

SUBJECT: PHARMACEUTICAL ANALYSIS - I

PRACTICAL MANUAL BOOK

**LAB MANUAL
PHARMACEUTICAL ANALYSIS - I
(B. Pharm 1ST SEM)**

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CONTENTS

Exp. No.	Name of Experiment	Page no.
1.	To study the steps involved in volumetric analysis.	1
2.	Limit Test for Chlorides	2-4
3.	Limit Test for Sulphates	5-6
4.	Limit Test for Iron	7-8
5.	Limit Test for Arsenic	9-11
6.	To prepare and standardize 0.1 N sodium hydroxide solution (100 ml).	12-14
7.	To prepare & standardize 0.1 M sodium thiosulphate solution (100 ml).	15-17
8.	To prepare & standardize 0.01 N potassium permanganate solution (100 ml).	18-19
9.	To perform the assay of ammonium chloride by acid base titration	20-22
10.	To perform the assay of the dilute hydrogen peroxide solution by permanganometry.	23
11.	To perform the assay of Sodium Benzoate by non-aqueous titration	24-25
12.	To conductometric titration of strong acid against strong base	26-27
13.	To Potentiometric titration of strong acid against strong base.	28-29

EXPERIMENT NO. 1

1. OBJECTIVE

To study the steps involved in volumetric analysis.

2. REFERENCES

1. Kamboj P.C., Pharmaceutical Analysis, Volume - I, Third edition, 2014, Vallabh Publications, Pages: 53–133.
2. Mendham J. et.al. Vogel's Textbook of Quantitative Chemical Analysis, Sixth edition, 2006, Dorling Kindersley (India) Pvt. Ltd, Pages: 33 - 36.

3. MATERIALS REQUIRED

Spatula, Funnel, Burette, Conical flask, Burette stand, Dropper, Volumetric pipette, Volumetric flask, Glass rod, Beaker, weighing balance.

4. THEORY

Terms involved in volumetric analysis:

1. **Titrant:** Solution whose concentration is known.
2. **Titrand:** Solution whose concentration is unknown.
3. **Stoichiometric / End point:** It shows that reaction between titrant and titrand is complete.
4. **Standard solution:** Solution whose exact concentration is known.
5. **Titration:** Reaction between titrand and titrant.

Steps involved in volumetric analysis:

1. **Method selection:** For analysis of base (NaOH) → acid is used (HCl): Acid – Base titration.
2. **Sampling:** Small amount of chemical is taken as sample.
3. **Solution preparation:** Using appropriate formula, weight of chemical is calculated, weighed and dissolved in suitable solvent.
4. **Removing interferences:** Calibration, blank titration, parallel determination is done.
5. **Observation:** Volume of Titrant used for end point is observed.
6. **Calculation:** Using equivalent factor, concentration of sample solution is calculated.
7. **Result analysis:** Sample pass or fail as per pharmacopoeial standards

5. RESULTS

Steps involved in volumetric analysis were studied.

EXPERIMENT NO. 2

LIMIT TEST FOR CHLORIDES

AIM: To perform the limit test for chlorides in the given sample.

APPARATUS REQUIRED: Nessler's cylinders, glass rod, beaker and pipette.

CHEMICALS REQUIRED: Standard Sodium Chloride solution, dilute Nitric acid, 0.1 M Silver nitrate solution and Hydrochloric acid.

PRINCIPLE: This test is designed for the control of chloride impurity in inorganic substances. It depends upon the precipitation of chlorides upon reaction with silver nitrate in the presence of nitric acid. The extent of precipitation depends upon the amount of silver chloride formed i.e. on the amount of chloride ions present in the substance. The opalescence produced was compared with a reference standard opalescence having a known amount of chloride impurity.



PROCEDURE:

Take two Nessler's Cylinders, wash the Dil. HNO_3 and then label as **STANDARD** and **TEST**

Preparation of Standard chloride solution: Accurately weigh 0.05845g of NaCl and dissolve in 100 ml of distilled water. (0.05845% w/v of NaCl).

Preparation of standard Solution:

Take 1 mL of NaCl solution and transfer into Nessler's cylinder and add 10 ml dilute Nitric Acid and make up the volume up to 50 mL with distilled water then add 1 mL of silver nitrate solution. Stir well with a glass rod and keep it aside for 5 min.

Preparation of Test Solution:

Weigh a specified quantity of test sample and transfer into Nessler's cylinder and add 10 ml dilute Nitric Acid and make up the volume up to 50 mL with distilled water then add 1 mL of silver nitrate solution. Stir well with a glass rod and keep it aside for 5 min.

SUMMARY:

STANDARD SOLUTION	Observation	Inference
In a Nessler's cylinder Chloride std. solution (25ppm Cl) 10ml taken. Add 5ml water + 10 ml of dil.HNO ₃ . Dilute to 50 ml in Nessler's cylinder + 1 ml of 0.1 M AgNO ₃ solution. Stir & allow to stand for 5 min. Observe the opalescence	The opalescence produced in sample solution is greater than / less than that of standard solution.	The sample passes/ doesn't pass the limit test for chlorides.
TEST SOLUTION Specified substance (1gm) + 10 ml of water + 10 ml of dil.HNO ₃ . Dilute to 50 ml in Nessler's cylinder + 1 ml of 0.1 M AgNO ₃ solution. Stir & allow to stand for 5 min. Observe the opalescence		

The opalescence produced in the test solution is compared with that produced in standard solution.

OBSERVATION:

REPORT: The sample _____ limit test for chlorides.

VIVA QUESTIONS:

1. What is impurity.
2. Define limit test.
3. What type of apparatus is used for performing limit test?
4. Write the principle involved in the limit test for chlorides.
5. How is standard solution prepared?
6. What type of reagent used in limit test for chlorides?
7. On what criteria the standard and test solutions are compared?
8. What is the purpose of dilute nitric acid?
9. What forms the precipitate in limit test for chlorides?
10. Define opalescence.
11. What is turbidity?

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EXPERIMENT NO. 3

LIMIT TEST FOR SULPHATES

AIM: To perform limit test for sulphates in the given sample.

APPARATUS REQUIRED: Nessler's cylinder, beaker, pipette, measuring cylinder, glass rods.

CHEMICALS REQUIRED: BaCl₂ solution, BaSO₄ reagent, dil. HCl, standard solution of potassium sulphate, distilled water, test sample,

PRINCIPLE: This test is designed for the control of sulphate impurity in inorganic substances. It depends upon the precipitation of the sulphate with barium chloride in the presence of HCl and traces of barium sulphate. The turbidity obtained is compared with standard solution, which contains the known amount of sulphate ions under the same experimental conditions.



