5 Algorithms I (FMS)

(a) Explain the quicksort algorithm. [Note: Pseudocode allowed but not required. Clarity of ideas, conciseness and legibility definitely required, but not absolute completeness.] [3 marks]

(b) Assume that, under certain hypothetical circumstances, quicksort always partitions into two regions of relative size $\alpha$ and $(1 - \alpha)$, with $\alpha$ a constant in the range $0 < \alpha < 0.5$. Under those circumstances, and ignoring rounding issues, derive an approximate expression for the minimum depth of a leaf in the recursion tree as a function of $n$ and $\alpha$. Clearly explain your derivation. [5 marks]

(c) How long will quicksort take if all the elements are equal? Clearly explain your derivation. [6 marks]

(d) It has been suggested that the pivot should be selected at random. What are the advantages and disadvantages of this strategy? How will it affect the worst-case and average-case asymptotic complexity? Discuss. [6 marks]