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 7040]

FDT for RL-circuit, Nyquist theory

Derive the Nyquist expression for the current-current correlation function in a closed ring, taking into account its inductance. Use the following procedure:

1. Cite an expression for the inductance L of a torus shaped ring given its radius R and its cross-section radius r.
2. Write the R-L circuit equation for the current I, where the flux $\Phi(t)$ through the ring is the driving parameter.
3. Identify the generalized susceptibility $\chi(\omega)$, and observe that it is formally the same expression as in the problem of Brownian motion.
4. Calculate the current-current correlation function $\langle I(t)I(0)\rangle$, taking the classical / high temperature limit.
5. Verify that $\langle I^2\rangle$ agree with the canonical result.