CREATIVE EDUCATION FOUNDATION, KARKALA
SECOND PU ANNUAL EXAMINATION MARCH – 2025
CHEMISTRY DETAILED SOLUTION

PART – A

I. Select the correct option from the given choices: **(15 × 1 = 15)**

1. Incorrect statement regarding vitamins,
   a) Excess vitamin intake is harmful
   b) Most of the vitamins contain amino groups
   c) Vitamins can be produced by plants
   d) Vitamin deficiency causes diseases
   Ans: b) Most of the vitamins contain amino groups

2. Camphor in nitrogen gas, is an example of _____ .
   a) liquid solution b) solid solution c) gaseous solution d) aqueous solution
   Ans: c) gaseous solution

3. Which of the following is not a subdivision of structural isomerism?
   a) Coordination isomerism b) Linkage isomerism
   c) Ionisation isomerism d) Geometrical isomerism
   Ans: d) Geometrical isomerism

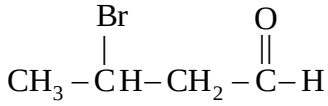
4. Cumene hydroperoxide on hydrolysis with dilute acid gives _____.
   a) alcohol and phenol b) only phenol
   c) phenol and acetone d) alcohol and acetone
   Ans: c) phenol and acetone

5. An example for pseudo first-order reaction is,
   a) The decomposition of gaseous ammonia on a hot platinum surface
   b) Photochemical reaction between hydrogen and chlorine
   c) Inversion of cane sugar
   d) Hydrogenation of ethene
   Ans: c) Inversion of cane sugar

6. The hybridisation of 'N' atom in trimethyl amine is,

a) sp^3 b) sp^2 c) sp d) dsp^2

Ans: a) sp^3

7. The IUPAC name of 

a) 3-bromobutyraldehyde b) 2-bromopropanaldehyde

c) 3-bromobutanal d) 2-bromobutanal

Ans: c) 3-bromobutanal

8. Select non-semiconductor from the following,

a) silicon b) carbon-black c) gallium arsenide d) doped silicon

Ans: b) carbon-black

9. Given below are two statements:

Statement I : Ammonolysis of alkyl halides has the disadvantage of yielding a mixture of primary, secondary, tertiary amines and quaternary salt.

Statement II : Tertiary amine is obtained as a major product by taking large excess of ammonia in ammonolysis of alkyl halides.

In the light of the above statement, choose the appropriate answer from the options given below:

a) Statement I is incorrect but Statement II is correct

b) Both Statement I and Statement II are correct

c) Both Statement I and Statement II are incorrect

d) Statement I is correct but Statement II is incorrect

Ans: d) Statement I is correct but Statement II is incorrect

10. The structure of pentacarbonyliron(0) is,

a) tetrahedral b) trigonal bipyramidal c) octahedral d) square pyramidal

Ans: b) trigonal bipyramidal

11. Two compounds 'A' and 'B' were being tested for their boiling points. It was observed that 'A' started boiling after 'B', when both were subjected to same conditions. If the compound 'B' is acetone, which of the following can be compound 'A'?

a) Propanal b) Propan-1-ol c) Methoxyethane d) n-Butane

Ans: b) Propan-1-ol

12. Select the correct order of melting points of isomeric dichlorobenzenes.

a) o-dichlorobenzene > m-dichlorobenzene > p-dichlorobenzene

b) p-dichlorobenzene > m-dichlorobenzene > o-dichlorobenzene

c) p-dichlorobenzene > o-dichlorobenzene > m-dichlorobenzene

d) m-dichlorobenzene > o-dichlorobenzene > p-dichlorobenzene

Ans: c) p-dichlorobenzene > o-dichlorobenzene > m-dichlorobenzene

13. Match the following given in List – I with List – II :

List – I	**List – II**
i) V_2O_5	A) Oxidation of ethyne to ethanol
ii) $TiCl_4$ with $AL(CH_3)_3$	B) Polymerisation of alkynes
iii) $PdCl_2$	C) Oxidation of SO_2 in the manufacture of sulphuric acid
iv) Nickel complexes	D) manufacture of polyethylene

