Pattern & Sequences

MATHEMATICS FORM 2

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1.1 Pattern

1.1.1

Learning Standard

Recognize and describe patterns of various number sets and objects based on real life situations, and hence make generalisation on patterns.

'I can...'

At the end of the lesson, you should be able to do all this following:

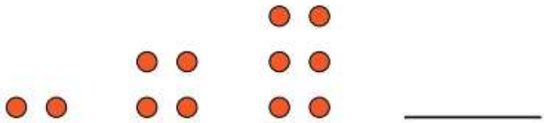
- Understand what pattern is
- Recognise Odd and Even Number Pattern
- Recognise Pascal's Triangle
- Recognize Fibonacci Numbers

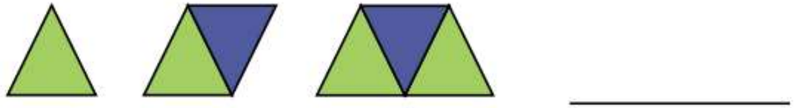
A PATTERN IS?

Patterns are list of numbers or objects arranged based on a rule or design.

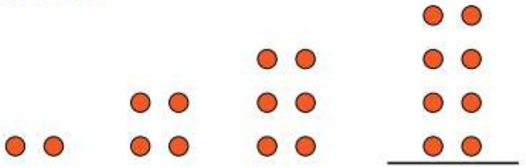
EXAMPLE 1

Draw the next object. State its pattern.

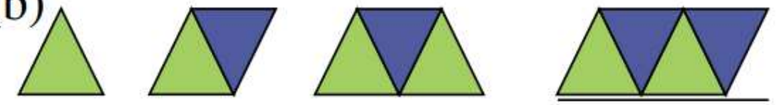
(a) 

(b) 

Solution:

(a) 

Pattern: Add two dots to the previous object.

(b) 

Pattern: Add a triangle to the previous object.

EXAMPLE 2

Determine the patterns for the following.

(a) $-10, -4, 2, 8, \ldots$

(b) $17, 7, -3, -13, \ldots$

(c) $2, 6, 18, 54, \ldots$

(d) $81, 27, 9, 3, \ldots$

(e) $1, \frac{3}{2}, 2, \frac{5}{2}, \ldots$

(f) $-2.3, -2.6, -2.9, -3.2, \ldots$

Solution:

(a) $-10,\ -4,\ 2,\ 8, \ldots$

Pattern: Add 6 to the previous number.

(b) $17,\ 7,\ -3, -13, \ldots$

Pattern: Subtract 10 from the previous number.

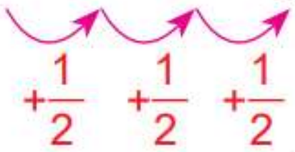
(c) $2,\ 6,\ 18,\ 54, \ldots$

Pattern: Multiply the previous number by 3.

(d) $81,\ 27,\ 9,\ 3, \ldots$

Pattern: Divide the previous number by 3.

(e) $1,\ \frac{3}{2},\ 2,\ \frac{5}{2}, \ldots$



Pattern: Add $\frac{1}{2}$ to the previous number.

(f) $-2.3, -2.6, -2.9, -3.2, \ldots$

Pattern: Subtract 0.3 from the previous number.

Even and Odd numbers

EXAMPLE 3

Given a series of numbers 7, 12, 17, 22, 27, …, 67. Identify and state the pattern for the sequence of

(i) odd numbers

(ii) even numbers

Solution:

