Problem A. Sum of Product of Binomial Coefficients

- Time Limit: 2 sec

Problem Statement

You are given integers N and K. For a positive integer k, $f(k)$ is defined as follows.

- The sum of $\binom{N}{a_1} \times \binom{a_1}{a_2} \times \cdots \times \binom{a_{k-1}}{a_k}$ for all integer sequences $(a_1, a_2, \ldots, a_k)$ that satisfy the condition $N \geq a_1 \geq a_2 \geq \ldots \geq a_k \geq 0$.

Answer the remainder of $\sum_{k=1}^{K} f(k)$ divided by 998244353.

For each input, solve T test cases.

Note that $\binom{A}{B}$ represents "the number of ways to select B distinct items from A items" (i.e., the binomial coefficient).

Input

T
case_1
$\vdots$
case_T

Each test case is given in the following format.

N K

The input satisfies the following constraints.

- All test cases consist of integers.
- $1 \leq T \leq 10^5$
- $0 \leq N \leq 10^9$
- $1 \leq K \leq 2 \times 10^5$
- The sum of K in one test case does not exceed 2×10^5.

Output

Output the remainder of $\sum_{k=1}^{K} f(k)$ divided by 998244353 for each test case.

Sample Input	Sample Output
3 3 3 0 1 31415 92653	99 1 276482222

Problem B. Mercurialist

- Time Limit: 2 sec

Problem Statement

This country has a medicine for immortality. Alice got $X + Y + Z$ bottles from the *Hatter*.

X bottles contain *elixir*. If Alice drinks it, she will immediately become immortal.

Y bottles contain mercury, and each has a different toxicity. If she drinks the i-th bottle, the following event i will occur after $K + i - 0.5$ days.

- Event i: Alice will immediately die if she has not drunk the elixir before event i. If she has drunk the elixir, she won't die.

The remaining Z bottles contain yogurt. Nothing will happen when Alice drinks it.

At the same time every morning, Alice chooses one non-empty bottle with equal probability and drinks it. If all bottles are empty, she does nothing.

Answer the probability that Alice will be alive $10^{10^{10}}$ days after the first day she starts drinking bottles. Note that Alice won't die other than events.

The probability can be expressed as $\frac{P}{Q}$ using coprime integers P and Q. Output a non-negative integer R less than 998244353 such that $R \times Q \equiv P \pmod{998244353}$. It can be proven that the probability is a rational number, and R is uniquely determined under the conditions of this problem.

Input

$X\ Y\ Z\ K$

The input satisfies the following constraints.

- All inputs consist of integers.
- $1 \leq X, Y, Z, K \leq 10^5$

Output

Output R defined in the statement. Add a new line at the end of the output.

Sample Input 1	Sample Output 1
`1 1 1 1`	`831870295`

Sample Input 2	Sample Output 2
`1 1 1 100`	`1`

Sample Input 3	Sample Output 3
`2 2 1 2`	`565671801`

Sample Input 4	Sample Output 4
`12912 83717 73177 1920`	`685360162`

In Sample Input 1, Alice will only die if she drinks mercury on day 1 and yogurt on day 2. The probability of death is $1/3 \times 1/2 = 1/6$, therefore the answer is $5/6$.

In Sample Input 2, Alice never dies.

Problem C. Umbrella Queries

- Time Limit: 2 sec

Problem Statement

Micchan noticed that an umbrella is a regular polygon when looking from above. So, she created the following problem.

Umbrella Query

A regular N polygon has N edges and $\frac{N(N-1)}{2} - N$ diagonals. Consider the union of them, which includes $\frac{N(N-1)}{2}$ line segments.

How many pairs of line segments satisfy the following 2 conditions?

- The 2 line segments have a common endpoint. In other words, they have a common point at one of the vertices of the regular N polygon.
- The 2 line segments are perpendicular.

Micchan has given T of the above problems. However, her friend cannot solve too many requests. Answer each problem on her behalf.

Input

$$
\begin{array}{l}
T \\
N_1 \\
N_2 \\
\vdots \\
N_T
\end{array}
$$

The input satisfies the following constraints.

- All inputs consist of integers.
- $1 \le T \le 10^5$
- $3 \le N_i \le 10^9$

Output

Output the answer in T lines. On the i-th line, output the answer to the problem when $N = N_i$. Add a new line at the end of each line.

Sample Input	Sample Output
3 4 3 1000000000	4 0 499999999000000000

In Sample Input 1, you count only pairs of line segments that intersect perpendicularly at the vertices of the square.

