

Essential Questions: What is an arithmetic sequence? What is an explicit formula? How do we use explicit formulas to find the terms in a sequence?

Do Now:

Arrange the following numbers in order from least to greatest: 17, 29, 21, 13, 25

Do you notice a pattern?

13, 17, 21, 25, 29

What is a sequence?

A **sequence** is a set of numbers that follow a particular pattern. The individual elements in a sequence are called **terms**.

List the sequence from the Do Now: 13, 17, 21, 25, 29

- What is the pattern? add 4
- Which number is the fourth term? 25 $f(4) = 25$

x	Term Number (position)	1	2	3	4	5
f(x)	Term	13	17	21	25	29

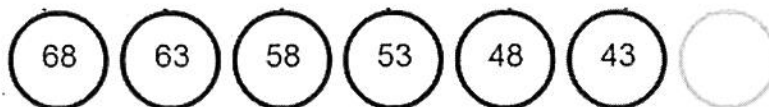
Sequences are functions

- whose **domain** is the set of natural numbers (1, 2, 3, 4, ...).
- whose **range** consists of the terms of the sequence.
- that can be expressed in **subscript** or **function** notation.

Term Number	Term	Subscript Notation	Function Notation
1	1	a_1	$f(1)$
2	5	a_2	$f(2)$
3	9	a_3	$f(3)$
4	13	a_4	$f(4)$
5	17	a_5	$f(5)$
6	21	a_6	$f(6)$
n	\vdots	a_n	$f(n)$

What is an Arithmetic Sequence?

An **arithmetic sequence** is an ordered list of numbers in which the difference between each pair of consecutive **terms** is the same. This difference is called the **common difference (d)** and it is a **constant value**.



To find the common difference: Take any term and subtract the previous term.

- The common difference in this example is -5.

To find the next term: Add the common difference to the previous term.

- The next term in this example is 38. $43 + (-5) = 38$

Let's take a look at some sequences...is there a **common** difference?

(2) -2, -5, -8, -11, ...

yes

$$d = -3$$

(3) 16, 12, 9, 8, 4, 2, ...

No

(4) $\frac{1}{4}, \frac{1}{2}, \frac{3}{4}, 1, \frac{5}{4}, \dots$

yes

$$d = \frac{1}{4}$$

Writing Arithmetic Sequences as Functions

You can use the first term and the common difference to write a function rule that describes an arithmetic sequence.

Let's take another look at the sequence from the Do Now. How can we find the 75th term of the sequence?

$$13, 17, 21, 25, 29$$

$$a_1 = 13 \quad d = 4$$

Term # n	Term a_n	Written in terms of a_1 and d	Term
1	a_1	a_1	13
2	a_2	$a_1 + d$	$13 + 4 = 17$
3	a_3	$a_1 + d + d \rightarrow a_1 + 2d$	$13 + 2(4) = 21$
4	a_4	$a_1 + d + d + d \rightarrow a_1 + 3d$	$13 + 3(4) = 25$
n	a_n	$a_1 + d(n-1)$	$13 + 4(n-1)$

The **Explicit Formula** to find the n th term of an **arithmetic sequence**:

Subscript Notation $a_n = a_1 + d(n-1)$

Function Notation $a(n) = a(1) + d(n-1)$

Use the explicit formula (function rule) from the Do Now to determine the 75th term of the sequence.

$$a(1) = 13$$

$$d = 4$$

$$n = 75$$

$$a(n) = a(1) + d(n-1)$$

$$a(75) = 13 + 4(75-1)$$

$$= 13 + 4(74)$$

$$= 13 + 296$$

$$a(75) = 309$$

The 75th term
is 309

(5) Given the following arithmetic sequence: 2, 6, 10, 14, ...

a) Define the sequence explicitly.

b) Find the 15th term. $n = 15$

$$a_1 = 2 \quad d = 4$$

general formula $a_n = a_1 + d(n-1)$

explicit formula for this sequence $a_n = 2 + 4(n-1)$

$$\begin{aligned} \rightarrow a_{15} &= 2 + 4(15-1) \\ &= 2 + 4(14) \\ &= 58 \end{aligned}$$

(6) Given the following arithmetic sequence: 160, 140, 120, 100, ...

a) Write an equation for the n th term.

b) Find the 10th term. $n = 10$

$$a_1 = 160 \quad d = -20$$

general formula $a_n = a_1 + d(n-1)$

explicit formula for this sequence $a_n = 160 + (-20)(n-1)$

$$\begin{aligned} \rightarrow a_{10} &= 160 + (-20)(10-1) \\ &= 160 - 20(9) \\ &= 160 - 180 \\ &= -20 \end{aligned}$$

The TAKEAWAY

- The increase or decrease in an arithmetic sequence is called the common difference.
- The explicit formula for an arithmetic sequence allows you to find the n th term of the sequence by substituting the values of a_1 (first term) and d (common difference) in the equation $a_n = \underline{a_1 + d(n-1)}$.