7, 12, 17, 22, 27, 32, 37, 42, 47, 52, 57, 62, 67

(i) **Odd numbers:** 7, 17, 27, 37, 47, 57 and 67

+10 +10

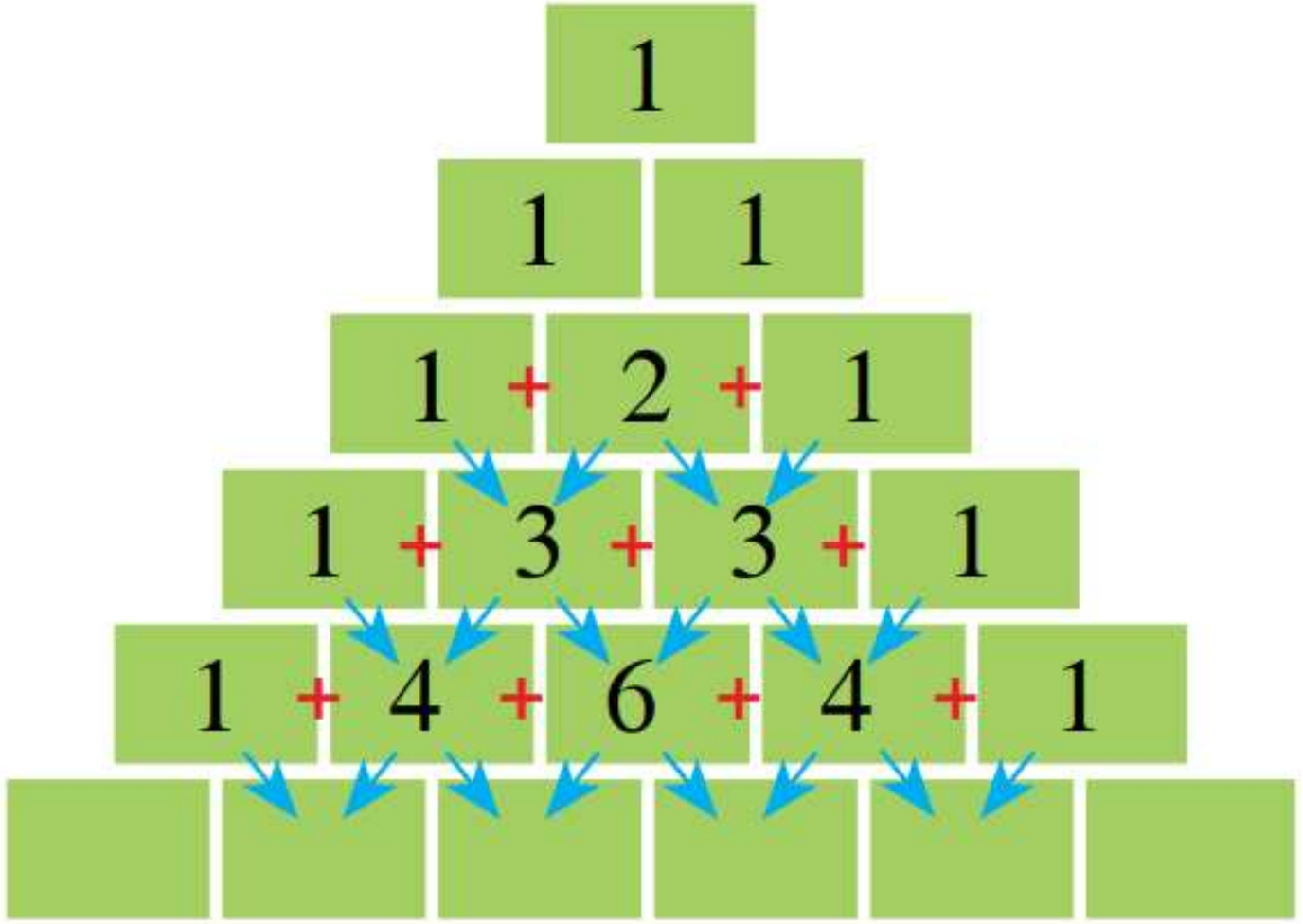
These odd numbers were obtained by adding 10 to the previous number.

