



## Topic 10 - Pattern & Missing Numbers

1



Tahnee is making a pattern out of white and black tiles.

She hasn't finished yet. She wants the finished pattern to have one vertical line of symmetry.

What is the smallest number of tiles she needs to add onto the right of the pattern?

- A** 2
- B** 3
- C** 6
- D** 8
- E** 9



2

In a 'magic square', each row, each column and each diagonal add up to the same total.

In the magic square below, some of the numbers are missing.

20	15	16
18		◆

What is the missing number at ◆?

- A** 4
- B** 14
- C** 17
- D** 18
- E** 21



3

Claudia makes a number pattern using these rules:

- Choose the first three numbers.
- After this, each number is the sum of the three numbers before it.

Here is Claudia's pattern with three missing numbers labelled X, Y and Z.

2, X, 0, Y, 6, Z

All the numbers are whole numbers.

What number does Z represent?

- A** 8
- B** 9
- C** 10
- D** 11
- E** 12



4

In a game, I collect stars and hearts.

I get points when I collect a star. The number of points for a star is always the same.

I get a different number of points when I collect a heart. The number of points for a heart is always the same.

If I collect 3 stars and 5 hearts, I get 27 points.



If I collect 5 stars and 7 hearts, I get 41 points.



How many points do I get if I collect 1 star and 1 heart?



- A 7
- B 12
- C 14
- D 24
- E 50



5

What is the value of the missing number  $\blacktriangle$  in this number pattern?

2, 6,  $\blacktriangle$ , 54, 162, ...

**A** 10

**B** 12

**C** 18

**D** 30

**E** 50



6

A pattern of boxes is drawn on a grid.

10				9	
9			8		
8		7			
7				6	
6			5		
5		4			
4				3	
3			2		
2		1			
1					
	A	B	C	D	E

Box 1 is at grid reference B2, box 2 is at C3, and so on.

If the pattern continues like this, what will be the grid reference of box 40?

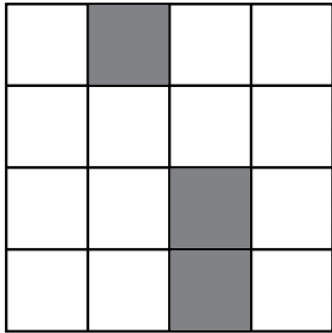
- A B41
- B B50
- C B121
- D C39
- E C60



7

Alison shaded 3 small squares in the grid below.

She wants to shade extra squares to make a pattern with exactly four lines of symmetry.



What is the smallest number of extra squares she needs to shade?

- A** 3
- B** 5
- C** 7
- D** 9
- E** 13



8

□ always represents the same number.

△ represents a different number.

If

$$9 \times \square = 108$$

and

$$\triangle + \square = 36$$

what is △?

**A** 3

**B** 12

**C** 24

**D** 28

**E** 48





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## Answer Key

1

Starting from the middle of the pattern so far, we can look for where the line of symmetry could go. The first chance we have to make the pattern symmetrical is by placing the vertical line of symmetry through the centre of the group of three black tiles:



Tahnee needs to add one black and one white tile to the right of the pattern:



So Tahnee can add on two more tiles, and the correct answer is **A 2**.

Alternatively, we can solve this by starting from the right and working out what tiles to add. Since the first tile is white, the last tile must also be white, but adding one white tile does not give a symmetric pattern. Since the second tile is black, the second-to-last tile must also be black, and that does give a symmetric pattern. So Tahnee can add on two more tiles.



2

Each of the rows, columns and diagonals add up to the same total.

The top row is complete so we can use that to find the total:

$$20 + 15 + 16 = 51.$$

Next we can look at the diagonal shown here with a dotted line:

20	15	16
18		◆

The number in the very centre must be added to  $16 + 18$  to give 51, so the number in the centre is  $51 - (16 + 18) = 17$ .

Finally, using the other diagonal,  $20 + 17 + \blacklozenge = 51$ , so  $\blacklozenge = 51 - (20 + 17) = 14$ . So the correct answer is **B 14**.

Here is the completed magic square (although we do not need to work it all out in order to answer the question):

20	15	16
13	17	21
18	19	14



3

We know that  $2 + X + 0 = Y$ , and  $X + 0 + Y = 6$ .

So we need two numbers that add up to 6, with Y two more than X. So X must be 2 and Y must be 4.

Finally, to work out Z, we know that  $0 + Y + 6 = Z$  so  $Z = 10$ . So the correct answer is **C 10**.

Alternatively, we could use trial and improvement.

Let's try the number 1 in position X. Then by adding the numbers three at a time, the sequence would be:

2, 1, 0, 3, 4




This doesn't work because the number after Y is 6, not 4. So X needs to be bigger.

We could try 2. That would give the sequence:

2, 2, 0, 4, 6, 10

This time, the fifth number is 6 which is what we need. So the sixth number, Z, is 10.



4	<p>Looking at the two arrangements of stars and hearts, the second arrangement has two extra stars, and two extra hearts.</p> <p></p> <p>The difference between the two totals is <math>41 - 27 = 14</math> points.</p> <p> = 14 points.</p> <p>One star and one heart must be worth half as much as two stars and two hearts, so</p> <p> = 7 points.</p> <p>So the correct answer is <b>A 7</b>.</p>
5	C
6	A
7	D
8	<p>First, use the fact that <math>9 \times \square = 108</math>. We can work out that <math>\square = 12</math>, because <math>9 \times 10 = 90</math> and <math>9 \times 2 = 18</math> so <math>9 \times 12 = 108</math> (or by working out that <math>108 \div 9 = 12</math>).</p> <p>Now we know that <math>\triangle + 12 = 36</math> so <math>\triangle = 36 - 12</math>, and <math>\triangle = 24</math>.</p> <p>So the correct answer is <b>C 24</b>.</p>