



CHAPTER

3

Algebra: Linear Equations and Functions

Indiana Academic Standards

7.2.1 Use variables and appropriate operations to write an expression, equation or inequality that represents a verbal description.

7.2.2 Write and solve two-step linear equations and inequalities in one variable.

Key Vocabulary

formula (p. 144)

linear equation (p. 164)

two-step equation (p. 151)

work backward strategy (p. 148)

Real-World Link

Segways The Segway's top speed is 12.5 miles per hour—two to three times faster than walking. You can use the equation $d = 12.5t$ to find the distance d you can travel in t hours.



FOLDABLES[®] Study Organizer

Algebra: Linear Equations and Functions Make this Foldable to help you organize your notes.

Begin with a sheet of 11" by 17" paper.

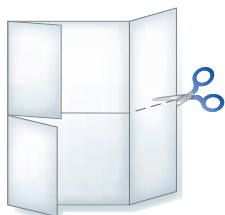
- 1** Fold the short sides toward the middle.



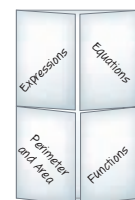
- 2** Fold the top to the bottom.



- 3** Open. Cut along the second fold to make four tabs.



- 4** Label each of the tabs as shown.



GET READY for Chapter 3

Diagnose Readiness You have two options for checking Prerequisite Skills.

Option 2

IN Math Online

Take the Online Readiness Quiz at glencoe.com.

Option 1

Take the Quick Quiz below. Refer to the Quick Review for help.

QUICK Quiz

Name the number that is the solution of the given equation. (Lesson 1-6)

- $a + 15 = 19$; 4, 5, 6
- $11k = 77$; 6, 7, 8
- $x + 9 = -2$; 7, -11, 11

Graph each point on a coordinate plane. (Lesson 2-3)

- $(-4, 3)$
- $(-2, -1)$

- HIKING** Keith hiked 4 miles north and 2 miles west from the campground before he rested. If the origin represents the campground, graph Keith's resting point. (Lesson 2-3)

Add. (Lesson 2-4)

- $-3 + (-5)$
- $-8 + 3$
- $9 + (-5)$
- $-10 + 15$

Subtract. (Lesson 2-5)

- $-5 - 6$
- $8 - 10$
- $8 - (-6)$
- $-3 - (-1)$

Divide. (Lesson 2-8)

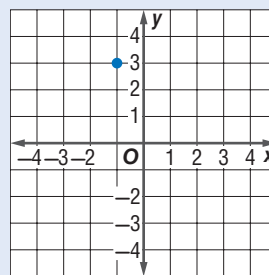
- $-6 \div (-3)$
- $-12 \div 3$
- $10 \div (-5)$
- $-24 \div (-4)$

QUICK Review

Example 1 Name the number that is the solution of $24 \div a = 3$; 7, 8, or 9.

- | | |
|------------------------|----------------------|
| $24 \div a = 3$ | Write the equation. |
| $24 \div 7 = 3$? No. | Substitute $a = 7$. |
| $24 \div 8 = 3$? Yes. | Substitute $a = 8$. |
| $24 \div 9 = 3$? No. | Substitute $a = 9$. |

Example 2 Graph the point $(-1, 3)$ on a coordinate plane.



The first number in an ordered pair tells you to move left or right from the origin. The second number tells you to move up or down.

Example 3 Find $-4 + (-2)$.

- $-4 + (-2) = -6$ Since -4 and -2 are both negative, add their absolute values. The sum is negative also.

Example 4 Find $9 - (-7)$.

- $9 - (-7) = 9 + (7)$ Subtracting -7 is the same as adding 7.
 $= 16$ Add.

Example 5 Find $-16 \div 2$.

- $-16 \div 2 = -8$ Since -16 and 2 have opposite signs, their quotient is negative.

3-1

Writing Expressions and Equations

MAIN IDEA

Write verbal phrases and sentences as simple algebraic expressions and equations.

IN Academic Standards

7.2.1 Use variables and appropriate operations to write an expression, equation or inequality that represents a verbal description.

IN Math Online

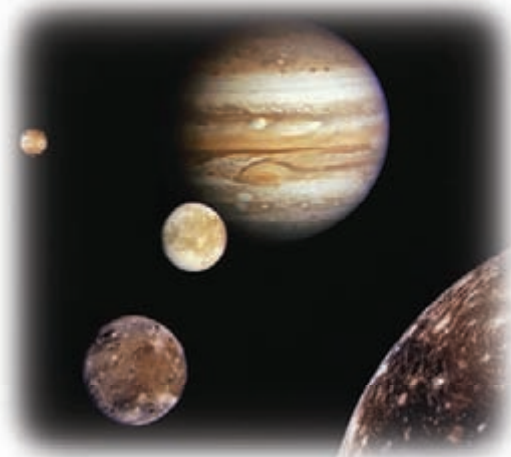
glencoe.com

- Extra Examples
- Personal Tutor
- Self-Check Quiz

▶ GET READY for the Lesson

PLANETS Earth has only one moon, but other planets have many moons. For example, Uranus has 21 moons, and Saturn has 10 more moons than Uranus.

1. What operation would you use to find how many moons Saturn has? Explain.
2. Jupiter has about three times as many moons as Uranus. What operation would you use to find how many moons Jupiter has?



Words and phrases in problems often suggest addition, subtraction, multiplication, and division. Here are some examples.

Addition and Subtraction		Multiplication and Division	
sum	difference	each	divide
more than	less than	product	quotient
increased by	less	multiplied	per
in all	decreased by	twice	separate

EXAMPLE Write a Phrase as an Expression

- 1 Write the phrase *five dollars more than Jennifer earned* as an algebraic expression.

Words

five dollars more than Jennifer earned.

Variable

Let d represent the number of dollars Jennifer earned.

Expression

$$d + 5$$

✓ CHECK Your Progress

Write the phrase as an algebraic expression.

- a. 3 more runs than the Pirates scored



Remember, an equation is a sentence in mathematics that contains an equals sign. When you write a verbal sentence as an equation, you can use the equals sign (=) for the words *equals* or *is*.

Reading Math

Less Than You can write *six more than a number* as either $6 + n$ or $n + 6$. But *six less than a number* can only be written as $n - 6$.

EXAMPLES Write Sentences as Equations

Write each sentence as an algebraic equation.

- 2 Six less than a number is 20.

Six less than a **number** is 20.

Let n represent the number.

$$n - 6 = 20$$

- 3 Three times Jack's age equals 12.

Three times **Jack's age** equals 12.

Let a represent Jack's age.

$$3a = 12$$

✓ CHECK Your Progress

Write each sentence as an algebraic equation.

- b. Seven more than a number is 15.
c. Five times the number of students is 250.



Real-World EXAMPLE

- 4 **WATERFALLS** The tallest waterfall in the United States is **Yosemite Falls** in California with a height of about **739 meters**. This height is **617 meters taller than Raven Cliff Falls**. What is the height of Raven Cliff Falls? Write an equation that models this situation.

Words	<i>Yosemite Falls</i> is 617 meters taller than <i>Raven Cliff Falls</i> .
Variable	Let h represent the height of <i>Raven Cliff Falls</i> .
Equation	$739 = 617 + h$

The equation is $739 = 617 + h$.

✓ CHECK Your Progress

- d. **ANIMALS** North American cougars are about 1.5 times as long as cougars found in the tropical jungles of Central America. If North American cougars are about 75 inches long, how long is the tropical cougar? Write an equation that models this situation.

Real-World Link

The tallest waterfall in South Carolina is Raven Cliff Falls, located in Caesars Head State Park.

Source: South Carolina Department of Parks, Recreation, and Tourism

**ISTEP+ EXAMPLE** 7.2.1

5 Which problem situation matches the equation $x - 5.83 = 3.17$?

- A Tyler ran 3.17 kilometers. His friend ran the same distance 5.83 seconds faster than Tyler. What is x , the time in seconds that Tyler ran?
- B Lynn and Heather measured the length of worms in science class. Lynn's worm was 5.83 centimeters long, and Heather's worm was 3.17 centimeters long. What is x , the average length of the worms?
- C Keisha's lunch cost \$5.83. She received \$3.17 in change when she paid the bill. What is x , the amount of money she gave the cashier?
- D Mr. Carlos paid \$3.17 for a notebook that originally cost \$5.83. What is x , the amount of money that Mr. Carlos saved?

Test-Taking Tip**Vocabulary Terms**

Before taking a standardized test, review the meaning of vocabulary terms such as *average*.

Read the Item

You need to find which problem situation matches the equation $x - 5.83 = 3.17$.

Solve the Item

- You can eliminate A because you cannot add or subtract different units of measure.
- You can eliminate B because to find an average you add and then divide.
- Act out C. If you gave the cashier x dollars and your lunch cost \$5.83, you would subtract to find your change, \$3.17. This is the correct answer.
- Check D, just to be sure. To find the amount Mr. Carlos saved, you would calculate $5.83 - 3.17$, not $x - 5.83$.

The solution is C.

 **CHECK Your Progress**

e. Which problem situation matches the equation $4y = 6.76$?

- F Mrs. Thomas bought 4 gallons of gas. Her total cost was \$6.76. What is y , the cost of one gallon of gas?
- G Jordan bought 4 CDs that were on sale for \$6.76 each. What is y , the total cost of the CDs?
- H The width of a rectangle is 4 meters. The length is 6.76 meters more than the width. What is y , the length of the rectangle?
- J The average yearly rainfall is 6.76 inches. What is y , the amount of rainfall you might expect in 4 years?



CHECK Your Understanding

Example 1
(p. 128)

Write each phrase as an algebraic expression.

1. a number increased by eight
2. ten dollars more than Grace has

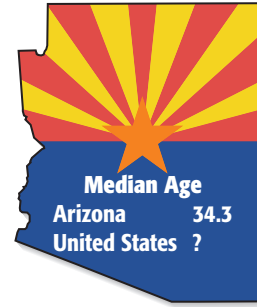
Examples 2, 3
(p. 129)

Write each sentence as an algebraic equation.

3. Nine less than a number equals 24.
4. Two points less than his score is 4.
5. Twice the number of miles is 18.
6. One half the regular price is \$13.

Example 4
(p. 129)

7. **ALGEBRA** The median age of people living in Arizona is 1 year younger than the median age of people living in the United States. Use this information and the information at the right to write an equation to find the median age in the United States.



Example 5
(p. 130)

8. **MULTIPLE CHOICE** Which problem situation matches the equation $x - 15 = 46$?
 - A The original price of a jacket is \$46. The sale price is \$15 less. What is x , the sale price of the jacket?
 - B Mark had several baseball cards. He sold 15 of the cards and had 46 left. What is x , the amount of cards Mark had to start with?
 - C Sonja scored 46 points in last week's basketball game. Talisa scored 15 points less. What is x , the amount of points Talisa scored?
 - D Katie earned \$15 babysitting this week. Last week she earned \$46. What is x , her average earnings for the two weeks?

Practice and Problem Solving

HOMEWORK HELP	
For Exercises	See Examples
9–16	1
17–22	2, 3
23–24	4
41	5

Write each phrase as an algebraic expression.

9. fifteen increased by t
10. five years older than Luis
11. a number decreased by ten
12. three feet less than the length
13. the product of r and 8
14. twice as many oranges
15. Emily's age divided by 3
16. the quotient of a number and -12

Write each sentence as an algebraic equation.

17. The sum of a number and four is equal to -8 .
18. Two more than the number of frogs is 4.
19. The product of a number and five is -20 .
20. Ten times the number of students is 280.
21. Ten inches less than her height is 26.
22. Five less than a number is 31.

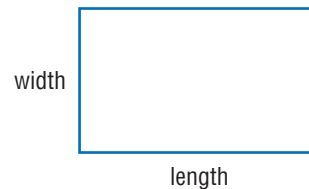


For Exercises 23 and 24, write an equation that models each situation.

23. **ANIMALS** A giraffe is 3.5 meters taller than a camel. If a giraffe is 5.5 meters tall, how tall is a camel?
24. **FOOTBALL** Carson Palmer led the National Football League with 32 touchdown passes in a season. This was twice as many touchdown passes as Donovan McNabb had. Find the number of touchdown passes for McNabb.

MEASUREMENT For Exercises 25–28, describe the relationship that exists between the length and width of each rectangle.

25. The width is x , and the length is $4x$.
26. The length is $x + 3$, and the width is x .
27. The length is x , and the width is $x - 5$.
28. The length is x , and the width is $0.5x$.



Write each phrase as an algebraic expression.

29. 2 more than twice as many bikes
30. nine CDs less than three times the number of CDs Margaret owns
31. 43 dollars off the price of each admission, which is then multiplied by 3 admissions
32. the quotient of a number w and (-8) , which is then increased by 7
33. the square of a number k which is then multiplied by 13
34. the sum of a number p and 0.4 which is then decreased by the fifth power of the same number



ANALYZE TABLES For Exercises 35 and 36, use the table.

The table shows the average lifespan of several types of pets. Let y represent the average lifespan of a gerbil.

Pets	
Type	Lifespan (years)
American toad	15
cat	25
dog	22
gerbil	5
rabbit	9

35. Which lifespan can be represented by $3y$?
36. Write an expression to represent the lifespan of a cat.

Academic Standards • ISTEP+

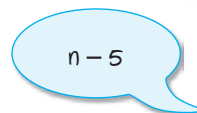
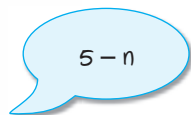
Extra Practice, pp. 674, 706

H.O.T. Problems

37. **OPEN ENDED** Write a verbal sentence for the equation $n - 3 = 6$.
38. **FIND THE ERROR** Sancho and Candace are writing an algebraic expression for the phrase *5 less than a number*. Who is correct? Explain.



Sancho



Candace



39. **CHALLENGE** If x is an odd number, how would you represent the odd number immediately following it? preceding it?
40. **WRITING IN MATH** Analyze the meaning of the expressions $a + 5$, $a - 3$, $2a$, and $\frac{a}{2}$ if a represents someone's age.

