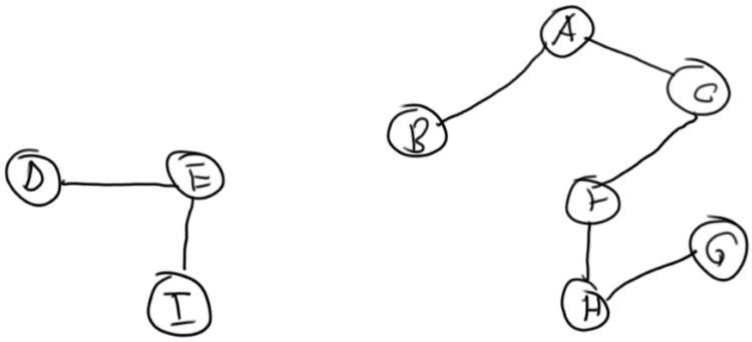
Answer of 1

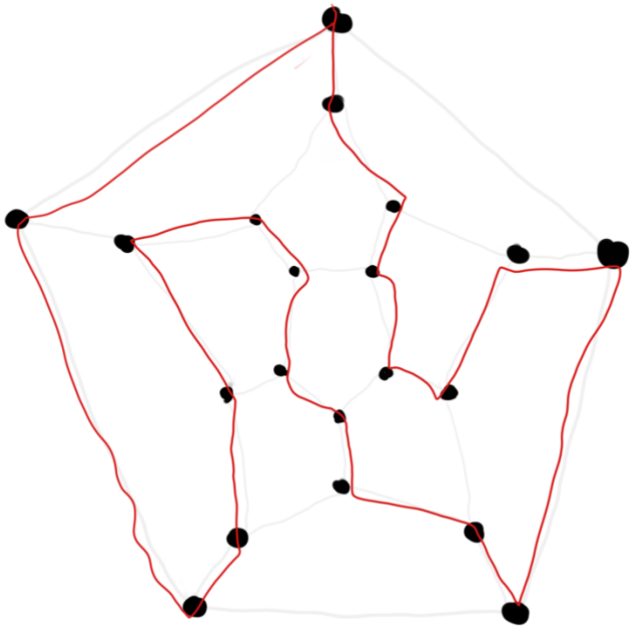
1 a) The graph is not connected. The connected components are {D,E,I} and {A,B,C,F,G,H}.
1 b) Spanning Tree/Forest of graph G is as follows:



1 c) No, G does not meet the criteria for being a Hamiltonian graph as there are two connected components. So, a cycle that goes through each vertices exactly once cannot be constructed due to disconnects.

1 d) No, a vertex cover of size 5 or less doesn't exist. As at least one vertex will not be covered if we try with size 5 or less. We'll need at least size 6.

Answer of 2



Answer of 3

$Algorithm$: $smallestVertexCover(V, E)$
$Input$: $V\ is\ a\ set\ of\ vertices, and\ E\ is\ the\ set\ of\ edges.$
$Output$: $A\ set\ of\ smallest\ vertex\ cover.$

$P \leftarrow powerSet(V)$

$minLength \leftarrow V.length + 1$
$minVertexCover \leftarrow null$

for $i \leftarrow 0\ to\ P.length\ do$
    $subset \leftarrow P[i]$

    $if\ isVertexCover(subset, E)\ then$
        $if\ minLength \geq subset.length\ then$
            $minLength \leftarrow subset.length$
            $minVertexCover \leftarrow subset$

$return\ minVertexCover$

$Algorithm: isVertexCover(V, E)$
$Input: V\ is\ a\ set\ of\ vertices, and\ E\ is\ the\ set\ of\ edges.$
$Output: True\ or\ False.$

$for\ i\ \leftarrow 0\ to\ E.length - 1\ do$
$\quad edge \leftarrow E[i]$
$\quad vertices \leftarrow computeEndpoints(edge)$

$\quad if\ not\ \big(\ belongsTo(vertices[0], V)\ or\ belongsTo(vertices[1], V)\big)\ then$
$\quad\quad return\ False$

$return\ True$

Answer of 4

```
class Solution {
    public int numIslands(char[][] grid) {
        boolean[][] visited = new boolean[grid.length][grid[0].length];
        int numberOfIslands = 0;

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

        return numberOfIslands;
    }

    private void dfs(char[][] grid, boolean[][] visited, int i, int j) {
        if (i < 0 || i >= grid.length || j < 0 || j >= grid[i].length ||
grid[i][j] == '0' || visited[i][j]) {
            return;
        }

        visited[i][j] = true;

        dfs(grid, visited, i - 1, j); // up
        dfs(grid, visited, i + 1, j); // down
        dfs(grid, visited, i, j - 1); // left
        dfs(grid, visited, i, j + 1); // right
    }
```

```
}
```

Answer of 5

```
class Solution {
    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 (grid[i][j] == 1 && !visited[i][j]) {
                    maxArea = Math.max(maxArea, dfs(grid, visited, i, j));
                }
            }
        }

        return maxArea;
    }

    private int dfs(int[][] grid, boolean[][] visited, int i, int j) {
        if (i < 0 || i >= grid.length || j < 0 || j >= grid[i].length ||
grid[i][j] == 0 || visited[i][j]) {
            return 0;
        }

        visited[i][j] = true;

        return 1 + dfs(grid, visited, i - 1, j) +
                   dfs(grid, visited, i + 1, j) +
                   dfs(grid, visited, i, j - 1) +
                   dfs(grid, visited, i, j + 1);
    }
}
```

Answer of 6

```
class Solution {
    public boolean exist(char[][] board, String word) {
        boolean[][] visited = new boolean[board.length][board[0].length];

        for (int i = 0; i < board.length; i++) {
            for (int j = 0; j < board[i].length; j++) {
                if (board[i][j] == word.charAt(0) && dfs(board, visited,
word, 0, i, j)) {
                    return true;
                }
            }
        }

        return false;
    }
```

```
    private boolean dfs(char[][] board, boolean[][] visited, String word, int
wordIndex, int i, int j) {
        if (i < 0 || i >= board.length || j < 0 || j >= board[i].length ||
            board[i][j] != word.charAt(wordIndex) || visited[i][j]) {
            return false;
        }

        if (wordIndex == word.length() - 1) {
            return true;
        }

        visited[i][j] = true;

        boolean result = dfs(board, visited, word, wordIndex + 1, i - 1, j)
||
                         dfs(board, visited, word, wordIndex + 1, i + 1, j)
||
                         dfs(board, visited, word, wordIndex + 1, i, j - 1)
||
                         dfs(board, visited, word, wordIndex + 1, i, j + 1);

        visited[i][j] = false;

        return result;
    }
}
```