Topic 2: Combinatorics: Review, Linear Recurrence **Handout**
CS 41100 - CP3 Competitive Programming III (Spring 2024) **Purdue University**
Instructor: Zhongtang Luo **Date:** January 25, 2025

Sample Problem: Pyramid
Link: `https://vjudge.net/problem/CodeForces-101981G`

Sample Problem: Doremy's Pegging Game
Link: `https://vjudge.net/problem/CodeForces-1764D`

Sample Problem: Sky Full of Stars
Link: `https://vjudge.net/problem/CodeForces-997C`

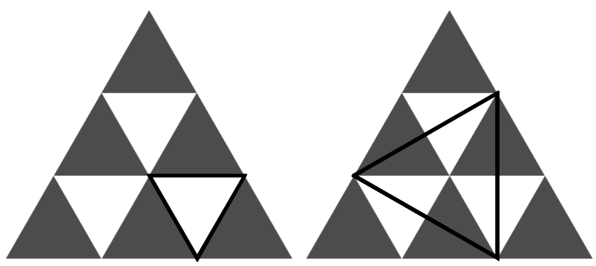
Sample Problem: So Easy!
Link: `https://vjudge.net/problem/HDU-4565`

Pyramid

The use of the triangle in the New Age practices seems to be very important as it represents the unholy trinity (Satan the Antichrist and the False Prophet bringing mankind to the New World Order with false/distorted beliefs). The triangle is of primary importance in all Illuminati realms whether in the ritual ceremonies of the Rosicrucians and Masons or the witchcraft astrological and black magic practices of other Illuminati followers.

One day you found a class of mysterious patterns. The patterns can be classified into different degrees. A pattern of degree n consists of $n(n+1)/2$ small regular triangles with side length of 1 all in the same direction. The figure below shows the pattern of degree 3. All small regular triangles are highlighted.

Since the pattern contains many regular triangles which is very evil and unacceptable, you want to calculate the number of regular triangles formed by vertices in the pattern so that you can estimate the strength of Illuminati. It is not necessary that each side of regular triangles is parallel to one side of the triangles. The figure below shows two regular triangles formed by vertices in a pattern of degree 3.



Since the answer can be very large, you only need to calculate the number modulo $10^9 + 7$.

Input

The first line contains an integer t ($1 \leq t \leq 10^6$) — the number of test cases. Each of the next t lines contains an integer n ($1 \leq n \leq 10^9$) — the degree of the pattern.

Output

For each test case, print an integer in one line — the number of regular triangles modulo $10^9 + 7$.

Examples

Input

```
6
1
2
3
```

```
4
5
6
```

Output

```
1
5
15
35
70
126
```

Source

2018-2019 ACM-ICPC Asia Nanjing Regional

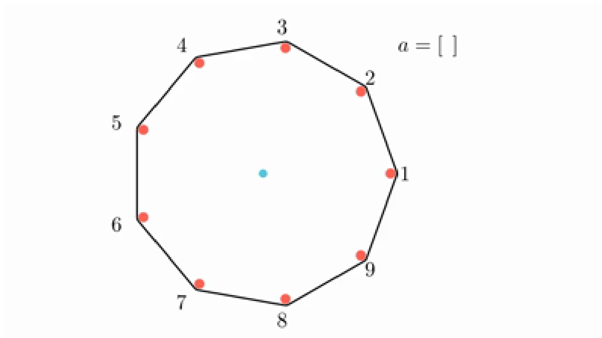
Doremy's Pegging Game

Doremy has $n + 1$ pegs. There are n red pegs arranged as vertices of a regular n-sided polygon, numbered from 1 to n in anti-clockwise order. There is also a blue peg of **slightly smaller diameter** in the middle of the polygon. A rubber band is stretched around the red pegs.

Doremy is very bored today and has decided to play a game. Initially, she has an empty array a. While the rubber band does not touch the blue peg, she will:

1. choose i ($1 \le i \le n$) such that the red peg i has not been removed;
2. remove the red peg i;
3. append i to the back of a.

Doremy wonders how many possible different arrays a can be produced by the following process. Since the answer can be big, you are only required to output it modulo p. p is guaranteed to be a prime number.



game with $n = 9$ and $a = [7, 5, 2, 8, 3, 9, 4]$ and another game with $n = 8$ and $a = [3, 4, 7, 1, 8, 5, 2]$

Input

The first line contains two integers n and p ($3 \le n \le 5000$, $10^8 \le p \le 10^9$) — the number of red pegs and the modulo respectively.

p is guaranteed to be a prime number.