PROCEDURE:

Preparation of BaSO₄ reagent: This reagent must be freely prepared by mixing 10 ml of 25 % solution of BaCl₂ and 15 ml of ethanolic sulphate standard solution, which contains 0.10891% K₂SO₄ in 3% ethanol. K₂SO₄ has been added to increase the sensitivity of the test. Very small amount of barium sulphate present in the reagent acts as seeding agent for precipitation of barium sulphate. Alcohol helps in preventing super saturation of barium sulphate.

Preparation of test solution: Dissolve a specified quantity of substance in water or prepare solution as directed by I.P and transfer to Nessler's cylinder. To this add 2 ml of dilute HCl and make the volume to 45 ml with water. And add 5 ml of BaSO₄ reagent. Stir and keep it aside for 5 min.

Preparation of standard solution: Take 1ml of 0.1089% w/v of K₂SO₄ in Nessler's cylinder and add 2 ml of HCl and transfer to Nessler's cylinder and make the volume to 45 ml with H₂O. To this add 5 ml of BaSO₄ reagent. Stir and keep aside for 5 min. Finally compare the turbidity of two solutions.

SUMMARY:

STANDARD SOLUTION	Observation	Inference
Take 1ml of 0.1089 % w/v solution of potassium sulphate in Nessler's cylinder + 2ml of dilute hydrochloric acid + Dilute to 45 ml in Nessler's cylinder + 5ml of barium sulphate reagent. Keep aside for 5 min.	The opalescence produced in sample solution is greater than / less than that of standard solution.	The sample passes/ doesn't pass the limit test for sulphates.
TEST SOLUTION Take specific weight(1gm) of sample + Add 2ml of dilute hydrochloric acid +Dilute to 45 ml in Nessler's cylinder + 5ml of barium sulphate reagent. Keep aside for 5 min.		

The opalescence produced in the test solution is compared with that produced in standard solution.

OBSERVATION:

REPORT: The given sample _____ the limit test for sulphates.

VIVA QUESTIONS:

1. Write the principle involved in limit test for sulphates.
2. What forms precipitate in limit test for sulphates?
3. How barium sulphate reagent is prepared?
4. The standard solution is prepared with_____.
5. What is the importance of dilute hydrochloric acid in limit test for sulphates?
6. What is seeding agent?
7. What is the importance of ethanol in limit test for sulphates?
8. Write reaction involved in limit test for sulphate.

EXPERIMENT NO. 4

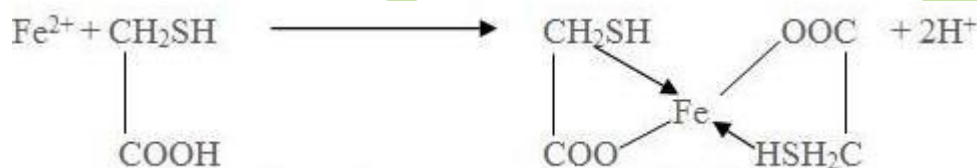
LIMIT TEST FOR IRON

AIM: To perform limit test for iron in the given sample.

APPARATUS REQUIRED: Nessler's cylinder, digital balance, beaker, pipette, measuring cylinder, glass rods.

CHEMICALS REQUIRED: Thioglycollic acid, standard ferric ammonium sulphate, distilled water, citric acid.

PRINCIPLE: The limit test is based on reaction between iron and thioglycollic acid in an alkaline media in the presence of 20% w/v of citric acid to produce ferrous thioglycollate which is deep red purple in colour.



Thioglycollic Acid

Ferrous thioglycollate

20% w/v of citric acid is added which will prevent reaction between iron and NH_3 by forming a complex with it. Ammonia is added to provide alkalinity to the solution.

PROCEDURE:

Preparation of standard iron solution: Dissolve 0.173 gm of ferric ammonium sulphate in 10ml of 0.1 H_2SO_4 . Add sufficient water to produce 1000 ml of solution. Each ml of solution contains 0.02mg of Fe.

Preparation of test solution: Weigh specific quantity of substance as specified in monograph and dissolve it in distilled water. Add 2 ml of 20 % w/v of citric acid and 0.1ml of thioglycollic acid and make the solution alkaline with NH_3 solution. And dilute it to 50ml with water and stir it well and allow it to stand for 5 min.

Preparation of standard solution: Take 2 ml of standard iron solution in Nessler's cylinder and make up the volume to 40ml with distilled water and add 2 ml of 20% w/v solution of citric acid and 0.1ml of thioglycollic acid. Make the solution alkaline with ammonia and finally dilute to 50 ml with distilled water. Stir well and allow it to stand for 5 min. Compare the colour produced by the test solution by viewing test solution with standard solution by viewing transversely.

Summary:

Standard:	Observation	Inference
Take 2 ml of standard solution of iron diluted with water upto 40ml + 2 ml of 20 % w/v of citric acid (iron free) + 2 drops of thioglycollic acid + ammonia + 50 ml water. Keep aside for 5 min Sample:	The purple color produced in sample solution is greater than / less than standard solution.	The sample passes/ doesn't pass the limit test for iron.
Sample(1gm) Sample is dissolved in specific amount of water and then volume is made up to 40 ml+ 2 ml of 20 % w/v of citric acid (iron free) + 2 drops of thioglycollic acid+ ammonia 50 ml of water. Keep aside for 5 min.		

OBSERVATION:

REPORT: The given sample _____ the limit test for iron.

VIVA QUESTIONS:

1. Write the principle involved in limit test for Iron.
2. Write reaction involved in limit test for Iron.
3. The standard solution is prepared with_____.
4. What is the importance of ammonia in limit test for Iron?
5. What is the agent used to produce colour in limit test for Iron?
6. On what criteria the standard and test solutions are compared?
7. What is the purpose of 20%w/v of citric acid?
8. What is the importance of thioglycollic acid in limit test for Iron?
9. What type of colour produced in limit test for Iron?

EXPERIMENT NO. 5

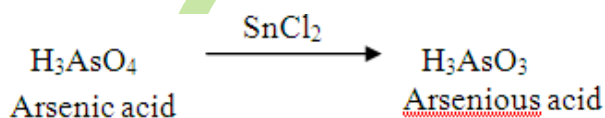
LIMIT TEST FOR ARSENIC

AIM: To carry out limit test for Arsenic in the given sample.

