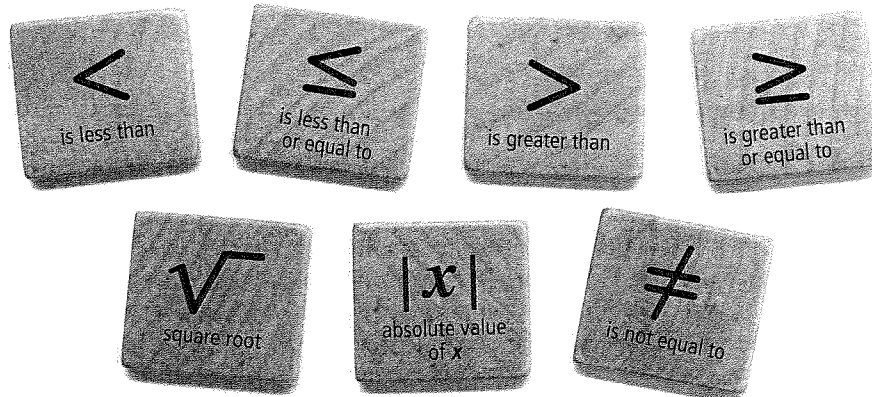# Reading and Writing Math

CHAPTER 4

Reading Strategy: Read and Interpret Math Symbols

It is essential that as you read through each lesson of the textbook, you can interpret mathematical symbols.

Common Math Symbols

$<$ is less than

$\leq$ is less than or equal to

$>$ is greater than

$\geq$ is greater than or equal to

$\sqrt{}$ square root

$|x|$ absolute value of x

$\neq$ is not equal to

You must be able to translate symbols into words . . .

Using Symbols	Using Words
$3\left(\dfrac{x}{12}\right) - 1 = 21$	Three times the quotient of x and 12, minus 1 equals 21.
$25x + 6 \geq 17$	Twenty-five times x plus 6 is greater than or equal to 17.
$|x| > 14$	The absolute value of x is greater than 14.
$\sqrt{60 + x} \leq 40$	The square root of the sum of 60 and x is less than or equal to 40.

. . . and words into symbols.

Using Words	Using Symbols
The height of the shed is at least 9 feet.	$h \geq 9$ ft
The distance is at most one tenth of a mile.	$d \leq 0.1$ mi
The silo contains more than 600 cubic feet of corn.	$c > 600$ ft^3

Try This

**Translate the symbols into words.**

1. $x \leq \sqrt{10}$

2. $|x| + 2 > 45$

3. $-5 \leq x < 8$

4. $-6 - \dfrac{1}{5}x = -32$

Translate the words into symbols.

5. There are less than 15 seconds remaining.

6. The tax rate is 8.25 percent of the cost.

7. Ann counted over 100 pennies.

8. Joe can spend at least $22 but no more than $30.

As seen in Example 1, some graphs are connected lines or curves called **continuous graphs**. Some graphs are only distinct points. These are called **discrete graphs**.

The graph on theme-park attendance is an example of a discrete graph. It consists of distinct points because each year is distinct and people are counted in whole numbers only. The values between the whole numbers are not included, since they have no meaning for the situation.

Theme Park Attendance
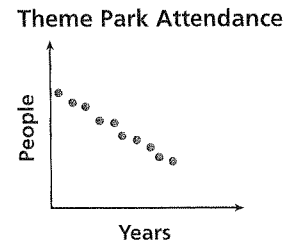
E X A M P L E 2   **Sketching Graphs for Situations**

Sketch a graph for each situation. Tell whether the graph is continuous or discrete.

A Simon is selling candles to raise money for the school dance. For each candle he sells, the school will get $2.50. He has 10 candles that he can sell.

Simon's Earnings
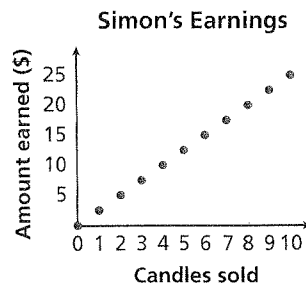
The amount earned (y-axis) increases by $2.50 for each candle Simon sells (x-axis).

Since Simon can only sell whole numbers of candles, the graph is 11 distinct points.

The graph is discrete.

B Angelique's heart rate is being monitored while she exercises on a treadmill. While walking, her heart rate remains the same. As she increases her pace, her heart rate rises at a steady rate. When she begins to run, her heart rate increases more rapidly and then remains high while she runs. As she decreases her pace, her heart rate slows down and returns to her normal rate.

As time passes during her workout (moving left to right along the x-axis), her heart rate (y-axis) does the following:

- remains the same,
- rises at a steady rate,
- increases more rapidly (steeper than previous segment),
- remains high,
- slows down,
- and then returns to her normal rate.
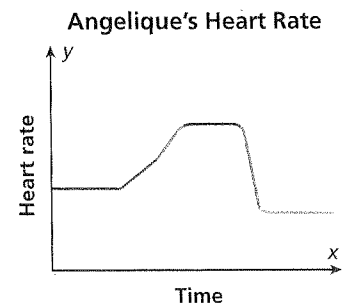
Angelique's Heart Rate

The graph is continuous.

CHECK IT OUT! Sketch a graph for each situation. Tell whether the graph is continuous or discrete.

2a. Jamie is taking an 8-week keyboarding class. At the end of each week, she takes a test to find the number of words she can type per minute. She improves each week.

2b. Henry begins to drain a water tank by opening a valve. Then he opens another valve. Then he closes the first valve. He leaves the second valve open until the tank is empty.

GUIDED PRACTICE

Vocabulary Apply the vocabulary from this lesson to answer each question.

1. A ___?___ graph is made of connected lines or curves. (*continuous* or *discrete*)

2. A ___?___ graph is made of only distinct points. (*continuous* or *discrete*)

SEE EXAMPLE **1**
p. 234

Choose the graph that best represents each situation.

3. A person alternates between running and walking.

4. A person gradually speeds up to a constant running pace.

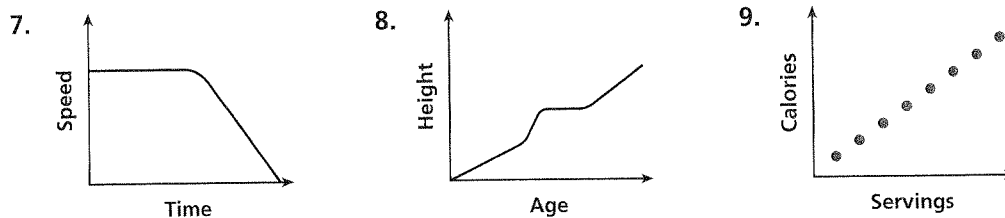5. A person walks, gradually speeds up to a run, and then slows back down to a walk.

Graph A · Graph B · Graph C (Speed vs. Time)
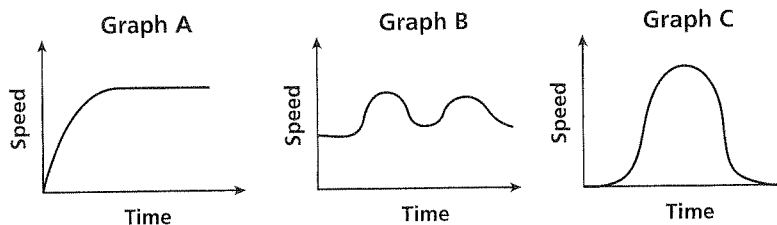
SEE EXAMPLE **2**
p. 235

6. Maxine is buying extra pages for her photo album. Each page holds exactly 8 photos. Sketch a graph to show the maximum number of photos she can add to her album if she buys 1, 2, 3, or 4 extra pages. Tell whether the graph is continuous or discrete.
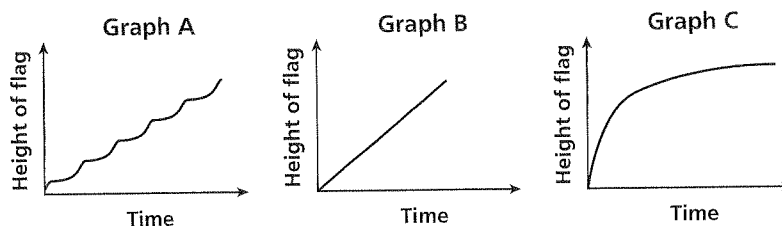
SEE EXAMPLE **3**
p. 236

Write a possible situation for each graph.

7.

Speed vs. Time

8.

Height vs. Age

9.

Calories vs. Servings

PRACTICE AND PROBLEM SOLVING

Independent Practice

For Exercises	See Example
10–12	1
13	2
14–16	3

Extra Practice
Skills Practice p. S10
Application Practice p. S31

Choose the graph that best represents each situation.

10. A flag is raised up a flagpole quickly at the beginning and then more slowly near the top.

11. A flag is raised up a flagpole in a jerky motion, using a hand-over-hand method.

12. A flag is raised up a flagpole at a constant rate of speed.

Graph A · Graph B · Graph C (Height of flag vs. Time)

23. Which situation would NOT be represented by a distinct graph?

Ⓐ Amount of money earned based on the number of cereal bars sold

Ⓑ Number of visitors to a grocery store per day for one week

Ⓒ The amount of iced tea in a pitcher at a restaurant during the lunch hour

Ⓓ The total cost of buying 1, 2, or 3 CDs at the music store

**24.** Which situation is best represented by the graph?

Ⓕ A snowboarder starts at the bottom of the hill and takes a ski lift to the top.

Ⓖ A cruise boat travels at a steady pace from the port to its destination.

Ⓗ An object falls from the top of a building and gains speed at a rapid pace before hitting the ground.

Ⓙ A marathon runner starts at a steady pace and then runs faster at the end of the race before stopping at the finish line.
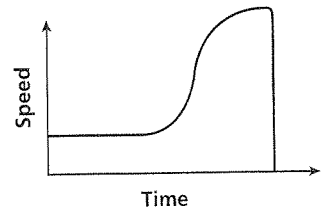
25. Short Response Marla participates in a triathlon consisting of swimming, biking, and running. Would a graph of Marla's speed during the triathlon be a continuous graph or a distinct graph? Explain.

CHALLENGE AND EXTEND

Pictured are three vases and graphs representing the height of water as it is poured into each of the vases at a constant rate. Match each vase with the correct graph.

26.

27.

