Handshakes

This is interactive problem!

You have entered the terrifying field of the Squid Game, where there are N participants aiming to win. Each participant is numbered from 1 to N. Among them is your closest friend, but his number is hidden. To save your friend, you must identify his number in a game called "handshakes", watched over by masked Guard.

Game Rules

The participants stand on an infinite line, where each position has a defined location. Participant number i starts at position i. The Guard announces a number D, which will be the step size during the game. Each participant is given a card marked either "L" or "R". Then, the following process is repeated 10^{100} times:

1. **Movement:** All participants move simultaneously based on their card:

   - A participant with an "L" card at position p moves D steps to the left to position $p - D$.
   - A participant with an "R" card moves D steps to the right to position $p + D$.
   - The line is infinite, so participants can move to any (positive or negative) position without restriction.

2. **Handshake:** After the movement, participants who land on the same position will shake hands and **swap** their cards with each other.

Your Task

Your friend is one of the participants, and your job is to identify his number and ensure their survival. The impatient and cold Guard only allows you to make query - assign the cards for each participant and start a game. After 10^{100} rounds, the Guard tells you how many times your friend did handshake during the process. By carefully choosing the card sequence and analyzing the Guard's answers, you must determine your friend's number in as few queries as possible. The Guard only allows **up to Z queries**, otherwise you will be executed. (Note: submitting the final answer does **not** count as a query.)

Communication

The first line of input contains one integer T — the number of test cases.

Each test case proceeds as follows:

- First, read two integers N and D — the number of participants and the step size.

- Then, you can send queries in the format "? S" (without quotes), where S is a string of length N representing the cards given to each participant. The i-th character in S is the card of participant i.

- The jury responds with a single integer K — the number of times your friend shook hands during the process based on your card assignment.

- Once you are ready to submit your answer, print "! X", where X is your guess for your friend's number.

If you receive -1 as a response at any point, you must immediately terminate your program to avoid a wrong verdict.

To ensure correct communication with the interactive judge, **flush the output buffer after making every printing**:

- In C/C++: use `fflush(stdout)` or `cout.flush()`
- In Python: use `sys.stdout.flush()`

Constraints

- $1 \leq T \leq 100$
- $6 \leq N \leq 1500$
- $1 \leq D$
- $6D \leq N$
- $10 \leq Z \leq 20$

Subtasks

1. (6 points) The answer is either 1 or N; $Z = 20$
2. (13 points) $N \leq 15$; $Z = 20$
3. (42 points) $Z = 20$
4. (12 points) $Z = 15$
5. (13 points) $Z = 11$
6. (14 points) $Z = 10$

Example

Example 1

User	Jury	Explanation
	1	$T = 1$
	6 1	$N = 6$ and $D = 1$
? RRRLLL		First query
	5	Handshakes of your friend in first game
? LRRLRL		Second query
	3	Handshakes of your friend in second game
! 3		Final guess

- Initially, $T = 1$, $N = 6$, $D = 1$.
- The hidden participant's id is 3.
- The user sends the query "RRRLLL". For this initial configuration, the friend shakes hands 5 times in total.
- The next query is "LRRLRL" — this time, 3 handshakes occur.
- The user submits "! 3" — the correct answer.

Attention: this example is not first test of task. You can find first test inside attachment.