

# Moon Safari (Hard)

[Air](#) is a music duo from France.

You will be told the secret of the critically acclaimed album [Moon Safari](#): mathematics.

The goal of your new task is to compute an ethereal sum.

$$\sum_{i=1}^N a^i i^r$$

Three trips on the moon are provided, [Moon](#) (easy), [Moon1](#) (medium), [Moon2](#) (hard) with different constraints.

## Input

The first line contains an integer  $T$ , the number of test cases.

On the next  $T$  lines, you will be given three integers  $N$ ,  $a$  and  $r$ .

## Output

Output  $T$  lines, one for each test case, with  $S_{N,a,r} = \text{sum}(a^i i^r, \text{ for } i \text{ in } [1..N])$ .

Since the answer can get very big, output it modulo  $10^9+7$ .

## Example

**Input:**

```
2
3 4 5
6 7 8
```

**Output:**

```
16068
329990641
```

## Explanation

The first case is, with  $N=3$ ,  $a=4$ ,  $r=5$ , about the sum :  $4^1 \times 1^5 + 4^2 \times 2^5 + 4^3 \times 3^5 = 4 + 512 + 15552 = \mathbf{16068}$ .

The second case is, with  $N=6$ ,  $a=7$ ,  $r=8$ , about the sum :  $7^1 \times 1^8 + 7^2 \times 2^8 + 7^3 \times 3^8 + 7^4 \times 4^8 + 7^5 \times 5^8 + 7^6 \times 6^8 + 7^7 \times 7^8 = 204329992069 \equiv \mathbf{329990641} \pmod{10^9+7}$ .

## Constraints

$0 < T \times r < 2\,560\,000$

$1 < N < 10^9$

$1 < a < 10^9$

Uniform random input in the range.

More precise information : there are 5 input files.

In0 :  $T < 20000$  and  $r \leq 128$

In1 :  $T < 2000$  and  $r \leq 1250$

In2 :  $T < 200$  and  $r \leq 11000$

In3 :  $T < 20$  and  $r \leq 100000$

In4 :  $T < 2$  and  $r \leq 1000000$

## Information

This trip can be done with a  $O(T \times r \times \log(N))$  method and some interpreted languages.

Edited(2017-02-11, after compiler changes).

My non optimal Py3 code got AC under 5s for each of the 5 input files.

@speed addicts : My fastest C code got AC in 0.42s. (approx 0.08s per file)

Good luck and have fun ;-)