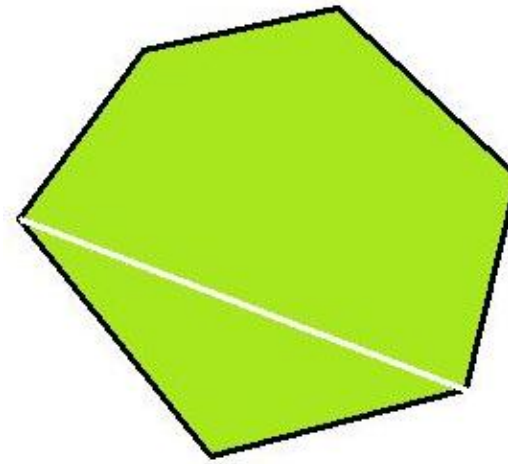
A-Playing Field

My kid's school cleared a large field on their property recently to convert it into a playing area. The field is polygonal. The school administration decided to separate the field into two areas by building a straight picket fence between the area for the older kids and the area for the younger kids. The fence would go between two non-adjacent vertices of the polygonal field, and given the shape of the field, all such possible fences would lie strictly and entirely within the field.

Naturally, the smaller of the two areas would go to the younger kids. So can you help the school determine what the area of the smaller play-area would be for different fence positions?



Input

The input consists on several cases.

For each case, the first line contains 2 numbers N denoting the number of points in the convex polygon and Q denoting the number of possible locations of straight line fences.

The next N lines contain 2 integers each. The ith line contains the integers x_i y_i denoting the coordinates of the ith point of the polygon. The points are given in clockwise order.

The next Q lines contain 2 integers a b denoting that a straight line fence is to be drawn connecting a and b.

End of input will be marked with a case with $N = 0$ and $Q = 0$.

Output

For each case, output Q lines one corresponding to each query. For each query, output the area of the smaller region for the corresponding query rounded to 1 decimal place. Always have 1 digit after the decimal place, so if the answer is 1, output it as 1.0 instead. Always have at least one digit before the decimal point also.

Constraints:

- $4 \leq N \leq 50000$
- $1 \leq Q \leq 50000$
- $-20,000,000 \leq x, y \leq 20,000,000$
- $0 \leq a < b - 1$
- $b < N$

Explanation:

The polygon of the Sample Input below is given by the points (0,0) (0,1) (1,2) (1,0).

In the first query, we join the points (0,1) and (1,0) which leads to the 2 areas given by (0,0) (0,1) (1,0) and (0,1) (1,2) (1,0). The first triangle has an area of 0.5 and the second triangle has an area of 1. The minimum of these 2 is 0.5.

In the second query, we join the points (0,0) and (1,2) which leads to the 2 areas given by (0,0) (0,1) (1,2) and (0,0) (1,2) (1,0). The first triangle has an area of 0.5 and the second triangle has an area of 1. The minimum of these 2 is 0.5.

Sample Input

```
4 2
0 0
0 1
1 2
1 0
1 3
0 2
0 0
```

Sample Output

```
0.5
0.5
```

B-Regular Expression Edit Distance

A regular expression is used to describe a set of strings. For this problem the alphabet is limited to '`a`' and '`b`'. R is a regular expression if:

1. R is '`a`' or '`b`'
2. R is of the form '`(`R_1R_2`)`' where R_1 and R_2 are regular expressions
3. R is of the form '`(`$R-1$`|`R_2`)`' where R_1 and R_2 are regular expressions
4. R is of the form '`(`R_1`*)`' where R_1 is a regular expression.

The set of strings recognised by R are as follows:

1. If R is '`a`', then the set of strings recognised = {`a`}
2. If R is '`b`', then the set of strings recognised = {`b`}
3. If R is of the form '`(`R_1R_2`)`' then the set of strings recognised = all strings which can be obtained by a concatenation of strings s_1 and s_2 where s_1 is recognised by R_1 and s_2 by R_2.
4. If R is of the form '`(`$R-1$`|`R_2`)`' then the set of strings recognised = union of the set of strings recognised by R_1 and R_2.
5. If R is of the form '`(`R_1`*)`' then the the strings recognised are the empty string and the concatenation of an arbitrary number of copies of any string recognised by R_1.

