Problem A
Opened-up Die

Input: A.txt

Summer Camp (3rd Day), Tokyo
25 Sep 2005

The die is cast.

— Julius Caesar (*100 B.C. – 45 B.C.*)

Dice have a very long history. It is not clear when and where dice are originated. It is known, however, that dice have been used in Egypt since the time before the year of 3000 B.C.

Figure 1: Picture of dice

Dice are sometimes represented by their *nets* as shown in Figure 2 when they are depicted on a plane. As you know, there are a number of nets that represent the same dice. In this problem, however, we consider only nets of the same shape as the one shown in Figure 2. For our convenience, we index the faces as shown in Figure 3.

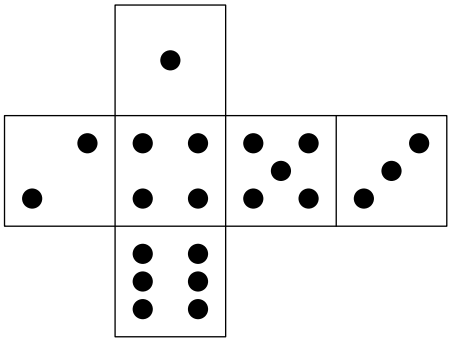

Figure 2: Net of die

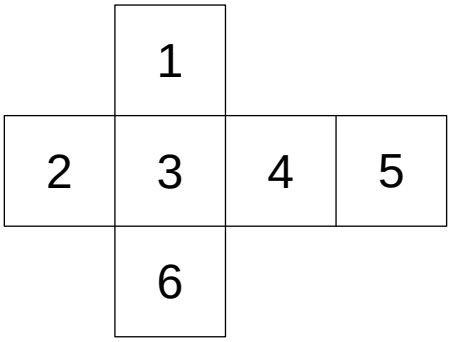

Figure 3: Indices of faces

One day, Dr. M introduced the concept of the optimum nets of dice. He defined the net with the minimum *M-value* as optimal. The M-value is given by the sum of differences of the numbers on adjacent faces of the net. For Figure 2, the M-value is $|1 - 4| + |2 - 4| + |4 - 5| + |5 - 3| + |4 - 6| = 9$. Because Dr. M has a little misunderstanding about dice, the sum of the numbers on the opposite faces is not always seven. Nevertheless, each face has a number from one to six, and no two different faces have the same number.

As a result of his research, he discovered the optimum nets under various conditions. However, unfortunately, part of his nets got unable to read because he had spilt coffee over his notebook by mistake.

Your task is to write a program to recover his nets of dice from their parts.

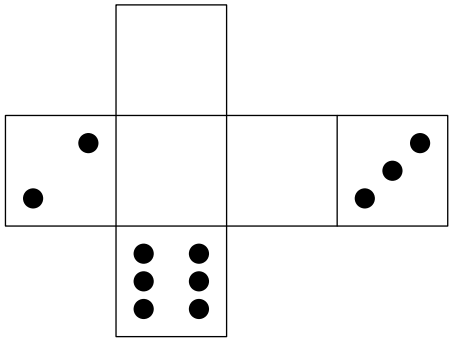

Figure 4: Net given as the sample input; unreadable faces indicated by empty.

Input

The first line of the input contains one positive integer T indicating the number of test cases. The following T lines contain the test cases.

Each test case consists of only one line that contains six characters, each of which is either a digit from '1' to '6', or a lowercase 'x'. The i-th character corresponds to the face indexed i in Figure 3. A digit represents the number on the face; a 'x' indicates that the number is unreadable, thus must be determined by your program. No test case contains more than one same digit.

Output

For each test case, output one line containing six digits that denote the optimum net under the condition that numbers on faces given in the input must be unchanged. The i-th digit must represent the number on the face indexed i in Figure 3, as in the input. If there is more than one solution, output any of them.

Sample Input

```
1
x2xx36
```

Output for the Sample Input

```
124536
```

Problem B
Game Fan

Input: B.txt

Summer Camp (3rd Day), Tokyo
25 Sep 2005

Note: All trademarks and registered trademarks mentioned in this problem are property of their respective holders.

After computers have been invented, maybe computer games are one of the most important applications of computers in our lives. The fascinating image, the lovely voice and the attractive plot have made those who are called ‘game fans’ wallowed in computer game deeply. Although nowadays the most advanced computer technologies in the world are used in computer games, ‘game fans’ are not always satisfied with the games, especially their prices. The more fascinating image, the lovelier voice and the more attractive plot the computer game has, the higher price it has. And what’s more, it requires ‘game fans’ to purchase the more advanced (which means the more expensive) equipments.

