

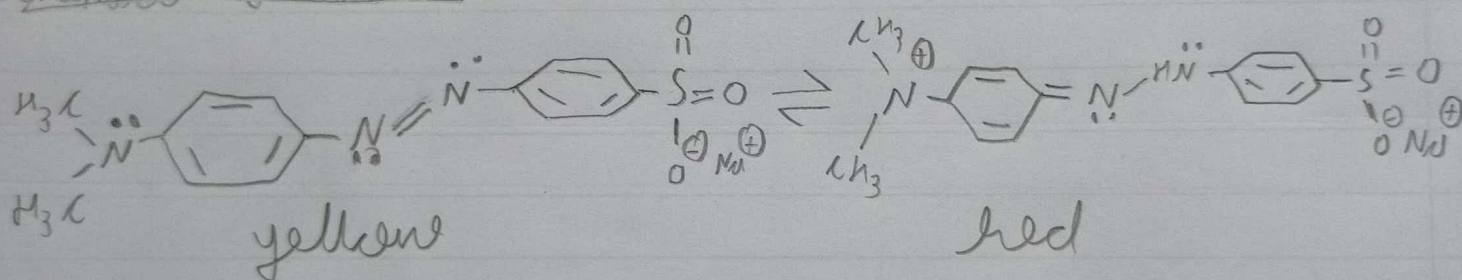
Experiment 1

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

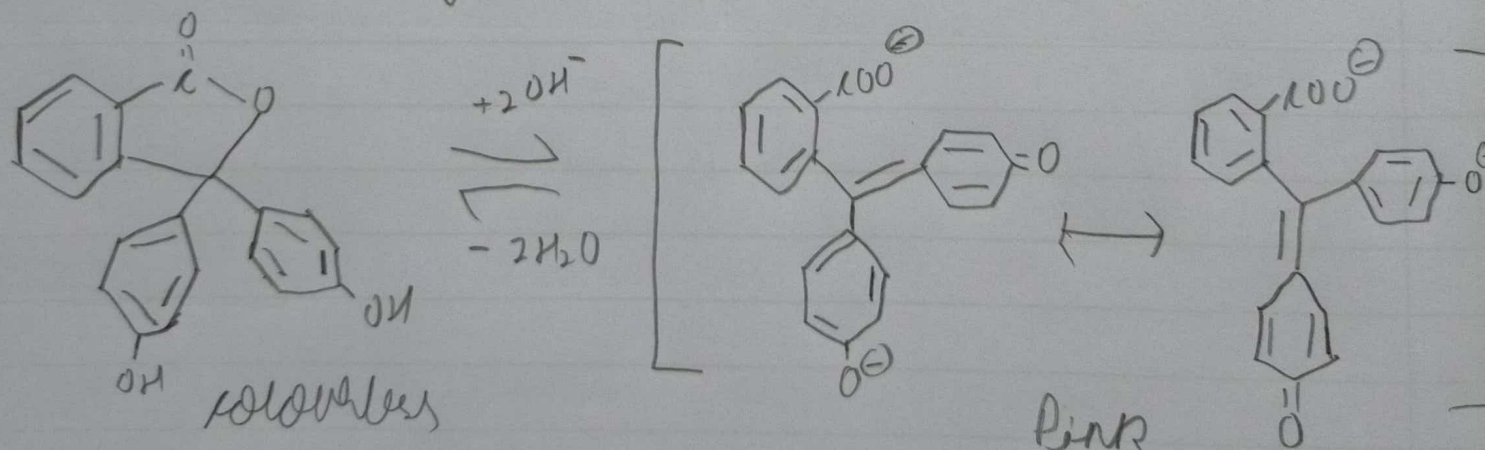
Apparatus - Pipette, burette, beakers, conical flask, funnel, burette stand and clamp

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

Chemical structures -



Methyl orange



Phenolphthalein

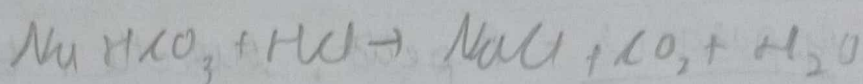
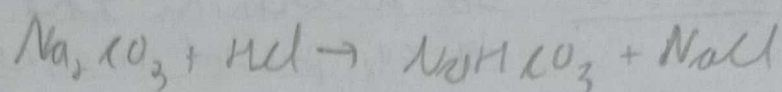
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Chemicals - Sodium carbonate (Na_2CO_3), Sodium hydroxide (NaOH), hydrochloric acid (HCl), Methyl orange and phenolphthalein.

Theory - When a mixture of NaOH and Na_2CO_3 is titrated against a standard HCl solution, colour of the solution changes from yellow to pink (using methyl orange as an indicator) due to complete neutralisation of both the alkalies at $\text{pH} \approx 4$, when the mixture is titrated with phenolphthalein as an indicator, the colour of solution changes from pink to colourless 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 $\text{pH} \approx 8$. The difference of two titrate values gives the amount of HCl required for half neutralisation of Na_2CO_3 while the difference of first value and twice the second titrate values gives the amount of HCl required for NaOH neutralisation.

