

General Instructions :

Read the following instructions very carefully and follow them:

- (i) This question paper contains 35 questions. All questions are compulsory.
- (ii) Question paper is divided into FIVE sections - Section A, B, C, D and E.
- (iii) In section - A : Question Numbers 1 to 18 are Multiple Choice (MCQ) type Questions carrying 1 mark each.
- (iv) In section - B : Question Numbers 19 to 25 are Very Short Answer (VSA) type questions carrying 2 marks each.
- (v) In section - C : Question Numbers 26 to 30 are Short Answer (SA) type questions carrying 3 marks each.
- (vi) In section - D : Question Numbers 31 and 32 are case based questions carrying 4 marks each.
- (vii) In section - E : Question Numbers 33 to 35 are Long Answer (LA) type questions carrying 5 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section - B, 2 questions in Section - C, 2 questions in Section - D and 2 questions in Section - E.
- (ix) Use of calculators is NOT allowed.

SECTION A

1. The colligative property used for the determination of molar mass of polymers and proteins is :
 - (a) Osmotic pressure
 - (b) Depression in freezing point
 - (c) Relative lowering in vapour pressure
 - (d) Elevation in boiling point
2. Low concentration of oxygen in the blood and tissues of people living at high altitude is due to :
 - (a) high atmospheric pressure
 - (b) low temperature
 - (c) low atmospheric pressure
 - (d) both low temperature and high atmospheric pressure
3. The correct cell to represent the following reaction is :

$$\text{Zn} + 2\text{Ag}^+ \rightarrow \text{Zn}^{2+} + 2\text{Ag}$$
 - (a) $2\text{Ag}|\text{Ag}^+||\text{Zn}|\text{Zn}^{2+}$
 - (b) $\text{Ag}^+|\text{Ag}||\text{Zn}^{2+}|\text{Zn}$
 - (c) $\text{Ag}|\text{Ag}^+||\text{Zn}|\text{Zn}^{2+}$
 - (d) $\text{Zn}|\text{Zn}^{2+}||\text{Ag}^+|\text{Ag}$
4. ΔG and E_{cell}° for a spontaneous reaction will be :
 - (a) positive, negative
 - (b) negative, negative
 - (c) negative, positive
 - (d) positive, positive
5. Which of the following is affected by catalyst ?
 - (a) ΔH
 - (b) ΔG
 - (c) E_a
 - (d) ΔS
6. The order of the reaction $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \xrightarrow{h\nu} 2\text{HCl}(\text{g})$ is :
 - (a) 2
 - (b) 1
 - (c) 0
 - (d) 3
7. The most common and stable oxidation state of a Lanthanoid is :
 - (a) +2
 - (b) +3
 - (c) +4
 - (d) +6
8. The compounds $[\text{Co}(\text{SO}_4)(\text{NH}_3)_5]\text{Br}$ and $[\text{Co}(\text{Br})(\text{NH}_3)_5]\text{SO}_4$ represent :
 - (a) optical isomerism
 - (b) linkage isomerism
 - (c) ionisation isomerism
 - (d) coordination isomerism
9. The synthesis of alkyl fluoride is best obtained from :
 - (a) Free radicals
 - (b) Swartz reaction
 - (c) Sandmeyer reaction
 - (d) Finkelstein reaction

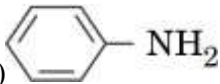
10. In the reaction $R-OH + HCl \xrightarrow{ZnCl_2} RCl + H_2O$, what is the correct order of reactivity of alcohol?

- (a) $1^\circ < 2^\circ < 3^\circ$ (b) $1^\circ > 3^\circ > 2^\circ$
(c) $1^\circ > 2^\circ > 3^\circ$ (d) $3^\circ > 1^\circ > 2^\circ$

11. CH_3CONH_2 on reaction with NaOH and Br_2 in alcoholic medium gives :

- (a) CH_3COONa (b) CH_3NH_2
(c) CH_3CH_2Br (d) $CH_3CH_2NH_2$

12. Which of the following is least basic ?

- (a) $(CH_3)_2NH$
(b) NH_3
(c) 
(d) $(CH_3)_3N$

13. The glycosidic linkage involved in linking the glucose units in amylase part of starch is :

- (a) $C_1 - C_6 \alpha$ linkage (b) $C_1 - C_6 \beta$ linkage
(c) $C_1 - C_4 \alpha$ linkage (d) $C_1 - C_4 \beta$ linkage

14. An α -helix is a structural feature of :

- (a) Sucrose (b) Starch
(c) Polypeptides (d) Nucleotides

For Questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

15. Assertion (A): $-NH_2$ group is *o*- and *p*-directing in electrophilic substitution reactions.

Reason (R) : Aniline cannot undergo Friedel-Crafts reaction.

16. Assertion (A) : Acetylation of aniline gives a monosubstituted product.

Reason (R) : Activating effect of $-NHCOCH_3$ group is more than that of amino group.

17. Assertion (A) : The molecularity of the reaction $H_2 + Br_2 \rightarrow 2HBr$ appears to be 2 .

Reason (R) : Two molecules of the reactants are involved in the given elementary reaction.

18. Assertion (A) : Low spin tetrahedral complexes are rarely observed.

Reason (R) : Crystal field splitting energy is less than pairing energy for tetrahedral complexes.

SECTION B

19. What is Henry's law ? Give one application of it.

20. (A) On diluting two electrolytes 'A' and 'B', the Λ_m of 'A' increases 25 times while that of 'B' increases by 1.5 times. Which of the two electrolytes is strong? Justify your answer graphically.

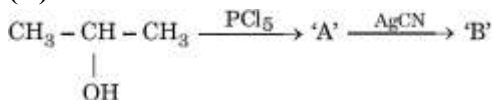
OR

(B) The electrical resistance of a column of $0.05 \text{ mol L}^{-1} \text{NaOH}$ solution of diameter 1 cm and length 50 cm is $5.55 \times 10^3 \text{ ohm}$. Calculate the conductivity.

21. Complete the following equations:

- (A) $2MnO_4^- + 5NO_2^- + 6H^+ \rightarrow$
(B) $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow$

22. (A)



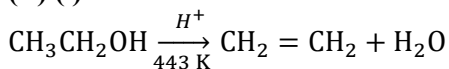
Identify 'A' and 'B' in the above reactions.

23. (A) Account for the following :

- (i) Phenol is a stronger acid than an alcohol.
- (ii) The boiling point of alcohols decreases with increase in branching of alkyl chain.

OR

(B) (i) Write the mechanism of the following reaction :



(ii) Write the equation involved in Reimer-Tiemann reaction.

24. Explain briefly:

- (A) Carbylamine reaction
- (B) Gabriel phthalimide synthesis

25. (A) Write chemical reaction to show that open structure of D-glucose contains the straight chain.

(B) What type of linkage is responsible for the formation of protein?

SECTION C

26. (A) Differentiate between Ideal solution and Non-ideal solution.

(B) 30 g of urea is dissolved in 846 g of water. Calculate the vapour pressure of water for this solution if vapour pressure of pure water at 298 K is 23.8 mm Hg .

27. Write main product formed when :

- (A) Methyl chloride is treated with NaI /Acetone.
- (B) 2,4,6-trinitrochlorobenzene is subjected to hydrolysis.
- (C) n-Butyl chloride is treated with alcoholic KOH

28. How do you convert the following : (Any three)

- (A) Phenol to picric acid
- (B) Propanone to 2-Methylpropan-2-ol
- (C) Phenol to anisole
- (D) Propene to Propan-1-ol

29. (A) Explain why :

- (i) Carboxyl group in benzoic acid is meta directing.
- (ii) Sodium bisulphite is used for the purification of aldehydes and ketones.
- (iii) Carboxylic acids do not give characteristic reactions of carbonyl group.

OR

(B) An organic compound 'A', having the molecular formula $\text{C}_3\text{H}_8\text{O}$ on treatment with Cu at 573 K, gives 'B'. 'B' does not reduce Fehling's solution but gives a yellow precipitate of the compound 'C' with I_2/NaOH . Deduce the structures of A, B and C.

30. (A) What are the hydrolysis products of (i) Lactose, (ii) Maltose ?

(B) Give the basic structural difference between starch and cellulose.

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

31. The rate of reaction is concerned with decrease in concentration of reactants or increase in the concentration of products per unit time. It can be expressed as instantaneous rate at a particular instant of time and average rate over a large interval of time. Mathematical representation of rate of reaction is given by rate law. Rate constant and order of a reaction can be determined from rate law or its integrated rate equation.

- (i) What is average rate of reaction?
- (ii) Write two factors that affect the rate of reaction.
- (iii) (1) What happens to rate of reaction for zero order reaction?
- (2) What is the unit of k for zero order reaction?

OR

(iii) (1) For a reaction $\text{P} + 2\text{Q} \rightarrow \text{Products}$ Rate = $k[\text{P}]^{1/2}[\text{Q}]^1$. What is the order of the reaction ?

(2) Define pseudo first order reaction with an example.

32. In coordination compounds, metals show two types of linkages, primary and secondary. Primary valencies are ionisable and are satisfied by negatively charged ions. Secondary valencies are non-ionisable and are satisfied by neutral or negative ions having lone pair of electrons. Primary valencies are non-directional while secondary valencies decide the shape of the complexes.

(i) If $\text{PtCl}_2 \cdot 2\text{NH}_3$ does not react with AgNO_3 , what will be its formula?

(ii) What is the secondary valency of $[\text{Co}(\text{en})_3]^{3+}$?

(iii) (1) Write the formula of Iron(III)hexacyanidoferrate(II).

(2) Write the IUPAC name of $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$.

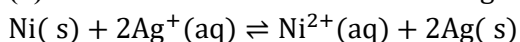
OR

(iii) Write the hybridization and magnetic behaviour of $[\text{Ni}(\text{CN})_4]^2-$. [Atomic number : Ni = 28]

SECTION E

33. (A) (i) State Kohlrausch's law of independent migration of ions. Write an expression for the limiting molar conductivity of acetic acid according to Kohlrausch's law.

(ii) Calculate the maximum work and $\log K_c$ for the given reaction at 298 K :



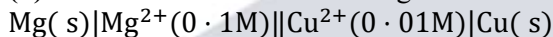
Given: $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V}$, $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$

1 F = 96500 C mol⁻¹

OR

(B) (i) State Faraday's first law of electrolysis. How much charge, in terms of Faraday, is required for the reduction of 1 mol Cu^{2+} to Cu?

