Problem 1. Let \( S = \{75, 123, 65, 9, 23, 67, 32, 12, 93\} \). Consider a hash function \( h(k) = 1 + ((2k + 17) \mod m) \), where \( m = 5 \). Show the resulting hash table. Also, explain how to use the hash table to answer a dictionary search query with value 34.

Problem 2. Let \( S_1 \) and \( S_2 \) be two sets of integers, such that \( |S_1| = |S_2| = n \). Give an algorithm to report all the integers in \( S_1 \cap S_2 \) in \( O(n) \) expected time.

Problem 3. Let \( S_1 \) and \( S_2 \) be two sets of integers, such that \( |S_1| = |S_2| = n \). All the integers are obtained from the domain \([1, 20n]\). Give an algorithm to report all the integers in \( S_1 \cap S_2 \) in \( O(n) \) worst-case time. (Hint: counting sort).

Problem 4. Let \( S \) be a perhaps multi-set of \( n \) integers. Give an algorithm to determine whether \( S \) has two identical integers. Your algorithm should terminate in \( O(n) \) expected time.

Problem 5. Let \( S \) be a perhaps multi-set of \( n \) integers. Give an algorithm to determine whether \( S \) has \( k \) identical integers. Your algorithm should terminate in \( O(n) \) expected time, regardless of \( k \). For example, suppose that \( S = \{75, 123, 65, 9, 9, 32, 9, 93\} \). Then the answer is yes if \( k \leq 3 \), but no if \( k \geq 4 \).