

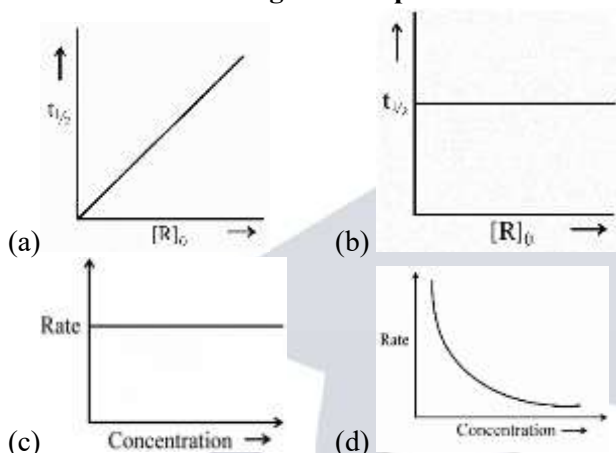
General Instructions :

Read the following instructions carefully and follow them :

- (i) This question paper contains 33 questions. All questions are compulsory.
- (ii) This question paper is divided into five sections - Section A, B, C, D and E.
- (iii) Section A - questions number 1 to 16 are multiple choice type questions. Each question carries 1 mark.
- (iv) Section B - questions number 17 to 21 are very short answer type questions. Each question carries 2 marks.
- (v) Section C - questions number 22 to 28 are short answer type questions. Each question carries 3 marks.
- (vi) Section D - questions number 29 and 30 are case-based questions. Each question carries 4 marks.
- (vii) Section E - questions number 31 to 33 are long answer type questions. Each question carries 5 marks.
- (viii) There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.
- (ix) Kindly note that there is a separate question paper for Visually Impaired candidates.
- (x) Use of calculator is not allowed.

SECTION – A

1. Which of the following curve represents the first order reaction?



2. Which of the following solutions will have the lowest freezing point in water?

- (a) 0.1 M Glucose
- (b) 0.1M CaCl_2
- (c) 0.1 M KCl
- (d) 0.1 M Urea

3. Which of the following is not a transition metal ?

- (a) Sc
- (b) Ag
- (c) Hg
- (d) Cu

4. Which of the following represents the fraction of molecules with energies equal to or greater than E_a ?

- (a) $+\frac{E_a}{RT}$
- (b) $e^{-E_a/RT}$
- (c) $-\frac{E_a}{RT}$
- (d) $e^{+E_a/RT}$

5. What will happen during the electrolysis of aqueous solution of CuCl_2 by using platinum electrodes?

- (a) Cu will deposit at Anode
- (b) H_2 gas will be released at cathode
- (c) O_2 gas will be released at anode
- (d) Cl_2 gas will be released at anode

6. Aspirin is obtained by acetylation of

- (a) Phenol
- (b) Salicylaldehyde
- (c) 2-Hydroxybenzoic acid
- (d) Benzoic acid

7. The secondary valency of Co in the complex $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$ is

- (a) 5
- (b) 1
- (c) 4
- (d) 6

8. At low temperature, phenol reacts with dil. HNO_3 to yield

- (a) 2, 4, 6-Trinitrophenol
- (b) o-Nitrophenol only

- (c) p-Nitrophenol only
(d) ortho-and para-nitrophenol

9. Which of the following is 'not' true about enantiomers?

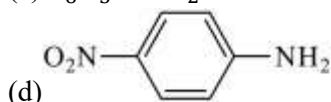
- (a) They have the same chemical reactivity.
(b) They have the same specific rotation.
(c) They have the same melting or boiling point.
(d) They have the same refractive index.

10. Aniline on direct nitration yields

- (a) 51%-ortho, 47%-para, 2%-meta derivatives
(b) 51%-meta, 47%-ortho, 2%-para derivatives
(c) 51%-para, 47%-meta, 2%-ortho derivatives
(d) 51%-ortho, 47%-meta, 2%-para derivatives

11. Which of the following amines has lowest pK_b value ?

- (a) $C_6H_5 - N(CH_3)_2$
(b) $C_6H_5 - NH(CH_3)$
(c) $C_6H_5 - NH_2$



12. The deficiency of which of the following vitamins causes increased fragility of red blood cells and muscular weakness:

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

For questions number 13 to 16, 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.

13. Assertion (A) : It is not possible to separate the components of an azeotrope by fractional distillation.

Reason (R) : Components of an azeotrope have the same composition in liquid and vapour phase and boil at a constant temperature.

14. Assertion (A) : The presence of -OH group in phenols directs the incoming group to meta position in the ring.

Reason (R) : -OH group in phenols activates the aromatic ring towards electrophilic substitution reaction.

15. Assertion (A) : Actinoids show wide range of oxidation states.

Reason (R) : Actinoids are radioactive in nature.

16. Assertion (A) : The pentaacetate of glucose does not react with H_2N-OH .

Reason (R) : It indicates the presence of free -CHO group in glucose.

SECTION – B

17. What type of deviation from Raoult's law is shown by a mixture of phenol and aniline? Give reason.

What will happen to the boiling point of the solution on mixing phenol and aniline?

18. Why are haloarenes less reactive towards nucleophilic substitution reaction? Give two reasons.

19. (A) Write IUPAC names of the following coordination compounds:

- (i) $[Ag(NH_3)_2][Ag(CN)_2]$
(ii) $K_3[Fe(C_2O_4)_3]$

OR

(B) (i) Give a chemical test to show that $[Co(NH_3)_5SO_4]Cl$ and $[Co(NH_3)_5Cl]SO_4$ are ionisation isomers.

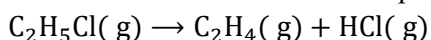
(ii) What is meant by the 'Chelate effect'? Give an example.

20. Differentiate between the following:

- (i) Peptide linkage and Glycosidic linkage
- (ii) Essential amino acids and Non-essential amino acids

21. Following reaction takes place in one step :


How will the rate of above reaction change if the volume of the reaction vessel is decreased to one third of its original volume ? Will there be any change in the order of reaction with the reduced volume?

SECTION – C
22. For the first order thermal decomposition reaction, following data was obtained :


S. No.	Time (s)	Total Pressure (atm)
1	0	0.30
2	30	0.50

Calculate rate constant.

[Given : $\log 3 = 0.48$]

23. (A) Answer the following :

- (i) Why is the Equilibrium Constant (K_c) related to E_{cell}° and not to E_{cell} ?
- (ii) Two metals 'A' and 'B' have standard electrode potential values of -0.24 V and +0.80 V respectively. Which of these will liberate hydrogen gas from dil. H_2SO_4 ?
- (iii) Write the cell reaction which occurs in lead storage battery when it is in charging.

OR

(B) What type of battery is Mercury cell ? Why it is more advantageous than dry cell? Write overall reaction taking place in Mercury cell.

24. Calculate the boiling point of a solution containing 0.61 g of benzoic acid (Molar mass = 122 g mol^{-1}) in 5 g° of CS_2 in which it dimerises to the extent of 88%. The boiling point and K_b of CS_2 are 46.2°C and $2.3 \text{ K kg mol}^{-1}$ respectively.
25. Write the reactions of D-Glucose with the following :

- (A) HI
- (B) Br_2 water
- (C) Conc. HNO_3

26. Give reasons for the following :

- (A) Carboxylic acids have higher boiling point than alcohols of comparable molecular masses.
- (B) Alpha (α) hydrogens of aldehydes and ketones are acidic in nature.
- (C) Nucleophilic addition of ammonia and its derivatives does not occur with carbonyl group in strongly acidic medium.

27. Write the reaction involved in the following :

- (A) Reimer-Tiemann reaction
- (B) Kolbe's reaction
- (C) Friedel-Crafts acylation of anisole

28. Compound 'X' with molecular formula C_4H_9Br reacts with aqueous KOH to give an alcohol. The rate of this reaction depends only on the concentration of the compound 'X'. When an optically active isomer 'Y' of the compound 'X' was treated with aqueous KOH solution, the rate of reaction was found to be dependent on concentration of compound 'Y' and aqueous KOH both.

- (A) Write down the structural formula of both 'X' and 'Y'.
- (B) Out of 'X' and 'Y', which one will undergo racemisation and why?
- (C) Out of 'X' and 'Y', which one will form product with inversion of configuration and why ?

SECTION – D

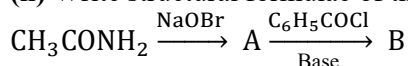
The following questions are case-based questions. Read the passage carefully and answer the questions that follow.

29. The reaction of amines with mineral acids to form ammonium salts shows that these are basic in nature. Aliphatic amines are stronger bases than ammonia whereas aromatic amines are weaker bases than ammonia. Aliphatic and aromatic primary and secondary amines react with acid chlorides, anhydrides and esters by nucleophilic substitution reaction. The main problem encountered during electrophilic substitution reactions of aromatic amines is that of their high reactivity. Substitution tends to occur at ortho-and para-positions. Hinsberg reagent is used for the identification and distinction between primary, secondary and tertiary amines. Aryldiazonium salts, usually obtained from arylamines, undergo replacement of the diazonium group with a variety of nucleophiles to provide advantageous methods for producing aryl halides, cyanides, phenols and arenes.

Answer the following questions :

(A) (i) Why $\text{CH}_3 - \text{NH}_2$ is a stronger base than $(\text{CH}_3)_3 \text{N}$ in aqueous solution?

(ii) Write structural formulae of the compound A and B :



(B) A compound 'X' with molecular formula $\text{C}_3\text{H}_9\text{N}$ reacts with Hinsberg reagent to give a product insoluble in alkali. Identify 'X'.

OR

(B) How can you convert aniline to benzonitrile?

(C) Why is $-\text{NH}_2$ group of aniline acetylated before carrying out nitration?

30. The Valence Bond Theory (VBT) explains the formation, magnetic behaviour and geometry of coordination compounds. The Crystal Field Theory (CFT) of coordination compounds is based on 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. The splitting of the d-orbitals provides different electronic arrangements in strong and weak crystal fields.

Answer the following questions :

(A) In octahedral crystal field, energies of which d-orbitals will be raised when ligands approach the central metal atom/ion ? Give reason in support of your answer.