Problem D. Gemini Tree (Ver.Jadeite)

- Time Limit: 5 sec

Problem Statement

Consider a tree with a green or blue stone placed at each vertex. Such a tree is called a "Gemini Tree" if condition 3 can be satisfied after performing the following operations 1 and 2.

1. First, operate "selecting pairs of vertices that are directly connected by edges and exchanging the stones placed on each endpoint," any number of times from zero to more.
2. Second, select one or fewer edges and delete them.
3. At this time, the tree is divided into at most two connected components, and only one type of stone is placed in either.

Consider a "Gemini tree" with a specified length for each edge, and define its value as follows.

1. First, operate "selecting pairs of vertices that are directly connected by edges and exchanging the stones placed on each endpoint" any number of times from zero to more. Each exchange operation costs equal to the length of the edge.
2. Second, select one or fewer edges and delete them.
3. At this time, the tree is divided into at most two connected components, and only one type of stone is placed in either.
4. The minimum value of the total cost of operation 1 required to achieve condition 3 is the value of "Gemini Tree."

Note that stones are not moved when calculating the value.

You are given a "Gemini tree" with a specified length for each edge. It has N vertices, where N is an odd number. The i-th edge connects two vertices, u_i and v_i, and has a length w_i. The stone colors placed on vertices represent the string $S = s_1 s_2 \ldots s_N$.

You sequentially perform Q operations on this tree. The j-th operation is defined by two integers e_j, a_j, which represents increasing the length of the e_j-th edge by a_j. The effect of the operation remains even in subsequent operations. Answer the value of the tree after each operation.

Input

$$
\begin{array}{l}
N \\
s_1 s_2 \ldots s_N \\
u_1\ v_1\ w_1 \\
\vdots \\
u_{N-1}\ v_{N-1}\ w_{N-1} \\
Q \\
e_1\ a_1 \\
\vdots \\
e_Q\ a_Q
\end{array}
$$

The input satisfies the following constraints.

- All inputs consist of integers.
- $3 \leq N \leq 10^5$
- N is an odd number.
- s_i is either "G" or "B" and represents the stone's color at vertex i. "G" represents green, and "B" represents blue.
- $1 \leq u_i, v_i \leq N$
- $0 \leq w_i \leq 10^5$
- The given graph satisfies the condition of "Gemini Tree."
- $1 \leq Q \leq 10^5$
- $1 \leq e_j \leq N-1$
- $1 \leq a_j \leq 10^5$

Output

Output the answer in Q lines. On the j-th line, output the value of the tree after the j-th operation. Add a new line at the end of each line.

Sample Input 1

```
5
GBBBB
1 2 0
1 3 0
2 4 0
2 5 0
5
1 1
2 3
3 3
4 10
2 2
```

Sample Output 1

```
0
1
1
3
4
```

Sample Input 2

```
5
BGBGB
1 2 0
1 3 0
2 4 0
2 5 1000
4
4 1
3 1
1 1
2 1
```

Sample Output 2

```
0
1
3
4
```

Sample Input 3

```
7
GGGBBBB
1 5 1
2 5 1
7 5 0
7 6 0
3 6 0
4 6 0
6
5 1
5 1
5 1
6 3
3 3
5 100000
```

Sample Output 3

```
1
2
2
3
6
11
```

In Sample Input 1, there is one green stone. Therefore, the problem is to move this to one of the leaves at a minimal cost.

Problem E. Gemini Tree (Ver.Lapislazuli)

- Time Limit: 2 sec

Problem Statement

Consider a tree with a green or blue stone placed at each vertex. Such a tree is called a "Gemini Tree" if condition 3 can be satisfied after performing the following operations 1 and 2.

1. First, operate "selecting pairs of vertices that are directly connected by edges and exchanging the stones placed on each endpoint," any number of times from zero to more.
2. Second, select one or fewer edges and delete them.
3. At this time, the tree is divided into at most two connected components, and only one type of stone is placed in either.

You are given an N-vertex tree with no stones. There are 2^N ways to place one stone at each vertex. How many of them satisfy the following condition?

- Select one leaf and remove it with the stone placed. The tree must be a "Gemini tree" before and after the operation.

Output the remainder of the answer after dividing by 998244353 because it can be large.

Input

N
u_1 v_1
$\vdots$
u_{N-1} v_{N-1}

The input satisfies the following constraints.

- All inputs consist of integers.
- $2 \leq N \leq 10^5$
- $1 \leq u_i, v_i \leq N$
- The given graph is a tree.

Output

Output the remainder of the answer after dividing by 998244353 in one line. Add a new line at the end of the output.

