Question Paper Specific Instructions

Please read each of the following instructions carefully before attempting questions:

There are EIGHT questions divided in TWO SECTIONS and printed both in HINDI and in ENGLISH. Candidate has to attempt FIVE questions in all.

Questions no. 1 and 5 are compulsory and out of the remaining, any THREE are to be attempted choosing at least ONE from each section.

The number of marks carried by a question/part is indicated against it.

Answers must be written in the medium authorized in the Admission Certificate which must be stated clearly on the cover of this Question-cum-Answer (QCA) Booklet in the space provided. No marks will be given for answers written in a medium other than the authorized one.

Coordinate diagrams, wherever required, shall be drawn in the space provided for answering the question itself.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if considered necessary, and indicate the same clearly.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Question-cum-Answer Booklet must be clearly struck off.
SECTION A

Q1. (a) Identify the compound from each of the following pairs, which exhibits aromatic character:

![Compound Images]

(b) Enumerate the reasons for different rates of acetolysis for the following compounds:

![Acetolysis Images]

(c) Name the following reaction and give suitable reagent and mechanism:

![Reaction Image]

(d) Design a suitable experiment to establish the presence of possible intermediate in the following reaction:

![Experimental Design]

 Identify the non-isolable intermediate.
Account for the stereochemical outcome in the following reaction by proposing appropriate, transition state:

\[
\begin{align*}
&\text{cis-trans-2,6-octadiene} \\
&\text{Meso-3,4-dimethyl-1,5-pentadiene}
\end{align*}
\]

Q2. (a) The kinetic (cauline) and thermodynamic (thermal) conditions determine the product of a reaction. While 2-methylcyclohexanone gives different enolates under kinetic and thermodynamic conditions. While 2-tetralone gives only one (same) enolate under kinetic and thermodynamic conditions. Predict the structures of enolates in each case and account for the same.

(b) Among the given compounds, which carbonyl compound is more stable? Explain.

C-AVZ-O-DINB
Which of the carbo-cations will be more stable in each of the following pairs? Give reasons.

10

(c) 3,3-Dimethyl-1-butene (A) reacts with hydrogen iodide to give a mixture of 3-iodo-2,2-dimethylbutane and 2-iodo-2,3-dimethylbutane. Offer a mechanism to account for the formation of the products.

Addition of hydrogen iodide to 3,3-dimethyl-1-butene (A) yields mixture of 3-iodo-2,2-dimethylbutane and 2-iodo-2,3-dimethylbutane. Offer a mechanism to account for the formation of the products.

15

(A)

(d) Identify the reaction and predict the product/s in the following transformations:

(i)  

(ii)  

(iii)  

C-AVZ-O-DINB
Q3. (a) Briefly explain the important methods of generation of carbenes. Explain what are singlet and triplet carbenes. Predict the product/s in the reaction of cis-2-butene with singlet and triplet carbenes.

(b) Predict the products and offer the mechanisms for the following chemical transformations:

(i) \[
\text{CH}_2 - \text{Ph} \quad \text{NaNH}_2 \quad \text{dr} \quad \text{NH}_3 \rightarrow ?
\]

(ii) \[
\text{OH} \quad \text{H}^+ \rightarrow ?
\]

(c) Write the products expected in the reactions shown below. Sketch the mechanisms involved in each case.

\[
? \xrightarrow{\text{KCN}} \text{CHO} \quad (i) \quad \text{NH}_2\text{NH}_2 \rightarrow ?
\]

(ii) \[
\text{KOH} \rightarrow ?
\]

(iii) \[
\Delta
\]
Q4. (a) Write the mechanism involved in the formation of the following compound by Fischer – Indole protocol:

![Chemical structure]

(b) Account for the stereoselectivity and propose a suitable mechanism for the following reaction:

![Chemical structures]

(c) Explain with the help of FMO approach, why stereoselectivity for 1,5-suprafacial carbon migration and 1,5-antarafacial carbon migration are different.

