GlobeX Cup '18 S3 - Playing With Bits

Time limit: 1.0s **Memory limit:** 64M

August is doing his binary math homework. While doing it, he came up with a problem, and thought it would be a good problem to put on the GlobeX Canada Cup.

August gives you 3 questions. Given the integers N, M, K, and V, how many ways are there to make an integer array a of length N where $0 \leq a_i < 2^K$ such that:

1. $a_1 \oplus a_2 \oplus a_3 \oplus \ldots \oplus a_N = V$?
2. $a_1 \parallel a_2 \parallel a_3 \parallel \ldots \parallel a_N = V$?
3. $a_1 \,\&\, a_2 \,\&\, a_3 \,\&\, \ldots \,\&\, a_N = V$?

Note that:

- $\oplus$ denotes the bitwise `xor` operation (`^` in most languages).
- $\parallel$ denotes the bitwise `or` operation (`|` in most languages).
- $\&$ denotes the bitwise `and` operation (`&` in most languages).

Since August has meganumerophobia, he wants the answer to each question modulo M.

Input Specification

The first line and only line will contain 4 space-separated integers N, M, K, V
$(1 \leq N \leq 10^9, 1 \leq M \leq 2 \times 10^9, 0 \leq K \leq 63, 0 \leq V < 2^K)$.

Output Specification

On the first line, output the answer to question 1, modulo M.
On the second line, output the answer to question 2, modulo M.
On the last line, output the answer to question 3, modulo M.

Subtasks

Subtask 1 [5%]

$N \leq 8, K \leq 3$

Subtask 2 [15%]

$N \leq 10^3, M = 10^9 + 7$

Subtask 3 [60%]

$N \leq 10^5$

Subtask 4 [20%]

No additional constraints.

Sample Input 1

```
2 1000000007 3 5
```

Sample Output 1

```
8
9
3
```

Sample Input 2

```
8 1000000007 1 0
```

Sample Output 2

```
128
1
255
```