Codeforces Round #614 (Div. 2)

A. ConneR and the A.R.C. Markland-N

1 second, 256 megabytes

Sakuzyo - Imprinting

A.R.C. Markland-N is a tall building with n floors numbered from 1 to n. Between each two adjacent floors in the building, there is a staircase connecting them.

It's lunchtime for our sensei Colin "ConneR" Neumann Jr, and he's planning for a location to enjoy his meal.

ConneR's office is at floor s of the building. On each floor (including floor s, of course), there is a restaurant offering meals. However, due to renovations being in progress, k of the restaurants are currently closed, and as a result, ConneR can't enjoy his lunch there.

CooneR wants to reach a restaurant as quickly as possible to save time. What is the minimum number of staircases he needs to walk to reach a closest currently open restaurant.

Please answer him quickly, and you might earn his praise and even enjoy the lunch with him in the elegant Neumanns' way!

Input

The first line contains one integer t $(1 \le t \le 1000)$ — the number of test cases in the test. Then the descriptions of t test cases follow.

The first line of a test case contains three integers n, s and k ($2 \le n \le 10^9$, $1 \le s \le n$, $1 \le k \le \min(n-1, 1000)$) — respectively the number of floors of A.R.C. Markland-N, the floor where ConneR is in, and the number of closed restaurants.

The second line of a test case contains k distinct integers $a_1, a_2, \ldots, a_k$ ($1 \le a_i \le n$) — the floor numbers of the currently closed restaurants.

It is guaranteed that the sum of k over all test cases does not exceed 1000.

Output

For each test case print a single integer — the minimum number of staircases required for ConneR to walk from the floor s to a floor with an open restaurant.

input

```
5
5 2 3
1 2 3
4 3 3
4 1 2
10 2 6
1 2 3 4 5 7
2 1 1
2
100 76 8
76 75 36 67 41 74 10 77
```

output

```
2
0
4
0
2
```

In the first example test case, the nearest floor with an open restaurant would be the floor 4.

In the second example test case, the floor with ConneR's office still has an open restaurant, so Sensei won't have to go anywhere.

In the third example test case, the closest open restaurant is on the 6-th floor.

B. JOE is on TV!

1 second, 256 megabytes

3R2 - Standby for Action

Our dear Cafe's owner, JOE Miller, will soon take part in a new game TV-show "1 vs. n"!

The game goes in rounds, where in each round the host asks JOE and his opponents a common question. All participants failing to answer are eliminated. The show ends when only JOE remains (we assume that JOE never answers a question wrong!).

For each question JOE answers, if there are s $(s > 0)$ opponents remaining and t $(0 \le t \le s)$ of them make a mistake on it, JOE receives $\frac{t}{s}$ dollars, and consequently there will be $s - t$ opponents left for the next question.

JOE wonders what is the maximum possible reward he can receive in the best possible scenario. Yet he has little time before show starts, so can you help him answering it instead?

Input

The first and single line contains a single integer n $(1 \le n \le 10^5)$, denoting the number of JOE's opponents in the show.

Output

Print a number denoting the maximum prize (in dollars) JOE could have.

Your answer will be considered correct if it's absolute or relative error won't exceed 10^{-4}. In other words, if your answer is a and the jury answer is b, then it must hold that $\frac{|a-b|}{max(1,b)} \le 10^{-4}$.

input

```
1
```

output

```
1.000000000000
```

input

```
2
```

output

```
1.500000000000
```

In the second example, the best scenario would be: one contestant fails at the first question, the other fails at the next one. The total reward will be $\frac{1}{2} + \frac{1}{1} = 1.5$ dollars.

C. NEKO's Maze Game

1.5 seconds, 256 megabytes

3R2 as DJ Mashiro - Happiness Breeze
Ice - DJ Mashiro is dead or alive

NEKO#ΦωΦ has just got a new maze game on her PC!

The game's main puzzle is a maze, in the forms of a $2 \times n$ rectangle grid. NEKO's task is to lead a Nekomimi girl from cell $(1, 1)$ to the gate at $(2, n)$ and escape the maze. The girl can only move between cells sharing a common side.

