Analysis of sodium bicarbonate present in a commercial sample of soda mint tablet.

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Aim: To determine the amount of sodium bicarbonate present in the given sample of soda mint tablet.

Theory:

Soda mint tablet contains sodium bicarbonate which is a weak base and, therefore, soda mint tablets are used as antacids. The amount of sodium bicarbonate present in the tablet can be estimated by volumetric analysis. This is an acid-base titration. Hydrochloric acid neutralizes Sodium bicarbonate as follows,

$$HCl + NaHCO_3 \rightarrow NaCl + H_2O + CO_2\uparrow$$

Methyl orange is used as an indicator in this titration to determine the neutralization point. $NaHCO_3$ present in a given sample tablet can be calculated using the relation,

1 M 1000 cm^3 HCl ≡ 84 g anhydrous $NaHCO_3$

Volumetric analysis

Volumetric analysis is a technique that employs the measurement of volumes to quantitatively determine the amount of a substance in solution. In any reaction between two or more species, the reaction equation shows the stoichiometric ratio of the reacting species. Hence, if the concentration of one of the solutions is known, the concentrations of the others can be determined from the volumes used.

Succinic acid ($C_4H_6O_4$, Molar mass 118g/mole) is used to standardize alkali (NaOH). Succinic acid is a stable solid organic acid, known molar solution of it can be prepared very easily. Using standardized alkali (NaOH) other acid (say HCl) can be standardize. Since the relation 1 M 1000 cm^3 HCl ≡ 84 g anhydrous $NaHCO_3$ is given, standardization of HCl is to be done carefully and accurately.

Requirements:

No.	Name of the apparatus/Chemical	Quantity
1	HCl solution	100cm^3
2	0.1M(aprox..)NaOH	100 cm^3
3	Soda mint tablets.	3
4	Phenolphthalein indicator.	1 small indicator bottle.
5	Methyl orange indicator.	1 small indicator bottle.
6	Distilled water (DW)	1 bottle
7	Burettes (25 cm^3)	2 (B and A)
8	Syringes (10 cm^3)	3 (N, H and S)
9	Volumetric flasks(100 cm^3)	1 (S)
10	Beaker (100 cm^3)	1 (S)
11	Conical flasks	3
12	Stirrer	1
13	Dropper	1
14	Funnels	2
15	0.05M Succinic acid solution	100cm^3

Procedure:

A. Preparation of Soda mint solution:

Place the supplied three soda mint tablets in the beaker 'N'. Add approximately 20 cm^3 distilled water to it crush and stir well to dissolve it completely (Solution will be slightly turbid due to undissolved binders). Filter this solution through cotton wool (**Plug the funnel with cotton to remove undissolved binders)**. Collect the filtrate and washings of beaker 'N' in100 cm^3 beaker 'S'.Transfer the filtrate quantitatively to 100cm^3 standard volumetric flask 'S', then add distilled water to the volumetric flask till mark on it (if required use dropper) to make the volume of the solution 100 cm^3. Shake the solution to homogenize.

B. Standardization of 0.1M (approx.) NaOH solution.

1. Wash the burette (B) thoroughly with distilled water. Rinse and fill it with the supplied 0.1M(approx.)NaOH solution.
2. Using syringe (N) take out 10 cm^3 of 0.05Msuccinic acid solution in a 100cm^3 conical flask. Add two drops of phenolphthalein indicator to it.
3. Titrate the contents of the flask against the supplied NaOH solution from the burette, with constant swirling till light pink colour is obtained.
4. Repeat the procedure to get constant readings.
5. Enter your readings in the observation table I

Observations Table I:

Titration of 0.05 M Succinic acid versus NaOH solution

Readings	**Pilot**	**I**	**II**	**III**	**CBR**
Final	--------- **to** ---------				**B cm^3**
Initial		0.0	0.0	0.0	
Difference					

Calculation:

Standardization of NaOH solution

$M_{NaOH} \times V_{NaOH} = M_{Succinic\ acid} \times V_{Succinic\ acid} \times 2$ (since succinic acid is dibasic acid)

