Project Euler #124: Ordered radicals

This problem is a programming version of Problem 124 from projecteuler.net

The radical of n, $\mathbf{rad}(n)$, is the product of the distinct prime factors of n. For example, $504 = 2^3 \times 3^2 \times 7$, so $\mathbf{rad}(504) = 2 \times 3 \times 7 = 42$.

If we calculate $\mathbf{rad}(n)$ for $1 \leq n \leq 10$, then sort them on $\mathbf{rad}(n)$, and sorting on n if the radical values are equal, we get:

	Unsorted		Sorted	
n	$\mathbf{rad}(n)$	n	$\mathbf{rad}(n)$	k
1	1	1	1	1
2	2	2	2	2
3	3	4	2	3
4	2	8	2	4
5	5	3	3	5
6	6	9	3	6
7	7	5	5	7
8	2	6	6	8
9	3	7	7	9
10	10	10	10	10

Let $E(k)$ be the kth element in the sorted n column; for example, $E(4) = 8$ and $E(6) = 9$.

Given L and k, if $\mathbf{rad}(n)$ is sorted for $1 \leq n \leq L$, find $E(k)$.

Input Format

The first line of input contains T, the number of test cases.

Each test case consists of a single line containing two integers, L and k.

Constraints

$1 \leq T$
$1 \leq k \leq L$

For the first few test files worth 30% of the total points:
$T \leq 20$
$L \leq 200000$

For the next few test files worth 30% of the total points:
$T \leq 100000$
$L \leq 200000$

For the last few test files worth 40% of the total points:
$T \leq 20$
$L \leq 10^{18}$
$k \leq 200000$

Output Format

For each test case, output a single line containing a single integer, the requested value $E(k)$.

Sample Input

```
3
10 4
10 6
12 9
```

Sample Output

```
8
9
12
```

Explanation

The first two cases can be answered by consulting the table in the problem statement. For the third test case, $L = 12$ so the new table is:

Unsorted		Sorted		
n	$\text{rad}(n)$	n	$\text{rad}(n)$	k
1	1	1	1	1
2	2	2	2	2
3	3	4	2	3
4	2	8	2	4
5	5	3	3	5
6	6	9	3	6
7	7	5	5	7
8	2	6	6	8
9	3	12	6	9
10	10	7	7	10
11	11	10	10	11
12	6	11	11	12

In this case, $E(9)$ is now 12.