1.
What does the following piece of code do?
What is its running time in terms of N, the number of elements in array a?

```
for (int p=1; p<a.size(); p++)
{
        int tmp=a[p];
        for (j=p; j> 0 && tmp < a[j-1]; j--)
                a[j] = a[j-1];
        a[j] = tmp;
}
```

2.
Questions similar to those in assignment 1.

3.
Write a recursive function to compute the sum of the integers in an array A.

4.
Solve the following recurrent to obtain the running time of an algorithm.
$T(1) = 1$
$T(N) = 2T(N/2) + cN$

5.
What is the running time of the following piece of code in terms of n, the number of elements to be added to the array?

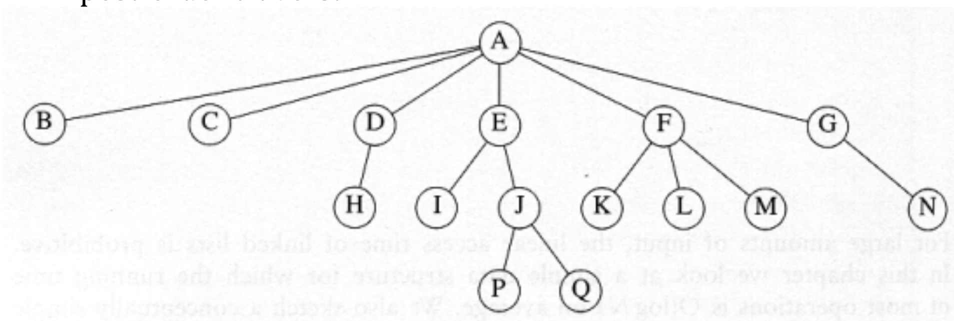
```
int [ ] V = new int[1]; N = 1;  top = –1;
input element e;
for( i = 0; i < n; i++ ) {
  if( stack is full ) {
    allocate a new array T of capacity 2N;
    copy V[i] to T[i] for i = 0, 1, …, N–1;      // a for loop
    set V = T;
    N = N * 2;
  }
  top = top + 1;
  V[top] = e;
  input next element e;
}
```

5.
Rewrite the quick sort algorithm in the lecture notes by picking the pivot as the middle element of the array (sub-array) instead of the median-of-three.

pivot = a[(left + right)/2];

6.
Given the following tree, what is the output from a

- pre-order traversal?
- post-order traversal?



7.
Assuming a singly linked list, give the running time of each method listed below.

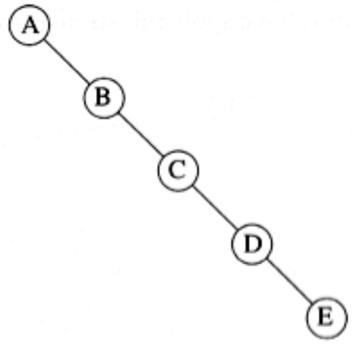
Algorithm	Running Time
Inserting at the head (*addFirst*)	O( )
Removing at the head (*removeFirst*)	O( )
Inserting at the tail (*addLast*)	O( )
Removing at the tail (*removeLast*)	O( )
Search for an element (*found*)	O( )

8.
Write a recursive algorithm to compute the depth of a node v in a tree T.

9.
Write a recursive algorithm to compute the height of a node v in a tree T.

10.
Assume an array implementation of binary trees.

- Given the tree below, what is the minimum size the array needs to store this tree?
- Assume a "linear" tree that looks like the tree below and has N nodes. What is the minimum size the array needs to store the tree of N nodes?



11.
Given the following set of integer keys 15, 6, 18, 3, 7, 17, 20, 2, 4, 13, and 9,

- draw a binary search tree that gives the search function the best performance
- draw a binary search tree that gives the search function the worst performance