HIGHER SECONDARY SECOND YEAR PUBLIC EXAMINATION

MARCH - 2025

CHEMISTRY – ANSWER KEY

PART-I

	TYPE-A		TYPE-B	
1.	**c**	3.0 mol min^{-1}	**c**	α-helical backbone.
2.	**a**	3	**a**	N-Methyl aniline
3.	**c**	1,1,2,2-tetrafluoroethane	**a**	6.022×10^{22}
4.	**a**	N-Methyl aniline	**a**	8 and 4
5.	**c**	accepts OH- from water ,releasing proton.	**c**	3.0 mol min^{-1}
6.	**a**	III > II > I > IV	**b**	+2
7.	**c**	Both assertion and reason are false.	**a**	4 – nitrophenol
8.	**a**	8 and 4	**c**	Both assertion and reason are false.
9.	**c**	α-helical backbone.	**c**	accepts OH- from water ,releasing proton.
10.	**c**	2.71×10^{-14}	**c**	acetylchloride
11.	**b**	+2	**a**	Displacement with zinc
12.	**a**	6.022×10^{22}	**c**	2.71×10^{-14}
13.	**a**	4 – nitrophenol	**a**	3
14.	**c**	acetylchloride	**c**	1,1,2,2-tetrafluoroethane
15.	**a**	Displacement with zinc	**a**	III > II > I > IV

PART-II

Answer any six of the following questions. Question no.24 is compulsory.[6 x 2 = 12]

16. Which type of ores can be concentrated by froth floatation method? Give two examples for such ores.

- Sulphide ores can be concentrated by froth flotation method.
  - Galena (PbS),
  - Zinc blende (ZnS)

17. What happens when PCl_5 is heated?

❖ On heating phosphorous penta chloride, it decomposes into phosphorous trichloride and chlorine.

$$PCl_{5(g)} \xrightarrow{\Delta} PCl_{3(g)} + Cl_{2(g)}$$

18. Why do Zirconium and Hafnium exhibit similar properties?

- Zirconium and Hafnium exhibit similar properties due to **lanthanoid contraction.**

Series	Element	Atomic radius
4d series	Zr	145 pm
5d Series	Hf	144 pm

19. Define solubility product

The solubility product of a compound is defined as the product of the molar concentration of the constituent ions, each raised to the power of its stoichiometric co – efficient in a balanced equilibrium equation.

$$X_mY_n \rightleftharpoons mX^{n+} + nY^{m-}$$

- $K_{sp} = [X^{n+}]^m \times [Y^{m-}]^n$

20. Define equivalent conductance

❖ Equivalent conductance is defined as the conductance of 'V' m^3 of electrolytic solution containing one gram equivalent of electrolyte in a conductivity cell in which the electrodes are one metre apart.

❖ $\Lambda = \kappa \times V$

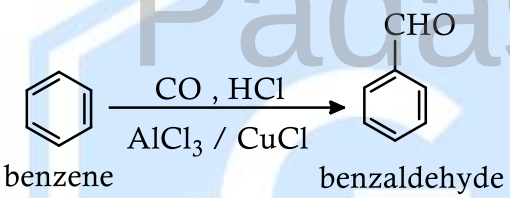
$$\Lambda = \frac{\kappa\,(Sm^{-1}) \times 10^{-3}(\text{gram equivalent})^{-1}m^3)}{N}$$

21. Peptising agent is added to convert precipitate into colloidal solution. Explain with an example.

- When peptising or dispersing agent like HCl is added to AgCl precipitate, Cl^- ion is adsorbed on the precipitate and it is converted into colloidal solution.

$$\underset{\text{Precipitate}}{AgCl} \xrightarrow{HCl} \underset{\text{colloid}}{AgCl}$$

