

M09T.2 - Particles on a Line (J94T.2)

Problem

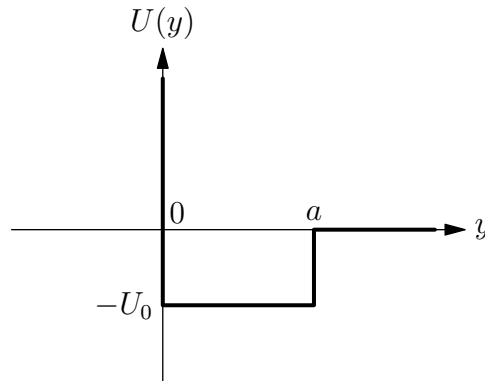
Consider a system of N classical particles on a line with Hamiltonian

$$H = \frac{p_1^2}{2m} + U(x_1) + \sum_{i=2}^N \frac{p_i^2}{2m} + U(x_i - x_{i-1}).$$

The potential between neighboring particles has the form:

$$U(y) = \begin{cases} +\infty, & \text{if } y < 0; \\ -U_0, & \text{if } 0 \leq y \leq a; \\ 0, & \text{if } a < y. \end{cases}$$

($U_0 > 0, a > 0$)



In addition, a constant force f is applied to the rightmost particle $i = N$.

- Compute the mean length, $\langle x_n \rangle$, of the system as a function of N, T and f .
- Obtain the high and low temperature limits of the result from part a).