1. Let $0 < \alpha \leq 1/2$. Suppose Quicksort takes a path such that each segment of length $m$ removes a pivot and produces two segments of length $\alpha m - 1$ and $(1 - \alpha)m$. Considering the top level of the recursion tree to be level 0, find an expression for $k = \text{deepest level at which a leaf (segment with one element) may appear}$. Ignore round-ups and round-downs by assuming that segments produced by the $\alpha$-expressions are integers.

2. Show that the instruction count along such a path is $O(n \lg n)$.

3. Show that the instruction count along such a path is $\Theta(n \lg n)$. 