CHEMISTRY
PAPER - II

Time Allowed: 3 hours
Full Marks: 100

Marks for each question is indicated against it.
Attempt any 5 (five) questions taking not more than 3 (three) questions from each Part.

PART-A

1. (a) Which of the following compounds can be classified as aromatic? Give reasons. (8)
   (i) 2, 4, 6-Cycloheptatriene –1-Carboxylic acid.
   (ii) Azulene
   (iii) Sydnone.
   (iv)

(b) Complete the following reactions with suitable mechanism. (4+8=12)

(i) $\text{CH}_3\text{CF}_2\text{CO}_2\text{H} \rightarrow \text{H}_2\text{O}^+ \rightarrow ?$

(ii) $\text{PhNHNNH}_2 + \text{PhCOCH}_3 \rightarrow \text{A Tautomerize} \rightarrow \text{B (enamine) Claisen-type Condensation}$

$\text{C Rearomatization } \rightarrow \text{D Cyclisation } \rightarrow \text{E } \rightarrow \text{F}$

2. (a) Write the reaction between methyl chloride and hydroxide ion. Sketch the potential energy diagram for this reaction showing transition state and activation energy involved in the reaction. (6)

(b) Arrange the following carbocations in their increasing order of stability. Give reasons to your answer. (4)

$(\text{CH}_3)_3\text{C}, (\text{CH}_2)_2\text{CH}, \text{CH}_3$ and $\text{CH}_2\text{CH}_3$
(c) For each of the following reactions, indicate whether elimination will occur through an E2 or E1. Give the major elimination product of each reaction with suitable mechanism. (5+5=10)

(i) \( \text{CH}_3\text{CH}_2\text{CHCH}_3\text{Br} \xrightarrow{\text{CH}_3\text{O}^-/\text{DMSO}} ? \)

(ii) \( \text{CH}_3\text{CH}_2\text{CHCH}_3\text{Br} \xrightarrow{\text{CH}_3\text{OH}} ? \)

3. Predict the products of the following with proper stereochemistry: (5×4=20)

(i) \( \text{Ph} \xrightarrow{\Delta} ? \)

(ii) \( \text{Ph} + \text{Ph} \xrightarrow{\Delta} ? \)

(iii) \( \text{H} \xrightarrow{\text{hv}} ? \)

(iv) \( \text{Cl} \xrightarrow{\Delta} ? \)

(v) \( \text{H} \xrightarrow{\Delta} ? \)

4. (a) Discuss in brief the primary, secondary and tertiary structures of proteins. (5)
(b) Draw the structure of purine nucleotide in DNA. (3)
(c) Give one method of preparation and one important property of the following: (4×3=12)
   (i) Nylon 66
   (ii) Polyvinyl chloride
   (iii) Polythene
   (iv) Terylene
5. (a) Benzoic acid on reduction with Na in liq. NH\textsubscript{3} gives 1, 2-dihydroproduct, whereas, anisole gives 2, 5-dihydroproduct. Explain. (5)

(b) Complete the following reactions with suitable mechanism: (3\times5=15)

(i) \[ \text{Ph} \xrightarrow{\text{CH} = \text{CH}} \xrightarrow{\text{CH}_3 + \text{OsO}_4} \xrightarrow{?} \xrightarrow{\text{Aq. Na}_2\text{CO}_3 \text{ Reflux}} ? \]

(ii) \[ \text{C}_6\text{H}_5\text{COCH}_3 \xrightarrow{\text{SeO}_2} ? \]

(iii) \[ \text{CH}_3 \xrightarrow{\text{i) n-BuLi}} \xrightarrow{\text{ii) } \text{O}} ? \xrightarrow{\text{HgCl}_2} ? \]

6. (a) What is fluorescence? How is it different from phosphorescence? Explain using proper labelled diagram. (6)

(b) What is a photosensitizer? Write the products involved in the photochemical reaction of butadiene in presence and absence of photosensitizer. (8)

(c) Write the product of the following reaction with suitable mechanism. (6)

\[ \text{O} \xrightarrow{\text{hv}} ? \text{ (Norrish type-1 reaction)} \]

7. (a) Which of the following has higher stretching frequency in IR spectra? Explain. (5)

\[ \xrightarrow{\text{C-Cl}, \text{C-Br}} \]

(b) The force constant of CO is 1840 Nm\textsuperscript{-1}. Calculate the vibrational frequency in cm\textsuperscript{-1} and the spacing between the vibrational energy levels in eV. The atomic masses are \( ^{12}\text{C} = 19.9\times10^{-27}\text{Kg}, ^{16}\text{O} = 26.6\times10^{-27}\text{Kg} \), \( 1\text{eV} = 8066 \text{ cm}^{-1} \). (5)

(c) Explain the origin of stokes and anti-stokes lines in the Raman Spectrum. Which lines are more intense and why? (5)

(d) Sketch all the vibrational modes of linear X-M-X and indicate the IR active and IR inactive ones. (5)
8. (a) Distinguish between 3-methyl and 4-methyl cyclohexanone on the basis of mass spectrometry. (5)

(b) Give the number of $^1H_{NMR}$ signals in the following compounds: (5)

(i) PhCH$_2$CH$_3$

(ii) 

(c) An organic compound A with molecular formula C$_5$H$_9$N show the following peaks in the IR spectrum (in cm$^{-1}$): 3012 (m), 3423(s), 3236(m) and 1615(m). When the compound A is treated with nitrous acid, we get a compound B which shows a strong peak at 3430 cm$^{-1}$. What are A and B and explain the reactions involved. (10)