(B) Using crystal field theory, write the electronic configuration of central metal atom/ion of the following :

(i) $[\text{CoF}_6]^{3-}$

(ii) $[\text{Co}(\text{NH}_3)_6]^{3+}$ [At. No. : Co = 27]

(C) $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CO})_4]$ is diamagnetic though both are tetrahedral. Why?
[Atomic No. : Ni = 28]

OR

(C) Write hybridization and magnetic behaviour of the complex $[\text{Fe}(\text{CN})_6]^{3-}$.
[Atomic No. : Fe = 26]

SECTION – E

31. (A) (i) An organic compound (X) has the molecular formula $\text{C}_5\text{H}_{10}\text{O}$. Draw structures for (X) if it :

(I) does not give Tollen's test but gives a positive iodoform test.

(II) does not give Tollen's test and iodoform test but undergoes Aldol condensation.

(III) undergoes Cannizzaro's reaction.

(ii) Show how each of the following compounds can be converted to benzoic acid :

(I) Acetophenone

(II) Ethyl benzene

OR

(B) Answer the following questions:

(i) Draw structure of the 2, 4-dinitrophenyl hydrazone derivative of benzaldehyde.

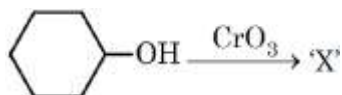
(ii) Arrange the following in increasing order of their reactivity towards HCN :

Di-tert. butyl ketone, Acetaldehyde, Acetone

(iii) Give a simple chemical test to distinguish between benzoic acid and ethyl benzoate.

(iv) Write the name of the reagent to convert Ethanenitrile to Ethanal.

(v) Draw the structure of 'X' in the following reaction :



32. (A) (i) From the given data of E° values, answer the following questions :

	$E^\circ_{M^{2+}/M}$
V	-1.18
Cr	-0.91
Mn	-1.18
Fe	-0.44
Co	-0.28
Ni	-0.25
Cu	+0.34

(I) Why $E^\circ_{M^{2+}/M}$ show irregular trend in the above values?

(II) Why is $E^\circ_{Cu^{2+}/Cu}$ value exceptionally positive?

(III) Why $E^\circ_{Mn^{2+}/Mn}$ value is highly negative ?

(ii) Write the ionic equations for the oxidising action of potassium permanganate for its reaction with I^- in both acidic and alkaline solutions.

OR

(B) Answer the following questions :

(i) Name a member of the lanthanoid series

(I) which exhibits +4 oxidation state

(II) which exhibits +2 oxidation state.

(ii) Why transition metals act as good catalyst?

(iii) Why Cr has higher melting point than Mn ?

(iv) What happens when acidic solution of potassium permanganate is allowed to stand for sometime ? Give the equation involved. What is this type of reaction called?

33. (A) Calculate emf and ΔG for the following cell at 298 K :



$$\text{Given : } E^\circ_{Mg^{2+}/Mg} = -2.37 \text{ V}, E^\circ_{Ag^+/Ag} = +0.80 \text{ V}$$

$$[1 \text{ F} = 96500 \text{ C mol}^{-1}, \log 10 = 1]$$

OR

(B) For the reaction :



Calculate emf of the cell at 25°C.

$$\text{Given : } \Delta G^\circ = -43500 \text{ J mol}^{-1}$$

$$[\log 10 = 1, 1 \text{ F} = 96500 \text{ C mol}^{-1}]$$

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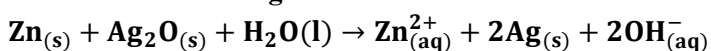
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SECTION - A

34. Consider the following reaction :



$$\text{Given : } E^\circ_{Ag^+/Ag} = 0.80 \text{ V}$$

$$E^0 \text{Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$$

$$1 \text{ F} = 96500 \text{ C mol}^{-1}$$

$\Delta_r G^0$ for the above reaction is

- (a) $-301.080 \text{ kJ mol}^{-1}$
- (b) $+310.080 \text{ kJ mol}^{-1}$
- (c) $-326.070 \text{ kJ mol}^{-1}$
- (d) $-375.060 \text{ kJ mol}^{-1}$

35. Identify the correct statement

- (a) Molecularity of a reaction is an experimental quantity.
- (b) For complex reactions molecularity has no meaning.
- (c) Molecularity of a reaction can be zero or even a fraction.
- (d) Molecularity more than three is very common in chemical reactions.

36. The order for the given reaction is :



- (a) 1.5
- (b) 1
- (c) 0.5
- (d) 2

37. Electronic configuration of chromium is :

- (a) $[\text{Ar}]3 \text{ d}^4 4 \text{ s}^1$
- (b) $[\text{Ar}]3 \text{ d}^4 4 \text{ s}^2$
- (c) $[\text{Ar}]3 \text{ d}^5 4 \text{ s}^1$
- (d) $[\text{Ar}]3 \text{ d}^5 4 \text{ s}^2$

38. The correct IUPAC name of the complex $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ is :

- (a) diamminedichloridoplatinum (IV)
- (b) diamminedichloridoplatinum (II)
- (c) dichloridodiammineplatinum (IV)
- (d) dichloridodiammineplatinum (II)

39. Which of the following is heteroleptic complex?

- (a) $[\text{Co}(\text{NH}_3)_6]^{3+}$
- (b) $[\text{Cr}(\text{NH}_3)_6]^{3+}$
- (c) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$
- (d) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$

40. Which of the following molecules is chiral in nature ?

- (a) Propan-2-ol
- (b) Butan-2-ol
- (c) 1-Bromobutane
- (d) 2-Bromopropane

41. Identify the correct increasing order of boiling points of the given compounds :

- (a) Propan-1-ol < butan-1-ol < butan-2-ol < pentan-1-ol
- (b) Pentan-1-ol < butan-1-ol < butan-2-ol < Propan-1-ol
- (c) Propan-1-ol < butan-2-ol < butan-1-ol < pentan-1-ol
- (d) Butan-1-ol < Butan-2-ol < Propan-1-ol < Pentan-1-ol

42. Identify the compound produced by the reduction of Ethanenitrile with Lithium aluminium hydride :

- (a) Ethylamine
- (b) Ethanal
- (c) Propylamine
- (d) Methylamine

43. The base which is present in DNA but not in RNA is :

- (a) Guanine
- (b) Cytosine
- (c) Thymine
- (d) Adenine

44. Proteins are polymers of α -amino acids which are joined to each other by:

- (a) Covalent Bond
- (b) Peptide Bond
- (c) Glycosidic Bond
- (d) Coordinate Bond

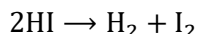
45. Which of the following reactions is not explained by the open chain structure of glucose?

- (a) Glucose on prolonged heating with HI forms n-hexane.
- (b) Glucose reacts with hydroxylamine to form an oxime.
- (c) Glucose gets oxidized to gluconic acid on reaction with bromine water.
- (d) Glucose exists in two different crystalline forms, alpha (α) and beta (β).

For question number 13 to 16, 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).
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- (c) Assertion (A) is true, but Reason (R) is false.
- (d) Assertion (A) is false, but Reason (R) is true.

46. **Assertion (A)** : The molecularity of the given reaction is 2



Reason (R) : Two molecules of the reactants are involved in simultaneous collision between them.

47. **Assertion (A)** : Zinc, cadmium and mercury are not considered as transition elements.

Reason (R) : These elements have completely filled orbitals in their ground state as well as in their common oxidation states.

48. **Assertion (A)** : Aromatic primary amines can be prepared by Gabriel Phthalimide synthesis.

Reason (R) : Aryl halides do not undergo nucleophilic substitution with the anion formed by phthalimide.

49. **Assertion (A)** : Glucose gets oxidized to six carbon gluconic acid on reaction with bromine water.

Reason (R) : The carbonyl group is absent in the open chain structure of glucose.

SECTION – B

50. (A) The concentration of the reactant is reduced from 0.6 mol L^{-1} to 0.2 mol L^{-1} in 5 minutes in a first order reaction. Calculate rate constant of the reaction. ($\log 3 = 0.48$)

OR

(B) Rate constant k for the first order reaction is $2.54 \times 10^{-3} \text{ s}^{-1}$. Calculate the time required for three-fourth of the reactant to decompose. ($\log 4 = 0.60$)

51. (A) Define activation energy.

(B) Write the unit of rate constant for (i) zero order reaction, (ii) second order reaction.

52. (A) First ionization enthalpy of Cr is lower than that of Zn. Why?

(B) Mention any one property of the transition elements which makes them good catalysts.

53. (A) Define coordination number.

(B) Indicate the type of isomerism exhibited by the following complex: $[\text{Co}(\text{en})_3]\text{Cl}_3$

54. (A) Draw the structure of the given compound :

4-Bromo-3-methylpent-2-ene

(B) What happens when chloroethane is treated with aqueous potassium hydroxide?

SECTION – C

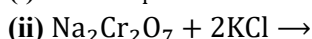
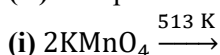
55. When 1.5 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point of benzene got raised from 353.23 K to 353.93 K. Calculate the molar mass of the solute. (Given K_b for benzene = $2.52 \text{ K kg mol}^{-1}$)

56. Calculate emf of the following cell at 298 K :



Given : $E^\circ_{\text{Sn}^{2+}/\text{Sn}} = -0.14 \text{ V}$, $E^\circ_{\text{H}^+/\text{H}_2} = 0.00 \text{ V}$ [$\log 10 = 1$]

57. (A) Complete and balance the following equations:

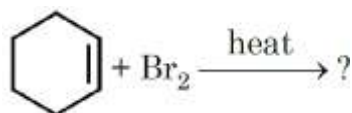


(B) Why is it difficult to separate lanthanoid elements in pure state?

58. (A) $[\text{Co}(\text{NH}_3)_6]^{3+}$ is diamagnetic whereas $[\text{CoF}_6]^{3-}$ is paramagnetic. Justify the statement. [Atomic number of Co = 27]

(B) Write the electronic configuration for d^4 ion if $\Delta_0 > P$ on the basis of crystal field theory.

