Problem A. Omar Khayyam

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

During the height of his work on algebra and astronomy, the renowned Persian polymath **Omar Khayyam** became intrigued by the mechanics of projectiles and their interactions with obstacles. To illustrate these ideas to his students, he devised the following experiment.

He arranged n gas tubes—each containing a precious antidote—and m robots in a straight line inside his laboratory. Each robot has exactly one bullet, which it can fire either to the left or to the right. A bullet travels at most k_i units from its robot's position, puncturing every gas tube in its path. However, upon striking any robot (including itself), the bullet shatters and stops immediately, without affecting further tubes.

Omar Khayyam wishes to maximize the number of gas tubes punctured by choosing for each robot a direction (left or right) in which to fire. Your task is to compute the maximum number of antidote tubes that can be punctured.

You are given three sequences:

1. $x_1, x_2, \ldots, x_n$: the positions of the n gas tubes (in strictly increasing order),
2. $r_1, r_2, \ldots, r_m$: the positions of the m robots (in strictly increasing order),
3. $k_1, k_2, \ldots, k_m$: the maximum travel distances of each robot's bullet.

Input

The first line contains an integer n ($1 \le n \le 10^5$) — the number of gas tubes.

The second line contains an integer m ($1 \le m \le 10^5$) — the number of robots. The third line contains n distinct integers $a_1, a_2, \ldots, a_n$ ($1 \le a_i \le 10^9$) — the positions of the gas tubes in strictly increasing order.

The fourth line contains m distinct integers $b_1, b_2, \ldots, b_m$ ($1 \le b_i \le 10^9$) — the positions of the robots in strictly increasing order.

The fifth line contains m integers $k_1, k_2, \ldots, k_m$ ($1 \le k_i \le 10^5$) — the maximum distance the bullet from the i-th robot can travel.

Output

Print one integer: the maximum number of gas tubes that can be punctured.

Examples

standard input	standard output
3 2 1 5 7 2 10 1 5	3
1 3 1 5 6 7 3 100 200	0
2 1 1 10 4 3	1

Problem B. Al-Khwarizmi's Swap Cipher

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

In the golden age of Islamic science, the brilliant mathematician **Al-Khwarizmi** laid the foundations of algebra. Inspired by his legacy, om4rr is developing a secure numerical cipher that uses a simple but clever operation based on element swapping.

Let $a = [a_1, a_2, \dots, a_n]$ be an array of n integers.

You may perform the following operation any number of times:

- Choose two integers x and y such that $x, y \in \{a_1, a_2, \dots, a_n\}$. Then for all i such that $1 \le i \le n$, do:

$$\text{if } a_i = x \text{ then set } a_i := y; \quad \text{else if } a_i = y \text{ then set } a_i := x$$

In other words, swap every occurrence of x with y and vice versa.

To complete his cipher system, om4rr wants to ensure that the numerical "weight"of the cipher (defined as the total sum of its elements) is **as small as possible** after any number of such swap operations.

Help om4rr by calculating the minimum possible value of the sum:

$$\sum_{i=1}^{n} a_i$$

after performing any number of operations.

Input

First, you're given an integer t ($1 \le t \le 10^3$), the number of testcases.

Each testcase consists of 2 lines; the first line contains one integer n ($1 \le n \le 10^5$), and the second line contains n integers ($1 \le a_i \le 10^9$).

It's guaranteed that the sum of n overall test cases doesn't exceed 10^5.

Output

Print one integer that represents the minimum sum after performing the operations.

Example

standard input	standard output
1 9 2 7 4 4 6 7 4 2 4	35

Note

In the first test case, after performing a valid set of swaps, the array becomes $4, 6, 2, 2, 7, 6, 2, 4, 2$.

Problem C. Al-Buzjani

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

During his seminal translations and commentaries on Greek and Indian works, the celebrated Persian mathematician and astronomer **Al-Buzjani** became fascinated with numerical arrangements and their hidden properties. To test the sharpness of his students, he devised the following challenge involving permutations.

