ACPC
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Collegiate Programming
Championship

International Collegiate Programming Contest
The 2023 ICPC Egyptian Collegiate Programming Contest
AAST, Egypt
August 2023

The International Collegiate Programming Contest
Sponsored by ICPC Foundation

ECPC
EGYPTIAN COLLEGIATE
PROGRAMMING CONTEST

The 2023 ICPC Egyptian Collegiate Programming Contest

(Qualifications - Day 6)

AAST, Egypt
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Problem A. Ancient

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Red`

In the hushed sands of time, a story unfolds, tracing back over 5,000 years to the birth of an ancient civilization along the banks of the Nile. Egypt's history, steeped in mystery and grandeur, weaves tales of ancient Egyptians, pyramids, and a timeless legacy that continues to captivate the world to this day. Jimmy, a determined archaeologist, and Mariam, a young historian, unite to unravel Egypt's enigmatic past. Their shared journey leads them through the ages, revealing secrets that will reverberate through time, as they uncover the untold tales of the mighty ancient Egyptians and the lost wonders of an ancient world.

Jimmy is a farmer who has magical chickens that lay i eggs on the ith day (1 egg on day 1, 2 eggs on day 2, etc..). You are a great farmer and wish to own the biggest farm in the whole country. You hired Jimmy and his chickens to work in your farm.

The farm starts with two farmers on day one. On each of the next days, you double the number of farmers working on your farm. You want all your farmers to be happy, so the eggs that the chickens produce on day i are split evenly between all the farmers where a farmer could even get a fraction of an egg.

Given a day r, Jimmy wants to know how many eggs any of the first two farmers received from day one until day r, inclusive. Since you want to look good, whenever Jimmy asks you a question, you multiply the answer by 2^r.

Jimmy asks you q questions, each containing an integer r. You are asked to print the answer to that question. Each question is independent. Since the answer might be too big, print the answer modulo $10^9 + 7$.

Input

The first line contains an integer q ($1 \le q \le 10^5$), the number of questions. Then q lines follow. Each contains an integer r ($1 \le r \le 10^9$).

Output

For each of the q questions, print the answer modulo $10^9 + 7$.

Examples

standard input	standard output
3 1 2 3	1 4 11
2 4 10	26 2036

Problem B. Bolbitine

Input file: `standard input`
Output file: `standard output`
Balloon Color: `Black`

In the year 1799, an intriguing stone slab, laden with three unique scripts, surfaced near the town of Bolbitine. An enigma etched in stone, it bore the key to unlocking ancient Egyptian hieroglyphs - the Rosetta Stone. Today, the original stone resides in the British Museum, while a replica stands in its discovery place, the town of Bolbitine, also known as Rosetta or Rashid.

President R runs a school. he gives some of his students money randomly depending on their groups because he discovered a secret on Rosetta stone. Each student s is assigned to a group x by the president. When R decides to give out money, he mentions the group x and the amount of money y. Luckily, when R mentions the group id, he enters the moolty-mood and also gives the same amount of money to all students currently in any group with an id which is a multiple of x.

R gives out q queries. Each query can be one of three forms:

- 1 s x Assign student s to group x. (If there is no group x, it is formed now)
- 2 x y Give away y money to all students currently in any group that has an id that is a multiple of x.
- 3 s Query the total amount of money the student s has gained from the president.

It is guaranteed that:

- Each student is only assigned to one group.
- When a student is assigned to group x, it's guaranteed that all groups with IDs $< x$ are formed.
- A student is not queried before he is assigned a group.

Input

The first list contains two integers, the total number of students to be assigned n, and the number of queries q. $(1 \le n \le 10^5)$, $(1 \le q \le 10^6)$

Then follows q lines each containing a query of the three forms. $(1 \le x \le 10^5)$, $(1 \le s \le n)$, $(1 \le y \le 10^9)$

Output

Output a line for each type 3 query, containing a single integer, the total amount of money the student s has gained from the president.

Example

standard input	standard output
6 15 1 1 1 2 1 5 1 2 1 1 3 2 2 2 3 1 4 2 1 5 3 1 6 4 2 2 2 3 1 3 2 3 3 3 4 3 5 3 6	5 0 5 2 0 2

Problem C. Cleopatra

Input file:	standard input
Output file:	standard output
Balloon Color:	Light Blue

Once upon a time, there was a legendary queen named Cleopatra, ruling over ancient Egypt around 2,000 years ago, from 51 BCE to 30 BCE. Her story seems so ancient to us now. But wait, here's a fascinating twist! The great pyramids, those incredible structures, were already standing tall roughly 3,000 years before her era! That means her time is much closer to ours than it was to the age of those majestic pyramids. It's mind-boggling to think just how ancient those pyramids truly are!