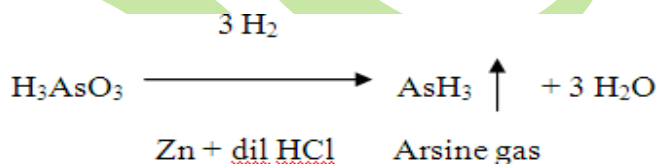
APPARATUS REQUIRED: Gutzeit apparatus, measuring cylinder, beaker and pipette.

CHEMICALS REQUIRED: Lead acetate cotton wool, mercuric chloride paper, zinc metal, stannous chloride, arsenic trioxide, potassium iodide, ammonium chloride etc.

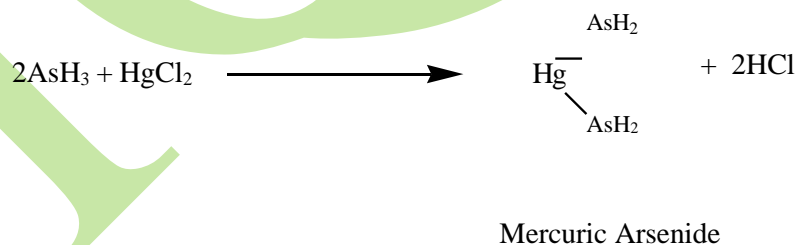
PRINCIPLE: The test is based on the fact that arsenic gets converted into arsenic acid in presence of an acid, which gets reduced by reducing agents (potassium iodide, stannous acid, zinc etc.,) to arsenious acid.



The nascent hydrogen produced by zinc and dil HCl reduced this arsenious acid to arsine gas.

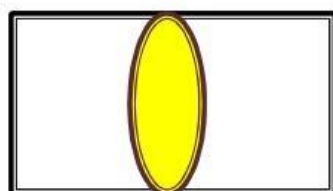


This gas is passed over mercuric chloride paper, it produces a stain, which ranges from yellow to brown. The intensity and length are proportional to amount of arsenic.

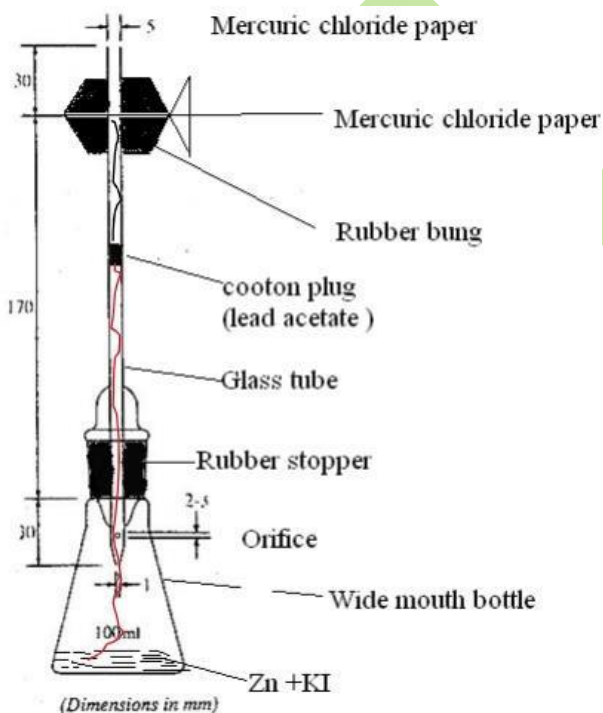


The stain of the test sample is compared in day light with standard stains produced by known quantity of arsenic in the sample.

APPARATUS: A wide mouthed glass bottle capable of holding 120 ml is fitted to a rubber bung through which passes a glass tube, the tube made from ordinary glass has total length of 200 mm, internal diameter of 6.5 mm and external diameter of about 8 mm. It is drawn out at one end and to a diameter of 1 mm and a hole not less than 2 mm in diameter is blown in the side of the tube near constricted part. When rubber bung is inserted in the bottle containing 70 ml of liquid, the constricted end of the tube is above the surface of the liquid and hole in the side is below the bottom of the bung, upper end of the tube is a cut off square and is either slightly rounded or ground smooth.



Gas stains the mercuric chloride paper yellow.



PROCEDURE:

For standard solution: Add 1 gm of potassium iodide AsT and 10 gm of zinc dust AsT in a wide mouthed glass bottle. Then 10 ml of stannated HCl and 1 ml of dilute arsenic solution are added to the above solution. Then add 50 ml of water, glass tube is placed quickly in position. The glass tube is tightly placed with lead acetate cotton wool. The reaction is allowed to take place for 45 to 90 minutes. To accurate the reaction the apparatus is kept on hot surface for atleast 10 minutes.

For test solution: Add 1 gm of potassium iodide AsT and 10 gm of zinc dust AsT in a wide mouthed glass bottle. Then 10 ml of stannated HCl and 1 ml of test solution (2.5 gm of ammonium chloride in 50 ml of water) are added to the above solution. Glass tube is placed quickly in position. The glass tube is tightly placed with lead acetate cotton wool. The reaction is allowed to take place for 45 to 90 minutes. To accurate the reaction the apparatus is kept on hot surface for atleast 10 minutes.

Standard stain is compared with test stain. Limit not more than 4 ppm.

Preparation of reagents

Stannous chloride solution: Dissolve 330 g of stannous chloride in 100 ml of hydrochloric acid and add sufficient water to make 1000 ml.

Stannous chloride solution AsT: It is prepared by adding stannous chloride solution to an equal volume of hydrochloric acid AsT, reducing to the original volume by boiling and filtering through a fine-grain filter paper.

Stannated hydrochloric acid AsT: It is prepared by adding 1 ml of stannous chloride solution AsT to 100 ml of hydrochloric acid AsT.

Potassium iodide: Dissolve 16.6gm of KI in sufficient water to produce 100ml.

Standard arsenic solution (10 ppm As): Dissolve 0.330 g of arsenic trioxide in 5 ml of 2M sodium hydroxide and dilute to 250.0 ml with water. Dilute 1 volume of this solution to 100 volumes with water.

OBSERVATION:

REPORT: The given sample _____ the limit test for arsenic.

