

2022

Time - 3 hours

Full Marks - 60

*Answer **all groups** as per instructions.*

Figures in the right hand margin indicate marks.

*Candidates are required to answer
in their own words as far as practicable.*

GROUP – A

1. Answer all questions. [1 × 8
- (a) What is the basic value of homoannular conjugated diene according to Woodward-Fieser rule ?
- (b) Convert 200 nm to micrometer.
- (c) Which of the following diatomic molecules don't absorb in the infra-red region :
- (HCl, N₂, ClBr, O₂)
- (d) What is the range of IR radiation ?
- (e) Write the structure of TMS.
- (f) What do you mean by base peak in mass spectroscopy ?

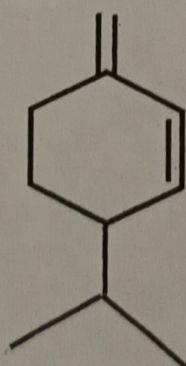
[2]

- (g) Give two examples of disaccharide carbohydrates.
- (h) Define Epimers with an example.

GROUP – B

2. Answer any eight of the following questions within two to three sentences each. [1½ × 8

- (a) What is auxochrome ? Give an example.
- (b) Calculate the energy associated with a radiation having wavelength 300 nm.
- (c) What do you mean by over tones ?
- (d) Give any three important applications of IR spectroscopy.
- (e) Name the various types of bending vibrations.
- (f) How many NMR signals are formed in n-propyl alcohol ?
- (g) Calculate the λ_{\max} of the following compound :



- (h) What do you understand by "Nitrogen rule" in mass spectroscopy ?

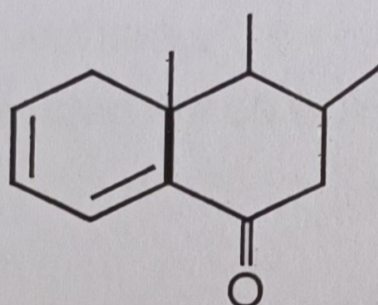
[3]

- (i) Write the molecular formula of Fructose and Lactose.
- (j) What are anomers ? Give an example.

GROUP – C

3. Answer any eight questions within 75 words each. [2 × 8]

- (a) Describe the effect of hydrogen bonding on ultra-violet absorption.
- (b) Calculate λ_{\max} using Woodward-Fieser rule :



- (c) Can you distinguish the type of hydrogen bonding by IR spectroscopy ? Explain with reason.
- (d) What do you mean by Fingerprint region ?
- (e) Why TMS is used as a reference standard in NMR spectroscopy ?
- (f) Define coupling constant (J).
- (g) What do you mean by shielding and de-shielding of a nucleus ?

[4]

- (h) What is Mc Lafferty rearrangement ?
- (i) What are reducing and non-reducing carbohydrates ? Give one example of each.
- (j) Fructose contains a keto group but still it gives silver mirror test with Tollen's reagent. Explain.

GROUP – D

Answer **any four** questions in 500 words each.

4. Discuss $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ electronic transition occurred in UV-visible spectroscopy. How do the polar solvent affect the above two electronic transitions ? [6]
5. Explain bathochromic and hypsochromic shifts with examples. [6]
6. Discuss different types of molecular vibrations involved in IR spectroscopy. [6]
7. Write short notes on within 250 words each. [3 × 2]
- (a) Fermi resonance
- (b) Hooke's law
8. Explain the basic principle of NMR spectroscopy. [6]

[5]

9. (a) What do you mean by parent peak and metastable peak ? [4]
- (b) Predict the mass spectra of n-butane. [2]
10. Write short notes on within 250 words each. [4 + 2]
- (a) Killiani-Fischer synthesis
- (b) Mutarotation

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GROUP – A

1. Answer all questions and fill in the blanks as required. [1 × 8]
- (a) The light of a firefly is an example of _____ .
- (b) A mole of quanta is called _____ .
- (c) Number of nodes in wave function of particle in one dimensional box when $n = 1$ is _____ .
- (d) Non-degenerate eigen functions of a Hermitian operator are _____ to each other.
- (e) The bond order in O_2 molecule is _____ .
- (f) The number of degrees of freedom for benzene is _____
- (g) Out of benzene and quinone _____ has more easily promoted electrons.

