SAMPLE PAPER 5

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 cal deg⁻¹ mol⁻¹ = 8.314 JK⁻¹ mol⁻¹ = 0.0821 dm³ atm K⁻¹mol⁻¹
1 L atm = 1 dm³ atm = 101.3 J, 1 Faraday = 96500 coulombs,   Avogadro's number = 6.023 x 10²³

SECTION A – 14 MARKS

Question 1

(A) Fill in the blanks by choosing the appropriate word(s) from those given in the brackets:
[straight line, curve line, -k/2.303, k/2.303, diamagnetic, sodium chloride, benzene, toluene, paramagnetic, Lucas reagent, Tollen's reagent, Grignard reagent, secondary, primary, tertiary, biphenyl]

(i) A plot of $\log_{10}$ [A] vs t is a _____ with a slope equal to _____.

(ii) $[NiCl_4]^-$ is _____ while $[Ni(CO)_4]$ is _____ although both are tetrahedral.

(iii) A mixture of conc. HCl and anhydrous $ZnCl_2$ is called _____ which shows maximum reactivity with _____ alcohol.

(iv) Chlorobenzene on reaction with sodium metal and choromethane in ethereal solution form _____ and _____.

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

(i) On passing 3 A of electricity for 50 min, 1.8 g metal deposits. The equivalent mass of metal is

   (a) 9.3
   (b) 19.3
   (c) 38.3
   (d) 39.9

(ii) Low spin complex of d^6 -cation in an octahedral field will have the following energy
(Δ_o = crystal field splitting energy in an octahedral field, P = Electron pairing energy)

   (a) $\dfrac{-12}{5}\Lambda_0 + P$

   (b) $\dfrac{-12}{5}\Delta_0 + 3P$

   (c) $\dfrac{-2}{5}\Delta_0 + 2P$

   (d) $\dfrac{-2}{5}\Delta_0 + P$

(iii) Copper exhibits only +2 oxidation state in its stable compounds. Why?
   (a) Copper is transition metal in +2 state
   (b) +2 state compounds of copper are formed by exothermic reactions
   (c) Electron configuration of copper in +2 state is [Ar] $3d^9\ 4s^0$.
   (d) Copper gives coloured compounds in +2 state.

(iv) $CHCl_3$ and KOH on heating with a compound from a bad smelling product, the compound is
   (a) C_2H_5CN
   (b) C_2H_5NC
   (c) C_2H_5OH
   (d) $C_2H_5NH_2$

(v) Raoult's law becomes a specific case of Henry's law when:
   (a) The solute is non-polar.
   (b) The solute is highly volatile.
   (c) The Henry's law constant (K_H) equals the partial pressure.
   (d) The temperature is decreased.

(vi) <u>Assertion</u>: More negative the electrode potential greater is the power to act as oxidising agent.
<u>Reason</u>: As the electrode potential becomes more negative there is greater tendency to undergo oxidation
(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) <u>**Assertion**</u>: Hoffmann's ammonolysis can be used to prepare pure primary amines.
<u>**Reason**</u>: Ammonolysis of haloalkanes lead to multiple substitution of alkyl groups on nitrogen.
(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.

The properties of the solutions which depend only on the number of solute particles but not on the nature of the solute are called colligative properties. Relative lowering in vapour pressure is also an example of colligative properties.

For an experiment, sugar solution is prepared for which lowering in vapour pressure was found to be 0.061 mm of Hg. (Vapour pressure of water at 20 °C is 17.5 mm of Hg.)

(i) What is the relative lowering of vapour pressure for the given solution?
(ii) Calculate the vapour pressure (mm of Hg) of solution.
(iii) If weight of sugar taken is 5 g in 108 g of water, then what will be the molar mass of sugar?

SECTION B – 20 MARKS

Question 2

(i) Chlorobenzene does not give Williamson's ether synthesis but sodium phenoxide gives Williamson's ether synthesis. Why?
(ii) What prevents the use of anhydrous calcium chloride for drying ethyl alcohol?

Question 3

Give a reason for each of the following:

    (i) $La(OH)_3$ is most basic and $Lu(OH)_3$ is least basic.

    (ii) Cu^{2+} salts are coloured but Cd^{2+} salts are colourless although both are transition elements.

