Problem 7: Put a Knife In It
8+6 Point(s)

Problem ID: `cipher`

Rank: 2+3

Introduction

Take a stab—or [23]—at this problem! Caesar may be remembered in the modern era for his salad dressing, but there is something else named after him: the Caesar cipher! In this problem, you will be working with basic cryptography to test your programming skills.

Problem Statement

Your task is to recover the original message from a ciphertext given a series of N ciphers used to encode it.

The ciphers encrypt the original message in series, with the output from one cipher becoming the input to the next. Each cipher can be any one of the following:

- A Caesar cipher with an offset x, where each alphabetic character in a string is shifted forward x letters in the alphabet (if $x = 2$, then "a" would become "c"). Non-alphabetic characters are ignored
  - A negative x symbolizes shifting each letter backwards instead of forwards. If the end of the alphabet is reached, you loop to the beginning of the alphabet, and vice versa.
- An Atbash cipher, where each alphabetic character in a string is flipped to its counterpart on the opposite end of the alphabet ("a" becomes "z" and "y" becomes "b"). Non-alphabetic characters are ignored
- A Reverse cipher, where the order of characters in a string is reversed ("atlanta" becomes "atnalta" and "racecar" becomes "racecar")

For your convenience, here are the lowercase letters of the English alphabet in order:
`abcdefghijklmnopqrstuvwxyz`

Input Format

The first line of the input contains a positive integer T denoting the number of test cases that follow. For each test case:

- The first line contains the ciphertext to be decrypted
- The second line contains a positive integer N denoting the number of ciphers used to encrypt the message
- The third line contains a space-separated sequence of N ciphers. The ciphers represent the order in which the original message was encoded, from left to right. The first cipher is on the very left, and the last cipher is on the very right. Each cipher can be any one of the following:
  - Caesar ciphers, represented by a C immediately followed by an integer x, representing a Caesar cipher with an offset of x
  - Atbash ciphers, represented by an A
  - Reverse ciphers, represented by an R
- The final line is blank to separate individual test cases

Output Format

For each test case, output a single line containing the original message by decoding the given ciphertext.

Problem Constraints

$1 \leq N \leq 10^3$
-26 $\leq x \leq$ 26 for all Caesar ciphers.
The ciphertext will be non-empty. All letters in the ciphertexts will be entirely in lowercase.
The ciphertext may contain numbers, special characters, or spaces.

Main Test Set

$1 \leq T \leq 100$
The length of the ciphertext will not exceed 100.

Bonus Test Set

$1 \leq T \leq 10$
The length of the ciphertext will not exceed 10^5.

Sample Test Cases

Sample Input

```
4
lipps asvph
1
C4

iatcqsa lq cetwcq mpnwry 22 qrtwra!
2
C-5 A

hw'x p ebuler mpr wbmpr.
2
A C-10

!wvhwqrf hkw ir wvhu hkw qr nfxo grrj
3
C14 R C-11
```

Sample Output

```
hello world
welcome to calico spring 22 online!
it's a lovely day today.
good luck on the rest of the contest!
```

Sample Explanations

For test case #2:

The message `iatcqsa lq cetwcq mpnwry 22 qrtwra!` was first encrypted using a Caesar cipher shifting each character backwards 5 positions, followed by an Atbash cipher. Undoing these ciphers will decode the message `welcome to calico spring 22 online!`