

MATHEMAGIC

- NEVER 2 WITHOUT 3 -



AMAZINGMATHS

Materials:

- Video of the trick
- 2 different objects
- 5 tokens (minimum)

How to do the Magic Trick

1. The magician performs a magic trick with two spectators. He asks their name and explains to them that, when he turns around, each one of them will have to choose one of the two objects that is available on the table (object A and B). For the rest of this explanation, we will call these two spectators Audrey and Bernard.
2. Then, the magician asks the spectator who chose object A to take 2 tokens, and for the other spectator to take 3 tokens. The spectators must hide their tokens and the object they chose.
3. The magician then asks the spectators to do a few operations. He asks Audrey to multiply the amount of tokens she has by an **odd** number of her choice. He asks the other spectator, Bernard, to multiply his number of tokens by an **even** number of his choice. The spectators must add their own individual results and they must only give their combined result to the magician.
4. The magician will then be able to determine which spectator chose which object. If the final result is even, then this means Audrey chose object A. If the final result is odd, then this means Audrey chose object B.



MATHEMATICAL EXPLANATION



Why this Trick Works

Let's first note that the objects in this magic trick do not matter: the magician is focusing solely on the numbers. The key to this magic trick is that the final result will have the same parity as the amount of tokens that Audrey would have taken. Let's see why.

Here are some observations on parity and mathematical operations:

1. When we multiply a natural number by an even number, the result will be even.
2. When we multiply a natural number by an odd number, the result will have the same parity as the initial number.
3. When we add two even numbers, the sum is even.
4. When we add an even number and an odd number, the sum is odd.

We can then conclude:

1. that the result of Bernard's multiplication will always be an **even** number, because he must multiply his amount of tokens by an even number.
2. that the result of Audrey's multiplication will be an **even** number if she took 2 tokens, so **if she chose object A**, and
3. that the result of Audrey's multiplication will be an **odd** number if she took 3 tokens, so **if she chose object B**.

We can then see that if the total is even, then the result obtained by Audrey must be even and that she has object A. If the total is odd, then the result obtained by Audrey must be odd and she has object B.

We can make a summary table to better understand the possibilities.

Amount of Audrey's tokens	Parity of the product obtained by Audrey	Parity of the product obtained by Bernard	Parity of the sum
2 (EVEN)	EVEN	EVEN	EVEN
3 (ODD)	ODD	EVEN	ODD