Problem A. Gender Textbox

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

Everyone has their own way of expressing their gender identity, and that's why lrw04 has decided to make the gender field a text area for her own social media site.

However, different people use different devices to access the site, and it becomes possible that the same gender might get input differently. For example, auto-capitalization happens more often on smart phones than on computers, so computer users might enter "female" but smart phone users might enter "Female", though they refer to the same gender.

lrw04's solution to this is to trim spaces from both ends of the incoming gender string and normalize all Latin letters to lowercase. Please write a program to help her with that.

Input

Each test contains multiple test cases. The first line contains the number of test cases T ($1 \le T \le 10^3$). The description of the test cases follows.

The first and only line of each test case contains a string G ($1 \le |G| \le 10^2$), representing the gender. The string contains only ASCII printable characters and space.

Output

For each test case output one line containing the normalized gender.

Example

standard input	standard output

5
Female
malE
  X
 NON binary
  non   binary
	female
	male
	x
	non binary
	non binary

Problem B. Trans Rights

Input file:	`standard input`
Output file:	`standard output`
Time limit:	5 seconds
Memory limit:	256 megabytes

Trans rights are important for lrw04 because she is trans. In a dream, she was in a park with n areas numbered with integers from 1 to n and $n-1$ undirected roads connecting them together such that she could reach any area from any area. In each area, there was a set of characters from the set $\{t, r, a, n, s, i, g, h\}$ and when she passes one area, she could pick one character from the set up and append it to her string in her memory, or choose to not pick one up nor append anything to her string in her memory at all. At first, the sets of characters in all areas are empty.

Since it was all a dream, the sets of characters in each area could change at her will, and she could choose to appear in any area she likes. She wonders, how many ways there are to go from area u to area v along the unique simple path, start with the empty string in her memory, picking up or not picking up a character from each area she passes in order (including u and v), appending to her string as she goes, and end up with every substring of the string "transrights" in her memory after she is done with the set of characters in area v. To reduce the output size, denoting the number of ways for the substring from index l to r with $C(l, r)$, please work out the value of

$$\sum_{1 \le l \le r \le 11} (r - l + 1) C(l, r)$$

modulo $10^9 + 7$. We consider two ways different, iff there exists one area where her choice is different (different character or different choice whether to pick one up).

Input

Each test contains multiple test cases. The first line contains the number of test cases T ($1 \le T \le 10^4$). The description of the test cases follows.

The first line of each test case contains a single integer n ($1 \le n \le 10^4$).

The second line of each test case contains $n-1$ integers $f_2, f_3, \cdots, f_n$ ($1 \le f_i < i$), each representing an undirected road connecting f_i and i.

The third line of each test case contains a single integer q ($1 \le q \le 10^4$).

Then, in the q lines following that, each line contains a query in either of the following format, where all values are integers:

- `1 u s` ($1 \le u \le n$, $0 \le s < 2^8$): a change of the set of characters in area u to S, where, with $T =$"transigh" (indices start from 1), $T_i \in S$ iff the 2^{i-1}'s digit in s in binary is 1.
- `2 u v` ($1 \le u, v \le n$): a query asking the problem described in the statement for the simple path from area u to area v.

It is guaranteed that the sum of n and q over all test cases do not exceed 10^4.

Output

For each query of the second type, print your response in a single line.

Example

standard input	standard output
1 11 1 1 2 3 4 5 6 7 8 9 14 2 10 11 1 11 1 1 9 2 1 7 4 1 5 8 1 3 16 1 1 2 1 2 32 1 4 64 1 6 128 1 8 1 1 10 16 2 10 11 2 11 10	0 36 332

Problem C. Hash

Input file:	`standard input`
Output file:	`standard output`
Time limit:	4 seconds
Memory limit:	256 megabytes

lrw04 loves hash functions with a passion, so much so that she made one up. To be exact, a family of them parameterized by x and k, to which the source code below is:

```
#include <cinttypes>
#include <vector>

const uint64_t p =
    (1ull << 32) | (1ull << 7) | (1ull << 3) | (1ull << 2) | (1ull << 0);

uint32_t conv(uint64_t a, uint64_t b) {
    uint64_t prod = 0;
    for (int i = 0; i < 32; i++)
        if (a >> i & 1) prod ^= b << i;
    for (int i = 63; i > 31; i--)
        if (prod >> i & 1) prod ^= p << (i - 32);
    return prod;
}

uint32_t my_hash(const std::vector<uint32_t> &a, uint32_t x, int k) {
    uint64_t h = 0;
    uint64_t xi = 1;
    for (int i = 0; i < (int)a.size(); i++) {
        h ^= conv(xi, a[i]);
        xi = conv(xi, x);
    }
    xi = 1;
    for (int i = 0; i < k; i++) xi = conv(xi, h);
    return xi;
}
```

