The 35th ACM-ICPC Asia Regional Contest (Chengdu)

This problem set should contain 11 (eleven) problems on 24 (twenty-four) numbered pages. Please inform a runner immediately if something is missing from your problem set.

Problem A. Balanced Number

A balanced number is a non-negative integer that can be balanced if a pivot is placed at some digit. More specifically, imagine each digit as a box with weight indicated by the digit. When a pivot is placed at some digit of the number, the distance from a digit to the pivot is the offset between it and the pivot. Then the torques of left part and right part can be calculated. It is balanced if they are the same. A balanced number must be balanced with the pivot at some of its digits. For example, 4139 is a balanced number with pivot fixed at 3. The torqueses are 4*2 + 1*1 = 9 and 9*1 = 9, for left part and right part, respectively. It's your job to calculate the number of balanced numbers in a given range [x, y].

Input

The input contains multiple test cases. The first line is the total number of cases T ($0 < T \leqslant 30$). For each case, there are two integers separated by a space in a line, x and y. ($0 \leqslant x \leqslant y \leqslant 10^{18}$).

Output

For each case, print the number of balanced numbers in the range [x, y] in a line.

Sample Input	Output for Sample Input
2 0 9 7604 24324	10 897

Problem B. Battle over Cities

It is vitally important to have all the cities connected by highways in a war, but some of them are destroyed now because of the war. Furthermore, if a city is conquered, all the highways from/toward that city will be closed by the enemy, and we must repair some destroyed highways to keep other cities connected, with the minimum cost if possible.

Given the map of cities which have all the destroyed and remaining highways marked, you are supposed to tell the cost to connect other cities if each city is conquered by the enemy.

Input

The input contains multiple test cases. The first line is the total number of cases T ($T \leqslant 10$). Each case starts with a line containing 2 numbers N ($0 < N \leqslant 20000$), and M ($0 \leqslant M \leqslant 100000$), which are the total number of cities, and the number of highways, respectively. Then M lines follow, each describes a highway by 4 integers:
City1 City2 Cost Status
where *City1* and *City2* are the numbers of the cities the highway connects (the cities are numbered from 1 to N), *Cost* ($0 <$ *Cost* $\leqslant 20000$) is the effort taken to repair that highway if necessary, and *Status* is either 0, meaning that highway is destroyed, or 1, meaning that highway is in use.

Note: It is guaranteed that the whole country was connected before the war and there is no duplicated high ways between any two cities.

Output

For each test case, output N lines of integers. The integer in the i-th line indicates the cost to keep the cities connected if the i-th city is conquered by the enemy. In case the cities cannot be connected after the i-th city is conquered by the enemy, output "inf" instead in the corresponding place.

Sample Input	Output for Sample Input
3 4 5 1 2 1 1 1 3 1 1 2 3 1 0 2 4 1 1	1 2 0 0 1 1

3 4 2 0 4 5 1 2 1 1 1 3 1 1 2 3 1 0 2 4 1 1 3 4 1 0 3 2 1 2 1 1 1 3 1 1	0 0 inf 0 0

Problem C. Binary Number

For 2 non-negative integers x and y, f(x, y) is defined as the number of different bits in the binary format of x and y. For example, f(2, 3)=1, f(0, 3)=2, f(5, 10)=4.

Now given 2 sets of non-negative integers A and B, for each integer b in B, you should find an integer a in A such that f(a, b) is minimized. If there are more than one such integer in set A, choose the smallest one.

Input

The first line of the input is an integer T ($0 < T \leqslant 100$), indicating the number of test cases. The first line of each test case contains 2 positive integers m and n ($0 < m, n \leqslant 100$), indicating the numbers of integers of the 2 sets A and B, respectively. Then follow ($m + n$) lines, each of which contains a non-negative integers no larger than 1000000. The first m lines are the integers in set A and the other n lines are the integers in set B.

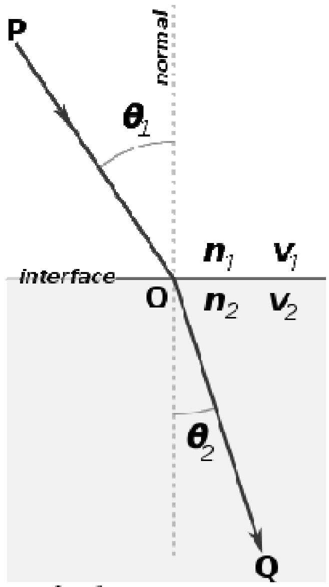
Output

For each test case you should output n lines, each of which contains the result for each query in a single line.

