Total number of printed pages–11

3 (Sem–6/CBCS) CHE HC 2

2025

CHEMISTRY

(Honours Core)

Paper : CHE–HC–6026

(Organic Chemistry–V)

Full Marks : 60

Time : Three hours

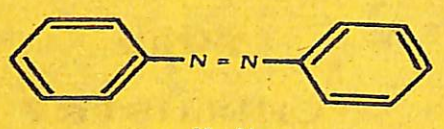
The figures in the margin indicate full marks for the questions.

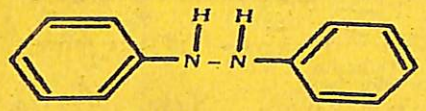
1. Answer the following questions : 1×7=7

   (a) Draw the Fischer projection formula of the C-2 epimer of D-glucose.

   (b) Ethyl acetate shows carbonyl stretching frequency at 1735 cm^{-1} whereas phenylactetate shows at 1770 cm^{-1}. Why ?

(c) Predict which *one* of the following will have higher λ_{max} value ?

(i) 

(ii) 

(d) Draw the Haworth presentation of β-D-glucopyranose.

(e) What are plasticisers ? Give an example.

(f) Aldehyde proton appear quite downfield in NMR spectrum. Give the name of this "effect".

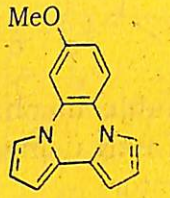
(g) How many ^{1}HNMR signals are obtained for cyclohexane at low temperature? Why ?

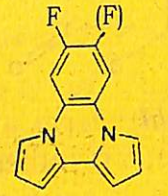
2. Give answer to the following questions : 2×4=8

(a) How the ring size of a monosaccharide can be determined by oxidation with periodic acid ? Explain with an example.

(b) Draw the structures of different types of polypropylene based on tacticity.

(c) State the electronic transition that is most common in the following molecules. In which EMR range this transition occurs. Identify the bathochrome and hypsochrome in the following compounds.





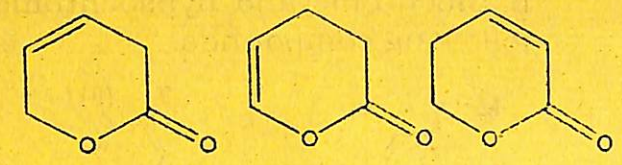
(d) Show the β-1,4-glycosidic linkages between glucose units in cellulose drawing a polymeric chain structure of cellulose.

3. Answer ***any three*** of the following : 5×3=15

(a) What is anomeric effect ? Explain why α-D(+)-glucopyranose is less stable than β-D(+)-glucopyranose, whereas methyl-α-D(+)-glucopyranoside is more stable than its β-anomer. 2+3=5

(b) (i) Phenolphthalein is colourless in acidic/neutral medium, pink in alkaline medium and again colourless in strongly alkaline medium. Explain showing the structural changes that occurs to phenolphthalein. 3

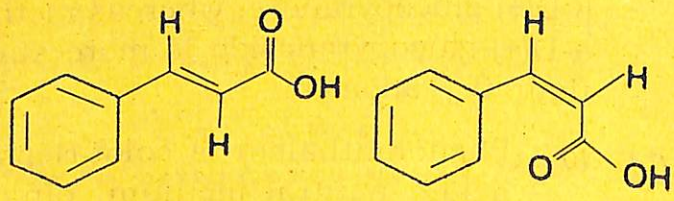
(ii) Giving reason arrange the following compounds in order of increasing wavelength of absorption in their IR spectra. 2



(c) (i) Give a suitable mechanism for synthesis of PAN using a suitable anionic initiator. 3

(ii) Calculate molar absorptivity ε_{max} of $1.0\times10^{-3} mol/L$ of a solution a compound in a $1 dm$ cell at $\lambda_{max} = 210 nm$, with $A = 1.2$. 2

(d) (i) Differentiate the following isomeric cinnamic acid molecules using ^{1}HNMR spectroscopy. 2



(ii) Classify dyes on the basis of chemical structure with examples. 2

(iii) What is Fermi resonance ? 1

(e) (i) Give a method for synthesis of BuNa-S rubber. 3

(ii) Amylopectin is a _____ polymer of _____ with _____ glycosidic linkage between _____ carbon atoms of subsequent monomeric units. 2
(Fill in the blanks)

4. Answer ***any three*** of the following : 10×3=30

(a) Spectral analysis of an organic compound *A*, with molecular formula $C_5H_8O_3$ gives the following data:

^{1}HNMR :

δ values	Intensity	Multiplicity
2.2	3	singlet
2.4	2	triplet
2.7	2	triplet
11.1	1	singlet

IR : 1715 and $1740 cm^{-1}$; $2950 cm^{-1}$, $3030 cm^{-1}$, 3500-$2500 cm^{-1}$; no doublet between 2720 and $2820 cm^{-1}$.
UV $\lambda_{max} 283 nm$ (ε^{25})
Compound *A* does not reduce Fehling solution but gives effervescence with sodium bicarbonate.

(i) Mention the electronic transition responsible for the $\lambda_{max} 283 nm$ in the UV spectrum ?

(ii) Which peaks in the IR spectrum indicates the presence of Carboxylic acid group in the compound *A*?

(iii) How many equivalent hydrogens are there in the compound? Assign the δ values to these hydrogens in the compound.

(iv) Calculate DBE of compound *A*.

Considering all the spectral data, find the structure of *A* with peak assignments.