You are given two integers n and k. Among all possible permutations p of length n, count the total number of indices i ($2 \leq i \leq n$) such that

$$p_i - p_{i-1} \geq k.$$

Since the answer can be very large, compute it modulo $10^9 + 7$.

† A permutation of length n is an array of length n that contains each integer from 1 to n exactly once.

Input

Each test consists of multiple test cases. The first line contains a single integer t ($1 \leq t \leq 10^4$) — the number of test cases. The description of the test cases follows.

The first and only line of each test case, contains two integers n and k ($2 \leq n \leq 10^6, 0 \leq k \leq 10^9$).

Output

For each test case, print the answer modulo $10^9 + 7$.

Example

standard input	standard output
1 2 0	1

Problem D. Hbab ask queries

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

Dr. Samira Mousa, one of Egypt's earliest and most brilliant nuclear physicists, was driven by a vision to make nuclear science serve humanity — especially in medicine and energy. Known as the "Miss Curie of the East,"she combined scientific precision with a humanitarian mission. While she worked on complex theories of atomic structure and radiation, Dr. Moussa also appreciated the rigor of mathematical problem-solving.

In a lecture she once gave to young researchers, she presented a challenging computational problem that reflected the analytical depth required in both physics and data science:

Given an array a of n positive integers and an integer k, along with q queries (l, r), for each query: Find the shortest subarray between l and r that contains k elements whose GCD is greater than 1. If no such subarray exists, output -1.

To Dr. Moussa, this problem wasn't just a matter of code — it symbolized the search for meaningful patterns within noisy data, akin to isolating valuable signals from within radiation readings. The notion of selecting a small, significant subset (with GCD $>$ 1) resonated with her belief in harnessing powerful forces for constructive purposes. Her legacy reminds us that behind every hard algorithmic challenge lies the potential to uncover clarity, structure, and even hope.

Input

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

The second line contains n integers $a_1, a_2, \ldots, a_n$ $(1 \le a_i \le 10^6)$.

Then q lines follow, the i'th line of them contains two integers l_i and r_i $(1 \le l_i \le r_i \le n)$.

Output

For each query output the answer.

Example

standard input	standard output
5 5 2 2 3 4 9 6 1 3 2 3 2 5 3 5 4 5	3 -1 2 2 2

Problem E. Ibn Hayyan and the Essence of Transformation

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

Jabir ibn Hayyan, known to the scholastic halls of the West as *Geber*, stood amidst the alembics and retorts of his Kufa workshop. He believed the universe was written in a language of balance and number, and that through the right operations—the *takwīn*—one could unveil the hidden potential, the inner soul, of any substance.

He picked up a piece of chalk and drew a row of numbers on a large slate, representing the initial measures of the salts. "First, we must impose order: replace each number by the maximum of all that preceded it, smoothing the chaos into a rising crescendo. Next, we sum these maxima one by one to see how the influence accumulates. Finally, the **khulasah**, the quintessence, is obtained by summing all these prefix-sums."

For an array a of n elements $(a_1, a_2, \ldots, a_n)$, define the function $f(a)$ as follows:

1. replace the array a with the prefix max array on it, that is make $a_i = \max(a_1, a_2, \ldots, a_i)$, for each i $(1 \le i \le n)$.
2. replace the array a with the prefix sum array on it, that is make $a_i = a_1 + a_2 + \cdots + a_i$, for each i $(1 \le i \le n)$.
3. now the value of the function f is the sum of the array a, that is $f = a_1 + a_2 + \cdots + a_n$.

For example: for the array $a = (2, 1, 3)$, after doing prefix max: $a = (2, 2, 3)$, then prefix sum: $a = (2, 4, 7)$, then $f(a) = 2 + 4 + 7 = 13$.

Given two integers n and m, calculate the sum of $f(a)$ for every array a with length **at most** n and each element with value at most m (i.e. $1 \le a_i \le m$). Print the answer modulo $10^9 + 7$.

Input

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

Each test case is a line with two integers n and m $(1 \le n \le 2 * 10^5)$, $(1 \le m \le 2 * 10^5)$.

