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 7020]

Fluctuations of harmonic oscillator

A particle (x, p) of mass m is bounded by a harmonic potential of frequency Ω, and experiences a damping with a coefficient eta. It is subject to an external force $f(t)$.

(a) Write the generalized susceptibility that describes the response of x to the driving by $f(t)$.

(b) Using the FD relation deduce what is the power spectrum of the x fluctuations.

(c) What are the fluctuations of the velocity?

(d) Show that in the limit $\eta - - > 0$ the second moments $\langle x^2 \rangle$ and $\langle v^2 \rangle$ are as expected from the canonical formalism.