Cleopatra had a directed acyclic graph containing n nodes, and m weighted edges.

Cleopatra wanted to answer q queries, each query consists of one integer q_i you have to determine the length of the longest path from node 1 to node n that includes node q_i.

The length of a path is the sum of the weights of the edges on this path.

Cleopatra wished she could answer the questions, but she couldn't. These questions were from thousands of years ago. Can you answer them?

Input

The first line contains three integers n, m and q,$(2 \leq n \leq 10^5)$,$(n-1 \leq m \leq \min(\frac{n*(n-1)}{2}, 3\times10^5)$,$(1 \leq q \leq n)$, — the number of nodes, the number of edges and the number of queries to answer.

Then m lines contain the descriptions of edges. Each of them is described by three integers v_i, u_i, w_i, $(1 \leq v_i, u_i \leq n, v_i \neq u_i, 1 \leq w_i \leq 10^9)$, where v_i, u_i are numbers of the nodes connected by this edge and w_i is the weight this edge.

Then follows q lines containing the queries. Each line contains q_i, the node you must include in your longest path from node 1 to node n.

Output

Print q lines, each line containing the length of the longest path from node 1 to node n that includes node q_i. If there is no path, print -1.

Example

standard input	standard output
7 9 3 1 2 5 1 3 6 1 4 7 2 5 1 2 6 8 5 7 2 6 7 1 3 2 1 3 7 12 2 3 4	16 18 -1

Problem D. Djoser (Zoser)

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Purple`

In the ancient land of Egypt, during the 27th century BCE, a mighty king named Djoser reigned. His name echoed across time, for he embarked on a remarkable endeavor—the construction of a groundbreaking step pyramid at Saqqara. With the ingenious architect Imhotep at his side, Djoser's pyramid rose, a marvel of its age. This grand monument, the earliest large-scale stone structure, heralded a new era in Egyptian funerary architecture, captivating the imagination of those who seek the mysteries of ancient Egypt, including young archaeology enthusiast Moamen.

Moamen was waking nearby Djoser's pyramid, and he found an array a of n elements and he decided to convert this array into a non-decreasing array. Can You help him?

You can perform the following operation:

- Choose any element in the array and XOR the element with 2^x. (XOR operation is the Bitwise Exclusive OR)

Moamen need to convert this array into a non-decreasing array with the least number of operations given that you choose x optimally (x can be different in each operation). $(0 \le x \le 9)$

Input

The first line contains an integer n $(1 \le n \le 10^5)$ — the length of the array a.

The second line contains n integers $a_1, a_2, ..., a_n$ $(0 \le a_i \le 10^3)$ — the array elements.

Output

Print a single integer — the minimum number of operations to make the array non-decreasing.

Examples

standard input	standard output
3 1 1 1	0
4 5 15 8 6	2
5 10 16 25 0 2	2

Note

In the first case, the array is already sorted.

In the second case, one possible sequence of operations would be:

1. Take the second element and XOR it with 2^3.
2. Take the last element and XOR it with 2^3.

The final array would look like: $[5, 7, 8, 14]$.

Problem E. Edfu

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Dark Green`

Salah and Hazem were friends who shared a passion for ancient Egypt. They often met at a cozy café to talk about their favorite topics, such as the temple of Edfu, a city that had a huge and well-preserved temple. Hazem explained how the temple was built from massive blocks of stone, arranged like a giant map of the sky. Salah was fascinated, especially by the idea of an ancient tool that measured the Nile's water level during the flood season. They both wished they could travel to Egypt and see these marvels with their own eyes.

Salah and Hazem were also math lovers. They liked to solve problems and puzzles, especially ones that involved astronomy and physics. They frequently challenged each other with difficult questions, such as how to find the length of a day on different planets.

One day, Hazem asked Salah a question that he had been thinking about for a long time. He said, "It's known that a day on Earth has 24 hours, well a day on Jupiter has n hours and you have k tasks that must be done.

Each task i is defined by two integers l_i, r_i, where l_i is the time when task i starts and r_i is the time when task i ends.

You can do several tasks at the same time, but you are lazy and want to sleep as many hours as you can. unfortunately, you can only sleep once a day.

Find the maximum number of consecutive hours you can sleep during the day given that you can't be sleeping when you have a task to do.

