

Algebra: Linear Equations and Functions

“What do horses have to do with math?”

A horse can gallop at a speed of 43 miles per hour. You can use the linear equation $d = 43t$ to find the **distance** d a horse gallops in a certain **time** t . In algebra, you will use variables and equations to describe many real-life situations.

You will solve problems about distance, rate, and time in Lesson 4-3.

GETTING STARTED

► Diagnose Readiness

Take this quiz to see if you are ready to begin Chapter 4. Refer to the lesson number in parentheses for review.

Vocabulary Review

Complete each sentence.

- When you replace the variable with a number that makes an equation true, you have ? the equation. (Lesson 1-5)
- The first number in an ordered pair is the ?, and the second number is the ?. (Lesson 3-3)

Prerequisite Skills

Name the number that is the solution of the given equation. (Lesson 1-5)

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

Graph each point on a coordinate plane.

(Lesson 3-3)

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

Add. (Lesson 3-4)

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

Subtract. (Lesson 3-5)

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

Divide. (Lesson 3-7)

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

FOLDABLES Study Organizer

Solving Equations Make this Foldable to help you organize your notes. Begin with a sheet of $8\frac{1}{2} \times 11$ paper.

STEP 1

Fold

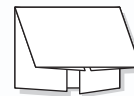
Fold the short sides toward the middle.



STEP 2

Fold Again

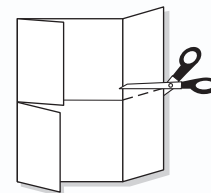
Fold the top to the bottom.



STEP 3

Cut

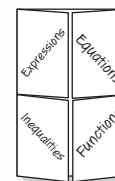
Open. Cut along the second fold to make four tabs.



STEP 4

Label

Label each of the tabs as shown.



Noteables™

Chapter Notes Each

time you find this logo throughout the chapter, use your *Noteables™: Interactive Study Notebook with Foldables™* or your own notebook to take notes. Begin your chapter notes with this Foldable activity.



Readiness To prepare yourself for this chapter with another quiz, visit msmath2.net/chapter_readiness

Writing Expressions and Equations

What You'll LEARN

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

REVIEW Vocabulary

expression: a combination of variables, numbers, and at least one operation
(Lesson 1-4)

WHEN am I ever going to use this?

COMICS Even these characters from *Peanuts* are using algebra.



1. Suppose the daughter is 12 years old. How old is the son?
2. What operation did you use to find the son's age? Explain.
3. Suppose the comic said that *the son is twice as old as the daughter*. If the daughter is 12 years old, how old is the son?
4. What operation did you use to find the son's age? Explain.

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

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

EXAMPLE Write a Phrase as an Expression

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

Words	five dollars less than Jennifer earned
Variable	Let d represent the number of dollars Jennifer earned.
Expression	$d - 5$

- Your Turn** Write each phrase as an algebraic expression.

- a. twice as many tomatoes as last year
- b. 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*.

EXAMPLES

Write Sentences as Equations

Write each sentence as an algebraic equation.

Sentence

Equation

1 Five more than a number is 20. $n + 5 = 20$

1 Three times Jack's age equals 12. $3a = 12$

1 **FOOD** It is estimated that 12.4 million pounds of potato chips were consumed during a recent Super Bowl. This was 3.1 million pounds more than the number of pounds of tortilla chips consumed. Write an equation that models this situation.

Words	Potato chips were 3.1 million more than tortilla chips.
Variable	Let t = number of millions of pounds of tortilla chips.
Equation	$12.4 = 3.1 + t$

The equation is $12.4 = 3.1 + t$.

Skill and Concept Check

- OPEN ENDED** Write a verbal sentence that translates into the equation $n + 5 = 8$.
- FIND THE ERROR** Antonio and Julia are writing an algebraic expression for the phrase *2 less than a number*. Who is correct? Explain.

Antonio
 $2 - n$

Julia
 $n - 2$

GUIDED PRACTICE

Write each phrase as an algebraic expression.

- eight more than x
- ten times as many hours
- nine less than t
- -15 divided by some number

Write each sentence as an algebraic equation.

- The sum of a number and four is -9 .
- Twice a number equals -10 .
- POPULATION** The median age of people living in the United States was 35.3 years in 2000. This is 2.4 years older than the median age in 1990. Write an equation that models this situation.



Practice and Applications

Write each phrase as an algebraic expression.

- | | |
|--------------------------------|--------------------------------|
| 10. fifteen increased by t | 11. five years older than Luis |
| 12. nine dollars less than j | 13. a number less six |
| 14. the product of r and 8 | 15. twice as many oranges |
| 16. Emily's age divided by 3 | 17. a number divided by -12 |

Write each sentence as an algebraic equation.

