

## 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 6040]

#### Effusion of electrons from a box in magnetic field

A box with electrons of mass  $m$  is subjected to a magnetic field  $B$ . The single particle interaction is described by  $-\gamma B \sigma_z$ . The chemical potential of the electrons inside the box is  $\mu$ . A hole through one of the walls is drilled. The electrons that are emitted from the hole with a velocity in the range  $v < v' < v + dv$  are filtered, and subsequently their spin is measured. The measured current is defined as  $I = I_{\uparrow} + I_{\downarrow}$ .

- Find the ratio  $\alpha(B; \mu) = (I_{\uparrow} - I_{\downarrow})/I$ .
- Find a linear approximation for  $\alpha(B; \mu)$  regarded as a function of the magnetic field.
- What is the maximal value of  $\alpha(B; \mu)/B$ , and what is the range for which the result is valid.