(ii) Calculate emf of the following cell at 298 K for



[$E^\circ_{\text{cell}} = +2.71 \text{ V}$, 1 F = 96500 C mol⁻¹, $\log 10 = 1$]

34. Assign reason for each of the following :

(i) Manganese exhibits the highest oxidation state of +7 among the 3d series of transition elements.

(ii) Transition metals and their compounds are generally found to be good catalysts in chemical reactions.

(iii) Cr^{2+} is reducing in nature while with the same d-orbital configuration (d^4) Mn^{3+} is an oxidising agent.

(iv) Zn has lowest enthalpy of atomization.

(v) Cu^+ is unstable in an aqueous solution.

35. (A) (i) Carry out the following conversions:

(1) Ethanal to But-2-en-1-ol

(2) Propanoic acid to 2-chloropropanoic acid

(ii) An alkene with molecular formula C_5H_{10} on ozonolysis gives a mixture of two compounds 'B' and 'C'.

Compound 'B' gives positive Fehling test and also reacts with iodine and NaOH solution. Compound 'C' does not give Fehling solution test but forms iodoform. Identify the compounds 'A', 'B' and 'C'.

OR

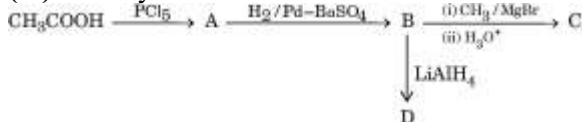
(B) (i) Distinguish with a suitable chemical test :

(1) $\text{CH}_3\text{COCH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$

(2) Ethanal and Ethanoic acid

(ii) Write the structure of oxime of acetone.

(iii) Identify A to D.



General Instructions :

Read the following instructions very carefully and follow them:

(i) This question paper contains 35 questions. All questions are compulsory.

(ii) Question paper is divided into FIVE sections - Section A, B, C, D and E.

(iii) In section - A : Question Numbers 1 to 18 are Multiple Choice (MCQ) type Questions carrying 1 mark each.

(iv) In section - B : Question Numbers 19 to 25 are Very Short Answer (VSA) type questions carrying 2 marks each.

- (v) In section - C : Question Numbers 26 to 30 are Short Answer (SA) type questions carrying 3 marks each.
 (vi) In section - D : Question Numbers 31 and 32 are case based questions carrying 4 marks each.
 (vii) In section - E : Question Numbers 33 to 35 are Long Answer (LA) type questions carrying 5 marks each.
 (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section - B, 2 questions in Section - C, 2 questions in Section - D and 2 questions in Section - E.
 (ix) Use of calculators is NOT allowed.

SECTION A

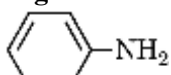
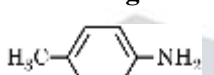
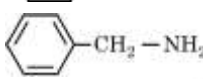
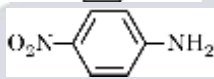
36. The conversion of an alkyl halide into an alkene by alcoholic KOH is classified as

- (a) a substitution reaction
 (b) an addition reaction
 (c) a dehydrohalogenation reaction
 (d) a dehydration reaction

37. The oxidation state of Fe in $[\text{Fe}(\text{CO})_5]$ is

- (a) +2 (b) 0
 (c) +3 (d) +5

38. Among the following, which is the strongest base ?

- (a)  (b) 
 (c)  (d) 

39. The slope in the plot of $\ln[R]$ vs. time for a first order reaction is

- (a) $\frac{+k}{2.303}$ (b) -k
 (c) $\frac{-k}{2.303}$ (d) +k

40. An α -helix is a structural feature of

- (a) Sucrose (b) Polypeptides
 (c) Nucleotides (d) Starch

41. Racemisation occurs in

- (a) $\text{S}_{\text{N}}1$ reaction
 (b) $\text{S}_{\text{N}}2$ reaction
 (c) Neither $\text{S}_{\text{N}}1$ nor $\text{S}_{\text{N}}2$ reaction
 (d) $\text{S}_{\text{N}}2$ reaction as well as $\text{S}_{\text{N}}1$ reaction

42. Value of Henry's constant K_{H} :

- (a) increases with decrease in temperature.
 (b) decreases with increase in temperature.
 (c) increases with increase in temperature.
 (d) remains constant.

43. Which of the following solutions of KCl will have the highest value of molar conductivity?

- (a) 0.01 M (b) 1 M
 (c) 0.5 M (d) 0.1 M

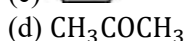
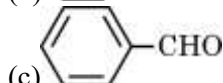
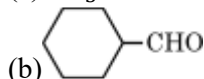
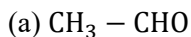
44. Which of the following reactions are feasible ?

- (a) $\text{CH}_3\text{CH}_2\text{Br} + \text{Na}^+\text{O}^-\text{C}(\text{CH}_3)_3 \rightarrow \text{CH}_3\text{CH}_2 - \text{O} - \text{C}(\text{CH}_3)_3$
 (b) $(\text{CH}_3)_3\text{C} - \text{Cl} + \text{Na}^+\text{O}^-\text{CH}_2\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2 - \text{O} - \text{C}(\text{CH}_3)_3$
 (c) Both (a) and (b)
 (d) Neither (a) nor (b)

45. Which of the following is most reactive in nucleophilic addition reactions?

- (a) HCHO (b) CH_3CHO
 (c) CH_3COCH_3 (d) $\text{CH}_3\text{COC}_2\text{H}_5$

46. Which of the following does not give aldol condensation reaction?



47. For the reaction $3\text{A} \rightarrow 2\text{B}$, rate of reaction $+\frac{d[\text{B}]}{dt}$ is equal to

(a) $\frac{-3}{2} \frac{d[\text{A}]}{dt}$

(b) $\frac{-2}{3} \frac{d[\text{A}]}{dt}$

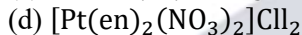
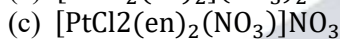
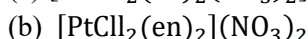
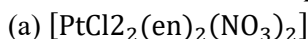
(c) $\frac{-1}{3} \frac{d[\text{A}]}{dt}$

(d) $+\frac{2}{3} \frac{d[\text{A}]}{dt}$

48. Which of the following characteristics of transition metals is associated with their catalytic activity?

- (a) Paramagnetic nature
- (b) Colour of hydrated ions
- (c) High enthalpy of atomisation
- (d) Variable oxidation states

49. The formula of the complex dichloridobis (ethane -1, 2-diamine) platinum (IV) nitrate is



Given below are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from the options given below :

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true, but (R) is not the correct explanation of (A).
- (c) (A) is true, but (R) is false.
- (d) (A) is false, but (R) is true.

50. Assertion (A) : Osmotic pressure is a colligative property.

Reason (R) : Osmotic pressure is proportional to the molality.

51. Assertion (A) : Conductivity decreases with decrease in concentration of electrolyte.

Reason (R) : Number of ions per unit volume that carry the current in a solution decreases on dilution.

52. Assertion (A) : Copper is a non-transition element.

Reason (R) : Copper has completely filled d-orbitals in its ground state.

53. Assertion (A) : Nucleophilic substitution of iodoethane is easier than chloroethane.

Reason (R) : Bond enthalpy of C-I bond is less than that of C-Cl bond.

SECTION – B

54. The vapour pressure of pure liquid X and pure liquid Y at 25°C are 120 mm Hg and 160 mm Hg respectively. If equal moles of X and Y are mixed to form an ideal solution, calculate the vapour pressure of the solution.

55. (A) Give reasons :

- (i) Mercury cell delivers a constant potential during its life time.
- (ii) In the experimental determination of electrolytic conductance, Direct Current (DC) is not used.

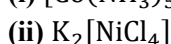
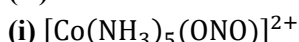
OR

(B) Define fuel cell with an example. What advantages do the fuel cells have over primary and secondary batteries?

56. (A) The conversion of molecule A to B followed second order kinetics. If concentration of A increased to three times, how will it affect the rate of formation of B ?

(B) Define Pseudo first order reaction with an example.

57. (A) Write the IUPAC names of the following :



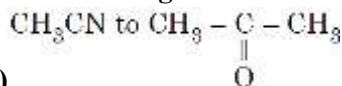
OR

- (B) (i) What is a chelate complex ? Give one example.
(ii) What are heteroleptic complexes? Give one example.

58. Write the chemical equation involved in the following reactions:

- (A) Reimer-Tiemann reaction
(B) Acetylation of Salicylic acid

59. Do the following conversions in not more than two steps:



(A)

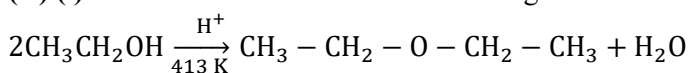


(B)

60. Write two differences between DNA and RNA.

SECTION – C

61. (A) (i) Write the mechanism of the following reaction :



(ii) Why ortho-nitrophenol is steam volatile while para-nitrophenol is not?

OR

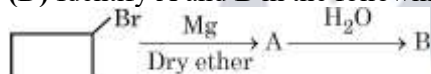
(B) What happens when

- (i) Anisole is treated with CH_3Cl / anhydrous AlCl_3 ?
(ii) Phenol is oxidised with $\text{Na}_2\text{Cr}_2\text{O}_7/\text{H}^+$?
(iii) $(\text{CH}_3)_3\text{C} - \text{OH}$ is heated with $\text{Cu}/573\text{ K}$?

Write chemical equation in support of your answer.

