Zonal Informatics Olympiad, 2026

Instructions to candidates

1. The question paper carries 80 marks, broken up into four problems of 20 marks each. Each problem has three Test Cases. If you solve all three Test Cases correctly, you get 20 marks for that problem. Otherwise, you get 5 marks for each Test Case that you solve correctly.
2. All the $4 \times 3 = 12$ Test Cases appear as separate Questions in the right panel ("Question Palette").
   The first three Questions correspond to the three Test Cases of Problem 1, the next three correspond to the three Test Cases of Problem 2 and so on.
   A question icon turning green in the Question Palette, does not mean that it is correct. It just denotes that you have attempted it. All the questions will be evaluated later.
3. Attempt all questions. There are no optional questions.
4. There are no negative marks.
5. All expected answers are integers. Type in only the integer. So, if your answer is "162", enter only "162". Not "0162", or "162.0", etc.
6. Remember to save each answer. Only your final saved answers will be considered.
7. Near the top-right corner, you should be able to see a calculator icon. Clicking it pops up a calculator which you may use.

1 Problem 1

You observed the night sky on N consecutive nights. On night i, you found that there were exactly A_i stars visible.

Due to peculiarities of the Solar System, it is known that every star is visible during a **continuous segment** of nights $[L, R]$ — i.e., every star has 2 integers L and R such that $1 \leq L \leq R \leq N$, and the star is visible on nights $L, L+1, L+2, \ldots, R$ only.

The input consists of N, the number of nights over which stars were observed, and $A = [A_1, A_2, \ldots, A_N]$, a sequence of N values where A_i denotes the number of stars observed on night i.

There could be many possible combinations of stars that lead to the same number of stars being observed each night. We are concerned with the total number of unique stars that were seen across those N nights.

Let m be the minimum and M be the maximum number of unique stars that you could have observed. Your task is to find the sum $m + M$.

For example, for the input $N = 2$, $A = [2, 2]$, the minimum m is 2, because it is possible that the same 2 stars are visible on both nights, while the maximum M is 4, because it is possible that 2 stars are visible on night 1 and 2 new stars are visible on night 2. Thus, the answer is $m + M = 2 + 4 = 6$.

(a) $N = 3$, $A = [2, 1, 2]$

(b) $N = 6$, $A = [1, 2, 3, 4, 2, 1]$

(c) $N = 12$, $A = [4, 1, 3, 5, 2, 2, 3, 1, 5, 6, 2, 1]$

2 Problem 2

We call an array $A = [A_1, A_2, \ldots, A_M]$ of M integers *good* if $A_i - A_{i-1} \leq K$ for all $1 < i \leq M$.

Given an array of integers A, C is said to be a subsequence of A if it is possible to delete some (possibly none) elements from A to form C, without changing the order of the remaining elements. For example, the non-empty subsequences of $[1, 1, 3]$ are $[1]$, $[1]$, $[3]$, $[1, 1]$, $[1, 3]$, $[1, 3]$ and $[1, 1, 3]$.

You are given a **non-decreasing** array A of N integers and the parameter K. Your task is to find the number of non-empty subsequences of A that are good. Notice that the same subsequence may arise multiple times in the array A. Each subsequence should be counted as many times as it appears in A.

For example, for the input $N = 3$, $K = 1$, $A = [1, 1, 3]$, there are 4 good non-empty subsequences, which are $[1]$, $[1]$, $[3]$ and $[1, 1]$.

(a) $N = 8$, $K = 0$, $A = [1, 1, 2, 3, 3, 3, 4, 4]$

(b) $N = 8$, $K = 4$, $A = [1, 2, 3, 4, 5, 6, 7, 8]$

(c) $N = 15$, $K = 9$, $A = [1, 1, 2, 3, 4, 4, 4, 5, 6, 8, 10, 10, 10, 11, 12, 14]$

3 Problem 3

Given a positive integer N, we say that an integer m is *good with respect to* N if it is possible to find a prime number p such that $(p \bmod N) = m$ — that is, the remainder when p is divided by N is m.

Recall that p is a prime number if it has exactly 2 distinct divisors, 1 and p. 1 is therefore not a prime number.

Given a positive integer N, your task is to find the sum of all m that are good with respect to N, for $0 \leq m < N$. To help you with the task, you are also given the prime decomposition of N.

For example, for the input $N = 4 = 2^2$, $m = 1, 2, 3$ are good with respect to 4, but $m = 0$ is not. We can find $p = 5$ for $m = 1$, $p = 2$ for $m = 2$ and $p = 3$ for $m = 3$. It is impossible to find a prime divisible by 4. Thus, the answer is $1 + 2 + 3 = 6$.

(a) $N = 12 = 2^2 \cdot 3$

(b) $N = 60 = 2^2 \cdot 3 \cdot 5$

(c) $N = 18900 = 2^2 \cdot 3^3 \cdot 5^2 \cdot 7$

4 Problem 4

The score of an array $B = [B_1, B_2, \ldots, B_M]$ of length M is defined as follows:

- Start with an array $C = [C_1, C_2, \ldots, C_M]$ of length M, with all values C_i initialized to 0.
- One operation consists of the following steps:
  - Choose 3 integers L, R, v such that $1 \leq L \leq R \leq M$ and $1 \leq v \leq 10^9$.
  - Set $C_i = \max(C_i, v)$ for all $L \leq i \leq R$.
- The score of B is defined to be the minimum number of operations needed to make C equal to B.

For example, the score of the array $[1, 2, 1]$ is 2 because we need 2 operations, as follows: first choose $L = 1$, $R = 3$, $v = 1$ to modify C from $[0, 0, 0]$ to $[1, 1, 1]$ and then choose $L = 2$, $R = 2$, $v = 2$ to modify C to $[1, 2, 1]$.

You are given an array A of N integers. Your task is to find the sum of scores of all its subarrays — i.e., find

$$\sum_{L=1}^{N} \sum_{R=L}^{N} score([A_L, A_{L+1}, A_{L+2}, \ldots, A_R])$$

For example, for the input $N = 2$, $A = [1, 1]$, there are 3 subarrays $[1]$, $[1]$ and $[1, 1]$, and each has a score of 1. Thus, the answer is $1 + 1 + 1 = 3$.

(a) $N = 6$, $A = [1, 2, 3, 3, 2, 1]$

(b) $N = 10$, $A = [1, 1, 2, 1, 2, 2, 1, 2, 1, 2]$

(c) $N = 20$, $A = [2, 3, 2, 4, 3, 3, 3, 4, 1, 2, 2, 1, 1, 1, 3, 1, 1, 6, 4, 4]$