MATHEMAGIC

- LUCKY 13 -

AMAZINGMATHS

Materials:

- Video of the trick
- 1 deck of cards

How to do the Magic Trick

Goal:

Find the sum of the values of the cards on top of the spectator's 3 piles.

Preparation:

The magician removes the 2 jokers from the deck of cards.

Trick:

1. He places the cards in descending order, from the king to the ace, for each suit. Then, he removes the kings from each of the piles (4 kings).
2. While he is not looking, the magician asks the spectator to make, for each suit, a pile of consecutive cards from the queen to the card of his choice. The other cards are removed and placed into a pile that we will call the pile of remaining cards.
3. The magician asks the spectator to eliminate a countdown among the 4. He places these cards in the pile of remaining cards.
4. The spectator adds the values of the last card of the three countdowns left. He does not tell the answer to the magician.
5. The magician asks the spectator to take the pile of remaining cards and remove 13 cards from it, since 13 is the lucky number. The spectator then counts the number of cards left in the pile of remaining cards and announces the number to the magician.
6. The magician can then tell the sum of the last cards' values of each of the spectator's 3 countdowns.

*** To do so, he simply has to add 4 to the number of cards left.*

MATHEMATICAL EXPLANATION

Why this trick works.

Because the magician removes the 2 jokers from the deck, there are only 52 cards left. He then removes the 4 kings from each pile. So, there are 48 cards left.

The spectator must form 4 piles by placing the cards in descending order starting with a queen but ending with any number.

If the spectator had made a pile of cards containing a queen, a jack, a 10, a 9, an 8 and a 7, his pile would then have counted 6 cards. We notice that if we add the value of the countdown's last card (7) to the number of cards in the pile (6), we get 13.

If he had chosen to make a pile formed only by the queen, he would have had 1 card in his pile. When we add the number of cards in his pile (1) to the value of the countdown's last card (12), we notice that the result is also 13.

If he had chosen, for example, to make a pile with a queen, jack, 10, 9, 8, 7, 6, 5, 4, 3, 2, he would have had 11 cards in his pile. Thus, once again, the value of the countdown's last card (2) added to the number of cards (11) gives 13.

This is true for all the countdowns possible. It does not matter what the value of the countdown's last card is, **it always tells us the number of cards missing from the pile to get to a total of 13 cards.**

From this piece of information, we can solve the trick in many ways.

First possible solution:

Let's imagine, to ease the comprehension, that we had placed the 4 kings in the pile of remaining cards at the beginning. *

As mentioned, we know that the value of a countdown's last card always indicates us the number of cards missing from the pile to get to a total of **13 cards**. Also, we know that each suit normally contains **13 cards** (12 cards and the king).

So, the value of the countdown's last card represents the number of cards that are removed and put in the pile of remaining cards.

Afterwards, the spectator eliminates one pile and places it with the remaining cards. By doing this, we end up forming a complete suit by joining the cards in the pile of remaining cards to the ones in the pile that was removed. In brief, the pile of remaining cards is composed of **a complete suit (13 cards)** and **the cards that complete the 3 countdowns** still on the table.

The magician then asks to remove 13 cards, which is the same number of cards **as a complete suit**. In the pile of remaining cards, there is then the same number of cards left than the **cards that complete the 3 countdowns**.

So, the number of cards in the pile of remaining cards corresponds to the sum of the values of the three countdowns' last card.

* But let's remember that the 4 kings have been removed at the beginning by the magician and that they are not counted in the number of cards left. That is why the magician must add 4 to the number of remaining cards to find the sum.

MATHEMATICAL EXPLANATION

Why this trick works.

Second possible solution:

We will try to express the number of cards in the pile of remaining cards according to the sum of the 3 numbers on top of the piles.

Let’s write the following variables:

> N := number of cards in the pile of remaining cards.
> X := value of the first countdown’s last card.
> Y := value of the second countdown’s last card.
> Z := value of the third countdown’s last card.

Since we know that the value of the countdown’s last card always indicates the number of cards missing to get to the number 13, we can conclude that in the first, the second and the third pile, there are respectively:

$$13 - X\ cards.$$
$$13 - Y\ cards.$$
$$13 - Z\ cards.$$

These cards are not in the pile of remaining cards, so we have to remove these three results. Plus, in the manipulations, we also have to remove 13 cards, because 13 is the lucky number.

Let’s not forget that the trick is done with 48 cards (that is a full deck of cards from which we removed the 2 jokers and the 4 kings). So, we can conclude that the number of cards in the pile of remaining cards (N) is:

Total of cards without the jokers and the kings (48)
Number of cards in the 1st pile $(13 - X)$
Number of cards in the 2nd pile $(13 - Y)$
Number of cards in the 3rd pile $(13 - Z)$
Lucky number (13)

$$N = 48 - (13 - X) - (13 - Y) - (13 - Z) - 13$$
$$\Rightarrow N = 48 - 13 + x - 13 + y - 13 + z - 13$$
$$\Rightarrow N = x + y + z - 4$$
$$\Rightarrow N + 4 = x + y + z.$$

We then conclude that the number of cards in the pile of remaining cards (N) added to 4 is equal to the sum of the values of the three countdowns’ last card.