

PART-B**What is Volumetric analysis?**

It is the technique of determining the volume of a solution of known concentration, which is required to react with the solution of the substance being determined.

.2. What is a standard solution?

A solution of accurately known concentration, which contains known weight of the solute in a definite volume of the solution, is called standard solution.

3. What is a titration?

The process of adding a standard solution to a solute in the solution until the reaction is just complete.

4. What is titrant and titrate?

The solution of known concentration (std. Solution) is called the titrant and the solution being analyzed is called titrate.

5. Differentiate between equivalence point and end point in titration?

The point at which the reaction between titrant and titrate is just complete is called equivalence point or the theoretical end point.

The point at which a clear change is observed after the reaction between titrant and titrate is practically complete is called the end point.

There exist a very small difference between the end point and equivalence point.

6. How is end point is detected?

The end point is detected by either color change or appearance of turbidity in the liquid being titrated.

7. What is an indicator?

A substance which indicates the end point of the titration by color change or appearance of turbidity. EX: Phenolphthalein, Methyl orange, Ferroin etc.,

8. What are different types of indicators used in volumetric analysis?

1. Acid base indicators, eg. Phenolphthalein.
2. Metal ion indicators, eg. Eriochrome black-T, Patton and Reader's
3. Redox indicator, eg, Ferroin
4. Internal indicator eg, phenolphthalein, Eriochrome black-T, Patton and Reader's
5. External indicator, eg, potassium ferricyanide.
6. Self indicator, eg, Potassium permanganate.

9 .What is a molar solution?

A solution, which contains one gram molecular weight of the solute per litre of the solution, is referred to as molar solution.

10. What is a normal solution?

A solution, which contains one gram equivalent weight of the solute per litre of the solution, is referred to as normal solution.

11. What is normality of a solution?

The normality of a solution is the number of gram equivalent weights of the solute per dm³ of the solution
weight of the solute

$$\text{Normality of a solution (N)} = \frac{\text{Equivalent weight of the solute}}{\text{Weight of the solute}} \text{ per dm}^3$$

12 What do you mean by standardization of a solution?

Determination of the accurate strength of a solution using another standard solution by means of a titration is called standardization.

13.What is molarity or molecularity of a solution?

The molarity or molecularity of a solution is the number of moles of the solute per dm³ of the solution.
weight of the solute

$$\text{Molarity of a solution (M)} = \frac{\text{Molecular weight of the solute}}{\text{Weight of the solute}} \text{ per dm}^3$$

14. What is an equivalent weight?

It is the parts by mass of a substance, which replaces or combines with 8 parts by mass of oxygen or 1 part by mass of hydrogen or 35.46 parts by mass of chlorine.

DETERMINATION OF TOTAL HARDNESS OF WATER

What is hard water?

Hard water is the one which requires considerable amount of soap to produce lather and also produce scales on hot water pipes, heaters, boilers etc.,

How is hardness of water caused?

Hardness of water is caused by the presence of dissolved salts of Calcium and Magnesium.

What are then types of hardness? Why are they due to?

There are two types of hardness. They are ,

- i. Temporary hardness ii. Permanent hardness

Temporary hardness is because of Unstable bicarbonates of Calcium and Magnesium.

Permanent hardness is because of more stable chlorides and sulphates of Calcium and Magnesium.

How is temporary hardness removed?

The temporary hardness of water can be removed by boiling water during which bicarbonates decompose to give carbonates.

How is permanent hardness removed?

Permanent hardness can be removed by passing the water through ion exchanger.

What do you mean by total hardness of water?

The sum of both temporary and permanent hardness is called the total hardness of water. (i.e., hardness due to both bicarbonates, chlorides, sulphates of calcium and magnesium)

How is the total hardness of water expressed?

Total hardness of water is expressed as parts per million (ppm) of CaCO_3

What is EDTA?

EDTA is Ethylene diamine tetra acetic acid.

Write the structural formula of EDTA and disodium salt of EDTA?

Refer manual for the structures.

Why is disodium salt of EDTA is preferred to EDTA?

EDTA is sparingly soluble in water whereas disodium salt of EDTA is completely soluble in water by ionizing.

Why is ammonia solution added while preparing EDTA solution?

