## Warm Up

Find the pattern within the number set.
$2,4,6,8,10$
$1,4,7,10,13$
$+2$
$+3$
$12,24,36,48,60$
$+12$
12, 16, 20, 24, 28
13, 26, 39, 52, 65
$+13$
$2.5,4,5.5,7,8.5$
$+1.5$

## Essential Question

How are arithmetic sequences related to linear functions?

Needed Vocab:

- Arithmetic Sequence
- Common Difference
- Explicit Formula
- Recursive Formula
- Sequence
- Term of the Sequence

GOAL: "I CAN. . .
Identify and describe arithmetic sequences."

Row 3

There are 5 shaded squares in row 3. The total number of shaded squares up to and including row 3 is 9 . Fill in the table for the remaining rows.

|  | 1 | 2 | 3 | 4 | 5 | $n$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :--- |
|  | 1 | 3 | 5 | 7 | 9 | $2 n-1$ |
|  | 1 | 4 | 9 | 16 | 25 | $n^{2}$ |

A sequence is an ordered list of numbers that often forms a pattern. Each number is a term of the sequence. In an arithmetic sequence, the difference between any two consecutive terms is a constant called the common difference.

## EXAMPLE 1

Is the ordered list $26,39,52,65,78$ an arithmetic sequence?
yes, arithmetic.

Sequences relate to functions where the number of the term is our $x$ and the value of the term is our $y$. So that means our domain relates to the term number and our range relates to the term value.

The arithmetic sequence form before was $26,39,52,65,78$. So that means if the function of the sequence is $A$ :

Function Notation
$A(1)=26$
The 1 term is 26 .
The 2 term is 39 .
The 3 term is 52 .
and so on...

Subscript Notation
$A_{1}=26$
$A_{2}=39$
$A_{3}=52$
and so on...

If $A(n)$ is the $n$th term of the sequence, $26,39,52,65,78$. Is the Domain of the sequence discrete or continuous? Explain.

D: Discrete
R': Discrete

## Recursive Definition

Recursive, in mathematics, means to repeat a process over and over again, using the output of each step as the next input. A recursive formula relates each term of a sequence to the previous term. It is composed of an initial value and a rule for generating the sequence.

The recursive formula for an arithmetic sequence is:

previous term of the sequence

A recursive formula describes the pattern of a sequence and can be used to find the next term in a sequence.

EXAMPLE 2 What is a recursive formula for the height above the ground of the nth step of the pyramid shown?


Using the formula we just found, $A_{n}=A_{n-1}+26$, where $A_{1}=26$, let's find the height off the ground of the 3rd step.

$$
\begin{array}{ll}
\text { nd of the ard step. } & A_{2}=A_{2-1}+26 \\
A_{3}=A_{3-1}+26 & A_{2}=A_{1}+26 \\
A_{3}=A_{2}+26 & A_{2}=26+26 \\
A_{3}=52+26 & A_{2}=52 \\
A_{3}=78 &
\end{array}
$$

Rewrite the recursive formula if the height of each step is changed from 26 to 18.

$$
A_{1}=18 \quad A_{n}=A_{n-1}+18
$$

## Explicit Formula

An explicit formula expresses the $n$th term of a sequence in terms of $n$.
The explicit formula for an arithmetic sequence is:

$$
a_{n}=a_{1}+(n-1) d \quad \text { common difference }
$$

first term of the sequence

## EXAMPLE 3

The cost of renting a bicycle is given in the table below. How can you represent the rental cost using an explicit formula?


What is the cost of renting the bicycle for 10 days? The explicit formula is $a_{n}=$ $14+12 n$ gives the rental cost for $n$ days.

$$
a_{10}=12(10)+14
$$

$$
\begin{aligned}
& a_{10}=120+14 \\
& a_{10}=134
\end{aligned}
$$

How is the explicit formula of an arithmetic sequence related to a linear function?

$$
a_{n}=\frac{12 n+14}{\text { thisis a line, but can only use whole }}
$$ \#'s. sO D: Discrete R: Discrete.

Can be written as a function $f(x)=12 x+14$ $f(x)$ is total cost for $x \neq$ of days.

The cost to rent a bike is $\$ 28$ for the first day plus $\$ 2$ for each day after that. Write an explicit formula for the rental cost for $n$ days. What is the cost to rent the bike for 8 days?

$$
\begin{array}{ll}
a_{1}=28 & a_{8}=2(8)+26 \\
a_{n}=28+(n-1)^{2} & a_{8}=16+26 \\
a_{n}=28+2 n-2 & a_{8}=16 \\
a_{n}=2 n+26 & a_{8}=42 \\
& \$ 42
\end{array}
$$

Example 4
The recursive formula for the height above the ground of the nth step of the stairs shown is $a_{n}=a_{n-1}+4$ with $a_{1}=7$. What explicit formula finds the height above the ground of the nth step? Difference

$$
\begin{aligned}
& a_{n}=7+(n-1) 4 \\
& a_{n}=7+4 n-4 \\
& a_{n}=4 n+3
\end{aligned}
$$



Write an explicit formula for each arithmetic sequence.

$$
\begin{array}{cl}
a_{n}=a_{n-1}-3 ; a_{1}=10 & a_{n}=10+(n-1)(-3) \\
\text { Difference } & a_{n}=10-3 n+3 \\
a_{n}=a_{n-1}+2.4 ; a_{1}=-1 & a_{n}=-3 n+13 \\
\text { i } & a_{n}=-1+(n-1)(2.4) \\
\text { difference } & a_{n}=-1+2.4 n-2.4 \\
a_{n}=2.4 n-3.4
\end{array}
$$

Example 5
The explicit formula for an arithmetic sequence is $a_{n}=1+\frac{1}{2} n$. What is the recursive formula for the sequence?

$$
\begin{aligned}
& a_{n}=a_{n-1}+d \\
& a_{n}=1+1 / 2 n a_{1}=1+1 / 2(1) \\
& d a_{1}=\frac{3}{2} \text { or } 1.5 \\
& a_{1}=3 / 2 ; a_{n}=a_{n-1}+1 / 2
\end{aligned}
$$

Write a recursive formula for each explicit formula.


$$
\begin{array}{ll}
a_{1}=8+3(1) \\
a_{1}=11
\end{array} a_{1}=11 ; a_{n}=a_{n-1}+3
$$

$$
a_{1}=7
$$

## Arithmetic Sequences

WORDS An arithmetic sequence is a sequence of numbers that follows a pattern. The difference between two consecutive terms is a constant called the common difference.

## FORMULAS <br> Used to describe a sequence and find the next few terms

## Explicit Formula



Used to find a specific term in the sequence


The first term of the sequence is $a_{1}$.

## NUMBERS

$$
1,7,13,19,25, \ldots
$$

Use the recursive formula to describe the Use the explicit formula to find the 15 th sequence and find the next two terms.

$$
a_{n}=a_{n-1}+6
$$



$$
\begin{aligned}
a_{6} & =a_{5}+6 & a_{7} & =a_{6}+6 \\
& =25+6 & & =31+6 \\
& =31 & & =37
\end{aligned}
$$

## Pg. 116

14, 17-28, 32-36 even, 45, 47

