

Problem A. Goodbye, Ziyin!

Input file: standard input
Output file: standard output
Time limit: 0.5 seconds
Memory limit: 256 megabytes

My Dearest Allie:

I couldn't sleep last night because I know that it's over between us. I'm not bitter anymore, because I know that what we had was real. '

And if in some distant place in the future we see each other in our new lives, I'll smile at you with joy and remember how we spent a summer beneath the trees, learning from each other and growing in love. The best love is the kind that awakens the soul and makes us reach for more, that plants a fire in our hearts and brings peace to our minds. And that's what you've given me. That's what I'd hoped to give to you forever.

I love you. I'll be seeing you.

Movie, The Notebook

Through time passes, there is always someone we will never forget.

"Although there were millions of trees in the world, there was only one that The Little Prince took care of with his heart. And although there are countless people in the world, there is only one that I take care of with my heart." said Zayin to Ziyin with affection.

"Millions of trees? I may not agree with you. Just a tree could have millions of structure." answered Ziyin proudly, "Let's do the some math."

...

Thinking of the days they have happily spent together, Zayin can't help bursting into tears. Though Ziyin has been gone for a long time, Zayin still misses her every much.



He remembers it was a sunny afternoon when Ziyin and him were lying in the yard, resting beneath the shade of a tree, working on the number of nodes satisfying that if the tree is rooted by the node, the rooted tree is a rooted binary tree.

When times smooths all sorrows, Zayin also forgets the answer of the problem. He only remember the structure of the tree. Maybe it's time for Zayin to let all memories about Ziyin go, but he still want to figure out the answer out of sentiment.

As Zayin's friend, you may want Zayin to get released as soon as possible, can you help him?

In short, given an unrooted tree, please calculate how many nodes satisfying that if the tree is rooted by the node, the rooted tree is a rooted binary tree.

Input

The first line contains an integer n ($1 \leq n \leq 10^6$), indicating the number of nodes.

Next $n - 1$ lines each contains two integers u, v ($1 \leq u, v \leq n$), denoting that there is an edge connecting node u and v .

It's guaranteed that the $n - 1$ edges form a tree.

Output

The only line contains an integer, denoting the number of satisfied nodes.

Examples

standard input	standard output
6 1 2 1 3 2 4 2 5 3 6	5

Note

A rooted binary tree is a rooted tree in which every node has at most 2 children.

Problem B. Subset

Input file: **standard input**
Output file: **standard output**
Time limit: 2 seconds
Memory limit: 256 megabytes

You are given a set S consisting of first $N + 1$ non-negative integers, i.e. $S = \{0, 1, 2, \dots, N\}$. Find the number of ways to choose a K -size subset of S with the property that the XOR-sum of all chosen integers has exactly B set bits in its binary representation (i.e. the bits that are equal to 1). Since the answer can be large, output it modulo $(10^9 + 7)$.

XOR-sum of n integers a_1, a_2, \dots, a_n is $a_1 \oplus a_2 \oplus \dots \oplus a_n$. \oplus means bit-wise xor.

Input

The first line contains an integer T ($1 \leq T \leq 5$) denoting the number of test cases. The description of T test cases follows.

The only line of each test case contains three integers N, K, B . ($1 \leq N \leq 10^9$, $1 \leq K \leq 5000$, $0 \leq B \leq 30$)

Output

For each test case, output a single line containing the answer to the corresponding test case.

Examples

standard input	standard output
3	0
2 2 0	2
2 2 1	1
2 2 2	

Problem C. Assign or Multiply

Input file: standard input
Output file: standard output
Time limit: 1.5 seconds
Memory limit: 256 megabytes

Zayin have a number x which is equal to 1 initially, a prime number p , and n operations, where the i -th operation must be one of the followings:

- $x:=a_i$: assign the value a_i to x
- $x*=a_i$: assign the value $(x \times a_i) \bmod p$ to x

Zayin will perform the n from left to right, for example, if $p = 7$ and there are 3 operation: $x:=1$, $x:=2$, $x*=3$, the value of x will be 6 eventually.

But Ziyin, as the naughty girlfriend of Zayin, may shuffle the operations randomly. In spite of that, Zayin finds that some values would never present as the result no matter how the operations are shuffled. For example, the value 0, 4, 5 can't be the final value of x no matter how $x:=1$, $x:=2$, $x*=3$ are shuffled.

Zayin is curious about how many values between 0 and $p-1$ (both inclusively) can't present as the result. Can you help him?

