



SAMPLE PAPER 6

CHEMISTRY PAPER 1 (THEORY)

Maximum Marks: 70

Time Allowed: Three Hours

*(Candidates are allowed **additional 15 minutes** for **only** reading the paper.*

*They must **NOT** start writing during this time.)*

This paper is divided into four sections – A, B, C and D.

*Answer **all** questions.*

*Section – A consists of **one** question **having sub-parts** of **one** mark each.*

*Section – B consists of **ten** questions of **two** marks each.*

*Section – C consists of **seven** questions of **three** marks each, and*

*Section – D consists of **three** questions of **five** marks each.*

***Internal choices have been provided in one question each in Section B,
Section C and Section D.***

All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [].

Balanced equations must be given wherever possible and diagrams where they are helpful.

When solving numerical problems, all essential working must be shown.

In working out problems, use the following data:

Gas constant $R = 1.987 \text{ cal deg}^{-1} \text{ mol}^{-1} = 8.314 \text{ JK}^{-1} \text{ mol}^{-1} = 0.0821 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$

$1 \text{ L atm} = 1 \text{ dm}^3 \text{ atm} = 101.3 \text{ J}$, $1 \text{ Faraday} = 96500 \text{ coulombs}$, $\text{Avogadro's number} = 6.023 \times 10^{23}$

SECTION A – 14 MARKS

Question 1

(A) Fill in the blanks by choosing the appropriate word(s) from those given in the brackets:

[octahedral, square planar, transition state, tetrahedral, $\text{mol}^{-1} \text{ L s}^{-1}$, s^{-1} , two, carbanions, phenol, methyl iodide, methanol, iodobenzene, three, carbocations]

(i) When the concentration of a reactant of first order reaction is tripled, the rate of reaction becomes _____ times. The unit of rate constant (k) for the zero order reaction is _____.

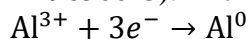
(ii) $\text{Ni}(\text{CO})_4$ possesses _____ geometry while $[\text{Ni}(\text{CN})_4]^{2-}$ is _____.

(iii) $\text{S}_\text{N}1$ and $\text{S}_\text{N}2$ involve the formation of _____ and _____ respectively.

(iv) Phenyl methyl ether (anisole) reacts with HI to give _____ and _____.

(B) Select and write the correct alternative from the choices given below:

(i) Aluminium oxide may be electrolysed at 1000 °C to furnish aluminium metal (atomic mass = 27 u; 1 F = 96500 C). The cathode reaction is



To prepare 5.12 kg of aluminium metal by this method would require

- (a) 5.49×10^1 C of electricity
- (b) 5.49×10^4 C of electricity
- (c) 1.83×10^7 C of electricity
- (d) 5.49×10^7 C of electricity

(ii) The hybridization involved in complex $[\text{Ni}(\text{CN})_4]^{2-}$ is (At.No. Ni = 28)

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

(iii) Which of the following is not correct about transition metals?

- (a) Their compounds are generally coloured.
- (b) They can form ionic or covalent compounds.
- (c) Their melting and boiling points are high.
- (d) They do not exhibit variable valency.

(iv) Alkyl halide (RX) on treatment with KCN followed by reduction leads to formation of:

- (a) RNH_2
- (b) RCH_2NH_2
- (c) $\text{RH} + \text{NH}_3$
- (d) $\text{RCH}_3 + \text{N}_2$

(v) Which of the following solutions is expected to have the highest boiling point?

- (a) 0.5 M Na_3PO_4
- (b) 0.5 M NaCl
- (c) 0.5 M NaNO_3
- (d) 0.5 M $\text{C}_6\text{H}_5\text{NH}_2$

(vi) Assertion: Leclanche cell gives constant voltage throughout its life.

Reason: The overall reaction of button cell does not involve any ion in solution whose concentration can change during its life time.

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

(vii) Assertion: Aniline is less basic than ammonia

Reason: The lone pair on nitrogen in aniline is donated into the ring through resonance.

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

(C) Read the passage given below carefully and answer the questions that follow.

Osmosis is the movement of a solvent across a semipermeable membrane toward a higher concentration of solute. In biological systems, the solvent is typically water, but osmosis can occur in other liquids, supercritical liquids, and even gases. When a cell is submerged in water, the water molecules pass through the cell membrane from an area of low solute concentration to high solute concentration. For example, if the cell is submerged in saltwater, water molecules move out of the cell. If a cell is submerged in freshwater, water molecules move into the cell. When the membrane has a volume of pure water on both sides, water molecules pass in and out in each direction at exactly the same rate. There is no net flow of water through the membrane. Osmosis can be demonstrated when potato slices are added to a high salt solution. The water from inside the potato moves out to the solution, causing the potato to shrink and to lose its 'turgor pressure'. The more concentrated the salt solution, the bigger the loss in size and weight of the potato slice.

- (i) How is osmotic pressure related to the concentration of a solute in a solution?
- (ii) Name one SPM which can be used in reverse osmosis plant.
- (iii) Give one practical use of the reverse osmosis.