Sample Input	Output for Sample Input
2 2 5 1 2 1 2 3 4 5 5 2 1000000 9999 1423 3421 0 13245 353	1 2 1 1 1 9999 0

Problem D. Detector Placement

Dr. Gale is testing his laser system. He uses a detector to collect the signals from a fixed laser generator. He also puts a special prism in the system so that he can filter the noise. But he is not sure where to put the detector to collect the signals. Can you help him with this problem?



$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2} = \frac{n_2}{n_1}$$

Here n_1 and n_2 are the refractive indices of the two media.

In order to simplify the problem, here we assume the prism is a triangle. The laser generator will not be placed on the surface of the prism or inside the prism. The laser goes in one direction and the detector can receive signals from any direction. The detector is place on the ground where the y-coordinate is zero. There is no energy lost in the refraction. That is to say, there is no reflection in the signal transmission. You can assume that there is no total reflection or the situation that the laser passes the vertex of the prism.

Given the position and the direction of the laser generator and the prism, you are asked to find the position of detector so that it can receive the signals from the laser generator.

Input

The input contains multiple test cases. The first line is the total number of cases T ($T \leqslant 100$). The first line of each test case contains 2 integers, indicating the x and y coordinates of the laser generator respectively.

The second line contains 2 integers describing a point the laser will go through when the prism is not placed. The third line contains 6 integers describing the three vertices of the prism. The fourth line contains a real number *u*, the refractive index of the prism ($1 < u \leq 10$). We assume the refractive index of the air is always 1.0. The absolute value of the coordinates will not exceed 1000. The y coordinates are all nonnegative. The prism and the laser generator are strictly above the ground.

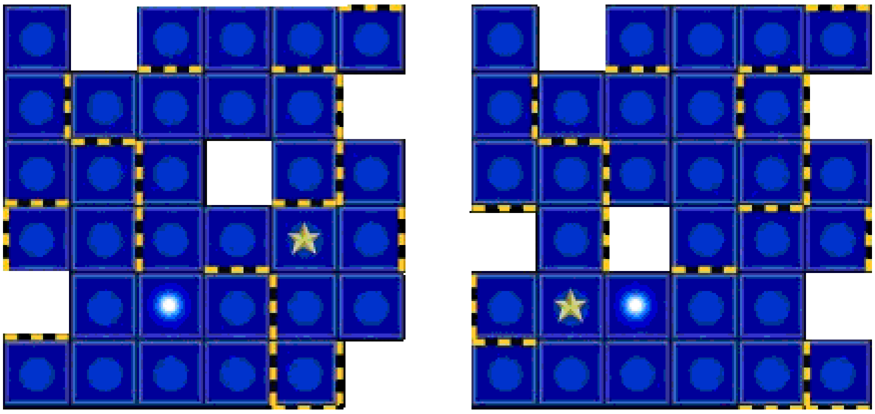
Output

If there is no place in the ground that can receive the signals output "Error". Otherwise, output the x coordinate of the place. Your answer should be rounded to the 3rd digit after the decimal point.

Sample Input	Output for Sample Input
2 0 10 0 0 -1 3 1 2 -1 1 1.325 0 10 0 20 -1 3 1 2 -1 1 1.325	-0.658 Error

Problem E. Double Maze

Unlike single maze, double maze requires a common sequence of commands to solve both mazes. See the figure below for a quick understanding.



A maze is made up of 6*6 cells. A cell can be either a hole or a square. Moreover, a cell may be surrounded by barriers. There is ONLY one start cell (with a ball) and ONLY one end cell (with a star) in a single maze. These two cells are both squares. It is possible that the start cell and the end cell are the same one. The goal of a single maze is to move the ball from the start cell to the end cell. There are four commands in total, 'L', 'D', 'R' and 'U' corresponding to moving the ball left, down, right and up one cell, respectively. The barriers may make the commands take no effect, i.e., the ball does NOT move if there is a barrier on the way. When the ball gets to a hole or outside of the maze, it fails.

A double maze is made up of two single mazes. The commands control two balls simultaneously, and the movements of two balls are according to the rules described above independently. Both balls will continue to move simultaneously if at least one of the balls has not got to the end cell. So, a ball may move out of the end cell since the other ball has not been to the target. A double maze passes when both balls get to their end cells, or fails if either of the two mazes fails. The goal of double maze is to get the shortest sequence of commands to pass. If there are multiple solutions, get the lexical minimum one.

