

# ANSWERS FOR MODEL VIVA-VOCE QUESTIONS\*

**CLASS : I / II Sem. B.E.**

**ACADEMIC YEAR : 2022 - 23 onwards**

Name : \_\_\_\_\_

Section : I / II Sem. B.E. \_\_\_\_\_

Batch No. : \_\_\_\_\_

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**DEPARTMENT OF CHEMISTRY**  
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## GENERAL

### 1. What is volumetric or Titrimetric analysis?

The analysis consisting of determining the volume of a solution of accurately known concentration which is required to react quantitatively with the solution of the substances being determined is called as volumetric or titrimetric analysis.

### 2. What is a standard solution?

The solution of accurately known strength is called the standard solution.

### 3. What is meant by titration?

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

### 4. Distinguish between a titrant and a titrate.

The reagent of known concentration is called titrant and the substance being titrated is termed as titrate.

### 5. Differentiate between equivalence point and end point in titrations.

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

### 6. How endpoint is detected?

The endpoint is detected by either a colour change or the formation of turbidity in the liquid being titrated.

### 7. What is an indicator?

A substance that facilitates the colour change at the endpoint in titrations is called an indicator. eg. methyl orange, Phenolphthalein, starch.

### 8. What is molar solution?

A solution which contains one gram molecular weight of the solute per  $\text{dm}^3$  of the solution is called molar solution.

### 9. What is normal solution?

A solution which contains one gram equivalent weight of the solute per  $\text{dm}^3$  of the solution is called normal solution.

### 10. What is normality of a solution?

The normality of solution is the number of gram equivalents of the solute per  $\text{dm}^3$  of the solution

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

### 11. What is molarity of a solution?

The molarity of solution is the number moles of the solute per  $\text{dm}^3$  of the solution

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

12. What is meant by standardization of a solution?

The technique used to find the exact concentration of a solution is called as standardization of a solution.

13. What is meant by equivalent weight of an oxidizing agent?

Equivalent weight of oxidizing agent is defined as the number of parts by mass of oxidizing agent that gives eight parts by mass of oxygen for oxidation.

$$\text{Equivalent mass of oxidizing agent} = \frac{\text{Molecular weight}}{\text{No. of electrons gained}}$$

14. What is meant by equivalent weight of an reducing agent?

Equivalent weight of reducing agent is defined as the number of parts by mass of reducing agent that is oxidized by eight parts by mass of oxygen for oxidation.

$$\text{Equivalent mass of reducing agent} = \frac{\text{Molecular weight}}{\text{No. of electrons lost}}$$

15. What is meant by equivalent weight of an acid?

Equivalent weight of an acid is defined as the number of parts by mass of an acid that is neutralized completely by one equivalent weight of a base.

$$\text{Equivalent weight of an acid} = \frac{\text{Molecular weight}}{\text{Basicity (Number of replacable } H^+ \text{ ions)}}$$

16. What is meant by equivalent weight of a base?

Equivalent weight of an acid is defined as the number of parts by mass of a base that is neutralized completely by one equivalent weight of an acid.

$$\text{Equivalent weight of an base} = \frac{\text{Molecular weight}}{\text{Acidity (Number of replacable } OH^- \text{ ions)}}$$

17. 0.6g of  $K_2Cr_2O_7$  crystals are present in  $250\text{cm}^3$  of the solution. Calculate the normality of the solution.

$$\begin{aligned}\text{Normality of Solution} &= \frac{\text{Weight of } K_2Cr_2O_7 \times 1000\text{cm}^3}{\text{Equivalent weight of } K_2Cr_2O_7 \times \text{volume of solution in cm}^3} \\ &= \frac{0.6 \times 1000}{49 \times 250} = 0.0489\end{aligned}$$

18. What is the molarity of a solution containing 10g EDTA in  $300\text{cm}^3$  of it?

$$\begin{aligned}\text{Molarity of solution} &= \frac{\text{Weight of solute} \times 1000\text{cm}^3}{\text{Molecular weight} \times 300\text{cm}^3} \\ &= \frac{10 \times 1000}{372.4 \times 300} = 0.0895\end{aligned}$$

