Q1. Problem 9-1 in CLRS (Largest $i$ numbers in sorted order). Be sure to choose your algorithms for optimal worst case behavior. Do not compare expected case behavior. Also, do not forget that the runtimes will be a function of both $n$ and $i$.

Q2. Problem 11-2 in CLRS (Slot-size bound for chaining).

Q3. Problem 11-4 in CLRS ($k$-universal hashing and authentication). Hint: Be sure to read the proof of Theorem 11.5 carefully. Remember, for a prime $p$, all elements of the set $\mathbb{Z}_p^* = \{1, ..., p - 1\}$ have multiplicative inverses modulo $p$, so it is safe to apply the standard rules of division when working modulo a prime number only. Note, the message $m$ referenced in part c of the problem is unrelated to the size of output range of the hash function (which is denoted by $m$ throughout chapter 11 of CLRS... for this problem, the output range is of size $p$, since $B = \mathbb{Z}_p$).

Q4. Problem 12-2 in CLRS (Radix trees).

Q5. Problem 12-3 in CLRS (Average node depth in a randomly built binary search tree).

Q6. Suppose you are asked to sort a list of $n$ numbers that contains many duplications, such that there are only $O(\log n)$ distinct numbers in the list. (For example, the input sequence $\{9, 4, 7, 4, 9, 9, 9\}$ should be output in sorted order as $\{4, 4, 7, 9, 9, 9, 9\}$.) Show how to sort the numbers in time $O(n \log \log n)$.

Q7. Starting from an initially empty 2-3 Tree, insert the following numbers one at a time, in order:

$$3, 15, 1, 17, 16, 18, 19, 2$$

(a) Show the resulting 2−3 Tree structure (including guide values for internal nodes).

(b) Delete the value 16, and show the resulting tree (again, including guide values).

Q8. Exercise 22.1-6 in CLRS (Universal sink).