

E 2203

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Reg. No.....

Name.....

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2011

Fifth Semester

Core Course—QUANTUM MECHANICS AND SPECTROSCOPY

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

Time : Three Hours

Maximum Weight : 25

Section A

Answer all questions.

Each bunch of four questions carries a weight of 1.

I. Fill in the blanks :

- 1 The number of normal modes of vibration for CO_2 molecule is _____.
- 2 Normally the—CH proton will absorb at a _____ field strength main—OH proton.
- 3 One photosensitized reaction is _____.
- 4 Bond order is defined as _____.

II. 5 What is a rigid rotator ?

- 6 Predict the number of signals in the PMR spectra of methyl acetate.
- 7 What is zero point energy ?
- 8 What is a primary process ?

III. 9 Give one example for chromophore.

- 10 Write the mathematical expression of de-Broglie hypothesis.
- 11 What is the significance of ψ^2 ?
- 12 What do you mean by base peak in mass spectrum ?

IV. State whether the following statements are true or false :

- 13 Carbon dioxide molecule is microwave active.
- 14 TMS is used as an internal reference in NMR spectrum.
- 15 Beer-Lambert's law is applied in spectrophotometer.
- 16 Einstein suggested that light has dual character.

(4 × 1 = 4)

Turn over

Section B

*Answer any five questions.
Each carries a weight 1.*

17. Define Chemical shift.
18. Name the different modes of vibration for water molecule and explain its IR activity.
19. What do you mean by wave function ψ ? What is the significance of ψ^2 ?
20. Define Eigenvalues and Eigenfunction.
21. What is the significance of Heisenberg's uncertainty principle?
22. Sketch the NMR spectrum of symmetrical trimethyl benzene and label the signals.
23. What is chemiluminescence?
24. State Frank-Condon principle.

(5 × 1 = 5)

Section C

*Answer any four questions.
Each carries a weight 2.*

25. What do you mean by finger-print region? What is its significance in IR spectral studies of organic compounds?
26. What is Raman shift? State and explain the rule of mutual exclusion.
27. Explain briefly the principles involved in mass spectroscopy. How does it help in the determination of molecular mass?
28. Draw Jablonsky diagram and explain Phosphorescence and Fluorescence.
29. Sketch the Radial distribution curve for 2s and 2p orbital and explain.
30. What are the criteria required for forming molecular orbitals from atomic orbitals?

(4 × 2 = 8)

Section D

*Answer any two questions.
Each carries a weight 4.*

31. Explain the following:
(i) Overtones (ii) Born-Oppenheimer approximation, (iii) Quantum theory of Raman effect.
32. State and explain the postulates of quantum mechanics.
33. (a) How can NMR method be used to distinguish between the structure of 1-Propanol and Propanol?
(b) Explain the concept of σ , σ^* , π , π^* orbitals and their characteristics.
(c) Discuss on spin-spin coupling and coupling constant.

(2 × 4 = 8)