

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 9012]

Equilibrium of a two level system

Consider N particles in a two level system, n_1 particles in energy level E_1 and n_2 particles in energy level E_2 . The system is in contact with a heat reservoir at temperature T . Energy can be transferred to the reservoir by a quantum emission in which $n_2 \rightarrow n_2 - 1, n_1 \rightarrow n_1 + 1$ and energy $E_2 - E_1$ is released. [Note: $n_1, n_2 \gg 1$.]

- (a) Find the entropy change of the two level system as a result of a quantum emission.
- (b) Find the entropy change of the reservoir corresponding to (a).
- (c) Derive the ratio n_2/n_1 ; do not assume a known temperature for the two level system. (Note: equilibrium is maintained by these type of energy transfers).