23129047

QP CODE: 23129047

Reg No : .....

Name : .....

B.Sc DEGREE (CBCS) REGULAR / REAPPEARANCE EXAMINATIONS, OCTOBER 2023

Fifth Semester

CORE COURSE - CH5CRT08 - PHYSICAL CHEMISTRY - II

Common for B.Sc Chemistry Model I, B.Sc Chemistry Model II Industrial Chemistry & B.Sc Chemistry Model III Petrochemicals

2017 Admission Onwards

081578EC

Time: 3 Hours Max. Marks : 60

Part A

*Answer any **ten** questions.*

*Each question carries **1** mark.*

1. Give two experiments that support the particle nature of light.
2. What is meant by an Eigen function?
3. If the energy of the ground state of one-dimensional box is E, what would be the energy of its first excited state?
4. Show that the value of the commutator [d/dx, x] = 1.
5. Mention the important criteria for the formation of MO's.
6. Arrange the following electromagnetic radiations in the increasing order of energy: Microwave, Infrared, Ultraviolet.
7. Specify the type of molecular excitations occur when a molecule absorbs an electromagnetic radiation of wavelength 1000 nm.
8. Give the selection rules governing the transition between vibrational energy levels.
9. State the selection rules for the Raman spectroscopy.
10. Arrange the different types of molecular orbitals in their increasing order of energy.
11. How many spin states are possible for a nucleus if its nuclear spin quantum number is one?
12. The ESR spectroscopy is generally less applicable than the NMR spectroscopy. Give reason.

(10×1=10)

Part B

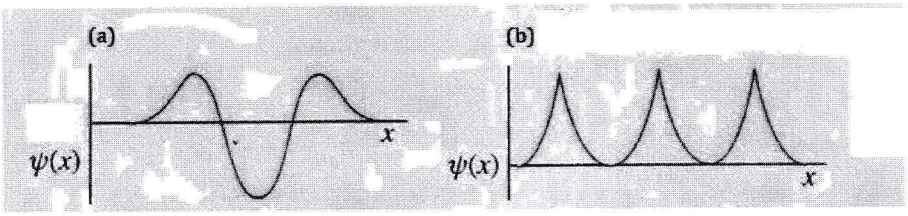
*Answer any **six** questions.*

*Each question carries **5** marks.*

13. Calculate the energy per photon and the energy per mole of photons of radiation of wavelength (a). 200 nm (ultraviolet) (b). 150 pm (X-ray).

14. Discuss the significance of
(a) the de Broglie equation (b) the position-momentum uncertainty relationship.

15. What do you mean by a well-behaved wavefunction? Estimate whether the wave functions shown in the figure are well-behaved or not? Give reason for your answer.



16. Outline the important conditions for the effective combination of atomic orbitals, and distinguish between bonding and anti-bonding MO's.

17. Provide the significance of force constant. Calculate the fundamental vibrational frequency of $^{12}C^{16}O$ molecule, if its force constant of 1902 Nm^{-1}.

18. Sketch the fundamental vibrational modes of H_2O indicating their activity in IR region.

19. Predict the activity of different fundamental vibrational modes of CO_2 molecule in the vibrational and the Raman spectroscopy. State the resulting conclusion as a rule.

20. Discuss the factors that affect chemical shifts in NMR spectroscopy.

21. Draw and explain the ^{1}HNMR spectrum of ethanol.

(6×5=30)

Part C

*Answer any **two** questions.*

*Each question carries **10** marks.*

22. Elaborate on the significance of various quantum numbers to specify the internal state of a hydrogenic atom.

23. Discuss the solution of the Schrodinger wave equation for the hydrogen molecule-ion, and obtain the normalized MO wavefunctions. Explain the potential energy curves of bonding and anti-bonding MO's, and substantiate the statement "The simple molecular orbital does not provide an accurate value for the bond dissociation energy".

24. (a) Derive an expression for the energy of a rigid rotator.
(b)The pure rotational spectrum of a gaseous molecule, $^{12}C^{16}O$, consists of a series of

equally spaced lines separated by $3.8451 cm^{-1}$. Calculate the internuclear distance of the molecule, if the reduced mass of the molecule is 1.1383×10^{-26} kg.

25. (a) Discuss the origin of the Frank-Condon principle and how it leads to the appearance of vibrational structure in an electronic transition.
(b) Explain how dissociation of a diatomic molecule can occur through absorption of radiation.

(2×10=20)