

Problem A

Maximum Diameter

Time Limit: 2 seconds

Let $X = (x_1, x_2, \dots, x_{n-1})$ be any integer sequence of length $n - 1$ whose elements are between 1 and n , inclusive. Consider all trees satisfying the following condition. At least one such tree always exists. Define $f(X)$ as the maximum diameter among these trees.

- The tree consists of n nodes numbered 1 through n . Edges are numbered 1 through $n - 1$. For each i ($1 \leq i \leq n - 1$), one of the endpoints of edge i is x_i .

Here, the diameter of a tree is the maximum number of edges on a path between two nodes.

You are given two integer sequences, $A = (a_1, a_2, \dots, a_{n-1})$ and $B = (b_1, b_2, \dots, b_{n-1})$. Each element in A is between 1 and n , inclusive. Each element in B is positive. You can assume that the pairs $(a_1, b_1), (a_2, b_2), \dots, (a_{n-1}, b_{n-1})$ are distinct.

For each $d = 2, 3, \dots, n - 1$, solve the following problem:

Choose an integer sequence $X = (x_1, x_2, \dots, x_{n-1})$ whose elements are between 1 and n , inclusive, and that satisfies $f(X) = d$. Such a sequence always exists. For each i ($1 \leq i \leq n - 1$), you pay a cost of 2^{b_i} if and only if $x_i \neq a_i$. Find the minimum possible total cost.

Because each answer may be large, output it modulo 998 244 353.

Input

The input consists of a single test case of the following format.

```
n
a1 a2 ⋯ an-1
b1 b2 ⋯ bn-1
```

The first line contains an integer n ($3 \leq n \leq 2 \times 10^5$). The second line contains $n - 1$ integers in the sequence A ($1 \leq a_i \leq n$). The third line contains $n - 1$ integers in the sequence B ($1 \leq b_i \leq 10^9$). It is guaranteed that $(a_i, b_i) \neq (a_j, b_j)$ if $i \neq j$.

Output

Output $n - 2$ lines. The k -th line should contain the answer for $d = k + 1$, i.e., the minimal possible total cost for a sequence X such that $f(X) = k + 1$, modulo 998 244 353.

Sample Input 1

```
5
2 4 3 4
1 2 4 8
```

Sample Output 1

```
18
2
0
```

Sample Input 2

```
10
6 2 1 6 10 4 6 10 4
1 1 7 8 1 5 5 5 10
```

Sample Output 2

```
454
196
68
36
4
2
0
2
```

Sample Input 3

```
9
1 1 1 1 1 1 1 1
24 27 30 33 36 39 42 45
```

Sample Output 3

```
0
16777216
150994944
226492415
830472183
671088562
394263947
```

Problem B

XOR Cycle

Time Limit: 2 seconds

You are given $2N$ nonnegative integers $A_1, B_1, A_2, B_2, \dots, A_N, B_N$.

Determine whether there exists a sequence of nonnegative integers $X = (X_1, X_2, \dots, X_N)$, each less than 2^{30} , that satisfies the following condition. If such a sequence exists, output any one of them.

- For each $i = 1, 2, \dots, N$, $X_i \equiv (A_i \oplus X_{i-1}) + (B_i \oplus X_{i-1}) \pmod{2^{30}}$.

Here, we define $X_0 = X_N$. Also, $a \oplus b$ denotes the bitwise XOR of a and b .

Input

The input contains one or more test cases. The first line of the input contains an integer T ($1 \leq T \leq 2 \times 10^5$), representing the number of test cases. The descriptions of the T test cases follow, each in the following format:

```

N
A1 B1
A2 B2
⋮
AN BN

```

The first line contains an integer N , representing the length of A and B ($1 \leq N \leq 2 \times 10^5$). For each $i = 1, 2, \dots, N$, the i -th of the following N lines contains two integers A_i and B_i ($0 \leq A_i, B_i < 2^{30}$).

The sum of N over all test cases does not exceed 2×10^5 .

Output

For each test case, if such a sequence X exists, output Yes followed by X in the following format:

```

Yes
X1 X2 ... XN

```

Otherwise, output No.

If multiple sequences X satisfy the condition, you may output any one of them.

Sample Input	Sample Output
3	Yes
2	3 5
4 7	Yes
1 0	1
1	Yes
0 1	0
1	
536870912 536870912	

Problem C

Neighbour or Opposite

Time Limit: 2 seconds

There are $2N$ seats arranged in a circle, numbered $1, 2, \dots, 2N$ in clockwise order.

