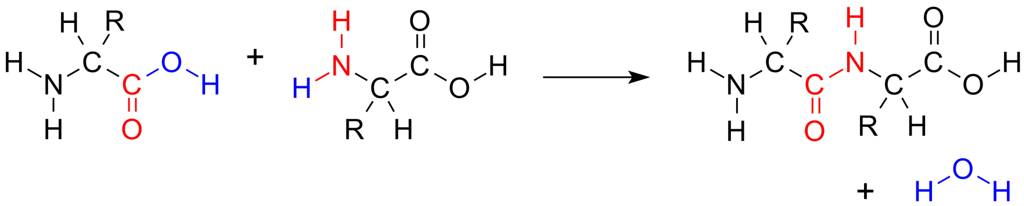
Problem A. Amino Acids

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

There are 20 kinds of common amino acids in the natural world. In this problem, we only consider 10 of them: Alanine, Asparagine, Aspartate, Cysteine, Glutamine, Glutamate, Glycine, Methionine, Serine and Threonine.

By condensation reaction, n ($n \geq 2$) amino acids can be linked by $n-1$ peptide bonds into a peptide chain and produce $n-1$ water molecules at the same time. Recall that each water molecule has a molecular mass of 18.



Idealized scheme showing condensation of two amino acids to give a peptide bond.

Given a set of different amino acids and a number N, you are asked to print the **structural formula** of all possible peptide chains, with a molecular mass not greater than N, which can be formed by the given amino acids. Chains are considered different if the permutations of amino acids of the chain is different.

Here are the **structural formula** of the 10 amino acids and the peptide bond.

```
Ala:
  H H O
  | | ||
H-N-C-C-O-H
    |
  H-C-H
    |
    H
```

```
Asp:
  H H O
  | | ||
H-N-C-C-O-H
    |
  H-C-H
    |
  O=C-O-H
```

```
Asn:
  H H O
  | | ||
H-N-C-C-O-H
    |
  H-C-H
    |
  O=C-N-H
      |
      H
```

```
Cys:
  H H O
  | | ||
H-N-C-C-O-H
    |
  H-C-S-H
    |
    H
```

```
Gly:
  H H O
  | | ||
H-N-C-C-O-H
    |
    H
```

```
Ser:
  H H O
  | | ||
H-N-C-C-O-H
    |
  H-C-O-H
    |
    H
```

```
Met:
  H H O
  | | ||
H-N-C-C-O-H
    |
  H-C-H
    |
  H-C-H
    |
    S
    |
  H-C-H
    |
    H
```

```
Thr:
  H H O
  | | ||
H-N-C-C-O-H
    |
  H-C-O-H
    |
  H-C-H
    |
    H
```

```
Gln:
  H H O
  | | ||
H-N-C-C-O-H
    |
  H-C-H
    |
  H-C-H
    |
  O=C-N-H
      |
      H
```

```
Glu:
  H H O
  | | ||
H-N-C-C-O-H
    |
  H-C-H
    |
  H-C-H
    |
  O=C-O-H
```

```
Peptide bond:
 O   H
 ||  |
-C---N-
```

See below for molecular mass of amino acids.

Amino acid	3-letter symbol	Molecular mass
Alanine	Ala	89
Asparagine	Asn	132
Aspartate	Asp	133
Cysteine	Cys	121
Glutamine	Gln	146
Glutamate	Glu	147
Glycine	Gly	75
Methionine	Met	149
Serine	Ser	105
Threonine	Thr	119

Input

The first line contains two integers M and N ($1 \le M \le 10$, $1 \le N \le 450$), denoting the number of amino acids and the molecular mass upper bound.

The second line contains M strings, each consisting of 3 letters denoting a kind of amino acid.

Output

In the first line, print a single integer denoting the number of possible peptide chains.

Then print the **structural formula** of every possible peptide chain by the lexicographical order of their 3-letter sequences, separated by a blank line in between.

Example

<table>
<tr><th>standard input</th><th>standard output</th></tr>
<tr><td>

```
2 150
Ala Gly
```

</td><td>

```
3
  H H O   H H O
  | | ||  | | ||
H-N-C-C---N-C-C-O-H
    |       |
  H-C-H     H
    |
    H

  H H O   H H O
  | | ||  | | ||
H-N-C-C---N-C-C-O-H
    |       |
    H     H-C-H
            |
            H

  H H O   H H O
  | | ||  | | ||
H-N-C-C---N-C-C-O-H
    |       |
    H       H
```

</td></tr>
</table>

Problem B. Blocks

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

Painting is always a boring job.