28.
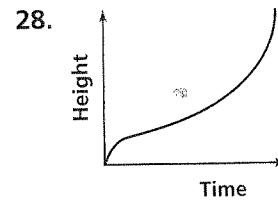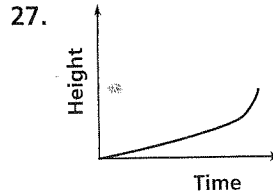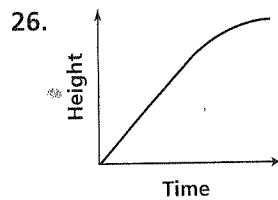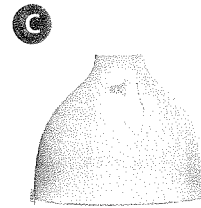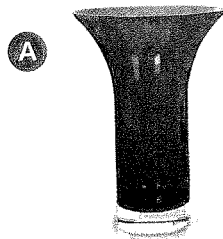
SPIRAL REVIEW

Evaluate each expression. *(Lesson 1-4)*

29. -2^3

30. 4^4

31. $\left(\dfrac{1}{3}\right)^2$

Generate ordered pairs for each function for $x = -2, -1, 0, 1,$ and 2. Graph the ordered pairs and describe the pattern. *(Lesson 1-8)*

32. $y = x - 2$

33. $2x + y = 1$
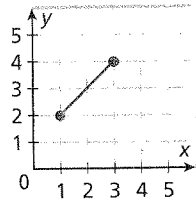
34. $y = |x - 1|$

35. $y = x^2 + 2$

Write and solve an equation to represent each relationship. *(Lesson 2-1)*

36. A number increased by 11 is equal to 3.

37. Five less than a number is equal to -2.

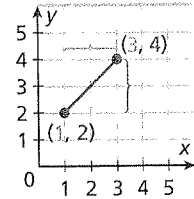EXAMPLE **2** **Finding the Domain and Range of a Relation**

Give the domain and range of the relation.
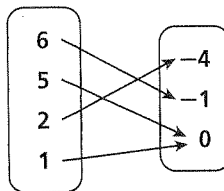
The domain is all *x*-values from 1 through 3, inclusive.

The range is all *y*-values from 2 through 4, inclusive.

D: $1 \le x \le 3$ R: $2 \le y \le 4$

CHECK IT OUT! Give the domain and range of each relation.

2a.

2b.

x	y
1	1
4	4
8	1

A **function** is a special type of relation that pairs each domain value with exactly one range value.

EXAMPLE **3** **Identifying Functions**

Give the domain and range of each relation. Tell whether the relation is a function. Explain.

A

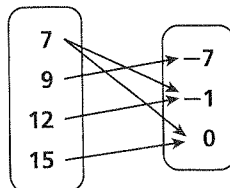| Field Trip	
Students *x*	Buses *y*
75	2
68	2
125	3

D: $\{75, 68, 125\}$ *Even though 2 appears twice in the table, it is written only once when writing the range.*

R: $\{2, 3\}$

This relation is a function. Each domain value is paired with exactly one range value.

B

D: $\{7, 9, 12, 15\}$

R: $\{-7, -1, 0\}$

Use the arrows to determine which domain values correspond to each range value.

This relation is not a function. Each domain value does not have exactly one range value. The domain value 7 is paired with the range values −1 and 0.

4-2 **Exercises**

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Parent Resources Online
KEYWORD: MA7 Parent

GUIDED PRACTICE

Vocabulary Apply the vocabulary from this lesson to answer each question.

1. Use a mapping diagram to show a relation that is not a *function*.

2. The set of x-values for a relation is also called the __?__. (*domain* or *range*)

SEE EXAMPLE 1
p. 240

Express each relation as a table, as a graph, and as a mapping diagram.

3. $\{(1, 1), (1, 2)\}$

4. $\left\{(-1, 1), \left(-2, \frac{1}{2}\right), \left(-3, \frac{1}{3}\right), \left(-4, \frac{1}{4}\right)\right\}$

5. $\{(-1, 1), (-3, 3), (5, -5), (-7, 7)\}$
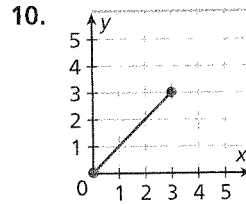
6. $\{(0, 0), (2, -4), (2, -2)\}$

SEE EXAMPLE 2
p. 241

Give the domain and range of each relation.

7. $\{(-5, 7), (0, 0), (2, -8), (5, -20)\}$

8. $\{(1, 2), (2, 4), (3, 6), (4, 8), (5, 10)\}$

9.

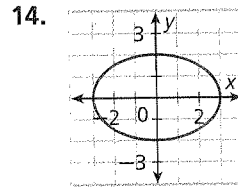| x	3	5	2	8	6
y	9	25	4	81	36

10.

SEE EXAMPLE 3
p. 241

Multi-Step Give the domain and range of each relation. Tell whether the relation is a function. Explain.

11. $\{(1, 3), (1, 0), (1, -2), (1, 8)\}$

12. $\{(-2, 1), (-1, 2), (0, 3), (1, 4)\}$

13.

x	−2	−1	0	1	2
y	1	1	1	1	1

14.

PRACTICE AND PROBLEM SOLVING

Extra Practice

Skills Practice p. S10
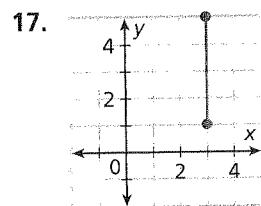Application Practice p. S31

Express each relation as a table, as a graph, and as a mapping diagram.

15. $\{(-2, -4), (-1, -1), (0, 0), (1, -1), (2, -4)\}$

16. $\left\{(2, 1), \left(2, \frac{1}{2}\right), (2, 2), \left(2, 2\frac{1}{2}\right)\right\}$

Give the domain and range of each relation.

17.

18.

x	y
4	4
5	5
6	6
7	7
8	8
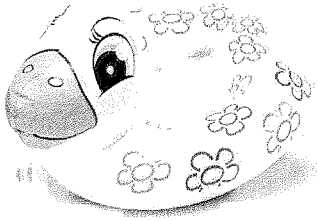
29. This problem will prepare you for the Multi-Step Test Prep on page 264.

a. The graph shows the amount of water being pumped into a pool over a 5-hour time period. Find the domain and range.

b. Does the graph represent a function? Explain.

c. Give the time and volume as ordered pairs at 2 hours and at 3 hours 30 minutes.

Filling Pool with Water
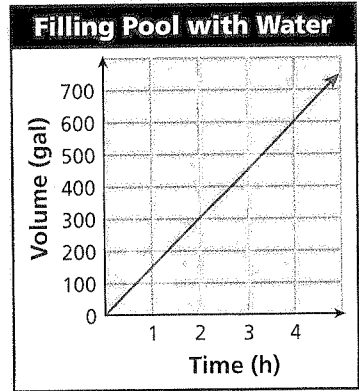
30. ///ERROR ANALYSIS/// When asked whether the relation $\{(-4, 16), (-2, 4), (0, 0), (2, 4)\}$ is a function, a student stated that the relation is not a function because 4 appears twice. What error did the student make? How would you explain to the student why this relation is a function?

31. Write About It Describe a real-world situation for a relation that is NOT a function. Create a mapping diagram to show why the relation is not a function.

TEST PREP

32. Which of the following relations is NOT a function?

Ⓐ $\{(6, 2), (-1, 2), (-3, 2), (-5, 2)\}$
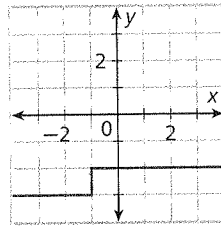
Ⓒ

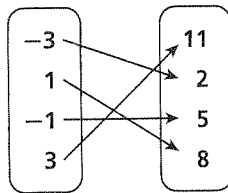| x	3	5	7
y	1	15	30

Ⓑ

Ⓓ
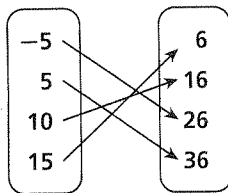
33. Which is NOT a correct way to describe the function $\{(-3, 2), (1, 8), (-1, 5), (3, 11)\}$?
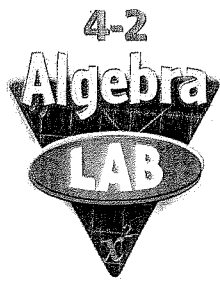
Ⓕ

Ⓗ Domain: $\{-3, 1, -1, 3\}$

Range: $\{2, 8, 5, 11\}$

Ⓖ

Ⓙ

x	y
-3	2
-1	5
1	8
3	11

Algebra LAB
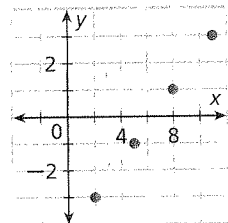
The Vertical-Line Test

The *vertical-line test* can be used to visually determine whether a graphed relation is a function.

Use with Lesson 4-2

Activity

1. Look at the values in Table 1. Is every x-value paired with exactly one y-value? If not, what x-value(s) are paired with more than one y-value?

2. Is the relation a function? Explain.

3. Graph the points from the Table 1. Draw a vertical line through each point of the graph. Does any vertical line touch more than one point?

Table 1	
x	y
−2	−5
−1	−3
0	−1
1	1
2	3
3	5

4. Look at the values in Table 2. Is every x-value paired with exactly one y-value? If not, what x-value(s) are paired with more than one y-value?

5. Is the relation a function? Explain.

6. Graph the points from the Table 2. Draw a vertical line through each point of the graph. Does any vertical line touch more than one point?

7. What is the x-value of the two points that are on the same vertical line? Is that x-value paired with more than one y-value?

8. Write a statement describing how to use a vertical line to tell if a relation is a function. This is called the vertical-line test.

9. Why does the vertical-line test work?

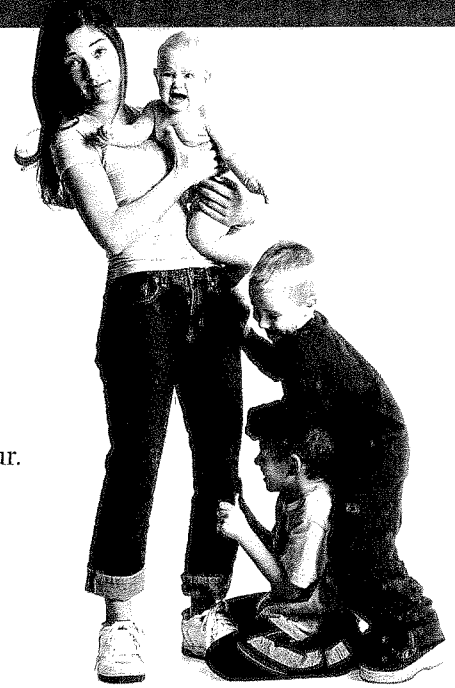| Table 2	
x	y
−2	−3
1	4
0	5
1	2
2	3
3	5

Try This

Use the vertical-line test to determine whether each relation is a function. If a relation is not a function, list two ordered pairs that show the same x-value with two different y-values.

1.

2.

3.
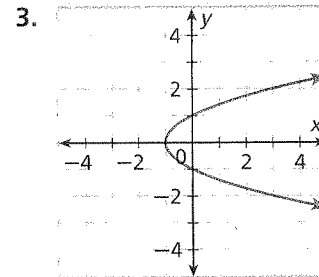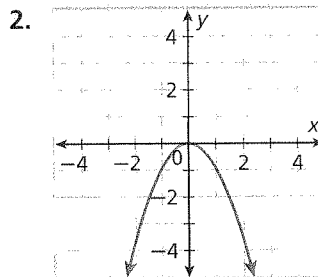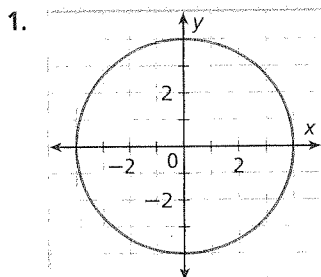
Writing Functions

Identify independent and dependent variables.

Write an equation in function notation and evaluate a function for given input values.

Vocabulary
independent variable
dependent variable
function rule
function notation

Why learn this?