It is guaranteed that the sum of n and the sum of m over all test cases don't exceed $2 * 10^5$.

Output

For each test case print the sum of $f(a)$ for every array a with length at most n and its values at most m. Print the answer modulo $10^9 + 7$.

Example

standard input	standard output
2 1 3 5 3	6 11132

Problem F. Al-Kindi and the Harmony of Numbers

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

In the heart of 9th-century Baghdad, within the House of Wisdom, Al-Kindi studied a captured Byzantine scroll filled with a long sequence of numbers. He realized that the true messages lay not in individual values but in the harmony of numbers that share no common divisor greater than 1. To probe the enemy's hidden code, he sought to count all "harmonious"sets of a given size.

You are given an array a of length N.

For each $1 \le k \le N$, you need to count the number of subsequences satisfying the following conditions:

- Each two elements of the subsequence are coprime.
- The length of the subsequence is k.

Input

The first line contains a single positive integer $1 \le N \le 10^5$.

The following line contains the elements of array a, $1 \le a_i \le 10^7$ for each $1 \le i \le N$.

It is guaranteed that $lcm(a_1, a_2, , ..a_N) \le 10^{18}$.

Output

Output an array ans of length N for which ans_i is the number of subsequences of length i satisfying the condition described in the problem statement modulo $10^9 + 7$.

Example

standard input	standard output
5 2 1 6 4 5	5 7 3 0 0

Problem G. Ibn Yunus

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

During his work on the Fatimid observatory in Cairo, the brilliant Egyptian mathematician and astronomer **Ibn Yunus** earned fame for his remarkably precise astronomical tables and his innovative numerical techniques. Inspired by patterns he noticed while computing lunar and solar positions, he became fascinated with how arithmetic properties could reveal hidden symmetries in numbers.

One evening, as he compared values in his planetary tables, Ibn Yunus stumbled upon a curious relationship between the greatest common divisor of two quantities and the bitwise XOR of their numerical representations. Convinced that this discovery would sharpen the minds of his brightest pupils, he devised the following challenge.

You are given an array of integers a of length n.

You need to count the number of pairs (i, j) such that $1 \le i, j \le n$ and $\gcd(a_i, a_j) = a_i \oplus a_j$.

Note:

- $\gcd(a, b)$ is the greatest common divisor of integers a and b.
- $\oplus$ denotes the bitwise exclusive-or operation.

Input

Each test consists of multiple test cases. The first line contains a single integer $t (1 \le t \le 10^4)$ — the number of test cases. The description of the test cases follows.

The first line of each test case contains the single integer n $(1 \le n \le 2 * 10^5)$ — the length of the array.

The second line of each test case contains n integers $a_1, a_2, ..., a_n$ $(1 \le a_i \le n)$ — the elements of the array.

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

Output

For each test case, print the answer.

Example

standard input	standard output
1 4 2 2 3 3	4

Problem H. Ibn Khaldun and the Tapestry of Time

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

In the heart of Cairo, under the flickering light of an oil lamp, the great scholar **Ibn Khaldun** sat hunched over a mountain of scrolls. The year was **1384**. He had withdrawn from the political turmoil of the Mamluk court to complete his masterwork, the *Muqaddimah*.

To his weary eyes, the history of humankind was not a chaotic jumble of names and dates, but a grand, intricate tapestry woven with repeating patterns.

"History is a string of events, a narrative," he murmured to his young scribe, who was diligently preparing fresh ink. *"And the rise of every great dynasty, every powerful civilization, is but a prefix to this long story. It has its own unique character, its own '**asabiyyah**,' or group solidarity."*

He unrolled a long parchment, representing the timeline of known history.

"Let us call this entire timeline the string s," he mused, his finger tracing the rise and fall of empires. *"The foundational years of a new power, say the first j years of the Rashidun Caliphate, form a prefix,* $s[1..j]$*. Each of these foundational years contributes a certain amount of strength, a value, to the dynasty's overall legacy. Let us call this the array a."*

And thus, with every scratch of his quill, Ibn Khaldun began to formalize history not only as a science, but as a problem of patterns, prefixes, and power.

