Exercise – *Astérix and the Roman Legions*

Knowing that the Gaulish village is temporarily out of magic potion, Julius Caesar has sent all his troops to attack in an attempt to subdue the rebels. In a desperate move, Astérix and Panoramix venture into the woods to gather the missing ingredients to prepare a new batch of the potion. Having found all the ingredients, they realize that they are now completely surrounded by Roman legions. Fortunately, the Romans seem to be oblivious to their advantage, and so Astérix and Panoramix stay hidden in the woods. Every legion lies in a straight line formation and is waiting for the signal to attack. There are so many soldiers that from the perspective of Astérix and Panoramix, every legion appears as (an unbounded number of soldiers arranged in) a straight line.

Astérix and Panoramix know that they need to get back to the village before the attack begins or the consequences will be dire. Their only option is to make a fire and brew the potion right there in the woods. They have all the ingredients ready. However, the moment they start making the fire, the Romans will notice the smoke and every single soldier will immediately run straight towards them. All soldiers within the same legion run at the same speed. However, soldiers in different legions may run at different speeds.

Knowing the position and speed of the legions, Astérix and Panoramix need to choose the location where to make the fire and brew the potion. This location must be *reachable*, that is, they can move from their starting location to this location without crossing any legion. For a location p, the *preparation time* for p is the time that passes between starting the fire at p up to the moment when the first soldier reaches p. Your job is to help Astérix and Panoramix to find the maximum preparation time among all reachable locations.

Remark. The signed distance $d(p, \ell)$ of a point $p = (p_x, p_y)$ to a line $\ell : ax + by + c = 0$ can be computed by

$$d(p, \ell) = \frac{ap_x + bp_y + c}{\sqrt{a^2 + b^2}}.$$

Input The first line of the input contains the number $t \leqslant 30$ of test cases. Each of the t test cases is described as follows.

- It starts with a line containing three integers `xs ys n`, separated by a space. They denote
  - (x_s, y_s), the initial location of Astérix and Panoramix ($|x_s|, |y_s| \leqslant 2^{24}$);
  - n, the number of legions ($1 \leqslant n \leqslant 2 \cdot 10^3$).
- The following n lines define the legions. Each legion is described by four integers `a b c v`, separated by a space. They denote
  - a, b, c, the coefficients of the equation $ax + by + c = 0$ of the straight line where the legion is positioned ($|a|, |b|, |c| \leqslant 2^{24}$; you may suppose that $\sqrt{a^2 + b^2} > 0$ is an integer);

- v, the speed of the legion ($1 \leqslant v \leqslant 2^8$), meaning that every soldier in this legion moves a distance of v per second.

You may assume that the n straight lines that represent legions are pairwise distinct and that the initial location of Astérix and Panoramix does not lie on any of these lines. You may also assume that any ray emanating from (x_s, y_s) hits at least one Roman legion.

Output The output for each test case consists of a separate line that contains a single integer that denotes the maximum preparation time in seconds among all reachable locations, rounded down to the nearest integer.

Points There are four groups of test sets, each of which is worth 25 points. So, there are $4 \cdot 25 = 100$ points in total.

1. For the first group of test sets, you may assume that $1 \leqslant n \leqslant 200$, and that every legion lies on a straight line that is either vertical or horizontal, that is, either $a = 0$ or $b = 0$.
2. For the second group of test sets, you may assume that $1 \leqslant n \leqslant 200$, that for each legion $ax_s + by_s + c < 0$, and that its speed is one ($v = 1$).
3. For the third group of test sets, you may assume the speed of all legions is one ($v = 1$).
4. For the fourth group of test sets, there are no additional assumptions.

Corresponding sample test sets are contained in `testi.in/out`, for $i \in \{1, 2, 3, 4\}$.

Sample Input

```
2
1 1 3
3 4 -24 1
0 -1 0 1
-1 0 0 1
0 4 4
4 -3 -2 1
0 2 -4 2
0 1 -6 1
1 0 1 2
```

Sample Output

```
2
1
```