The problem sets consist of **11** problems:

Problem **A**	Difficult math
Problem **B**	Palindrome substrings
Problem **C**	Lights chain
Problem **D**	Upgrade planning
Problem **E**	Connecting points
Problem **F**	Memorized lookalike cards
Problem **G**	Optimal division
Problem **H**	Beautiful trails
Problem **I**	Festivals
Problem **J**	Pokemon Go Level
Problem **K**	Missing mutex

Notes:

Contestants should use standard input and output.

Problem A: Difficult math

Given two integer N and K, and a sequence a with N numbers: $a_1, a_2, \ldots, a_N$.

Let $S = a_1^{a_2^{a_3^{\cdot^{\cdot^{a_N}}}}} = a_1^{\left(a_2^{(a_3^{\cdot^{\cdot^{a_N}})}}\right)}$

Your task is to calculate S mod K.

Input

The input starts with the number of test - T ($T <= 20$). Then T tests follow:

- The first line consists of 2 integers N and K. ($2 \leq N \leq 1000, 1 \leq K \leq 10^9$)
- The second line consists of N integers a_i. ($2 \leq a_i \leq 10^9$)

Output

For each test in the input, print a single number.

Sample input	Sample output
2 3 1000000 2 2 2 4 10 2 2 2 2	16 6

Problem B: Palindrome substrings

Palindrome is a string which reads the same forward and backward. For example,

- the following strings are palindrome: "racecar", "abba", "x"
- the following strings are not palindrome: "abc", "racecars", "xy"

A substring of a string $S = S_1S_2 \dots S_N$ is defined as $S' = S_uS_{u+1} \dots S_v$ where $1 \le u \le v \le N$.

Little Long just learn about these two definitions and he is eager to study problem of palindrome. He tried to the longest palindrome substring problem and found out that there is a very efficient linear algorithm by Manacher to solve this problem. He read Wikipedia, articles, sample source codes, ... about this algorithm but did not understand it fully. He is still unable to prove the algorithm is actually $\Theta(N)$.

Frustrated, he decided to run the algorithm by hand with small cases to understand it. In the first step, he decided to list all palindrome substrings and count the number of distinct palindrome substrings. Can you help him to do this first step?

Input

The input starts with the number of test - T ($T <= 150$). Then T tests follow. Each test is printed in a line with a non-empty string S. The length of S does not exceed 100.

Output

For each test in the input, print the number of distinct palindrome substrings in a line.

Sample input	Sample output
1 banana	6

Explanation: a, b, n, ana, nan, anana.

