1. (10%) A stack is used to convert the infix expression $a + b - c / (d * e) + f$ to an equivalent postfix expression. The operators follow the arithmetic convention of precedence hierarchy (i.e., the precedence of multiplication/division is higher than that of addition/subtraction.) Please show the contents of the stack and the output as each symbol (operand or operator) is scanned.

2. (10%) The snapshot of a max heap is as shown in the figure. Five more keys 6, 12, 24, 14, 30 are subsequently inserted into the heap in that order. Please show graphically the max heap after each new key is added.
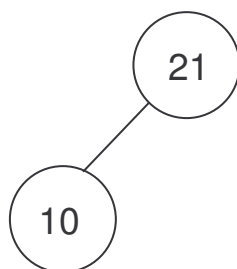
3. (8%) Suppose the number of nodes of degree 2 in a binary tree is N_2, and the number of leaf nodes is N_L. Show that $N_L = N_2 + 1$.

4. (12%) A binary tree is as depicted in the figure. Please write down the nodes in the order they are visited using (a) inorder and (b) postorder traversal schemes.

- 2 -
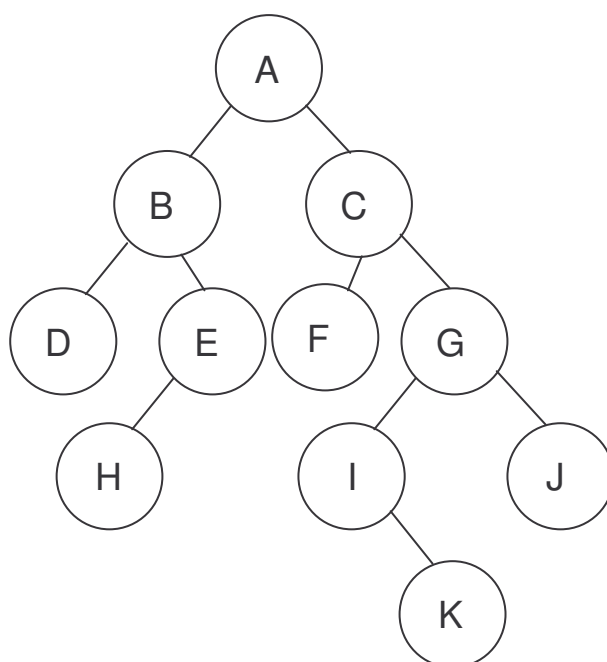
5. (10%) Draw diagrams showing all the distinct binary trees that can be formed with four nodes.

6. (12%) Open addressing is a strategy used to hash a key to the hash table. Please give three common techniques used by the open addressing to resolve collisions.

7. (14%) What is the worst-case time complexity of Merge-Sort algorithm? Prove or disprove that Merge-Sort is an asymptotically optimal comparison sort.

8. (10%) The two most common computational representations of graphs are adjacency list and adjacency matrix. Please discuss the advantages and disadvantages of the two representations.

9. (14%) Please list the nodes in sequence if the graph is explored using (a) depth-first search (b) breadth-first search. (Assume node A is the start node.)