Output

Output a single integer, the number of different arrays a that can be produced by the process described above modulo p.

Examples

Input

```
4 100000007
```

Output

```
16
```

Input

```
1145 141919831
```

Output

```
105242108
```

Note

In the first test case, $n = 4$, some possible arrays a that can be produced are $[4, 2, 3]$ and $[1, 4]$. However, it is not possible for a to be $[1]$ or $[1, 4, 3]$.

Source

Codeforces Global Round 24

Sky Full of Stars

On one of the planets of Solar system, in Atmosphere University, many students are fans of bingo game.

It is well known that one month on this planet consists of n^2 days, so calendars, represented as square matrix n by n are extremely popular.

Weather conditions are even more unusual. Due to the unique composition of the atmosphere, when interacting with sunlight, every day sky takes one of three colors: blue, green or red.

To play the bingo, you need to observe the sky for one month — after each day, its cell is painted with the color of the sky in that day, that is, blue, green or red.

At the end of the month, students examine the calendar. If at least one row or column contains only cells of one color, that month is called lucky.

Let's call two colorings of calendar different, if at least one cell has different colors in them. It is easy to see that there are $3^{n \cdot n}$ different colorings. How much of them are lucky? Since this number can be quite large, print it modulo 998244353.

Input

The first and only line of input contains a single integer n ($1 \le n \le 1000\,000$) — the number of rows and columns in the calendar.

Output

Print one number — number of lucky colorings of the calendar modulo 998244353

Examples

Input

```
1
```

Output

```
3
```

Input

```
2
```

Output

```
63
```

Input

```
3
```

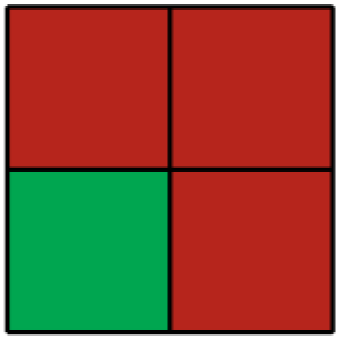
Output

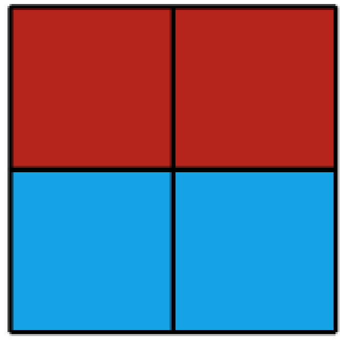
```
9933
```

Note

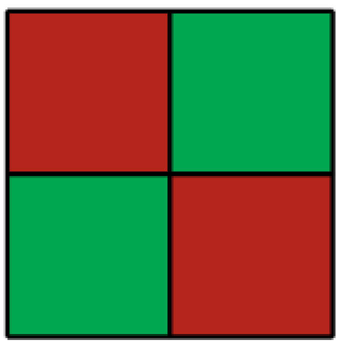
In the first sample any coloring is lucky, since the only column contains cells of only one color.

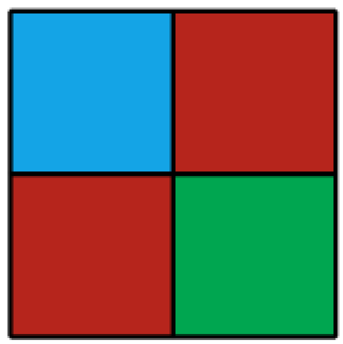
In the second sample, there are a lot of lucky colorings, in particular, the following colorings are lucky:





While these colorings are not lucky:





Source

Codeforces Round 493 (Div. 1)

So Easy!

A sequence S_n is defined as:

$$S_n = \left\lceil (a + \sqrt{b})^n \right\rceil \% m$$

where a, b, n, and m are positive integers. $\lceil x \rceil$ is the ceiling of x. For example, $\lceil 3.14 \rceil = 4$. You, a top coder, are tasked with calculating S_n.

You, a top coder, say: "So easy!"

Input

There are several test cases, each test case in one line contains four positive integers: a, b, n, m. Where $0 < a, m < 2^{15}$, $(a-1)^2 < b < a^2$, $0 < b, n < 2^{31}$. The input will finish with the end of the file.

Output

For each case, output an integer S_n.

Examples

Input

```
2 3 1 2013
2 3 2 2013
2 2 1 2013
```

Output

```
4
14
4
```

Source

2013 ACM-ICPC Changsha Invitational