



SAMPLE PAPER 2

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:

[$\text{mol L}^{-1} \text{ s}^{-1}$, s^{-1} , $\text{mol}^{-1} \text{ L s}^{-1}$, s^{-1} , 4, nucleophilic, 3, electrophilic, yellow, 2,4,6-tribromophenol, carbanions, white, 4-bromophenol, 6, carbocations]

(i) For a first-order reaction, the unit of rate is _____ and that of the rate constant is _____.

(ii) The coordination number and the oxidation state of the Co in the complex, $[\text{Co}(\text{en})_3]\text{Cl}_3$, where (en) is ethylenediamine are, respectively _____ and _____.

(iii) In $\text{S}_{\text{N}}1$ mechanism _____ are involved as intermediate species. Formation of phenol from chlorobenzene is an example of _____ aromatic substitution.

(iv) When phenol is treated with bromine water, a _____ precipitate is obtained. The name of the compound formed is _____.

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

(i) A silver nitrate (AgNO_3) solution becomes cloudy upon the addition of sodium chloride (NaCl). Which one of the following statements explains this phenomenon?

(P) Chloride ions from NaCl combine with silver ions to form a yellow precipitate.

(Q) Chloride ions from NaCl combine with silver ions to form a white precipitate of AgCl .

(R) The solubility product of AgNO_3 is exceeded upon addition of NaCl .

(S) The solubility product of AgCl is exceeded upon addition of NaCl .

(a) Only P and R

(b) Only Q and R

(c) Only Q and S

(d) Only P and S

(ii) The spin only magnetic moment of Fe^{2+} ion (in BM) is approximately.

(a) 4

(b) 7

(c) 5

(d) 6

(iii) Lanthanide contraction occurs because

(a) f-orbitals are incompletely filled.

(b) f-orbital electrons are easily lost.

(c) f-orbital do not come out on the surface of atom and are buried inside.

(d) f-orbital electron are poor shielders of nuclear charge.

(iv) Arrange the following in the increasing order of their boiling points:

A: Butanamine, B: N,N-Dimethylethanamine, C: N- Ethylethanamine

(a) $C < B < A$

(b) $A < B < C$

(c) $A < C < B$

(d) $B < C < A$

(v) Which of the following is temperature dependent?

(a) Molarity

(b) Molality

(c) Mole fraction

(d) Mass percentage

(vi) Assertion: Reduction of 1 mole of Cu^{2+} ions require 2 faraday of charge.

Reason: 1 Faraday is equal to the charge of 1 mole of electrons.

(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: Acetylation of aniline enhances the tendency to undergo electrophilic substitution reactions.

Reason: Acetylation reduces the activation of the benzene ring by the NH_2 group since it can undergo resonance with both benzene ring and Acetyl 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.

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

An ideal solution may be defined as the solution which obeys Raoult's law exactly over the entire range of concentration. The solutions for which vapour pressure is either higher or lower than that predicted by Raoult's law are called non-ideal solutions.

Non-ideal solutions can show either positive or negative deviations from Raoult's law depending on whether the A-B interactions in solution are stronger or weaker than A-A and B-B interactions.

- (i) Which of the following solutions is/are ideal solution(s)?
 - (I) Bromoethane and iodoethane
 - (II) Acetone and chloroform
 - (III) Benzene and acetone
 - (IV) n-heptane and n-hexane
 - (a) only I
 - (b) I and II
 - (c) II and III
 - (d) I and IV
- (ii) For which of the following solutions ΔH_{mix} and ΔV_{mix} is negative?
 - (a) Acetone and aniline
 - (b) Ethyl alcohol and cyclohexane
 - (c) Acetone and CS_2
 - (d) Benzene and toluene
- (iii) Define azeotropic mixture.

SECTION B – 20 MARKS

Question 2

- (i) Arrange the following compounds in increasing order of acidity and give a suitable explanation. Phenol, o-nitrophenol, o-cresol.
- (ii) Explain why nucleophilic substitution reactions are not very common in phenols.

Question 3

Give a reason for each of the following:

- (i) Transition elements form alloys.
- (ii) Zn^{2+} salts are white whereas Cu^{2+} salts are coloured.

Question 4

Give balanced chemical equations to convert the following:

- (i) Benzene to DDT
- (ii) Benzene to BHC

Question 5

Answer for the following:

- (i) Why does the density of transition elements increase from Titanium to Copper? (at. no. Ti = 22, Cu = 29)
- (ii) Why is zinc not regarded as a transition element? (at. no. Zn = 30)

Question 6

- (i) (\pm) 2-Butanol is optically inactive. Why?
- (ii) C-X bond length in halobenzene is smaller than C-X bond length in $\text{CH}_3\text{-X}$. Why?

Question 7

- (i) Define the term specific resistance and give its SI unit.
- (ii) Solutions of two electrolytes 'A' and 'B' are diluted. The Λ_m of 'B' increases 1.5 times while that of A increases 25 times. Which of the two is a strong electrolyte? Justify your answer.

Question 8

- (i) What happens when (write chemical reactions) only
 - (a) Sodium ethoxide is treated with ethyl bromide
 - (b) Ethanol with iodine and sodium hydroxide

OR

- (ii) One mole of an organic compound A with the formula $\text{C}_3\text{H}_8\text{O}$ reacts completely with two moles of HI to form X & Y. When Y is boiled with aqueous alkali it forms Z. Z answers the iodoform test. Identify Compound A, X, Y and Z.