For each i ($1 \leq i \leq 2N - 1$), seats i and $i + 1$ are neighbours. Seats 1 and $2N$ are also neighbours.

For each i ($1 \leq i \leq N$), seats i and $i + N$ are opposite each other.

Some of the seats are occupied. For each i ($1 \leq i \leq 2N$), seat i is occupied by exactly one person if S_i is o, and is empty if S_i is x.

You want to form pairs of people subject to the following conditions.

- Each person belongs to at most one pair.
- Each pair consists of two people seated in neighbouring or opposite seats.

Find the maximum possible number of pairs and the number of ways to achieve this maximum.

Two ways of forming pairs are considered different if their sets of unordered pairs differ.

Input

The input consists of a single test case of the following format.

N
 S

The first line contains an integer N ($1 \leq N \leq 10^6$).

The second line contains a string S of length $2N$ consisting of o and x.

Output

Print two integers separated by a space.

The first integer is the maximum possible number of pairs.

The second integer is the number of ways to achieve this maximum, modulo 998 244 353.

Sample Input 1

3
ooxoox

Sample Output 1

1 2

Sample Input 2

2
oooo

Sample Output 2

2 3

Sample Input 3

4
xxxxxxxx

Sample Output 3

0 1

Problem D

CPK! Remix

Time Limit: 2 seconds

Kaguya spends her days enjoying *parfaits* and taking part in *programming contests*.

She has a string S of length N consisting of uppercase English letters. She may perform the following operation any number of times, including zero.

- Choose an integer i ($1 \leq i \leq N - 2$) such that $S_i S_{i+1} S_{i+2}$ is one of CPK, CKP, and PCK. Replace $S_i S_{i+1} S_{i+2}$ with any one of CPK, CKP, and PCK.

Find the number of distinct strings that can be obtained from S by performing the operation any number of times, modulo 998 244 353.

Input

The input consists of a single test case of the following format.

N
 S

The first line contains an integer N ($1 \leq N \leq 10^6$), representing the length of the string S .

The second line contains a string S of length N consisting of uppercase English letters.

Output

Print the number of distinct strings that can be obtained from S , modulo 998 244 353.

Sample Input 1

9
CPKCKPPCK

Sample Output 1

63

Sample Input 2

34
CPKPARTICIPATEDINPCKWHILEEATINGCKP

Sample Output 2

45

Sample Input 3

15
CPKCPKCPKCPFKKK

Sample Output 3

63

Problem E

JAG City Marathon I

Time Limit: 2 seconds

Just A Grid City (JAG City) has N horizontal roads and N vertical roads. These roads form a square grid. The distance between any two neighboring parallel roads is 1. The horizontal roads are numbered from 1 to N from top to bottom, and the vertical roads are numbered from 1 to N from left to right. We call the intersection of horizontal road i and vertical road j (i, j) .

A marathon will be held on the roads of JAG City. To make the runners visit many parts of the city, the organizers have placed N checkpoints. You are given a permutation $P = (P_1, P_2, \dots, P_N)$ of $(1, 2, \dots, N)$. The checkpoints are placed at (i, P_i) ($i = 1, 2, \dots, N$).

The organizers want the course to be easy to follow. Therefore, the marathon course must satisfy all of the following conditions:

- The course is a closed route that uses only the roads.
- The course uses **all** N horizontal roads and **all** N vertical roads, traveling a distance of at least 1 along every road.
- The course passes through every checkpoint and **turns at every checkpoint**.
- The course has exactly $2N$ turns.

The course **may cross itself**, even at intersections where it does not turn. At each turn, the course switches from a horizontal road to a vertical road or vice versa.

A route is valid if it satisfies all the conditions above. It is guaranteed that at least one valid route exists. Among all valid routes, output one with the **maximum** possible length.

