Department Strengths (INOI2001)

The company ZIPCOT Inc. has N employees, who have employee IDs from 1 to N. No two employees have the same employee ID. The company is divided into different departments, and each employee belongs to exactly one department. The employees in each department are organized hierarchically like a tree. That is, each department has a Department Head, who could have some other employees who work directly under him. Those employees could in turn have more employees under them, and so on. In other words, each employee who is not a Department Head has exactly one manager directly above them.

Each department is classified as either a Type Even department, or Type Odd department, based on its size. That is, if the total number of employees in a particular department is even, then that department is of Type Even. Else, it is of Type Odd.

The departments follow a peculiar rule: In every department which is of Type Even, the Department Head of that department will have the smallest employee ID among the employees in that department. And in every Type Odd department, the Department Head will have the largest employee ID among all the employees in that department. For example, a valid department could be: Employee 3 is the Head, who has employees 5 and 7 under him. Employee 5, in turn, has the employees 4, 8 and 9 under him. This follows the rule, because there are 6 employees in this department, which is even, and the Head (3) is the smallest employee ID among {3, 4, 5, 7, 8, 9}.

Each employee also has a Level associated with them, which measures how far down they are from the Department Head of their department. In particular, all Department Heads are in Level 1. The employees directly beneath them are in Level 2, and so on. Formally, the Level of an employee who is not a Department Head is 1 + the Level of their manager.

The company is now organizing a programming competition, and the departments are divided into two teams based on their Type. All the employees from Type Even departments form one team. And all the employees from Type Odd departments form the other team. The Strength of a team is defined to be the sum of Levels of all the employees in it. You need to find the Strength of both the teams.

Input Format

- The first line contains T, the number of testcases.
- The first line of each testcase contains N and M. N is the total number of employees. M is the number of manager - managee relationships.
- The i-th of the next M lines contains two integers, u and v. This denotes that either u is the manager of v, or v is the manager of u.

Output Format

- For each testcase, output a single line containing 2 integers - the total Strength of Team Type Even, and the total Strength of Team Type Odd. If one of the teams is empty, report its total Strength as 0 (zero).

Constraints:

- $1 \leq T \leq 10$
- $2 \leq N \leq 10^5$
- $0 \leq M \leq N-1$
- $1 \leq u, v \leq N$

Subtasks:

- **Subtask 1** (35% points) : It is guaranteed that there is exactly one department.
- **Subtask 2** (65% points) : Original constraints

Sample Input:

```
1
9 7
1 6
```

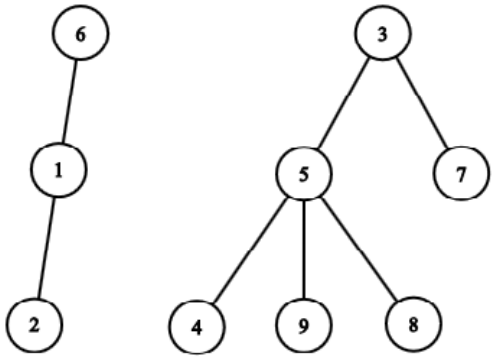
```
5 3
1 2
9 5
3 7
4 5
5 8
```

Sample Output:

```
14 6
```

Explanation:

There are two departments:



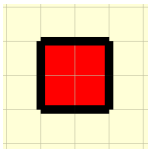
- One department which has 6 as its Head, who has 1 under him, who in turn has 2 under him. 6 is in Level 1, 1 is in Level 2 and 2 is in Level 3. Since there are 3 employees in this department, it is of Type Odd.
- There is only one more department, which has 3 as its Head. 5 and 7 are directly under 3. And 5 has the employees 4, 8 and 9 under him. 3 is in Level 1. 5 and 7 are in Level 2. 4, 8 and 9 are in Level 3. Since there are 6 employees in this department, it is of Type Even.

So Team Type Even has a total strength of 1 + 2 + 2 + 3 + 3 + 3 = 14. And Team Type Odd has a total strength of 1 + 2 + 3 = 6.

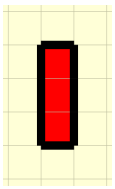
3xN Tiling (INOI2002)

There is a floor with dimensions $K \times N$, where K is 1, 2, or 3. You have infinite tiles of two types:

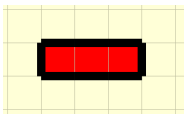
- Type 1: 2×2 square tiles



- Type 2: 3×1 tiles.



These tiles can be rotated and be used as 1×3 tiles as well.



You need to use these tiles to cover the entire floor, in such a way that every cell of the floor is covered by exactly one tile and all the tiles lie completely within the floor. You have to find the number of different ways to doing so. Since the answer might be large, output it modulo $10^9 + 7$.

Input Format

- The first line contains a single integer, T, denoting the number of testcases.
- Each testcase consists of a single line containing two integers, K and N.

Output Format

- For each testcase, output a single line containing a single integer, which is the number of different tilings possible, modulo $10^9 + 7$.

Constraints

- $1 \leq T \leq 10$
- $1 \leq K \leq 3$
- $1 \leq N \leq 10^6$

Subtasks

- **Subtask 1** (15% points) : $K = 1$
- **Subtask 2** (17% points) : $K = 2$
- **Subtask 3** (68% points) : $K = 3$

Sample Input

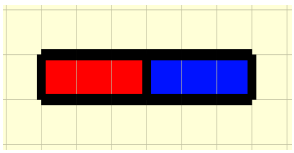
```
4
1 5
1 6
2 6
3 6
```

Sample Output

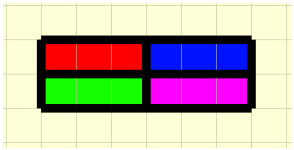
```
0
1
2
8
```

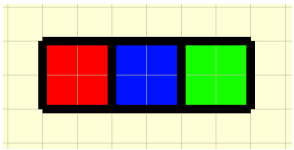
Explanation

- There is no way to tile a 1×5 floor with the given tiles. Hence the answer is 0.
- There is only one way to tile a 1×6 floor.

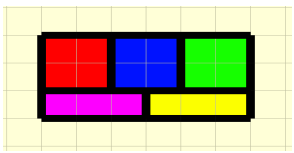


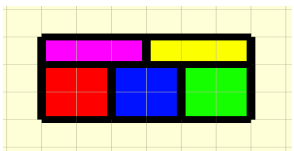
- There are two ways to tile a 2×6 floor.

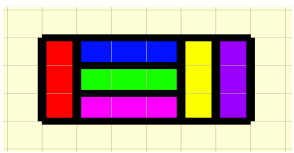


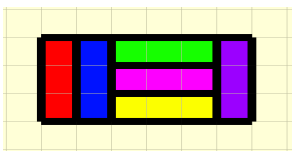


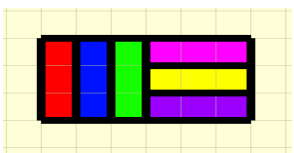
- There are eight ways to tile a 3×6 floor.

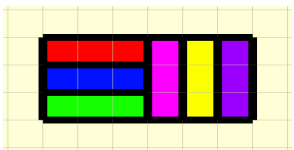


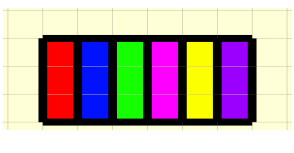












INOI 2020 Cutoffs

- Class 12, 11, 10: 200/200
- Class 9 and below: 132/200