VOLUMETRY

CHEMISTRY PRACTICAL – CLASS: 11; VOLUMETRIC ANALYSIS

Instructions:

1. After the completion of every titration work, the detailed calculation and result should be attested (before the next practical session) by the teacher-in-charge.
2. You should compulsorily use logarithm table for calculation work.
3. Show detailed calculation work at the side of the work sheet itself.
4. Do not "*round off*" the results obtained.
5. It is compulsory that completed Journal is submitted for correction in the following week's practical session.
6. In your JOURNAL: Draw all tables and show all calculations (not detailed) on the left hand side and write the rest on the right hand side. (Result should be written on both the sides)
7. INDEX (Journal) may be written in the following format:
8. Main Title: **VOLUMETRIC ANALYSIS**
9. sub-title: **Oxalic acid vs. NaOH; Estimation of NaOH**

PREPARATION OF STANDARD SOLUTION

Expt No:_______
Date: _________

Aim: To prepare a 0.1N solution of oxalic acid.
Requirements: 100ml volumetric flask, oxalic acid crystals (AR Quality), Weighing bottle, Funnel, Glass rod, wash bottle, balance etc
Theory: A solution whose concentration is known exactly is called a standard solution.
Normality may be defined as the number gram equivalents of solute per liter of the solution and is represented by "N"

$$\text{Normality} = \frac{\text{Mass of solute} \times 1000}{\text{Equivalent mass} \times \text{volume of solution (ml)}}$$

Equivalent mass of oxalic acid dihydrate ($H_2C_2O_4.2H_2O$)
RMM of oxalic acid dihydrate = 126 amu; and number of replaceable hydrogen in oxalic acid = 2
Therefore equivalent mass of oxalic acid dihydrate = 126/2 = 63 amu.
Note: Normality of 1L of solution, which contains 63g of oxalic acid dihydrate = 1N
Procedure: Weigh **0.6300 g** of Oxalic acid crystals (AR grade), accurately in a weighing bottle and transfer into a clean funnel placed over a **100 ml**. standard volumetric measuring flask. Wash down the crystals carefully into the flask by a jet of distilled water. Wash the funnel also down into the flask. Dissolve the crystals completely and then make up the solution to 100 ml. mark. Shake well to make a homogeneous solution.

Calculation:

Mass of oxalic acid crystals = Xg= ……………………..g

Volume of oxalic acid solution prepared = $V\ ml$ =100 ml.

Normality of the oxalic acid solution = N = $\frac{Xg \times 1000}{63 \times Vml} = \frac{\text{……………} \times 1000}{63 \times 100} =$ …………..

Result: **The normality of the oxalic acid solution = ……………….N**

VOLUMETRIC ANALYSIS – I

ESTIMATION OF SODIUM HYDROXIDE

Experiment Number:________
Date:___________

Aim: To estimate the strength of a give solution of sodium hydroxide solution by titrating it against a standard solution of oxalic acid.

Requirements: Burette, Pipette, Conical flask, weighing bottle, oxalic acid crystals (A R. Grade) Balance, Funnel, Glass rod, wash bottle etc.

Indicator used:Phenolphthalein

Theory: The estimation is based on the reaction between oxalic acid and sodium hydroxide as per the following chemical equation

$$H_2C_2O_4 + 2NaOH \rightarrow Na_2C_2O_4 + 2H_2O$$

Normality of the given solution is calculated using the **law of equivalence** formula.

$\boxed{N_aV_a = N_bV_b}$ **Where,**
N_a= Normality of the acid; N_b = Normality of the base
V_a= Volume of the acid used; V_b = Volume of the base used.

Procedure: Preparation of oxalic acid solution (standard 0.1N)

Weigh **0.6300 g** of Oxalic acid crystals (A R. grade), accurately in a weighing bottle and transfer into a clean funnel placed over a **100 ml**. standard volumetric measuring flask. Wash down the crystals carefully into the flask by a jet of distilled water. Wash the funnel also down into the flask. Dissolve the crystals completely and then make up the solution to 100 ml. mark. Shake well to make a homogeneous solution

Mass of oxalic acid crystals = Xg= …………..g

Volume of solution prepared = $V\ ml$ =100 ml.