19. How is  $250\text{cm}^3$  of 0.25N HCl prepared? Given the normality of conc. HCl=11.8

$$N_1V_1 = N_2V_2$$

$$0.25 \times 250 = 11.8 \times V_2$$

$$V_2 = \frac{0.25 \times 250}{11.8}$$

$$= 5.3 \text{ cm}^3$$

### **A1: DETERMINATION OF PK<sub>a</sub> OF GIVEN SAMPLE OF SOFT DRINK USING PH SENSOR AND ITS GRAPHICAL INTERPRETATION USING ORIGIN SOFTWARE.**

1. What is a weak acid?.

Weak acid is a weak electrolyte, which ionises incompletely in aqueous solution.

2. What is pK<sub>a</sub> of a weak acid?

pK<sub>a</sub> is a modern method of expressing the strength of weak acids. It is mathematically expressed as  $\text{pK}_a = -\log_{10} K_a$ , where  $K_a$  is the dissociation constant of the weak acid.

3. What is meant by pH of a solution?

S.P.L. Sorensen defined pH of a solution as the negative logarithm to base 10 of hydrogen ion concentration.  $\text{pH} = -\log_{10} [\text{H}^+]$ .

4. Why is a glass electrode called an ion selective electrode?

The glass electrode is called an ion selective electrode because, it is able to respond to certain specific ions ( $\text{H}^+$  ions) only and develop a potential while ignoring the other ions in a solution.

5. How is the measurement of pH made?

The measurement of pH is made by determining the e.m.f. of the cell containing glass electrode and the calomel electrode immersed in the test solution. The e.m.f. of the cell is expressed by the equation,  $E = K + 0.0591 \text{ pH}$ , where  $K$  is a constant.

6. How are pH and pK<sub>a</sub> related?

According to Henderson-Hasselbalch equation,  $\text{pH} = \text{pK}_a + \log_{10} [\text{salt}] / [\text{acid}]$ . At half equivalence point,  $[\text{salt}] = [\text{acid}]$ . Therefore, pH at half equivalence gives the pK<sub>a</sub> of the weak acid.

7. How are pK<sub>a</sub> and strength of a weak acid related?

Higher the pK<sub>a</sub>, lower is the strength of the weak acid.

8. What are the electrodes used in the measurement of pH for the determination of pK<sub>a</sub>?

In the determination of pK<sub>a</sub> of a weak acid, glass electrode (indicator electrode) and calomel electrode (reference electrode) are used. In this case, glass electrode acts as an anode and calomel electrode acts as a cathode.

9. Why is pH increases suddenly at the equivalence point?

At the equivalence point, all the weak acid has been neutralised by the base. After wards the concentration of hydroxyl ions increases resulting in sudden increase of pH.

10. How is pK<sub>a</sub> of a weak acid evaluated from the graph?.

pH at half equivalence point gives the pK<sub>a</sub> of a weak acid.

## **A2: ESTIMATION OF IRON PRESENT IN STAINLESS STEEL SOLUTION USING ELECTROCHEMICAL SENSOR AND ITS GRAPHICAL INTERPRETATION USING ORIGIN SOFTWARE.**

1. What is single electrode potential?.

The potential that is developed when an element is in contact with a solution containing its own ions is called single electrode potential.

2. What is standard electrode potential?

The potential that is developed when an element is in contact with a solution containing its own ions of 1M concentration at 298 K is referred to as standard electrode potential. If the gases are involved, they must be passed at a partial pressure of 1 atmosphere.

3. Define the term EMF of a cell.

E.M.F. is the potential difference required to drive a current across the electrodes.  
 $E.M.F. = E_{\text{cathode}} - E_{\text{anode}}$ .

4. What is a potentiometer?

It is a device or circuit used for comparing potential sources.

