EXPERIMENT-7

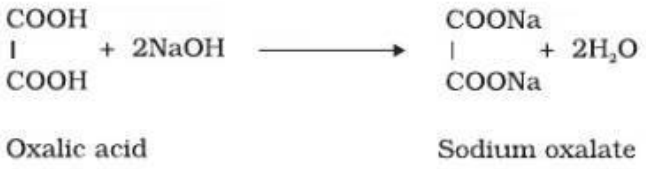
DETERMINATION OF THE CONCENTRATION (STRENGTH) OF A GIVEN SODIUM HYDROXIDE SOLUTION BY TITRATING IT AGAINST A STANDARD SOLUTION OF OXALIC ACID:

AIM:

Determination of the concentration (strength) of a given sodium hydroxide solution by titrating it against a standard solution of oxalic acid.

THEORY:

In the titration of a strong acid with a strong base, the amount of acid and base becomes chemically equivalent at the end point and the chemical reaction is called neutralization reaction. Near the end point there is a sudden change in the pH of the solution. If after end point even a small amount of base/acid is added the solution would become slightly alkaline or acidic respectively. In the titration between oxalic acid (weak acid) and sodium hydroxide (strong base), following reaction takes place:

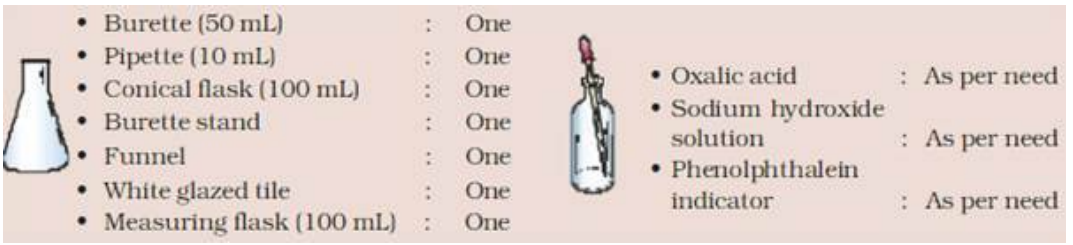


In this titration phenolphthalein (HPh) is used as an indicator. The concentration of unknown solution is calculated in g/L. Molarity of the solution can be calculated by using the formula

$$a_1 M_1 V_1 = a_2 M_2 V_2 \qquad ...(4)$$

where a_1, M_1, V_1 are respectively basicity, molarity and volume of acid used and a_2, M_2 and V_2 are acidity, molarity and volume respectively of base used in the titration.

MATERIAL REQUIRED:



PROCEDURE:

(A) Preparation of 0.1M Standard Solution of Oxalic Acid

Follow the procedure as described in Experiment No. 2.1.

(B) Titration of Sodium Hydroxide and Oxalic Acid Solution

(i) Clean the burette thoroughly, wash it with distilled water and finally rinse it with sodium hydroxide solution. (Always rinse the burette (Fig. 2.17) with the solution, which is to be taken in it). Clamp the burette vertically in a burette stand.

(ii) Fill sodium hydroxide solution into the burette through a funnel above the zero mark.

(iii) Remove the air gap, if any, from the nozzle of the burette by running the solution forcefully from the burette nozzle.

(iv) Remove the funnel before noting initial reading of the burette. Also while noting the reading, see that no drop of the liquid is hanging at the nozzle of the burette.

(v) Note the initial reading by keeping the eye exactly at the same level as the meniscus of the solution.

(vi) Pipette out 10 mL of oxalic acid solution in a washed and dried conical flask. Always wash the pipette with water and rinse (Fig. 2.21) with the liquid to be measured before pipetting out the liquid.

(vii) Add 1-2 drops of phenolphthalein indicator to the conical flask. Place the flask over the glazed tile as shown in Fig. 6.3 Titrate the acid with sodium hydroxide solution till a very faint permanent pink colour is obtained. Add sodium hydroxide solution in small amounts initially and then dropwise.

