Data Structures and Algorithms

What is a priority queue? Explain the data structure known as a heap and document how a heap is stored in a simple linear block of memory. [4 marks]

If a heap stores $N$ items, describe how it can be viewed as an almost-balanced binary tree. What difference can there be between the greatest and least lengths of paths from the root of the tree to a leaf? What operations must be performed to move from one node in the tree to (a) its parent and (b) its offspring? [5 marks]

Describe, and estimate the costs of, procedures to

(a) insert a new item into an existing heap;

(b) delete the topmost item from a non-empty heap;

(c) starting from an array holding $N$ items in arbitrary order, rearrange those items so that they form a heap, taking time less than that which would be needed if the items were just inserted into the heap one after the other. [6 marks]

A stable sorting method is one where items whose keys compare as equal will appear in the output in the same order that they appeared in the input list. Would a heap sort based on the algorithms you have documented be stable? Justify your answer. [5 marks]