$M_{NaOH} = (0.05 \times 10 \times 2) \div$ **B**

M_{NaOH} = **X** M

Exact molarity of NaOH solution is **X** M

C. Determination of exact molarity of the supplied HCl.

1. Fill the burette (B) with the **X** M NaOH solution.

2. Using the syringe (H) take out 10 cm^3 of the supplied HCl acid solution in a 100cm^3 conical flask. Add two drops of phenolphthalein indicator to it.
3. Titrate the contents of the flask against the **X M** NaOH solution from the burette, with constant swirling till light pink colour is obtained.
4. Repeat the procedure to get constant readings.
5. Enter your readings in the observation table II

Observations Table II:

Titration of X M NaOH solution versus HCl solution

Readings	**Pilot**	**I**	**II**	**III**	**CBR**
Final	---------				**C cm^3**
Initial	**to**	0.0	0.0	0.0	
Difference	---------				

Calculation:

Standardization of HCl solution

$M_{HCl} \times V_{HCl} = M_{NaOH} \times V_{NaOH}$

$M_{HCl} = (\mathbf{X} \times \mathbf{C}) \div 10$

$M_{HCl} = \mathbf{Y}$ M

Exact molarity of the HCl solution is **Y** M

D. Titration of soda mint solution with standard Y M HCl solution.

1. Wash the burette (A) thoroughly with distilled water. Rinse and fill this burette (A) with standard Y M HCl solution.
2. Transfer the soda mint tablet solution in the container 'S'.
3. Using syringe (S) take out 10cm^3 of the soda mint solution in 100cm^3 conical flask. Add four drops of methyl orange indicator to it.
4. Titrate the contents of the flask against standard Y M HCl solution from the burette, with constant swirling till orange colour is obtained.
5. Repeat the procedure to get constant readings.
6. Enter your readings in the observation table III

Observations Table III:

Titration of soda mint solution versus Y M HCl solution

Readings	**Pilot**	**I**	**II**	**III**	**CBR**
Final	---------				**D cm^3**
Initial	**to**	0.0	0.0	0.0	
Difference	---------				

Calculation:

Amount of Sodium bicarbonate present in10 cm^3 diluted solution of soda mint tablet:

Using the relation

1 M 1000 cm^3HCl ≡ 84 g anhydrous $NaHCO_3$

Y M **D** cm^3HCl ≡ (**Y** × **D** × 84) ÷ 1000 = **Z** g anhydrous $NaHCO_3$

100 cm^3 diluted solution of soda mint tablets contain **10 Z** g anhydrous $NaHCO_3$

Since three tablets dissolved in 100cm^3 solution , **10Z** g of anhydrous $NaHCO_3$ is present in 3 tablets hence one soda mint tablet contain average (**10Z** ÷ 3) g anhydrous $NaHCO_3$

1) Exact molarity of HCl

2) Amount of anhydrous $NaHCO_3$ present in the given sample solution g

3) Average amount of anhydrous $NaHCO_3$ in the given sample of one soda mint tablet g

Observations:

I) Reading of part B (NaOH∝ Succinic acid)=12.5 cm^3

II)Reading of part C (NaOH∝ HClacid)=12.4 cm^3

III) Reading of part D(HCl∝ $NaHCO_3$)=10.5 cm^3

Calculations:

I) Exact molarity of NaOH is 0.08M

II)Exact molarity of HCl is 0.0992M = 0.1M

III)
1 M 1000 cm^3HCl ≡ 84 g anhydrous $NaHCO_3$
0.1M 10.5 cm^3HCl =(0.1x10.5x84)/1000= 0.0882g

Therefore for 100cm^3 of soda mint solution amt. of $NaHCO_3$ = 0.882g

For three tablets amt. of $NaHCO_3$ = 0.882g
For one tabletamt. of $NaHCO_3$ = 0.882/3= 0.294g

In the commercial sample of soda mint tablet amount of$NaHCO_3$ is 0.300g

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