Problem 1 (12)

(a) (5) For the min Fibonacci heap of figure below, perform a DecreaseKey operation by changing 19 to 2. Draw the resulting min Fibonacci heap, clearly label ChildCut values. (The ChildCut field is shown in parentheses; ChildCut is undefined for the root.)

```
min
  /
  /
14(T) 7(T) 9(F)
  /
  /
8(T) 11(T) 10(T) 13(T)
  /
  /
15(T)
  /
17(T) 19(T)
  /
21(T)
```

(b) (6) Perform a DeleteMin operation on the resulting Fibonacci heap of (a) , clearly label ChildCut values.
Problem 2 (12)

(a) (6) Insert the following sequence of keys: 2, 5, 8, 4, 7, 12, 3 and 9 in this order in an empty max pairing heap. Show each step.

(b) (6) For the max pairing heap given below, perform a RemoveMax operation using two-pass scheme and show each step.

```
15
 /  /  /   \
10 13 12 11 5 9 7
```
Problem 3 (14)

(a) (7) Insert the keys 6,3,11,7,8,5,1,2,4,9,10 and 12, one by one in this order into an initially empty 2-3-Tree (i.e., B-tree of order 3). Show the tree after each insert.

(b) (7) Delete the keys 12,7,2,5,1 and 11, in this order, from the tree constructed in part (a). Show the tree after each delete.
Problem 4 (12)

Perform a Split operation using the split key 6 in the following bottom-up splay tree. Show each Step.

```
      18
     / \  
    8   20
   / \  /  
  4   10 22
 / \ / \ / \  
2  6  9 15 30
 / \ / \ /  
5  7 11 17
```