Problem A – Wheel of fortune

A supermarket is planning for its opening event. To attract customers, they have invited N guests to the opening ceremony. Each guest will have one chance to play in a game "Wheel of fortune". Each of the N rolls from N customers is independent and completely random.

This wheel has been divided into M parts, it also have a pointer which point to a number in the wheel. Customer will roll the wheel; when it stops, he or she will get a number. In the picture, it is the number 7. If a customer got number x, he or she will get the gift x.

For example, there are 4 the customers and the wheel has 3 parts #0, #1, #2 and the results of customers are #2, #0, #2, #2. If one particular gift is chosen too many times over others, it might affects the supermarket plan for product storage. So, the supermarket wants to know:

- A - the number of types of gifts give out to the customers. In the previous example, A = 2.
- B - the sum of square of how many times a gift is chosen. In the previous example, gift #0 was selected once, gift #1 has never been selected, gift #2 was selected 3 times. Thus, $B = 1^2 + 0^2 + 3^2 = 10$.

Given N and M, your task is to calculate the expected value of A and the expected value of B.

Input
The first line of input is the number of tests T ($1 \le T \le 10{,}000$). The following T tests, each will consists of 2 integers N and M. ($1 \le N, M \le 10^6$)

Output
For each test case in the input, print out 2 numbers the expected value of A and the expected value of B with exactly 2 digits after decimal point.

Sample

Sample input	Output for sample input
3 1 2 2 1 3 3	1.00 1.00 1.00 4.00 2.11 5.00

Problem B – Football league

There are n teams in a football league. During a season each team plays with every other team exactly once. Thus, there are n(n-1)/2 matches in total.

A winner in a match gets 3 points; a loser gets 0 point; in case the match ends with a draw, each team get 1 point. You have the final standing of the league (how many points each team get), can you determine how many possible results of n(n-1)/2 matches? Two results are considered different if there is at least a match between team x and team y in the first result where the outcome is different from the match between team x and team y in the second result.

Input

The input consists of several test cases. Each starts with the number of teams n ($2 \leq n \leq 8$), followed by n non-negative integers the point of team i^{th} Pi ($0 \leq Pi \leq 3(n-1)$).
The input terminates with n = 0 and you don't have to process this case.

Output

For each test case, print a string in the format "Case #x: y" where x is the number of the test case and y is your result.

Sample

Sample input	Output for sample input
3 6 1 1 4 6 6 6 0 2 2 1 0	Case #1: 1 Case #2: 2 Case #3: 0

Explanation

For the first case, the only possible result is team 1 beat both team 2 and team 3, team 2 draw team 3.
For the second case, there are 2 possible results:

- Team 4 loses all other teams, team 1 beats team 2, team 2 beats team 3, team 3 beats team 1.
- Team 4 loses all other teams, team 1 beats team 3, team 3 beats team 2, team 2 beats team 1.

Problem C – Board game

Kalista is a student. She has a deep passion for board games, and she is very good at it. In birthday party of her friend Potm, he awards a very special prize for a person who can solve a board game fastest. His question is: Given a board with 4 rows and 4 columns, fill all cells of the board with either -1 or 1. In how many ways we can fill so that the products of numbers in each row and column are equals to 1?

It is not a task of challenge for Kalista to solve, and of course she is the person who can solve the task in just a few minutes.

Kalista gets the prize and then comes home and opens it. She is so surprised because the prize is actually another question. Maybe, Potm can anticipate that Kalista will be the winner, and he would like to challenge her one more time.

The now problem is quite similar, but more difficult. Given a board with N rows and M columns. Again, fills the board with 1 and -1. How many ways Kalista could fill so that it guarantees the criteria mentioned above? Because the result may be very large, Kalista must tell Potm the result modulo 1,000,000,007. Now, it is really a hard problem. Kalista needs your help!

Input

The first line contains an integer T ($T \leq 10{,}000$), which is the number of test cases.
Each of the next T lines contains a test case, including 2 integers N and M. ($1 \leq N, M \leq 1{,}000{,}000{,}000$).

Output

Print the result of each test case in one line.

Sample

Sample input	Output for sample input
2 1 1 2 2	1 2

Problem D – Sum of digits

Minh is interested in studying about the sum of digits of a number. Minh thinks that there might be some interesting patterns for this function. Today, he is looking at the relation between a number and its product.

Let S(a) be the sum of all digits of a. He starts by counting how many number a where ($0 \leq a < 10^N$) which satisfy S(a) = S(a * M). It turns out to be not an easy task when N grows bigger. Can you help Minh to solve that?