To simplify the input, a cell is encoded to an integer as follows. The lowest 4 bits signal the existence of the barriers around a cell. The fifth bit indicates whether a cell is a hole or not. The sixth and seventh bits are set for the start cell and end cell. Details are listed in the following table with bits counted from lowest bit. For a barrier, both of the two adjacent cells will have the corresponding barrier bit set. Note that the first two mazes in the sample input is the encoding of two mazes in the figure above, make sure you understand the encoding right.

Bit	Value	Description
1	0	No barrier to the left
	1	A barrier to the left
2	0	No barrier to the bottom
	1	A barrier to the bottom
3	0	No barrier to the right
	1	A barrier to the right
4	0	No barrier to the up
	1	A barrier to the up
5	0	A hole
	1	A square
6	0	Not start cell
	1	A start cell
7	0	Not end cell
	1	An end cell

Input

The first line of input gives the total number of mazes, T ($1 < T \leqslant 20$). Then follow T mazes. Each maze is a 6*6 matrix, representing the encoding of the original maze. There is a blank line between mazes.

Output

For every two consecutive mazes, you should treat them as a double maze and output the answer. So there are actually $T - 1$ answers. For each double maze, output the shortest sequence of commands to pass. If there are multiple solutions, output the lexicographically minimum one. If there is no way to pass, output -1 instead.

Sample Input	Output for Sample Input
3 16 0 18 16 18 24 20 19 24 16 28 1 18 28 17 0 22 17	RRLULLLRRDLU RURDRLLLURDULURRRRRDDU

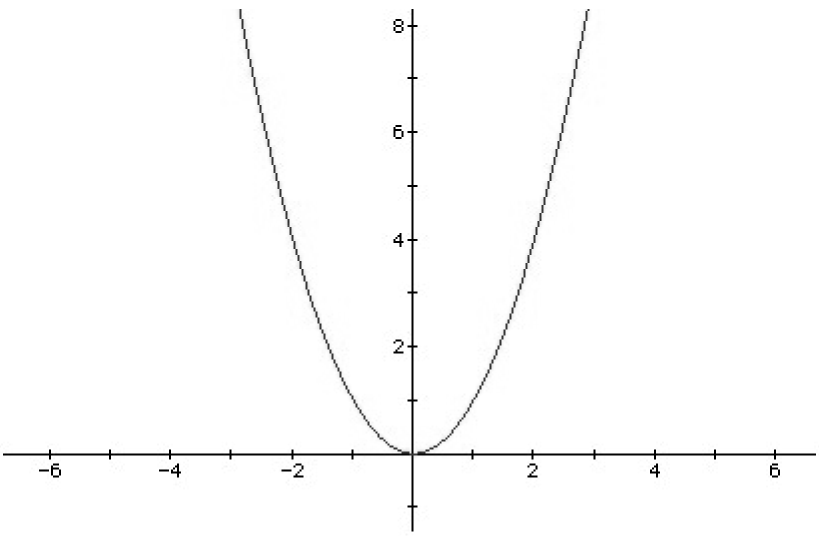
25 20 17 18 88 20 2 16 48 28 17 16 24 16 16 20 23 1 16 0 18 16 18 24 20 19 24 20 29 1 18 28 17 16 22 17 8 20 1 18 24 20 19 80 48 24 16 0 24 16 16 16 22 19 18 16 18 16 18 80 24 18 24 16 24 18 18 24 0 0 18 24 24 18 0 0 24 18 18 24 18 16 18 24 56 18 24 18 24 18	

Problem F. Error Curves

Josephina is a clever girl and addicted to Machine Learning recently. She pays much attention to a method called Linear Discriminant Analysis, which has many interesting properties.

In order to test the algorithm's efficiency, she collects many datasets. What's more, each data is divided into two parts: training data and test data. She gets the parameters of the model on training data and test the model on test data.

To her surprise, she finds each dataset's test error curve is just a parabolic curve. A parabolic curve corresponds to a quadratic function. In mathematics, a quadratic function is a polynomial function of the form $f(x) = ax^2 + bx + c$. The quadratic will degrade to linear function if $a = 0$.



It's very easy to calculate the minimal error if there is only one test error curve. However, there are several datasets, which means Josephina will obtain many parabolic curves. Josephina wants to get the tuned parameters that make the best performance on all datasets. So she should take all error curves into account, i.e., she has to deal with many quadric functions and make a new error definition to represent the total error. Now, she focuses on the following new function's minimum which related to multiple quadric functions.

