Project Euler #254: Sums of Digit Factorials

This problem is a programming version of Problem 254 from projecteuler.net

Define $f(n)$ as the sum of the factorials of the digits of n. For example, $f(342) = 3! + 4! + 2! = 32$.

Define $sf(n)$ as the sum of the digits of $f(n)$. So $sf(342) = 3 + 2 = 5$.

Define $g(i)$ to be the smallest positive integer n such that $sf(n) = i$. Though $sf(342)$ is 5, $sf(25)$ is also 5, and it can be verified that $g(5)$ is 25.

Define $sg(i)$ as the sum of the digits of $g(i)$. So $sg(5) = 2 + 5 = 7$.

Further, it can be verified that $g(20)$ is 267 and $\sum_{i=1}^{20} sg(i)$ is 156.

What is $\sum_{i=1}^{n} sg(i)$? As the number can be large, print it modulo m.

Input Format

The first line of each test file contains a single integer q, which is the number of queries per test file. q lines follow, each containing two integers separated by a single space: n and m of the corresponding query.

Constraints

- $1 \leq q \leq 10^5$
- $1 \leq n \leq 10^{18}$
- $2 \leq m \leq 2^{30} - 1$

Output Format

Print exactly q lines, each containing a single integer, which is the answer to the corresponding query.

Sample Input 0

```
2
3 1000000
20 1000000
```

Sample Output 0

```
8
156
```

Explanation 0

$g(1) = 1, g(2) = 2$ and $g(3) = 5. 1 + 2 + 5 = 8.$