

Course Code: 13554/Y1

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Experiment 2: Acid base titration I

Objective:

- 1) To practice the procedure for preparing a standard solution
- 2) To perform the standardization of an unknown hydrochloric acid solution
- 3) To determine the given sodium hydroxide solution
- 4) To estimate the ethanoic acid content in commercial vinegar solution

Apparatus & equipments used:

- 1) Burette, 50mL capacity
- 2) Bulb pipette, 25mL capacity
- 3) Volumetric flask, 250mL capacity
- 4) Conical flask, 250mL capacity
- 5) Analytical balance

Chemicals used:

- 1) Anhydrous sodium carbonate
- 2) Hydrochloric Acid, 0.1M
- 3) Methyl orange indicator
- 4) Phenolphthalein indicator
- 5) Commercial vinegar solution

Results and Data Treatment:

Weighting Data:

Mass of vial: 6.281g

Mass of vial and Na_2CO_3 : 7.583g

Mass of Na_2CO_3 : 1.302g

Na_2CO_3 solution made up to: 250.0cm³

Titration I: Standardization of 0.1M hydrochloric acid solution

Titrant (in burette): Hydrochloric acid

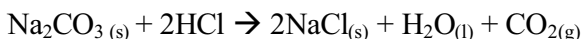
Titrate (in conical flask): 25.0cm³ of Na₂CO₃

Indicator used: Methyl Orange

Colour of indicator changed from: yellow to pink

Titration No.	1(trial)	2	3	4
Final burette reading (cm ³)	23.00	23.30	23.10	23.15
Initial burette reading (cm ³)	0.00	0.00	0.00	0.00
Volume of titrant used (cm ³)	23.00	23.30	23.10	23.15

Average volume: 23.18 cm³

Calculation:

$$\begin{aligned}\text{Number of mole of Na}_2\text{CO}_3 (\text{aq}) &= 1.302\text{g} / 105.8089\text{gmol}^{-1} \\ &= 0.0123\end{aligned}$$

$$\therefore \text{HCl} : \text{Na}_2\text{CO}_3 = 2 : 1$$

$$\begin{aligned}\therefore \text{Number of mole of HCl} &= (0.0123)(2)(25/250) \\ &= 0.00246\end{aligned}$$

$$\begin{aligned}\text{Molarity of HCl} &= 0.00246 / (23.183 / 1000) \\ &= 0.1062 \\ &\sim 0.11\text{M}\end{aligned}$$

Titration II: Determination of the given sodium hydroxide solution

Titrant (in burette): Hydrochloric acid

Titrate (in Conical flask): 25.0cm³ of NaOH

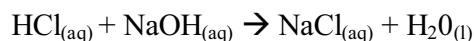
Indicator used: Methyl Orange

Colour of indicator changed from: yellow to pink

Titration No.	1(trial)	2	3	4
Final burette reading (cm ³)	23.55	23.85	47.70	23.80
Initial burette reading (cm ³)	0.00	0.00	23.85	0.00
Volume of titrant used (cm ³)	23.55	23.85	23.85	23.8

Average volume: 23.83 cm³

Calculation:



$$\begin{aligned}\text{Number of mole of HCl} &= (0.1062)(23.83 / 1000) \\ &= 0.00253\end{aligned}$$

$$\therefore \text{HCl} : \text{NaOH} = 1 : 1$$

$$\therefore \text{number of mole of NaOH} = \text{number of mole of HCl} = 0.00253$$

$$\begin{aligned}\text{Molarity of NaOH} &= 0.00253 / (25/1000) \\ &= 0.1012 \\ &\sim 0.10\text{M}\end{aligned}$$

Titration III: Estimation of acetic acid content in commercial vinegar

Titrant (in burette): dilute commercial vinegar solution

Titrate (in Conical flask): 25.0cm³ of NaOH

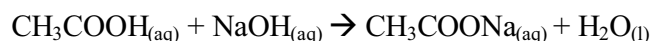
Indicator used: Phenolphthalein

Colour of indicator changed from: purple to colourless

Titration No.	1(trial)	2	3	4
Final burette reading (cm ³)	17.10	16.95	17.00	34.00
Initial burette reading (cm ³)	0.00	0.00	0.00	17.00
Volume of titrant used (cm ³)	17.10	16.95	17.00	17.00

Average volume: 16.98 cm³

Calculation:



$$\begin{aligned}\text{Number of mole of NaOH} &= (0.1012)(25/1000) \\ &= 0.00253\end{aligned}$$

$$\therefore \text{CH}_3\text{COOH} : \text{NaOH} = 1 : 1$$

$$\therefore \text{number of mole of CH}_3\text{COOH}_{(\text{dil})} = \text{number of mole of NaOH} = 0.00253$$

$$\begin{aligned}\text{Molarity of CH}_3\text{COOH}_{(\text{dil})} &= 0.00253 / (16.98 / 1000) \\ &= 0.1489999\end{aligned}$$

$$\begin{aligned}\text{Molarity of CH}_3\text{COOH} &= (0.1489999)(250 / 25) \\ &= 1.489999\end{aligned}$$

$$\begin{aligned}\text{Number of mole of CH}_3\text{COOH in commercial vinegar} &= (1.489999)(250/1000) \\ &= 0.3725\end{aligned}$$

$$\begin{aligned}\text{Mass of CH}_3\text{COOH in commercial vinegar} &= \\ &= (0.3725)[(2)(12.0107)+(4)(1.00794)+(2)(15.9994)] \\ &= 22.369\end{aligned}$$

$$\text{The percentage of CH}_3\text{COOH in commercial vinegar} = (22.369 / 250)(100\%)$$

$$= 8.948$$

$$\sim 8.95\%$$

Conclusion:

We prepared standard solution 0.05M NaOH.

Through the titration I, we know that the molarity of HCl was 0.11M.

In the titration II, we determinate NaOH solution is 0.1012M.

At the titration III, we found out the molarity of diluted commercial vinegar is $\sim 0.15\text{M}$ and also calculation out the original vinegar was $\sim 1.49\text{M}$. In calculation, we found out there are 8.95% ethanoic acid in commercial vinegar.