As you know, not every game fan has a large fortune. Facing various hardwares and softwares in computer games, fans will be at a loss as they want to make a decision to buy some of them. But unfortunately, fans have to purchase corresponding hardwares to play special softwares. For instance, “Mario Bro.” is one of Nintendo Incorporation’s software products, and only those who have “Family Computer” (which is one of Nintendo Incorporation’s hardware products) can play it. So game fans have to buy “Family Computer” before they want to buy “Mario Bro.”. Here is another instance about “Duck Hunter” which is another game of Nintendo Incorporation. To play “Duck Hunter”, game fans have to buy “Laser Gun” which is specially designed for “Family Computer” by Nintendo Incorporation. Neither those who have “Family Computer” and “Duck Hunter” but without “Laser Gun”, nor those who have “Laser Gun” and “Duck Hunter” but without “Family Computer” can play the game. And if a game fan has “Family Computer”, he can play any games designed for “Family Computer” without to purchase another “Family Computer”. For example, “Mario Bro.” and “Mario Bro. II” are both designed for “Family Computer”, those who have a “Family Computer” could enjoy themselves fully in playing “Mario Bro.” and “Mario Bro. II”. Finally, since game fans who have special hardwares and softwares have fully enjoyed themselves in playing corresponding computer games, it wouldn’t make any sense for them to buy the same hardware or the same software. After all, the same hardware or the same software will not bring game fans the additional pleasure.

In this problem, you will be given the description about a game fan, including his cash and the detailed list of the hardwares and softwares he wants to buy. The list includes the name of the hardwares and the softwares, the equipments they depend on, their prices and the pleasure they will bring to the fan. It’s unlucky that the fan couldn’t buy all the hardwares and the softwares in the list because his cash is limited. So you are required to write a program to help him. Your program should calculate the maximum pleasure the fan could get and the cash he would pay for the corresponding pleasure. Undoubtedly, the fan should have the means to pay for the pleasure.

- Your program should make a decision for each of the items in the detailed list whether buy or not, but should not buy the same item twice or more times. That is, each item in the list should be bought at most once.
- If some items in the list aren’t bought, these items wouldn’t bring any pleasure to the fan. And also, other items which depend on those wouldn’t bring the fan any pleasure either.
- You may assume that there isn’t circular dependency in the detailed list. For example, the following condition will not take place: in the detailed list, item A depends on item B, item B depends on item C, item C depends on item A.
- You may assume that there would be no more than 32 items in the list depend on the same item. And the level of the dependence is less than 5.

Input

The input for this problem will consist of multiple test cases. Each test case contains several lines. A line containing a single '%' signifies the end of the test case. The first line of each test case contains a 'word' ('word' is a continuous string consists of alphabetic and digital characters) which is the game fan's name, and an integer m ($0 \leq m \leq 1024$) which is the fan's cash. It is followed by several lines of the items in the list, each item in a separate line. Each line contains 2 'words' and 2 integers. The first 'word' is the name of the item. The second 'word' is another item that the item (of the first 'word') depends on. If the second 'word' is '`&`', the item doesn't depend on any other items. The first integer is c_i ($0 \leq c_i \leq 1024$), the price for the item, and the second integer is h_i ($0 \leq h_i \leq 100000$), the pleasure the fan could get from the item. The case with the first line containing a single '`#`' indicates the end of the input file. And this case should not be processed. A 'word' in the input file is case-sensitive. Sample Input includes a complete case about the problem.

Output

Output for each test case begins with a line identifying the game fan's name. The next line includes a string of '`Max happiness:`' and an integer that tells the pleasure the fan could get in the case. It is followed by a line including a string of '`Cost:`' and an integer that tells the cash the fan should pay for the corresponding pleasure. If there is more than one way to gain the maximum pleasure, output the minimum cost to get the pleasure. Output a blank line between each case. You should not print any more whitespaces in the output.

Sample Input

```
GameFan 55
FC & 10 10
  LaserGun FC 2 2
    DuckHunter LaserGun 1 85
  MarioBro FC 6 10
  SuperMarioBro FC 6 10
  SuperMarioBro2 FC 6 10
  SuperMarioBro3 FC 6 10
  SuperMarioBro4 FC 6 10
MD & 20 4
  ShiningForceII MD 12 50
  ShiningAndDarkness MD 8 40
  ShiningForce MD 10 70
  DemoGames MD 0 10
%
#
```

Output for the Sample Input

```
GameFan
Max happiness:231
Cost:55
```

Problem C
The Revolution of the Ants

Summer Camp (3rd Day), Tokyo
25 Sep 2005

Input: C.txt

The ants have been living in *Bill Hill* for 100 million years. However, they are facing the most serious crisis. One soldier ant, *White Young Hunter*, has got the news that human beings will develop this area. He must let all communication ants (com-ants) know this message so that the message can be broadcast to the whole empire, and these ants can start a revolution to survive the distress.

