



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: 3

Name of the Experiment: STANDARDIZATION OF HYDROCHLORIC ACID (HCl) SOLUTION WITH STANDARD SODIUM CARBONATE (Na_2CO_3) SOLUTION.

Date of Performance: _____, 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.....

FOR FACULTY USE ONLY

Faculty comments: , Signature:
Date:

Objectives

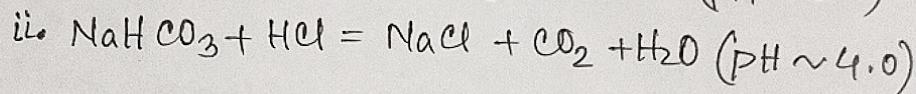
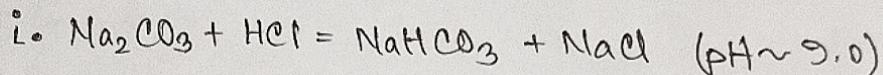
To know the strength of HCl solution (being a solution made from secondary standard substance) against a weak base like Na_2CO_3 by acid-base titration

Theory

Method: Acid-base titration.

An acid-base titration is a method in chemistry that allows quantitative analysis of the concentration of an unknown acid or base solution. The technique relies on the neutralization reaction between acids and bases, and measurement reaction endpoint. The reactivity between acids and bases can be determined with knowledge of their chemical formula.

Reactions:



In this first reaction, Na_2CO_3 acts as a weak base and HCl acts as a strong acid. When Na_2CO_3 reacts with HCl, it neutralizes the acid and form NaHCO_3 and NaCl .

The second reaction is also neutralization of hydrochloric acid with NaHCO_3 . This reaction result in the formation of NaCl , CO_2 and H_2O .

Indicator: (Phenolphthalein, Methyl Orange)

In the first reaction one mole Na_2CO_3 is reacted with one mole HCl to produce NaHCO_3 and NaCl with a pH range ~ 9.0 . So the choice of indicator is Phenolphthalein, since it works within pH (8.3-10).

In the second reaction one mole NaHCO_3 is reacted with another mole of HCl to produce NaCl , H_2O and CO_2 , with pH range ~ 4.0 , so, the choice of indicator is methyl orange, since it works within pH (3.1-4.4)

Required Chemicals:

<u>Chemicals Name</u>	<u>Chemicals Formula</u>
1. Hydrochloric acid solution	HCl
2. Sodium Carbonate solution	Na_2CO_3
3. Phenolphthalein indicator	$\text{C}_{20}\text{H}_{14}\text{O}_4$
4. Methyl orange indicator	$\text{C}_{14}\text{H}_{14}\text{N}_3\text{NaO}_3\text{S}$

Apparatus:

1. Burette (50 ml)
2. Pipette (40 ml)
3. Conical Flask (250 ml)
4. Volumetric Flask (100 ml)
5. Pipette Filler.
6. Dropper.
7. Stand.
8. Clamp.
9. Funnel
10. Measuring Cylinder
11. Wash Bottle .



Experiment 3

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

EXPERIMENT NO. 3: STANDARDIZATION OF HYDROCHLORIC ACID (HCl) SOLUTION WITH STANDARD SODIUM CARBONATE (Na₂CO₃) SOLUTION.

OBJECTIVE:

To know the strength of HCl solution (being a solution made from secondary standard substance) against a weak base like Na₂CO₃ by acid-base titration.

THEORY:

- (i) Method: Acid-base titration,
- (ii) Reaction: Na₂CO₃ + HCl = NaHCO₃ + NaCl (pH ~9.0)
NaHCO₃ + HCl = NaCl + CO₂ + H₂O (pH ~4.0)
- (iii) Indicator: 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. HCl acid solution,
2. Na₂CO₃ solution,
3. Phenolphthalein indicator
4. Methyl Orange indicator

PREPARATION OF APPROX. 0.1N Na₂CO₃ SOLUTION: Transfer approx. 0.53 gm of anhydrous Na₂CO₃ in a 100 mL measuring flask and then dissolve it with distilled water up to the mark.

$$\begin{aligned} \text{Strength of sodium carbonate solution} &= \frac{\text{Weight taken (in gm)} \times 0.1}{0.53} (\text{N}) \\ &= \frac{55 \times 0.1}{0.53} = 0.1037 \text{ N} \end{aligned}$$

PROCEDURE: Take 10 mL of Na₂CO₃ solution in a conical flask and dilute it to about 50 mL. Add 1-2 drops of phenolphthalein and titrate against dilute HCl solution (prepared as expt. no.2) contained in a burette. Now note the burette reading when just one drop of HCl discharges the pink color of the solution. This is the first end point. Then add 2-3 drops of methyl orange inside the same conical flask and continue titration against the same HCl solution. The end point reached when the yellow color of the solution just changes to faint pink (or orange). Note the burette reading. This is the second end point. The difference of the burette reading from initial to second end point will be the volume of the acid required for titration. Repeat the whole experiment 2-3 times and take the mean reading initial to second end point. *Take last reading without using phenolphthalein.* Calculate the strength of supplied dilute HCl solution and then find out the strength of concentrated HCl.

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(Expt. 3 contd.)

EXPERIMENTAL DATA:

Table: Standardization of supplied HCl solution against standard Na_2CO_3 solution by acid-base titration.

No. of reading	Vol. of Na_2CO_3 (in mL)	Vol. of HCl (in mL)			Difference between (a) and (c) (in mL)	Mean (in mL)
		Initial (a)	1 st End-point (b)	2 nd End-point (c)		
1	10	0.00	4.60	10.50	10.50	
2	10	10.50	15.30	26.80	10.10	
3	10	20.60	25.30	31.00	10.40	
4*	10	31.00	---	40.10	9.10	10.025

*4th reading with methyl orange only

CALCULATIONS:

(A) Strength of supplied dil. HCl solution:

$$V_{\text{Na}_2\text{CO}_3} \times N_{\text{Na}_2\text{CO}_3} = V_{\text{dil. HCl}} \times N_{\text{dil. HCl}} \text{ to be determined}$$

$$10 \times 0.1037 = 10.025 \times N_{\text{dil. HCl}}$$

$$N_{\text{dil. HCl}} = 0.10351 \text{ N}$$

(B) Strength of conc. HCl solution:

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

$$1000 \times 0.10351 = 10 \times N_{\text{conc. HCl}}$$

$$N_{\text{conc. HCl}} = 10.351 \text{ N}$$

RESULTS:

(a) The strength of supplied dil. HCl soln is 0.10351 N

(b) The strength of conc. HCl is 10.351 N

Student should know:

- Is Na_2CO_3 a primary standard substance?
- Tell atomic weight, molecular weight and gram equivalent weight of HCl and Na_2CO_3 .
- Can you use methyl orange first instead of phenolphthalein? If not why?
- Can you calculate the normality and molarity of HCl and Na_2CO_3 ?

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

Discussion:

Precautions taken:

1. All the apparatus were washed with distilled water
2. The solution was shaken spontaneously
3. All the readings from burette were taken from the eye level

Possible Errors:

1. Error might be occurred while taking the readings from burette
2. While preparing the solution more than 40ml distilled water might be added
3. While taking reading from burette, proper meniscus might not have been taken.