Choose the correct option:

a) i – C, ii – D, iii – A, iv – B

b) i – A, ii – B, iii – C, iv – D

c) i – A, ii – C, iii – B, iv – D

d) i – C, ii – A, iii – D, iv – B

Ans: a) i – C, ii – D, iii – A, iv – B

14. Which of the following explains the increase in the reaction rate by a catalyst?

a) Catalyst decreases the rate of backward reaction so that rate of forward reaction increases

b) Catalyst provides extra energy to reacting molecules, so that they produce effective collisions

c) Catalyst provides an alternative pathway by reducing the activation energy between the reactants and products

d) Catalyst increases the number of collisions between the reacting molecules

Ans: c) Catalyst provides an alternative pathway by reducing the activation energy between the reactants and products

15. Sufficient amount of 2-methylpropan-2-ol heated with 20% phosphoric acid at 358 K gives main product 'X' with the elimination of water and tert-butyl alcohol undergoes dehydration when it is passed over heated copper at 573 K gives 'Y'

Pick the correct statement regarding X and Y.

a) The boiling points of 'X' and 'Y' are equal

b) The boiling points of 'X' is greater than the boiling points of 'Y'

c) The boiling points of 'X' is lesser than the boiling points of 'Y'

d) At room temperature both 'X' and 'Y' exists as a solids

Ans: a) The boiling points of 'X' and 'Y' are equal

II. Fill in the blanks by choosing the appropriate word from those given in the brackets : (5 × 1 = 5)

[Carbocation, pre-exponential, exponential, unpaired, carbohydrate, CCl_2F_2]

16. Arrhenius factor is also called _____ factor.

Ans: pre-exponential

17. Paramagnetism arised from the presence of _____ electrons.

Ans: unpaired

18. _____ is one of the most common freon in industrial use.

Ans: CCl_2F_2

19. The electrophilic attack of $H_3O^{\oplus}$ on alkene forms _____.

Ans: Carbocation

20. The hormone glucorticoids control the _____ metabolism.

Ans: carbohydrate

PART – B

III. Answer any three of the following. Each question carries 2 marks: (3 × 2 = 6)

21. Explain Wurtz reaction with suitable chemical equation.

Ans: When alkyl halides are heated with sodium metal in dry ether medium, higher alkanes containing even number of carbon atoms are formed. This reaction is called Wurtz reaction

$$CH_3\text{-}Br + 2Na + Br\text{-}CH_3 \xrightarrow{\text{Dry ether}} CH_3\text{-}CH_3 + 2NaBr$$

Bromomethane Ethane

22. Molarity (M), molality (m) and mole fraction (χ) are some methods for expressing concentration of solutions.

Which of these are temperature dependent? Give reason.

Ans: Molarity (M)

Molarity is function of temperature because volume depends on temperature.

23. What are non – essential amino acids? Name an optically inactive naturally occurring α - amino acid.

Ans: The amino acids, which can be synthesised in the body, are known as non-essential amino acids. Glycine is optically inactive naturally occurring α-amino acid.

24. Write any two characteristic properties of interstitial compounds.

Ans: 1) They have high M.P than those of pure metal

2) They are very hard

3) They retain metallic conductivity
4) They are chemically inert

25. While separating a mixture of ortho and para nitrophenols by steam distillation, name the isomer which will be steam volatile. Give reason.

Ans: Ortho-nitrophenol is steam volatile due to intra molecular hydrogen bonding.

PART – C

IV . Answer any three of the following. Each question carries 3 marks : (3 × 3 = 9)

26. State any three postulates of Werner's theory of coordination compounds.

Ans:

1. In coordination compounds metals show two types of linkages (valences)-primary and secondary.
2. The primary valences are normally ionisable and are satisfied by negative ions.
3. The secondary valences are non ionisable. These are satisfied by neutral molecules or negative ions. The secondary valence is equal to the coordination number and is fixed for a metal.
4. The ions/groups bound by the secondary linkages to the metal have characteristic spatial arrangements corresponding to different coordination numbers.