Sample Input 1	Sample Output 1
3 1 2 2 3	8

Sample Input 2	Sample Output 2
4 1 2 1 3 1 4	10

Sample Input 3	Sample Output 3
7 1 2 1 3 1 4 2 5 2 6 2 7	84

In Sample Input 1, All of the stone placements satisfy the condition.

In Sample Input 2, there are 10 different ways that the first placement is "Gemini Tree." They could also be "Gemini

Tree" after one leaf is removed.

In Sample Input 3, there are 86 ways that the first placement is a "Gemini Tree." Two of these are not "Gemini Tree," if any one leaf is removed.

Problem F. Tea time in the grand garden

- Time Limit: 2 sec

Problem Statement

Appropriate temperature changes are essential for brewing delicious tea. Noli has been taught a recipe for delicious tea.

The recipe is represented by a sequence of non-negative integers $A = a_0, a_1, a_2, \dots, a_N, a_{N+1}$ of length $N+2$. She must change the temperature accordingly.

Raising the temperature is hard work. The cost of a recipe A is defined by the following $f(A)$.

$f(A) = \sum_{i=0}^{N} \max(0, a_{i+1} - a_i)$

Noli has forgotten the recipe she was taught. All she remembers is that $a_0 = a_{N+1} = 0$ and that the cost was K.

How many possible recipes can be considered? Find the remainder of the number of possible recipes divided by 998244353.

Note that two recipes are different when the values of a_i are different for any $i (0 \le i \le N+1)$.

Input

$N\ K$

The input satisfies the following constraints.

- All inputs consist of integers.
- $1 \le N \le 2 \times 10^5$
- $0 \le K \le 2 \times 10^5$

Output

Output the remainder of the number of possible recipes divided by 998244353. Add a new line at the end of the output.

Sample Input 1	Sample Output 1
`2 2`	`5`

Sample Input 2	Sample Output 2
`100 0`	`1`

Sample Input 3	Sample Output 3
`300 300`	`527212271`

Sample Input 4	Sample Output 4
`200000 200000`	`885086300`

In Sample Input 1, There are five possible sequences A.

- {0,2,0,0}
- {0,0,2,0}
- {0,1,2,0}
- {0,2,1,0}
- {0,2,2,0}

Problem G. Fraises dans une boîte

- Time Limit: 4 sec

Problem Statement

A box is divided into grids with H rows and W columns. Some squares contain strawberries.

The state of the box is denoted by S, and $S_{x,y} = 1$ means that the square in the x-th row and y-th column contains one strawberry. If $S_{x,y} = 0$, the square in the x-th row and y-th column is empty.

Tomoe devised the following method to distinguish between these strawberries.

- Let $A_{x,y}$ be defined as the sum of $S_{i,j}$ for all integer pairs (i, j) satisfying $i = x, 1 \leq j \leq y$.
- Let $B_{x,y}$ be defined as the sum of $S_{i,j}$ for all integer pairs (i, j) satisfying $1 \leq i \leq x, j = y$.
- If the square in the x-th row and y-th column contains a strawberry, label the strawberry with the tuple $(A_{x,y}, B_{x,y})$.

This method could result in multiple strawberries having the same label, and the strawberries could not be distinguished. Therefore, she decided to add some strawberries before labeling them.

More formally, for (x, y) such that $S_{x,y} = 0$, we operated $S_{x,y} \leftarrow 1$ any number of times greater than 0.

What is the minimum number of strawberries that must be added to label all the strawberries differently?

Input

$$
\begin{array}{l}
H\ W \\
S_{1,1}\ S_{1,2}\ \ldots\ S_{1,W} \\
S_{2,1}\ S_{2,2}\ \ldots\ S_{2,W} \\
\vdots \\
S_{H,1}\ S_{H,2}\ \ldots\ S_{H,W}
\end{array}
$$

The input satisfies the following constraints.

- All inputs consist of integers.
- $1 \leq H \leq 300$
- $1 \leq W \leq 300$
- $0 \leq S_{x,y} \leq 1$

Output

Output the answer in one line. Add a new line at the end of the output.

Sample Input 1

```
3 2
1 0
0 1
0 1
```

Sample Output 1

```
1
```

Sample Input 2

```
4 4
0 1 1 1
1 1 1 0
1 0 1 1
1 0 1 0
```

Sample Output 2

```
2
```

Sample Input 3

```
5 5
0 0 1 0 1
0 1 0 1 0
0 0 1 0 1
0 1 0 1 0
0 0 1 0 1
```

Sample Output 3

```
8
```

Sample Input 4	Sample Output 4
`1 1` `0`	`0`

In Sample Input 1, Tomoe can achieve the condition by placing a strawberry in the upper right square.