ISTEP+ PRACTICE 7.2.1

41. Asha had some change in her purse. After her brother gave her \$0.79, Asha had \$2.24 altogether. Which equation can she use to find the original amount of money m she had in her purse?
- A $2.24 = m - 0.79$
 B $m = 2.24 \times 0.79$
 C $m + 0.79 = 2.24$
 D $m + 2.24 = 0.79$
42. Which algebraic equation best describes the total distance D traveled in miles after a 6-hour period, if r represents the rate of travel in miles per hour?
- F $D = 6 + r$
 G $D = \frac{r}{6}$
 H $D = 6r$
 J $D = \frac{6}{r}$

Spiral Review

Divide (Lesson 2-8)

43. $-42 \div 6$ 44. $36 \div (-3)$ 45. $-45 \div (-3)$
46. **MONEY** Jordan withdraws \$14 per week from his savings account for a period of 7 weeks. Write a multiplication expression to represent this situation. Then find the product and explain its meaning. (Lesson 2-7)

Evaluate each expression. (Lesson 1-4)

47. $3 + 7 \cdot 4 - 6$ 48. $8(16 - 5) - 6$ 49. $75 \div 3 + 6(5 - 1)$

ANALYZE DATA For Exercises 50–52, use the table that shows the cost of two different plans for downloading music. (Lesson 1-1)

50. Suppose you download 12 songs in one month. Find the cost per song using Plan B.
51. Which plan is less expensive for downloading 9 songs in one month?
52. When is it less expensive to use Plan B instead of Plan A?



GET READY for the Next Lesson

PREREQUISITE SKILL Find each sum. (Lesson 2-4)

53. $-8 + (-3)$ 54. $-10 + 9$ 55. $12 + (-20)$ 56. $-15 + 15$

Explore 3-2

Algebra Lab Solving Equations Using Models

MAIN IDEA







Solve equations using models.

IN Academic Standards

Preparation for

7.2.2 Write and solve two-step linear equations and inequalities in one variable. *Also addresses P.5.1, P.5.2, P.5.3.*

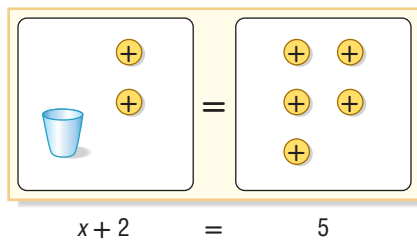
In Chapter 2, you used counters to add, subtract, multiply, and divide integers. Integers can also be modeled using algebra tiles. The table shows how these two types of models are related.

Type of Model	Variable x	Integer 1	Integer -1
Cups and Counters			
Algebra Tiles			

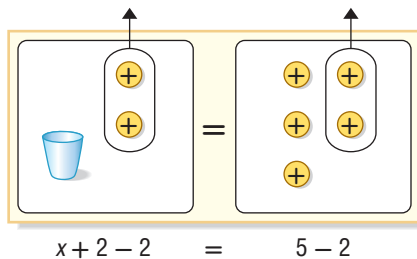
You can use either type of model to solve equations.

ACTIVITY

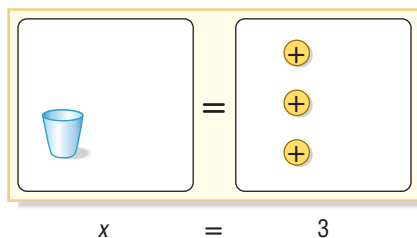
- 1** Solve $x + 2 = 5$ using cups and counters or a drawing.



Model the equation.



Remove the same number of counters from each side of the mat until the cup is by itself on one side.



The number of counters remaining on the right side of the mat represents the value of x .

Therefore, $x = 3$. Since $3 + 2 = 5$, the solution is correct.

CHECK Your Progress

Solve each equation using cups and counters or a drawing.

- a. $x + 4 = 4$ b. $5 = x + 4$ c. $4 = 1 + x$ d. $2 = 2 + x$

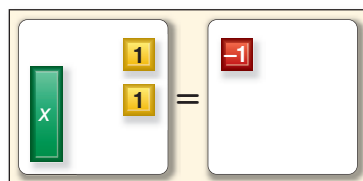
Review Vocabulary

zero pair a number paired with its opposite; Example: 2 and -2 . (Explore 2-4)

You can add or subtract a zero pair from either side of an equation without changing its value, because the value of a zero pair is zero.

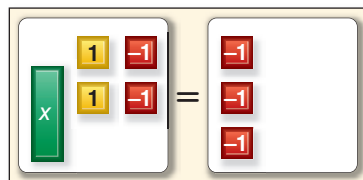
ACTIVITY

- 2 Solve $x + 2 = -1$ using models.



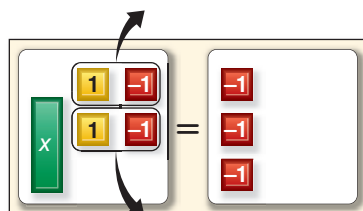
$$x + 2 = -1$$

Model the equation.



$$x + 2 + (-2) = -1 + (-2)$$

Add 2 negative tiles to the left side of the mat and add 2 negative tiles to the right side of the mat.



$$x = -3$$

Remove all of the zero pairs from the left side. There are 3 negative tiles on the right side of the mat.

Therefore, $x = -3$. Since $-3 + 2 = -1$, the solution is correct.

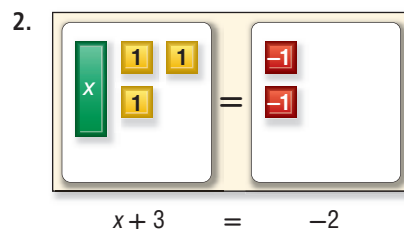
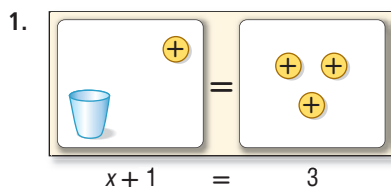
CHECK Your Progress

Solve each equation using models or a drawing.

- e. $-2 = x + 1$ f. $x - 3 = -2$ g. $x - 1 = -3$ h. $4 = x - 2$

ANALYZE THE RESULTS

Explain how to solve each equation using models or a drawing.



3. **MAKE A CONJECTURE** Write a rule that you can use to solve an equation like $x + 3 = 2$ without using models or a drawing.

3-2

Solving Addition and Subtraction Equations

MAIN IDEA

Solve addition and subtraction equations.

IN Academic Standards

Preparation for

7.2.2 Write and solve two-step linear equations and inequalities in one variable. *Also addresses 7.2.1, P.5.1, P.5.2, P.5.3.*

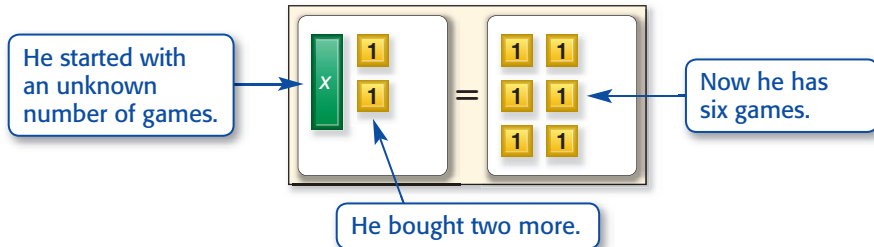
IN Math Online

glencoe.com

- Extra Examples
- Personal Tutor
- Self-Check Quiz
- Reading in the Content Area

▶ GET READY for the Lesson

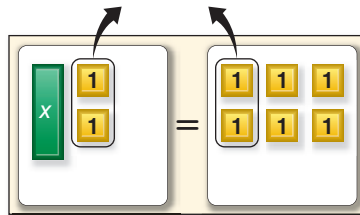
VIDEO GAMES Max had some video games, and then he bought two more games. Now he has six games.



1. What does x represent in the figure?
2. What addition equation is shown in the figure?
3. Explain how to solve the equation.
4. How many games did Max have in the beginning?

You can solve the equation $x + 2 = 6$ by *removing*, or subtracting, the same number of positive tiles from each side of the mat. You can also subtract 2 from each side of the equation. The variable is now by itself on one side of the equation.

Use Models



Use Symbols

$$\begin{array}{r} x + 2 = 6 \\ \underline{-2 = -2} \\ x = 4 \end{array}$$

Subtracting 2 from each side of an equation illustrates the Subtraction Property of Equality.

Subtraction Property of Equality

Key Concept

Words If you subtract the same number from each side of an equation, the two sides remain equal.

Symbols If $a = b$, then $a - c = b - c$.

Examples

Numbers

$$\begin{array}{r} 6 = 6 \\ \underline{-2 = -2} \\ 4 = 4 \end{array}$$

Algebra

$$\begin{array}{r} x + 2 = 6 \\ \underline{-2 = -2} \\ x = 4 \end{array}$$



EXAMPLES Solve Addition Equations

- 1 Solve $x + 5 = 8$. Check your solution.

$$\begin{array}{r} x + 5 = 8 \\ -5 = -5 \\ \hline x = 3 \end{array}$$

Write the equation.
Subtract 5 from each side.
Simplify.

Check

$$\begin{array}{r} x + 5 = 8 \\ 3 + 5 \stackrel{?}{=} 8 \\ 8 = 8 \quad \checkmark \end{array}$$

Write the original equation.
Replace x with 3.
The sentence is true.

The solution is 3.

- 2 Solve $x + 6 = 4$. Check your solution.

$$\begin{array}{r} x + 6 = 4 \\ -6 = -6 \\ \hline x = -2 \end{array}$$

Write the equation.
Subtract 6 from each side.
Simplify.

The solution is -2 .

Check the solution.

CHECK Your Progress

Solve each equation. Check your solution.

a. $y + 6 = 9$

b. $x + 3 = 1$

c. $-3 = a + 4$

Real-World EXAMPLE

- 3 **MARINE BIOLOGY** Clownfish and angelfish are popular tropical fish. An angelfish can grow to be 12 inches long. If an angelfish is 8.5 inches longer than a clownfish, how long is a clownfish?

Words	An angelfish is 8.5 inches longer than a clownfish.
Variable	Let c represent the length of the clownfish.
Equation	$12 = 8.5 + c$

$$12 = 8.5 + c \quad \text{Write the equation.}$$

$$\begin{array}{r} -8.5 = -8.5 \\ \hline 3.5 = c \end{array} \quad \text{Subtract 8.5 from each side.}$$

$$3.5 = c \quad \text{Simplify.}$$

A clownfish is 3.5 inches long.

CHECK Your Progress

- d. **WEATHER** The highest recorded temperature in Warsaw, Missouri, is 118°F . This is 158° greater than the lowest recorded temperature. Write and solve an equation to find the lowest recorded temperature.

Study Tip

Solutions Notice that your new equation, $x = 3$, has the same solution as the original equation, $x + 5 = 8$.



Real-World Career . . .

How Does a Marine Biologist Use Math?

A marine biologist uses math to analyze data about marine plants, animals, and organisms.

IN Math Online

For more information, go to: glencoe.com.



- Similarly, you can use inverse operations and the Addition Property of Equality to solve equations like $x - 2 = 1$.

Vocabulary Link

Inverse

Everyday Use something that is opposite
Math Use undo

Addition Property of Equality

Key Concept

Words If you add the same number to each side of an equation, the two sides remain equal.

Symbols If $a = b$, then $a + c = b + c$.

Examples

Numbers

$$\begin{array}{r} 5 = 5 \\ + 3 = + 3 \\ \hline 8 = 8 \end{array}$$

Algebra

$$\begin{array}{r} x - 2 = 4 \\ + 2 = + 2 \\ \hline x = 6 \end{array}$$

EXAMPLE

Solve a Subtraction Equation

4 Solve $x - 2 = 1$. Check your solution.

$$\begin{array}{r} x - 2 = 1 \\ + 2 = + 2 \\ \hline x = 3 \end{array}$$

Write the equation.
Add 2 to each side.
Simplify.

Check the solution. Since $3 - 2 = 1$, the solution is 3.

CHECK Your Progress

- e. $y - 3 = 4$ f. $r - 4 = -2$ g. $q - 8 = -9$



Real-World EXAMPLE

5 SHOPPING A pair of shoes costs \$25. This is \$14 less than the cost of a pair of jeans. Find the cost of the jeans.

Words	Shoes	are	\$14 less than	jeans
Variable		Let j represent the	cost of	jeans.
Equation	25	=	j	- 14

$$\begin{array}{r} 25 = j - 14 \\ + 14 = + 14 \\ \hline 39 = j \end{array}$$

Write the equation.
Add 14 to each side.
Simplify.

The jeans cost \$39.

CHECK Your Progress

h. **ANIMALS** The average lifespan of a tiger is 22 years. This is 13 years less than a lion. Write and solve an equation to find the lifespan of a lion.

Study Tip

Check for Reasonableness
Ask yourself which costs more: the shoes or the jeans. Then check your answer. Does it show that the jeans cost more than the shoes?



CHECK Your Understanding

Examples 1, 2
(p. 137)

Solve each equation. Check your solution.

1. $n + 6 = 8$

2. $7 = y + 2$

3. $m + 5 = 3$

4. $-2 = a + 6$

Example 3
(p. 137)

5. **FLYING** Orville and Wilbur Wright made the first airplane flights in 1903. Wilbur's flight was 364 feet. This was 120 feet longer than Orville's flight. Write and solve an equation to find the length of Orville's flight.

Example 4
(p. 138)

Solve each equation. Check your solution.

6. $x - 5 = 6$

7. $-1 = c - 6$

Example 5
(p. 138)

8. **PRESIDENTS** John F. Kennedy was the youngest president to be inaugurated. He was 43 years old. This was 26 years younger than the oldest president to be inaugurated—Ronald Reagan. Write and solve an equation to find how old Reagan was when he was inaugurated.



Practice and Problem Solving

HOMEWORK HELP

For Exercises	See Examples
9–12	1
13–16	2
17–20	4
21–24	3, 5

Solve each equation. Check your solution.

