Space

SEASON 8 – FOURTH ROUND

Captain Picard pilots a space ship but he's no in grave danger. He got into the range of the so-called Quantum Attractive Temporal Chasm (a type of black whole). It is extremely massive and swallows everything that gets near it.

Because of strange quantum phenomena the space around it is divided into separate locations and between some of them there are two-way connections. Picard's ship moves by making so-called "jumps", where one jump is instantaneous and consists of sequential moving along an arbitrary number of connections. The ship has an energy reservoir, which stores no more than K energy units at once. Each jump has an energy cost equal to the number of connections it goes through.

Between the jumps the ship recharges one unit of energy per time unit, but because of the strong gravity around Q.A.T.C. with each passing time unit, the ship gets sucked closer and closer, and if it reaches the center, it will get destroyed and Picard will die. More formally, if the ship is located at position i at the end of moment t, it will be located at location D_i at the start of moment $t+1$ and will have a one unit of energy more (unless it was already at its maximum). After that it can perform another jump or just wait. Picard can wait and fall by making any jumps for however many moments he wants.

It is known that the values D_i are such that, if Picard makes no jumps, the ship will eventually reach the center and will get swallowed by Q.A.T.C, which is located at location 1. It is also known that there are no connections from/to location 1.

Picard has a map of all connection as well as all D_i. He is located at location S and his ship has a charge of one energy unit. He wants to know for different locations whether he can reach them and, if he can, what is the minimum number of jumps needed. Help him by writing a program that answers such queries.

Input

From the first line of the file `space.in` four numbers N, M, S and K are inputted – the number of locations, the number of connections, the starting location and the energy capacity of the ship. From the next line $N-1$ numbers $D_2, D_3, \dots, D_N$ are inputted. From the next M lines two numbers per line are inputted – the locations which that connection connects. From the next line a single number Q is inputted – the number of queries. From the next line Q numbers are inputted – the queries.

Output

In the output file `space.out` print Q numbers – the answers to the queries one after another. If a particular location can't be reached, print -1.

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Constraints

$1 \leq N, M, Q \leq 10^5$
$1 \leq D_i \leq N$
$2 \leq S$, the queries $\leq N$
$1 \leq K \leq 20$

Time limit: 1.85 sec
Memory limit: 256 MB

Sample tests

Input (space.in)	Output (space.out)	Input (space.in)	Output (space.out)
14 11 4 2 1 2 3 1 5 1 7 1 9 1 11 12 13 2 6 3 5 3 6 5 8 7 9 7 10 8 10 9 12 10 12 12 13 13 14 5 2 8 10 13 14	0 1 2 4 -1	14 11 4 5 1 2 3 1 5 1 7 1 9 1 11 12 13 2 6 3 5 3 6 5 8 7 9 7 10 8 10 9 12 10 12 12 13 13 14 6 4 6 9 12 13 14	0 1 2 2 3 4

Explanation of sample test 1

Falling is notated with a single arrow and jumps – with a double arrow, where the subscripts shows the intermediary locations of the jump.

$4 \rightarrow 3 \rightarrow 2$
$4 \rightarrow 3 \Rightarrow_5 8$
$4 \rightarrow 3 \Rightarrow 6 \rightarrow 5 \Rightarrow_8 10$
$4 \rightarrow 3 \Rightarrow 6 \rightarrow 5 \Rightarrow 8 \rightarrow 7 \Rightarrow 10 \rightarrow 9 \Rightarrow_{12} 13$