MAR IVANIOS COLLEGE (AUTONOMOUS)
THIRUVANANTHAPURAM

Reg. No. :…… **Name :…….**

Fifth Semester B.Sc. Degree Examination, November 2016
First Degree Programme under CBCSS
Core Course: Physics – VII
AUPY544: Atomic and Molecular Physics

Time: **3** Hours Max. Marks: **80**

SECTION – A

*Answer **ALL** questions in a word or one or two sentences.*

1. State Pauli's exclusion principle.
2. What is Stark effect ?
3. State Mosley's law.
4. Explain absorption edge in X – ray absorption spectrum.
5. State and explain Larmor's theorem.
6. What is Paschen – Back effect ?
7. In which part of em spectrum does ESR is observed ?
8. What do you mean by Bohr magneton ? Give the expression.
9. What are symmetric top molecules ?
10. Write down the selection rule for rotational transition.

(10 × 1 = 10 Marks)

SECTION – B

*Answer any **EIGHT** questions, not exceeding a paragraph.*

11. Explain the fine structure of Sodium D – line.
12. Distinguish between l–s coupling and j–j coupling
13. Explain Stoke lines and Anti Stoke lines in Raman spectroscopy. Which lines (Stokes or Anti Stokes) will be more intense ? Explain.

14. Explain normal and abnormal Zeeman effect.
15. What are continuous and characteristic X – ray spectra ?
16. Write down any two differences between Raman Spectrum and IR spectrum.
17. Explain Franck – Condon principle of vibrational electronic spectra.
18. Explain the isotope effect in rotational spectrum.
19. State the intensity rules for the spectral lines.
20. Explain Mossbauer spectroscopy
21. Write down any two applications of ESR spectroscopy.
22. What are the basic concepts of vector atom model ?

(8 × 2 = 16 Marks)

SECTION – C

*Short essay type / Problems : Answer any **SIX** questions.*

23. Calculate the longest wavelength of Balmer series of hydrogen atm. (given $R = 1.095 \times 10^{7}\ m^{-1}$).
24. The rotational spectrum of HCl molecule shows a series of lines separated by 20.6 cm^{-1}. Find the moment of inertia and intermolecular distance.
25. The fundamental and first overtone frequencies of NO molecule are centred at 1876.06 cm^{-1} and 3724.2 cm^{-1} respectively. Evaluate the equilibrium vibrational frequency and the anharmonicity constant of the molecule.
26. An unpaired electron gives ESR resonance at 40 GHz when the magnetic field is 1.5 T Calculate the electron g–factor.
27. Calculate the wavelength separation between the two component lines which are observed in the normal Zeeman effect. The magnetic field used is 0.4T, the specific charge = $1.76 \times 10^{11}\ Ckg^{-1}$ and λ=6000Å.
28. For d – electron of the hydrogen atom, calculate the values of L, S, and J.
29. The wavelength of the L_α X–ray line of platinum (atomic no. 78) is 1.321Å. An unknown substance emits L_α X–rays of wavelength (4.174 Å). Calculate the atomic number of the unknown substance. Given b=7.4 for L_α lines.

30. The HCl molecule gives the vibrational absorption line of wavelength 3.465 μm. Calculate the force constant of the HCl band. Given that ^{1}H= 1.0087u, ^{35}Cl=35.453u and u=1.67 x 10^{-27} kg.

31. A hydrogen atom is placed in a magnetic field of 3 T. Calculate the energy difference between the m_l=-1 and m_l=+1 components in p state.

(6 × 4 = 24 Marks)

SECTION – D

*Long essay type : Answer any **TWO** questions.*

32. Explain the concepts underlying the vector atom model. Explain the vector atom model in terms of different quantum number used.

33. What is Zeeman effect ? Describe the experimental set for normal Zeeman effect. Based on the classical theory, derive an expression for the Zeeman shift.

34. Explain the principle of NMR. Briefly describe the working of a NMR spectrometer.

35. Briefly explain rotational Raman spectra. Describe a Raman spectrometer.

(2 × 15 = 30 Marks)

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