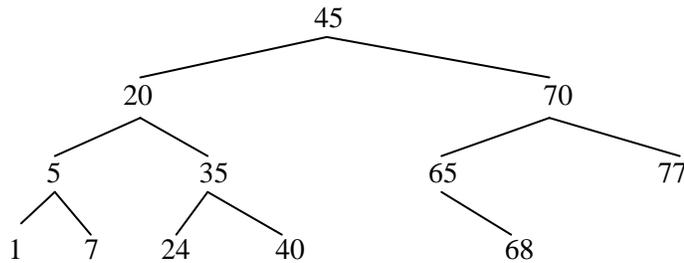Due: Tuesday, March 13th by 4:00pm

1. (20 points, 1 point each)   Answer the questions based on the following tree, T.

a)   Is the tree a binary tree? Why or why not?
b)   Is the tree a binary search tree? Why or why not?
c) T is not a complete binary tree. What is the range of values of a single insert that would be guaranteed to make it a complete binary tree?
d)   With the change you made in c), could this tree be a minheap or maxheap? Why or why not?
e)   What is/are the sibling(s) of 65?
f)   What are the leaves of T?
g)   What is the root of T?
h)   What is the depth of 5?
i)   What is the height of 70?
j)   List all of the descendents of 20.
k)   List the ancestors of 40.
l)   What is the parent of 5?
m) What is the length of the path from 45 to 40?
n)   Print the preorder traversal of T.
o)   Print the inorder traversal of T.
p)   Print the postorder traversal of T.
q)   Print the level order traversal of T.
r)   Draw a tree resulting from the deletion of 77.
s)   Draw a tree resulting from the deletion of 45.
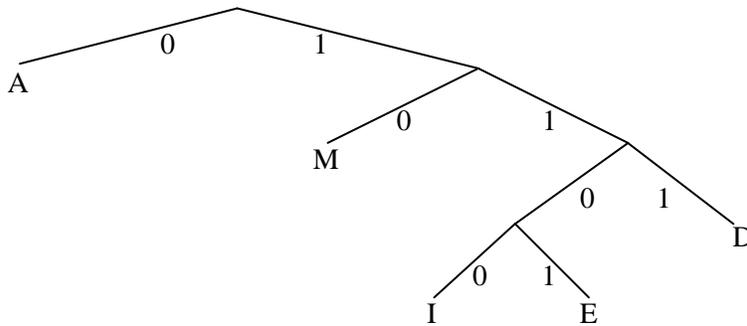t)   Draw a tree resulting from the deletion of 65.

2. (5 points) Draw the binary search tree that would result from inserting the following in order: 50, 9, 71, 6, 4, 12, 51, 54, and 89.

3. (5 points, 1 point each) Answer the questions based on the following minheap, H.

```
              4
         /         \
       12           25
      /   \        /   \
    52     33    89     46
   /  \   /  \
  65  53 78  35
```
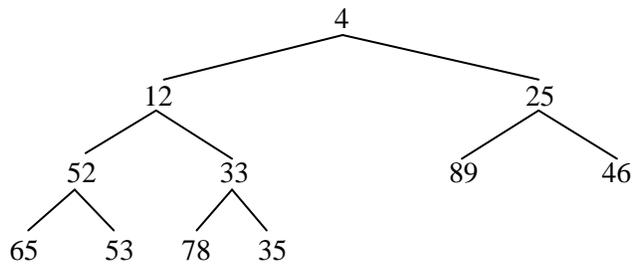
   a) Draw the heap that would result from an insertion of 8.
   b) Draw the heap that would result from an insertion of 3.
   c) Assuming that H is stored in a linear array, what number is after 33 in the array?
   d) Draw the heap that would result from deleting the root.
   e) Draw the heap that would result from deleting the root twice.

4. (8 points, 2 point each) Answer the questions based on the following Huffman binary tree. As in example 10.13 of the text, left edges are assigned 0, and right edges are assigned 1.

```
         0           1
      A
            0           1
          M
                  0       1
                              D
                0     1
               I      E
```

   a) Encode: "I made mamma mad." Could have this been the basis of the Huffman tree? Why or why not?
   b) Encode: "Madam I am a dame." Could have this been the basis of the Huffman tree? Why or why not?
   c) Decode and add spaces where appropriate: 0101101111110001001100111111111001101111

5. (5 points) Create a Huffman binary tree for the following sentence ignoring the punctuation marks, letter cases, and spaces. There are 62 letters. In the case where two trees to be joined have the same count, please have the tree with the letter closest to the beginning of the alphabet on the left of the new tree. There is more than one possible tree. "I have a theory that it is impossible to prove anything, but I cannot prove it!"