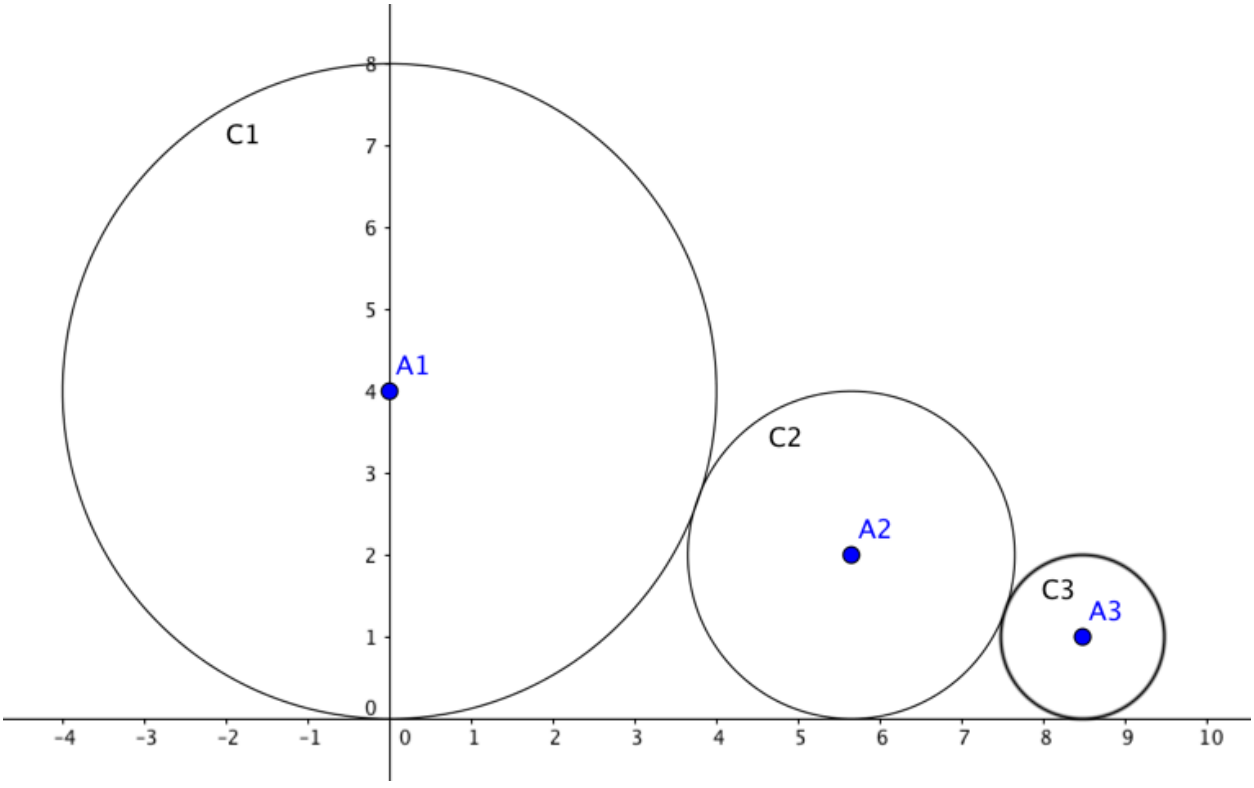
Problem C: Lights

For the coming Christmas, Santa is planning to decorate his house with circle LED lights. He has bought N circle LED lights. The first light's radius is $R1$, the second light's radius is $R_2 = R_1 * k$, the third light's radius is $R_3 = R_2 * k$, and so on.

He decided to put all the LEDs on the ground, so that the size of the LEDs decreases from left to right, and each LED touches the LED on its left and its right. More precisely:

- The first LED's center is at $(0, R_1)$.
- The second LED's center is at (X_2, R_2), touches the first LED, and touches Ox at $(X_2, 0)$. Note that $X_2 > X_1$.
- The third LED's center is at (X_3, R_3), touches the second LED, and touches Ox at $(X_3, 0)$. Note that $X_3 > X_2$.

The following picture illustrates the case where $R1 = 4$, $k = 0.5$:



Given N and k, calculate the coordinate of the center of the rightmost light X_N, Y_N.

Input

The input starts with the number of test - T ($T \leq 10{,}000$). Then T tests follow. Each test consists of an integer N ($N \leq 10^9$), two positive real numbers R_1 and k ($0 < R1 \leq 100$, $0.001 \leq k \leq 0.777$). R_1 and k has at most 3 digits after decimal point.

Output

For each test in the input, print x-coordinate of the center of the rightmost light in a single line. The number should be printed with exactly 3 digit after decimal.

Sample input	Sample output
2 4 2 0.5 4 3 0.5	4.950 7.425

Problem D: Upgrade planning

Alice is a country which has n islands. There are some bridges connecting some islands, which allows people to travel by car or train. The government decided to upgrade this system by building new bridges such that all the islands are connected. They have planned some pairs of islands in which new bridges will be built between them. Unfortunately, the government found a problem that they do not have any material for building new bridges, then finally decided to reuse old bridges. They will destroy some old bridges and use the material from them to build new ones.

Given list of existed bridges and new bridges that could be built with their length, your task is to find a list of bridges to be destroyed and to be built such that the total length of bridges to be built is at most the total length of bridges to be destroyed, while keeping all n islands connected.

Input

The input starts with the number of test - T ($T \leq 15$). Then T tests follow:

- The first line consists of three integers n ($2 \leq n \leq 50000$), m ($0 \leq m \leq 250000$) and l ($0 \leq l \leq m$), where n is the number of islands, m is the number of bridges and l is the number of bridges already built.
- m lines describing the connections. Each connection is described by one line with three integers a, b ($1 \leq a, b \leq n$), and c ($0 \leq c \leq 5000$) describing that there is a bridge from island a to island b of length c. The first l of those bridges already exist.

Output

For each test in the input, print “yes” if it is possible to construct a connected system as described, otherwise output “no”.

Sample input	Sample output
1 4 4 3 1 2 1 2 3 1 1 3 2 2 4 2	Yes

Problem E: Connecting points

On a circle, there are N points numbered 1 to N closewise. We want to connect these points using some straight lines such that:

- Each point can connect directly to exactly 1 other point or does not have any connection.
- There is no pair of connections which intersect each other.

A way of connecting points can be represented using a one-dimensional array C where:

- $C_u = u$ if point u does not connect to any other points.
- $C_u = v \neq u$ if point u connect to point v.
- If $C_u = v$ then $C_v = u$.

2 ways of connecting points $C1$ and $C2$ are considered different if exists u where $C1_u \neq C2_u$.

Your task is to count ways of connecting these N points modulo $10^9 + 7$.

Input

The input starts with the number of test - T ($T \leq 100$). Then T tests follow. Each test is printed in a line with an integer N. ($N \leq 10^7$)

Output

For each test in the input, print the answer in a single line.

