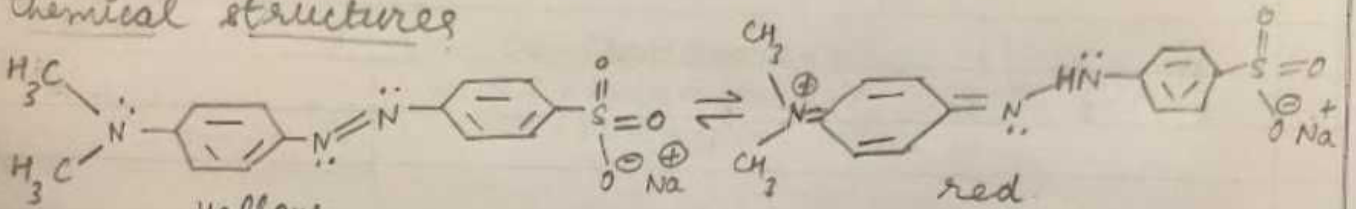
Experiment 1

Experiment :- To determine the amount of NaOH and Na_2CO_3 present in the same solution.

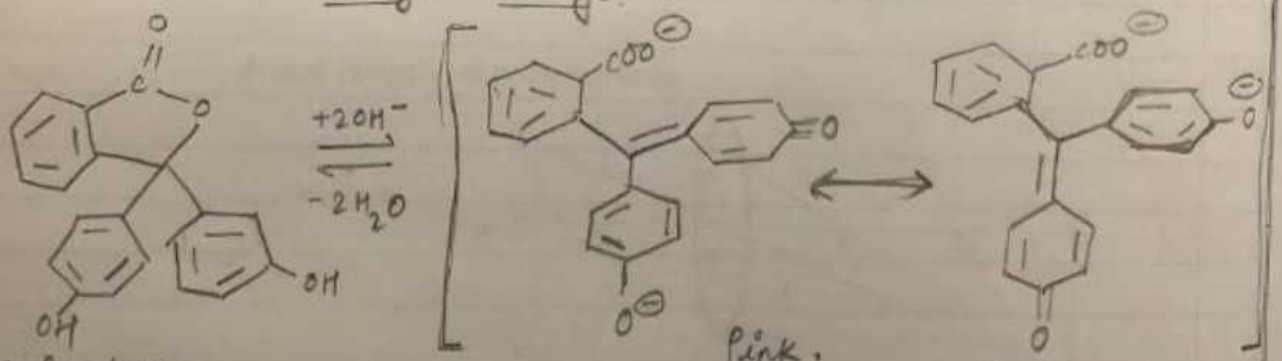
Apparatus – Pipette, burette, beakers, conical flask, funnel, burette stand and clamp.

Chemicals → Sodium Carbonate (Na_2CO_3), Sodium Hydroxide (NaOH), hydrochloric acid (HCl), methyl orange and phenolphthalein.

Chemical structures



Methyl orange.



colorless

Phenolphthalein

Chemical Equation

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

$$Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$$

$$NaHCO_3 + HCl \longrightarrow NaCl + CO_2 + H_2O$$

Khushi Goel

Date 6th Nov.

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Apparatus :- Pipette, burette, beakers, conical flask, funnel, burette stand and clamp.

Chemicals - Sodium carbonate (Na_2CO_3), sodium hydroxide (NaOH), hydrochloric acid (HCl), methyl orange and phenolphthalein

Theory :- When a mixture of NaOH and Na_2CO_3 is titrated against a standard HCl solution, color of the solution changes from yellow to pink (using methyl orange as an indicator) due to complete neutralisation of both the alkalis at pH ≈ 4, when the mixture is titrated with phenophthalein as an indicator, the colour of solution changes from pink to colorless due to complete neutralisation of NaOH and half neutralisation of Na_2CO_3 (i.e upto the conversion of Na_2CO_3 to $NaHCO_3$) at pH ≈ 8. The difference of two titre values gives the amount of HCl required for half neutralisation of Na_2CO_3 while the difference of first value and twice the second titre values gives the amount of HCl required for NaOH neutralisation.

Equations :

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

$$Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$$

$$NaHCO_3 + HCl \longrightarrow NaCl + CO_2 + H_2O.$$

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Indicator → Methyl orange, Phenolphthalein.

End point → Yellow to orange.

Observation: (i) Standardization of HCl soln.