5. What is a potentiometric titration?

The determination of the equivalence point of red-ox titrations on the basis of potential measurements is called a potentiometric titration.

6. Give the principle of potentiometric titration.

The principle involved in potentiometric titration is the measurement of the emf between two electrodes, an indicator electrode and a reference electrode. In these titrations, measurements of emf are made while the titration is in progress. The equivalence point of the reaction is revealed by a sudden change in potential in the plot of emf readings against the volume of titrant.

7. What are the electrodes used in potentiometric titration?.

The indicator electrode used is the platinum electrode (acts as an anode) and the reference electrode used is the calomel electrode (acts as a cathode).

8. What is the determining factor in the oxidation- reduction reaction?

The determining factor is the ratio of the concentrations of the oxidised and reduced forms  
i.e.  $\text{Fe}^{2+} \longleftrightarrow \text{Fe}^{3+} + e^-$

9. What is an indicator electrode?

The electrode whose potential is dependent upon the concentration of the ion to be determined is termed as the indicator electrode.

10. What is an Reference electrode?

Acidified potassium dichromate oxidises ferrous sulphate to ferric sulphate and itself gets reduced to chromic sulphate i.e. redox reaction.



11. What is the reaction that occurs between FAS and potassium dichromate?.

Reaction between FAS and  $\text{K}_2\text{Cr}_2\text{O}_7$  is a redox reaction where  $\text{Fe}^{2+}$  is oxidised to  $\text{Fe}^{3+}$  by oxidising agent  $\text{K}_2\text{Cr}_2\text{O}_7$  only in the presence of acidic medium.

12. Why is  $\text{H}_2\text{SO}_4$  added to FAS solution during EMF measurement?

When FAS, in beaker reacts with  $\text{K}_2\text{Cr}_2\text{O}_7$  it reduces  $\text{K}_2\text{Cr}_2\text{O}_7$  to  $\text{Cr}_2(\text{SO}_4)_3$  which is a green salt solution.

13. Why is the EMF rises steeply at the equivalence point?

This is because, the potential of the solution before the equivalence point is determined by  $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+}$  system only i.e., 0.75V, while at equivalence point, it is determined by both  $\text{Fe}^{3+}$  and  $\text{Cr}_2\text{O}_7^{2-}$  ions which is = 1.04V. But beyond equivalence point, the potential of the solution is determined by  $\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{3+}$  only i.e. = 1.33V. Therefore, just after the equivalence point, the potential of the solution rises steeply.

14. What are the advantages of potentiometric titrations?

- i) Turbid, fluorescent, opaque or coloured solutions can be titrated.
- ii) Mixture of solutions or very dilute solutions can be titrated.
- iii) The results are more accurate because the actual end point is determined graphically.

### **A3: OPTICAL SENSOR FOR COPPER DETERMINATION FROM E - WASTE SAMPLE (PRINTED CIRCUIT BOARD) AND ITS GRAPHICAL INTERPRETATION USING ORIGIN SOFTWARE.**

1. What is colorimetry?

Chemical analysis through measurements of absorption of light radiation in the visible region of the spectrum (400-760 nm) with respect to a known concentration of the substance is known as colorimetry.

2. What forms the basis for colorimetric determination?

The variation of colour of a system with change in concentration of some component forms the basis for the colorimetric determination.

3. What is the basic principle of colorimetric measurements?

The variation of the color of a system with change in concentration of some component constitutes the basis for colorimetric analysis. It is used for the solutions, which are themselves colored or which give color when mixed with a suitable reagent. The color is generally developed by the addition of an appropriate coloring agent. The intensity of the colour depends on the concentration of the constituent present. The determination of the concentration of a substance by measuring the relative absorption of light with respect to a known concentration of the substance forms the basis of colorimetry.

4. What is photoelectric colorimeter?

It is an electrical instrument, which measures the amount of light absorbed using a photocell.

