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Reg. No. : .....

Name : .....

Fifth Semester B.Sc. Degree Examination, December 2023

First Degree Programme under CBCSS

Physics

Core Course VIII

PY 1544 : ATOMIC AND MOLECULAR PHYSICS

(2018 Admission Onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions in **one** or **two** sentences. Each question carries **1** mark.

1. Based on his postulates, what did Bohr derive?
2. What is LS coupling?
3. State Larmor's theorem.
4. What is the importance of Bohr's correspondence principle?
5. What is meant by Paschen Back effect?
6. Distinguish between soft and hard X-rays.
7. What is meant by isomer shift in Mossbauer spectroscopy?
8. What is rule of mutual exclusion?

9. Write down the Morse function and explain the terms

10. What is meant by ionization energy?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions, not exceeding a paragraph. Each question carries **2** marks.

11. What is the possible smallest magnet known today? Explain.

12. What are the distinct features of vector atom model? Explain.

13. Why do certain diatomic molecules not show rotational spectra? Explain with example.

14. What are the modifications introduced in the Bohr theory by Sommerfeld?

15. What do you understand from the term symbol $^4F_{3/2}$?

16. Explain the origin of characteristic x-rays.

17. Discuss the classification of symmetric top molecules with example.

18. What are progressions and sequences?

19. Why do we consider FTIR one of the most popular methods of Spectroscopy?

20. Make comparison of Raman spectroscopy and IR spectroscopy.

21. Draw the block diagram of an NMR spectrometer.

22. Explain the features of fundamental vibrations in a molecule.

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** questions. Each question carries **4** marks.

23. Find the wavelength of the Spectral line that corresponds to a transition in hydrogen from n = 10 to the ground state. In what part of the spectrum does this belong? Rydberg constant = $1.097 \times 10^7\ m^{-1}$

24. Determine the expression for the rotational level with maximum population.

25. Determine the wavelength separation between the two component lines which are observed in the normal Zeeman Effect. The magnetic field applied is 0.5 T and the wavelength of the laser used is 532 nm.

26. Explain the fine structure of sodium D lines.

27. Find the critical wavelength of X-rays produced by the application of 18kV potential.

28. If the bond length of CO is 0.1128 nm, find the average spacing between the adjacent rotational lines.

29. A Raman line is observed at 476.85 nm when the substance was excited by 435.83 nm. Where will be the Raman anti-Stoke's line observed when the excitation laser has a wavelength of 532 nm?

30. Find the energy difference between the spin-up and spin down states of a proton in a magnetic field of IT. Given the spin magnetic moment of the proton = 2.793x nuclear magneton.

31. Find the force constant of CO if the Oscillating frequency is 64 THz.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. **Each** question carries **15** marks.

32. Explain the Bohr atom model. Obtain the expression for the radius and energy of electron in *n*-th Orbit.

33. Make a comparative analysis on the classical and quantum theory of Raman effect.

34. Discuss the rotational-vibrational transitions of a diatomic molecule.

35. Discuss the principle of ESR and the basic requirements for an ESR spectrometer with a block diagram.

(2 × 15 = 30 Marks)