HW #7 (221B), due Mar 4, 4pm

1. The copper metal is a cubic lattice with the lattice constant of 3.61Å. Assume that there is one conduction electron per lattice site and treat the electrons as free particles. Calculate the Fermi energy and show that it is much higher than the room temperature.

2. Use Thomas–Fermi model of atoms to answer the following questions.

   (a) Solve the differential equation numerically for neutral atoms and obtain a plot of Thomas–Fermi function $\chi(x)$ for $x < 20$.

   (b) Argue why higher l orbitals have higher energies with a given principal quantum number n.

   (c) Calculate the total binding energy of an atom.

   (d) Show that the "radius" of atoms depends only weakly on Z, consistent with the empirical fact. The radius is naively infinite in this model because the charge density extends smoothly to infinity. Define the radius R instead to contain $Z - 1$ electrons

   $$Z - 1 = \int_0^R 4\pi r^2 dr \rho(r). \tag{1}$$

   Plot R in Å as a function of Z.