5. What are filters? Why are they used?

The filters consist of either thin films of gelatin containing different dyes or of coloured glass. The filters are used in colorimeters for isolating (selecting) any desired spectral region.

6. Define the terms – wavelength, frequency, wavenumber.

**Wavelength:** The distance between any two successive peaks or troughs of waves is called wave length. It is represented by  $\lambda$ .

**Frequency:** It is the number of waves passing through a point per second. It is represented by  $\nu$ .

**Wavenumber:** It is the reciprocal of wavelength. It is represented by  $\frac{1}{\lambda} = \bar{\nu} = \frac{\nu}{C}$ ;  $\nu = \frac{c}{\lambda}$

$1/\text{wavelength} = \text{wavenumber} = \text{frequency/velocity of light}$

7. State Beer's law.

When a monochromatic light passes through a homogeneous absorbing medium, the rate of decrease in intensity with the concentration of the medium is proportional to the intensity of the light.

OR

The intensity of a monochromatic light decreases exponentially as the concentration of the absorbing substance increases arithmetically.

8. State Lambert's law.

When a monochromatic light passes through a transparent medium, the rate of decrease in intensity with the thickness of the medium is proportional to the intensity of the light.

OR

The intensity of the emitted light decreases exponentially as the thickness of the absorbing medium increases arithmetically.

9. State Beer-Lambert's law.

The amount of light absorbed is directly proportional to the concentration of the solution.

$$A = \log I_0 / I_t = \epsilon ct - \text{Fundamental equation of colorimetry}$$

$\epsilon$  = Molar extinction coefficient;  $c$  = concentration;  $t$  = path length  **$A \propto c$**

10. What is a calibration curve?

It is the plot of optical density (absorbance) against concentration of solutions. For solutions obeying Beer's law, this is a straight line.

11. Define the terms absorbance & transmittance.

It is the ratio of the intensity of transmitted light ( $I_t$ ) to that of the incident light ( $I_0$ ).

$$T = I_t / I_0$$

Reciprocal of transmittance,  $I_0 / I_t$  is called absorbance or optical density.

$$A = \log I_0 / I_t = \log 1 / T = - \log T$$

12. How is optical density related to the concentration of the substance?

The optical density is directly proportional to the concentration of the substance.

13. Can different Nessler's tubes be used during optical density measurements of solutions?

Different Nessler's tubes (if they vary in thickness) cannot be used during optical density measurements of solutions because, absorbance depends on the thickness/path length of the solution. If the thickness is same, different Nessler's tubes can be used.

14. Mention a few important criteria for a satisfactory colorimetric analysis.

- i) In order to obey Beer-Lambert's law, the solute must not undergo solvation, association, dissociation, hydrolysis or polymerization in the solvent used.
- ii) The colour produced should be sufficiently stable to permit an accurate reading to be taken.
- iii) Clear solutions free from traces of precipitate or foreign substances in either blank or standard test solution should be used.

15. Mention a few advantages of photoelectric colorimetric determinations.

- i) A colorimetric method often gives more accurate results at low concentrations than the corresponding titrimetric or gravimetric procedure.
- ii) A colorimetric method may frequently be applied where no satisfactory gravimetric or titrimetric procedure exists i.e. for certain biological substances.

16. What is a stock solution?

A stock solution is a standard solution in which a known amount of solute is dissolved in a known volume of solvent.

17. Why are the different volumes of stock solution taken?

Different volumes of solution are taken to prepare standard solutions of different concentration, which are used to plot a calibration curve.

18. What is a blank solution?

A blank solution is identical in all respects to the test solution except for the absence of test solute.

19. Why is a blank solution used in colorimetric estimation?

To nullify the absorbance caused due to the coloring impurities present in the reagents.

20. Why is ammonia added? Why is the same amount of ammonia added to different volumes of  $\text{CuSO}_4$  solution?

Ammonia is added to get cuprommonium sulphate,  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ , a dark blue complex.

Same amount of ammonia is added to nullify the absorbance due to any colouring impurities present in ammonia.