(ii) **Even numbers:** 12, 22, 32, 42, 52 and 62

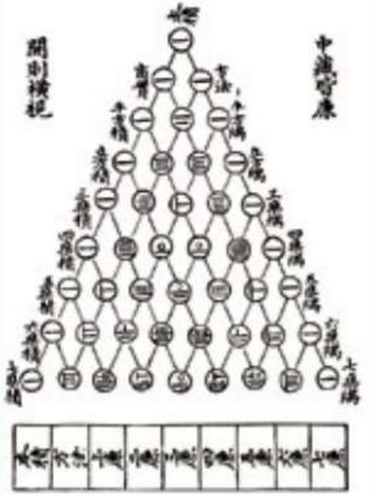
+10 +10

These even numbers were obtained by adding10 to the previous number.

Pascal's Triangle



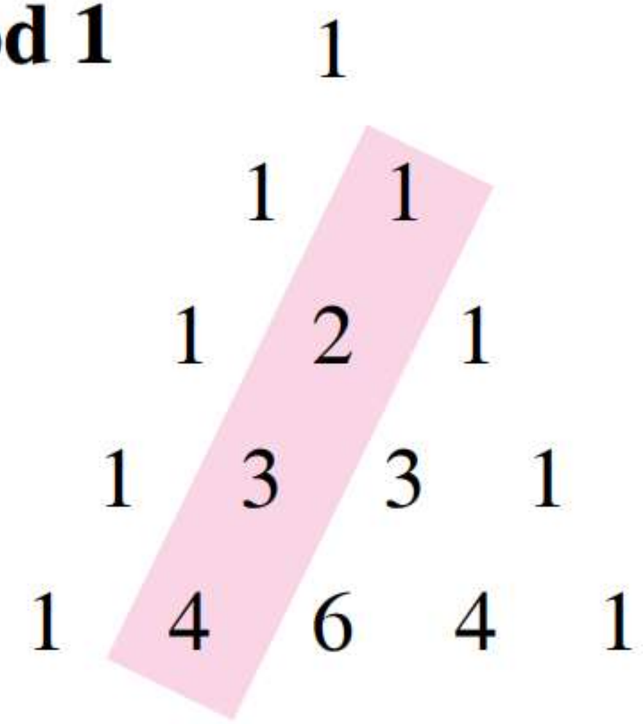
DO YOU KNOW ?



Yang Hui Triangle

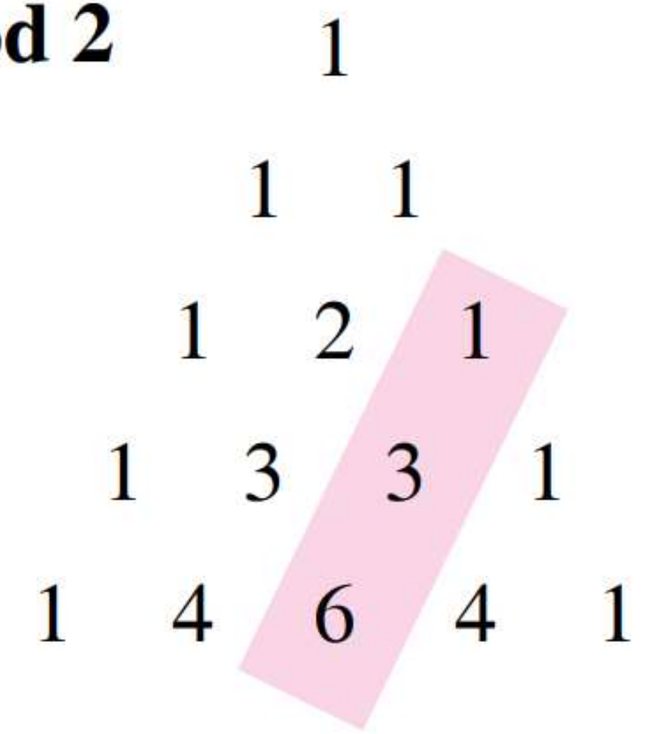
Pascal's Triangle was known as Yang Hui's Triangle by the Chinese and is illustrated using magic squares and magic circles.

