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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

(2013 Admission)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** questions. **Each** carries **1** mark.

1. What are the postulates of vector atom model?
2. Which experiment proven the existence of spin of electrons.
3. What do you mean by fine structure?
4. Define hyperfine structure.
5. Why x-ray emission is known as reverse photo electric effect.
6. Distinguish between soft x-rays and hard x-rays.
7. Define rotational constant.
8. Write the selection rule for a rotational transition.

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9. Define zero-Point energy of anatomic harmonic oscillator.
10. Define spin resonance spectroscopy.

(10 × 1 = 10 Marks)

SECTION – B

Answer **any eight** questions. **Each** carries **2** marks.

11. Distinguish between L-S coupling and .J-J coupling.
12. Distinguish between normal and anomalous Zeeman effect.
13. Explain Stark effect.
14. Explain spin-orbit interaction.
15. Explain Pauli's exclusion principle.
16. What is Lande's g factor?
17. How x-rays are produced?
18. Explain with examples, different types of molecules based on their moments of inertia.
19. Compare the magnitude of energies of rotational, vibrational and electronic spectra of a diatomic molecule.
20. Explain isotope effect of rotational spectra.
21. Write the principle of NMR.
22. Write a short note on the magnetic properties of a nucleus. How it is useful in spectroscopy?

(8 × 2 = 16 Marks)

SECTION – C

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

23. What are the possible orientations of J for the $j = \frac{3}{2}$, and $j = \frac{1}{2}$ state corresponding $l = 1$?
24. The term symbol of the ground state of sodium is $3^2S_{1/2}$ and that of the first excited state is $3^2P_{1/2}$, list possible quantum numbers n, l, j , and m_j of the outer electron in each case.
25. For a given element its K_α line has wavelength of 0.180 nm. Identify the element, by calculating its atomic number.
26. Derive the expression for Larmor frequency of an electron in a magnetic field B .
27. Derive the Quantum theory of Raman Effect.
28. Write a note on the vibrational rotational spectra of a diatomic molecule.
29. The frequency of OH stretching vibration in CH_3OH is 3300 cm^{-1} . Estimate the frequency, of OD vibration of CH_3OD , if Hydrogen is replaced with Deuterium D.
30. Explain the Rotational spectra of a linear molecule. State the selection rules also.
31. A free electron is placed in a magnetic field of strength 1.3T. calculate the resonance frequency if $g = 2.0023$.

(6 × 4 = 24 Marks)

SECTION – D

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

32. With necessary theory explain the magnetic dipole moment of electron due to orbital and spin motion.
33. Explain the splitting of spectral lines in weak, moderate and strong magnetic fields Derive the expression for Paschen-Back effect?

34. Discuss in detail the Rotational Spectrum of a diatomic molecule.
35. Write the principle of ESR Spectroscopy. How ESR Spectrometer works?
Discuss any two applications of ESR Spectroscopy.

(2 × 15 = 30 Marks)