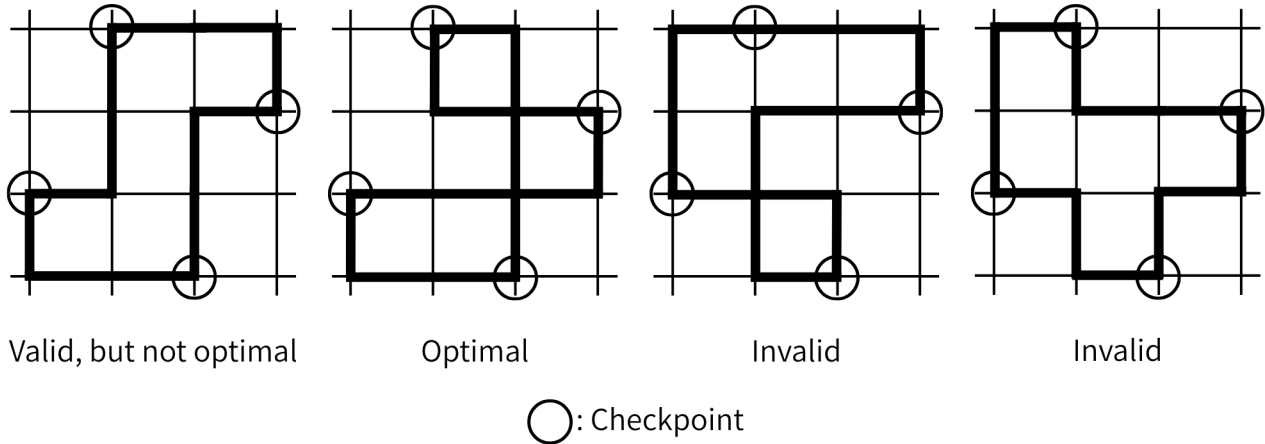


Figure E-1: Examples of valid and invalid marathon courses

Figure E-1 shows four routes for the sample input. The leftmost route is valid but not optimal; its length is 12. The second route is optimal, with length 14. Although it crosses itself at two intersections where it does not turn, such crossings are allowed. The third route is invalid because it passes through a checkpoint without turning there. The rightmost route is invalid because it has more than $2N$ turns.

Input

The input consists of a single test case of the following format.

$$\begin{array}{l} N \\ P_1 \ P_2 \ \dots \ P_N \end{array}$$

The first line contains an integer N ($2 \leq N \leq 2 \times 10^5$), representing the number of roads in each direction.

The second line contains N distinct integers $P_1, P_2, \dots, P_N$ ($1 \leq P_i \leq N$), which form the permutation P .

Output

Let L be the maximum possible length of a valid route.

Output L and the $2N$ intersections at which a valid route of length L turns, in the order in which they are visited along the course, in the following format:

$$\begin{array}{l} L \\ X_1 \ Y_1 \\ X_2 \ Y_2 \\ \vdots \\ X_{2N} \ Y_{2N} \end{array}$$

For each i ($1 \leq i \leq 2N$), the pair (X_i, Y_i) represents the intersection of horizontal road X_i and vertical road Y_i , where $1 \leq X_i, Y_i \leq N$.

If there are multiple valid routes of length L , you may output any of them.

You may choose any turning intersection as (X_1, Y_1) and output the intersections in either direction along the course.

Sample Input

```
4
2 4 1 3
```

Sample Output

```
14
1 2
1 3
4 3
4 1
3 1
3 4
2 4
2 2
```

Problem F

Professor JAG's Language

Time Limit: 2 seconds

Professor JAG, a researcher of sequences, is developing a new expression language. You are given an integer N and a string $O = O_1O_2 \cdots O_{N-1}$ consisting of $+$ and $|$. Throughout this problem, a sequence with elements $a_1, a_2, \dots, a_k$ is denoted by $[a_1, a_2, \dots, a_k]$.

Consider the following expression:

$$[1] \ O_1 \ [2] \ O_2 \ \dots \ O_{N-1} \ [N]$$

Here, O_i is the i -th character of the input string O and is used as the operator between $[i]$ and $[i+1]$.

Since operator precedence is not defined, we consider all possible ways to fully parenthesize this expression without changing the order of its operands or operators. Each expression obtained in this way is called a *valid expression*.

For each expression Z , let $S(Z)$ denote the set of sequences represented by Z . The set $S(Z)$ is defined recursively as follows.

- If Z has the form $[i]$ for some i ($1 \leq i \leq N$), then $S(Z)$ consists only of the one-element sequence $[i]$.
- If Z has the form $(X + Y)$, where X and Y are its left and right subexpressions, then $S(Z)$ consists of every sequence obtained by concatenating a sequence in $S(X)$ with a sequence in $S(Y)$. For example, if $S(X)$ contains $[1, 3]$ and $S(Y)$ contains $[2, 4]$, then $S(Z)$ contains $[1, 3, 2, 4]$.
- If Z has the form $(X | Y)$, where X and Y are its left and right subexpressions, then $S(Z) = S(X) \cup S(Y)$.

