



**Advanced Mathematics
Support Programme®**

21 card trick

- This trick enables you to identify a card that someone chooses.
- Start with 21 cards.
- You will correctly identify the cards.
- Either watch [this](#) link (up until 2:33)
- Or demonstrate the trick on your class

Unpicking the trick

- Start with splitting in to 3 piles. The identified pile becomes the second pile you pick up.
- Repeat the process, the card becomes the second pile again.
- Make sure you are dealing cards the same way as demonstrated.
- Put the pile with the chosen card in the second pile. Your chosen card will now be in the 11th position.

- Step 1: Place the pile with the identified card in the middle pile.
- When the cards are now dealt out, what card position, from 1 (top) to 21 (bottom) must your card now be in if it is in the middle pile?

- Step 2: Place the pile with the identified card in the middle pile.
- When the cards are now dealt out, what card position, from 1 (top) to 21 (bottom) must your card now be in if it is in the middle pile?

- Step 3: Now deal out the cards in to the three piles. Can you identify which positions the card could be in?
- How do you ensure your card ends in the 11th position?
- How do can you make sure your card ends in a different position? What other positions could it end up in?

Explaining the trick

- Each decision you make reduces where the card could possibly be
- Can you draw a diagram or write some words to explain how the trick works?

Extending the trick

- The trick each time asks you to put the pile in the second position to ensure the card ends up in the 11th position.
- What would happen if you put the cards in different positions?
- Try 2,2,1 or 2,2,3. Where does the card end up? Can you predict before trying?

How can you guarantee where the card ends up?

- The 3 cards possible after the 2nd pile choices are in the 4th row in columns 1, 2 and 3
- This is due to modulo arithmetic ($10 = 1 \pmod{3}$, $11 = 2 \pmod{3}$, $12 = 0 \pmod{3}$)
- Why would the trick not work if the cards ended up in the 8th, 9th and 10th position?

1 Mod 3



10

2 Mod 3



11

0 Mod 3



12

Positions 10, 11, 12
Row 4,4,4

1 Mod 3



2 Mod 3



0 Mod 3



Positions 8,9,10
 Row 4,3,3

How can you guarantee where the card ends up?

Position of piles	Possible card positions after choices	Row number	Same number?
1,1			
1,2			
1,3			
2,1	3,4,5	2,2,1	N
2,2	10,11,12	4,4,4	Y
2,3			
3,1			
3,2			
3,3			

Improvements?

- The 21 card trick can be adapted so you can place the card in the 1st, 8th, 15th, 4th, 11th, 18th, 7th, 14th, 21st
- Can you describe the order you would put the piles to end up with those positions?
- Why is it so limiting? Can you change the trick start so that you could end up with a pre defined order for every card (see 27 card trick)

Contact the AMSP



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