

## 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. Horowitz (BGU), S. Fishman (Technion), and D. Cohen (BGU).

### ===== [Exercise 5010]

#### One dimensional hard sphere gas

$N$  spheres with diameter  $a$  are threaded over a wire of length  $L$ . Assume  $N \gg 1$  but  $Na \ll L$ . The system is in thermic equilibrium, temperature  $T$ . Find the force  $F$  that operates on the edges of the wire. Write the result in the shape  $F = NT/L_{eff}$ . Express  $L_{eff}$  using the data and explain it's physical meaning. Hints:

- While calculating the distribution function, notice that if the beads permutation were permitted, it was causing  $Z \rightarrow N!Z$ .
- Assume that a typical distance between two beads is much bigger than  $a$ .
- To calculate a product  $A = \prod_{n=1}^N a_n$  look at the sum  $\ln A$ , and use reasonable approximations.