Input

The first line contains two integers n, k $(1 \le n \le 200,000, 1 \le k \le n)$ — the number of hours in a Jupiter day and the number of tasks respectively.

Then k lines follow:

The i_{th} line contains two integers l_i, r_i $(1 \le l_i \le r_i \le n)$ — the start and end time of task i.

Output

Output a single integer — the maximum number of consecutive hours you can sleep.

Example

standard input	standard output
20 4 1 3 6 9 8 11 15 20	3

Problem F. Fayoum

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Yellow`

In the western desert of Egypt, lies the ancient city of Fayoum, where history spans not only thousands of years but millions. A city that is filled with countless natural and historical wonders such as Lake Qarun and Wadi Al-Rayyan. Of all the interesting archaeological sites, Amr found Wadi Al Hitan to be the most extraordinary site that reveals a rich fossil record of ancient marine life from the Eocene epoch. Among its wonders are fossilized whale skeletons and bones, revealing precious insights into the ancient ancestors of today's magnificent whales.

Amr was in Wadi Al-Rayyan and he found a string s, consisting of n lowercase Latin letters, he wants to count the number of Anomaly substrings in s. Can you help Amr?

A string is called Anomaly if the second letter in it matches the last letter, for example "aacba"is an Anomaly string while "abcba"is not.

A substring of string s is a continuous segment of letters from s, for example, "odefor"is a substring of "codeforces"while "fors"is not.

Input

The first line contains a single integer t - the number of test cases.

The first line in each test case contains a single integer n $(1 \le n \le 10^5)$ - the length of string s.

The second line in each test case contains the string s, consisting of exactly n lowercase Latin letters.

It is guaranteed that the sum of n over all test cases does not exceed 10^5.

Output

For each test case, output a single integer - the number of Anomaly substrings in the string s.

Example

standard input	standard output
5 2 aa 11 abracadabra 6 ababab 4 aazz 1 h	1 18 9 4 0

Problem G. Giza

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Gold`

In ancient history, Giza city witnessed humanity's most astounding achievement—the Great Pyramids. Over 4,500 years ago, the majestic structures of Khufu, Khafre, and Menkaure rose on the Giza Plateau, Egypt. As tombs for powerful kings, these remarkable pyramids showcased ancient Egyptian ingenuity and precision. Enduring through time, these iconic monuments captivate the world, a testament to the enigmatic allure of ancient engineering prowess.

Mostafa was visiting the pyramids and he drew a tree rooted at node 1 where each node i has a value a_i and asked you to mark all the nodes with the minimum number of operations.

The operation is that you can pick a subset of nodes such that they have the same value and for every pair of them u, v either u is an ancestor of v or v is an ancestor of u and mark all of them.

Input

The first line contains a single integer t $(1 \le t \le 10^5)$ — the number of test cases.

The first line of each test case contains an integer n $(1 \le n \le 10^5)$, the number of nodes.

The second line contains n integers $a_1, a_2, ..., a_n$ $(1 \le a_i \le n)$ the values of the nodes.

Each of the next $n-1$ lines contains two integers u_i and v_i $(1 \le u_i, v_i \le n; u_i \ne v_i)$ indicating that there is an edge between nodes u_i and v_i in the tree.

It is guaranteed that the sum of n over all test cases does not exceed 10^5.

Output

Print the answer to each test case on a single line.

Example

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

Problem H. Heliopolis

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`White`

You are a student of astronomy and history, and you have a passion for ancient Egypt. You have been studying the city of Heliopolis, which was once a center of knowledge and culture in what is now Cairo. You are fascinated by its big stone pillars that symbolized the sun and the stars, and by its legacy of learning and big ideas. You want to learn more about Heliopolis and its secrets.

You have found an old manuscript that contains a string of size n and q queries. The string is written in a mysterious code that you don't understand, but the queries are clear. For each query, you are given a length x and your task is to determine if it is possible to divide the string into subsequences of length x such that all subsequences are equal.

You think that the string might be a clue to some hidden information about Heliopolis, and that the queries might be a way to test your skills and knowledge. You decide to try to solve the queries and see what you can discover. Maybe you will find something amazing about the ancient city and its wonders.

Input

The first line of the input contains a single integer T $(1 \le T \le 10^5)$ – the number of test cases.

Then follows the descriptions of the test cases.

The first line of the test case contains two integers n, q $(1 \le n, q \le 2 \cdot 10^5)$ – where n is the size of string s and q is the number of queries.

The second line of the test case contains a string s of length n. The string consists of lower case English letters.

Each of the next q lines contains an integer x $(1 \le x \le n)$ – the size of the subsequence.

