



**Advanced Mathematics  
Support Programme®**

# The 27 card trick

# The set up

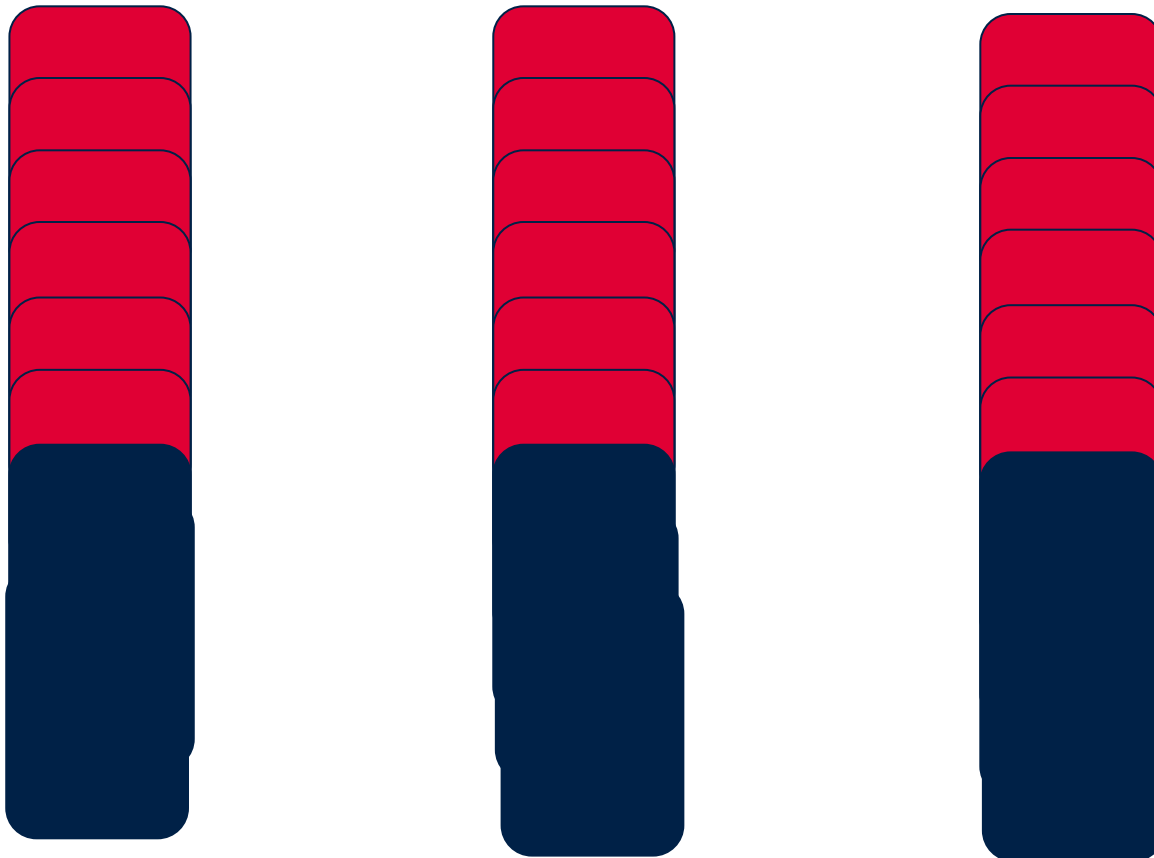
- Either watch [this](#) video or follow these instructions:
- Pick a card from the deck
- Place it back in to the deck
- Tell your teacher your favourite number between 1 and 27
- Follow their instructions
- Be amazed.

# Unpicking the trick

- We will put the chosen card in to 12<sup>th</sup> position.
- Start with splitting the card in to 3 piles
- Choose a pile. Keep the cards the right way up, collect the piles in so that the right way up pile is at the bottom.
- Deal the cards out again.

