ACM ICPC Guangzhou Summer Series August Contest
Time Limit: 5 hours

Judge Setup:
Core 2, 1.6Ghz, 2GB ram.
8/13/2017

Problem A: Alice's Travels II
Time Limit: 5 seconds

Description

Alice is a merchant in the world. Layout of this world is a tree on N nodes (i.e., there is only one simple path between any two cities). Each city has an infinite number of gems, each with cost T_i dollars and brightness S_i. Suppose Alice traveled from city U to city V on the shortest path and started with K dollars, then the maximum total brightness (from gems purchased on her route) she can achieve is a some function; let's call it $f(K)$. Compute the following 2 quantities:

$g(K) = \sum_{i=1}^{K} f(i)$ and $h(K) = f(1) \wedge f(2) \ldots \wedge f(K)$ where ^ means XOR.

Input

A number of inputs (≤**20**) described as follows. Input start with N, the number of cities ($0<N\leq 40000$) and K $(0<K \leq 61)$, the maximum dollars. This is followed by N-1 line consecutively, with two numbers x and y between 1 and N on each line, specifying there is a road between cities x and y. Next is a line with N numbers, which is the cost of the gems T_i $(0<T_i \leq K)$. This is followed by a line with N integers, the brightness of the gems S_i $(0<S_i \leq 10^6)$, The next line is an integer Q, the number of inquiries ($0<Q\leq 40000$). Then Q lines, each line input three positive integer U, V, which means Alice travels from city U to city V. Note that $1 \leq x, y, U, V \leq N$.

Output

Output for each query, g(K) and h(K), separated by a space.

Sample Input

```
5 10
1 2
2 3
2 4
1 5
1 2 3 4 5
10 15 30 45 50
5
1 1
5 4
```

Sample Output

```
550 14
600 64
```

Problem B: Between Ceiling and Floor
Time Limit: 5 seconds

Description
Given positive integers *m* and *k*, *let* $f(x, y) = x\lceil y\sqrt{k}\rceil - y\lfloor x\sqrt{k}\rfloor$, compute the number of positive integer pairs such that $f(a, b) = m$, $f(a - b, b) \neq m$, and $f(a, b - a) \neq m$ hold simultaneously.

Input
A number of of inputs (≤**1000**) described as follows.
Each input is just a single line with m and k ($0 < m, k \leq 10^{18}$).

Output
For each input, output a line with the number of pairs.

Sample Input
3 4
3 5

Sample Output
0
4

Problem C: Count Equation Solutions
Time Limit: 5 seconds

Description

Count the number of positive integer solutions to the following equation:

$$a_1 x_1 - a_2 x_2 + a_3 x_3 - a_4 x_4 + a_5 x_5 - a_6 x_6 = 0$$

where a_i are integer coefficients, and x_i are the variables such that $1 \leq x_i \leq M$.

Input

A number of of inputs (≤**600**) described as follows. The first line is M on a single line, followed by the 6 coefficients a_i on the next line. Constraint is $1 \leq M \leq 100$ *and* $0 < a_i \leq 1000000$.

Output

For each input, output the number of solutions on a single line.

Sample Input

2
1 1 1 1 1 1

Sample Output

20

Problem D: Determinant Fun
Time Limit: 5 seconds

Description

Let $M_N = (m_{ij})$ be an NxN matrix, with integer constants *Q, K, A, B* satisfying:

m_{ij} = $A\cos((i+Q\,j)x)+B\sin((i+Q\,j)x), where\ 0\le i, j<N, with\ x=K\frac{\pi}{N}$.

Given an integer interval [*L*, *R*], compute $\sum_{N=L}^{R} det(I+M_N)$, where *I* is the identity matrix, and *det* is the determinant of a square matrix.

Input

A number of of inputs (≤**1000**), each line with integers *Q, K, A, B, L, R.* They satisfy,
$0 < K, A, B, L, R \le 10^9$, $0 < L \le R \le 10^9$, $|Q| \le 1$. Additionally, if Q=0 and K is odd, then $R - L \le 300$.

Output

For each input, output the answer on one line, rounded to **6** digits after the decimal.

