

B.SC. CHEMISTRY
FIFTH SEMESTER
PHYSICAL CHEMISTRY V
BSC – 502 [SPECIAL REPEAT]
[USE OMR FOR OBJECTIVE PART]

**SET
A**

Duration: 3 hrs.

Full Marks: 70

Time: 30 min.

(Objective)

Marks: 20

Choose the correct answer from the following:

1×20=20

- In a dielectric, phase difference between the field vector \vec{E} and \vec{H} is
 - 2π
 - π
 - $\pi/2$
 - $\pi/4$
- The velocity of electromagnetic wave in a medium is given by
 - $\frac{1}{\mu\epsilon}$
 - $\frac{1}{\sqrt{\mu\epsilon}}$
 - $\sqrt{\frac{\epsilon}{\mu}}$
 - $\sqrt{\frac{\mu}{\epsilon}}$
- The frequency range 3×10^{12} Hz– 3×10^{14} Hz is in the region of
 - visible
 - microwave
 - infrared
 - radiowave
- The microwave active molecule is
 - O_2
 - N_2
 - Cl_2
 - CO
- The selection rule for the transmission among the rotational energy levels of rigid diatomic molecule is
 - $\Delta J = \pm 1$
 - $\Delta J = +1$
 - $\Delta J = -1$
 - $\Delta J = 0, \pm 1$
- Wave number is expressed by
 - $\frac{c}{\lambda}$
 - $\frac{1}{\lambda}$
 - $\frac{\lambda}{c}$
 - $\frac{c}{\lambda^2}$
- The nucleus which has spin 3/2 among the following is
 - N^{15}
 - Cl^{35}
 - O^{17}
 - F^{19}

- b. Deduce the frequencies of fundamental, first overtone, second overtone, and first hot band. Write the expression of zero-point energy.
3. a. State and explain Frank-Condon principle. Write the mutual exclusion principle and explain it with an example. 2+3=5
- b. Discuss the mechanism of fluorescence and phosphorescence spectra with a diagram. 5
4. a. State the requirement for a molecule to show pure rotational spectrum. Show that the separation of rotational energy levels increases with the increase of rotational quantum numbers. What change of the rotational spectrum will be obtained if one of the atoms of a diatomic molecule is replaced by a heavy isotope. 1+2+1=4
- b. Write the condition of resonance in NMR spectroscopy. Define chemical shift and what are the different scales used in chemical shift and how they are related? Why TMS is used as a reference in NMR spectroscopy. 1+2+3=6
5. a. State the condition of resonance in ESR spectroscopy. Why ESR spectra is obtained in derivative mode? At what value of the magnetic field will a free electron resonate in a 9500 MHz ESR spectrometer. 1+1+3=5
- b. Find the degeneracy of an excited state in a 3D box with energy three times its ground state. 2
- c. Find the degeneracy of a 3D simple harmonic oscillator with energy $\frac{91}{2} h\nu$ 3
6. a. What is quenching? Describe the factors affecting quenching. 2+3=5
- b. What is a chemical actinometry? Give an example of actinometer. 2
- c. What is chemiluminescence? Give two examples. 3
7. a. Give the energy expression of H atom in the nth shell. Derive the average radius of a H-atom. 1+4=5
- b. What are normalized, orthogonal and orthonormal wavefunctions? What is an expectation value? 3+2=5

8. a. State the postulates of quantum chemistry. 5
- b. Derive and solve the Schrodinger equation for a particle in a one-dimensional box. 5

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