59. (A) Write the major product in the following reactions :



(B) Define Racemic mixture.

(C) p-dichlorobenzene has a higher melting point as compared to its ortho and meta isomers. Why ?

60. Write the reaction involved in

(A) Rosenmund's reduction

(B) Cannizzaro's reaction

(C) Hell - Volhard - Zelinsky reaction

61. (A) Define the following term :

(i) Reducing sugar

(ii) Differentiate between the following :

(I) Fibrous proteins and globular proteins

(II) Nucleotide and nucleoside

OR

(B) Write the reaction of glucose with the following :

(i) $\text{H}_2\text{N}-\text{OH}$

(ii) $(\text{CH}_3\text{CO})_2\text{O}$

(iii) conc HNO_3

SECTION – D

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

62. Osmosis is a process by which the molecules of a solvent pass from a solution of low solute concentration to a solution of high solute concentration through a semi-permeable membrane. Osmotic pressure is a colligative property. When the applied pressure on a solution exceeds its osmotic pressure, reverse osmosis occurs. When two solutions are separated by a semipermeable membrane and they have same osmotic pressure they are said to be isotonic. Of the two solutions separated by a semipermeable membrane, if one is a lower osmotic pressure, it is said to be hypotonic relative to the second solution. If it has a higher osmotic pressure, than the second solution, it is said to be hypertonic relative to the second solution. The osmotic pressure associated with the fluid inside the blood cell is equivalent to that of 0.9% (mass/volume) sodium chloride solution called normal saline solution and it is safe to inject intravenously. Osmotic pressure is vital in daily life and nature. It helps in explain, why IV fluids match blood's osmotic pressure, its also the principle behind food preservation using salt or sugar.

(A) Calculate the amount of CaCl_2 ($i = 2.59$) dissolved in 2.46 litre of water such that its osmotic pressure is 0.70 atm at 27°C .

[Given : $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$, molar mass of $\text{CaCl}_2 = 111 \text{ g mol}^{-1}$]

(B) When raisins are kept in water, they get swollen. Name the phenomenon involved in this process.

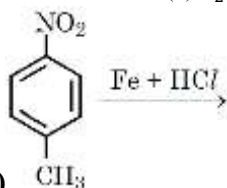
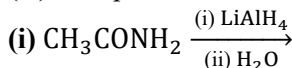
OR

(B) Why osmotic pressure is more advantageous than other colligative properties?

(C) Which phenomenon is responsible for desalination of sea water?

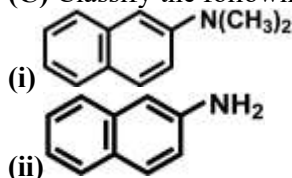
63. Like NH_3 , nitrogen atom of amine is trivalent and carries an unshared pair of electrons. Nitrogen orbitals in amines are therefore sp^3 hybridised and the geometry of amines is pyramidal. Lower aliphatic amines are soluble in water due to the formation of hydrogen bond with water molecules. The solubility decreases as the molar mass of amines increases due to increase in size of hydrophobic part. Higher amines are insoluble in water. However amines are less soluble in water than alcohols because of low electronegativity of nitrogen as compared to oxygen. Boiling points of isomeric amines follow the order $1^\circ > 2^\circ > 3^\circ$. It is due to the fact the amines are held together due to hydrogen bonding. Extent of hydrogen bonding is more in primary amines than in secondary amines as two hydrogen atoms are available for hydrogen bond formation. Tertiary amines do not show hydrogen bonding because of the absence of hydrogen atom attached to nitrogen. Amines can be prepared from, nitro compounds, nitriles, amides etc.

(A) Complete the following equations:



(B) Why primary amines have higher boiling points than tertiary amines?

(C) Classify the following amines as primary, secondary or tertiary :



OR

(C) Out of Butan-1-amine and Butan-1-ol, which is more soluble in water?

SECTION – E

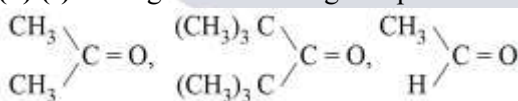
64. (A) (i) How will you convert the following :

(I) Propanone to Propene

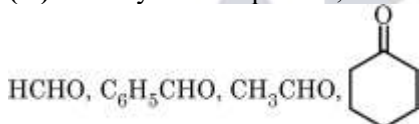
(II) Benzoic acid to Benzaldehyde

(III) Benzene to m-Nitroacetophenone

(ii) (I) Arrange the following compounds in increasing order of their reactivity towards HCN :



(II) Identify the compounds, which would undergo Aldol condensation :



OR

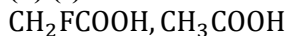
(B) (i) Give chemical tests to distinguish between the following pairs of compounds :

(I) Acetophenone and Benzophenone

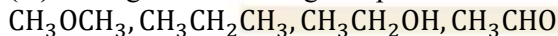
(II) Propanal and Propanone

(III) Pentan-2-one and Pentan-3-one

(ii) (I) Which of the following acids is stronger and why ?



(II) Arrange the following compounds in the increasing order of their boiling points :

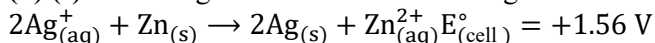


65. (A) (i) The conductivity of 0.1 mol L^{-1} solution of NaCl is $1.06 \times 10^{-2} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation.

$\lambda^\circ \text{Na}^+ = 50.1 \text{ S cm}^2 \text{ mol}^{-1}$

$\lambda^\circ \text{Cl}^- = 76.5 \text{ S cm}^2 \text{ mol}^{-1}$

(ii) (I) Following cell reaction occurs in a galvanic cell :



Predict the direction of flow of current.

(II) Differentiate between a primary battery and a secondary battery.

OR

(B) (i) Resistance of a conductivity cell filled with 0.1 M KCl solution is 100Ω . If the resistance of the same cell when filled with $0.01 \text{ mol L}^{-1} \text{ KCl}$ solution is 300Ω , calculate the conductivity and molar conductivity of $0.01 \text{ mol L}^{-1} \text{ KCl}$ solution. The conductivity of 0.1 M KCl solution is $1.29 \times 10^{-2} \text{ S cm}^{-1}$.

(ii) (I) Write any two advantages of $\text{H}_2 - \text{O}_2$ fuel cell.

(II) Why does the cell potential of mercury cell remain constant throughout the life?

66. (A) An organic compound 'A', with molecular formula C_2H_6O reacts with active metals such as sodium to give compound 'B' and hydrogen gas. 'A' on treatment with iodine and sodium hydroxide gives 'C' and in presence of H_2SO_4 at 413 K gives 'D' ($C_4H_{10}O$). 'D' on reaction with excess of HI gives 'E'. Identify 'A', 'B', 'C', 'D' and 'E' and write all the reactions involved.

OR

(B) (i) Write the reagents which are used in the given conversions :

(I) Phenol to 2, 4, 6-tribromophenol

(II) Propene to propan-1-ol

(III) Butan-2-one to butan-2-ol

(ii) Explain the mechanism of acid catalyzed hydration of alkene to form corresponding alcohol.

General Instructions :

Read the following instructions carefully and follow them :

(i) This question paper contains 33 questions. All questions are compulsory.

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(iii) Section A - questions number 1 to 16 are multiple choice type questions. Each question carries 1 mark.

(iv) Section B - questions number 17 to 21 are very short answer type questions. Each question carries 2 marks.

(v) Section C - questions number 22 to 28 are short answer type questions. Each question carries 3 marks.

(vi) Section D - questions number 29 and 30 are case-based questions. Each question carries 4 marks.

(vii) Section E - questions number 31 to 33 are long answer type questions. Each question carries 5 marks.

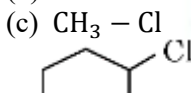
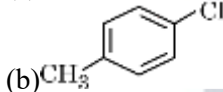
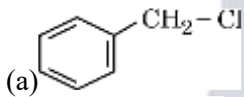
(viii) There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.

(ix) Kindly note that there is a separate question paper for Visually Impaired candidates.

(x) Use of calculator is not allowed.

SECTION A

67. Which of the following will be the least reactive towards nucleophilic substitution reaction?



68. The intermediate formed during the slowest step involved in the dehydration of alcohol is :

(a) protonated alcohol

(b) carbanion

(c) free radical

(d) carbocation

69. The oxidation number of Co in $[Co(en)_3]_2(SO_4)_3$ is :

(a) +3

(b) +2

(c) +4

(d) +6

70. According to Werner's theory, the primary valencies of the central metal atom :

(a) are satisfied by neutral molecules or negative ions.

(b) are equal to its coordination number.

(c) are satisfied by negative ions.

(d) are non-ionisable.

71. Which of the following reagent is used to distinguish between $(C_2H_5)_2NH$ and $(C_2H_5)_3N$?

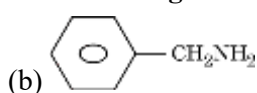
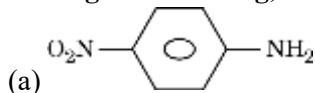
(a) $CHCl_3 + KOH$

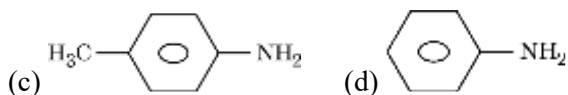
(b) $C_6H_5SO_2Cl$

(c) Conc. $HCl + ZnCl_2$

(d) $NaOH + I_2$

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





73. In aqueous solution, $\text{Cr}_2\text{O}_7^{2-}$ ion converts to which of the following in alkaline medium ?

- (a) Cr^{3+} (b) CrO_4^{2-}
(c) CrO (d) CrO_3

74. The boiling point of an azeotropic mixture of water and ethanol is less than that of pure water and ethanol.

The mixture shows:

- (a) positive deviation from Raoult's Law.
(b) negative deviation from Raoult's Law.
(c) no deviation from Raoult's Law.
(d) that the solution is an ideal solution.