Normality of the oxalic acid solution = N = $\frac{Xg \times 1000}{63 \times Vml} = \frac{\text{……………} \times 1000}{63 \times 100} =$ ……….… N

Estimation of Sodium Hydroxide:

1. Pipette out 20 ml (Wash the pipette thoroughly with distilled water followed by **rinsing with NaOH solution**) of the given NaOH into a clean conical flask. (Wash the conical flask thoroughly with distilled water only)
2. Add one drop of phenolphthalein indicator to the flask.
3. Titrate this pink coloured solution against standard oxalic acid solution taken in a clean burette. (Wash the burette thoroughly with distilled water followed by **rinsing with oxalic acid solution**)
4. End point is marked by the disappearance of the pink colour.
5. End point of the titration is recorded as titre value in a tabular form.
6. Repeat the titration till concordant values are obtained. [Record only two titre (concordant) readings in the table]
7. Using the titre value concentration of the given NaOH is calculated.

Sl No	Volume of NaOH (ml)	Burette reading		Titre value "Va" (Volume of Oxalic acid consumed) (X – Y) ml
		Initial reading Y ml	Final reading X ml	
1	**20 ml**			
2	**20 ml**			

Calculation:

Volume of NaOH used = V_b = 20 ml

Volume of Oxalic acid used = V_a = ……………. ml

Normality of oxalic acid = N_a = ……………..N

Normality of NaOH = N_b = $\dfrac{N_a V_a}{V_b} = \dfrac{\ldots\ldots\ldots \times \ldots\ldots\ldots}{20}$ = …………..N

Concentration of NaOH = Normality x Equivalent mass = N_b x 40 = ………. x 40 = ……….g/L

Result:

1. **Normality of NaOH** = …………….. N

2. **Concentration of NaOH** = …………..…g / L

VOLUMETRIC ANALYSIS – II

ESTIMATION OF POTASSIUM HYDROXIDE

Experiment Number: ______
Date: ________________
Aim: To estimate the strength of a give solution of potassium hydroxide solution by titrating it against a standard solution of oxalic acid.

Requirements: Burette, Pipette, Conical flask, weighing bottle, oxalic acid crystals (AR Grade) Balance, Funnel, Glass rod, wash bottle etc.

Indicator used:Phenolphthalein

Theory: The estimation is based on the reaction between oxalic acid and potassium hydroxide as per the following chemical equation

$$H_2C_2O_4 + 2KOH \rightarrow K_2C_2O_4 + 2H_2O$$

Normality of the given solution is calculated using the **law of equivalence** formula.

$$\boxed{\mathbf{N_aV_a = N_bV_b}}$$

Where,
N_a = Normality of the acid; N_b = Normality of the base
V_a = Volume of the acid used; V_b = Volume of the base used.

Procedure:

Preparation of oxalic acid solution (standard 0.1N)

Weigh **0.6300 g** of Oxalic acid crystals (AR. grade), accurately in a weighing bottle and transfer into a clean funnel placed over a **100 ml**. standard volumetric measuring flask. Wash down the crystals carefully into the flask by a jet of distilled water. Wash the funnel also down into the flask. Dissolve the crystals completely and then make up the solution to 100 ml. mark. Shake well to make a homogeneous solution

Mass of oxalic acid crystals = Xg= …………..g

Volume of solution prepared = $V\ ml$ =100 ml.

Normality of the oxalic acid solution $= \text{N} = \dfrac{Xg \times 1000}{63 \times Vml} = \dfrac{\ldots\ldots\ldots\ldots\ldots \times 1000}{63 \times 100} =$

Estimation of Potassium Hydroxide:

1. Pipette out 20 ml (Wash the pipette thoroughly with distilled water followed by **rinsing with KOH solution**) of the given KOH into a clean conical flask. (Wash the conical flask thoroughly with distilled water only)
2. Add one drop of phenolphthalein indicator to the flask.
3. Titrate this pink coloured solution against standard oxalic acid solution taken in a clean burette. (Wash the burette thoroughly with distilled water followed by **rinsing with oxalic acid solution**)
4. End point is marked by the disappearance of the pink colour.
5. End point of the titration is recorded as titre value in a tabular form.
6. Repeat the titration till concordant values are obtained. [Record only two titre (concordant) readings in the table]
7. Using the titre value concentration of the given NaOH is calculated.

