Physics 847: Problem Set 5

Due Thursday, May 13 at 11:59 P. M.

Each problem is worth 10 points unless otherwise specified.

1. Consider a ferromagnetic Ising model with nearest neighbor interactions on a simple cubic lattice. Each spin thus has 6 nearest neighbors. If there are a total of N spins on the lattice, calculate the energy and degeneracy of the first excited state.


3. Consider the model of problem 11.9 (the antiferromagnetic Ising model), but instead of a uniform applied magnetic field B, assume that you have a “staggered magnetic field” which equals B on one sublattice and -B on the other. Define a “staggered susceptibility” which equals \((\partial M/\partial B)_{B=0}\), where M is the magnetization on one of the sublattices. Show that in the mean field approximation, this staggered susceptibility diverges as T approaches the Neel temperature \(T_N\) from above, with temperature dependence \(1/(T - T_N)\).

4. Pathria, Problem (11.12) (20 pts.). Skip the sentence beginning “Further show that...” Also, find the critical temperature at \(x = 1/2\) in terms of the interaction parameters \(\epsilon\).