It is guaranteed that the sum of n over all test cases does not exceed $2 \cdot 10^5$.

Output

For each query, output "YES"if you can divide the string into subsequences with length x such that they are equal, and "NO"otherwise.

Example

standard input	standard output
3 9 3 abaabbccc 3 2 4 5 2 abbxe 5 4 3 1 zzz 3	YES NO NO YES NO YES

Note

For the first test case: one way of dividing the string

Seq1 $= s_1 s_2 s_9$

Seq2 $= s_3 s_6 s_8$

Seq3 $= s_4 s_5 s_7$

Seq1 = Seq2 = Seq3 = "abc"

Problem I. Imhotep

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Silver`

Imhotep was a brilliant man who served as the chief minister, architect, and physician of King Djoser in ancient Egypt. He designed the first step pyramid at Saqqara, which was a marvel of engineering and a symbol of royal power. He was also skilled in astronomy, mathematics, and medicine, and wrote many books on various subjects. Imhotep was facing a complex problem, but unfortunately, he passed away before he could solve it. Now, it's your mission to solve Imhotep's complex problem.

Imhotep had an array a of size n and q queries. Each query consists of two numbers l and r. He needed to count the number of unordered pairs of integers i and j that exist in the range l to r such that $a_i * a_j$ is a perfect square. Can you solve this problem?

Notice that the pair (i, j) is the same as the pair (j, i).

Input

The first line contains two integers n and q $(1 \leq n, q \leq 10^5)$.

The second line contains n integers, the elements of the array a $(1 \leq a_i \leq 10^9)$.

Each of the next q lines contains two integers l, r $(1 \leq l \leq r \leq n)$.

Output

For each query, output the number of pairs i, j such that $a_i * a_j$ is a perfect square and $l \leq i < j \leq r$ on a single line.

Example

standard input	standard output
8 5 1 2 2 3 1 4 8 16 1 8 4 8 3 6 2 7 5 6	9 3 1 4 1

Problem J. Jewels

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Orange`

You are a cryptographer and an adventurer, and you have a love for ancient Egypt. You have been exploring the Nile, where you have seen many wonders and mysteries. You have also found a hidden chamber that contains an array a of size n consisting of non-negative numbers, and a number y.

You think that the array and the number might be part of a puzzle that leads to a secret treasure. You wonder if you can append one non-negative number x to the array to make the result of bitwise OR of the array equal to y.

You decide to try to solve the puzzle and see what you can find. Maybe you will uncover something amazing about the ancient past and its jewels.

Formally: can you add exactly one non-negative number x such that $(a_1|a_2|...|a_n|x) = y$

where $|$ denotes the bitwise OR and x is minimum as possible.

You need to answer t test cases.

Input

The first line contains integer t $(1 \le t \le 10^3)$ the number of test cases.

The first line of each test case contains two integers n $(1 \le n \le 10^3)$ the size of the array, and y $(1 \le y \le 2^{32})$ the desired OR.

The next line contains an array a of size n $(1 \le a_i \le 2^{32})$

Output

For each test case print one integer x the minimum possible number to make $(a_1|a_2|...|a_n|x) = y$ on a separate line.

If no such value exists, print -1

Example

standard input	standard output
4 4 15 3 5 6 2 3 8 1 2 1 1 1 0 5 7 1 2 4 2 1	8 -1 1 0

Problem K. Karnak

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Dark Blue`

Besho was not only a tourist, but also a mathematician. He loved to explore ancient sites and find mathematical patterns and puzzles in them. He had a special interest in ancient Egypt, where he believed that mathematics was a sacred and mystical art.

He had come to Karnak City, near Luxor, to see the Karnak Temple Complex, one of the most impressive and ancient monuments in the world. He was amazed by the grandeur and beauty of the temples and statues, which showed the skill and creativity of ancient Egyptian architects. He also felt a connection with the spiritual and historical significance of the site, which was once the center of worship and culture in Egypt. He wanted to learn more about the secrets and mysteries of Karnak.

He had brought with him a notebook and a pen, where he wrote down his observations and questions. He noticed that some of the walls and columns had numbers and symbols carved on them, which he thought might be part of a code or a formula. He also saw that some of the stones had grids drawn on them, with numbers written in each cell.

He approached one of the grids and saw that it was an $n * n$ grid, where n was a positive integer. He looked at the numbers in each cell and realized that they followed a pattern: the cell in the i_{th} row and the j_{th} column had the number $i * j$ written on it.