VIVA QUESTIONS:

1. In which form the arsenic impurities are present?
2. What are the chemicals required for performing Limit test for Arsenic?
3. Write the principle involved in limit test for Arsenic.
4. Write the reactions involved in limit test for Arsenic.
5. What are different reducing agents used in limit test for Arsenic?
6. In what medium the limit test for Arsenic is performed?
7. How the nascent hydrogen is obtained in limit test for Arsenic?
8. What type of paper is used in limit test for Arsenic?
9. What is the apparatus used in limit test for Arsenic?
10. What colour of stain produced on mercuric chloride paper?
11. What forms stain on mercuric chloride paper?
12. How arsine gas is produced?

EXPERIMENT NO. 6

PREPARE AND STANDARDIZE 100 ML OF 0.1 N SODIUM HYDROXIDE

OBJECTIVE

To prepare and standardize 100 ml of 0.1 N NaOH solution using Oxalic Acid as primary standard.

MATERIALS REQUIRED

Apparatus Required:

Funnel, volumetric flasks, conical flask, volumetric pipette, beaker, burette, burette stand, weighing balance.

Chemicals Required:

NaOH, oxalic acid, phenolphthalein solution.

THEORY

Primary standard is a chemical which has following properties: stable, high purity, non-hygroscopic, high molecular weight and give stoichiometric reaction. Eg. oxalic acid, KCl. Secondary standard is a chemical which has following properties: unstable, low purity, hygroscopic, low molecular weight, poor solubility. Eg. HCl, NaOH.

	Property	Primary Standard	Secondary Standard
1.	Purity	High	Low
2.	Stability	Stable	Unstable
3.	Oxidization by air	No	Yes
4.	Hygroscopic	No	Yes
5.	Molecular weight	High	Low
6.	Solubility	Good	Poor

1. PROCEDURE

1. Preparation of NaOH solution

..... g of NaOH was weighed, dissolved in distilled water & volume made upto 100 ml.

2. Preparation of 0.1 N Oxalic acid solution.

.....g of Oxalic Acid was weighed, dissolved in distilled water & volume made upto 100 ml.

6. OBSERVATIONS

Table 1: Titration of 0.1 N Oxalic Acid Solution Vs NaOH solution

S. No	Volume of 0.1 N Oxalic Acid solution (ml)	Burette Reading for NaOH Solution (ml)		
		Initial Reading	Final Reading	Used volume of NaOH
1.	10			(a)
2.	10			(b)
3.	10			(c)
Average volume of NaOH solution used in titration = $\frac{a+b+c}{3}$ = A				

Table 2: Blank Titration for 0.1 N Oxalic Acid solution Vs NaOH solution

S. No	Volume of Distilled water (ml)	Burette Reading for NaOH Solution (ml)		
		Initial Reading	Final Reading	Used volume of NaOH
1.	10			(x)
2.	10			(y)
3.	10			(z)
Average volume of NaOH solution used in blank titration = $\frac{x+y+z}{3}$ = B				

7. CALCULATIONS

Step 1: Calculations for weighing

$$\text{weight of the solute (w)} = \frac{N \cdot EW \cdot V}{1000}$$

1: 0.1 N NaOH solution

N = Normality of NaOH solution = 0.1

EW = Equivalent weight of NaOH = Molecular weight / 1 =

V = Volume of NaOH solution = 100 ml

Thus w of NaOH taken = * * / 1000 = g

2: 0.1 N Oxalic Acid solution

N = Normality of Oxalic Acid solution = 0.1

EW = Equivalent weight of Oxalic Acid = Molecular weight / 2 =

V = Volume of Oxalic Acid solution = 100 ml

Thus w of Oxalic Acid taken = * * / 1000 = g

Step 2: Calculation for Standardization of NaOH solution

$$N_{\text{NaOH}} V_{\text{NaOH}} = N_{\text{Oxalic Acid}} V_{\text{Oxalic Acid}}$$

Here

V_{NaOH} = volume used in titration (A) - volume used in blank titration (B) =

$N_{\text{Oxalic Acid}} = 0.1$

$V_{\text{Oxalic Acid}} = 10$

Thus
$$N_{\text{NaOH}} = \frac{N_{\text{Oxalic Acid}} V_{\text{Oxalic Acid}}}{V_{\text{NaOH}}} = \frac{0.1 \times 10}{\dots\dots\dots} = \dots\dots\dots \text{ N}$$

8. RESULTS

NaOH solution was prepared & was found to beN.

EXPERIMENT NO. 7

PREPARE AND STANDARDIZE 100 ML OF 0.05 N SODIUM THIOSULPHATE

1. OBJECTIVE

To prepare and standardize 100 ml of 0.05 N sodium thiosulphate solution using Potassium Iodate as primary standard.

2. REFERENCES

1.. Mendham J. et.al. Vogel's Textbook of Quantitative Chemical Analysis, Sixth edition, 2006, Dorling Kindersley (India) Pvt. Ltd, Pages: 456-466.

2.. Beckett A.H., Stenlake J.B., Practical Pharmaceutical Chemistry, Fourth edition - Part One, CBS Publishers. Page: 187.

3. MATERIALS REQUIRED

Apparatus Required:

Funnel, volumetric flasks, iodine flask, volumetric pipette, graduated pipette, burette, burette stand, rubber bulb, weighing balance.

Chemicals Required:

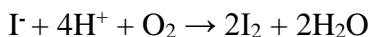
$\text{Na}_2\text{S}_2\text{O}_3$, KIO_3 , KI , H_2SO_4 .

4. THEORY

“**Iodometry** is a redox titration in which iodine is formed by reaction of sample with excess of iodide”. It is used in for quantitative reduction of oxidising agents. It involves:



In presence of light I^- is oxidised by oxygen to I_2 . Thus, iodometry is done in diffused light / dark.



Titrand / titrant: Iodide (I^-). **Molecular iodine** is formed. Molecular iodine is highly volatile and sparingly soluble in water and it is retained in the titrand mixture due to formation of potassium tri-iodide with KI. **Indicator:** Iodine itself act as indicator (self-indicator). Iodine is pale yellow in colour and iodide is colourless. Starch act as external indicator and iodine forms blue coloured complex with starch. **Iodine flask:** Iodometry is carried in iodine flask to prevent the Oxidation of KI by atmospheric oxidation & Loss of iodine formed due to the chemical reaction. **Oxidizing agent:** Example: KIO_3 , **Reducing agent:** I^- . **Titration:** I^- reacts with KIO_3 to form I_2 .