- | | |
|---|---|
| 18. The sum of a number and four is -8 . | 19. Two more than the number of cookies is 4. |
| 20. The product of a number and five is -20 . | 21. Ten times the number of students is 280. |
| 22. Ten inches less than her height equals 26. | 23. Five less than a number equals 31. |
| 24. Seven more than twice his age is 51. | 25. Three more than twice a number is 15. |

MONEY For Exercises 26 and 27, use the table.

The table shows the average lifespan of several kinds of paper currency in the United States. Let y represent the average lifespan of a \$5 bill.

26. Which lifespan can be represented by $2y$?
27. Write an expression to represent the lifespan of a \$50 bill.
28. **TOURISM** The Washington Monument is 555 feet tall. It is 75 feet shorter than the Gateway to the West Arch. Write an equation that models this situation.
29. **CRITICAL THINKING** If x is an odd number, how would you represent the odd number immediately following it? preceding it?

U.S. Currency	
Kind	Lifespan (years)
\$1	1.5
\$5	2
\$10	3
\$20	4
\$50	9
\$100	9

Source: Federal Reserve System

Spiral Review with Standardized Test Practice

30. **MULTIPLE CHOICE** A mechanic charges a \$35 initial fee and \$32.50 for each hour he works. Which equation could be used to find the cost c of a repair job that lasts h hours?
- | | |
|--|--|
| <input type="radio"/> A $c = 32.5 + 35h$ | <input type="radio"/> B $c = 35 + 32.5h$ |
| <input type="radio"/> C $c = 32.5 - 35h$ | <input type="radio"/> D $c = 32.5(35 - h)$ |
31. **MULTIPLE CHOICE** Translate *12 more than d* into an algebraic expression.
- | | | | |
|-------------------------------|----------------------------------|----------------------------------|----------------------------------|
| <input type="radio"/> F $12d$ | <input type="radio"/> G $d - 12$ | <input type="radio"/> H $d + 12$ | <input type="radio"/> I $12 - d$ |
|-------------------------------|----------------------------------|----------------------------------|----------------------------------|

Divide. (Lesson 3-7)

- | | | | |
|------------------|--------------------|---------------------|--------------------|
| 32. $-18 \div 3$ | 33. $25 \div (-5)$ | 34. $-14 \div (-7)$ | 35. $72 \div (-9)$ |
|------------------|--------------------|---------------------|--------------------|

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Add. (Lesson 3-4)

- | | | | |
|-----------------|---------------|------------------|----------------|
| 36. $-8 + (-3)$ | 37. $-10 + 9$ | 38. $12 + (-20)$ | 39. $-15 + 15$ |
|-----------------|---------------|------------------|----------------|

Study Skill

Simplify the Problem

Reading Math Problems

Have you ever tried to solve a long word problem and didn't know where to start? Try to rewrite the problem using fewer and fewer words. Then translate the problem into an equation.

► **READ** the problem.

Shopping networks on television are a popular way to shop. In addition to the cost of the items, you usually pay a shipping fee. Kylie wants to order several pairs of running shorts that cost \$12 each. The total shipping fee is \$7. How many shorts can she order with \$55?

► **REWRITE** the problem to make it simpler. Keep all of the important information but use fewer words.

Kylie has \$55 to spend on some shorts that cost \$12 each plus a shipping fee of \$7. How many can she buy?

► **REWRITE** the problem using even fewer words. Write a variable for the unknown.

The total cost of x shorts at \$12 each plus \$7 is \$55.

► **TRANSLATE** the words into an equation.

$$12x + 7 = 55$$

SKILL PRACTICE

Use the method above to write an equation for each word problem.

- FLYING** Orville and Wilbur Wright flew their airplane called Flyer I in Kitty Hawk, North Carolina, on December 17, 1903. Wilbur's flight was 364 feet. This was 120 feet longer than Orville's flight. How far was Orville's flight?
- ANIMALS** The cougars that are found in the colder parts of North and South America are about 75 inches long. They are about 1.5 times longer than the cougars that are found in the tropical jungles of Central America. Find the length of the tropical cougar.
- 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?
- TRAVEL** A taxi company charges \$1.50 per mile plus a \$10 fee. Suppose Olivia can afford to spend \$19 for a taxi ride from her apartment to the mall. How far can she travel by taxi with \$19?



What You'll LEARN

Solve equations using models.

REVIEW Vocabulary

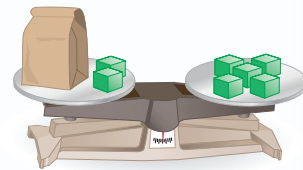
equation: a mathematical sentence that contains an equals sign (Lesson 1-5)

Materials

- cups and counters
- equation mat

Solving Equations Using Models

INVESTIGATE The scale at the right is balanced, and the bag contains a certain number of blocks.



1. Suppose you cannot look in the bag. How can you find the number of blocks in the bag?
2. In what way is a balanced scale like an equation?
3. What does it mean to *solve an equation*?

To solve an equation using models, you can use these steps.

- You can add or subtract the same number of counters from each side of the mat.
- You can add or subtract zero from each side of the mat.

