1. Find the maximum flow (form S to D) of the following diagram. Explain briefly the method you used step by step. (10%)

![Diagram of flow network with capacities: S to 16: 15, 16 to 10: 14, 10 to 12: 8, 12 to D: 22, 15 to 7: 12, 12 to 5: 10, 20 to 16: 16.]

2. Consider an array which contains the following elements: 24, 26, 3, 9, 45, 1, 12. Please write down the order of these elements after applying the following algorithms to a certain pass.
   (a) Bubble sort (after the third pass). (5%)
   (b) Heap sort (after the third pass). (5%)

3. Explain the following terms:
   (a) ADT (3%)
   (b) Biconnected graph (3%)
   (c) Hash function (4%)

4. Write the prefix and postfix notations of the following arithmetic expression:
   \[a-b*(c*d+e-f*a)/(g-c*d)-(a+b)*c\] (10%)
5. The permutation program designed by the recursive method is listed as follows. Please analysis the time complexity of the recursive program. (10%)

```c
void perm(char list[], int i, int n)
{
    int j, temp;
    if(i==n){
        for(j=0; j<=n; j++)
            printf("%c", list[j]);
        printf(" ");
    }
    else{
        for(j=i; j<=n, j++){
            SWAP(list[i], list[j], temp); //swap list[i] and list[j]
            Perm(list, i+1, temp)
            SWAP(list[i], list[j], temp); //swap list[i] and list[j]
        }
    }

}
```

6. Solve the recurrence equation

\[ T(1) = a, \]
\[ T(n) = b + 3/2T(\lfloor n/2 \rfloor), n > 1. \]

Express the solution in closed form. (10%)
7. (10%)  
(a) Give the code fragment necessary to insert a leaf in an inorder threaded tree so that the tree remains properly threaded.  
(b) Use your answer to (a) to design an algorithm that inserts a given node x (not necessarily a leaf) from an inorder threaded tree so that the inorder of the remaining nodes is unchanged and the tree remains properly threaded.

8. What is a trie? Discuss the relative advantages in speed of retrieval of a trie and a binary search tree. (10%)  

9. Write a function that will interchange all left and right subtrees in a linked binary tree. (10%)  

10. The greatest common divisor (GCD) of two positive integers is the largest integer that divides both of them. Thus, for example, the GCD of 8 and 12 is 4, the GCD of 9 and 18 is 9, and the GCD of 16 and 25 is 1. (10%)  
(a) Write a recursive function GCD(x, y: integer): integer that implements the division algorithm: If y = 0, then the GCD of x and y is x; otherwise the GCD of x and y is the same as the GCD of y and x % y.  
(b) Rewrite the function in iterative form.