1.

h(k)	keys
0	
1	19->10
2	2->20
3	39
4	22
5	5
6	
7	
8	8->35->26

2.

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.
(correct answer not unique)
height=2:

```
          10
         /  \
        3    17
       / \   / \
      2   8 16  22
```

Height = 3:

```
          10
```

```
       /     \
      3       16
     /  \       \
    2    8       17
                   \
                    22
```
Height = 4:
```
         8
       /   \
      3     10
     /        \
    2          16
                 \
                  17
                    \
                     22
```
Height = 5:
```
        3
       / \
      2   8
           \
            10
              \
               16
                 \
                  17
                    \
                     22
```
Height = 6:
```
      2
       \
        3
         \
          8
           \
            10
              \
               16
                 \
                  17
                    \
                     22
```

4.

a)

```
   A
    \
     C
    / \
   D   E
      /
     F
```

b)

```
   A
    \
     F
    / \
   D   E
```

c)

```
   F
  / \
 D   E
```

d)

```
   D
  / \
 B   C
      \
       E
      /
     F
```