He wondered what this grid meant, and what it had to do with Karnak. He decided to try to solve the grid and see what he could discover. Maybe he would find something fascinating about the ancient mathematics and its secrets.

You have to calculate the number of cells in the grid that have the number x written on them.

Input

There is only one line containing two integers n, x ($1 \le n \le 10^5, 1 \le x \le 10^9$).

Output

Print one line containing the number of cells in the grid that have the number x written on them.

Examples

standard input	standard output
10 5	2
5 13	0

Problem L. Luxor

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Bronze`

Luxor, the "Hundred Gates City,"boasts the iconic Luxor Temple at its heart. Dedicated to the Theban triad of Amun, Mut, and Khonsu, this ancient masterpiece showcases grand statues, towering obelisks, and intricate hieroglyphics. A living relic of human civilization, the temple exudes an ethereal charm, especially when illuminated by the setting sun.

Given two numbers a and b you have to determine if a is strictly greater than b or not.

Input

only one line contains two integers a and b $(1 \leq a, b \leq 100)$

Output

Print "YES"if a is strictly greater than b otherwise print "NO"on a single line (without quotes).

You may print each letter in any case.

Examples

standard input	standard output
5 7	NO
4 2	YES

Problem M. Memphis

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Pink`

You are a historian and a programmer, and you have a passion for ancient Egypt. You have been studying the history of Memphis, the first capital of Egypt, founded by King Menes around 3100 BC. You are fascinated by its role as a political and cultural center, and by its grand monuments, temples, and statues. You also want to know more about its decline and disappearance, and what secrets it might still hold. You have found an ancient scroll that contains a mathematical problem that might be related to Memphis. The problem is written in hieroglyphs, but you can translate it into modern notation. It says: Given an integer n, find the sum of costs of all permutations p of size n modulo $10^9 + 7$.

You think that the problem might be a clue to some hidden information about Memphis, and that the permutations might represent some order or arrangement of the city's monuments or rulers. You decide to try to solve the problem and see what you can find. Maybe you will uncover something amazing about the ancient city and its mysteries.

A permutation of size n is a sequence of integers from 1 to n containing each number exactly once. For example, (1), $(4, 3, 5, 1, 2)$, $(3, 2, 1)$ are permutations, while $(1, 1)$, $(4, 3, 1)$, $(2, 3, 4)$ are not.

Define the cost of a permutation p of size n as the number of indices i $(1 \le i \le n)$ such that $p[i]$ is bigger than all the elements with indices j $(1 \le j < i)$.

Input

The first line of the input contains an integer t $(1 \le t \le 10^5)$ — the number of test cases.

Then t lines follow:

Each test case contains an integer n $(1 \le n \le 10^6)$ — the size of the permutation p.

Output

For each test case, Output one integer — the sum of costs of all permutations p of size n modulo $10^9 + 7$ on a separate line.

Example

standard input	standard output
4 2 3 7 100	3 11 13068 665373141

Problem N. Nefertiti

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Light Green`

Abdelrahman was not only an admirer of Nefertiti, but also a computer scientist. He loved to explore ancient history and find computational problems and solutions in it. He had a special interest in ancient Egypt, where he believed that mathematics and logic were essential tools for understanding the past.

He had come across a book that contained a problem that might be related to Nefertiti and her mysterious fate. The problem was written in an old script, but he could decipher it into modern notation. It said: Given an undirected tree with n nodes, each node i has a value v_i, you are also given an integer x.

He thought that the problem might be a clue to some hidden information about Nefertiti and her role in ancient Egypt. He wondered if the tree might represent some hierarchy or network of the royal family or the court, and if the values and the integer might have some symbolic meaning. He decided to try to solve the problem and see what he could discover. Maybe he would find something fascinating about the ancient queen and her secrets.

You are given q queries, in each query, you are given two integers l, r, and you should calculate the number of ways to choose a subgraph of that tree, such that it contains node x and the sum of values in it is at least l and at most r, modulo 998244353.

Input

The first line of the input contains three integers n, x, q $(1 \le x \le n \le 5000, 1 \le q \le 10^5)$ – the number of nodes in the tree, the node x and the number of queries.

The second line contains n space-separated integers $v_1, v_2, ..., v_n$ $(1 \le v_i \le 2000)$ – the values on the nodes.

Each of the next $n-1$ lines contains two integers u, v $(1 \le u, v \le n, u \ne v)$ – there is an edge between u and v.

Each of the next q lines contains two integers l, r $(1 \le l, r \le 2000)$

Output

For each query, print one integer – the answer to the problem on a separate line.

Example

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