9. $a + 3 = 10$

10. $y + 5 = 11$

11. $9 = r + 2$

12. $14 = s + 7$

13. $x + 8 = 5$

14. $y + 15 = 11$

15. $r + 6 = -3$

16. $k + 3 = -9$

17. $s - 8 = 9$

18. $w - 7 = 11$

19. $-1 = q - 8$

20. $-2 = p - 13$



For Exercises 21–24, write an equation. Then solve the equation.

21. **MUSIC** Last week Tiffany practiced her bassoon a total of 7 hours. This was 2 hours more than she practiced the previous week. How many hours did Tiffany practice the previous week?
22. **CIVICS** In the 2004 presidential election, Ohio had 20 electoral votes. This is 14 votes less than Texas had. How many electoral votes did Texas have in 2004?
23. **AGES** Zack is 15 years old. This is 3 years younger than his brother Tyler. How old is Tyler?
24. **BASKETBALL** The Miami Heat scored 79 points in a recent game. This was 13 points less than the Chicago Bulls score. How many points did the Chicago Bulls score?



Solve each equation. Check your solution.

25. $34 + r = 95$

26. $64 + y = 84$

27. $-23 = x - 18$

28. $-59 = m - 11$

29. $-18 + c = -30$

30. $-34 = t + 9$

31. $a - 3.5 = 14.9$

32. $x - 2.8 = 9.5$

33. $r - 8.5 = -2.1$

34. $z - 9.4 = -3.6$

35. $n + 1.4 = 0.72$

36. $b + 2.25 = 1$

For Exercises 37–42, write an equation. Then solve the equation.

37. **MONEY** Suppose you have d dollars. After you pay your sister the \$5 you owe her, you have \$18 left. How much money did you have at the beginning?

38. **MONEY** Suppose you have saved \$38. How much more do you need to save to buy a small television that costs \$65?

39. **GEOMETRY** The sum of the measures of the angles of a triangle is 180° . Find the missing measure.



40. **VOLCANOES** Alaska, Hawaii, and Washington have active volcanoes. Alaska has 43, Hawaii has 5, and Washington has v . If they have 52 active volcanoes in all, how many volcanoes does Washington have?

41. **GOLF** The table shows Cristie Kerr's scores for four rounds of the 2007 U.S. Women's Open. Her total score was -5 (5 under par). What was her score for the third round?

Round	Score
First	0
Second	+1
Third	s
Fourth	-1

42. **BUSINESS** At the end of the day, the closing price of XYZ Stock was \$62.87 per share. This was \$0.62 less than the opening price. Find the opening price.

ANALYZE TABLES For Exercises 43–45, use the table.

Tallest Wooden Roller Coasters	Height (feet)	Drop (feet)	Speed (mph)
Son of Beast	218	214	s
El Toro	181	176	70
The Rattler	180	d	65
Colossos	h	159	75
Voyage	163	154	67

Source: Coaster Grotto

43. The difference in speeds of Son of Beast and The Rattler is 13 miles per hour. If Son of Beast has the greater speed, write and solve a subtraction equation to find its speed.

44. The Rattler has a drop that is 52 feet less than El Toro. Write and solve an addition equation to find the height of The Rattler.

45. Colossos is 13 feet taller than Voyage. Write and solve a subtraction equation to find the height of Colossos.



Real-World Link

Cristie Kerr donates \$50.00 to breast cancer research for every birdie she makes.

Source: Birdies for Breast Cancer

Academic Standards • ISTEP+

Extra Practice, pp. 674, 706

H.O.T. Problems

46. **Which One Doesn't Belong?** Identify the equation that does not have the same solution as the other three. Explain your reasoning.

$$x - 1 = -4$$

$$b + 5 = -8$$

$$11 + y = 8$$

$$-6 + a = -9$$

47. **CHALLENGE** Suppose $x + y = 11$ and the value of x increases by 2. If their sum remains the same, what must happen to the value of y ?
48. **WRITING IN MATH** Write a problem about a real-world situation that can be represented by the equation $p - 25 = 50$.

ISTEP+ PRACTICE**Preparation for 7.2.2, 7.21**

49. The Oriental Pearl Tower in Shanghai, China, is 1,535 feet tall. It is 280 feet shorter than the Canadian National Tower in Toronto, Canada. Which equation can be used to find the height of the Canadian National Tower?
- A $1,535 + h = 280$
 B $h = 1,535 - 280$
 C $1,535 = h - 280$
 D $280 - h = 1,535$
50. Which of the following statements is true concerning the equation $x + 3 = 7$?
- F To find the value of x , add 3 to each side.
 G To find the value of x , add 7 to each side.
 H To find the value of x , find the sum of 3 and 7.
 J To find the value of x , subtract 3 from each side.

Spiral Review

51. **SCIENCE** The boiling point of water is 180° higher than its freezing point. If p represents the freezing point, write an expression that represents the boiling point of water. (Lesson 3-1)
52. **ALGEBRA** Evaluate the expression $xy \div (-4)$ if $x = 12$ and $y = -2$. (Lesson 2-8)
53. **ALGEBRA** The table shows the number of pages of a novel Ferguson read each hour. If the pattern continues, how many pages will Ferguson read during the 8th hour? (Lesson 2-7)

Hour	Number of Pages Read
1	11
2	13
3	16
4	20
5	25

GET READY for the Next Lesson

PREREQUISITE SKILL Find each quotient.

54. $15.6 \div 13$

55. $8.84 \div 3.4$

56. $75.25 \div 0.25$

57. $0.76 \div 0.5$

3-3

Solving Multiplication Equations

MAIN IDEA

Solve multiplication equations.

IN Academic Standards

Preparation for

7.2.2 Write and solve two-step linear equations and inequalities in one variable. *Also addresses 7.2.1, P.5.1, P.5.2, P.5.3.*

New Vocabulary

formula

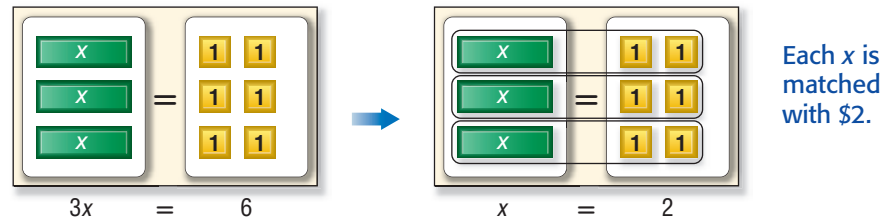
IN Math Online

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- Concepts In Motion
- Extra Examples
- Personal Tutor
- Self-Check Quiz

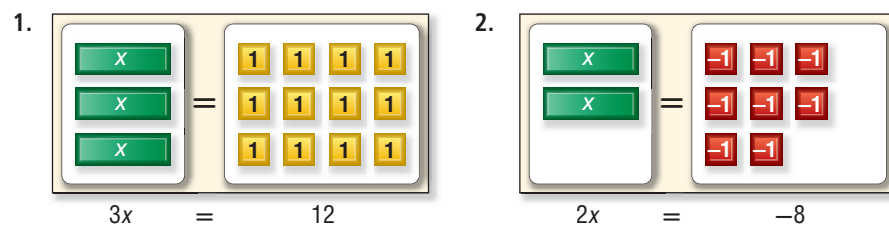
MINI Lab

MONEY Suppose three friends order an appetizer of nachos that costs \$6. They agree to split the cost equally. The figure below illustrates the multiplication equation $3x = 6$, where x represents the amount each friend pays.



Each friend pays \$2. The solution of $3x = 6$ is 2.

Solve each equation using models or a drawing.



- $4x = 20$
- $8 = 2x$
- $3x = -9$
- What operation did you use to find each solution?
- How can you use the coefficient of x to solve $8x = 40$?

Equations like $3x = 6$ are called multiplication equations because the expression $3x$ means 3 times the value of x . So, you can use the Division Property of Equality to solve multiplication equations.

Division Property of Equality

Key Concept

Words If you divide each side of an equation by the same nonzero number, the two sides remain equal.

Symbols If $a = b$ and $c \neq 0$, then $\frac{a}{c} = \frac{b}{c}$.

Examples

Numbers

$$\begin{aligned} 8 &= 8 \\ \frac{8}{2} &= \frac{8}{2} \\ 4 &= 4 \end{aligned}$$

Algebra

$$\begin{aligned} 2x &= -6 \\ \frac{2x}{2} &= \frac{-6}{2} \\ x &= -3 \end{aligned}$$

Review Vocabulary

coefficient the numerical factor for a multiplication expression; Example: the coefficient of x in the expression $4x$ is 4. (Lesson 1-4)

EXAMPLES Solve Multiplication Equations

1 Solve $20 = 4x$. Check your solution.

$$20 = 4x$$

Write the equation.

$$\frac{20}{4} = \frac{4x}{4}$$

Divide each side of the equation by 4.

$$5 = x$$

$$20 \div 4 = 5$$

The solution is 5.

Check the solution.

2 Solve $-8y = 24$. Check your solution.

$$-8y = 24$$

Write the equation.

$$\frac{-8y}{-8} = \frac{24}{-8}$$

Divide each side by -8 .

$$y = -3$$

$$24 \div (-8) = -3$$

The solution is -3 .

Check the solution.

CHECK Your Progress

Solve each equation. Check your solution.

a. $30 = 6x$

b. $-6a = 36$

c. $-9d = -72$

Many real-world situations increase at a constant rate. These can be represented by multiplication equations.

Real-World EXAMPLE

3 **TEXT MESSAGING** It costs \$0.10 to send a text message. You can spend a total of \$5.00. How many text messages can you send?

Words	Total	is equal to	cost of each message	times	number of messages.
Variable	Let m	represent	the number of messages	you can send.	
Equation	5.00	=	0.10	•	m

$$5.00 = 0.10m$$

Write the equation.

$$\frac{5.00}{0.10} = \frac{0.10m}{0.10}$$

Divide each side by 0.10.

$$50 = m$$

$$5.00 \div 0.10 = 50$$

 At \$0.10 per message, you can send 50 text messages for \$5.00.

CHECK Your Progress

d. **TRAVEL** Mrs. Acosta's car can travel an average of 24 miles on each gallon of gasoline. Write and solve an equation to find how many gallons of gasoline she will need for a trip of 348 miles.



Real-World Link

Over 60% of teenagers' text messages are sent from their homes—even when a landline is available.

Source: Xerox



A **formula** is an equation that shows the relationship among certain quantities. One of the most common formulas is the equation $d = rt$, which gives the relationship among distance d , rate r , and time t .

Reading Math

Speed Another name for *rate* is *speed*.

Real-World EXAMPLE

- 4 ANIMALS** The tortoise is one of the slowest land animals, reaching an average top speed of about 0.25 mile per hour. At this speed, how long will it take a tortoise to travel 1.5 miles?

You are asked to find the time t it will take to travel a distance d of 1.5 miles at a rate r of 0.25 mile per hour.

METHOD 1 Substitute, then solve.

$$d = rt$$

Write the equation.

$$1.5 = 0.25t$$

Replace d with 1.5 and r with 0.25.

$$\frac{1.5}{0.25} = \frac{0.25t}{0.25}$$

Divide each side by 0.25.

$$6 = t$$

$$1.5 \div 0.25 = 6$$

METHOD 2 Solve, then substitute.

$$d = rt$$

Write the equation.

$$\frac{d}{r} = \frac{rt}{r}$$

Divide each side by r to solve the equation for t .

$$\frac{d}{r} = t$$

Simplify.

$$\frac{1.5}{0.25} = t$$

Replace d with 1.5 and r with 0.25.

$$6 = t$$

$$1.5 \div 0.25 = 6$$



It would take a tortoise 6 hours to travel 1.5 miles.

CHOOSE Your Method

- e. **SCIENCE** A sound wave travels a distance of 700 meters in 2.5 seconds. Find the average speed of the sound wave.

CHECK Your Understanding

Examples 1, 2
(p. 143)

Solve each equation. Check your solution.

1. $6c = 18$

2. $15 = 3z$

3. $-8x = 24$

4. $-9r = -36$

Example 3
(p. 143)

5. **WORKING** Antonia earns \$6 per hour helping her grandmother. How many hours does she need to work to earn \$48?

Example 4
(p. 144)

6. **SWIMMING** A shark can swim at an average speed of about 25 miles per hour. At this rate, how long will it take a shark to swim 60 miles?



Practice and Problem Solving

HOMEWORK HELP

For Exercises	See Examples
7–12	1
13–18	2
19–20	3
21–22	4

Solve each equation. Check your solution.

- | | | |
|-----------------|-----------------|-----------------|
| 7. $7a = 49$ | 8. $9e = 27$ | 9. $2x = -6$ |
| 10. $3y = -21$ | 11. $35 = 5v$ | 12. $72 = 12r$ |
| 13. $-4j = 36$ | 14. $-12y = 60$ | 15. $-4s = -16$ |
| 16. $-6z = -36$ | 17. $48 = -6r$ | 18. $-28 = -7f$ |

For Exercises 19–22, write an equation. Then solve the equation.

19. **MONEY** Brandy wants to buy a digital camera that costs \$300. If she saves \$15 each week, in how many weeks will she have enough money for the camera?
20. **COMPUTERS** The width of a computer monitor is 1.25 times as long as its height. Find the height of the computer monitor at the right.
21. **SPEED** A racecar can travel at a rate of 205 miles per hour. At this rate, how long would it take to travel 615 miles?
22. **INSECTS** A dragonfly, the fastest insect, can fly a distance of 50 feet in about 2 seconds. Find a dragonfly's average speed in feet per second.



Solve each equation. Check your solution.

- | | | |
|-------------------|--------------------|-------------------|
| 23. $0.4x = 9.2$ | 24. $0.9y = 13.5$ | 25. $5.4 = 0.3p$ |
| 26. $9.72 = 1.8a$ | 27. $3.9y = 18.33$ | 28. $2.6b = 2.08$ |



ANALYZE TABLES For Exercises 29 and 30, use the following information.

The table shows women's championship record holders for several track events.

29. Without calculating explain whether Evelyn Ashford or Sanya Richards has the faster average speed.
30. Find the average speed of each athlete in meters per second. Round to the nearest hundredth.

