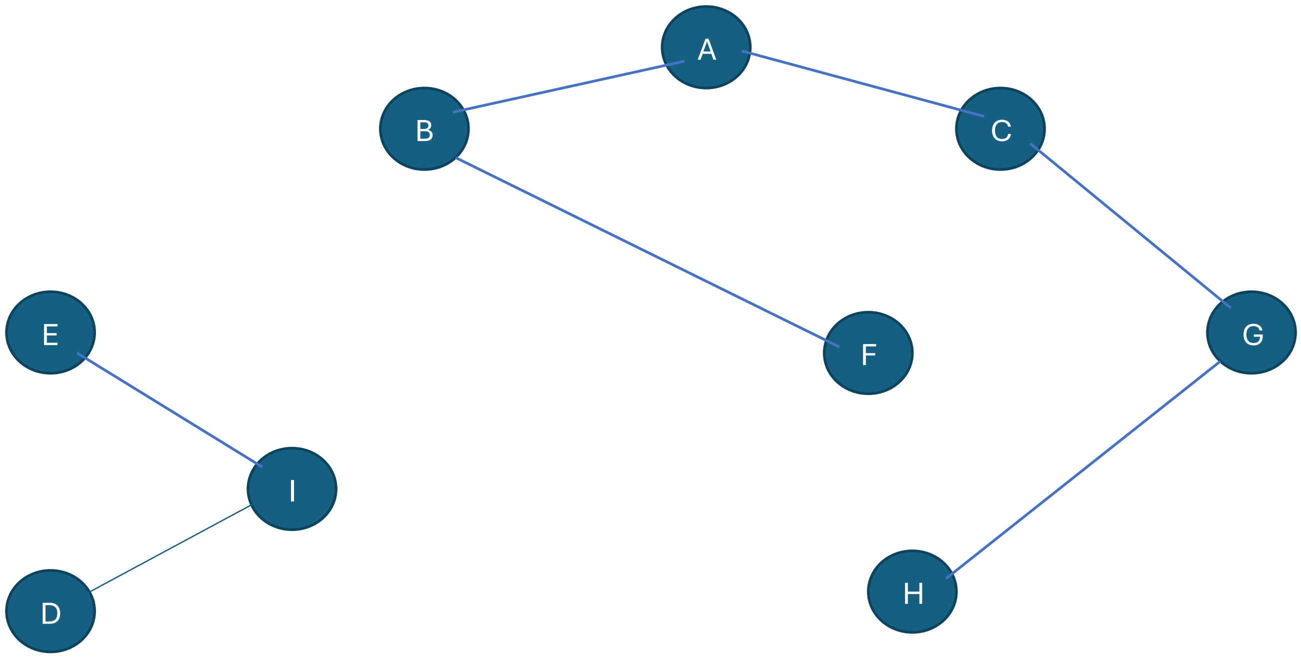
Q1.

a. No the graphs are not connected. BACGHF and DEI are the connected components for graph G.

b.

