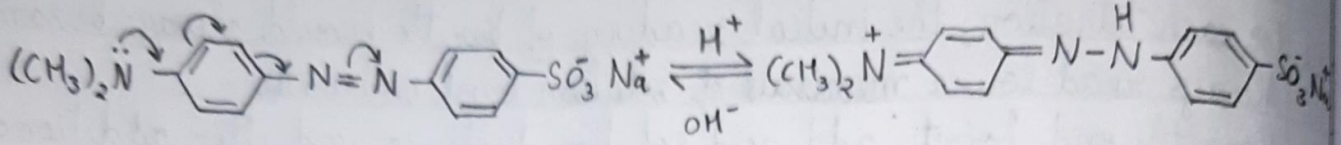
Indicator:

Methyl orange (yellow to red)



Benzenoid structure, yellow  Quinonoid structure, pink

Chemical reactions:

$$HCl + Na_2CO_3 \rightarrow NaHCO_3 + NaCl$$
$$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$$

Ionic reactions:

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$
$$HCO_3^- + H^+ \rightarrow H_2O + CO_2$$

Observations:

Titration of given HCl v/s standard N/40 $Na_2CO_3$ solution (Table 3.1)

| S. No. | Volume of $Na_2CO_3$ (ml) | Burette readings | | Volume of HCl used (ml) | Concordant readings ($V_o$) |
|---|---|---|---|---|---|
| | | Initial | Final | | |
| 1. | 10 ml | 0.0 | 6.0 | 6.0 | 6.0 ml |
| 2. | 10 ml | 6.0 | 12.0 | 6.0 | |
| 3. | 10 ml | 12.0 | 18.0 | 6.0 | |
| 4. | 10 ml | 18.0 | 24.0 | 6.0 | |

Date ...7/10/2023...

Expt. No./ Name : .....

Page No. ...16...

# Experiment 3

**Aim:**

To determine the total alkalinity of given water sample using methyl orange as indicator. Given standard N/40 Sodium Carbonate to standardize given HCl solution

**Apparatus required:**

Pipette, Burette, Stand, Conical flask, Measuring cylinder, White paper.

**Reagents required:**

Sodium Carbonate ($Na_2CO_3$), Hydrochloric Acid (HCl), Alkaline water sample, Distilled water.

**Theory:**

This is an example of neutralization reaction titration. The titration is based upon the specific pH range of the indicator. Methyl orange gives red colour in pH range 4.4 - 3.0. Initially when standard hydrochloric acid is added, $CO_3^{2-}$ ions are converted to $HCO_3^-$. On addition of further acid, the $HCO_3^-$ ions are converted to $CO_2$ and $H_2O$. When all $HCO_3^-$ ions are used up the pH of solution becomes less than 4.4 instantaneously. At this point methyl orange gives red colour.

**Procedure:**

1. Standardization of given HCl solution
   (i) Take 10 ml of standard $Na_2CO_3$ with the help of pipette into conical flask. Add 1-2 drops of methyl orange.

Teacher's Signature : .....

## Titration of standardized HCl v/s given Alkaline water sample. (Table 3.2)

| S.no. | Volume of water sample | Burette readings | | Volume of HCl used (ml) | Concordant reading ($V_o$) |
|---|---|---|---|---|---|
| | | Initial | Final | | |
| 1. | 10 ml | 0.0 | 10.5 | 10.5 | 10.5 ml |
| 2. | 10 ml | 10.5 | 21 | 10.5 | |
| 3. | 10 ml | 21 | 31.5 | 10.5 | |
| 4. | 10 ml | 31.5 | 42.0 | 10.5 | |

### Calculations:

To calculate Normality of given HCl solution, apply normality equation:

$$N_{HCl} \times V_{HCl} = N_{Na_2CO_3} \times V_{Na_2CO_3}$$

$$N_{HCl} = \frac{N_{Na_2CO_3} \times 10}{V_{HCl}} = \frac{10}{40} \times \frac{1}{6} = \frac{1}{24} N = 0.04167 N$$

To calculate Normality of given water solution, apply normality equation:

$$N_{sample} \times V_{sample} = N_{HCl} \times V_{HCl}$$

$$N_{sample} = \frac{N_{HCl} \times V_{HCl}}{10} = \frac{1}{24} \times \frac{10.5}{10} = 0.04375 N$$

Strength of Alkaline content in given water sample:

Strength = Normality × Eq. wt. of $CaCO_3$

$= 0.04375 \times 50 = 2.1875 g L^{-1}$

Strength $\simeq 2.19 g L^{-1}$ or „ 2187.5 ppm

(ii) Ran the acid solution from the burette into conical flask drop wise with constant shaking of solution.
(iii) Found the end point when light yellow colour solution turned red. Noted volume of acid used. Repeated this step 4-5 times till you got atleast 2 concordant readings.

2. Titration of given water sample with HCl solution
(i) Pipette out 10 ml of given water sample into conical flask. Added 2-3 drops of methyl orange indicator.
(ii) Added HCl solution from burette into the conical flask with constant shaking.
(iii) Titrated with acid till yellow coloured solution turned red (end point). Noted the volume of acid used ($V_3$). Repeated the steps to get concordant reading.

Result:
Total alkalinity of the given solution (in terms of $CaCO_3$) is 2187.5 ppm

Precautions:
(i) Before starting the experiment, the glass apparatus must be cleaned.
(ii) For each titration, the initial readings of burette should always be same.
(iii) Always read lower meniscus of solution level in burette.
(iv) Near the end point, add acid solution dropwise and after addition of each drop, see the colour against white background.
(v) Do not blow last drop of solution from pipette. Just tap the tip of pipette to the walls of the flask.

Teacher's Signature : _____