Sample input	Sample output
1 3	4

Problem F: Memorize lookalike cards

Memorize lookalike cards is a fun children-friendly card game. Ti and Teo are playing this game.

The game is played with a deck of $2N$ cards. There are N pairs of cards, each pair consists of 2 lookalike cards and is different from other pairs. The game starts with shuffling the deck and lay all the card face down on a table, so that you can not determine which cards are in the same pair.

Ti and Teo takes alternate turns and Ti will take the first turn. In each turn, the player will choose 2 cards and turn them face up simultaneously.

- If the 2 cards are look alike, they will be removed from the deck and the player will get 1 point.
- If the 2 cards are not look alike, the player will turn them face down and put back to the deck.

The game ends when there is no face down card left or the number of turns exceed 10^{100}.

Ti and Teo are very intelligent kid and also have incredible memory. They will always optimal (so that his point is maximized). Can you calculate the expected value of Ti's point?

Input

The input starts with the number of test - T ($T \leq 1000$). Then T tests follow. Each test consists of a single integer N. ($N \leq 1000$)

Output

For each test in the input, print the expected point of Ti in a single line. The number should be printed with exactly 3 digit after decimal.

Sample input	Sample output
2 1 2	1.000 1.000

Problem G: Optimal division

Byteland is a beautiful and peaceful kingdom. Since the trade deal with Bitland came into effect, the economy has grown so much. A lot of people has moved to Byteland to live and work.

This kingdom is a grid of M rows and N columns. M rows are numbered from 1 to M; N rows are numbered from 1 to N; $area_{i,j}$ is in the i-th row and j-th column. Currently, all areas are under direct govern of the King. However, due to the high rise in population, the King decided he will divide the Kingdom into 4 districts using one vertical line and one horizontal line, each area will be governed by a district leader. He wants to find a division that minimizes the difference between the minimum and the maximum population.

Please help the King to find such optimal division.

Input

The input starts with the number of test - T ($T \leq 15$). Then T tests follow:

- The first line consists of two integer M and N ($2 \leq M \leq 1000$; $2 \leq N \leq 1000$).
- The next M lines describe the current population. In the i-th line, the j-th integer represents the population of $area_{i,j}$. These numbers do not exceed 1000.

Warning: input is large. Please use fast input method.

Output

For each test in the input, print a single number: the minimal gap possible.

Sample input	Sample output
2 2 2 1 2 3 4 3 3 1 1 9 1 1 1 8 1 1	3 9

Problem H: Beautiful trails

In the highlands in north Vietnam, there are remoted areas where ethnic groups are living. Although the living condition here is far from sufficient but the people are living a peaceful and enjoyable life with the fresh air and the beautiful scenery. There are N villages in this area (numbered 1 to N), connected by M one-way trails (numbered 1 to M). There is no trail connect a village to itself. Between two villages, there might be multiple trails connect them. Along each trail, there are different types of wildflowers. The flowers along each trail is represent with a string consists of uppercase letters. A trail from village x to village y has the wildflowers ABCD means that it has length 4 and the wild flower you will see when trekking along this trail is A, B, C, D in that order. If there is a trail from village y to village z and it has the wildflowers XYZ, if you trek along village 1 to village 2 and on to village 3 then the wildflowers you see is ABCDXYZ (in that order).

Mark loves trekking and he knows these areas very well. He is wonder if there exist 2 different trekking path where the wildflowers he sees along the trails are exactly the same. These 2 paths does not need to have the same starting and ending village. If they exist, what is the minimal length?

Input

The input starts with the number of test - T ($T \leq 300$). Then T tests follow:

- The first line is the number of villages N ($N \leq 50$) and the number of trails M ($M \leq 1000$).
- The next M lines consists of 2 integers x, y ($1 \leq x, y \leq N$) and a string S representing a trail. The length of S does not exceed 20.

Output

For each test, print the minimal length of 2 similar trekking paths or print -1 if there is no such pair of paths.

Sample input	Sample output
2 4 4 1 2 ABA 2 4 CD 1 3 AB 3 4 ACD 3 4 1 2 AAA 2 1 AAAA 1 3 AAAAA 3 1 A	5 4

First test, 2 similar paths are 1-2-4 and 1-3-4 (ABACD)

Second test, 2 similar paths are 3-1-2 and 2-1 (AAAA)

Problem I: Festivals

Jack is such a naughty boy that he can't stop himself from hanging out with friends in his leisure time. Recently, he has been informed that his city will organize a lot of festivals to celebrate New Year. Wonderful!