75. The mole fraction of a solute in 2.0 molal aqueous solution is :

- (a) 1.87 (b) 0.347
(c) 0.0347 (d) 0.00347

76. On electrolysis of very dilute aqueous solution of NaCl using platinum electrodes:

- (a) H_2 gas is evolved at anode.
(b) Na is produced at cathode.
(c) O_2 gas is evolved at anode.
(d) H_2 gas is evolved at cathode.

77. For a reaction $3\text{A} \rightarrow 2\text{B}$, the 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) $+2 \frac{d[\text{A}]}{dt}$

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

- (a) Sucrose (b) Galactose
(c) Lactose (d) Maltose

For Questions number 13 to 16, 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.

79. Assertion (A) : Separation of Zr and Hf is difficult.

Reason (R) : Because Zr and Hf lie in the same group of the periodic table.

80. Assertion (A) : Phenol is less acidic than 4-methylphenol.

Reason (R) : The presence of an electron releasing group in phenol makes it less acidic.

81. Assertion (A) : Aromatic primary amines cannot be prepared by Gabriel phthalimide synthesis.

Reason (R) : Gabriel phthalimide synthesis is used for the preparation of primary aliphatic amines.

82. Assertion (A) : Order of reaction is applicable to elementary as well as complex reactions.

Reason (R) : Order of a reaction is an experimental quantity.

SECTION B

83. For the compound having molecular formula $\text{C}_4\text{H}_9\text{Br}$, write :

(A) the isomer which is most reactive towards $\text{S}_{\text{N}}1$ displacement.

(B) the isomer which, on reacting with Na metal in the presence of dry ether, gives 2,5-Dimethylhexane.

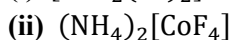
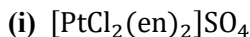
84. For a reaction $\text{A} + \text{B} \rightarrow \text{Products}$, the rate law is:

$$\text{Rate} = k[\text{A}][\text{B}]^{\frac{3}{2}}$$

Write the overall order of the reaction. Can this reaction be an elementary reaction? Give reason in support of your answer.

85. Explain why, on addition of 1 mol of KCl to 1 litre of water, the boiling point of water increases, while the addition of 1 mol of methyl alcohol to 1 litre of water decreases the boiling point.

86. (A) Write IUPAC names of the following compounds:



OR

(B) Define the following terms with a suitable example in each case :

(i) Ambidentate ligand

(ii) Double salt

87. How do you explain the following?

(A) Presence of a straight chain in glucose

(B) Presence of five -OH groups in glucose which are attached to different carbon atoms

SECTION C

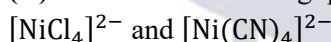
88. The half-life period of a radioactive element is 1.5×10^{10} years. Calculate the time in which the activity of the element is reduced to 75% of its original value.

[Given : $\log 2 = 0.30$, $\log 3 = 0.48$, $\log 4 = 0.60$]

89. State Kohlrausch's law of independent migration of ions. With the help of a curve, explain why it is not easy to determine Λ_m° for weak electrolytes by extrapolating the concentration - molar conductivity curve, as it is for strong electrolytes.

90. An antifreeze solution is prepared by dissolving 31 g of ethylene glycol (Molar mass = 62 g mol^{-1}) in 600 g of water. Calculate the freezing point of the solution. (K_f for water = $1.86 \text{ K kg mol}^{-1}$)

91. (A) Answer the following questions about the complexes



(i) Write the hybridization involved in each case.

(ii) Which of them is the inner orbital complex and which one is the outer orbital complex?

(iii) Compare their magnetic behaviour.

[Atomic number : Ni = 28]

OR

(B) (i) Name two coordination compounds which are important in biological systems.

(ii) What is meant by chelate effect? Give an example.

(iii) Why are low spin tetrahedral complexes rarely formed?

92. Give reasons for the following :

(A) Although chlorine is an electron-withdrawing group, yet it is ortho-, para-directing in electrophilic aromatic substitution reactions.

(B) Aryl halides cannot be prepared by reacting phenol with concentrated halogen acids or phosphorus halides.

(C) Chloroform is stored in closed dark coloured bottles.

93. How will you obtain the following from benzenediazonium chloride? Give chemical equations involved :

(A) Chlorobenzene

(B) Benzene

(C) Benzonitrile

94. An organic compound (A) with molecular formula $\text{C}_3\text{H}_5\text{N}$ on reaction with $\text{C}_6\text{H}_5\text{MgBr}$ followed by hydrolysis, gives a compound (B). Compound (B) forms an orange-red precipitate with 2,4-DNP reagent and does not give iodoform test. It neither reduces Tollens' or Fehling's reagent nor does it decolourise bromine water. On drastic oxidation with chromic acid it gives a carboxylic acid (C) having molecular formula $\text{C}_7\text{H}_6\text{O}_2$. Identify the compounds (A), (B) and (C). Write the reactions of compound (A) with $\text{C}_6\text{H}_5\text{MgBr}$ followed by hydrolysis to give compound (B).

SECTION D

95. Living systems are made up of various complex biomolecules like carbohydrates, proteins, nucleic acids, lipids, etc. Proteins and carbohydrates are essential constituents of our food. In addition, some simple molecules like vitamins and mineral salts also play an important role in the functions of organisms. All proteins are polymers of

α -amino acids. Proteins can be classified into two types on the basis of their molecular shape-Fibrous and Globular proteins. Vitamins are accessory food factors required in the diet. They are classified as fat-soluble and water-soluble. Deficiency of vitamins leads to many diseases. Nucleic acids are the polymers of nucleotides which in turn consist of a base, a pentose sugar and phosphate moiety. There are two types of nucleic acids - DNA and RNA. Nucleic acids are responsible for the transfer of characters from parents to offsprings.

(A) Write the name of basic building units of proteins and nucleic acids. How can you differentiate between Fibrous and Globular proteins on the basis of their structures ?

(B) (i) What products would be formed when a nucleotide from DNA containing thymine is hydrolyzed ?

OR

(ii) Write one structural difference between DNA and RNA.

(C) Give one example each of a fat-soluble vitamin and a water-soluble vitamin.

96. Alcohols have higher boiling points than other compounds, namely hydrocarbons, ethers and haloalkanes of comparable molecular masses. On oxidation, primary alcohols yield aldehydes with mild oxidizing agents and carboxylic acids with strong oxidizing agents. Secondary alcohols yield ketones on oxidation while tertiary alcohols are resistant to oxidation. Ethers may be prepared by dehydration of alcohols and Williamson synthesis. The C – O bond in ethers can be cleaved by hydrogen halides. The presence of -OH group in phenols activates the aromatic ring towards electrophilic substitution and directs the incoming group to ortho and para positions due to resonance effect. In presence of NaOH, phenol generates phenoxide ion which is even more reactive than phenol. Thus, in alkaline medium, phenol undergoes Kolbe's reaction.

(A) Name the reagents used in the following reactions:

(i) Oxidation of a primary alcohol to aldehyde

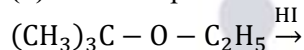
(ii) Oxidation of a primary alcohol to carboxylic acid

(B) Write the reaction involved in Kolbe's reaction.

(C) (i) Why are tertiary alcohols resistant to oxidation?

OR

(ii) Write the products of the following reaction :



SECTION E

97. (A) (i) Describe giving reason which one of the following pairs has the property indicated :

(I) Fe or Cu - higher melting point

(II) Ti^{3+} or Sc^{3+} - coloured in aqueous solution

(III) Cr or Zn - higher third ionisation enthalpy

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

(I) Fe^{2+} ion

(II) I^- ion

OR

(B) (i) A black-brown coloured solid (A) when fused with KOH in the presence of air, produces a dark green coloured compound (B) which on electrolytic oxidation in alkaline medium gives a dark purple coloured compound (C). Identify (A), (B) and (C). Write the reactions involved.

(ii) What happens when an acidic solution of the green compound (B) is allowed to stand for some time? Also write the equation involved. What is this type of reaction called ?

98. (A) (i) Write the product(s) when :

(I) One mol of ethanal is treated with 1 mol of CH_3OH in the presence of dry HCl gas.

(II) Benzaldehyde is treated with conc. NaOH .

(III) Ethanoic acid is heated in the presence of P_2O_5 .

(ii) Write a simple chemical test to distinguish between Ethanal and Propanal.

(iii) Write the name of the reagent to transform Allyl alcohol to Propenal.

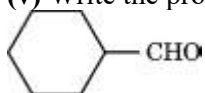
OR

(B) (i) Draw the structure of the semicarbazone of acetone.

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

(iii) Arrange the following compounds in increasing order of their reactivity towards HCN :

- (iv) Write the reaction involved in Etard reaction.
 (v) Write the product when



reacts with Zn(Hg)/ conc. HCl.

99. (A) (i) Calculate the electrode potential of a half-cell for zinc electrode dipping in 0.01M ZnSO₄ solution at 25°C.

Given : $E_{\text{Zn}^{2+}/\text{Zn}}^0 = -0.76 \text{ V}$

[log10 = 1]

(ii) Write anode, cathode and overall reaction involved in dry cell.

(iii) Equilibrium constant (K_c) is related to E_{cell}^0 , but not to E_{cell} . Why?

OR

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

Given : $\lambda_{\text{CH}_3\text{COO}^-} = 40 \cdot 9 \text{ S cm}^2 \text{ mol}^{-1}$

$\lambda_{\text{H}^+}^0 = 349 \cdot 6 \text{ S cm}^2 \text{ mol}^{-1}$

(ii) Give reasons for the following :

(I) Why does a mercury cell deliver a constant voltage for its entire life?

(II) Why is it necessary to use salt bridge in a galvanic cell?

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(x) Use of calculator is not allowed.