You can use a function rule to calculate how much money you will earn for working specific amounts of time.

Suppose Tasha baby-sits and charges $5 per hour.

Time Worked (h) x	1	2	3	4
Amount Earned ($) y	5	10	15	20

The amount of money Tasha earns is $5 times the number of hours she works. Write an equation using two different variables to show this relationship.

Amount earned is $5 times the number of hours worked.

$$y = 5 \cdot x$$

Tasha can use this equation to find how much money she will earn for any number of hours she works.

EXAMPLE 1 Using a Table to Write an Equation

Determine a relationship between the x- and y-values. Write an equation.

x	1	2	3	4
y	-2	-1	0	1

Step 1 List possible relationships between the first x- and y-values.

$1 - 3 = -2$ or $1(-2) = -2$

Step 2 Determine if one relationship works for the remaining values.

$2 - 3 = -1 \checkmark \qquad 2(-2) \neq -1 \; ✗$

$3 - 3 = 0 \checkmark \qquad 3(-2) \neq 0 \; ✗$

$4 - 3 = 1 \checkmark \qquad 4(-2) \neq 1 \; ✗$

The first relationship works. The value of y is 3 less than x.

Step 3 Write an equation.

$y = x - 3$ *The value of y is 3 less than x.*

CHECK IT OUT! **1.** Determine a relationship between the x- and y-values in the relation $\{(1, 3), (2, 6), (3, 9), (4, 12)\}$. Write an equation.

The equation in Example 1 describes a function because for each x-value (input), there is only one y-value (output).

Identify the independent and dependent variables. Write an equation in function notation for each situation.

B The admission fee to a local carnival is $8. Each ride costs $1.50.

The total cost depends on the number of rides ridden, plus $8.

Dependent: total cost   Independent: number of rides

Let r represent the number of rides ridden.

The function for the total cost of the carnival is $f(r) = 1.50r + 8$.

CHECK IT OUT! Identify the independent and dependent variables. Write an equation in function notation for each situation.

3a. Steven buys lettuce that costs $1.69/lb.

3b. An amusement park charges a $6.00 parking fee plus $29.99 per person.

You can think of a function as an input-output machine. For Tasha's earnings, $f(x) = 5x$, if you input a value x, the output is $5x$.

If Tasha wanted to know how much money she would earn by working 6 hours, she could input 6 for x and find the output. This is called *evaluating the function*.

Input
x 6 2
Function
$f(x) = 5x$
30 5x 10
Output
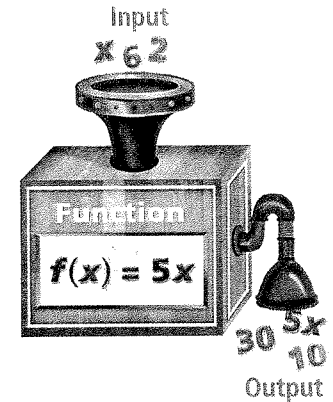
EXAMPLE 4 Evaluating Functions

Evaluate each function for the given input values.

Functions can be named with any letter; f, g, and h are the most common. You read $f(6)$ as "f of 6," and $g(2)$ as "g of 2."

A For $f(x) = 5x$, find $f(x)$ when $x = 6$ and when $x = 7.5$.

$f(x) = 5x$

$f(6) = 5(6)$ *Substitute 6 for x.*

$= 30$ *Simplify.*

$f(x) = 5x$

$f(7.5) = 5(7.5)$ *Substitute 7.5 for x.*

$= 37.5$ *Simplify.*

B For $g(t) = 2.30t + 10$, find $g(t)$ when $t = 2$ and when $t = -5$.

$g(t) = 2.30t + 10$

$g(2) = 2.30(2) + 10$

$= 4.6 + 10$

$= 14.6$

$g(t) = 2.30t + 10$

$g(-5) = 2.30(-5) + 10$

$= -11.5 + 10$

$= -1.5$

C For $h(x) = \frac{1}{2}x - 3$, find $h(x)$ when $x = 12$ and when $x = -8$.

$h(x) = \frac{1}{2}x - 3$

$h(12) = \frac{1}{2}(12) - 3$

$= 6 - 3$

$= 3$

$h(x) = \frac{1}{2}x - 3$

$h(-8) = \frac{1}{2}(-8) - 3$

$= -4 - 3$

$= -7$

CHECK IT OUT! Evaluate each function for the given input values.

4a. For $h(c) = 2c - 1$, find $h(c)$ when $c = 1$ and $c = -3$.

4b. For $g(t) = \frac{1}{4}t + 1$, find $g(t)$ when $t = -24$ and $t = 400$.

4-3

Exercises

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KEYWORD: MA7 Parent

GUIDED PRACTICE

Vocabulary Apply the vocabulary from this lesson to answer each question.

1. The output of a function is the ___?___ variable. (*independent* or *dependent*)

2. An algebraic expression that defines a function is a ___?___. (*function rule* or *function notation*)

SEE EXAMPLE **1**
p. 249

Determine a relationship between the *x*- and *y*-values. Write an equation.

3.

x	1	2	3	4
y	−1	0	1	2

4. $\{(1, 4), (2, 7), (3, 10), (4, 13)\}$

SEE EXAMPLE **2**
p. 250

Identify the independent and dependent variables in each situation.

5. A small-size bottle of water costs $1.99 and a large-size bottle of water costs $3.49.

6. An employee receives 2 vacation days for every month worked.

SEE EXAMPLE **3**
p. 250

Identify the independent and dependent variables. Write an equation in function notation for each situation.

7. An air-conditioning technician charges customers $75 per hour.

8. An ice rink charges $3.50 for skates and $1.25 per hour.

SEE EXAMPLE **4**
p. 251

Evaluate each function for the given input values.

9. For $f(x) = 7x + 2$, find $f(x)$ when $x = 0$ and when $x = 1$.

10. For $g(x) = 4x - 9$, find $g(x)$ when $x = 3$ and when $x = 5$.

11. For $h(t) = \frac{1}{3}t - 10$, find $h(t)$ when $t = 27$ and when $t = -15$.

SEE EXAMPLE **5**
p. 252

12. A construction company uses beams that are 2, 3, or 4 meters long. The measure of each beam must be converted to centimeters. Write a function to describe the situation. Find the reasonable domain and range for the function. (*Hint:* 1 m = 100 cm)

PRACTICE AND PROBLEM SOLVING

Independent Practice

For Exercises	See Example
13–14	1
15–16	2
17–19	3
20–22	4
23	5

Extra Practice

Skills Practice p. S10
Application Practice p. S31

Determine a relationship between the *x*- and *y*-values. Write an equation.

13.

x	1	2	3	4
y	−2	−4	−6	−8

14. $\{(1, -1), (2, -2), (3, -3), (4, -4)\}$

Identify the independent and dependent variables in each situation.

15. Gardeners buy fertilizer according to the size of a lawn.

16. The cost to gift wrap an order is $3 plus $1 per item wrapped.

Identify the independent and dependent variables. Write an equation in function notation for each situation.

17. To rent a DVD, a customer must pay $3.99 plus $0.99 for every day that it is late.

18. Stephen charges $25 for each lawn he mows.

19. A car can travel 28 miles per gallon of gas.

33. Marsha buys x pens at \$0.70 per pen and one pencil for \$0.10. Which function gives the total amount Marsha spends?

  Ⓐ $c(x) = 0.70x + 0.10x$ Ⓒ $c(x) = (0.70 + 0.10)x$

  Ⓑ $c(x) = 0.70x + 1$ Ⓓ $c(x) = 0.70x + 0.10$

34. Belle is buying pizzas for her daughter's birthday party, using the prices in the table. Which equation best describes the relationship between the total cost c and the number of pizzas p?

Pizzas	Total Cost ($)
5	26.25
10	52.50
15	78.75

  Ⓕ $c = 26.25p$ Ⓗ $c = p + 26.25$

  Ⓖ $c = 5.25p$ Ⓙ $c = 6p - 3.75$

35. Gridded Response What is the value of $f(x) = 5 - \frac{1}{2}x$ when $x = 3$?

CHALLENGE AND EXTEND

36. The formula to convert a temperature that is in degrees Celsius x to degrees Fahrenheit $f(x)$ is $f(x) = \frac{9}{5}x + 32$. What are reasonable values for the domain and range when you convert to Fahrenheit the temperature of water as it rises from 0° to 100° Celsius?

37. Math History In his studies of the motion of free-falling objects, Galileo Galilei found that regardless of its mass, an object will fall a distance d that is related to the square of its travel time t in seconds. The modern formula that describes free-fall motion is $d = \frac{1}{2}gt^2$, where g is the acceleration due to gravity and t is the length of time in seconds the object falls. Find the distance an object falls in 3 seconds. (*Hint:* Research to find acceleration due to gravity in meters per second squared.)
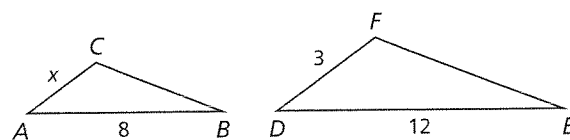
SPIRAL REVIEW

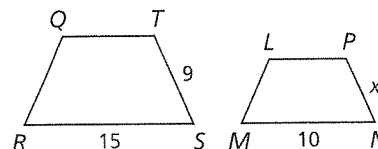Solve each equation. Check your answer. *(Lesson 2-3)*

38. $5x + 2 - 7x = -10$ **39.** $3(2 - y) = 15$ **40.** $\frac{2}{3}p - \frac{1}{2} = \frac{1}{6}$

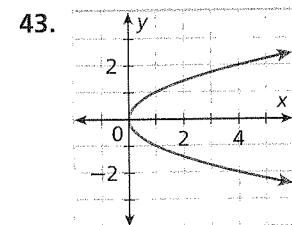Find the value of x in each diagram. *(Lesson 2-8)*

41. $\triangle ABC \sim \triangle DEF$ **42.** $QRST \sim LMNP$

Give the domain and range of each relation. Tell whether the relation is a function. Explain. *(Lesson 4-2)*

43.

44.

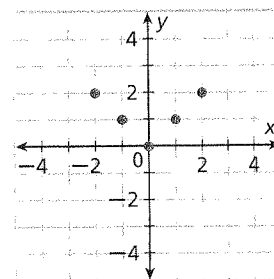| x	y
−3	4
−1	2
0	0
1	2
3	−4

Graph each function for the given domain.

B $f(x) = |x|$; D: $\{-2, -1, 0, 1, 2\}$

Step 1 Use the given values of the domain to find values of $f(x)$.

x	$f(x) = |x|$	$(x, f(x))$
-2	$f(x) = |-2| = 2$	$(-2, 2)$
-1	$f(x) = |-1| = 1$	$(-1, 1)$
0	$f(x) = |0| = 0$	$(0, 0)$
1	$f(x) = |1| = 1$	$(1, 1)$
2	$f(x) = |2| = 2$	$(2, 2)$

Step 2 Graph the ordered pairs.

✓ CHECK IT OUT! Graph each function for the given domain.

1a. $-2x + y = 3$; D: $\{-5, -3, 1, 4\}$

1b. $f(x) = x^2 + 2$; D: $\{-3, -1, 0, 1, 3\}$

If the domain of a function is all real numbers, any number can be used as an input value. This process will produce an infinite number of ordered pairs that satisfy the function. Therefore, arrowheads are drawn at both "ends" of a smooth line or curve to represent the infinite number of ordered pairs. If a domain is not given, assume that the domain is all real numbers.