ACTIVITY

Work with a partner.

1. Solve $x + 2 = 5$ using models.

Model the equation.

$$x + 2 = 5$$

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

$$x + 2 - 2 = 5 - 2$$

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

$$x = 3$$

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

2. **Your Turn** Solve each equation using models.

a. $x + 1 = 3$

b. $x + 3 = 7$

c. $x + 4 = 4$

STUDY TIP

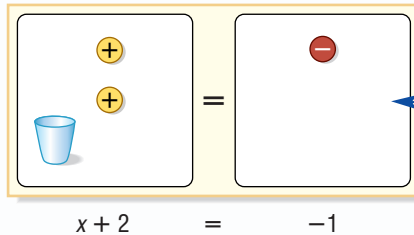
Look Back You can review **zero pairs** in Lesson 3-4.

Some equations are solved by using **zero pairs**. 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.

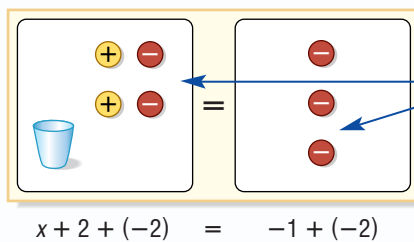
ACTIVITY

Work with a partner.

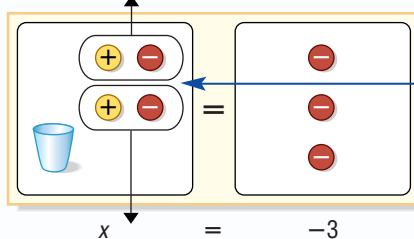
1 Solve $x + 2 = -1$ using models.



Model the equation.



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



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

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

2 **Your Turn** Solve each equation using models.

d. $x + 3 = -2$

e. $x + 4 = 1$

f. $-2 = x + 1$

g. $x - 3 = -2$

h. $x - 1 = -3$

i. $4 = x - 2$

Writing Math

- How is solving an equation similar to keeping a scale in balance?
- For any equation, how can you determine how many counters to add or subtract from each side?
- Identify** the property of numbers that is illustrated by a zero pair.
- Identify** the property of numbers that allows you to add or subtract zero without changing the value of a number.
- MAKE A CONJECTURE** Write a rule that you can use to solve an equation like $x + 3 = 2$ without using models.

Solving Addition and Subtraction Equations

What You'll LEARN

Solve addition and subtraction equations.

NEW Vocabulary

inverse operations

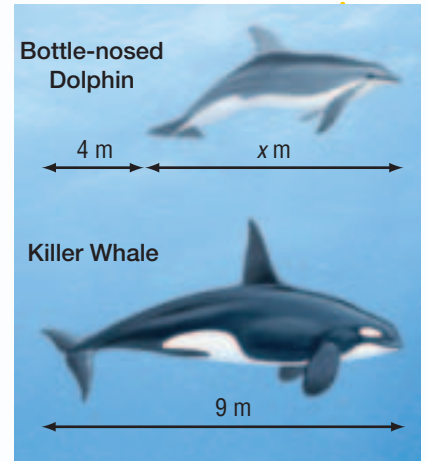
REVIEW Vocabulary

solve: finding a number that makes the equation true (Lesson 1-5)

WHEN am I ever going to use this?

SCIENCE Bottle-nosed dolphins and killer whales are the best-known species of the dolphin family. A killer whale, which can grow to a length of 9 meters, is 4 meters longer than a bottle-nosed dolphin.

1. What does x represent in the figure?
2. Write an expression to represent 4 meters longer than a dolphin.
3. Write an addition equation you could use to find the length of a dolphin.



You can use inverse operations to solve the equation $x + 4 = 9$. **Inverse operations** “undo” each other. To undo the addition of 4 in the equation $x + 4 = 9$, you would subtract 4 from each side of the equation.

EXAMPLE Solve an Addition Equation

1 Solve $x + 4 = 9$.

Method 1 Use symbols.

$$x + 4 = 9 \quad \text{Write the equation.}$$

$$\begin{array}{r} x + 4 = 9 \\ - 4 = - 4 \\ \hline \end{array} \quad \text{Subtract 4 from each side.}$$

$$\begin{array}{r} x + 4 = 9 \\ - 4 = - 4 \\ \hline x = 5 \end{array} \quad \text{Simplify.}$$

The solution is 5.

Your Turn Solve each equation.

a. $y + 6 = 9$

b. $x + 3 = 1$

c. $-3 = a + 4$

Method 2 Use models.

$$x + 4 = 9$$

$$x + 4 - 4 = 9 - 4$$

$$x = 5$$

READING in the Content Area

For strategies in reading this lesson, visit msmath2.net/reading.

You can use the **Subtraction Property of Equality** and the **Addition Property of Equality** to solve equations like $x + 4 = 9$ and $x - 2 = 1$.

