

KAMARAJ COLLEGE (Autonomous)

Accredited with A+ Grade by NAAC

(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

THOOTHUKUDI – 628 003

(5 Pages)

Reg. No:

Question. Code No : 2400224

Sub Code : 24PECH14

PG Degree - End Semester Examinations, November 2024

First Semester

M.Sc. Chemistry

Elective - MOLECULAR SPECTROSCOPY

(For those who joined in July 2024 onwards)

Time : 3 Hours

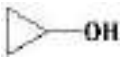
Maximum : 75 Marks

PART A – (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer:

1. Which radiation among the following has a minimum value of wavelength?
(a) Gamma rays (b) Infrared rays
(c) X rays (d) Microwaves
2. The unit of energy of radiations is
(a) joules (b) meter
(c) sec (d) kelvin
3. Identify the molecule which is not a symmetric top.
(a) H₂O (b) BCl₃

- (c) CH_3Cl (d) BF_3
4. Number of vibrational degrees of freedom of CO_2 is
 (a) 3 (b) 2
 (c) 1 (d) 4
5. The expansion of LASER is
 (a) Light Amplification by Stimulated Emission of Radiation
 (b) Light Accusation by Stimulated Emission of Radiation
 (c) Light Amplification by Sonic Emission of Radiation
 (d) Light Amplification by Stranded Emission of Radiation
6. The wavelength of X-rays is of the order of
 (a) 1 metre (b) 1 centimeter
 (c) 1 Angstrom (d) 1 micron
7. How many signals for following compound observed in C-
 ^{13}NMR spectroscopy? 
 (a) 1 (b) 2
 (c) 3 (d) 4
8. The nuclei that don't give NMR signal is
 (a) ^{15}N (b) ^{31}P
 (c) ^{11}B (d) ^{19}F
9. Which of the following will not show electron spin resonance (ESR)?
 (a) Free radicals (b) Paramagnetic materials
 (c) Transition metals (d) Diamagnetic materials
10. For an unbound electron, value of Lande' factor (g-factor) is
 (a) 1.0098 (b) 2.0023
 (c) 3.0015 (d) 6.0621

PART - B (5X5=25Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not Exceed 250 words.

11. (a) Differentiate stokes lines from antistokes lines.

(OR)

(b) Explain the rule of mutual exclusion with suitable examples.

12. (a) Compare harmonic oscillator with anharmonic oscillator with the relevant energy profile diagram.

(OR)

(b) Identify the cause of appearance of P,Q and R branches in vibrational spectra.

13. (a) List the properties of lasers and mention its types.

(OR)

(b) What is photoelectric effect? Explain the principle of ultraviolet photoelectron spectroscopy.

14. (a) Summarize nuclear over Hauser effect.

(OR)

(b) Examine the reason for using TMS as internal standard in NMR spectroscopy.

15. (a) Explain Molecular ion peak, Base peak, and Isotopic peak in mass spectrometry.

(OR)

- (b) Give short notes on Zero-field splitting (ZFS) and Kramer's Degeneracy.

PART - C (5 × 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not Exceed 600 words.

16. (a) Discuss the effect of isotopic substitution in microwave spectroscopy.

(OR)

- (b) Describe the quantum theory of Raman Spectroscopy.

17. (a) (i) Calculate the force constant of the NO molecule if its fundamental vibrational frequency is $1.876 \times 10^3 \text{ cm}^{-1}$. The reduced mass of the molecule is $1.24 \times 10^{-26} \text{ kg}$.

- (ii) Summarize the selection rules of a vibrational spectra.

(OR)

- (b) Give short notes on hot bands, fundamental, overtones and combination bands.

18. (a) Discuss Franck Condon principle for the electronic transition of a diatomic molecule.

(OR)

- (b) (i) Distinguish spontaneous emission from simulated emission.
(ii) Enumerate the conditions for population inversion.
(iii) Explain Q-switching.

19. (a) (i) Evaluate the factors influencing the chemical shift in NMR spectroscopy.
(ii) Draw the structural formula of the following organic compounds that give two singlets in their proton-NMR spectra.
- $C_3H_6O_2$
 - C_2H_5OCl

(OR)

- (b) Write a brief introduction on 2D NMR spectra COSY and HETCOR.
20. (a) (i) Explain the ESR spectra of the hydrogen atom.
(ii) Identify which of the following show ESR spectra.
- Cu^+ and Cu^{2+}
 - N_2 and O_2

(OR)

- (b) Discuss the various ionization techniques of mass spectroscopy.