(d) What frontier molecular orbitals are involved in the reaction of (E, Z)-2,4-hexadiene via thermal and photochemical pathways? Account for the formation of the different stereoisomeric products.

C-AVZ-O-DINB
(c) Prove the existence of intramolecular mechanism, when allyl phenyl ether on heating yields o-allyl phenol.

(d) Predict the products and give the mechanisms involved in the following chemical transformations:

(i) \[
\text{Br} \quad \xrightarrow{\text{KOH}} \quad ?
\]

(ii) \[
\text{CHCl}_3 \quad \xrightarrow{\text{KOH}} \quad ?
\]
Q5. (a) Ethylene के मूलक बहुलकन, जिसके परिसमस्तक गृंखलावुक बहुलक बनता है, की क्रियाविधि लिखिए।

Write the mechanism of radical polymerization of ethylene leading to branching in the resultant polymer. 10

(b) निम्नलिखित हाइड्रोबोरेशन-ऑक्सिडेशन अभिक्रिया में प्रशिक्ष प्रमुख उत्पाद का पूर्वानुमान लगाए और रैखियोलेक्टिविटी एवं स्टॉरोलेक्टिविटी के उदाहरण के कारण को समझाएँ:।

Predict the major product and explain the origin of the regioselectivity and stereoselectivity observed in the following hydroboration-oxidation reaction:

$$\text{CH}_3 \quad (i) \quad \text{B}_2\text{H}_6 \xrightarrow{} \quad ?$$

(ii) $\text{H}_2\text{O}_2, \text{OH}$

(c) निम्नलिखित वैज्ञानिक के लिए नोरिष प्रकार-II विघटन दर्शाएँ:।

Show Norrish type-II fragmentation for the following compound:

(d) संक्षेप में समझाएँ कि क्या कारण है कि $\text{C} = \text{O}$ आवंध की प्रतान आवृत्ति ऐलिफैटिक एस्टर के कार्बोनिल वैज्ञानिक के लिए 1740 सेमी$^{-1}$ पर होती है जबकि एसिड क्लोराइड के कार्बोनिल समूह की प्रतान आवृत्ति 1850 सेमी$^{-1}$ पर होती है।

Briefly explain why $\text{C} = \text{O}$ bond stretch frequency occurs at 1740 cm$^{-1}$ for the carbonyl compound of an aliphatic ester and at 1850 cm$^{-1}$ for the carbonyl group of acid chloride. 10

(e) निम्नलिखित वैज्ञानिक के बीच प्रोटोन NMR स्पेक्ट्रा के उपयोग से विभेदन कीजिएः।

(i) 1-ब्रोमोप्रोपेन एवं 2-ब्रोमोप्रोपेन

(ii) प्रोपेनल एवं प्रोपेनोन

Distinguish between the following compounds using proton NMR spectra: 10

(i) 1-bromopropane and 2-bromopropane

(ii) Propanal and propanone
Q6. (a) Given below are two isomeric compounds with molecular formula C₅H₁₀O. Predict the base peaks for each of the following:

\[ \text{and} \quad \text{O} \quad \text{O} \]

Show McLafferty fragmentation peak wherever applicable.

(b) An unknown compound, C₉H₁₀O₂, did not dissolve in aqueous NaOH. The IR spectrum exhibited strong absorption at 1730 cm⁻¹. The ¹H NMR spectrum had signals at δ 7·2 (multiplet), 4·1 (quartet) and 1·3 (triplet). Elucidate the structure of the unknown compound.

(c) DNA की दुर्बिक्षिलती संरचनाओं के स्वाभाविक के लिए कौन-कौन से कारक उत्तरदायी हैं? DNA के दो स्ट्रैंडों के बीच, पूरे आधारों के बीच हाइड्रोजन आयंधन की संरचनाओं को दर्शाइए।

What are the factors responsible for the stability of the double helix structures of DNA? Show the structures of hydrogen bonding between complementary bases between two DNA strands.