Noteables™

Key Concept: Subtraction Property of Equality

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

Symbols	Arithmetic	Algebra
	$5 = 5$	$x + 2 = 3$
	$\underline{- 3 = - 3}$	$\underline{- 2 = - 2}$
	$2 = 2$	$x = 1$

Noteables™

Key Concept: Addition Property of Equality

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

Symbols	Arithmetic	Algebra
	$5 = 5$	$x - 2 = 4$
	$\underline{+ 3 = + 3}$	$\underline{+ 2 = + 2}$
	$8 = 8$	$x = 6$

EXAMPLE

Solve a Subtraction Equation

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

Method 1 Use symbols.

$$1 = x - 2 \quad \text{Write the equation.}$$

$$\begin{array}{r} 1 = x - 2 \\ \underline{+ 2 = + 2} \end{array} \quad \text{Add 2 to each side.}$$

$$\begin{array}{r} 1 = x - 2 \\ \underline{+ 2 = + 2} \\ 3 = x \end{array} \quad \text{Simplify.}$$

Check $1 = x - 2$ Write the original equation.
 $1 \stackrel{?}{=} 3 - 2$ Replace x with 3.
 $1 = 1$ ✓ This sentence is true.

The solution is 3.

Method 2 Use models.

$$1 = x - 2$$

$$1 + 2 = x - 2 + 2$$

$$3 = x$$

STUDY TIP

Checking Solutions

It is always wise to check your solution. You can often use arithmetic facts to check the solutions of simple equations.

Your Turn Solve each equation.

d. $y - 3 = 4$

e. $r - 4 = -2$

f. $-9 = q - 8$



EXAMPLE

Use an Equation to Solve a Problem

- SPORTS** Tiger Woods won the 2002 Masters Championship with a final score of 12 under par, or -12 . His scores for the first three rounds were -2 , -3 , and -6 . What was his score for the fourth round?

Look Back To review adding integers, see Lesson 3-4.

Words	The sum of the scores for all of the rounds was -12 .												
Variable	Let s represent the score for the fourth round.												
Equation	<table border="0"> <tr> <td>scores for the first three rounds</td> <td>+</td> <td>score for the fourth round</td> <td>=</td> <td>final score</td> </tr> <tr> <td>$-2 + (-3) + (-6)$</td> <td></td> <td>s</td> <td></td> <td>-12</td> </tr> </table>	scores for the first three rounds	+	score for the fourth round	=	final score	$-2 + (-3) + (-6)$		s		-12		
scores for the first three rounds	+	score for the fourth round	=	final score									
$-2 + (-3) + (-6)$		s		-12									

$$-2 + (-3) + (-6) + s = -12 \quad \text{Write the equation.}$$

$$-11 + s = -12 \quad -2 + (-3) + (-6) = -11$$

$$\underline{+ 11} \quad \underline{= + 11} \quad \text{Add 11 to each side.}$$

$$s = -1 \quad \text{Simplify.}$$

Check You can check the solution by adding.
 $-2 + (-3) + (-6) + (-1) = -12$ ✓

Skill and Concept Check

- Tell what property you would use to solve $x - 4 = -2$.
- OPEN ENDED** Write two different equations that have -2 as a solution.
- Which One Doesn't Belong?** Identify the equation that does not have the same solution as the other three. Explain your reasoning.

$$x + 3 = 4$$

$$b + 5 = 4$$

$$7 + y = 8$$

$$8 + a = 9$$

GUIDED PRACTICE

Solve each equation. Check your solution.

4. $n + 6 = 9$

5. $m + 5 = 3$

6. $-2 = a + 6$

7. $x - 5 = 6$

8. $-1 = c - 6$

9. $s - 4 = -7$

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



Practice and Applications

HOMWORK HELP

For Exercises	See Examples
11–16	1
17–22	2
29–30, 37–38	3

Extra Practice
See pages 572, 599.

Solve each equation. Check your solution.

- | | | |
|--------------------|---------------------|--------------------|
| 11. $a + 3 = 10$ | 12. $y + 5 = 11$ | 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. $q - 8 = -1$ |
| 20. $p - 13 = -2$ | 21. $x - 5 = -9$ | 22. $w - 9 = -12$ |
| 23. $34 + r = 95$ | 24. $64 + y = 84$ | 25. $-23 = x - 18$ |
| 26. $-59 = m - 11$ | 27. $-18 + c = -30$ | 28. $-34 = t + 9$ |

29. The sum of a number and 3 is -2 . Find the number.
 30. If you decrease a number by 4, the result is -5 . Find the number.

Solve each equation. Check your solution.

- | | | |
|----------------------|----------------------|----------------------|
| 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. $b + 2.25 = 1$ |

ROLLER COASTERS For Exercises 37 and 38, use the table.

37. *Superman The Escape* is 105 feet taller than *Millennium Force*. Write and solve an addition equation that you could use to find the height of *Millennium Force*.
38. The difference in the speeds of *Superman The Escape* and *Millennium Force* is 7 miles per hour. If *Superman The Escape* has the greater speed, write and solve a subtraction equation to find its speed.
39. **CRITICAL THINKING** Suppose $x + y = 10$ and the value of x increases by 3. What must happen to the value of y so that $x + y = 10$ is still a true sentence?