There are n blocks on an infinite two-dimensional plane. Each block is a rectangle parallel to the x-axis and y-axis with a non-zero area.

The coordinates of bottom-left corner and top-right corner of the i-th block are $(x_{1,i}, y_{1,i})$ and $(x_{2,i}, y_{2,i})$.

There is another block with coordinates of bottom-left corner and top-right corner are $(0, 0)$ and (W, H). Nike wants to paint this block black. He will repeatedly choose one of the n blocks **uniformly at random** and fill it black, until the rectangle $((0, 0), (W, H))$ is completely filled black.

Find the expected value of the number of times the procedure is done, modulo 998244353. If Nike will never fill $((0, 0), (W, H))$ completely black, output -1.

Input

The input contains several test cases, and the first line contains a positive integer T indicating the number of test cases which is up to 500.

For each test case, the first line contains an integer n $(1 \le n \le 10)$.

The second line contains 2 integers W, H $(1 \le W, H \le 10^9)$.

Each of the following n lines contains 4 integers $x_{1,i}, y_{1,i}, x_{2,i}, y_{2,i}$ $(0 \le x_{1,i} < x_{2,i} \le 10^9$, $0 \le y_{1,i} < y_{2,i} \le 10^9)$, describing the coordinates according to the problem statement.

Output

For each test case, output one line, the answer modulo 998244353. If the procedure is impossible to stop, output -1.

It can be proved that the expected value is always a rational number. Additionally, under the constraints of this problem, when that value is represented as Q/P using two coprime integers P and Q, it can be proved that there uniquely exists an integer R such that $R \times Q \equiv P \pmod{998244353}$ and $0 \le R < 998244353$. In this case, you should find this R.

Example

standard input	standard output
1 8 5 5 0 0 2 2 2 2 5 5 0 2 2 5 2 0 5 2 0 0 1 1 1 1 5 5 0 1 1 5 1 0 5 1	10

Problem C. Cup of Water

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

There is an empty cup, and a dumb robot is going to fill it with 1 liter of water.

For every turn, the robot will randomly select a real number t between 0 and x (x is a given number) and then fill the cup with t liter of water. The robot will repeat it until the cup is full (at least 1 liter of water has been filled).

You need to answer the expected number of turns the robot should fill.

Input

The first line contains an integer T ($T \le 10000$), denoting the number of test cases.

In the following T lines, each line contains a real number x ($0.05 \le x \le 10^9$), describing a test case.

It is guaranteed that x contains no more than 3 decimal places.

Output

For each test case, output one line with a real number, denoting the expected number of turns.

Any answer with a relative or absolute error less than 10^{-4} will be accepted.

Example

standard input	standard output
2 0.3 1.5	7.3332227396 1.9477340411

Problem D. Divisions

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

Nami will get a sequence S of n positive integers $S_1, S_2, \ldots, S_n$ soon and she wants to divide it into two subsequences.

At first, Nami has two empty sequences S_A and S_B. She will consider each integer in S in order, and append it to either S_A or S_B. Nami calls sequences S_A, S_B she gets in the end a division of S. Note that S_A and S_B are different and subsequences can be empty, so there are 2^n ways to divide S into S_A and S_B, which means there are 2^n possible divisions of S.

For a division, supposing that there are n_A integers in S_A and n_B integers in S_B, Nami will call it a great division if and only if the following conditions hold:

- $S_{A,1} \leq S_{A,2} \leq \cdots \leq S_{A,n_A}$
- $S_{B,1} \geq S_{B,2} \geq \cdots \geq S_{B,n_B}$

Nami defines the greatness of S as the number of different great divisions of S. Now Nami gives you a magic number k, and your task is to find a sequence S with the greatness equal to k for her.

Note that the length of S should not exceed 365 and the positive integers in S should not exceed 10^8.

If there are several possible sequences, you can print any of them. If there is no sequence with the greatness equal to k, print -1.

Input

A single line contains an integer k ($0 \leq k \leq 10^8$) – the magic number from Nami.

Output

If there is no sequence with the greatness equal to k, print -1 in a single line.

