ACPC
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Collegiate Programming
Championship

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

جامعة الدول العربية
الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري

The International Collegiate Programming Contest
Sponsored by ICPC Foundation

ECPC
EGYPTIAN COLLEGIATE
PROGRAMMING CONTEST

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(Qualifications - Day 5)

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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. *Don*, a determined archaeologist, and *Ali*, 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.

Don wants to find the cheapest hotel to book for his upcoming vacation to visit the pyramids. He has a limited budget and wants to factor in the costs of different activities: visiting the beach every 2 days, the pool every 3 days, and the gym every day. After extensive research *Don* gathered some hotel offers and he needs your help in choosing the cheapest offer.

Each hotel offer consists of N days at the hotel and X, Y, and Z costs of going to the beach, pool, and gym, respectively.

Help *Don* choose the hotel offer with the **minimum** cost.

Note that he does all activities on the first day.

Input

The first line contains one integer T ($1 \le T \le 10^5$) — The number of hotels.

The next T lines contain four integers $N, X, Y,$ and Z ($1 \le N, X, Y, Z \le 10^5$).

N — Number of days at the hotel,

X, Y, and Z — The costs of going to the beach, pool, and gym, respectively.

Output

Print the cost of the cheapest hotel offer.

Example

standard input	standard output
3 5 1 2 3 4 1 4 3 3 1 5 7	22

Note

At the first hotel *Don* would go to the beach on the 1^{st}, 3^{rd}, and 5^{th} day, to the pool on the 1^{st} and 4^{th} day, and to the gym every day.

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.

On Rosetta stone, Ahmed found an array a of n integers, an integer k. and Ahmed has q questions. Each question consists of two integers L and R, and the answer to this question is the number of subarrays (l, r) such that $(L \le l \le r \le R)$ and $\sum_{i=l}^{r} a_i = k$.

Input

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

The first line of each test case contains two integers n $(1 \le n \le 3 \cdot 10^4)$, and k $(0 \le k \le 10^{12})$ – the number of elements in the array and the number k, respectively.

The second line of each test case contains n integers $a_1, a_2, a_3, ...a_n$ $(0 \le a_i \le 10^{12})$ – represents the array a.

The third line of each test case contains an integer q $(1 \le q \le 3 \cdot 10^4)$ – represents the number of questions for this test.

Each of the next q lines contains two integers L, R $(1 \le L \le R \le n)$ – represents the query.

It is guaranteed that the sum of n and the sum of q over all test cases won't exceed $3 \cdot 10^4$.

Output

For each query, print the number of pairs satisfying the conditions above.

Example

standard input	standard output
1 10 5 2 3 0 0 0 2 3 1 1 0 7 1 2 1 3 1 7 1 10 2 7 2 6 3 8	1 2 9 11 5 1 4

Problem C. Cleopatra

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

Cleopatra, the legendary queen of ancient Egypt, had a secret passion for playing *Among Us*, a popular game in the future. She had a time machine that allows her to travel to the year 2023 and join online matches with other players. She enjoyed being a crewmate, but she found some of the tasks too boring and repetitive. You decided to help her to make the game more interesting. You hack into the game's code and create a new algorithm that can remove some of the tasks from each round. You want to make sure that the remaining tasks are still challenging and fun, so you set some constraints on how to remove them.

Each round consists of n tasks. Task i's type can be represented by integer a_i. You are allowed to perform some number of operations. In each operation, you choose **exactly one** type of tasks and remove all the occurrences of this type from the n tasks. Denote $p^{(x)}$ as the array of indices of tasks of type x after performing the operations. Find for each d ($1 \le d \le n-1$) the minimum number of operations to perform, such that for all x ($0 \le x \le 9$), the difference between any 2 consecutive elements in $p^{(x)}$ doesn't exceed d.

You want to minimize the number of operations you perform, and you want to keep the tasks evenly distributed among the different types. You also want to avoid making the tasks too easy or too hard, so you limit the distance between any two consecutive tasks of the same type. But will the other players notice your meddling? And will you help Cleopatra to escape back to her own time before they catch her!

Input

The first line of input contains an integer n ($1 \le n \le 10^4$) – the number of tasks.