5. PROCEDURE

1. Preparation of $\text{Na}_2\text{S}_2\text{O}_3$ solution

.....g of $\text{Na}_2\text{S}_2\text{O}_3$ was weighed, dissolved in distilled water & volume made upto 100 ml.

2. Standardization of Na₂S₂O₃ solution

a. Preparation of 0.05 N KIO₃ solution.

...g of KIO₃ was accurately weighed, dissolved in distilled water & volume made upto 100 ml.

b. Titration of 0.05 N KIO₃ solution Vs Na₂S₂O₃ solution

10 ml of KIO₃ solution, 5.2 g of KI & 4 ml of 1 M H₂SO₄ were taken in an Iodine flask. Flask was closed, shaken & placed in dark for 10 minutes. To that solution Na₂S₂O₃ solution was added until the solution became colourless.

Blank titration cannot be performed as in absence of KIO₃, iodine will not evolve to give colour to the titrand solution.

6. OBSERVATIONS

Table 1: Titration of Na₂S₂O₃ solution Vs 0.05 N KIO₃ solution

S. No.	Volume of 0.05 N KIO ₃ solution (ml)	Burette Reading for Na ₂ S ₂ O ₃ solution (ml)		
		Initial Reading	Final Reading	Used volume of Na ₂ S ₂ O ₃
1.	10			(a)
2.	10			(b)
3.	10			(c)
Average volume of Na ₂ S ₂ O ₃ solution = $\frac{a+b+c}{3}$ =				

7. CALCULATIONS

Step 1: Calculations for weighing

$$\text{weight of solute (g)} = N \cdot \text{EW} \cdot V / 1000$$

1: 0.05 N Na₂S₂O₃ solution

$$N = \text{Normality of Na}_2\text{S}_2\text{O}_3 \text{ solution} = 0.05$$

$$\text{EW} = \text{Equivalent weight of Na}_2\text{S}_2\text{O}_3 = 158 / 1 = 158V$$

$$V = \text{Volume of Na}_2\text{S}_2\text{O}_3 \text{ solution in ml} = 100 \text{ ml Thus}$$

$$w \text{ of Na}_2\text{S}_2\text{O}_3 \text{ taken} = * * / 1000 = \dots\dots\dots \text{ g}$$

2: 0.05 N KIO₃ solution

$$N = \text{Normality of KIO}_3 \text{ solution} = 0.05$$

$$\text{EW} = \text{Equivalent weight of KIO}_3 = 214 / 6 = 35.667V = \text{Volume of KIO}_3 \text{ solution in ml} = 100 \text{ ml Thus } w \text{ of KIO}_3 \text{ taken} = * * / 1000 = \text{ g}$$

Step 2: Calculation for Standardization of Na₂S₂O₃ solution

$$N_{\text{Na}_2\text{S}_2\text{O}_3} V_{\text{Na}_2\text{S}_2\text{O}_3} = N_{\text{KIO}_3} V_{\text{KIO}_3}$$

Here $N_{\text{KIO}_3} = 0.05$

$$V_{\text{KIO}_3} = 10$$

$$V_{\text{Na}_2\text{S}_2\text{O}_3} =$$

$$\text{Thus } N_{\text{Na}_2\text{S}_2\text{O}_3} = \frac{N_{\text{KIO}_3} \times V_{\text{KIO}_3}}{V_{\text{Na}_2\text{S}_2\text{O}_3}}$$

$$=$$

8. RESULTS

Sodium thiosulphate solution was prepared & found to be ____N.

EXPERIMENT NO. 8

PREPARATION AND STANDARDIZATION OF 0.1 N POTASSIUM PERMANGANATE SOLUTION

Aim:

To prepare and standardized Potassium permanganate solution.

Apparatus Required:

Conical flask, burette, pipette, volumetric flask, test tube, beaker, funnel.

Chemicals Required:

Potassium permanganate solution, (0.1 N) sodium oxalate (0.1 N), conc. Sulphuric acid 5 ml.

Principle: Potassium permanganate is not the primary standard because it contains a small amount of manganese dioxide. Potassium permanganate would be standardized using a primary standard such as, arsenic trioxide, oxalic acid, sodium oxalate, anhydrous potassium ferrocyanide.

PROCESS OF PREPARATION OF 0.1 N KMnO₄

Solution of 0.1 KMnO₄ can be prepared by dissolving (22.5 × 0.1) g of KMnO₄ in 900 ml of water. Heat on water bath if needed and after thorough cooling, filter it through sintered glass filter and add sufficient amount of water to produce 1000 ml.

Molecular wt. of KMnO₄ = 158

Valency = 7

Equivalent wt = $\frac{158}{7}$ 22.5

Procedure: Dissolve about 0.316 gm of KMnO₄ in 100 ml volumetric flask. Boil the solution about 15 minutes. Stopper the flask and allow standing for 2 days and filtered to asbestors. KMnO₄ may contain organic matter as impurity. It is kept for 2 days to complete its organic matter if present with asbestors to remove all reaction between organic matter and potassium permanganate. Weigh sodium oxalate 0.67 gms and dissolves in 100 ml water in volumetric flask. Sodium oxalate is the best primary standard to standardized KMnO₄ solution due to its high purity. Take the solution of sodium oxalate 25 ml and add 5 ml of concentrated H₂SO₄ and warm the solution at 50 to 60°C. Then titrate this solution (in water solution) till the point pink colour appears due to presence of slight KMnO₄ solution.

Titration profile:

1. Burette content: 0.1 N KMnO₄.
2. Conical flask mixture of sodium oxalate 25 ml + conc.H₂SO₄ (5 ml)
3. No indicator, KMnO₄ act as a self-indicator.
4. End point pink colour appears (or) pale yellow to pink colour appears.

Calculation :

S.No.	Burette Reading		Indicator	End point
	Initial	Final		
1	0 ml		KMnO ₄ act as self-indicator	Pale pink
2	0 ml			

$$N_1 V_1 = N_2 V_2$$

$$M_1 = \frac{N_2 V_2}{V_1}$$

Where, N_1 = Normality of KMnO₄ solution
 V_1 = Volume of KMnO₄ solution
 N_2 = Normality of sodium oxalate = 0.1 N
 V_2 = volume of sodium oxalate

$$N_1 = \frac{0.1 * 25}{V_1}$$

Report: Normality of KMnO₄ is

EXPERIMENT:. 9

ASSAY OF AMMONIUM CHLORIDE

1. OBJECTIVE

To perform the assay of ammonium chloride as per Indian Pharmacopoeia 2014.

