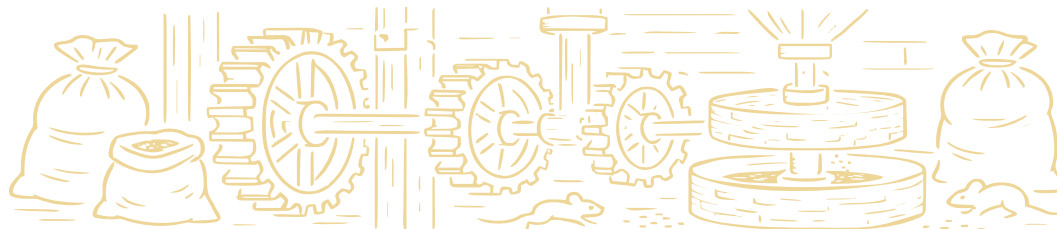Julian Williams
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The Song of Ducks and Dragons [2025]

Quests   Leaderboards   Stats   Head to Head   Your times

Quest 4: Teeth of the Wind

< Quest 3   Quest 5 >

Part I

> **Story section**
>
> The heavy loads mean the wagons trundle slowly along the muddy road. You sit on one of them and take in the lovely scenery around you. The village where your story began is still visible behind you. The grain fields spread out in front of you, rolling like a golden sea. Three windmills are visible on the hill above the fields. A light breeze is blowing through the air, but their huge blades are absolutely still.
>
> The knight points to one of the mills and says, "That's where we stop. The garrison needs flour, and because you planned the packing of the crates so well, there is still some room left."
>
> From a distance, you see an older man with a grey beard covered in flour dust. He looks distressed. Before you had a chance to greet each other, he raised his hand in a gesture of apology, shouting, "Apologies sir! The mill is out of order!"
>
> You talk for a while to find out what happened. It turns out that the gears transmitting the wind's energy to the millstones have been replaced, but the mechanism has not yet been properly calibrated. The miller does not want to risk wasting the wheat grains and wants to first calculate everything precisely before restarting the mill. The knight looks in your direction, and you exchange a knowing nod.

The miller hands you a list of numbers representing the gears of the first mill (your notes). Each number corresponds to the number of teeth on the given gear. The first gear on the list is connected directly to the windmill. The last gear is responsible for driving the millstones. The gears are connected to each other in the order on the list.

Sample list of gears:

```
10
7
13
6
```

looks like this in practice:

To calibrate the first mill, you need to calculate the number of full turns the last gear will make if the first one makes exactly `2025` full rotations.

Example based on the following notes:

```
128
64
32
16
8
```

The second gear (64) has half as many teeth as the first one (128). For this reason, for every full turn of the first gear, the second gear will make two full turns.

The same relationship occurs between successive pairs of gears. The gear (32) will therefore turn twice for one turn of the gear (64) and thus 4 times for each turn of the gear (128).

Analysing the movement of gears (16) and (8) analogously, it can be observed that for each single turn of gear (128), the last gear (8) will make exactly 16 full turns.

Multiplying 16 by 2025 (the number of full turns of the first gear) gives you the final result for this example: [32400].

```
102
75
50
35
13
```

In the second example, the relationship between the sizes of the gears no longer fits together perfectly, but you notice a faster and equally accurate method for calculating the required value. In this example, after 2025 full turns of the first gear, the last one will complete [15888] full turns.

How many full turns will the last gear make if the first one turns exactly [2025] times?

Your notes for this part:

⎘ Copy   ⬈ Open   ⬇ Download

Part 1 solved with answer: 10714
⚙ Check your progress ⚙

Part II

The first mill is starting to operate and produce flour! You promptly proceed to calibrate the next mill (your notes). The gears' operation and list format are the same as for the first mill. Only the method of calibrating is different.

To calibrate the second mill, you need to provide the minimum number of full turns that the first gear must make, so that the last one turns at least [10000000000000] times.

Example based on the following notes:
```
128
64
32
16
8
```

For the last gear to turn at least [10000000000000] times, the first gear must make at least [625000000000] full turns.

```
102
75
50
35
13
```

In the second example, for the last gear to turn at least [10000000000000] times, the first gear must make at least [1274509803922] full turns.

What is the minimum number of full turns for the first gear, after which the last one turns at least [10000000000000] times?

Your notes for this part:

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Part 2 solved with answer: 715835140998
⚙ Check your progress ⚙

Part III

The second mill is also starting up at full capacity! The miller is regaining his positive mood. Only the third mill remains to be calibrated.

The mechanism of the last mill differs from the previous ones. The list of gears provided by the miller (your notes) starts and ends with single gears, just like before. However, between them are pairs of gears mounted on common shafts. Thanks to this,

they always turn at the same speed, meaning that if one of the gears makes, for example, 10 full turns, the other will also make exactly 10 full turns.

The list represents gear pairs as numbers separated by a pipe character, such as `15 | 45`. The number on the left represents the gear connected to the previous gear on the list. The number on the right represents the gear connected to the subsequent gear on the list.
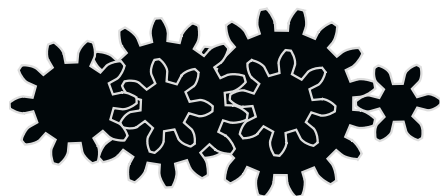
Sample list of gears:

```
10
7 | 14
8 | 16
6
```

is connected in the following way:

`10 > 7 | 14 > 8 | 16 > 6`

and it looks like this in practice:

To calibrate the last mill, it is necessary to calculate how many full turns the last gear makes, if the first one turns exactly `100` times.

Example based on the following notes:

```
5
5 | 10
10 | 20
5
```

The second gear turns once after the first gear turns once because the left side gear of the first pair has the same number of teeth as the first gear on the list (5).

The next gear also turns once because its gear on the left side has exactly the same number of teeth as the gear of the previous pair of gears on the right side (10).

The last gear with 5 teeth turns 4 times because it is connected to a gear with 20 teeth, which has only turned once.

After 1 turn of the first gear, the last gear turns exactly 4 times; therefore, after `100` full turns of the first gear, the last gear will turn exactly `400` times.

```
5
7 | 21
18 | 36
27 | 27
10 | 50
10 | 50
11
```

In the second example, after `100` full turns of the first gear, the last gear will make `6818` full turns.

How many full turns will the last gear make if the first one turns exactly `100` times?

Your notes for this part:

📋 Copy   ⊡ Open   ⬇ Download

Part 3 solved with answer: 253146706419

⚙ Check your progress ⚙

Puzzle solved! Don't stop now!

Post your solution, compare ideas, and help others grow on Reddit 🔴