Input

The first line contains two integers p, n . ($2 \leq p \leq 2 \cdot 10^5$, $1 \leq n \leq 10^6$)

Next n lines each contains two numbers op_i, a_i — if $op_i = 0$, the i -th operation is $x:=a_i$, otherwise it is $x*=a_i$. ($0 \leq a_i < p$)

It's guaranteed that p is a prime number.

Output

The only line contains an integer, indicating how many values between 0 and $p-1$ (both inclusively) can't present as the result no matter how the operations are shuffled.

Examples

standard input	standard output
19 3 0 5 1 7 1 17	15

Problem D. Period

Input file: **standard input**
Output file: **standard output**
Time limit: 0.5 seconds
Memory limit: 256 megabytes

Zayin have learned how to compute the number of periods of a string recently.

As his girlfriend, Ziyin would like to give Zayin some strings and test whether he really learn the knowledge well. But Ziyin is too lazy to produce strings which are completely different, so she would firstly give Zayin a string, and ask him if she modify the i -th character of the string to $\#$, what is the number of periods of the new string. (Note that Ziyin wouldn't really perform the modification)

It's really a big question for Zayin. Can you help him so that he would not lose face in front of his girlfriend?

Input

The first line contains a string s ($1 \leq |s| \leq 10^6$), which only contains lowercase letters.

The second line contains an integer q ($1 \leq q \leq 10^6$), indicating the number of queries.

Each of the next q lines contains an integer i , indicating Ziyin would modify the i -th character of the string to $\#$.

Output

For each of the q queries, print an integer indicating the number of periods of the new string after Ziyin's modification.

Examples

standard input	standard output
ccpc	0
4	1
1	1
2	0
3	
4	

Note

A integer number T is a period of a string s if and only if $1 \leq T < |s|$ and $s[i] = s[i - T]$ for every $i \in (T, |s|]$.

Problem E. CHASE!

Input file: **standard input**
Output file: **standard output**
Time limit: **0.5 seconds**
Memory limit: **256 megabytes**

Setsuna likes staying at home. No matter what happens at school, she has little interest and only wants to go home to play games. One day when she was back, she opened a rhythm game and found that her favorite event was being held.

For each round in this event, a player has to play two different songs which are randomly chosen by system. There are totally n songs in the system, and Setsuna is able to gain a score of a_i if she plays the i -th song. The score of a round is the sum of scores of the two songs.

Initially the system presents two different songs which are randomly selected with equal probability. If the player is unsatisfied with the result, he can ask the system to reselect (of course randomly). But there are only k opportunities of reselecting in total.

Setsuna had many questions. Firstly, she wanted to know her maximum expected score under optimal decision. Secondly, she assumed Q cases, each of which was as the form of "the system selected the x -th song and the y -th song currently, and there were c chances of reselecting left", and you need to answer whether she should accept the result, or reselect, or the difference of expected scores of these two choices under optimal decision is less or equal to 10^{-4} .

Input

The first line contains three integers n, k, Q . ($2 \leq n \leq 10^5$, $1 \leq Q \leq 10^5$, $0 \leq k \leq 100$)

The second line contains n integers a_1, \dots, a_n . ($0 \leq a_i \leq 10^6$)

Next Q lines each contains three integers x, y, c . ($1 \leq x < y \leq n$, $0 \leq c \leq k$)

Output

The first line contains a real number, representing the maximum expected score. The absolute difference between your answer and the standard answer should be within 10^{-4} .

For next Q lines, if she should accept the result in the i -th case, output "accept"; if she should reselect, output "reselect"; if both are OK, output "both".

Examples

standard input	standard output
3 2 1	85.555555556
30 40 50	reselect
1 2 1	

Problem F. Stone

Input file: **standard input**
Output file: **standard output**
Time limit: **0.5 seconds**
Memory limit: **256 megabytes**

Zayin and Ziyin are playing a game with n piles of stones, where the i -th pile has a_i stones for each $1 \leq i \leq n$. Zayin and Ziyin play in turn, with Zayin going first.

- First, Zayin chooses a positive integer s_1 and some piles with at least s_1 stones, removes s_1 stones from each of the chosen piles.
- Then Ziyin chooses a positive integer s_2 such that s_2 divides s_1 and some piles with at least s_2 stones, removes s_2 stones from each of the chosen piles.
- Then Zayin chooses a positive integer s_3 such that s_3 divides s_2 and some piles with at least s_3 stones, removes s_3 stones from each of the chosen piles.
- ...
- In general, s_i , the number of stones removed in each of the chosen piles in turn i , must divide s_{i-1} for $i > 1$.

