

Experiment No. 1

Aim of the experiment:

To determine the amount of Na_2CO_3 and NaOH in a mixture using hydrochloric acid.

Principle:

When a known volume of the mixture of Na_2CO_3 and NaOH is titrated with HCl using phenolphthalein indicator, at the end point, all the hydroxide ions (OH^-) and only half of the carbonate ions (CO_3^{2-}) are reacted with hydrochloric acid.

When the titration is continued with methyl orange indicator, the remaining half of CO_3^{2-} ions will be neutralized with HCl at the end point



1st Titration

Titration of HCl against Na_2CO_3

Aim: To know the strength of HCl solution

Performing chemical reactions quantitatively to determine the exact amount of a reagent is called a **titration**

A titration is the quantitative reaction of an acid and a base.

Indicators are used to show that all the analyte has reacted with the titrant.

Known things:

Concentration of Na_2CO_3 solution: $N_1 = 0.1$

Volume of Na_2CO_3 solution: V_1 (20 ml)

Known volume of HCl consumed (from titration): V_2

Concentration of HCl solution: N_2 ??

Strength of HCl solution,

$$\begin{aligned} N_2 &= N_1 V_1 / V_2 \\ &= 0.1 \times 20 / 24.4 = 0.081967 \text{ N} \end{aligned}$$

2nd Titration

Titration of HCl against mixture of NaOH and Na₂CO₃

A = volume of HCl required for neutralization of hydroxyl as well as half of carbonate ions

B = volume of HCl required for neutralization of whole carbonate ions

B - A = C = neutralization of half carbonate ions

Volume required for neutralization of whole carbonate ions = 2C ml

Volume of HCl required for neutralization of only hydroxyl ions = A - C ml

Calculations

Known things:

$$\begin{aligned}\text{Volume of HCl required for neutralization of Na}_2\text{CO}_3 &= 2 C \\ &= 2 (B-A) \text{ ml} = 2(35.3-26.3) \\ &= 18 \text{ ml}\end{aligned}$$

$$\text{Strength of HCl} = 0.081967 \text{ N}$$

$$\text{Volume of Na}_2\text{CO}_3 = 20 \text{ ml}$$

$$\begin{aligned}\text{Strength of Na}_2\text{CO}_3 &= 18 \times 0.081967 / 20 \\ &= 0.07377 \text{ N}\end{aligned}$$

$$\begin{aligned}\text{Amount of Na}_2\text{CO}_3 \text{ present in the mixture} &= 0.07377 \times 53 / 10 \\ &= 0.39098 \text{ g}\end{aligned}$$

Volume of HCl required for C= B-A = 9 ml

Volume of HCl required for neutralization of only hydroxyl ions,

$$\mathbf{A-C = 26.3-9 = 17.3 \text{ ml}}$$

$$\mathbf{\text{Strength of hydroxyl ions} = 0.081967 \times 17.3 / 20}$$

$$\mathbf{= 0.0709 \text{ N}}$$

$$\mathbf{\text{Amount of NaOH present in the mixture} = 0.0709 \times 40 / 10}$$

$$\mathbf{= 0.2836 \text{ g}}$$

Conclusion

The amount of Na_2CO_3 and NaOH present in the mixture are found to be 0.39098 g and 0.2836 g, respectively.

Normality of NaOH = x

x gm equivalent of NaOH is present in 1 litre or 1000 ml of the solution

1 gm equivalent of NaOH = 40

x gm equivalent = 40 . x gm of NaOH is present in 1000 ml of the solution

$40.x/10$ gm of NaOH is present in 100 ml of the solution