SECTION A

100. Oxidation of chloroform by air in the presence of sunlight produces a poisonous gas known as:

- (a) Mustard gas (b) Tear gas
 (c) Chlorine gas (d) Phosgene gas

101. Lucas reagent produces cloudiness immediately with :

- (a) 2-methyl-1-propanol
 (b) Butan-2-ol
 (c) 2-methyl-2-propanol
 (d) Butan-1-ol

102. Which of the following d-orbitals experience more repulsion in the crystal field splitting of octahedral complex?

- (a) d_{xy}, d_{yz}, d_{zx} (b) $d_x^2 - y^2, d_z^2$
 (c) $d_{xy}, d_x^2 - y^2$ (d) d_{xz}, d_z^2

103. The chelating ligand used for the treatment of lead poisoning is :

- (a) Ethane-1,2-diamine (b) Oxalate ion
 (c) Dimethylglyoxime (d) EDTA

104. Manganate ion is paramagnetic due to the presence of :

- (a) one unpaired electron
 (b) two unpaired electrons

- (c) three unpaired electrons
(d) fully paired electrons
105. The correct order of decreasing basicities of $\text{C}_2\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$ and $(\text{C}_2\text{H}_5)_3\text{N}$ in aqueous solution is :
- (a) $(\text{C}_2\text{H}_5)_3\text{N} > (\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_2\text{H}_5\text{NH}_2$
(b) $(\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_2\text{H}_5\text{NH}_2 > (\text{C}_2\text{H}_5)_3\text{N}$
(c) $\text{C}_2\text{H}_5\text{NH}_2 > (\text{C}_2\text{H}_5)_2\text{NH} > (\text{C}_2\text{H}_5)_3\text{N}$
(d) $(\text{C}_2\text{H}_5)_2\text{NH} > (\text{C}_2\text{H}_5)_3\text{N} > \text{C}_2\text{H}_5\text{NH}_2$
106. The boiling point of one molal NaCl solution, assuming NaCl to be completely dissociated in water is : (K_b for water = $0.52 \text{ K kg mol}^{-1}$)
- (a) 100.52°C (b) 101.04°C
(c) 100.04°C (d) 101.52°C
107. When a liquid and its vapour are at equilibrium and the pressure is suddenly decreased :
- (a) vapour pressure of the solution increases
(b) heating occurs
(c) cooling occurs
(d) equilibrium remains unaffected
108. Consider the following cell at 298 K :
 $\text{Mg(s)}|\text{Mg}^{2+}(1.0\text{M})||\text{Cu}^{2+}(1.0\text{M})|\text{Cu(s)}$
How can we increase the emf of the cell using the same substances?
- (a) By decreasing only the $[\text{Mg}^{2+}]$ to 0.1 M
(b) By decreasing only the $[\text{Cu}^{2+}]$ to 0.1M
(c) By increasing both $[\text{Mg}^{2+}]$ and $[\text{Cu}^{2+}]$ to 2.0 M
(d) By increasing only the $[\text{Mg}^{2+}]$ to 2.0 M
109. The rate of a first order reaction is $5.6 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$, when the concentration of reactant is 0.2 mol L^{-1} . The rate constant 'k' is :
- (a) $5.6 \times 10^{-3} \text{ s}^{-1}$ (b) $2.8 \times 10^{-4} \text{ s}^{-1}$
(c) $2.8 \times 10^{-5} \text{ s}^{-1}$ (d) $2.8 \times 10^{-3} \text{ s}^{-1}$
110. Nucleic acids are polymers of :
- (a) amino acids (b) nucleosides
(c) nucleotides (d) pentose sugar
111. In the reaction of NaOBr with amide, the carbonyl carbon is lost as:
- (a) HCO_3^- (b) CO_3^{2-}
(c) CO_2 (d) CO
- For Questions number 13 to 16, 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.
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(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.
112. Assertion (A) : Alcohols act as Bronsted bases as well as Bronsted acids.
Reason (R) : It is due to the presence of unshared electron pairs on oxygen atom and presence of polar O – H bond.
113. Assertion (A) : Diazonium salts of aromatic amines are more stable than those of aliphatic amines.
Reason (R) : Diazonium salts of aliphatic amines undergo resonance.
114. Assertion (A) : For complex reaction, order of reaction is given by the slowest step.
Reason (R) : Order of a reaction is an experimental quantity.

115. Assertion (A) : $E_{\text{Sc}^{3+}/\text{Sc}^{2+}}^0$ has low value.

Reason (R) : Because of the stability of Sc^{3+} ion which has a noble gas configuration.

SECTION B

116. (A) Reactions of which order will show the rate to be independent of the concentration of the reactant? Give one example of this order.

(B) State the condition under which a bimolecular reaction may be kinetically a first order reaction.

117. (A) Explain the following with the help of Henry's law :

(i) Bends

(ii) Anoxia

OR

(B) How does sprinkling of salt help in clearing the snow covered roads in hilly areas? Write the name of the colligative property involved in this process.

118. Write IUPAC names of the following compounds:

(A) $[\text{Cr}(\text{NH}_3)_4(\text{ONO})\text{Cl}]\text{NO}_3$

(B) $\text{Na}[\text{Ag}(\text{CN})_2]$

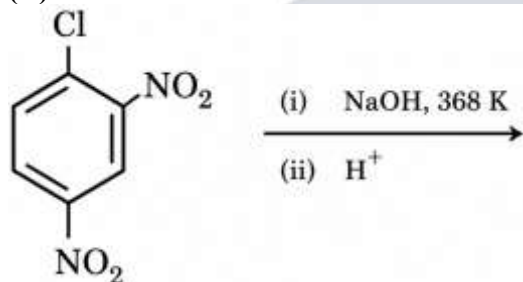
119. What are the hydrolysis products of the following?

(A) Lactose

(B) DNA containing Thymine

120. Draw the structures of major product(s) in each of the following reactions:

(A)

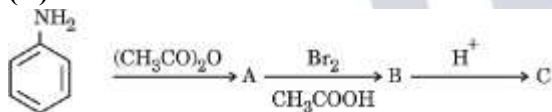


(B) $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)_2 + \text{HBr} \rightarrow$

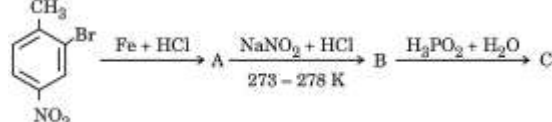
SECTION C

121. Write the structures of A, B and C in the following reactions :

(A)



(B)



122. What happens when :

(A) Propanenitrile is treated with phenyl magnesium bromide followed by hydrolysis?

(B) p-fluorotoluene is treated with CrO_3 in the presence of acetic anhydride followed by hydrolysis with aqueous acid.

(C) Phthalic acid is treated with NH_3 followed by heating?

Write chemical reactions in support of your answer.

123. Answer the following questions:

(A) Why is direct current (DC) not used to measure the resistance of an ionic solution?

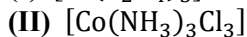
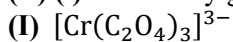
(B) Why are the products of electrolysis different for the electrolysis of aqueous solution of AgNO_3 with silver electrodes and electrolysis of aqueous solution of AgNO_3 with platinum electrodes?

(C) Why are magnesium blocks fixed to the iron pipelines carrying water?

124. (A) When a coordination compound $\text{CoCl}_3 \cdot 6\text{NH}_3$ is mixed with excess of AgNO_3 solution, 3 moles of AgCl are precipitated per mole of the compound. Write the structural formula of the complex, IUPAC name, its hybridisation and magnetic behaviour on the basis of valence bond theory.

OR

(B) (i) How many geometrical isomers are possible in each of the following complexes?



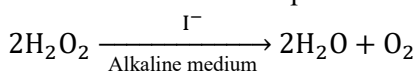
(ii) $[\text{Co}(\text{NH}_3)_6]^{3+}$ is an inner orbital complex whereas $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is an outer orbital complex. Why?

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

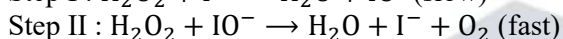
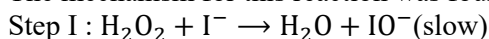
(iii) Write the formula of Wilkinson catalyst and its use.

125. Calculate the vapour pressure of a solution containing 61 g of benzoic acid (molar mass = 122 g mol^{-1}) dissolved in 500 g of benzene when the vapour pressure of pure benzene at this temperature of experiment is 66 torr. Assume complete dimerization of benzoic acid in benzene.

126. Consider the decomposition of hydrogen peroxide (H_2O_2) as per the equation given below :



The mechanism for this reaction was found to be :



(A) Write the rate law expression.

(B) Determine the order of reaction with respect to H_2O_2 , I^- and overall order of reaction.

(C) What is the molecularity of the reaction in Step II?

127. Answer the following :

(A) Which isomer of $\text{C}_4\text{H}_9\text{Br}$ is most reactive towards $\text{S}_{\text{N}}1$ reaction?

(B) Predict the alkene that would be formed by dehydrohalogenation of 1-Bromo-1-methylcyclohexane.

(C) Although chlorine shows strong -I effect, yet it is ortho- and para-directing in electrophilic aromatic substitution reactions. Why?

SECTION D

128. Alcohols and Phenols are acidic in nature. Electron withdrawing groups in phenol increase its acidic strength and electron releasing groups decrease it. Alcohols undergo nucleophilic substitution with hydrogen halides to yield alkyl halides. Dehydration of alcohols gives alkenes. On oxidation, primary alcohols yield aldehydes with mild oxidising agents and carboxylic acids with strong oxidising agents, while secondary alcohols yield ketones. Tertiary alcohols are resistant to oxidation. The presence of -OH group in phenols activates the aromatic ring towards electrophilic substitution and directs the incoming group to ortho and para positions due to resonance effect.

Answer the following questions:

(A) Write the mechanism of acid dehydration of ethanol to yield ethene.

(B) (i) Why are tertiary alcohols resistant to oxidation?

OR

(ii) Write the structure of the major product expected from the dinitration of 3-methylphenol.

(C) Why is ortho-nitrophenol more acidic than ortho-methoxyphenol?

129. Carbohydrates are optically active polyhydroxy aldehydes or ketones or the compounds which produce such units on hydrolysis. They have been broadly classified into three groups - monosaccharides, oligosaccharides and polysaccharides. The carbohydrates may also be classified as either reducing or non-reducing sugars. An important monosaccharide glucose is an aldohexose and is correctly named as D(+)-glucose. It was assigned the open structure on the basis of its reactions with HI, NH_2OH , Br_2 water, $(\text{CH}_3\text{CO})_2\text{O}$ and nitric acid. Despite having the -CHO group, glucose does not give Schiff's test and hydrogen sulphite addition product with NaHSO_3 . It was found that glucose forms a six-membered ring in which one of the -OH groups add to the -CHO group and form a cyclic hemiacetal structure.