Question 9

Calculate the freezing point of an aqueous solution containing 10.50 g of MgBr_2 in 200 g of water (Molar mass of $\text{MgBr}_2 = 184 \text{ g mol}^{-1}$, K_f for water = $1.86 \text{ K kg mol}^{-1}$).

Question 10

- (i) Aromatic carboxylic acids do not undergo Friedel Crafts reaction. Explain
- (ii) pK_a value of 4-nitrobenzoic acid is lower than that of benzoic acid. Explain.

Question 11

- (i) Define lanthanoid contraction? What are its causes and consequences?
- (ii) Lanthanides and actinides are coloured. Explain.

SECTION C – 21 MARKS**Question 12**

The rate constant for the first order decomposition of H₂O₂ is given by the following equation:

$$\log k = 14.2 - \frac{1.0 \times 10^4}{T}$$

Calculate E_a for this reaction and rate constant *k* if its half-life period be 200 minutes.

(Given: R = 8.314 JK⁻¹ mol⁻¹)

Question 13

- (i) Arrange the following in increasing order of basic strength:
C₆H₅NH₂, C₆H₅ N(CH₃)₂, (C₂H₅)₂NH and CH₃NH₂
- (ii) Arrange the following in the increasing order of their boiling point:
C₂H₅NH₂, C₂H₅OH, (CH₃)₃N

Ans.: (i) C₆H₅NH₂ < C₆H₅NHCH₃ < CH₃NH₂ < (C₂H₅)₂NH

(ii) (CH₃)₃N < C₂H₅NH₂ < C₂H₅OH

Question 14

- (i) Name one oil soluble vitamin which is a powerful antioxidant and give its one natural source.
- (ii) What are glycosidic linkages? In which type of biomolecules are they present?
- (iii) Which one of the following is a disaccharide: Starch, Maltose, Fructose, Glucose?

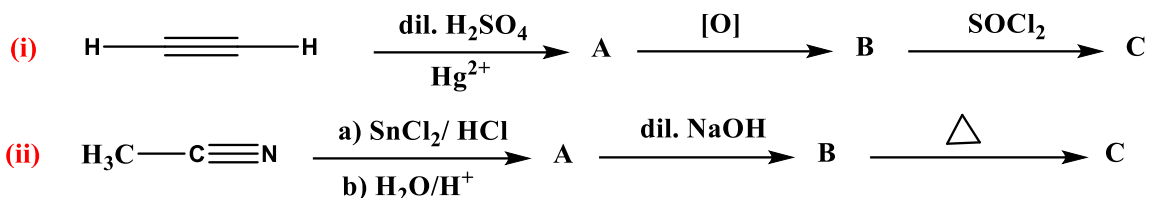
Question 15

An aqueous solution containing 12.48 g of barium chloride in 1.0 kg of water boils at 373.0832 K. Calculate the degree of dissociation of barium chloride.

[Given K_b for H₂O = 0.52 K m⁻¹, Molar mass of BaCl₂ = 208.34 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) Salicylaldehyde from phenol
- (b) Propan-2-ol from Grignard's reagent
- (c) Picric acid from phenol

OR

(ii) How is 1-propoxypropane synthesised from propan-1-ol? Write mechanism of this reaction.

Question 18

(i) The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume:

Experiment	Times (s)	Total pressure (atm)
1	0	0.4
2	100	0.7

Calculate the rate constant (k)

[Given: $\log 2 = 0.3010$; $\log 4 = 0.6021$]

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

SECTION D – 15 MARKS**Question 19**

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

- (a) Acetaldehyde undergoes aldol condensation, but formaldehyde does not.
- (b) Acetic acid is a weaker acid as compared to formic acid.
- (c) α -hydrogen of aldehydes and ketones is acidic in nature.

(ii) An organic compound A ($\text{C}_4\text{H}_6\text{O}_4$) on treatment with ethyl alcohol gives a carboxylic acid B and compound C. Hydrolysis of C under acidified conditions gives B and D. Identify A, B, C and D.

Question 20

- (i) Show that all octahedral complexes of Ni^{2+} must be outer-orbital complexes.
- (ii) How would you account for the following?
- (a) $[\text{Fe}(\text{CN})_6]^{3-}$ is weakly paramagnetic while $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic.
- (b) $\text{Ni}(\text{CO})_4$ possesses tetrahedral geometry while $[\text{Ni}(\text{CN})_4]^{2-}$ is square planar.

Question 21

- (i) (a) Define molar conductivity of a substance and describe how for weak and strong electrolytes, molar conductivity changes with concentration of solute. How is such change explained?
- (b) Write the name of the cell which is generally used in transistors. Write the reactions taking place at the anode and the cathode of this cell.
- (c) What will be the amount of electricity in terms of Faraday's is required to produce 20 g of calcium from molten CaCl_2 ?

Or

- (ii) (a) Why conductivity of an electrolyte solution decreases with the decrease in concentration?
- (b) What is the dissociation constant of acetic acid if Λ_m° for acetic acid is $390 \text{ S cm}^2 \text{ mol}^{-1}$ and the conductivity of 0.001 M acetic acid is $4 \times 10^{-5} \text{ S/m}$?
- (c) What would be the voltage of a voltaic cell at 25°C with the following half cells:
 $\text{Ag}^+(0.001 \text{ M}) \mid \text{Ag}$ and $\text{Cu}^{2+}(0.10 \text{ M}) \mid \text{Cu}$. ($E^\circ_{\text{cell}} = 0.46 \text{ V}$)

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