PROGRAMMING OLYMPIAD 2011

- This paper is for ALL candidates.
- Each correct answer earns 5 marks.
- You have 2 hours to attempt as many questions as possible.
- After that you may be given up to 30 minutes to print your results.
- Programs that produce 3 correct answers can earn additional marks for readability, conciseness, and for appropriate comments and variable names.

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1. Area

Alice is sick and tired of her maths homework. At the moment she is looking at the areas of rectangles and squares. Help Alice by writing a program that will read in the width and height of a shape and output whether the shape is a square or a rectangle and the area of the shape.

Example

Enter the width: 10
Enter the height: 15

The area of the Rectangle is 150

Test your program with:
(a) 3 7
(b) 100 100
(c) 14 3

2. Cross Country

Carl and his two friends have entered as a team for an upcoming cross country relay event. Each member may run only once, but may run as many laps as they like. Each lap a runner runs will take one minute more than the previous lap. Carl and his two friends each run their first laps in 3, 5 and 7 minutes respectively. Given the total number of laps to be run, what is the fastest time in which they can finish?

Example

Input the total laps: 9

Total running time is 50 minutes

Test your program with:
(a) 5
(b) 15
(c) 25

3. Frequency Sorting

Johan is an avid marbles collector and has recently bought a large number of new marbles. Johan likes his marbles sorted by colour, with the most common colours appearing before less common colours. Each marble's colour is represented by a lowercase letter from a to z.

Johan is afraid of losing his marbles if they are not sorted the way he likes them to be. Help him output his preferred order.

Example

Input the marbles: acccbdbabb

bbbbcccaad

Test your program with:
(a) abbcccddddeeeee
(b) ecdbadaccdabacc
(c) dfadccabbcdfdcfacedad

4. Teleportation

(Teleportation: moving from one place to another without transport – usually instantaneously – as if by magic)

Debra has recently acquired the ability to teleport to any place she can see. She has just found out that she is late for a meeting on the other side of town. She has decided to use her newly acquired ability to teleport from roof-top to roof-top in order to get there on time.

Find the minimum number of teleports Debra needs bearing in mind she has to see the top of each building to teleport there. Each building is adjacent to the previous one and each has the same width. Debra is currently located on the roof of the first building and needs to reach the roof of the last building.

Example

Input the number of buildings: 7
Input building heights: 1 5 3 7 2 5 2

The number of teleports is: 4

Test your program with:
(a) 5
1 2 4 8 16
(b) 10
3 3 6 11 13 6 9 2 29 8
(c) 20
1 15 9 7 11 7 4 25 3 17 12 31 13 33 100 120 2 150 200 500

5. Stacking Tiles

Stacking tiles against the wall is one of Bongani's favourite pasttimes. His tiles all have the same thickness, but vary in width and height. Bongani is given N tiles and has to use them in the sequence given according to a set of rules. He can place a tile on top of another only if it is narrower than the previously stacked tile. Bongani is allowed to rotate the tiles by 90 degrees so that width becomes height and height becomes width. He is also allowed to discard a tile altogether.

Given a list of tiles, help Bongani find the highest stack he can build

The example specifies tiles (3, 3), (12, 5), (5, 8), (6, 10). To get the highest stack Bongani ignores the first tile (3, 3) as it is smaller than the next tile. He uses the next tile (12, 5) with 12 as the width and 5 as the height. He uses the next two tiles with 8 as the width and 5 as the height followed by 6 as the width and 10 as the height.

Example

Input the number of tiles: 4
Input the tiles' width and heights: 3 3 12 5 5 8 6 10

The highest stack is 20
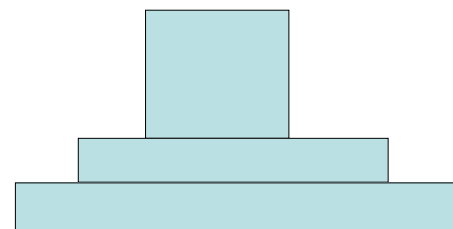
(Illustration is not to scale)

Test your program with:
(a) 5
1 4 17 7 7 6 15 19 12 13
(b) 7
10 15 10 19 13 9 9 19 8 18 14 17 12 7
(c) 10
9 10 13 18 13 12 1 18 16 8 11 17 8 19 3 15 2 12 1 4