Sl No	Volume of KOH (ml)	Burette reading		Titre value "Va" (Volume of Oxalic acid consumed) (X – Y) ml
		Initial reading Y ml	Final reading X ml	
1	20 ml			
2	20 ml			

Calculation:

Volume of KOH used = V_b = 20 ml

Volume of Oxalic acid used = V_a = ……………. ml

Normality of oxalic acid = N_a = ……………..N

Normality of KOH = N_b = $\frac{N_a V_a}{V_b} = \frac{\ldots\ldots\ldots \times \ldots\ldots\ldots}{20}$ = …………..N

Concentration of KOH = Normality x Equivalent mass = N_b x 56 = ……… x 56 = ………..g/L

Result:

1. **Normality of KOH** = **…………….. N**

2. **Concentration of KOH** = **……………..g/L**

VOLUMETRIC ANALYSIS – III

ESTIMATION OF HYDROCHLORIC ACID

Experiment Number: ………
Date: ………..

Aim: To estimate the strength of a give solution of hydrochloric acid solution by titrating it against a standard solution of sodium carbonate.

Requirements: Burette, Pipette, Conical flask, weighing bottle, sodium carbonate crystals (AR Grade) Balance, Funnel, Glass rod, wash bottle etc.

Theory: The estimation is based on the reaction between HCland Na_2CO_3as per the following chemical equation

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

Normality of the given solution is calculated using the law of equivalence formula.

$$\boxed{N_aV_a = N_bV_b}$$

Where,
N_a = Normality of the acid; N_b = Normality of the base

V_a = Volume of the acid used; V_b = Volume of the base used.

Indicator used: Methyl Orange

Procedure: Preparation of Na_2CO_3 solution (standard 0.1N)

Weigh **0.5300 g**of Na_2CO_3 crystals (AR grade), accurately in a weighing bottle and transfer into a clean funnel placed over a **100.0 ml**. standard volumetric measuring flask. Wash down the crystals carefully into the flask by a jet of distilled water. Wash the funnel also down into the flask. Dissolve the crystals completely and then make up the solution to 100 ml. mark. Shake well to make a homogeneous solution

Mass of Na_2CO_3 crystals = *Xg*= …………..g

Volume of solution prepared = *V ml* =100 ml.

Normality of the Na_2CO_3 solution $= N = \dfrac{Xg \times 1000}{53 \times Vml} = \dfrac{.................\times 1000}{53 \times 100} =$ …………N

Estimation of Hydrochloric acid:

1. Pipette out 20 ml (Wash the pipette thoroughly with distilled water followed by **rinsing with Na_2CO_3 solution)** of the given Na_2CO_3 into a clean conical flask (Wash thoroughly with distilled water only).
2. Add a drop of Methyl Orange indicator to the flask.
3. Titrate this yellow coloured solution against hydrochloric acid solution taken in a clean burette. (Wash the burette thoroughly with distilled water followed by **rinsing with HCl acid solution**)
4. At the end point the colour of the solution changes from yellow to pink.
5. End point of the titration is recorded as titre value in a tabular form.
6. Repeat the titration till concordant values are obtained. [Record only two titre (concordant) readings in the table]
7. Using the titre value concentration of the given HCl is calculated.

Sl No	Volume of Na_2CO_3 (ml)	Burette reading		Titre value "Va" (Volume of HCl acid consumed) (X – Y) ml
		Initial reading Y ml	Final reading X ml	
1	20 ml			
2	20 ml			

Calculation:

Volume of Na_2CO_3 used = V_b = 20 ml

Volume of HCl acid used = V_a = ……………. ml

Normality of Na_2CO_3 = N_b = ……………..N

Normality of HCl = N_a = $\dfrac{N_b V_b}{V_a} = \dfrac{\text{……….} \times 20}{\text{………………}}$ = …………..N

Concentration of HCl = Normality x Equivalent mass = N_a x 36.5 = ……… x 36.5 = …....g/L

Result:

1. **Normality of HCl = …………….. N**

2. **Concentration of HCl = …………..…g / L**