

Exercises in Statistical Mechanics

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This exercises pool is intended for a graduate course in “statistical mechanics”. Some of the problems are original, while other were assembled from various undocumented sources. In particular some problems originate from exams that were written by B. Horovitz (BGU), S. Fishman (Technion), and D. Cohen (BGU).

===== [Exercise 5660]

Ising model of adsorption sites (Exam2003 Q3)

A large number $M \gg 1$ of adsorption sites are ordered along the length of a ring. Between every two adsorption sites a spin $\sigma_i = \pm 1$ is located. The ring is soaked in a gas temperature T and it's chemical potential. At most, one particle gas can be adsorbed to a given site $n_i = 0, 1$. The adsorption energy is $\varepsilon > 0$ if the two adjacent spins are in the same direction. The adsorption energy is $-\varepsilon$ if the adjacent spins are in the opposite direction. Assume positive adsorption energy that gives "priority" to the promagnetical order. Write the expression for the energy $E[\sigma_i, n_i]$ of a given configuration. Write the transfer matrix T that is shown in the calculation of the grand canonical distribution function $Z(\beta, \mu)$ of the system. (Guideline: carry out the sum over the occupation options. Define T for the remaining sum over she spins). Find the self values of the transfer matrix. Write expressions for the basic function $F(T, \mu)$ and for the adsorbed particles $N = \sum \langle n_i \rangle$. Write an expression for the correlation length ξ that characterize the arrangement of the spins in the system.