Name	Race (m)	Time (s)
Evelyn Ashford	200	21.88
Sanya Richards	400	49.27

Source: USA Outdoor Track & Field

31. **HURRICANES** A category 3 hurricane reaches speeds up to 20.88 kilometers per hour. The distance from Cuba to Key West is 145 kilometers. Write and solve a multiplication equation to find how long it would take a category 3 hurricane to travel from Cuba to Key West.

32. **WATER** A case of water bottles costs \$9.48. If there are 12 water bottles in the case, find the cost per bottle. Then find the decrease in cost per bottle if the cost of a case is reduced to \$8.64.

Academic Standards • ISTEP+

Extra Practice, pp. 674, 706

H.O.T. Problems

33. **FIND THE ERROR** Steve and Becky are solving $-6x = 72$. Who is correct? Explain.



Steve

$$\begin{aligned} -6x &= 72 \\ \frac{-6x}{-6} &= \frac{72}{-6} \\ x &= -12 \end{aligned}$$

$$\begin{aligned} -6x &= 72 \\ \frac{-6x}{6} &= \frac{72}{6} \\ x &= 12 \end{aligned}$$



Becky

34. **CHALLENGE** Solve $3|x| = 12$. Explain your reasoning.

WRITING IN MATH Write a real-world problem that could be represented by each equation.

35. $2x = 16$

36. $3x = 75$

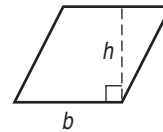
37. $4x = -8$

ISTEP+ PRACTICE**Preparation for 7.2.2, 7.2.1**

38. A football player can run 20 yards in 3.4 seconds. Which equation could be used to find y , the number of yards the football player can run in a second?

- A $20y = 3.4$
 B $3.4 - y = 20$
 C $3.4y = 20$
 D $20 + y = 3.4$

39. **SHORT RESPONSE** Use the formula $A = bh$ to find the base in inches of a rhombus with a height of 7 inches and an area of 56 square inches.

**Spiral Review**

ALGEBRA Solve each equation. Check your solution. (Lesson 3-2)

40. $y + 8 = -2$

41. $x - 7 = -2$

42. $20 = z + 23$

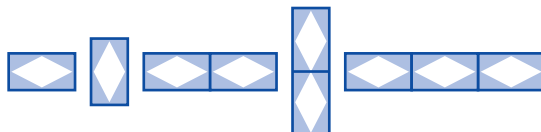
43. **ALGEBRA** Write an algebraic expression for the phrase *the product of -3 and y* . (Lesson 3-1)

44. **MONTHS** A lunar month, the time from one new moon to the next, is 29.5 days. How many days longer is our calendar year of 365 days than 12 lunar months? (Lesson 1-1)

GET READY for the Next Lesson

PREREQUISITE SKILL Draw the next two figures in the pattern. (Lesson 2-7)

45.



Write each sentence as an algebraic equation.

(Lesson 3-1)

- The product of a number and 3 is -16 .
- 10 less than a number is 45.
- CLIMBING** A rock climber is at an altitude of a feet before she climbs up another 80 feet. Write an expression for her new altitude. (Lesson 3-1)



- MULTIPLE CHOICE** Stephanie has 5 dollars more than Necie. If Necie has d dollars, which expression represents the number of dollars Stephanie has? (Lesson 3-1)

A $d - 5$

C $5 - d$

B $d + 5$

D $5d$

Solve each equation. Check your solution.

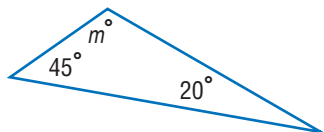
(Lesson 3-2)

- $21 + m = 33$
- $a - 5 = -12$
- $p + 1.7 = -9.8$
- $56 = k - (-33)$



- GEOMETRY** The sum of the measures of the angles of a triangle is 180° . Write and solve an equation to find the missing measure m .

(Lesson 3-2)



- MULTIPLE CHOICE** Trevor's test score was 5 points lower than Ursalina's test score. If Ursalina scored 85 on the test, which equation would give Trevor's score d when solved? (Lesson 3-2)

F $85 = d + 5$

G $d - 5 = 85$

H $80 = d + 5$

J $d - 5 = 80$



- PETS** Cameron has 11 adult Fantail goldfish. This is 7 fewer Fantail goldfish than his friend Julia has. Write and solve a subtraction equation to determine the number of Fantail goldfish g that Julia has. (Lesson 3-2)



- MEASUREMENT** The Grand Canyon has a maximum depth of almost 5,280 feet. An average four-story apartment building has a height of 66 feet. Write and solve a multiplication equation to determine the number of apartment buildings b , stacked on top of each other, that would fill the depth of the Grand Canyon. (Lesson 3-3)

Solve each equation. Check your solution.

(Lesson 3-3)

- $5f = -75$
- $-1.6w = 4.8$
- $63 = 7y$
- $-28 = -2d$
- $3.7g = -4.44$
- $2.25 = 1.5b$



- MULTIPLE CHOICE** Michelann drove 44 miles per hour and covered a distance of 154 miles. Which equation accurately describes this situation if h represents the number of hours Michelann drove?

(Lesson 3-3)

A $154 = 44 + h$

B $44h = 154$

C $154 = 44 \div h$

D $h - 44 = 154$



- LAWN SERVICE** Trey estimates he will earn \$470 next summer cutting lawns in his neighborhood. This amount is 2.5 times the amount a he earned this summer. Write and solve a multiplication equation to find how much Trey earned this summer. (Lesson 3-3)

3-4

Problem-Solving Investigation

MAIN IDEA: Solve problems using the work backward strategy.

Academic Standards

7.3.4 Recognize, describe, or extend geometric patterns using tables, graphs, words, or symbols. **P.1.3** Apply and adapt a variety of appropriate strategies to solve problems.

P.S.I. TEAM +

e-Mail: WORK BACKWARD

MIGUEL: Yesterday, I earned extra money by doing yardwork for my neighbor. Then I spent \$5.50 at the convenience store and four times that amount at the bookstore. Now I have \$7.75 left.

YOUR MISSION: **Work backward** to find how much money Miguel had before he went to the convenience store and the bookstore.



Understand	You know he has \$7.75 left. You need to find the amount he started with.	
Plan	Start with the end result and work backward.	
Solve	<p>He has \$7.75 left.</p> <p>Undo the four times \$5.50 spent at the bookstore. Since 5.50×4 is 22, add \$7.75 and 22.</p> <p>Undo the \$5.50 spent at the convenience store. Add \$5.50 and \$29.75.</p> <p>So, Miguel had \$35.25 to start with.</p>	$\begin{array}{r} \$7.75 \\ + 22.00 \\ \hline \$29.75 \\ + \$5.50 \\ \hline \$35.25 \end{array}$
Check	Assume Miguel started with \$35.25. After going to the convenience store, he had $35.25 - 5.50$ or \$29.75. He spent four times the amount he spent at the convenience store at the bookstore. So, he had $29.75 - 4(\$5.50)$ or \$7.75 left. So, \$35.25 is correct. ✓	

Analyze The Strategy

1. Explain when you would use the work backward strategy to solve a problem.
2. Describe how to solve a problem by working backward.
3. **WRITING IN MATH** Write a problem that could be solved by working backward. Then write the steps you would take to find the solution to your problem.

Use the *work backward* strategy to solve Exercises 4–7.

- MONEY** Marisa spent \$8 on a movie ticket. Then she spent \$5 on popcorn and one half of what was left on a drink. She has \$2 left. How much did she have initially?
- NUMBER THEORY** A number is multiplied by -3 . Then 6 is subtracted from the product. After adding -7 , the result is -25 . What is the number?
- TIME** Timothy's morning schedule is shown. At what time does Timothy wake up?

Timothy's Schedule	
Activity	Time
Wakes up	■
Get ready for school – 45 min	■
Walk to school – 25 min	9:00 A.M.

- LOGIC** A small box has 4 tennis balls inside it. There are 6 of these small boxes inside a medium box. There are 8 medium boxes inside each large box, and there are 100 large boxes shipped in a large truck. How many tennis balls are on the truck?



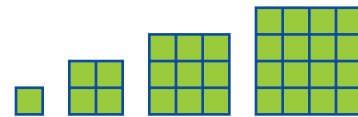
Use any strategy to solve Exercises 8–15. Some strategies are shown below.

PROBLEM-SOLVING STRATEGIES

- Guess and check.
- Look for a pattern.
- Work backward.

- GEOGRAPHY** The land area of North Dakota is 68,976 square miles. This is about 7 times the land area of Vermont. Estimate the land area of Vermont.
- AGE** Brie is two years older than her sister Kiana. Kiana is 4 years older than their brother Jeron, who is 8 years younger than their brother Trey. Trey is 16 years old. How old is Brie?

- ELEVATION** New Orleans, Louisiana, has an elevation of -8 feet related to sea level. Death Valley, California, is 274 feet lower than New Orleans. What is the elevation of Death Valley?
- GEOMETRY** Draw the sixth figure in the pattern shown.



- WATERFALLS** Angel Falls in Venezuela, the highest waterfall in the world, is 3,212 feet high. It is 87 feet higher than 2.5 times the height of the Empire State Building. Find the height of the Empire State Building.
- AIRCRAFT** An aircraft carrier travels about 6 inches per gallon of fuel. Raquel's car travels about 28 miles per gallon of fuel. If there are 5,280 feet in one mile, how many more inches per gallon would Raquel's car get than an aircraft carrier?
- SCHOOL SUPPLIES** Alexandra wishes to buy 5 pens, 1 ruler, and 7 folders to start the school year. The prices are shown in the table.

Item	Cost
Pens	\$2.09
Ruler	\$0.99
Folder	\$1.19

If there is no tax, is \$20 enough to pay for Alexandra's school supplies? Explain your reasoning.

- MONEY** Antonio has saved \$25 in cash to spend at the arcade. If he has 10 bills, how many of each kind of bill does he have?

READING to SOLVE PROBLEMS

Simplify the Problem

Have you ever tried to solve a long word problem and didn't know where to start? Try to rewrite the problem using only the most important words. Here's an example.

STEP 1 Read the problem and identify the important words and numbers.

CELL PHONES There is a wide range of cell phone plans available for students. With Janelle's plan, she pays \$15 per month for 200 minutes, plus \$0.10 per minute once she talks for more than 200 minutes. Suppose Janelle can spend \$20 each month for her cell phone. How many minutes can she talk?

STEP 2 Simplify the problem. Keep all of the important words and numbers, but use fewer of them.

The total monthly cost is the \$15 for 200 minutes plus \$0.10 times the number of minutes over 200. How many minutes can she talk for \$20?

STEP 3 Simplify it again. Use a variable for the unknown.

The cost of m minutes at \$0.10 per minute plus \$15 is \$20.

PRACTICE

Use the method above to simplify each problem.

- MONEY** Akira is saving money to buy a scooter that costs \$125. He has already saved \$80 and plans to save an additional \$5 each week. In how many weeks will he have enough money for the scooter?
- SHOPPING** Online shopping is a popular way to buy books. Cheryl wants to order several books that cost \$7 each. In addition, she will pay a shipping fee of \$8. How many books can she order with \$43?
- TEMPERATURE** The current temperature is 40° . It is expected to rise 5° each hour for the next several hours. In how many hours will the temperature be 60° ?
- MONEY** Joaquin wants to buy some DVDs that are each on sale for \$10 plus a CD that costs \$15. How many DVDs can he buy if he has \$75 to spend?

Academic Standards

P.1.3 Apply and adapt a variety of appropriate strategies to solve problems
Also addresses P.4.2.

3-5

Solving Two-Step Equations

MAIN IDEA

Solve two-step equations.

IN Academic Standards

7.2.2 Write and solve two-step linear equations and inequalities in one variable.

New Vocabulary
two-step equation

IN Math Online

glencoe.com

- Concepts In Motion
- Extra Examples
- Personal Tutor
- Self-Check Quiz

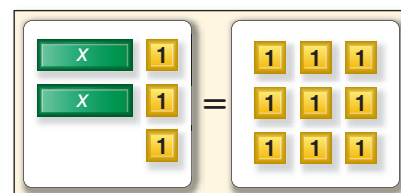
MINI Lab

MONEY A florist charges \$2 for each balloon in an arrangement and a \$3 delivery fee. You have \$9 to spend. The model illustrates the equation $2x + 3 = 9$, where x represents the number of balloons.

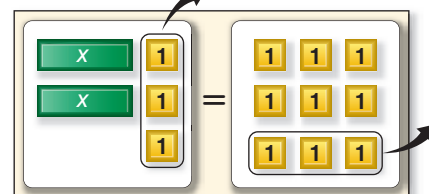
To solve $2x + 3 = 9$, remove three 1-tiles from each side of the mat. Then divide the remaining tiles into two equal groups. The solution of $2x + 3 = 9$ is 3.

Solve each equation by using models or a drawing.

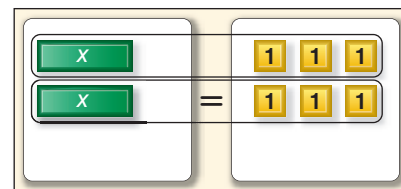
- $2x + 1 = 5$
- $3x + 2 = 8$
- $2 = 5x + 2$



$$2x + 3 = 9$$



$$2x + 3 - 3 = 9 - 3$$



$$x = 3$$

A **two-step equation** has two different operations. To solve a two-step equation, undo the operations in reverse order of the order of operations. You can review the order of operations in Lesson 1-4.

EXAMPLE

Solve a Two-Step Equation

- 1** Solve $2x + 3 = 9$. Check your solution.

$$2x + 3 = 9 \quad \text{Write the equation.}$$

$$\underline{-3 = -3} \quad \text{Undo the addition first by subtracting 3 from each side.}$$

$$2x = 6$$

$$\underline{\frac{2x}{2} = \frac{6}{2}} \quad \text{Next, undo the multiplication by dividing each side by 2.}$$

$$x = 3 \quad \text{Simplify.}$$

Check the solution. Since $2(3) + 3 = 9$, the solution is 3.