The one who is unable to remove stones in his turn lose.

Compute the number of strategies Zayin can make in his first turn in order to guarantee a win no matter what choices Ziyin makes.

Two strategies are considered to be different if they remove a different number of stones or they remove stones from different set of piles.

Input

The first line contains the number of stone piles n ($1 \leq n \leq 10^6$).

The second line contains n integers a_1, a_2, \dots, a_n ($1 \leq a_i \leq 10^9$) - the number of stones in each pile.

Output

The only line contains an integer, representing the number of strategies Zayin can make in his first turn modulo 998244353.

Examples

standard input	standard output
9 9 9 8 2 4 4 3 5 3	2

Note

a divides b means that b is a multiple of a .

Problem G. Desserts

Input file: **standard input**
Output file: **standard output**
Time limit: 0.5 seconds
Memory limit: 256 megabytes

During your participation in CCPC-Weihai, Yukino is preparing desserts for every team of this competition.

There are n kinds of desserts in total, and she has prepared a_i number of the i -th dessert for every $i \in [1, n]$. Due to shortage of manpower, the total number of all kinds of desserts is no larger than 10^5 .

After the competition, she will hand all the desserts out to k teams. Each team can get different kinds of desserts but for each kind it can get one at most.

Now Yukino wants to know the number of ways to hand the desserts out. As she doesn't know the number of participating teams, you need to calculate the answers for $k = 1, 2, \dots, m$.

As the answer can be large, print it modulo 998244353.

Input

The first line contains two integers n, m . ($1 \leq m, n \leq 5 \cdot 10^4$)

The second line contains n integers a_1, \dots, a_n . ($0 \leq a_i \leq 10^5$, $\sum_{i=1}^n a_i \leq 10^5$)

Output

m lines each contains one integer. The i -th integer indicates the answer of $k = i$ modulo 998244353.

Examples

standard input	standard output
4 6	0
0 1 2 3	0
	9
	96
	500
	1800

Problem H. City Safety

Input file: standard input
Output file: standard output
Time limit: 1 second
Memory limit: 256 megabytes

Country X is a prosperous free-trade country, which has n cities connected by $n - 1$ bidirectional roads. Although country X has been very stable, businessmen are generally very sensitive to the safety of cities. They hope country X can strengthen public security forces to ensure the safety of cities.

In addition, businessmen are also concerned about the safety of the surrounding areas. Therefore, if the security force in a city is strengthened, but the security force in the nearby cities are not strengthened, they will still be worried about the threat in nearby cities.

Formally, to strengthen the security force in city i , a cost of w_i should be paid. Such effort is not in vain, as more businessmen will be attracted and country X will benefit from it. If every city with a distance from city i less or equal to p is strengthened, the city i will gain v_p more income than before. (if more than one p satisfy the condition, only the maximum one is considered.)

Now you, as the country's officer, are appointed to deal with this problem. Your goal is to get the maximum benefit (the increased income minus the cost of strengthening the security force).

Input

The first line contains one integer n ($1 \leq n \leq 200$), representing the number of cities in country X.

The second line contains n integers w_1, w_2, \dots, w_n ($1 \leq w_i \leq 10^5$), representing the cost of strengthening security force in city i .

The third line contains n integers v_0, v_1, \dots, v_{n-1} ($1 \leq v_i \leq 10^5$, $v_i \leq v_{i+1}$), representing the benefit as stated above.

Next $n - 1$ lines each contains two integers u, v ($1 \leq u, v \leq n$, $u \neq v$), representing that there is a bidirectional road between city u and v .

Output

The only line contains an integer, indicating the maximum benefit.

Examples

standard input	standard output
3 2 3 4 1 3 4 1 2 1 3	3

Problem I. Distance

Input file: **standard input**
Output file: **standard output**
Time limit: 2 seconds
Memory limit: 256 megabytes

Moon has learned the Hasse Diagram in his math course. Therefore, he draws an undirected graph with n nodes indexed $1, 2, \dots, n$ and adds some edges between node x and node y if $x|y$ and $\frac{y}{x}$ is a prime while the weight of the edge is $\frac{y}{x}$.

Moon wants to know the value of $\sum_{i=1}^n \sum_{j=1}^n \text{dis}(i, j)$, where $\text{dis}(x, y)$ means the shortest distance between node x and node y . Since the answer will be very large, you should print the answer modulo $10^9 + 7$.

Input

The only line contains an integer n . ($1 \leq n \leq 10^{11}$)

Output

The only line contains an integer, indicating the answer modulo $10^9 + 7$.