Know it! Note

| Graphing Functions Using a Domain of All Real Numbers	
Step 1	Use the function to generate ordered pairs by choosing several values for x.
Step 2	Plot enough points to see a pattern for the graph.
Step 3	Connect the points with a line or smooth curve.

EXAMPLE 2 Graphing Functions

Graph each function.

A $2x + 1 = y$

Step 1 Choose several values of x and generate ordered pairs.

x	$2x + 1 = y$	(x, y)
-3	$2(-3) + 1 = -5$	$(-3, -5)$
-2	$2(-2) + 1 = -3$	$(-2, -3)$
-1	$2(-1) + 1 = -1$	$(-1, -1)$
0	$2(0) + 1 = 1$	$(0, 1)$
1	$2(1) + 1 = 3$	$(1, 3)$
2	$2(2) + 1 = 5$	$(2, 5)$
3	$2(3) + 1 = 7$	$(3, 7)$
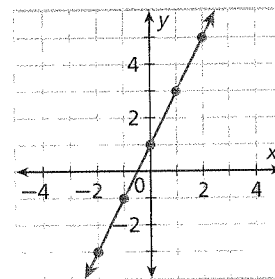
Step 2 Plot enough points to see a pattern.

Step 3 The ordered pairs appear to form a line. Draw a line through all the points to show all the ordered pairs that satisfy the function. Draw arrowheads on both "ends" of the line.

Recall that in real-world situations you may have to limit the domain to make answers reasonable. For example, quantities such as time, distance, and number of people can be represented using only nonnegative values. When both the domain and the range are limited to nonnegative values, the function is graphed only in Quadrant I.

EXAMPLE 4 Problem-Solving Application

The function $y = 2.5x$ describes how many millimeters sea level y rises in x years. Graph the function. Use the graph to estimate how many millimeters sea level will rise in 3.5 years.

1 Understand the Problem

The **answer** is a graph that can be used to find the value of y when x is 3.5.

List the important information:
• The function $y = 2.5x$ describes how many millimeters sea level rises.

2 Make a Plan

Think: What values should I use to graph this function? Both, the number of years sea level has risen and the distance sea level rises, cannot be negative. Use only nonnegative values for both the domain and the range. The function will be graphed in Quadrant I.

3 Solve

Choose several nonnegative values of x to find values of y.
Then graph the ordered pairs.

x	$y = 2.5x$	(x, y)
0	$y = 2.5(0) = 0$	$(0, 0)$
1	$y = 2.5(1) = 2.5$	$(1, 2.5)$
2	$y = 2.5(2) = 5$	$(2, 5)$
3	$y = 2.5(3) = 7.5$	$(3, 7.5)$
4	$y = 2.5(4) = 10$	$(4, 10)$

Draw a line through the points to show all the ordered pairs that satisfy this function.
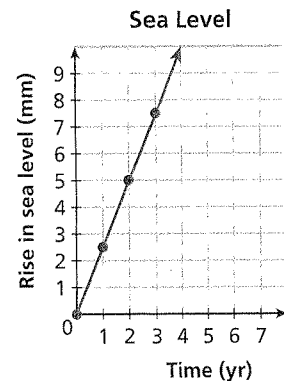
Sea Level

Use the graph to estimate the y-value when x is 3.5.
Sea level will rise about 8.75 millimeters in 3.5 years.

4 Look Back

As the number of years increases, sea level also increases, so the graph is reasonable. When x is between 3 and 4, y is between 7.5 and 10. Since 3.5 is between 3 and 4, it is reasonable to estimate y to be 8.75 when x is 3.5.

CHECK IT OUT!

4. The fastest recorded Hawaiian lava flow moved at an average speed of 6 miles per hour. The function $y = 6x$ describes the distance y the lava moved on average in x hours. Graph the function. Use the graph to estimate how many miles the lava moved after 5.5 hours.

27. **Transportation** An electric motor scooter can travel at 0.25 miles per minute. The function $y = 0.25x$ describes the number of miles y the scooter can travel in x minutes. Graph the function. Use the graph to estimate the number of miles an electric motor scooter travels in 15 minutes.

Graph each function.

28. $f(x) = x - 1$

29. $12 - x - 2y = 0$

30. $3x - y = 13$

31. $y = x^2 - 2$

32. $x^2 - y = -4$

33. $2x^2 = f(x)$

34. $f(x) = |2x| - 2$

35. $y = |-x|$

36. $-|2x + 1| = y$

37. Find the value of x so that $(x, 12)$ satisfies $y = 4x + 8$.

38. Find the value of x so that $(x, 6)$ satisfies $y = -x - 4$.

39. Find the value of y so that $(-2, y)$ satisfies $y = -2x^2$.

For each function, determine whether the given points are on the graph.

40. $y = 7x - 2$; $(1, 5)$ and $(2, 10)$

41. $y = |x| + 2$; $(3, 5)$ and $(-1, 3)$

42. $y = x^2$; $(1, 1)$ and $(-3, -9)$

43. $y = \frac{1}{4}x - 2$; $\left(1, -\frac{3}{4}\right)$ and $(4, -1)$

44. /// **ERROR ANALYSIS** /// Student A says that $(3, 2)$ is on the graph of $y = 4x - 5$, but student B says that it is not. Who is incorrect? Explain the error.

Ⓐ

$y = 4x - 5$	
3	$4(2) - 5$
3	$8 - 5$
3	3 ✓

Ⓑ

$y = 4x - 5$	
2	$4(3) - 5$
2	$12 - 5$
2	7 ✗

Determine whether $(0, -7)$, $\left(-6, -\frac{5}{3}\right)$, and $(-2, -3)$ lie on the graph of each function.

45. $x + 3y = -11$

46. $y + |x| = -1$

47. $x^2 - y = 7$

For each function, find three ordered pairs that lie on the graph of the function.

48. $-6 = 3x + 2y$

49. $y = 1.1x + 2$

50. $y = \frac{4}{5}x$

51. $y = 3x - 1$

52. $y = |x| + 6$

53. $y = x^2 - 5$

54. **Critical Thinking** Graph the functions $y = |x|$ and $y = -|x|$. Describe how they are alike. How are they different?
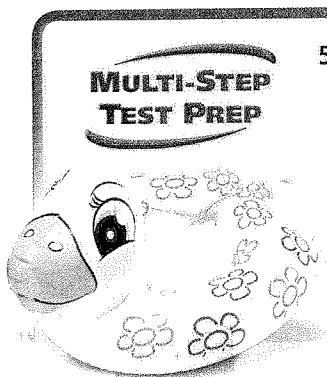
55. This problem will prepare you for the Multi-Step Test Prep on page 264.

A pool containing 10,000 gallons of water is being drained. Every hour, the volume of the water in the pool decreases by 1500 gallons.

a. Write an equation to describe the volume v of water in the pool after h hours.

b. How much water is in the pool after 1 hour?

c. Create a table of values showing the volume of the water in gallons in the pool as a function of the time in hours and graph the function.

Technology LAB
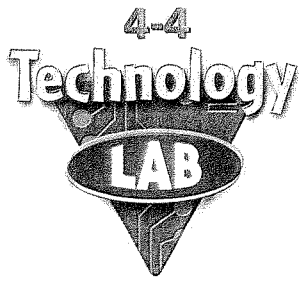
Connect Function Rules, Tables, and Graphs

You can use a graphing calculator to understand the connections among function rules, tables, and graphs.

Use with Lesson 4-4

Activity

Make a table of values for the function $f(x) = 4x + 3$.
Then graph the function.

1. Press ▣Y=▣ and enter the function rule **4x + 3**.

2. Press ▣2nd▣ ▣WINDOW▣ (TBLSET). Make sure **Indpnt: Auto** and **Depend: Auto** are selected.

```
TABLE SETUP
  TblStart=1
  △Tbl=1
Indpnt: Auto Ask
Depend: Auto Ask
```

3. To view the table, press ▣2nd▣ ▣GRAPH▣ (TABLE). The x-values and the corresponding y-values appear in table form. Use the up and down arrow keys to scroll through the table.

```
  X    | Y1
  1    | 7
  2    | 11
  3    | 15
  4    | 19
  5    | 23
  6    | 27
  7    | 31
X=3
```

4. To view the table with the graph, press ▣MODE▣ and select **G-T** view. Press ▣ENTER▣. Be sure to use the standard window.

```
Normal Sci Eng
Float 0123456789
Radian Degree
Func Par Pol Seq
Connected Dot
Sequential Simul
Real a+bi re^θi
Full Horiz G-T
```

5. Press ▣TRACE▣ to see both the graph and a table of values.

6. Press the left arrow key several times to move the cursor. Notice that the point on the graph and the values in the table correspond.

```
Y1=4X+3
         X     | Y1
         0     | 3
         .4348 | 4.739
         .8696 | 6.478
         1.304 | 8.217
         1.739 | 9.957
         2.174 | 11.7
X=0      2.609 | 13.43
Y=3
```

Try This

Make a table of values for each function. Then graph the function.

1. $f(x) = 2x - 1$ 2. $f(x) = 1.5x$ 3. $f(x) = \frac{1}{2}x + 2$

4. Explain the relationship between a function, its table of values, and the graph of the function.
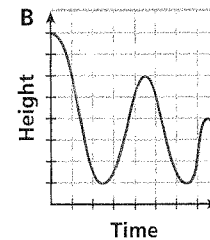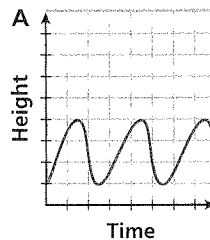
READY TO GO ON?

Quiz for Lessons 4-1 Through 4-4

4-1 Graphing Relationships

Choose the graph that best represents each situation.

1. A person bungee jumps from a high platform.

2. A person jumps on a trampoline in a steady motion.

3. Xander takes a quiz worth 100 points. Each question is worth 20 points. Sketch a graph to show his score if he misses 1, 2, 3, 4, or 5 questions.

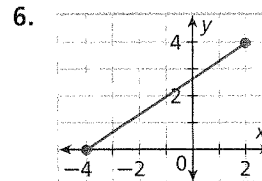### 4-2 Relations and Functions

Give the domain and range of each relation. Tell whether the relation is a function. Explain.

4.

5.

x	−2	−2	0	2	2
y	3	3	3	3	3

6.
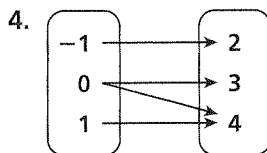
4-3 Writing Functions

Determine a relationship between the x- and y-values. Write an equation.

7.

x	1	2	3	4
y	−6	−5	−4	−3

8.

x	1	2	3	4
y	−3	−6	−9	−12

9. A printer can print 8 pages per minute. Identify the dependent and independent variables for the situation. Write an equation in function notation.

Evaluate each function for the given input values.

10. For $f(x) = 3x − 1$, find $f(x)$ when $x = 2$.   11. For $g(x) = x^2 + x$, find $g(x)$ when $x = −2$.

12. A photographer charges a sitting fee of $15 plus $3 for each pose. Write a function to describe the situation. Find a reasonable domain and range for up to 5 poses.