The new function $F(x)$ is defined as follows:

$F(x) = max(S_i(x))$, $i = 1...n$. The domain of x is [0, 1000].
$S_i(x)$ is a quadric function.

Josephina wonders the minimum of $F(x)$. Unfortunately, it's too hard for her to solve this problem. As a super programmer, can you help her?

Input

The input contains multiple test cases. The first line is the number of cases T ($T < 100$). Each case begins with a number n ($n \leqslant 10000$). Following n lines, each line contains three integers a ($0 \leqslant a \leqslant 100$), b ($|b| \leqslant 5000$), c ($|c| \leqslant 5000$), which mean the corresponding coefficients of a quadratic function.

Output

For each test case, output the answer in a line. Round to 4 digits after the decimal point.

Sample Input	Output for Sample Input
2 1 2 0 0 2 2 0 0 2 -4 2	0.0000 0.5000

Problem G. Go Deeper

Here is a procedure's pseudocode:

```
go(int dep, int n, int m)
begin
    output the value of dep.
    if dep < m and x[a[dep]] + x[b[dep]] != c[dep] then go(dep + 1, n, m)
end
```

In this code n is an integer. a, b, c and x are 4 arrays of integers. The index of array always starts from 0. Array a and b consist of non-negative integers smaller than n. Array x consists of only 0 and 1. Array c consists of only 0, 1 and 2. The lengths of array a, b and c are m while the length of array x is n.

Given the elements of array a, b, and c, when we call the procedure go(0, n, m) what is the maximal possible value the procedure may output?

Input

There are multiple test cases. The first line of input is an integer T ($0 < T \leqslant 100$), indicating the number of test cases. Then T test cases follow. Each case starts with a line of 2 integers n and m ($0 < n \leqslant 200$, $0 < m \leqslant 10000$). Then m lines of 3 integers follow. The i-th($1 \leqslant i \leqslant m$) line of them are a_{i-1}, b_{i-1} and c_{i-1} ($0 \leqslant a_{i-1}, b_{i-1} < n$, $0 \leqslant c_{i-1} \leqslant 2$).

Output

For each test case, output the result in a single line.

Sample Input	Output for Sample Input
3 2 1 0 1 0 2 1 0 0 0 2 2 0 1 0 1 1 2	1 1 2

Problem H. Jenga

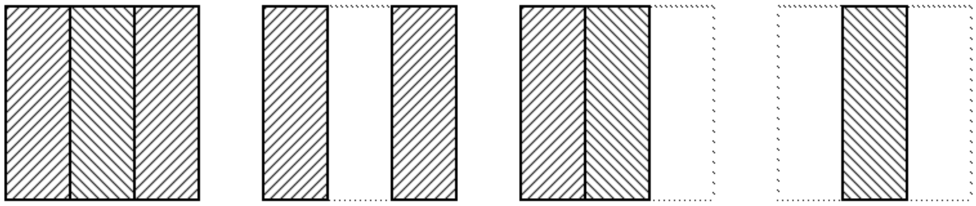
In their spare time of training, Alice and Charles often play Jenga together. As they've played the game together so many times, they both know each others' performance as well as themselves'. Now with their success rate of each move provided, can you tell in what probability each of them will win? And of course, Alice and Charles, like other ACM-ICPC contestants such as you, are very clever.

Jenga is a game of physical and mental skill. In Jenga, players take turns to remove a block from a tower and balance it on top, creating a taller and increasingly unstable structure as the game progresses.

Jenga is played with 54 wooden blocks. Each block is three times as long as it is wide. To set up the game, the included loading tray is used to stack the initial tower which has 18 levels of three blocks placed adjacent to each other along their long side and perpendicular to the previous level (so, for example, if the blocks in the first level lie lengthwise north-south, the second level blocks will lie east-west).

Once the tower is built, the players take turns to move. Moving in Jenga consists of taking one and only one block from any level (except those mentioned later) of the tower, and placing it on the topmost level in order to complete it. The blocks in the top level, and the level below it if the top level is not completed, cannot be removed. However, if the top level is completed, the blocks in the one below it can be removed. The removed block should be placed to make the top level as same as the other levels (with no block removed). The move is successful if the tower does not fall.

The game ends when the tower falls, or no block can be removed without making the tower fall (rarely happened). And the loser is the player who made the tower fall (i.e., whose turn it was when the tower fell), or who cannot make the move.



