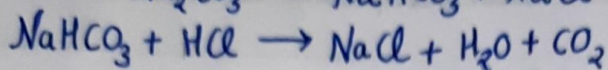
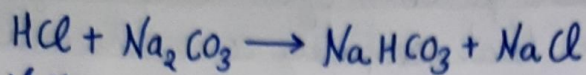
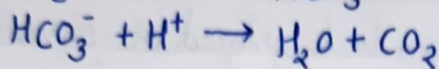
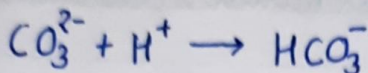


Reactions:



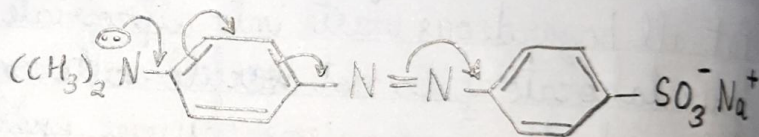
Ionic reactions:



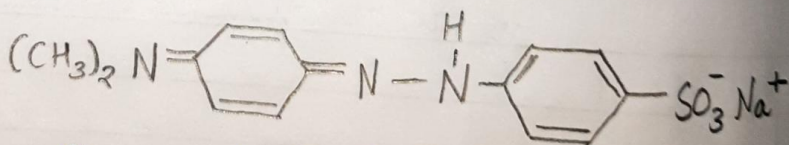
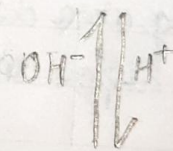
Indicator: Methyl orange

End point: Yellow to pink (light red)

Resonance structures:



Benzenoid structure (yellow)



Quinonoid structure (pink) (light red)



## Experiment 1

### Aim:

To determine the strength of commercial hydrochloric acid (HCl), 10 ml of which have been dissolved per liter of the given solution.

### Apparatus required:

Pipette, Burette, Stand, Beaker, Measuring cylinder, Conical flask, etc.

### Chemical required:

Hydrochloric acid (HCl),  $N/10$  solution of Sodium carbonate ( $Na_2CO_3$ ), methyl orange (indicator).

### Theory:

Titration process involved between HCl and  $Na_2CO_3$  is acid-base titration. Methyl orange is used as indicator in given titration.

At pH value less than 3.1, methyl orange is red.

At pH value greater than 4.4, it will be yellow.

In the range between 3.1 to 4.4 a mixture of red and yellow colours are obtained.

In the middle of this range, solution appears to orange in colour.

### Titration:

It is a qualitative analysis of a given compound by neutralising its fixed equivalents with a known solution.

### Types of titration:

1. Acid base titration





## Observations:

### 1. Preparation of 0.1 N sol<sup>n</sup> of $\text{Na}_2\text{CO}_3$ ,

wt. of weighing bottle,  $w_1 = 14.6432 \text{ g}$

wt. of weighing bottle +  $\text{Na}_2\text{CO}_3$ ,  $w_2 = 15.9682 \text{ g}$

wt. of weighing bottle after transferring salt,  $w_3 = 14.6392 \text{ g}$

wt. of  $\text{Na}_2\text{CO}_3$ ,  $w_4 = w_2 - w_3 = 1.329 \text{ g}$

vol<sup>m</sup> of sol<sup>n</sup> made = 250 ml

### 2. Titration,,

vol<sup>m</sup> of  $\text{Na}_2\text{CO}_3$  sol<sup>n</sup> taken for each titration = 10 ml

Burette readings:

⇒ titration of  $\text{Na}_2\text{CO}_3$  vs HCl

S. no.	Initial reading	Final reading	Vol <sup>m</sup> of HCl used
1.	0.0	5.6	5.6
2.	5.6	11.2	5.6
3.	11.2	16.8	5.6

Concordant reading = 5.6 ml



2. Redox titration
3. Complexometric titration
4. Precipitation titration

**Titrant:** standard solution

**Titrand:** unknown solution whose concentration is to be found.

**Equivalence point:** point at which no. of eq. of titrant equals to the no. of eq. of titrand.

**End point:** point at which indicator gives visible change in colour.

**Titration error:** small difference b/w eq. pt & end pt.

**Requirements for titration:**

1. It should involve a simple chemical reaction
2. The reaction should be very fast.
3. Some proper indicator should be available

Equivalence point is also known as stoichiometric or theoretical end pt.

**Indicators:**

Compounds used in titration to identify the equivalence point.

Acid base indicators are complex organic compounds which have different colours in acid & base media.

**Procedure:**

1. We weight out 1.325g of dried  $\text{Na}_2\text{CO}_3$ .
2. Transfer the weight in 250 ml volumetric flask.





## Calculations:

1. Preparation of 0.1 N sol<sup>n</sup> of  $\text{Na}_2\text{CO}_3$ ,

$$N = \frac{\text{weight}}{\text{eq. weight}} \times \frac{100}{V(\text{ml})}$$

$$\text{eq. weight} = \frac{\text{molar mass}}{n}$$

$$\text{Normality of } \text{Na}_2\text{CO}_3 \text{ sol}^n = \frac{(w_2 - w_3)}{53} \times \frac{1000}{250} = \frac{1.329}{53} \times 4 = 0.1003$$

## 2. Titration,

To calculate Normality of dil HCl sol<sup>n</sup>, apply eq<sup>n</sup>,

$$\Rightarrow N_{\text{HCl}} \times V_{\text{HCl}} = N_{\text{Na}_2\text{CO}_3} \times V_{\text{Na}_2\text{CO}_3}$$

$$N_{\text{HCl}} = N_{\text{Na}_2\text{CO}_3} \times \frac{V_{\text{Na}_2\text{CO}_3}}{V_{\text{HCl}}}$$

$$N_{\text{HCl}} = N_{\text{Na}_2\text{CO}_3} \times \frac{10}{V_{\text{HCl}}} = \frac{0.1 \times 10}{5.6}$$

$$\text{Strength of dil HCl sol}^n = N_{\text{HCl}} \times 36.5 \text{ g/l}$$

$$= \frac{0.1 \times 10 \times 36.5}{5.6} = 6.518 \text{ g/l}$$

$$\text{Strength of commercial HCl} = N_{\text{HCl}} \times 36.5 \times 100$$

$$= 6.518 \times 100 = 651.785 \text{ g/l}$$

3. We mix solid and water for the volume 250 ml.
4. We filled the burette with given HCl solution.
5. We removed air bubbles and set it at zero mark.
6. We pipetted out 10 ml of standard  $\text{Na}_2\text{CO}_3$  solution into a 100 ml titration flask and added 1-2 drops of methyl orange.
7. We titrated with HCl upto sharp colour change i.e. till red colour obtained.
8. We repeated the titration with every 10 ml of  $\text{Na}_2\text{CO}_3$  solution until two same readings were obtained.

### Result:

Strength of commercial HCl is 651.785 g/l

### Precautions:

1. Shake the titration flask continuously during adding sol<sup>n</sup> from burette.
2. Keep your eye in level with liquid surface while taking the reading.
3. Always read lower meniscus in case of colourless solution.
4. Funnel must be removed before starting with the titration.