Input

The input consists of several test cases. The first line is the number of tests T ($T \leq 40$),then T tests follow. Each contains two integers N and M. ($1 \leq N \leq 18$, $1 \leq M \leq 100$)

Output

For each test, print the result in one line.

Sample

Sample input	Output for sample input
2 18 1 1 2	1000000000000000000 2

Problem E – Prime form

Leona is a student very good at mathematics, especially prime numbers. One day, her close friend Thresh asks her a question. Thresh mentions all prime numbers in form of:

$$P = 2x^3 - 6xy + 3y^2 - 2x^2y + 3x^2$$

Thresh asks Leona to find the number of integer pairs (x, y) so that P is a prime with x is not negative and less than or equal to a given integer N.

Input

The first line contains an integer T ($T \leq 10{,}000$), which is the number of test cases. Each of the next T lines contains a test case that is an integer N ($0 \leq N \leq 10^7$).

Output

Print the number of integer pairs (x, y) for each test case in one line.

Sample

Sample input	Output for sample input
4 0 1 100 9	2 3 50 11

Problem F – Array again

Given an array arr[] of integers. There are 3 types of update operations (A, B, C) and 1 type of query operation S. Initially, all elements of array are equal to 0. The operations are described as following:

- Operation A: There are 2 parameters s and t.
  For each i from s to t, increase arr[i] by (i - s + 1).
- Operation B: There are 2 parameters s and t.
  For each i from s to t, increase arr[i] by (t - i + 1).
- Operation C: There are 3 parameters s, t and x.
  For each i from s to t, set the value of arr[i] to x.
- Operation S: There are 2 parameters s and t.
  Return the sum arr[s] + arr[s+1] + arr[s+2] + ... + arr[t].

Input

Input starts with an integer T, denoting the number of test cases.

- Each case starts with a line containing an integer N ($1 \le N \le 10^5$) denoting the number of operations.
- Each of the next N lines starts with a character ('A', 'B', 'C' or 'S'), which indicates the type of operation. Character 'A', 'B' or 'S' will be followed by two integers, s and t in the same line. Character 'C' is followed by three integers, s, t and x. It's assumed that, $1 \le s \le t \le 250{,}000$ and $-10^5 \le x \le 10^5$. The meanings of these integers are explained above.

Output

For each case, print the case number first. Then for each operation 'S', print the result of query in a line.

Sample

Sample input	Output for sample input
2 5 A 1 6 B 3 5 S 1 6 C 6 10 -2 S 1 6 1 S 1 10	Case 1: 27 19 Case 2: 0

Problem G – Repetition codes

In information theory and coding theory with applications in computer science and telecommunication, error detection and correction or error control are techniques that enable reliable delivery of digital data over unreliable communication channels. Many communication channels are subject to channel noise, and thus errors may be introduced during transmission from the source to a receiver. Error detection techniques allow detecting such errors, while error correction enables reconstruction of the original data in many cases.

The general idea for achieving error detection and correction is to add some redundancy (i.e., some extra data) to a message, which receivers can use to check consistency of the delivered message, and to recover data determined to be corrupted.

About error detection, there are a large number of Error detection schemes. And now we will concern about one of simplest schemes called Repetition codes. A repetition code is a coding scheme that repeats the bits across a channel to achieve error-free communication. Given a stream of data to be transmitted, the data are divided into blocks of data. Each block is transmitted some predetermined number of times. For example, to send the 3-blocks data "ABC", these blocks can be repeated three times, thus producing "AAABBBCCC". However, if theseblocks was received as "AAABBBCCD" –it can be determined that an error has occurred.

Based on this scheme, we need to encrypt a message S before sending it to the destination. Given a number N, which is the number of times each character of S is repeated. Let's encrypt it following the method mentioned above.

Input

The first line contains a single number t, which is the number of data sets.
Each data set is a single line of input consisting of the data set number n, followed by the repeated count N, followed by the string S. In this problem, S can contain any characters with ASCII code larger than 32.

Output

For each data set, write the output in a single line, consisting of the data set number n, followed by the new string T.

Sample

Sample input	Output for sample input
2 1 3 XYZ 2 5 ACM?	1 XXXYYYZZZ 2 AAAAACCCCCMMMMM?????

Problem H – Cyclic

Smith is very good at mathematics. He loves interesting features of numbers. And one day, he found a very special type of numbers called "cyclic number".