The edit distance between two strings s_1 and s_2 is the minimum number of characters to be inserted/deleted or replaced in s_1 to make it equal to s_2.

Given two regular expressions R_1 and R_2, find the minimum edit distance amongst all pairs of strings s_1 and s_2 such that s_1 is recognised by R_1 and s_2 is recognised by R_2.

Input

The first line contains the number of test cases T. T test cases follow.

Each test case contains two lines containing two regular expressions R_1 and R_2. There is a blank line after each test case.

Output

Output T lines one corresponding to each test case containing the required answer for the corresponding test case.

Constraints:

- $T \leq 85$
- $1 \leq length(R_1), length(R_2) \leq 50$

You are guaranteed that R_1 and R_2 will conform to the definition provided above.

Explanation:

For the first case R_1 recognises all strings over the alphabet '`a`' and '`b`'. Thus it recognises the string '`abaa`' which is also recognised by R_2.

For the second case the strings '`aababab`' and '`ababbb`' are recognised by R_1 and R_2 respectively and have edit distance of 2.

Sample Input

```
2
((a|b)*)
(a(b(aa)))

(a((ab)*))
(a(b(((ab)b)b)))
```

Sample Output

```
0
2
```

C-Sqaure Free Numbers

You all know about factorization of an integer. Here we want you to factor a number into as few factors as possible. That is easy, you say, just have the number itself, and that will be the smallest number of factors i.e. 1.

But wait, I haven't finished — each of the factors that you find must be square-free. A square-free number, however you factor it, won't have any factor that is a perfect square. Of course, you can never include 1 as a factor.

Input

The first line of input is the number of test cases T.

The next T lines each have an integer N.

Output

For each testcase, output the smallest number of square-free factors.

Constraints:

- $T \leq 10^4$
- $2 \leq N \leq 10^6$

Explanation:

6 can be factored as just 6 (further factorable as 2×3 only, and hence square free), a single factor. 8 has to be factored as $2 \times 2 \times 2$ so that all factors are square-free.

Sample Input

```
2
6
8
```

Sample Output

```
1
3
```

D-Soccer Teams

My kid's favorite subject is math, as you know by now. He is learning division now, and his teacher has taught him about even numbers being divisible by 2, numbers whose digits add up to a multiple of 3 being exactly divisible by 3 etc.

He was familiar with division by 11 during selection for soccer teams on his playground, and was wondering whether there was any easy rule to see if a number was divisible by 11. For example, he wondered, if he arranged a number of digits `0-9` in a row to form a number, which ones would be divisible by 11?

He decided to start off with $d[1]$ `1`'s, $d[2]$ `2`'s, ..., $d[9]$ `9`'s, and seeing what is the minimum multiple of 11 that he could get by using all these digits, together with any number of `0`'s. Please help him figure out how many digits there are in this minimum multiple.

Input

The first line will contain the number of test cases T. T lines follow one corresponding to each test case. Each line has 9 integers $d[1], \ldots, d[9]$.

Output

Output T lines one corresponding to each test case. The i-th line should contain the required answer for the corresponding test case.

If he will not be able to form a multiple of 11 in this way, print '`-1`'.

Constraints:

- $1 \leq T \leq 100$
- $1 \leq d[1] + \cdots + d[9] \leq 100$

Explanation:

For the first case, the number 11 can be formed which has 2 digits.

For the second case, number 209 can be formed which is divisible by 11 and has 3 digits.

Sample Input

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

Sample Output

```
2
3
```

E-Sales Prediction

The department store where my family goes shopping is trying to predict how much of each item they stock they will sell each month. Keeping a large amount of inventory is costly, and running out of items is also not a good idea. Since the manager asked for my help as a sales consultant, I decided to formulate a model for predicting each month's sales S of an item based on its sales during the previous R months. After a lot of trial and error, I came up with such a model, where

$$S(n) = a_1 * S(n-1) + a_2 * S(n-2) + \cdots + a_R * S(n-R)$$

where $S[n]$ is the predicted sales for the n-th month for $n > R$, and $S(1)$ to $S(R)$ are seed values.

