DMOPC '19 Contest 1 P6 - Bob and Binary Strings

Time limit: 1.4s **Memory limit:** 512M

Bob is playing with binary strings. He defines two strings S and T to be similar if at least one of the following conditions holds:

1. $S = T$
2. The lengths of both S and T must be divisible by 2. Let S_1 denote the first half of S, and S_2 denote the second half. Similarly, define T_1 and T_2 as the first and second halves of T. Then S and T are similar if either:
   - S_1 is similar to T_1 and S_2 is similar to T_2 or
   - S_1 is similar to T_2 and S_2 is similar to T_1

If both conditions do not hold then S and T are not similar.

Bob begins to wonder about N particular lengths of binary strings. These lengths are $a_1, a_2, \ldots, a_N$.

For each a_i, Bob generates all 2^{a_i} possible binary strings of length a_i. He wonders how many **ordered** pairs of binary strings from his set are similar. Since these numbers may be massive, print the answers modulo $10^9 + 7$.

Constraints

In all subtasks,
$1 \leq N \leq 50$
$1 \leq a_i \leq 10^{18}$

Subtask 1 [5%]

$1 \leq a_i \leq 5$

Subtask 2 [10%]

All the a_i are odd integers.

Subtask 3 [15%]

$N = 1$
$1 \leq a_i \leq 26$

Subtask 4 [10%]

$N = 1$
$1 \leq a_i \leq 52$

Subtask 5 [30%]

$1 \leq a_i \leq 1024$

Subtask 6 [30%]

$1 \leq a_i \leq 10^{18}$

Input Specification

The first line contains a single integer, N.
N lines follow, the i-th of which containing a single integer, a_i.

Output Specification

Output N lines, the i-th of which containing the answer modulo $10^9 + 7$ for binary strings of length a_i.

Sample Input 1

```
1
2
```

Sample Output 1

```
6
```

Sample Input 2

```
2
3
4
```

Sample Output 2

```
8
54
```

Explanation for Sample Output 2

There are a total of 8 ordered pairs of similar strings for binary strings of length 3, and there are a total of 54 ordered pairs of similar strings for binary strings of length 4.