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**Fifth Semester B.Sc. Degree Examination, December 2024**

**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. State correspondence principle.
2. State Pauli's exclusion principle.
3. Explain Larmor's theorem.
4. What is the Stark effect?
5. Give the difference between soft x-rays and hard x-rays.
6. State Bragg's law.
7. With an example explain spherical top molecules.
8. Explain the isotope effect in rotational spectra.
9. Homo nuclear diatomic molecules do not show vibrational spectra. Why?
10. What are Stoke's and anti Stoke's lines?

**(10 × 1 = 10 Marks)**

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## SECTION – B

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

11. Write the drawbacks of Bohr atom model.

12. Explain the various quantum numbers associated with the vector atom model.

13. Explain Paschen-Back effect.

14. What is Bohr magneton? Calculate its value.

15. Explain the two methods of producing characteristic x-rays.

16. Give four applications of x-rays.

17. Write any two information derived from rotational spectra.

18. Distinguish between prolate and oblate symmetric top molecules.

19. What are hot bands? Why are they called so?

20. Which are the main parts of an IR spectrometer?

21. Explain the classical theory of Raman effect.

22. State Franck-Condon Principle.

**(8 × 2 = 16 Marks)**

## SECTION – C

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

23. Calculate the radius and energy of the electron in the $n^{th}$ orbit in Hydrogen from the following data.

$e = 1.6 \times 10^{-19} C$; $m = 9.1 \times 10^{-31} kg$ $h = 6.6 \times 10^{-34} Js$; $\epsilon_0 = 8.85 \times 10^{-12} F/m$



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24. Calculate the wavelength separation between the two component lines which are observed in the normal Zeeman effect, The magnetic field used is 0.4 $Wb/m^2$. The specific charge = $1.76 \times 10^{11} C/kg$ and $\lambda = 6000$ Å.

25. Write a note on J-J coupling.

26. The spacing between principle planes of NaCl crystal is 2.82 Å. It is found that first order Bragg reflection occurs at an angle of 10°. What is the wavelength of X rays.

27. What is the change in the rotational constant B, when $H_2$ is replaced by deuterium in $H_2$ molecule?

28. How many normal modes of vibration are possible for the following molecules?
    (a) HBr
    (b) $SO_2$
    (c) $O_2$
    (d) OCS

29. Draw a schematic diagram of Raman spectrometer.

30. The OH radical has a moment of inertia $1.48 \times 10^{-47}$ $kg.m^2$. Calculate its inter nuclear distance. Calculate its average momentum for J = 5.

31. A Mossbauer nucleus $^{57}Fe$ makes the transition from the excited state of energy 14.4 keV to the ground state. What is the recoil energy?

**(6 × 4 = 24 Marks)**

## SECTION – D

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

32. Describe the vector atom model of the atom and explain the different quantum numbers associated with it. Write down the electronic configuration for Cu (29) employing modern symbolism and explain it?

33. What is Zeeman effect? Describe the experimental arrangement for studying the Zeeman effect. Show that Zeeman shift. $d\lambda = \pm Be\lambda^2 / 4\pi m c$.



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34. Obtain an expression for the rotational energy levels of a diatomic molecule taking it as a rigid rotator. Draw the energy level diagram. How does the spectrum of non rigid rotator differ from this?

35. Write short notes on.

(a) Principle of N.M.R spectroscopy.

(b) Resonance condition in NMR

(c) Chemical shift in NMR

(d) Applications of NMR.

**(2 × 15 = 30 Marks)**

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