KS2 Problem

Magic Squares

This is a magic square:

8	3	4
1	5	9
6	7	2

It uses the consecutive digits 1 to 9 once only and each row, column and diagonal add up to the same 'magic number'.

For this magic square, the 'magic number' is 15,

e.g. 8 + 3 + 4 = 15

3 + 5 + 7 = 15

6 + 5 + 4 = 15

and so on.

What else do you notice about this magic square?

Complete these magic squares (their magic number is also 15):

	1	
		7
		2

		6
9		
	3	

KS2 Problem

Challenge 1

- Do you still get a magic square if you add 2 to every number? Use this blank grid to find out:

8	3	4
1	5	9
6	7	2

- Do you still get a magic square if you double every number? Use this blank grid to find out:

8	3	4
1	5	9
6	7	2

Challenge 2

This magic square uses the numbers 2, 3, 4, 5, 6, 7, 8, 9, 10. Can you complete it?

3		
	6	
		9

KS2 Problem

Make your own magic square that has a 'magic number' of 27. You can't use the same number twice!

Make your own magic square that uses nine consecutive numbers that are greater than 10.

Support for Parents and Carers

It might help to provide your child with digits on pieces of card or paper that they can move around the grid to help them find a solution before writing the numbers into the grid.

Magic squares have the following patterns in them, look at some of these patterns together if your child is struggling to find a solution.

8	3	4
1	5	9
6	7	2

Lancashire Mathematics Team (2020)

KS2 Problem

- All rows, columns and diagonals have the same total (in this example 15).

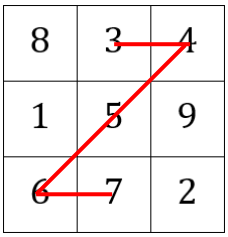
  8 + 3 + 4 = 15 1 + 5 + 9 = 15 6 + 7 + 2 = 15

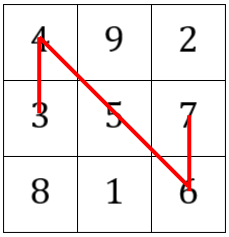
  8 + 1 + 6 = 15 3 + 5 + 7 = 15 4 + 9 + 2 = 15

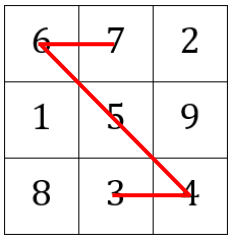
  8 + 5 + 2 = 15 6 + 5 + 4 = 15

The key to finding the 'magic number; is to list the nine consecutive numbers in order, in this case 1, 2, 3, 4, 5, 6, 7, 8, 9. The consecutive numbers don't have to be increasing in ones, they could be, for example, the 9 times table, as long as no numbers were missed, so 9, 18, 27, 36 etc.

- Add them up then divide by three to find the number you get when you add the three numbers in a row, column or diagonal (1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 = 45 and 45 ÷3 = 15).
- The very middle number in the consecutive number list, also known as the median, is the number that goes in the middle square. In this case, the median is the number five (1, 2, 3, 4, **5**, 6, 7, 8, 9).
- The 'magic number' is always three times the middle number, i.e. 3 × 5 = 15
- The sum of the two numbers on opposite sides of the centre (horizontally, vertically and diagonally) is double the middle number,
  i.e. 8 + 2 = 10 6 + 4 = 10 1 + 9 = 10 3 + 7 = 10
- The sum of the four corner numbers equals the sum of the four numbers in the middle of each side,
  i.e. 8 + 4 + 6 + 2 = 20 3 + 1 + 9 + 7 = 20
- A magic square always has a 'Z shape' of five numbers. The numbers will be increasing by the same amount (in the examples below the numbers are increasing in ones). Sometimes the 'Z shape' may be 'on its side' or 'back to front' e.g.







KS2 Problem

Solutions

8	1	6
3	5	7
4	9	2

2	7	6
9	5	1
4	3	8

Challenge 1 Solution

You still get a magic square if you add 2 to every number. The 'magic number' is 21.

10	5	6
3	7	11
8	9	4

You still get a magic square if you double every number. The 'magic number' is 30.

16	6	8
2	10	18
12	14	4

Challenge 2 Solution

These magic squares use the consecutive numbers 2 to 10.

3	8	7
10	6	2
5	4	9

3	10	5
8	6	4
7	2	9

KS2 Problem

For a 'magic number' of 27, the numbers 5, 6, 7, 8, 9, 10, 11, 12, 13 should be used, e.g.

12	7	8
5	9	13
10	11	6

6	11	10
13	9	5
8	7	12

8	7	12
13	9	5
6	11	10

10	11	6
5	9	13
12	7	8

There are other possibilities but 9 will always be the middle number.

There are many possible magic squares that use nine consecutive numbers that are greater than 10, e.g.

18	13	14
11	15	19
16	17	12