# Unpicking the trick

The cards should now look like this

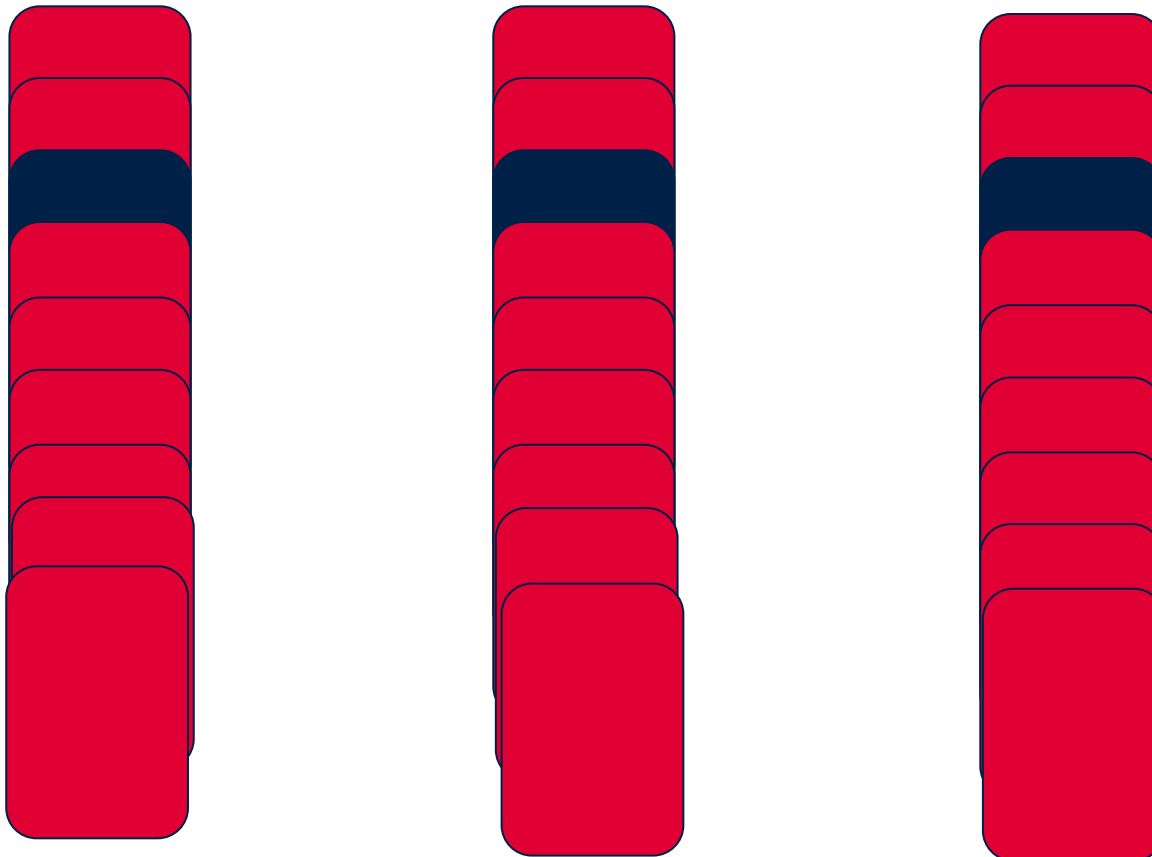


# Unpicking the trick

- Choose a pile, keep that pile as it is and collect it in at the top (there should be 3 cards face up, the rest face down)
- Collect the other two piles in below, ensuring all the cards are face down.
- Deal the cards out again. What do the piles look like? What does this tell you?

# Unpicking the trick

The cards should now look like this



# Unpicking the trick

- Collecting the chosen pile in second should ensure that the upturned card from the chosen pile is now in 12<sup>th</sup> place (remember to turn the other cards back the right way round).
- How??



# Next steps

- The card trick works on how you can divide your chosen number in to powers of 3 – how many 9s, 3s, and 1s will go in to your number.
- This is best computed using *ternary* numbers.