Assume that x and k are given, please find the shortest same-length collision, namely two sequences A and B such that $A \neq B$, $\text{hash}(A, x, k) = \text{hash}(B, x, k)$, $|A| = |B|$ and the length of A is minimized.

Input

Each test contains multiple test cases. The first line contains the number of test cases T ($1 \leq T \leq 10^5$). The description of the test cases follows.

The first and only line of each test case contains two integers, x ($0 \leq x < 2^{32}$) and k ($1 \leq k \leq 10^9$).

Output

For each test case, first output one line containing an integer n ($0 \leq n \leq 10$), representing the length of A and B.

Then on the second and third line, output n integers in each line, representing the two sequences A and B. $0 \leq A_i, B_i < 2^{32}$ must hold for all i.

Example

standard input	standard output
3 2 1 2 3 2 5	2 1 2 0 2147483716 1 1 1425871461 1 1 3438024028

Problem D. Pie

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

lrw04 owns a pie shop. She sometimes receives bulk orders, the profit from which enables her to expand the business.

To be more specific, she hired three new pie crafters. Given sufficient time, their crafted pies can be arbitraily perfect.

The first crafter is

$$4\sum_{k=0}^{\infty}\frac{(-1)^k}{2k+1},$$

the second one is

$$\frac{1}{2^6}\sum_{k=0}^{\infty}\frac{(-1)^k}{2^{10k}}\left(-\frac{2^5}{4k+1}-\frac{1}{4k+3}+\frac{2^8}{10k+1}-\frac{2^6}{10k+3}-\frac{2^2}{10k+5}-\frac{2^2}{10k+7}+\frac{1}{10k+9}\right),$$

and the third, idealized one is

$$\min_{\substack{x>0\\ \sin x=0}} x.$$

Now lrw04 is curious how nice the pie would be if she interrupts the first crafter.

To be specific, for specified n, let $A = 4\sum_{k=0}^{n}\frac{(-1)^k}{2k+1}$ and $B = \pi$, please work out the length of the longest common prefix of the two strings resulting from taking the decimal form of A and B and removing the decimal points.

It can be proven that the length is finite.

Input

Each test contains multiple test cases. The first line contains the number of test cases T ($1 \le T \le 10^6$). The description of the test cases follows.

The first and only line of each test case contains an integer n ($1 \le n \le 10^9$).

Output

For each test case, output one number in one line representing your answer.

Example

standard input	standard output
4 998 2 10000 10	3 1 4 1

Problem E. noitatumreP

Input file:	`standard input`
Output file:	`standard output`
Time limit:	10 seconds
Memory limit:	256 megabytes

lrw04 used to play with meat blobs during barbecue.

She put meat blobs in an $n \times n$ grid, and made sure that in each row and each column, there was only one blob of meat. She also wanted to string the blobs together, so she could only put blobs in the main diagonal and the two next to it.

However, not all ways of arranging the blobs are pretty. If we represent a way of arranging the meat blobs as a permutation p where the blob on the i-th row is on the p_i-th column, its beauty value would be

$$\frac{(-1)^{\tau(p)}}{(\nu(p) \bmod m) + 1},$$

where $\tau(p)$ and $\nu(p)$ represents the number of inversions in p and the number of fixed points under p, respectively.

Please work out the sum of beauty values for all ways of arranging the meat blobs.

In other words, please work out

$$\sum_{\substack{p \in S_n \\ |p_i - i| \le 1}} \frac{(-1)^{\tau(p)}}{(\nu(p) \bmod m) + 1}.$$

Input

Each test contains multiple test cases. The first line contains the number of test cases T ($1 \le T \le 5$). The description of the test cases follows.

The first and only line of each test case contains two integers n ($1 \le n \le 10^9$) and m ($1 \le m \le 10^2$).

Output

For each test case, output an integer in one line representing the answer modulo $10^9 + 7$.

Example

standard input	standard output
3 7 7 7 8 7 4	500000004 625000004 750000003