Otherwise, in the first line, print the length n ($1 \leq n \leq 365$) of the sequence S.

In the second line, print n positive integers $S_1, S_2, \ldots, S_n$ ($1 \leq S_i \leq 10^8$) – the sequence for Nami.

Examples

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

Note

For the sequence $S = 1, 1, 4, 5, 1, 4$, it can be shown that the only great division of S is:

- $S_A = 1, 1, 4, 4$, $S_B = 5, 1$

For the sequence $S = 1$, it can be shown that all the divisions of S are great:

- $S_A = 1$, S_B is empty
- S_A is empty, $S_B = 1$

Problem E. Easy String Problem

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

You are given a string with length n, and the size of the alphabet also is n.

There are q queries. For a query, you are given two integers l, r and you need to answer the number of different strings (which can be empty) that can be obtained by removing a substring containing $[l, r]$.

Input

The first line contains one integer n ($3 \le n \le 10^5$), denoting the length of the string a.

The second line contains n integers $a_1, a_2, \cdots, a_n$ ($1 \le a_i \le n$).

The third line contains one integer q ($1 \le q \le 10^5$), denoting the number of queries.

For the 4-th to $(q+3)$-th lines, each line contains two integers l, r ($1 \le l \le r \le n$), denoting a query.

Output

For each query, output a number in a line indicating the answer.

Example

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

Note

The string in the sample is equal to “abca”.

For the first query $1, 1$:

- “bca” can be obtained by removing substring $[1, 1]$.
- “ca” can be obtained by removing substring $[1, 2]$.
- “a” can be obtained by removing substring $[1, 3]$.
- Empty string can be obtained by removing substring $[1, 4]$.

So the answer is 4.

For the third query $2, 3$:

- “aa” can be obtained by removing substring $[2, 3]$.
- “a” can be obtained by removing substring $[1, 3]$ or $[2, 4]$.
- Empty string can be obtained by removing substring $[1, 4]$.

So the answer is 3.

Problem F. Find the Maximum

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

A tree with n vertices is a connected undirected graph with n vertices and $n-1$ edges.

You are given a tree with n vertices. Each vertex has a value b_i. Note that for any two vertices there is exactly one single path between them, whereas a simple path doesn't contain any edge more than once. The length of a simple path is considered as the number of edges in it.

You need to pick up a simple path whose length is not smaller than 1 and select a real number x. Let V be the set of vertices in the simple path. You need to calculate the maximum of $\frac{\sum_{u \in V}(-x^2+b_u x)}{|V|}$.

Input

The first line contains a single integer n ($2 \le n \le 10^5$), indicating the number of vertices in the tree.

The second line contains n integers $b_1, b_2, \cdots, b_n$ ($-10^5 \le b_i \le 10^5$), indicating the values of each vertex.

Each line in the next $n-1$ lines contains two integers u, v, indicating an edge in the tree.

Output

The output contains a single real number, indicating the answer.

Your answer will be accepted if and only if the absolute error between your answer and the correct answer is not greater than 10^{-4}.

Example

standard input	standard output
2 3 2 1 2	1.562500

Problem G. Glass Bead Game

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

Abstractions are fine, but I think people also have to breathe air and eat bread.

— Hermann Hesse, *The Glass Bead Game*

You are playing with n distinct glass beads $B_1, B_2, \ldots, B_n$ in some order. In each step, you move exactly one bead to the front. The cost of moving the bead to the front is the number of beads before that bead. For example, if we move B_1 in the list B_2, B_4, B_3, B_1 the total cost is 3 and the resulting sequence of beads is B_1, B_2, B_4, B_3.

Suppose that at each step glass bead B_i is moved with probability $p_i > 0$, where $\sum_{i=1}^{n} p_i = 1$. What is the limit of the expected cost of the m-th move, when m tends to infinity?

Input

The first line contains an integer n ($1 \le n \le 100$).

The second line contains n real numbers $p_1, p_2, \ldots, p_n$ each with 6 digits of precision.

Output

Output one real number, the answer.

Your answer will be considered correct if its absolute or relative error does not exceed 10^{-6}. Formally let your answer be a, jury answer be b. Your answer will be considered correct if $\frac{|a-b|}{\max(1,|b|)} \le 10^{-6}$.

