

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 6050]

Radiation from a 1D blackbody fiber

Consider an optical fiber that has a length L . Its section area is A . The fiber is in thermal equilibrium at temperature T . Assume the fiber is a one dimensional medium for the electromagnetic field. Regard the system as a 1D photon gas.

- (a) What is the electromagnetic energy density per unit length?
- (b) What is the radiation pressure on each fiber end?
- (c) Assuming that the radiation is freely emitted from an end of the fiber, find the energy flow per unit time.
- (d) What is the spectral distribution $J(\omega)$ of the emitted radiation?
- (e) What is the entropy and what is the heat capacity of the system?

You can use the following integral

$$\int_0^{\infty} \frac{x}{e^x - 1} dx = \frac{\pi^2}{6}$$