PRACTICE EXAM

Difficulty: MEDIUM

Questions: 10

Algorithm Analysis Exam
Instructions: Please answer all questions to the best of your ability. Show your work where applicable.

Section 1: Multiple Choice (4 points each, 40 points total)

Instructions: Choose the best answer for each question and clearly indicate your choice (A, B, C, or D).

Question 1: What algorithmic concept is primarily illustrated by the provided examples involving the insertion of elements into a sorted array?
A) Divide and Conquer
B) Dynamic Programming
C) Greedy Algorithms
D) Insertion Sort

Question 2: According to the provided text, what is the algorithmic complexity of T(n) = ■(1) if n = 1; T(n-1) + lgn if n > 1?
A) O(lgn)
B) O(n)
C) O(nlgn)
D) O(n^2)

Question 3: In the provided insertion sort example, what is the purpose of the 'key' variable?
A) It stores the index of the element being inserted.
B) It stores the value of the element being inserted.
C) It represents the number of comparisons made.
D) It holds the final sorted array.

Question 4: Which method is demonstrated for determining the complexity of a recurrence relation, other than the substitution method?
A) Divide and Conquer
B) Recursion Tree Method
C) Dynamic Programming
D) Greedy Algorithms

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

Instructions: Answer each question concisely in 2-3 sentences.

Question 5: Briefly explain how the Substitution Method is used to find the complexity of a recursive algorithm.

Question 6: Explain, in your own words, what is meant by "merging two sorted arrays," as it relates to algorithmic efficiency.

Question 7: Describe the difference between finding an upper bound and a lower bound when analyzing the complexity of an algorithm.

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

Instructions: Provide detailed solutions, showing all steps of your reasoning.

Question 8: Given the recurrence relation $T(n) = 2T(n/2) + \blacksquare(n)$, and the guess $T(n) \leq cn \lg n$, demonstrate how you would verify the upper bound using substitution, including a step indicating the value of n0 where the condition holds true.

Question 9: Using the provided example of insertion sort, show the state of the array [9, 5, 1, 4, 3] after the second iteration (j=3) of the outer loop. Clearly indicate the values of 'key' and 'i' during the comparison.

Question 10: $T(n) = T(n-1) + \blacksquare(n)$, and the Guess: $T(n) \leq n2$
Upper bound: Solve for c.