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Reg. No. : .....

Name : .....

Fifth Semester B.Sc Degree Examination, February 2021.

First Degree Programme under CBCSS

Physics

Core Course VIII

PY 1544: ATOMIC AND MOLECULAR PHYSICS

(2018 Admission Regular)

Time : 3 Hours Max. Marks : 80

SECTION – A

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

1. What is j-j coupling?
2. What do you mean by critical potential of an atom?
3. What is the selection rule for J and S in optical spectra?
4. What is scattering?
5. What is Frank Condon principle?
6. Give an example for microwave inactive molecule.
7. What is the condition for a molecule which is both I R active and Raman active?
8. What is the lowest rotational energy gap in rotational Raman spectrum?
9. Write the full form of NMR and ESR
10. What is NMR imaging?

(10 × 1 = 10 Marks)

P.T.O.

SECTION – B

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

11. What are the limitations of Somerfield atom model?

12. State Pauli's exclusion principle.

13. Name the spectral series of hydrogen atom.

14. What is Anomalous Zeemen effect?

15. Explain Larmor's theorem.

16. What is stark effect?

17. Write down any two application of x-ray spectrum.

18. Mention properties of x-rays.

19. What is chemical shift?

20. Explain dissociation energy.

21. Write down two differences between Raman spectra and IR spectra.

22. Factors affecting intensity of molecular spectra. Any two.

23. What are the different types of energies possessed by a molecule?

24. Explain the principle of mutual exclusion in vibrational spectroscopy.

25. Explain Mossbauer spectroscopy.

26. Mention any two applications of ESR spectroscopy.

(8 × 2 = 16 Marks)

SECTION – C

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

27. A hydrogen atom is placed in a magnetic field of 3T. Calculate the energy difference between $m_l = -1$ and $m_l = +1$ components in the 2p state.

28. Find the values of L and S of the ground state of nitrogen.

29. Draw the energy level diagram of sodium D lines and explain the fine structure.

30. Explain Paschen-Bach effect.

31. What is x-ray? Give its important applications.

32. Explain measurement of X-ray wavelengths by ruled gratings.

33. Explain the quantum theory of Raman effect.

34. Calculate the vibrational energy levels of an HCL molecule, assuming the force constant to be 5l6Nm^{-1}.

35. HCL molecule has a rotational constant B value of 1059.3m^{-1} and a centrifugal distortion constant D of $5.3 \times 10^{-2} m^{-1}$. Estimate the vibrational frequency.

36. The spacing between the vibrational levels of CO molecule is 8.45 x 10^{-2}eV of energy. Calculate the frequency of the molecule.

37. Explain the principle of NMR spectroscopy.

38. An unpaired electron gives ESR resonance at 35 GHz when the magnetic field is 1.3T. Calculate electron g-factor.

(6 × 4 = 24 Marks)

PART – D

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

39. What are the postulates of Bohr atom model? Explain Vector atom model and quantum numbers corresponding to each atom.

40. (a) Explain spectral terms and notations with examples.

    (b) Explain the quantum theory of Zeeman effect.

41. What are Xrays? How are they produced? Explain their energy level diagrams and applications.

42. Discuss the rotational spectra of diatomic molecules and explain their selection rules.

43. Explain the working and principle of IR spectrometer with suitable diagram.

44. What is the principle behind NMR spectroscopy? Explain the working of a NMR spectrometer and mention its uses.

(2 × 15 = 30 Marks)