The store manager was pleased with my model's ability to help him in controlling his inventory.

He asked me to list out every Kth month's sales, and give him the sum of the first N values from this list. For example he wanted every Christmas month's sales summed up for the next 10 years ($N = 10$ and $K = 12$, month 1 being January), or every end-of-quarter month's sales for the next 2 years ($N = 8$, $K = 3$).

Can you please help me write a program that does all the above?

Input

The first line of the input T, the number of test cases. Each test case consists of three lines.

The first line of each test case contains N, R, K.

The second line of each test case contains R integers denoting $S(1)$, $S(2)$, ..., $S(R)$.

The third line of each test case contains R integers denoting the coefficients a_1, a_2, ..., a_R of the predictive model.

Output

For each test case, output the sum requested by the manager as given in the problem statement, *modulo* 1,000,000,007.

Constraints:

- $T \leq 40$
- $1 \leq N \leq 1000000000$
- $1 \leq R \leq 8$
- $1 \leq K \leq 8$
- $0 \leq$ All other input values < 1000000007

Explanation:

In the first test case, it is given that $F(1) = 1$ and the relation is $F(n) = 2 * F(n-1)$. The sequence G consists of all the terms of F since K is 1. Hence, the answer is just the sum of the first 4 terms of F.

In the second test case, the sequence F is the fibonacci sequence which is: 1, 1, 2, 3, 5, 8, 13, 21, 34. Sequence G consists of 2, 8, 34 which sum up to 44.

Sample Input

```
2
4 1 1
1
2
3 2 3
1 1
1 1
```

Sample Output

```
15
44
```

F-Cookie Piles

The kids in my son's kindergarten made Christmas cookies with their teacher, and piled them up in columns. They then arranged the columns so that the tops of the columns, going from shortest to tallest, were in a nice straight ramp. The cookies were all of uniform size. Given that there were A cookies in the shortest pile, that the difference in height between any two adjacent piles was D cookies, and that there were N piles, can you write a program to figure out how many cookies there were in total?

Input

The first line contains the number of test cases T.

T lines follow, one corresponding to each test case, containing 3 integers : N, A and D.

Output

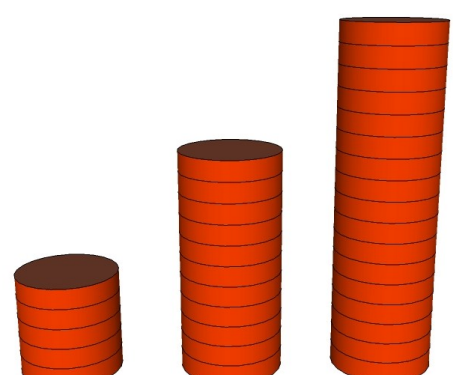
Output T lines, each line containing the required answer for the corresponding test case.

Constraints:

- $T \leq 100$
- $1 \leq N, A, D \leq 100$

Explanation:

In the second test case the sequence is: 5, 11, 17 whose sum is 33. See figure.



Sample Input

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

Sample Output

```
1
33
4
```

G-Christmas Play

My kid's kindergarten class is putting up a Christmas play. (I hope he gets the lead role.) The kids are all excited, but the teacher has a lot of work. She has to produce costumes for a scene with K soldiers. She wants to buy all the costumes in the same size, allowing for some small amount of length alteration to be done by the kids' parents later. So she has taken all the kids' height measurements. Can you help her select K kids from her class of N to play the soldier role, such that the height difference between the tallest and shortest in the group is minimized, and alternations will be easiest? Tell her what this minimum difference is.

Input

The first line contains the number of test cases T. T test cases follow each containing 2 lines.

The first line of each test case contains 2 integers N and K.

The second line contains N integers denoting the height of the K kids.

Output

Output T lines, each line containing the required answer for the corresponding test case.

Constraints:

- $T \leq 30$
- $1 \leq K \leq N \leq 20000$
- $1 \leq height \leq 1000000000$

Explanation:

In the first test case, the teacher needs to only select 1 kid and hence she can choose any kid since the height difference is going to be 0.

