Registration Number:

Date & Session:

ST JOSEPH'S UNIVERSITY, BENGALURU -27
B.Sc (CHEMISTRY) – 4th SEMESTER
SEMESTER EXAMINATION: April 2024
(Examination conducted in May / June 2024)
CH 422 – CHEMISTRY IV
(For current batch students only)

Time: 2 Hours **Max Marks: 60**

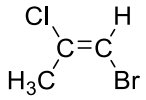
This paper contains FOUR printed pages and THREE parts.

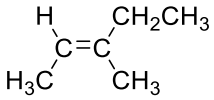
(Spectral data is provided towards the end of this question paper)

PART-A

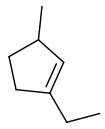
Answer any SEVEN of the following questions. **(7 x 2 = 14)**

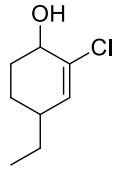
1. Identify the microwave active molecules from the following;
   HCl, N_2, CO_2, OCS
2. Calculate the zero point energy of HCl, if the fundamental vibrational frequency is 2992 cm^{-1}?
3. Why are Stokes lines more intense than anti-Stokes lines?
4. Which of the following molecule will absorb at longer wavelength? Justify your answer.
   i) 1, 3-butadiene (CH_2=CH–CH=CH_2) ii) 1, 4-pentadiene (CH_2=CH-CH_2–CH=CH_2).
5. Predict the *E* and *Z* configuration of the given molecules.

   i) 

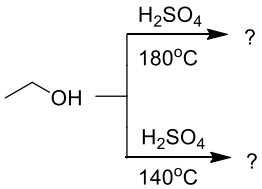
   ii) 

6. What are meso compounds? Give an example.
7. The boiling point of n-pentane is higher than the neopentane. Give reason.
8. Give the IUPAC name of the following compounds.

   i) 

   ii) 

9. Identify the major product formed from the following reactions.



PART – B

Answer any SIX of the following questions. (6 x 6 = 36)

10. a) The bond length of CO molecule is 1.53 x 10^{-10} m. Calculate the reduced mass and moment of inertia of the molecule. Given: atomic masses are ^{12}C = 1.99 x 10^{-26} kg and ^{16}O = 2.66 x 10^{-26} kg.

    b) Give the pictorial representation of the fundamental vibrations of CO_2 molecule and explain their IR activity. (3+3)

11. a) Depict the rotational-vibrational energy level diagram for the allowed transitions of a diatomic molecule.

    b) Discuss the mutual exclusion principle with a suitable example. (3+3)

12. a) The UV spectrum of acetone (CH_3COCH_3) shows two absorption bands at λ_{max} = 195 nm and λ_{max} = 274 nm. Which electronic transition is responsible for each of these bands? Explain your answer.

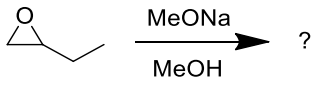
    b) The ^1H NMR spectrum of undecadeuteriocyclohexane ($C_6D_{11}H$) obtained at room temperature is different from that obtained at -100 ^oC. Explain. (3+3)

13. a) Illustrate shielding and deshielding in ^1H NMR taking $CH_3CHClCH_3$ as an example.

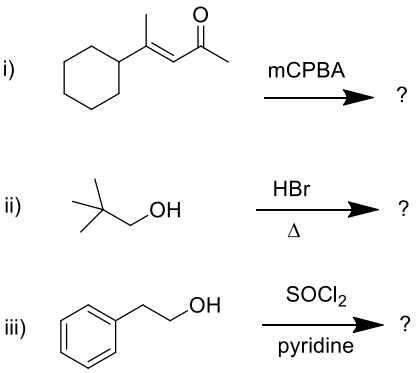
    b) Esters and amides show different C=O stretching frequency in IR spectroscopy. Give reason. (3+3)

14. Discuss the conformational analysis of butane with potential energy diagram.

15. a) Predict the product/s for the following and propose the probable mechanism.

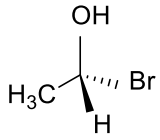


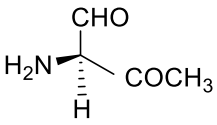
    b) Complete the following reaction.

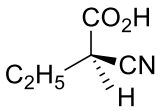


(3+3)

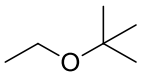
16. a) Convert the given molecules to Fischer configuration.

i) 

ii) 

iii) 

b) Propose a synthetic route for the preparation of following molecule using Williamson ether synthesis.



(3+3)

17. a) Write the possible enantiomers and diastereoisomers of 2-hydroxy-3-chloro pentane.
b) Define specific rotation. Give its mathematical expression and explain the terms. (3+3)

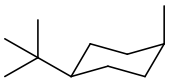
PART – C

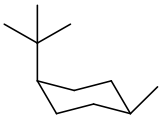
Answer any TWO of the following questions. (2 x 5 = 10)

18. a) With suitable explanation arrange the following in their increasing order of stretching frequency of vibration.

i) C-C ii) C-H iii) C–Cl iv) C-O

b) Identify the more stable conformation from the structures given below. Justify.

i) 

ii) 

(3+2)

19. Write the structure of hex-4-ene-3-ol and write all the possible stereoisomers for the molecule. Give the *R* / *S* and *E* / *Z* configuration for all the stereoisomers.
20. Propose the structure of the organic compound with the molecular formula C_8H_9Br from the chemical shift values in ^1H NMR spectrum given below. Assign the spectral signals to the structure you propose.

δ(ppm)	splitting	Integration
2.0	d	3H
5.15	q	1H
7.35	m	5H

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Table 1: NMR data

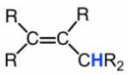
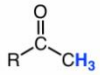
Type of Proton	Chemical Shift (ppm)	Type of Proton	Chemical Shift (ppm)
R—CH_3	0.9 – 1.2	X—CH_2R (X: Cl, Br, I)	3.1 – 3.8
R—CH_2	1.2 – 1.5	R—OH	variable, 1 – 5
R—CH	1.4 – 1.9	R—NH_2	variable, 1 – 5
	1.5 – 2.5		4.5 – 6.0
	2.0 – 2.6	Ar—H	6.0 – 8.5
Ar—CH_3	2.2 – 2.5		9.5 – 10.5
R—C≡C—H	2.5 – 3.0		10 – 13
(H)R—O—CH_3	3.3 – 4.0		

Table 2: IR data

Table 13.4 Important IR Stretching Frequencies

Type of bond	Wavenumber (cm^{-1})	Intensity
C≡N	2260–2220	medium
C≡C	2260–2100	medium to weak
C=C	1680–1600	medium
C=N	1650–1550	medium
	~1600 and ~1500–1430	strong to weak
C=O	1780–1650	strong
C—O	1250–1050	strong
C—N	1230–1020	medium
O—H (alcohol)	3650–3200	strong, broad
O—H (carboxylic acid)	3300–2500	strong, very broad
N—H	3500–3300	medium, broad
C—H	3300–2700	medium