

C 20225

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Name.....

Reg. No.....

SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MARCH 2022

Physics/Applied Physics

PHY 6B 11/APY 6B 12—SOLID STATE PHYSICS, SPECTROSCOPY AND LASER
PHYSICS

(2014 to 2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A*Answer in word or a phrase each.**Answer all questions.**Each question carries 1 marks.*

1. The process of determination of crystal structure is called _____.
2. X-rays are produced when an element of high atomic weight is bombarded by high energy _____.
3. The vibrational energy of lowest energy state is called _____.
4. In Raman scattering, if the scattered photon have energy $h(\nu_0 + \nu_m)$ that corresponds to _____ line.
5. If the number of atoms in the excited state is greater than that in the lower energy level, it is called

Questions 6 to 10 : Write True or False :

6. Crystalline solids are anisotropic.
7. In an asymmetric top molecule, all the three moment of inertia are distinct.
8. Soft superconductors show Meissner effect.
9. X-rays have electromagnetic wave nature as ordinary light.
10. In superconductors, the critical field depends on temperature.

(10 × 1 = 10 marks)

Section B*Answer in two or three sentences each.**Answer all questions.**Each question carries 2 marks.*

11. Define crystal lattice.
12. What is Meissner effect ?

Turn over

13. What is Doppler broadening ?
14. Write down Bragg's equation.
15. Why anti-stokes lines are less intense than stokes lines ?
16. Distinguish between stimulated emission and spontaneous emission.
17. Write any 4 medical applications of laser.

(7 × 2 = 14 marks)

Section C

Answer in a paragraph of about half a page to one page each.

Answer any five questions.

Each question carries 4 marks.

18. Write a brief note on crystal systems.
19. Distinguish between Type I and Type II superconductors.
20. Write a note on Absorption instruments.
21. Outline the effect of isotopic substitution on the rotational spectra of molecules.
22. Write a note on vibrational Raman spectra.
23. Which are the factors that affect the intensity of spectral lines ?
24. What are Einstein's co-efficients ?

(5 × 4 = 20 marks)

Section D

Problems : write all relevant formulas, all important steps carry separate marks.

Answer any four questions.

Each question carries 4 marks.

25. A Raman line is observed at 4768.5\AA when acetylene was radiated by 4358.3\AA radiations. Calculate the vibrational frequency that causes this shift.
26. An atom has two atomic levels spaced by 3eV in energy. Calculate the ratio of population in higher and lower energy at 50°C . Boltzmann's constant = $1.38 \times 10^{-23}\text{J/K}$.
27. What is the minimum voltage applied to an X-ray tube to produce X-rays of 0.5\AA .
28. Electrons are accelerated to 728 volts and are reflected from a crystal. The first reflection maximum occurs when glancing angle is 8° . Determine the interplanar spacing of the crystal.
29. Copper has fcc structure with the lattice constant 0.361nm . Calculate the interplanar spacing for (112) and (120) planes.

30. If the bond length of H_2 is 0.07417nm , what would be the positions of the first three rotational Raman lines in the spectrum? What is the effect of nuclear spin on the spectrum ?
 ${}^1\text{H} = 1.673 \times 10^{-27} \text{ kg}$.
31. The frequency of OH stretching vibration in CH_3OH is 3300cm^{-1} . Estimate the frequency of OD stretching vibration in CH_3OD .

(4 × 4 = 16 marks)

Section E

Essays - answer in about two pages each.

Answer any two questions.

Each question carries 10 marks.

32. Explain the close-packed structures in crystal.
33. Explain the rotational spectra of rigid diatomic molecule with energy level diagram.
34. Explain the working of Infrared spectrophotometer.
35. Describe a semiconductor laser and explain its working.

(2 × 10 = 20 marks)