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).

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Gas in a box with parbolic potential wall

Coansider N classical particles in a potential

$$V(x,y,z) = \begin{cases} \frac{1}{2}ax^2 & 0 < x,\ 0 < y < L,\ 0 < z < L \\ \infty & \text{else} \end{cases}$$

Calculate the partition function and detirve from it an expression for the pressure on the wall at $x = 0$. Note that for this purpose you have to re-define the potential, such that it would depend on a paramter X that describes the poition of the wall.
Show that the result for the perssure can be optionally obtained by assuming that the pressure is the same as that of an ideal gas. For this purpose evalute the density of the particles in the vicinity of the wall.