The second line contains n integers $a_1, a_2, \ldots, a_n$ ($0 \le a_i \le 9$) – the type of each task.

Output

For each d ($1 \le d \le n-1$), print an integer k_i representing the minimum number of removals such that the difference between the indices of every two consecutive tasks of the same type doesn't exceed d.

Examples

standard input	standard output
5 0 1 0 0 1	1 1 0 0
7 1 2 5 2 1 5 9	2 1 1 0 0 0

Note

In the second test case, one can do the following:

- For $d = 1$, we can remove types 1 and 5. The final tasks are $[2, 2, 9]$. Here $p^{(2)} = [1, 2]$, and $p^{(9)} = [3]$.
- For $d = 2$, and 3, we can remove type 1. The final tasks are $[2, 5, 2, 5, 9]$. Here $p^{(2)} = [1, 3]$, $p^{(5)} = [2, 4]$, and $p^{(9)} = [5]$.
- For $d = 4$, 5, and 6, we can remove nothing. The final tasks are $[1, 2, 5, 2, 1, 5, 9]$. Here $p^{(1)} = [1, 5]$, $p^{(2)} = [2, 4]$, $p^{(5)} = [3, 6]$, and $p^{(9)} = [7]$.

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 Philo.

While visiting the pyramid, Philo discovered that an integer z is an x-perfect exponent if $\sqrt[x]{z}$ is an integer.

Philo gives you an array a of size n and two integers x and k.

Find the minimum number of subarrays you need to split the array into such that:

- Each element in the array belongs to exactly one subarray.
- In each subarray, the number of pairs of numbers that have a product equal to an x-perfect exponent is $\leq k$.

An array c is a subarray of an array d if c can be obtained from d by deletion of several (possibly, zero) elements from the beginning and several (possibly, zero) elements from the end. In particular, an array is a subarray of itself.

Construct an array b where b_i is the length of the i-th subarray.

Out of all possible arrays b, print the greatest one lexicographically.

Input

The first line of input contains three integers n ($1 \leq n \leq 5 \cdot 10^5$), x ($2 \leq x \leq 5 \cdot 10^5$) and k ($0 \leq k \leq 10^9$).

The second line contains n integers $a_1, a_2, \ldots, a_n$ ($1 \leq a_i \leq 5 \cdot 10^5$).

Output

The first line of output should contain a single integer l — the length of the array b.

The second line of input should contain l integers $a_1, a_2, \ldots, a_l$ — the elements of the array b.

Example

standard input	standard output
5 2 0 18 9 2 4 1	3 2 2 1

Problem E. Edfu

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

In a cozy café, friends Ahmed and Mohamed chatted excitedly about their love for ancient Egypt. Mohamed talked about Edfu, a city known for its big, well-preserved temple. He described how the temple was made from huge blocks of stone, set out like a giant map of the sky. Ahmed listened, wide-eyed, particularly taken by the idea of an ancient tool used to measure the Nile's water during the flood season. Together, they dreamed of traveling to Egypt to see these wonders with their own eyes.

Welcome to the realm between realms, where the magical Yggdrasil tree (undirected connected graph) with n nodes stands tall. Each node is assigned a letter that holds a unique power. Your task, brave adventurer, is to solve the *Palindrome Quest*!

You will be given q queries, each consisting of two nodes (u, v). Your challenge is to determine whether the letters on the shortest path from node u to node v, when concatenated in order, form a palindrome. Only the most astute adventurers can solve this quest!

A palindrome is a string that reads the same backward as forward, for example strings "z "aaa "aba "abccba"are palindromes, but strings "meow "reality "ab"are not.

Input

The first line of the input contains a single integer n $(1 \leq n \leq 10^5)$ – the number of nodes in the tree.

The second line of the input contains n space-separated lowercase Latin letters $c_1, c_2, ..., c_n$, where c_i is the letter assigned to node i.

The next $n - 1$ lines describe the edges of the tree, where each line contains two integers u and v $(1 \leq u, v \leq n)$ – denoting an undirected edge between nodes u and v.

The next line contains a single integer q $(1 \leq q \leq 10^5)$ – the number of queries.

Each of the next q lines contains two integers u and v $(1 \leq u, v \leq n)$ – denoting a query.

