Physics 4243/5243
Problem Set 7
Due Monday March 23rd 2015

Problem 1:

a) Show that for a simple square lattice (2D) that the kinetic energy of a free electron in the corner of the first zone is higher than that of an electron a midpoint to a side face of the zone by a factor of 2.
b) What is the corresponding factor for a simple cubic lattice in 3D?
c) What bearing might b) have on the conductivity of divalent metals?

Problem 2:

Consider the free electron bands of an FCC crystal lattice in the approximation of an empty lattice but in the reduced zone scheme in which all the **Ks** are transformed to lie in the first Brillouin zone. Plot in the [111] direction the energies of all the bands up to six times the lowest band energy at the zone boundary $k=2\pi/a$ (½, ½, ½). Let this be the unit of energy. This problem shows why band edges need not necessarily be at the zone center. Several of the degeneracies (band crossings) will be removed when the crystal potential is included.

Problem 3:

Use the Kronig-Penney Model. (see link on D2L website to Kittel and read chapter 7)

a) For the delta function potential and with $P<<1$ find for $k=0$ the energy of the lowest band.
b) Find the band gap at $k=\pi/a$