Question 4

Give balanced chemical equations to convert the following:

    (i) Tert-butyl bromide to isobutyl bromide
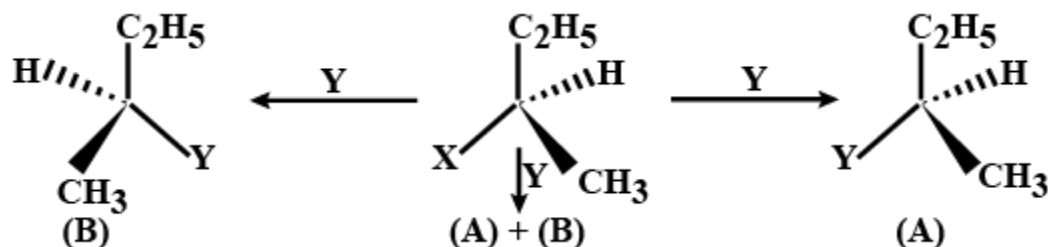   **(ii)** Benzyl alcohol to 2-phenylethanoic acid

Question 5

Answer for the following:

(i) Why interstitial compounds well known for transition metals?

(ii) Why some compounds of transition metals show paramagnetic behaviour?

Question 6

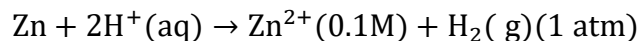Consider the three types replacement of group X by group Y as shown here.

This can result in giving compound (A) or (B) or both. What is the process called if

(i) (A) is the only compound obtained ?

(ii) (A) and (B) are formed in equal proportions?

Question 7

The e.m.f. of a cell corresponding to the reaction

$Zn + 2H^+(aq) \rightarrow Zn^{2+}(0.1M) + H_2(g)(1 \text{ atm})$

is 0.26 volt at 25°C. Calculate the pH of the solution at the hydrogen electrode.

Question 8

(i) What happens when

    (a) Phenol is oxidized by $Na_2Cr_2O_7/ H_2SO_4$?

    (b) Anisole is treated with $CH_3Cl/$ anhydrous $AlCl_3$?

    (Write chemical reactions only)

<p align="center">**OR**</p>

(ii) An organic compound A(C_2H_6O) reacts with Na to give compound B with evolution of H_2 gas. A is heated with conc H_2SO_4 at 413 K to give compound C. Identify the compound A.

Question 9

Give reasons for the following.

  (a) Aquatic species are more comfortable in cold water than warm water.

  (b) At higher altitudes people suffer from anoxia resulting in inability to think.

Question 10

Give reason for the following.

(a) *t*-butyl bromide is more reactive towards S_N1 reaction as compared to *n*-butyl bromide.

(b) CH_3CH_2I undergoes S_N2 reaction faster than CH_3CH_2Br.

Question 11

Complete the following equations:

(i) $Cr_2O_7^{2-} + 2OH^- \rightarrow$

(ii) $MnO_4^- + 4H^+ + 3e^- \rightarrow$

SECTION C – 21 MARKS

Question 12

(i) For the reaction $A + B \rightarrow C + D$, 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) Classify the following into monosaccharides and disaccharides. Ribose, 2-deoxyribose, maltose, galactose, fructose and lactose.

(ii) Where does the water present in the egg go after boiling the egg?

(iii) The melting points and solubility in water of amino acids are generally higher than that of the corresponding halo acids Explain.
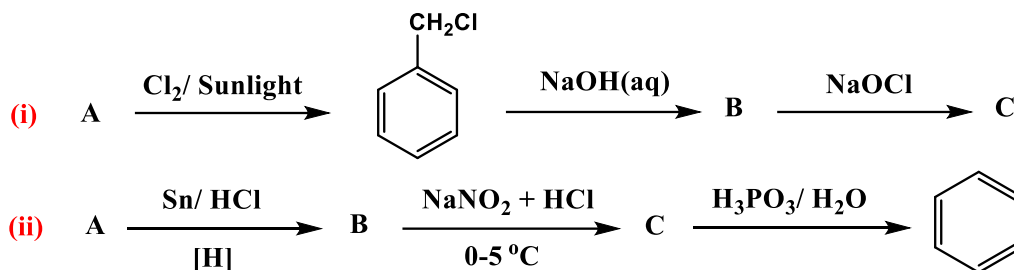
Question 15

Phenol associates in benzene to a certain extent of form a dimer. A solution containing 20 g of phenol in 1.0 kg of benzene has its freezing point lowered by 0.69 K. Calculate the fraction of phenol that has dimerized.

