# Problem A. Pty loves sequence

| | |
|---|---|
| Input file: | `standard input` |
| Output file: | `standard output` |
| Time limit: | 6 seconds |
| Memory limit: | 512 megabytes |

A positive integer sequence $A$ is considered good if and only if the following conditions are satisfied:

1. The length of $A$ equals to $n$.

2. Suppose that $k$ is the maximum value of $A$, $A$ should contain $[1, 2, 3 \ldots, k-1, k]$ as a subsequence.

A subsequence is a sequence that can be derived from another sequence by deleting some or no elements without changing the order of the remaining elements.

First, Pty wants to know the number of good sequences.

Second, for each integer $x \in [1, n]$, Pty also wants to know the occurrence number of $x$ in all good sequences.

Since the answers might be very large, print the answers modulo $p$.

There are $T$ test cases in total.

## Input

The first line contains a single integer $T (1 \leq T \leq 10)$ — the number of test cases.

For each test case, only one line contains two integers $n, p$ $(1 \leq n \leq 3000, 1 \leq p \leq 10^9)$.

## Output

For each test case, output two lines.

The first line contains a integer - the number of good suquences modulo $p$.

The second line contains $n$ integers separated by spaces - The $x$-th integer represent the occurrence number of $x$ in all good sequences modulo $p$.

## Example

| standard input | standard output |
|---|---|
| 2<br>3 3<br>3 1216 | 0<br>1 1 1<br>6<br>10 7 1 |

# Problem B. Pty with card

| | |
|---|---|
| Input file: | `standard input` |
| Output file: | `standard output` |
| Time limit: | 8 seconds |
| Memory limit: | 512 megabytes |

An upsurge in a card game has swept across Pty Town. As a Mayor of the town, Pty is certainly curious about the game and about to organize a large-scale game in his town. The game is played in this rule:

1. $N$ participants stand in a circle, and everyone has one card in hand.

2. Choose one randomly to take the lead in Round 1.

3. In Round $i$, let's assume that it's Steve's turn and Tom is standing next to him at the clockwise. Then Tom will take cards from Steve. If $i$ is odd, he takes 1, otherwise 2. And if at this time Steve has no card left, he is considered 'out' and quits the circle, keeping others in the original order. In Round $i+1$, it comes to Tom's turn.

4. Anytime there's only one participant left, the game is over.

Obviously there's some values of $N$ making the game constant. So for those $N$, we define the 'Circle' of the game with $N$ participants - $F(N)$. That means, $F(N)$ equals to the minimized $T$ so that there exists an $i$ , for all $j \geq i+T$, there are uniform participants and each has uniform number of cards in Round $j$ and Round $j-T$. Particularly, if the game will be over with $N$ original participants, $F(N)=0$.

Pty Town is composed of $M$ cities. We can reach arbitrary cities from each city through $M-1$ paths. We use $(x_i, y_i)$ to describe the $i$-th path, which connects City $x_i$ and City $y_i$. Formally, we have $dist(x, y)$ represent the distance between City $x$ and City $y$. Pty figures out that, a route from City $x$ to City $y$ to be chosen for the game, the number of the participants $p(x, y)$ equals to $v_x + dist(x, y)$. For City $x$, Pty wants to know the summation of 'Circle' when he choose all the routes ending with City $x$. Namely, for each $x$, you should tell him $\sum_{j=1}^{n} F(p(j, x))$.

You are given the value of $M$, $v_i$,$x_i$ and $y_i$, you should tell Pty the answer.

## Input

$T$ testcases in total. $T$ is given in the first line. $(1 \leq T \leq 10)$

For each testcase:

The first line contains a single positive integer $M$ $(1 \leq M \leq 10^5)$ the number of the cities.

The second line contains $M$ positive integers $v_i$ $(1 \leq v_i \leq 10^5)$.

Each of the other $M-1$ lines contains two positive integers $x_i$,$y_i$, representing a path between City $x_i$ and City $y_i$ $(1 \leq x_i, y_i \leq M)$.

It is guaranteed that $\sum M \leq 5 \times 10^5$.

## Output

There are $T$ lines in total.

For each testcase, you should output $M$ numbers in one line. The $i$-th number means the answer to City $i$.

