

The world is full of interesting patterns and designs that we see every day. From patterns on a shell to the complex camouflage of certain animals, patterns play a very important role in the world.

Many patterns and designs can be modelled using mathematical sequences. In this chapter, you will begin to examine some of these patterns around us.



A **pattern** is a set of objects, numbers, letters, shapes, pictures, symbols or diagrams which repeat in a set way.

Here are some patterns found in nature:



Snowflake



DNA spirals



Peacock



Sunflower



Butterfly

Complete the following patterns:

Question 1:

(a) _ _

(b) _____

(c) _____

(d) Mary, Paul, Peter, Sean, Mary, _____, Peter, _____

Question 2:

Paul and Shay are playing a game by forming a pattern using letters. Examine the patterns and predict the next three letters in each pattern.

(a) A, C, E, G, I, A, C, E, _____, _____, _____

(b) B, B, C, D, D, B, B, C, _____, _____, _____

(c) X, X, X, Y, X, X, X, Y, _____, _____, _____

(d) S, S, T, V, P, S, S, T, V, _____, _____, _____

(e) H, A, P, P, Y, H, A, P, _____, _____, _____

A pattern obeys some mathematical rule to create a predictable sequence. Every day we are surrounded by patterns in nature and in designs such as wallpaper and clothes.

Question 3:

Identify two patterns in your around you at home or in your garden. Explain why you decided these were patterns.

To understand any pattern, we need to carefully study the sequence. A **sequence** is a pattern of numbers given in a definite order and connected by some rule. Starting at the beginning, we must determine if the pattern is increasing or decreasing by some numerical value or whether the pattern is repeating itself at regular times.

Each number is called a **term**. Each number's place in the sequence is called its **position**.

Consider the following sequence of numbers:

1, 3, 5, 7, 9,

The numbers are increasing by 2 each time. To find the next two patterns we add 2 to the next term, then add two to find the term after that

1, 3, 5, 7, 9, **add 2**, **add 2**

1, 3, 5, 7, 9, **11, 13**

Consider the following sequence of numbers:

5, 2, 7, 4, 9, 6, 11, 8, 13,

The number pattern first decreases by 3 then increases by 5. The pattern repeats in this way. To find the next two terms, we subtract 3 to get the next term and then add 5 find the term after that.

5, 2, 7, 4, 9, 6, 11, 8, 13, **minus three, add 5**

5, 2, 7, 4, 9, 6, 11, 8, 13, **10, 15**

Question 4:

In the following number sequence

-66, -32, 2, 36, 70, 104, 138, 172, 206, ?, ?, ?

(i) Determine the next three values

(ii) Explain what rule you used to determine your answers

Repeating Patterns:

Example 1:

A four-shape repeating pattern is shown below;



- (a) if the pattern is continued, what would the 12th shape be?
- (b) if the pattern is continued, what would the 130th shape be?
- (c) if the pattern is continued, what would the 53rd shape be?
- (d) if the pattern is continued, what would the 96th shape be?

Solution:

The pattern repeats every 4th shape

Term	1	2	3	4
Shape	Red triangle	Navy triangle	Green parallelogram	Blue rectangle

(a) the 12th shape: This is found by $12/4$, as there is no remainder the shape must be **Blue rectangle**. This means the 12th shape consists of 3 repeating patterns and 0 extra colours. The remainder of zero corresponds with the fourth shape **Blue rectangle**, since it's the last term in the pattern.

(b) the 130th shape: This is found by $130/4$, as there is a remainder of 2 the shape is **Navy triangle**

(c) the 53rd shape: This is found by $53/4$, as there is a remainder of 1 the shape is **Red triangle**

(d) the 963rd shape: This is found by $963/4$, as there is a remainder of 3 the shape is **Green parallelogram**

Example 2:

If the pattern continued, what colour would each of the following blocks be?



- (a) The 19th block (b) The 39th block (c) The 270th block (d) The 6,000th block

Solution:

The pattern repeats every 9th colour

Term	1	2	3	4	5	6	7	8	9
Colour	Red	Red	Yellow	Green	Green	Yellow	Blue	Blue	Yellow

- (a) What colour would the 19th term be?
 $19 \div 9 = 2$, with a remainder of one. This means 19 consists of 2 repeating blocks and 1 extra colour. The remainder of one corresponds with the colour red.
- (b) What colour would the 39th term be?
 $39 \div 9 = 4$, with a remainder of three. This means 39 consists of 4 repeating blocks and 3 extra colours. The remainder of three corresponds with the colour yellow.
- (c) What colour would the 270th term be?
 $270 \div 9 = 30$, with a remainder of zero. This means 270 consists of 30 repeating blocks and 0 extra colours. The remainder of zero corresponds with the ninth colour yellow, since it has an entire block.
- (d) What colour would the 6,000th term be?
 $6,000 \div 9 = 666$, with a remainder of six. This means 6,000 consists of 666 repeating blocks and 6 extra colours. The remainder of six corresponds with the sixth colour yellow.