Problem H. Empty Quartz

- Time Limit: 2 sec

Problem Statement

N crystals are aligned in a row. However, some of them may be phantoms.

Jun counted the number of **real** crystals from l-th to r-th (closed interval) for every $l, r(1 \le l \le r \le N)$ pair and recorded their evenness.

His $\frac{N(N+1)}{2}$ records show that there were K intervals that contained an odd number of real crystals. How many possible crystal alignments are there? Answer the remainder divided by 998244353.

Note that if there is i such that the i-th crystal from the left is real on one side and phantom on the other, the two alignments are considered different.

You are given T of the above problems. Answer each of them.

Input

T
$N_1\ K_1$
$\vdots$
$N_T\ K_T$

The input satisfies the following constraints.

- All inputs consist of integers.
- $1 \le T \le 10^5$
- $1 \le N_i \le 10^5$
- $0 \le K_i \le \frac{N_i(N_i+1)}{2}$

Output

Output T lines. On the line i, answer the problem when $N = N_i, K = K_i$. Add a new line at the end of each line.

Sample Input 1	Sample Output 1
1 3 4	3

Sample Input 2	Sample Output 2
5 5 9 6 10 10 24 10 25 100000 75915540	10 21 165 0 651081880

If we denote a real crystal as 1 and an phantom as 0, the following three alignments satisfy the condition at Sample Input 1.

- $0, 1, 0$
- $1, 0, 1$
- $1, 1, 1$

Problem I. Distance Permutation

- Time Limit: 5 sec

Problem Statement

You construct a permutation $P = (P_1, P_2, \ldots, P_{10^5})$ of length 10^5 in the following way.

The number line has points $1, 2, \ldots, 10^5$. The distance between points i and j is $|i - j|$. Also, there is a sequence P that is initially empty. Repeat the following operations from any point until the length of P is 10^5.

- Let x be the number corresponding to the current point. if x is not in P, add x to the end of P. Next, move to one of the points whose distance is less than or equal to K.

Answer the following Q queries.

- You are given integers N, L, R. Let the sequence created by removing elements larger than N from P be $P' = (P'_1, P'_2, \ldots, P'_N)$. Among the possible permutations of P', answer the number of permutations in which P'_1 is greater than or equal to L and less than or equal to R with $\bmod 998244353$.

Input

K Q
query_1
$\vdots$
query_Q

query_i represents the i-th query.

Each query is given in the following format.

N L R

The input satisfies the following constraints.

- All inputs consist of integers.
- $1 \le Q \le 2 \times 10^5$
- $1 \le K \le 10^5$
- $1 \le N \le 10^5$
- $1 \le L \le R \le N$

Output

Output Q lines. On the i-th line, output the answer of the i-th query.

Sample Input 1

```
2 4
4 1 1
3 1 3
10 2 7
1 1 1
```

Sample Output 1

```
4
6
140172
1
```

Sample Input 2

```
314 6
60522 7560 25373
79445 26896 78962
33447 12441 21469
47202 17227 32455
63982 13450 41311
2156 1226 2148
```

Sample Output 2

```
925500464
455690352
567782656
893053639
942918900
458845228
```

In Sample Input 1, There are four possible sequences as P' in the first query.

- $(1, 2, 3, 4)$
- $(1, 2, 4, 3)$
- $(1, 3, 2, 4)$

- $(1, 3, 4, 2)$

Problem J. Knight Game

- Time Limit: 2 sec

Problem Statement

The rule of this game is given as follows.

- There is a knight and a chessboard with H rows and W columns. The square at the i-th row from the top and the j-th column from the left is called square (i, j). Initially, the knight is placed on square (x, y).
- Alice and Bob alternately take the following action, starting with Alice.
- Move the knight onto one of the unvisited squares according to the knight's movement.
- Knights can move from (x_1, y_1) to (x_2, y_2) if and only if $(x_1 - x_2)^2 + (y_1 - y_2)^2$ is 5.
- The player who cannot move the knight is the loser.

When both players have done their best, determine whether Alice or Bob will win. Answer for T test cases.

The unvisited square is defined as follows.

- A square on the board that the knight has never visited since the beginning of the game.

Input

$$\begin{array}{l} T \\ \mathrm{case}_1 \\ \vdots \\ \mathrm{case}_T \end{array}$$

case_i represents the i-th test case.

Each test case is given in the following format.

$$H \ W \ x \ y$$

The input satisfies the following constraints.

