

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 3010]

Heat capacity of an ideal Bose gas

Consider a volume V that contains N mass m bosons. The gas is in a thermal equilibrium at temperature T .

1. Write an explicit expression for the condensation temperature T_c .
2. Calculate the chemical potential, the energy and the pressure in the Boltzmann approximation $T \gg T_c$.
3. Calculate the chemical potential, the energy and the pressure in the regime $T < T_c$.
4. Calculate C_v for $T < T_c$
5. Calculate C_v for $T = T_c$
6. Calculate C_v for $T \gg T_c$
7. Express the ratio C_p/C_v using the polylogarithmic functions. Explain why $C_p \rightarrow \infty$ in the condensed phase?
8. Find the γ in the adiabatic equation of state. Note that in general it does not equal C_p/C_v .