27. Write the balanced chemical equations involved in the manufacture of potassium dichromate $(K_2Cr_2O_7)$ from chromite ore $(FeCr_2O_4)$.

Ans:

1. Fusion of chromite ore ($FeCr_2O_4$) with sodium or potassium carbonate in free access of air.

$$4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \longrightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$$

Sodium chromate

2. Yellow solution of sodium chromate is filtered and acidified with sulphuric acid.

$$2Na_2CrO_4 + 2H^+ \longrightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$$

Sodium dichromate

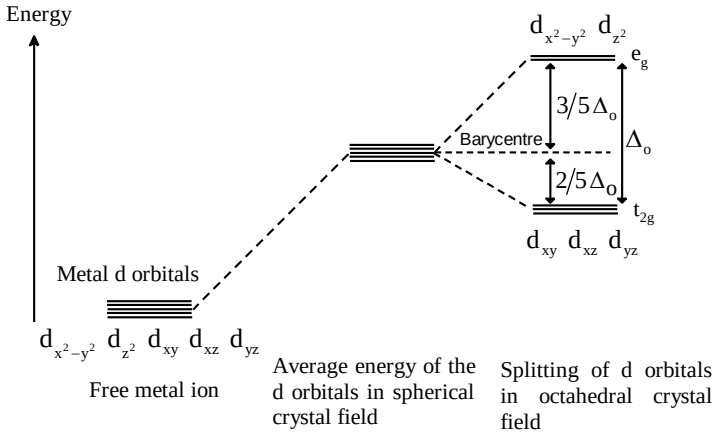
3. Sodium dichromate solution is treated with potassium chloride. Orange crystals of potassium dichromate crystallise out.

$$Na_2Cr_2O_7 + 2KCl \longrightarrow K_2Cr_2O_7 + 2NaCl$$

Potassium dichromate

28. $[Co(NH_3)_5Br]SO_4$ is an octahedral coordination compound. Write its IUPAC name and draw the diagram, which indicates the splitting of d – orbitals in above complex with respect to CFT (Crystal Field Theory).

Ans: IUPAC name - Pentaamminebromidocobalt(III) sulphate



29. What is lanthanoid contraction? Write one comparison and one difference between lanthanoids and actinoids with respect to oxidation states shown by them.

Ans:

Lanthanoid contraction: Regular decrease (contraction) in the atomic and ionic radii of lanthanoids with increasing atomic number is known as lanthanoid contraction.

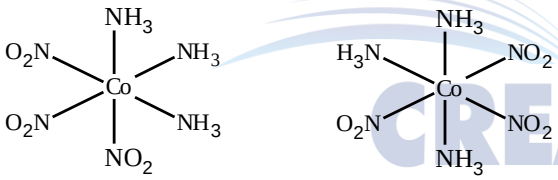
Comparison: They exhibit common oxidation state of +3

Difference:

Lanthanoids	Actinoids
1) The common oxidation state is +3	1) Beside +3 they exhibit variable oxidation states

30. Write the facial (fac) and meridional (mer) isomeric structures of $[Co(NH_3)_3(NO_2)_3]$. Mention the coordination number of a metal ion in an above complex.

Ans:



facial

meridional

Coordination number = 6

V. Answer any two of the following. Each question carries 3 marks. (2 × 3 = 6)

31. Derive an integrated rate equation for the rate constant of zero – order reaction.

Ans: Zero order reaction means that the rate of the reaction is proportional to zero power of the concentration of reactants.

Consider the reaction, $R \longrightarrow P$

$$\text{Rate} = -\frac{d[R]}{dt} = k[R]^0 \qquad [R]^0 = 1$$

$$\text{Rate} = -\frac{d[R]}{dt} = k$$

$$d[R] = -kdt$$

Integrating both sides

$[R] = -kt + I$ ----(1)

Where, I is the constant of integration.

At t = 0, the concentration of the reactant $R = [R]_0$, Where $[R]_0$ is the initial concentration of the reactant.

