Programming Interview Questions

Problem 1) (Aziz) A number of apartment buildings are coming up on a new street. The postal service wants to place a single mailbox on the street. Their objective is to minimize the total distance that residents have to walk to collect their mail each day. (Different buildings may have different numbers of residents.) Devise an algorithm that computes where to place the mailbox so as to minimize the total distance that residents travel to get to the mailbox. Assume you are given two arrays D and R where D_i is the distance from the end of the street to building i and R_i is the number of residents in building i.

Problem 2) Suppose you have access to a uniform random number generator (it can generate random numbers u uniformly from the interval $[0, 1]$). Devise an algorithm to return a random variable distributed uniformly over the disk of radius r centered on the origin.

Problem 3)(CSES) You have n coins with positive integer values. Devise an algorithm to compute the smallest sum you cannot create using a subset of the coins.

Problem 4)(CSES) Given an $a \times b$ rectangle, your task is to cut it into squares. On each move, you can select a rectangle and cut it into two rectangles in such a way that all side lengths remain integers. Come up with an algorithm to compute the minimum number of moves required.

Problem 5)(CSES) You are given an array of n integers. You want to modify the array so that it is increasing, i.e., every element is at least as large as the previous element. On each move, you may increase the value of any element by one. Come up with an algorithm to compute the minimum number of moves required.

Problem 6) (Leetcode) You are given an integer array PRICES where PRICES$[i]$ is the price of a given stock on the i-th day. On each day, you may decide to buy and/or sell the stock. You can only hold at most one share of the stock at any time. However, you can buy it and then immediately sell it on the same day. Devise an algorithm that returns the maximum profit you can achieve.

Hints:

1. Try writing out the objective function as a function of mailbox location x. What happens as you vary x?
2. You can parameterize a circle with two parameters: the radius from the origin r, and the angle θ. What is the distribution of each of these parameters when sampling uniformly from a disk?
3. Starting with the smallest coins, try keeping track of the smallest coin you cannot make.