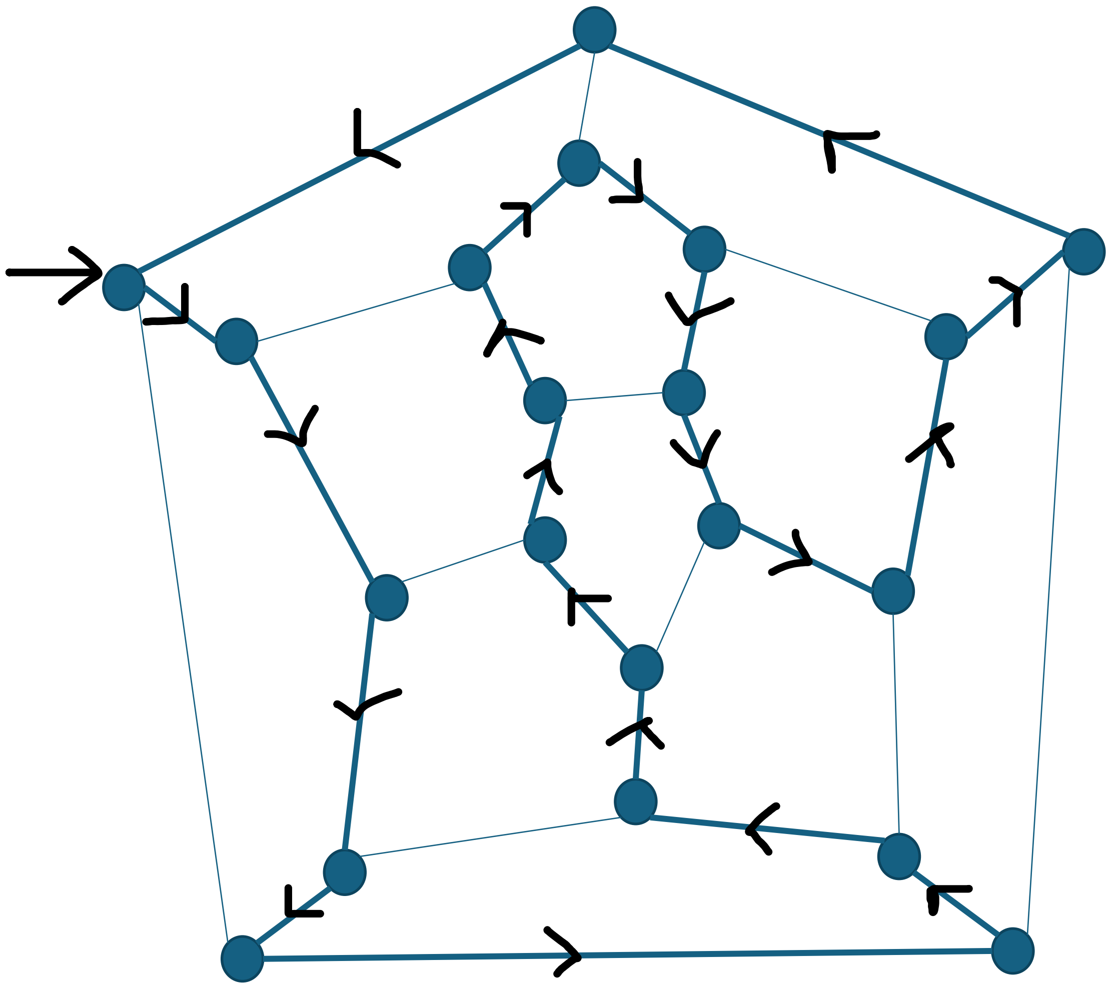


c. No Graph G is not a hamiltonian cycle, because of its disconnected nature we cannot reach to all of its vertices.

d. Yes, there is a vertex cover of size less than or equal to 5.

Vc1 = { E , I } , Vc2 = { F , G , A } => Vc = { A , G , F , E , I }

Q2.



