Kick Start 2021 - Round D

Primes and Queries

Problem

You are given a prime number $\mathbf{P}$.

Let's define $V(x)$ as the degree of $\mathbf{P}$ in the prime factorization of x. To be clearer, if $V(x) = y$ then x is divisible by $\mathbf{P}^y$, but not divisible by $\mathbf{P}^{y+1}$.
Also we define $V(0) = 0$.

For example, when $\mathbf{P} = 3$, and $x = 45$, since $45 = 5 \cdot 3^2$, therefore $V(45) = 2$.

You are also given an array $\mathbf{A}$ with $\mathbf{N}$ elements. You need to process $\mathbf{Q}$ queries of 2 types on this array:

- type 1 query: `1 pos val` - assign a value $\mathbf{val}$ to the element at $\mathbf{pos}$, i.e. $\mathbf{A_{pos}} := \mathbf{val}$
- type 2 query: `2 S L R` - print $\sum_{i=\mathbf{L}}^{\mathbf{R}} V(\mathbf{A_i}^{\mathbf{S}} - (\mathbf{A_i} \bmod \mathbf{P})^{\mathbf{S}})$.

Input

The first line of the input gives the number of test cases, $\mathbf{T}$. $\mathbf{T}$ test cases follow.
The first line of each test case contains 3 space separated positive integers $\mathbf{N}$, $\mathbf{Q}$ and $\mathbf{P}$ - the number of elements in the array, the number of queries and a prime number.
The next line contains $\mathbf{N}$ positive integers $\mathbf{A_1}, \mathbf{A_2}, \ldots, \mathbf{A_N}$ representing elements of array $\mathbf{A}$.
Each of the next $\mathbf{Q}$ lines describes a query, and contains either

- 3 space separated positive integers: `1 pos val`
- or 4 space separated positive integers: `2 S L R`

Output

For each test case, output one line containing `Case #`x`:` y, where x is the test case number (starting from 1) and y is a list of the answers for each query of type $\mathbf{2}$.

Limits

Time limit: 90 seconds.
Memory limit: 1 GB.
$1 \leq \mathbf{T} \leq 100$
$2 \leq \mathbf{P} \leq 10^9$
$\mathbf{P}$ is a prime number.
$1 \leq \mathbf{pos} \leq \mathbf{N}$
$1 \leq \mathbf{L} \leq \mathbf{R} \leq \mathbf{N}$

For at most 10 cases:
$1 \leq \mathbf{N} \leq 5 \times 10^5$
$1 \leq \mathbf{Q} \leq 10^5$

For the remaining test cases:

$1 \leq \mathbf{N} \leq 10^3$
$1 \leq \mathbf{Q} \leq 10^3$

There will always be at least one query of type $\mathbf{2}$.

Test Set 1

$1 \leq \mathbf{S} \leq 4$
$1 \leq \mathbf{A_i} \leq 10^3$
$1 \leq \mathbf{val} \leq 10^3$

Test Set 2

$1 \leq \mathbf{S} \leq 10^9$
$1 \leq \mathbf{A_i} \leq 10^{18}$
$1 \leq \mathbf{val} \leq 10^{18}$

Sample

Sample Input

```
2
5 5 2
16 94 62 67 91
2 3 3 4
1 1 69
2 3 1 4
2 1 1 1
2 3 2 2
5 5 5
1 2 3 4 5
2 1 1 5
1 3 98
2 3 2 4
1 5 3
2 2 1 5
```

Sample Output

```
Case #1: 4 9 2 3
Case #2: 1 1 1
```

In Sample Case #1

The first query is a query of type 2, where $\mathbf{S} = 3, \mathbf{L} = 3, \mathbf{R} = 4$. Let's calculate the result for this query:
$i = 3, V(62^3 - (62 \bmod 2)^3) = 3$
$i = 4, V(67^3 - (67 \bmod 2)^3) = 1$
$\sum_{i=3}^{4} V({\mathbf{A_i}}^3 - (\mathbf{A_i} \bmod \mathbf{P})^3) = 3 + 1 = 4$
The second query is of type 1, where we need to assign 69 to $\mathbf{A_1}$, so our array $\mathbf{A}$ now becomes: $69\ \ 94\ \ 62\ \ 67\ \ 91$.