21. Why is estimation of copper carried at 620 nm wavelength?



The estimation of copper is carried at 620 nm wavelength because, the complex shows a maximum absorbance at 620 nm.

#### **A4: ESTIMATION OF HCL USING STANDARD NAOH CONDUCTOMETRICALLY AND ITS GRAPHICALINTERPRETATION USING ORIGIN SOFTWARE.**

1. State ohm's law.

Ohm's law states that the current, I (ampere), flowing in a conductor is directly proportional to the applied electromotive force, E (volt) and inversely proportional to the resistance, R (ohm) of the conductor.  $I=E/R$

2. What is conductance?

The reciprocal of resistance is called the conductance.

3. What is conductivity?

The reciprocal of resistivity is called conductance.

4. What is the unit of conductance?

The unit of conductance is  $\text{ohm}^{-1}$ .

5. Mention the different types of conductances.

- i) Specific conductance
- ii) Equivalent conductance
- iii) Molar conductance

6. Which of the above conductance measured during conductometric titration?

The specific conductance is measured.

7. What is specific conductance?

It is the conductance of a solution placed between two electrodes of  $1\text{ cm}^2$  area and kept 1cm apart.

8. What is equivalent conductance?

It is the conductance of the solution which contains 1 gram equivalent of solute, when placed between two electrodes of 1 cm apart.

$$\lambda = k V \quad \lambda = \frac{k \times 1000}{c}$$

V = volume containing 1 gram equivalent of solute

c = Normality of solution.

9. What is molar conductance?

It is the conductance of a solution, which contains 1 gram molecular weight of a substance, when placed between two electrodes of 1 cm apart.

10. What is a cell?

A device, which produces an electromotive force and delivers an electric current as the result of a chemical reaction is known as a cell.

11. What factors determine the conductance of a solution?

Two factors determining the conductance of a solution are

- (i) Mobility of ions - higher the mobility, higher is the conductance and
- (ii) Number of ions - more the number of ions in solution, more is the conductance.

12. What is the principle involved in conductometric titration?

The principle underlying conductometric titration is the replacement of ions of a particular mobility by the ions of another particular mobility during the titration.

13. What are the advantages of conductometric titrations over visual or potentiometric titrations?

- (i) The method is accurate in dilute as well as more concentrated solutions.
- (ii) It can also be employed with coloured solutions.
- (iii) Very weak acids such as  $\text{H}_3\text{BO}_3$ , phenol, which cannot be titrated potentiometrically in aqueous solutions can be titrated conductometrically.
- (iv) Mixture of acids can be titrated more accurately.

14. How is the equivalence point obtained in conductometric titration?

During the progress of the titration, changes in conductivity occur. The specific conductance

is measured after each addition of a small volume of the titrant. A graph of conductivity (on Y-axis) versus volume of titrant (on X-axis) is plotted. The point of intersection of the two straight lines give the equivalence point.

15. Why is the conductance decreases in the beginning?

As the titration begins, the conductance decreases, due to the replacement of highly mobile  $\text{H}^+$  ions by the less mobile  $\text{Na}^+$  ions.

16. Why is the conductance increases after the equivalence point?

After the equivalence point, with further additions of strong alkali, the conductance rises due to increase in the number and mobility of the  $\text{OH}^-$  ions.

## **B1: DETERMINATION OF TOTAL HARDNESS OF WATER FOR DRINKING PURPOSE**

1. What is hard water?

Hardness of water is caused by divalent metallic cations such as Calcium and Magnesium in association with anions such as  $\text{HCO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ .

In general hard water is generally considered to be that water which requires considerable amount of soap to produce foam and lather.

2. Mention the different types of hardness of water?

Temporary hardness and permanent hardness of water.

3. Mention the ions responsible for temporary hardness of water.

Temporary hardness of water is due to the presence of bicarbonates of Ca and Mg,

4. Mention the ions responsible for permanent hardness of water.

Permanent hardness of water is due to the presence of chlorides and sulphates of Ca and Mg.