4-4 Graphing Functions

Graph each function for the given domain.

13. $2x + y = 3$; D: $\{−2, 0, 1, 3\}$ 14. $y = 4 + x^2$; D: $\{−1, 0, 1, 2\}$ 15. $y = 3 − 2x$; D: $\{−1, 0, 1, 3\}$

Graph each function.

16. $x + y = 6$ 17. $y = |x| − 3$ 18. $y = x^2 + 1$

19. The function $y = 8x$ represents how many miles y a certain storm travels in x hours. Graph the function and estimate the number of miles the storm travels in 10.5 h.

Identify the correlation you would expect to see between each pair of data sets. Explain.

C the monthly rainfall and the depth of water in a reservoir
You would expect to see a positive correlation. As more rain falls, there is more water in the reservoir.

CHECK IT OUT! Identify the correlation you would expect to see between each pair of data sets. Explain.

3a. the temperature in Houston and the number of cars sold in Boston

3b. the number of members in a family and the size of the family's grocery bill

3c. the number of times you sharpen your pencil and the length of your pencil

EXAMPLE **4** **Matching Scatter Plots to Situations**

Choose the scatter plot that best represents the relationship between the number of days since a sunflower seed was planted and the height of the plant. Explain.
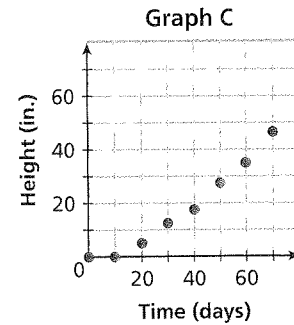
Graph A	Graph B	Graph C
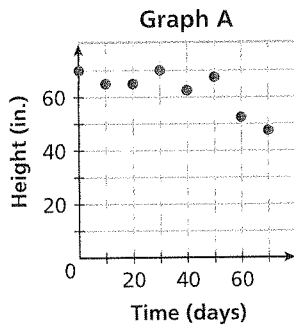
There will be a positive correlation between the number of days and the height because the plant will grow each day.

Graph A has a negative correlation, so it is incorrect.
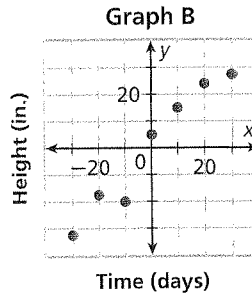
Neither the number of days nor the plant heights can be negative.

Graph B shows negative values, so it is incorrect.

This graph shows all positive coordinates and a positive correlation, so it could represent the data sets.

Graph C is the correct scatter plot.

CHECK IT OUT! **4.** Choose the scatter plot that best represents the relationship between the number of minutes since a pie has been taken out of the oven and the temperature of the oven. Explain.

Graph A	Graph B	Graph C
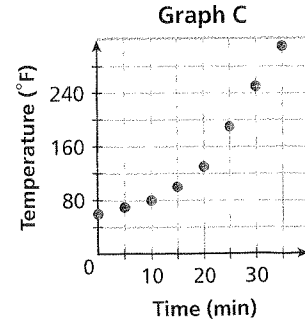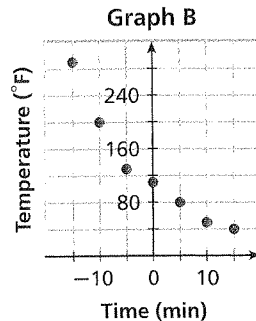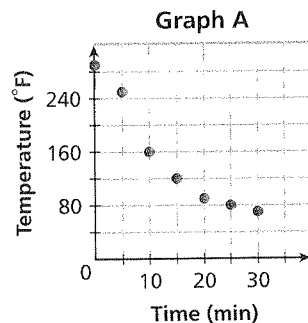
You can graph a line on a scatter plot to help show a relationship in the data. This line, called a **trend line,** helps show the correlation between data sets more clearly. It can also be helpful when making predictions based on the data.

EXAMPLE **5**

Fund-raising Application

The scatter plot shows a relationship between the total amount of money collected and the total number of rolls of wrapping paper sold as a school fund-raiser. Based on this relationship, predict how much money will be collected when 175 rolls have been sold.

Fund-raiser

Draw a trend line and use it to make a prediction.
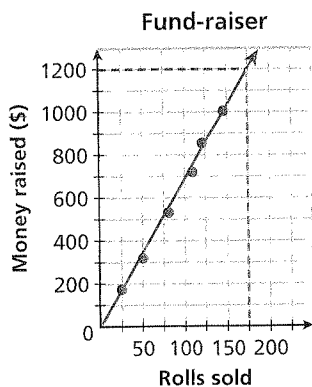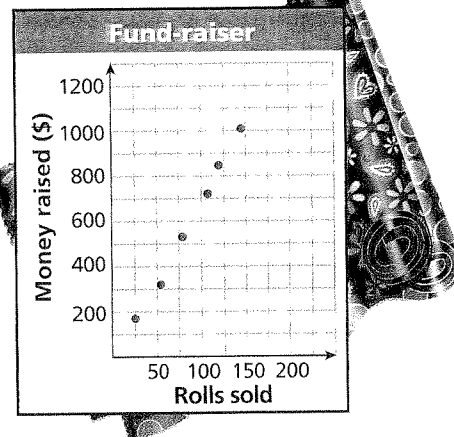
Fund-raiser

Draw a line that has about the same number of points above and below it. Your line may or may not go through data points.

Find the point on the line whose x-value is 175. The corresponding y-value is 1200.

Based on the data, $1200 is a reasonable prediction of how much money will be collected when 175 rolls have been sold.

CHECK IT OUT!

5. Based on the trend line above, predict how many wrapping paper rolls need to be sold to raise $500.

THINK AND DISCUSS

1. Is it possible to make a prediction based on a scatter plot with no correlation? Explain your answer.

2. GET ORGANIZED Copy and complete the graphic organizer with either a scatter plot, a real-world example, or both.

Know It Note

	Graph	Example
Positive Correlation		
Negative Correlation		The amount of water in a watering can and the number of flowers watered
No Correlation		

13. Transportation The scatter plot shows the total number of miles passengers flew on U.S. domestic flights in the month of April for the years 1997–2004. Based on this relationship, predict how many miles passengers flew in April 2008.
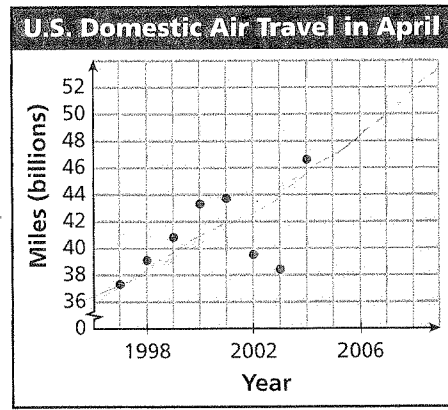
U.S. Domestic Air Travel in April

PRACTICE AND PROBLEM SOLVING

14. Graph a scatter plot using the given data.

Train Arrival Time	6:45 A.M.	7:30 A.M.	8:15 A.M.	9:45 A.M.	10:30 A.M.
Passengers	160	148	194	152	64

Describe the correlation illustrated by each scatter plot.

**15.** Nascar
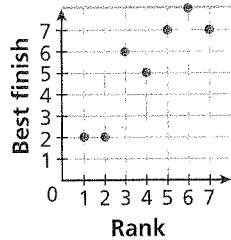
16. Concert Ticket Costs
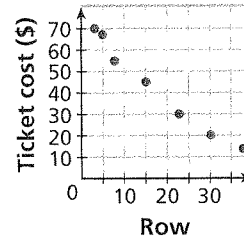
Identify the correlation you would expect to see between each pair of data sets. Explain.

17. the speed of a runner and the distance she can cover in 10 minutes

18. the year a car was made and the total mileage

Choose the scatter plot that best represents the described relationship. Explain.

19. the number of college classes taken and the number of roommates

20. the number of college classes taken and the hours of free time.

Graph A   Graph B
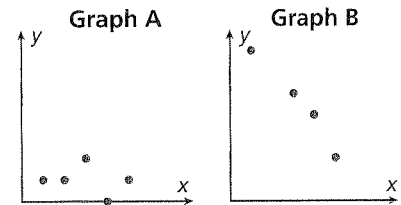
21. Ecology The scatter plot shows a projection of the average ocelot population living in Laguna Atascosa National Wildlife Refuge near Brownsville, Texas. Based on this relationship, predict the number of ocelots living at the wildlife refuge in 2014 if nothing is done to help manage the ocelot population.
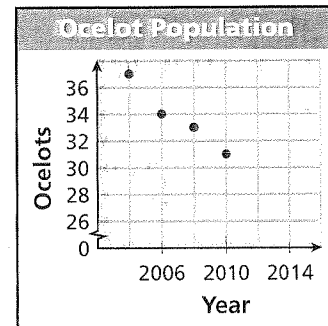
Ocelot Population

Ecology

The ocelot population in Texas is dwindling due in part to their habitat being destroyed. The ocelot population at Laguna Atascosa National Wildlife Refuge is monitored by following 5–10 ocelots yearly by radio telemetry.

28. Write About It Conduct a survey of your classmates to find the number of siblings they have and the number of pets they have. Predict whether there will be a positive, negative, or no correlation. Then graph the data in a scatter plot. What is the relationship between the two data sets? Was your prediction correct?

29. Which graph is the best example of a negative correlation?

Ⓐ   Ⓑ   Ⓒ   Ⓓ
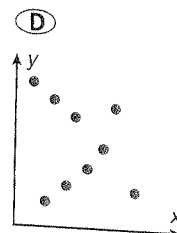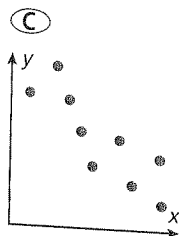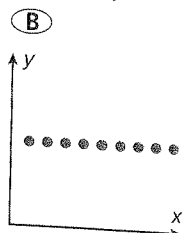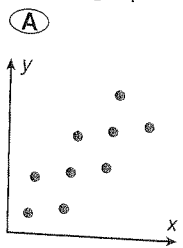
30. Which situation best describes a positive correlation?
Ⓕ The amount of rainfall on Fridays
Ⓖ The height of a candle and the amount of time it stays lit
Ⓗ The price of a pizza and the number of toppings added
Ⓙ The temperature of a cup of hot chocolate and the length of time it sits

31. Short Response Write a real-world situation for the graph. Explain your answer.
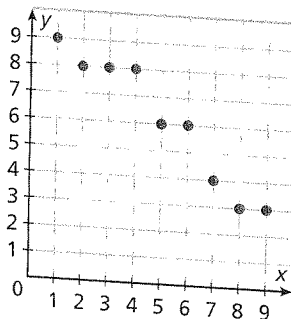
CHALLENGE AND EXTEND

32. Describe a situation that involves a positive correlation. Gather data on the situation. Make a scatter plot showing the correlation. Use the scatter plot to make a prediction. Repeat for a negative correlation and for no correlation.

33. Research an endangered or threatened species in your state. Gather information on its population for several years. Make a scatter plot using the data you gather. Is there a positive or negative correlation? Explain. Draw a trend line and make a prediction about the species population over the next 5 years.

