**Laboratory of Analytical chemistry**

Lab. of the first stage

Date / /

**Experimental 3:**

**A- Preparation and standardization of an acid ( HCl )**

NHCl= $\frac{Specific gravity ×\%\frac{w}{w}×10}{Eq. wt. HCl}$

Specific gravity= 1.18

Eq.wt HCl = 36.5

%w/w of HCl is obtained from the reagent bottle

Therefore: N of concentration HCl = 12 Normal

To prepare 0.1N from 250 ml HCl:

N1×V1= N2×V2 [Dilution low]

N1×V1= 0.1×250ml

V1=2.08ml transfer into 250ml =0.1 N from HCl

**B- Standardization of prepared of 0.1 N HCl solution**

-Fill the burette with the prepared HCl solution.

- Transfer 10 ml of exactly 0.1N Na2CO3 (Primary standard) into a conical flask by using a bulb pipette (0.1 N Na2CO3 solution is prepared by weighing exactly 5.3 gram of Na2CO3 and diluted to 1000 ml with distilled water in a volumetric flask).

- Add 2 drops of methyl orang (M.O) as **an indicator**. Yellow color is obtained.

- Titrate with HCl solution drop by drop from the burette into the conical flask until a faint orange color is obtained.

- The exact Normality of HCl can be calculated from Two Stages as the following .

(1) Na2CO3+ HCl NaCl + NaHCO3

(2) NaHCO3 + HCl NaCl + H2O + CO2

In the equivalence point in the equation (1) the pH equal **8.3** So; we can use **phenolphthalein indicator (ph.ph)** , but in the step (2) the pH equal **3.8** So does not used ph.ph but another indicator is **Methyl Orange(M.O)**.

In this experimental; Methyl orange is used as single, So the Reaction equation between Hydrochloric acid and Sodium Carbonate is as follows:

2HCl + Na2CO3 2NaCl + CO2 + H2O

**An indicator?** Is a chemical compound that exhibits a change in color as a result of concentration changes that occurring near the equivalence point.

**Indicators theory:**

 Most of the evidence used in acid and base measurements is weak acids, as their degree of disintegration is very much affected by the change of hydrogen ion concentration in the solution, resulting in a change in color. For example, phenolphthalene is a very weak organic acid (**HA**), as it dissolves into hydrogen ion and negative ion.

 H+ + A- HA

**Pink**

**Colorless**

When acid is added, the concentration of the hydrogen ion produced by the acid is very high compared to the **H+** concentration of the dissociation of the guide. This leads to the inhibition of the dissociation of the guide. Therefore, the evidence will not be ionized and will not be noticed when adding an alkaline solution. The hydrogen ions produced by the guide interact with some hydroxyl ions To form the water and thus will increase the dissociation of weak acid and accompanied by an increase in colored ions (**A**), which make the solution pink that these changes in color occur at different concentrations with different evidence.

**Characteristics of Suitable indicator:**

1 - The change in the color of the manual must be clear.

2 - The pH range during which the change in color must be based on the full reaction.

|  |  |  |
| --- | --- | --- |
| **Indicators** | **pH Range** | **Change color**  |
| **Acidic medium** | **Basic medium** |
| Methyl Orange (M.O) | **3-4.4** | **red** | **yellow** |
| Methyl Red (M.R) | **4.4-6.3** | **red** | **yellow** |
| Bromothymol blue  | **6-7.6** | **yellow** | **blue** |
| phenolphthalein (ph.ph) | **8.2-10** | **colorless** | **red** |
| Litmus paper | **6-8** | **red** | **blue** |

**Adding hydrochloric acid to sodium carbonate solution**

The overall equation for the reaction between sodium carbonate solution and dilute hydrochloric acid is:



If you had the two solutions of the same concentration, you would have to use twice the volume of hydrochloric acid to reach the equivalence point - because of the **1 : 2** ratio in the equation.

Suppose you start with **25** ml of sodium carbonate solution, and that both solutions have the same concentration of **1** mol dm-3. That means that you would *expect* the steep drop in the titration curve to come after you had added **50** ml of acid.

The actual graph looks like this:



The graph is more complicated than you might think - and curious things happen during the titration.

You expect carbonates to produce carbon dioxide when you add acids to them, but in the early stages of this titration, no carbon dioxide is given off at all.

Then - as soon as you get past the half-way point in the titration - lots of carbon dioxide is suddenly released.

The graph is showing two end points - one at a pH of **8.3** (little more than a point of inflexion), and a second at about pH **3.7**. The reaction is obviously happening in two distinct parts.

In the first part, complete at **A** in the diagram, the sodium carbonate is reacting with the acid to produce sodium hydrogencarbonate:



You can see that the reaction doesn't produce any carbon dioxide.

In the second part, the sodium hydrogencarbonate produced goes on to react with more acid - giving off lots of CO2.



That reaction is finished at **B** on the graph.

It is possible to pick up both of these end points by careful choice of indicator. That is explained on the separate page on indicators.