[2]

(h) $\hat{A}f(x) = m f(x)$

What is the eigen values of the eigen function $f(x)$ where \hat{A} is the operator.

GROUP – B

2. Answer any eight of the following questions within two to three sentences each. [1½ × 8

- (a) State Beer's law.
- (b) What is photosensitization ?
- (c) How many fundamental vibration frequencies are there in CO_2 ?
- (d) What is force constant ?
- (e) What is the significance of + and – sign in orbitals ?
- (f) Find the value of the operator $\frac{\partial^2}{\partial x^2}$ for the function $5x^2 + y + 3$.
- (g) What is a π^* molecular orbital ?
- (h) Write the expression for \hat{p}_x operator.
- (i) What is zero point energy ?
- (j) Write the selection rule for two rotational states of a diatomic molecule.

[3]

GROUP – C

3. Answer any eight questions within 75 words each. [2 × 8]
- (a) What is Hamiltonian operator ?
 - (b) Write the condition of normalization of two wave functions.
 - (c) What are commutator operators ?
 - (d) Write the molecular orbital energy level diagram of N_2^+ .
 - (e) What are non-bonding molecular orbitals ?
 - (f) What is rotational constant of diatomic molecule ? Write its unit.
 - (g) What is Morse potential ?
 - (h) What are Stoke's lines and anti-Stoke's lines ?
 - (i) What is Raman shift ?
 - (j) What is phosphorescence ?

GROUP – D

Answer **any four** questions in 500 words each.

4. What is quantum mechanical operator ? Write the postulates of quantum mechanics. [1 + 5]
5. Discuss the degeneracy of a particle in three dimensional box. [6]

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GROUP – A

1. Answer all questions and fill in the blanks as required. [1 × 8]
- (a) A polymer obtained from more than one type of monomer molecules is known as _____ .
- (b) The number of repeating units in a polymer molecule is called _____ .
- (c) What is the role of Per acetic acid in polymerization process ?
- (d) Between ortho and para substituted polymers, which has lower T_m value ?
- (e) Osmotic pressure method is used to determine the _____ weight of a polymer.
- (f) Write the relationship between T_g and T_m .

[2]

- (g) What are the monomers of Bakelite ?
- (h) Which initiator is used during the synthesis of PVC from vinyl chloride ?

GROUP – B

2. Answer any eight of the following questions within two to three sentences each. [1½ × 8

- (a) What are thermosetting polymers ? Give an example.
- (b) Define functionality with an example.
- (c) Write the name of any three free radical initiators used in polymerization process.
- (d) What is the chemical composition of Zeigler-Natta catalyst ? In which polymerization process, it is required ?
- (e) Define configuration of a polymer.
- (f) What is \bar{M}_w ? Give the equation to derive \bar{M}_w .
- (g) What is glass transition temperature ?
- (h) Write any two factors that affect T_g of a polymer.
- (i) Write any two differences between LDPE and HDPE.
- (j) Give two examples of biodegradable polymer.

[3]

GROUP – C

3. Answer any eight questions within 75 words each. [2 × 8]

- (a) How polymers can be classified on the basis of intermolecular forces ?
- (b) Define degree of polymerization.
- (c) What is poly dispersity index ? Explain : Haemoglobin is a monodisperse protein.
- (d) What do you understand by number average molecular weight of polymers ?
- (e) What is the effect of bulky group present in a polymer on the crystallinity ?
- (f) How cis and trans configuration of polymers affect T_g value ?
- (g) What is copolymer ? Give an example.
- (h) How is Nylon-6,6 prepared ?
- (i) What is the role of doping in polymer science ?
- (j) Give the preparation of poly urethanes.

GROUP – D

Answer **any four** questions in 500 words each.