Sample Input

```
-1 12 10 8 3 10
1 13 7 9 3 10
0 11 10 7 3 10
```

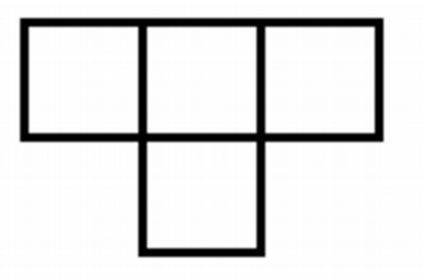
Sample Output

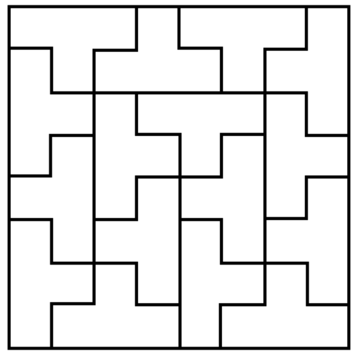
```
13607.000000
-12342.000000
57.083113
```

Problem E: Easy Tiling Problem
Time Limit: 5 seconds

Description

Given an *N*x*M* rectangle, compute the number of tilings (complete coverings) with the following piece with 4 blocks (on the left):





Note that the piece can be rotated and flipped but not cut. An example tiling of an 8x8 rectangle is given above right.

Input

A number of of inputs (≤**100**), each line with N and M ($4 \le N \le 24$, $4 \le M \le 10^9$). Additionally, we stipulate the condition that both N and M are integer multiples of 4 (i.e. $4|N$ and $4|M$).

Output

For each input, output the answer modulo **1000000007** on one line.

Sample Input

4 4
4 8

Sample Output

2
6

Problem F: Finding Paths
Time Limit: 5 seconds

Description

Compute the number of paths in 3D caretesian space from *(0, 0, 0)* to *(n, m, k)*, where n, m, k are positive integers, such that each step consist of going from *(x, y, z)* to one of *{(x+1, y+1, z+1), (x, y+1, z+1), (x+1, y, z+1), (x+1, y+1, z), (x+1, y, z), (x, y+1, z), (x, y, z+1)}*. Additionally, in at least one of the steps in each path, we end up going from *(x, y, z)* to one of *{(x+1, y+1, z+1), (x, y+1, z+1), (x+1, y, z+1), (x+1, y+1, z)}*.

Input

A number of of inputs (≤**200**), with *n, m, k* on each line separated by a single space,
such that $0 < n, m, k \leq 1000$.

Output

For each input, output the number of paths modulo **1000000007**.

Sample Input

1 1 1
1 2 3

Sample Output

7
179

Problem G: Great Coin Game
Time Limit: 5 seconds

Description

Before the game begins, each of *n* students writes down a unique string of length *m* consisting of only 'H' for head and 'T' for tail (any 2 students will not write the same string). Subsequently, when the game begins, a fair coin is flipped repeatedly until the last *m* flips matches one of the pre-written strings. Compute the probability of each student winning a prize.

Input

A number of of inputs (≤**100**) with the following format.
The first line has *n*, *m*. Next, we have *n* lines, each with a string of length *m* consisting of 'H' and 'T'.
Note that $1 \le n, m \le 300$.

Output

Print the probability of each student winning, one on each line. Round to 6 digits after decimal.

Sample Input

```
3 3
THT
TTH
HTT
```

Sample Output

```
0.333333
0.250000
0.416667
```

Problem H: Half the Polygon
Time Limit: 5 seconds

Description
An orthogonal polygon has the property that all of its edge intersections are at right angles. Thus the interior angle at each vertex is either 90° or 270°. Given an orthogonal simple polygon (non-self intersecting or touching) with integer coordinates, determine if it can be cut exactly in half with a horizontal or vertical segment, such that we end up dividing the polygon into two identical polygons. Two polygons are considered identical if one can be transformed into the other using some combination of reflections, rotations and translations. Also, the endpoints of the dividing segment must also be integers.

