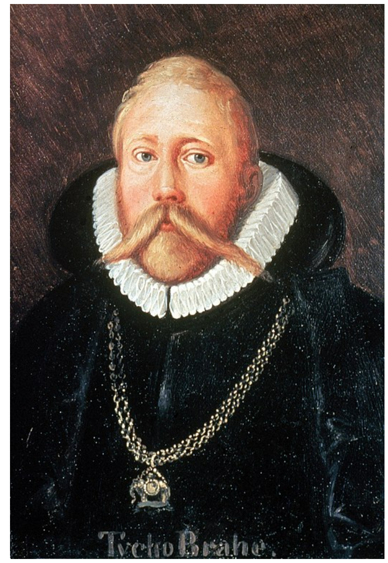
Astronomer
Problem ID: astronomer



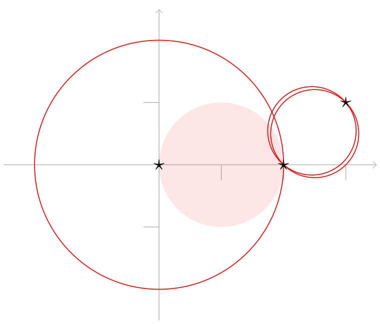
The astronomer has a passion for stargazing. In particular, he gets immense pleasure out of gazing at k stars simultaneously through his telescope. Building a telescope with radius r costs $t \cdot r$ kroner. A newly built telescope will point exactly at the origin $(0, 0)$. Moving it to point somewhere else also takes effort; shifting the telescope a distance of d units incurs a cost of $s \cdot d$ kroner. The astronomer can observe all stars at distance at most r from where the telescope points.

How much does it cost to build and move a telescope that allows k stars to be observed at once?

All coordinates and distances are given in the Euclidean plane.

Example

Here is an example with $n = 3$ stars at positions $(0, 0)$, $(2, 0)$, and $(3, 1)$. The shaded area shows a telescope of radius 1 pointing at $(1, 0)$ covering two stars; this costs $s + t$ kroner and is an optimal solution to sample input 3. The image also shows optimal solutions to sample inputs 1, 2, and 4.



Input

The first line consists of four integers: the number k of stars the astronomer wants to observe, the number n of stars in tonight's sky, the shifting cost s, and the telescope building cost t. Then follow n lines, where the ith line contains the integer coordinates x_i and y_i of the ith star.

Output

A single real number: the minimum number of kroner that the astronomer needs to spend.

Constraints and Scoring

You can assume

1. $1 \le k \le n \le 700$.
2. $x_i, y_i \in \{-10^9, \ldots, 10^9\}$ for all $i \in \{1, \ldots, n\}$.
3. $s, t \in \{0, \ldots, 10^9\}$.
4. Your output is accepted if it is within a relative or absolute tolerance of $\epsilon = 10^{-6}$ of the correct answer.

Your solution will be tested on a set of test groups, each worth a number of points. Each test group contains a set of test cases. To get the points for a test group you need to solve all test cases in the test group. Your final score will be the maximum score of a single submission.

Group	Points	Constraints
1	8	$t \le s$
2	9	$n \le 50$ and $s = 0$
3	18	$s = 0$
4	13	$n \le 50$
5	14	$n \le 350$
6	15	$\epsilon = 1/10$
7	23	*No further constraints*

Sample Input 1

```
2 3 1000 500
0 0
2 0
3 1
```

Sample Output 1

```
1000.0
```

Sample Input 2

```
2 3 500 3000
0 0
2 0
3 1
```

Sample Output 2

```
3387.277541898787
```

Sample Input 3

```
2 3 250 750
0 0
2 0
3 1
```

Sample Output 3

```
1000.0
```

Sample Input 4

```
2 3 0 500
0 0
2 0
3 1
```

Sample Output 4

```
353.5533905932738
```

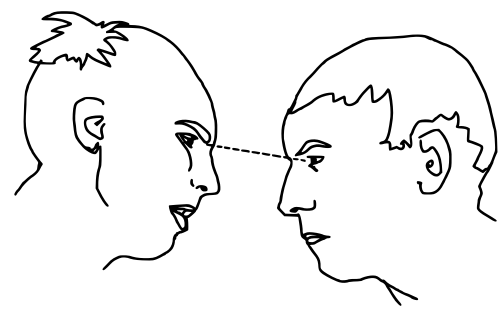
Sample Input 5

```
3 4 0 10
0 0
10 0
5 10
5 5
```

Sample Output 5

```
50.0
```

Staring Contest
Problem ID: staringcontest



A staring contest is a classical battle of imperturbability in which two people stare into each other's eyes while maintaining a facial expression of assured serenity. The goal is to maintain eye contact for longer than your opponent. The contest ends when one participant breaks composure, typically by looking away, smiling, speaking, or giggling.

