Design and Analysis of Algorithms

Problem #1
Given a string s, find the length of the longest substring without repeating characters. Please explain the design, write the pseudo code and explain the complexity.

Problem #2
The input consists of a directed graph, encoded in the usual adjacency list representation, along with two distinguished vertices s and t. Design and analyze a linear time algorithm to decide whether or not there is a path from s to t that contains a cycle.

Problem #3
Please design your algorithm and explain the complexity.
Given a 2D board containing 'X' and 'O' (the letter O), capture all regions surrounded by 'X'.

A region is captured by flipping all 'O's into 'X's in that surrounded region.

Example:
X X X X
X O O X
X X O X
X O X X
X O X X

After running your function, the board should be:
X X X X
X X X X
X X X X
X X X X
X O X X