CSM—19/23

PART—II/PAPER—VII

CHEMISTRY

PAPER—II

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Time : 3 Hours

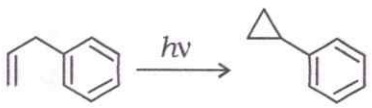
Full Marks : 250

The question paper contains **18 (Eighteen)** *questions in* **GROUP—A, (12)** *and* **GROUP—B, (06)** *together.*

GROUP—A

Candidates to attempt **10** ***(ten)*** *questions within word limit of* **250**. *Each question carries* **15** *marks.*

1. Identify the following reaction where allyl benzene rearranges to phenyl cyclopropane photochemically and explain its mechanism.



2. Discuss the chemical properties of Teflon that make it highly inert. How does its molecular structure contribute to its chemical stability?

3. Define secondary structure in proteins and highlight the role of hydrogen bonds. How do hydrogen bonds contribute to the formation of α-helices and β-sheets?

4. Provide an example of annulenes by taking compound having six carbons that exhibit aromaticity and discuss the criteria for aromaticity in cyclic compounds with reference to conjugation, planarity and Hückel's rule.

5. Given a polymer sample with M_n = 5000 g/mol and M_w = 7500 g/mol, calculate the polydispersity index (PDI). Explain what PDI value indicates about the distribution of polymer chain lengths.

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6. Explain the use of intermediate trapping in predicting the reaction mechanism. Explain by taking the example of benzyne trapping with cyclopentadiene using Diels-Alder reaction. Provide the structure of the product formed.

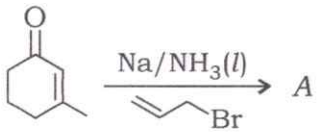
7. The treatment of a cyclic α-haloketones with sodium hydroxide leads to the ring contraction and yield the cyclopentanecarboxylic acid. Predict the reaction intermediate formed and the name of rearrangement with possible steps involved in the mechanism.

8. Explore the regioselectivity between Saytzeff and Hofmann eliminations. Predict the major product formed during the elimination reaction of 2-bromobutane under Saytzeff elimination.

9. Discuss the mechanical properties of nylon that make it suitable for applications requiring strength and flexibility. How does its molecular structure contribute to these properties?

10. Which product is anticipated to result from the photochemical cyclization of (2*E*, 4*Z*, 6*E*)-2,4,6-octatriene? Provide an explanation using the Frontier Molecular Orbital theory. Additionally, investigate the cyclization of (2*E*, 4*Z*, 6*E*)-2,4,6-octatriene under thermal conditions.

11. Determine the reaction product *A* and elucidate the mechanism for the provided reaction.



12. Upon subjecting salicylaldehyde (2-hydroxybenzaldehyde) to a nucleophilic addition reaction with propylamine, compound *A* is formed. Subsequent treatment of compound *A* with $NaBH_4$ results in the formation of compound *B*. However; a reaction between salicylaldehyde and 2-aminothiophenol generated the heterocyclic compound *C*. Identify the structures of compounds *A*, *B* and *C*.

GROUP—B

Candidates to attempt **05** ***(five)*** *questions within word limit of* **300**.
Each question carries **20** *marks.*

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13. Explore the impact of substrate structure on the probability of neighbouring group participation in substitution reactions. Discuss the steric and electronic factors that contribute to this phenomenon. Predict the product formed, if threo *dl* pair of 3-bromo-2-butanol undergoes neighbouring group participation, when treated with HBr.

14. A compound with the molecular weight 116 gave the following spectral information :

(i) UV: λ_{max} 266 nm, ε_{max} 22.

(ii) IR: Significant absorption bands at 3000–2500 (*b*), 1715 (s), 1342 (*w*) cm^{-1}.

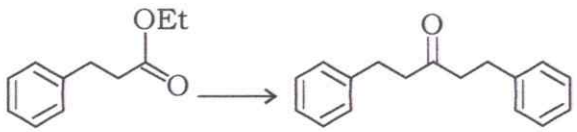
(iii) ^{1}H-NMR: δH 2·10 (s, 3H), 2·60 (*t*, 2H), 2·72 (*t*, 2H) and 12·2 (*bs*, exchangeable with D_2O, 1H)

Find the structural formula of the compound.

15. Describe the double helical structure of DNA and the role of hydrogen bonds between complementary base pairs with suitable diagram. How does the specificity of base pairing contribute to the stability of the DNA double helix?

16. Organic compound *A*, with the molecular formula $C_5H_{10}O$, exhibits a negative Tollens' test, undergoes Clemmensen reduction to form *n*-pentane and does not produce a positive iodoform test. Identify compound *A* and provide a comprehensive overview of all the reactions involved.

17. Develop a synthetic pathway for the creation of the ketone depicted, utilizing the provided ester as the starting material. Your synthesis should incorporate a Claisen condensation.



18. How does the Electron Spin Resonance (ESR) spectroscopy reveal information about the hyperfine structure in specific free radicals? Explain by taking example of (*a–d*) and calculate the hyperfine structure.

(a) $\dot{C}H_3$ *(b)* $\dot{C}D_3$ *(c)* $\dot{C}F_2H$ *(d)* $^{13}\dot{C}H_3$

Given that for : $F\left(I=\frac{1}{2}\right)$ and for $^{13}C\left(I=\frac{1}{2}\right)$

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