Different valid expressions may represent the same sequence. Find the number of distinct sequences represented by at least one valid expression. Since the answer may be large, output it modulo 998 244 353.

Input

The input consists of a single test case in the following format.

N
 O

The first line contains an integer N ($2 \leq N \leq 10^6$). The second line contains a string O consisting of $+$ and $|$ ($|O| = N - 1$).

Output

Output the number of distinct sequences that can be represented, modulo 998 244 353.

Sample Input 1

Sample Output 1

4 + +	4
----------	---

Sample Input 2

7 +

Sample Output 2

17

Sample Input 3

17 + + +++ + +

Sample Output 3

1774

For the first sample, the expression is $[1] + [2] \mid [3] + [4]$.

The following five valid expressions can be obtained by adding parentheses:

- $((([1] + [2]) \mid [3]) + [4])$
- $(([1] + [2]) \mid ([3] + [4]))$
- $(([1] + ([2] \mid [3])) + [4])$
- $([1] + (([2] \mid [3]) + [4]))$
- $([1] + ([2] \mid ([3] + [4])))$

The following four distinct sequences are represented by at least one of these valid expressions:

- $[1, 2]$
- $[1, 2, 4]$
- $[1, 3, 4]$
- $[3, 4]$

Therefore, the answer is 4.

Problem G

Find Iotas

Time Limit: 2 seconds

You are given a positive integer N and a nonnegative integer X .

Determine whether there exists a sequence $A = (A_1, A_2, \dots, A_{2N})$ of length $2N$ satisfying all of the following conditions.

- Each integer from 1 to N appears in A exactly twice.
- The sequence $(1, 2, \dots, N)$ occurs exactly X times as a subsequence of A . In other words, there are exactly X ways to choose indices $1 \leq i_1 < i_2 < \dots < i_N \leq 2N$ such that $A_{i_j} = j$ ($1 \leq j \leq N$).

If such a sequence exists, output one. If multiple such sequences exist, output any one of them.

Input

The input consists of multiple test cases in the following format.

```
T
case1
case2
⋮
caseT
```

Each test case is given in the following format.

```
N X
```

The first line contains an integer T ($1 \leq T \leq 2 \times 10^5$), the number of test cases.

For each test case, you are given a positive integer N ($1 \leq N \leq 2 \times 10^5$) and a nonnegative integer X ($0 \leq X \leq 10^{18}$).

The sum of N over all test cases does not exceed 2×10^5 .

Output

For each test case, if there is no sequence satisfying the conditions, print No on a single line.

Otherwise, print Yes on the first line, and print $2N$ integers $A_1, A_2, \dots, A_{2N}$ representing a sequence satisfying the conditions on the second line.

If there are multiple valid sequences, you may output any of them.

Sample Input	Sample Output
3	Yes
2 3	1 2 1 2
50 1000000000000000000	No
4 0	Yes
	4 4 3 3 2 2 1 1

Problem H

Longest Symmetry

Time Limit: 2 seconds

There are N houses numbered $1, 2, \dots, N$ on a number line. House i is located at coordinate X_i . It is guaranteed that $X_i < X_{i+1}$ for every i ($1 \leq i \leq N - 1$).

For integers a, b with $1 \leq a < b \leq N$, we say that the consecutive houses $a, a + 1, \dots, b$ form a *symmetric interval of houses* if the following condition holds:

- For every $i = 0, 1, \dots, b - a$, $X_a + X_b = X_{a+i} + X_{b-i}$ holds.

You are given Q queries. Process them in order.

- In the i -th query, you are given integers l_i, r_i ($1 \leq l_i < r_i \leq N$). Among all pairs of integers (s, t) satisfying $l_i \leq s < t \leq r_i$ such that the consecutive houses $s, s + 1, \dots, t$ form a symmetric interval of houses, output the maximum possible width $X_t - X_s$ of the interval.

Input

The input consists of a single test case of the following format:

```

N
X1 X2 ... XN
Q
l1 r1
l2 r2
⋮
lQ rQ

```

The first line contains an integer N , representing the number of houses ($2 \leq N \leq 2 \times 10^5$).