Examples

standard input	standard output
`2` `0.500000 0.500000`	`0.500000000000000`
`3` `0.500000 0.250000 0.250000`	`0.916666666666667`

Problem H. Helesta

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

You are given n points $(x_i, y_i),\ 1 \le i \le n$ and m sets $S_j = \{(x_i, y_i) \mid A_j x_i + B_j y_i + C_j > 0\}$ $(1 \le j \le m)$.

You need to find a permutation $p_1, \ldots, p_m$ of $1, 2, \ldots, m$, such that $|S_{p_1}| + \sum_{i=2}^{m} |S_{p_i} \oplus S_{p_{i-1}}| \le M$, where $M = 1.8 \times 10^8$ is a given constant and $A \oplus B$ means $(A \cup B) - (A \cap B)$.

If there are several possible answers, you can print any of them.

Input

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

Each line in the next n lines contains two integers x_i, y_i $(-10^8 \le x_i, y_i \le 10^8)$.

Each line in the next m lines contains three integers A_j, B_j, C_j $(-10^8 \le A_j, B_j, C_j \le 10^8)$.

It is guaranteed that $A_j^2 + B_j^2 > 0$ for $1 \le j \le m$.

Output

Print m lines. In the i-th line, print a single integer p_i.

Example

standard input	standard output
5 3 2021 700 -9384 1031 2201 2561 4982 6255 -1700 388 -2151 1808 -4359815 -2850 -1980 7147359 -924 217 -8902828	2 1 3

Problem I. Interval Mex

Input file:	standard input
Output file:	standard output
Time limit:	1 second
Memory limit:	64 megabytes

For any multiset S (S may contain duplicated elements) of non-negative integers, define $\text{mex}(S)$ as the smallest non-negative integer that is not in S.

You are given a sequence of n non-negative integers $A_1, A_2, \ldots, A_n$ and q queries.

For any interval $[l, r]$ $(1 \leq l \leq r \leq n)$, let its weight be $\text{mex}([l, r]) = \text{mex}(\{A_l, A_{l+1}, \cdots, A_r\})$.

For each query, you are given an interval $[L, R]$ and a positive integer k. Find the k-th smallest weight among all subintervals of $[L, R]$.

Input

The first line contains two integers n, q $(n, q \leq 10^5)$, denoting the length of the sequence and the number of queries.

The second line contains n non-negative integers $A_1, A_2, \cdots, A_n$ $(0 \leq A_i \leq n)$ separated by spaces.

In the following q lines, each line contains three integers L, R, k $(1 \leq L \leq R \leq n, 1 \leq k \leq \frac{(R-L+1)(R-L+2)}{2})$, denoting a query.

Output

Output q lines. The i-th line should contain the answer of the i-th query.

Example

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

Problem J. Just Another String Problem

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

You are given a string s of length n consisting of lowercase English letters and a non-decreasing array $\{v_1, v_2, \cdots, v_n\}$.

A set T of non-empty strings is called good if and only if:

- There does not exist a pair of strings in T such that one is a suffix of the other. Here, string A is said to be a suffix of string B if A can be obtained by deleting some letters (possibly, none) in B in the beginning.

For a good set T, denote the value of T as $\sum_{t \in T} v_{|t|}$, where $|t|$ is the length of string t.

For a string t and some positive integer k, define $f(t, k)$ as the maximum value among all good sets T that satisfies the following conditions:

- $|T| \leq k$;
- T only contains substrings of t. Here, string A is said to be a suffix of string B if A can be obtained by deleting some letters (possibly, none) in B in the beginning and some letters (again, possibly none) in the end.

You need to answer q queries. For each of them, you are given two values l, k $(1 \leq l \leq n, 1 \leq k \leq 10^9)$, and you need to find out $f(s[1, l], k)$, where $s[1, l]$ denotes the prefix with l letters of s.

Input

The input consists of multiple test cases.

The first line contains a single integer T – the number of test cases. Then T test cases descriptions follow.

The first line of each test case contains two integers n, q $(1 \leq n, q \leq 2 \times 10^5)$ – the length of the string s and the number of queries.

The second line contains the string s.

The third line contains n positive integers $v_1, v_2 \cdots v_n$ $(1 \leq v_i \leq 10^9)$. It is guaranteed that $v_1 \leq v_2 \leq \cdots \leq v_n$.

For the next q lines, each line contains two positive integers l, k $(1 \leq l \leq n, 1 \leq k \leq 10^9)$, describing a query.

