

## D. Needle in a Numstack

time limit per test: 3 seconds  
memory limit per test: 256 megabytes

*This is an interactive problem.*

You found the numbers  $k$  and  $n$  in the attic, but lost two arrays  $A$  and  $B$ .

You remember that:

- $|A| + |B| = n$ , the total length of the arrays is  $n$ .
- $|A| \geq k$  and  $|B| \geq k$ , the length of each array is at least  $k$ .
- The arrays consist only of numbers from 1 to  $k$ .
- If you take any  $k$  consecutive elements from array  $A$ , they will all be different. Also, if you take any  $k$  consecutive elements from array  $B$ , they will all be different.

Fortunately, a kind spirit that settled in the attic found these arrays and concatenated them into an array  $C$  of length  $n$ . That is, the elements of array  $A$  were first written into array  $C$ , followed by the elements of array  $B$ .

You can ask the kind spirit up to 250 questions. Each question contains an index  $i$  ( $1 \leq i \leq n$ ). In response, you will receive the  $i$ -th element of the concatenated array  $C$ .

You need to find the lengths of arrays  $A$  and  $B$ , or report that it is impossible to determine them uniquely.

### Input

Each test contains multiple test cases. The first line contains the number of test cases  $t$  ( $1 \leq t \leq 300$ ). The description of the test cases follows.

The only line of each test case contains two integers  $n$  and  $k$  ( $1 \leq k \leq 50$ ,  $2k \leq n \leq 10^6$ ).

Note that the sum of  $n$  across test cases is **not limited**.

### Interaction

The interaction for each test case begins with reading the integer  $n$ .

Then you can make up to 250 queries.

To make a query, output a string in the format " $? \ x$ " (without quotes) ( $1 \leq x \leq n$ ). After each query, read an integer — the answer to your query.

If you make too many queries, you will receive a verdict of `Wrong answer`.

To report your answer, output a string in the format " $! \ a \ b$ " (without quotes), where  $a$  and  $b$  are the lengths of arrays  $A$  and  $B$  that you found, respectively. The answer is not counted when counting the number of queries.

If it is impossible to determine the lengths of the arrays uniquely, output " $! \ -1$ " (without quotes). Note that if you answer  $-1$  while there is a sequence of at most 250 queries that uniquely determines the lengths of arrays, you will get a `Wrong answer` verdict.

It is guaranteed that there are arrays  $A$  and  $B$  that do not contradict the statement, for which the interactor output is correct.

The interactor is **not** adaptive, which means that the answer is known before the participant makes queries and does not depend on the queries made by the participant.

If your program makes more than 250 queries, your program should immediately terminate to receive the verdict `Wrong answer`. Otherwise, you can get an arbitrary verdict because your solution will continue to read from a closed stream.

After outputting a query, do not forget to output a newline and flush the output buffer. Otherwise, you will receive a verdict of `IL` (Idleness limit exceeded). To flush the buffer, use:

### Codeforces Round 1022 (Div. 2)

Finished

Practice



### → Virtual participation

Virtual contest is a way to take part in past contest, as close as possible to participation on time. It is supported only ICPC mode for virtual contests. If you've seen these problems, a virtual contest is not for you - solve these problems in the archive. If you just want to solve some problem from a contest, a virtual contest is not for you - solve this problem in the archive. Never use someone else's code, read the tutorials or communicate with other person during a virtual contest.

Start virtual contest

### → Clone Contest to Mashup

You can clone this contest to a mashup.

Clone Contest

### → Submit?

Language: GNU G++23 14.2 (64 bit, ms)

Choose file:  No file chosen

Submit

### → Last submissions

Submission	Time	Verdict
<a href="#">321862762</a>	May/29/2025 07:47	Accepted

### → Problem tags

binary search brute force implementation interactive \*2200

No tag edit access

### → Contest materials

- Announcement
- Tutorial

- `fflush(stdout)` or `cout.flush()` in C++;
- `System.out.flush()` in Java;
- `flush(output)` in Pascal;
- `stdout.flush()` in Python;
- see the documentation for other languages.

Hacks

Hacks are disabled for this problem.

Example

input

Copy

```
6
5 2

1
2
2
18 4
2
4
1
1
4
3 1
10 5
9 3
3
3
2
12 4
1
3
1
3
1
3
```

output

Copy

```
? 1
? 2
? 3
! 2 3
? 9
? 13
? 10
? 14
? 6
! 9 9
! -1
! 5 5
```

?	3
?	6
?	9
!	6 3
?	1
?	2
?	5
?	6
?	9
?	10
!	-1

Note

Consider the first example. We queried the first 3 elements out of 5. Now we know that the array *C* looks like [1, 2, 2, ?, ?]. We know for sure that the third element is not from array *A* — because according to the condition, any *k* consecutive elements (in our case *k* = 2) in array *A* are different. Thus, the third element is definitely located in array *B*. This means that the length of array *A* is 2, and the length of array *B* is 3.

The picture shows arrays from all test cases. The elements whose values were requested are marked in yellow.

In the first test case, the array C looks like:

1	2	2	1	2
---	---	---	---	---

There is only one way to split it into correct A and B:

1	2	2	1	2
---	---	---	---	---

Therefore, the answer: 2 3

In the second test case, the array C looks like:

2	4	3	1	2	4	3	1	2	1	3	2	4	1	3	2	4	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

There is only one way to split it into correct A and B:

2	4	3	1	2	4	3	1	2	1	3	2	4	1	3	2	4	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Therefore, the answer: 9 9

In the third test case, the array C looks like:

1	1	1
---	---	---

There are two ways to split it into correct A and B:

1	1	1
---	---	---

or

1	1	1
---	---	---

Therefore, the answer: -1. We cannot definitively determine which of these ways is correct.

In the fourth test case, the array C looks like:

1	2	3	4	5	1	2	3	4	5
---	---	---	---	---	---	---	---	---	---

There is only one way to split it into correct A and B:

1	2	3	4	5	1	2	3	4	5
---	---	---	---	---	---	---	---	---	---

Therefore, the answer: 5 5. Note that the answer is the only one because the length of arrays A and B must be at least k by statements.

In the fifth test case, the array C looks like:

1	2	3	1	2	3	1	3	2
---	---	---	---	---	---	---	---	---

There is only one way to split it into correct A and B:

1	2	3	1	2	3	1	3	2
---	---	---	---	---	---	---	---	---

Therefore, the answer: 6 3. Note that the answer is the only one because the length of array B must be at least k by statements.

In the sixth test case, the array C looks like:

1	3	2	4	1	3	4	2	1	3	4	2
---	---	---	---	---	---	---	---	---	---	---	---

There are three ways to split it into correct A and B:

1	3	2	4	1	3	4	2	1	3	4	2
---	---	---	---	---	---	---	---	---	---	---	---

or

1	3	2	4	1	3	4	2	1	3	4	2
---	---	---	---	---	---	---	---	---	---	---	---

or

1	3	2	4	1	3	4	2	1	3	4	2
---	---	---	---	---	---	---	---	---	---	---	---

Therefore, the answer: -1. We cannot definitively determine which of these ways is correct.

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