2. REFERENCE

Indian Pharmacopoeia, Volume II, 2014, Pages: 1049-1050.

3. MATERIALS REQUIRED

Apparatus Required:

Funnel, volumetric flasks, conical flask, volumetric pipette, graduated pipette, burette, burette stand, rubber bulb, weighing balance.

Chemicals Required:

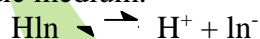
Sample (Ammonium chloride), formaldehyde solution, phenolphthalein solution, 0.1 M sodium hydroxide solution.

4. THEORY

“Acid base indicator is a chemical which determine the end point in neutralization titration by changing colour according to pH of titrand solution”.

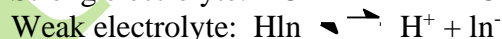
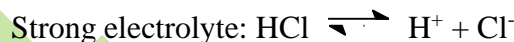
Ostwald theory: Acid base indicator is either a weak acid or a weak base having different colour in ionized and unionized forms.

Example: Phenolphthalein (HIn) is a weak acid. It shows pink coloured in basic medium and is colourless in acidic medium.



Phenolphthalein in basic solution: OH^- combine with H^+ of indicator to form H_2O . To maintain equilibrium, HIn is ionized (forward reaction increases) to increase the amount of In^- and indicator is colourless.

Phenolphthalein in acidic solution: HCl decreases the ionization of HIn due to common ion effect. This increases the rate of backward reaction (amount of unionized HIn increases) and indicator show pink colour.



5. PROCEDURE (I.P. 2014):

Dissolved 0.1 g ammonium chloride in 20 ml of water and added a mixture of 5 ml of formaldehyde solution, previously neutralized to dilute phenolphthalein solution, and 20 ml of water. After 2 minutes, titrated slowly with 0.1 M sodium hydroxide using a further 0.2 ml of phenolphthalein solution as indicator.

6. OBSERVATIONS

Table 1: Titration of ammonium chloride Vs NaOH solution

S. No	ammonium chloride (g)	Burette Reading for NaOH Solution (ml)		
		Initial Reading	Final Reading	Used volume of NaOH
1.	10			(a)
2.	10			(b)
3.	10			(c)
Average volume of NaOH solution = $\frac{a+b+c}{3}$ =				A

Table 2: Blank titration for ammonium chloride Vs NaOH solution

. No	Ammonium chloride (g)	Burette Reading for NaOH Solution (ml)		
		Initial Reading	Final Reading	Used volume of NaOH
1.	0			(x)
2.	0			(y)
3.	0			(z)
Average volume of NaOH solution = $\frac{x+y+z}{3}$ =				B

7. CALCULATIONS

Estimation of ammonium chloride

Equivalent factor: 1 ml of 0.1 M NaOH is equivalent to 0.005349 g of NH₄Cl.

Here

V_{NaOH} = volume used in titration (A) - volume used in blank titration (B) =

M_{NaOH} =

Each ml of 0.1 M NaOH is equivalent to

0.005349 g of NH₄Cl.

Thus, each ml of M_{NaOH} NaOH is equivalent to

$M_{\text{NaOH}} \times 0.005349$ g of NH₄Cl.

Thus, V_{NaOH} ml of M_{NaOH} NaOH is equivalent to

$V_{\text{NaOH}} \times M_{\text{NaOH}} \times 0.005349$ g of NH₄Cl.

= g of NH₄Cl.

= Experimental value

Claimed amount of NH_4Cl = quantity of NH_4Cl taken in the experiment = 0.1 g

Percentage Purity of ammonium chloride = $\frac{\text{Experimental amount of } \text{NH}_4\text{Cl}}{\text{Claimed Amount of } \text{NH}_4\text{Cl}} \times 100$

= _____ X 100 = %

8. RESULTS

The percentage purity of the given ammonium chloride was found to be%.

100%

EXPERIMENT NO. 10

STANDARDIZATION OF 0.1 N HYDROGEN PEROXIDE

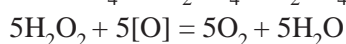
Aim : To prepare and standardize 0.1 N Hydrogen Peroxide solution direct titration method.

Apparatus Required : Volumetric flask, Beaker, Pipette, Stopper, Burette, Burette stand etc.

Chemicals Required : Hydrogen peroxide solution, 5 n sulphuric acid, 0.1 N Potassium permanganate.

Principle : H_2O_2 is a pharmaceutical substance that may be estimated by employing 0.1 N potassium permanganate solution and adopting the direct titrating method.

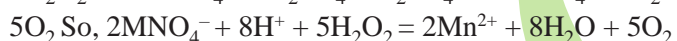
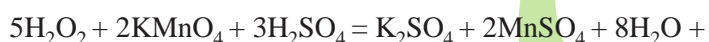
Reaction :



Procedure : Dilute 10 ml hydrogen peroxide solution to 250 ml with distilled water in a volumetric flask. To 25 ml of this solution, add 5 ml of 5 N H_2SO_4 with 0.1 N KMnO_4 to a permanent pink red end point.

Each ml of 0.1 N KMnO_4 is equivalent to 0.001701 gm of H_2O_2 .

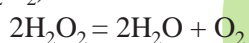
Calculation :



$$34.02 \text{ g H}_2\text{O}_2 = 2000 \text{ ml 1 N}$$

$$17.01 \text{ g H}_2\text{O}_2 = 1000 \text{ ml 1 N } 0.001701$$

$$\text{g H}_2\text{O}_2 = 1 \text{ ml 0.1 N KMnO}_4 \text{ (for \% w/v of H}_2\text{O}_2)$$



$$68.04 \text{ g H}_2\text{O}_2 = 22400 \text{ ml O}_2$$

$$\text{gm H}_2\text{O}_2 = 329.2 \text{ ml O}_2$$

The I.P. limit of H_2O_2 solution is 5-7% w/v

For example, suppose. A sample containing 6.25% w/v H_2O_2

$$100 \text{ ml sample} = 6.25 \text{ g H}_2\text{O}_2$$

$$1 \text{ ml sample} = 0.0625 \text{ g H}_2\text{O}_2$$

$$= 0.0625 \times 329.2 \text{ ml O}_2$$

$$= 20.58 \text{ ml O}_2$$

Hence the volume strength of the sample is 20.58

Reports : The strength of the H_2O_2 is found to be

EXPERIMENT:. 11

ASSAY OF SODIUM BENZOATE

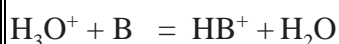
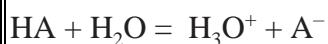
Aim : To perform the assay of Sodium benzoate.

