

# Project Euler #14: Longest Collatz sequence

This problem is a programming version of [Problem 14](#) from [projecteuler.net](#)

The following iterative sequence is defined for the set of positive integers:

$$\begin{array}{ll} n \rightarrow \frac{n}{2} & n \text{ is even} \\ n \rightarrow 3n + 1 & n \text{ is odd} \end{array}$$

Using the rule above and starting with 13, we generate the following sequence:

$$13 \rightarrow 40 \rightarrow 20 \rightarrow 10 \rightarrow 5 \rightarrow 16 \rightarrow 8 \rightarrow 4 \rightarrow 2 \rightarrow 1$$

It can be seen that this sequence (starting at 13 and finishing at 1) contains 10 terms. Although it has not been proved yet (Collatz Problem), it is thought that all starting numbers finish at 1.

Which starting number,  $\leq N$  produces the longest chain? If many possible such numbers are there print the maximum one.

**Note:** Once the chain starts the terms are allowed to go above  $N$ .

## Input Format

The first line contains an integer  $T$ , i.e., number of test cases.  
Next  $T$  lines will contain an integers  $N$ .

## Constraints

- $1 \leq T \leq 10^4$
- $1 \leq N \leq 5 \times 10^6$

## Output Format

Print the values corresponding to each test case.

## Sample Input

```
3
10
15
20
```

## Sample Output

```
9
9
19
```

## Explanation

Collatz sequence for  $n = 9$  is,

$$9 \rightarrow 28 \rightarrow 14 \rightarrow 7 \rightarrow 22 \rightarrow 11 \rightarrow 34 \rightarrow 17 \rightarrow 52 \rightarrow 26 \rightarrow 13 \rightarrow 40 \rightarrow 20 \rightarrow 10 \rightarrow 5 \rightarrow 16 \rightarrow 8 \rightarrow 4 \rightarrow 2 \rightarrow 1$$

containing 19 steps and is the longest for  $n \leq 10$