# Number systems

- We work in base 10,
- $723 = 7 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$
- Ternary is base 3
- Can you convert the last 3 numbers back to base 10?

$3^3$	$3^2$	$3^1$	$3^0$	Number in base 10
2	1	1	0	$2 \times 27 + 1 \times 9 + 1 \times 3 + 0 \times 1 = 66$
	2	0	1	$2 \times 9 + 0 \times 3 + 1 \times 1 = 19$
	1	2	0	
1	1	0	2	
	2	2	1	

# Setting up the trick

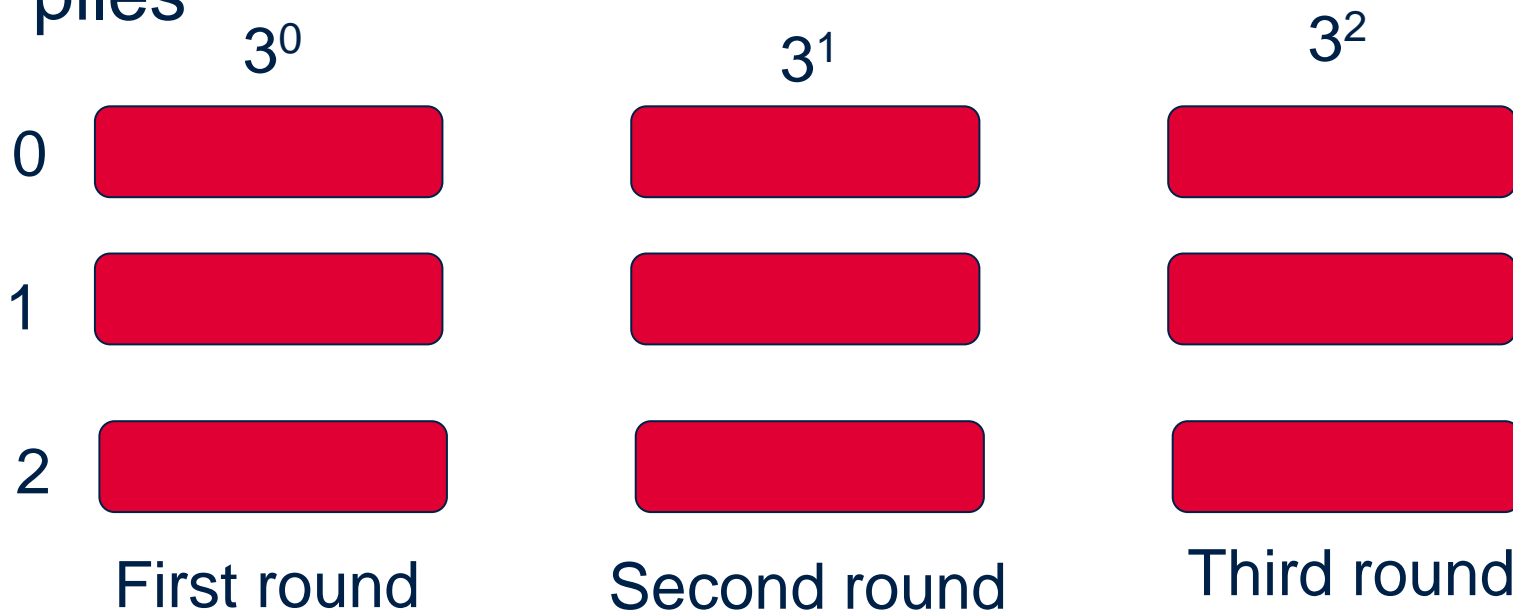
- To perform the trick you need to convert base 10 numbers to base 3.
- Can you convert the following numbers in to base 3:
  1. 16
  2. 20
  3. 8
  4. 9
  5. 0

# Performing the trick

- Follow the following steps to perform the trick:
  1. Ask your partner to choose a number between 1 and 27.
  2. Subtract one from it.
  3. Turn that number in to ternary.

