--- Day 17: Clumsy Crucible ---

The lava starts flowing rapidly once the Lava Production Facility is operational. As you leave, the reindeer offers you a parachute, allowing you to quickly reach Gear Island.

As you descend, your bird's-eye view of Gear Island reveals why you had trouble finding anyone on your way up: half of Gear Island is empty, but the half below you is a giant factory city!

You land near the gradually-filling pool of lava at the base of your new **lavafall**. Lavaducts will eventually carry the lava throughout the city, but to make use of it immediately, Elves are loading it into large crucibles on wheels.

The crucibles are top-heavy and pushed by hand. Unfortunately, the crucibles become very difficult to steer at high speeds, and so it can be hard to go in a straight line for very long.

To get Desert Island the machine parts it needs as soon as possible, you'll need to find the best way to get the crucible **from the lava pool to the machine parts factory**. To do this, you need to minimize **heat loss** while choosing a route that doesn't require the crucible to go in a **straight line** for too long.

Fortunately, the Elves here have a map (your puzzle input) that uses traffic patterns, ambient temperature, and hundreds of other parameters to calculate exactly how much heat loss can be expected for a crucible entering any particular city block.

For example:

```
2413432311323
3215453535623
3255245654254
3446585845452
4546657867536
1438598798454
4457876987766
3637877979653
4654967986887
4564679986453
1224686865563
2546548887735
4322674655533
```

Each city block is marked by a single digit that represents the **amount of heat loss if the crucible enters that block**. The starting point, the lava pool, is the top-left city block; the destination, the machine parts factory, is the bottom-right city block. (Because you already start in the top-left block, you don't incur that block's heat loss unless you leave that block and then return to it.)

Because it is difficult to keep the top-heavy crucible going in a straight line for very long, it can move **at most three blocks** in a single direction before it must turn 90 degrees left or right. The crucible also can't reverse direction; after entering each city block, it may only turn left, continue straight, or turn right.

One way to **minimize heat loss** is this path:

```
2>>34^>>>1323
32v>>>35v5623
32552456v>>54
3446585845v52
4546657867v>6
14385987984v4
44578769877v6
36378779796v>
465496798688v
456467998645v
122468686556<v
254654888774v5
432267465553v>
```

This path never moves more than three consecutive blocks in the same direction and incurs a heat loss of only **102**.

Directing the crucible from the lava pool to the machine parts factory, but not moving more than three consecutive blocks in the same direction, **what is the least heat loss it can incur?**

Your puzzle answer was **767**.

--- Part Two ---

The crucibles of lava simply aren't large enough to provide an adequate supply of lava to the machine parts factory. Instead, the Elves are going to upgrade to **ultra crucibles**.

Ultra crucibles are even more difficult to steer than normal crucibles. Not only do they have trouble going in a straight line, but they also have trouble turning!

Once an ultra crucible starts moving in a direction, it needs to move **a minimum of four blocks** in that direction before it can turn (or even before it can stop at the end). However, it will eventually start to get wobbly: an ultra crucible can move a maximum of **ten consecutive blocks** without turning.

In the above example, an ultra crucible could follow this path to minimize heat loss:

```
2>>>>>>>>1323
32154535v5623
32552456v4254
34465858v5452
45466578v>>>>
14385987984v
44578769877v
36378779796v
46549679868v
45646799864v
12246868655v
25465488877v
43226746555v
```

In the above example, an ultra crucible would incur the minimum possible heat loss of **94**.

Here's another example:

```
111111111111
999999999991
999999999991
999999999991
999999999991
```

Sadly, an ultra crucible would need to take an unfortunate path like this one:

```
1>>>>>>>1111
9999999v9991
9999999v9991
9999999v9991
9999999v>>>>
```

This route causes the ultra crucible to incur the minimum possible heat loss of **71**.

Directing the **ultra crucible** from the lava pool to the machine parts factory, **what is the least heat loss it can incur?**

Your puzzle answer was **904**.

**Both parts of this puzzle are complete! They provide two gold stars: **

At this point, you should return to your Advent calendar and try another puzzle.

If you still want to see it, you can get your puzzle input.

You can also [Share] this puzzle.