It is guaranteed that $T \leq 20, \sum q \leq 10^6, \sum n \leq 10^6$.

Output

For each query, print an integer indicating your answer.

Example

standard input	standard output
2 8 3 ababaaab 1 2 2 5 7 8 10 10 8 1 1 2 4 4 6 2 abcacb 4 7 9 10 13 49 4 2 6 3	10 1 7 19 72

Problem K. King of Gamers

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

Little G is going to play n games.

Little G is the king of gamers. If he wants to win, he will definitely win a game. But if he doesn't care about winning or losing, he will lose a game because of his bad luck. Little G has an expected winning rate of $x = \frac{a}{b}$. When playing the i-th game, if his current winning rate is lower than or equal to x, he will be eager to win and win the game easily. Otherwise, he will enjoy the game and lose it.

Given n, a, b, Little G is wondering how many games he will win.

Note that when playing the first game, the winning rate is regarded as 0.

Input

The input consists of multiple test cases.

The first line consists of a single integer T $(1 \le T \le 100000)$ – the number of test cases.

In the following T lines, each line consists of three integers n, a, b $(1 \le n \le 10^9, 0 \le a \le b \le 10^9, b \ne 0)$, denoting a test case.

Output

Print T lines. Print one integer in each line, representing the answer of a test case.

Example

standard input	standard output
3 4 3 5 8 7 10 1 1 3	2 5 1

Note

In the first test case, $x = \frac{3}{5} = 0.6$:

- When playing the first game, the winning rate $= 0 \le x$, so Little G will win the game;
- When playing the second game, the winning rate $= \frac{1}{1} > x$, so Little G will lose the game;
- When playing the third game, the winning rate $= \frac{1}{2} \le x$, so Little G will win the game;
- When playing the fourth game, the winning rate $= \frac{2}{3} > x$, so Little G will lose the game.

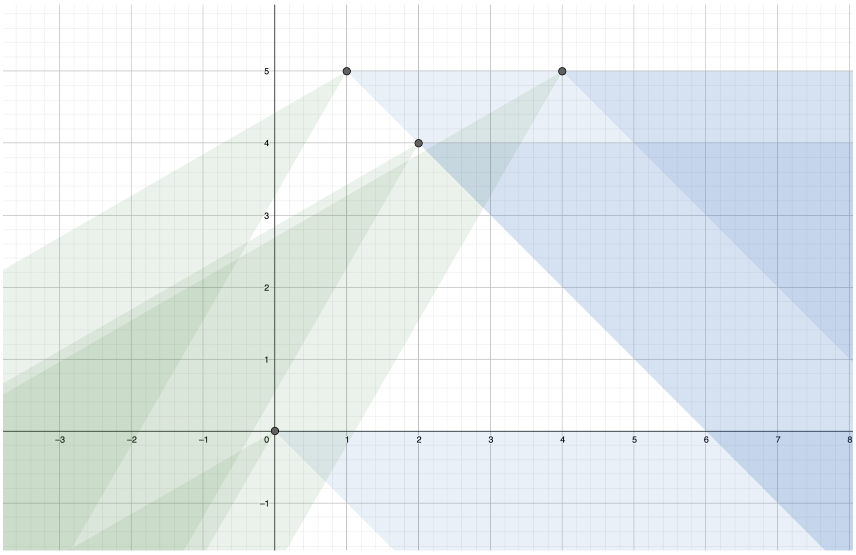
In total, Little G will win 2 games, which is the answer of the first test case.

Problem L. Light of Stars

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

There are n shining stars on an infinite two-dimensional plane. The i-th star can be seen as a point located at (x_i, y_i). It's guaranteed no two stars occupy the same place.

Each star emits the **same** regions of light that don't intersect. Every region of light is given in the form of an angle. Now you want to know, for every star, the number of times it is lightened by other stars. Note that stars will not block the light.



Input

The first line contains two integers n, k $(1 \le n \le 10^5, 1 \le k \le 10)$ – the number of stars and the number of light regions.

The following n lines describe all the stars on the plane. The i-th of these lines contains two integers x_i, y_i $(0 \le x_i, y_i \le 50000)$, describing the coordinates.