Tallest Steel Roller Coasters in North America	Height (feet)	Speed (mph)
Superman The Escape	415	?
Millennium Force	?	93
Titan	245	85
Goliath	235	85
Nitro	230	80

Source: www.rcdb.com

Spiral Review with Standardized Test Practice

40. **MULTIPLE CHOICE** The Sears Tower in Chicago is 1,454 feet tall. It is 204 feet taller than the Empire State Building in New York City. Use the equation $e + 204 = 1,454$ to find the height of the Empire State Building.
 (A) 1,250 ft (B) 1,350 ft (C) 1,450 ft (D) 1,650 ft

41. **GRID IN** If $x + 3 = 2$, what is the value of $2x + 5$?
 42. **ALGEBRA** Write an expression for 6 inches less than w . (Lesson 4-1)

Divide. (Lesson 3-7)

- | | | | |
|------------------|--------------------|---------------------|------------------|
| 43. $-15 \div 3$ | 44. $36 \div (-9)$ | 45. $-63 \div (-7)$ | 46. $-27 \div 9$ |
|------------------|--------------------|---------------------|------------------|

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Divide. (Page 562)

- | | | | |
|--------------------|---------------------|-----------------------|---------------------|
| 47. $15.6 \div 13$ | 48. $8.84 \div 3.4$ | 49. $75.25 \div 0.25$ | 50. $0.76 \div 0.5$ |
|--------------------|---------------------|-----------------------|---------------------|



Solving Multiplication Equations

What You'll LEARN

Solve multiplication equations.

REVIEW Vocabulary

coefficient: the numerical factor of a multiplication expression (Lesson 1-4)

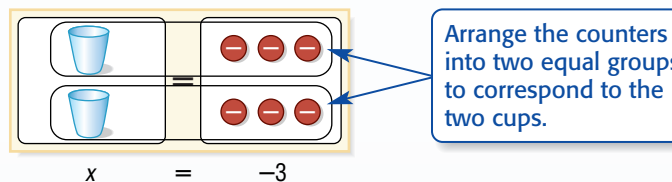
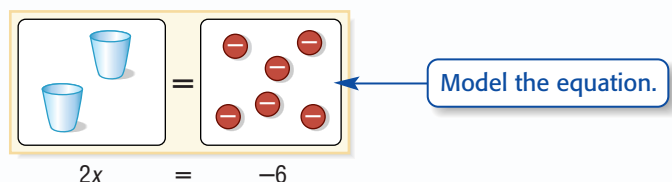
HANDS-ON Mini Lab

Materials

- cups and counters
- equation mat

Work with a partner.

Equations like $2x = -6$ are called multiplication equations because the expression $2x$ means *2 times the value of x* . Follow these steps to solve $2x = -6$.



Each cup is matched with 3 negative counters. So, $x = -3$.

Solve each equation using models.

- $4x = 8$
- $-8 = 2x$
- $3x = 3$
- What operation did you use to find each solution?
- How can you use the coefficient of x to solve $4x = 12$?
- How can you use the coefficient of x to solve $-5x = 10$ without using cups and counters?

In the Mini Lab above, you matched each cup with an equal number of counters. This suggests the operation of division. You can use the **Division Property of Equality** to solve equations like $2x = -6$.

Noteables

Key Concept: Division Property of Equality

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

Symbols

Arithmetic

$$8 = 8$$

$$\frac{8}{2} = \frac{8}{2}$$

$$4 = 4$$

Algebra

$$2x = -6$$

$$\frac{2x}{2} = \frac{-6}{2}$$

$$x = -3$$

Notice that the division expression $8 \div 2$ can be written as the fraction $\frac{8}{2}$.

EXAMPLES

Solve Multiplication Equations

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

$$20 = 4x \quad \text{Write the equation.}$$

$$\frac{20}{4} = \frac{4x}{4} \quad \text{Divide each side of the equation by 4.}$$

$$5 = x \quad 20 \div 4 = 5$$

Check $20 = 4x$ Write the original equation.

$$20 \stackrel{?}{=} 4(5) \quad \text{Replace } x \text{ with 5. Is this sentence true?}$$

$$20 = 20 \quad \checkmark$$

The solution is 5.

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

$$-8y = 24 \quad \text{Write the equation.}$$

$$\frac{-8y}{-8} = \frac{24}{-8} \quad \text{Divide each side by } -8.$$

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

Check $-8y = 24$ Write the original equation.

$$-8(-3) \stackrel{?}{=} 24 \quad \text{Replace } y \text{ with } -3. \text{ Is this sentence true?}$$

$$24 = 24 \quad \checkmark$$

The solution is -3 .