Equation (1) becomes

$[R]_0 = -k \times 0 + I$

$I = [R]_0$

Substituting value of I in equation (1)

$[R] = -kt + [R]_0$ ----(2)

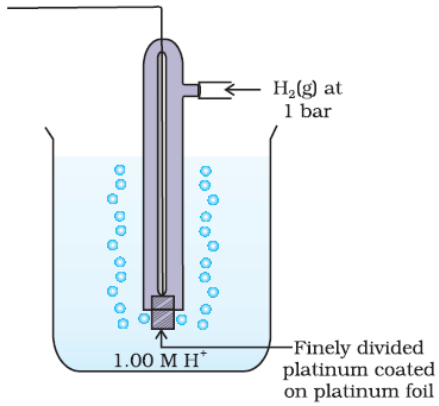
$kt = [R]_0 - [R]$ ----(3)

$$k = \frac{[R]_0 - [R]}{t} \quad \text{----(4)}$$

Equation (4) is the rate constant expression for zero order reaction.

32. Write a neat labelled diagram, cell representation and half – cell reaction of Standard Hydrogen Electrode (S.H.E).

Ans:



Cell representation: $Pt(s) \mid H_2(g,1bar) \mid H^+(aq,1M)$

Half cell reaction: $H^+(aq) + e^- \longrightarrow \frac{1}{2}H_2(g)$

33. Define azeotropes. What type of azeotropes are formed by solutions with negative deviation from Raoult's law? Give an example for it.

Ans:

Binary liquid mixture having the same composition in both liquid and vapour phase and boils at constant temperature is called azeotrope.

Maximum boiling azeotropes are formed by solutions with negative deviation from Raoult's law.

68% HNO_3 and 32% H_2O

34. Lead storage battery is commonly used as a secondary cell in automobiles. What is secondary cell? Write down the reactions occurs at anode and cathode during discharging of the lead storage battery.

Ans: A cell that can be recharged or reused is known as secondary cell.

Anode: $Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$

Cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \longrightarrow PbSO_4(s) + 2H_2O(l)$

PART – D

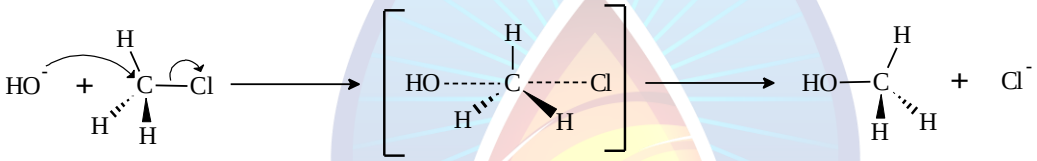
VI . Answer any four of the following. Each question carries 5 marks: (4 × 5 = 20)

35. a) Write the S_N2 mechanism for the conversion of chloromethane to methanol. Mention its order. (3)

b) What is racemic mixture? Represent the butan – 2 – ol in racemic mixture form. (2)

Ans:

a) It follows second order kinetics.



Methyl chloride or Chloromethane — Transition state — Methyl alcohol or Methanol

b) A mixture containing two enantiomers in equal proportions will have zero optical rotation are known as racemic mixture.

(±) butan-2-ol.

36. a) Amylose and Amylopectin are two components of the starch. Write any two differences between them. (2)

b) List any two nitrogenous bases commonly found in both RNA and DNA. (2)

c) Name the enzyme that catalyses hydrolysis of maltose into glucose. (1)

Ans:

a)