Output

For each query, you must shout "1"(without quotes) if the characters on the shortest path from node u to node v form a palindrome. But if they do not, you must shout "0"(without quotes).

Examples

standard input	standard output
7 z b a c b a y 1 2 2 3 2 4 4 7 4 5 5 6 2 3 6 1 7	1 0
9 b a a a c a c d d 1 2 1 3 2 4 2 5 2 6 5 8 3 7 7 9 5 8 9 4 6 4 5 4 7 5 7	1 1 0 0 1

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, Nasser 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.

When Nasser visited Wadi Al-Rayyan, he discovered n candles, candle i has a size equal to p_i. The candles' sizes represent a permutation of size n.

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

Nasser challenges you to a game. You have to light candles one by one. At the i^{th} minute, you light candle i. When you light candle i, it stays lit for p_i minutes. In other words, it stays lit starting from the i^{th} minute till the $(i+p_i-1)^{th}$ minute, inclusive.

Find the **maximum** number of lit candles at any minute.

Input

The first line contains a single integer n $(1 \le n \le 10^5)$ – the number of candles.

The second line contains a permutation p of length n $(1 \le p_i \le n)$ – the candles' sizes.

Output

Output the maximum number of candles that are lit at any minute.

Example

standard input	standard output
5 5 2 3 1 4	3

Problem G. Giza

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

You are a mathematician who has always been fascinated by the Great Pyramids of Giza. You wonder how the ancient Egyptians managed to build such perfect structures with such limited tools and resources. You decide to visit Egypt and see the pyramids for yourself. As you stand in awe of the majestic monuments, you notice something peculiar. The numbers of blocks on each side of the pyramids seem to follow a pattern. You take out your notebook and start jotting down the numbers. You realize that they are arrays consisting only of positive integers, and that the greatest common divisor between any two elements in the array is 1. You are intrigued by this discovery and wonder if there is a deeper meaning behind it. You decide to conduct an experiment to see how many such arrays of **positive** numbers exist for a given range of total sum.

You are given T testcases. For each testcase, you need to count the number of different arrays satisfying these conditions and having a total sum in the range $[L, R]$.

However, since you are a mathematician with a keen eye for detail, you also notice that two arrays are different if they differ in size or if two numbers in the same position are different. You want to make sure that your experiment is as accurate as possible, so you need to take this into account when counting the number of arrays.

Can you help the mathematician by writing a program to count the number of different arrays that satisfy these conditions for each testcase?

Input

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

Each testcase consists of a single line containing two integers L and R ($1 \le L \le R \le 50$), separated by a space.

Output

For each testcase, output a single integer, the number of different arrays.

Example

standard input	standard output
2 2 4 1 3	13 7

Note

For the second testcase, the valid arrays are [1], [1, 1], [1, 1, 1], [2], [1, 2], [2, 1], [3].

Problem H. Heliopolis

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

Bastardeeno was a young archaeologist who had a passion for maps and plus signs. He had always been fascinated by the ancient city of Heliopolis, where the ancient Egyptians studied astronomy and worshiped the sun god. He wanted to learn more about the secrets of this lost city and its connection to the stars. One day, he received a mysterious package from his friends. It was a map that can be represented as a 2D grid of size n x n, where $cell(i, j)$ represents the cell in the i^{th} row from the top and j^{th} row from the left. The map had strange symbols and markings on it, some of them resembling $plus(+)$ signs. *Bastardeeno* was intrigued by this map and decided to follow its clues. He hoped that it would lead him to the hidden ruins of Heliopolis and reveal its mysteries.

If $cell(i, j)$ is occupied, it will be represented with a '*' on the map, and '.' if it's empty.

He immediately thought of counting the number of $plus(+)$ signs found on this map. A $plus(+)$ sign is formed when a cell and its four side-adjacent neighbors are occupied cells. A cell on the border of the map can't be counted as the center of a $plus(+)$ sign (as it doesn't have four side-adjacent neighbors).

Help *Bastardeeno* count the number of $plus(+)$ signs on this map.

Input

The first line contains an integer n $(1 \leq n \leq 100)$ — the number of rows and columns of the map.

The following n lines each contain n characters — the description of each cell. (whether it's occupied or not)

$Cell(i, j)$ is either '*' or '.'.

