

**B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2015****Fifth Semester****Core Course—QUANTUM MECHANICS AND SPECTROSCOPY**

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

[2013 Admissions]

Time : Three Hours

Maximum : 60 Marks

**Section A**

Answer all questions.

Each question carries 1 mark.

1. What is Compton effect ?
2. If 'n' denotes the quantum number and 'c' the velocity of light, the energy of a particle of mass 'm' in a bar of length 'l' is proportional to ———.
3. For a 'e' moving in the 's' orbital its total angular momentum is ———.
4. If the energy of an 'e' in the second energy level of  $H_2$  atom is E, its value in the third energy level will be ———.
5. Rotational spectra is observed in the ——— region of electromagnetic spectrum.
6.  $N_2$  has a nuclear spin of 1. The NMR of nitrogen has ——— lines.
7. The number of vibrational degrees of freedom in  $CO_2$  molecule.
8. The degree of degeneracy for a rigid rotor in an energy level with quantum number I is ———.

(8 × 1 = 8)

**Section B**

Answer any six questions.

Each question carries 2 marks.

9. What are the reasons for the failure of classical mechanics ?
10. What is an eigen function ?
11. Draw the radial distribution curve for 2s orbitals.
12. Write the MO configuration of  $N_2$  molecule.
13. What are the selection rules for rotational spectra ?
14. State Frank-Condon principle.
15. What do you mean by a hot band ?

Turn over

16. Explain the rule of mutual exclusion.
17. Why TMS is used as a standard reference in NMR spectroscopy?
18. What is McLafferty rearrangement?

(6 × 2 = 12)

### Section C

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

19. Briefly explain Davisson and Germer's experiment.
20. What are quantum numbers?
21. What are the basic principles of MO theory?
22. Explain photosensitized reaction with example.
23. Draw and discuss the high resolution proton NMR spectra of acetaldehyde.
24. Explain the instrumentation for mass spectra.

(4 × 4 = 16)

### Section D

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

25. Derive the expression for energy of particle in one-dimensional box and apply this to butadiene system.
26. Compare IR and Raman spectra.
27. (a) What is the B.E. of an electron in a hydrogen atom?  
(b) Obtain the radius of hydrogen atom.  
(c) Explain sinusoidal wave equation.
28. (a) Explain the term quantum yield.  
(b) Basic fragmentation pattern in mass spectra.  
(c) Draw the PE curves for the bonding and antibonding molecular orbitals.

(2 × 12 = 24)