# Inaho VIII

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

Inaho was thinking of a tree problem, when he came up with this rather beautiful problem!

Given a tree originally rooted at $1$ containing $N$ nodes each with a value $v_i$ and an arbitrary value $K$, support $Q$ of the following operations:

- `1 R` Reroot the tree so that node $R$ is the root.
- `2 a b` Print the highest common ancestor of nodes $a$ and $b$.
- `3 a b` Print the sum of all nodes' $v_i$ on the path from $a$ to $b$, inclusive.
- `4 a b` Print the product of all nodes' $v_i$ on the path from $a$ to $b$, inclusive, modulo $10^9 + 7$.
- `5 a b` Print the minimum of all nodes' $v_i$ on the path from $a$ to $b$, inclusive.
- `6 a b` Print the maximum of all nodes' $v_i$ on the path from $a$ to $b$, inclusive.
- `7 a b` Print the greatest common divisor of all nodes' $v_i$ on the path from $a$ to $b$, inclusive.
- `8 a b` Print the bitwise AND of all nodes' $v_i$ on the path from $a$ to $b$, inclusive.
- `9 a b` Print the bitwise OR of all nodes' $v_i$ on the path from $a$ to $b$, inclusive.
- `10 a b` Print the bitwise XOR of all nodes' $v_i$ on the path from $a$ to $b$, inclusive.
- `11 a b` Print the number of nodes whose $v_i > K$ on the path from $a$ to $b$, inclusive.
- `12 a b` Print the number of nodes whose $v_i < K$ on the path from $a$ to $b$, inclusive.
- `13 a b` Print the value $v_i$ that minimizes $v_i - K$, and $v_i > K$ of all nodes on the path from $a$ to $b$, inclusive. Print $K$ if there is no such node where $v_i > K$.
- `14 a b` Print the value $v_i$ that minimizes $K - v_i$, and $v_i < K$ of all nodes on the path from $a$ to $b$, inclusive. Print $K$ if there is no such node where $v_i < K$.

It is guaranteed $1 \leq a, b, R \leq N$.

## Input Specification

The first line will contain three space-separated integers, $N, Q, K$ $(1 \leq N, Q \leq 10^5, 1 \leq K \leq 1\,000)$, the number of nodes, the number of operations, and the arbitrary value $K$, respectively.

The second line will contain $N$ space-separated integers, $v_1, v_2, \ldots, v_N$ $(1 \leq v_i \leq 1\,000)$, the values of each node.

The next $N - 1$ lines will each contain two space-separated integers, $a, b$ $(1 \leq a, b \leq N)$, indicating that nodes $a$ and $b$ are connected by an edge. It is guaranteed the entire tree is connected.

The next $Q$ lines will each contain a valid operation as defined above.

## Output Specification

For each operation that requires something to be outputted (everything except operation $1$), print the answer on its own line.

## Sample Input

```
6 15 3
4 10 2 2 5 1
1 2
1 3
3 4
3 5
3 6
2 1 2
1 3
2 1 2
3 2 5
4 4 1
5 1 6
6 3 5
7 2 3
8 3 4
9 5 3
10 6 2
11 2 6
12 3 1
13 4 5
14 1 2
```

## Sample Output

```
1
3
21
16
1
5
2
2
7
13
2
1
5
3
```