However, at some moments during the game, some cells may change their state: either from normal ground to lava (which forbids movement into that cell), or vice versa (which makes that cell passable again). Initially all cells are of the ground type.

After hours of streaming, NEKO finally figured out there are only q such moments: the i-th moment toggles the state of cell (r_i, c_i) (either from ground to lava or vice versa).

Knowing this, NEKO wonders, after each of the q moments, whether it is still possible to move from cell $(1, 1)$ to cell $(2, n)$ without going through any lava cells.

Although NEKO is a great streamer and gamer, she still can't get through quizzes and problems requiring large amount of Brain Power. Can you help her?

Input

The first line contains integers n, q ($2 \le n \le 10^5$, $1 \le q \le 10^5$).

The i-th of q following lines contains two integers r_i, c_i ($1 \le r_i \le 2$, $1 \le c_i \le n$), denoting the coordinates of the cell to be flipped at the i-th moment.

It is guaranteed that cells $(1, 1)$ and $(2, n)$ never appear in the query list.

Output

For each moment, if it is possible to travel from cell $(1, 1)$ to cell $(2, n)$, print "Yes", otherwise print "No". There should be exactly q answers, one after every update.

You can print the words in any case (either lowercase, uppercase or mixed).

input
```
5 5
2 3
1 4
2 4
2 3
1 4
```
output
```
Yes
No
No
No
Yes
```

We'll crack down the example test here:

- After the first query, the girl still able to reach the goal. One of the shortest path ways should be: $(1, 1) \to (1, 2) \to (1, 3) \to (1, 4) \to (1, 5) \to (2, 5)$.
- After the second query, it's impossible to move to the goal, since the farthest cell she could reach is $(1, 3)$.
- After the fourth query, the $(2, 3)$ is not blocked, but now all the 4-th column is blocked, so she still can't reach the goal.
- After the fifth query, the column barrier has been lifted, thus she can go to the final goal again.

D. Aroma's Search

1 second, 256 megabytes

THE SxPLAY & KIVΛ - 漂流
KIVΛ & Nikki Simmons - Perspectives

With a new body, our idol Aroma White (or should we call her Kaori Minamiya?) begins to uncover her lost past through the OS space.

The space can be considered a 2D plane, with an infinite number of data nodes, indexed from 0, with their coordinates defined as follows:

- The coordinates of the 0-th node is (x_0, y_0)
- For $i > 0$, the coordinates of i-th node is $(a_x \cdot x_{i-1} + b_x, a_y \cdot y_{i-1} + b_y)$

Initially Aroma stands at the point (x_s, y_s). She can stay in OS space for at most t seconds, because after this time she has to warp back to the real world. She **doesn't** need to return to the entry point (x_s, y_s) to warp home.

While within the OS space, Aroma can do the following actions:

- From the point (x, y), Aroma can move to one of the following points: $(x - 1, y)$, $(x + 1, y)$, $(x, y - 1)$ or $(x, y + 1)$. This action requires 1 second.
- If there is a data node at where Aroma is staying, she can collect it. We can assume this action costs 0 seconds. Of course, each data node can be collected at most once.

Aroma wants to collect as many data as possible before warping back. Can you help her in calculating the maximum number of data nodes she could collect within t seconds?

Input

The first line contains integers x_0, y_0, a_x, a_y, b_x, b_y ($1 \le x_0, y_0 \le 10^{16}$, $2 \le a_x, a_y \le 100$, $0 \le b_x, b_y \le 10^{16}$), which define the coordinates of the data nodes.

The second line contains integers x_s, y_s, t ($1 \le x_s, y_s, t \le 10^{16}$) – the initial Aroma's coordinates and the amount of time available.

Output

Print a single integer — the maximum number of data nodes Aroma can collect within t seconds.

input
```
1 1 2 3 1 0
2 4 20
```
output
```
3
```

input
```
1 1 2 3 1 0
15 27 26
```
output
```
2
```

input
```
1 1 2 3 1 0
2 2 1
```
output
```
0
```

In all three examples, the coordinates of the first 5 data nodes are $(1, 1)$, $(3, 3)$, $(7, 9)$, $(15, 27)$ and $(31, 81)$ (remember that nodes are numbered from 0).

