

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 8494]

Sweep of electric field over an oscillator

Consider a massive disc of area A and mass M that is attached to a spring that has an elastic constant α . The system is immersed in gas of particles that have mass m , density n per unit volume, and temperature T . A time dependent slowly varying electric field $\mathcal{E}(t)$ is applied. The units are chosen such that the electric charge of the disc is unity.

- (1) Write an expression for the position $\langle x \rangle$ of the disc at a given moment when the electric field has strength \mathcal{E} and rate of change $\dot{\mathcal{E}}$.
- (2) Discuss possible refinement of your result assuming that the spring has temperature T_A , while the gas has temperature T_B . Note: there are two possible perspectives for the analysis: (a) Treating A+B as one system. (b) Treating A as the system, and B as the bath. In the latter context, explain the limitations of the Langevin formulation. In the former context note that the temperature is ill defined.