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 8020]

Correlation functions from Langevin dynamics

Consider the Langevin equation for a particle with mass M and velocity $\mathbf{v}\,(t)$ in a medium with viscosity γ and a random force $\mathbf{A}(t)$.

(a) Find the equilibrium value of $\langle \mathbf{v}(t)\mathbf{A}(t)\rangle$.

(b) Given $\langle \mathbf{v}(t)\mathbf{v}(0)\rangle \sim e^{-\gamma|t|}$ and $\langle \mathbf{v}\rangle = 0$, use $\mathbf{v}(t) = \dot{\mathbf{x}}(t)$ to evaluate $\langle \mathbf{x}^2(t)\rangle$ [do not use Langevin's equation] .