Round B 2022 - Kick Start 2022

Unlock the Padlock

PROBLEM	ANALYSIS

Problem

Imagine you have a padlock, which is a combination lock consisting of ${\bf N}$ dials, set initially to a random combination. The dials of the padlock are of size ${\bf D}$, which means that they can have values between 0 and ${\bf D}-1$, inclusive, and can be rotated upwards or downwards. They are also ordered from left to right, with the leftmost and rightmost dials at positions 1 and ${\bf N}$, respectively. The padlock can be unlocked by setting the values of all its dials to 0.

You can perform zero or more operations of this kind:

• Pick any range [l,r] such that $1 \le l \le r \le \mathbf{N}$ and rotate all the dials in [l,r] together, upwards or downwards. Rotating up increases the value of each dial in the range [l,r] by 1, and rotating down decreases its value by 1. Note that a dial with value $\mathbf{D}-1$ becomes 0 when increased (rotated up) and a dial with value 0 becomes $\mathbf{D}-1$ when decreased (rotated down).

The series of operations must satisfy the following condition:

• The range $[l_{i-1},r_{i-1}]$ chosen in the (i-1)-th operation needs to be completely contained within the range $[l_i,r_i]$ chosen in the i-th operation; that is, $l_i \leq l_{i-1} \leq r_{i-1} \leq r_i$. The initial range $([l_1,r_1])$ can be chosen arbitrarily.

Example of a valid sequence of operations to unlock a padlock with initial combination [1,1,2,2,3,3]:

- 1. Rotate range [5, 6] downwards.
- 2. Rotate range $\left[3,6\right]$ downwards.
- 3. Rotate range [1, 6] downwards.

The following are some operations that cannot be performed:

- 1. Rotating range [1,4] after [6,9], because [6,9] is not completely contained in [1,4] (does not satisfy $r_{i-1} \leq r_i$ where $r_{i-1} = 9$ and $r_i = 4$).
- 2. Rotating range [3, 6] after [2, 7].

The goal for you is to output the *minimum* number of valid operations needed to make all dials in the padlock set to 0.

Input

The first line of the input contains the number of test cases, T. T test cases follow.

Each test case consists of two lines.

The first line of each test case contains two integers N and D, representing the number of dials in the padlock and the size of the dials, respectively.

The second line of each test case contains N integers V_1, V_2, \ldots, V_N , where the i-th integer represents the value of the i-th dial in the initial combination of the padlock.

Output

For each test case, output one line containing Case #x:y, where x is the test case number (starting from 1) and y is the minimum number of operations needed to unlock the padlock as described in the statement.

Limits

Time limit: 30 seconds.

Memory limit: 1 GB.

 $1 < \mathbf{T} < 100.$

 $0 \leq \mathbf{V_i} \leq \mathbf{D} - 1$, for all i.

Test Set 1

 $1 \leq \mathbf{N} \leq 40$.

 $\mathbf{D}=2.$

Test Set 2

 $1 \le N \le 40$.

 $2 \le \mathbf{D} \le 10$.

Test Set 3

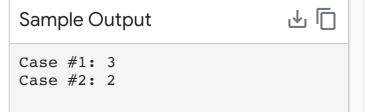
 $1 \le N \le 400$.

 $2 \leq \mathbf{D} \leq 10^9$.

Sample

Note: there are additional samples that are not run on submissions down below.





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6 2 0 1 0 0 1 1
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In Sample Case #1, the minimum number of operations needed to unlock the padlock is 3. We can unlock it using the following operations:

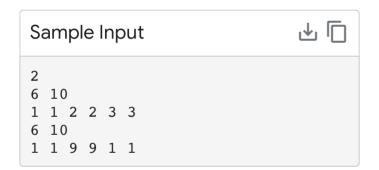
- 1. Rotate range [4, 4] downwards.
- 2. Rotate range [3, 5] downwards.
- 3. Rotate range [1, 6] downwards.

In Sample Case #2, the minimum number of operations needed to unlock the padlock is 2. We can unlock it using the following operations:

- 1. Rotate range [3, 4] upwards.
- 2. Rotate range [2, 6] downwards.

Additional Sample - Test Set 2

The following additional sample fits the limits of Test Set 2. It will not be run against your submitted solutions.





In Sample Case #1, the minimum number of operations needed to unlock the padlock is 3. We can unlock it using the following operations:

- 1. Rotate range $\left[5,6\right]$ downwards.
- 2. Rotate range $\left[3,6\right]$ downwards.
- 3. Rotate range [1, 6] downwards.

In Sample Case #2, the minimum number of operations needed to unlock the padlock is 3. We can unlock it using the following operations:

- 1. Rotate range [3,4] upwards.
- 2. Rotate range [3, 4] upwards.
- 3. Rotate range [1,6] downwards.