As a coach of the national staring contest you need to determine the imperturbability of each of your team's n members for the upcoming world finals. The ith athlete can maintain eye contact for exactly a_i seconds, but these values are unknown to you in the beginning. For instance, you could have a team of $n = 3$ members:

i	Name	a_i
1	Anna	431
2	Esther	623
3	Tony	121

When athletes i and j compete, the confrontation lasts exactly $\min(a_i, a_j)$ seconds, at which moment the weaker contestant breaks composure and both contestants start smiling and giggling within a fraction of a second. For instance, if Anna competes against Esther, the contest lasts for 431 seconds. Importantly, to an outside observer the actual *winner* of the confrontation (in this case, Esther) is impossible to determine, only the *duration* of the contest is measurable.

Your goal is to estimate the values $a_1, \ldots, a_n$ using as few staring contests as possible. Clearly, the strength of the strongest athlete can never be determined, so you are allowed to underestimate one of the a_i.

Interaction

This is an interactive problem. The interaction begins with you reading a single line containing the integer n. You may then ask queries of the form "? i j" such that $1 \le i \le n$ and $1 \le j \le n$ and $i \ne j$. The response to a query is a single integer: the value $\min(a_i, a_j)$. The interaction ends with you printing a single line consisting of ! followed by n estimates in the form of integers $b_1, \ldots, b_n$, separated by spaces. This must be your final line of output.

Your submission is correct if $b_i = a_i$ for every contestant i except one, which you may underestimate. To be precise, we require $b_i \le a_i$ for all $1 \le i \le n$ and allow $b_k \ne a_k$ for at most one k.

The interactor is *non-adaptive*, meaning that the $a_1, \ldots, a_n$ are determined before the interaction begins.

Constraints and Scoring

The number n of athletes satisfies $2 \le n \le 1500$. The imperturbability a_i of each athlete satisfies $1 \le a_i \le 86\,400$, they are all different. You can use at most 3000 queries; your final line of output, *i.e.*, the line starting with !, is not counted as a query.

Your solution will be tested on a set of test groups, each worth a number of points. Each test group contains a set of test cases. To get the points for a test group you need to solve all test cases in the test group. Your final score will be the maximum score of a single submission.

For group 3, your score is the minimum score among all test cases in the group. The score for each test case depends on the number of queries you use; fewer queries are better: Suppose you use q queries. If $q \le n + 25$, then you get the full 80 points. If $q > 3000$, then you get no points. Otherwise, you get $118.2 - 12 \cdot \ln(q - n)$ points, rounded to the nearest integer. For instance, for $n = 1500$ and $q = 3000$, you get 30 points.

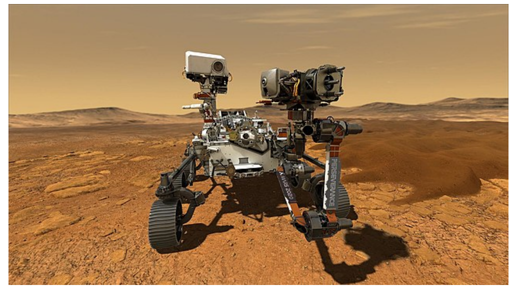
Group	Points	Constraints
1	9	$n \le 50$
2	11	$n \le 1000$
3	0–80	$1000 < n \le 1500$

Explanation of sample interactions

Sample interaction 1 shows a possible interaction using the above example. Note that Anna's and Tony's strengths are correctly determined. (Esther's can never be determined.)

Read	Sample Interaction 1	Write
`3`		
		`? 1 2`
`431`		
		`? 1 3`
`121`		
		`? 3 2`
`121`		
		`! 431 431 121`

Tycho
Problem ID: tycho



The planetary exploration vehicle *Tycho VIII* needs to get back to the home base after collecting mineral samples. Tycho travels in a straight line from position 0 to the home base at position b. While moving, it advances at a slow but steady pace of 1 unit per second. Every second, Tycho takes 1 unit of environmental damage from the harsh planetary conditions.

