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).*

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*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 dm^3 atm $K^{-1}mol^{-1}$

1 l atm = 1 dm^3 atm = 101·3 J. 1 Faraday = 96500 coulombs.

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: **[4×1]**

[two, Williamson's synthesis, three, anisole, toluene, Friedel-Crafts alkylation, iodoform, sec^{-1}, $mol^{-1}L$ sec^{-1}, Lewis base, acetone, Lewis acid, chloroform, formaldehyde]

(i) Sodium phenoxide reacts with methyl chloride to give _____. The reaction is known as _____.

(ii) 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 first order reaction is _____.

(iii) In coordination complexes, the central metal atom or ion behaves as _____ and the ligands behave as _____.

(iv) Calcium acetate on dry distillation gives _____ which gives _____ on heating with iodine and alkali.

(B) Select and write the correct alternative from the choices given below: **[4×1]**

(i) An alkyl isocyanide on complete reduction gives :

(a) Primary amine.

(b) Secondary amine.

(c) Tertiary amine.

(d) Carboxylic acid.

(ii) For a spontaneous reaction $E^{o}cell$ and ΔG^{o} will be respectively:

(a) -ve and -ve

(b) -ve and +ve

(c) +ve and -ve

(d) +ve and +ve .

(iii) Which of the following pairs of transition elements have exceptional electronic configuration?

(a) Sc and Cu

(b) Fe and Ni

(c) Cr and Cu

(d) Mn and Zn

(iv) For a first order reaction, when 100g of the reactant is taken, 75g of the reactant reacts in 8 minutes. If 200g of the same reactant is taken, in how much time 150g of the reactant will react?

(a) 8 minutes

(b) 16 minutes

(c) 20 minutes

(d) 24 minutes.

(C) Match the following: **[4×1]**

(i)	Phenol	(a)	Osmotic pressure
(ii)	Ethylenediamine	(b)	Zwitter ion
(iii)	Colligative property	(c)	Neutral $FeCl_3$ solution
(iv)	Amino acid	(d)	Bidentate ligand.

(D) **[2×1]**

(i) **Assertion:** Specific conductance of all electrolytes decreases on dilution.
Reason: On dilution, number of ions per unit volume decreases.

(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.

(ii) **Assertion:** Nitration of chlorobenzene leads to the formation of m-nitro chlorobenzene.
Reason: Nitro ($-NO_2$) group is a m-directing group.

(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.

SECTION B – 20 MARKS

Question 2 **[2]**

The osmotic pressure of 20g haemoglobin in 500ml of solution is 0·016atm at 25°C. Calculate the molecular mass of haemoglobin.

Question 3 **[2]**

Give reason for the following:

(i) Transition metals form large number of complex compounds.

(ii) Transition elements show variable oxidation states.

Question 4 **[2]**

Identify compounds [A] and [B] in the following reactions.

(i) $CH_3Br + KCN_{(alc)} \longrightarrow [A] \xrightarrow[\text{(complete hydrolysis)}]{+HOH/H^+} [B]$

(ii) $C_6H_5NH_2 + HNO_2 + HCl \xrightarrow{0\text{-}5^oC} [A] \xrightarrow{Cu_2Cl_2/HCl} [B]$

Question 5 **[2]**

State reasons for the following:

(i) Ethylamine is soluble in water whereas aniline is not soluble in water.

(ii) Aliphatic amines are stronger bases than aromatic amines.

Question 6 **[2]**

Calculate the standard free energy change (ΔG^o) for the following chemical reaction:

(i) $Cd_{(s)} + 2Ag^+ \longrightarrow Cd^{2+} + 2Ag_{(s)}$

(ii) $E^o_{Cd^{2+}/Cd} = -0{\cdot}40V$, $E^o_{Ag^+/Ag} = +0{\cdot}80V$

Question 7 **[2]**

Complete and balance the following chemical equations:

(i) $KMnO_4 + H_2SO_4 + FeSO_4 \longrightarrow$ _____ + _____ + _____ + _____

(ii) $K_2Cr_2O_7 + KI + H_2SO_4 \longrightarrow$ _____ + _____ + _____ + _____

Question 8 **[2]**

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

(a) Picric acid from phenol

(b) Ethanol from formaldehyde

OR

(ii) Write the chemical equations for the dehydration of ethanol with conc. H_2SO_4 at 140^oC and 170^oC.

Question 9 **[2]**

A solution of urea in water has boiling point 100·128°C. Calculate the freezing point of the same solution. Molal constants for water are K_b = 0·512 K kg mol^{-1} and K_f = 1·86 K kg mol^{-1} respectively.

Question 10 **[2]**

Give one chemical test for each to distinguish between the following pair of compounds.

(i) Formaldehyde and acetic acid

(ii) Acetaldehyde and acetone

Question 11 **[2]**

Why are Zn, Cd and Hg not regarded as transition elements?

SECTION C – 21 MARKS

Question 12 **[3]**

The rate constant for a first order reaction becomes six times when the temperature is increased from 350 K to 410 K. Calculate activation energy (Ea) for the reaction.