Input
A number of of inputs (≤**50**), each starting with two integers n ($4 \le n \le 100000$) on a line, the number vertices in the polygon. This is followed by n lines, each with the x, y ($0 \le x, y \le 10^9$) coordinates indicating a vertex on the polygon (listed in order, such that connecting them in order yields the polygon).

Output
For each input, output "Yes", if the polygon can be split in half with a vertical or horizontal, cut and "No" otherwise.

Sample Input
```
4
0 2
2 2
2 0
0 0
6
0 0
1 0
1 1
2 1
2 2
0 2
```

Sample Output
```
Yes
No
```

Problem I: Interesting Resister Graph
Time Limit: 5 seconds

Description

A graph G has n nodes, v_1, v_2, …, v_n such that v_i is connected to v_{i+1} for $0 \le i \le n\text{-}2$. The last node, v_n is connected to all nodes v_j for $0 \le j \le n\text{-}1$. Each edge of the graph has a single resistor with resistance of 1 ohm. Given 2 nodes, v_i and v_j, find the equivalent resistance between these 2 nodes. Note that when we add a power source to the 2 nodes with I amperes, then each node on the graph has some fixed voltage, and each edge has some fixed current, such that the inward current equals the outward current on each node that is not v_i (has net input current I) and v_j (has net output current I). Moreover, Ohm's law is followed, which says that $R = V / I$, where I is the current in amperes, V the voltage in volts and R the resistance in ohms. This is all the information needed to solve the problem.

Input

A number of of inputs (≤10000), each starting with n, i, j on a line ($1 \le i < j \le n \le 10000$).

Output

For each input, output the equivalent resistance between v_i and v_j, rounded to 6 digits after the decimal.

Sample Input

3 1 2
3 1 3

Sample Output

0.298142
0.447214

Problem J: Journey through Gridland
Time Limit: 5 seconds

Description

Alice is journeying through grid land. She starts in the southwest corner at coordinate *(0, 0)* and must reach the northeast corner at *(n, m)*, where *n, m* are positive integers indicating the northeast corner is *n* units to the east and *m* units to the north. At each step she can move one unit to the east at cost *u*, one unit to the north at cost *v*, or $\sqrt{2}$ units to the northeast (45° angle) at cost *w* for integers *u, v, w*. The cost of a single path is the sum of the cost of all steps taken to reach the northeast corner. Compute the sum of the cost of all possible paths that Alice can take!

Input

A number of of inputs (≤**1000**), each start with the integer *n, m, u, v, w* ($1 \le n, m, u, v, w \le 1000000$).

Output

Output the answer modulo **1000000007**.

Sample Input

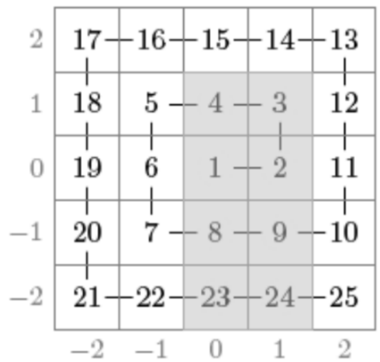
```
2 3 1 1 1
3 2 1 2 3
```

Sample Output

```
25
278
```

Problem K: Kid's Spiral Problem
Time Limit: 5 seconds

Description



A spiral on a grid of size (*2n+1*) x (*2n+1*) has been constructed as follows. Number 1 is in the center square, number 2 is to the right of it, and then we continue place the positive integers in order along the spiral in counterclockwise fashion. Now, given 2 coordinates indicating 2 corners of a rectangle, find the sum of all numbers in the enclosing rectangle. See the figure above for example.

Input

A number of of inputs (≤**100**), each starting with line contains two integers and n ($1 \le n \le 10^9$) and q ($1 \le q \le 100$): the size of the grid and the number of queries. After this, there are lines, each containing four integers (x_1, y_1) and (x_2, y_2) in that order, where $-n \le x_1, y_1, x_2, y_2 \le n$. This is the 2 corners of the rectangle.

Output

For each input, output the answer modulo **1000000007**.

Sample Input

2 3
0 -2 1 1
-1 0 1 0
1 2 1 2

Sample Output

74
9
14