[Given K_f for benzene = 5.1 K m^{-1}]

Question 16

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

(i)

$$A \xrightarrow{\text{Cl}_2/\text{ Sunlight}} \underset{\text{CH}_2\text{Cl}}{\boxed{}} \xrightarrow{\text{NaOH(aq)}} B \xrightarrow{\text{NaOCl}} C$$

(ii)

$$A \xrightarrow[\text{[H]}]{\text{Sn/ HCl}} B \xrightarrow[\text{0-5 °C}]{\text{NaNO}_2 + \text{HCl}} C \xrightarrow{\text{H}_3\text{PO}_3/\text{ H}_2\text{O}} \boxed{}$$

Question 17

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

    (a) Isopropyl alcohol to iodoform

    (b) Anisole to phenyl isocyanide

    (c) Benzene to biphenyl

<p align="center">OR</p>

(ii) Write the mechanism involved in the esterification of a carboxylic acid with alcohol.

Question 18

(i) A first order reaction is 20% complete in 10 min. Calculate the time for 75% completion of the reaction

(ii) For the chemical change A→B it is found that the rate of reaction doubles when the concentration is increased by 4 times. What is the order of the reaction?

SECTION D – 15 MARKS

Question 19

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

        (a) Presence of α-hydrogen in aldehydes and ketones is essential for aldol condensation.

        (b) Chloroacetic acid is stronger acid than acetic acid.

        (c) Aldehydes and Ketones have lower boiling points than corresponding alcohols. Why?

(ii) An aromatic compound 'A' on heating with Br_2 and KOH forms a compound 'B' of molecular formula C_6H_7N, which on reacting with $CHCl_3$ and alcoholic KOH produces a foul-smelling compound 'C'. Further, A on reaction with $LiAlH_4$ in THF produces 'D'. Identify the compounds A, B, C and D.
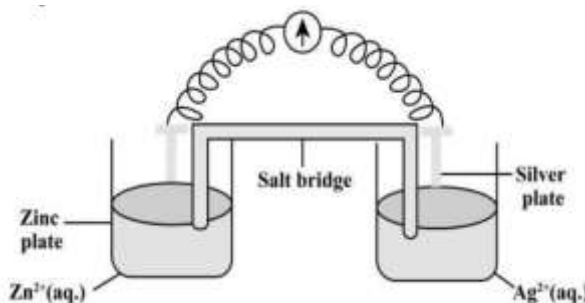
Question 20

(i) A metal complex having composition $Cr(NH_3)_4 Cl_2Br$ has been isolated in two forms (A) and (B). The form (A) reacts with $AgNO_3$ to give a white precipitate readily soluble in dilute aqueous ammonia, whereas (B) gives a pale yellow precipitate soluble in concentrated ammonia. Write the formula of (A) and (B) and state the hybridisation of chromium in each. Calculate the magnetic moments (spin-only value).

(ii) A compound has an empirical formula $CoCl_3.5NH_3$. When an aqueous solution of this compound is mixed with excess of silver nitrate, 2 moles of AgCl precipitates per mole of the compound. On reaction with excess of HCl, no NH_4^+ is detected. Identify the compound.

Question 21

(i) When a bright silver object is placed in the solution of gold chloride, it acquires a golden tinge but nothing happens when it is placed in a solution of copper chloride. Explain the behaviour of silver.

(ii) Consider the figure given above and answer the following questions:

    (a) What is the direction of flow of electrons?

    (b) Which is anode and which is cathode?

    (c) What will happen if the salt bridge is removed?

    (d) How will concentration of Zn^{2+} and Ag^+ ions be affected when the cell functions?

    (e) How will concentration of these ions be affected when the cell becomes dead?

OR

(ii) (a) The conductivity of a 0.01M solution of acetic acid at 298 K is 1.65×10^{-4} S cm^{-1}. Calculate molar conductivity (Λ_m) of the solution.

(b) Calculate the molar conductivity and degree of dissociation. Conductivity of 2.5×10^{-4} M methanoic acid is 5.25×10^{-5} S cm^{-1}.

Given: $\Lambda°(H^+) = 349.5$ S cm^2 mol^{-1} and $\Lambda°(HCOO^-) = 50.5$ S cm^2 mol^{-1}.

(c) A solution is placed in two different cells having cell constant 0.1 and 0.5 cm^{-1} respectively. Which of the two will have greater value of specific conductance?

*************************** The End ***************************