Examples

standard input	standard output
5	104
10	666

Note

$A|B$ means that A is a factor of B .

Problem J. Circular Billiard Table

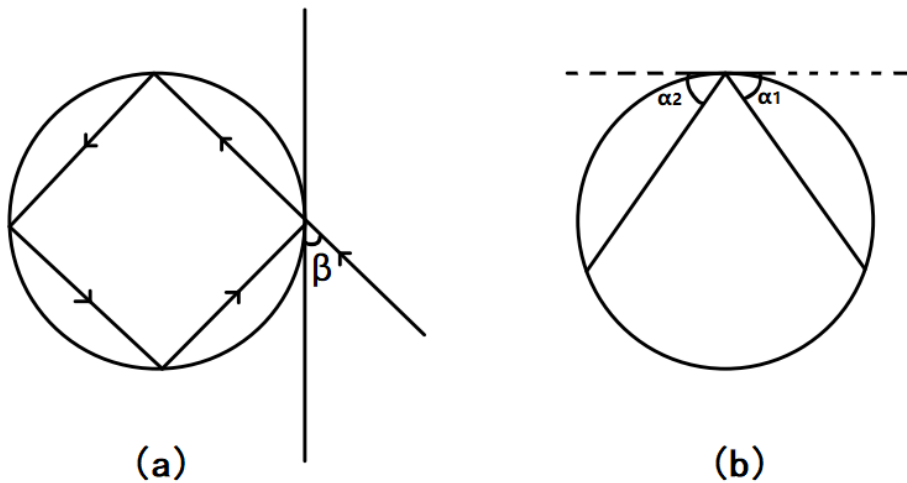
Input file: standard input
Output file: standard output
Time limit: 0.5 seconds
Memory limit: 256 megabytes

Mr. JR is an expert billiard player who has won the championship of BBPC (Billiard Ball Playing Contest). Nowadays, Mr. JR is tired of the ordinary rectangular billiards table and has great interest in the circular billiards table. Specifically, he is thinking about the following problem.



Mr. JR puts a white ball on the edge of the circular billiard table, and uses the club to hit the white ball at the angle of β ($0 < \beta < 90$). He wants to know how many times the white ball will collide with the edge of the circular billiard table before it returns to the origin for the first time.

The collision between the ball and the table conforms to the law of mechanics, that is, relative to the tangent of the collision point on the table edge, the incident angle α_1 is equal to the exit angle α_2 (as shown in figure (b)). And there will be no energy loss in the collision (that means the friction between the ball and the table is not considered, as shown in figure (a)).



This problem is too difficult for Mr. JR. Can you help him?

Input

The first line contains an integer T ($1 \leq T \leq 10^4$), denoting the number of test cases.

The only line of each test case contains two space-separated integers a and b ($0 < a, b \leq 10^9$, $0 < \frac{a}{b} < 90$), denoting the value of $\beta = \frac{a}{b}$.

Output

For each test case, output a single line containing the answer to the corresponding test case. If the white

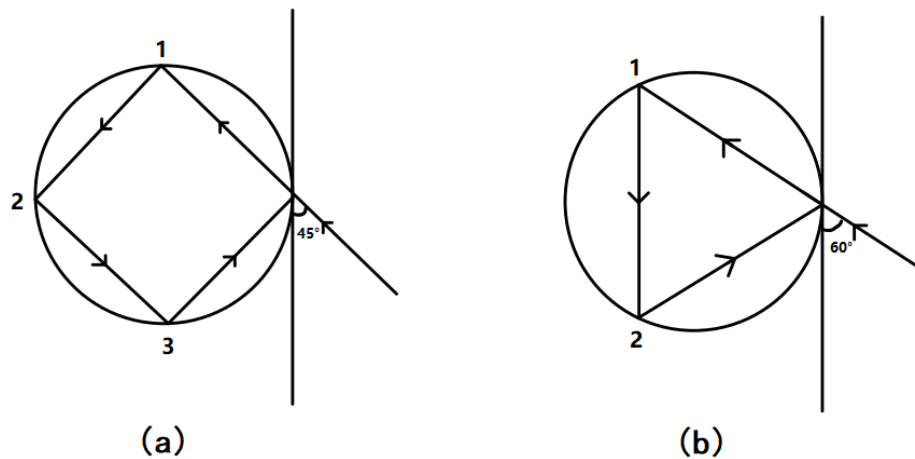
ball can never return to the origin, output -1 .