4. What is tacticity of a polymer ? How polymers are classified depending on tacticity ? [6]

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5. Explain the mechanism of addition polymerization via free radical route by giving example. [6]
6. Write short notes on within 250 words each. [4 + 2]
- (a) Crystalline polymers and Amorphous polymers
 - (b) Degree of crystallinity
7. Discuss the principle and method used to determine the molecular weight of a polymer by viscometry. [6]
8. Briefly describe the factors that affect T_g of a polymer. [6]
9. Write short notes on within 250 words each. [3 × 2]
- (a) Silicone polymers
 - (b) PVC
10. Discuss the preparation, structure and uses of – [3 × 2]
- (a) Novalac
 - (b) Teflon

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GROUP – A

1. Answer all questions and fill in the blanks as required. [1 × 8]
- (a) Photosynthesis in green plants requires _____.
- (b) Michael addition reaction can be carried in presence of which green solvent ?
- (c) Minamata disease is caused due to the toxicity of _____
- (d) CFCs are also called as _____.
- (e) The ionic liquids are otherwise called as _____ solvents.
- (f) Name the green reagent used for methylation reaction.
- (g) _____ is the key intermediate in the production of Monsanto's round up herbicide.

- (h) Biodiesel is an example of which of the Twelve principles of Green Chemistry.

GROUP – B

2. Answer any eight of the following questions within two to three sentences each. [1½ × 8]

- (a) Write any two goals of Green Chemistry ?
- (b) Name two applications of Ultrasound assisted reactions.
- (c) What are Zeolites ? Give one application.
- (d) What is Saponification reaction ?
- (e) Which catalyst is used in Green Synthesis by avoiding harmful byproducts ?
- (f) Define e-factor.
- (g) What is acid rain ?
- (h) Define atom economy.
- (i) What are neat reactions ?
- (j) What is an antifoulant ?

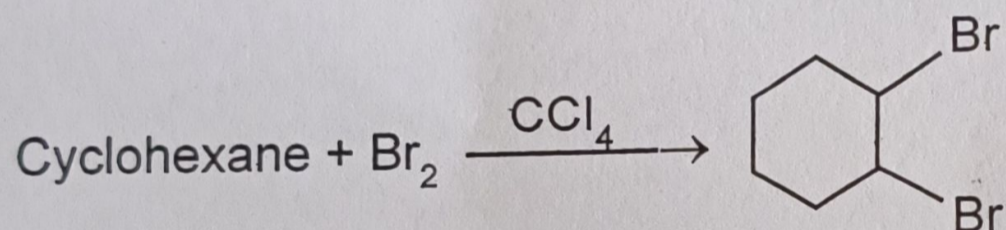
GROUP – C

3. Answer any eight questions within 75 words each. [2 × 8]

- (a) Define super critical water.

[3]

- (b) Comment on "Water as a reaction solvent".
- (c) Define homogeneous and heterogeneous catalyst with examples.
- (d) Explain Diels-Alder reaction.
- (e) Write the full form of CFC and VOC.
- (f) Name two chemicals used in dry cleaning.
- (g) Write down the synthesis of adipic acid by Green method.
- (h) What is biocatalyst ? Give examples.
- (i) Calculate the % of atom economy in the following reaction :



- (j) What is Sustainable Development ?

GROUP – D

Answer **any four** questions in 500 words each.

- 4. State and explain Twelve principles of Green Chemistry. [6]
- 5. Explain coupling and Friedal-Craft reactions using ultrasound technique with examples. [3 + 3]

P.T.O.

[4]

6. Write short notes on within 250 words each.

[3 × 2

(a) Bhopal Gas Tragedy

(b) Biocatalysis

7. Using green synthesis method, synthesize the following compounds :

[3 × 2

(a) Paracetamol

(b) Catechol

8. Discuss replacing smog producing and ozone depleting solvents.

[6

9. Explain the following microwave assisted reactions in water :

[3 × 2

(a) Hoffman Elimination

(b) Methyl benzoate to benzoic acid

10. Discuss advantages and disadvantages of biocatalyst in comparison with chemical catalysts.

[6