5. How temporary hardness of water can be removed?

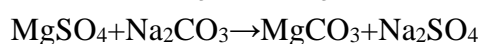
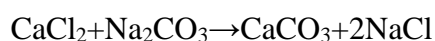
The temporary hardness of water can be removed by boiling water during which bicarbonates decompose to give carbonates.



6. What are the different techniques to remove permanent hardness of water.

Reverse osmosis, Ion exchange technique, Washing soda process, etc.

Ex. Hard water is treated with a calculated amount of washing soda when chlorides and sulphates of calcium and magnesium present in hard water get precipitated as insoluble calcium and magnesium carbonates which can be filtered off.

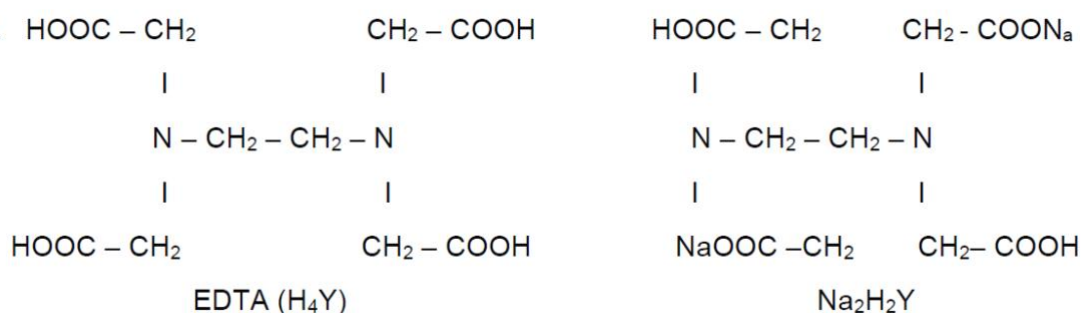


7. What is the unit to express the hardness of water.
8. Total hardness is expressed as parts per million (ppm) of  $\text{CaCO}_3$ .
9. What is EDTA (Full name)?

Ethylene diamine tetra acetic acid.

10. What is the structure of EDTA and disodium salt of EDTA

11. What is buffer solution.



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

Ex. Ammonia + Ammonium chloride is an example of basic buffer

Acetic acid and sodium acetate is an example of basic buffer

12. What is the purpose of adding buffer to hard water experiment?
13. Why disodium salt of EDTA is preferred than EDTA?

EDT A is sparingly soluble in water. Its disodium salt is more soluble as it is ionisable and hence it is preferred.

14. What are ligands? Give an example.

15. What is the indicator used in hard water experiment?

The chemical name of Eriochrome Black T is sodium 1-(1-hydroxy-2-naphthylazo)-6-nitro-2-naphthol-4-sulphonate (SHNNNS)

16. Why the end point is blue in color?

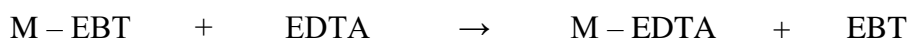
The original color of Eriochrome Black T is blue in colour.

When a small amount of Eriochrome Black T, is added to a hard water with a pH of about 10, it combines with a few of the calcium and magnesium ions to form a weak complex produces wine red colour.



M= Ca, Mg,      Blue colour      Wine red color complex

During the titration of the complex with EDTA,



Wine red color complex      Colourless      Clear blue

M= Ca, Mg,      blue colour      wine red color complex

This action makes the Eriochrome Black T indicator from the complex, (M-EBT), and the wine red colour changes to a blue colour at the end of the titration

17. Why ammonia is added to prepare standard EDTA solution?

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

18. What is the meaning of total hardness of water

The sum of both temporary and permanent hardness of water is called the total hardness of water.

19. What are Lignads?

Ligands are the species which can able to donate at least a pair of electron to other groups.

