Problem B - Roni (de Capa Vermelha)

Check our instructions page for detailed information on the qualification and the format of this problem.

Roni (with the Red Cape) has to visit her grandmother who lives at the end of a very long road of length N. Her mother, worried about her daughter, warns her for the 256th time to be careful along the way because Onis (creatures from Japanese mythology) are always lurking around.

The road has K traffic lights, each second showing one of two colors: green or red. The i-th traffic light is located X_i meters from the beginning of the road, and no two traffic lights are at the same distance from the start.

To confuse the Onis and help her daughter arrive safely at her grandmother's house, Roni's mother programmed the traffic lights to follow certain patterns.

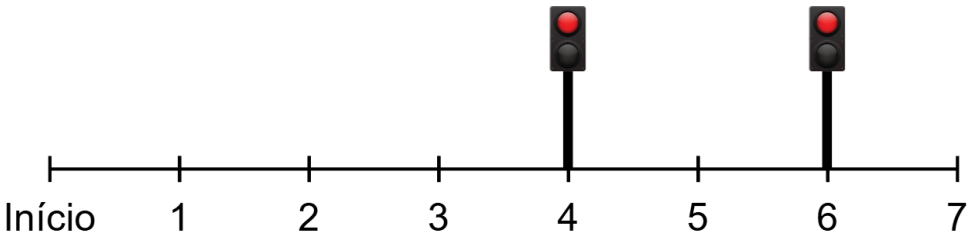
Part I

Initially, Roni's mother programmed the traffic lights so that the i-th traffic light, located at position X_i, turns green for exactly 1 second every X_i seconds. For instance, a traffic light at position 4 is red for 3 seconds, green for 1 second, red again for 3 seconds, etc. Determine the smallest number of seconds Roni's mother has to wait until all lights turn green simultaneously.

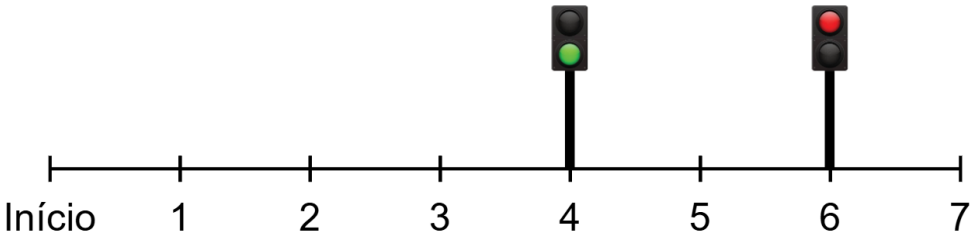
Example

Suppose $N = 7$ and $K = 2$, with traffic lights at positions $x_1 = 6$ and $x_2 = 4$.

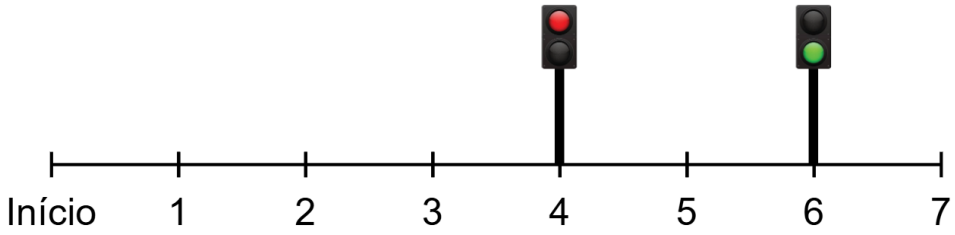
During the first 3 seconds, both traffic lights are red:



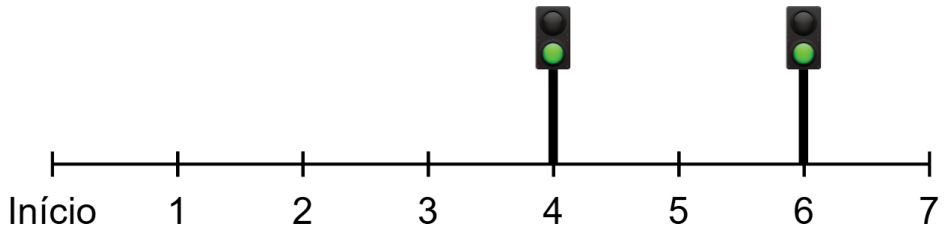
In the 4th second, the traffic light at position 4 turns green (the one at position 6 remains red):



In the 5th second, the traffic light at position 4 becomes red again (back to both red). Only in the 6th second does the light at position 6 turn green:



In the 7th second, both lights are red again; in the 8th second, only the first traffic light is green (similar to the 4th second). Finally, in the 12th second, both traffic lights are green simultaneously, making 12 the answer for this example.



