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B.Sc (PS) Computer Sci VI Sem

Assignment (Lattice vibration)

Assignment-2.
(Lattice vibrations)

Q1. The unit cell side of NaCl is 5.6 \AA and Young's modulus in a $[100]$ direction is $5 \times 10^{10} \text{ N/m}^2$. Estimate the wavelength at which electromagnetic radiation is strongly reflected by a sodium chloride crystal, ~~explaining~~ ~~any assumption~~ ~~you~~ assuming that the extinction in $[100]$ direction produces negligible contribution in the perpendicular direction. (at wt. of Na = 23, Cl = 37)

Q2. The velocity of sound in a solid is $3 \times 10^3 \text{ m/s}$ and the interatomic separation is $3 \times 10^{-10} \text{ m}$. Calculate the cut-off freq. assuming a linear lattice.

Q3. Calculate Einstein frequency in a case for which $\theta_E = 236 \text{ K}$. Give that $k_B = 1.4 \times 10^{-23} \text{ J/K}$, $h = 6.6 \times 10^{-34} \text{ Js}$

Q4. Calculate Einstein's frequency for copper for which ~~$\theta_E = 236 \text{ K}$~~ $\theta_E = 230 \text{ K}$. Using this result, prove that $C_V = 3R$ is valid if $T \gg 230 \text{ K}$

Q5. The Debye temperature for Carbon crystallized as diamond is 2230 K . Calculate the heat capacity per kilo mole for diamond at 20 K . Also compute the highest lattice frequency ν_m involved in Debye theory.

Q6. Compute energies (in eV) corresponding to a wavelength of 1 \AA for e^- and neutrons given that $h = 6.6 \times 10^{-34} \text{ Js}$, $m_n = 1.7 \times 10^{-27} \text{ Kg}$, $m_e = 9.1 \times 10^{-31} \text{ Kg}$, $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$.

