SOLID STATE.PREVIOUS YEARS QUESTION

1. Calculate the closest distance between the atoms placed in a face centered unit cube.
2. For identical experimental conditions the first order Bragg-reflection from a plane of a cubic crystal comes up at 5.9° and 5.85° respectively at 20°C and 50°C. Calculate the coefficient of cubic expansion of the solid.
3. Find the value of C_v^- for a monoatomic solid by using the classical equipartition theorem. Explain why the experimental value of C_v^- for diamond largely deviates from the classical value.
4. Explain whether x-ray of wavelength 1000 pm is suitable for studying Bragg reflection of a cubic crystal with a=450 pm.
5. KCl has a face centered cubic lattice. But from X-ray diffraction experiment it appears to be simple cubic. Explain.
6. The characteristic k_α lines of Cr, Fe and Ni have wavelength of 2.2009, 1.9373 and 1.6591 A° respectively. Can all be used to determine a lattice spacing of 1 A°? Explain.
7. Derive Einstein equation for heat capacity of elemental solid, C_v^-. stating the assumptions and hence deduce the limiting value of C_v^- of $T \rightarrow 0$ and $T \rightarrow \infty$. Draw the C_v^- vs T plot.
8. The element polonium (at. Wt. = 210) crystallizes in the cubic system. Bragg first order reflections using X-rays of wavelength 0.154 nm occur at sin Θ values of 0.225, 0.316, 0.388 for reflections from (100), (110) and (111) type planes.
   Show whether the unit cell is simple, face centered or body centered. Calculate the value of 'a', the side of the unit cell. Calculate the density of polonium.
9. Einstein equation for the heat capacity of solid is given by
   $C_v = 3R(h\nu/kT)^2 \ e^{h\nu/KT} / (e^{h\nu/KT} - 1)^2$ where the terms have their usual meaning. Arrive at Dulong Petits law from the Einstein equation. Define Einstein characteristic temperature and state its significance.
10. Consider a two dimensional square lattice (each side being a) and show that the separation between the successive (hkl) planes is given by $d_{hkl} = a / (h^2 + k^2)^{1/2}$

11. State the assumptions involved in the Einstein theory of heat capacity of solids. Demonstrate the limitation of the theory through (C_v / 3R) vs T plot. Mention its probable reason and suggest the scope of modification.
12. The distance between two successive parallel planes in a cubic crystal can not be a/ $\sqrt{7}$ – comment. (a = length of the edge of the cube).
13. Using X-rays of wavelength χ, = 179 pm, a metal produces a reflection at 2 θ = 47.2°. If this is a first order reflection from the 110 planes of a body centered cubic lattice, what is the edge length of the cube?
14. Evaluate the percentage packing in a simple cubic lattice.
15. If a radiation of wavelength χ is incident over a crystal surface making an angle θ, find the relation among χ , θ and distance between crystal planes.
16. From the following data evaluate the type of cubic lattice to which the two system belong:

	X	y
Edge length (pm)	286	388
Density (gm cm-3)	7.86	12.16
Molar mass (gm mol-1)	55.85	106.40

17. Barium forms bcc lattice. Given that the distance between the 211 planes in such a lattice is 204.9 pm and atomic weight of barium is 137.33, calculate the density of barium.
18. What is the lowest limit to the spacing of the lattice planes to produce x-ray diffraction spectra for a given radiation?
19. State the law of rational indices. Determine the Miller indices of the planes that intersects the crystal axes at (i) a, 2b, 3c and (ii) a, b, -c
20. Explain why Einstein theory of heat capacity of solid fails to explain the experimental temperature variation of heat capacity in its entirety.
21. Silver is known to crystallize in f.c.c form and the distance between the nearest neighbour atoms is 2.87 A°. Calculate the density of silver.(Ag = 108).
22. Justify or criticize: i. K^+ and Cl^{-l} ions have the same scattering power for X-rays. ii An X-ray analysis fails to locate the position of H^- atoms.