Exercises in Statistical Mechanics

Based on course by Doron Cohen, has to be proofed
Department of Physics, Ben-Gurion University, Beer-Sheva 84105, Israel

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 2310]

Defects in Lattice

A perfect lattice is composed of N atoms on N sites. If M of these atoms are shifted to interstitial sites (i.e. between regular positions) we have an imperfect lattice with M defects. The number of available interstitial sites is N' and is of order N. The energy needed to create a defect is w. Assume that $T << w$, and show that the leading order estimate for the typical number of defects is $M = NN'exp\left(\frac{-w}{2T}\right)$. Evaluate also the contribution of the defects to the entropy, and to the specific heat in the same level of approximation.