- All inputs consist of integers.
- $1 \leq T \leq 2 \times 10^5$
- $1 \leq H, W \leq 10^9$
- $1 \leq x \leq H$
- $1 \leq y \leq W$

Output

Output T lines. On the line i, answer the winner of the i-th test case, Alice or Bob.

Sample Input	Sample Output
2 4 4 1 1 9 17 7 3	Alice Bob

Problem K. Drifting

- Time Limit: 2 sec

Problem Statement

You are given a weighted directed graph of N vertices and M edges, with vertices numbered 1 to N and edges numbered 1 to M. The i-th $(1 \leq i \leq M)$ edge connects from vertex u_i to vertex v_i $(u_i < v_i)$, and the weight of the edge is w_i.

Also, K triplets of integers are given. The i-th $(1 \leq i \leq K)$ triplet is (a_i, b_i, c_i) $(a_i < b_i < c_i)$.

You start at vertex 1 and move to vertex N by repeatedly moving along an edge.

In addition, for all i $(1 \leq i \leq K)$, if you move from vertex a_i to vertex b_i directly, we must next move to a vertex **other than** vertex c_i.

Judge whether it is possible to reach vertex N. If it is possible to reach, also calculate the minimum sum of the weights of the edges you pass through.

Input

$$
\begin{array}{l}
N \ M \\
u_1 \ v_1 \ w_1 \\
u_2 \ v_2 \ w_2 \\
\vdots \\
u_M \ v_M \ w_M \\
K \\
a_1 \ b_1 \ c_1 \\
a_2 \ b_2 \ c_2 \\
\vdots \\
a_K \ b_K \ c_K
\end{array}
$$

The input satisfies the following constraints.

- All inputs consist of integers.
- $3 \leq N \leq 2 \times 10^5$
- $0 \leq M \leq 2 \times 10^5$
- $1 \leq u_i < v_i \leq N$ $(1 \leq i \leq M)$
- $i \neq j \Rightarrow (u_i, v_i) \neq (u_j, v_j)$ $(1 \leq i, j \leq M)$
- $1 \leq w_i \leq 10^9$ $(1 \leq i \leq M)$
- $0 \leq K \leq 2 \times 10^5$
- $1 \leq a_i < b_i < c_i \leq N$ $(1 \leq i \leq K)$

Output

If you cannot reach vertex N, output -1. Otherwise, output the minimum sum of the weights of the edges you pass through.

Sample Input 1	Sample Output 1
4 4 1 2 1 1 3 2 2 4 2 3 4 2 1 1 2 4	4

Sample Input 2

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

Sample Output 2

```
9
```

Sample Input 3

```
3 2
1 2 1
2 3 1
1
1 2 3
```

Sample Output 3

```
-1
```

In Sample Input 1, the best move is $1 \to 3 \to 4$.

In Sample Input 2, the best move is $1 \to 2 \to 4 \to 6 \to 7$.

Problem L. Disjoint-Sparse-Table Optimization

- Time Limit: 2 sec

Problem Statement

You are given an integer sequence A of length $2Q-1$ and Q intervals $[L_i, R_i)$. Here, L_i, R_i satisfy $L_i < R_i$, and each integer between 1 and $2Q$ appears once as an end of an interval.

Your goal is to create a set S of intervals to satisfy at least one of the following conditions for all $i = 1, 2, \ldots, Q$.

- $[L_i, R_i) \in S$
- There exists an integer x $(L_i < x < R_i)$ such that $[L_i, x) \in S$ and $[x, R_i) \in S$.

The cost of the set S is defined as follows.

- The sum of $A_l + A_{l+1} + \ldots + A_{r-1}$ for all intervals $[l, r)$ included in S.

Find the minimum cost of the set that satisfies the condition.

Input

Q
L_1 R_1
$\vdots$
L_Q R_Q
A_1 A_2 $\ldots$ A_{2Q-1}

The input satisfies the following constraints.

- All inputs consist of integers.
- $1 \le Q \le 100$
- $1 \le L_i < R_i \le 2Q$
- Each integer from 1 to $2Q$ appears in $L_1, \ldots, L_Q, R_1, \ldots, R_Q$.
- $1 \le A_i \le 10^9$

Output

Output the minimum cost of the set that satisfies the condition. Add a new line at the end of the output.

Sample Input 1	Sample Output 1
3 1 4 2 5 3 6 1 2 3 4 5	20

Sample Input 2	Sample Output 2
5 3 7 1 10 5 9 4 8 2 6 6 4 8 5 9 8 9 8 2	132

In Sample Input 1, the optimal set is $S = \{[1,4), [2,3), [3,5), [5,6)\}$, where the cost is $6+2+7+5=20$.