## Example

| standard input | standard output |
| --- | --- |
| 1<br>5<br>1 2 3 4 5<br>1 2<br>3 2<br>3 5<br>5 4 | 12 12 0 0 0 |

## Note

For the route $(2, 1)$ the number of the participants is 3. The game performs like this: $(1, 1, 1) \to (2, 1) \to (3)$ and the game is over. $F(p(2, 1)) = F(3) = 0$.

For the route $(5, 1)$ the number of the participants is 8. The game performs like this: $(1, 1, 1, 1, 1, 1, 1, 1) \to (2, 1, 1, 1, 1, 1, 1) \to (3, 1, 1, 1, 1, 1) \to (2, 2, 1, 1, 1, 1) \to \cdots (2, 2, 2, 2) \to (4, 2, 2) \to (3, 3, 2) \to (3, 1, 4) \to (4, 1, 3) \to (2, 3, 3) \to (2, 2, 4) \to (4, 2, 2) \to (3, 3, 2) \to \cdots$

So $F(p(5, 1)) = F(8) = 6$.

# Problem C. Pty loves lines

| | |
|---|---|
| Input file: | `standard input` |
| Output file: | `standard output` |
| Time limit: | 1.5 seconds |
| Memory limit: | 256 megabytes |

You are required to put $n$ straight lines on a plane, guaranteeing no three lines share a common point and no lines are coincident. They will form some intersections, please output all possible numbers of intersections.

## Input

The first line, an integer $T(1 \leq T \leq 5)$ - the number of test cases.

Following T lines, an positive integer $n(1 \leq n \leq 700)$ in each line - the number of lines.

## Output

Several lines, each line several numbers separated by a blank space - all possible numbers of intersections.

## Example

| standard input | standard output |
|---|---|
| 2<br>3<br>5 | 0 2 3<br>0 4 6 7 8 9 10 |

# Problem D. Pty hates prime numbers

| | |
|---|---|
| Input file: | `standard input` |
| Output file: | `standard output` |
| Time limit: | 3 seconds |
| Memory limit: | 512 megabytes |

Pty thinks prime numbers are extremely annoying numbers. Specifically, he hates the first $k$ prime numbers.

As "Hate me Hate my dog." , if one prime factor of the integer $x$ is what Pty hates, Pty will also hate $x$.

Now Pty wants to know how many integers in $[1, n]$ he dosen't hate.

Formally, Pty wants to know $\sum_{x=1}^{n}[\forall i \in [1,k], p[k] \nmid x]$ ($p[k]$ means the $k_{th}$ prime number).

## Input

The first line contains a single integer $T(1 \leq T \leq 10^5)$ — the number of test cases.

The only line of each test case contains two integers $n, k(1 \leq n \leq 10^{18}, 1 \leq k \leq 16)$.

## Output

For each test case, output the number of integers Pty doesn't hate.

## Example

| standard input | standard output |
|---|---|
| 5<br>10 1<br>20 2<br>30 3<br>40 4<br>50 5 | 5<br>7<br>8<br>9<br>11 |

# Problem E. Pty loves book

| | |
|---|---|
| Input file: | standard input |
| Output file: | standard output |
| Time limit: | 10 seconds |
| Memory limit: | 512 megabytes |

Pty has a string $s$ and a dictionary.

There are $m$ words in the dictionary. Each word $t_i$ has its value $w_i$.

Define function $f(s,l,r) = \sum_{i=1}^{m} occur(s,l,r,t_i) * w_i$, where $occur(s,l,r,t_i)$ is the number of occurrences of string $t_i$ in $s[l...r]$

The interest value of string $s$ is $\sum_{l=1}^{|s|} \sum_{r=l}^{|s|} f(s,l,r)^5$.

Pty wants to know the interest value of string $s$.

Since the answer might be very large, print the answer modulo $10^9 + 7$.

## Input

The first line of input contains a interge $T(1 \le T \le 11)$, the number of test cases.

For each case, the first line contains a string $s$ $(1 \le |s| \le 5 \times 10^5)$.

The second line contains a integer $m(0 \le m \le 5 \times 10^5)$.

