(i) Printed Pages : 4 Roll No. .....

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B.A./B.Sc. (General) 6th Semester

(2055)

CHEMISTRY

(Same for B.Sc. Microbial & Food Technology)

Paper–XXIII : Physical Chemistry-B

Time Allowed : Three Hours] [Maximum Marks : 22

Note :— (i) Attempt **five** questions in all, selecting at least **one** question each from Sections A to D. Section E is compulsory.

(ii) Use of log tables and simple calculators is allowed.

SECTION—A

1. (a) Explain the terms-Axis of symmetry, Mirror planes and Centre of inversion. Show them diagrammatically for a cubic system.

   (b) The parameters of an orthorhombic unit cell are a = 50 pm, b = 100 pm, c = 150 pm. Determine the spacing between (123) planes. 2,2

2. (a) What are Miller indices of the faces of a cube ? Derive an expression for the distance of separation of *(hkl)* planes of a cubic crystal of edge length 'a'.

   (b) Explain in detail Steno's law of constancy of interfacial angles. How are interfacial angles measured ? 2,2

SECTION—B

3. (a) What do you mean by coupling effect in the solid state reactions ? Explain with a suitable example.

   (b) Describe power method for X-ray diffraction studies by crystals. What are its advantages over Bragg's method ? Using this method, how the interplanar spacing can be calculated ? 2,2

4. (a) What is the wavelength of X-rays which give a diffraction angle 2θ equal to 16.80° for a crystal if the interplanar distance in the crystal is 0.200 nm and only first order reflection is observed ? Given that sine of 8.40° is 0.146.

   (b) Show by calculation what types of diffraction patterns will be obtained for three types of cubic lattices. 2,2

SECTION—C

5. (a) Derive appropriate expression to show that the spacing of lines in the rotational spectrum is 2B, where B is rotational constant. Show allowed rotational transitions on an energy level diagram.

   (b) Explain the terms-stimulated absorption, stimulated emission and spontaneous emission. Prove that the net absorption is proportional to the population difference of the two states involved in the transition. 2,2

6. (a) The pure rotational spectrum of carbon monoxide molecule consists of a series of equidistant lines spaced at 3.84 cm^{-1} apart. Calculate the moment of intertia and bond length of carbon monoxide molecule.

(b) What do you understand by degrees of freedom of motion of a molecule ? Find out various degrees of freedom of motion associated with (i) HCl molecule (ii) SO_3 molecule. 2,2

SECTION—D

7. (a) What do you understand by symmetric, asymmetric, bending, parallel and perpendicular modes of vibration ? Explain with suitable examples.

(b) Taking the example of carbonyl compounds, represent molecular orbitals and explain the electronic transitions taking place between them. 2,2

8. (a) What are the selection rules of rotation-vibration Raman spectra of a polyatomic molecule ? Applying these rules explain what type of rotation-vibration Raman spectrum is obtained for a diatomic molecule ?

(b) The force constant of HF is 880 Nm^{-1}. At what wave number is the fundamental absorption expected ? 2,2

SECTION—E

(Compulsory Question)

9. (i) What is the effect on rotational energy levels of a molecule if an atom is replaced by its heavier isotope ?

(ii) Calculate the number of points per unit cell in End centric monoclinic lattice.

(iii) Why cooling curves of molten crystalline solids have breaks but those of amorphous solids do not have breaks ?

(iv) Why X-rays are used to study diffraction pattern of crystals ?

(v) H_2, N_2 and O_2 do not show vibrational spectra. Why ?

(vi) What do you understand by Doppler broadening and life time broadening ? $6 \times 1 = 6$