2026/2027 SOUTHERN CALIFORNIA REGIONAL INTERNATIONAL COLLEGIATE PROGRAMMING CONTEST

Problem 10
Mathematical Card Trick

You, a novice magician, are practicing a mathematical card trick with your friend, who will be your assistant.

The trick is performed with a standard deck of 52 playing cards. A deck is divided into four distinct suits: Clubs (♣), Diamonds (♢), Hearts (♡), and Spades (♠). Each suit contains 13 cards of varying ranks. Low to high, the ranks are: 2, 3, 4, 5, 6, 7, 8, 9, 10, Jack, Queen, King, and Ace.

The trick goes as follows:

1. The assistant invites a spectator to pick 5 cards from the deck.
2. The assistant hides one of the cards (say, in the spectator's pocket) and shows the other 4 cards to the magician.
3. The magician correctly identifies the identity of the 5th card just by looking at the 4 cards shown.

To make this trick possible, you and your friend decide to use the following secret protocol.

Because the spectator chooses 5 cards, at least 2 of the cards must share the same suit. If there are multiple cards of more than one suit, the assistant chooses an arbitrary suit. Call the chosen suit S.

Consider all 13 cards of suit S and imagine arranging them around a circle in clockwise order, so that the 2 is the clockwise neighbor of the Ace. Let the ranks of two cards of suit S chosen by the spectator be x and y. Since there are 13 ranks in a suit, the shortest distance between x and y measured along the circle must be at most 6. The choice of which card is x and which y is made so that y is at most 6 clockwise ranks away from x. If there are multiple such pairs of cards, the assistant may choose any two for x and y. Let the clockwise distance from x to y be d.

For example, Figure 1 shows that the 3 of Spades is 5 clockwise ranks away from the Jack of Spades. For this pair of cards, x is the Jack of Spades, y is the 3 of Spades, and d is 5.

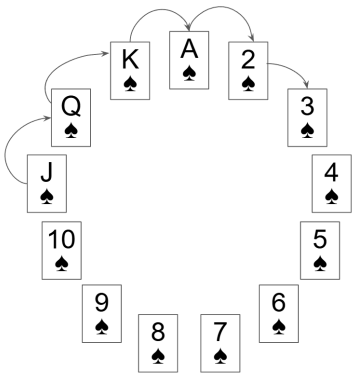


Figure 1. The 3 of Spades is 5 ranks away from the Jack of Spades.

The assistant then hides the card of suit S and rank y. The remaining 4 cards are arranged so that the card with suit S and rank x is shown first, and the remaining 3 cards encode the distance d via their permutation. We predetermine the ordering of the cards as follows:

- Use the rank first to determine the ordering: $2 < 3 < \ldots < 10 <$ Jack $<$ Queen $<$ King $<$ Ace.
- Within the same rank, use the suit: Clubs $<$ Diamonds $<$ Hearts $<$ Spades.

With this ordering, the 2 of Clubs is the "smallest" card, and the 2 of Diamonds is the second smallest. The Ace of Spades is the "largest" card.

Problem 10
Mathematical Card Trick (continued)

Let the 3 cards be a, b, and c, where $a < b < c$ according to the ordering above. The permutation of these cards determines d:

- abc: $d = 1$
- acb: $d = 2$
- bac: $d = 3$
- bca: $d = 4$
- cab: $d = 5$
- cba: $d = 6$

The magician then sees the 4 cards. From the first card, the magician infers the suit S and the starting rank x. Then, from the next 3 cards, the magician infers the distance d, computes the rank y (wrapping around the ranks as needed), and declares the hidden card to be the one with suit S and rank y!

Since the trick requires both you and your friend to be deeply familiar with the protocol, you decide to write a program to train yourselves.

Input starts with T ($1 \leq T \leq 10{,}000$), the number of test cases. Each test case is given on a single line. When a line starts with the uppercase letter "`A`", it is followed by 5 space-separated strings representing the 5 cards chosen by the spectator. Otherwise, the line starts with the uppercase letter "`M`", and it is followed by 4 space-separated strings representing the 4 cards shown to the magician by the assistant.

Each card is specified by its rank first (`2`, `3`, ..., `9`, `T`, `J`, `Q`, `K`, `A`, where `T` denotes 10, `J` denotes Jack, `Q` denotes Queen, `K` denotes King, and `A` denotes Ace), followed by its suit (`C` for Clubs, `D` for Diamonds, `H` for Hearts, and `S` for Spades). For example, `KD` represents the King of Diamonds, `TS` represents the 10 of Spades, and `2C` represents the 2 of Clubs.

For each input line starting with the uppercase letter "`A`", print the 4 cards that must be shown to the magician in order, according to the secret protocol. If there are multiple possible solutions, print any of them.

For each input line starting with the uppercase letter "`M`", print a string that represents the hidden card. You may assume that the 4 cards are correctly presented according to the secret protocol.

Sample Input

```
6
M 2S JS TH 6C
M 9C 5S 5H 8D
A 6S KH 5C AD 3C
A 7H QH 7C 4H 3D
M TS QS 4D KD
A TD 9D QD 2H 4C
```

Output for the Sample Input

```
8S
QC
3C 6S AD KH
4H 7C 3D QH
KS
9D 2H 4C QD
```