# Performing the trick

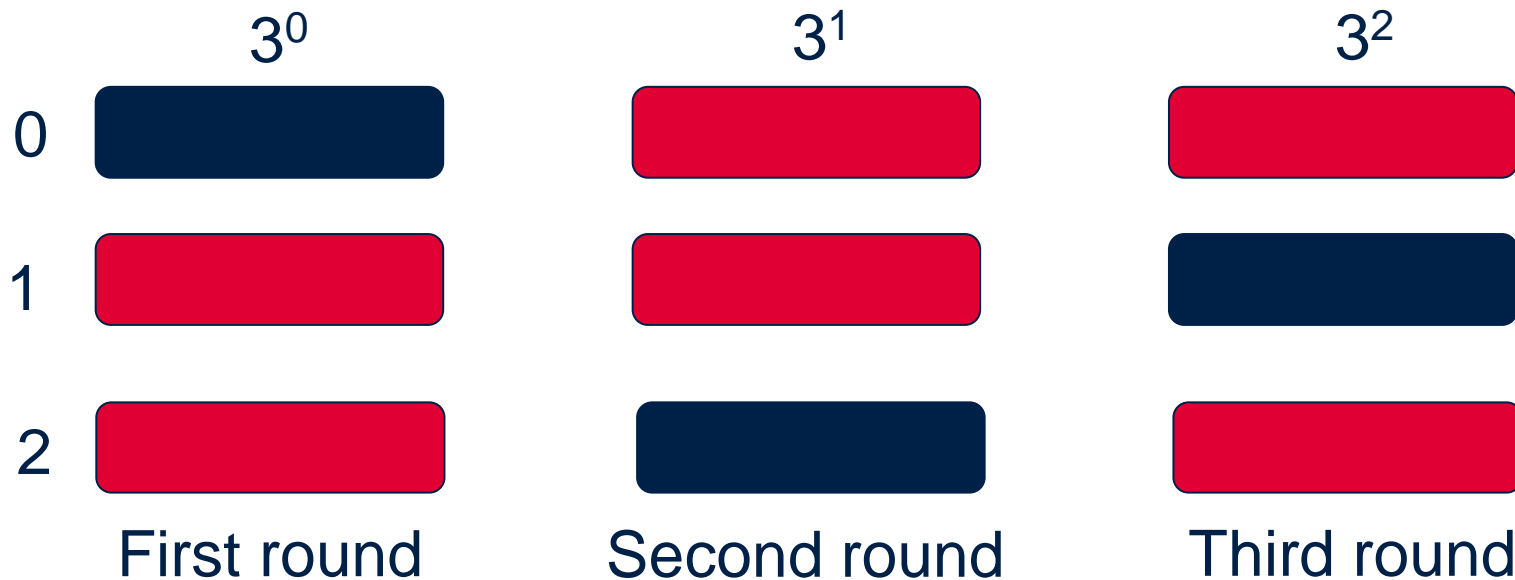
- Reverse your number and use the diagram below to work out where to place the chosen piles



# Performing the trick

## ■ Example:

- Number chosen = 16.  $16 - 1 = 15$ .
- $15 = 0 \times 3^0 + 2 \times 3^1 + 1 \times 3^2 = 021$
- You collect the indicated pile in the top, then bottom, then middle pile



Your chosen card will now be in the 16<sup>th</sup> position

# Now practise!!



# Extending the trick

- With 27 cards, we split them in to 3 piles 3 times as  $3^3 = 27$ .
- What if we had 25 cards?
- What if we had 49 cards?
- What if we had 1,000 cards?
  
- How long would it take you to carry out the trick?
  
- Can you put your chosen card in to 16<sup>th</sup> place out of 25 cards? (You will need to work in base 5)



# Contact the AMSP



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