Project Euler #191: Prize Strings

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This problem is a programming version of Problem 191 from projecteuler.net

A particular school offers cash rewards to children based on their score history.

During an $l\text{-day}$ period, a string (scores) is formed, for each child, in the following way:

$$s_1|s_2|\ldots|s_l$$

where $0 \le s_i \le c-1$ is the score of the child at the i^{th} day.

If they get 1 for m consecutive days $\textbf{or}$ 0 on more than n occasion(s) then they forfeit their prize.

For a given l, n, m and c, let's call strings for which the child gets his prize $\textbf{prize strings}$, and denote $f(l,n,m,c)$ the number of prize strings for these parameters.

For example, with $l=4$ (4-day period), $n=1$, $m=3$ and $c=3$, it can be verified that $f(4,1,3,3)=43$ and here are the different prize strings that can be formed:

$2|2|2|2$ $2|2|2|1$ $2|2|2|0$ $2|2|1|2$ $2|2|1|1$ $2|2|1|0$ $2|2|0|2$ $2|2|0|1$ $2|1|2|2$ $2|1|2|1$
$2|1|2|0$ $2|1|1|2$ $2|1|1|0$ $2|1|0|2$ $2|1|0|1$ $2|0|2|2$ $2|0|2|1$ $2|0|1|2$ $2|0|1|1$ $1|2|2|2$
$1|2|2|1$ $1|2|2|0$ $1|2|1|2$ $1|2|1|1$ $1|2|1|0$ $1|2|0|2$ $1|2|0|1$ $1|1|2|2$ $1|1|2|1$ $1|1|2|0$
$1|1|0|2$ $1|1|0|1$ $1|0|2|2$ $1|0|2|1$ $1|0|1|2$ $1|0|1|1$ $0|2|2|2$ $0|2|2|1$ $0|2|1|2$ $0|2|1|1$
$0|1|2|2$ $0|1|2|1$ $0|1|1|2$.

You are given L, N, m and c, what is $\sum_{l=1}^{L}\sum_{n=1}^{N} f(l,n,m,c) \bmod 10^9+7$.

Input Format

The only line of each test case contains exactly four integers separated by single spaces: L, N, m and c

Constraints

- $1 \le N \times L \le 10^7$
- $1 \le m \le L$
- $2 \le c \le 10^{18}$

Output Format

Print the answer modulo 10^9+7

Sample Input

```
4 1 3 3
```

Sample Output

```
73
```

Explanation

$f(4,1,3,3) = 43$, $f(3,1,3,3) = 19$, $f(2,1,3,3) = 8$ and $f(1,1,3,3) = 3$. Hence the sum is 73.