CHECK Your Progress

Solve each equation. Check your solution.

a. $2x + 4 = 10$

b. $3x + 1 = 7$

c. $5 = 2 + 3x$

**EXAMPLES****Solve Two-Step Equations****Study Tip****Order of Operations**

Multiplication comes before addition in the order of operations. To undo these operations, reverse the order. So, undo the addition first by subtracting. Then, undo the multiplication by dividing.

2 Solve $3x + 2 = 23$. Check your solution.

$$3x + 2 = 23$$

Write the equation.

$$\underline{-2 = -2}$$

Undo the addition first by subtracting 2 from each side.

$$3x = 21$$

Divide each side by 3.

$$\frac{3x}{3} = \frac{21}{3}$$

Simplify.

$$x = 7$$

Check $3x + 2 = 23$

Write the original equation.

$3(7) + 2 \stackrel{?}{=} 23$

Replace x with 7.

$21 + 2 \stackrel{?}{=} 23$

Simplify.

$23 = 23 \checkmark$ The sentence is true.

The solution is 7.

3 Solve $-2y - 7 = 3$. Check your solution.

$$-2y - 7 = 3$$

Write the equation.

$$\underline{+7 = +7}$$

Undo the subtraction first by adding 7 to each side.

$$-2y = 10$$

Divide each side by -2 .

$$\frac{-2y}{-2} = \frac{10}{-2}$$

Simplify.

$$y = -5$$

The solution is -5 . Check the solution.**4** Solve $4 + 5r = -11$. Check your solution.

$$4 + 5r = -11$$

Write the equation.

$$\underline{-4 = -4}$$

Undo the addition of 4 first by subtracting 4 from each side.

$$5r = -15$$

Divide each side by 5.

$$\frac{5r}{5} = \frac{-15}{5}$$

Simplify.

$$r = -3$$

The solution is -3 . Check the solution.**Study Tip****Equations**

Remember, solutions of the new equation are also solutions of the original equation.

✓ CHECK Your Progress

Solve each equation. Check your solution.

d. $4x + 5 = 13$

e. $8y + 15 = 71$

f. $-3n - 8 = 7$

g. $-5s + 8 = -2$

h. $1 + 2y = -3$

i. $-2 + 6w = 10$

Solving Two-Step Equations**Key Concept**To solve a two-step equation like $3x + 4 = 16$ or $2x - 1 = -3$:**Step 1** Undo the addition or subtraction first.**Step 2** Then undo the multiplication or division.



Some real-world situations start with a given amount and increase at a certain rate.

Real-World EXAMPLE



Real-World Link . . .
Most teenagers see more than 7 movies a year.
Source: Gallup News Service

5 MOVIES Aisha wants to have her birthday party at the movies. It costs \$27 for pizza and \$8.50 per friend for the movie tickets. Since it is Aisha's birthday, she does not have to pay for her movie ticket. How many friends can Aisha have at her party if she has \$78 to spend?

Words	Cost of pizza	plus	cost of 1 friend	times	number of friends	equals \$78.
Variable	Let n represent the number of friends.					
Equation	27	+	8.50	·	n	= 78

$$\begin{array}{r}
 27 + 8.50n = 78 \\
 \underline{-27} \qquad \qquad \qquad = \underline{-27} \\
 8.50n = 51 \\
 \underline{\frac{8.50n}{8.50} = \frac{51}{8.50}} \\
 n = 6
 \end{array}$$

Write the equation.
Subtract 27 from each side.
Divide each side by 8.50.
 $51 \div 8.50 = 6$

Check $27 + 8.50n = 78$ Write the original equation.
 $27 + 8.50(6) \stackrel{?}{=} 78$ Replace n with 6.
 $27 + 51 \stackrel{?}{=} 78$ Simplify.
 $78 = 78$ ✓ The sentence is true.



Aisha can have 6 friends at her party.

CHECK Your Progress

j. **FITNESS** A fitness club is having a special offer where you pay \$22 to join plus a \$16 monthly fee. You have \$150 to spend. Write and solve an equation to find how many months you can use the fitness club.

CHECK Your Understanding

Examples 1–4
(pp. 151–152)

Solve each equation. Check your solution.

- | | |
|--------------------|-------------------|
| 1. $3x + 1 = 7$ | 2. $4h - 6 = 22$ |
| 3. $-6r + 1 = -17$ | 4. $-3y - 5 = 10$ |
| 5. $13 = 1 + 4s$ | 6. $-7 = 1 + 2n$ |

Example 5
(p. 153)

7. **MONEY** Syreeta wants to buy some CDs, each costing \$14, and a DVD that cost \$23. She has \$65 to spend. Write and solve an equation to find how many CDs she can buy.



Practice and Problem Solving

HOMEWORK HELP

For Exercises	See Examples
8–11	1, 2
12–15	3
16–19	4
20–21	5

Solve each equation. Check your solution.

- | | | |
|--------------------|---------------------|---------------------|
| 8. $3x + 1 = 10$ | 9. $5x + 4 = 19$ | 10. $2t + 7 = -1$ |
| 11. $6m + 1 = -23$ | 12. $-4w - 4 = 8$ | 13. $-7y + 3 = -25$ |
| 14. $-8s + 1 = 33$ | 15. $-2x + 5 = -13$ | 16. $3 + 8n = -5$ |
| 17. $5 + 4d = 37$ | 18. $14 + 2p = 8$ | 19. $25 + 2y = 47$ |

For Exercises 20 and 21, write an equation. Then solve the equation.

20. **BICYCLES** Cristiano is saving money to buy a new bike that costs \$189. He has saved \$99 so far. He plans on saving \$10 each week. In how many weeks will Cristiano have enough money to buy a new bike?
21. **PETTING ZOOS** It cost \$10 to enter a petting zoo. Each cup of food to feed the animals is \$2. If you have \$14, how many cups of food can you buy?

Solve each equation. Check your solution.

- | | | |
|-----------------------|-----------------------|-----------------------|
| 22. $2r - 3.1 = 1.7$ | 23. $4t + 3.5 = 12.5$ | 24. $16b - 6.5 = 9.5$ |
| 25. $5w + 9.2 = 19.7$ | 26. $16 = 0.5r - 8$ | 27. $0.2n + 3 = 8.6$ |

For Exercises 28 and 29, write an equation. Then solve the equation.

28. **CELL PHONES** A cell phone company charges a monthly fee of \$39.99 for unlimited *off-peak* minutes on the nights and weekends but \$0.45 for each *peak* minute during the weekday. If Brad's monthly cell phone bill was \$62.49, for how many *peak* minutes did he get charged?
29. **PLANTS** In ideal conditions, bamboo can grow 47.6 inches each day. At this rate, how many days will it take a bamboo shoot that is 8 inches tall to reach a height of 80 feet?

TEMPERATURE For Exercises 30 and 31, use the following information and the table.

Temperature is usually measured on the Fahrenheit scale ($^{\circ}\text{F}$) or the Celsius scale ($^{\circ}\text{C}$). Use the formula $F = 1.8C + 32$ to convert from one scale to the other.

Alaska Record Low Temperatures ($^{\circ}\text{F}$) by Month	
January	-80
April	-50
July	16
October	-48

30. Convert the temperature for Alaska's record low in July to Celsius. Round to the nearest degree.
31. Hawaii's record low temperature is -11°C . Find the difference in degrees Fahrenheit between Hawaii's record low temperature and the record low temperature for Alaska in January.



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Extra Practice, pp. 675, 706

H.O.T. Problems

32. **CHALLENGE** Refer to Exercises 30 and 31. Is there a temperature at which the number of Celsius degrees is the same as the number of Fahrenheit degrees? If so, find it. If not, explain why not.
33. **CHALLENGE** Suppose your school is selling magazine subscriptions. Each subscription costs \$20. The company pays the school half of the total sales in dollars. The school must also pay a one-time fee of \$18. What is the fewest number of subscriptions that can be sold to earn a profit of \$200?
34. **SELECT A TECHNIQUE** Bianca rented a car for a flat fee of \$19.99 plus \$0.26 per mile. Which of the following techniques might she use to determine the approximate number of miles she can drive for \$50? Justify your selection(s). Then use the technique(s) to solve the problem.

Mental Math

Number Sense

Estimation

35. **WRITING IN MATH** Write a real-world problem that would be represented by the equation $2x + 5 = 15$.

ISTEP+ PRACTICE 7.2.2

36. A rental car company charges \$30 a day plus \$0.05 a mile. Which expression could be used to find the cost of renting a car for m miles?
- A $30.05m$
 B $30m + 0.05m$
 C $30 + 0.05m$
 D $30m + 0.05$
37. The Rodriguez family went on a vacation. They started with \$1,875. If they spent \$140 each day, which expression represents how much money they had after d days?
- F $1,735d$
 G $1,875 - 140d$
 H $140d$
 J $1,875 + 140d$

Spiral Review

38. **SCHEDULES** Jaime needs to be at the bus stop by 7:10 A.M. If it takes her 7 minutes to walk to the bus stop and 40 minutes to get ready in the morning, what is the latest time that she can set her alarm in order to be at the bus stop 5 minutes earlier than she needs to be? (Lesson 3-4)

ALGEBRA Solve each equation. Check your solution. (Lessons 3-2 and 3-3)

39. $4f = 28$

40. $-3y = -15$

41. $p - 14 = 27$

42. $-11 = n + 2$

43. **HIKING** Two people are hiking in the Grand Canyon. One is 987 feet below the rim and the other is 1,200 feet below the rim. Find the vertical distance between them (Lesson 2-5)

GET READY for the Next Lesson**PREREQUISITE SKILL** Multiply or divide.

44. 2.5×20

45. 3.5×4

46. $4,200 \div 2.1$

47. $104 \div 6.5$

Measurement: Perimeter and Area

MAIN IDEA

Find the perimeters and areas of figures.

IN Academic Standards

7.2.4 Solve an equation or formula with two variables for a particular variable.

New Vocabulary

perimeter
area

IN Math Online

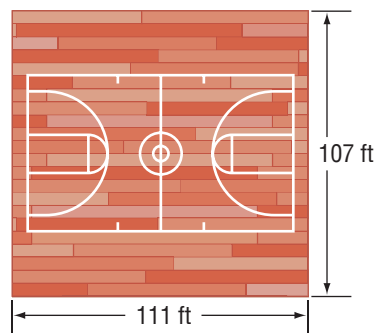
glencoe.com

- Extra Examples
- Personal Tutor
- Self-Check Quiz

▶ GET READY for the Lesson

MEASUREMENT At the end of gym class, Mrs. Dalton has the students run around the perimeter of the gym.

1. If the students run around the gym 5 times, how far would they run?
2. Explain how you can use both multiplication and addition to find the distance.



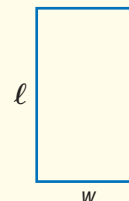
The distance around a geometric figure is called the **perimeter**. To find the perimeter of a rectangle, you can use these formulas.

Perimeter of a Rectangle

Key Concept

Words The perimeter P of a rectangle is twice the sum of the length ℓ and width w .

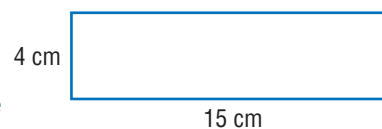
Model



Symbols $P = \ell + \ell + w + w$
 $P = 2\ell + 2w$ or $2(\ell + w)$

EXAMPLE Find the Perimeter of a Rectangle

- 1** Find the perimeter of the rectangle shown at the right.



$$P = 2\ell + 2w \quad \text{Perimeter of a rectangle}$$

$$P = 2(15) + 2(4) \quad \text{Replace } \ell \text{ with 15 and } w \text{ with 4.}$$

$$P = 30 + 8 \quad \text{Multiply.}$$

$$P = 38 \quad \text{Add.}$$

The perimeter is 38 centimeters.

✓ CHECK Your Progress

- a. Find the perimeter of a rectangle whose length is 14.5 inches and width is 12.5 inches.



Real-World EXAMPLE

Find a Missing Side

- 2 GARDENS** Elan is designing a rectangular garden. He wants the width to be 8 feet. He also wants to put a fence around the garden. If he has 40 feet of fencing, what is the greatest length the garden can be?

$$\begin{array}{ll}
 P = 2\ell + 2w & \text{Perimeter of a rectangle} \\
 40 = 2\ell + 2(8) & \text{Replace } P \text{ with } 40 \text{ and } w \text{ with } 8. \\
 40 = 2\ell + 16 & \text{Multiply.} \\
 \underline{-16 = -16} & \text{Subtract 16 from each side.} \\
 24 = 2\ell & \text{Simplify.} \\
 12 = \ell & \text{Divide each side by 2.}
 \end{array}$$



The greatest length the garden can be is 12 feet.



CHECK Your Progress

- b. **FRAMES** Angela bought a frame for a photo of her friends. The width of the frame is 8 inches. If the distance around the frame is 36 inches, what is the length of the frame?

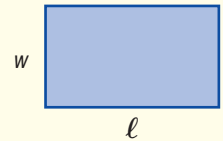
The distance *around* a rectangle is its perimeter. The measure of the surface *enclosed* by a rectangle is its **area**.

Area of a Rectangle

Key Concept

Words The area A of a rectangle is the product of the length ℓ and width w .

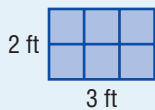
Model



Symbols $A = \ell w$

Study Tip

Area Units
When finding area, the units are also multiplied. So, area is given in *square units*. Consider a rectangle 2 ft by 3 ft.



$$\begin{aligned}
 A &= 2 \text{ ft} \cdot 3 \text{ ft} \\
 A &= (2 \cdot 3)(\text{ft} \cdot \text{ft}) \\
 A &= 6 \text{ ft}^2
 \end{aligned}$$

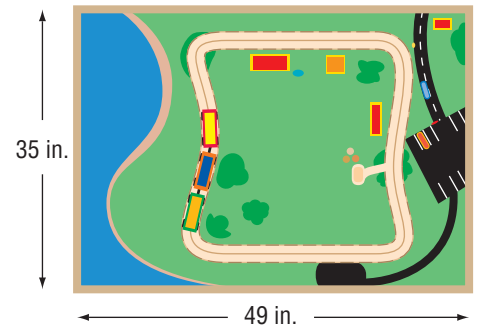
EXAMPLE

Find the Area of a Rectangle

- 3 TOYS** Find the area of the top of the wooden train table shown at the right.

$$\begin{array}{ll}
 A = \ell w & \text{Area of a rectangle} \\
 A = 49 \cdot 35 & \text{Replace } \ell \text{ with } 49 \\
 & \text{and } w \text{ with } 35. \\
 A = 1,715 & \text{Multiply.}
 \end{array}$$

The area is 1,715 square inches.



