

# Physics 8510

## Problem Set 13

1) Consider a crystal of GaAs in which the sound velocity is  $5.6 \times 10^5$  cm/s and the optical phonon energy is 36 meV. Using the Debye model for the acoustic phonon energy and Einstein model for optical phonons, calculate the lattice vibration energy per  $\text{cm}^3$  at liquid  $\text{N}_2$  temperature. (77 K)

2) We solved the problem of phonon dispersion in a two atom basis which has the same force constants between atoms. This is true only for longitudinal modes but not for transverse modes. Do the calculation again for two different force constants  $f_1$  and  $f_2$ . Also find the expression which describes the adjacent displacements. (i.e.  $U_2 / U_1 = \dots$ ).

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