22. Write Gattermann – Koch reaction.

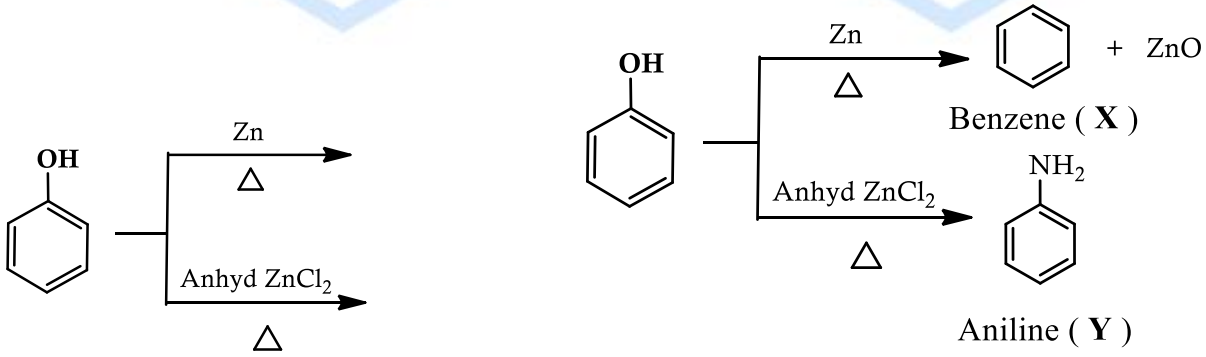


23. How are drugs classified?

Classification based on

- The chemical structure
- Pharmacological effect
- Target system (drug action)
- Site of action (molecular target)

24. Find the products X and Y in the following reaction.



PART-III

25. Describe a method for refining nickel.

- Impure nickel is heated in a stream of carbon monoxide at around 350K.
- Nickel reacts with CO to form a highly volatile nickel tetracarbonyl.

$$\underset{\text{Impure}}{Ni_{(s)}} + 4CO_{(g)} \xrightarrow{350\ K} [Ni(CO)_4]_{(g)}$$

- On heating nickel tetra carbonyl around 460K, decomposes to give pure nickel.

$$[Ni(CO)_4]_{(g)} \xrightarrow{460\ K} \underset{\text{Pure}}{Ni_{(s)}} + 4CO_{(g)}$$

26. Give an account on bleaching action of SO_2.

$$SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2[H]$$

$$\underset{\text{(coloured)}}{X} + 2[H] \longrightarrow \underset{\text{(colourless)}}{XH_2}$$

- In the presence of water, SO_2 bleaches coloured wool, silk, sponges & straw into colourless product due to its reducing property.Bleaching action of SO_2 is temporary.
- The colourless bleached product is allowed to stand in air, it is reoxidised by atmospheric oxygen to its original colour.

27. What are hydrate isomers? Explain with an example.

- The exchange of water molecules in the crystal lattice with a ligand in the coordination entity will give different isomers. These type of isomers are called hydrate isomers.
- Example : $CrCl_3.6H_2O$ has three hydrate isomers
  - $[Cr(H_2O)_6]Cl_3$ - violet colour - gives three chloride ions in solution
  - $[Cr(H_2O)_5Cl]Cl_2.H_2O$ - pale green colour - two chloride ions in solution
  - $[Cr(H_2O)_4Cl_2]Cl.2\ H_2O$ - dark green colour - one chloride ion in solution.

28. Distinguish tetrahedral and octahedral voids.

Tetrahedral voids	Octahedral voids
When a sphere of second layer (b) is above the void in the first layer (a), tetrahedral void is formed	When a sphere of second layer (b) partially covers the void in the first layer (a), octahedral void is formed
If the number of close packed spheres be 'n' then, the number of tetrahedral voids generated is equal to **2n**	If the number of close packed spheres be 'n' then, the number of octahedral voids generated is equal to **n**
This constitutes four spheres, three in the lower layer (a) and one in the upper layer (b).	This constitutes six spheres, three in the lower layer (a) and three in the upper layer (b)
When the centers of these four spheres are joined, a tetrahedron is formed	When the centers of these six spheres are joined, an octahedron is formed

29. What are the limitations Freundlich adorption isotherm

- Freundlich equation is purely empirical and valid over a limited pressure range.
- The values of constants k and n are found vary with temperature. No theoretical explanation were given.

