

Homework #3 for STAT MECH 505-Due Oct. 20

1. From your favorite textbook learn the relation between the partition function of a system and its free energy, state it, and compute from that relation the free energy of a non-interacting system of N harmonic oscillators. Do this both for a quantum system and a classical system. Plot the free energy as a function of the ratio of the oscillator energy quantum to k_{BT} .
2. Explain (very) briefly the Weiss theory of ferromagnetism of a system of interacting tiny magnets (spins) taught to you in class and derive from it an expression for the dependence of the critical temperature at which the phase transition occurs in terms of parameters such as the magnetic moment of the individual spins and the coordination number (find out what that phrase might mean from reading a text if you cannot guess it from the theoretical development you have seen). Plot the magnetization versus temperature curve. Do this both via a program you write to solve the transcendental equation you obtain in the theory AND analytically via a Taylor series expansion of such a function as $\tanh(x)$ or $\coth(x)$.