1. Demonstrate what happens when we insert the keys 10, 22, 35, 12, 1, 21, 6, 15, 36, 33 into a hash table with collisions resolved by chaining.

h(k)	keys
0	36
1	1->10
2	
3	21->12
4	22
5	
6	33->15->6
7	
8	35

2. Exercise 11.2-1 in CLRS Textbook.

Under the assumption of simple uniform hashing, we will use linearity of expectation to compute this. Suppose that all the keys are totally ordered $\{k_1, \ldots, k_n\}$. Let Xi be the number of $l > k_i$ so that $h(l) = h(k_i)$. Note, that this is the same thing as $\sum_{j>i} \Pr(h(k_j)=h(k_i)) = \sum_{j>i}\frac{1}{m} = \frac{(n-i)}{m}$. Then, by linearity of expectation, the number of collisions is the sum of the number of collisions for each possible smallest element in the collision. The expected number of collisions is $\sum_{i=1}^{n}\frac{n-i}{m} = \frac{n^2-\frac{n(n+1)}{2}}{m} = \frac{n^2-n}{2m}$.

3. Given a binary search tree in pre-order as {22,19,12,6,21,36,40,39}, draw this BST and determine if this BST is the same as one described in post-order as {6,12,21,19,36,40,39,22}.

```
          22
         /  \
       19    36
      /  \     \
    12    21    40
   /           /
  6          39
```

The BST described in post-order is {6,12,21,19,39,40,36,22}, so they are not the same one.

4. For the following binary search tree, show the result of following operations (Please follow the algorithm from the lecture/textbook):

```
          8
        /   \
      4       16
             /    \
            9       19
                   /   \
                 17     22
```

a) Insert key 20;
b) Delete 8 from the result of a);
c) Delete 19 from the result of b);
d) Delete 16 from the result of c).

a)

```
          8
        /   \
      4       16
             /    \
            9       19
                   /   \
                 17     22
                       /
                     20
```

b)

```
          9
        /   \
      4       16
                  \
                   19
                   /   \
                 17     22
                       /
                     20
```

c)

```
        9
       / \
      4   16
            \
             20
            /  \
          17    22
```

d)

```
        9
       / \
      4   20
         /  \
       17    22
```