There are $m$ lines next. The $i$-th line contains a string $t_i$ and a integer $w_i$ $(0 \le \sum_{i=1}^{m} |t_i| \le 5 \times 10^5, 1 \le w_i < 10^9 + 7)$.

It's guaranteed that $s, t_i$ are non-empty strings.

## Output

For each test case, print the interest value of string $s$, modulo $10^9 + 7$ in one line.

## Example

| standard input | standard output |
|---|---|
| 1<br>whkfqbw<br>3<br>h 3<br>hkfq 2<br>qb 2 | 75128 |

# Problem F. Pty loves lcm

| | |
|---|---|
| Input file: | standard input |
| Output file: | standard output |
| Time limit: | 5 seconds |
| Memory limit: | 512 megabytes |

$lcm(x1, x2, ..., x_k)$ is the least common multiple of $\{x_1, x_2, ..., x_k\}$.

$\phi(x) = \sum_{y=1}^{x}[gcd(x, y) = 1]$

Define function $f(x, y) = lcm(x, x + 1, \ldots, y - 1, y)(x < y)$(both $x, y$ are non-negative integers)

Now Pty wants to know $\sum_{x=1}^{+\infty}\sum_{y=x+1}^{+\infty}\phi(f(x, y)) \times [L \le f(x, y) \le R]$ modulo $2^{32}$.

## Input

The first line contains a single integer $T(1 \le T \le 50)$— the number of test cases.

The only line of each test case contains two integers $L, R(1 \le L \le R \le 10^{18})$.

## Output

For each test case, output the answer modulo $2^{32}$.

## Example

| standard input | standard output |
|---|---|
| 5<br>1 10<br>1 20<br>20 60<br>60 100<br>123456 1234567 | 5<br>25<br>164<br>160<br>158548536 |

# Problem G. Pty loves graph

| | |
|---|---|
| Input file: | standard input |
| Output file: | standard output |
| Time limit: | 10 seconds |
| Memory limit: | 512 megabytes |

Given a undirected graph and a Hamiltonian cycle of it, output whether it is a planar graph.

For convenience, the indices of vertex are advancely relabeled so that the given Hamiltonian cycle is $1-2-3-4-...-(n-1)-n-1$. The edges on this cycle are not given in the input.

Notice that there might be self loops and multiedges in the graph.

There are $T$ test cases in total.

## Input

The first line contains one integer $T$ – the number of test cases.

For each test case:

The first line, two positive integer $N, M$ - the number of vertices and edge besides the Hamiltonian cycle.

Following $m$ lines, two positive integer $x, y$, representing an edge $(x, y)$.

$1 \leq T \leq 26$

$1 \leq N, M \leq 5 \times 10^5, \sum N, \sum M \leq 3 \times 10^6$

$1 \leq x, y \leq N$

## Output

For each test case, output "Yes" or "No" in one line.

## Example

| standard input | standard output |
|---|---|
| 2<br>5 5<br>1 3<br>1 4<br>2 4<br>2 5<br>3 5<br>4 4<br>1 3<br>2 4<br>2 2<br>1 2 | No<br>Yes |

# Problem H. Pty loves string

| | |
|---|---|
| Input file: | standard input |
| Output file: | standard output |
| Time limit: | 10 seconds |
| Memory limit: | 512 megabytes |

Pty has a string $S$ of length $n$ consisting of lowercase English letters. He denotes the value of string $T$ as the number of occurrences of $T$ in string $S$.

Now he has $Q$ queries, for each query he gives you $x, y$. Let the string $T$ be the concatenation of the prefix of length $x$ in the string $S$ and its suffix of length $y$. He wants you to tell him the value of $T$.

## Input

An integer $T$ in the first line indicates the number of tests.

For each test,first line contains two integer $n, Q$ - the length of $S$ and the number of queries.

The second line contains string $S$ of length $n$ consisting of lowercase English letters.

For the next $Q$ lines, each line contains two integers $x, y$.

$1 \leq T \leq 5, 1 \leq n, Q \leq 2 \times 10^5, 1 \leq x, y \leq n$

## Output

For each test,output $Q$ lines in total.

For each query, print the answer in one line.