In the second test case, the teacher can choose kids with height 4 and 5.

In the third test case, the teacher is forced to choose all 3 kids and hence the answer = 5-2 = 3

Sample Input

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

Sample Output

```
0
1
3
```

H-Shopping Rush

The manager of the multi-storey department store in my town is trying to figure out how to arrange gifts in his shop for Christmas. He runs a peculiar shop such that each customer buys exactly two gifts at the shop (he could buy two of the same gifts too). He knows the probability that a customer might want gift i, is P_i.

He needs to arrange the gifts across several floors. Each floor should have exactly one gift. It takes $A * (|x - y|)^2 + B * (|x - y|) + C$ seconds to go from floor x to floor y.

Since my wife takes my kid shopping, he begged me to help the manager arrange the gifts across floors such that the expected time spent by a typical shopper such as my wife is minimized.

For the purpose of this problem assume that the first gift choice and the second gift choice are independent of each other. i.e., Choosing a first gift as i does not change his probability of choosing the second gift as j. It still remains P_j. Do not count the time taken to reach floor x and leave from floor y — only count the time taken to go from x to y.

Input

The first line contains the number of test cases T. $2 * T$ lines follow, 2 per test case. The first line contains 4 integers : N, A, B, C. The second line contains N integers in the range 1 to 100. The i-th integer represents the percentage probability P_i. All P_i's will sum to 100.

Output

Output T lines one for each test case. Each line contains the minimum expected travelling time for the corresponding test case. Output the answer as a reduced fraction as below.

Constraints:

- $1 \leq T \leq 100$
- $1 \leq N \leq 20$
- $0 \leq A, B, C \leq 10$

Sample Input

```
4
3 0 1 0
60 10 30
1 1 1 0
100
1 1 1 3
100
4 3 7 2
25 25 25 25
```

Sample Output

```
3/5
0/1
3/1
73/4
```

I-Dividing Stones

There are N stones, which can be divided into some piles arbitrarily. Let the value of each division be equal to the product of the number of stones in all the piles modulo P. How many possible distinct values are possible for a given N and P?

Input

The first line contains the number of test cases T.

T lines follow, one corresponding to each test case, containing 2 integers: N and P.

Output

Output T lines, each line containing the required answer for the corresponding test case.

Constraints:

- $T \leq 20$
- $2 \leq N \leq 70$
- $2 \leq P \leq 10^9$

Explanation:

In the first test case, the possible ways of division are (1,1,1), (1,2), (2,1) and (3) which have values 1, 2, 2, 3 and hence, there are 3 distinct values.

In the second test case, the numbers 1 to 6 constitute the answer and they can be obtained in the following ways:

- $1 = 1 * 1 * 1 * 1 * 1$
- $2 = 2 * 1 * 1 * 1$
- $3 = 3 * 1 * 1$
- $4 = 4 * 1$
- $5 = 5$
- $6 = 2 * 3$

Sample Input

```
2
3 1000
5 1000
```

Sample Output

```
3
6
```

J-Chemicals

There are N bottles each having a different chemical. For each chemical i, you have determined $C[i]$, which means that mixing chemicals i and $C[i]$ causes an explosion. You have K distinct boxes. In how many ways can you divide the N chemicals into those boxes such that no two chemicals in the same box can cause an explosion together?

Input

The first line of input is the number of test cases T. T test cases follow each containing 2 lines.

The first line of each test case contains 2 integers N and K.

The second line of each test case contains N integers, the ith integer denoting the value $C[i]$. The chemicals are numbered from 0 to $N-1$.

Output

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

Constraints:

- $T \leq 50$
- $2 \leq N \leq 100$
- $2 \leq K \leq 1000$
- $0 \leq C[i] < N$
- For all i, $i \neq C[i]$

Explanation:

In the first test case, we cannot mix any 2 chemicals. Hence, each of the 3 boxes must contain 1 chemical, which leads to 6 ways in total.

In the third test case, we cannot put the 3 chemicals in the 2 boxes satisfying all the 3 conditions.

Sample Input

```
3
3 3
1 2 0
4 3
1 2 0 0
3 2
1 2 0
```

Sample Output

```
6
12
0
```