62. Answer any 3 of the following :

- (A) Which isomer of C_5H_{10} gives a single monochloro compound $\text{C}_5\text{H}_9\text{Cl}$ in bright sunlight?
(B) Arrange the following compounds in increasing order of reactivity towards $\text{S}_\text{N}2$ reaction :
2-Bromopentane, 1-Bromopentane, 2-Bromo-2-methylbutane
(C) Why p-dichlorobenzene has higher melting point than those of ortho and meta-isomers?
(D) Identify A and B in the following :



63. A first order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K . Calculate activation energy (E_a) for the reaction. [$R = 8.314\text{ J K}^{-1}\text{ mol}^{-1}$]
[Given : $\log 2 = 0.3010, \log 3 = 0.4771, \log 4 = 0.6021$]

64. When 19.5 g of $\text{F} - \text{CH}_2 - \text{COOH}$ (Molar mass = 78 g mol^{-1}), is dissolved in 500 g of water, the depression in freezing point is observed to be 1°C . Calculate the degree of dissociation of $\text{F} - \text{CH}_2 - \text{COOH}$.
[Given : K_f for water = $1.86\text{ K kg mol}^{-1}$]

65. (A) Draw the geometrical isomers of $[\text{Co}(\text{en})_2\text{Cl}_2]^{2+}$. Which geometrical isomer of $[\text{Co}(\text{en})_2\text{Cl}_2]^{2+}$ is not optically active and why?
(B) Write the hybridisation and magnetic behaviour of $[\text{CoF}_6]^{3-}$.
[Given : Atomic number of Co = 27]

SECTION - D

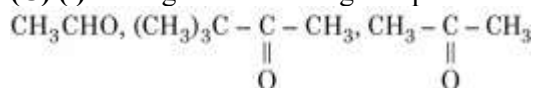
The following questions are case based questions. Read the passage carefully and answer the questions that follow :

66. The carbon - oxygen double bond is polarised in aldehydes and ketones due to higher electronegativity of oxygen relative to carbon. Therefore they undergo nucleophilic addition reactions with a number of nucleophiles such as HCN , NaHSO_3 , alcohols, ammonia derivatives and Grignard reagents. Aldehydes are easily oxidised by mild oxidising agents as compared to ketones. The carbonyl group of carboxylic acid does not give reactions of aldehydes and ketones. Carboxylic acids are considerably more acidic than alcohols and most of simple phenols.

Answer the following :

- (A) Write the name of the product when an aldehyde reacts with excess alcohol in presence of dry HCl .
(B) Why carboxylic acid is a stronger acid than phenol?

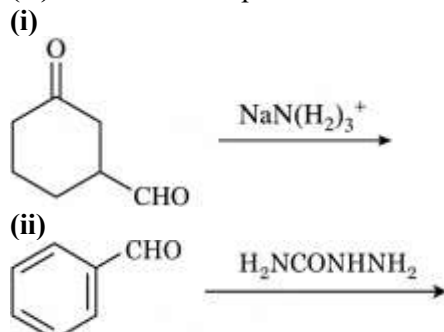
(C) (i) Arrange the following compounds in increasing order of their reactivity towards CH_3MgBr :



(ii) Write a chemical test to distinguish between propanal and propanone.

OR

(C) Write the main product in the following :



67. Carbohydrates are optically active polyhydroxy aldehydes and ketones. They are also called saccharides. All those carbohydrates which reduce Fehling's solution and Tollen's reagent are referred to as reducing sugars. Glucose, the most important source of energy for mammals, is obtained by the hydrolysis of starch. Vitamins are accessory food factors required in the diet. Proteins are the polymers of α -amino acids and perform various structural and dynamic functions in the organisms. Deficiency of vitamins leads to many diseases.

Answer the following :

(A) The penta-acetate of glucose does not react with Hydroxylamine. What does it indicate?

(B) Why cannot vitamin C be stored in our body ?

(C) Define the following as related to proteins :

(i) Peptide linkage

(ii) Denaturation

OR

(C) Define the following as related to carbohydrates:

(i) Anomers

(ii) Glycosidic linkage

SECTION – E

68. (A) (I) Account for the following :

(i) E° value for $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is much more positive than that for $\text{Cr}^{3+}/\text{Cr}^{2+}$.

(ii) Sc^{3+} is colourless whereas Ti^{3+} is coloured in an aqueous solution.

(iii) Actinoids show wide range of oxidation states.

(II) Write the chemical equations for the preparation of KMnO_4 from MnO_2 .

OR

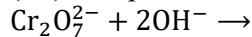
(B) (I) Account for the following:

(i) Transition metals form alloys.

(ii) Ce^{4+} is a strong oxidising agent.

(II) Write one similarity and one difference between chemistry of Lanthanoids and Actinoids.

(III) Complete the following ionic equation :



69. (A) (I) Give reasons :

(i) Aniline on nitration gives good amount of m-nitroaniline, though $-\text{NH}_2$ group is o/p directing in electrophilic substitution reactions.

(ii) $(\text{CH}_3)_2\text{NH}$ is more basic than $(\text{CH}_3)_3\text{N}$ in an aqueous solution.

(iii) Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.

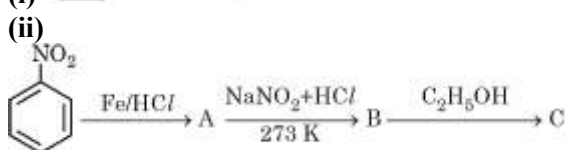
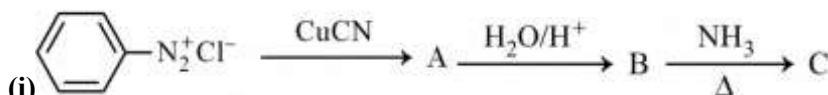
(II) Write the reaction involved in the following :

(i) Carbyl amine test

(ii) Gabriel phthalimide synthesis

OR

(B) (I) Write the structures of A, B and C in the following reactions :



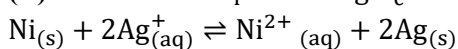
(II) Why aniline does not undergo Friedal-Crafts reaction?

(III) Arrange the following in increasing order of their boiling point :

C_2H_5OH , $C_2H_5NH_2$, $(C_2H_5)_3N$

70. (A) Conductivity of $2 \times 10^{-3} M$ methanoic acid is $8 \times 10^{-5} S cm^{-1}$. Calculate its molar conductivity and degree of dissociation if Λ_m° for methanoic acid is $404 S cm^2 mol^{-1}$.

(B) Calculate the $\Delta_r G^\circ$ and $\log K_c$ for the given reaction at 298 K :



Given : $E^\circ_{Ni^{2+}/Ni} = -0.25 V$, $E^\circ_{Ag^+/Ag} = +0.80 V$

$1 F = 96500 C mol^{-1}$.

General Instructions :

Read the following instructions very carefully and follow them:

- This question paper contains 35 questions. All questions are compulsory.
- Question paper is divided into FIVE sections - Section A, B, C, D and E.
- In section - A : Question Numbers 1 to 18 are Multiple Choice (MCQ) type Questions carrying 1 mark each.
- In section - B : Question Numbers 19 to 25 are Very Short Answer (VSA) type questions carrying 2 marks each.
- In section - C : Question Numbers 26 to 30 are Short Answer (SA) type questions carrying 3 marks each.
- In section - D : Question Numbers 31 and 32 are case based questions carrying 4 marks each.
- In section - E : Question Numbers 33 to 35 are Long Answer (LA) type questions carrying 5 marks each.
- There is no overall choice. However, an internal choice has been provided in 2 questions in Section - B, 2 questions in Section - C, 2 questions in Section - D and 2 questions in Section - E.
- Use of calculators is NOT allowed.

SECTION A

71. Which of the following is not true about enantiomers?

- They have the same density.
- They have the same melting or boiling point.
- They have the same specific rotation.
- They have the same chemical reactivity.

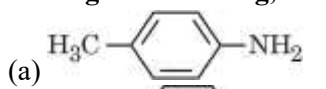
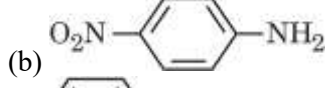
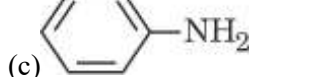
72. Aspirin is obtained by the acetylation of which of the following compounds?

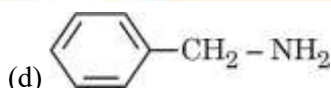
- Salicylaldehyde
- Salicylic acid
- Acetyl salicylic acid
- Phenol

73. The reactivities of the carbonyl compounds $HCHO$ (I), CH_3CHO (II) and CH_3COCH_3 (III) towards nucleophilic addition reaction decreases in the order :

- $III > II > I$
- $I > II > III$
- $II > III > I$
- $I > III > II$

74. Among the following, which is the strongest base ?

- 
- 
- 



75. On hydrolysis, which of the following carbohydrates gives only glucose ?

- (a) Starch (b) Fructose
(c) Lactose (d) Sucrose

76. Which of the following vitamins is water soluble?

- (a) Vitamin A (b) Vitamin D
(c) Vitamin E (d) Vitamin C

77. The unit of the rate of reaction is the same as that of the rate constant for a :

- (a) first order reaction
(b) second order reaction
(c) zero order reaction
(d) it cannot be same

78. Kohlrausch gave the following relation for strong electrolyte :

$$\Lambda = \Lambda_0 - A\sqrt{C}$$

Which of the following equality holds true?

- (a) $\Lambda = \Lambda_0$ as $C \rightarrow \sqrt{A}$
(b) $\Lambda = \Lambda_0$ as $C \rightarrow 0$
(c) $\Lambda = \Lambda_0$ as $C \rightarrow \infty$
(d) $\Lambda = \Lambda_0$ as $C \rightarrow 1$

79. An azeotropic mixture of two liquids has a boiling point higher than either of the two liquids when it :

- (a) shows large negative deviation from Raoult's law.
(b) shows no deviation from Raoult's law.
(c) shows large positive deviation from Raoult's law.
(d) obeys Raoult's law.

80. Which of the following colligative property is used to find the molar mass of proteins?

- (a) Osmotic pressure
(b) Elevation in boiling point
(c) Depression in freezing point
(d) Relative lowering of vapour pressure

81. Among the following outermost configurations of transition metals which one shows the highest oxidation state ?

- (a) $3d^3 4s^2$ (b) $3d^5 4s^1$
(c) $3d^5 4s^2$ (d) $3d^6 4s^2$

82. How many ions are produced in the solution from the complex $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$?

- (a) 4 (b) 3
(c) 2 (d) 5

83. Which of the following species is not expected to be a ligand ?

- (a) CO (b) NH_4^+
(c) NH_3 (d) H_2O

84. Which of the following is the most stable complex species ?

- (a) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ (b) $[\text{Fe}(\text{CN})_6]^{3-}$
(c) $[\text{Fe}(\text{CO})_5]$ (d) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

For Questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

85. Assertion (A) : Order and molecularity of a reaction are always same.

Reason (R) : Complex reactions involve a sequence of elementary reactions and the slowest step is rate determining.

