8.231, Physics of Solids I   Due on Wed., Oct 18.

Problem set #5

1. (20 pts)

   A kind of triangular molecules form a 1D lattice as shown below. The mass of the molecule is m and the separation between the molecules is a. The interaction between the molecules can be modeled by two kind of springs with spring constants C_1 and C_2 (see the figure below)

   (a) Find the fundamental translation vector of the 1D lattice. Find the fundamental translation vector the reciprocal lattice.

   (b) Calculate the dispersion relation ω_k of the two branches of sound waves.

   (c) Plot the dispersion relations.

   (d) Describe how molecules vibrate in the two branches of sound waves at wave vector $k = 0$.

   (e) Discuss the $C_1 \to \infty$ and $C_1 = C_2$ limits of your result.

2. Problem 6 on page 103 in Kittel.

3. Problem 1 on page 128 in Kittel.

4. Problem 3 on page 128 in Kittel.