In the first example, the optimal route to collect 3 nodes is as follows:

- Go to the coordinates $(3, 3)$ and collect the 1-st node. This takes $|3 - 2| + |3 - 4| = 2$ seconds.
- Go to the coordinates $(1, 1)$ and collect the 0-th node. This takes $|1 - 3| + |1 - 3| = 4$ seconds.
- Go to the coordinates $(7, 9)$ and collect the 2-nd node. This takes $|7 - 1| + |9 - 1| = 14$ seconds.

In the second example, the optimal route to collect 2 nodes is as follows:

- Collect the 3-rd node. This requires no seconds.
- Go to the coordinates $(7, 9)$ and collect the 2-th node. This takes $|15 - 7| + |27 - 9| = 26$ seconds.

In the third example, Aroma can't collect any nodes. She should have taken proper rest instead of rushing into the OS space like that.

E. Xenon's Attack on the Gangs

3 seconds, 512 megabytes

INSPION FullBand Master - INSPION
INSPION - IOLITE-SUNSTONE

On another floor of the A.R.C. Markland-N, the young man Simon "Xenon" Jackson, takes a break after finishing his project early (as always). Having a lot of free time, he decides to put on his legendary hacker "X" instinct and fight against the gangs of the cyber world.

His target is a network of n small gangs. This network contains exactly $n-1$ direct links, each of them connecting two gangs together. The links are placed in such a way that every pair of gangs is connected through a sequence of direct links.

By mining data, Xenon figured out that the gangs used a form of cross-encryption to avoid being busted: every link was assigned an integer from 0 to $n-2$ such that all assigned integers are distinct and every integer was assigned to some link. If an intruder tries to access the encrypted data, they will have to surpass S password layers, with S being defined by the following formula:

$$S = \sum_{1 \leq u < v \leq n} mex(u, v)$$

Here, $mex(u, v)$ denotes the smallest non-negative integer that does not appear on any link on the unique simple path from gang u to gang v.

Xenon doesn't know the way the integers are assigned, but it's not a problem. He decides to let his AI's instances try all the passwords on his behalf, but before that, he needs to know the maximum possible value of S, so that the AIs can be deployed efficiently.

Now, Xenon is out to write the AI scripts, and he is expected to finish them in two hours. Can you find the maximum possible S before he returns?

Input

The first line contains an integer n ($2 \leq n \leq 3000$), the number of gangs in the network.

Each of the next $n-1$ lines contains integers u_i and v_i ($1 \leq u_i, v_i \leq n$; $u_i \neq v_i$), indicating there's a direct link between gangs u_i and v_i.

It's guaranteed that links are placed in such a way that each pair of gangs will be connected by exactly one simple path.

Output

Print the maximum possible value of S — the number of password layers in the gangs' network.

input

```
3
1 2
2 3
```

output

```
3
```

input

```
5
1 2
1 3
1 4
3 5
```

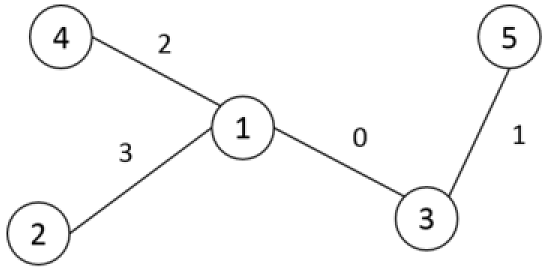
output

```
10
```

In the first example, one can achieve the maximum S with the following assignment:

With this assignment, $mex(1, 2) = 0$, $mex(1, 3) = 2$ and $mex(2, 3) = 1$. Therefore, $S = 0 + 2 + 1 = 3$.

In the second example, one can achieve the maximum S with the following assignment:



With this assignment, all non-zero mex value are listed below:

- $mex(1, 3) = 1$
- $mex(1, 5) = 2$
- $mex(2, 3) = 1$
- $mex(2, 5) = 2$
- $mex(3, 4) = 1$
- $mex(4, 5) = 3$

Therefore, $S = 1 + 2 + 1 + 2 + 1 + 3 = 10$.

F. Chaotic V.

2 seconds, 512 megabytes

Æsir - CHAOS
Æsir - V.

