TB245338K

Reg. No :.....

Name :.....

BACHELOR'S DEGREE (C.B.C.S.) EXAMINATION, FEBRUARY 2024

2021 ADMISSIONS SUPPLEMENTARY (SAY)

SEMESTER V - CORE COURSE (CHEMISTRY)

CH5B08B18 - Physical Chemistry – II

Time : 3 Hours **Maximum Marks : 60**

Part A

I. Answer any Ten questions. Each question carries 1 marks **(10x1=10)**

1. Calculate the momentum of a particle which has a de Broglie wavelength of 1 Å.
2. Define the operator.Give an example.
3. Give the diagrammatic representation for formation of σ2pz and σ^*2pz Molecular orbitals.
4. Represent the wave functions for the lowest three levels for particle in a box, stationary state.
5. Sketch the probability densities for the lowest three levels in particle in a box stationary states.
6. In the spectrum of HBr is a series of lines having a separation of 16.94cm^{-1}. Calculate the moment of inertia and the internuclear separation in HBr.
7. List the vibrations of the CO_2 molecule that are infra-red active.
8. Describe force constant. Give its relation with bond order and bond length.
9. Predict which among the following shows the highest stretching frequency:

   $C \equiv C$ $C = C$ $C - C$

10. Give the resonance condition in EPR Spectroscopy.
11. Define chemical shift.
12. Discuss the reason for the observed trend in proton chemical shift values of the following molecules: CH_4 (ð 0.23), CH_2Cl (ð 3.05), CH_2Cl_2 (ð 5.33), CH_3Cl (ð 7.26)

Part B

II. Answer any Six questions. Each question carries 5 marks **(6x5=30)**

13. List the conditions for a wave function to be acceptable.Write a note on the significance of wave function.
14. Briefly explain Plank's quantum theory. Calculate and compare the energies of two radiations,one with wavelength 800 nm and the other 400 nm.
15. Sketch the MO diagram of N_2 molecule.Calculate its bond order and stability.
16. Explain the formation of Bonding and antibonding molecular orbitals.Distinguish between bonding and antibonding MO.
17. Explain the term hot bands with regard to vibrational spectroscopy. How can hot bands be distinguished from fundamental and overtones.
18. Discuss the complementary character of IR and Raman spectroscopies.
19. Discuss the vibrational energy levels of an anharmonic oscillator.
20. Explain the splitting of a signal into multiplets due to spin-spin coupling taking the example of ethyl bromide.
21. Sketch and explain the ESR spectrum of methyl radical.

Part C

III. Answer any Two questions. Each question carries 10 marks **(2x10=20)**

22. Explain quantum numbers and its significance.

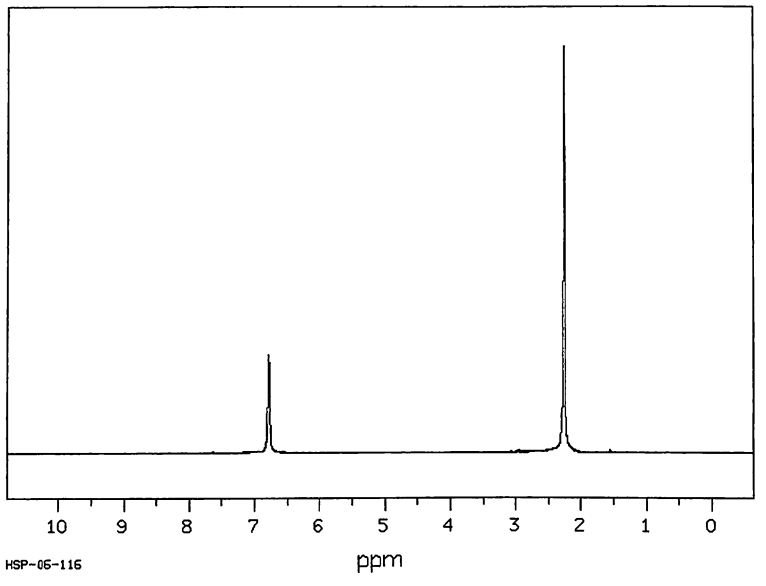
23. Explain Stokes and anti-Stokes lines.

24. a) Calculate the wavenumber shift for the vibrational mode of Cl_2, given that the force constant k for the bond is 3.23 N cm^{-1}.

    b) Explain why the major constituents of air doesnot absorb infrared radiation.

    c) The greenhouse effect is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without this atmosphere. Explain why methane and carbondioxide are called green house gases.

25. a) A molecule gives the following proton NMR spectrum (a 9 proton singlet at δ 2.2 ppm and 3 proton singlet at δ 6.9 ppm). Its molecular formula is C_9H_{12}. Find the structure of the molecule.



b) Explain magnetic anisotropy with an example.