Method 1



Sequence: 1, 2, 3, 4, ...
Pattern: Add 1

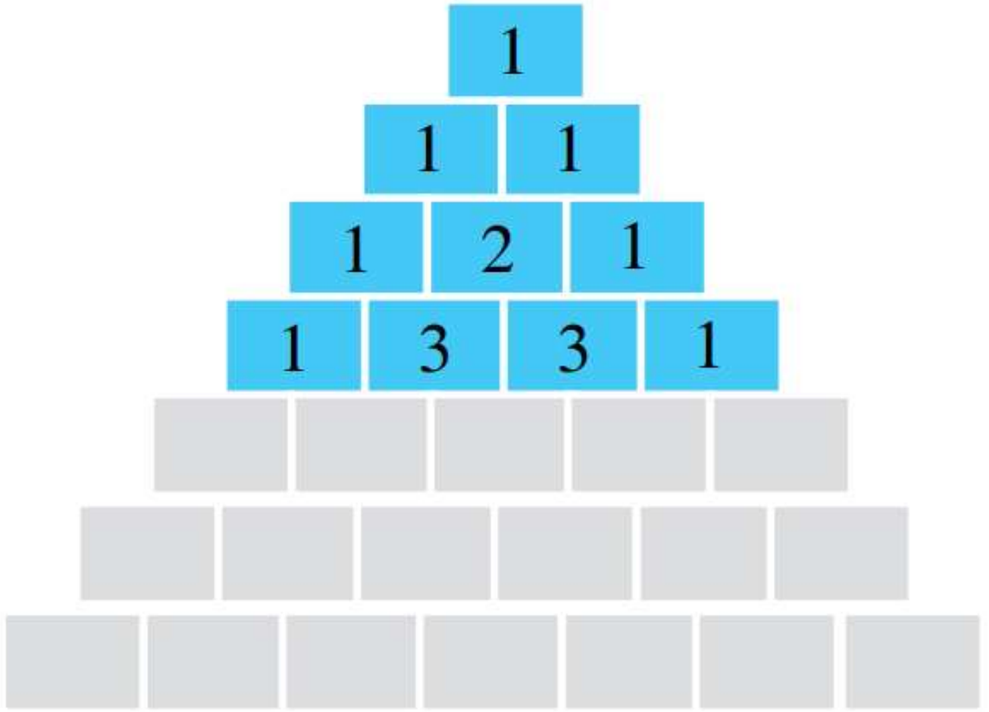
Method 2



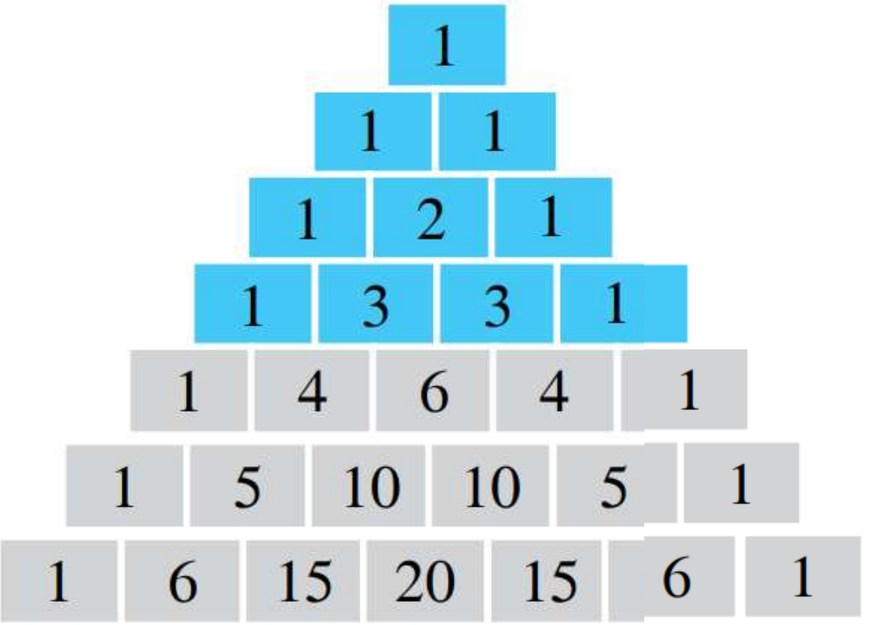
Sequence: 1, 3, 6, ...
Pattern: Add 2, 3, 4, ...

