

## 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 3550]

#### Fermions in magnetic field - Pauli

$N$  electrons with mass  $m$  and spin  $\frac{1}{2}$  are placed in a box at zero temperature. A magnetic field  $B$  is applied, such that the interaction is  $-\gamma B\sigma_z$  where  $\gamma$  is the gyromagnetic ratio. Consider the following cases:

- (a) one-dimensional box with length  $L$ .
- (b) two-dimensional box with area  $A$ .
- (c) three dimensional box with volume  $V$ .

Answer the following questions. Express your results using  $\gamma$ ,  $m$ ,  $N$ ,  $L$ ,  $A$ ,  $V$ .

- (1) What is the single particle density of states. Distinguish between a spin up and spin down particles.
- (2) Which is the graph that describes the magnetization  $M(B)$  of each case (a),(b),(c). Complete the missing details: what are  $M_s$ ,  $B_c$ ,  $\chi$ .

