

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 2046]

Gas in a centrifuge

A cylinder of radius R rotates about its axis with a constant angular velocity Ω . It contains an ideal classical gas of N particles at temperature T . Find the density distribution as a function of the radial distance from the axis. Write what is the pressure on the walls.

Note that the Hamiltonian in the rotating frame is $H'(r, p; \Omega) = H(r, p) - \Omega L(r, p)$ where $L(r, p)$ is the angular momentum.

It is conceptually useful to realize that formally the Hamiltonian is the same as that of a charged particle in a magnetic field (“Coriolis force”) plus centrifugal potential $V(r)$. Explain how this formal equivalence can be used in order to make a shortcut in the above calculation.