LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – NOVEMBER 2016

PH 3815 - SPECTROSCOPY

Date: 03-11-2016   Dept. No.   Max. : 100 Marks
Time: 09:00-12:00

Part - A

Answer all the questions: (10 × 2 = 20)

1. Comment on the moments of inertia of a linear molecule.
2. The rotational constant for HI is 6.4275 cm^{-1}. Determine its moment of inertia.
3. Sketch the fundamental vibrational modes of H_2O molecule.
4. What are Stokes and anti-Stokes lines?
5. What is the energy of a wave of wavelength 13,100 Å.
6. State the difference between progression and sequence
7. State the advantages of TMS when recording NMR spectra?
8. Calculate the recoil velocity of a free Mossbauer nucleus of mass 1.67×10^{-25} kg when emitting a γ-ray of wavelength 0.1 nm.
9. Mention two advantages of surface spectroscopy.
10. Give the principle of UPES.

PART - B

Answer any four of the following question: (4 × 7.5 = 30)

11. Discuss the factors governing the intensity of spectral lines in microwave spectroscopy. Arrive at an expression for the most populated quantum state.
12. With a neat schematic diagram, explain the construction and working of each section of an IR spectrometer.
13. What is Fortrat Parabolae? Obtain an expression for band head
14. Discuss the interaction of nuclear spin with magnetic field and deduce an expression for the energy associated with the transitions.
15. Explain the chemical shift in NMR spectroscopy.
16. Explain the principle of Auger electron spectroscopy.

Part - C

Answer any four of the following questions: (4 × 12.5 = 50)

17. a) Discuss in detail the spectrum of a rigid diatomic molecule.   **(7.5 marks)**
    b) For HI, absorptions were measured as 64.275 cm^{-1}, 77.130 cm^{-1} and 89.985 cm^{-1}.
       Find B, I and r. (H = 1.673×10^{-27} kg, I = 210.7×10^{-27} kg)   **(5 marks)**
18. a) Explain the theory of pure rotational Raman spectra of   **(10 marks)**
       (i) linear molecule   and   (ii) symmetric top molecule.
    b) Bond length of H_2 molecule is 0.7417 Å. Determine the positions of the first three rotational Raman lines in the spectrum. Given, mass of ^1H = 1.673×10^{-27} kg.   **(2.5 marks)**
19. State Franck-Condon principle. Account for intensity of spectral lines and why the spectrum is discrete and not continuous.
20. Obtain an expression for frequency of P,Q,R branches. Derive expressions associated with it.
21. Using family tree method, explain how spectral splitting is taking place in NMR spectroscopy due to coupling of other nuclei. Give examples.
22. Outline the principle of electron energy loss spectroscopy in detail.

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