(d) Give the mechanism for reduction of a ketone by LiAlH₄ and predict the products in the following reactions:

(i) \[ \text{CH₂─CH(CH₂)₇CH₃} \quad \text{LiAlH₄} \quad ? \]

(ii) \[ \text{OH} \quad \text{LiAlH₄} \quad ? \]

(iii) \[ \text{H₃C─CH₂CN} \quad \text{LiAlH₄} \quad ? \]
Q7. (a) Give the mechanisms involved in the epoxidation of an alkene and Baeyer–Villiger oxidation of a ketone using MCPBA.

(b) What is the advantage of anionic polymerization process in the formation of polystyrene? Enumerate the steps involved in the polymerization of styrene using butyl lithium as an initiator.

(c) Draw the possible structures for the compounds that meet the following descriptions:

(i) \( \text{C}_2\text{H}_6\text{O} \); one singlet
(ii) \( \text{C}_3\text{H}_7\text{Cl} \); one doublet and one septet
(iii) \( \text{C}_4\text{H}_8\text{Cl}_2\text{O} \); two triplets
(iv) \( \text{C}_4\text{H}_8\text{O}_2 \); one singlet, one triplet and one quartet

(d) Draw the possible structures for the compounds that meet the following descriptions:

(i) \( \text{HIO}_4 \)
(ii) \( \text{CHO NaBH}_4 \)
(iii) \( \text{CH}_3\text{LiAlH}_4 \)
(iv) \( \text{CrO}_3 \)
Complete the following reactions and suggest a suitable reaction mechanism for each:

(i) \( \text{OH} \quad \text{CH}_2\text{OH} \xrightarrow{\text{HIO}_4} \) ?

(ii) \( \text{O}_2\text{N} \quad \text{CHO} \xrightarrow{\text{NaBH}_4} \text{methanol} \) ?

(iii) \( \text{O} \quad \text{S} \quad \text{CH}_3 \xrightarrow{\text{LiAlH}_4} \) ?

(iv) \( \text{C} \quad \text{O} \xrightarrow{\text{CrO}_3} \) ?

Q8. (a) निम्नलिखित यौगिक के लिए, मैक्लाफर्टी पुनर्विभाजन आवन (m/c) शिर अयुक्त यौगिक कीजिए:

Predict the McLafferty rearrangement ion (m/c) peak for the following compound:

(b) निम्नलिखित अभिक्रिया के उत्पाद का पूर्वनुमान कीजिए और अभिक्रिया की क्रियाविधि सुझाइए:

Suggest the product and offer the mechanism in the following reaction:

(c) निम्नलिखित रासायनिक रूपांतरण की क्रियाविधि प्रस्तावित कीजिए:

C-AVZ-O-DINB
(d) RNA एवं DNA दोनों में पाए जाने वाले सभी बेसों की संरचनाएं दीजिए । उन बेसों की भी संरचनाएं दीजिए जो केवल RNA में या केवल DNA में होते हैं ।

Give the structures of all the bases which occur in both RNA and DNA. Also give the structures of the bases which occur in RNA alone or in DNA alone.

(e) नीचे दिखाए गए पाँच चीज़ों में से एक का IR स्पेक्ट्रोस्कोपी द्वारा विश्लेषण किया गया ।

1639 सेमी$^{-1}$ (दुबल) एवं 1714 सेमी$^{-1}$ (प्रबल) पर पेक्षा देखे गए । 3100 सेमी$^{-1}$ से 3500 सेमी$^{-1}$ के बीच कोई संकेत नहीं था । निम्नलिखित में से किस चीज का विश्लेषण किया गया था ।

One of the five compounds shown below was analysed by IR spectroscopy. Peaks were observed at 1639 cm$^{-1}$ (weak) and 1714 cm$^{-1}$ (strong). There was no signal between 3100 cm$^{-1}$ to 3500 cm$^{-1}$. Which compound was analysed?