CCC 2014 Stage 2
Day 2, Problem 1: Where's That Fuel?

Problem Description

The heroic Team Star Fox is on a mission to collect as much fuel as possible from various planets across the Lylat System. There are N $(1 \leq N \leq 10^5)$ planets, and the ith one contains A_i fuel cells - but travelling there from any other planet uses up B_i fuel cells $(1 \leq A_i, B_i \leq 10^4)$. Unfortunately, fuel cells are not a sustainable resource, so if a planet is visited for a second time, there will be no new fuel to collect.

Team Star Fox starts on planet P $(1 \leq P \leq N)$ – as such, they may collect its fuel cells immediately. They may then travel to as many different planets as they'd like to, in any order, as long as they have sufficient fuel to spend on each flight (that is, their fuel cell count remains non-negative). Finally, they may choose to stop at any point (possibly even before leaving planet P), with the goal of maximizing the number of fuel cells they end up with. If this can be done in multiple ways, they'd like to maximize the number of different planets they visit as a secondary objective. Can you help our heroes?

Input Specification

The first line contains two integers: N $(1 \leq N \leq 10^5)$, followed by a space, followed by P $(1 \leq P \leq N)$, which represents the number of planets followed by the starting planet number. The next N lines contain A_i, followed by a space, followed by B_i $(1 \leq A_i, B_i \leq 10^4)$.

You can assume that for test cases worth 20% of the marks, $N \leq 10$.

Output Specification

The output consists of two lines, with each line containing one positive integer. The first line contains the largest number of fuel cells that Team Star Fox can possess once they decide to stop. The second line contains the largest number of planets that Team Star Fox can visit, such that they still end up with this maximal number of fuel cells.

Sample Input

```
5 2
12 12
10 100
8 3
4 5
25 15
```

Output for Sample Input

```
25
4
```

Explanation of Output for Sample Input

Team Star Fox starts on planet 2, on which they collect 10 fuel cells to start off. They should proceed by travelling to planet 3, costing them 3 fuel cells but then increasing their fuel cell count to 15. Next, they can fly to planet 1, lowering their fuel cell count to 3 but then promptly restoring it to 15. Finally, they have just enough fuel to reach planet 5, at which point they can collect its fuel cells to end up with 25. They should then choose to stop without ever visiting planet 4.

CCC 2014 Stage 2
Day 2, Problem 2: Early Exam Evacuation

Problem Description

You find yourself writing an exam in a long, narrow auditorium – it has N ($1 \leq N \leq 10^5$) rows, numbered $1..N$ from the front to the back, each of which has 6 seats, 3 on each side of the aisle running down the middle of the auditorium. Each seat is identified by its row number immediately followed by a letter from "A" to "F", which indicates its position in that row (with seat "A" at the far left, and "F" at the far right). The aisle lies between seats "C" and "D" in each row. The auditorium also has two secure rooms – one at the front (in front of row 1), and one at the back (behind row N).

Every seat in the auditorium is initially occupied by exactly one exam-writer per seat. However, over the course of the exam, M different exam writers decide that they have written all they can on the exam, and then would like to leave the auditorium, one after another. The ith exam writer is in seat R_iC_i ($1 \leq R_i \leq N$, C_i is one of "A".."F"). When the exam writer leaves the auditorium, they must stay in one of the secure rooms until the end of the exam. Fortunately, both secure rooms can hold as many people as necessary.

Exam writers not only worry about writing exams, but they would like their lives to be as convenient as possible - as such, they're interesting in working together to minimize the total inconvenience experienced by all of them. The inconvenience a single exam-writer experiences is $Ax+By$, where A and B are given constants ($0 \leq A, B \leq 10^9$), x is the number of different people passed on the way to the chosen secure room (explained below), and y is the number of people already in that secure room before that exam-writer enters. Note that if an exam-writer does not leave their seat, their inconvenience is 0.

When walking from a seat to a secure room, one must first pass any other exam writers in the same row on the way to the aisle, and then any exam writers in seats adjacent to the aisle from that row to either row 1 or N (depending on which secure room is chosen), inclusive. Note that any vacant seats passed along the way don't count towards this value.

Can you help the poor exam writers make their lives as convenient as possible?

Input Specification

The first line contains four space-separated integers: N ($1 \leq N \leq 10^5$), the number of rows in the auditorium; M ($1 \leq M \leq 6N$), the number of exam writers that leave early; A, followed by B ($1 \leq A, B \leq 10^9$), the constants used in determining the inconvenience caused by an exam writer leaving early.

The next M lines each contain one integer followed by one character, R_i and C_i, for $i = 1..N$ in order, where $1 \leq R_i \leq N$ and $C_i \in$ "A".."F".

You can assume that for test cases worth 60% of the marks, $M \leq 5000$.

Output Specification
Output the integer which is the minimum total inconvenience experienced by all M exam writers who leave early.

