PRACTICE EXAM

Difficulty: MEDIUM

Questions: 10

Data Structures Exam

Instructions: Please answer all questions to the best of your ability.

Multiple Choice (4 points each, 40 points total)

Instructions: Choose the best answer for each question.

Question 1: What is the worst-case time complexity of Heap Sort?
A) O(n)
B) O(n^2)
C) O(n lg n)
D) O(lg n)

Question 2: In a heap data structure represented as an array, what is the index of the left child of the node at index *i*?
A) *i*/2
B) *i* - 1
C) 2*i* + 1
D) 2*i*

Question 3: Which of the following describes a Stack Overflow condition?
A) Attempting to remove an element from an empty stack.
B) Attempting to add an element to a full stack.
C) Successfully adding an element to a stack.
D) Attempting to remove an element from a full stack.

Question 4: In the context of sets, which operation finds the element with the smallest key value?
A) Search(S, k)
B) Maximum(S)
C) Successor(S, x)
D) Minimum(S)

Short Answer (6 points each, 30 points total)

Instructions: Answer each question in 2-3 sentences.

Question 5: Briefly explain the difference between a Queue Overflow and a Queue Underflow.

Question 6: Describe how a linked list differs from an array in terms of how elements are ordered.

Question 7: Explain the purpose of the `key` variable in the provided Insertion Sort pseudocode.

Problem Solving (10 points each, 30 points total)

Instructions: Provide detailed solutions, showing all steps.

Question 8: Trace the execution of the `ENQUEUE` operation on a queue `Q` with length 5, head = 1, and tail = 5, when adding the element `x`. Clearly show the updated values of `Q`, `head[Q]`, and `tail[Q]` after the operation.

Question 9: Given the initial unsorted array [9, 8, 2, 4, 9, 3, 6], demonstrate the steps of Insertion Sort to sort this array in ascending order. Show the state of the array after each iteration of the outer loop (for j = 2 to n).

Question 10: Describe the steps involved in building a Heap data structure and then performing a sorting operation using Heap Sort. Briefly explain the role of the `MAX or MIN HEAPIFY` procedure.