Exercises in Statistical Mechanics

Based on course by Doron Cohen, has to be proofed

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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 2042]

Pressure of an ideal gas in the atmosphere

An ideal classical gas of N particles of mass m is in a container of height L which is in a gravitational field of a constant acceleration g. The gas is in uniform temperature T.

(a) Find the dependence $P(h)$ of the pressure on the height h.

(b) Find the partition function and the internal energy. Examine the limits $mgL \ll T$ and $mgL \gg T$.

(c) Find $P(h)$ for an adiabatic atmosphere, i.e. the atmosphere has been formed by a constant entropy process in which T, μ, are not equilibrated, but $Pn^{-\gamma} = \text{const}$. The equilibrium is maintained within each atmospheric layer. Find $T(h)$ and $n(h)$ at height h in terms of the density n_0 and the temperature T_0 at $h = 0$.