

Question 1

Given that NaCl has an optical mode frequency of 3.08×10^{13} s⁻¹ and unit cell side of 5.6Å.

1- Calculate the interatomic force constant for NaCl.

2- Given that the density of this substance is 2.18 gm/cm^3 , use the obtained data to calculate the velocity of sound in NaCl. (Atomic weights: Na =23, Cl =37).

Question 2

Given that the group velocity of a monoatomic chain at small q is 1 km/s. What is :

- the group velocity of vibrations at $q = (\pi/3a)$?

- the density of states at $q = (\pi/3a)$?

Question 3

An interaction with an incoming photon of energy 3meV produces a phonon at $q = \pi/3a$ (where $a = 5\text{\AA}$) with a phase velocity of 580m/s. What is the energy of the outgoing photon?

Question 4

Compare the contribution of electrons and phonons to the thermal conductivity of a monovalent metal at 300K. assume its ionic heat capicity is given by the classical value, the Fermi energy is 5eV, the speed of sound in the metal is 4000m/s and the mean free paths of electrons and phonons are approximately the same.

Question 5

Solve problems 1, 7 & 11 from **Chp.4** in your text book.

Question 6

A) Show that the **Fermi - Dirac** equation predicts the shown distribution at (T = 0).

(*Hint*: $e^{+\infty} = \infty$ and $e^{-\infty} = 0$)

B) Show that the probability of occupation for an electron state at the Fermi energy is equal to (0.5) for all finite temperatures (T > 0).



(2++26)=6