## Example

| standard input | standard output |
|---|---|
| 1<br>6 3<br>ababaa<br>1 1<br>2 1<br>3 1 | 1<br>2<br>1 |

# Problem I. Pty loves SegmentTree

| | |
|---|---|
| Input file: | `standard input` |
| Output file: | `standard output` |
| Time limit: | 15 seconds |
| Memory limit: | 512 megabytes |

Pty loves data structures, especially segmenttree.

Pty thinks that the segmenttree satisfies each point to represent the interval $[l, r]$. The point with $l = r$ is called a leaf. The other point select mid in $[l, r-1]$ and take $[l, mid]$ and $[mid+1, r]$ as son.

Pty gives each point in the tree a value. For the leaves, the value is 1; For the point whose right son interval size is $k$, the value is $A$; The other point's value is $B$. Pty denotes the value of the tree as the value product of all points.

Pty denotes $f_n$ as the sum of all the tree that the interval of the root is $[1, n]$. He thinks that the two trees are different if and only if the shape is different.

Now Pty has $Q$ queries, for each query Pty wants to know the value of $\sum_{i=L}^{R} f_i^2$

Noticed that the answer is large, you only need to find the answer after modulo 998244353.

## Input

A positive integer $T$ in the first line indicates the number of test.

For each test,the first line contains four integers $Q, k, A, B$.

For the next $Q$ lines, each line contains two intergers $L, R$.

$1 \le T \le 5, 1 \le Q \le 5 \times 10^4, 0 \le A, B < 998244353, 1 \le L \le R \le 10^7, 1 \le k \le 10^7$

## Output

For each query, print the answer.

## Example

| standard input | standard output |
|---|---|
| 1<br>1 1 3 1<br>4 4 | 3249 |

## Note

There are 5 different trees, 1 with a value of $3$, 3 with a value of $9$, 1 with a value of 27. The sum is $3 * 1 + 9 * 3 + 27 * 1 = 57, 57 * 57 = 3249$

# Problem J. Pty plays game

| | |
|---|---|
| Input file: | standard input |
| Output file: | standard output |
| Time limit: | 5 seconds |
| Memory limit: | 256 megabytes |

Pty is playing a game, where he is leading a team of soldiers. He is facing a challenge in the game. He plans to complete the challenge $x$ days later.

The monster is also leading a team of soldiers. And to complete the challenge Pty must beat these soldiers.

The battle will execute as follows. At first, the first soldier of both teams will fight first. When a soldier's hitpoints becomes 0, the soldier will be replaced by the next soldier in the same team. A team is considered a victory only if there is any soldier alive but nobody is alive in the opposite team finally.

The soldier $x$ have $h_x$ hitpoints and can cause $d_x$ damage to the enemy per second. Notice that the seconds of a fight may not be an integer.

Both Pty and the monster will train their soldiers continuously, so the hitpoints and damage per second of all the soldiers will increase every day.

Pty wants to know the minimum $x$ that he will complete the challenge if it take place on $x$ days later.

If Pty can't win the monster in $10^{18}$ days, please print none . Specially, if Pty can win now, the answer is 0.

Notice that the battle will end in one day, and pty can't choose the order of soidiers (they must fight in the given order), so the only thing that pty can do is choose the best day to complete the challenge.

## Input

An integer $T$ in the first line, it is the number of tesecases. And there are $T$ cases later.

In each case, two integers in the first line $n, m$, which is the numbers of soldiers in the pty's team and the monster's team.

In the next n lines, each line contains 4 integers. They means the hitpoint, the increment of hitpoint every day, the damage and the increment of damage every day.

In the next m lines, also contains 4 integers. They are the information of the soldier in the monster's team.

$(1 \le n, m \le 10^5, \sum(n+m) \le 2 \times 10^6, 0 \le h_x, d_x \le 10^6, 0 \le increment \le 10^3)$

## Output

For each test case, output 'none' or integer means the minimum of $x$ in one line.

## Example

| standard input | standard output |
|---|---|
| 2<br>3 2<br>2 3 1 3<br>3 2 4 3<br>1 2 2 3<br>3 3 4 2<br>4 1 1 3<br>1 1<br>1 1 1 1<br>1 1 1 1 | 1<br>none |