

Project Euler #214: Totient Chains

This problem is a programming version of [Problem 214](#) from [projecteuler.net](#)

Let φ be Euler's totient function, i.e. for a natural number x , $\varphi(x)$ is the number of $1 \leq y \leq x$, for which $\gcd(x, y) = 1$.

By iterating φ , each positive integer generates a decreasing chain of numbers ending in 1.

E.g. if we start with 5 the sequence $5 \rightarrow 4 \rightarrow 2 \rightarrow 1$ is generated.

For an integer $x \geq 1$, denote $\psi(x)$ the length of its chain. For example, $\psi(1) = 1$ and $\psi(5) = 4$.

Let p_1, p_2, \dots be the sequence of prime numbers ($p_1 = 2, p_2 = 3, \dots$), and consider two positive integers n and a . We define the set $S(n, a)$ as:

$$S(n, a) = \left\{ \prod_{i=1}^n p_i^{\alpha_i} \mid 0 \leq \alpha_i \leq a \text{ for all } 1 \leq i \leq n \right\}$$

You will be given n, a and k , how many integers $x \in S(n, a)$ satisfy $\psi(x) = k$. Print your answer modulo 1004535809.

Input Format

The first line of each test file contains three space-separated integers n, a (as described above) and q which is the number of queries.

Each of the next q lines contains a value of k .

Constraints

- $1 \leq n \leq 10^5$.
- $1 \leq q, k \leq 5 \times 10^4$.
- $1 \leq a \leq 2000$.

Output Format

Print the answer to each query in a new line.

Sample Input

```
3 2 5
2
3
1
```

4
7

Sample Output

1
3
1
5
4

Explanation

$S(3, 2) = \{1, 2, 3, 4, 5, 6, 9, 10, 12, 15, 18, 20, 25, 30, 36, 45, 50, 60, 75, 90, 100, 150, 180, 225, 300, 450, 900\}$

The corresponding values of ψ are:

$\{1, 2, 3, 3, 4, 3, 4, 4, 4, 5, 4, 5, 6, 5, 5, 6, 6, 6, 7, 6, 7, 7, 7, 8, 8, 8, 9\}$

All you need now is to count the occurences of k in this list.
E.g. $k = 7$ (last query), the answer is 4.