"Everything has been planned out. No more hidden concerns. The condition of Cytus is also perfect.

The time right now...... 00:01:12......

It's time."

The emotion samples are now sufficient. After almost 3 years, it's time for Ivy to awake her bonded sister, Vanessa.

The system inside A.R.C.'s Library core can be considered as an undirected graph with infinite number of processing nodes, numbered with all positive integers ($1, 2, 3, \ldots$). The node with a number x ($x > 1$), is directly connected with a node with number $\frac{x}{f(x)}$, with $f(x)$ being the lowest prime divisor of x.

Vanessa's mind is divided into n fragments. Due to more than 500 years of coma, the fragments have been scattered: the i-th fragment is now located at the node with a number $k_i!$ (a factorial of k_i).

To maximize the chance of successful awakening, Ivy decides to place the samples in a node P, so that the total length of paths from each fragment to P is smallest possible. If there are multiple fragments located at the same node, the path from that node to P needs to be counted multiple times.

In the world of zeros and ones, such a requirement is very simple for Ivy. Not longer than a second later, she has already figured out such a node.

But for a mere human like you, is this still possible?

For simplicity, please answer the minimal sum of paths' lengths from every fragment to the emotion samples' assembly node P.

Input

The first line contains an integer n ($1 \leq n \leq 10^6$) — number of fragments of Vanessa's mind.

The second line contains n integers: $k_1, k_2, \ldots, k_n$ ($0 \leq k_i \leq 5000$), denoting the nodes where fragments of Vanessa's mind are located: the i-th fragment is at the node with a number $k_i!$.

Output

Print a single integer, denoting the minimal sum of path from every fragment to the node with the emotion samples (a.k.a. node P).

As a reminder, if there are multiple fragments at the same node, the distance from that node to P needs to be counted multiple times as well.

input

```
3
2 1 4
```

output

```
5
```

input

```
4
3 1 4 4
```

output

```
6
```

input

```
4
3 1 4 1
```

output

```
6
```

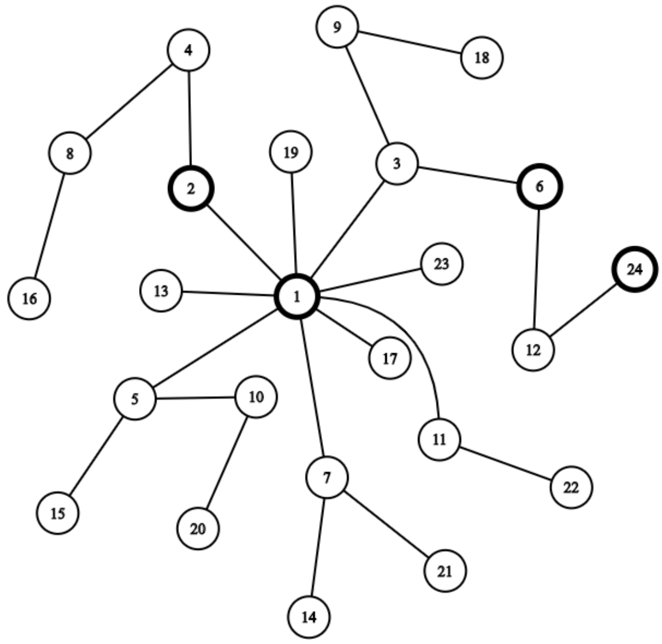
input

```
5
3 1 4 1 5
```

output

```
11
```

Considering the first 24 nodes of the system, the node network will look as follows (the nodes $1!$, $2!$, $3!$, $4!$ are drawn bold):



For the first example, Ivy will place the emotion samples at the node 1. From here:

- The distance from Vanessa's first fragment to the node 1 is 1.
- The distance from Vanessa's second fragment to the node 1 is 0.
- The distance from Vanessa's third fragment to the node 1 is 4.

The total length is 5.

For the second example, the assembly node will be 6. From here:

- The distance from Vanessa's first fragment to the node 6 is 0.
- The distance from Vanessa's second fragment to the node 6 is 2.
- The distance from Vanessa's third fragment to the node 6 is 2.
- The distance from Vanessa's fourth fragment to the node 6 is again 2.

The total path length is 6.