Output

Output a single integer, the number of $plus(+)$ signs.

Examples

standard input	standard output
4 ..*. .*** ..*.	1
5 .**.. ****. .***. ..*..	3

Note

In the first test case, the only $plus(+)$ sign has its center at $(2, 3)$.

In the second test case, the centers of the 3 $plus(+)$ signs are at $(2, 2)$, $(2, 3)$, and $(3, 3)$.

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 n integers and integer k. Denote $a^{(x)}$ as the array a after performing x operations on it. Where $a^{(0)} = a$, and $a^{(x)} = [a_1^{(x-1)} \oplus a_2^{(x-1)}, a_2^{(x-1)} \oplus a_3^{(x-1)}, ..., a_{n-x}^{(x-1)} \oplus a_{n-x+1}^{(x-1)}]$.

For any integer y, $a_i^{(y)}$ denotes the i^{th} integer in array a after performing y operations on it.

For any 2 integers p and q, $p \oplus q$ denotes the XOR of p and q.

Find the XOR of $a^{(k)}$.

Input

The first line contains 2 integers n $(1 \le n \le 10^6)$ and k $(0 \le k < n)$ – the number of integers and the number of operations performed, respectively.

The second line contains n integers $a_1, a_2, a_3, ..., a_n$ $(0 \le a_i \le 10^9)$.

Output

Print a single integer, the XOR of the array after performing k operations.

Examples

standard input	standard output
`7 4` `1 4 3 12 5 8 6`	`13`
`4 2` `1 2 3 4`	`4`

Note

In the first testcase:

$a^{(0)} = [1, 4, 3, 12, 5, 8, 6]$.

$a^{(1)} = [5, 7, 15, 9, 13, 14]$.

$a^{(2)} = [2, 8, 6, 4, 3]$.

$a^{(3)} = [10, 14, 2, 7]$.

$a^{(4)} = [4, 12, 5]$.

The XOR of $a^{(4)} = 4 \oplus 12 \oplus 5 = 13$.

Problem J. Jewels

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

Zuqa and *Beevo* were two avid historians who loved to learn about ancient civilizations and cultures. They had always been fascinated by ancient Egypt and its many jewels. They wanted to see them for themselves and uncover more secrets. They signed up for a tour on the Nile and started their adventure. They were mesmerized by the ancient wonders that surrounded them, a tapestry of history. They saw the pyramids, the sphinx, the temples, and the tombs. They learned about the pharaohs, the gods, the hieroglyphs, and the mummies. They felt like they were traveling back in time, on the majestic Nile.

Zuqa and *Beevo* are on a quest to find a *perfect* sandwich on . According to their definition, a sandwich is *perfect* if it consists of alternating portions of macaroni and grapes. After searching long and hard, they decided to take matters into their own hands.

They decided to go to their favorite restaurant and order a macaroni and grapes sandwich. Then, they would make the sandwich *perfect* themselves.

Making a sandwich *perfect* — especially a macaroni and grapes sandwich — is no easy task, you can move portions of macaroni and grapes around by preforming the following operation zero or more times:

- Select two adjacent components.
- Swap their places in the sandwich.

According to the famous *Quaso identity*, it can be easily proven that the more you edit the sandwich the less tasty it becomes.

Help *Zuqa* and *Beevo* find the minimum number of operations to make the sandwich *perfect* or state that this sandwich is a case of lost hope and can't be made *perfect*.

Input

The first line of input contains an 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 components in the sandwich.

The second line of each test contains a string s — a binary string representing the ingredients of the sandwich (0 for macaroni and 1 for grapes).

The sum of n over all test cases doesn't exceed 10^5.

Output

For each test case, output the minimum number of moves to make the sandwich *perfect* or -1 if it's not possible.

Example

standard input	standard output
2 5 01011 2 00	2 -1

Problem K. Karnak

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

In the ancient ruins of Karnak City near Luxor, Bevvo was amazed. The magnificent Karnak Temple Complex, stood before him. The grand temples and statues showcased the brilliance of ancient Egyptian architecture. As he explored the sacred site, Bevvo imagined the elaborate religious ceremonies that once made Karnak the spiritual heart of Egypt. The whispers of history enveloped him, urging him to uncover the secrets of this timeless place.

