ALGOLYMPICS 2023

Sample Problem
Party at the End of the Universe
Time Limit: 1.5 seconds

Billions of years in the future, you and the few remaining immortals sit on the barren wasteland that used to be Earth. All other civilizations have risen and fallen, and now the only thing left is for you and the others to sit back and wait for the final proton to decay. You turn to the other immortals and say, you know, all and all, we had a good life. Why don't we crack open some beers and watch the end of the universe?

You are planning an *end-of-the-universe watch party*. That's still a long ways away, but we might as well start planning now. There are n other immortals remaining, all of whom conveniently have single-letter names `A`, `B`, `C`, Also, the immortals are part of m different *group chats*, each of which contains some non-empty subset of the n immortals (can you imagine spending an eternity without the internet?)

There are k nights remaining until the end of the universe. You plan to do the following once every night, for each of those k nights:

- Select one of the group chats. Then, send a message to that group chat, inviting **everyone** there to your party. **Everyone** in that group chat is invited; you can't selectively only invite *some* people from that chat.

Note that there are m^k different ways to send these messages from now until the end of the universe.

Now, suppose you had a **must** list of immortals who *must* be invited to your party, and a **must-not** list that *must not* be invited to your party. For anyone in neither list, you *don't care* whether they are invited or not. Note that someone is invited if and only if you had sent a message to *any* of the group chats that they belong to.

Here's an interesting question—of the m^k different ways to send messages, how many of them result in everyone in the must list being invited, and everyone in the must-not list *not* being invited? This number can be quite huge, so output it modulo 998244341. And actually, you're not quite decided yet on how you feel about the other immortals, so you should answer T different test cases, each with a different must and must-not list.

Input

The first line of input contains three space-separated integers n, m, k.

Descriptions of the m group chats follow. This is a single line containing m space-separated strings of uppercase letters, with each string corresponding to a group chat. Each letter in eah string corresponds to some immortal that is a member of that group chat.

Then, a line of input containing a single integer T.

Descriptions of the T test cases follow. Each is described by a line containing two space-separated strings of uppercase letters, corresponding to the must list and the must-not lists, respectively. Again, each letter in each string corresponds to some immortal that is a member of that list. An empty must list or must-not list is instead represented by an `!` exclamation point.

Output

Output T integers, each of which contains the answer for the corresponding test case. Again, the answers should be given modulo 998244341.

Constraints

$1 \le n \le 16$
$1 \le m \le 10^5$
$1 \le k \le 10^{18}$
$1 \le T \le 2 \times 10^5$
Only the first n uppercase English letters appear in each group chat, must list, and must-not list (unless some list is empty, in which case it is represented by `!`)
In the list for some group chat, each immortal appears at most once.
In each pair of must and must-not lists, each immortal appears at most once across both lists.

Sample Input	Sample Output
5 3 4 ACDE ABC BCD 4 ! ! AC ! ABCD E B CD	81 80 14 0

Explanation

- If we do not care about who is or isn't invited, then there are simply $3^4 = 81$ valid sequences.
- If we must invite `A` and `C`, then we can show that there is only one sequence of message-sends that *doesn't* achieve this goal—if we send all the messages to the third *group chat*. All other sequences would be valid. Thus, the answer is $3^4 - 1 = 80$.
- We must invite `A`, `B`, `C`, and `D`, but we must **not** invite `E`. Thus, we should never send a message to the first group chat. However, as long as we send at least one message to the second group chat and one message to the third group chat, the sequence is valid. Thus, the answer is $2^4 - 2 = 14$.
- Note that all group chats with `B` also include `C` or `D`. Thus, the task is impossible, and we output that there are 0 valid ways.