Please typeset your answers. If TAs cannot read your handwriting, they will not grade your assignment.

1. (10 pts) Suppose \( T_1(n) = O(g(n)) \) and also \( T_2(n) = O(g(n)) \). Which of the following are true? Explain your answer.
   (a) \( T_1(n) + T_2(n) = O(g(n)) \).
   (b) \( T_1(n) - T_2(n) = o(g(n)) \).
   (c) \( T_1(n)/T_2(n) = O(1) \).
   (d) \( T_1(n) = O(T_2(n)) \).

2. (10 pts) You are given an \( n \times n \) matrix (array) of numbers, already stored in memory. The matrix is monotone in the following sense: in each row, the numbers are increasing from left to right; and in each column, the numbers are increasing from top to bottom. Give a worst-case \( O(n) \) time algorithm to decide if a given number \( X \) is in the matrix.

3. (10 pts) Given an array \( A \) of \( n \) positive numbers, describe an \( O(n) \) time algorithm for each of the following problem. Find the indices \( i \) and \( j \), with \( j \geq i \), such that
   (a) \( A[j] + A[i] \) has the maximum value,
   (b) \( A[j] - A[i] \) has the maximum value,
   (c) \( A[j] \times A[i] \) has the maximum value,
   (d) \( A[j]/A[i] \) has the maximum value.

4. (10 pts) Given the hash function \( h(x) = x \) mod 10, and the following set of numbers as input \{4371, 1323, 6173, 4199, 4344, 9679, 1989\}, show the resulting:
   (a) Separate chaining hash table,
   (b) Open addressing hash table with linear probing.
   (c) Open addressing using quadratic probing.