Project Euler #120: Square remainders

This problem is a programming version of Problem 120 from projecteuler.net

Consider the remainder when $(a−1)^n + (a+1)^n$ is divided by a^e.

For example, if $a = 7$, $e = 2$ and $n = 3$, then $6^3 + 8^3 = 728 \equiv 42 \pmod{49}$, so the remainder is 42. And as n varies, so too will the remainder, but for $a=7$ and $e = 2$ it turns out that the maximum remainder is 42.

Let $R(a,e)$ be the largest remainder when $(a−1)^n + (a+1)^n$ is divided by a^e, among all $n \ge 0$.

Given A and e, find $$\sum_{a=1}^A R(a,e)$$ Since this value can be very large, output it modulo $10^9 + 7$.

Input Format

The first line of input contains T, the number of test cases.

Each test case consists of a single line containing two integers, A and e.

Constraints

$1 \le T \le 10000$
$e \in \{2,3\}$
$A \ge 1$

For test cases worth $1/3$ of the total score, $A \le 10^3$.
For test cases worth $2/3$ of the total score, $A \le 10^6$.
For test cases worth $3/3$ of the total score, $A \le 10^9$.

Note 0^0 is calculated as 1.

Output Format

For each test case, output a single line containing the requested sum modulo $10^9 + 7$.

Sample Input

```
1
2 2
```

Sample Output

```
2
```

Explanation

$A = 2$ and $e = 2$, so we want $R(1,2) + R(2,2)$.

$R(1,2)$ is simply 0, because $a^e = 1^2 = 1$, and the remainder of anything when divided by 1 is

0.

$R(2,2)$ is 2, which can be obtained for example with $n = 4$: $1^4 + 3^4 = 82 \equiv 2 \pmod{4}$

Thus, the answer is $0 + 2 = 2$, and modulo $10^9 + 7$ this is simply 2.