There are N festivals which will be held at N places on the main street of Jack's city. It is possible to have more than one event at each place. Festival i will take place at position X_i from day S_i to day E_i. Besides, Jack also evaluates festival i by the attractive value V_i. Jack and his friends have listed out M possible plans. For plan j, they will travel from position L_j to position R_j on day D_j. However, they don't have much time thus they will only join the festival which is the most attractive on their way (highest value V).

Your task is to help them know what is maximum attractive value of a festival they can join for each plan. If there is no such festival, output -1.

Input

The input starts with the number of test - T ($T \leq 5$). Then T tests follow:

- The first line contains the number of festivals N ($1 \leq N \leq 100000$).
- The i-th line of N following lines contains 4 integers X_i, S_i, E_i and V_i. ($1 \leq X_i, S_i, E_i, V_i \leq 10^9$; $S_i \leq E_i$)
- Next line contains the number of plans M ($1 \leq M \leq 100000$).
- The j-th line of M following lines contains 3 integer D_j, L_j and R_j. $(1 \leq L_j, R_j, D_j \leq 10^9;\ Lj \leq Rj)$

Output

For each test, print M lines containing the results for M plans.

Sample input	Sample output
1 4 2 4 8 11 3 10 14 27 4 6 12 19 6 1 16 8 4 6 1 4 7 2 3 15 3 9 16 3 4	19 11 8 -1

Problem J: Pokemon Go level

Pokemon Go is a location-based pervasive augmented reality game. Right after its release, the game has been the top downloaded game app all over the world.

The ultimate goal of the game is to catch all the Pokemons. In this game, each player will starts at level 1 with 0 experience point. The higher the level of a player, the stronger the Pokemon he catches. In order to go from level $u-1$ to level u, the player will need to earn S_u experience points. S_u is given in the following table:

Level u	XP needed to reach level u from level u-1
1	0
2	1000
3	2000
4	3000
5	4000
6	5000
7	6000
8	7000
9	8000
10	9000

Level u	XP needed to reach level u from level u-1
11	10000
12	10000
13	10000
14	10000
15	15000
16	20000
17	20000
18	20000
19	25000
20	25000

Level u	XP needed to reach level u from level u-1
21	50000
22	75000
23	100000
24	125000
25	150000
26	190000
27	200000
28	250000
29	300000
30	350000

Level u	XP needed to reach level u from level u-1
31	500000
32	500000
33	750000
34	1000000
35	1250000
36	1500000
37	2000000
38	2500000
39	3000000
40	5000000

Trung is obsessed with the game and has tried so hard to gain his level. His current total experience point is P, can you determine what level he is in right now?

Input

The input starts with the number of test - T. Then T tests follow. Each test consists of a single integer P ($0 \leq P \leq 10^8$).

Output

For each test in the input, print a single number: the current level of Trung.

Sample input	Sample output
2 10 2016	1 2

Problem K: Missing mutex

Hieu is an famous competitive programmer in Vietnam. Tired of winning matches, he started to study a new programming language called X+*. This language is very simple with one variable X that hold an integer and several operations:

Operations	*Meaning*	*C++ equivalent*
INC	Increase X by one	`X = X + 1`
DOUBLE	Double X	`X = X * 2`
TRIPLE	Triple X	`X = X * 3`
SQR	Square of X	`X = X * X`
SET y	Set the value of X equal to y $(0 \leq y \leq 255)$	`X = y`

In the beginning of the program, X is default to be 0. After writing a program consists of several operations, he tested it and it had operated as expected. However, after deploying this program to the server and he realized that he did not handle the concurrency problem. When two programs are executed at the same time, operations of the same program still keep order but the operations between two programs might merge together.

For example, consider this program.

```
INC
DOUBLE
```

When this program is called twice in parallel, we can have very different outcomes:

Op	P1	P2
1	INC	
2	DOUBLE	
3		INC
4		DOUBLE
Result = 6		

Op	P1	P2
1	INC	
2		INC
3	DOUBLE	
4		DOUBLE
Result = 8		

Op	P1	P2
1	INC	
2		INC
3		DOUBLE
4	DOUBLE	
Result = 8		

Op	P1	P2
1		INC
2	INC	
3	DOUBLE	
4		DOUBLE
Result = 8		

Op	P1	P2
1		INC
2	INC	
3		DOUBLE
4	DOUBLE	
Result = 8		

Op	P1	P2
1		INC
2		DOUBLE
3	INC	
4	DOUBLE	
Result = 6		

Given the program, your task is to find how many different results we could get when 2 programs are running at the same time.

Input

The input starts with the number of test - T ($T \leq 20$) Then T tests follow.

- The first line is N the number of operations in the code. ($N \leq 10$)
- The next N lines, each represents an operation.

Output

For each test in the input, print the number of different results we can get.

Sample input	Sample output
1 2 INC DOUBLE	2