

E 3199

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Reg. No.....

Name.....

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2016

Fifth Semester

Core Course—QUANTUM MECHANICS AND SPECTROSCOPY

(Common for B.Sc. Chemistry Model I, Model II B.Sc. Petrochemicals, B.Sc. Chemistry Environment and Water Management)

[2013 Admission onwards]

Time : Three Hours

Maximum : 60 Marks

Section A

Answer all questions.

Each question carries 1 mark.

1. State Planks radiation law.
2. Wave function in quantum mechanics represents _____.
3. The orbital angular momentum (in units of $h/2\pi$) of the \bar{e} in the 3d orbital is _____.
4. The zero point energy of an \bar{e} is equal to _____.
5. The rotational constant B of a diatomic molecule is _____.
6. The chemical shift of a proton on the ' δ ' scale is 4. The value on τ scale is _____.
7. In practical Organic Chemistry Tetramethyl silane is used mainly for _____.
8. The spectra resulting from changes in vibrational energy levels for the same electronic state fall in which region of the spectrum.

(8 × 1 = 8)

Section B

Answer any six questions.

Each question carries 2 marks.

9. State and explain Heisenberg's uncertainty principle.
10. Explain the concept of operators with example.
11. What is the physical significance at ψ .

Turn over

12. Why phosphorescence lasts for sometime even after the source of light is removed?
13. What is Born-Oppenheimer approximation?
14. What are the selection rules for IR spectra?
15. Explain the origin of Stokes and anti-Stokes lines in Raman Spectrum.
16. Explain the term dissociation energy.
17. What is meant by Larmor precession?
18. What is the basic principle of Mass spectra?

(6 × 2 = 12)

Section C

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

19. State and explain postulates of quantum mechanics.
20. Derive the expression for the energy of particle in a one dimensional box.
21. Differentiate between fluorescence and phosphorescence giving stress to their mechanism of origin.
22. Draw and discuss the high resolution HNMR spectra of toluene.
23. Pure rotational spectrum of the CN molecule consists of a series of equally spaced lines of separated by 3.7978 cm^{-1} . Calculate internuclear distance.
24. The fundamental vibrational frequency of HCl is 2890 cm^{-1} . Calculate force constant masses of $\text{H} = 1.673 \times 10^{-27} \text{ kg}$; $^{35}\text{Cl} = 58.06 \times 10^{-27} \text{ kg}$.

(4 × 4 = 16)

Section D

*Answer any two.
Each question carries 12 marks.*

25. What are quantum numbers. What is their significance?
26. (a) Construct the molecular orbitals of H_2^+ ion.
(b) What are the characteristics of σ and π^* orbitals?

27. (a) Explain the origin of microwave spectra.
(b) How will you determine the bond length of a diatomic molecule using this spectra ?
28. (a) What are the selection rules for electronic spectra ?
(b) What are the basic principle of NMR spectra ?
(c) What are spin-spin splitting and coupling constant.

(2 × 12 = 24)