86. Assertion (A) : Electrolysis of aqueous solution of NaCl gives chlorine gas at anode instead of oxygen gas.

Reason (R) : Formation of oxygen gas at anode requires overpotential.

87. Assertion (A) : Nucleophilic substitution of iodoethane is easier than chloroethane.

Reason (R) : Bond energy of C – Cl bond is less than C – I bond.

88. Assertion (A): Zinc is not regarded as a transition element.

Reason (R): In zinc, 3d orbitals are completely filled in its ground state as well as in its oxidised state.

SECTION B

89. Write the structures and IUPAC names of the products expected from the following reactions:

(A) Reaction of methanal with $(\text{CH}_3)_2\text{CHMgBr}$ followed by hydrolysis.

(B) Reaction of phenol with conc. HNO_3 .

90. A chemical reaction $2 \text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$ in gas phase was carried out in a closed vessel. The concentration of NO_2 was found to increase by $5 \times 10^{-8} \text{ mol L}^{-1}$ in 10 seconds. Calculate:

(A) the rate of formation of NO_2 , and

(B) the rate of consumption of N_2O_5 .

91. (A) Define fuel cell and write its two advantages.

OR

(B) Using E° values of X and Y given below, predict which is better for coating the surface of Iron to prevent corrosion and why?

Given :

$$E^\circ_{\text{X}^{2+}/\text{X}} = -2.36 \text{ V}$$

$$E^\circ_{\text{Y}^{2+}/\text{Y}} = -0.14 \text{ V}$$

$$E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$$

92. (A) (i) How are carbohydrates stored in animal body ? Mention any one organ where they are present.

(ii) What is the basic structural difference between starch and cellulose?

OR

(B) Differentiate between :

(i) Peptide linkage and Glycosidic linkage

(ii) Nucleoside and Nucleotide

93. Give reasons for the following :

(A) Carboxylic carbon is less electrophilic than Carbonyl carbon of aldehydes and ketones.

(B) Propanal is more reactive than Propanone towards addition of HCN .

94. Write the chemical equation involved in the following reactions :

(A) Carbylamine reaction

(B) Gabriel phthalimide synthesis

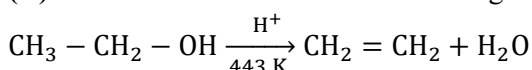
95. Give reasons for the following :

(A) Aquatic animals are more comfortable in cold water in comparison to warm water.

(B) Sprinkling of salt helps in clearing the snow-covered roads in hilly areas.

SECTION C

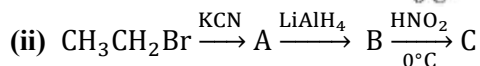
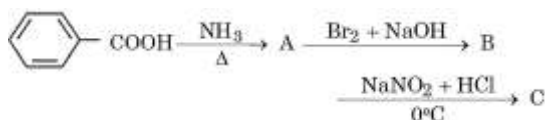
96. (A) Write the mechanism of the following reaction :



(B) Write the equation of the reaction for the preparation of phenol from cumene.

97. (A) Write the structures of A, B and C in the following reactions

(i)



OR

(B) How will you convert the following :

(i) Aniline to p-bromoaniline

(ii) Ethanoic acid to methanamine

(iii) Butanenitrile to 1-aminobutane

98. 0.3 g of acetic acid ($M = 60 \text{ g mol}^{-1}$) dissolved in 30 g of benzene shows a depression in freezing point equal to 0.45°C . Calculate the percentage association of acid if it forms a dimer in the solution.

(Given : K_f for benzene = $5.12 \text{ K kg mol}^{-1}$)

99. The rate of a reaction doubles when temperature changes from 27°C to 37°C . Calculate energy of activation for the reaction.

($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

(Given : $\log 2 = 0.3010, \log 3 = 0.4771, \log 4 = 0.6021$)

100. Write the structure of product when D-Glucose reacts with the following : (any three)

(A) HI

(B) Conc. HNO_3

(C) Br_2 water

(D) HCN

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

101. The polarity of C – X bond of alkyl halides is responsible for their nucleophilic substitution, elimination and their reaction with metal atoms to form organometallic compounds. Alkyl halides are prepared by the free radical halogenation of alkanes, addition of halogen acids to alkenes, replacement of -OH group of alcohols with halogens using phosphorus halides, thionyl chloride or halogen acids. Aryl halides are prepared by electrophilic substitution of arenes. Nucleophilic substitution reactions are categorised into S_N^1 and S_N^2 on the basis of their kinetic properties. Chirality has a profound role in understanding the S_N^1 and S_N^2 mechanism.

Answer the following questions :

(i) What happens when bromobenzene is treated with Mg in the presence of dry ether?

(ii) Which compound in each of the following pairs will react faster in S_N^1 reaction with OH^- ?

(1) $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{Cl}$ or $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl}$

(2) $(\text{CH}_3)_3\text{C} - \text{Cl}$ or CH_3Cl

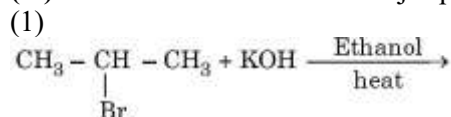
(iii) Write the equations for the preparation of 1-iodobutane from

(1) 1-chlorobutane

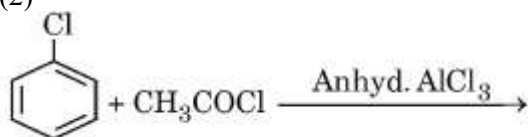
(2) but-1-ene.

OR

(iii) Write the structure of the major products in each of the following reactions :



(2)



102. Coordination compounds are widely present in the minerals, plant and animal worlds and are known to play many important functions in the area of analytical chemistry, metallurgy, biological systems and medicine. Alfred Werner's theory postulated the use of two types of linkages (primary and secondary), by a metal atom/ion in a

coordination compound. He predicted the geometrical shapes of a large number of coordination entities using the property of isomerism. The Valence Bond Theory (VBT) explains the formation, magnetic behaviour and geometrical shapes of coordination compounds. It, however, fails to describe the optical properties of these compounds. The Crystal Field Theory (CFT) explains the effect of different crystal fields (provided by the ligands taken as point charges) on the degeneracy of d-orbital energies of the central metal atom/ion.

Answer the following questions :

(i) When a coordination compound $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ is mixed with AgNO_3 solution, 2 moles of AgCl are precipitated per mole of the compound. Write the structural formula of the complex and secondary valency for Nickel ion.

(ii) Write the IUPAC name of the ionisation isomer of $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)]\text{Cl}$.

(iii) Using Valence Bond Theory, predict the geometry and magnetic nature of :

(1) $[\text{Ni}(\text{CO})_4]$

(2) $[\text{Fe}(\text{CN})_6]^{3-}$

[Atomic number : Ni = 28, Fe = 26]

OR

(iii) Give reasons :

(1) Low spin tetrahedral complexes are not formed.

(2) $[\text{Co}(\text{NH}_3)_6]^{3+}$ is an inner orbital complex whereas $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is an outer orbital complex.

[Atomic number : Co = 27, Ni = 28]

SECTION E

103. (A) (i) Account for the following :

(1) Transition metals form complex compounds.

(2) The $E_{\text{Mn}^{2+}/\text{Mn}}^\circ$ value for manganese is highly negative whereas $E_{\text{Mn}^\circ/\text{Mn}^{2+}}^{2+}$ is highly positive.

(3) Cu^+ ion is unstable in aqueous solution.

(ii) Write the equations involved in the preparation of KMnO_4 from Pyrolusite ore (MnO_2).

OR

(B) (i) Identify the following:

(1) Transition metal of 3d series that exhibits only one oxidation state.

(2) Transition metal of 3d series that acts as a strong reducing agent in +2 oxidation state in aqueous solution.

(ii) Complete and balance the following equations :

(1) $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{Fe}^{2+} \rightarrow$

(2) $\text{KMnO}_4 \xrightarrow{\text{heat}}$

(iii) What is Misch metal? Write its one use.

104. (A) (i) An organic compound (X) having molecular formula $\text{C}_5\text{H}_{10}\text{O}$ can show various properties depending on its structures. Draw each of the structures if it

(1) gives positive iodoform test.

(2) shows Cannizzaro's reaction.

(3) reduces Tollens' reagent and has a chiral carbon.

(ii) Write the reaction involved in the following :

(1) Wolff-Kishner reduction

(2) Hell-Volhard-Zelinsky reaction

OR

(B) (i) How can you convert each of the following compounds to Benzoic acid?

(1) Acetophenone

(2) Ethylbenzene

(3) Bromobenzene

(ii) Arrange the following compounds in increasing order of their property as indicated :

(1) $\text{O}_2\text{N}-\text{CH}_2-\text{COOH}$, $\text{F}-\text{CH}_2-\text{COOH}$, $\text{CN}-\text{CH}_2\text{COOH}$

(Acidic character)

(2) Ethanal, Propanal, Butanone, Propanone (Reactivity in nucleophilic addition reactions)

105. (A) Calculate the emf of the following cell at 25°C :

$\text{Zn(s)}|\text{Zn}^{2+}(0.1\text{M})||\text{H}^+(0.01\text{M})|\text{H}_2(\text{g})(1\text{bar}),\text{Pt(s)}$

[Given : $E_{\text{Zn}^{2+}/\text{Zn}}^\circ = -0.76 \text{ V}$, $E_{\text{H}^+/\text{H}_2}^\circ = 0.00 \text{ V}$, $\log 10 = 1$]

(B) State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution?

General Instructions :

Read the following instructions very carefully and follow them:

- This question paper contains 35 questions. All questions are compulsory.
- Question paper is divided into FIVE sections - Section A, B, C, D and E.
- In section - A : Question Numbers 1 to 18 are Multiple Choice (MCQ) type Questions carrying 1 mark each.
- In section - B : Question Numbers 19 to 25 are Very Short Answer (VSA) type questions carrying 2 marks each.
- In section - C : Question Numbers 26 to 30 are Short Answer (SA) type questions carrying 3 marks each.
- In section - D : Question Numbers 31 and 32 are case based questions carrying 4 marks each.
- In section - E : Question Numbers 33 to 35 are Long Answer (LA) type questions carrying 5 marks each.
- There is no overall choice. However, an internal choice has been provided in 2 questions in Section - B, 2 questions in Section - C, 2 questions in Section - D and 2 questions in Section - E.
- Use of calculators is NOT allowed.