Constraints

The following limits are guaranteed for all test cases of this Part:

$1 \leq \boldsymbol{N} \leq 40$ Length of the road
$1 \leq \boldsymbol{K} \leq 20$ Number of traffic lights

The test cases for this Part of the problem are organized into a single group.

Subtask	Points	Additional Constraints
1	20	$\boldsymbol{N}, \boldsymbol{K} \leq 10$
2	30	No additional restrictions

Part II

The Onis quickly discovered the original pattern, so Roni's mother devised a more complicated pattern for protection. This new pattern is a *string* S_i of length p_i consisting of letters '`m`' or '`d`' (reD or green). Each traffic light cyclically alternates colors every second according to the given pattern.

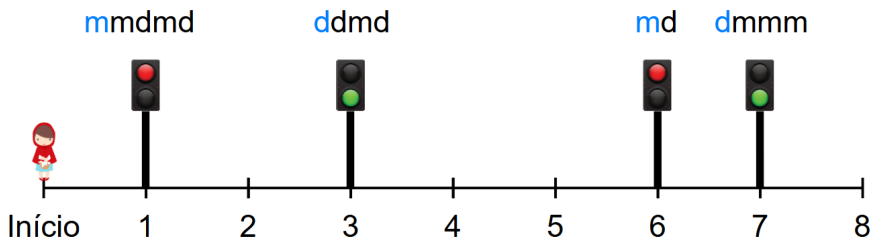
For example, pattern $S_i =$ `mmdmd` means the traffic light is red for 2 seconds, green for 1 second, red for another second, green for 1 second, red again for 2 seconds, and so on.

Roni travels from one end of the road to the other (from position 0 to N), passing each traffic light in increasing order of their positions. She strictly obeys the rules, only passing each traffic light when it's green. Roni takes exactly one second to travel one unit of distance. Traffic lights change color at integer seconds, and the new color is considered valid at these instants.

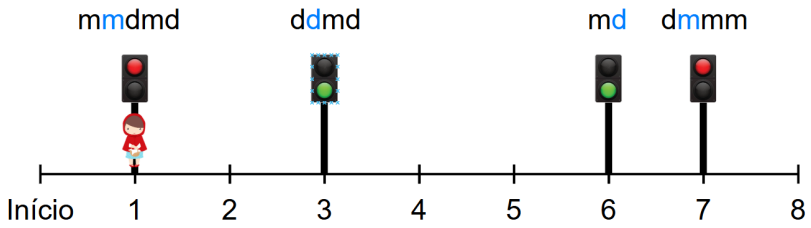
Determine the time Roni takes to travel the road safely.

Example

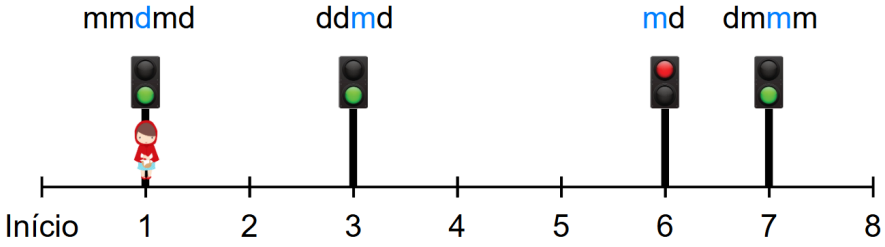
Consider a case with $N = 8$ and $K = 4$, with traffic lights and patterns as indicated below.



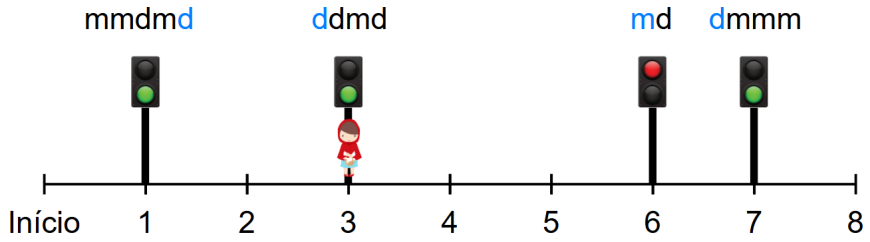
Roni starts traveling; 1 second later, at position 1, she encounters a red traffic light.



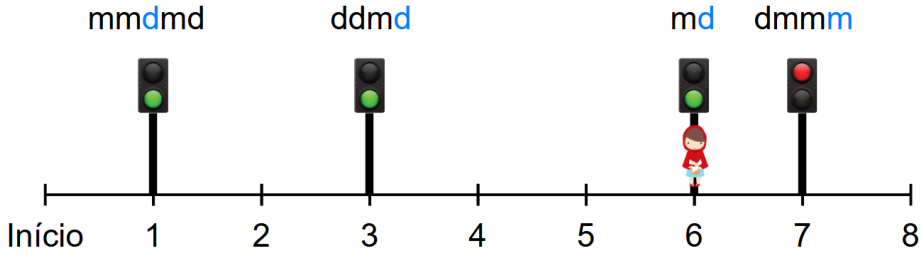
Roni waits 1 second until it turns green. At 2 seconds, she advances to the next traffic light.



