# Math Magic
## *-Incredible-*

## How to perform the magic trick

1. The magician takes 28 cards.

2. The spectator cuts the deck approximately in half, and then chooses one of the piles. The spectator counts the number of cards in that pile. The spectator then sums together the digits of that number. The sum corresponds to the position of the card that he looks at, starting from the bottom of the pack.

3. The magician then takes that pack of cards from the spectator. Starting from the top of the pack, he spells the word "incredible" while turning over a card for each letter in the word. The card he flips on the last "e" is the spectator's card.

# Mathematical Explanation

## Why the trick works

Once the cards are cut into two piles, each pile has about 14 cards (the trick works for piles of sizes 10 to 19 cards). The sum of the digits of the number of cards counted will always cause the spectator to look at the 10<sup>th</sup> card from the top. The word "incredible" has 10 letters.

## Detailed Explanation

The spectator sums the digit in the tens and the digit in the ones of the number of cards in the selected pile. We'll call this sum $x$.

Notice that the number of cards in each pile is between 10 and 19. Therefore, the digit in the tens is always 1, so $x = 1 +$ (digit in the ones). This means that $(x - 1)$ will be the digit in the ones.

The total number of cards in the pile is the sum of the tens (10) and the ones $(x - 1)$, which is $10 + (x - 1)$.

The spectator looks at the $x^{th}$ card from the bottom. That means that there are $x - 1$ cards below their card

The position of the selected card can be calculated from the following equation:

# of cards in the pile – # of cards below the selected card = Position of the selected card

Using the values found above that is:

$$[10 + (x - 1)] - (x - 1) = 10$$

The word "incredible" has 10 letters, so the magician will always flip the spectator's card on the last letter.

For example, if the selected pile of cards contains 12 cards, the spectator will look at the 3<sup>rd</sup> card from the bottom $(1 + 2 = 3)$. This is also the 10<sup>th</sup> card from the top.