# Essential Question How can you recognize when a pattern

in real life is linear or nonlinear?

# **ACTIVITY:** Finding Patterns for Similar Figures

Work with a partner. Copy and complete each table for the sequence of similar rectangles. Graph the data in each table. Decide whether each pattern is linear or nonlinear.



- Perimeters of similar rectangles a.
- COMMON CORE

Functions

- In this lesson, you will
- identify linear and nonlinear functions from tables or graphs.
- compare linear and nonlinear functions. Learning Standard

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2 1 3 4 5 Х Ρ



### **b.** Areas of similar rectangles

x	1	2	3	4	5
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## 2 ACTIVITY: Comparing Linear and Nonlinear Functions

Work with a partner. Each table shows the height *h* (in feet) of a falling object at *t* seconds.

- Graph the data in each table.
- Decide whether each graph is linear or nonlinear.
- Compare the two falling objects. Which one has an increasing speed?
- **a.** Falling parachute jumper
- **b.** Falling bowling ball

t	0	1	2	3	4	
h	300	285	270	255	240	

t	0	1	2	3	4	
h	300	284	236	156	44	



Mathematics What will the graph look like for an object that has a constant speed? an increasing speed? Explain.









# What Is Your Answer?

**3. IN YOUR OWN WORDS** How can you recognize when a pattern in real life is linear or nonlinear? Describe two real-life patterns: one that is linear and one that is nonlinear. Use patterns that are different from those described in Activities 1 and 2.



Use what you learned about comparing linear and nonlinear functions to complete Exercises 3–6 on page 270.

#### 6.4 Lesson





The graph of a linear function shows a constant rate of change. A **nonlinear function** does not have a constant rate of change. So, its graph is *not* a line.

## **EXAMPLE**

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# **Identifying Functions from Tables**

# Study Tip

A constant rate of change describes a quantity that changes by equal amounts over equal intervals.



As *x* increases by 3, y decreases by 8. The rate of change is constant. So, the function is linear.



• As *x* increases by 2, y increases by different amounts. The rate of change is not constant. So, the function is nonlinear.

#### 2 **EXAMPLE**

## **Identifying Functions from Graphs**

### Does the graph represent a *linear* or *nonlinear* function? Explain.

b.

- a. 3 2 1  $2 \ 3 \ x$ -3 - 21 2
  - The graph is *not* a line. So, the function is nonlinear.



The graph is a line. So, the function is linear.

## On Your Own

Does the table or graph represent a *linear* or *nonlinear* function? **Explain.** 

1.	x	У	2.	x	У	3.	3 7
	0	25		2	8		2
	7	20		4	4		-3-2 1 2 3 x
	14	15		6	0		
	21	10		8	-4		



#### EXAMPLE 3

**EXAMPLE** 

### Identifying a Nonlinear Function

#### Which equation represents a *nonlinear* function?

(A) 
$$y = 4.7$$
  
(B)  $y = \pi x$   
(C)  $y = \frac{4}{x}$   
(D)  $y = 4(x - 1)$ 

You can rewrite the equations y = 4.7,  $y = \pi x$ , and y = 4(x - 1) in slope-intercept form. So, they are linear functions.

You cannot rewrite the equation  $y = \frac{4}{x}$  in slope-intercept form. So, it is a nonlinear function.

• The correct answer is **C**.

## 4 Real-Life Application

On Your Own

Account A earns simple interest. Account B earns compound interest. The table shows the balances for 5 years. Graph the data and compare the graphs.

**Savings Account** 

				Account B
Year, t	Account A Balance	Account B Balance	1	
0	\$100	\$100		150
1	\$110	\$110	100	
2	\$120	\$121	-	
3	\$130	\$133.10	Ó	110
4	\$140	\$146.41		100
5	\$150	\$161.05		0 1 2 3 4 5 6 7 <i>t</i>
				Year

Both graphs show that the balances are positive and increasing.

The balance of Account A has a constant rate of change of \$10. So, the function representing the balance of Account A is linear.

The balance of Account B increases by different amounts each year. Because the rate of change is not constant, the function representing the balance of Account B is nonlinear.

### Now You're Ready Exercises 12–14

Does the equation represent a *linear* or *nonlinear* function? Explain.

**4.** y = x + 5 **5.**  $y = \frac{4x}{3}$  **6.**  $y = 1 - x^2$ 

# 6.4 Exercises



# Vocabulary and Concept Check

- **1. VOCABULARY** Describe how linear functions and nonlinear functions are different.
- **2.** WHICH ONE DOESN'T BELONG? Which equation does *not* belong with the other three? Explain your reasoning.

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# Practice and Problem Solving

Graph the data in the table. Decide whether the graph is *linear* or *nonlinear*.

3.	x	0	1	2	3
	У	4	8	12	16
-		r		r	r
5.	x	6	5	4	3
	у	21	15	10	6

•	x	1	2	3	4
	У	1	2	6	24

6.	x	-1	0	1	2	
	У	-7	-3	1	5	

### Does the table or graph represent a *linear* or *nonlinear* function? Explain.



9.	x	5	11	17	23
	У	7	11	15	19



10.	x	-3	-1	1	3	
	У	9	1	1	9	

**11. VOLUME** The table shows the volume *V* (in cubic feet) of a cube with an edge length of *x* feet. Does the table represent a linear or nonlinear function? Explain.

Edge Length, x	1	2	3	4	5	6	7	8
Volume, V	1	8	27	64	125	216	343	512

### Does the equation represent a *linear* or *nonlinear* function? Explain.

**3 12.** 
$$2x + 3y = 7$$

**13.** 
$$y + x = 4x + 5$$
 **14.**  $y = \frac{8}{x^2}$ 

**15. LIGHT** The frequency *y* (in terahertz) of a light wave is a function of its wavelength *x* (in nanometers). Does the table represent a linear or nonlinear function? Explain.

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Color	Red	Yellow	Green	Blue	Violet
Wavelength, <i>x</i>	660	595	530	465	400
Frequency, y	454	504	566	645	749

**16. MODELING** The table shows the cost *y* (in dollars) of *x* pounds of sunflower seeds.

Pounds, x	Cost, y
2	2.80
3	?
4	5.60

- **a.** What is the missing *y*-value that makes the table represent a linear function?
- **b.** Write a linear function that represents the cost *y* of *x* pounds of seeds. Interpret the slope.
- **c.** Does the function have a maximum value? Explain your reasoning.
- **17. TREES** Tree A is 5 feet tall and grows at a rate of 1.5 feet per year. The table shows the height *h* (in feet) of Tree B after *x* years.
  - **a.** Does the table represent a linear or nonlinear function? Explain.

Years, x	Height, <i>h</i>		
0	5		
1	11		
4	17		
9	23		

- **b.** Which tree is taller after 10 years? Explain.
- 18. Number Sense

The ordered pairs represent a function. (0, -1), (1, 0), (2, 3), (3, 8), and (4, 15)

- **a.** Graph the ordered pairs and describe the pattern. Is the function linear or nonlinear?
- **b.** Write an equation that represents the function.

# Fair Game Review What you learned in previous grades & lessons

The vertices of a figure are given. Draw the figure and its image after a dilation with the given scale factor k. Identify the type of dilation. (Section 2.7)