30. Identify compounds A,B and C in the following sequence of reactions.

$$C_6H_5NO_2 \xrightarrow{Sn/HCl} A \xrightarrow{HNO_2/273K} B \xrightarrow{CuCN} C$$

$$\underset{\text{Nitrobenzene}}{C_6H_5NO_2} \xrightarrow{Sn/HCl} \underset{\substack{\text{aniline}\\(A)}}{C_6H_5NH_2} \xrightarrow{HNO_2/273K} \underset{\substack{\text{benzene diazoium chloride}\\(B)}}{C_6H_5\overset{+}{N}_2\overset{-}{Cl}} \xrightarrow{CuCN} \underset{\substack{\text{cyanobenzene}\\(C)}}{C_6H_5-CN}$$

A	$C_6H_5NH_2$	aniline
B	$C_6H_5\overset{+}{N}_2\overset{-}{Cl}$	benzene diazoium chloride
C	C_6H_5-CN	cyanobenzene

31. What is Condensation polymer? Give two examples

- Condensation polymers are formed by the reaction between functional groups an adjacent monomers with the elimination of simple molecules like H_2O, NH_3 etc

Examples :Nylon – 6,6 , Nylon – 6, Bakelite , Melamine

32. Mention three functions of lipids in living organisms.

- Lipids are the integral component of cell membrane.
- The main function of triglycerides (lipids) in animals is as an energy reserve.
- They act as protective coating in aquatic organisms.
- Lipids of connective tissues give protection to internal organs.
- Lipids help in the absorption and transport of fat soluble vitamins.
- Essential for activation of enzymes such as lipases.
- Act as emulsifier in fat metabolism

33. The rate constant for a first order reaction is $1.54 \times 10^{-3}s^{-1}$. Calculate its half life time.

Given

$k = 1.54 \times 10^{-3}s^{-1}$

$t_{1/2} = ?$

$$\boxed{t_{1/2} = \frac{0.693}{k}}$$

$$= \frac{0.693}{1.54 \times 10^{-3}} = \frac{693}{1.54}$$

$$\boxed{t_{1/2} = 450 \text{ sec}}$$

PART-IV

Answer all the questions. **[5 x 5 = 25]**

34. a) (i) Describe the role of the following in the process mentioned.

a) Cryolite in the extraction of aluminium.

b) Iodine in the refining of Zirconium.

a) **Cryolite in the extraction of aluminium.**

- Cryolite lowers the melting point of the electrolyte.
- As Al_2O_3 is a poor conductor, cryolite improves the electrical conductivity.

b) **Iodine in the refining of Zirconium**

- Impure Zr metal is heated with iodine to form the volatile zirconium tetraiodide (ZrI_4). The impurities do not react with iodine.
- On passing volatile zirconium tetraiodide vapour over a tungsten filament, it is decomposed to give pure zirconium.

(ii) Write the Properties of inter halogen compounds?

- The central atom will be the larger one.
- It can be formed only between two halogen and not more than two halogens.
- Fluorine can't act as a central metal atom being the smallest one
- Due to high electronegativity with small size fluorine helps the central atom to attain high coordination number
- They are strong oxidizing agents.
- They can undergo the auto ionization.
  - $2\,IC\ell \rightleftharpoons I^+ + IC\ell_2^-$
  - $2\,IC\ell_3 \rightleftharpoons IC\ell_2^+ + IC\ell_4^-$

(OR)

b) (i) How will you identify borate radical?

- When boric acid or borate salt is heated with ethyl alcohol in presence of conc. H_2SO_4, an ester, trialkylborate is formed.
- The vapour of this ester burns with a green edged flame and this reaction is used to identify the presence of borate.

$$H_3BO_3 + 3\,C_2H_5OH \xrightarrow{\text{Conc } H_2SO_4} \underset{\text{green edged flame}}{B(OC_2H_5)_3} + 3H_2O$$

(ii) Write the uses of borax.

- Borax is used for the identification of coloured metal ions
- In the manufacture optical and borosilicate glass, enamels and glazes for pottery
- It is also used as a flux in metallurgy and also acts as a preservative

35. a) Describe the preparation of potassium dichromate

- **Ore :** Chromite Ore
- **Concentration :** Gravity Separation
- **Rosating:**It is then mixed with excess sodium carbonate and lime and roasted in a reverbratory furnace.

$$4\,FeCr_2O_4 + 8\,Na_2CO_3 + 7O_2 \xrightarrow{900-1000\,^{\circ}C} 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$$

$$\underset{\substack{\text{Sodium chromate}\\(\text{Yellow colour})}}{2\,Na_2CrO_4} + H_2SO_4 \longrightarrow \underset{\substack{\text{Sodium dichromate}\\(\text{OrangeRed})}}{Na_2Cr_2O_7} + Na_2SO_4 + H_2O$$

$$\underset{\substack{\text{Sodium dichromate}\\(\text{OrangeRed})}}{Na_2Cr_2O_7} + 2KCl \longrightarrow \underset{\substack{\text{Potassim dichromate}\\(\text{OrangeRed})}}{K_2Cr_2O_7} + NaCl$$

