

In the name of God

Department of Physics
Shahid Beheshti University

CRITICAL PHENOMENA

Exercise Set 2

(Due Date: 1401/08/13)

1. Paramagnetism with discrete magnetic moment. Suppose that $\mathcal{H} = -g\mu_B H m$, where H is the magnitude of external magnetic field, and $m = -j, -j + 1, \dots, +j$ and j is the value of total angular momentum.
A: Compute canonical partition function for magnetic degree of freedom.
B: Compute $\langle \mu \rangle$.
C: Compute $C_H = \frac{\partial \langle \mathcal{H} \rangle}{\partial T}$ and plot it as a function of T .
D: Compare the C_H given from classical and quantum approaches.
2. Mapping between Lattice Gas model and Ising Model: Suppose that $\mathcal{H} = \sum_{i=1}^N U_i n_i + \frac{1}{2} \sum_{i,j=1}^N U_{ij} n_i n_j$. Here U_i and U_{ij} are one and two particles interacting terms. The n_i is the occupation number at i th site. Show that this model can be represented by Ising model if we adopt proper mapping between occupation number of molecules in i th site and spin value s_i .
3. Solve exercise 2-2 of Goldenfeld's book.
4. Solve the exercises 1.1, 1.2 of Scaling and Renormalization in statistical Physics, written by John Cardy.

Good luck, Movahed