Ex. NH<sub>3</sub> donates one pair of electron (mono dentate ligand)

H<sub>2</sub>O donates two pair of electron (bi dentate ligand)

EDTA donates six pair of electron (hexa dentate ligand or poly dentate ligand)

## **B2: DETERMINATION OF CHEMICAL OXYGEN DEMAND (COD) OF THE GIVEN INDUSTRIAL WASTE WATER SAMPLE**

1. What is sewage?

Sewage is commonly a cloudy dilute aqueous solution containing human and house hold waste water, industrial wastes, ground wastes, street washings. Sewage contains organic and inorganic matters in dissolved, suspended and colloidal states.

2. What is meant by an industrial sewage?

The waste water coming out of industrial establishments such as chemical plants, fertilizer industries, leather tanneries, sugar and paper industries, breweries, textile mills, oil refineries, pharmaceutical units is called an industrial sewage.

3. What is chemical oxygen demand?

COD is the amount of oxygen required for the complete oxidation of organic matter present in the sample of water by a strong chemical oxidising agents such as acidified potassium dichromate.

4. What general groups of organic compounds are not oxidised in the COD test?

Aromatic hydrocarbons and pyridine are not oxidised in COD test.

5. What are the products formed after COD analysis?

During COD analysis, organic matter is completely oxidised to carbon dioxide and water by acidified potassium dichromate solution.

6. Why is sulphuric acid added during the preparation of standard FAS solution?

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

7. What is the composition of ferroin?

Ferroin is ferrous 1, 10-phenanthroline sulphate.

8. Explain the colour changes encountered during the titration.

Ferroin indicator is red in colour in the reduced form with the composition,  $[\text{Fe}(\text{o-Phen})_3]^{2+}$ . When it is added to sewage containing excess of  $\text{K}_2\text{Cr}_2\text{O}_7$  an oxidising agent, gets converted into its oxidised form,  $[\text{Fe}(\text{o-Phen})_3]^{3+}$ , which is pale blue (bluish green colour observed). The green colour observed during the course of titration is due to the reduction of  $\text{K}_2\text{Cr}_2\text{O}_7$  by FAS to green  $\text{Cr}_2(\text{SO}_4)_3$ . At the end point, red colour reappears as the indicator is restored to its original form, i.e. reduced form.

9. What is the unit of COD?

COD is expressed as mg of  $\text{O}_2/\text{dm}^3$

Mention a few applications of COD test in environmental engineering practice

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

10. What is the limitation 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 the biologically active material would be stabilised under conditions that exist in nature.

### **B3: DETERMINATION OF IRON IN THE GIVEN TMT BARS BY EXTERNAL INDICATOR METHOD.**

1. What is an alloy?

An alloy is a homogeneous mixture of two or more metallic elements which gives greater strength and resistant to corrosion.

2. What is a mineral?

A mineral is a naturally occurring metallic compound.

3. What is the main constituent of haematite ore and TMT iron bars?

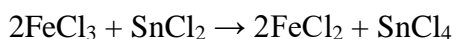
Haematite is an important ore of iron containing mainly ferric oxide.

4. Give the other forms of iron ore.

Magnetite ( $\text{Fe}_3\text{O}_4$ ), Siderite or Spathic iron ( $\text{FeCO}_3$ ), Iron pyrites ( $\text{FeS}_2$ ), etc., are the other forms of iron ore.

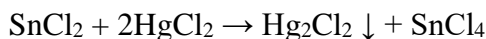
5. What is the role of stannous chloride?

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



6. Why is mercuric chloride added?

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



7. What happens when the excess of stannous chloride is not removed?

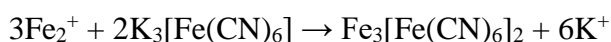
If the excess of stannous chloride is not removed, the ferric ions formed during the course of the titration get reduced to ferrous ions. As a result, the volume of titrant, potassium dichromate consumed will be more.

8. What is the indicator used?

Potassium ferricyanide,  $[\text{K}_3\text{Fe}(\text{CN})_6]$  is used as an external indicator.