Volume of 0·1 N Na_2CO_3 solution taken for each titration = 10ml.

S·No	Burette Reading (ml)		Volume of the HCl used (ml)
	Initial	Final	
1	0	9·9	9·9
2	0	9·9	9·9
3	0	9·9	9·9

Mean Volume of HCl (V_0) = 9·9 ml

(ii) Determination of NaOH and Na_2CO_3 in the mixture

Volume of mixture of NaOH and Na_2CO_3 solution taken for each titration = 10ml.

S·No	Burette Reading (ml)			Vol. of HCl used (ml)	
	Initial (A)	Colorless with Phenolphthalein (B)	Orange color with methyl orange (C)	P = B-A	M = C-A
1	0	14-0·1 = 13·9	16·5-0·1 = 16·4	13·9	16·4
2	0	13·9	16·4	13·9	16·4
3	0	13·9	16·4	13·9	16·4

Mean value of HCl used for P = 13·9 ml

Mean value of HCl used for M = 16·4 ml

As P corresponds to ½ neutralisation Na_2CO_3 and NaOH

Half of Na_2CO_3 = M - P = 2·5 ml

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Procedure: (i) Standardisation of HCl.

i) Transfer 10 ml of standard 0.1 N Na_2CO_3 solution in a clean conical flask using a pipette.

ii) Add 2 drops of methyl orange indicator. Titrate the solution against HCl from the burette.

iii) The color of the solution changes from yellow to pink (end point)

iv) Note the volume of the solution used and repeat the titration at least 4 times and take the mean of the closely related readings (V_a)

(ii) Determination of NaOH and Na_2CO_3 present.

i) Transfer 10 ml of mixture of alkali solution into a conical flask.

ii) Add 2-3 drops of phenolphthalein indicator. The solution becomes pink in color.

iii) Note the initial reading of HCl from the burette (A) Titrate the solution with standard HCl while the solution becomes colourless (B)

iv) Note the titre values and this is the phenolphthalein end point (P). To the same solution, and 2-3 drops of methyl orange indicator and continue the titration with HCl, initial a sharp color change occurs. from yellow to orange at the end point (C)

v) This titre value i.e, the total value to HCl run down from the beginning of the experiment to the methyl orange end point is noted and this is the methyl orange end point (M)

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So, volume of HCl required for neutralization of Na_2CO_3

$\Rightarrow 2(M-P) = V_1 = 2 \times 2.5 = 5$ ml.

Volume required for neutralisation of NaOH

$V_2 = M - 2(M-P)$

$\Rightarrow 16.4 - 5 \Rightarrow 11.4$ ml

Calculation: (i) Standardization of HCl.

Vol. of alkali solution (Na_2CO_3) taken = 10 ml.

Normality (N_1) of Na_2CO_3 = 0.1 ; Vol. of HCl used = 9.9 ml (V_0)

$N_1 = \frac{N_2}{V_0} \times 10 = \frac{0.1}{9.9} \times 10 \Rightarrow \frac{1}{9.9} = 0.101\,N$.

ii) Determination of NaOH and Na_2CO_3 -

i) Determination of NaOH

1L of 1N HCl = 40g of NaOH

Normality of HCl used = $N_1 = 0.101\,N$

11.4 ml of 0.101 N HCl = $40 \times \frac{11.4 \times 0.101}{1000}$ = y_1 gram of NaOH

= 0.046 gr

Strength of NaOH = $y_1 \times 100 \Rightarrow 0.046 \times 100 = 4.6$ g/L

ii) Determination of Na_2CO_3.

1L of 1N HCl = 53g of NaOH

5ml of 0.101N HCl = $53 \times \frac{5 \times 0.101}{1000} \Rightarrow y_2$ gram of Na_2CO_3.

= 0.027 g.

Strength of Na_2CO_3 = $y_2 \times 100$ = 2.7 g/L

Result → The given alkali mixture contains NaOH = 4.6 g/L

The given alkali mixture contains Na_2CO_3 = 2.7 g/L

RESULTS :- The given alkali mixture contains NaOH = 4.6 g/L

The given alkali mix. contains Na_2CO_3 = 2.7 g/L

Expected CLOs / Daily life Applications

The total basic content of an antacid tablet can be determined in a similar manner.

PRECAUTION

1.) Rinse the pipette and burette.
2.) Always put the solution from burette drop wise to the conical flask.

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