# ACM ICPC Guangzhou Summer Series May Contest
# Time Limit: 5 hours

**Judge Setup:**
**Core 2, 1.6Ghz, 2GB ram.**
**5/27/2017**

# Problem A:  Logical Equivalence
# Time Limit: 3 seconds

## Description

An ACM ICPC team wants to determine whether the two logical expressions are equivalent. Equivalent means that their truth tables are the same. Can you help them?
Your task is to determine whether the two logical expressions are equivalent.

## Input

The first line of input data is the number of data inputs, **N (N≤1000).** Then for the following **N** lines, each line includes two expressions. The expression is composed of the **26** characters of **a..z** and the operators of **| & ^ ~ ()**. Where **| & ^ ~** denote '**or**', '**and**', '**exclusive or**' and '**not**' respectively. Priority from high to low are **() ~ & ^ |**. You need to ignore any other characters. There may be no separation between the two expressions, and you need to judge their own separation.

Each expression has a maximum of **10 different variables** (letters), an expression of no more than 100 operators, the length of the expression does not exceed 1000. Each line of input is guaranteed to be uniquely separable into 2 syntactically valid expressions.

## Output

Output n lines, corresponding to each input, if the two expressions are equivalent, then the output 'Yes', otherwise the output 'No'.

## Sample Input

3
a ^b&(b|a)~b^ a
a^b&(b|a)(a^(b&(b|a)))
~~~~z~~z

## Sample Output

No
Yes
Yes
~~~~

# Problem B: Solve this Equation
# Time Limit: 5 seconds

## Description

Find number of solutions to the integer equation: $36\,a^2 + 18\,b^2 + 6\,c^2 = 5 * N$, where **N** is a square (i.e., **N** = $n^2$ for some integer n), where **a, b, c** are integers.

## Input

A number of of inputs (≤1000), each start with the number of value of integer **N** ( |**N**| < 1000000).

## Output

Output the number of solutions.  Output **-1**, if there is an infinite number of solutions.

## Sample Input

0
4

## Sample Output

1
0

# Problem C: Cuberoot This
# Time Limit: 3 seconds

## Description

Given a prime **p**, and a constant 0 < **a** < **p**. Find all **x** such that $\mathbf{x}^3 \equiv \mathbf{a} \pmod{\mathbf{p}}$.

## Input

Each input is on one line (≤1000 inputs), with **a** and **p** (**p** < 1000).

## Output

Output all **x** satisfying the condition above in increasing order. Print a blank line if there are none.

## Sample Input
2 31

## Sample Output
4 7 20

# Problem D:  Knight on Wide Board
# Time Limit: 5 seconds

## Description

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 26 | 29 | 2 | 21 | 8 | 23 | 6 | 17 | 14 | 11 |
|  | 20 | 27 | 24 | 3 | 18 | 9 | 12 | 5 | 16 |
| 28 | 25 | 30 | 19 | 22 | 7 | 4 | 15 | 10 | 13 |

A knight can move in any one of 8 directions (see diagram above on the left).  A knight's tour is a succession of moves made by a knight that traverses every square on an **M** x **N** chessboard once and only once.  A closed knight's tour is one in which the knight's last move in the tour places it a single move away from where it started.  See example above to the right (follow the numbers in increasing order to trace the path).  In this problem you will count the number of *closed* knight tours.

## Input

A number of of inputs (≤1000), each line with **N and M (0 < N < 5, 1 ≤ M ≤ 1000000000)**.

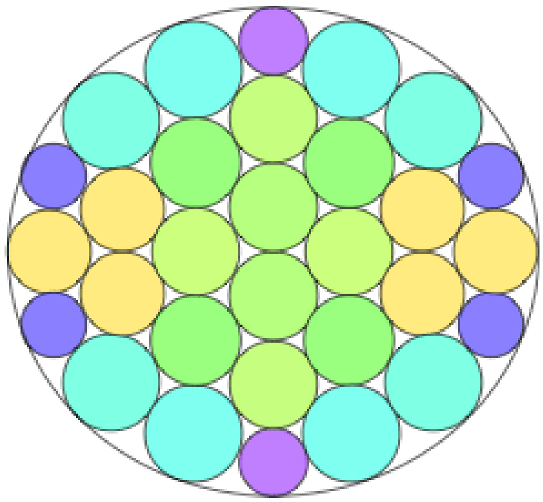
## Output

Output one line per input, the number of closed knight tours modulo **1000000007**.

## Sample Input
1 2
3 10

## Sample Output
0
16

# Problem E: Circles in Ellipse
# Time Limit: 3 seconds



## Description

The following pictures show the best way to have 30 circles with the largest possible sum of radii packed inside an ellipse with perimeter 2π * **A**. Given **A**, you will compute **ΣR**, the sum of all radii over the 30 circles. Each color represent a circle of different size.