Q3.

```
/*
*
*   Time complexity: O(2^n) * O(n)
*   2^n choices and on each choice copying the array takes O(k) where k ranges from 0 - n
*   on average size of subset is O((0+n)/2) -> O(n)
*/
Algorithm SubsetList(list,subset,arr,i)
   Input: result list, subset is current subset, arr original elements , i current index
   Output: list containing subsets of arr

   if i>arr.length then
      return list
   if i==arr.length then
      list.add(new List(subset))
      return list

   SubsetList(list,subset,arr,i+1)
   subset.add(arr[i])
   SubsetList(list,subset,arr,i+1)
   subset.removeLast()
   return list

/*
*
* Time complexity => O(n * 2^n)
*
*/
Algorithm powerSets(arr)
   Input: arr containing list of items
   Output: List of list of subsets of arr
   return SubsetList(new List(), new List(), arr, 0)

Algorithm computeEndpoints(edge)
   Input: edge of a graph
   Output: List of the vertices of the edge

Algorithm belongsTo(vertices,set)
   Input: two lists of vertices
   Output: true if at least one of the item in vertices is in set
```

```
/*
*
* Time complexity => O(n * 2^n) + (2^n * k) ; n is # of vertices and k is # of edges
*
*/
Algorithm smallestVertexCover(v,e)
  Input: v-> set of vertices, e -> set of edges
  Output: smallest vertex cover

  smallestVertexCover <- v;
  powerSet <- powerSets(v)
  for set in powerSet do
    isSVC <- true
    for edge in e do
      vertices <- computeEndpoints(edge)
      isSVC <- isSVC && belongsTo(vertices,set)
    if isSVC then
      if set.length < smallestVertexCover.length then
        smallestVertexCover = set
  return smallestVertexCover
```

Q4.

```
class Solution {
  private void visit(char[][]grid,boolean[][]visited,int i, int j){
    if(i < 0 || i >= grid.length || j < 0 || j >= grid[i].length || visited[i][j]==true || grid[i][j]=='0'){
      return ;
    }
    visited[i][j] = true;
    visit(grid,visited,i-1,j);
    visit(grid,visited,i+1,j);
    visit(grid,visited,i,j-1);
    visit(grid,visited,i,j+1);
  }
  public int numIslands(char[][] grid) {
    boolean[][] visited = new boolean[grid.length][grid[0].length];
    int islands = 0;
```

```
      for(int i=0;i<grid.length;i++){
         for(int j=0;j<grid[i].length;j++){
            if(!visited[i][j] && grid[i][j]=='1'){
               visit(grid,visited,i,j);
               islands++;
            }
         }
      }
      return islands;
   }
}
```

Q5.

```
class Solution {
   private int areaofIsland(int[][] grid,boolean[][]visited,int i, int j, int area){
      if(i < 0 || j < 0 || grid.length <= i || grid[i].length <= j || grid[i][j]==0 || visited[i][j]==true){
         return area;
      }
      visited[i][j] = true;
      return 1 + area + areaofIsland(grid,visited,i-1,j,area)
               + areaofIsland(grid,visited,i+1,j,area)
                + areaofIsland(grid,visited,i,j+1,area)
                + areaofIsland(grid,visited,i,j-1,area);
   }
  public int maxAreaOfIsland(int[][] grid) {
      boolean[][] visited = new boolean[grid.length][grid[0].length];
      int maxArea = 0;

      for(int i=0;i<grid.length;i++){
         for(int j=0;j<grid[i].length;j++){
            if(!visited[i][j] && grid[i][j]!=0){
               int area = areaofIsland(grid,visited,i,j,0);
               if(area > maxArea){
                  maxArea = area;
               }
            }
         }
      }
      return maxArea;
  }
}
```

Q6.

```
public class WordSearch {
   private static boolean backtrack(char[][] board, String word, int i,int j, int strIndex){
      if(strIndex >= word.length()) return true;

      if(i<0||j<0||i>=board.length||j>=board[i].length){
         return false;
      }
      if(board[i][j]!=word.charAt(strIndex)){
         return false;
      }

      char temp = board[i][j];
      board[i][j] = '*';
      if(
         backtrack(board,word,i+1,j,strIndex+1)||
         backtrack(board,word,i-1,j,strIndex+1)||
         backtrack(board,word,i,j+1,strIndex+1)||
         backtrack(board,word,i,j-1,strIndex+1)
      ){
         return true;
      };

      board[i][j] = temp;
      return false;
   }

   public static boolean exist(char[][] board, String word) {

      for(int i=0;i<board.length;i++){
         for(int j=0;j<board[i].length;j++){
            if(backtrack(board,word,i,j,0)){
               return true;
            }
         }
      }
      return false;
   }
}
```