

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:

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

$$1 \text{ l atm} = 1 \text{ dm}^3 \text{ atm} = 101.3 \text{ J. } 1 \text{ Faraday} = 96500 \text{ coulombs.}$$

$$\text{Avogadro's number} = 6.023 \times 10^{23}.$$

SECTION A – 14 MARKS

Question 1

- (A) Fill in the blanks by choosing the appropriate word(s) from those given in the [4×1] brackets:

[two, Williamson's synthesis, three, anisole, toluene, Friedel-Crafts alkylation, iodoform, sec^{-1} , $\text{mol}^{-1}\text{L sec}^{-1}$, 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° cell and ΔG° 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 (-NO₂) 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]

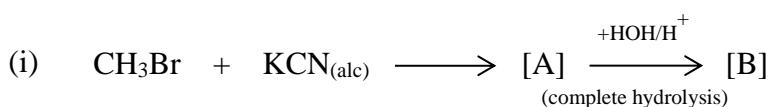
Give reason for the following:

- (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.



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

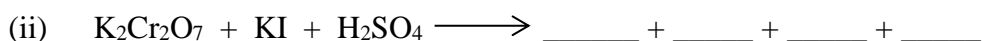
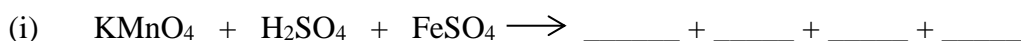
[2]

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



Question 7**[2]**

Complete and balance the following chemical equations:

**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°C and 170°C .

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 $K_b = 0.512 \text{ K kg mol}^{-1}$ and $K_f = 1.86 \text{ K kg mol}^{-1}$ 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 (E_a) for the reaction.

Question 13

[3]

An organic compound 'A' on treatment with aq.KCN produces compound 'B'. Compound 'B' on reduction with Na/C₂H₅OH gives compound 'C' with molecular formula C₂H₇N. Compound 'C' reacts with NaNO₂ and HCl to form compound 'D'. Compound 'D' on treatment with acetic acid in presence of conc. H₂SO₄ 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 H₂O = 0.52K kg mol⁻¹, molecular mass of BaCl₂ = 208.34 g mol⁻¹

Question 16

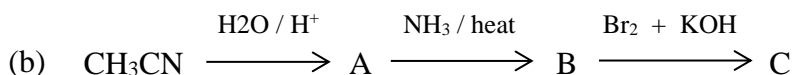
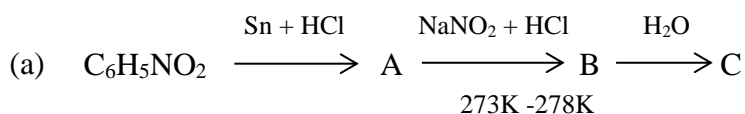
[3]

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:

**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) 0.0462 min⁻¹
- (b) 0.462 min⁻¹
- (c) 4.62 min⁻¹
- (d) 46.2 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) $[\text{Pt}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}_2 \cdot \text{H}_2\text{O}$ and $[\text{Pt}(\text{H}_2\text{O})_3\text{Cl}_3]\text{Cl} \cdot 2\text{H}_2\text{O}$
 - (b) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Br}_2$ and $[\text{Co}(\text{NH}_3)_4\text{Br}_2]\text{Cl}_2$
 - (c) $[\text{Cr}(\text{H}_2\text{O})_5(\text{SCN})]\text{Cl}_2$ and $[\text{Cr}(\text{H}_2\text{O})_5(\text{NCS})]\text{Cl}_2$
- (ii) Consider the complex ion $[\text{Co}(\text{CN})_6]^{3-}$ 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**[3]**

- (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 $398.5\text{ohm}^{-1}\text{cm}^2\text{mol}^{-1}$. 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.
- $$2\text{Cr}_{(s)} + 3\text{Fe}^{2+}_{(0.1\text{M})} \longrightarrow 2\text{Cr}^{3+}_{(0.01\text{M})} + 3\text{Fe}_{(s)}$$
- Given $E^\circ_{(\text{Cr}^{3+}/\text{Cr})} = -0.74\text{V}$, $E^\circ_{(\text{Fe}^{2+}/\text{Fe})} = -0.44\text{V}$
- (ii) Calculate the molar conductance at infinite dilution (Λ^∞_m) for NH_4OH . Given that Λ^∞_m for $\text{Ba}(\text{OH})_2$, BaCl_2 and NH_4Cl are $457\text{ohm}^{-1}\text{cm}^2\text{mol}^{-1}$, $240\text{ohm}^{-1}\text{cm}^2\text{mol}^{-1}$ and $129\text{ohm}^{-1}\text{cm}^2\text{mol}^{-1}$ respectively.