SECTION A

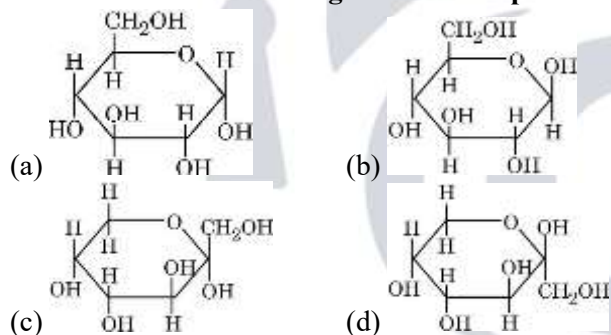
106. A compound undergoes complete tetramerization in a given organic solvent. The Van't Hoff factor ' i ' is :

- 4.0
- 0.25
- 0.125
- 2.0

107. The half-life for a zero order reaction equals:
where R is the initial concentration.

- $\frac{2k}{R}$
- $\frac{1}{2} \frac{k}{R^2}$
- $\frac{R^2}{2k}$
- $\frac{R}{2k}$

108. Which of the following structures represents α -D-glucose ?



109. The ions of metals of Group 12 (Zn, Cd and Hg) have completely filled d orbitals and so they :

- behave like semiconductors
- are very high melting solids
- do not behave like transition metals
- behave like superconductors

110. $[\text{Co}(\text{NH}_3)_5\text{NO}_3]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{NO}_3$ exhibit :

- linkage isomerism
- ionization isomerism
- optical isomerism
- coordination isomerism

111. Reaction of 1-phenyl-2-chloropropane with alcoholic KOH gives mainly :

- 1-phenylpropene
- 3-phenylpropene
- 1-phenylpropan-3-ol
- 1-phenylpropan-2-ol

112. When diethyl ether is heated with excess of HI, it produces :
 (a) ethanol (b) iodoform
 (c) methyl iodide (d) ethyl iodide
113. The reduction of ethanenitrile with sodium and alcohol gives :
 (a) 1-aminopropane (b) 1-aminoethane
 (c) Ethanoic acid (d) Ethanamide
114. How many Faradays are required to reduce 1 mol of MnO_4^- to Mn^{2+} ?
 (a) 4 (b) 3
 (c) 6 (d) 5
115. In a reaction, the initial concentration of the reactants increases four fold and the rate becomes sixteen times its initial value. The order of the reaction is :
 (a) 2.0 (b) 3.5
 (c) 1.5 (d) 2 · 5
116. On hydrolysis, which of the following carbohydrates gives only glucose ?
 (a) Maltose (b) Sucrose
 (c) Lactose (d) Galactose
117. Deficiency of which of the following vitamins causes Pernicious anaemia?
 (a) Vitamin B₁ (b) Vitamin B₂
 (c) Vitamin B₆ (d) Vitamin B₁₂
118. $\text{C}_6\text{H}_5\text{CHO} + \text{CH}_3\text{COCH}_3 \xrightarrow[\Delta]{\text{OH}^-} \text{C}_6\text{H}_5\text{CH} = \text{CH} - \text{COCH}_3$

This reaction is known as:

- (a) Aldol condensation
 (b) Cross-Aldol condensation
 (c) Cannizzaro's reaction
 (d) Friedel-Crafts reaction
119. In which of the following does the central atom exhibit an oxidation state of +3 ?
 (a) $\text{K}_2[\text{Ni}(\text{CN})_4]$ (b) $\text{K}_4[\text{Fe}(\text{CN})_6]$
 (c) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ (d) $[\text{Cu}(\text{NH}_3)_4]^{2+}$

For Questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is true, but Reason (R) is false.
 (d) Assertion (A) is false, but Reason (R) is true.
120. **Assertion (A)** : When NaCl is added to water, a depression in freezing point is observed.
Reason (R) : The lowering of vapour pressure of a solution causes depression in the freezing point.
121. **Assertion (A)** : Λ_m for weak electrolytes shows a sharp decrease when the electrolytic solution is diluted.
Reason (R) : For weak electrolytes, degree of dissociation increases with dilution of solution.
122. **Assertion (A)** : Zr and Hf have almost identical radii.
Reason (R) : Both Zr and Hf exhibit similar properties.
123. **Assertion (A)** : Monobromination of aniline can be conveniently done by protecting the amino group by acetylation.
Reason (R) : Acetylation decreases the activating effect of the amino group.

SECTION B

124. An alkyl halide (A) of molecular formula $\text{C}_6\text{H}_{18}\text{Cl}$ on treatment with alcoholic KOH gives two isomeric alkenes (B) and (C) of molecular formula C_6H_{12} . Both alkenes on hydrogenation give 2,3-dimethylbutane. Write the structures of (A), (B) and (C).
125. (A) What type of deviation from Raoult's law is shown by a mixture of ethanol and acetone? Give reason.

OR

(B) Define Azeotrope. What type of azeotrope is formed by negative deviation from Raoult's law? Give an example.

126. Name the cell which :

- (A) was used in Apollo Space programme.
- (B) is used in automobiles and inverters.
- (C) is suitable for hearing aids and watches.
- (D) does not give a steady potential and is used in transistors.

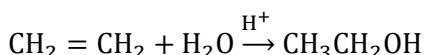
127. The rate constant for the first order decomposition of N_2O_5 is given by the following equation :

$$\log k = 23.6 - \frac{2 \times 10^4 \text{ K}}{T}$$

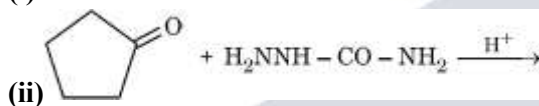
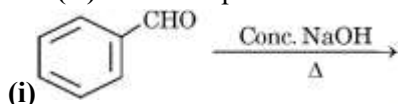
Calculate E_a for this reaction.

$$[R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}]$$

128. Write the mechanism of the following reaction :



129. (A) Write the products of the following reactions :

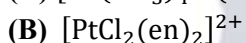
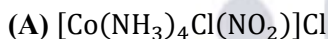


OR

(B) Do the following conversions in not more than two steps :

- (i) Toluene to Benzoic acid
- (ii) Benzaldehyde to 1-Phenylethanol

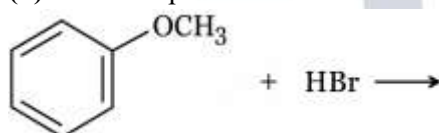
130. Write IUPAC names of the following coordination entities :



SECTION C

131. (A) (i) Write hydroboration-oxidation reaction with an example.

(ii) Write the products of the following reaction :



(iii) Why is p-nitrophenol more acidic than phenol?

OR

(B) (i) What happens when phenol reacts with

- (1) Conc. HNO_3 , and
 - (2) $CHCl_3$ in presence of aqueous NaOH followed by acidification?
- Write equations only.

(ii) Why does the reaction of CH_3ONa with $(CH_3)_3C-Br$ give 2-methylpropene and not $(CH_3)_3C-OCH_3$?

132. Account for the following :

- (A) Benzyl chloride is highly reactive towards S_N1 reaction.
- (B) ($\pm$)-Butan-2-ol is optically inactive, though it contains a chiral carbon atom.
- (C) Chloroform is stored in closed dark coloured bottles.

133. Answer any three of the following questions:

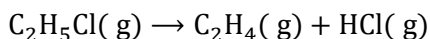
- (A) Explain the type of hybridization in $[Fe(CN)_6]^{3-}$ on the basis of valence bond theory. (Given : Atomic number of Fe = 26)
- (B) Draw the geometrical isomers of $[PtCl_2(en)_2]^{2+}$ ion.
- (C) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral. Why?

(D) Name the type of isomerism when ambidentate ligands are attached to central metal ion. Give one example of ambidentate ligand.

134. If benzoic acid ($M = 122 \text{ g mol}^{-1}$) is associated into a dimer when dissolved in benzene and the osmotic pressure of a solution of 6.1 g of benzoic acid in 100 mL benzene is 6.5 atm at 27°C , then what is the percentage association of benzoic acid ?

(Given : $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)

135. The following data were obtained during the first order thermal decomposition of $\text{C}_2\text{H}_5\text{Cl}$ at a constant volume :



Experiment	Time (s^{-1})	Total pressure (atm)
1	0	0.4
2	100	0.6

Calculate the rate constant.

(Given : $\log 2 = 0.3010, \log 3 = 0.4771, \log 4 = 0.6021$)

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

136. Living systems are made up of various complex biomolecules like carbohydrates, proteins, nucleic acids, lipids, etc. Carbohydrates are optically active polyhydroxy aldehydes or ketones or molecules which provide such units on hydrolysis. They are broadly classified into three groups - monosaccharides, oligosaccharides and polysaccharides. Monosaccharides are held together by glycosidic linkages to form disaccharides like sucrose, maltose or polysaccharides like starch and cellulose.

Another biomolecule : proteins are polymers of α -amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids. Structure and shape of proteins can be studied at four different levels i.e. primary, secondary, tertiary and quaternary, each level being more complex than the previous one.

Answer the following questions:

- What is the difference between a glycosidic linkage and peptide linkage?
- Which amino acids are called essential amino acids?
- What are the common types of secondary structures of proteins? Write any two forces which stabilise the secondary and tertiary structures of protein.

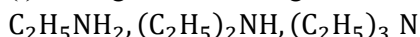
OR

(iii) Define denaturation of protein with an example. During denaturation which structures of protein lose their biological activity?

137. Amines are usually formed from nitro compounds, halides, amides, imides, etc. They exhibit hydrogen bonding which influences their physical properties. In alkyl amines, a combination of electron releasing, steric and hydrogen bonding factors influence the stability of the substituted ammonium cations in protic polar solvents and thus affect the basic nature of amines. In aromatic amines, electron releasing and withdrawing groups, respectively increase and decrease their basic character. Influence of the number of hydrogen atoms at nitrogen atom on the type of reactions and nature of products is responsible for identification and distinction between primary, secondary and tertiary amines. Presence of amino group in aromatic ring enhances reactivity of the aromatic amines. Aryl diazonium salts provide advantageous methods for producing aryl halides, cyanides, phenols and arenes by reductive removal of the diazo group.