EXAMPLE 4

Complete the Pascal's Triangle below.

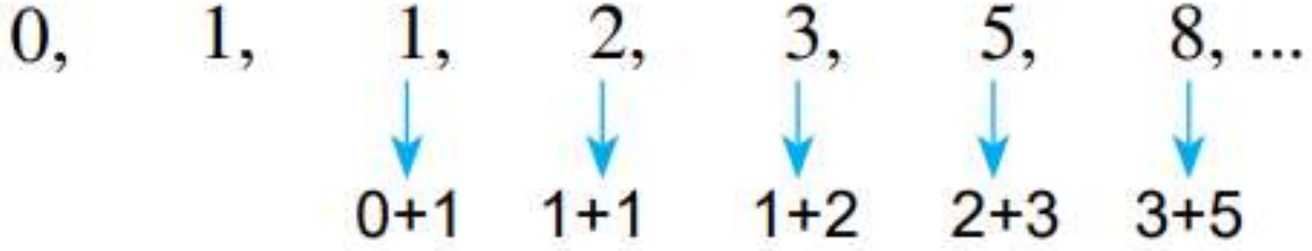


Solution:



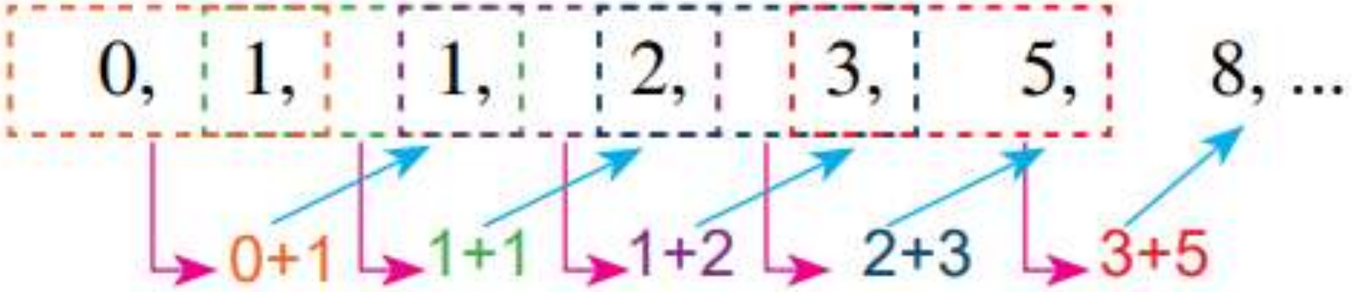
Fibonacci Numbers

Fibonacci Numbers are a pattern of numbers in a sequence.



This sequence starts with 0, 1, 1 and the next term is obtained by adding the previous two terms.

Example:



EXAMPLE 5

Complete the number sequence below .

(a) 0, 1, 1, ☐, ☐, ☐, 8, 13, ☐, ...

(b) 1, 3, ☐, ☐, 11, ...

Solution:

(a) 0, 1, 1, [2], [3], [5], 8, 13, [21], ...

(b) 1, 3, [4], [7], 11, ...

1.2 Sequences

1.2.1

Learning Standard

Explain the meaning of sequence.

1.2.2

Learning Standard

Identify and describe the pattern of a sequence, and hence complete and extend the sequence.