## Input

A number of of inputs, each line with an integer **0 ≤ A ≤ 1000000000**.

## Output

Output the answer rounded to an integer.

## Sample Input

1
10
100

## Sample Output

5
50
503

# Problem F: Super Gifts
# Time Limit: 5 seconds

## Description

How many different ways you can distribute **N** (distinguishable) gifts to **K** children where each child should receive at least **M** gifts? Two distributions are considered different if there is at least one gift which is given to different children in the distributions.

## Input

A number of inputs (≤**100**) with three space separated integers **N**, **K** and **M** (1 ≤ **M, K** ≤ **N** ≤ **100000**), one on each line.

## Output

Output one line per input, the answer modulo **1000000007**.

## Sample Input

4 2 2
100000 7 2000

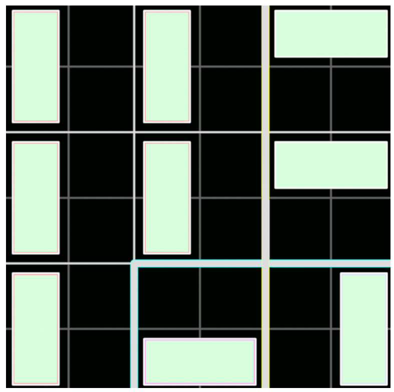
## Sample Output

6
516629367

# Problem G: Sparse Domino Tiling
# Time Limit: 5 seconds

## Description

A domino is a **1x2** or **2x1** Tile. Determine in how many ways exactly $\mathbf{N^2}$ dominoes can be placed without overlapping on an **(2M) x (2N)** chessboard, such that every **2x2** square contains at least two uncovered unit squares which lie in the same row or column. One possible tiling is shown below:



## Input

A number of inputs (≤**1000**), with space separated integers **N**, **M** (1 ≤ **M, N** ≤ **1000000**), each on one line.

## Output

Output one line per input, the answer modulo **10000000007**.

## Sample Input

1 1
2 2

## Sample Output

4
36

# Problem H: Firefighting Heroes
# Time Limit: 3 seconds

## Description

In a small town, there are **N*N** houses in a square grid, indexed by row i, and column, j: **(i, j)**. For $1 \le$ **i,j** $\le$ **N**. (1,1) is the house in the top left corner. At time 0, a fire breaks out at the house indexed by (1, **C**), where **C** ≤ **N**/2. During each subsequent time interval **[t, t+1]**, the fire fighters defend a house which is not yet on fire while the fire spreads to all undefended neighbors of each house which was on fire at time t. Once a house is defended, it remains so all the time. The process ends when the fire can no longer spread. At most how many houses can be saved by the fire fighters?
A house indexed by (**a, b**) is a neighbor of a house indexed by (**c, d**) if **|a-c| + |b-d| ≤ 1**.

## Input

A number of inputs (<**1000**) with three space separated integers **N, C** (1 ≤ **N** ≤ **1000000, 1 ≤C** ≤ **N**/2).

## Output

Output one line per input, the answer.

## Sample Input
2 1
3 1

## Sample Output
2
6

# Problem I: Disk Madness
# Time Limit: 3 seconds

## Description

Consider **N** disks in the plane: $\mathbf{C}_1$, $\mathbf{C}_2$, …, $\mathbf{C}_N$ such that, for all **i**, where 0 < **i** < **N**, we have the center of $\mathbf{C_i}$ on the circumference of $\mathbf{C_{i+1}}$, and the center of $\mathbf{C_n}$ on the circumference of $\mathbf{C_1}$. What is the maximum number of pairs of disks **(**$\mathbf{C_i}$, $\mathbf{C_j}$), with 1 ≤ **i,j** ≤ **N** such that $\mathbf{C_i}$ properly contains $\mathbf{C_j}$. Note, the set **T** **properly contains**, the set **S**, If and only if **S**⊆**T** and **S**≠**T**.

## Input

A number of inputs (<**1000**) with integer **N** (1 ≤ **N** ≤ **1000000**).

## Output

Output one line per input, the answer.

## Sample Input

1
2
3

## Sample Output

0
0
1

# Problem J: Count these Permutations
# Time Limit: 4 seconds

## Description

Let $\lfloor x \rfloor$ be the floor of **x.** Count the number of permutations ($a_1, a_2, ..., a_n$) of (**1, 2, …, n**) such that

$$| a_1 - 1 | + | a_2 - 2 | \dots + | a_n - n | = \lfloor n^2 / 2 \rfloor$$

## Input

A number of of inputs (≤**1000**), each start with the number of value of integer **n** (1 ≤ **n** ≤ 1000000).

## Output

Output the number of permutations modulo **1000000007**.

## Sample Input

```
1
2
3
```

## Sample Output

```
1
1
3
```