The ancient Egyptians were very skilled in math, but Bevvo doesn't really like math, so let's help him out. You know the following about a polynomial P:

- P is of the form $P(X) = C_0 + C_1 \cdot X^1 + C_2 \cdot X^2 + ... + C_D \cdot X^D$.
- For all i $(0 \le i \le D)$: $C_i \ge 0$.
- $P(1) = A$.
- $P(A) = B$.

Given A and B, find any polynomial that matches the description of P or say that there is none.

Input

The only line contains two integers A and B $(2 \le A, B \le 10^{18})$.

Output

The first line should contain a single integer $D + 1$ — the degree of the polynomial.

The second line should contain D integers $C_0, C_1, ..., C_D$ — the coefficients of the polynomial.

If there is no polynomial that satisfies the given constraints print a single line containing -1.

Please, don't output any extra spaces or new lines.

The sum of coefficients should not exceed 10^{18}.

Example

standard input	standard output
3 48	-1

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.

You are given n strings $s_1, s_2, ..., s_n$, where each string i $(1 \le i \le n)$ has an integer value a_i, initially set to 1.

Let $F(i, r)$ for some i $(1 \le i \le n)$ and r $(1 \le r \le |s_i|)$, be equal to the **maximum** value of $a_j \cdot a_k$, where j and k $(1 \le j \ne k \le n)$ satisfy **all** of the following conditions:

- $r < |s_j|$.
- $r < |s_k|$.
- The prefix of s_j of length r **equals** the prefix of s_i of length r.
- The prefix of s_k of length r **equals** the prefix of s_i of length r.
- The prefix of s_j of length $r+1$ **doesn't equal** the prefix of s_k of length $r+1$.

If no such j and k exist for some i and r, $F(i, r) = 0$.

Let $Walk(i, l) = \sum_{r=l}^{|s_i|} F(i, r)$.

You are given q queries, each query is one of the following:

- $1\ i\ x$ — Set a_i to x.
- $2\ i\ l$ — Print the value of $Walk(i, l)$.

For some i $(1 \le i \le n)$ and r $(1 \le r \le |s_i|)$, the prefix of s_i of length r equals to the concatenation of the first r characters of s_i, in order.

Note that $|t|$ is the length of the string t.

Input

The first line contains 2 integers n $(1 \le n \le 2 \cdot 10^4)$, and q $(1 \le q \le 5 \cdot 10^4)$ — the number of strings, and queries, respectively.

The next n lines each contain a string of lowercase Latin letters. **It is guaranteed that the sum of characters in the n strings doesn't exceed $2 \cdot 10^4$.**

The next q lines each contain a query as described above, where $(1 \le x \le 10^5)$, and $(1 \le l \le |s_i|)$.

Output

For each query of type 2, print a single integer — the answer to the query.

Example

standard input	standard output
3 2 abcd abc abce 1 1 2 2 2 1	2

Note

In the example, in the 2^{nd} query, $F(2,1) = 0$, $F(2,2) = 0$, and $F(2,3) = 2 \cdot 1 = 2$, and so $Walk(2,1) = 0 + 0 + 2 = 2$.

Problem M. Memphis

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

In ancient Egypt, Memphis stood as the first capital of the unified country, founded around 3100 BC by King Menes. This influential city witnessed the rise and fall of many dynasties and kings, flourishing as a cultural and artistic hub. Grand monuments, temples, and statues adorned its landscape. However, Memphis's significance waned with the ascent of Thebes and Alexandria, eventually leading to its abandonment and burial under the sand.

While you were discovering the ancient Egypt temples in Egypt, you decided to buy some souvenirs for your friends. You found a cute keychain medal with the name "Memphis" written on it and wanted to buy one for each of your N friends.

Given that you have X E£, and one keychain medal costs you Y E£, will you be able to buy N keychain medals as you wanted?

Input

A single line contains three integers, N, X, and Y ($1 \leq N, X, Y \leq 100$) — the number of keychain medals you want to buy, your budget, and the cost of one keychain medal, respectively.

Output

Output "YES" if you can buy N keychain medals. Otherwise, output "NO".

Examples

standard input	standard output
`4 30 5`	`YES`
`8 20 5`	`NO`