D 150265 **(Pages : 3)** **Name.....**

Reg. No.....

THIRD SEMESTER M.Sc. (CBCSS) REGULAR/SUPPLEMENTARY DEGREE EXAMINATION, NOVEMBER 2026

Chemistry

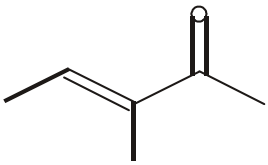
CHE 3C 09—MOLECULAR SPECTROSCOPY

(2019 Admission onwards)

Time : Three Hours Maximum Weightage : 30

Section A

Answer any **eight** *questions.*
Each question carries a weightage of 1.

1. Which of the following are microwave active ? Justify your answer :
   (a) CH_2Cl_2 ; (b) C_6H_6 ; (c) CO_2 ; (d) NH_3.
2. What is lifetime broadening ?
3. No shows a Q branch in the vibration-rotation spectrum. Why ?
4. What is meant by resonance Raman ?
5. Explain the term 'gyromagnetic ratio'.
6. Name one reference material used while recording EPR spectra.
7. Predict λ_{max} for absorption in UV spectrum of 
8. In a 100 MHz NMR instrument the OH signal is 240 Hz higher in frequency wrt TMS. Find the δ (delta) value.
9. Explain with example heteronuclear decoupling.
10. Calculate the apparent mass of metastable ion produced when *m/z* = 77 decomposes to *m/z* = 51.

(8 × 1 = 8 weightage)

Turn over

Section B

Answer any **six** *questions.*

Each question carries a weightage of 2.

11. Bond length of CO is 1.13 Å. Find its rotation constant (B).

12. Write Morse equation represent graphically show that it approximates to simple harmonic oscillator for low frequency vibrations.

13. How would you determine spin-spin relaxation time (T_2) ? Explain.

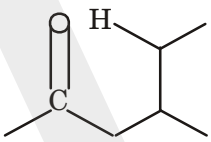
14. How many lines do you expect in the EPR spectrum of ND_3 radical ? What is the relative intensity ?

15. A compound with molecular formula C_3H_3N shows IR absorptions at 1650, 2250 and 3030 $cm.^{-1}$ Predict the structure.

16. What are the factors affecting spin-spin coupling ? Explain.

17. State the number of nonequivalent carbon, atoms in 1, 2-dinitrobenzene, 1, 3-dinitrobenzene and 1,4-dinitrobenzene. Explain.

18. Illustrate McLafferty rearrangement using the following molecular. Discuss :



(6 × 2 = 12 weightage)

Section C

Answer any **two** *questions.*

Each question carries a weightage of 5.

19. (a) Using Franck Condon principle discuss vibrational character of electronic spectrum.

    (b) The fundamental absorption and first overtone of HCl occur at 2886 and 5668 $cm.^{-1}$ respectively. Find the fundamental vibrational frequency and anharmonicity constant for HCl.

20. Briefly discuss theory of FT NMR.

21. Discuss the application of ORD for conformational analysis.

22. A compound with molecular formula $(C_6H_{10}O)$ gave the following spectral data. Deduce the structure :

UV λ_{max} 230 nm

IR 1620 $cm.^{-1}$ (m), 1695 $cm.^{-1}$ (s)

^1H NMR δ 1.9 (3H singlet) δ 2.1 (6H, singlet) δ 6.15 (1H singlet)

Mass m/z 55(100), 83(90), 43(78), 98(49), 29(46), 39(43), 27(42), 53(13), 41(13), 28(8)

^{13}C NMR δ = 20, 27, 31, 124, 154 and 197.

(2 × 5 = 10 weightage)