There are on *Bill Hill* many anthills connected by some paths, which have special smell. Each com-ant always moves at the same speed on its circular cruise route, which is composed of several smell paths. When two com-ants meet in a path or at an anthill, they will exchange all of their messages. The time of the exchange can be ignored. At the beginning, all the com-ants are at the first anthill in their routes, and *White Young Hunter* tells the news to the com-ant numbered 1 (the soldier ant has been tired out after having run from the human world to *Bill Hill*, and had better have a good rest). Your task is to write a program to figure out whether all the com-ants can get the message.

Input

The input file consists of several test cases. Each case will begin with a line containing three integers n, m and a ($0 \le n < 100$, $0 \le m < 100$, $0 \le a < 100$), which indicate the number of the anthills, the number of the paths, and the number of the com-ants. Following that, there are m lines which describe the paths. Each line contains three positive integers x, y and t, which indicate the two end points of the path and the time for an ant to cruise from one end to the other. Each (x, y) cruise routes. Each line includes several integers, which indicate the anthill number on the route, and is ended by a single zero. Any route will not contain more than 100 waypoints.

A line that contains triple zeros indicates the end of the file, which should not be processed.

Output

For each test case, find out whether all the com-ants can get the message. Display, as shown below, the test case number and the solution "`Revolution can start.`" if it is possible to let all com-ants know the message, or "`Revolution fails.`" otherwise. A blank line should be printed after each test case.

Sample Input

```
3 3 2
1 2 2
2 3 2
3 1 2
1 2 3 0
3 2 1 0
3 3 2
1 2 2
2 3 2
3 1 2
1 2 3 0
2 3 1 0
0 0 0
```

Output for the Sample Input

```
Revolution #1
Revolution can start.

Revolution #2
Revolution fails.
```

Problem D
Polygon Revolution

Input: D.txt

Summer Camp (3rd Day), Tokyo
25 Sep 2005

Given a convex polygon with N vertices $p_1, \ldots, p_N$ and a line L on a 2-dimensional plane. You can generate a 3-dimensional solid of revolution by the revolution of the convex polygon around the axis L. Now your mission is to calculate the volume of this solid.

When the axis L is an external line of the convex polygon, it's much easier, because the following theorem will help you. However, you have to note that the axis may intersect the convex polygon.

The second theorem of Pappus: The volume V of a solid of revolution generated by the revolution of a lamina about an external axis is equal to the product of the area A of the lamina and the distance traveled by the lamina's geometric centroid $\bar{x}$.

$$V = Ad_2 = 2\pi A\bar{x}$$

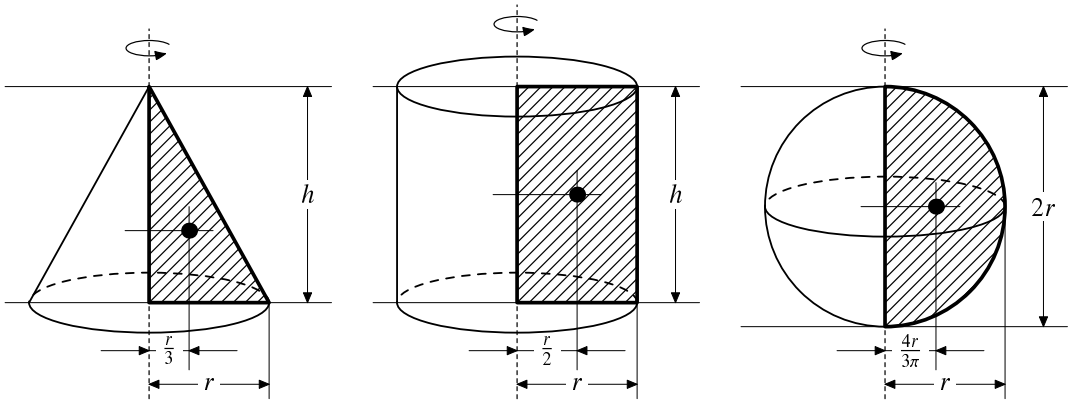

Figure 5: Sample revolutions

Input

The first line of the input is a positive integer T, denoting the number of test cases followed. The first line of each test case is a positive integer N ($2 < N \leq 100$), which represents the number of vertices of the convex polygon. Then N lines follow. The i-th ($1 \leq i \leq N$) line contains two real numbers X_i ($0 \leq X_i \leq 10000$), Y_i ($0 \leq Y_i \leq 10000$) which give the coordinates of the vertices of the convex polygon in clockwise order. Finally, there are three real numbers A, B, C ($-1000 \leq A, B, C \leq 1000$) representing the equation of the axis $Ax + By + C = 0$.

Output

The output should consist of T lines, one line for each test case. Each line should contain only one real number which represents the volume V of the solid of revolution, with an error not greater than 0.1.

Sample Input

```
2
4
0 0
0 1
1 1
1 0
1 0 0
4
0 0
0 1
1 1
1 0
2 0 -1
```

Output for the Sample Input

```
3.1
0.8
```