Answer the following questions :

- Arrange the following in the increasing order of their pK_b values in aqueous solution :



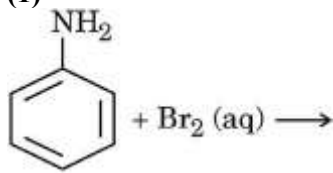
(ii) Aniline on nitration gives a substantial amount of m-nitroaniline, though amino group is o/p directing. Why ?

(iii) An aromatic compound 'A' of molecular formula $\text{C}_7\text{H}_6\text{O}_2$ on treatment with aqueous ammonia and heating forms compound 'B'. Compound 'B' on heating with Br_2 and aqueous KOH gives a compound 'C' of molecular formula $\text{C}_6\text{H}_7\text{N}$. Write the structures of A, B and C .

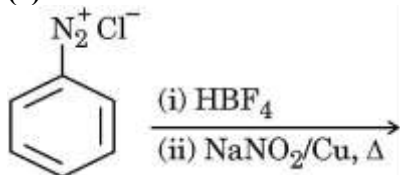
OR

(iii) Complete the following reactions giving main products:

(1)

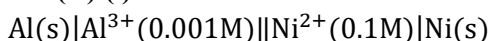


(2)



SECTION E

138. (A) (i) Calculate the emf of the following cell at 298 K :



[Given : $E^\circ_{\text{Al}^{3+}/\text{Al}} = -1.66 \text{ V}$, $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V}$, $\log 10 = 1$]

(ii) With the help of a graph explain why it is not possible to determine Λ°_m for a weak electrolyte by extrapolating the molar conductivity (Λ_m) versus $C^{1/2}$ curve as for strong electrolyte.

OR

(B) (i) The molar conductivities of NH_4^+ and Cl^- ion are $73.8 \text{ S cm}^2 \text{ mol}^{-1}$ and $76.2 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. The conductivity of $0.1\text{MNH}_4\text{Cl}$ is $1.29 \times 10^{-2} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation.

(ii) Calculate the half-cell potential at 298 K for the reaction



if $[\text{Zn}^{2+}] = 0.1\text{M}$ and $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$.

139. (A) (i) Account for the following :

(1) Zn^{2+} salts are colourless while Ni^{2+} salts are coloured.

(2) Cr^{2+} is a strong reducing agent.

(3) Transition metals and their compounds show catalytic activities.

(ii) Write the ionic equations for the oxidizing action of MnO_4^- in acidic medium with

(1) I^- ion, and

(2) Fe^{2+} ion.

OR

(B) (i) Name two oxometal anions of the 3d series of the transition metals in which the metal exhibits the oxidation state equal to its group number.

(ii) What is the effect of increasing pH on a solution of $\text{K}_2\text{Cr}_2\text{O}_7$?

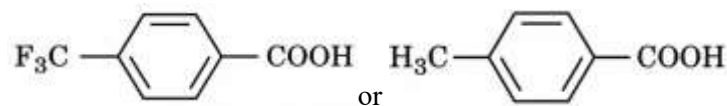
(iii) Why is Cu^+ not stable in aqueous solution?

(iv) Name a member of Lanthanoid series which is well-known to exhibit +4 oxidation state.

(v) Name two elements of 3d series which show anomalous electronic configuration.

140. (A) Draw structure of the 2,4-dinitrophenylhydrazone of benzaldehyde.

(B) Which acid of the following pair is a stronger acid ?



(C) Write the chemical equation involved in Rosenmund's reduction.

(D) Why are α -hydrogen atoms of aldehydes and ketones acidic in nature?

(E) Write a chemical test to distinguish between Benzaldehyde and Benzoic acid.

General Instructions :

Read the following instructions very carefully and follow them:

(i) This question paper contains 35 questions. All questions are compulsory.

(ii) Question paper is divided into FIVE sections - Section A, B, C, D and E.

(iii) In section - A : Question Numbers 1 to 18 are Multiple Choice (MCQ) type Questions carrying 1 mark each.

- (iv) In section - B : Question Numbers 19 to 25 are Very Short Answer (VSA) type questions carrying 2 marks each.
- (v) In section - C : Question Numbers 26 to 30 are Short Answer (SA) type questions carrying 3 marks each.
- (vi) In section - D : Question Numbers 31 and 32 are case based questions carrying 4 marks each.
- (vii) In section - E : Question Numbers 33 to 35 are Long Answer (LA) type questions carrying 5 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section - B, 2 questions in Section - C, 2 questions in Section - D and 2 questions in Section - E.
- (ix) Use of calculators is NOT allowed.

SECTION-A

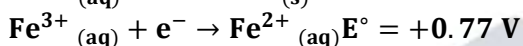
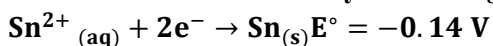
141. Which of the following molecules has a chiral centre correctly labelled with an asterisk (*) ?

- (a) $\text{CH}_3\text{C}^*\text{HBrCH}_3$ (b) $\text{CH}_3\text{C}^*\text{HClCH}_2\text{Br}$
 (c) $\text{HOCH}_2\text{C}^*\text{H}(\text{OH})\text{CH}_2\text{OH}$ (d) $\text{CH}_3\text{C}^*\text{Br}_2\text{CH}_3$

142. Which of the following alcohols will not undergo oxidation ?

- (a) Butanol (b) Butan-2-ol
 (c) 2-Methylbutan-2-ol (d) 3-Methylbutan-2-ol

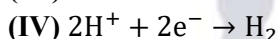
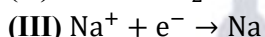
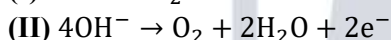
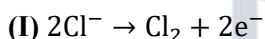
143. A voltaic cell is made by connecting two half cells represented by half equations below :



Which statement is correct about this voltaic cell?

- (a) Fe^{2+} is oxidised and the voltage of the cell is -0.91 V
 (b) Sn is oxidised and the voltage of the cell is 0.91 V
 (c) Fe^{2+} is oxidised and the voltage of the cell is 0.91 V
 (d) Sn is oxidised and the voltage of the cell is 0.63 V

144. Four half reactions I to IV are shown below :



Which two of these reactions are most likely to occur when concentrated brine is electrolysed?

- (a) I and III (b) I and IV
 (c) II and III (d) II and IV

145. Which property of transition metals enables them to behave as catalysts ?

- (a) High melting point
 (b) High ionisation enthalpy
 (c) Alloy formation
 (d) Variable oxidation states

146. In the two tetrahedral structures of dichromate ion

- (a) 4Cr – O bonds are equivalent in length.
 (b) 6Cr – O bonds are equivalent in length.
 (c) All Cr – O bonds are equivalent in length.
 (d) All Cr – O bonds are non-equivalent.

147. 1 mole of liquid A and 2 moles of liquid B make a solution having a total vapour pressure 40 torr. The vapour pressure of pure A and pure B are 45 torr and 30 torr respectively. The above solution

- (a) is an ideal solution.
 (b) shows positive deviation.
 (c) shows negative deviation.
 (d) is a maximum boiling azeotrope.

148. Which of the following would not be a good choice for reducing nitrobenzene to aniline?

- (a) LiAlH_4 (b) H_2/Ni
 (c) Fe and HCl (d) Sn and HCl

149. If molality of a dilute solution is doubled, the value of the molal elevation constant (K_b) will be

- (a) halved (b) doubled
(c) tripled (d) unchanged

150. Hydrolysis of sucrose is called

- (a) inversion (b) hydration
(c) esterification (d) saponification

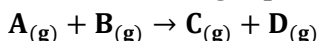
151. Which one of the following has lowest pK_a value ?

- (a) $CH_3 - COOH$ (b) $O_2N - CH_2 - COOH$
(c) $Cl - CH_2 - COOH$ (d) $HCOOH$

152. Which of the following cell was used in Apollo space programme ?

- (a) Mercury cell (b) Daniel cell
(c) $H_2 - O_2$ Fuel cell (d) Dry cell

153. The following experimental rate data were obtained for a reaction carried out at $25^\circ C$:



Initial $[A_{(g)}] / \text{mol dm}^{-3}$	Initial $[B_{(g)}] / \text{mol dm}^{-3}$	Initial rate / $\text{mol dm}^{-3} \text{ s}^{-1}$
3.0×10^{-2}	2.0×10^{-2}	1.89×10^{-4}
3.0×10^{-2}	4.0×10^{-2}	1.89×10^{-4}
6.0×10^{-2}	4.0×10^{-2}	7.56×10^{-4}

What are the orders with respect to $A_{(g)}$ and $B_{(g)}$?

Order with respect to $A_{(g)}$	Order with respect to $B_{(g)}$
(a) Zero	Second
(b) First	Zero
(c) Second	Zero
(d) Second	First

154. The magnetic moment of $[NiCl_4]^{2-}$

[Atomic number : Ni = 28]

- (a) 1.82 BM (b) 2.82 BM
(c) 4.42 BM (d) 5.46 BM

For questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below :

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

155. Assertion (A) : Proteins are polymers of α -amino acids connected by a peptide bond.

Reason (R) : A tetrapeptide contains 4 amino acids linked by 4 peptide bonds.

156. Assertion (A) : For a zero order reaction the unit of rate constant and rate of reaction are same.

Reason (R) : Rate of reaction for zero order reaction is independent of concentration of reactant.

157. **Assertion (A)** : Acetic acid but not formic acid can be halogenated in presence of red P and Cl₂.

Reason (R) : Acetic acid is a weaker acid than formic acid.

158. **Assertion (A)** : Trans [CrCl₂(ox)₂]³⁻ shows optical isomerism.

Reason (R) : Optical isomerism is common in octahedral complexes involving didentate ligands.

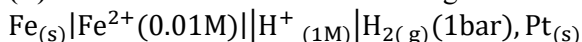
SECTION – B

159. (A) (i) What should be the signs (positive/negative) for E° Cell and ΔG° for a spontaneous redox reaction occurring under standard conditions?

(ii) State Faraday's first law of electrolysis.

OR

(B) Calculate the emf of the following cell at 298 K :



Given E°_{Cell} = 0.44 V.

160. What happens to the rate constant k and activation energy E_a as the temperature of a chemical reaction is increased? Justify.

161. (A) Which of the following species cannot act as a ligand ?

Give reason. OH⁻, NH₄⁺, CH₃NH₂, H₂O

(B) The complex [Co(NH₃)₅(NO₂)]Cl₂ is red in colour. Give IUPAC name of its linkage isomer.

162. Why is boiling point of o-dichlorobenzene higher than p-dichlorobenzene but melting point of para isomer is higher than ortho isomer?