Amylose	Amylopectin
1) Water soluble component	1) Water insoluble component
2) Long unbranched chain structure	2) Branched chain structure

b) Adenine, guanine and cytosine

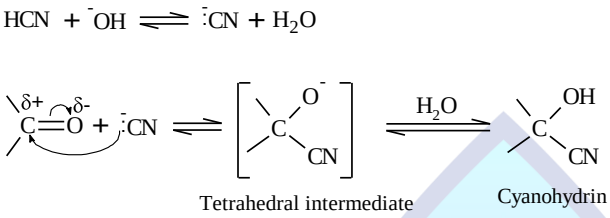
c) Maltase

37. a) Write the mechanism of addition of HCN (hydrogen Cyanide) to carbonyl group in presence of base **(3)**

b) Explain Rosenmund reduction with chemical equation **(2)**

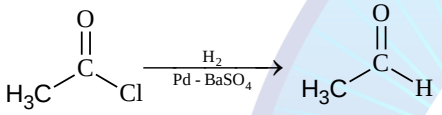
Ans:

a) This reaction occurs very slowly with pure HCN. Therefore, it is catalysed by a base and the generated cyanide ion (CN^-) being a stronger nucleophile readily adds to carbonyl compounds to yield corresponding cyanohydrin.



Tetrahedral intermediate Cyanohydrin

b) Acetyl chloride is hydrogenated over catalyst, palladium on barium sulphate, gives Acetaldehyde. This reaction is called **Rosenmund reduction**.



Acetyl chloride Acetaldehyde

38. a) Describe carbylamine reaction with suitable chemical equation **(2)**

b) Explain the conversion of aniline to benzene diazonium chloride with chemical equation. **(2)**

c) Among aryl amines and ammonia which is more basic **(1)**

Ans:

a) Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides or carbylamines.

$$CH_3-CH_2-NH_2 + CHCl_3 + 3KOH(alc.) \xrightarrow{Heat} CH_3-CH_2-NC + 3KCl + 3H_2O$$

Ethyl amine Ethyl isocyanide

Or any suitable example

b) Aniline on treatment with Nitrous acid (produced, in situ, by the action of dilute HCl on sodium nitrite) at 273 – 298 K forms Benzenediazonium chloride.

$$C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{273\text{-}278\ K} C_6H_5-\overset{+}{N}_2\overset{-}{Cl} + NaCl + 2H_2O$$

Benzenediazonium chloride

c) Ammonia

39. a) Lucas reagent is an important reagent which helps to distinguish between three classes of alcohols. Write the chemical composition of the Lucas reagent and explain how the above reagent helps to distinguish 1^0 and 3^0 alcohols? **(3)**

b) Illustrate preparation of ether by Williamson synthesis with a general chemical equation **(2)**

Ans:

a) Mixture of Conc. HCl and anhydrous $ZnCl_2$.

Lucas reagent reacts with primary alcohol do not produce turbidity at room temperature and with tertiary alcohol gives turbidity immediately.

b) Alkyl halide reacts with sodium alkoxide to form ether.FT

$$R-X + Na-O-R' \longrightarrow R-O-R' + NaX$$

40. An organic compound 'A' on treatment with ethanoic acid in the presence of hydrochloric acid gas a catalyst produces an ester 'B'. 'A' on oxidation with CrO_3 in an anhydrous medium gives 'C'. 'C' is heated with concentrated KOH followed by acidification with dilute HCl generates 'A' and 'D'. Three moles of 'D' reacts with PCl_3 gives three miles of compound with molecular formula HCOCl and 'E' . 'D' is reduced to 'A' by lithium aluminium hydride followed by hydrolysis. Write the molecular formulas of the compounds 'A', 'B' , 'C', 'D' and 'E'

Ans:

A ⟶ CH_3OH

B ⟶ CH_3COOCH_3

C ⟶ HCHO

D ⟶ HCOOH

E ⟶ $P(OH)_3$

PART – E

VII. Answer any three of the following. Each question carries 3 marks: (3 × 3 = 9)

41. The initial concentration of N_2O_5 in the following first order reaction.

$N_2O_5(g) \longrightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ was $1.24\times10^{-2}\,mol\,L^{-1}$ at 318 K. The concentration of N_2O_5 after 60 minutes was $0.20\times10^{-2}\,mol\,L^{-1}$. Calculate the rate constant of the reaction at 318 K.

