

General Instructions:

- There are 33 questions in this question paper with internal choice.
- 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.

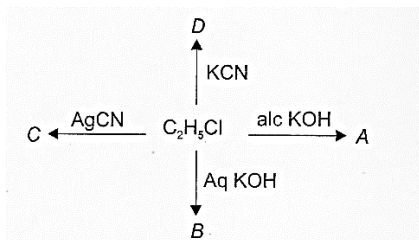
SECTION – A

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

1. On the electrolysis of aqueous sodium chloride solution, which of the half-cell reactions will occur at anode?

- $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$ $E^\circ_{\text{cell}} = -2.71 \text{ V}$
- $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$ $E^\circ_{\text{cell}} = 1.23 \text{ V}$
- $\text{H}^+ + \text{e}^- \rightarrow \frac{1}{2} \text{H}_2$ $E^\circ_{\text{cell}} = 0.00 \text{ V}$
- $\text{Cl}^- \rightarrow \frac{1}{2} \text{Cl}_2 + \text{e}^-$ $E^\circ_{\text{cell}} = 1.36 \text{ V}$

2. Identify A, B, C and D.



- $\text{A} = \text{C}_2\text{H}_4$, $\text{B} = \text{C}_2\text{H}_5\text{OH}$, $\text{C} = \text{C}_2\text{H}_5\text{NC}$, $\text{D} = \text{C}_2\text{H}_5\text{CN}$
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 - $\text{A} = \text{C}_2\text{H}_5\text{OH}$, $\text{B} = \text{C}_2\text{H}_4$, $\text{C} = \text{C}_2\text{H}_5\text{NC}$, $\text{D} = \text{C}_2\text{H}_5\text{CN}$
3. When two liquids with volume V each are combined to form an ideal solution, what is the volume of the resulting solution?
- V
 - 2V
 - Greater than 2V
 - Less than 2V
4. KMnO_4 act as an oxidising agent in alkaline medium. When alkaline KMnO_4 is treated with KI, iodide ion oxidised to
- I_2
 - IO^-
 - IO_3^-
 - IO_4^-
5. When one mole of $\text{CoCl}_3 \cdot 5\text{NH}_3$ is treated with excess of silver nitrate, 2 mol of AgCl was precipitated. The formula of the compound is:
- $[\text{Co}(\text{NH}_3)_5\text{Cl}_2]\text{Cl}$
 - $[\text{Co}(\text{NH}_3)_5]\text{Cl}_2$
 - $[\text{Co}(\text{NH}_3)_4\text{Cl}_2](\text{NH}_3)\text{Cl}$
 - $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
6. Which of the following observations is shown by tert-butyl alcohol when treated with Lucas Reagent?
- Turbidity will be observed within five minutes
 - No turbidity will be observed
 - Turbidity will be observed immediately
 - Turbidity will be observed at room temperature but will disappear after five minutes.

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. A 5% solution of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ (Molar mass = 322 g mol^{-1}) is isotonic with 2% solution of a non-electrolytic, non-volatile substance X. Find out the molecular weight of X.
18. Give a chemical test to distinguish between phenol and ethanol. Give chemical equation to support your answer.

(OR)

Explain with the help of resonance structures how does -OH group in phenol activates it towards electrophilic substitution reaction.

19. a) What are enantiomers?
b) Which of the following is a chiral molecule?
Butan-1-ol or Butan-2-ol
20. Answer the following questions on lead storage battery:
a) What type of battery is lead storage battery?
b) Name the electrolyte used in it.
c) Mention one advantage of lead storage battery over nickel-cadmium cell.
d) What are the uses of lead storage cell?
21. a) The standard reduction potential values of three metal cations X, Y, and Z are 0.52, -3.03 and -1.18 V respectively. What will be the increasing order of reducing power for these metals?
b) If a current of 0.5 A flows through a metallic wire 2 hours, how many electrons would flow through the wire?

