Sum of geometric series

In the lecture, we gave you three algorithms of calculating the prefix sum of geometric series $\{ar^{n-1}\}$. The time complexity of Algorithm 3 is $O(\log n)$, but it is quite hard to use because it needs division ($\frac{a(r^n-1)}{r-1}$).

So, we are going to introduce a new algorithm in this problem. Try to implement this algorithm that calculates $r + r^2 + \cdots + r^n$. We will explain the algorithm using an example.

1. Precalculate $r, r^2, r^4, r^8, \cdots, r^{2^k}$.
2. Precalculate $r,\ r + r^2,\ r + r^2 + r^3 + r^4,\ r + r^2 + r^3 + \cdots + r^8, \cdots,\ r + r^2 + r^3 + \cdots + r^{2^k}$.
   - How? Hint: $r + r^2 + r^3 + \cdots + r^8 = (1 + r^4)(r + r^2 + r^3 + r^4)$.
3. Suppose $n = 19 = 2^4 + 2^1 + 2^0$.
4. $r + r^2 + \cdots + r^{19} = r + r^{2^0}\left(r + r^{2^1}\right) + r^{2^1+2^0}\left(r + r^2 + r^3 + \cdots + r^{2^4}\right)$.

Given two integers r and n, please write a program that calculates the last 9 digits of $r + r^2 + \cdots + r^n$. Take a look at the 'Hints' section of the problem 'Bank of Braham'.

Input

Your input consists of an arbitrary number of lines, but no more than 100.

Each line contains two integers r $(1 \le r < 10^9)$ and n $(1 \le n \le 10^{18})$. Please use 64-bit integer type to store n!

The end of input is indicated by a line containing only the value -1.

Output

For each given input line, print the last 9 digits of $r + r^2 + \cdots + r^n$. Please print **exactly** 9 digits. If the answer is shorter than 9 digits, then print zeroes in the front of the answer to make it 9 digits.

Example

Standard input	Standard output
1 5 3 10 20170712 10000000000000000 -1	000000005 000088572 109375000

Time Limit

2 seconds.