163. For the pair phenol and cyclohexanol, answer the following :

(A) Why is phenol more acidic than cyclohexanol?

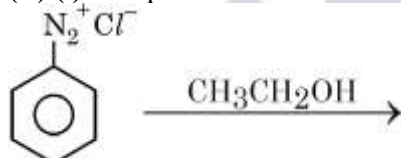
(B) Give one chemical test to distinguish between the two.

164. (A) (i) Draw the zwitter ion structure for sulphanilic acid.

(ii) How can the activating effect of –NH₂ group in aniline be controlled?

OR

(B) (i) Complete the reaction with the main product formed :

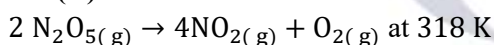


(ii) Convert Bromoethane to Propanamine.

165. Give the reaction of glucose with hydrogen cyanide. Presence of which group is confirmed by this reaction?

SECTION - C

166. (A) For the reaction



calculate the rate of reaction if rate of disappearance of N₂O_{5(g)} is 1.4 × 10⁻³ m s⁻¹.

(B) For a first order reaction derive the relationship t_{99%} = 2t_{90%}

167. (A) On the basis of crystal field theory write the electronic configuration for d⁵ ion with a strong field ligand for which Δ₀ > P.

(B) [Ni(CO)₄] has tetrahedral geometry while [Ni(CN)₄]²⁻ has square planar yet both exhibit diamagnetism. Explain.

[Atomic number : Ni = 28]

168. (A) Illustrate Sandmeyer's reaction with an equation.

(B) Explain, why (CH₃)₂NH is more basic than (CH₃)₃N in aqueous solution.

169. Give reasons for any 3 of the following observations :

(A) Penta-acetate of glucose does not react with hydroxylamine.

(B) Amino acids behave like salts.

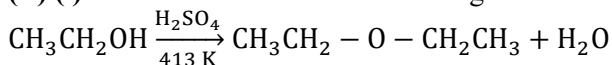
(C) Water soluble vitamins must be taken regularly in diet.

(D) The two strands in DNA are complementary to each other.

170. (A) (i) Why is the C – O bond length in phenols less than that in methanol?
(ii) Arrange the following in order of increasing boiling point : Ethoxyethane, Butanal, Butanol, n-butane
(iii) How can phenol be prepared from anisole? Give reaction.

OR

- (B) (i) Give mechanism of the following reaction :



- (ii) Illustrate hydroboration-oxidation reaction with an example.

SECTION - D

The following questions are case - based questions. Read the passage carefully and answer the questions that follow :

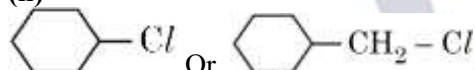
171. Nucleophilic Substitution

Nucleophilic Substitution reaction of haloalkane can be conducted according to both $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ mechanisms. $\text{S}_{\text{N}}1$ is a two step reaction while $\text{S}_{\text{N}}2$ is a single step reaction. For any haloalkane which mechanism is followed depends on factors such as structure of haloalkane, properties of leaving group, nucleophilic reagent and solvent. Influences of solvent polarity : In $\text{S}_{\text{N}}1$ reaction, the polarity of the system increases from the reactant to the transition state, because a polar solvent has a greater effect on the transition state than the reactant, thereby reducing activation energy and accelerating the reaction. In $\text{S}_{\text{N}}2$ reaction, the polarity of the system generally does not change from the reactant to the transition state and only charge dispersion occurs. At this time, polar solvent has a great stabilizing effect on Nu than the transition state, thereby increasing activation energy and slow down the reaction rate. For example, the decomposition rate ($\text{S}_{\text{N}}1$) of tertiary chlorobutane at 25°C in water (dielectric constant 79) is 300000 times faster than in ethanol (dielectric constant 24). The reaction rate ($\text{S}_{\text{N}}2$) of 2-Bromopropane and NaOH in ethanol containing 40% water is twice slower than in absolute ethanol. Hence the level of solvent polarity has influence on both $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reaction, but with different results. Generally speaking weak polar solvent is favourable for $\text{S}_{\text{N}}2$ reaction, while strong polar solvent is favourable for $\text{S}_{\text{N}}1$. Generally speaking the substitution reaction of tertiary haloalkane is based on $\text{S}_{\text{N}}1$ mechanism in solvents with a strong polarity (for example ethanol containing water).

Answer the following questions :

- (A) Why racemisation occurs in $\text{S}_{\text{N}}1$?
(B) Why is ethanol less polar than water?
(C) Which one of the following in each pair is more reactive towards $\text{S}_{\text{N}}2$ reaction?
(i) $\text{CH}_3 - \text{CH}_2 - \text{I}$ or $\text{CH}_3\text{CH}_2 - \text{Cl}$

(ii)



OR

- (C) Arrange the following in the increasing order of their reactivity towards $\text{S}_{\text{N}}1$ reactions :

- (i) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane
(ii) 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 2-Bromo-3methylbutane

172. Rahul set-up an experiment to find resistance of aqueous KCl solution for different concentrations at 298 K using a conductivity cell connected to a Wheatstone bridge. He fed the Wheatstone bridge with a.c. power in the audio frequency range 550 to 5000 cycles per second. Once the resistance was calculated from null point he also calculated the conductivity K and molar conductivity Λ_{m} and recorded his readings in tabular form.

	Conc. (M)	k S cm ⁻¹	Λ_{m} S cm ² mol ⁻¹
1.	1.00	111.3×10^{-3}	111.3
2.	0.10	12.9×10^{-3}	129.0

3.	0.01	$\frac{1.41}{\times 10^{-3}}$	141.0
----	------	-------------------------------	-------

Answer the following questions:

(A) Why does conductivity decrease with dilution?

(B) If Λ_m° of KCl is $150.0 \text{ S m}^2 \text{ mol}^{-1}$, calculate the degree of dissociation of 0.01 M KCl.

(C) If Rahul had used HCl instead to KCl then would you expect the Λ_m values to be more or less than those per KCl for a given concentration. Justify.

OR

(C) Amit, a classmate of Rahul repeated the same experiment with CH_3COOH solution instead of KCl solution. Give one point that would be similar and one that would be different in his observations as compared to Rahul.

SECTION-E

173. (A) (i) Why is boiling point of 1 M NaCl solution more than that of 1 M glucose solution?

(ii) A non-volatile solute 'X' (molar mass = 50 g mol^{-1}) when dissolved in 78 g of benzene reduced its vapour pressure to 90%. Calculate the mass of X dissolved in the solution.

(iii) Calculate the boiling point elevation for a solution prepared by adding 10 g of MgCl_2 to 200 g of water assuming MgCl_2 is completely dissociated.

(K_b for Water = $0.512 \text{ K kg mol}^{-1}$, Molar mass $\text{MgCl}_2 = 95 \text{ g mol}^{-1}$)

OR

(B) (i) Why is the value of Van't Hoff factor for ethanoic acid in benzene close to 0.5 ?

(ii) Determine the osmotic pressure of a solution prepared by dissolving $2.32 \times 10^{-2} \text{ g}$ of K_2SO_4 in 2 L of solution at 25°C , assuming that K_2SO_4 is completely dissociated.

($R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$, Molar mass $\text{K}_2\text{SO}_4 = 174 \text{ g mol}^{-1}$)

(iii) When 25.6 g of Sulphur was dissolved in 1000 g of benzene, the freezing point lowered by 0.512 K . Calculate the formula of Sulphur (S_x).

(K_f for benzene = $5.12 \text{ K kg mol}^{-1}$, Atomic mass of Sulphur = 32 g mol^{-1})

174. (A) (i) Write the reaction involved in Cannizaro's reaction.

(ii) Why are the boiling point of aldehydes and ketones lower than that of corresponding carboxylic acids?

(iii) An organic compound 'A' with molecular formula $\text{C}_5\text{H}_8\text{O}_2$ is reduced to n-pentane with hydrazine followed by heating with NaOH and Glycol. 'A' forms a dioxime with hydroxylamine and gives a positive Iodoform and Tollen's test. Identify 'A' and give its reaction for Iodoform and Tollen's test.

OR

(B) (i) Give a chemical test to distinguish between ethanal acid and ethanoic acid.

(ii) Why is the α -hydrogens of aldehydes and ketones are acidic in nature?

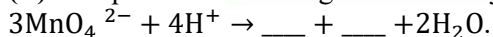
(iii) An organic compound 'A' with molecular formula $\text{C}_4\text{H}_8\text{O}_2$ undergoes acid hydrolysis to form two compounds 'B' and 'C'. Oxidation of 'C' with acidified potassium permanganate also produces 'B'. Sodium salt of 'B' on heating with soda lime gives methane.

(1) Identify 'A', 'B' and 'C'.

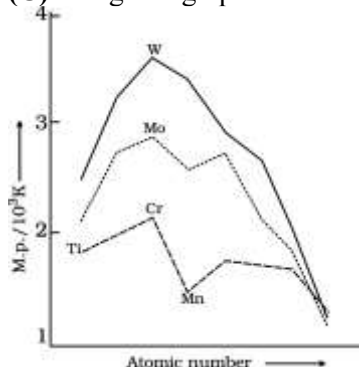
(2) Out of 'B' and 'C', which will have higher boiling point ? Give reason.

175. (A) Why is chemistry of actinoids complicated as compared to lanthanoids?

(B) Complete the following reaction and justify that it is a disproportionation reaction :



(C) The given graph shows the trends in melting points of transition metals:



Explain the reason why Cr has highest melting point and manganese (Mn) a lower melting point.

General Instructions :

Read the following instructions very carefully and follow them:

- (i) This question paper contains 35 questions. All questions are compulsory.
- (ii) Question paper is divided into FIVE sections - Section A, B, C, D and E.
- (iii) In section - A : Question Numbers 1 to 18 are Multiple Choice (MCQ) type Questions carrying 1 mark each.
- (iv) In section - B : Question Numbers 19 to 25 are Very Short Answer (VSA) type questions carrying 2 marks each.
- (v) In section - C : Question Numbers 26 to 30 are Short Answer (SA) type questions carrying 3 marks each.
- (vi) In section - D : Question Numbers 31 and 32 are case based questions carrying 4 marks each.
- (vii) In section - E : Question Numbers 33 to 35 are Long Answer (LA) type questions carrying 5 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section - B, 2 questions in Section - C, 2 questions in Section - D and 2 questions in Section - E.
- (ix) Use of calculators is NOT allowed.