Apparatus Required : Burette, conical flask, Measuring cylinder, pipette, beaker, funnel, Burette stand.

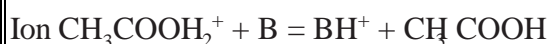
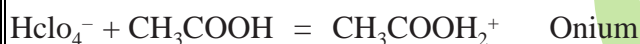
Chemicals Required : Sodium benzoate, glacial acetic acid, potassium hydrogen phthalate, per chloric acid, crystal violet indicator.

Principle : The principle and technique of this method is simple. It is based upon the Brwonsted-lowry and Lewis theory of acids and bases and the nature and influence of leveling effect of non-aqueous solvents on substances.

The chemical reaction of acid HA with base B in aqueous solution is represented as



A very weak base B may be weak proton acceptor as compared to water in aqueous medium. However, in non- aqueous solvents like glacial acetic acid, it can accept proton readily when acetous perchloric acid is used as titrant.



Similarly, substances which are weakly acidic in nature like phenol, barbiturates etc. can be satisfactorily titrated in di methyl formamide solvent and using alkali methoxide as solvent.

Procedure:

PREPARATION OF PERCHLORIC ACID (0.1 N): Mix 8.5 ml of Perchloric acid (70-72%) with 500 ml of glacial acetic acid. Add 25 ml of acetic anhydride, cool and add more glacial acetic acid to make 1000 ml. Alternatively mix 11 ml of Perchloric acid (60%) with 500 ml glacial acetic acid add 30 ml of acetic anhydride, cool and make 1000 ml with glacial acetic acid. Allow the prepared solution to stand for one day for the excess of acetic anhydride to be combined and carry out determination of water. If the water content exceeds 0.05% add more acetic anhydride. Allow the solution to stand for one day.

STANDARDISATION OF PERCHLORIC ACID: Weight accurately about 0.2 gm of potassium hydrogen phthalate previously powdered and dried at 120°C for two hours and dissolve it in 14.3 ml of glacial acetic acid. Add 2 drops of crystal violet solution and titrate with Perchloric acid solution until violet color changes to emerald green. Detect the volume of Perchloric acid consumed by 14.3 ml of glacial acetic acid. Each ml of 0.1 N HClO₄ = 0.02042 gm of potassium hydrogen phthalate.

ASSAY OF SODIUM BENZOATE: Weigh accurately about 0.25 g dissolve in 20 ml of anhydrous glacial acetic acid, warming to 50°C if necessary. Cool and titrate with 0.1 N NaOH using 1-naphthol benzoin (or) crystal violet solution as indicator.

Each ml of 0.1 N HClO₄ = 0.01441 gm of Sodium Benzoate.

Observations and Calculations:**STANDARDIZATION OF PERCHLORIC ACID**

	Contents in conical flask (ml)	Burette readings		Vol. of NaOH run down
		Initial (ml)	Final (ml)	
1.	0.2 gm of potassium hydrogen phthalate + 14.3 ml glacial acetic acid + indicator.			
2.	0.2 gm of potassium hydrogen phthalate + 14.3 ml glacial acetic acid + indicator			

Normality =

$$\frac{\text{Wt. of sample}}{\text{titer value}} \times \frac{1}{\text{Equivalent wt}}$$

ASSAY OF SODIUM BENZOATE

S.No.	Contents in conical flask (ml)	Burette readings		Vol. of NaOH run down	Indicator
		Initial (ml)	Final (ml)		
1.	0.25 gm of sodium benzoate + 20 ml glacial acetic acid + indicator.				
2.	0.25 gm of sodium benzoate + 20 ml glacial acetic acid + indicator				

$$\% \text{ of purity} = \frac{\text{Vol. of HClO}_4 \times \text{actual normality} \times 100 \times \text{equalent weight}}{\text{Wt. of sample} \times \text{expected normality}}$$

EXPERIMENT:.12

CONDUCTOMETRIC TITRATION OF STRONG ACID AGAINST STRONG BASE

Aim : To determine the concentration of strong acid using strong base.

Apparatus Required : Conductometer, beakers, pipette etc.

Principle : Conductometric titrations mainly depend on principle of ohm's law. The electric current "i" passing through a given solution of migrating ion is directly proportional to potential difference.

$$V = ir$$

V = Potential

difference i = electric

current

r = Resistance in Ohm

For chemical purposes, increase of resistance i.e. conductance is measured by a change in the conductivity of solution usually occurs during the titration depending on the relative mobility of ions added or removed from the solution. This is used to determine the equivalence point involved in neutralization. In the titration of strong acid versus strong base there is always an initial decrease in conductance followed beyond the equivalence point by a raise. In the titration of NaOH and HCl, the initial fall in conductance is due to the replacement of the hydrogen ions with sodium ions finally rise is due to excess hydroxyl ions being present. The stronger the solution used the sharper and more definite is the appearance of equivalence point which is obtained by the interaction of two straight lines.

Process :

- Calibrate the instrument using 0.1 M KCl Soution.
- Prepare 0.1 N HCl solution as described. It was dilute to 10 times to obtain 0.1 N HCl solutions.
- Known volume 50 ml of 0.01 N HCl solution was taken in a 100 ml beaker.
- A glass rod was dipped and stirred and conductivity of solution was measured.
- Then NaOH was added drop by drop and conductance of solution was measured.
- A graph was plotted by taking volume of NaOH ml on X-axis and conductance on Y-axis.
- Molarity of HCl was determined from the graph.

Observations and Calculations :

CALIBRATION:

S.No	gms of Kcl/kg of solution	Normality	Conductance observed at 25°C in \square s/cm
1.	0.07453 gm	0.001	147
2.	0.7453	0.01	1409
3.	7.4191	0.1	12,856
4.	71.1352	1	1,11,342

Calculations :

STANDARDIZATION OF 0.1 N NaOH :

S.No.	Contents in the conical flask	Burette readings		Volume of NaOH run down
		Initial	Final	
1.	0.2 gms of potassium hydrogen phthalate + 5 ml water + phenolphthalein			
2.	0.2 gms of potassium hydrogen phthalate + 5 ml water + phenolphthalein			

Each ml of 1 M NaOH = 0.2042 gms of potassium hydrogen phthalate

Report :

Molarity of HCl theoretically =

Molarity of HCl graphically =

References : "Pharmaceutical Analysis" Vol-I by kasturi wadodkar Pg.No.19.1-19.6 published by NIRALI PRAKASHAN.

