Kick Start 2022 - Coding Practice with Kick Start Session #3

Sherlock and Watson Gym Secrets

Problem

Download the Starter Code!

Watson and Sherlock are gym buddies.

Their gym trainer has given them three numbers, $\mathbf{A}$, $\mathbf{B}$, and $\mathbf{N}$, and has asked Watson and Sherlock to pick two different strictly positive integers i and j, where i and j are both less than or equal to $\mathbf{N}$. Watson is expected to eat exactly i^A sprouts every day, and Sherlock is expected to eat exactly j^B sprouts every day.

Watson and Sherlock have noticed that if the total number of sprouts eaten by them on a given day is divisible by a certain integer $\mathbf{K}$, then they get along well that day.

So, Watson and Sherlock need your help to determine how many such pairs of (i, j) exist, where $i \neq j$ and they get along well that day. As the number of pairs can be really high, please output it modulo $10^9 + 7 (1000000007)$.

Input

The first line of the input gives the number of test cases, $\mathbf{T}$. $\mathbf{T}$ test cases follow. Each test case consists of one line with 4 integers $\mathbf{A}$, $\mathbf{B}$, $\mathbf{N}$ and $\mathbf{K}$, as described above.

Output

For each test case, output one line containing `Case #`x`:` y, where x is the test case number (starting from 1) and y is the required answer.

Limits

Time limit: 60 seconds.
Memory limit: 1 GB.
$1 \leq \mathbf{T} \leq 100$.
$0 \leq \mathbf{A} \leq 10^6$.
$0 \leq \mathbf{B} \leq 10^6$.

Test Set 1

$1 \leq \mathbf{K} \leq 10^4$.
$1 \leq \mathbf{N} \leq 10^3$.

Test Set 2

$1 \leq \mathbf{K} \leq 10^5$.
$1 \leq \mathbf{N} \leq 10^{18}$.

Sample

Sample Input

```
3
1 1 5 3
1 2 4 5
1 1 2 2
```

Sample Output

```
Case #1: 8
Case #2: 3
Case #3: 0
```

In Case #1, the possible pairs are $(1, 2)$, $(1, 5)$, $(2, 1)$, $(2, 4)$, $(4, 2)$, $(4, 5)$, $(5, 1)$, and $(5, 4)$.

In Case #2, the possible pairs are $(1, 2)$, $(1, 3)$, and $(4, 1)$.

In Case #3, No possible pairs are there, as $i \neq j$.