Answer the following questions:

(A) How do you explain the following?

(i) Presence of a carbonyl group in glucose

- (ii) Presence of five -OH groups in glucose which are attached to different carbon atoms.
 (B) What type of carbohydrates are called reducing sugars ?
 (C) (i) In D(+)-glucose, what do the letter 'D' and sign '(+)' represent?

OR

- (ii) Draw the six-membered ring structure of α - D(+)-glucose.

SECTION E

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

- (I) MnO is basic while Mn_2O_7 is acidic.
 (II) Iron has higher enthalpy of atomization than that of copper.
 (III) Mn^{3+} is a stronger oxidising agent than Cr^{3+} .
 (ii) How do you prepare potassium dichromate from sodium chromate ? Write balanced chemical equation for each step.

OR

- (B) Answer the following questions:

- (i) Why is chemistry of actinoids more complicated as compared to lanthanoids?
 (ii) $E_{M^{2+}/M}^0$ values are not regular for first row transition elements (3d series). Why ?
 (iii) Identify the following :
 (I) Oxoanion of chromium which is stable in acidic medium.
 (II) The lanthanoid element that exhibits +4 oxidation state.
 (iv) Write the products obtained on heating $KMnO_4$.
 (v) Predict which of the following ions will be coloured in aqueous solution :
 Cu^+ , Sc^{3+} , Fe^{2+} , Ti^{3+} , Zn^{2+}

131. (A) (i) How will you bring about the following conversions:

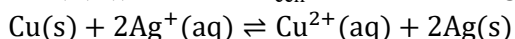
- (I) Bromobenzene to 1-phenylethanol
 (II) Benzene to m-nitroacetophenone
 (ii) An organic compound with the molecular formula C_8H_8O forms 2,4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation with acidic or alkaline $KMnO_4$ it gives Benzene-1,2-dicarboxylic acid. Identify the compound and write the products when it undergoes Cannizzaro reaction.
 (iii) Arrange the following compounds in increasing order of their acid strength :
 C_6H_5COOH , O_2N-CH_2-COOH , CF_3-COOH , $HCOOH$

OR

- (B) (i) Write the products formed when benzaldehyde reacts with the following reagents:

- (I) 2,4-Dinitrophenylhydrazine
 (II) Acetophenone in the presence of dilute NaOH followed by heating
 (ii) Give reasons for the following :
 (I) Benzoic acid does not undergo Friedel-Crafts reaction.
 (II) Carboxylic acids have higher boiling point than alcohols of comparable molecular mass.
 (iii) Write simple chemical test to distinguish between propanal and propanone.

132. (A) (i) Calculate E_{cell}^0 for the following reaction which is at equilibrium :



Equilibrium constant (K_c) for the cell is 10^{15} .

[Given : $\log 10 = 1$]

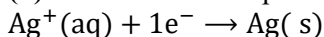
- (ii) Write anode, cathode and overall reaction of lead storage battery when it is in use.

- (iii) How much electricity is required in coulombs for the oxidation of 1 mol of FeO to Fe_2O_3 ?

OR

- (B) (i) Conductivity of 0.0024 M acetic acid is $7.2 \times 10^{-5} S cm^{-1}$. If Λ_m° for acetic acid is $390.5 S cm^2 mol^{-1}$, then calculate the degree of dissociation (α) of acetic acid.

- (ii) Calculate the cell potential for the following half cell reaction at $25^\circ C$:



Given that : $[Ag^+] = 0.01M$ and

$$E_{Ag^+/Ag}^0 = +0.80 V$$

[$\log 10 = 1$]

(iii) Write the name of the electrolyte used in :

(I) Dry cell

(II) Fuel cell ($H_2 - O_2$)

General Instructions :

Read the following instructions carefully and follow them :

(i) This question paper contains 33 questions. All questions are compulsory.

(ii) This question paper is divided into five sections - Section A, B, C, D and E.

(iii) Section A - questions number 1 to 16 are multiple choice type questions. Each question carries 1 mark.

(iv) Section B - questions number 17 to 21 are very short answer type questions. Each question carries 2 marks.

(v) Section C - questions number 22 to 28 are short answer type questions. Each question carries 3 marks.

(vi) Section D - questions number 29 and 30 are case-based questions. Each question carries 4 marks.

(vii) Section E - questions number 31 to 33 are long answer type questions. Each question carries 5 marks.

(viii) There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.

(ix) Kindly note that there is a separate question paper for Visually Impaired candidates.

(x) Use of calculator is not allowed.

SECTION A

133. Which of the reactions is used in the conversion of a ketone into hydrocarbon?

(a) Reimer-Tiemann reaction

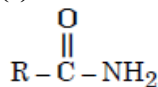
(b) Wolff-Kishner reduction

(c) Aldol condensation

(d) Stephen reaction

134. Which of the following reagents are used to prepare primary amines by Hoffmann bromamide degradation reaction?

(I)



(II) NaOH

(III) Br_2

(IV) $CHCl_3$

(a) (I), (II) and (IV)

(b) (I) and (III)

(c) (I), (II) and (III)

(d) (I), (III) and (IV)

135. The major product of carbylamine reaction is:

(a) Carboxylic acid

(b) Aldehyde

(c) Cyanide

(d) Isocyanide

136. Actinoids show larger number of oxidation states:

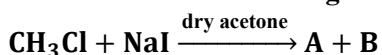
(a) because they are radioactive in nature

(b) because they have large atomic numbers

(c) because they have large atomic masses

(d) due to comparable energies of 5f, 6d and 7s orbitals

137. Consider the following reaction and identify A and B :



(a) $A = CH_3I$, $B = NaCl$

(b) $A = CH_3OH$, $B = NaCl$

(c) $A = CH_3CHO$, $B = NaCl$

(d) $A = C_2H_6$, $B = CH_3I$

138. The correct formula of Hinsberg's reagent is :

(a) C_6H_5COCl

(b) $C_6H_5SO_2Cl$

(c) $C_6H_5CONHCH_3$

(d) $C_6H_5CH_2NH_2$

139. Half-life ($t_{1/2}$) of a first order reaction is 1386 s . The value of rate constant is :

(a) $0.5 \times 10^4 \text{ s}^{-1}$

(b) $5.0 \times 10^{-4} \text{ s}^{-1}$

(c) $0.5 \times 10^{-5} \text{ s}^{-1}$

(d) $0.5 \times 10^{-2} \text{ s}^{-1}$

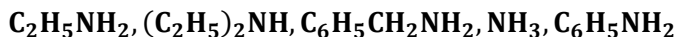
140. Which of the following ligands forms a chelate complex?

- (a) Ammonia (b) Water
(c) NO_2^- (d) Oxalate ion

141. Primary, secondary and tertiary alcohols can be distinguished by :

- (a) Lucas test (b) Fehling's test
(c) Tollens' test (d) Hinsberg's test

142. Consider the following compounds:



The correct increasing order of the above compounds on the basis of their basic strength is :

- (a) $\text{C}_6\text{H}_5\text{NH}_2 < \text{NH}_3 < \text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH}$
(b) $\text{NH}_3 < \text{C}_6\text{H}_5\text{NH}_2 < \text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH}$
(c) $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH} < \text{NH}_3 < \text{C}_6\text{H}_5\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2$
(d) $\text{C}_2\text{H}_5\text{NH}_2 < \text{C}_6\text{H}_5\text{NH}_2 < \text{NH}_3 < \text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH}$

143. Identify the polysaccharide among the following :

- (a) Fructose (b) Maltose
(c) Glucose (d) Cellulose

144. The polypeptide chain in a protein has amino acids linked with each other in a specific sequence. This specific sequence of amino acids is called:

- (a) Primary structure of protein
(b) Secondary structure of protein
(c) Tertiary structure of protein
(d) Quaternary structure of protein

For Questions number 13 to 16, 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.

145. Assertion (A) : D (+)-Glucose is dextrorotatory in nature.

Reason (R) : (+) represents dextrorotatory nature and D represents the configuration.

146. Assertion (A) : Highest oxidation state of Mn is +7 in first series of transition elements.

Reason (R) : Transition metals exhibit variable oxidation states.

147. Assertion (A) : p-nitrophenol is more acidic than phenol.

Reason (R) : Nitro group is an electron-withdrawing group, it stabilises phenoxide ion by dispersal of negative charge.

148. Assertion (A) : All aliphatic aldehydes give a positive Fehling's test.

Reason (R) : Aliphatic aldehydes are reduced by Fehling's reagent.

SECTION B

149. (A) 1.00 molal aqueous solution of trichloroacetic acid is heated to its boiling point. Boiling point of this solution was found to be $100 \cdot 18^\circ\text{C}$. Calculate the van't Hoff factor for trichloroacetic acid. (Given : K_b for water = $0.512 \text{ K kg mol}^{-1}$)

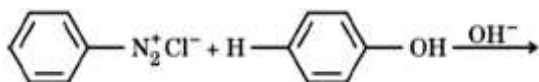
OR

(B) State Henry's law. Calculate the mole fraction of CO_2 in water at 298 K under 760 mm Hg .
(Given : K_H for CO_2 in H_2O at 298 K = $1.25 \times 10^6 \text{ mmHg}$)

150. (A) Name the cell which was used in the Apollo space programme for providing electrical power.

(B) Define limiting molar conductivity.

151. (A) Complete the following equation :



(B) How will you convert nitromethane to methyl isocyanide?

152. (A) What are the products obtained on hydrolysis of sucrose ?

(B) What are essential amino acids ?

153. (A) Write any two fat soluble vitamins.

(B) How will you confirm the presence of five -OH groups in a glucose molecule, which are attached to different carbon atoms?

SECTION C

154. Calculate emf of the following cell at 298 K :



(Given : $E_{\text{Cr}^{3+}/\text{Cr}}^0 = -0.74\text{ V}$, $E_{\text{Fe}^{2+}/\text{Fe}}^0 = -0.44\text{ V}$, $[\log 10 = 1]$)

155. (A) Define order of a reaction.