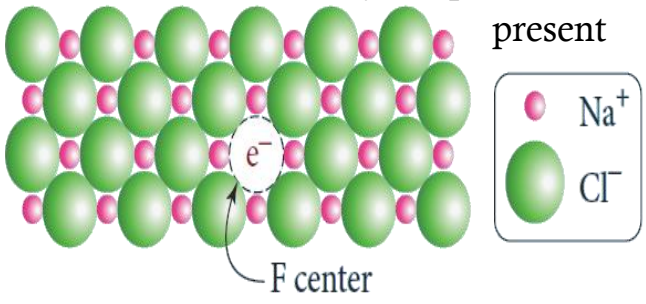
(OR)

b) (i) Write the postulates of Werner's theory.

- Most of the elements exhibit, two types of valence.
  - Primary valence
  - Secondary valence
- Primary valence is referred as the oxidation state of the metal atom and the Secondary valence as the coordination number.
- The primary valence of a metal ion is positive in most of the cases and zero in certain cases. They are always satisfied by negative ions.
- The secondary valence is satisfied by negative ions, neutral molecules, positive ions or the combination of these.
- There are two spheres of attraction around a metal atom/ion in a complex.
  - The inner sphere - coordination sphere.
  - The outer sphere - ionisation sphere.
- The primary valences - non-directional
  The secondary valences - directional.
- The geometry of the complex is determined by the spacial arrangement of the groups which satisfy the secondary valence.
  - Six - octahedral geometry.
  - Four -either tetrahedral or square planar geometry.

36. a) (i) Write short note on metal excess with an example.

- Metal excess defect arises due to the presence of more number of metal ions than the anions
- Example : NaCl, KCl
- The electrical neutrality of the crystal is maintained by the presence of anionic vacancies equal to the excess metal ions or by the presence of extra cation and electron present in interstitial position.
- The anionic vacancies, which are occupied by unpaired electrons are called F centers.



(ii) Explain pseudo first order reaction with an example.

- A second order reaction can be altered to a first order reaction by taking one of the reactant in large excess, such reaction is called pseudo first order reaction.
- Example : <u>acid hydrolysis of an ester</u>,

$$CH_3\,COOCH_{3(aq)} + H_2O \xrightarrow{H^+} CH_3\,COOH_{(aq)} + CH_3OH_{(aq)}$$

$$Rate = k\,[CH_3\,COOCH_3\,]\,[H_2O]$$

- If the reaction is carried out with the large excess of water, there is no significant change in the concentration of water during hydrolysis. i.e., concentration of water remains almost a constant.

$$Rate = k'\,[CH_3\,COOCH_3\,]$$

Thus it follows first order kinetics.

b) (i) Calculate the pH of 0.1M CH_3COOH solution. Dissociation constant of acetic acid is $K_a = 1.8 \times 10^{-5}$.

Given

$$K_a = 1.8 \times 10^{-5}$$

For weak acids,

$$[H^+] = \sqrt{K_a \times C}$$

$$[H^+] = \sqrt{1.8 \times 10^{-5} \times 0.1}$$

$$[H^+] = 1.34 \times 10^{-3}\,M$$

$$pH = -\log [H_3O^+]$$

$$= -\log [1.34 \times 10^{-3}]$$

$$= 3 - \log 1.34$$

$$= 3 - 0.1271$$

$$= 2.8729$$

$$\boxed{pH \simeq 2.87}$$

37. a) Derive an expression for Nernst equation

❖ Nernst equation is the one which relates the cell potential and the concentration of the species involved in an electrochemical reaction.

$$xA + yB \rightleftharpoons \ell C + mD$$

$$\text{The reaction quotient (Q)} = \frac{[C]^{\ell}[D]^{m}}{[A]^{x}[B]^{y}} \qquad \text{\_\_\_\_\_(1)}$$

$$\Delta G = \Delta G^\circ + RT\,lnQ \qquad \text{\_\_\_\_\_(2)}$$

The Gibbs free energy can be related to the cell emf as follows

$$\Delta G = -nFE \qquad \text{\_\_\_\_\_(3)}$$

$$\Delta G^\circ = -nFE^\circ_{cell} \qquad \text{\_\_\_\_\_(4)}$$

Substitute these values and Q from (1) in the equation (2)

$$-nFE = -nFE^\circ_{cell} + RT \ln \frac{[C]^{l}[D]^{m}}{[A]^{x}[B]^{y}} \qquad \text{\_\_\_\_\_(5)}$$

