## EXPERIMENT-3

**OBJECT**

To determine total alkalinity in given water sample due to the presence of carbonate and bicarbonate ions by titrating against standard hydrochloric acid (N/10) solution by using phenolphthalein and methyl orange as indicators.

**(A)APPARATUS:** Burette, Pipette, Conical Flask, Funnel, Beaker, Burette Stand.

**(B) CHEMICALS:** Sodium Bicarbonate Solution, Sodium Carbonate Solution, Standard Hydrochloric Acid (N/10), Distilled Water

**(C) Indicator:** Phenolphthalein and Methyl Orange

**PRINCIPLE**

When alkaline water solution containing carbonate and bicarbonate ions is titrated against standard HCL solution in presence of phenolphthalein indicator, the carbonate ions are converted to bicarbonate ions. At this point the pink color of the alkaline solution disappears.

The chemical reactions involved in this process are given below: -

$Na_2CO_3$ + HCl [phenolphthalein] = $NaHCO_3$ + NaCl

$CO_3^{--}$ion + $H^+$ ion [phenolphthalein] = $HCO_3^-$ ion

On further titration against the standard HCl solution in presence of methyl orange indicator the bicarbonate ions are completely neutralized. The chemical reaction involved can be depicted as:-

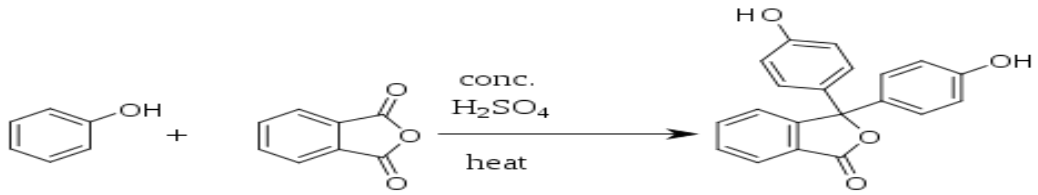
$Na_2HCO3$ + HCl [methyl orange] = NaCl + $H_2O$ + $CO_2$

$HCO_3^{--}$ion + $H^+$ ion [methyl orange] = $H_2O$ + $CO_2$

THE OVERALL REACTION INVOLVED IN THE PROCESS IS:-

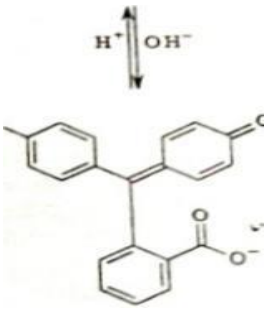
$Na_2CO_3$ + HCl phenolphthalein = $NaHCO_3$ [methyl orange] = NaCl $H_2O$ + $CO_2$

$NaHCO_3$ + NaCl [methyl orange] = NaCl $H_2O$ + $CO_2$




**Phenolphthalein: -**

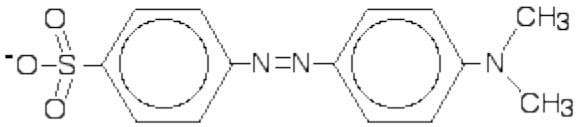
Colorless acidic medium benzenoid form



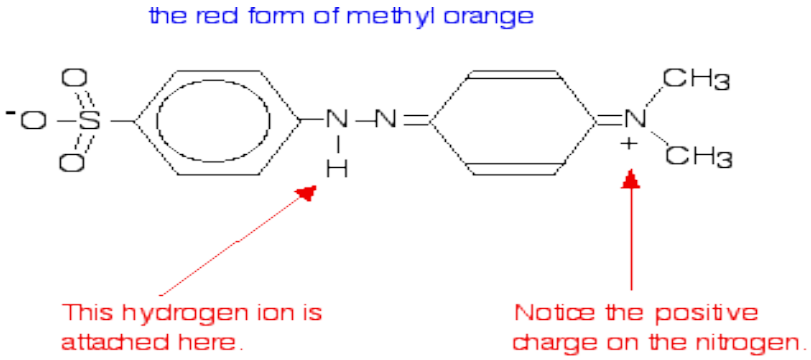

**Pink color (alkaline medium) Quinonoid form**

**Methyl Orange: -**

the yellow form of methyl orange




$H^+$ ⇕ $OH^-$




**PROCEDURE**

1. Rinse the glass apparatus properly with distilled water. Fill the burette with standard HCl solution.
2. Take out 10 ml alkaline water sample in conical flask with the help of pipette and add 1 drop phenolphthalein in it. Pink color appears.
3. Start titration with this solution against standard HCL solution with continuous shaking till the pink color of the solution disappears at end point.
4. The reading is noted down. This is phenolphthalein end point of the titration.
5. Now add 1 drop of methyl orange indicator in it. Light yellow color appears. Start the titration process in similar manner against standard HCl solution with continuous shaking till the color of sample solution changes from light yellow to wine red which indicates the completion of reaction and thereby end point of the titration.
6. Note down this reading. This is methyl orange end point of the titration.
7. The process is repeated till we get two concordant readings

**OBSERVATION**

| S.No | Volume of sample solution taken ml | Burette reading | | | | Volume of HCl used by $CO_3^{-2}$ [2X] | Volume of HCl used by $OH^-$ [y-2X] |
|---|---|---|---|---|---|---|---|
| | | Phenolphthalein | | methyl orange | | | |
| | | Initial | Finial (X) | Initial | Finial (Y) | | |
| 1. | | | | | | | |
| 2. | | | | | | | |
| 3. | | | | | | | |

**CALCULATION**

**(A): FOR carbonate ions**

$N_1V_1$ = $N_2V_2$

Water sample HCl

Strength of the solution = normality × Equivalent weight

Normality of alkaline water due to the presence of $Na_2CO_3$ or $CO_3^{--}$ions =

Equivalent weight of $co_3^{--}$ ion =30

Strength of the $co_3^{--}$ ion in alkaline solution =------g/L

**B: for Bicarbonate ions**

$N_1V_1$ = $N_2V_2$

Water sample HCl

Strength of the solution = normality × Equivalent weight

Normality of alkaline water due to the presence of bicarbonate ions =

Equivalent weight of $HCO_3^-$ ion = 61

Strength of the $HCO_3^-$ ion in alkaline solution =---g/L

**END POINT**

Tow END POINTS are recorded in this titration: -

1. Phenolphthalein END POINTS- pink color to colorless solution.
2. Methyl orange END POINTS- light yellow color to Wine Red color solution

**RESULT**

The alkalinity of water sample due to presence of carbonate ions =-----g/l

The alkalinity of water sample due to presence of bicarbonate ions =-----g/l

Total alkalinity =---------g/l

**PRECAUTIONS**

1. Glass apparatus should be cleaned properly.
2. Always distilled water should be used for reagent preparation.
3. Titration should be done drop wise and with regular shaking of sample solution.
4. The pH of solution should be maintained during the process of titration.
5. End point should be observed correctly.
6. Standard solution in burette should be free from leaks and bubbles.