

Physics 617 Problem Set 2 Due Friday, Sept. 14

(1) Kaxiras 2.2

(2) Kaxiras 2.7

(3) Using the Hartree-Fock modification of the free electron energies given on page 52, find the density of states. You can use the method outlined on the August 30 handout, or equivalently there is a method in ch. 5 that works as well. What happens at the Fermi energy? What does this imply about the electronic contribution to the specific heat for metals in the Hartree-Fock approximation?

[Note: the result that you obtain this way does not agree with what is observed in real metals.]

(4) Consider BCC potassium metal (K), with lattice constant $a = 5.33 \text{ \AA}$, and simple-rhombohedral mercury (Hg) crystals with $a=2.99\text{\AA}$ and angle $70^\circ 45'$. Assume a free-electron density corresponding to one electron per atom in K with valence = 1, and two per atom in valence=2 Hg.

(a) For both cases calculate r_s .

(b) Calculate the Fermi temperatures.

(c) At 300 K, determine the differences in energy between μ and ε_F , in temperature units.

(d) Evaluate the linear-temperature contributions to the specific heat at low temperatures.