You are given a string s and an array of integers a, both of length n. You need to process q queries. Each query provides two values: i and k. For this query, you need to:

1. Find all prefixes of string s that match a substring ending at position i of the string.
2. Calculate the "value"of each matching prefix. The value of a prefix $s[1..j]$ is defined as the sum of the corresponding elements in array a: $\sum_{i=1}^{j} a_i$.
3. Sort these values in non-increasing order (from largest to smallest).
4. Output the k-th largest value. If there are fewer than k matching prefixes, output 0.

Input

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

The second line contains the string s consisting of lowercase English letters.

The third line contains n integers $a_1, a_2, \ldots, a_n$ ($|a_i| \le 10^9$) — the elements of array a.

The fourth line contains a single integer q ($1 \le q \le 10^5$) — the number of queries.

The next q lines describe the queries. Each query contains two integers x and y ($1 \le x, y \le n$).

The actual values of i and k for a query are calculated as:

$i = ((x + lastAnswer)\ mod\ n) + 1,\ k = ((y + lastAnswer)\ mod\ n) + 1$

Here, $lastAnswer$ is the answer to the previous query (initially 0).

Since $lastAnswer$ may be negative, the value $(x + lastAnswer) \bmod n$ (or similarly for k) might also be negative depending on the programming language. In such cases, you should normalize the result to ensure it lies in the range $[0,\ n-1]$ by computing a positive value congruent modulo n. For example, in C++ or Java, you can use the expression $((x + lastAnswer)\ \%\ n + n)\ \%\ n$ to ensure a non-negative result.

This means the input is encoded, and you need to decode each query based on the previous result.

Output

For each query, output a single integer — the k-th largest value among the values of prefixes that match a substring ending at position i, or 0 if there are fewer than k such prefixes.

Example

standard input	standard output
5 ababc 5 -3 2 0 4 2 3 1 1 2	2 0

Note

For the first query, the prefixes matching a substring ending at position 4 are:

- **ab**, whose value is $5 + (-3) = 2$
- **abab**, whose value is $5 + (-3) + 2 + 0 = 4$.

Since the query asks for the second largest value, the answer is 2.

Problem I. Ibn al-Haytham's Missing Grid

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

As you all know, the great Arab polymath **Ibn al-Haytham** once studied the geometry of light and patterns in a rectangular grid. In his lost manuscript, he describes a mysterious grid with n rows and m columns, but the exact dimensions have been forgotten. He only recorded two quantities:

— The number of cells on the boundary (edge) of the grid, denoted by A

— The number of cells strictly inside the grid, denoted by B.

Your task is to reconstruct the dimensions (n, m) of the grid given A and B. If there are multiple valid pairs, you must choose the one that **maximizes** the number of rows n.

It is guaranteed that at least one solution exists.

Input

On the first line, given T $(1 \le T \le 10^4)$ — the number of test cases.

On the next T lines, given two integer A, B $(0 \le A, B \le 2 \cdot 10^9)$ — The number of cells on the boundary (edge) of the grid and the number of cells strictly inside the grid respectively.

Output

For each test case, print n m separated with a space, and remember if there are multiple solutions fits the answer , print the one that **maximize** n.

Example

standard input	standard output
2 10 2 8 1	4 3 3 3

Problem J. Dr. Farouk El-Baz's XOR Puzzle

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

$Dr.FaroukElBaz$, the celebrated Egyptian-American space scientist behind NASA's Apollo missions and groundbreaking desert research, often reminded his students that true discovery lies in finding hidden patterns—whether on the Moon or beneath the sands.

In one of his legendary lectures blending geology, satellites, and sharp reasoning, $Dr.ElBaz$ posed this challenge:

Given an array of n integers $(a_1, a_2, \ldots, a_n)$, partition it into k non-empty groups. The value of each group is the bitwise XOR of its elements.

Find the **maximum** sum of group values possible and the **minimum** number of groups k needed to reach it.

Notes: A Group is a non-empty subset of the array such that each element belongs to exactly one group.