Now let's consider each level of the tower, there're only four types of valid arrangement of wooden blocks, as illustrated above. At the beginning of the game, they're all of the type **A** (or rotated by 90 degrees). And by removing a block from type **A**, one will get either type **B** or type **C** (or the mirrored equivalent of type **C**). No block from type **B** can be removed without making the tower fall. From type **C** we can only remove a block and result in type **D**. Then no block can be removed further. So there are only three types of moves: (1) **A** -> **B**, (2) **A** -> **C** and (3) **C** -> **D**, in addition to adding the removed block to the top level.

As Alice and Charles have played Jenga so many times, their success rate of each move is very stable and can be formulated as $P = b - d*n$, where b is the player's base success rate of this type of move, d is the decrease of success rate for each additional level, and n is the number of levels in the tower before this move. The incomplete top level also counts as one level. For example, if the game begins with 18 levels, and both players have the same performance with $b = 2.8$ and $d = 0.1$, then P will be 1.0 for the first turn, and become 0.9 between the 2nd and the 4th turns. If P does not lie in the range [0, 1], the nearest number in the range is indicated. (E.g. when a player cannot fail the first several moves, P will be more than 1 until n is a bit larger.)

Input

The input file contains multiple test cases. The first line of the input file is a single integer T ($T \leqslant 500$), the number of test cases.

Each test cases begins with a line of n_0 ($3 \leqslant n_0 \leqslant 18$), the number of levels in the tower when the game starts. (When n_0 is not 18, the rules are the same.) The second line contains 6 real numbers b_{a1}, d_{a1}, b_{a2}, d_{a2}, b_{a3}, d_{a3}, indicating Alice's base success rates and the decreases of success rates for each of the three moves: (1) A -> B, (2) A -> C and (3) C -> D. The third line also contains 6 real numbers b_{c1}, d_{c1}, b_{c2}, d_{c2}, b_{c3}, d_{c3}, those of Charles. ($0 \leqslant b - d*n_0 \leqslant 2$ and $0 < d \leqslant 0.5$ for all the 6 pairs of parameters. No real number will have more than 4 digits after the decimal point.)

Output

For each test case, print a line with Alice's winning probability, assume that she always moves first. Your answer should be rounded to the 4th digit after the decimal point.

Sample Input	Output for Sample Input
2 3 1.3 0.1 1.3 0.1 1.3 0.1 1.3 0.1 1.3 0.1 1.3 0.1 4 1.5 0.1 1.5 0.1 1.5 0.1 1.5 0.1 1.5 0.1 1.5 0.1	0.1810 0.8190

Problem I. Rescue

The princess is trapped in a magic place. In this place, there are N magic stones. In order to rescue the princess, you should destroy all the stones.

The N stones are in a straight line. We number them as s_1, s_2, ... s_n from left to right. Each stone has a magic strength m_1, m_2, ... m_n. You have a powerful skill that can do some damage to the stones. To release the skill, you should stand to the right of some stone (s_i). Then you throw a power ball towards left. Initially, this ball has a power of p. When it hits a stone, it will do some damage to the stone and its power will be decreased, and the ball will continue to fly left to the next stone if its power is still positive. Formally, if you stand to the right of s_i and the power ball's initial power is p, then the ball will do Max(0, $p - (i - j) * (i - j)$) damage to s_j, for each $j <= i$. So from this formula, we can see that the damage to stone s_j is only determined by the initial power of the ball and the number of stones between s_i and s_j.

A stone is destroyed if the damage you do is larger than its magic strength. Note that even if a stone is destroyed, it will not disappear; your magic ball will do damage to it and the power will be decreased by that stone. You are not strong enough so that you can release at most k magic balls. It will cost a lot of energy if the power of the magic ball is too high. So what is the minimum value of p with which you can destroy all the magic stones, with no more than k magic balls? You can choose where to release each magic ball as your will, and the power of the ball **must be a positive integer**.

Input

The first line is the number of cases T ($T \leqslant 100$). For each case, the first line gives two integers n, k ($1 \leqslant n \leqslant 50000$, $1 \leqslant k \leqslant 100000$). The second line are n integers, giving m_1, m_2, ... m_n ($1 \leqslant m_i \leqslant 10^9$).