SECTION – C

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

22. The data given below are for the reaction of NO and Cl_2 to form NOCl at 298 K.

Expt. No.	$[\text{Cl}_2]$ (mol L^{-1})	$[\text{NO}]$ (mol L^{-1})	Initial Rate ($\text{mol L}^{-1} \text{ s}^{-1}$)
1.	0.05	0.05	1.0×10^{-3}
2.	0.15	0.05	3.0×10^{-3}
3.	0.05	0.15	9.0×10^{-3}

- i) What is the order with respect to NO and Cl_2 in the reaction?
ii) Calculate the rate constant.
iii) Determine the reaction rate when concentration of Cl_2 and NO are 0.2 M and 0.4 M respectively.
23. Write the structure and IUPAC name of the product formed:
i) Phenol reacts with CHCl_3 in the presence of NaOH followed by hydrolysis.
ii) $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{ONa}$ reacts with $\text{C}_2\text{H}_5\text{Br}$
iii) Phenol is heated with zinc dust.

(OR)

Give mechanism for acid catalysed dehydration of ethyl alcohol, if the reaction is carried out at 413 K and ether is the major product formed.

24. Give chemical reaction only to explain the following:
i) Kolbe's reaction
ii) Fittig reaction
iii) Hydroboration-oxidation reaction

25. Explain the following:
- Transition metals have high enthalpy of atomisation.
 - Sc^{3+} ion is colourless.
 - Transition metals and their compounds act as good catalysts.
26. Explain the preparation potassium dichromate from chromite ore by giving chemical equations only.
27. a) Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25.
b) Complete the following reaction:
$$\text{Cr}_2\text{O}_7^{2-} + \text{Fe}^{2+} + \text{H}^+ \rightarrow$$

c) Mn^{2+} compounds are more stable than Fe^{2+} compounds towards oxidation to their +3 state. Explain.
28. a) Give formula of the coordination complex:
Amminebromidochloridonitrito-N-platinate(II).
b) What are homoleptic complexes? Give an example.
c) Give evidence that $[\text{Co}(\text{NH}_3)_5 \text{Cl}] \text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5 \text{SO}_4] \text{Cl}$ are ionisation isomers.

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 study of the conductivity of electrolyte solutions is important for the development of electrochemical devices, for the characterisation of the dissociation equilibrium of weak electrolytes and for the fundamental understanding of charge transport by ions. The conductivity of electrolyte is measured for electrolyte solution with concentrations in the range of 10^{-3} to $10^{-1} \text{ mol L}^{-1}$ as solution in this range of concentrations can be easily prepared. The molar conductivity (λ_m) of strong electrolyte solutions can be nicely fit by Kohlrausch equation.
- Explain the variation of conductivity of an electrolyte with dilution.
 - Write equation for the calculation of λ_m^0 for H_2O on the basis of Kohlrausch law.
 - The cell constant of a conductivity cell is 0.146 cm^{-1} . What is the conductivity of 0.01 M solution of an electrolyte at 298 K , if the resistance of the cell is 1000 ohm ?
- (OR)
- Resistance of a conductivity cell filled with 0.1 mol/L KCl solution is 100Ω . If the resistance of the same cell when filled with 0.02 mol/L KCl solution is 520Ω , calculate the conductivity and molar conductivity of 0.02 mol/L KCl solution. The conductivity of 0.1 mol/L KCl solution is $1.29 \times 10^{-2} \Omega^{-1} \text{ cm}^{-1}$.
30. Read the passage given below and answer **any four** the following questions:
- The word kinetics is derived from the Greek word 'kinesis' meaning movement. Thermodynamics tells only about the feasibility of a reaction whereas chemical kinetics tells about the rate of a reaction. For example, thermodynamic data indicate that diamond shall convert to graphite but in reality the conversion rate is so slow that the change is not perceptible at all. Kinetic studies not only help us to determine the speed or rate of a chemical reaction but also describe the conditions by which the reaction rates can be altered. The factors such as concentration, temperature, pressure and catalyst affect the rate of a reaction. At the macroscopic level, we are interested in amounts reacted or formed and the rates of their consumption or formation. At the molecular level, the reaction mechanisms involving orientation and energy of molecules undergoing collisions, are discussed.