(B) The rate for the following reaction is given by : $\text{A} + \text{B} \rightarrow \text{C}$

$$\text{Rate} = k[\text{A}][\text{B}]^2$$

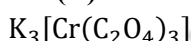
(i) How is the rate of reaction affected if we double the concentration of B ?

(ii) Write the overall order of a reaction if 'A' is present in large excess.

156. The rate of the chemical reaction doubles when the temperature is raised from 298 K to 308 K . Calculate activation energy (E_a) for this reaction assuming that it does not change with temperature.

(Given : $R = 8 \cdot 314\text{ J mol}^{-1}\text{ K}^{-1}$, $\log 2 = 0 \cdot 30$)

157. (A) Write the IUPAC name of the following complex :



(B) Differentiate between homoleptic complex and heterolytic complex.

(C) Which type of isomerism is exhibited by the following complex:



158. (A) A coordination compound $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ is mixed with excess of AgNO_3 solution, two moles of AgCl are precipitated per mole of the compound. Write the structural formula of the coordination compound.

(B) Write the oxidation state and hybridisation of the central metal in the following complex:



(C) Why is $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ coloured ? [Atomic number of Ni = 28]

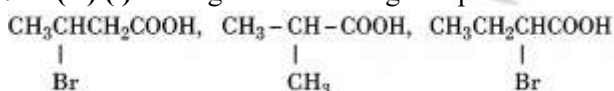
159. How do you convert the following ?

(A) Acetophenone to Benzoic acid

(B) Acetonitrile to Acetone

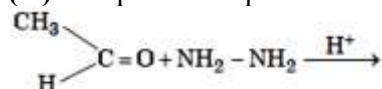
(C) Benzoic acid to Benzene

160. (A) (i) Arrange the following compounds in increasing order of their acidic strengths:



(ii) Why is CH_3CHO more reactive than acetone towards reaction with HCN ?

(iii) Complete the equation :



OR

(B) An organic compound with the molecular formula $\text{C}_8\text{H}_8\text{O}$ forms 2,4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation it gives Benzene-1,2-dicarboxylic acid. Identify the compound and write the reactions of compound 2,4-DNP and when it undergoes Cannizzaro reaction.

SECTION D

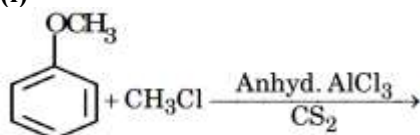
161. Ethers are prepared by the dehydration of alcohols in presence of protic acids at 413 K . Symmetrical and unsymmetrical ethers can also be prepared by Williamson synthesis. This reaction involves $\text{S}_{\text{N}}2$ attack of an alkoxide ion on primary alkyl halide. If a tertiary alkyl halide is used, elimination reaction occurs and an alkene is formed, no ether is formed. C – O bond in ethers are cleaved under drastic conditions with excess of HI . When

unsymmetrical ethers react with HI, the alkyl halide is formed from smaller alkyl group. If one of the alkyl group is tertiary, the alkyl halide is formed from the tertiary alkyl group because tertiary alkyl carbocation is more stable than the primary carbocation. Cleavage of alkyl aryl ethers takes place at the alkyl-oxygen bond due to more stable aryl-oxygen bond. The order of reactivity of hydrogen halides is $\text{HI} > \text{HBr} > \text{HCl}$. Aromatic ethers undergo electrophilic substitution reactions. The alkoxy group attached to the aromatic ring activates the ring towards electrophilic substitution and directs the incoming group to ortho- and para-positions.

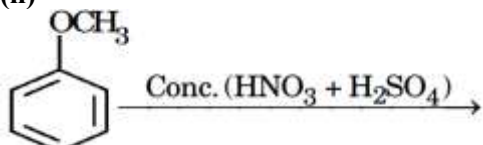
Answer the following questions :

(A) Complete the following equations:

(i)



(ii)



(B) (i) Write the names of alkyl halide and sodium alkoxide used to prepare tert-butyl ethyl ether.

OR

(ii) Anisole on reaction with HI gives phenol and $\text{CH}_3 - \text{I}$ and not methanol and iodobenzene. Justify the statement.

(C) Why is $\text{C} - \text{O} - \text{C}$ bond angle in ethers slightly greater than tetrahedral angle ?

162. Electrochemistry is the study of the relationship between chemical energy and electrical energy. Many spontaneously occurring chemical reactions liberate electrical energy. In electrolysis, electrical energy is converted directly into chemical energy. The product of an electrolytic reaction depends on the nature of the material being electrolysed and the type of electrode used. Oxidising and reducing species present in the electrolytic cell and their standard electrode potential too, affect the products of electrolysis. Electrolysis plays an important role in most people's daily lives, whether it is for the manufacturing of aluminium, electroplating of metals, or the synthesis of chemical compounds.

Michael Faraday was the first scientist who proposed two laws to explain the quantitative aspects of electrolysis, popularly known as Faraday's laws of electrolysis. Faraday's laws of electrolysis provide a basis for mathematical analysis of the mass deposited at electrodes and the amount of charge passed through them.

Faraday's laws are fundamental in various applications, including electroplating, metal extraction, battery technology and chemical synthesis. These laws also help in environmental monitoring and in various chemistry experiments.

Answer the following questions :

(A) Predict the products of electrolysis in each of the following:

(i) An aqueous solution of CuCl_2 with platinum electrodes.

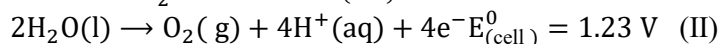
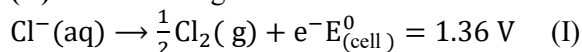
(ii) A concentrated solution of H_2SO_4 with platinum electrodes.

(B) (i) How much charge in faraday is required for the reduction of 1 mol of Ag^+ to Ag ?

OR

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

(C) The following reactions occur at the anode during the electrolysis of aqueous sodium chloride solution :



Which reaction is feasible at the anode and why?

SECTION E

163. (A) (i) Calculate the freezing point of a solution when 10.5 g of MgBr_2 was dissolved in 250 g of water, assuming MgBr_2 undergoes complete dissociation.

(Given : Molar mass of $\text{MgBr}_2 = 184 \text{ g mol}^{-1}$,

K_f for water = $1.86 \text{ K kg mol}^{-1}$)

(ii) Write two differences between ideal and non-ideal solutions.

OR

(B) (i) A solution is prepared by dissolving 0.025 g of potassium sulphate in 2 L of water at 27°C . Assuming potassium sulphate is completely dissociated, determine its osmotic pressure.

(Given : $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$,

Molar mass of $\text{K}_2\text{SO}_4 = 174 \text{ g mol}^{-1}$)

(ii) What type of azeotrope will be formed by a solution of acetone and chloroform ? Give reason.

164. (A) (i) (I) Why do transition metals show variable oxidation states?

(II) Out of Mn^{2+} and Ti^{2+} which will be more paramagnetic and why? [Atomic No. : Ti = 22, Mn = 25]

(III) Which ion is the strongest oxidising agent in the options given below :

Cr^{3+} , V^{3+} , Mn^{3+}

Give reason.

[Atomic No. : Cr = 24, V = 23, Mn = 25]

(ii) Complete and balance the following equations:

(I) $2\text{MnO}_2 + 4\text{KOH} + \text{O}_2 \rightarrow$

(II) $5\text{C}_2\text{O}_4^{2-} + 2\text{MnO}_4^- + 16\text{H}^+ \rightarrow$

OR

(B) (i) What is meant by lanthanoid contraction?

(ii) Why do transition metals form coloured compounds?

(iii) Why are $E_{\text{M}^{2+}/\text{M}}^0$ values for Mn and Zn more negative than expected?

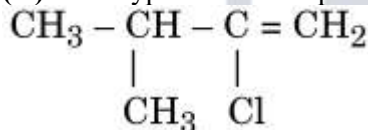
(iv) Which is the most stable oxidation state of Cu and why?

(v) Why is Ce^{4+} in aqueous solution a good oxidising agent ?

165. (A) (i) (I) Which of the following is more reactive towards $\text{S}_{\text{N}}1$ reaction :

2-Bromo-2-methylbutane or 1-Bromopentane

(II) What type of halide is present in the following compound :



(III) Why is chloroform stored in dark coloured bottles?

(ii) Define the following terms :

(I) Ambident Nucleophiles

(II) Racemic mixture

OR

(B) (i) Answer the following :

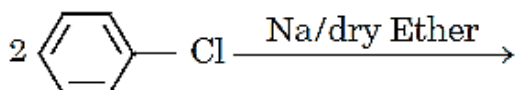
(I) Which isomer of $\text{C}_4\text{H}_9\text{Br}$ is most reactive towards $\text{S}_{\text{N}}1$ reaction?

(II) Predict the alkene that would be formed by dehydrohalogenation of 1-Bromo-1-methylcyclohexane.

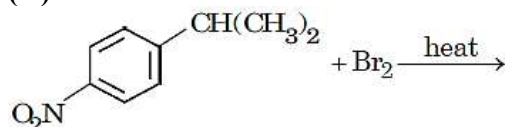
(III) Although chlorine shows strong - I effect, yet it is ortho/para-directing in electrophilic aromatic substitution reactions. Why?

(ii) Write the major product in the following reactions :

(I)



(II)



General Instructions :

Read the following instructions carefully and follow them :

(i) This question paper contains 33 questions. All questions are compulsory.

(ii) This question paper is divided into five sections - Section A, B, C, D and E.

(iii) Section A - questions number 1 to 16 are multiple choice type questions. Each question carries 1 mark.

- (iv) Section B - questions number 17 to 21 are very short answer type questions. Each question carries 2 marks.
- (v) Section C - questions number 22 to 28 are short answer type questions. Each question carries 3 marks.
- (vi) Section D - questions number 29 and 30 are case-based questions. Each question carries 4 marks.
- (vii) Section E - questions number 31 to 33 are long answer type questions. Each question carries 5 marks.
- (viii) There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.
- (ix) Kindly note that there is a separate question paper for Visually Impaired candidates.
- (x) Use of calculator is not allowed.

SECTION – A

166. Which of the following colligative properties can preferably determine the molar mass of proteins?
 - (a) Relative lowering of vapour pressure
 - (b) Osmotic pressure
 - (c) Elevation of boiling point
 - (d) Depression of freezing point
167. For an electrolyte consisting of a monovalent cation and a monovalent anion undergoing dissociation in water, the van't Hoff factor (i) is :
 - (a) less than 1
 - (b) equal to 1
 - (c) greater than 1
 - (d) greater than 2
168. The standard electrode potentials of three metals A, B and C are, respectively, +0.34 V, –1.18 V and –0.25 V. The correct order of reducing power of these metals is :
 - (a) $B > C > A$
 - (b) $A > B > C$
 - (c) $C > B > A$
 - (d) $A > C > B$
169. The rate of a reaction is doubled when the concentration of the reactant is doubled. The order of the reaction is :
 - (a) 0
 - (b) 1
 - (c) 2
 - (d) 0.5
170. Which of the following is not a transition metal ?
 - (a) Hg
 - (b) Cu
 - (c) Ag
 - (d) Pt
171. The secondary valency of Co in $[\text{Co}(\text{en})_3]_2(\text{SO}_4)_3$ is :
 - (a) 12
 - (b) 2
 - (c) 3
 - (d) 6
172. Vitamin B₁₂ is a complex compound of :
 - (a) Fe^{2+}
 - (b) Mg^{2+}
 - (c) Co^{3+}
 - (d) Cu^{2+}
173. Chloroform, in the presence of air and sunlight, produces a poisonous gas known as :
 - (a) Phosgene
 - (b) Phosphine
 - (c) Tear gas
 - (d) Mustard gas
174. Propan-2-ol on oxidation with CrO_3 gives :
 - (a) Propanal
 - (b) Propanoic acid
 - (c) Propene
 - (d) Propanone
175. The reaction of ammonia with a large excess of ethyl chloride will give mainly :
 - (a) Ethylamine
 - (b) Tetraethylammonium chloride
 - (c) Triethylamine
 - (d) Diethylamine
176. Acetamide reacts with Br_2 and aqueous KOH to form :
 - (a) Ethanamine
 - (b) Ammonia
 - (c) Methanamine
 - (d) Ethanenitrile

177. In the ring structure of fructose, the anomeric carbon is:

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

For Questions number 13 to 16, 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.

178. **Assertion (A)** : Transition metals have high melting points.

Reason (R) : Transition metals have incompletely filled d-orbitals.

179. **Assertion (A)** : Rate of reaction increases with an increase in temperature.

Reason (R) : Number of effective collisions decreases with an increase in temperature.

180. **Assertion (A)** : p-nitrophenol is less acidic than phenol.

Reason (R) : Nitro group is an electron-withdrawing group, which stabilises the phenoxide ion.

181. **Assertion (A)** : Boiling point of propylamine is higher than that of trimethylamine.

Reason (R) : In propylamine, intermolecular hydrogen bonding occurs, whereas trimethylamine does not undergo intermolecular hydrogen bonding.

SECTION B

182. State Raoult's law for a solution containing volatile components. Write any two characteristics of a solution which obeys Raoult's law at all concentrations.

183. Write any two differences between the order of a reaction and molecularity of a reaction.

184. Define the following terms :

- (A) Ambidentate ligand
(B) Crystal field splitting energy

185. What happens when :

- (A) n-butyl chloride is treated with alcoholic KOH ?
(B) Chlorobenzene is treated with CH_3Cl in the presence of anhydrous AlCl_3 ?

186. (A) What are essential amino acids ? How do you explain the amphoteric behaviour of amino acids?

OR

(B) Define the following terms :

- (i) Peptide linkage
(ii) Nucleotide

SECTION C

187. Calculate the molarity and molality of a KI solution if the density of 20% (mass/mass) aqueous solution of KI is 1.2 g mL^{-1} .

[Given : Molar mass of KI = 166 g mol^{-1}]

188. Define conductivity and molar conductivity for a solution of an electrolyte. Why does the conductivity of a solution decrease with decrease in concentration?

189. A first order reaction is 50% complete in 20 minutes. Calculate the time for 75% completion of the reaction. [$\log 4 = 0.6$]

190. (A) Give reasons :

- (i) Why are low spin tetrahedral complexes not formed?
(ii) Why is $[\text{Co}(\text{en})_3]^{3+}$ complex more stable than $[\text{Co}(\text{NH}_3)_6]^{3+}$?
(iii) Why are geometrical isomers not possible for tetrahedral complexes having two different types of unidentate ligands coordinated to the central metal ion?

OR

(B) (i) Write the hybridisation and magnetic behaviour of the following complexes:

- (I) $[\text{Ni}(\text{CN})_4]^{2-}$
(II) $[\text{FeF}_6]^{3-}$

(ii) What type of isomerism is shown by $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$ and $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+}$?
[Given : Atomic number : Ni = 28, Fe = 26]

191. Write two differences between $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions. Out of chlorobenzene and 2,4,6-trinitrochlorobenzene, which one is more reactive towards nucleophilic substitution reactions?

192. Explain the following :

- (A) Carbylamine reaction
- (B) Hoffmann's bromamide degradation reaction
- (C) Diazotisation reaction

193. How do you convert the following?

- (A) Propanone to Propan-2-ol
- (B) Ethanal to Ethane
- (C) Sodium benzoate to Benzene

SECTION D

194. The boiling points of alcohols and phenols increase with increase in the number of carbon atoms due to increase in van der Waals forces. The - OH group in alcohols and phenols is involved in intermolecular hydrogen bonding, due to which their boiling points are higher than those of ethers, haloalkanes and haloarenes of comparable molecular masses. Alcohols and phenols are acidic in nature. Electron-withdrawing groups in phenol increase its acidic strength, while electron-releasing groups decrease it. The presence of -OH group in phenols activates the aromatic ring towards electrophilic substitution and directs the incoming group to the ortho and para positions due to resonance effect. The Reimer-Tiemann reaction of phenol yields salicylaldehyde, whereas Kolbe's reaction of phenol yields salicylic acid. Aspirin is formed by the acetylation of salicylic acid.

(A) (i) Write the name of the major product(s) formed in :

- (I) Reimer-Tiemann reaction
- (II) Kolbe's reaction

(ii) Name the method by which aspirin is formed from salicylic acid.

(B) (i) Why does phenol undergo electrophilic substitution reaction easily?

OR

(ii) Why is phenol more acidic than alcohol ?

(C) Arrange the following compounds in order of their increasing boiling points :

Propan-1-ol, Ethanol, Butan-2-ol, Butan-1-ol

195. Carbohydrates are optically active polyhydroxy aldehydes or ketones or molecules that provide such units on hydrolysis. They are broadly classified into three groups : monosaccharides, oligosaccharides and polysaccharides. Monosaccharide units are held together by glycosidic linkages to form disaccharides or polysaccharides. Starch and cellulose are polysaccharides. Starch is a polymer of α -glucose and consists of two components : Amylose and Amylopectin. Amylose is water soluble, having 15 – 20% of starch, whereas Amylopectin is insoluble in water, having 80 – 85% starch. Chemically, amylose is a long unbranched chain of α -glucose units held together by C1-C4 glycosidic linkage. Amylopectin is a branched chain of α -glucose units held together by C1-C4 and C1-C6 glycosidic linkages.

(A) Write two differences between Amylose and Amylopectin.

(B) (i) Classify the following into monosaccharides and disaccharides:

Fructose, Lactose, Glucose, Maltose

OR

(ii) Define polysaccharide with an example.

(C) Name the linkage which joins two monosaccharide units.

SECTION E

196. (A) Give reasons for the following:

(i) Oxidation of propanal is easier than propanone.

(ii) There are two $-\text{NH}_2$ groups in semicarbazide. However, only one $-\text{NH}_2$ groups is involved in the formation of semicarbazones.

(iii) HCHO does not undergo aldol condensation reaction.

- (iv) Boiling points of carboxylic acids are higher than those of alcohols of comparable molecular masses.
 (v) Aldehydes are more reactive towards nucleophilic addition reactions than ketones.

OR

- (B) (i) Write the names of the product(s) formed when :
 (I) Benzoyl chloride undergoes Rosenmund reduction.
 (II) Ethanal is treated with CH_3MgBr , followed by hydrolysis.
 (III) Benzaldehyde undergoes Cannizzaro's reaction.
 (ii) Write a simple chemical test to distinguish between :
 (I) Propanal and Propanone
 (II) Phenol and Benzoic acid

197. (A) (i) Write the Nernst equation and calculate the emf of the following cell at 298 K :



Given : $E_{\text{Mg}^{2+}/\text{Mg}}^{\circ} = -2.36 \text{ V}$, $E_{\text{Cu}^{2+}/\text{Cu}}^{\circ} = +0.34 \text{ V}$

[$\log_{10} = 1$]

- (ii) Define fuel cell and write its two advantages.

OR

- (B) (i) The cell in which the following reaction occurs:
 $2\text{Fe}^{3+}(\text{aq}) + 2\text{I}^{-}(\text{aq}) \rightarrow 2\text{Fe}^{2+}(\text{aq}) + \text{I}_2(\text{s})$
 has $E_{\text{(cell)}}^{\circ} = 0.24 \text{ V}$ at 298 K . Calculate $\Delta_r G^{\circ}$ and $\log K_C$ of the cell reaction.
 [Given : $1 \text{ F} = 96500 \text{ Cmol}^{-1}$]

- (ii) State the following laws:
 (I) Faraday's first law of electrolysis
 (II) Kohlrausch's law of independent migration of ions

198. (A) (i) Define transition elements. Mention any two characteristics of transition elements.

- (ii) How will you prepare KMnO_4 from pyrolusite ore (MnO_2) ?

OR

- (B) (i) What is lanthanoid contraction ? What are the consequences (any two) of lanthanoid contraction?
 (ii) (I) Why does $E_{\text{Cu}^{2+}/\text{Cu}}^{\circ}$ have positive value (+0.34 V)?
 (II) Why do actinoids show a wide range of oxidation states?