1.2 Sequences

IGCSE

Learning Standard

Continue a number sequence or pattern

'I can...'

At the end of the lesson, you should be able to do all this following:

- Understand what sequence is
- Determine whether a set of numbers is a sequence
- Complete number sequences
- Complete number sequences based on given pattern

A SEQUENCE IS?

Sequence is a set of numbers or objects arranged according to a certain pattern.

EXAMPLE 6

Determine whether each set of numbers is a sequence

(a) $-10, -6, -2, 2, 6, \ldots$

(b) $4, 5, -7, 10, -14, \ldots$

Solution:

(a) $-10, -6, -2, 2, 6, \ldots$

Pattern: Add 4
Therefore, the set of numbers is a sequence.

(b) $4, 5, -7, 10, -14, \ldots$

Pattern: None
Therefore, the set of numbers is not a sequence.

EXAMPLE 7

Complete the number sequences below.

(a) 7, 13, $\square$, 25, $\square$, $\square$, ...

(b) 88, $\square$, 64, 52, $\square$, $\square$, ...

(c) $\square$, 0.3, $\square$, 0.027, 0.0081, $\square$, ...

(d) $\square$, $\square$, $\frac{1}{3}$, $\frac{4}{6}$, $\square$, ...

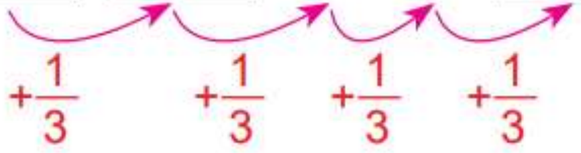
Solution:

(a) $7,\ 13,\ \boxed{19},\ 25,\ \boxed{31},\ \ldots$

(b) $88,\ \boxed{76},\ 64,\ 52,\ \boxed{40},\ \boxed{28},\ \ldots$

(c) $\boxed{1},\ 0.3,\ \boxed{0.09},\ 0.027,\ 0.0081,\ \boxed{0.00243},\ \ldots$

(d) $\boxed{-\frac{1}{3}},\ \boxed{0},\ \frac{1}{3},\ \frac{4}{6},\ \boxed{1},\ \ldots$



EXAMPLE 8

Complete the number sequences below based on the given pattern.

(a) Subtract 4 from the previous number.

96, ☐, ☐, ☐, ☐, ☐, ...

(b) Multiply the previous number by 3.

7, ☐, ☐, ☐, ☐, ☐, ...

(c) Subtract 8 from the previous number.

21.3, ☐, ☐, ☐, ☐, ☐, ...

(d) Divide the previous number by 5.

400, ☐, ☐, ☐, ☐, ☐, ...

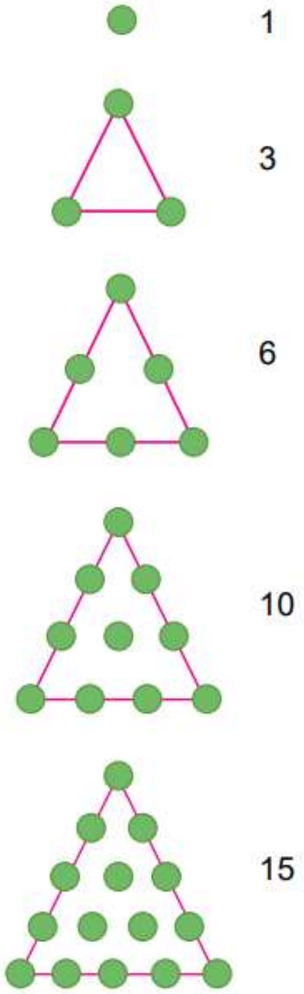
Solution:

(a) 92, 88, 84, 80, 76, ...
(b) 21, 63, 189, 567, 1 701, ...
(c) 13.3, 5.3, −2.7, −10.7, −18.7, ...
(d) 80, 16, 3.2, 0.64, 0.128, ...