- Define Molecularity of a reaction.
- Draw a graph showing how the rate of a first order reaction changes with change in concentration of the reactants.
- How does the temperature dependence of the rate of a reaction expressed mathematically?
- Give an example for a pseudo first order reaction.
- What is the order of a chemical reaction if rate constant, $K = 5 \times 10^{-3} \text{ s}^{-1}$?

SECTION – E

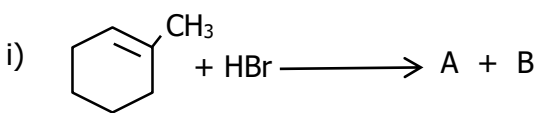
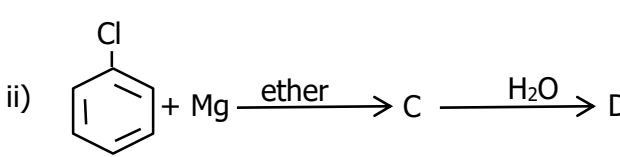
This section contains 3 questions carrying 5 marks each. All 3 questions have internal choice.

- Why does an aqueous solution of sodium chloride freezes at a lower temperature than water?
 - What is the expected van't Hoff factor value for $\text{K}_3[\text{Fe}(\text{CN})_6]$?
 - Explain non-ideal behaviour showing positive deviation from Raoult's law. Draw the graphical representation of the deviation.
 - Calculate the temperature at which a solution containing 54 g of glucose. (molar mass = 180 g/mol) in 250 g of water will freeze. (K_f for water = $1.86 \text{ K Kg mol}^{-1}$)

(OR)

 - Out of 0.1 M solution of glucose and 0.1 M solution of sodium chloride, which will have higher boiling point and why?
 - Find the molarity of a 15% aqueous solution of H_2SO_4 having density 1.02 g cm^{-3} . (Molar mass $\text{H}_2\text{SO}_4 = 98 \text{ g/mol}$)
 - Why aquatic animals are more comfortable in cold water than warm water?
 - Calculate the temperature at which a solution containing 54 g of glucose. (molar mass = 180 g/mol) in 250 g of water will freeze. (K_f for water = $1.86 \text{ K Kg mol}^{-1}$)
- Account for the following:
 - Dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.
 - Haloarenes are less reactive towards electrophilic substitution reactions.
 - Benzylic halides undergo nucleophilic substitution by SN_1 mechanism.
 - Show by a chemical reaction how will you synthesise 1-phenyl ethanol from a suitable alkene.
 - You are given benzene, con. H_2SO_4 and NaOH . Write chemical equation for the preparation of phenol using these reagents.

(OR)

 - While separating a mixture of ortho and para nitrophenols by steam distillation, name the isomer which is steam volatile. Give reason.
 - Identify A, B, C and D.
 - 
 - 
 - How to bring about the following conversions:
 - n-propyl chloride to isopropyl chloride.
 - Methyl magnesium bromide to 2-methyl propan-2-ol.

33. a) Using valence bond theory predict the state of hybridisation, geometry and magnetic behaviour of $[\text{Ni}(\text{NH}_3)_6]^{2+}$. (Atomic no. Ni = 28)
- b) What are chelate ligands?
- c) Give name of a coordination complex which is used in medicine.

(OR)

- a) For the complex $[\text{Fe}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$, answer the following questions:
- Give oxidation number and coordination number of the central metal atom.
 - What is the primary valency of this complex?
 - Name the type of structural isomerism shown by this complex.
- b) Draw crystal field splitting diagram for an octahedral complex.
- c) Give configuration of a d^4 complex in an octahedral field if $\Delta_o < P$.

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