CHECK Your Progress

- c. **VIDEO GAMES** Find the perimeter and area of the top of a video game console that measures 18 inches long and 15 inches wide.

**EXAMPLE****Use Area to Find a Missing Side**

- 4 The area of a rectangle is 53.94 square feet. If the width is 8.7 feet, find the length.

METHOD 1**Substitute, then solve.**

$$A = \ell w$$

Write the equation.

$$53.94 = \ell(8.7)$$

Replace A with 53.94 and w with 8.7.

$$\frac{53.94}{8.7} = \frac{\ell(8.7)}{8.7}$$

Divide each side by 8.7.

$$\ell = 6.2$$

Simplify.

METHOD 2**Solve, then substitute.**

$$A = \ell w$$

Write the equation.

$$\frac{A}{w} = \frac{\ell w}{w}$$

Divide each side by w .

$$\frac{A}{w} = \ell$$

Simplify.

$$\frac{53.94}{8.7} = \ell$$

Replace A with 53.94 and w with 8.7.

$$\ell = 6.2$$

Simplify.

So, the length of the rectangle is 6.2 feet.

✓ CHOOSE Your Method

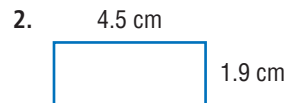
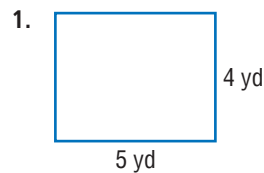
- d. What is the width of a rectangle that has an area of 135 square meters and a length of 9 meters?

Study Tip**Check for Reasonableness**

You know that $53.94 \approx 54$ and that $8.77 \approx 9$. Since $54 \div 9 = 6$, the answer is reasonable.

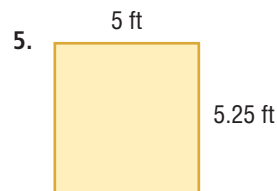
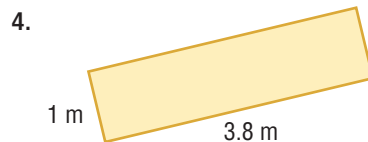
✓ CHECK Your Understanding

- Example 1** Find the perimeter of each rectangle.
(p. 156)



- Example 2** 3. **PHOTOGRAPHY** A photograph is 5 inches wide. The perimeter of the photograph is 24 inches. What is the length of the photograph?
(p. 157)

- Example 3** Find the area of each rectangle.
(p. 157)



- Example 4** 6. **MEASUREMENT** The area and length of a rectangle are 30 square feet and 6 feet, respectively. What is the width of the rectangle?
(p. 158)

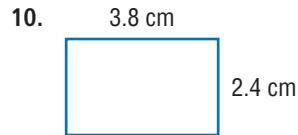
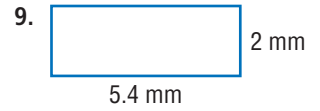
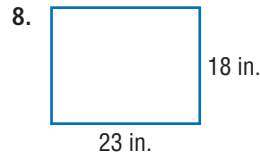
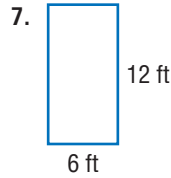


Practice and Problem Solving

HOMEWORK HELP

For Exercises	See Examples
7–12	1
13–14	2
15–20	3
21–22	4

Find the perimeter of each rectangle.



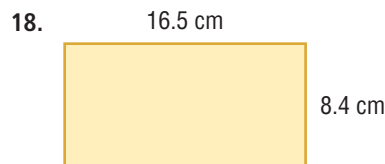
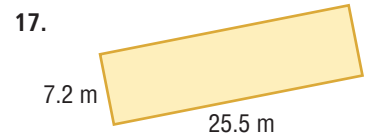
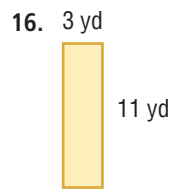
11. $\ell = 1.5$ ft,
 $w = 4$ ft

12. $\ell = 5.75$ ft,
 $w = 8$ ft

13. **SEWING** The fringe used to outline a placemat is 60 inches. If the width of the placemat is 12 inches, what is the measure of its length?

14. **GAMES** Orlando marks off a rectangular section of grass to use as a playing field. He knows that he needs to mark off 111 feet around the border of the playing field. If the field is 25.5 feet long, what is its width?

Find the area of each rectangle.



19. $\ell = 3.25$ in.,
 $w = 2$ in.

20. $\ell = 4.5$ ft,
 $w = 10.6$ ft

21. **QUILTING** Daniela's grandmother is making a quilt that is 7 squares wide. If she needs 35 squares total, how many squares long is the length?

22. **PAINTING** A rectangular mural is painted on a wall. If the mural is 12 feet wide and covers 86.4 square feet, what is the height of the mural?

Find the missing measure.

23. $P = 115.6$ ft, $w = 24.8$ ft

24. $A = 189.28$ cm², $w = 16.9$ cm

ANALYZE TABLES For Exercises 25 and 26, use the table shown.

25. How much greater is the area of a soccer field for a 14-year-old than for a 10-year-old?

26. An *acre* equals 4,840 square yards. How many acres are there in a field for a 12-year-old? Round to the nearest hundredth.

Youth Soccer Fields		
Age (years)	Length (yards)	Width (yards)
10	70	40
12	80	50
14	100	60



For Exercises 27–30, determine whether the problem involves perimeter, area, or both. Then solve.



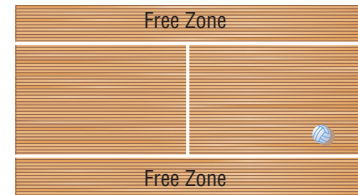
27. **HIKING** Ramón walked along a rectangular hiking path. Initially, he walked 3 miles north before he turned east. If he walked a total of 14 miles, how many miles did he walk east before he turned south?
28. **BORDERS** Kaitlyn’s bedroom is shaped like a rectangle with rectangular walls. She is putting a wallpaper border along the top of the two longer walls and one of the shorter walls. If the length of the room is 13 feet and the width is 9.8 feet, how many feet of border does she need?
29. **DECKS** Armando built a rectangular deck in his backyard. The deck takes up 168.75 square feet of space. If the deck’s width is 12.8 feet, what is its approximate length?
30. **FENCING** Kina plans to fence her rectangular backyard on three sides. Her backyard measures 48 feet in length. She will not fence one of the shorter sides. If the area of her backyard is 1,752 square feet, how many feet of fencing is required?



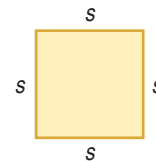
Real-World Link
Regulation volleyball courts are 18 meters long by 9 meters wide, not including the free zone.

Source: USA Volleyball

31. **VOLLEYBALL** For safety, regulation courts have a “free zone” added to the width of each side of the court. If the free zone on each side is 3 meters wide, use the information to the left to find the area of the entire volleyball court including the free zone.



32. **GEOMETRY** Use the diagram at the right to write formulas for the perimeter P and area A of a square.



33. **FIND THE DATA** Refer to the Data File on pages 16–19. Choose some data and write a real-world problem in which you would find the perimeter and area of a rectangle.

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Extra Practice, pp. 675, 706



H.O.T. Problems

34. **OPEN ENDED** Draw and label three different rectangles that have an area of 24 square centimeters.

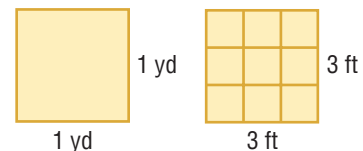
CHALLENGE For Exercises 35–38, find each equivalent measurement. Provide a diagram to justify your answers. The diagram for Exercise 35 is shown.

35. $1 \text{ yd}^2 = \square \text{ ft}^2$

36. $4 \text{ yd}^2 = \square \text{ ft}^2$

37. $1 \text{ ft}^2 = \square \text{ in}^2$

38. $2 \text{ ft}^2 = \square \text{ in}^2$



NUMBER SENSE For Exercises 39 and 40, describe the effect on the perimeter and area in each of the following situations.

39. The width of a rectangle is doubled.
40. The length of a side of a square is doubled.

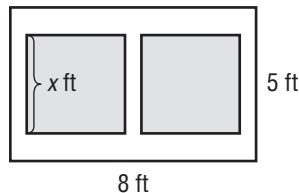


41. **CHALLENGE** A rectangle has width w . Its length is one unit more than 3 times its width. Write an expression that represents the perimeter of the rectangle.
42. **WRITING IN MATH** Decide whether the statement is *true* or *false*. Explain your reasoning and provide examples.

Of all rectangles with a perimeter of 24 square inches, the one with the greatest area is a square.

ISTEP+ PRACTICE 7.2.4

43. Oakland Garden Center created a design plan for the Nelson family's rock garden. The shaded areas will hold flowers and the rest of the garden will be rock.



If each shaded area is a square, which expression represents the area of the garden that will be rock?

- A $(40 - 2x^2)$ ft² C $(40 + x)$ ft²
 B $(40 - x)$ ft² D $(40 + x^2)$ ft²

44. The rectangle below has width 4.75 feet and perimeter P feet.



Which of the following could be used to find the length of the rectangle?

- F $P = 4.75 + \frac{\ell}{2}$
 G $P = 4.75 - \ell$
 H $P = 9.5 + 2\ell$
 J $P = 9.5 - 2\ell$

Spiral Review

Solve each equation. Check your solution. (Lesson 3-5)

45. $5d + 12 = 2$ 46. $13 - f = 7$ 47. $10 = 2g + 3$ 48. $6 = 3 - 3h$

49. **ALGEBRA** Anna was charged \$11.25 for returning a DVD 5 days late. Write and solve an equation to find how much the video store charges per day for late fees. (Lesson 3-3)

Multiply. (Lesson 2-6)

50. $14(-5)$ 51. $(-3)^3$ 52. $-10(2)(-8)$

53. **AGE** The sum of Denise's and Javier's ages is 26 years. If Denise is 4 years older than Javier, find Javier's age. Use the *guess and check* strategy. (Lesson 1-5)

GET READY for the Next Lesson

PREREQUISITE SKILL Graph and label each point on a coordinate plane. (Lesson 2-3)

54. $(-4, 2)$ 55. $(3, -1)$ 56. $(-3, -4)$ 57. $(2, 0)$

Explore 3-7

Measurement Lab Representing Relationships

In this lab, you will investigate the relationships between the dimensions and the perimeter of a rectangle.

MAIN IDEA

Graph data to demonstrate the relationship between the dimensions and the perimeter of a rectangle.

IN Academic Standards

7.2.1 Use variables and appropriate operations to write an expression, equation or inequality that represents a verbal description.

7.3.4 Recognize, describe, or extend geometric patterns using tables, graphs, words, or symbols.

ACTIVITY

STEP 1 Use 10 chenille stems, 24 centimeters in length, to form 10 rectangles with different dimensions.



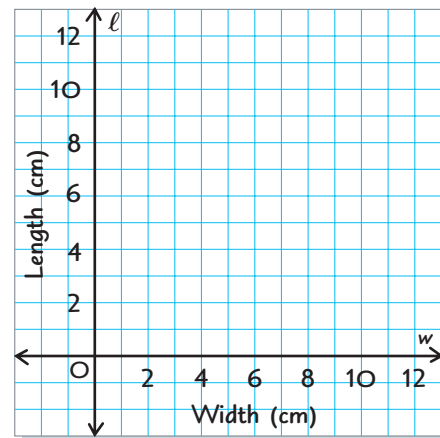
STEP 2 Measure and record the width and length of each rectangle to the nearest centimeter in a table like the one at the right.

Width (cm)	Length (cm)

ANALYZE THE RESULTS

1. What rectangle measure does 24 centimeters represent?
2. Find the sum of the width and length for each of your rectangles. Write a sentence that describes the relationship between this sum and the measure of the length of the stem for each rectangle. Then write a rule that describes this relationship for a rectangle with a width w and length l .
3. In this activity, if a rectangle has a length of 4.5 centimeters, what is its width? Explain your reasoning. Write a rule that can be used to find w when l is known for any rectangle in this Activity.

4. **GRAPH THE DATA** Graph the data in your table on a coordinate plane like the one at the right.
5. Describe what the ordered pair (w, l) represents. Describe how these points appear on the graph.
6. Use your graph to find the width of a rectangle with a length of 7 centimeters. Explain your method.



7. **MAKE A CONJECTURE** If the length of each chenille stem was 20 centimeters, how would this affect the data in your table? the rule you wrote in Exercise 3? the appearance of your graph?

3-7

Functions and Graphs

MAIN IDEA

Graph data to demonstrate relationships.

IN Academic Standards

Preparation for 8.2.4

Identify and graph linear functions and identify lines with positive and negative slope. *Also addresses P.4.1.*

New Vocabulary

linear equation

IN Math Online

glencoe.com

- Extra Examples
- Personal Tutor
- Self-Check Quiz

▶ GET READY for the Lesson

MONEY The Westerville Marching Band is going on a year-end trip to an amusement park. Each band member must pay an admission price of \$15. In the table, this is represented by $15m$.

Total Cost of Admission		
Number of Members	$15m$	Total Cost (\$)
1	$15(1)$	15
2	$15(2)$	30
3	$15(3)$	
4		
5		
6		

1. Copy and complete the function table for the total cost of admission.
2. Graph the ordered pairs (number of members, total cost).
3. Describe how the points appear on the graph.