The following k lines describe all light regions. The i-th of these lines contains two integers l_i, r_i $(0 \le l_i \le r_i < 180)$, describing an illuminated region. The evaluation of degree starts from the positive x-axis and rotates clockwise.

It is guaranteed that any two different angle intervals do not intersect.

Output

One line contains n integers, denoting the number of times each star is lightened.

Example

standard input	standard output
4 2 0 0 4 5 2 4 1 5 0 45 120 150	1 1 1 0

Problem M. Mountain Is Quiet and Alone

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

Slipped, tumbled, Mountain is quiet and alone.

— Santōka Taneda, *Grass Tree Stupa*

Peng is a young climber who enjoys mountaineering really much. One day he was climbing a tall mountain alone when he, unfortunately, slipped. He started tumbling, rolling down the mountain.

The mountain (up to the point where Peng is at) is a monotone slope described by n points $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$ such that $0 < x_1 < x_2 < \ldots < x_n < 1000$ and $0 < y_1 < y_2 < \ldots < y_n < 1000$. The slope contains the following segments: $((-\infty, 0), (0, 0))$, $((0, 0), (x_1, y_1))$, and $((x_i, y_i), (x_{i+1}, y_{i+1}))$ for all $1 \le i \le n - 1$. For simplicity we consider Peng to be a segment $((x_n, y_n), (x_n, y_n + 1))$ of length 1, and we call the $(x_n, y_n + 1)$ end of the segment Peng's "head".

We now describe the rolling process. Peng always rotates counter-clockwise (downhill) around his lowest contact point with the hill. Whenever he has a new (lower) contact point with the hill, he starts rolling from that point. He only stops rolling when his "head" has y-coordinate 0.

Peng would like to know the total length his "head" travels in the rolling process.

Input

The first line contains an integer n ($1 \le n \le 1000$).

For each of the following n lines, the i-th line contains two real numbers x_i and y_i with at most 6 digits of precision.

Output

Output one real number, the total distance.

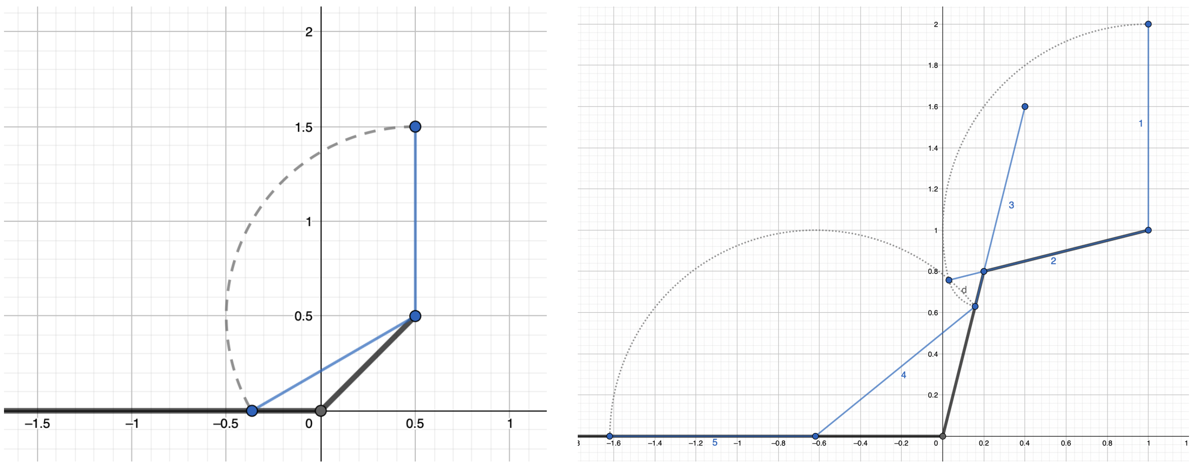
Your answer will be considered correct if its absolute or relative error does not exceed 10^{-6}. Formally let your answer be a and jury's answer be b. Your answer will be considered correct if $\frac{|a-b|}{\max(1,|b|)} \le 10^{-6}$.

Examples

standard input	standard output
1 0.5 0.5	2.094395102393195
2 0.2 0.8 1 1	4.465554239614399

Note

It is guaranteed that during the rotation, when an **end point** of the segment is in contact with the hill, the point is not within 0.0001 distance of points $(0, 0), (x_1, y_1), \ldots, (x_{n-1}, y_{n-1})$.



Explanation for examples.