

CLO: Students will be able to write linear equations using what they know from writing recursive formulas of an arithmetic sequence.

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Warm - Up

Given the sequence write a recursive formula.

1. 3, 8, 13, 18, ...

$$u_n = u_{n-1} + 5$$

$$u_1 = 3$$

2. 11, 7, 3, -1, ...

$$u_1 = 11$$

$$u_n = u_{n-1} - 4$$

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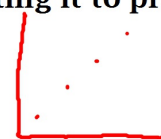
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Vocabulary

Linear equation: An equation that has a constant rate of change. When graphed it will show a linear pattern or straight line.

Examples:  $y = mx + b$ ;  $y = y_1 + m(x - x_1)$ ,  $Ax + By = C$

Explicit Formula: A Formula that gives a direct relationship between two quantities. A formula for a sequence that defines the  $n^{\text{th}}$  term rather than relating it to previous terms.



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You can solve many rate problems by using recursion.

Karen called her aunt in Chile on her birthday. She learned that placing the call costs \$2.27 and that each minute she talks costs \$1.37. How much would it cost to talk for 30 minutes?

Create a recursive formula for Karen's phone call.

$$u_0 = 2.27$$
$$u_n = u_{n-1} + 1.37$$

Use your calculator to find the 30<sup>th</sup> term.

30<sup>th</sup> term:

$$\$43.37$$

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As you learned in algebra, you and Karen can also find the cost of a 30-minute call by using a **linear equation**.

Linear Equation:

$$y = 1.37x + 2.27$$

The  $x$  represents the length of the phone call in minutes and the  $y$  is the cost in dollars. If the phone company always rounds up the length of call to the nearest whole minute, then the costs become a sequence of discrete (distinct) points, and we can now write this relationship as an **explicit formula**.

Explicit Formula:

$$u_n = 1.37n + 2.27 \leftarrow u_0$$

common difference

The  $n$  represents the length of the call in whole minutes and  $u_n$  represents the cost in dollars.

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**EXAMPLE A**

Look at the recursively defined arithmetic sequence

$$u_0 = 2$$

$$u_n = u_{n-1} + 6 \text{ where } n \geq 1$$

- a. Find an explicit formula for the sequence.

$$u_n = 6n + 2$$

- b. Use the explicit formula to find  $u_{22}$ .

$$u_{22} = 6(22) + 2$$

$$u_{22} = 132 + 2$$

$$u_{22} = 134$$

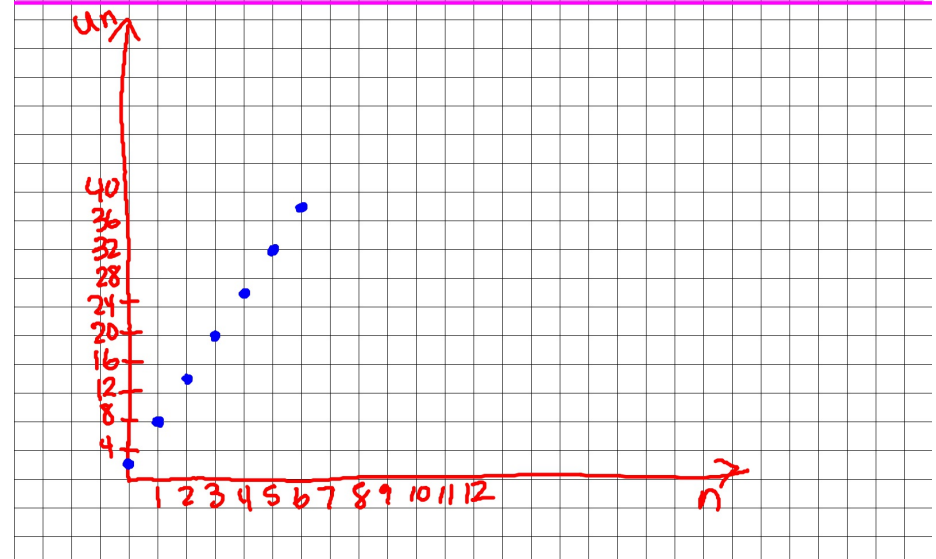
- c. Find the value of  $n$  so that  $u_n = 86$ .

$$\begin{array}{r} 86 = 6n + 2 \\ -2 \quad -2 \end{array}$$

$$\frac{84}{6} = \frac{6n}{6}$$

$$n = 14$$

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When  $n$  increases by 1,  $u_n$  increases by 6, which is the common difference.

When we use the terms  $x$  and  $y$ , the number 6 is the change in the  $y$ -value, while the  $x$ -value is changing by 1.

$$\frac{\Delta y}{\Delta x} = \frac{6}{1} = \frac{u_n}{n}$$

So the points that represent the sequence lie on a line with a **slope** of 6. The common difference or rate of change, of an arithmetic sequence usually represents the **slope**.

$$u_0 = 2$$

When you see the pair  $(0, 2)$ , this tells us the starting value is 2, which is the  $y$ -intercept.

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The main point of this lesson is that an **explicit formula**  $u_n = a + dn$  can model the same situations as a recursive formula

$$u_0 = a,$$

$$u_n = u_{n-1} + d.$$

Both models are **discrete**, applying only to whole numbers.

The **linear equation**  $y = a + bx$  is **continuous**, describing a line that might pass through a given set of discrete points.

#### CLASSWORK

PAGE 117 -118: # 2,3,4,6,7,8

