20P2033

Reg. No ..... Name .....

M. Sc DEGREE END SEMESTER EXAMINATION - MARCH 2020

SEMESTER 2 : CHEMISTRY / PHARMACEUTICAL CHEMISTRY

COURSE : **16P2CHET07 / 16P2CPHT07 : PHYSICAL CHEMISTRY - II**

(For Regular - 2019 Admission & Supplementary 2018/2017/2016 Admissions)

Time : Three Hours Max. Marks: 75

Section A
Answer any 10 (2 marks each)

1. What is meant by degree of depolarization?
2. Why is the vibrational frequency of a molecule in the excited state is smaller than in the ground state?
3. CO molecule vibrates with a frequency of 1700cm^{-1}. Express the energy in kJ/mol.
4. State the guiding principle for investigating the vibrational structure of eletronic spectra
5. The photoelectrons ejected from N_2 with a radiation of wavelength 58.43nm has a kinetic energy of 5.63eV. Calculate the ionisation energy.
6. The absorption spectrum of O_2 molecule shows vibrational structure which becomes a continuum at 56.876cm^{-1}. The upper electronic state dissociate into one ground state atom and one excited atom. The excitation energy for this process 15875cm^{-1}. Estimate the dissociation energy of the ground state of O_2 in kJmol^{-1}.
7. How is Mossbauer nuclides formed?
8. Does ^{19}F exhibit nuclear magnetic resonance? Why?
9. Discuss Zeeman splitting with an example.
10. What is meant by shielding and deshielding of a nucleus?
11. Predict the low resolution NMR spectrum and high resolution NMR spectrum of acetone.
12. Write down Mc Connell equation and explain the terms. Mention its significances.
13. What is the general name for nuclear gamma resonance fluorescence(NRF) spectroscopy and what is its basic principle?

(2 x 10 = 20)

Section B
Answer any 3 (5 marks each)

14. Analyse the vibrations of CO_2 molecule to assess which are Raman active and which are IR active?
15. Draw the schematic diagram of Michelson interferometer and discuss the experimental technique
16. What is stimulated and spontaneous emission?
17. Explain the factors responsible for the hyperfine structure in ESR spectra?
18. Explain
    a. Spin-Spin coupling in AX type of NMR spectrum
    b. Relaxation methods in NMR spectroscopy

(5 x 3 = 15)

Section C
Answer any 2 (5 marks each)

19. The rotational spectrum of gaseous HBr has a series of equally spaced lines separated by 16.94 cm^{-1}. Calculate the moment of inertia and bond length for HBr (H = 1.008, Br = 79.909).
20. The rotational constant for $^{35}Cl_2$ has been found to be 0.2438cm^{-1}.Find the spacing between two consecutive Stokes lines.
21. A particular NMR instrument operates at 60 MHz; what magnetic fields are required to bring ^{1}H and $^{13.}C$ nuclei to resonate at this frequency? (h = 6.626 x 10^{-34}, ß = 5.051 x 10^{-27} JT^{-1}, "g" for ^{1}H = 5.585, "g" for ^{13}C = 1.404)
22. a) The magnitude of the nuclear spin angular momentum of a nucleus is $\frac{\sqrt{15}}{2}\hbar$. The value of I is?
    b) Toluene shows two peaks corresponding to methyl and aromatic protons when the NMR spectrum is recorded at 60 MHz and 1.41T. What would be the magnetic field at 300 MHz?

(5 x 2 = 10)

Section D
Answer any 2 (15 marks each)

23. (a) Show that for a rigid diatomic rotor, the moment of inertia is given by I = μr^2
    (b) Using the energy level expression and selection rules, draw an energy level diagram and the spectral transitions for the pure rotational spectrum of a rigid diatomic rotor. Also show the appearance of the spectrum.
24. (a) State and illustrate with suitable potential energy curves, the frank-condon principle in the vibronic spectrum of a diatomic molecule. Briefly discuss
    (b) Predict the kind of electronic transitions in (i) Cl_2 and (ii) C = O group. Also give their intensity.
    (c) What is meant by population inversion? Mention any one method of achieving it.
25. Explain the application of Mossbauer spectroscopic techniques in the study of Fe (II) and Fe (III) cyanides
26. a) Explain chemical shift in $^{1}HNMR$ spectroscopy?
    b) What are the factors influencing chemical shift?

(15 x 2 = 30)