PRACTICE EXAM

Difficulty: MEDIUM

Questions: 10

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# Algorithms and Data Structures Exam
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Section 1: Multiple Choice Questions (4 points each, 40 points total)

Instructions: Choose the best answer for each question.

Question 1: In the Insertion Sort algorithm, what is the purpose of the 'key' variable?
A) To store the index of the element being inserted.
B) To store the value of the element being inserted.
C) To store the number of comparisons made during the sorting process.
D) To store the size of the array.

Question 2: In the provided code snippet for Insertion Sort, what is the role of the `while` loop?
A) To iterate through the entire array.
B) To compare the 'key' element with the elements to its right.
C) To shift elements larger than the 'key' to the right.
D) To find the minimum element in the unsorted portion of the array.

Question 3: The provided code snippets on Merging two sorted arrays illustrates which concept?
A) An incomplete process, as the array is not fully merged or sorted
B) A complete array merging and sorting
C) Reversing array contents
D) Insertion into array

Question 4: According to the provided slides on the Master Theorem ($T(n) = 2T(n/2) + \Theta(n)$), if you guess that $T(n) \leq cn \lg n$, what must be true of c in the upper bound proof?
A) c must be equal to 0.
B) c must be less than 0.
C) c must be greater than or equal to 1.
D) c must be equal to 1.

Section 2: Short Answer Questions (6 points each, 30 points total)

Instructions: Answer the following questions in 2-3 sentences each.

Question 5: Explain the general strategy of the Insertion Sort algorithm.

Question 6: In the Insertion Sort, why is the index `i` decremented within the `while` loop? Explain with reference to the code.

Question 7: What information does the course outline provide, according to the provided slides?

Section 3: Problem-Solving Questions (10 points each, 30 points total)

Instructions: Provide a detailed explanation of your solution for each question.

Question 8: Trace the execution of the INSERTION-SORT algorithm on the array A = [5, 1, 4, 2, 8]. Show the state of the array A after each iteration of the outer `for` loop (i.e., after each insertion).

Question 9: Using the recurrence $T(n) = T(n-1) + \Theta(n)$ and the guess $T(n) \leq cn^2$, show that the upper bound holds, and determine what condition must be true.

Question 10: The merging of two sorted arrays shown in the slides illustrates sorting. Can this be used for an unsorted array and, if so, what will be the final merged array if the input arrays are [20, 13, 7, 2] and [12, 11, 9, 1]?
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