SECTION A

176. For an electrolyte undergoing dissociation in an aqueous solution the Van't Hoff factor :

- (a) is always less than one.
- (b) is always greater than one.
- (c) has zero value.
- (d) has negative value.

177. Which of the following cells has a constant voltage throughout its life?

- (a) Dry cell
- (b) Electrolytic cell
- (c) Mercury cell
- (d) Daniell cell

178. How many Faradays are required to reduce one mole of Sn^{4+} to Sn^{2+} ?

- (a) 2.0
- (b) 4.0
- (c) 1.0
- (d) 6.0

179. For the reaction $\text{A} + 2\text{B} \rightarrow 3\text{C} + \text{D}$, $d[\text{C}]/dt$ is equal to :

- (a) $-\frac{d[\text{A}]}{dt}$
- (b) $-\frac{d[\text{B}]}{dt}$
- (c) $+\frac{3}{2}\frac{d[\text{A}]}{dt}$
- (d) $-\frac{3}{2}\frac{d[\text{B}]}{dt}$

180. The unit of rate constant and rate of reaction are identical for a :

- (a) zero order reaction
- (b) first order reaction
- (c) second order reaction
- (d) third order reaction

181. Which of the following transition metals do not show variable oxidation states?

- (a) Cu
- (b) Ti
- (c) Mn
- (d) Sc

182. The coordination number of Ag in $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$ is :

- (a) 3
- (b) 1
- (c) 2
- (d) 4

183. Amongst the following, the most stable complex is :

- (a) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$
- (b) $[\text{FeCl}_6]^{3-}$
- (c) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
- (d) $[\text{Fe}(\text{NH}_3)_6]^{3+}$

184. Acetyl chloride is treated with H_2 in the presence of $\text{Pd} - \text{BaSO}_4$. The product formed is :

- (a) $\text{CH}_3\text{CH}_2\text{OH}$
- (b) CH_3CHO
- (c) CH_3COOH
- (d) CH_3COCH_3

185. The Gabriel phthalimide synthesis is used for the preparation of:

- (a) primary aromatic amines
- (b) primary aliphatic amines

- (c) secondary amines
(d) tertiary amines

186. The action of nitrous acid on ethylamine gives mainly :

- (a) ethyl nitrite (b) ethane
(c) nitroethane (d) ethyl alcohol

187. The helix structure of proteins is stabilized by:

- (a) peptide bonds (b) disulphide bonds
(c) hydrogen bonds (d) Van der Waals forces

188. The deficiency of which Vitamin causes rickets?

- (a) Vitamin A (b) Vitamin B
(c) Vitamin C (d) Vitamin D

189. Oligosaccharides on hydrolysis could yield :

- (a) 3 to 9 monosaccharides
(b) 4 to 10 monosaccharides
(c) more than 10 monosaccharides
(d) 3 to 10 monosaccharides

For Questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

190. Assertion (A) : Molarity of solution in liquid state changes with temperature.

Reason (R): The volume of a solution changes with change in temperature.

191. Assertion (A) : Fe^{2+} acts as a reducing agent.

Reason (R): Fe^{3+} state is stable due to 3 d^5 configuration.

192. Assertion (A) : Nucleophilic substitution reaction of an optically active halide gives a mixture of enantiomers.

Reason (R): $\text{S}_{\text{N}}2$ reactions of optically active halides are accompanied by inversion of configuration.

193. Assertion (A) : The boiling point of ethanol is lower than that of diethyl ether.

Reason (R) : In ethanol, the molecules are associated due to intermolecular hydrogen bonding, whereas in diethyl ether it is not possible.

SECTION B

194. What type of deviation from Raoult's law is shown by chloroform and acetone solution? Give reason.

195. (A) Write anode, cathode and overall reaction of lead storage battery.

OR

(B) Define fuel cell with an example. Write two advantages of fuel cell compared to other ordinary cells.

196. Write two differences between order of reaction and molecularity of reaction.

197. (A) Using IUPAC norms, write the systematic names of the following complexes :

- (i) $\text{K}_3[\text{Fe}(\text{CN})_6]$
(ii) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$

OR

(B) Write the role of coordination compounds with an example in each of the following :

- (i) Biological system
(ii) Extraction of metals

198. What happens when :

- (A) 1-chlorobutane is treated with alcoholic KOH ?
(B) Chlorobenzene is treated with sodium in dry ether?

199. Write the chemical equation involved in :

- (A) Reimer-Tiemann reaction
(B) Williamson ether synthesis

200. Give reasons :

- (A) Oxidation of aldehydes is easier than that of ketones.
(B) Carboxylic acid is a stronger acid than phenol.

SECTION C

201. The freezing point of a solution containing 5 g of benzoic acid ($M = 122 \text{ g mol}^{-1}$) in 35 g of benzene is depressed by 2.94 K. What is the percentage association of benzoic acid if it forms a dimer in solution? (K_f for benzene = $4.9 \text{ K kg mol}^{-1}$)
202. The rate constant of a reaction is $2 \times 10^{-2} \text{ s}^{-1}$ at 300 K and $8 \times 10^{-2} \text{ s}^{-1}$ at 340 K. Calculate the energy of activation of the reaction.
[$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$], [$\log 2 = 0.3010, \log 4 = 0.6021$]
203. (A) What is a 'chelate complex'? Give an example.
(B) Write the hybridisation and magnetic character of $[\text{FeF}_6]^{3-}$.
[Atomic number : Fe = 26]
(C) What type of isomerism is shown by the coordination compound $[\text{Cr}(\text{H}_2\text{O})_5\text{BrSO}_4]$?
204. Answer any three of the following :
(A) p-nitrochlorobenzene undergoes nucleophilic substitution reaction faster than chlorobenzene.
(B) Why is (±)-Butan-2-ol optically inactive, though it contains a chiral carbon atom?
(C) Why is chloroform kept in airtight dark coloured bottle?
(D) Write the major product formed when 2-Bromobutane is heated with alcoholic KOH.
205. (A) How do you convert the following :
(i) Phenol to Benzene
(ii) Ethanol to propan-2-ol
(iii) Anisole to 2-methoxyacetophenone
OR
(B) (i) How will you distinguish between primary, secondary and tertiary alcohol by Lucas reagent?
(ii) Why is o-nitrophenol steam volatile while p-nitrophenol is not?

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

206. Amines can be considered as derivatives of ammonia obtained by replacement of hydrogen atoms with alkyl or aryl groups. Like ammonia, all the three types of amines have one unshared electron pair on nitrogen atom due to which they behave as Lewis bases. Amines are usually formed from nitro compounds, halides, amides, etc. They exhibit hydrogen bonding which influences their physical properties. Alkyl amines are found to be stronger bases than ammonia. In aromatic amines, electron releasing and withdrawing groups, respectively increase and decrease their basic character.

Answer the following :

- (i) Out of aniline and methylamine, which is a stronger base and why?
(ii) Why does tertiary amine have lower boiling point than primary amine of comparable molecular masses?
(iii) What happens when :
(1) Ethanamide is heated with Br_2 and aqueous KOH?
(2) Benzene diazonium chloride is treated with Ethanol?

OR

(iii) Write short notes on the following:

- (1) Carbylamine reaction
(2) Acetylation of aniline

207. Carbohydrates are broadly classified into three groups: monosaccharides, oligosaccharides and polysaccharides. Monosaccharides are held together by glycosidic linkages to form disaccharides or polysaccharides.

Proteins which contain only α -amino acids are called simple proteins. Proteins get denatured if subjected to change in temperature or pH.

Answer the following :

(i) What is the difference between glycosidic linkage and peptide linkage?

(ii) What is the effect of denaturation on the structures of protein?

(iii) Define the following terms:

(1) Essential amino acids

(2) Anomers

OR

(iii) What are the hydrolysis products of :

(1) Sucrose

(2) Lactose

SECTION E

208. (A) 'A' and 'B' are two functional isomers of compound C_3H_6O . On heating with NaOH and I_2 , isomer 'B' forms yellow precipitate of iodoform whereas isomer 'A' does not form any precipitate. Identify 'A' and 'B'.

(B) Give reasons for the following :

(i) Carboxylic acid does not give reactions of carbonyl group.

(ii) Propanone is less reactive towards nucleophilic addition reaction as compared to propanal.

(C) Write a simple chemical test to distinguish between benzoic acid and phenol.

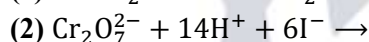
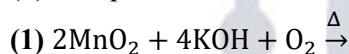
209. (A) (i) Account for the following:

(1) Mn shows the highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation state of +4.

(2) Cr^{2+} is a strong reducing agent.

(3) Cu^{2+} salts are coloured while Zn^{2+} salts are white.

(ii) Complete and balance the following chemical equations:



OR

(B) (i) The elements of 3d transition series are given as: Sc Ti V Cr Mn Fe Co Ni Cu Zn

Answer the following :

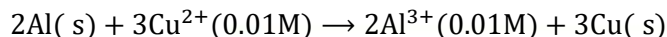
(1) Which element has the highest melting point and why ?

(2) Which element is most stable in +2 oxidation state and why?

(3) Which element has lowest enthalpy of atomisation and why?

(ii) Write the preparation of $Na_2Cr_2O_7$ from chromite ore.

210. (A) (i) Calculate E_{cell}^0 for the following reaction at 298 K :



Given : $E_{cell} = 1.98 V, \log 10 = 1$

(ii) Using the E° values of A and B, predict which is better for coating the surface of iron ($E^\circ_{2+} = -0.44 V$) to prevent corrosion and why?

Given :

$$E^\circ_{(A^{2+}/A)} = -2.37 V$$

$$E^\circ_{(B^{2+}/B)} = -0.14 V$$

OR

(B) (i) The conductivity of 0.001 M solution of CH_3COOH is $3.905 \times 10^{-5} S cm^{-1}$. Calculate its degree of dissociation (α).

Given :

$$\lambda^\circ_{(CH_3COO^-)} = 40.9 S cm^2 mol^{-1}$$

$$\lambda^\circ_{H^+} = 349.6 S cm^2 mol^{-1}$$

(ii) State Faraday's second law of electrolysis.

(iii) What happens if external potential applied becomes greater than E_{cell}^0 of electrochemical cell?