Your Turn Solve each equation.

a. $30 = 6x$

b. $-6a = 36$

c. $-9d = -72$

REAL-LIFE MATH

ANIMALS The tortoise is one of the slowest land animals, reaching a top speed of about 0.25 mile per hour. Dragonflies, the fastest insect, can fly at a speed of about 18 miles per hour.

Source: *Incredible Comparisons*



The equation $d = rt$ shows the relationship between the variables d (distance), r (rate or speed), and t (time).

EXAMPLE

Use an Equation to Solve a Problem

1 **ANIMALS** Refer to the information at the left. At this speed, how long will it take a tortoise to travel 1.5 miles?

Words	Distance is equal to the rate times the time.
Variables	$d = r \cdot t$
Equation	$1.5 = 0.25t$

$$1.5 = 0.25t \quad \text{Write the equation.}$$

$$\frac{1.5}{0.25} = \frac{0.25t}{0.25} \quad \text{Divide each side by 0.25.}$$

$$6 = t \quad 1.5 \div 0.25 = 6$$

At this speed, it would take a tortoise 6 hours to travel 1.5 miles. Check this solution.



Skill and Concept Check

- Tell whether -4 is a solution of $-3x = -12$. Explain.
- OPEN ENDED** Write two different multiplication equations that have a negative integer as a solution.
- FIND THE ERROR** Jesse and Haley are solving $-5x = 30$. Who is correct? Explain.

$$\begin{array}{l} \text{Jesse} \\ -5x = 30 \\ \frac{-5x}{-5} = \frac{30}{-5} \\ x = -6 \end{array}$$

$$\begin{array}{l} \text{Haley} \\ -5x = 30 \\ \frac{-5x}{5} = \frac{30}{5} \\ x = -6 \end{array}$$

GUIDED PRACTICE

Solve each equation. Check your solution.

- $6c = 18$
- $10y = 20$
- $-6s = 24$
- $-9r = 36$
- $-8z = -40$
- $-11r = -77$
- $15 = 5z$
- $72 = 12r$
- The product of a number and -4 is 64 . Find the number.
- If you multiply a number by 3 , the result is -21 . What is the number?

Practice and Applications

Solve each equation. Check your solution.

- $7a = 49$
- $9e = 27$
- $35 = 5v$
- $112 = 8p$
- $4j = -36$
- $12y = -60$
- $48 = -6r$
- $266 = -2t$
- $-3w = -36$
- $-10g = -100$
- $-28 = -7f$
- $-275 = -5s$

- When a number is multiplied by -12 , the result is -168 . Find the number.
- The product of a number and 25 is $1,000$. What is the number?

BABY-SITTING Gracia earns \$5 per hour when she baby-sits. How many hours does she need to work to earn \$75?

TRAVEL A Boeing 747 aircraft has a cruising speed of about 600 miles per hour. At that speed, how long will it take to travel 1,500 miles? Use the formula $d = rt$.

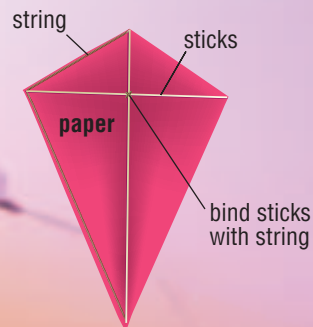
KITES For Exercises 30 and 31, use the following information. In a simple kite, the length of the longer stick should be 1.5 times the length of the shorter stick.

- Suppose the length of the longer stick is 36 inches. Write a multiplication equation to find the length of the shorter stick.
- Solve the equation.

HOMESCHOOL HELP

For Exercises	See Examples
14–19	1
20–25	2
26–31, 38–39	3

Extra Practice
See pages 572, 599.



Solve each equation. Check your solution.

32. $4x = 9.2$

33. $9y = 13.5$

34. $-5.4 = 0.3p$

35. $-9.72 = 1.8a$

36. $3.9y = 18.33$

37. $2.6b = 2.08$

EARTHQUAKES For Exercises 38 and 39, use the following information.

Scientists determine the epicenter of an earthquake by measuring the time it takes for surface waves to travel between two places. Surface waves travel about 6 kilometers per second through Earth's crust.

38. The distance from Los Angeles, California, to Phoenix, Arizona, is 600 kilometers. Write a multiplication equation to find how long it would take surface waves to travel from Los Angeles to Phoenix.

39. Solve the equation.

ROLLER COASTERS For Exercises 40 and 41 use the table.

40. Without calculating, explain whether the *Blue Streak* or *Magnum* has the greater speed.

41. Find the speed of each roller coaster in feet per second.

Name	Track Length (ft)	Time of Ride
Blue Streak	2,558	1 min 45 s
Corkscrew	2,050	2 min
Magnum	5,106	2 min
Mean Streak	5,427	2 min 45 s

Source: www.rcdb.com

42. **CRITICAL THINKING**

Solve $3|x| = 12$.

