6011. Minimum Time to Finish the Race

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User Accepted:	0
User Tried:	0
Total Accepted:	0
Total Submissions:	0
Difficulty:	Hard

You are given a **0-indexed** 2D integer array `tires` where `tires[i] = [f_i, r_i]` indicates that the i^{th} tire can finish its x^{th} successive lap in $f_i * r_i^{(x-1)}$ seconds.

- For example, if $f_i = 3$ and $r_i = 2$, then the tire would finish its 1^{st} lap in 3 seconds, its 2^{nd} lap in $3 * 2 = 6$ seconds, its 3^{rd} lap in $3 * 2^2 = 12$ seconds, etc.

You are also given an integer `changeTime` and an integer `numLaps`.

The race consists of `numLaps` laps and you may start the race with **any** tire. You have an **unlimited** supply of each tire and after every lap, you may **change** to any given tire (including the current tire type) if you wait `changeTime` seconds.

Return *the **minimum** time to finish the race.*

Example 1:

```
Input: tires = [[2,3],[3,4]], changeTime = 5, numLaps = 4
Output: 21
Explanation:
Lap 1: Start with tire 0 and finish the lap in 2 seconds.
Lap 2: Continue with tire 0 and finish the lap in 2 * 3 = 6 seconds.
Lap 3: Change tires to a new tire 0 for 5 seconds and then finish the lap in another 2 seconds.
Lap 4: Continue with tire 0 and finish the lap in 2 * 3 = 6 seconds.
Total time = 2 + 6 + 5 + 2 + 6 = 21 seconds.
The minimum time to complete the race is 21 seconds.
```

Example 2:

```
Input: tires = [[1,10],[2,2],[3,4]], changeTime = 6, numLaps = 5
Output: 25
Explanation:
Lap 1: Start with tire 1 and finish the lap in 2 seconds.
Lap 2: Continue with tire 1 and finish the lap in 2 * 2 = 4 seconds.
Lap 3: Change tires to a new tire 1 for 6 seconds and then finish the lap in another 2 seconds.
Lap 4: Continue with tire 1 and finish the lap in 2 * 2 = 4 seconds.
Lap 5: Change tires to tire 0 for 6 seconds then finish the lap in another 1 second.
Total time = 2 + 4 + 6 + 2 + 4 + 6 + 1 = 25 seconds.
The minimum time to complete the race is 25 seconds.
```

Constraints:

- $1 <= tires.length <= 10^5$
- `tires[i].length == 2`
- $1 <= f_i, changeTime <= 10^5$
- $2 <= r_i <= 10^5$
- $1 <= numLaps <= 1000$

JavaScript

```
const MAX = Number.MAX_SAFE_INTEGER;
const minimumFinishTime = (tires, changeTime, numLaps) => {
    let min = Array(20).fill(MAX), dp = Array(numLaps + 1).fill(MAX);
    min[0] = 0;
    for (const [f, r] of tires) {
        let sum = 0;
        for (let i = 1; i < 20; i++) {
            sum += f * r ** (i - 1);
            min[i] = Math.min(min[i], sum);
            if (sum > 1e6) break;
        }
    }
```

```
    dp[0] = 0;
    for (let i = 1; i <= numLaps; i++) {
        for (let j = 1; j < 20; j++) {
            if (i >= j) dp[i] = Math.min(dp[i], dp[i - j] + min[j] + changeTime);
        }
    }
    return dp[numLaps] - changeTime;
};
```

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