SPIRAL REVIEW

Write an equation to represent each relationship. Then solve the equation. *(Lesson 2-4)*

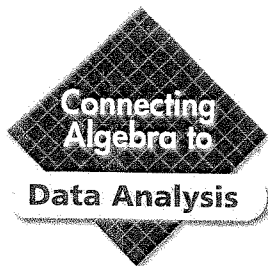**34.** Five times a number increased by 2 is equal to twice the number decreased by 4.

35. Five times the sum of a number and 2 is equal to 8 less than twice the number.

Solve each inequality. *(Lesson 3-5)*

36. $4(6 + x) \geq -2x$

37. $3(x - 1) > 3x$

38. $2(3 - x) < 2(1 + x)$

Graph each function. *(Lesson 4-4)*

39. $y = 2x - 3$

40. $y = -|x| + 3$

41. $y = x^2 - 4$

Median-Fit Line

You have learned about trend lines. Now you will learn about
another line of fit called the *median-fit line*.

Example

At a water raft rental shop, a group of up to four people can rent a single raft.
The table shows the number of rafts rented to different groups of people one
morning. Graph the median-fit line for the data.

People x	1	2	4	5	5	5	7	9	10	11	12	15
Rafts Rented y	1	1	1	3	4	5	4	7	5	3	4	6

① Plot the points on a coordinate plane.

② Divide the data into three sections of equal size. Find the
medians of the x-values and the y-values for each section.
Plot the three median points with an X.

1	2	4	5	5	5	7	9	10	11	12	15
1	1	1	3	4	5	4	7	5	3	4	6

Median point: Median point: Median point:
   (3, 1)   (6, 4.5)   (11.5, 4.5)

③ Connect the outside, or first and third, median
points with a line.

④ Lightly draw a dashed line straight down from the
middle median point to the line just drawn. Mark
the dashed line to create three equal segments.

⑤ Keeping your ruler parallel to the first line you
drew, move your ruler to the mark closest to the
line. Draw the line. This is the median-fit line.

Canoe Rentals

Canoe Rentals

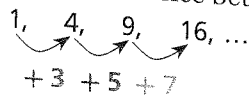**Canoe Rentals**
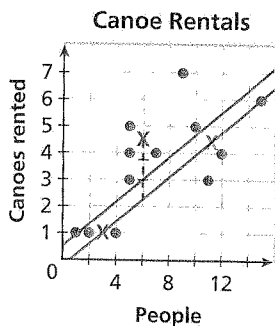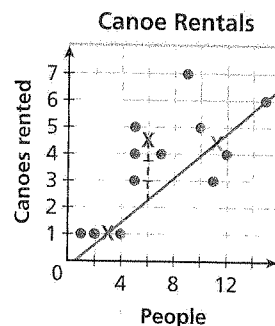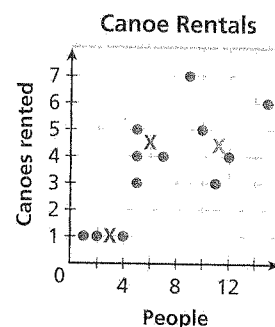
Try This

1. A manager at a restaurant kept track one afternoon
of the number of people in a party and the time
it took to seat them. Graph the median-fit line for
the data.

2. Use your median-fit line to predict the time it
would take to seat a party of 6.

People x	3	7	8	8	10	12
Wait Time y (min)	1	5	3	9	6	6

B 1, 4, 9, 16, ...

Find the difference between successive terms.

1,　4,　9,　16, ...

+3 +5 +7

The difference between successive terms is not the same.

This sequence is not an arithmetic sequence.

CHECK IT OUT! Determine whether each sequence appears to be an arithmetic sequence. If so, find the common difference and the next three terms.

1a. $-\dfrac{3}{4}, -\dfrac{1}{4}, \dfrac{1}{4}, \dfrac{3}{4}, \ldots$

1b. $-4, -2, 1, 5, \ldots$

To find the nth term of an arithmetic sequence when n is a large number, you need an equation or rule. Look for a pattern to find a rule for the sequence below.

$$
\begin{array}{ccccc}
1 & 2 & 3 & 4\ldots & n \leftarrow \text{Position} \\
\downarrow & \downarrow & \downarrow & \downarrow & \\
3, & 5, & 7, & 9\ldots & \leftarrow \text{Term} \\
a_1 & a_2 & a_3 & a_4 & a_n
\end{array}
$$

The sequence starts with 3. The common difference d is 2. You can use the first term and the common difference to write a rule for finding a_n.

Words	Numbers	Algebra
1st term	3	a_1
2nd term = 1st term plus common difference	$3 + (1)2 = 5$	$a_1 + 1d$
3nd term = 1st term plus 2 common differences	$3 + (2)2 = 7$	$a_1 + 2d$
4th term = 1st term plus 3 common differences	$3 + (3)2 = 9$	$a_1 + 3d$
$\vdots$	$\vdots$	$\vdots$
nth term = 1st term plus $(n-1)$ common differences	$3 + (n-1)2$	$a_1 + (n-1)d$

The pattern in the table shows that to find the nth term, add the first term to the product of $(n-1)$ and the common difference.

Know it!
Note

Finding the nth Term of an Arithmetic Sequence

The nth term of an arithmetic sequence with common difference d and first term a_1 is
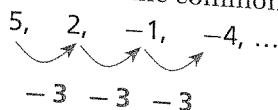
$$a_n = a_1 + (n-1)d.$$

EXAMPLE 2 Finding the nth Term of an Arithmetic Sequence

Find the indicated term of each arithmetic sequence.

A 22nd term: 5, 2, −1, −4, ...

Step 1 Find the common difference.

5,　2,　−1,　−4, ...

−3 −3 −3

The common difference is −3.

GUIDED PRACTICE

1. **Vocabulary** When trying to find the nth term of an arithmetic sequence you must first know the _____?_____. (*common difference* or *sequence*)

SEE EXAMPLE **1**
p. 276

Multi-Step Determine whether each sequence appears to be an arithmetic sequence. If so, find the common difference and the next three terms.

2. 2, 8, 14, 20, …

3. 2.1, 1.4, 0.7, 0, …

4. 1, 1, 2, 3, …

5. 0.1, 0.3, 0.9, 2.7, …

SEE EXAMPLE **2**
p. 277

Find the indicated term of each arithmetic sequence.

6. 21st term: 3, 8, 13, 18, …

7. 18th term: $a_1 = -2; d = -3$

SEE EXAMPLE **3**
p. 278

8. **Shipping** To package and ship an item, it costs $5.75 for the first pound and $0.75 for each additional pound. What is the cost of shipping a 12-pound package?

PRACTICE AND PROBLEM SOLVING

Independent Practice

For Exercises	See Example
9–12	1
13–14	2
15	3

Extra Practice

Skills Practice p. S12
Application Practice p. S31

Multi-Step Determine whether each sequence appears to be an arithmetic sequence. If so, find the common difference and the next three terms.

9. −1, 10, −100, 1,100, …

10. 0, −2, −4, −6, …

11. −22, −31, −40, −49, …

12. 0.2, 0.5, 0.9, 1.1, …

Find the indicated term of each arithmetic sequence.

13. 31st term: 1.40, 1.55, 1.70, …

14. 50th term: $a_1 = 2.2$; $d = 1.1$

15. **Travel** Rachel signed up for a frequent-flier program. She receives 4300 frequent-flier miles for her first round trip and 1300 frequent-flier miles for each additional round-trip. How many frequent-flier miles will she have after 5 round-trips?

Find the common difference for each arithmetic sequence.

16. 0, 6, 12, 18, …

17. $\frac{1}{2}, \frac{3}{4}, 1, \frac{5}{4}, …$

18. 107, 105, 103, 101, …

19. 7.9, 5.7, 3.5, 1.3, …

20. $\frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}, …$

21. 4.25, 4.32, 4.39, 4.46, …

Find the next four terms in each arithmetic sequence.

22. −4, −7, −10, −13, …

23. $\frac{1}{8}, 0, -\frac{1}{8}, -\frac{1}{4}, …$

24. 505, 512, 519, 526, …

25. 1.8, 1.3, 0.8, 0.3, …

26. $\frac{2}{3}, \frac{4}{3}, 2, \frac{8}{3}, …$

27. −1.1, −0.9, −0.7, −0.5

Find the given term of each arithmetic sequence.

28. 5, 10, 15, 20, …; 17th term

29. 121, 110, 99, 88, …; 10th term

30. −2, −5, −8, −11, …; 41st term

31. −30, −22, −14, −6, …; 20th term

32. **Critical Thinking** Is the sequence $5a - 1, 3a - 1, a - 1, -a - 1, …$ arithmetic? If not, explain why not. If so, find the common difference and the next three terms.

42. What are the next three terms in the arithmetic sequence $-21, -12, -3, 6, \dots$?

   Ⓐ 9, 12, 15   Ⓑ 15, 24, 33   Ⓒ 12, 21, 27   Ⓓ 13, 20, 27

43. What is the common difference for the data listed in the second column?

   Ⓕ −1.8   Ⓗ 2.8

   Ⓖ 1.8   Ⓙ −3.6

Altitude (ft)	Boiling Point of Water (°F)
1000	210.2
2000	208.4
3000	206.6

44. Which of the following sequences is NOT arithmetic?

   Ⓐ −4, 2, 8, 14, …   Ⓑ 9, 4, −1, −6, …   Ⓒ 2, 4, 8, 16, …   Ⓓ $\frac{1}{3}, 1\frac{1}{3}, 2\frac{1}{3}, 3\frac{1}{3}, \dots$

CHALLENGE AND EXTEND

45. The first term of an arithmetic sequence is 2, and the common difference is 9. Find two consecutive terms of the sequence that have a sum of 355. What positions in the sequence are the terms?

46. The 60th term of an arithmetic sequence is 106.5, and the common difference is 1.5. What is the first term of the sequence?

47. Athletics Verona is training for a marathon. The first part of her training schedule is shown below.

Session	1	2	3	4	5	6
Distance Run (mi)	3.5	5	6.5	8	9.5	11

   a. If Verona continues this pattern, during which training session will she run 26 miles? Is her training schedule an arithmetic sequence? Explain.

   b. If Verona's training schedule starts on a Monday and she runs every third day, on which day will she run 26 miles?

SPIRAL REVIEW

48. Three sides of a triangle are represented by x, $x + 3$ and $x + 5$. The perimeter of the triangle is 35 units. Solve for x. (*Lesson 2-3*)

49. The length of a rectangle is 2 and the width is represented by $x + 4$. The area of the rectangle is 40 square units. Find the width of the rectangle. (*Lesson 2-3*)

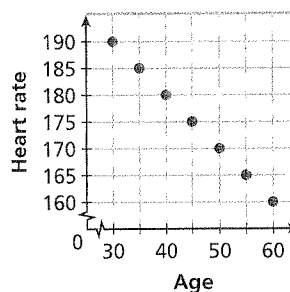**Solve each compound inequality and graph the solutions.** (*Lesson 3-6*)

50. $4 < 2n + 6 \le 20$

51. $t + 5 > 7$ OR $2t - 8 < -12$

Describe the correlation illustrated by each scatter plot. (*Lesson 4-5*)

52. Household Televisions

53. Safe Heart Rate

READY TO GO ON?
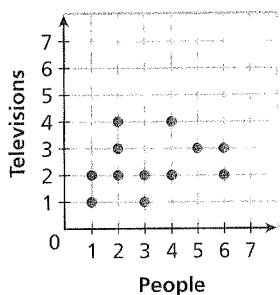
Quiz for Lessons 4-5 Through 4-6

4-5 Scatter Plots and Trend Lines

The table shows the time it takes different people to read a given number of pages.

| Pages Read	2	6	6	8	8	10	10
Time (min)	10	15	20	15	30	25	30

1. Graph a scatter plot using the given data.

2. Describe the correlation illustrated by the scatter plot.

Choose the scatter plot that best represents the described relationship. Explain.

