Al-Karkh University of Science
College of science
First year level
General chemistry Labs

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Lab -6-

Titrating Sodium Carbonate with Hydrochloric Acid

1. Introduction:

Laboratory grade hydrochloric acid is not sufficiently pure to use as a primary standard. In experiment, a standard solution of sodium carbonate use to determine the exact concentratio a hydrochloric acid solution.

Sodium carbonate reacts with dilute hydrochloric acid in two stages.

STAGE 1 $Na_2CO_3 + HCl \rightarrow NaCl + NaHCO_3$

STAGE 2 $NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$

The overall reaction is

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$$

The end points for the two stages can be found using suitable indicators. The reaction can be followed using a pH meter.

Two indicators are needed to cover both stages:

- in stage 1, phenolphthalein (pH= 8-10) is most suitable, and will respond to the pH cha associated with the formation of sodium hydrogen carbonate, $NaHCO_3$.
- in stage 2, methyl orange (pH= 3.1-4) is most suitable, and will respond to the pH cha associated with the final formation of sodium chloride, NaCl.

2. Objective: To determine the molarity of an unknown concentration of hydrochloric acid two steps.

3. Materials and apparatus:

Ring stand, 1 Erlenmeyer flask, Phenolphthalein indicator, methyl orange indicatori, buret, water, unknown HCl, double bure, clamp, 0.1 M $Na_2CO_3(aq)$, 2 beakers, funnel

4. Procedure (method):

1) Use a pipette and safety filler to put 10.0 ml of approximately 0.1 $mol.dm^{-3}$ (M) sodi carbonate solution into a small conical flask.

2) Add 2-3 drops of phenolphthalein indicator. The solution should be red-pink.

3) Titrate with HCl from a burette until the last traces of pale pink colour have disappeared. Note down the burette readings in the table below.

4) Add 3-4 drops of methyl orange. The solution should now be a yellow colour.

5) Continue to add acid from the burette until the solution just turns orange-red. Note down the final burette reading.

6) Repeat steps from 1 to 5 to get concordant titres for the two end points.

5. Calculation:

A - with using phenolphthalein

$V1(HCl) = 1/2\ Na_2CO_3$

$2V = \text{all } Na_2CO_3$

$$\frac{(M.V)_{acid}}{n} = \frac{(M'.V')_{base}}{n}$$

$(M.V)_{acid} = (M'.V')_{base}$

$M = (M'.V')_{base} / 2V$

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$$

B - with using methyl orange

$$\frac{(M.V)_{acid}}{n} = \frac{(M'.V')_{base}}{n}$$

$(M.V)_{acid} = (M'.V')_{base}$

$M = (M'.V')_{base} / V$

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

6. Conclusions:

The molarity of the given for sodium carbonate was _____ M.

7. Questions:

1. In using a burette, why is it important?
(a) to rinse it with a little of the solution it is going to contain,
(b) to clamp it vertically,
(c) to have the part below the tap full?

2. Explain why hydrochloric acid is not used as a primary stand