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 0010]

Average distance between two particles in a box

In a one dimensional box with length L, two particles have random positions x_1, x_2 . The particles do not know about each other. The probability function for finding a particle in a specific location in the box is uniform. Let $r = x_1 - x_2$ be the relative distance of the particles. Find $\langle \hat{r} \rangle$ and the dispertion σ_r as follows:

(1) By using theorems for "summing" the expectation values and variances of independent variables.
(2) By calculating the probability function $f(r)\,dr = P(r < \hat{r} < r + dr)$.