

Russian Peasant Exponentiation



We all know how to calculate a^b using b operations by multiplying 1 by a a total of b times. The drawback to this method is that b can be large, which makes exponentiation very slow.

There is a well known method called *Russian Peasant Multiplication* that you can read about [here](#). Now let's use this to raise some complex numbers to powers!

You're given q queries where each query consists of four integers: a , b , k , and m . For each query, calculate $(a + b \cdot i)^k = c + d \cdot i$ (where i is an imaginary unit) and then print the respective values of $c \bmod m$ and $d \bmod m$ as two space-separated integers on a new line.

Input Format

The first line contains a single integer, q , denoting the number of queries.

Each of the q subsequent lines describes a query in the form of four space-separated integers: a , b , k , and m (respectively).

Constraints

- $1 \leq q \leq 10^5$
- $0 \leq k \leq 10^{18}$
- $2 \leq m \leq 10^9$
- $0 \leq a, b \leq m$

Output Format

For each query, print the two space-separated integers denoting the respective values of $c \bmod m$ and $d \bmod m$ on a new line.

Sample Input

```
3
2 0 9 1000
0 1 5 10
8 2 10 1000000000
```

Sample Output

```
512 0
0 1
880332800 927506432
```

Explanation

In the first query, we have $a = 2$, $b = 0$, $k = 9$, $m = 1000$. We calculate the following:

1. $2^9 = 512$
2. $i^5 = i$