SECTION B – 20 MARKS

Question 2

- (i) *Ortho*-nitrophenol is less acidic than *para*-nitrophenol. Why?
- (ii) Anisole on reaction with HI produces only phenol and methyl iodide. Give reason?

Question 3

Give a reason for each of the following:

- (i) Actinoids show irregularities in their electronic configurations.
- (ii) Mn_2O_3 is basic whereas Mn_2O_7 is acidic.

Question 4

Give balanced chemical equations to convert the following:

- (i) Toluene to benzyl alcohol
- (ii) Ethanol to propane nitrile

Question 5

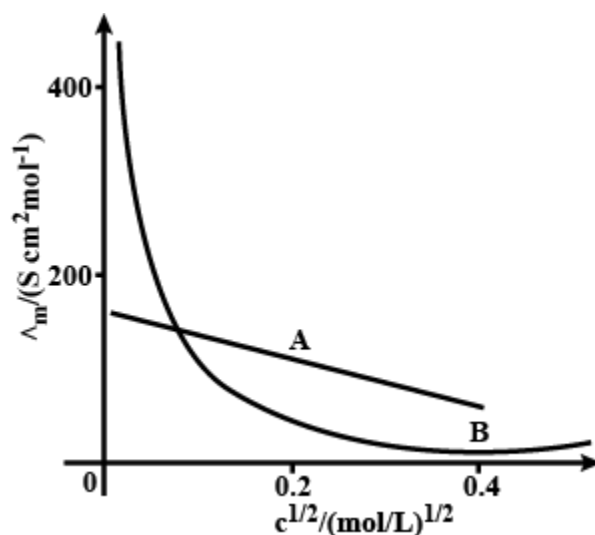
- (i) Zn, Cd and Hg are soft and have low melting point. Why?
- (ii) Orange solution of potassium dichromate turns yellow on adding sodium hydroxide to it. Why?

Question 6

- (i) An alkyl halide having molecular formula C_4H_9Cl is optically active. Write its structure.
- (ii) Why dextro and laevo – rotatory isomers of Butan-2-ol are difficult to separate by fractional distillation?

Question 7

In the plot of molar conductivity (Λ_m) vs square root of concentration ($C^{1/2}$), following curves are obtained for two electrolytes A and B:



- (i) Predict the nature of electrolytes A and B.
- (i) How do you account for the increase in the molar conductivity of the electrolyte A on dilution?

Question 8

- (i) What happens when
 - (a) Anisole is treated with CH_3COCl / anhydrous $AlCl_3$?
 - (b) Phenol is treated with Br_2 in CS_2 .
 (Write chemical reactions only)

OR

- (ii) An organic compound [A] having molecular formula C_2H_7N on treatment with nitrous acid gives a compound [B] having molecular formula C_2H_6O . [B] on treatment with an organic compound [C] gives a carboxylic acid [D] and a sweet-smelling compound [E]. Oxidation of [B] with acidified potassium dichromate also gives [D]. Identify [A], [B], [C] and [D].

Question 9

Calculate the mass of a non-volatile solute (molar mass 40 g) which should be dissolved in 114 g octane to reduce its vapour pressure to 80%?

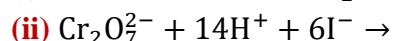
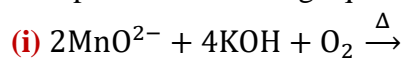
Question 10

(i) Even though the phenoxide ion possesses more resonating structures than the carboxylate ion, carboxylic acids are stronger acids than phenols. What factors contribute to the higher acidity of carboxylic acids compared to phenols, despite the resonance stabilization in phenoxide ions?

(ii) Oxidation of aldehydes is easier than ketones. Why?

Question 11

Complete the following equations:

**SECTION C – 21 MARKS****Question 12**

(i) For the reaction $\text{A} + \text{B} \rightarrow \text{C} + \text{D}$, the initial rate for different reactions and initial concentration of reactants are given below:

S. No.	Initial Conc.		Initial rate (mole L ⁻¹ sec ⁻¹)
	[A] mol L ⁻¹	[B] mol L ⁻¹	
1	1.0	1.0	2×10^{-3}
2	2.0	1.0	4×10^{-3}
3	4.0	1.0	8×10^{-3}
4	1.0	2.0	2×10^{-3}
5	1.0	4.0	2×10^{-3}

(i) What is the overall order of reaction?

(ii) Write the rate law equation.

Question 13

Write the equations involved in the following reactions:

(i) Reimer-Tiemann reaction

(ii) Williamson ether synthesis

Question 14

(i) What is the effect of denaturation on the structure of proteins?

(ii) Name two water soluble vitamins. Why cannot vitamin C be stored in our body?

