water up to the mark.

PROCEDURE: Take 10 mL of NaOH solution in a conical flask by means of a pipette and dilute it to about 50 mL. Add 2-3 drops of methyl orange indicator to the solution. Then add previously prepared (approx. 0.1N) HCl acid solution drop wise from a burette. Shake the flask frequently during addition of HCl acid. Stop the addition of HCl acid solution as soon as the yellow color of the solution just changes to orange or pink. Note the burette reading. Repeat the process at least three times and take the mean of the readings. Calculate the strength of the dilute HCl solution and from there calculate the strength of commercial HCl.

EXPERIMENTAL DATA:

Table-2: Standardization of supplied HCl solution against standard NaOH solution by acid-base titration.

No. of reading	Vol. of NaOH (in mL)	Vol. of HCl (burette reading) (in mL)			Mean (in mL)
		Initial	Final	Difference	
1	10	0	10.3	10.3	10.167
2	10	10.3	20.5	10.2	
3	10	20.5	30.5	10	
4	10				

CALCULATIONS:

(A) Strength of supplied dil. HCl solution:

$$V_{\text{NaOH}} \times N_{\text{NaOH}} = V_{\text{dil. HCl}} \times N_{\text{dil. HCl to be determined}}$$

$$\Rightarrow 10 \times 0.09717 = 10.167 \times N_{\text{dil. HCl}}$$

$$\Rightarrow N_{\text{dil. HCl}} = 0.09557 \text{ N}$$

(B) Strength of conc. HCl solution:

$$V_{\text{dil. HCl}} \times N_{\text{dil. HCl determined}} = V_{\text{conc. HCl taken}} \times N_{\text{conc. HCl to be determined}}$$

$$\Rightarrow 1000 \times 0.09557 = 10 \times N_{\text{conc. HCl}}$$

$$\Rightarrow N_{\text{conc. HCl}} = 9.557$$

RESULTS: The strength of supplied dil. HCl solution is 0.09557 N.
And, the strength of conc. HCl solution is 9.557 N.

Students should know

- What is normality and molarity?
- Atomic weight, molecular weight and gram equivalent weight of NaOH, HCl and HOOC-COOH, 2H₂O
- Why phenolphthalein and/or methyl orange are used?
- Reason of using methyl orange instead of phenolphthalein.

Text: M. Mahbubul Huque and A. Jabber Mian, "Practical Chemistry", 2nd 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. Might added more than 100 mL distilled water in the oxalic acid or HCl solution.
2. Error might be occurred while taking the burette reading.
3. using the equipment incorrectly.