If you are given a function, ordered pairs in the form (input, output), or (x, y) , provide useful information about that function. These ordered pairs can then be graphed on a coordinate plane and form part of the graph of the function. The graph of the function consists of the points in the coordinate plane that correspond to *all* the ordered pairs of the form (input, output).

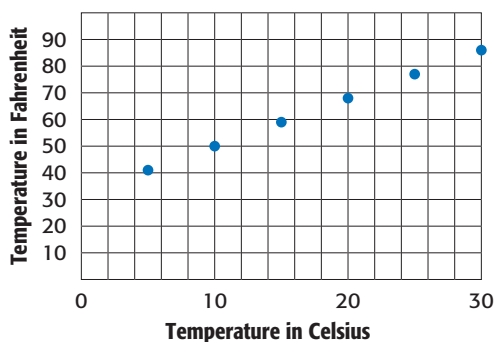
Real-World EXAMPLE

1 TEMPERATURE The table shows temperatures in Celsius and the corresponding temperatures in Fahrenheit. Make a graph of the data to show the relationship between Celsius and Fahrenheit.

The ordered pairs (5, 41), (10, 50), (15, 59), (20, 68), (25, 77), and (30, 86) represent this function. Graph the ordered pairs.

Celsius (input)	Fahrenheit (output)
5	41
10	50
15	59
20	68
25	77
30	86

Celsius to Fahrenheit





Review Vocabulary

function a relation in which each element of the input is paired with exactly one element of the output according to a specified rule (Lesson 1-10)

CHECK Your Progress

- a. **MUSIC** The table shows the money remaining on a \$75 gift certificate after a certain number of CDs are bought. Make a graph to show how the number of CDs bought and the remaining balance are related.

\$75 Music Gift Certificate	
Number of CDs	Balance (\$)
1	63
2	51
3	39
4	27
5	15

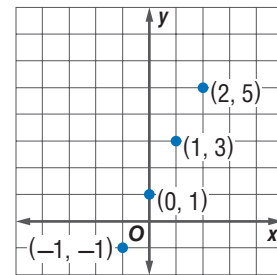
The solution of an equation with two variables consists of two numbers, one for each variable, that make the equation true. The solution is usually written as an ordered pair (x, y) .

EXAMPLE Graph Solutions of Linear Equations

2 Graph $y = 2x + 1$.

Select any four values for the input x . We chose 2, 1, 0, and -1 . Substitute these values for x to find the output y .

x	$2x + 1$	y	(x, y)
2	$2(2) + 1$	5	(2, 5)
1	$2(1) + 1$	3	(1, 3)
0	$2(0) + 1$	1	(0, 1)
-1	$2(-1) + 1$	-1	$(-1, -1)$



The four inputs correspond to the solutions $(2, 5)$, $(1, 3)$, $(0, 1)$, and $(-1, -1)$. By graphing these ordered pairs, you can create the graph of $y = 2x + 1$.

CHECK Your Progress Graph each equation.

b. $y = x - 3$

c. $y = -3x$

d. $y = -3x + 2$

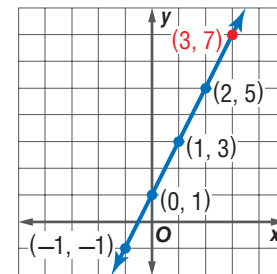
Study Tip

Graphing Equations
Only two points are needed to graph the line. However, graph more points to check accuracy.



Notice that all four points in the graph lie on the same straight line. Draw a line through the points to graph *all* solutions of the equation $y = 2x + 1$. Note that the point $(3, 7)$ is also on this line.

$y = 2x + 1$ Write the equation.
 $7 \stackrel{?}{=} 2(3) + 1$ Replace x with 3 and y with 7.
 $7 = 7$ ✓ This sentence is true.



So, $(3, 7)$ is also a solution of $y = 2x + 1$. An equation like $y = 2x + 1$ is called a **linear equation** because its graph is a straight line.



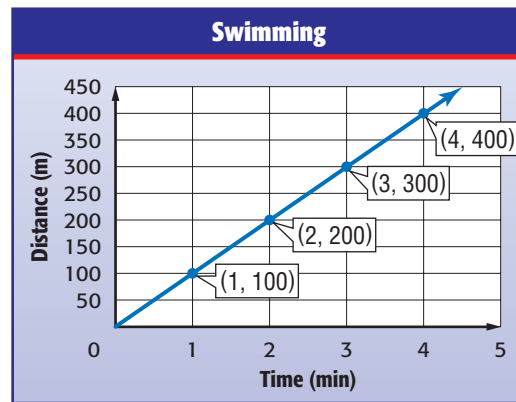
Real-World EXAMPLE

3 SWIMMING Michael Phelps swims the 400-meter individual medley at an average speed of 100 meters per minute. The equation $d = 100t$ describes the distance d that he can swim in t minutes at this speed. Represent the function by a graph.

Step 1 Select any four values for t . Select only positive numbers because t represents time. Make a function table.

t	$100t$	d	(t, d)
1	100(1)	100	(1, 100)
2	100(2)	200	(2, 200)
3	100(3)	300	(3, 300)
4	100(4)	400	(4, 400)

Step 2 Graph the ordered pairs and draw a line through the points.



✓ CHECK Your Progress

e. **JOBS** Sandi makes \$6 an hour babysitting. The equation $m = 6h$ describes how much money m she earns babysitting for h hours. Represent this function by a graph.

Representing Functions

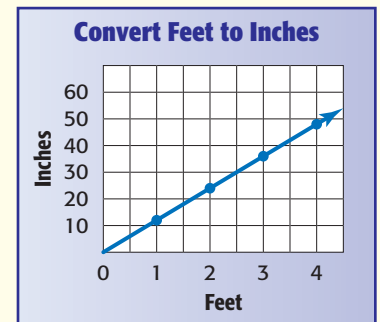
Key Concept

Words There are 12 inches in one foot.

Table

Feet	Inches
1	12
2	24
3	36
4	48

Graph



Equation $f = 12n$, where f represents the number of feet and n represents the number of inches.



CHECK Your Understanding

Example 1 Graph the function represented by each table.
(p. 163)

1.

Total Cost of Baseballs	
Baseball	Total Cost (\$)
1	4
2	8
3	12
4	16

2.

Convert Minutes to Seconds	
Minutes	Seconds
1	60
2	120
3	180
4	240

Example 2 Graph each equation.
(p. 164)

3. $y = x - 1$

4. $y = -1x$

5. $y = -2x + 3$

Example 3 6. **MEASUREMENT** The perimeter of a square is 4 times greater than the length of one of its sides. The equation $p = 4s$ describes the perimeter p of a square with sides s units long. Represent this function by a graph.
(p. 165)

Practice and Problem Solving

HOMEWORK HELP

For Exercises	See Examples
7-8	1
9-14	2
15-16	3

Graph the function represented by each table.

7.

Total Phone Bill	
Time (min)	Total (c)
1	8
2	16
3	24
4	32

8.

Calories in Fruit Cups	
Servings	Total Calories
1	70
3	210
5	350
7	490

Graph each equation.

9. $y = x + 1$

10. $y = x + 3$

11. $y = x$

12. $y = -2x$

13. $y = 2x + 3$

14. $y = 3x - 1$

For Exercises 15 and 16, represent each function by a graph.

15. **CARS** A car averages 36 miles per gallon of gasoline. The function $m = 36g$ represents the miles m driven using g gallons of gasoline.

16. **FITNESS** A health club charges \$35 a month for membership fees. The equation $c = 35m$ describes the total charge c for m months of membership.

Graph each equation.

17. $y = 0.25x$

18. $y = x + 0.5$

19. $y = 0.5x - 1$

20. **SHOPPING** You buy a DVD for \$14 and CDs for \$9 each. The equation $t = 14 + 9c$ represents the total amount t that you spend if you buy 1 DVD and c CDs. Represent this function by a graph.

Academic Standards • ISTEP+
 Extra Practice, pp. 676, 706.

H.O.T. Problems

21. **OPEN ENDED** Draw the graph of a linear function. Name three ordered pairs in the function.

CHALLENGE For Exercises 22 and 23, let x represent the first number and let y represent the second number. Draw a graph of each function.

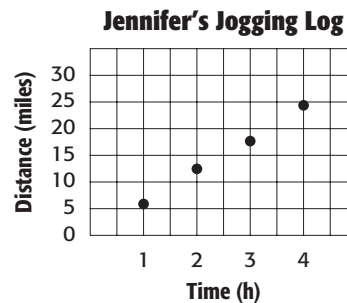
22. The second number is three more than the first number.

23. The second number is the product of -3 and the first number.

24. **WRITING IN MATH** Describe how you use a function table to create the graph of a function.

ISTEP+ PRACTICE**Preparation for 8.2.4**

25. The graph shows the relationship between the number of hours Jennifer spent jogging and the total number of miles she jogged. Which table best represents the data in the graph?



A

Time (h)	Distance (mi)
6	4
12	3
18	2
24	1

B

Time (h)	Distance (mi)
2	6
3	12
4	18
5	24

C

Time (h)	Distance (mi)
1	6
2	12
3	18
4	24

D

Time (h)	Distance (mi)
4	6
3	6
2	6
1	6

Spiral Review

26. **MEASUREMENT** The area and width of a rug are 323 square inches and 17 inches respectively. What is the perimeter of the rug? (Lesson 3-6)

Solve each equation. Check your solution. (Lesson 3-5)

27. $4y + 19 = 7$

28. $10x + 2 = 32$

29. $48 - 8j = 16$

30. $14 = 2 - 6d$

31. Evaluate $|5| + |-10|$. (Lesson 2-1)

Problem Solving in Social Studies**Real-World Unit Project**

Stand Up and Be Counted! It's time to complete your project. Use the data you have gathered about how the U.S. Census affects the House of Representatives to prepare a poster. Be sure to include a map, frequency table, and paragraph discussing the changes in the House of Representatives.



IN Math Online

Unit Project at glencoe.com

Graphing Calculator Lab

Graphing Relationships

You can use a graphing calculator to graph relationships.

MAIN IDEA

Use technology to graph relationships involving conversions of measurement.

IN Academic Standards

Preparation for

8.2.4 Identify and graph linear functions and identify lines with positive and negative slope. Also addresses P.4.1, P.7.1.

ACTIVITY

1 MEASUREMENT Use the table at the right to write a function that relates the number of yards x to the number of feet y . Then graph your function.

Yards (x)	Feet (y)
1	3
2	6
3	9
4	12

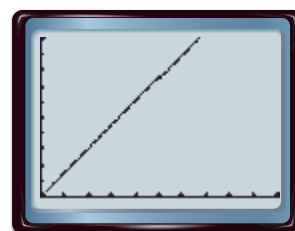
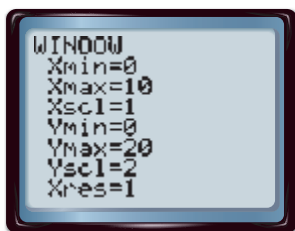
STEP 1 By examining the table, you can see that the number of feet is 3 times the number of yards. Write a function.

The number of feet y is $=$ 3 times the number of yards x .

STEP 2 Press $\boxed{Y=}$ and enter the function $y = 3x$ into Y_1 .

STEP 3 Adjust your viewing window. Press \boxed{WINDOW} and change the values to reflect the range of values in the table.

STEP 4 Finally, graph the function by pressing \boxed{Graph} .



ANALYZE THE RESULTS

1. Test the function above using one of the values from the table and the CALC feature on your calculator. Press $\boxed{2nd}$ $\boxed{[CALC]}$ 1 and then enter an x -value of 3. What y -value is displayed? What do each of these values represent and how are they represented on the graph?
2. Use your graph to convert 7 yards into feet. Explain your method.
3. **MAKE A CONJECTURE** Write a function that could be used to convert feet into yards. What is an appropriate window for a graph of this function? Graph and test your function.
4. Use your function from Exercise 3 to convert 16 feet into yards.
5. Write a function that could be used to convert 36 ounces to pounds. Indicate an appropriate window, then use a graph of the function to convert 36 ounces to pounds. (*Hint*: 1 pound = 16 ounces)

FOLDABLES

Study Organizer

▶ GET READY to Study

Be sure the following Big Ideas are noted in your Foldable.



BIG Ideas

Solving Equations (Lessons 3-2, 3-3, and 3-5)

- If you add or subtract the same number from each side of an equation, the two sides remain equal.
- If you divide each side of an equation by the same nonzero number, the two sides remain equal.
- To solve a two-step equation like $3x + 4 = 19$ or $2x - 1 = -5$:
 - Step 1 Undo the addition or subtraction first.
 - Step 2 Then undo the multiplication or division.

Perimeter and Area Formulas (Lesson 3-6)

- The perimeter P of a rectangle is twice the sum of the length ℓ and width w .
- The area A of a rectangle is the product of the length ℓ and width w .

Linear Functions (Lesson 3-7)

- The graph of a linear function is a straight line. Ordered pairs in the form (x, y) can be used to represent a function and graphed on the coordinate plane as part of the graph of the function.

Key Vocabulary

formula (p. 144)

linear equation (p. 164)

two-step equation (p. 151)

work backward strategy (p. 148)

Vocabulary Check

State whether each sentence is *true* or *false*. If *false*, replace the underlined word or number to make a true sentence.

- The expression $\frac{1}{3}y$ means one third of y .
- The words *more than* sometimes suggest the operation of multiplication.
- The formula $d = rt$ gives the distance d traveled at a rate of r for t units of time.
- The algebraic expression representing the words *six less than m* is $6 - m$.
- Use the work backward strategy when you are given a final result and asked to find an earlier amount.
- The word *each* sometimes suggests the operation of division.
- In solving the equation $4x + 3 = 15$, first divide each side by 4.
- The solution to the equation $p + 4.4 = 11.6$ is 7.2.
- The process of solving a two-step equation uses the work backward strategy.
- The expression $5x$ means 5 more than x .
- To find the distance around a rectangle, use the formula for its area.
- The word *per* sometimes suggests the operation of subtraction.