Question 13 **[3]**

An organic compound 'A' on treatment with aq.KCN produces compound 'B'. Compound 'B' on reduction with Na/C_2H_5OH gives compound 'C' with molecular formula C_2H_7N. Compound 'C' reacts with $NaNO_2$ and HCl to form compound 'D'. Compound 'D' on treatment with acetic acid in presence of conc. H_2SO_4 produces a sweet smelling compound 'E'.

(i) Identify the compounds 'A' to 'E'.

(ii) Name the reaction for the formation of compound 'E' from compound 'D'.

Question 14 **[3]**

(i) Name the four bases present in DNA. Which one of these is not present in RNA?

(ii) Deficiency of which vitamin causes the following diseases.

(a) Scurvy

(b) Night blindness

Question 15 **[3]**

An aqueous solution containing 12·48g of barium chloride in 1000g of water boils at 373·0832K. Calculate the degree of dissociation (α) of barium chloride.
K_b for H_2O = 0·52K kg mol $^{-1}$, molecular mass of $BaCl_2$ = 208·34 g mol $^{-1}$

Question 16 **[3]**

Write the chemical equation for the following named organic reactions.

(i) Haloform reaction

(ii) Reimer - Tiemann reaction

(iii) Kolbe - Schmidt reaction or Kolbe reaction

Question 17 **[3]**

(i) Identify the compounds A, B and C in the following reactions:

(a) $C_6H_5NO_2 \xrightarrow{Sn + HCl} A \xrightarrow[273K\text{ -}278K]{NaNO_2 + HCl} B \xrightarrow{H_2O} C$

(b) $CH_3CN \xrightarrow{H2O / H^+} A \xrightarrow{NH_3 / heat} B \xrightarrow{Br_2 + KOH} C$

OR

(ii) How will the following be converted? (Give chemical equations)

(a) Benzenediazonium chloride to Benzene

(b) Ethylamine to ethyl alcohol

(c) Methylamine to methyl isocyanide

Question 18 **[3]**

Suppose 50 bacteria are placed in a flask containing nutrients, so that they can multiply. A study at 35°C gave the following results:

Time (in minutes)	0	15	30	45	60
Number of bacteria	100	200	400	800	1600

Answer the following questions:

(i) This multiplication of bacteria follows:

(a) Zero order reaction

(b) First order reaction

(c) Second order reaction

(d) Third order reaction

(ii) The rate constant for the reaction is:

(a) $0{\cdot}0462\ min^{-1}$

(b) $0{\cdot}462\ min^{-1}$

(c) $4{\cdot}62\ min^{-1}$

(d) $46{\cdot}2\ min^{-1}$

(iii) The half life period ($t_{1/2}$) of the reaction is:

(a) 1500 minutes

(b) 150 minutes

(c) 15 minutes

(d) 1·5 minutes

SECTION D – 15 MARKS

Question 19 **[5]**

(i) Starting with methyl magnesium bromide, how will the following compounds be synthesised?

(a) Acetaldehyde

(b) Acetone

(c) Acetic acid

(ii) Explain the following:

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

(b) Formic acid reduces Tollen's reagent but acetic acid does not.

Question 20 **[5]**

(i) Name the type of isomerism shown by the following pairs of coordination compounds.

(a) $[Pt(H_2O)_4Cl_2]Cl_2.H_2O$ and $[Pt(H_2O)_3Cl_3]Cl.2H_2O$

(b) $[Co(NH_3)_4Cl_2]Br_2$ and $[Co(NH_3)_4Br_2]Cl_2$

(c) $[Cr(H_2O)_5(SCN)]Cl_2$ and $[Cr(H_2O)_5(NCS)]Cl_2$

(ii) Consider the complex ion $[Co(CN)_6]^{3-}$ and answer the following questions:
(atomic number of Co = 27)

(a) Type of hybridisation of central metal atom

(b) Magnetic nature

(c) Geometry of the complex ion

(d) Low spin complex or high spin complex

Question 21 **[5]**

(i) A 0·06 molar CH_3COOH solution offers a resistance of 55 ohms to a conductivity cell at 25°C. If the cell constant is 0·45cm^{-1} and the molar conductance of CH_3COOH at infinite dilution is 398·5 $ohm^{-1}cm^2mol^{-1}$. Calculate:

(a) Specific conductance

(b) Molar conductance

(c) Degree of dissociation

(ii) Calculate the number of coulombs of charge required to deposit 24·35g of aluminium from a solution containing Al^{3+} ions.
(Atomic weight of Al = 27)

OR

(i) Write the Nernst equation for the cell reaction given below and calculate the emf of the cell at 298K.

$2Cr_{(s)} + 3Fe^{2+}_{(0.1M)} \longrightarrow 2Cr^{3+}_{(0.01M)} + 3Fe_{(s)}$

Given $E^o_{(Cr^{3+}/Cr)} = -0{\cdot}74V$, $E^o_{(Fe^{2+}/Fe)} = -0{\cdot}44V$

(ii) Calculate the molar conductance at infinite dilution (Λ^∞_m) for NH_4OH. Given that Λ^∞_m for $Ba(OH)_2$, $BaCl_2$ and NH_4Cl are 457 $ohm^{-1}cm^2mol^{-1}$, 240 $ohm^{-1}cm^2mol^{-1}$ and 129 $ohm^{-1}cm^2mol^{-1}$ respectively.