

Night at the Museum

Input file: **standard input**
Output file: **standard output**
Time limit: 3 seconds
Memory limit: 1024 megabytes

A security guard patrols a museum to monitor exhibits. The patrol route is a closed polyline consisting of n points labeled from 1 to n , which are connected in order (the last point connects back to the first point) to form n consecutive segments. The guard patrols in the order $1 \rightarrow 2 \rightarrow \dots \rightarrow n \rightarrow 1 \rightarrow \dots$. When the guard is not at a segment endpoint, their field of view is a sector with radius r and central angle $2a$, with the sector's bisector aligned with the forward direction of the patrol segment.

A point P on a patrol segment (endpoints exclusive) can see an exhibit at point Q if and only if Q lies within the sector region with apex at P . Given the closed polyline patrol route defined by n points and m exhibit locations, for each $k = 0, 1, \dots, m$, find the total length of patrol routes where exactly k exhibits can be seen.

Input

There is only one test case in each test file.

The first line contains four integers n , m , r , and a ($3 \leq n \leq 2 \times 10^3$, $1 \leq m \leq 2 \times 10^3$, $1 \leq r \leq 10^4$, $0 < a < 90$), indicating the number of points of the closed polyline, the number of exhibits, the radius of the field of view, and the half-angle of the field of view in degrees, respectively.

For the following n lines, the i -th line contains two integers x_i and y_i ($-10^4 \leq x_i, y_i \leq 10^4$), indicating the coordinates of the i -th point of the polyline. Consecutive points form patrol segments, and the last point connects back to the first point to form a closed loop. It is guaranteed that no two consecutive points (including the last and first points) are identical.

For the following m lines, the i -th line contains two integers x'_i and y'_i ($-10^4 \leq x'_i, y'_i \leq 10^4$), indicating the coordinates of the i -th exhibit.

Output

Output $(m + 1)$ lines, where the i -th line contains a real number, indicating the total length of patrol routes where exactly $(i - 1)$ exhibits can be seen.

Your answer will be considered correct if its absolute or relative error does not exceed 10^{-6} . Formally speaking, suppose that your answer is a and the jury's answer is b , your answer is accepted if and only if $\frac{|a-b|}{\max(1,|b|)} \leq 10^{-6}$.

Examples

standard input	standard output
3 2 3 45 1 1 5 5 8 1 2 3 4 2	14.178145584873 2.247170915928 1.231537748691
4 1 3 60 0 0 6 6 6 0 0 6 2 1	25.279547784093 3.691014964384

Note

The first sample test case is illustrated below. A and B are the two exhibits, and G is the guard.