Spiral Review with Standardized Test Practice

43. **MULTIPLE CHOICE** A car is traveling at a speed of 75 feet per second. How many yards will the car travel in 90 seconds if it maintains the same speed?

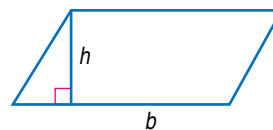
(A) 75 yd

(B) 270 yd

(C) 2,250 yd

(D) 6,750 yd

44. **MULTIPLE CHOICE** Use the formula $A = bh$ to find the height of a parallelogram with a base of 34 millimeters and an area of 612 square millimeters.



(F) 20,800 mm

(G) 646 mm

(H) 578 mm

(I) 18 mm

ALGEBRA Solve each equation. (Lesson 4-2)

45. $y + 8 = -2$

46. $x - 7 = -2$

47. $20 = z + 23$

ALGEBRA Write an algebraic expression for each phrase. (Lesson 4-1)

48. the product of -3 and y

49. 5 years older than Rafael

50. 10 fewer students than last year

51. twice as many runs as the Marlins scored

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Subtract. (Lesson 3-5)

52. $8 - (-2)$

53. $-7 - 7$

54. $-3 - (-9)$

55. $-3 - 18$



4-4a

Problem-Solving Strategy

A Preview of Lesson 4-4

What You'll LEARN

Solve problems using the work backward strategy.

Work Backward

Alicia, how much money did we take to the movies today?

Well, we spent \$9 on movie tickets. Then we spent \$5 on candy, and one half of what was left on popcorn. We have \$3 left. Let's **work backward** to figure it out.



Explore	We know we have \$3 left and the amounts spent. We need to find the initial amount we had.
Plan	Let's start with the end result and work backward.
Solve	We have \$3 left. 3
	Undo the half spent on popcorn. × 2
	Undo the \$5 spent on candy. 6
	Undo the \$9 spent on movie tickets. + 5
	11
	+ 9
	20
Examine	Assume that we started with \$20. After buying movie tickets, we had $\$20 - \9 or \$11. We spent \$5 on candy, so we had $\$11 - \5 or \$6. Then we spent one half of the remaining money on popcorn, so we had $\$6 \div 2$ or \$3. So, our answer of \$20 is correct.

Analyze the Strategy

- Explain** when you would use the work backward strategy to solve a problem.
- Describe** how to solve a problem by working backward.
- Write** a problem that can be solved by working backward. Then write the steps you would take to find the solution to your problem.

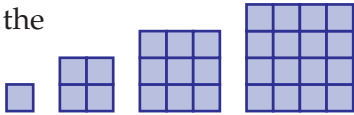
Apply the Strategy

Solve. Use the work backward strategy.

4. **MONEY** Mia spent \$4.50 at the bakery and then spent four times that amount at the grocery. She had \$12.80 left. How much money did she have initially?
5. **NUMBER THEORY** A number is multiplied by 4. Then 6 is subtracted from the product. After adding 5, the result is 15. What is the number?

Mixed Problem Solving

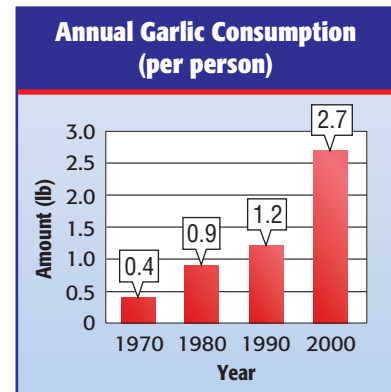
Solve. Use any strategy.

6. **PATTERNS** Draw the sixth figure in the pattern shown.
- 
7. **FOOD** Mateo goes to the grocery store and buys a ham for \$24.98 and a vegetable tray for \$17.49. There is no tax. He gives the cashier one bill and receives less than \$10 in change. What was the denomination of the bill Mateo gave the cashier?
8. **TIME** A shuttle bus schedule is shown. What is the earliest time after noon when the bus departs?

Departs	Arrives
8:55 A.M.	9:20 A.M.
9:43 A.M.	10:08 A.M.
10:31 A.M.	10:56 A.M.
11:19 A.M.	11:44 A.M.

9. **GEOGRAPHY** The land area of Texas is 267,277 square miles. This is about 5 times the land area of Arkansas. Estimate the land area of Arkansas.
10. **NUMBER THEORY** How many different two-digit numbers can you make using the digits 2, 4, and 9 if no digit is repeated within a number?
11. **AGE** Maya is two years older than her sister Jenna. Jenna is 5 years older than their brother Trevor, who is 9 years younger than their brother Trent. Trent is 17 years old. How old is Maya?

FOOD For Exercises 12 and 13, use the graph below.



12. How much more garlic was eaten in 2000 than in 1990?
13. Find the average monthly consumption of garlic in 2000.
14. **VIDEOS** Carlos rented 2 times as many DVDs as Ashley last month. Ashley rented 4 fewer than Greg, but four more than Grace. Greg rented 9 DVDs. How many DVDs did each person rent?