DO YOU KNOW ?

Triangular numbers are numbers represented by dots to make an equilateral triangle.

1, 3, 6, 10, 15, 21, 28, 36, ...



1.3 Pattern & Sequences

1.3.1

Learning Standard

Make generalisation about the pattern of a sequence using numbers, words and algebraic expressions.

1.3.2

Learning Standard

Determine specific terms of a sequence

1.3.3

Learning Standard

Solve problems involving sequences.

1.2 Sequences

IGCSE

Learning Standard

Continue a number sequence or pattern

'I can...'

At the end of the lesson, you should be able to do all this following:

- ***Describe the pattern of a number sequence using***
  - ***Numbers***
  - ***Words***
  - ***Algebraic expressions***
- ***Finding the nth term of a sequence***
- ***Solving problems***

EXAMPLE 9

Describe the pattern for the number sequence 1, 9, 17, 25, 33, …
by using numbers, words and algebraic expressions.

Solution:

(i) **Numbers**

1, 9, 17, 25, 33, ...

+8 +8 +8 +8

Therefore, the pattern is + 8.

(ii) **Words**

1, 9, 17, 25, 33, ...

+8 +8 +8 +8

Therefore, the pattern for the above sequence is add 8 to the previous number.

(iii) **Algebraic expressions**

1, 9, 17, 25, 33, ...

+8 +8 +8 +8

$1 = 1 + 8\,(0)$
$9 = 1 + 8\,(1)$
$17 = 1 + 8\,(2)$
$25 = 1 + 8\,(3)$
$33 = 1 + 8\,(4)$

Therefore, the pattern for the number sequence can be expressed as $1 + 8n$ where, $n = 0, 1, 2, 3, 4, \ldots$.

WHERE DOES *that "n"* COME FROM?

1.3.2 Terms of a sequence

The n^{th} term in a number sequence and is written as T_n whereby T is the term and n is the position of the term.

$$T_n = n^{th} \text{ term}$$

For example,

4, 8, 12, 16, ...

From the sequence above...

$T_1 = 4,$

$T_2 = 8,$

$T_3 = 12,$

$T_4 = 16, \ldots$

DO YOU KNOW ?

The queen bee lays eggs in its nest which has a hexagonal pattern.

EXAMPLE 10

State the 5th term for the following number sequence.

2, 10, 18, ...

Solution:

Step 1: Determine the pattern for the number sequence.

2, 10, 18, ...

+8 +8

Number pattern: Add 8 to the previous number.

Step 2: List down the first 5 terms as shown below.

$T_1 = 2$ $T_4 = 26$

$T_2 = 10$ $T_5 = 34$

$T_3 = 18$

Hence, the 5th term is 34.

EXAMPLE 11

Given the number sequence 65, 60, 55, 50, ... Determine which term in the number sequence is 40.

Solution:

Step 1:

65, 60, 55, 50, ...

Pattern: Subtract 5 from the previous number.

Step 2:

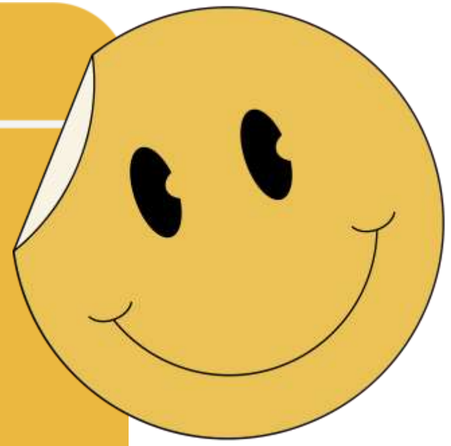
$T_1 = 65$ $T_4 = 50$

$T_2 = 60$ $T_5 = 45$

$T_3 = 55$ $T_6 = 40$

Hence, 40 is the 6^{th} term.

THANK YOU



I hope you can get helpful knowledge from this presentation.
Good luck!