Input

The first line contains a single integer n $(1 \leq n \leq 16)$ — the number of elements in the array.

The second line contains n space-separated integers $a_1, a_2, \ldots, a_n$ $(0 \leq a_i < 2^{55})$.

Output

Print two integers: the **minimum** k and the **maximum** possible sum.

Example

standard input	standard output
3 1 1 1	3 3

Problem K. The Cautious Thief

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

As you all know, the renowned Arab polymath **Al-Kindi** once explored patterns of stealth and detection. In one of his thought experiments, he imagined a thief sneaking through a street of houses, constrained by his own fear of making noise. You are to analyze Al-Kindi's scenario:

There is a thief in a street consisting of n houses, numbered from 1 to n. Each house initially contains a_i gold bars. The thief is very cautious: he steals at most x bars per house each day.

Each day, the thief does the following:

- On odd days he starts at house 1 and moves to house n (left to right),
- On even days he starts at house n and moves to house 1 (right to left),
- At each house that has at least x bars remaining, he steals exactly x bars.
- If he enters a house with fewer than x bars, he panics, makes a loud noise, and is caught immediately in that house on that day.

Determine the day the thief is caught, the house index where he is caught, and the total number of gold bars stolen by that time.

Input

The first line contains two integers n and x ($1 \le n \le 2 \cdot 10^5$, $1 \le x \le 10^9$).

The second line contains n integers $a_1, a_2, \ldots, a_n$ ($1 \le a_i \le 10^9$).

Output

Print three integers:

day, **the house index**, **total stolen**

Examples

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

Problem L. Zewail's Substring Symphony

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Lim green`

Dr. Ahmed Zewail, the Egyptian Nobel laureate and pioneer of femtochemistry, was not only passionate about science but also deeply fascinated by the beauty of mathematical logic and computational challenges. During one of his reflective moments, Dr. Zewail encountered an intriguing problem that captivated his analytical mind:

Given string S of N digits. You will process Q queries. In the i-th query, you take a substring from l_i to r_i from the original string, sort this substring, and write the whole string with this sorted substring on a board. You have to calculate the number of different strings after performing all queries.

At first glance, the problem seemed like a simple string manipulation task, but Dr. Zewail quickly realized that maintaining the integrity of the original string while applying sorted modifications required a delicate balance of data structures and optimization. Much like his experiments capturing molecules in femtoseconds, every operation had to be precise and efficient. This blend of logical rigor and creative problem-solving reminded him that whether in chemistry or com

Input

First line contains two integers $N (1 \le N \le 2 \times 10^5)$, the length of the string, $Q (1 \le Q \le 2 \times 10^5)$.

Second line contains string S consisting of Digits $(0 \le s_i \le 9)$.

Next Q lines, the $i-th$ line contains two integers l_i, r_i $(1 \le l_i \le r_i \le N)$.

Output

Output a single integer, the answer to the problem.

Example

standard input	standard output
8 5 19708041 1 3 4 5 4 6 5 6 3 8	4

Note

Testcase explanation: $S =$ "19708041".

1. after sorting $S[1:3]$, $S = \underline{179}08041$
2. after sorting $S[4:5]$, $S = 197\underline{08}041$
3. after sorting $S[4:6]$, $S = 197\underline{008}41$
4. after sorting $S[5:6]$, $S = 1970\underline{08}41$
5. after sorting $S[3:8]$, $S = 19\underline{001478}$

There are 4 distinct strings$[17908041, 19708041, 19700841, 19001478]$

Problem M. Domty Distribution

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

In the ECPC competition, each team consists of 3 members. The organizers have a certain number of **Domty** and want to distribute them evenly among the teams. You are given the number of **Domty** available, and your task is to determine if it can be evenly distributed among the three members of each team

Input

A single integer $d (1 \leq d \leq 10^9)$, which represents the total number of Domty available.

Output

Print "YES" if the Domty can be evenly distributed among the three members of each team, otherwise print "NO".

Examples

standard input	standard output
3333	YES
3334	NO