The second line contains N integers $X_1, X_2, \dots, X_N$, representing the coordinates of the houses ($-10^9 \leq X_i \leq 10^9$). It is guaranteed that $X_i < X_{i+1}$ for every i ($1 \leq i \leq N - 1$).

The third line contains an integer Q , representing the number of queries ($1 \leq Q \leq 2 \times 10^5$).

Each of the following Q lines contains two integers l_i and r_i , representing the left and right endpoints of the range specified in the i -th query ($1 \leq l_i < r_i \leq N$).

Output

For each query, output the maximum possible width.

Sample Input	Sample Output
7	14
-5 -2 0 4 6 9 12	8
5	6
1 7	6
2 6	4
3 7	
4 7	
3 6	

Problem I

Capybara Petting Club

Time Limit: 2 seconds

The International Capybara Petting Club is preparing T-shirts for an event. There are four sizes, S, M, L, and XL, in increasing order. The numbers of T-shirts needed are n_S , n_M , n_L , and n_{XL} , respectively. At the standard color intensity, T-shirts of sizes S, M, L, and XL require B , Br , Br^2 , and Br^3 units of dye, respectively.

The dyeing machine uses an integer intensity x . The minimum allowed color intensity is P , and $x = K$ is the standard intensity. Thus, x must satisfy $P \leq x \leq K$. If a T-shirt requires q units at the standard intensity, dyeing it at intensity x uses $\lceil qx/K \rceil$ units. All T-shirts must use the same intensity x .

Given A units of dye, find the maximum possible intensity x such that all T-shirts can be dyed without using more than A units. If no such x exists, output -1 .

Input

The input contains T test cases. The first line contains an integer T ($1 \leq T \leq 100$), the number of test cases. Each test case consists of nine integers given in the following format:

$n_S \ n_M \ n_L \ n_{XL} \ r \ A \ B \ P \ K$

n_S , n_M , n_L , and n_{XL} denote the numbers of T-shirts of sizes S, M, L, and XL, respectively ($0 \leq n_S, n_M, n_L, n_{XL} \leq 10^5$ and $n_S + n_M + n_L + n_{XL} \geq 1$).

The value r denotes the factor by which the amount of dye required at the standard intensity increases with each increase in size ($1 \leq r \leq 10$).

A denotes the total amount of dye available, in units ($0 \leq A \leq 10^{15}$).

B denotes the amount of dye required to dye one size-S T-shirt at the standard intensity, in units ($1 \leq B \leq 10^6$).

P denotes the minimum allowed color intensity, and K denotes the standard color intensity ($1 \leq P \leq K \leq 10^9$).

Output

For each test case, output the maximum integer x such that $P \leq x \leq K$ and all T-shirts can be dyed using at most A units of dye. If no such integer exists, output -1 .

Sample Input	Sample Output
3	6
1 1 1 1 2 15 2 1 12	-1
2 0 1 0 3 8 2 4 10	999999
0 0 0 1 10 1000 1 900000 999999	

Problem J

Sliding Puzzle on Tree

Time Limit: 2 seconds

You are given a tree with N vertices numbered 1 through N . The i -th edge of the tree connects vertices u_i and v_i . Initially, for each i ($1 \leq i \leq N$), vertex i contains one stone if $A_i = 1$ and no stone if $A_i = 0$.

You can repeatedly perform the following operation:

- Select an unchosen edge with a stone on exactly one of its endpoints, and move that stone to the other endpoint.

Determine whether you can perform the operation exactly $N - 1$ times. If possible, output the order in which the edges are selected.

Input

The input contains one or more test cases. The first line of the input contains an integer T ($1 \leq T \leq 10^5$), which is the number of test cases. The descriptions of the T test cases follow, each in the following format.

```

N
u1 v1
u2 v2
⋮
uN-1 vN-1
A1 A2 ... AN

```

The first line contains an integer N ($2 \leq N \leq 2 \times 10^5$) representing the number of vertices.

For each i ($1 \leq i \leq N - 1$), the i -th of the following $N - 1$ lines contains two integers u_i and v_i ($1 \leq u_i, v_i \leq N$) separated by a space, representing that the i -th edge connects vertices u_i and v_i . It is guaranteed that the given graph is a tree.