3. number of movie tickets sold and number of available seats

4. number of movie tickets sold and amount of concession sales

5. number of movie tickets sold and length of movie

Graph A

Graph B

Graph C
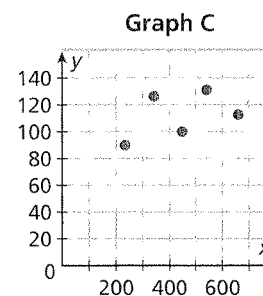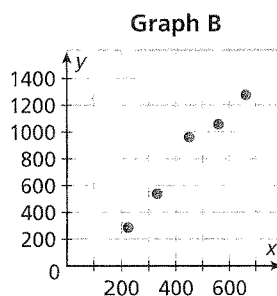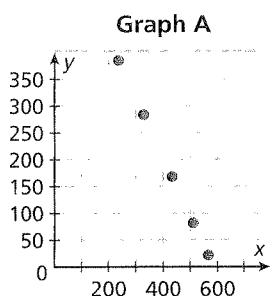
6. The scatter plot shows the estimated annual sales for an electronics and appliance chain of stores for the years 2004–2009. Based on this relationship, predict the annual sales in 2012.

Estimated Annual Sales
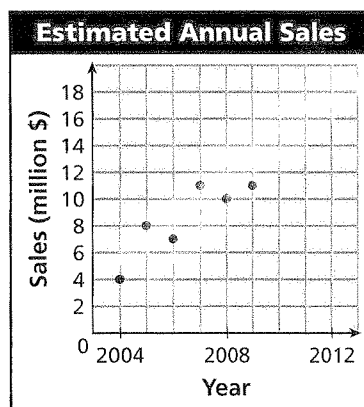
4-6 Arithmetic Sequences

Determine whether each sequence appears to be an arithmetic sequence. If so, find the common difference and the next three terms.

7. $7, 3, -1, -5, \dots$

8. $3, 6, 12, 24, \dots$

9. $-3.5, -2, -0.5, 1, \dots$

Find the indicated term of the arithmetic sequence.

10. 31st term: $12, 7, 2, -3, \dots$

11. 22nd term: $a_1 = 6; d = 4$

12. With no air resistance, an object would fall 16 feet during the first second, 48 feet during the second second, 80 feet during the third second, 112 feet during the fourth second, and so on. How many feet will the object fall during the ninth second?
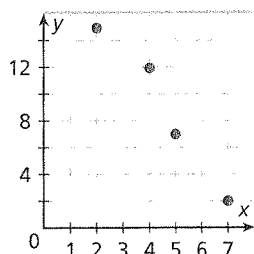
4-2 Relations and Functions (pp. 240–246)

EXAMPLES

- Express the relation $\{(2, 15), (4, 12), (5, 7), (7, 2)\}$ as a table, as a graph, and as a mapping diagram.
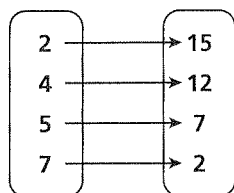
Table

x	y
2	15
4	12
5	7
7	2

Graph

Mapping Diagram

Give the domain and range of each relation. Tell whether the relation is a function. Explain.

x	y
−3	0
−2	0
−1	1

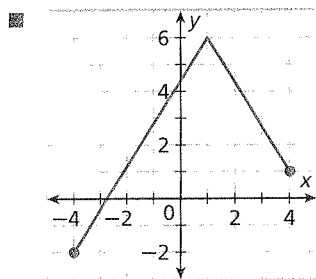D: $\{-3, -2, -1\}$

R: $\{0, 1\}$

The relation is a function because each domain value is paired with exactly one range value.
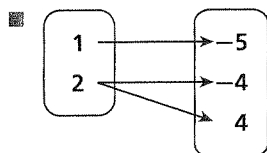
D: $\{1, 2\}$

R: $\{-5, -4, 4\}$

The relation is not a function because one domain value is paired with two range values.

D: $-4 \leq x \leq 4$

R: $-2 \leq y \leq 6$

The relation is a function because every x-value is paired with exactly one y-value.

EXERCISES

Express each relation as a table, as a graph, and as a mapping diagram.

9. $\{(-1, 0), (0, 1), (2, 1)\}$

10. $\{(-2, -1), (-1, 1), (2, 3), (3, 4)\}$
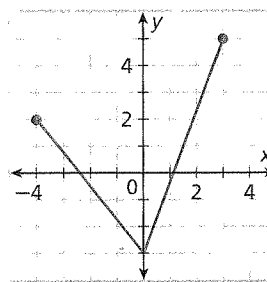
Give the domain and range of each relation.

11. $\{(-4, 5), (-2, 3), (0, 1), (2, -1)\}$

12. $\{(-2, -1) (-1, 0), (0, -1), (1, 0), (2, -1)\}$

13.

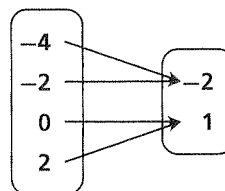| x	0	1	4	1	4
y	0	−1	−2	1	2

14.

Give the domain and range of each relation. Tell whether the relation is a function. Explain.

15. $\{(-5, -3), (-3, -2), (-1, -1), (1, 0)\}$

16.

17.

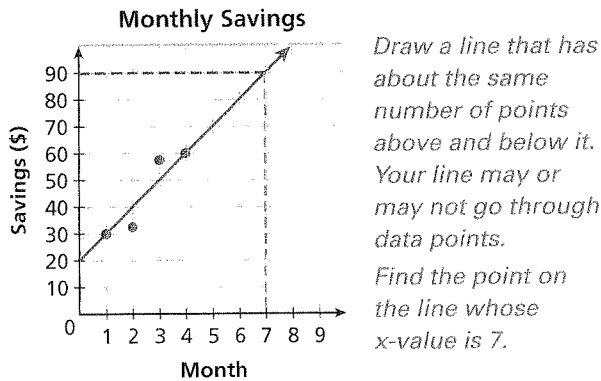| x	1	2	3	4	1
y	3	2	1	0	−1

18. A local parking garage charges $5.00 for the first hour plus $1.50 for each additional hour or part of an hour. Write a relation as a set of ordered pairs in which the x-value represents the number of hours and the y-value represents the cost for x hours. Use a domain of 1, 2, 3, 4, 5. Is this relation a function? Explain.

19. A baseball coach is taking the team for ice cream. Four students can ride in each car. Create a mapping diagram to show the number of cars needed to transport 8, 10, 14, and 16 students. Is this relation a function? Explain.

4-5 Scatter Plots and Trend Lines (pp. 266–273)

EXAMPLE

■ The graph shows the amount of money in a savings account. Based on this relationship, predict how much money will be in the account in month 7.

Monthly Savings

Draw a line that has about the same number of points above and below it. Your line may or may not go through data points.

Find the point on the line whose x-value is 7.

Based on the data, $90 is a reasonable prediction.

EXERCISES

34. The table shows the value of a car for the given years. Graph a scatter plot using the given data. Describe the correlation illustrated by the scatter plot.

Year	2000	2001	2002	2003
Value (thousand $)	28	25	23	20

35. The graph shows the results of a 2003–2004 survey on class size at the given grade levels. Based on this relationship, predict the class size for the 9th grade.

Class Size
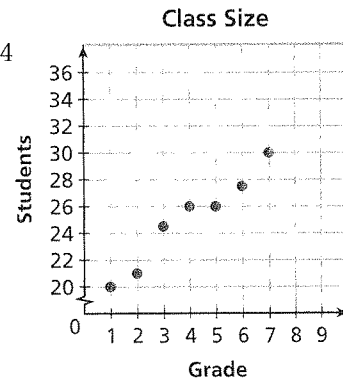
4-6 Arithmetic Sequences (pp. 276–281)

EXAMPLES

■ Determine whether the sequence appears to be arithmetic. If so, find the common difference and the next three terms.

$-8, -5, -2, 1,\ldots$

Step 1 Find the difference between successive terms.

$-8, -5, -2, 1,\ldots$ *The common difference is 3.*
$+3 +3 +3$

Step 2 Use the common difference to find the next 3 terms.

$-8, -5, -2, 1, \quad 4, \quad 7, \quad 10$
$+3 +3 +3$

■ Find the 18th term of the arithmetic sequence for which $a_1 = -4$ and $d = 6$.

$a_n = a_1 + (n-1)d$ *Write the rule.*
$a_{18} = -4 + (18-1)6$ *Substitute.*
$\quad = -4 + (17)6$ *Simplify.*
$\quad = -4 + 102$ *Simplify.*
$\quad = 98$

The 18th term is 98.

EXERCISES

Determine whether each sequence appears to be arithmetic. If so, find the common difference and the next three terms.

36. $20, 14, 8, 2,\ldots$ **37.** $-15, -12, -9, -4,\ldots$

38. $5, 4, 2, -1,\ldots$ **39.** $-8, -5.5, -3, -0.5,\ldots$

Find the indicated term of each arithmetic sequence.

40. 31st term: $-15, -11, -7, -3,\ldots$

41. 24th term: $a_1 = 7; d = -3$

42. 17th term: $a_1 = -20; d = 2.5$

43. Marie has $180 in a savings account in week 1. She plans to deposit $12 each following week. Assuming that she does not withdraw any money from her account, what will her balance be in week 20?

44. The table shows the temperature at the given heights above sea level. Use an arithmetic sequence to find the temperature at 8000 feet above sea level.

Height Above Sea Level (thousand feet)	1	2	3	4
Temperature (°C)	30	23.5	17	10.5

COLLEGE ENTRANCE EXAM PRACTICE
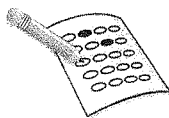
FOCUS ON ACT

Questions on the ACT Mathematics Test do not require the use of a calculator, but you may bring one to use with the test. Make sure that it is a calculator that is on the approved list for the ACT.

You may want to time yourself as you take this practice test. It should take you about 6 minutes to complete.

When taking the test, you will be more comfortable using a calculator that you are used to. If you already have a calculator, make sure it is one of the permitted calculators. If you plan to use a new one, make sure to practice using it before the test.

---

1. The soccer team is ordering new uniforms. There is a one-time setup charge of $50.00, and each uniform costs $23.50. Which of the following best describes the total cost C for ordering uniforms for p players?

   (A) $C = 23.50p$

   (B) $C = 50p$

   (C) $C = 73.50p$

   (D) $C = 23.50p + 50$

   (E) $C = 50p + 23.50$

---

2. In the given relation, what domain value corresponds to the range value -2?
   $\{(-1, 2), (-2, 4), (2, 5), (0, -2), (2, 0)\}$

   (F) -2

   (G) 0

   (H) 2

   (J) 4

   (K) 5

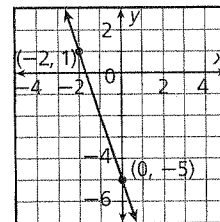3. Evaluate $h(x) = \frac{1}{2}(5 - 6x) + 9x$ when $x = \frac{2}{3}$.