9. Why is potassium ferricyanide cannot be used as an internal indicator in the determination of iron in haematite?

Potassium ferricyanide cannot be used as an internal indicator in the determination of iron in haematite because, potassium ferricyanide combines irreversibly with ferrous iron to form a deep blue ferrous ferricyanide complex (Turnbull's blue). 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 color change.



10. Why is potassium ferrocyanide cannot be used as an indicator in the estimation of iron?

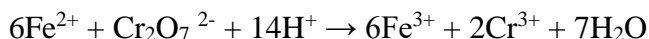
Potassium ferrocyanide cannot be used as an indicator in the estimation because, ferrocyanide does not react with ferrous iron.

11. Why is the colour 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 oxidised to ferric ions by the time the end point is reached.

12. What is the reaction that occurs during the titration?

Acidified potassium dichromate oxidises ferrous iron present in the haematite solution to ferric iron and itself gets reduced to chromic ion.



13. Can iron be determined using internal indicators?

Yes, iron can be determined using internal indicators.

14. Name the internal indicators used for iron determination.

(i) Diphenylamine (ii) N-phenylanthranilic acid

15. Mention the uses of TMT iron bars.

TMT bars are used in the construction of buildings.

#### **B4: DETERMINATION OF PERCENTAGE OF COPPER FROM ELECTROPLATING INDUSTRIAL EFFLUENT**

1. What are the constituents of electroplating industrial effluent?

Electroplated effluent contains copper (50-90%) and zinc (20-40%). It also contains small quantities of tin, lead and iron.

2. What is the purpose of adding urea to the electroplating industrial effluent?

Urea is added to destroy excess of nitrous acid and oxides of nitrogen which interfere with the determination. If they are not destroyed, they also oxidise KI to I<sub>2</sub> which should have been done by Cu<sup>2+</sup> ions.

3. Why is ammonium hydroxide added to the electroplating industrial effluent?

Ammonium hydroxide is added to neutralise the mineral acid.

4. What is the need to neutralise the mineral acid?

The mineral acid, HNO<sub>3</sub> is a powerful oxidising agent. It also oxidises KI to I<sub>2</sub>. Therefore, the amount of I<sub>2</sub> liberated does not correspond to the exact concentration of Cu<sup>2+</sup> ions and hence erroneous result.

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

A bluish white precipitate of cupric hydroxide is formed, when ammonia solution is added to the solution of brass.

6. Why is acetic acid added?

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

7. Why is acidic medium necessary?

The oxidation of KI to I<sub>2</sub> takes place in acidic medium.

8. Why is potassium iodide added to electroplating industrial effluent although copper in brass is determined?

Cupric ions do not react with sodium thiosulphate solution. However, cupric ions oxidise potassium iodide and iodine is liberated. The amount of iodine liberated is equal to the amount of cupric ions present in the solution.



9. Although copper ions are blue in colour in the beginning, become white after the end point. Why?

At the beginning of the titration, Cu<sup>2+</sup> ions are present (blue) which are reduced to cuprous Cu<sup>+</sup> ions (colorless) state.

10. Why do you get blue colour when starch indicator is added?

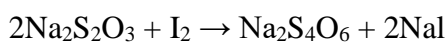
When I<sub>2</sub> solution reacts with amylose, a component of starch gives a blue color.

11. How is iodine liberated estimated?

The amount of iodine liberated is estimated by titrating it against standard sodium thiosulphate solution using starch as an indicator.

12. What is the reaction that occurs between iodine and sodium thiosulphate?

Iodine reacts with sodium thiosulphate to form sodium iodide and sodium tetrathionate which are colorless products.



13. Why is starch indicator added towards the end point?

When the concentration of iodine is more, the indicator, starch forms a stable water insoluble complex with iodine. As a result, the volume of sodium thiosulphate consumed will be less than expected.

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

The white precipitate produced at the end point is cuprous iodide, Cu<sub>2</sub>I<sub>2</sub>.