Output

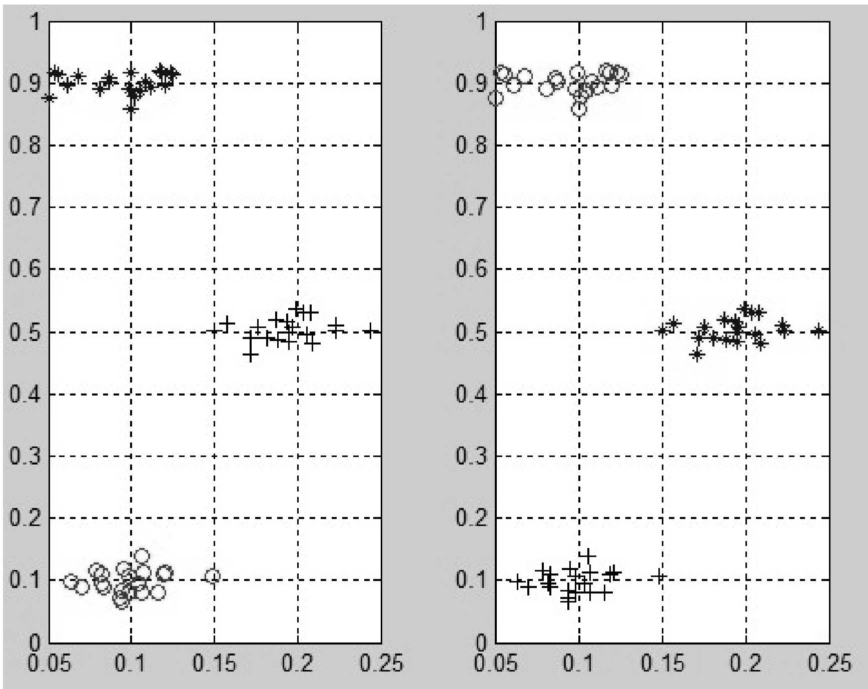
Print minimum possible p in a line.

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

Problem J. Similarity

When we were children, we were always asked to do the classification homework. For example, we were given words {Tiger, Panda, Potato, Dog, Tomato, Pea, Apple, Pear, Orange, Mango} and we were required to classify these words into three groups. As you know, the correct classification was {Tiger, Panda, Dog}, {Potato, Tomato, Pea} and {Apple, Pear, Orange, Mango}. We can represent this classification with a mapping sequence {A,A,B,A,B,B,C,C,C,C}, and it means Tiger, Panda, Dog belong to group A, Potato, Tomato, Pea are in the group B, and Apple, Pear, Orange, Mango are in the group C.

But the **LABEL** of group doesn't make sense and the **LABEL** is just used to indicate different groups. So the representations {P,P,O,P,O,O,Q,Q,Q,Q} and {E,E,F,E,F,F,W,W,W,W} are equivalent to the original mapping sequence. However, the representations {A,A,A,A,B,B,C,C,C,C} and {D,D,D,D,D,D,G,G,G,G} are not equivalent.



The pupils in class submit their mapping sequences and the teacher should read and grade the homework. The teacher grades the homework by calculating the maximum similarity between pupils' mapping sequences and the answer sequence. The definition of similarity is as follow.

$$Similarity(S, T) = sum(S_i == T_i) / L$$
$$L = Length(S) = Length(T), i = 1, 2, ... L,$$

where sum(S_i == T_i) indicates the total number of equal labels in corresponding positions.

The maximum similarity means the maximum similarities between S and all equivalent sequences of T, where S is the answer and fixed.

Now given all sequences submitted by pupils and the answer sequence, you should calculate the sequences' maximum similarity.

Input

The input contains multiple test cases. The first line is the total number of cases T ($T < 15$). The following are T blocks. Each block indicates a case. A case begins with three numbers n ($0 < n < 10000$), k ($0 < k < 27$), m ($0 < m < 30$), which are the total number of objects, groups, and students in the class. The next line consists of n labels and each label is in the range [A...Z]. You can assume that the number of different labels in the sequence is exactly k. This sequence represents the answer. The following are m lines, each line contains n labels and each label also is in the range [A...Z]. These m lines represent the m pupils' answer sequences. You can assume that the number of different labels in each sequence doesn't exceed k.

Output

For each test case, output m lines, each line is a floating number (Round to 4 digits after the decimal point). You should output the m answers in the order of the sequences appearance.

Sample Input	Output for Sample Input
2 10 3 3 A A B A B B C C C C F F E F E E D D D D X X X Y Y Y Y Z Z Z S T R S T R S T R S 3 2 2 A B A C D C F F E	1.0000 0.7000 0.5000 1.0000 0.6667