Examples

standard input	standard output
2 45 1 60 1	3 2

Explanation

The example is shown in the following figure:



Problem K. Tiny Stars

Input file: standard input
Output file: standard output
Time limit: 0.5 seconds
Memory limit: 256 megabytes

Even though they are tiny now, they will be shiny shooting stars someday.

It is every newbie's dream to be a grandmaster in algorithm contests, including Zayin. So it is your task to encourage him.

Zayin is solving a problem. He is given an integer n where n is an odd prime. Simultaneously there is an undirected graph with $n - 1$ vertexes, labeled from 1 to $n - 1$, and a parameter $a \in [1, n)$. For every vertex i , Zayin has to assign an edge for it from one of the two options:

- add an edge between i and $\frac{i}{a} \bmod n$. The time cost of it is 1 due to the calculation of multiplying $a^{-1} \bmod n$.
- add an edge between i and $\frac{a}{i} \bmod n$. The time cost of it is $\lceil \log_2 n \rceil$ due to the calculation of the inverse of i .

a is not shown to Zayin until he has decided the way to assign edges. After that, Zayin runs his naive algorithm on the graph. For every connected component with size s , the time cost is s^2 .

If the total time cost is less or equal than $12n$, the algorithm will be accepted.

You are to help Zayin in the following ways:

1. You give him an oracle sequence $oracle_1, \dots, oracle_{n-1}$ where each $oracle_i \in \{0, 1\}$ represents the option to choose for vertex i , i.e. if $oracle_i = 0$, he links i and $\frac{i}{a} \bmod n$, otherwise he links i and $\frac{a}{i} \bmod n$.
2. Then the judge will randomly generate 20 parameters a_1, \dots, a_{20} . The algorithm passes the test case if it is accepted on some a_i of them. Notice that Zayin uses the same oracle for every a .

Input

The only line contains an integer n . ($3 \leq n \leq 10^4$, n is an odd prime.)

Output

The only line contains $n - 1$ integers $oracle_1, \dots, oracle_{n-1}$, representing your oracle sequence.

Examples

standard input	standard output
5	0 0 0 0

Problem L. Shake Hands

Input file: standard input
Output file: standard output
Time limit: 1.5 seconds
Memory limit: 256 megabytes

There are n lovely children standing in a row, numbered from 1 to n from left to right. Their positions are also numbered from 1 to n from left to right. Initially, no one has shaken hands with others. The teacher is playing a game. In each turn, the teacher chooses two **adjacent** children and let them shake hands with each other. After shaking hands, the two children will swap their positions. After m turns, the teacher asks you a question: can you choose some children as many as possible such that every pair of chosen children has shaken hands with each other?

Input

The first line contains two integers n, m ($2 \leq n \leq 2 \cdot 10^5$, $1 \leq m \leq 2 \cdot 10^5$), denoting the number of children and operations.

In the next m lines, each line contains an integer x ($1 \leq x < n$), which means that in this turn, the children on the x -th position and $(x + 1)$ -th position shake hands with each other.

Output

The only line contains an integer, denoting the maximum number of children that have shaken hands with each other.

Examples

standard input	standard output
6 12 1 3 5 1 2 3 5 4 3 2 4 4	4

Problem M. 810975

Input file: **standard input**
Output file: **standard output**
Time limit: **0.5 seconds**
Memory limit: **256 megabytes**

In the platypus kingdom, there is a popular game throughout the kingdom—Hearthstone. Hearthstone consists of eight players in each game, and only one of them wins. Due to the difficulty of winning, many platypuses share their best moments of playing the game via live streams. Recently, a Bible "810975" spread.

"810975, why can't newcomers understand?!"

"810975, why are you the only one who doesn't understand?"

...

Recently, Zayin is reciting the Bible 810975 every day. He also continues to explain to his friends the specific meaning of 810975: On August 10, the Platypus King played 9 games and won 7 times, including a 5-game winning streak. But today, there comes a new platypus, Ziyin, who doesn't know the meaning of 810975. So Zayin excitedly explains to him. However, Ziyin has a question, "How many situations are there if I play n games and win m games, and the longest winning streak is k ?"

If we use 1 to represent victory and 0 to represent defeat, any string consisting of 0 and 1 of length n can represent a situation of an n -round game. Two situations are different if and only if the two 01 strings are different.

Input

The first line contains three integers n, m, k ($0 \leq n, m, k \leq 10^5$).

Output

The only line contains an integer: the number of situations meeting the constraints. You should output the answer modulo 998244353.

Examples

standard input	standard output
9 7 5	9