The last line contains N integers $A_1, A_2, \dots, A_N$ ($A_i \in \{0, 1\}$) separated by spaces. A_i represents whether a stone is initially placed on vertex i .

The sum of N over all test cases does not exceed 2×10^5 .

Output

For each test case, print the answer as follows.

If it is impossible to perform the operation exactly $N - 1$ times, output No on a single line.

If it is possible, output Yes on the first line, followed by the sequence of edges on the second line in the following format:

```
e1 e2 ... eN-1
```

Here, e_k ($1 \leq e_k \leq N - 1$) represents the index of the edge selected in the k -th operation. If there are multiple valid sequences, you can output any of them.

Sample Input

```
3
5
1 2
2 3
2 4
2 5
1 1 1 0 0
2
1 2
0 0
9
1 2
2 3
2 4
4 5
4 6
6 7
6 8
6 9
0 0 1 0 1 1 0 1 1
```

Sample Output

```
Yes
3 2 4 1
No
Yes
6 7 4 2 1 3 5 8
```

Problem K

Group Strength

Time Limit: 2 seconds

There are N students in a class. Student i has an ability value of A_i .

The teacher will divide the students into exactly K groups. Each student must belong to exactly one group, and each group must contain at least one student.

The strength of a group is defined as the average of the ability values of the students in that group. The teacher wants to maximize the sum of the strengths of the K groups.

Find the maximum possible sum of the strengths of the K groups.

Input

The input consists of multiple test cases in the following format.

```
T
case1
case2
⋮
caseT
```

Each test case is given in the following format.

```
N K
A1 A2 ... AN
```

The first line contains an integer T ($1 \leq T \leq 2 \times 10^5$), the number of test cases.

The first line of each test case contains two integers N and K ($1 \leq K \leq N \leq 2 \times 10^5$), the number of students and the number of groups, respectively.

The second line of each test case contains N integers $A_1, A_2, \dots, A_N$ ($1 \leq A_i \leq 10^9$), where A_i represents the ability value of student i .

The sum of N over all test cases does not exceed 2×10^5 .

Output

For each test case, print the maximum possible sum of the strengths of the K groups on a separate line. Your answer will be considered correct if its absolute or relative error does not exceed 10^{-7} .

Sample Input

```
3
6 3
23 5 41 12 9 30
9 5
37 4 91 18 52 11 73 26 45
7 4
17 17 17 17 17 17 17
```

Sample Output

```
83.25
280.2
68.0
```

Problem L

Rabbit, Rabbit, Rabbit

Time Limit: 2 seconds

There are N rabbits and N watering holes on a number line, where the positive direction is to the right. The i -th rabbit is initially at coordinate X_i , and the i -th watering hole is at coordinate Y_i . You may perform the following operation zero or more times:

- For each of the N rabbits, independently move it by a distance of 1 to either the right or the left. If R rabbits move to the right and L rabbits move to the left, this operation incurs a cost of $R \times L$.

Note that multiple rabbits may occupy the same coordinate simultaneously.

Your objective is to reach a state where the coordinates of the N rabbits match the coordinates of the N watering holes in some order. Find the minimum total cost required to achieve this objective. If it is impossible, output -1 .

Input

The input contains one or more test cases. The first line of the input contains an integer T ($1 \leq T \leq 3 \times 10^5$), which is the number of test cases. The descriptions of the T test cases follow, each in the following format.

N
 $X_1 X_2 \dots X_N$
 $Y_1 Y_2 \dots Y_N$

The first line contains an integer N ($1 \leq N \leq 3 \times 10^5$).

The second line contains N integers $X_1, X_2, \dots, X_N$ ($-10^7 \leq X_i \leq 10^7$). X_i represents the initial coordinate of the i -th rabbit.

The third line contains N integers $Y_1, Y_2, \dots, Y_N$ ($-10^7 \leq Y_i \leq 10^7$). Y_i represents the coordinate of the i -th watering hole. It is guaranteed that $Y_i \neq Y_j$ for all $i \neq j$.

The sum of N over all test cases does not exceed 3×10^5 .

Output

For each test case, output the minimum total cost required to achieve the objective. If it is impossible, output -1 .

Sample Input	Sample Output
3	6
3	-1
2 4 8	467
-2 6 10	
2	
0 2	
0 1	
10	
37 -82 14 91 -5 68 -47 22 55 -16	
-73 44 19 -88 67 2 95 -31 58 10	