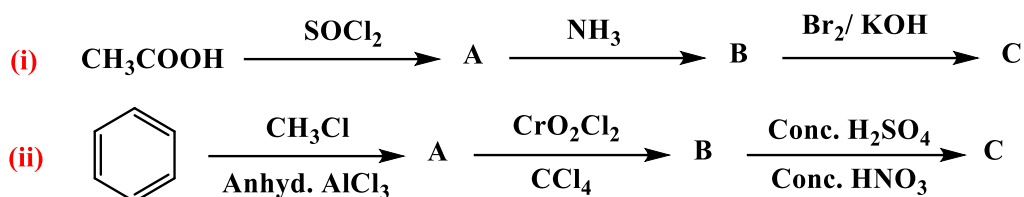
(iii) What is glycogen? How is it different from starch?

Question 15

When 2.56 g of sulphur was dissolved in 100 g of CS_2 , the freezing point lowered by 0.383 K. Calculate the formula of sulphur (S_x). (K_f the $\text{CS}_2 = 3.83 \text{ K kg mol}^{-1}$, atomic mass of sulphur = 32 g mol^{-1})

Question 16

Identify the compounds [A], [B] and [C].

**Question 17**

(i) How will the following be obtained? (Give chemical equations only)

- (a) Benzyl chloride to Benzyl alcohol
- (b) Anisole to *p*-Bromoanisole
- (c) Nitrobenzene to Acetanilide

OR

(ii) Explain the mechanism of acid catalysed hydration of an alkene to form corresponding alcohol

Question 18

(i) For the reaction $\text{A} + \text{B} \rightarrow \text{C}$, it is found that doubling the concentration of A increases the rate by four times and doubling the concentration of B doubles the reaction rate. What is the overall order of the reaction?

(ii) 25% of a first order reaction is completed in 30 minutes. Calculate the time taken in minutes for the reaction to go to 90% completion.

SECTION D – 15 MARKS

Question 19

(i) Give a reason for each of the following:

- (a) HCOOH and CH_3COOH can be differentiated by Tollen's Reagent.
- (b) Benzoic acid is weaker acid than formic acid.
- (c) Oxidation of alcohols to get aldehyde is carried out under controlled conditions.

Question 20

(i) A reaction of cobalt (III) chloride and ethylene diamine in 1:2 molar ratio generates two isomeric products "A" and "B". "A" can show optical activity but "B" is optically inactive. What type of isomers "A" and "B" represent? Draw their structures.

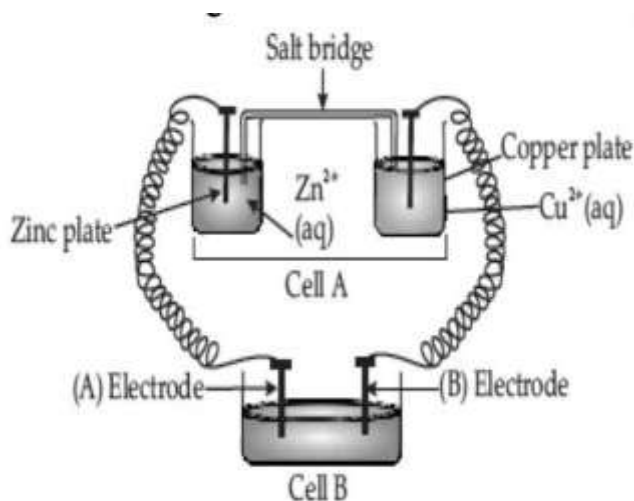
(ii) Show that all octahedral complexes of Ni^{2+} must be outer-orbital complexes.

Question 21

(i) (a) What is the reaction taking place at the anode when an aqueous solution of copper sulphate is electrolysed using Pt-electrodes (inert)?

(b) Specific conductance decreases with dilution whereas equivalent conductance increases with dilution. Why?

(c) Consider the figure and answer the following questions.



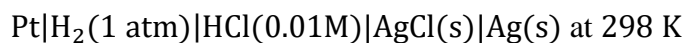
(1) Cell 'A' has $E_{\text{Cell}} = 2 \text{ V}$ and Cell 'B' has $E_{\text{Cell}} = 1.1 \text{ V}$ which of the two cells 'A' or 'B' will act as an electrolytic cell. Which electrode reactions will occur in this cell?

(2) If cell 'A' has $E_{\text{Cell}} = 0.5 \text{ V}$ and cell 'B' has $E_{\text{Cell}} = 1.1 \text{ V}$ then what will be the reaction at cathode and anode.

OR

(ii) (a) Write two advantages the fuel cells have over primary and secondary batteries.

(b) Calculate the cell EMF for



If ΔG_f° values are at 25°C

$$-109.56 \frac{\text{kJ}}{\text{mol}} \text{ for } \text{AgCl(s)} \text{ and}$$

$$-130.79 \frac{\text{kJ}}{\text{mol}} \text{ for } (\text{H}^+ + \text{Cl}^-)(\text{aq})$$

(c) Calculate Λ_m° for acetic acid.

Given that

$$\Lambda_m^\circ(\text{HCl}) = 426 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Lambda_m^\circ(\text{NaCl}) = 126 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Lambda_m^\circ(\text{CH}_3\text{COONa}) = 91 \text{ S cm}^2 \text{ mol}^{-1}$$