

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 3530]

Ideal Fermi gas in 2D box

N fermions with mass m and spin $\frac{1}{2}$ are in a box, its dimensions are $L \times L \times \gamma$, ($\gamma \ll L$). The system is kept in low temperature T . Find the pressure on the box walls and the heat capacity of the gas in conditions where it's possible to consider as 2 dimensional. The one particle states are $|np_x p_y\rangle$

$$E_{np_x p_y} = \frac{1}{2m} \left(\frac{\pi}{\gamma} R \right)^2 + \frac{p_x^2}{2m} + \frac{p_y^2}{2m}$$

It's possible to consider the gas as a 2 dimensional as long as the occupation of the levels $1 < n$ is negligible.

$$g(E) = 2 \cdot A \frac{m}{2\pi}, \frac{1}{2m} \left(\frac{\pi}{\gamma} \right)^2 < E < 4 \cdot \frac{1}{2m} \left(\frac{\pi}{\gamma} \right)^2$$

It's convenient to take in to calculation the $E = \frac{1}{2m} \left(\frac{\pi}{\gamma} \right)^2$ like an attribute level to the uniparticles state energy, but there's a need to be careful when you calculate the pressure on the upper and lower walls.

