Project Euler #238: Infinite string tour

This problem is a programming version of Problem 238 from projecteuler.net

Create a sequence of numbers using the pseudo-random number generator:
$s_0 = 4$
$s_{n+1} \equiv s_n^5 \pmod{16710461}$

Concatenate these numbers $s_0 s_1 s_2 \ldots$ to create a string w of infinite length.

Then, $w = 41024115686749788043194661412184143163431\ldots$

For a positive integer k, if no substring of w exists with a sum of digits equal to k, $p(k)$ is defined to be zero. If at least one substring of w exists with a sum of digits equal to k, we define $p(k) = i$, where i is the starting position of the earliest such substring. **The string w is 1-based indexed**.

For instance:

The substrings "4", "41" and "4102" with respective sums of digits equal to 4, 5 and 7 start at position 1, hence $p(4) = p(5) = p(7) = 1$.

The substrings "1" and "102" with respective sums of digits equal to 1 and 3 start at position 2, hence $p(1) = p(3) = 2$. Note that the substring "1024" starting at position 2, has a sum of digits equal to 7, but there was an earlier substring (starting at position 1) with a sum of digits equal to 7, so $p(7) = 1$, not 2.

Let $P_e(N) = \sum_{k=1}^{N} p(k) k^e$.

Given two integers e and N, find $P_e(N)$ modulo 1004535809.

Input Format

The only line of each test file contains two space-separated integers e and N.

Constraints

- $0 \le e \le 10^5$.
- $1 \le N \le 10^{18}$.
- The time limit is the double of the usual time limit.

Output Format

Print a single integer denoting $P_e(N)$ modulo 1004535809.

Sample Input 0

```
0 10
```

Sample Output 0

```
38
```

Sample Input 1

```
1 8
```

Sample Output 1

```
64
```

Sample Input 2

```
2 100
```

Sample Output 2

```
2035208
```

Sample Input 3

```
100000 1000000000000000000
```

Sample Output 3

```
57752062
```