21100033

QP CODE: 21100033

Reg No : ....

Name : ....

BSc DEGREE (CBCS) EXAMINATION, FEBRUARY 2021

Fifth Semester

Core Course - CH5CRT08 - PHYSICAL CHEMISTRY - II

B.Sc Chemistry Model I ,B.Sc Chemistry Model II Industrial Chemistry ,B.Sc Chemistry Model III Petrochemicals

2017 Admission Onwards

88844BA6

Time: 3 Hours — Max. Marks : 60

Part A

*Answer any **ten** questions.*

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

1. Find the wave length of the shortest wavelength transition in the Lyman series of hydrogen spectrum.
2. Specify the condition for orthonormality of wavefunctions.
3. What do you mean by an expectation value?
4. How many electrons can be placed in a sub shell with quantum numbers n = 4, l = 0?
5. Mention the important criteria for the formation of MO's.
6. Express a wavelength of 400 nm as a wavenumber.
7. Which electromagnetic region has energy corresponding to the energy gap between consecutive rotational energy levels?
8. Give the selection rules governing the transition between vibrational energy levels.
9. Predict whether the symmetric stretching mode of ethene, in which all of the C-H bonds vibrate in phase, is infrared active, Ram active, or both.
10. What technological advance enabled the routine use of the Raman Spetroscopy?
11. How is the magnitude of the nuclear magnetic moment of a nucleus related to its spin quantum number?
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. Explain the uncertainty principle. An electron in a carbon nanofibre is effectively confined within a region of length 100 nm. What is the minimum uncertainty in the speed of the electron?

15. What are quantum mechanical operators? Discuss their significance.

16. Construct the bonding and anti-bonding π – MO's in terms of LCAO-MO.

17. Provide the significance of force constant. Calculate the fundamental vibrational frequency of 12C16O molecule, if its force constant of 1902 Nm-1.

18. State the ways in which the IR spectrum of CO2 differs from that of NO2.

19. Define the term molal extinction coefficient. A sample of pathlength 2 cm transmits 40% incident light. Find the concentration of the solution, given that ε = 6000 dm3/mol/cm.

20. Explain the term chemical shift. How is it expressed?

21. How will you distinguish between 1-chloropropane and 2-chloropropane using the NMR spectroscopy.

(6×5=30)

Part C

*Answer any **two** questions.*

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

22. Set up and solve Schrodinger equation for a particle in one-dimensional box with the potential energy value zero inside the box, and obtain the expressions for normalized wavefunction and energy. Apply this model to the π-$\pi-$ electrons in 1,3-butadiene.

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**) Arrive at expressions for (a) moment of inertia and (b) rotational energy of a rigid diatomic molecule.

(**B**) Evaluate the rotational constant of 2HCl (masses of 2H and Cl are 2.0141 mu and 34.969 mu, respectively)

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)