Ammonia is added during the preparation of EDTA solution to increase the rate of dissolution of the salt.

What is a buffer solution?

A solution which resists a change in its pH value even after adding small amounts of acid or base to it, is called a buffer solution.

Why is ammonia – ammonium chloride buffer added?

Ammonia – ammonium chloride buffer is added to maintain a pH at 10, the desired pH for the titration. Otherwise, pH decreases as H^+ ions are released due to the substitution of metal ions for H^+ in EDTA.

What is the color change a) when indicator is added b) At the end point.

Give reasons.

a) Wine red color --- When a small amount of Eriochrome Black – T , which is blue in color, is added to a hard water with a pH at 10, it combines with a few of the calcium and magnesium ions to form a weak M – In complex which is wine red in color.

b) Clear blue -- During the titration with EDTA, all the free Ca and Mg ions forms a stable complex with EDTA. As a result, Indicator is released from the M-In complex.

What is the application of hardness data in environmental engineering?

Hardness of water is an important consideration in determining the suitability of water for domestic and industrial uses.

Determination of hardness serves as a basis for routine control of softening processes

DETERMINATION OF % OF CaO IN THE GIVEN SAMPLE OF CEMENT SOLUTION

1. What is cement?

Cement is a lime based binding material used for the construction of buildings.

2. What are the constituents of cement?

Oxides of calcium, magnesium, iron, aluminum and silicon are the constituents of cement.

3. Mention the general composition of Cement. Which is the major constituent?

Refer manual

4. How is cement solution prepared?

Refer manual.

5. What is the role of glycerol?

Glycerol is added to get the sharp end point.

6. What is the role of diethyl amine?

Diethyl amine is added to maintain a pH of about 12.5

7. What is the function of Sodium hydroxide?

Sodium hydroxide precipitates magnesium ions as magnesium hydroxide.

8. Why Eriochrome black -T cannot be used in this experiment?

Eriochrome black T indicator forms a very weak complexes with calcium ions.

DETERMINATION OF % COPPER IN BRASS

1. What is an alloy?

An alloy is a homogeneous solid solution of two or more metals

Ex: brass

2. What is brass?

Brass is an alloy of copper.

3. What are the constituents of brass?

Refer manual.

4. How do you prepare brass solution?

Refer manual.

5. What is the purpose of adding urea?

Urea is added to destroy excess of nitric acid and oxides of nitrogen which interfere with the determination. If they are not destroyed, they also oxidize KI to iodine which should have been done by cupric ions.

6. Why ammonium hydroxide is added?

Ammonium hydroxide is added to neutralize the mineral acid.

7. What happens if mineral acid is not removed?

The mineral acid, nitric acid is a powerful oxidizing agent. It oxidizes KI to iodine. As result, the amount of iodine liberated does not correspond to the exact concentration of cupric ions in the alloy and hence gives an erroneous result.

8. What is the bluish white precipitate formed after adding ammonia solution?

A bluish white precipitate formed after adding ammonia solution is cupric hydroxide

9. Why acetic acid is added?

Acetic acid is added to neutralize the excess of ammonium hydroxide and to provide slightly acidic medium.

11. Why is KI is added to brass solution although copper in brass is determined?

Cupric ions do not react with sodium thiosulphate solution. However, cupric ions oxidize potassium iodide and iodine is liberated.

The amount of iodine liberated is equal to the amount of cupric ions present in the solution.

12. Although copper ions are blue in color in the beginning become colorless after the end point. Why?

At the beginning of the titration, cupric ions Cu^{2+} ions are present (blue) which are reduced to cuprous Cu^+ ions (colorless) at the end.

13. What is the white precipitate left at the end point?

The white precipitate left at the end is cuprous iodide. Cu_2I_2 .

14. Why do you get blue color when starch indicator is added?

Iodine liberated reacts with amylase of starch to give blue color.

15. Why starch is added towards the end point?

If starch is added in the beginning when the concentration of iodine is high, the starch forms a stable water insoluble complex with iodine. As a result, the volume of sodium thiosulphate consumed will be less than expected. This will cause an error in the determination.

DETERMINATION OF % IRON IN HAEMATITE

1. What is an ore?

Ore is a naturally occurring substance from which metal can be extracted conveniently and economically.