Lesson-by-Lesson Review

3-1

Writing Expressions and Equations (pp. 128–133)



7.2.1

Write each phrase as an algebraic expression.

13. the sum of a number and 5
14. six inches less than her height
15. twice as many apples

Write each sentence as an algebraic equation.

16. Ten years older than Theresa's age is 23.
17. Four less than a number is 19.
18. The quotient of 56 and a number is 14.
19. **AMUSEMENT PARKS** This year, admission to a popular amusement park is \$8.75 more than the previous year's admission fee. Write an expression describing the cost of this year's admission.

Example 1 Write the phrase as an algebraic expression.

four times the price

Let p represent the price.

The algebraic expression is $4p$.

Example 2 Write the sentence as an algebraic equation.

Six less than the number of cookies is 24.

Let c represent the number of cookies.

The equation is $c - 6 = 24$.

3-2

Solving Addition and Subtraction Equations (pp. 136–141)



7.2.2

Solve each equation. Check your solution.

20. $x + 5 = 8$
21. $r + 8 = 2$
22. $p + 9 = -4$
23. $s - 8 = 15$
24. $n - 1 = -3$
25. $w - 9 = 28$

26. **COOKIES** Marjorie baked some chocolate chip cookies for her and her sister. Her sister ate 6 of these cookies. If there were 18 cookies left, write and solve an equation to find how many cookies c Marjorie baked.

Example 3 Solve $x + 6 = 4$.

$$x + 6 = 4$$

$$\underline{-6 = -6} \quad \text{Subtract 6 from each side.}$$

$$x = -2$$

Example 4 Solve $y - 3 = -2$.

$$y - 3 = -2$$

$$\underline{+3 = +3} \quad \text{Add 3 to each side.}$$

$$y = 1$$

3-3 Solving Multiplication Equations (pp. 142–146)



7.2.2

Solve each equation. Check your solution.

27. $7c = 28$ 28. $-8w = 72$
29. $10y = -90$ 30. $-12r = -36$

31. **MONEY** Matt borrowed \$98 from his father. He plans to repay his father at \$14 per week. Write and solve an equation to find the number of weeks w required to pay back his father.

Example 5 Solve $-4b = 32$.

$$-4b = 32$$

$$\frac{-4b}{-4} = \frac{32}{-4}$$

$$b = -8$$

Divide each side by -4 .

3-4 PSI: Work Backward (pp. 148–149)



P.1.3

Solve. Use the *work backward* strategy.

32. **BASEBALL** Last baseball season, Nelson had four less than twice the number of hits Marcus had. Nelson had 48 hits. How many hits did Marcus have last season?
33. **CREDIT CARDS** Alicia paid off \$119 of her credit card balance and made an additional \$62.75 in purchases. If she now owes \$90.45, what was her starting balance?

Example 6 A number is divided by 2. Then 4 is added to the quotient. After subtracting 3, the result is 18. What is the number?

Start with the final value and work backward with each resulting value until you arrive at the starting value.

$$18 + 3 = 21 \quad \text{Undo subtracting 3.}$$

$$21 - 4 = 17 \quad \text{Undo adding 4.}$$

$$17 \cdot 2 = 34 \quad \text{Undo dividing by 2.}$$

The number is 34.

3-5 Solving Two-Step Equations (pp. 151–155)



7.2.2

Solve each equation. Check your solution.

34. $3y - 12 = 6$ 35. $6x - 4 = 20$
36. $2x + 5 = 3$ 37. $5m + 6 = -4$
38. $10c - 8 = 90$ 39. $3r - 20 = -5$

40. **ALGEBRA** Ten more than five times a number is 25. Find the number.

Example 7 Solve $3p - 4 = 8$.

$$3p - 4 = 8$$

$$\frac{-4}{-4} = \frac{-4}{-4} \quad \text{Add 4 to each side.}$$

$$3p = 12$$

$$\frac{3p}{3} = \frac{12}{3}$$

Divide each side by 3.

$$p = 4$$

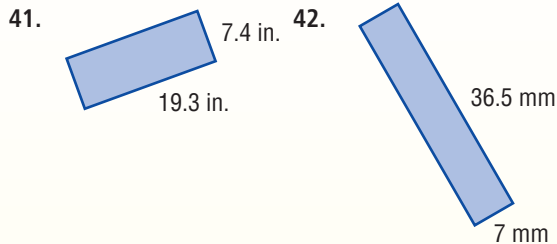
3-6

Measurement: Perimeter and Area (pp. 156–161)



7.2.4

Find the perimeter and area of each rectangle.



Find the missing measure.

43. $P = 56$ mi, $\ell = 21$ mi
 44. $A = 10.26$ ft², $w = 2.7$ ft
 45. $A = 272$ yd², $\ell = 17$ yd
 46. $P = 14.2$ cm, $w = 2.6$ cm
 47. **CARPET** In order to carpet her rectangular living room, Flora needs 192 square feet of carpet. If the length of her living room is 16 feet, find the width.

Example 8 The perimeter of a rectangle is 38 meters. If the length is 7 meters, find the width.

$$P = 2\ell + 2w \quad \text{Perimeter formula}$$

$$38 = 2(7) + 2w \quad \text{Replace } P \text{ with } 38 \text{ and } \ell \text{ with } 7.$$

$$38 = 14 + 2w \quad \text{Simplify.}$$

$$24 = 2w \quad \text{Subtract } 14 \text{ from each side.}$$

$$\frac{24}{2} = \frac{2w}{2} \quad \text{Divide each side by } 2.$$

$$12 = w \quad \text{Simplify.}$$

The width is 12 meters.

Example 9 The area of a rectangle is 285 square inches. If the width is 15 inches, find the length.

$$A = \ell w \quad \text{Area formula}$$

$$285 = \ell(15) \quad \text{Replace } A \text{ with } 285 \text{ and } w \text{ with } 15.$$

$$\frac{285}{15} = \frac{15\ell}{15} \quad \text{Divide each side by } 15.$$

$$19 = \ell \quad \text{Simplify.}$$

The length is 19 inches.

3-7

Functions and Graphs (pp. 163–167)



8.2.4

Graph each equation.

48. $y = x + 5$ 49. $y = x - 4$
 50. $y = 2x$ 51. $y = -1x$
 52. $y = 3x + 2$ 53. $y = -2x + 3$

MONEY For Exercises 54–56, use the following information.

Clara earns \$9 per hour mowing lawns.

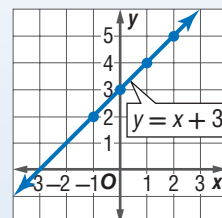
54. Make a table that shows her total earnings for 2, 4, 6, and 8 hours.
 55. Write an equation in which x represents the number of hours and y represents Clara's total earnings.
 56. Graph the equation.

Example 10 Graph $y = x + 3$.

Select four values for x . Substitute these values for x to find values for y .

x	$x + 3$	y
-1	-1 + 3	2
0	0 + 3	3
1	1 + 3	4
2	2 + 3	5

Four solutions are $(-1, 2)$, $(0, 3)$, $(1, 4)$, and $(2, 5)$. The graph is shown below.



Write each phrase as an algebraic expression or equation.

- \$5 less than Tomasita has
- 4 years older than Hana
- 56 inches is 9 inches shorter than Jacob's height.
- Twice the distance from the park to the post office is 5 miles.
- FLOWERS** The number of tulips in Paula's garden is 8 less than the number of marigolds. If there are 16 tulips, write and solve an equation to determine the number of marigolds m .

6. **MULTIPLE CHOICE** If you divide a number by 8 and subtract 11 from the result, the answer is 4. Which equation matches this relationship?

A $\frac{n-11}{8} = 4$ C $\frac{n}{8} = 11 - 4$
 B $4 = \frac{n}{8} - 11$ D $4 = 11 - \frac{n}{8}$

7. **ANALYZE TABLES** For Exercises 7–9, use the table below. It shows how Jared's age and his sister Emily's are related.

Jared's age (yr)	1	2	3	4	5
Emily's age (yr)	7	8	9	10	11

- Write an equation in which x represents Jared's age, and y represents Emily's age.
- Graph the equation.
- Predict how old Emily will be when Jared is 10 years old.

10. **TOURISM** The Statue of Liberty is 151 feet tall. It is 835 feet shorter than the Eiffel Tower. Write and solve an equation to find the height of the Eiffel Tower.

Solve each equation. Check your solution.

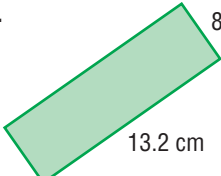

- $x + 5 = -8$
- $y - 11 = 15$
- $9z = -81$
- $-6k + 4 = -38$
- $3z - 7 = 17$
- $2g - 9 = -5$

17. **PIZZA** Chris and Joe shared a pizza. Chris ate two more than twice as many pieces as Joe, who ate 3 pieces. If there were 3 pieces left, how many pieces were there initially? Use the *work backward* strategy.

18. **MULTIPLE CHOICE** A giant cake in the shape of and decorated as an American flag was 60 feet in length. If it took A square feet of icing to cover the top of the cake, which of the following would represent the cake's perimeter?

F $P = 120 + 2 \cdot \frac{A}{60}$ H $P = 60 + \frac{A}{60}$
 G $P = 120 + 2A$ J $P = 60 + 2A$

Find the perimeter and area of each rectangle.

19.  20. 

Graph each equation.

- $y = x + 1$
- $y = 2x$
- $y = 2x - 3$
- $y = -x + 1$

25. **MOVIES** A student ticket to the movies costs \$6. The equation $c = 6t$ describes the total cost c for t tickets. Make a function table that shows the total cost for 1, 2, 3, and 4 tickets and then graph the equation.

PART 1 Multiple Choice

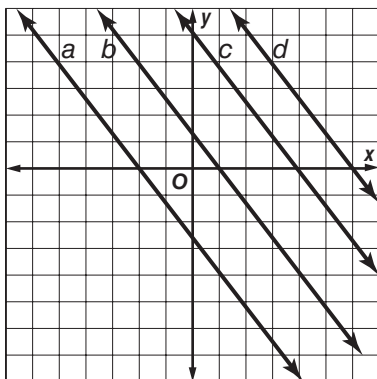
Read each question. Then fill in the correct answer on the answer sheet provided by your teacher or on a sheet of paper.

1. During a bike-a-thon, Shalonda cycled at a constant rate. The table shows the distance she covered in half-hour intervals.

Time (h)	Distance (mi)
$\frac{1}{2}$	6
1	12
$1\frac{1}{2}$	18
2	24

Which of the following equations represents the distance d Shalonda covered after h hours?

- A $d = 6 + h$
 - B $d = 6h$
 - C $d = 12 + h$
 - D $d = 12h$
2. Which line contains the ordered pair $(-2, 4)$?



- F line a
- G line c
- H line b
- J line d

3. The table gives the value of several terms and their positions in a sequence.

Position	3	4	5	6	7	n
Value of Term	13	17	21	25	29	

Which description shows the relationship between a term and n , its position in the sequence?

- A Add 4 to n .
 - B Multiply n by 5 and add 1.
 - C Multiply n by 3 and add 2.
 - D Multiply n by 4 and add 1.
4. Mr. McDowell owes \$1,750 on his car loan and pays off \$185 each month towards the loan balance. Which expression represents how much money in dollars he still owes after x months?
- F $1,750x$
 - G $1,750x + 185$
 - H $1,750x - 185$
 - J $1,750 - 185x$
5. Which of the following problems can be solved by solving the equation $x - 9 = 15$?
- A Allison is nine years younger than her sister Pam. Allison is 15 years old. What is x , Pam's age?
 - B David's portion of the bill is \$9 more than Sam's portion of the bill. If Sam pays \$9, find x , the amount in dollars that David pays.
 - C The sum of two numbers is 15. If one of the numbers is 9, what is x , the other number?
 - D Pedro owns 15 CDs. If he gave 9 of them to a friend, what is x , the number of CDs he has left?

6. The table below shows values for x and corresponding values for y .

x	y
18	2
27	3
9	1
36	4

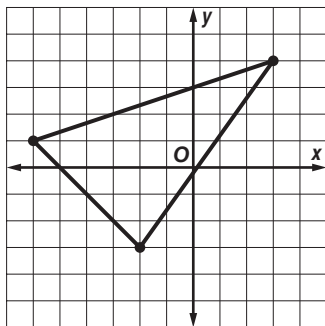
Which of the following represents the relationship between x and y ?

- F $y = x + 16$
 G $y = 9x$
 H $y = \frac{1}{9}x$
 J $y = x + 9$

TEST-TAKING TIP

Question 7 Read the question carefully to check that you answered the question that was asked. In question 7, you are asked to pick which coordinates lie within the triangle, not to identify a vertex.

7. Which of the following coordinates lies within the triangle graphed below?



- A (3, 4) C (-3, 6)
 B (2, 0) D (-1, -1)

PART 2 Short Response/Grid In

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

8. Write an expression that can be used to find the maximum number of 3-foot pieces of lumber than can be cut from a 12-foot length of lumber.
9. Tonya bought p pounds of sand. Each pound of sand costs \$0.40. How many pounds of sand could Tonya buy with \$3.20?

PART 3 Extended Response

Record your answers on the answer sheet provided by your teacher or on a sheet of paper. Show your work.

10. The distances traveled by cars traveling at 40 miles per hour and at 60 miles per hour are given in the table.

Time (hours)	Distance (miles) at 40 mph	Distance (miles) at 60 mph
0	0	0
1	40	60
2	80	120
3	120	180
4	160	240

- a. Graph the ordered pairs (time, distance) for 40 miles per hour.
- b. Graph the ordered pairs (time, distance) for 60 miles per hour.
- c. Predict where the ordered pairs for 50 miles per hour would be graphed. Explain how you know.

NEED EXTRA HELP?

If You Missed Question...

Go to Lesson...

IN Academic Standards

1	2	3	4	5	6	7	8	9	10
3-7	3-7	1-9	3-1	3-1	3-7	3-7	2-8	1-7	3-7
8.2.4	8.2.4	7.2.1	7.2.1	7.2.1	8.2.4	8.2.4	7.1.7	P.6.6	8.2.4