Metropolis Monte-Carlo Algorithm for two particles connected by a spring

Let's assume a system comprising of two beads connected by a spring. The initial positions of the two particles are x_1 and x_2, the temperature T, spring constant k. The energy function $E(x_1, x_2) = \frac{1}{2}k(|x_2 - x_1| - l_0)^2$, where l_0 is the equilibrium spring length.

Repeat the following steps for a number of iterations:

1. **Propose a random move:** For each particle $i = 1, 2$, propose a new position $x'_i = x_i + \Delta x$, where Δx is sampled from a Gaussian distribution.
2. **Compute the change in energy:**
$$\Delta E = E(x'_1, x'_2) - E(x_1, x_2).$$
3. **Accept or reject the move:**
   - Accept the move if ΔE is negative, indicating that the new state corresponds to the lower energy.
   - In case ΔE is positive, accept the move with a probabiltiy of $\exp(-\Delta E/k_B T)$.

     This can be achieved by generating an uniform random number $u \sim \mathcal{U}(0, 1)$ and checking $u \leq \exp(-\Delta E/k_B T)$, accept the move:
$$x_1 = x'_1, \quad x_2 = x'_2.$$
   - Else, reject the move and keep x_1 and x_2 unchanged.