A cyclic number is a n-digits integer which, when multiplied by any integer from 1 to n, results in a "cycle" of the digits of the original number.

The most widely known is 142857. This is as illustrated by the following explanation:

$$142857 \times 1 = 142857$$
$$142857 \times 2 = 285714$$
$$142857 \times 3 = 428571$$
$$142857 \times 4 = 571428$$
$$142857 \times 5 = 714285$$
$$142857 \times 6 = 857142$$

Write a program determining whether or not numbers are cyclic. The input file is a list of integers from 2 to 60 digits in length. Note that for cyclic numbers, leading zeros are important. So, preceding zeros should not be removed, they are considered part of the number and count in determining n. Thus, "01" is a two-digit number, distinct from "1" which is a one-digit number.

Input
Each line contains an integer number.

Output
For each input integer, write a line in the output indicating whether or not it is cyclic.

Sample

Sample input	Output for sample input
142857	YES
142856	NO
142858	NO
01	NO
0588235294117647	YES

Problem I – Assign!

There are N students numbered from 0 to N-1. For each student i, we knowH[i] means that student i hates student H[i]. We have K distinct classes. In how many ways can students be assigned into those classes such that no student in any class hates any others in the same class?

Input

The first line of input is the number of test cases T. Each of them contains 2 lines.

- The first line of each test case contains 2 integers N ($2 \leq N \leq 100$) and K ($2 \leq K \leq 100$).
- The second line of each test case contains N integers, the i^{th} integer (0-based) denoting the value H[i] ($0 \leq H[i] < N$; H[i] != i).

Output

For each testcase, output the number of ways modulo 1,000,000,007.

Sample

Sample input	Output for sample input
3 3 3 1 2 0 4 3 1 2 0 0 3 2 1 2 0	6 12 0

Problem J – Vacation

John is an engineer. On this summer, he has an intention to pay a visit to many places in his country. The country contains total N cities numbered from 1 to N. There are M bidirectional roads connecting these cities. Each of these roads connects 2 cities and cost an amount of time to go between 2 connected cities.

All of these cities are very beautiful. After considerations, John chose Q cities to visit. John lives in city 1. He does not have much time for the vacation, so he would like to minimize the amount of time travelling on roads. He will start his journey from home, visiting Q cities, and then come back home. Please help John!

Input

The first line contains the number of test cases T. For each of test cases:

- The first line contains 3 integers N ($1 \leq N \leq 5{,}000$), M ($1 \leq M \leq 100{,}000$), Q ($1 \leq Q \leq 10$).
- The second line contains Q integers, which are the cities John will visit.
- Each of the next M lines contains 3 integers A, B, C, which indicates that there is a road connecting city A and city B, and it takes C time units to travel. ($1 \leq A, B \leq N$; $0 < C \leq 1{,}000{,}000$).

Output

For each case, write a line in the output indicating the minimum amount of time John must travel on roads. If there is no way to visit all Q cities, print -1.

Sample

Sample input	Output for sample input
1 5 8 2 3 2 3 2 9 3 4 7 4 1 6 4 5 3 2 5 10 3 2 7 1 4 6 2 1 7	27

Problem K – Birthday present

Hieu's birthday is coming and his best friend - Thinh has already bought him a present. In order to make a big surprise (and to annoy his friend), Thinh decided that he will put the present in a box, put that box in a bigger box, put that bigger box in a even bigger box and so on (each box will contain exactly one other box or contain the actual present).

Thinh has R rectangular-cuboid-shaped boxes and C cylinder-shaped boxes, all with the same height. The edges of the i^{th} rectangular-cuboid-shaped box are (ai, bi). The radius of the j^{th} cylinder-shaped box is rj. A box can put into another box if you can put them without any edges touching (for this problem, we ignore the height of the boxes and always put them upright).

To annoy Hieu the most, Thinh wants to choose as many boxes as possible to wrap the present. Can you determine the maximal number of boxes Thinh could use?

Input

The first line is the number of tests T. Then T tests follow.

- The first line of a test is R ($R \leq 100$), followed by R lines, each contains 2 integers ai, bi ($1 \leq ai, bi \leq 100$).
- The next is C ($C \leq 100$), followed by C lines, each contains a positive integer ri ($1 \leq ri \leq 100$).

Output

For each test, print the maximal number of boxes Thinh could use.

Sample

Sample input	Output for sample input
1 3 2 2 2 3 3 4 1 3	3