Sample Input
```
5 5 3 4
3E
1D
5C
1E
4A
```

Output for Sample Input
```
55
```

Explanation of Output for Sample Input
One optimal strategy is as follows. The first person to leave can go to the front secure room, passing six people along the way (in seats 3D, 3C, 2D, 2C, 1D, and 1C) for an inconvenience of $3 \cdot 6 + 4 \cdot 0 = 18$. The second person to leave can also go to the front secure room, passing only one person (in seat 1C) and finding one person already in the secure room, for an inconvenience of $3 \cdot 1 + 4 \cdot 1 = 7$. The third person can go to the back secure room, passing one person for an inconvenience of 3. The fourth person can join the first two in the front secure room, passing only one person (as seat 1D is vacant at that point) for an inconvenience of 11. Finally, the fifth person to leave can go to the back secure room, passing four people and meeting one person in the back secure room for an inconvenience of 16. The total inconvenience experienced by the exam writers with this strategy is $18 + 7 + 3 + 11 + 16 = 55$.

CCC 2014 Stage 2
Day 2, Problem 3: Gates

Problem Description

You're in an airport hallway with G $(1 \leq G \leq 10^9)$ gates, numbered from 1 to G in order. The entrance to gate i is $100 \cdot i$ metres from the start of the hallway.

There are also N $(0 \leq N \leq 10^5)$ moving walkways. The ith walkway runs from the entrance to gate A_i $(1 \leq A_i \leq G)$ to the entrance to a different gate B_i $(1 \leq B_i \leq G)$ at a speed of S_i $(1 \leq S_i \leq 10^9)$ metres per minute, in one direction only. At every point along the hallway, there is at most one walkway moving in each direction (towards the start of the hallway, or away from it). However, it is possible that one walkway starts at the same gate as another walkway, moving in the same direction, ends.

You can walk in either direction along the hallway at a speed of W $(1 \leq W \leq 10^9)$ metres per minute. Additionally, when at the start of a walkway, you may choose to get on it, in which case it'll carry you directly to its end - you may not get on or off in between these points. While on walkway i, you will move at a speed of $W + S_i$ metres per minute.

To amuse yourself while waiting for your flight (which, of course, has been delayed), you've posed Q $(1 \leq Q \leq 10^5)$ queries to yourself. The ith query involves finding the minimal time in which you can get from gate X_i $(1 \leq X_i \leq G)$ to gate Y_i $(1 \leq Y_i \leq G)$. To make things more interesting, you've decided that you won't board your flight unless you can correctly answer all of these queries - so you'd better not screw up!

Input Specification

The first line contains four integers: G $(1 \leq G \leq 10^9)$, the number of gates; W $(1 \leq W \leq 10^9)$, the walking speed; N $(0 \leq N \leq 10^5)$, the number of moving walkways; and Q $(1 \leq Q \leq 10^5)$, the number of queries.

The next N lines each contain three integers dealing with walkway i $(i = 1..N)$: A_i $(1 \leq A_i \leq G)$, the starting gate; B_i $(1 \leq B_i \leq G)$, the ending gate; S_i $(1 \leq S_i \leq 10^9)$, the speed. Note that $A_i \neq B_i$ for any i.

The next Q lines each contain two integers dealing with query $i = 1..Q$: X_i $(1 \leq X_i \leq G)$, the starting gate; and Y_i $(1 \leq Y_i \leq G)$, the ending gate.

You can assume that for some test cases, at least some of G, N and Q are small. This information may be helpful, or not.

Output Specification

The output is Q lines, each line containing one real number which is the minimal amount of time required to travel from gate X_i to gate Y_i (in minutes), for $i = 1..Q$. The output will be judged to be correct if the outputted answer is within a factor of 10^{-4} of the correct solution: that is, if D is the correct answer, values in the range $[D \cdot (1 - 10^{-4}), D \cdot (1 + 10^{-4})]$ will be judged as correct.

Sample Input

```
6 10 3 4
2 3 15
4 2 150
3 6 290
3 2
2 3
1 4
4 6
```

Output for Sample Input

```
10.0
4.0
24.0
6.25
```

Explanation of Output for Sample Input

For the first query, you should simply walk from gate 3 to gate 2, covering 100 metres at a speed of 10 metres per minute.

For the second query, you should immediately get on the moving walkway going from gate 2 to gate 3, covering 100 metres at a speed of $10 + 15 = 25$ metres per minute.

For the third query, you should walk to gate 2 (taking 10 minutes), then take the walkway as before (taking 4 minutes), and then walk to gate 4 (taking 10 minutes).

Finally, for the fourth query, you should take the walkway from gate 4 to gate 2 (taking 1.25 minutes), then the walkway from gate 2 to gate 3 (taking 4 minutes), and finally the walkway from gate 3 to gate 6 (taking 1 minute).