Chemical Equation - $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$



Indicator - Methyl orange, Phenolphthalein

End point - yellow to orange

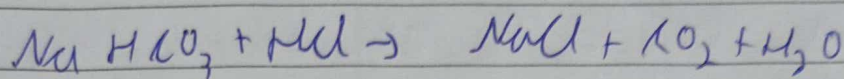
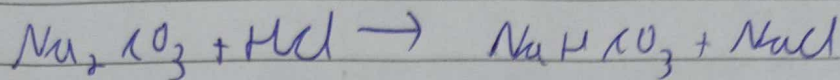
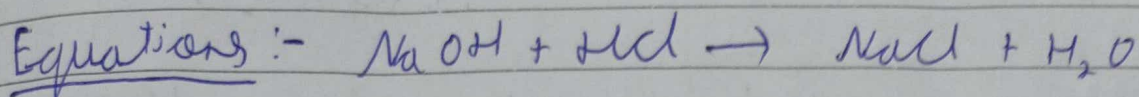
Observation - (i) Standardization of HCl sol.

Volume of 0.1 N Na_2CO_3 solution taken for each titration = 10 ml.

S. No	Burette Reading (ml)		Volume of the HCl used (ml)
	Initial	Final	
1	0	9.7	9.7
2	0	9.7	9.7
3	0	9.7	9.7

Mean value of HCl (V_0) = 9.7 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 = 10 ml.



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~~ 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 ~~experiment~~ titration at least 4 times and take the mean of the closely related readings (V_a).

(2) Determination of NaOH and Na_2CO_3 present.

- (i) A Transfer 10 ml of mixture of alkali solution into a conical flask.
- (ii) Add 2-3 drops of phenolphthalein indicator. The

S.No	Burette Reading (ml)			Volume of HCl used (ml)	
	Initial (A)	Colorless with phenolphthalein (B)	Orange color with methyl orange (C)	$P = B - A$	$M = C - A$
1	0	$14.03 = 13.7$	$16.5 - 0.3 = 16.2$	13.7	16.2
2	0	13.7	16.2	13.7	16.2
3	0	13.7	16.2	13.7	16.2

Mean value of HCl used for $P = 13.7$ ml

Mean value of HCl used for $M = 16.2$ ml

As P corresponds to $\frac{1}{2}$ neutralisation Na_2CO_3 and NaOH

$$\text{Half of } \text{Na}_2\text{CO}_3 = M - P = 2.5 \text{ ml}$$

So, volume of HCl required for neutralization of $\text{Na}_2\text{CO}_3 = 2(M - P) = V_1 = 2 \times 2.5 = 5 \text{ ml}$

Volume required for neutralisation of NaOH

$$\begin{aligned} V_2 &= M - 2(M - P) \\ &= 16.2 - 5 = 11.2 \text{ ml} \end{aligned}$$

Calculation - (1) Standardization of HCl

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

Normality (N_1) of $\text{Na}_2\text{CO}_3 = 0.1$

Volume of HCl used = 9.7 ml (V_0)

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 value and this is the phenolphthalein end point (P). To the same solution add 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 (X).

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

Results:- The given alkali mixture contains
 $\text{NaOH} = 4.6 \text{ g/L}$

The given alkali mix. contains $\text{Na}_2\text{CO}_3 = 2.7 \text{ g/L}$

Expected dos / Daily life Applications- The total basic content of an antacid tablet can be determined in a similar manner

$$N_1 = \frac{N_2}{V_0} \times 10 = \frac{0.1}{9.7} \times 10 = \frac{1}{9.7} = 0.103 \text{ N.}$$

(2) Determination of NaOH and Na_2CO_3

(i) Determination of NaOH

1 L of 1 N HCl = 40 g of NaOH

Normality of HCl used = 0.103 N

$$11.4 \text{ ml. of } 0.103 \text{ N HCl} = 40 \times \frac{11.4 \times 0.103}{1000} =$$

$$y_1 \text{ grams of NaOH} = 0.046 \text{ g}$$

$$\text{Strength of NaOH} = y_1 \times 100 = 0.046 \times 100 = 4.6 \text{ g/L}$$

(ii) Determination of Na_2CO_3

1 L of 1 N HCl = 53 g of Na_2CO_3

$$5 \text{ ml of } 0.103 \text{ N HCl} = 53 \times \frac{5 \times 0.103}{1000} = y_2 \text{ grams of } \text{Na}_2\text{CO}_3$$

$$= 0.027 \text{ g}$$

$$\text{Strength of } \text{Na}_2\text{CO}_3 = y_2 \times 100 = 2.7 \text{ g/L}$$

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

The given alkali mixture contains Na_2CO_3 = 2.7 g/L

Precaution - (i) Rinse the pipette and burette

(ii) Always put the solution ~~in~~ burette drop wise to the conical flask.