2. What is a mineral?

Mineral is a naturally occurring substance in which metal is present

3. What is the main constituent of hematite ore?

Hematite is an important ore of iron containing mainly ferric oxide

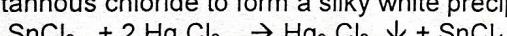
4. What is the role of stannous chloride?

Stannous chloride reduces ferric iron to ferrous iron and slight excess is added to ensure complete reduction.



5. Why mercuric chloride is added?

Mercuric chloride is added to remove excess of stannous chloride. Mercuric chloride reacts with stannous chloride to form a silky white precipitate of mercurous chloride



6. What happens if excess of stannous chloride is not removed?

If excess of stannous chloride is not removed, ferric ions formed during the course of the titration get reduced to ferrous ions. As a result, the volume of potassium dichromate consumed will be more. This causes an error in the determination of iron in hematite.

7. What is the indicator used?

Potassium ferricyanide is used as an external indicator.

8. Why potassium ferricyanide cannot be used as an internal indicator in the determination of iron in hematite?

Potassium ferricyanide cannot be used as an internal indicator because potassium ferricyanide combines irreversibly with ferrous iron to form a deep blue ferro - ferricyanide complex. These ferrous ions involved in complex formation are not available for reaction with potassium dichromate. Moreover, the end point cannot be detected, as there is no change in the color.

9. Why potassium ferricyanide cannot be used as an indicator in the estimation of iron in hematite?

Potassium ferricyanide cannot be used as an indicator because it does not react with the ferrous iron.

10. What is the chemical species reacting with potassium dichromate?

Ferrous ions are reacting with potassium dichromate.

11. Why the color of the indicator drop remains the same at the end point?

At the end point there are no more ferrous ions available to react with the indicator, as they are oxidized to ferric ions.

12. What are the reactions that occur during the titration?

Refer manual.

13. Can iron be determined using internal indicator?

Yes, iron can be determined using internal indicators like diphenylamine.

DETERMINATION OF CHEMICAL OXYGEN DEMAND OF THE GIVEN WASTE WATER**1. What is chemical oxygen demand (COD)?**

COD is the amount of oxygen required for the complete oxidation of organic matter present in the sample of water by a strong chemical oxidizing agent such as acidified potassium dichromate. It oxidizes both organic and inorganic impurities.

2. What general groups of organic compounds are not oxidized in the COD test?

Aromatic hydrocarbons and pyridine are not oxidized in COD test.

3. What is the role of silver sulphate?

Silver sulphate acts as a catalyst in the oxidation of straight chain aliphatic hydrocarbons and acetic acid. Oxidation is effective in presence of silver ions.

4. What is the role of mercuric sulphate?

Chloride ions present in high concentration in waste water undergo oxidation in COD test and cause erroneous result. Mercuric ions of mercuric sulphate bind the halide ions present in waste water to form poorly ionized mercuric chloride and prevent the precipitation of silver halide by making halide ions unavailable.

5. Why sulphuric acid is added in the preparation of standard FAS solution?

Sulphuric acid is added to prevent the hydrolysis of ferrous sulphate into ferrous hydroxide.

6. Explain the color changes encountered during the titration.

Ferroin indicator is red in color in the reduced form with the composition. When it is added to sewage containing excess of potassium dichromate, an oxidizing agent, gets converted into its oxidized form, which is pale blue (bluish green color observed). The green color observed during the course of titration is due to the reduction of potassium dichromate by FAS to green chromium sulphate. At the end point, red color reappears as the indicator is restored to its original form

7. What is the unit of COD?

COD is expressed as mg of oxygen/litre.

8. Mention a few applications of COD test in environmental engineering practice.

- The COD test is extensively used in the analysis of industrial wastes.
- It is particularly valuable in survey designed to determine and control losses to sewer systems.
- The COD is helpful in indicating toxic conditions and the presence of biologically resistant organic substances.

9. What are the limitations of COD?

One of the chief limitations of COD test is its inability to differentiate between biologically oxidisable and biologically inert organic matter. Also, it does not provide any evidence of the rate at which biologically active material would be stabilized under conditions that exist in nature.