

Project Euler #124: Ordered radicals

Problem Statement

This problem is a programming version of [Problem 124](#) from [projecteuler.net](#)

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

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

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

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

Given L and k , if $\text{rad}(n)$ 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:

```
\begin{array}{rrrr} & \text{Unsorted} & & \text{Sorted} & n & \text{rad}(n) & n & \text{rad}(n) & k \\ \hline 1 & 1 & 1 & 1 & 1 & 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 \end{array}
```

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