1. Draw the binary tree whose inorder traversal is jlgfmechbdak and whose postorder traversal is jgfileebahkm. [5 points]

2. The balance factor of an internal node $v$ of a binary tree is the difference between the heights of the left and right subtrees of $v$. Write a recursive routine which will print the balance factors of all nodes in a binary tree. What is the running time of this routine? [6 points]

3. Consider an ordered tree $T$ and a binary tree $T'$ representing it, using the first-child next-sibling representation (section 10.4). An inorder traversal of $T'$ is equivalent to what kind of traversal of $T$? [4 points]

4. In class we defined the internal path length $I$ and the external path length $E$, both measures of a binary tree. If that tree has $n$ (internal) nodes, show that $E = I + 2n$. (This is exercise B.5-5, p 1091.) [8 points]

5. Consider the tree of Figure 12.2 on p 257. How many different permutations of the values it contains, when inserted in that order, will yield this particular tree? [8 points]

6. How many permutations of 1, 2, ..., $n$ yield a skew tree? (Since any one skew tree is generated by just one permutation, this question is asking for the number of skew trees of $n$ nodes.) [5 points]

7. (Search path splitting a BST) Exercise 12.2-4, p 260. [4 points]

Total: 40 points

Notes:

- (Q2) Consider the following three formulas:
  
  - $\text{height}(\text{null}) = -1$
  
  - $\text{height}(p) = 1 + \max\{\text{height}(p.l)\text{eft}, \text{height}(p.right)\}$
  
  - $\text{balFac}(p) = \text{height}(p.l\text{eft}) - \text{height}(p.right)$

  These suggest that you may want to compute the height and the balance factor at the same time. You may simply print out the balance factors, in any order.

- (Q3) To get $T'$, imagine the first-child as a left pointer and the next-sibling as a right pointer.
• (Q4) We had $I = \sum_{v \in V} d(v)$, where $V$ is the set of nodes and $d(v)$ is the depth of a node. $E$ is defined similarly, over all external nodes. You will want to use induction.

• (Q5) Consider a tree where
  
  – the left subtree contains $n$ nodes and is generated by $r$ permutations
  – the right subtree contains $m$ nodes and is generated by $s$ permutations

Then the whole tree contains $n + m + 1$ nodes and is generated by $r \cdot s \cdot \binom{n+m}{n}$ permutations.