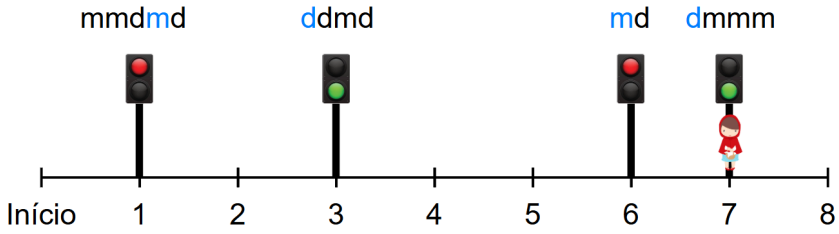
Roni spends 2 seconds traveling 2 units of length, arriving at position 3 (4 seconds since the start), encountering a green traffic light, allowing her to continue.



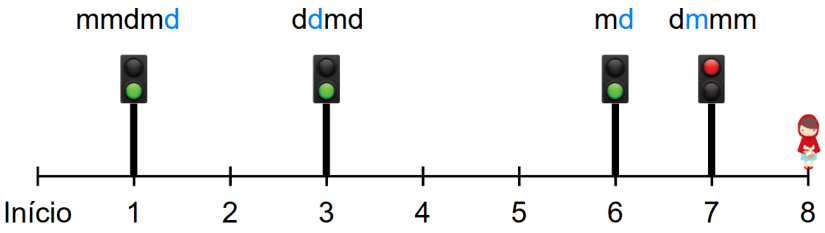
Three seconds later, at position 6 (7 seconds since the start), Roni finds another green traffic light, requiring no wait.



Moving one position forward, at 8 seconds, she finds the last green traffic light.



Finally, she travels one more unit (1 second), reaching her grandmother's house safely at 9 seconds.



Constraints

Guaranteed limits for Part II:

$1 \leq \boldsymbol{N} \leq 10^9$	Road length
$1 \leq \boldsymbol{K} \leq 10^5$	Number of traffic lights
$1 \leq \boldsymbol{p_1} + \boldsymbol{p_2} + \ldots + \boldsymbol{p_K} \leq 10^5$	Sum of the string lengths

The test cases for Part II are organized in three groups with different additional restrictions:

Subtask	Points	Additional Constraints
3	20	$\boldsymbol{N} \leq 10^5$
4	30	No additional restrictions

Input Format

The first line contains an integer $\boldsymbol{P}$, indicating the Part this test case represents (1 for Part I, 2 for Part II).

The second line contains two integers, $\boldsymbol{N}$ and $\boldsymbol{K}$, representing the length of the road and the number of traffic lights, respectively.

Part I

For Part I, the following $\boldsymbol{K}$ lines each contain a single integer $\boldsymbol{X_i}$, the position of the i-th traffic light.

The input format is as follows:

1
$\boldsymbol{N}$ $\boldsymbol{K}$
$\boldsymbol{X_1}$
...
$\boldsymbol{X_K}$

Part II

For Part II, the following $\boldsymbol{K}$ lines each contain an integer $\boldsymbol{X_i}$, the position of the i-th traffic light, followed by another integer $\boldsymbol{P_i}$, the length of the pattern for the i-th traffic light, followed by a *string* $\boldsymbol{S_i}$ (consisting of $\boldsymbol{P_i}$ characters, either `m` or `d`), representing the pattern of the i-th traffic light.

The input format is as follows:

2
$\boldsymbol{N}$ $\boldsymbol{K}$
$\boldsymbol{X_1}$ $\boldsymbol{P_1}$ $\boldsymbol{S_1}$
...
$\boldsymbol{X_K}$ $\boldsymbol{P_K}$ $\boldsymbol{S_K}$

Output Format

Part I

The output for Part I should contain a single line with an integer, the smallest number of seconds Roni's mother has to wait until all lights turn green simultaneously.

Part II

The output for Part II should contain a single line with an integer, the time Roni takes to travel the road.

Note: There should be no spaces at the end of each line (only a line break after the integer). If this format is not respected, the submission will result in `Presentation Error` (check the instructions for more information).

Note: The answer may exceed $2^{31} - 1$. Use `long long int` in `C/C++`, `long` in `Java`, or `Longint` in `Pascal`.

Example 1 Input

```
1
7 2
6
4
```

Example 1 Output

```
12
```

Example 1 Description

This example corresponds to the Part I example mentioned in the statement.

Example 2 Input

```
2
8 4
3 4 ddmd
6 2 md
7 4 dmmm
1 5 mmdmd
```

Example 2 Output

```
9
```

Example 2 Description

This example corresponds to the Part II example mentioned in the statement.