EXPERIMENT:.13

POTENTIOMETRIC TITRATION OF STRONG ACID Vs STRONG BASE

Aim : To determine the endpoint and molarity of hydrochloric acid using potentiometric titrations.

Apparatus Required : pH meter, Burette, pipette, beaker etc.

Principle : Potentiometric titrations involve the measurement of potential of suitable indicator electrode as a function of volume. These titrations provide a reliable data than that of titrations that use chemical indicator. This measurement is based on titrant volume that causes a rapid change in potential near the equivalence point. This titration does not depend on measuring absolute values and give reliable data.

A combination of electrode consists of an indicator glass and silver electrode. Silver electrode is a reference electrode; it acts as a internal reference in center and external reference out side arranged concentrically. An Acid- Base potentiometric titration involves neutralization reaction in which acid is reacted with an equal amount of base. In case of strong acid verses strong base both the titrant and analyte are completely ionized. The determination of end point involves plotting titration curves as follows.

- 1) Measurement of pH against the volume of titrant, the end point is taken as the intersection point which is the steepest part of the curve.
- 2) Plot of volume of titrant (Δ pH / Δ V) gives the curve with the maximum corresponds to point of intersection which is taken as end point.

Procedure :

- 1) The pH meter was calibrated using standard buffers of pH -4 & pH 9.2.
- 2) 0.1 M NaOH and 0.1 M HCl solutions were prepared and standardized.
- 3) 20 ml of HCl was taken in a beaker and initial pH was noted.
- 4) The pH was noted after each addition of NaOH until there was a drastic change in pH.
- 5) Following graphs were plotted.
 - a) A graph was plotted by taking volume of NaOH (ml) on X-axis and pH on Y-axis. From the graph, volume of NaOH consumed is determined and molarity of HCl was calculated.
 - b) A graph was plotted by taking volume of NaOH (ml) on X-axis and (Δ pH / Δ V) on Y-axis. The molarity of HCl was calculated from the graph and also theoretically.

Observations and Calculations :

STANDARDIZATION OF 0.1 M NAOH :

S.No.	Contents in the conical flask	Burette readings		Volume of NaOH run down (ml)	Indicator
		Initial	Final		
1.	0.2 g of potassium hydrogen phthalate + 5 ml water + indicator.				phenolphthalein
2.	0.2 g of potassium hydrogen phthalate + 5 ml water + indicator.				phenolphthalein

$$\text{Molarity of NaOH} = \frac{\text{Wt. sample} \times 0.1}{\text{Equivalent factor} \times \text{titer value}}$$

STANDARDIZATION OF 0.1 M HCL:

S.No.	Contents in the conical flask	Burette readings		Volume of NaOH run down	Indicator
		Initial	Final		
1.	5 ml HCl + 1 drop indicator.				phenolphthalein
2.	5 ml HCl + 1 drop indicator.				phenolphthalein

$$M_1V_1 = M_2V_2$$

(HCl) (NaOH)

$$M_1 = \frac{M_2V_2}{V_1}$$

Report :

The molarity of sodium hydroxide was found to be
Molarity of Hydrochloric acid theoretically was found to be
Molarity of Hydrochloric from graph was found to be

References : "Introduction of Instrumental Analysis" by Robert Braun Pg.No.734-744.

DEFINATION

- **Sample:** Small amount of pharmaceutical substance representing the property of complete pharmaceutical substance.
- **Analyte:** The component of interest in the sample.
- **Impurity:** A component present in the pharmaceutical product that is not the chemical entity defined as the drug substance or an excipient in the drug product.
- **Pharmaceutical analysis:** The identification and chemical composition determination of the analyte present in the sample of the pharmaceutical substances.
- **Quantitative analysis:** It determine the amount of analyte and impurity present in the sample.
- **Molarity (M):** It indicates the number of moles of solute present per litre of solution". Its unit is moles/litre.
- **1 mole:** Total of the atomic weights of the elements present in the solute. Example: 1 mole NaOH = 23 + 16 + 1 = 40g.
- **Molar solution (1M):** It contains 1 mole of solute present in 1 litre of solution. Example: 1 M NaOH solution contains 40 g NaOH in 1 litre of solution.
- **Normality (N):** It indicates the number of gram equivalents of solute present per litre of solution". Its unit is gm equivalents/litre.
- **Volumetric titration:** Reagent solution is added to sample solution (or vice versa) until reaction is complete. Volume of reagent used to achieve end point of the chemical reaction is measured and used for calculating the amount of analyte present in the sample.
- **Titration:** Reaction between titrand and titrant.
- **Standard solution:** It is a solution whose exact concentration is known. It is known as titrant during titration.
- **Titrand:** It is a solution used in titration whose exact concentration is unknown.
- **Standardisation:** It is the process of determining the exact concentration of a solution.
- **Stoichiometric point / End point / equivalence point:** It is the titration point at which chemical reaction between titrant and titrand is complete and titrant and titrand are in equilibrium. Eg: At end point in acid – base titration, moles of H^+ are equal to moles of OH^-
- **Indicator:** is a chemical which indicates the end point of the titration.
- **Acid base (Neutralization) titration:** Sample / reagent are complimenting acid and base and undergo neutralization reaction with each other.

- **Oxidation-reduction (Redox) titration:** Sample / reagent are complimenting oxidizing agent and reducing agent and undergo redox reaction with each other.
- **Complexometric Titration:** Sample and reagent react to form a complex.

$$\text{CaCO}_3 + \text{EDTA} \rightarrow \text{Ca-Edetate}$$
- **Electrochemical methods of analysis:** They determine the end point in a titration by measuring the change in electrical property of the sample during the chemical reaction.
- **Conductometry:** It measure the change in conductance due to substitution of one ion by other ion.
- **Potentiometry:** It measure change in electrode potential of sample during redox reaction.
- **Redox reaction:** It is a reaction in which oxidation and reduction takes place together”.



- **Oxidizing agent (oxidant):** It help in oxidation of other chemical and itself gets reduced. Eg. Ceric sulphate, I_2 , KIO_3 .
- **Reducing agent (reductant):** It help in the reduction of other chemical and itself gets oxidized. Eg: KI , $\text{Na}_2\text{S}_2\text{O}_3$.
- **Neutralization curve:** It is a curve between pH of titrand (x axis) and volume of titrant used in acid base titration (y axis).