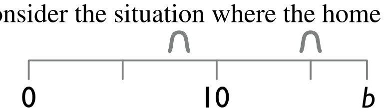
The situation is made even worse by radiation from a nearby pulsar, which adds d additional units of damage every p seconds. However, the radiation damage can be avoided by seeking shelter in one of n different hiding spots—caves, vegetation, large rocks, carcasses of the planet's megafauna—along the way. Tycho can choose to stand still at any point for any integer number of seconds.

The starting position 0 and the home base at b are both sheltered, so Tycho takes no radiation damage there.

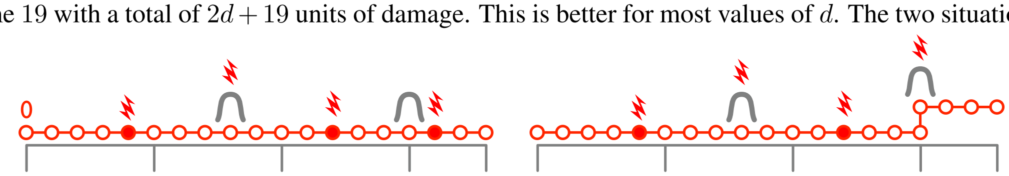
What is the minumum damage Tycho will take on its journey back to the home base?

Example

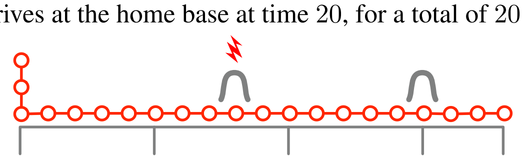
Consider the situation where the home base is at position 18 and there are shelters at positions 8 and 15.



Assume that the pulsar's period is 4, so unsheltered Tycho would take damage at times 4, 8, 12, etc. If Tycho leaves from the starting position (where it's sheltered) at time 0, it can reach the first shelter after 8 seconds, incurring radiation damage d at time 4 (but none at time 8 because it's sheltered then). Continuing without stopping, it reaches the home base at time 18, incurring $d + d$ more units of radiation damage (at times 12 and 16, respectively). This way it incurs $d + d + d = 3d$ units of radiation damage and 18 units of environmental damage. If instead Tycho waits at the 2nd shelter (at position 15) for 1 second, the pulse at time 16 causes it no damage, and it reaches the home base at time 19 with a total of $2d + 19$ units of damage. This is better for most values of d. The two situations are shown here:



If the pulsar's period is 10, Tycho can wait at the starting position for 2 seconds and then just go home without stopping at any shelter. Thus it passes the 1st shelter (at position 8) at just the right moment when the pulsar flares and arrives at the home base at time 20, for a total of 20 environmental damage and no radiation damage at all.



Input

The first line consists of four integers b, p, d, and n, separated by single spaces: the location b of the home base, the pulsar's flare period p, the additional radiation damage d caused by each flare of the pulsar, the number n of the shelters. The following n lines each contain an integer giving the shelter locations $a_1, \ldots, a_n$, with $0 < a_1 < \cdots < a_n < b$.

Output

Print a single integer: the minimum amount of damage Tycho must take to reach b.

Constraints and Scoring

You can assume $p < b$ and $n < b$. We always have $1 \le b \le 10^{12}$, $0 \le d \le 10^6$, and $0 \le n \le 10^5$.

Your solution will be tested on a set of test groups, each worth a number of points. Each test group contains a set of test cases. To get the points for a test group you need to solve all test cases in the test group. Your final score will be the maximum score of a single submission.

Group	Points	Constraints
1	8	$p \le 10^6$ and Tycho does not need to wait *after* leaving position 0.*
2	5	$b \le 1000$, $p \le 100$, $n \le 10$
3	7	$b \le 1000$
4	15	$p \le 10^6$, $n \le 1000$
5	20	$p \le 100$
6	35	$p \le 10^6$
7	10	*No additional constraints*

* In test group 1, Tycho may still need to wait at position 0 *before* it starts moving. For example, sample inputs 2, 3, and 4 belong to test group 1.

Sample Input 1

```
18 4 5 2
8
15
```

Sample Output 1

```
29
```

Sample Input 2

```
18 4 0 2
8
15
```

Sample Output 2

```
18
```

Sample Input 3

```
18 10 100 2
8
15
```

Sample Output 3

```
20
```

Sample Input 4

```
18 4 100 0
```

Sample Output 4

```
418
```

Sample Input 5

```
65 20 100 3
14
25
33
```

Sample Output 5

```
172
```