

E 4388

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Reg. No.....

Name.....

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2012

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

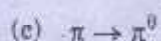
Section A

Answer all questions.

Each bunch of four questions carries a weight of 1.

I. Fill in the blanks :

- 1 A linear n atom molecule has _____ normal modes of vibration.
- 2 The type of transition generally having the lowest energy is _____



- 3 The rotational spectrum of a rigid diatomic molecule will consist of a series of equispaced lines such that $\Delta v =$ _____ cm^{-1} .
- 4 Davisson and Gerner experiments illustrates _____ nature of electron.

II. 5 How many nodes are present for a 3s orbital.

- 6 How many electrons in magnesium have a value of zero for a azimuthal quantum number ?
- 7 What is meant by Red shift ?
- 8 How many absorption lines will be obtained in the vibrational spectrum of a diatomic harmonic oscillator molecule ?

III. 9 Name the vibration of CO_2 molecule that is Raman active but IR inactive.

- 10 How many peaks will be obtained in the PMR spectrum of Benzene ?
- 11 What is zero point energy ?
- 12 Define Quantum yield.

IV. State whether True or False :

- 13 Photochemical reaction occurs by absorption of radiation.
- 14 Selection rule for microwave spectroscopy is $\Delta f = \pm 1, \pm 2, \pm 3 \dots$
- 15 N_2 molecule gives Raman spectra.
- 16 Schrödinger equation is an eigenvalue equation.

(4 × 1 = 4)

Turn over

Section B

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

- 17 Which is stable O_2 or O_2^+ ? Why ?
- 18 Sketch the modes of vibrations for CO_2 molecule.
- 19 What is Compton effect ?
- 20 What is an operator ? Give two examples.
- 21 Stoke lines are far more intense than anti stoke lines in Raman spectra. Give reasons.
- 22 What do you mean by photosensitized reaction. Write one example.
- 23 Describe the features of Black body radiations.
- 24 Write the principles involved in mass spectroscopy.

(5 × 1 = 5)

Section C

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

- 25 State and explain the law of photochemical equivalence. How is it helpful in explaining primary and secondary process ?
- 26 Give a brief idea of valence bond model of hydrogen molecule.
- 27 Explain how rotational spectroscopy can be used to calculate the bond lengths in diatomic molecules.
- 28 Explain Shielding and Deshielding with regard to NMR spectroscopy.
- 29 What are quantum numbers ? Give the significance of each.
- 30 Sketch the radial probability distribution curves of 2s and 2p orbitals and compare.

(4 × 2 = 8)

Section D

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

- 31 Solve the Schrödinger wave equation for a particle in one dimensional box.
- 32 State and explain the following :
 - (a) Frank Condon principle.
 - (b) Rule of Mutual exclusion.
 - (c) Beer Lambert's law.
- 33 How many NMR signals will be obtained in the following molecules and explain ?
 - (a) CH_3COCH_3 .
 - (b) CH_3-CH_2CHO .
 - (c) Explain the principle of IR. spectroscopy.

(2 × 4 = 8)