15. STANDARDIZED TEST PRACTICE

Which of the following is the most reasonable total amount for the items purchased?

- (A) \$17 (B) \$20
(C) \$26 (D) \$30

Pens	\$ 2.09
Ruler	\$ 0.99
Paper	\$ 1.49
Book	\$14.99
Candy	\$ 0.49
Glue	\$ 0.89
Folder	\$ 1.19
Erasers	\$ 1.99
Pencils	\$ 1.87

4-4

Solving Two-Step Equations

HANDS-ON Mini Lab

Materials

- cups and counters
- equation mat

What You'll LEARN

Solve two-step equations.

NEW Vocabulary

two-step equation

Work with a partner.

A **two-step equation** has two different operations. Follow these steps to solve $2x - 3 = 1$.

Model the equation.

$$2x - 3 = 1$$

Add 3 positive counters to each side of the equation. Then remove the zero pairs.

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

Arrange the cups and counters into two equal groups.

$$2x = 4$$

Each cup is matched with 2 positive counters. So, $x = 2$.

Solve each equation using models.

- $3x + 1 = 7$
- $2x - 4 = 2$
- $2x + 3 = -3$

To solve two-step equations, “undo” the operations in reverse order of the order of operations. You are using the *work backward* strategy.

EXAMPLE Solve a Two-Step Equation

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

$$3x + 2 = 23 \quad \text{Write the equation.}$$

$$\underline{- 2 = - 2} \quad \text{Subtract 2 from each side.}$$

$$3x = 21 \quad \text{Simplify.}$$

$$\frac{3x}{3} = \frac{21}{3} \quad \text{Divide each side by 3.}$$

$$x = 7 \quad \text{Simplify.}$$

The solution is 7. Check the solution.

STUDY TIP

Solving Equations

When you solve a simple equation like $-2y = 10$, you can mentally divide each side by -2 .

EXAMPLES

Solve Two-Step Equations

Solve each equation. Check your solution.

$$\begin{aligned} -2y - 7 &= 3 && \text{Write the equation.} \\ -2y - 7 &= 3 && \\ \underline{+ 7} &= \underline{+ 7} && \text{Add 7 to each side.} \\ -2y &= 10 && \text{Simplify.} \\ \frac{-2y}{-2} &= \frac{10}{-2} && \text{Divide each side by } -2. \\ y &= -5 && \text{Simplify.} \end{aligned}$$

The solution is -5 . Check the solution.

$$\begin{aligned} -11 &= 4 + 5r && \text{Write the equation.} \\ -11 &= 4 + 5r && \\ \underline{- 4} &= \underline{- 4} && \text{Subtract 4 from each side.} \\ -15 &= 5r && \text{Simplify.} \\ \frac{-15}{5} &= \frac{5r}{5} && \text{Divide each side by 5.} \\ -3 &= r && \text{Simplify.} \end{aligned}$$

The solution is -3 . Check the solution.

Your Turn Solve each equation.

a. $4x + 5 = 13$

b. $-3n - 8 = 7$

c. $1 + 2y = -3$

REAL-LIFE MATH

BOWLING Handicapping allows bowlers with varying skills to score about the same. Your handicap h is added to your score s , so your final score is $h + s$.

Source: www.bowl.com



Some problems start with a given amount and increase at a certain rate.

EXAMPLE

Use an Equation to Solve a Problem

BOWLING Suppose you spend \$6 to rent bowling shoes at The Bowling Alley. Each game costs \$3.50. How many games can you bowl if you have \$20 to spend?

Variable	Let x = the number of games.
Words	Cost of the shoes plus the cost of the games equals \$20.
Equation	$6 + 3.50x = 20$

$$\begin{aligned} 6 + 3.50x &= 20 && \text{Write the equation.} \\ \underline{- 6} &= \underline{- 6} && \text{Subtract 6 from each side.} \\ 3.50x &= 14 && \text{Simplify.} \\ \frac{3.50x}{3.50} &= \frac{14}{3.50} && \text{Divide each side by 3.50.} \\ x &= 4 && 14 \div 3.50 = 4 \end{aligned}$$

You can bowl 4 games. Is this answer reasonable?



Skill and Concept Check

- OPEN ENDED** Write a two-step equation that has -2 as the solution.
- FIND THE ERROR** Jackson and Michele are solving $4 + 2x = -8$. Who is correct? Explain.

Jackson

$$4 + 2x = -8$$

$$4 + \frac{2x}{2} = \frac{-8}{2}$$

$$4 + x = -4$$

$$x = -8$$

Michele

$$4 + 2x = -8$$

$$\frac{-4}{2} = \frac{-4}{2}$$

$$2x = -12$$

$$x = -6$$

GUIDED PRACTICE

Solve each equation. Check your solution.

- $3x + 1 = 7$
- $4h - 6 = 22$
- $-6r + 1 = -17$
- $13 = 1 + 4s$
- