

General Instructions:

- There are 33 questions in this question paper with internal choices.
- SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
- SECTION B consists of 5 short answer questions carrying 2 marks each.
- SECTION C consists of 7 short answer questions carrying 3 marks each.
- SECTION D consists of 2 case-based questions carrying 4 marks each.
- SECTION E consists of 3 long answer questions carrying 5 marks each.
- All questions are compulsory.
- Use of log tables and calculators is not allowed.

**SECTION – A**

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

- For the reaction  $A \rightarrow \text{products}$ , at  $[A] = 0.4 \text{ M}$ ,  $t_{1/2}$  is 24 s and at  $[A] = 0.2 \text{ M}$ ,  $t_{1/2}$  is 12 s. The unit of rate constant is,
  - Mol/L/s
  - Mol L/s
  - $\text{L}^2 / \text{mol}^2/\text{s}$
  - $\text{s}^{-1}$
- $k_H$  for  $\text{O}_2$  is  $34840 \text{ bar L mol}^{-1}$  and the partial pressure exerted by  $\text{O}_2$  is 1 bar. The solubility of gaseous oxygen in water at a temperature of 293 K is:
  - $8.4 \times 10^{-3} \text{ mol L}^{-1}$
  - $1.02 \times 10^7 \text{ mol L}^{-1}$
  - $34.84 \times 10^2 \text{ mol L}^{-1}$
  - $2.87 \times 10^{-5} \text{ mol L}^{-1}$
- Solutions of two electrolytes 'A' and 'B' are diluted. The  $\lambda_m$  of 'B' increases 1.5 times and that of 'A' increases 25 times. Which of the two is a strong electrolyte?
  - A is a strong electrolyte.
  - B is a strong electrolyte.
  - Both A and B are strong electrolytes.
  - Cannot predict.
- For the reaction  $2X \rightarrow X_2$ , the rate of reaction becomes 3 times when the concentration of X increased by 27 times. What will be the order of the reaction?
  - 3
  - 1/9
  - 1/3
  - 9
- On mixing liquids X and Y, the volume of the resulting solution increases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing the liquids X and Y?
  - Negative deviation, Increases.
  - Negative deviation, Decreases.
  - Positive deviation, Increases.
  - Positive deviation, Decreases.
- Reaction of  $\text{C}_6\text{H}_5\text{CH}_2\text{Br}$  with aqueous sodium hydroxide solution follows,
  - $\text{SN}^1$  mechanism
  - $\text{SN}^2$  mechanism
  - $\text{SN}^1$  or  $\text{SN}^2$  depending on the temperature of the reaction
  - saytzeff rule
- Crystal field splitting is maximum for,
  - $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
  - $[\text{Co}(\text{CN})_6]^{3-}$
  - $[\text{Co}(\text{NH}_3)_6]^{3+}$
  - All the complex ions have the same  $\Delta_o$
- Which of the following reagents is used to prepare 2-methoxy-2-methyl propane by Williamson's synthesis?
  - $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{-ONa} + \text{CH}_3\text{Br}$
  - $(\text{CH}_3)_3\text{C-Br} + \text{CH}_3\text{-ONa}$
  - $(\text{CH}_3)_3\text{C-ONa} + \text{CH}_3\text{Br}$
  - $\text{CH}_3\text{CHBrCH}_2\text{CH}_3 + \text{CH}_3\text{-ONa}$
- Which of the following statements is not true about glucose?
  - It is an aldohexose
  - On heating with HI it forms n-hexane
  - It is present in furanose form
  - It does not give 2,4-DNP test
- Name the alkene which on reductive ozonolysis gives acetone as the only product
  - 2-methyl but-2-ene
  - 2,3-dimethyl but-2-ene
  - Hex-3-ene
  - Propene
- How many coordination sites are there in an ethylene diamine tetraacetate ion?
  - 2
  - 4
  - 6
  - 8

12. Deficiency of which vitamin causes increase in time for blood clotting?
- |              |              |
|--------------|--------------|
| a) Vitamin B | b) Vitamin K |
| c) Vitamin C | d) Vitamin E |

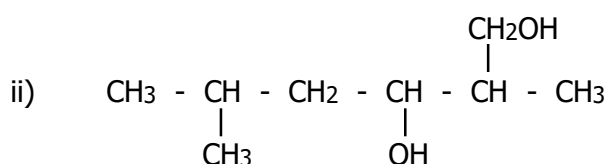
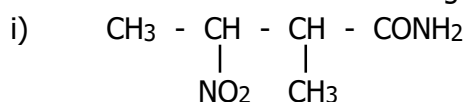
Given below are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from the options given below:

- 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.
13. Assertion(A): Benzaldehyde is less reactive than ethanal towards nucleophilic attack. .  
 Reason(R): All the carbon atoms of benzaldehyde have  $sp^2$  hybridisation.
14. Assertion(A):  $C_6H_5CH_2NH_2$  is an aryl amine.  
 Reason(R) : In aryl amines , aromatic ring is directly attached to nitrogen atom.
15. Assertion(A): The two strands in DNA are complementary to each other.  
 Reason(R): The hydrogen bonds are formed between specific pairs of bases.
16. Assertion(A): Sucrose is a non-reducing sugar.  
 Reason(R): A free aldehydic group is present in sucrose.

### SECTION – B

This section contains 5 questions with internal choice in one question. The questions are very short answer type and carry 2 marks each.

17. Give IUPAC name for the following compounds:

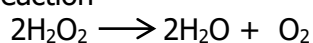


(OR)

Give structure of the following organic compounds according to IUPAC norms:

- i) Hex-2-en-4-ynoic acid  
 ii) 4-tert-Butyl-3-iodo heptane

18. For a reaction



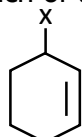
The proposed mechanism is as given below:

- I)  $\text{H}_2\text{O}_2 + \text{I}^- \longrightarrow \text{H}_2\text{O} + \text{IO}^-$  (slow)  
 II)  $\text{H}_2\text{O}_2 + \text{IO}^- \longrightarrow \text{H}_2\text{O} + \text{I}^- + \text{O}_2$  (fast)

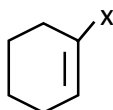
- i) Write the rate law for the reaction.  
 ii) Write the overall order of the reaction.  
 iii) Out of the steps (I) and (II), which one is the rate determining step?

19. Hexane and Heptane form an ideal solution. At 373 K the vapour pressure of the two liquid components are 105.2 kPa and 46.8 kPa respectively. What will be the vapour pressure of a mixture of 26 g of hexane and 35 g of heptane?  
 (Molar mass, Heptane = 100 g/mol, Hexane = 86 g/mol)

20. a) Which of the following is an allylic halide?



or



- b) Which alkyl halide from the following pair is (i) Chiral (ii) undergo  $SN^2$  reaction faster?



or



21. a) Explain the mechanism of a nucleophilic attack on the carbonyl group of an aldehyde or ketone.  
 b) 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 where as isomer A does not form any precipitate. Write the formulae of A and B.

### SECTION – C

This section contains 7 short answer type questions with internal choice in one question and carry 3 marks each.

22. a) Write the IUPAC name of the coordination compound  $K_2[Ni(CN)_4]$ . Explain its geometry and magnetic behaviour on the basis of valence bond theory. (Atomic No. Ni = 28)  
 b) Write formula for the coordination compound iron(III) hexacyanidoferrate(II).
23. Give chemical equations only to explain the following reactions:  
 i) Cross aldol condensation reaction between benzaldehyde and acetophenone.  
 ii) Hell- Volhard- Zelinsky reaction.  
 iii) Riemer-Tiemann reaction.
24. a) Complete the reaction:  $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow$   
 b) Why is  $Cr^{2+}$  reducing and  $Mn^{3+}$  oxidising when both have  $d^4$  configuration?  
 c) What is lanthanoid contraction? What are its consequences?
25. 3.9 g of benzoic acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. Calculate van't Hoff factor and predict the nature of the solute. (Molar mass of benzoic acid 122 g/mol,  $k_f$  for benzene = 4.9 K Kg mol<sup>-1</sup>)  
 (OR)  
 Calculate the mass of a non-volatile solute (molar mass= 40 g/mol) which should be dissolved in 114 g of octane to reduce its vapour pressure to 80% (molar mass of octane = 114 g/mol).
26. How to bring about following conversions?  
 i) Propanoic acid to ethanoic acid.                      ii) 1-bromobutane to 2-bromobutane  
 iii) Propanone to propane
27. Give a chemical test to distinguish between following pairs of chemical compounds. Support your answer with a chemical equation.  
 i) Benzoic acid and sodium benzoate                      ii) Aniline and N-methyl aniline  
 iii) Ethanol and 2-methyl propan-2-ol
28. Three electrolytic cells containing electrolytes  $ZnSO_4$ ,  $AgNO_3$  and  $CuSO_4$  were connected in series. A steady current of 1.50 ampere was passed through them until 1.45 g of Ag were deposited at the cathode of cell B. How long did the current flow? What mass of copper and zinc were deposited?  
 (Atomic Mass: Cu = 63.5 g/mol, Zn = 65.3 g/mol, Ag = 108 g/mol)

### SECTION – D

This section contains 2 case based questions carrying 4 marks each.

29. Read the passage given below and answer the following questions:

The d-block of the periodic table contains the elements of the groups 3-12 in which the d orbitals are progressively filled in each of the four long periods. The f-block consists of elements in which 4 f and 5 f orbitals are progressively filled. They are placed in a separate panel at the bottom of the periodic table. The names transition metals and inner transition metals are often used to refer to the elements of d-and f-blocks respectively. Zinc, cadmium and mercury of group 12 are not regarded as transition metals. The presence of partly filled d or f orbitals in their atoms makes transition elements different from that of the non-transition elements. Hence, transition elements and their compounds are studied separately.

The elements of 3d transition series are given as: Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn  
 (Atomic numbers: 21-30)

Answer **any four** of the following questions:

- a) Which element of 3d series has the highest melting point and why?  
 b) Why zinc not regarded as a transition element?

- c) Which element of 3d series shows maximum number of oxidation states?  
 d)  $\text{Cu}^{2+}$  is more stable than  $\text{Cu}^+$ . Explain.  
 e) Which trivalent ion of 3d series is most paramagnetic?

30. Read the passage given below and answer the following questions:

A living system grows, sustains and reproduces itself. The most amazing thing about a living system is that it is composed of non-living atoms and molecules. The pursuit of knowledge of what goes on chemically within a living system falls in the domain of biochemistry. Living systems are made up of various complex biomolecules like carbohydrates, proteins, nucleic acids, lipids, etc. Proteins and carbohydrates which are essential constituents of our food. These biomolecules interact with each other and constitute the molecular logic of life processes. In addition, some simple molecules like vitamins and mineral salts also play an important role in the functions of organisms.

- a) What are the expected products of hydrolysis of lactose?  
 b) Define: i) Denaturation ii) Glycosidic linkage  
 c) Differentiate between:  
 Amylose and Amylopectin (OR) Fibrous protein and Globular protein.

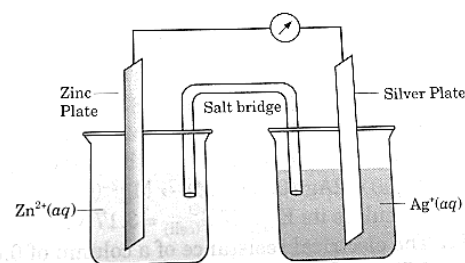
### SECTION – E

This section contains 3 questions carrying 5 marks each. All 3 questions have internal choice.

31. a) Write the cell reaction and calculate emf of the following cell at 298 K.  
 $\text{Sn} / \text{Sn}^{2+}(0.004 \text{ M}) \parallel \text{H}^+(0.020 \text{ M}) / \text{H}_2(\text{g})(1\text{bar}) / \text{Pt}$   
 $(E^\circ \text{Sn}^{2+}/\text{Sn} = -0.14 \text{ V}, R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}, F = 96500 \text{ C})$   
 b) 0.05 M NaOH solution offered a resistance of 31.6 ohm in a conductivity cell at 298 K. If cell constant of the cell is  $0.367 \text{ cm}^{-1}$ , calculate the molar conductivity of NaOH solution.

(OR)

- a) Consider the given diagram and answer the following questions:



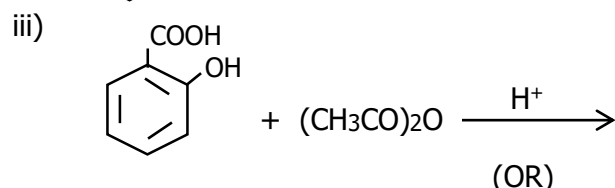
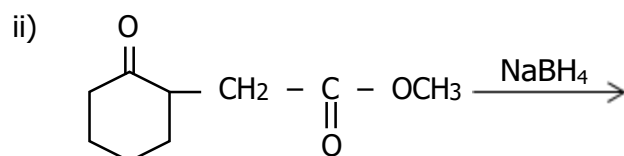
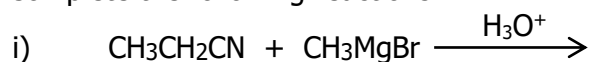
- i) What is the direction of flow of electrons?  
 ii) How will concentration of  $\text{Zn}^{2+}$  and  $\text{Ag}^+$  ions be affected when the cell functions?  
 iii) What will happen if the salt bridge is removed?  
 b) Write the cell reaction of a lead storage battery while the battery is recharging.  
 c) Predict the products of electrolysis of a solution of  $\text{H}_2\text{SO}_4$  using platinum electrodes.
32. ( $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $\log 2 = 0.3010$ ,  $\log 3 = 0.4771$ ,  $\log 4 = 0.6021$ ,  $\log 6 = 0.7782$ )  
 a) A first order reaction is 50% completed in 40 minutes at 300 K and in 20 minutes at 320 K. Calculate the energy of activation.  
 b) The rate constant for a first order reaction is  $60 \text{ s}^{-1}$ . How much time will it take to reduce the initial concentration of the reactant to  $1/10^{\text{th}}$  of its initial value?  
 c) For the reaction  $\text{A} \rightleftharpoons \text{B}$ ,  $\Delta H = +40 \text{ KJ/mol}$ . If  $E_a$  of the forward reaction is  $60 \text{ KJ/mol}$ . What will be  $E_a$  of the backward reaction?

(OR)

- a) State a condition for a bimolecular reaction may be kinetically of first order.  
 b) Define collision frequency.  
 c) Half-life of a first order reaction is  $5 \times 10^4 \text{ s}$ . What percentage of the initial reactant will react in two hours? ( $\text{antilog } 0.0433 = 1.1$ )  
 d) When a graph is plotted for  $\log k$  v/s  $1/T$  a straight line with slope  $-6670$  is obtained. Calculate the energy of activation for this reaction.

33. a) Arrange the following compounds in the increasing order of property as indicated:  
 i)  $C_2H_5NH_2$ ,  $C_6H_5NHCH_3$ ,  $(C_2H_5)_2NH$ ,  $C_6H_5NH_2$  ( $pK_b$  values)  
 ii) pentan-1-ol, n-butane, pentanal, ethoxyethane (boiling point)

b) Complete the following reactions:



a) Account for the following:

- Aniline on nitration gives substantial amount of m-nitro aniline.
- Benzoic acid does not give Friedel-Crafts reactions.
- The carbon-oxygen bond length in phenol is smaller than that of methanol.
- Ethanoic acid is more acidic than phenol.
- OH group attached to benzene ring is o, p directing and activating.

-X-X-X-X-X-X-X-