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C 80720

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Name..................................

Reg. No..............................

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, MARCH 2020

(CUCSS)

Physics

PHY 4C 12—ATOMIC AND MOLECULAR SPECTROSCOPY

(2017 Admission onwards)

ime : Three Hours

Maximum : 36 Weightage

Section A

Answer **all** *questions, each carries weightage* 1.

1. Explain Stark effect.
2. State and explain Hund's rule. Give an example.
3. Give the selection rules for Zeeman pattern.
4. What are hot bands ? How are they formed ?
5. How do you find out the bond length and angles from the rotational spectra for a symmetric top molecule ? Give the relevant equations.
6. Explain Mutual exclusion principle. In which type of molecule it is observed and why ?
7. Distinguish between Anti-Stokes Raman scattering and inverse Anti-Stokes Raman Scattering. Give the conditions for them to occur.
8. Explain the intensity variation of vibrational electronic spectra on the basis of Franck -Condon principle.
9. What are progressions and sequences in the vibrational analysis of a spectrum ?
10. Briefly explain recoilless emission and absorption of gamma rays.
11. What is chemical shift ? Describe its relevance.
12. Derive the resonance condition in ESR spectroscopy.

(12 × 1 = 12 weightage)

Section B

Answer any **two** *questions, each carries weightage* 6.

13. Compare Paschen Back Effect and Zeeman effect. Illustrate with the example of a principal series doublet.
14. Discuss in detail the spectra of a diatomic vibrating rotator. Explain the break down of the Born Oppenheimer approximation.

Turn over

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15. Describe with the diagrams the Raman Spectrometer and the sample handling techniques fo same.

16. Derive Bloch equations in NMR spectroscopy. Describe how they can be used to defin susceptibilities.

(2 × 6 = 12 weigh

Section C

Answer any **four** *questions, each carries weightage* 3.

17. Compute the interaction energies for pd electrons in LS coupling.

18. Rotational and centrifugal distortion constants of HCl molecule are 10.593 cm^{-1} 5.8 × 10^{-4} cm^{-1} respectively Estimate the vibrational frequency and the force constant of molecule. Given the mass of hydrogen and chlorine are 1.673 × 10^{-27} kg. and 58.06 × 10^{-2} respectively.

19. Describe the method for the structure determination of triatomic molecules using Ra Spectroscopy. Illustrate with the example of CO$_2$.

20. The band origin of a transition in C$_2$ is observed at 19,378 cm^{-1} while the rotational structure indicates that the rotational constants in excited and ground states are respecti B′ = 1.7527 cm^{-1} and B″ = 1.6326 cm^{-1}. Estimate the position of the band head. Which state the larger inter nuclear distance ?

1. The spectroscopic bond dissociation energy of ^{35}Cl^{16}O radical is 1.9 eV. Calculate the equilibri bond dissociation energy of ClO, if the fundamental frequency is 780 cm^{-1}. Given Avaga number = 6.022 × 10^{23} mol^{-1}, Planck's constant = 6.626 × 10^{-34} Js.

2. Illustrate the decay scheme of ^{57}Co in ^{57}Fe with respect to Mössbauer transition.

(4 × 3 = 12 weight