Answer one of the following questions using up to a page. Please type up your answer. If you are doing problems 1 or 2, for extra credit you could replace 4 by $n$.

1. Give a proof that every permutation of $\{1, 2, 3, 4\}$ may be written as a product of transpositions. (Do not do this by showing this is true for each of the 24 permutations! However if you are stuck, you could write out all 24 and verify it is indeed the case to get an idea how to write the proof. It is ok to divide the proof into several cases.)

2. Note that the number of transpositions used to express an element is not unique, for example $(12)(34)(12) = (34)$. Prove however that the parity is unique, that is, either one can only express a permutation using an even number of transpositions or an odd number.

3. Define a bijective map from the interval $[0, 1]$ of real numbers and the Cantor set. (Hint: if one uses a decimal type expansion, one must show that the map is well defined when a number may be expressed by two different decimal expansions.)