(b) (i) Explain anisotropic effect and state why acetylenic proton absorbs at lower δ values in comparison to ethylenic protons in ^{1}HNMR spectra. 4

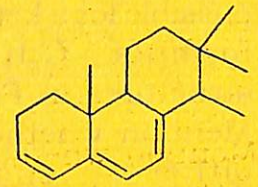
(ii) Different isomeric compounds are possible with the molecular formula C_4H_9Cl. Among these isomers propose the structures of the two isomers with the following ^{1}HNMR specifications. 3

(a) Isomer with only a single peak.

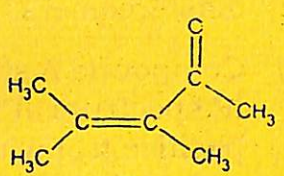
(b) Several peaks including two distinct three proton signals, one of them a triplet at δ 1.0 and other a doublet at δ 1.5.

(iii) Calculate λ_{max} for $\pi \rightarrow \pi^*$ transition in the following compounds : 3

(i)



(ii)



Homoannular conjugated diene's base value = 253*nm*

Heteroannular conjugated diene's base value = 215*nm*

Increment for each substitution

Alkyl substituent or ring residue = 5*nm*

Exocyclic double bond = 5*nm*

Double bond extending conjugation = 30*nm*

Acyclic enone base value = 215*nm*

α-Alkyl group or ring residue = 10*nm*

β-Alkyl group or ring residue = 12*nm*

γ-Alkyl group or ring residue = 17*nm*

(c) (i) Write reactions involved in the Molisch's test for carbohydrates. 3

(ii) How many epimeric pairs are possible for a ketose with molecular formula $C_5H_{10}O_5$? Draw the structures in Fischer projections. Mention whether these pairs are either enantiomers or diastereomers. 4

(iii) Compound A shows strong peak in IR spectrum at 1717 cm^{-1} ' and give positive test with DNP. on reaction with hydroxylamine and followed by a well known Beckmann rearrangement gives compound *B*. Compound *B* polymerizes to give polymer *C*. Identify, give name and structural formula of the compounds *A*, *B* and *C* (polymer). 3

$$\underset{A}{C_6H_{10}O} \xrightarrow[\text{(ii) } H_2SO_4]{\text{(i) } NH_2OH} B \xrightarrow{H_2O} C \text{ (Polymer)}$$

(d) (i) Give the structural formula of the following : 2

(a) Congo red

(b) Methyl orange

(ii)

$$\underset{(C_6H_{12}O_6)}{A} \xrightarrow{\text{Ruff's degradation}} \underset{(C_5H_{10}O_5)}{C} \xrightarrow{\text{Conc. } HNO_3} D(C_5H_8O_7)$$

(D-Aldohexose) (Aldopentose) (Optically active dicarboxylic acid)

$$\downarrow L_1AlH_4$$

$$\underset{(C_6H_{14}O_6)}{B}$$

(Optically inactive alditol)

Assuming all sugars belong to *D*-series, deduce the structures of *A*, *B*, *C*, *D* and write all the reactions. 4

(iii) Deduce possible monomers for polymers with the following repeating units. 2

(i) $-(--CH_2—CH=CH—CH_2--)_n$

(ii) $-(--CO-(CH_2)_6---NH---)_n$

(iv) Which of the two, o-benzoquinone and *p*-benzoquinone is deeper in colour ? Give reason. 2

(e) (i) Write short notes on : *(any two)* 3×2=6

(I) Uses of alizarin and its synthesis from anthracene

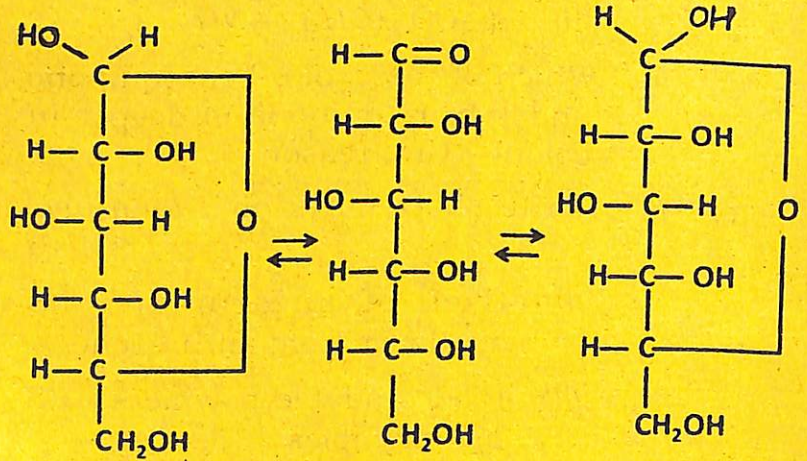
(II) Biodegradable polymers with *two* examples

(III) Synthesis and applications of Nylon 6,6

(ii) What is hyperfine splitting in EPR spectroscopy? Explain the hyperfine splitting pattern of methyl radical. 3

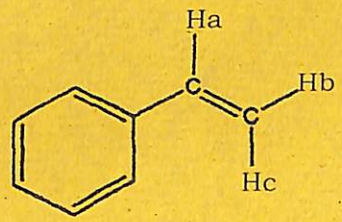
(iii) What is fingerprint region in FTIR spectroscopy ? 1

(f) (i) In aqueous solution glucose exhibits the following equilibrium. What is the phenomenon responsible for this equilibrium ? Explain the phenomenon with a suitable mechanism. How does it support the cyclic structure of glucose ? 3



(ii) What is leuco base in triphenylmethane dyes ? Explain with appropriate reaction. 2

(iii) Describe the splitting pattern of protons 'b' and 'c' in the following compound with the help of a diagram. Give J values also. 2



(iv) Which of the following monomer will undergo anionic addition polymerization easily ? Write the mechanism of anionic addition polymerization taking this monomer as example. 3

$CH_2=CH-CH_3$, $CH_2=CH-Ph$, $CH_2=CH-C_6H_4CN$