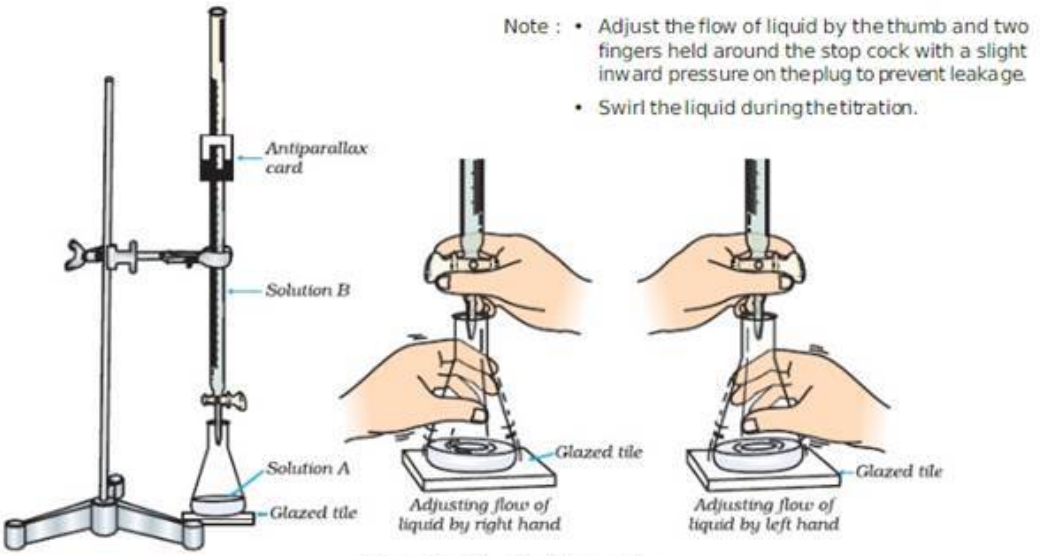


Fig. 6.3 : Titrating the solution

(viii) Read the lower meniscus of the solution in the burette again and record it as final reading.

(ix) Repeat the procedure until three concordant readings are obtained. Record your readings as in Table 6.1.

Table 6.1 : Titration of sodium hydroxide vs oxalic acid solution

Sl. No.	Volume of oxalic acid solution taken in conical flask each time V_1 mL	Burette readings		Volume of sodium hydroxide solution used V_2 mL = (y–x) mL	Concordant reading in mL
		Initial reading (x)	Final reading (y)		

CALCULATION:

Molarity of NaOH solution can be calculated by using the equation:

Oxalic acid Sodium hydroxide

$$a_1 M_1 V_1 = a_2 M_2 V_2$$

where, M_1 and V_1 are the molarity and volume of the oxalic acid solution.

M_2 and V_2 are the molarity and volume of the sodium hydroxide solution.

a_1 and a_2 are respectively the basicity of oxalic acid and acidity of sodium hydroxide. In this case $a_1 = 2$ and $a_2 = 1$.

Also, Molar mass of oxalic acid, $(COOH)_2.2H_2O = 126\ g\ mol^{-1}$ and Molar mass of sodium hydroxide (NaOH) = $40\ g\ mol^{-1}$

Calculate the concentration of sodium hydroxide solution in g/L by using the equation given below.

Concentration (strength) in g/L = Molarity×Molar mass

RESULT:

Concentration of NaOH solution is ———————— g/L.

PRECAUTIONS:

(a) Always rinse the burette with the solution, which is to be taken in it.
(b) Remove the air gap if any, from the burette before titrating the solution. Make sure that the nozzle of burette is also filled.
(c) Never forget to remove the funnel from the burette before noting the readings of the burette and ensure that no drop is hanging from the nozzle of the burette.
(d) Always read the lower meniscus for all transparent solutions and upper meniscus for coloured solutions.
(e) To note the burette readings place the eye exactly at the level of the meniscus.
(f) Never hold the pipette at the bulb.
(g) Never use the pipette and burette with a broken nozzle.
(h) Never suck a strong acid or an alkali with the pipette.
(i) Always keep the lower end of the pipette dipped in the liquid while sucking the liquid.
(j) Do not blow out the last drop of the solution from the jet end of the pipette into the flask.
(k) The concentration (strength) of the solution must be calculated up to the fourth place of decimal.