PHYS 446 Fall 2010

Homework Assignment 6 Due (before the Final Exam)
EXTRA CREDIT / Make up for the missed HW's

1. The diamagnetic susceptibility due to the ion cores in metallic copper is -0.20×10^{-6}. Knowing that the density of Cu is 8.93 g/cm^3 and atomic weight is 63.5, calculate the average ionic radius of Cu.

2. A system of spins ($j = s = ½$) is placed in the magnetic field $H = 5\times10^4$ Amp/m. Calculate the following:
   a) The fraction of spins parallel to the field at T = 300 K and T = 1 K
   b) The average component of magnetic dipole moment along the field at these temperatures.
   c) The field for which the average dipole moment component along the field is $½\mu_B$ at 300 K.

   (You can use simple formulas for this particular case of two-level splitting ($j = ½$), given in Omar, p.436).

3. a) Calculate the paramagnetic spin susceptibility for K, (density 0.87 g/cm^3 and atomic weight 39.1)
   b) Calculate the diamagnetic susceptibility of the conduction electrons in K.
   c) Using the above results and Table 9.5 (Omar, p. 444) calculate the ionic radius of K in metallic state.

4. Iron has a bcc structure with a lattice constant a = 2.86 Å.
   a) Using the value of the saturation magnetization in Table 9.6 (Omar, p. 445), show that the dipole moment of a Fe atom is $2.22\mu_B$. The density of Fe is 7.92 g/cm^3 and atomic weight is 55.6. (In this problem you may assume, that the 3d electrons are completely localized.)
   b) Calculate the Weiss constant λ and the molecular field in iron.
   c) Evaluate the Curie constant.

5. Nuclear magnetic resonance in water is due to the protons of hydrogen. Find the field necessary to produce NMR at 60 MHz.