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Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, JULY 2017

Second Semester

Faculty of Science

Branch : Chemistry

AN2C08/AP2C08/CH2C08/PH2C08/POH2C08- MOLECULAR SPECTROSCOPY

(2012 Admission onwards)

[Common to all branches of Chemistry]

Time : Three Hours

Maximum Weight : 30

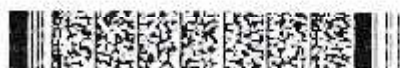
Section A

Answer any ten questions, each question carries weight 1.

1. What is Larmor precession ? Explain its use in NMR spectra.
2. Explain Born-Oppenheimer approximation. List its shortcomings.
3. What is Fermi resonance ? How the Fermi resonance lines are identified in IR spectra ?
4. Give the spectroscopic term symbol for Cl_2 molecule.
5. State and explain Karplus relationships used in NMR spectra.
6. What is Nuclear Overhauser Effect (NOE) ? What is its use in NMR spectra ?
7. Explain Kramer's Theorem. What is its relevance in EPR spectra ?
8. What are 'symmetric tops', spherical tops and asymmetric tops ? Give one example for each.
9. Explain the use of microwave spectroscopy in chemical analysis.
10. What are overtones and hot bands in IR spectra ?
11. Give the principle of NQR spectroscopy.
12. Draw the EPR spectra of C_6H_6 radical.
13. What are shift reagents ? Give examples. Explain how they simplify the second order NMR spectra.

(10 × 1 = 10)

Turn over





G 17003241

Section B

Answer any **five** questions by attempting not more than **three** questions from each bunch
Each question carries weight 2.

BUNCH 1

14. What is meant by the term 'chemical shift' as given in NMR spectra? Explain the different factors which affect the value of chemical shifts of different protons giving suitable examples.
15. Explain briefly a method for the determination of bond distance of a homonuclear diatomic molecule.
16. Draw Morse potential energy diagram and explain fundamental, overtone and hot bands.
17. Explain the relaxation methods in NMR spectroscopy.

BUNCH 2

18. The first stokes line in the rotational Raman spectrum of $^{14}\text{N}^{15}\text{N}$ is observed at 11.5416 cm^{-1} (1) What is its B value (2) Calculate its bond length (3) would there be an intensity alteration in the spectrum of $^{14}\text{N}^{15}\text{N}$ (4) Would $^{14}\text{N}^{15}\text{N}$ show a rotational spectrum.
19. The equilibrium vibration frequency of the Iodine molecule is 215 cm^{-1} and the anharmonicity constant $X_e = -0.003$. What is the intensity of the hot band $v = 0$ to $v = 2$ relative to that of the fundamental $v = 0$ to $v = 1$ if the temperature is 300° K .
20. One of the fundamental vibration modes of H_2O occurs at $3,752\text{ cm}^{-1}$. What would be the frequency of the corresponding mode in D_2O .
21. A particular NMR instrument operates at 30.256 MHz . What magnetic fields are required to bring a proton nucleus and C^{13} nucleus to resonate at this frequency? Magnetic moment of proton nucleus = $2.7927\mu_N$ and a $\text{C}^{13} = 0.7022\mu_N$.

(5 × 2 = 10)

Section C

Answer any **two** questions.
Each question carries weight 5.

22. Write briefly on the applications of (1) Mossbauer spectroscopy, (2) X-ray photoelectron spectroscopy
23. Give a brief description of two dimensional NMR spectroscopy with special reference to COSY and HETCOR





C 17003241

24. Explain the following factors which are decisive in determining the line width of spectral lines :

- (1) Natural line width.
- (2) Pressure broadening.
- (3) Doppler broadening.
- (4) Power broadening.

25. Write briefly on the following type of lasers :

- (1) Solid state laser.
- (2) Continuous wave laser.
- (3) Gas lasers.
- (4) Chemical laser.

(2 × 5 = 10)

