Consider the Ehrenfest chain with \( N \) particles. Suppose \( X_0 = 0 \), i.e., initially all the particles are on the right. Let \( T_0 \) be the first time all the particles end up on the right again. Calculate \( E_0(T_0) = E(T_0 \mid X_0 = 0) \), the conditional expectation of \( T_0 \) given \( X_0 = 0 \).

(For this problem, you may assume that the stationary distribution of the Ehrenfest chain is the binomial distribution \( \text{Bin}(N, 1/2) \). This is can be checked directly from the definition of stationary distributions. I'll also discuss it in class when we talk about the detailed balance condition.)