

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 3040]

Quantum Bose Gas with an oscillating piston

A cylinder of length L and cross section A is divided into two compartments by a piston. The piston has mass M and it is free to move without friction. Its distance from the left basis of the cylinder is denoted by x . In the left side of the piston there is an ideal Bose gas of N_a particles with mass m_a . In the right side of the piston there is an ideal Bose gas of N_b particles with mass m_b . The temperature of the system is T .

(*) Assume that the left gas can be treated within the framework of the Boltzmann approximation.

(**) Assume that the right gas is in condensation.

- Find the equilibrium position of the piston.
- What is the condition for (*) to be valid?
- Below which temperature (**) holds?
- What is the frequency of small oscillations of the piston.

Express your answers using $L, A, N_a, N_b, m_a, m_b, T, M$.