Ans:

$[R]_0 = 1.24\times10^{-2}\,mol\,L^{-1}$ $\quad t = 60\ min$ $\quad [R] = 0.20\times10^{-2}\,mol\,L^{-1}$

$$K = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$$

$$= \frac{2.303}{60}\times\log\frac{1.24\times10^{-2}}{0.20\times10^{-2}}$$

$$= 0.03838\times\log 6.2 = 0.03044\ min^{-1}$$

42. Calculate the osmotic pressure in Pascals exerted by a solution prepared by dissolving 1.0 g of polymer of molar mass 185000 in 450 mL of water at $37^{o}C$.

$\left[R = 8.314 \times 10^{3}\, PaLK^{-1}mol^{-1}\right]$

Ans:

$$\pi = \frac{W_2 RT}{M_2 \times V}$$

$W_2 = 1g \qquad M_2 = 185000 \qquad V = 450mL = 0.45L \qquad T = 37°C = 310K$

$$\pi = \frac{1 \times 8.314 \times 10^{3} \times 310}{185000 \times 0.45}$$

$$\pi = \frac{2577.34 \times 10^{3}}{83250}$$

$$\pi = 0.03095 \times 10^{3}$$

$$\pi = 30.95\, Pa$$

43. The standard electrode potential for Daniel cell is 1.1 V. Calculate the standard Gibbs energy for the reaction:

$$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$$

Ans:

$$\Delta_r G° = nE^{o}_{cell}F$$

$$\Delta_r G° = -2 \times 1.1 \times 96487$$

$$= -212.27\, kJ\, mol^{-1}$$

44. The vapour pressure of pure liquids 'A' and 'B' are 450 and 700 mm Hg respectively, at 350 K. Find out the composition of the liquid mixture if total vapour pressure is 600 mm Hg.

Ans:

$P^{0}_{A} = 450mm\ Hg$

$P^{0}_{B} = 700mm\ Hg$

$P_T = P^{0}_{B} + \left(P^{0}_{A} - P^{0}_{B}\right)\chi_A$

$600 = 700 + (450 - 700)\chi_A$

$250\chi_A = 100$

$$\chi_A = \frac{100}{250} = 0.40$$

$\chi_B = 1 - 0.40 = 0.60$

45. The rate constant of a first order reaction increases from $2\times10^{-2}S^{-1}$ to $4\times10^{-2}S^{-1}$ when the temperature changes from 300 K to 310 K. Calculate the energy of activation (E_a) .

[log 2 = 0.3010, log 2.5 = 0.6979, log 4 = 0.6021, R = 8.314 $JK^{-1}mol^{-1}$]

Ans:

$K_1 = 2\times10^{-2}s^{-1}$

$K_2 = 4\times10^{-2}s^{-1}$

$T_1 = 300, T_2 = 310$

$$\log\frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1T_2}\right]$$

$$\log\frac{4\times10^{-2}s^{-1}}{2\times10^{-2}s^{-1}} = \frac{E_a}{2.303\times8.314}\left[\frac{310-300}{310\times300}\right]$$

$$\log 2 = \frac{E_a}{19.147}\times\frac{10}{93,000}$$

$$= \frac{0.3010\times19.147\times93,000}{10} = 53.598\,kJ\ mol^{-1}$$

46. The conductivity of 0.001028 mol L^{-1} acetic acid is $4.95\times10^{-5}S\ cm^{-1}$. Calculate the dissociation constant if Λ_m^0 for acetic acid is 390.5 Scm^2mol^{-1}

Ans:

C = 0.001028

$\kappa = 4.95\times10^{-5}Scm^2$

$\Lambda_m^o = 390.5\,Scm^2mol^{-1}$

$$\Lambda_m = \frac{\kappa\times1000}{C} = \frac{4.95\times10^{-5}\times1000}{0.001028} = 48.15\ S\ cm^2\ mol^{-1}$$

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{48.15}{390.5} = 0.1233$$

$$K_a = \frac{C\alpha^2}{1-a}$$

$$= \frac{0.001028\times(0.123)^2}{1-0.001028}$$

$$= 1.78\times10^{-5}\,mol\,L^{-1}$$

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