# MATHEMAGIC

## - THE BALLOON -

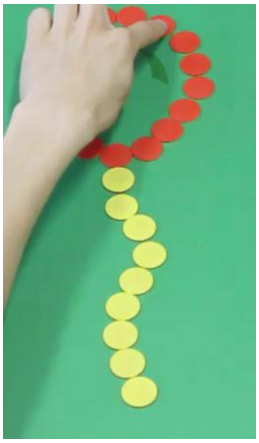
AMAZINGMATHS

***Materials:***

- Video of the trick
- 1 small piece of paper
- 26 tokens

## Preparation

1. The magician places his 26 tokens as in the adjacent example. 9 for the balloon's rope and 17 to make the balloon.
2. He then places his small piece of paper underneath the 20$^{th}$ token, starting from the end of the rope, counting counterclockwise.



## How to do the Magic Trick

1. First, the magician asks the spectator to choose a number between 10 and 30. (It works with any number greater than 10, but the rest would be slightly long.)

2. Next, he asks the spectator to count the tokens until he reaches his number, starting on the first token at the bottom of the rope. Once he reaches the balloon, he must keep counting, counterclockwise. If his number is greater than 26, he keeps going around the balloon, always in the same direction.

3. Then, he tells the spectator to start from the token on which he arrived and to start counting again until he reaches his number, but this time moving clockwise and staying only on the balloon's tokens.

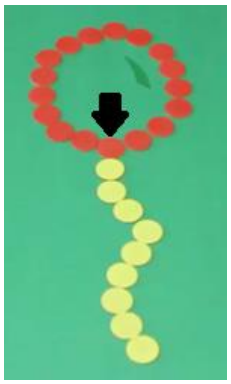
4. The token on which the spectator ends up is the one where the surprise is hidden!

# MATHEMATICAL EXPLANATION

## Why this trick works.

No matter what the number chosen by the spectator is, the final token is always the same! Let's see why this is.

We remember that there are 26 tokens in total, including 9 that constitute the rope.



During his first countdown, the spectator covers the 9 tokens of the rope before reaching the 10$^{th}$ token, which is at the junction of the rope and the balloon. Next, he goes counterclockwise to count what is left.

During the second countdown, the spectator covers the same red tokens again, but in the opposite direction. *He does not count the token on which he ended up* (because that is not what the magician asks him to do), so once he reaches the junction's token (the 10$^{th}$ token indicated by the arrow), he has exactly 10 tokens left to count.

Indeed, if he kept counting the tokens going down the rope, he would come back to where he started with still one token to count (*because he did not count the token on which he ended up during his second countdown).*

The final position *does not depend on* the initial chosen number: the final token is *always* the tenth one clockwise from the junction (without counting the junction's token), so the twentieth from the bottom of the rope.