

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 4215]

Equilibrium of condensed Bosons and atoms $B=2A$

N Boson molecules of type B are inserted into a box with volume V . The system temperature is T . Each molecule is composed from two atoms of type A . The mass of each atom is m , and the binding energy of the molecules is ε . Assume that there are molecules in condensation, and that the atoms can be treated within the framework of the Boltzmann’s approximation.

1. With regard to the atoms - what is the condition for the Boltzmann approximation.
2. How many free atoms occupy the the box?
3. How many molecules occupy excited states?
4. What is the minimal N that is required to have condensation as assumed?
5. What is the pressure on the walls?
6. Who dominates the pressure - molecules or atoms?