Reg. No. : ....

Name : ....

Fifth Semester B.Sc. Degree Examination, December 2022

First Degree Programme under CBCSS

Physics

Core Course VIII

PY 1544 – ATOMIC AND MOLECULAR PHYSICS

(2014-2017 Admission)

Time : 3 Hours　　　　　　　　　　　　　　　　　　　　Max. Marks : 80

SECTION A

Very short answer type questions. Answer all **ten** questions of **1** mark each.

1.　Which spectral line of hydrogen atom is in the visible region?

2.　What do you mean by spatial quantization?

3.　Define Bohr magneton.

4.　What is Stark effect?

5.　Why are anti stokes lines less intense than stokes lines?

6.　What is the **j** value of $^2P_{3/2}$ state?

7.　Define polarizability of a molecule.

8.　What is rotational fine structure in electronic transition?

9.　What are the two types of symmetric top molecule?

10.　Define wave number.

(10 × 1 = 10 Marks)

SECTION B

Short answer type questions. (Answer any **eight** questions). Each question carries **2** marks.

11. What is Larmor frequency? Give the expression for it.

12. What are the properties of X-rays?

13. Sketch the normal mode of vibration of water molecule.

14. State Bohr's correspondence principle.

15. What is Paschen-Back effect?

16. What do you mean by rotational constant? Draw the rotational energy levels and allowed transition for a rigid diatomic molecule.

17. Calculate the wavelength separation between the unmodified line of wavelength 6000 A° and the modified lines when a magnetic induction of 1 Wbm^{-2} is applied, in normal Zeeman effect.

18. Explain magnetic orbital quantum number.

19. Sketch the energy levels and ESR transitions resulting from the coupling of an unpaired electron with a nucleus of spin 1.

20. Discuss about the magnetic dipole moment of electron due to orbital motion.

21. The intensity $J = 0 \rightarrow J = 1$ is often not the most intense rotational line. Why?

22. What is indirect spin-spin interaction?

(8 × 2 = 16 Marks)

SECTION C

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

23. Explain the magnetic spin quantum number and magnetic total angular momentum quantum number.

24. Briefly discuss the evidences in favour of Bohr's theory.

25. The first rotational Raman line of H_2 appears at 346 cm^{-1} from the exiting line. Calculate the bond length of H_2 molecule. Given $^1H = 1.673 \times 10^{27}$ kg.

26. What is Pauli's exclusion Principle? On the basis of this principle explain the configuration of electrons in atoms.

27. The K_α line of molybdenum has a wavelength of 0.7078 A°. Calculate the wavelength of line of K_α copper. Atomic number of molybdenum = 42 and Atomic number of copper = 29.

28. Explain Franck-Condon Principle.

29. The average spacing between adjacent rotational lines of CO molecule is 3.8626 cm^{-1}. Calculate the length of the CO bond.

30. What are the applications of ESR spectroscopy?

31. Explain the principle of Mossbauer spectroscopy.   **(6 × 4 = 24 Marks)**

SECTION D

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

32. Describe Stern and Gerlach experiment. What are the conclusions drawn from it.

33. Explain clearly the phenomenon of anomalous Zeeman effect and Paschen-Back effect. Describe the spectral patterns expected for the yellow lines of sodium according to these two effects.

34. Explain the quantum theory of Raman scattering. Discuss about vibrational and rotational Raman spectra.

35. Explain the principle of NMR and hence discuss the NMR spectrometer. Indirect spin-spin interaction and the applications of NMR.

(2 × 15 = 30 Marks)

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