   (A) $\frac{9}{2}$

   (B) $\frac{13}{2}$

   (C) 7

   (D) $\frac{19}{2}$

   (E) $\frac{23}{2}$

---

4. What is the seventh term of the arithmetic sequence $-4, -1, 2 \ldots$?

   (F) 5

   (G) 10

   (H) 11

   (J) 14

   (K) 17

---

5. The graph of which function is shown below?

   (A) $y = -3x - 5$

   (B) $y = -\frac{1}{3}x - \frac{5}{3}$

   (C) $y = -5x - 3$

   (D) $y = 3x - 5$

   (E) $y = 5x + 3$

---

6. Which of the following relations is NOT a function?

   (F) $\{(0, 1), (1, 2), (2, 3), (3, 4)\}$

   (G) $\{(1, 2), (2, 2), (3, 3), (4, 3)\}$

   (H) $\{(0, 2), (2, 4), (4, 1), (1, 3)\}$

   (J) $\{(1, 3), (4, 2), (2, 0), (3, 4)\}$

   (K) $\{(0, 2), (1, 3), (4, 3), (1, 2)\}$

Read each test item and answer the questions that follow using the rubric below.

Scoring Rubric:

4 points: The student shows all of the work, correctly answers all parts of the question, and provides a clear explanation.

3 points: The student shows most of the work and provides a clear explanation but has a minor computation error, or the student shows all of the work and arrives at a correct solution but does not provide a clear explanation.

2 points: The student makes major errors resulting in an incorrect solution, or the student gives a correct solution but does not show any work nor provide an explanation.

1 point: The student shows no work and gives an incorrect solution.

0 points: The student gives no response.

Item A
Extended Response Draw a graph that is a function. Explain why it is a function. Then draw a graph that is NOT a function. Explain why it is not a function.

1. What should be included in a 4-point response?

2. Explain how would you score the response below.

Function   Not a function
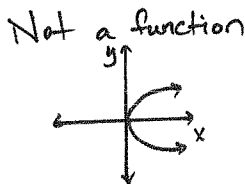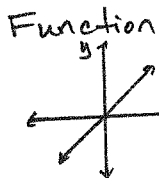
The first graph is a function because each x-value has exactly one y-value. When x=1, y=1. The second graph is not a function because there is more than one y-value for each x-value. When x=1, y=1, and y=-1. Therefore, the second graph is not a function.

Item B
Extended Response A car travels at a steady rate of 60 miles per hour. Identify the independent and dependent variables. Describe the domain and range. Write an equation to describe the situation.

3. Ana wrote the response below.

The equation is $y = 60x$. The independent variable is time and the dependent variable is distance. The domain and range are all real numbers.

Explain how would you score Ana's response.

4. If you did not give Ana full credit, what should be added to Ana's response, if anything, so that it receives full credit?

Item C
Extended Response Lara bought 8 notebooks and 4 binders. She spent $14 total without tax. How much did each notebook cost if each binder cost $2.50? Write an equation and find the solution.

5. Explain how would you score the response below.

Let s = the cost of each notebook.
Let b = the cost of each binder.
$8s + 4b = 14$
$8s + 4(2.50) = 14$
$8s + 10 = 14$
$8s = 4$
$s = 2$ The notebooks cost $2 each

6. If you did not give the response full credit, what should be added to the response, if anything, so that it receives full credit?

HOT TIP! If possible, use the same calculator you usually use in math class. A timed test is not the right place to figure out where buttons are and how they work. Also, replace your batteries the night before the test. If your batteries run out, you may be given a replacement calculator you are not familiar with.

11. The graph below shows a function.
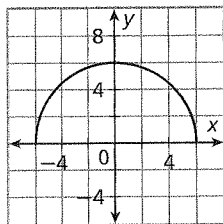
What is the domain of the function?

Ⓐ $x \geq 0$

Ⓑ $x \geq -6$

Ⓒ $0 \leq x \leq 6$

Ⓓ $-6 \leq x \leq 6$

12. Which situation best describes a negative correlation?

Ⓕ The speed of a runner and the time it takes to run a race

Ⓖ The number of apples in a bag and the weight of the bag of apples

Ⓗ The time it takes to repair a car and the amount of the bill

Ⓙ The number of people in a household and the amount of mail in their mailbox

**13.** Which of the following is a solution of $x + 1 \leq \frac{3}{2}$ AND $x - 1 \geq -\frac{5}{4}$?

Ⓐ $\frac{3}{2}$ Ⓒ $-\frac{1}{3}$

Ⓑ $\frac{1}{3}$ Ⓓ $-\frac{3}{2}$

Gridded Response

14. What is the value of x when $3(x + 7) - 6x = 4 - (x + 1)$?

15. For $h(x) = x^3 + 2x$, find $h(4)$.

16. WalkieTalkie phone company charges $18.00 for basic phone service per month and $0.15 per minute for long distance calls. Arena Calls charges $80.00 per month with no fee for long distance calls. What is the minimum number of minutes of long distance calls for which the cost of WalkieTalkie is more than the cost of Arena Calls?
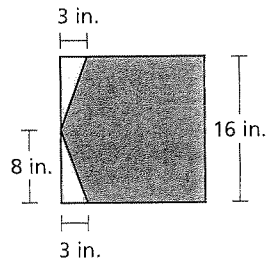
Short Response

17. A function is graphed below.
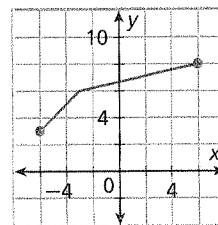
What is the domain and range of the function?

18. Rory made a pentagon by cutting two triangles from a square piece of cardboard as shown.

What is the area of the pentagon? Show your work or explain how you got your answer.

19. The manager of a new restaurant needs at most 12 servers. He has already hired 7 servers.

a. Write and solve an inequality to determine how many more servers the manager could hire.

b. Graph the solutions to the inequality you solved in part a.

20. Study the sequence below.

18, 24.5, 31, 37.5, 44,...

a. Could this sequence be arithmetic? Explain.

b. Find the 100th term of the sequence. Show your work.

Extended Response

21. A relation is shown in the table.

a. Express the relation as a mapping diagram.

b. Is the relation a function? Explain why or why not.

c. Write a possible real-life situation for the relation.

x	y
2	12
3	15
3	18
5	40
6	64

⭐ Maple Syrup

Michigan produces about 90,000 gallons of maple syrup each year. This places the state among the top ten states in U.S. production of maple syrup. Maple syrup is made from the sap of maple trees, but only about 1% of Michigan's maple trees are used in maple syrup production.
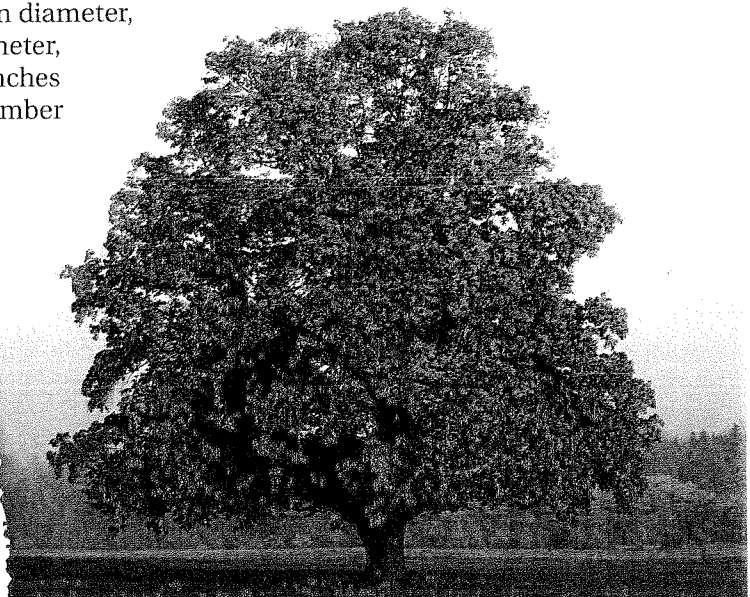
Choose one or more strategies to solve each problem.

1. The standard sugar concentration level of maple syrup is 66%. At certain levels above 66%, the product develops into maple cream, soft maple sugar, or hard maple sugar. The sugar concentration never reaches 100%, even in hard maple sugar. What is the range of sugar concentration levels in the various maple products? Show your answer on a number line.

For 2 and 3, use the table.

2. How many Calories are in 1 cup of maple syrup? (*Hint:* 4 tbsp $= \frac{1}{4}$ c)

3. Approximately how many tablespoons of maple syrup would you need to have the same number of Calories that are in 7 tablespoons of honey? Round to the nearest tablespoon.

4. It takes 40 gallons of maple sap to make 1 gallon of maple syrup. Each tap hole in a maple tree will produce about 10 gallons of sap in an average year. How many gallons of maple syrup could be made with the sap from 20 tap holes?

Sweetener	Calories (per tbsp)
Blackstrap molasses	43
Granulated sugar	46
Maple syrup	50
Corn syrup	57
Honey	64

5. It is recommended that maple trees be at least 10 inches in diameter before they are tapped. Only one tap should be placed in trees that are 10 to 18 inches in diameter, while 2 taps can be placed in trees greater than 18 inches in diameter. An orchard has 130 trees that are less than 10 inches in diameter, 104 trees that are 10–18 inches in diameter, and 48 trees that are greater than 18 inches in diameter. What is the maximum number of tap holes this orchard should have?

ARE YOU READY?

✓ Vocabulary

Match each term on the left with a definition on the right.

1. coefficient
2. coordinate plane
3. transformation
4. perpendicular

A. a change in the size or position of a figure

B. forming right angles

C. a two-dimensional system formed by the intersection of a horizontal number line and a vertical number line

D. an ordered pair of numbers that gives the location of a point

E. a number that is multiplied by a variable

✓ Ordered Pairs

Graph each point on the same coordinate plane.

5. $A(2, 5)$
6. $B(-1, -3)$
7. $C(-5, 2)$
8. $D(4, -4)$
9. $E(-2, 0)$
10. $F(0, 3)$
11. $G(8, 7)$
12. $H(-8, -7)$

✓ Solve for a Variable

Solve each equation for the indicated variable.

13. $2x + y = 8; y$
14. $5y = 5x - 10; y$
15. $2y = 6x - 8; y$
16. $10x + 25 = 5y; y$

✓ Evaluate Expressions

Evaluate each expression for the given value of the variable.

17. $4g - 3; g = -2$
18. $8p - 12; p = 4$
19. $4x + 8; x = -2$
20. $-5t - 15; t = 1$

✓ Connect Words and Algebra

21. The value of a stock begins at $0.05 and increases by $0.01 each month. Write an equation representing the value of the stock v in any month m.

22. Write a situation that could be modeled by the equation $b = 100 - s$.

✓ Rates and Unit Rates

Find each unit rate.

23. 322 miles on 14 gallons of gas
24. $14.25 for 3 pounds of deli meat
25. 32 grams of fat in 4 servings
26. 120 pictures on 5 rolls of film