Divide the whole equation (5) by (-nF)

$$E = E^\circ_{cell} - \frac{2.303\,RT}{nF} \log \frac{[C]^{l}[D]^{m}}{[A]^{x}[B]^{y}}$$

The above equation is called the Nernst equation

At 25°C (298K),

$$E = E^{\circ}_{cell} - \frac{0.0591}{n} \log \frac{[C]^l[D]^m}{[A]^x[B]^y}$$

(OR)

b) (i) How will you prepare the following compounds from Glycerol?

i) ethyl alcohol to ethene ii) ethylene Glycol to 1,4 – dioxane

iii) Glycerol Acrolein

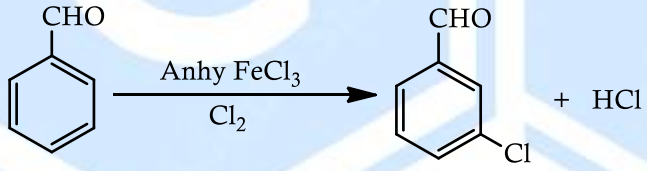
i) $CH_3 - CH_2 - OH \xrightarrow[(or)\ Al_2O_3]{H_2SO_4\ /\ 443K} CH_2 = CH_2$

Ethanol → Ethene

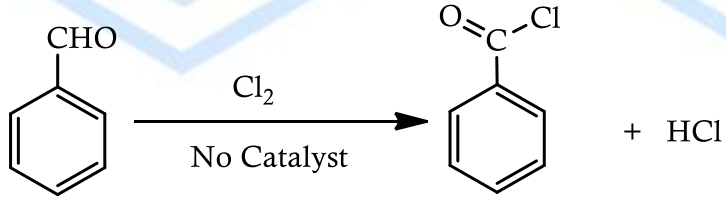
ii) HO–CH$_2$–CH$_2$–OH + HO–CH$_2$–CH$_2$–OH (ethane-1,2-diol) $\xrightarrow[-\ 2\ H_2O]{Conc\ H_2SO_4}$ 1,4-dioxane

iii) Propane - 1,2,3 - triol $\xrightarrow[(or)\ Conc\ H_2SO_4]{KHSO_4}$ Prop - 2- enal (acrolein)

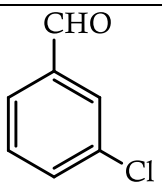
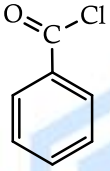
38. a) (i) An organic compound (A) of molecular formula C_7H_6O undergoes Cannizaro reaction. Compound (A) also reacts with Chlorine in the presence of Conc.$FeCl_3$ to give Compound (B). Compound (A) reacts with Chlorine in the absence of catalyst to give Compound (C). Identify A, B and C with suitable reactions.



3-chlorobenzaldehyde **(B)**



benzoyl chloride **(C)**

	COMPOUND	NAME
A	C_6H_5CHO	Benzaldehyde (Phenyl methanal)
B	 (or) $Cl-C_6H_4CHO$	3- chlorobenzaldehyde
C	 (or) C_6H_5COCl	Benzoyl chloride

(OR)

b) (i) How will you distinguish between Nitro and aci of CH_3NO_2?

Nitro form	Aci – form
Less acidic	More acidic
Dissolves in NaOH slowly	Dissolves in NaOH instantly
Decolourises $FeCl_3$ solution	Gives reddish brown colour
Electrical conductivity is low	Electrical conductivity is high

(ii) What are the different types of RNA which are found in cell?

RNA molecules are classified into three major types.

1. Ribosomal RNA (r RNA)
2. Messenger RNA (m RNA)
3. Transfer RNA (t RNA)

Prepared by

N.GOPALAKRISHNAN.M.Sc., B.Ed.
POST GRADUATE TEACHER IN CHEMISTRY
BHARATHIDASAN MAT.HR.SEC.SCHOOL
TIRUVALLUR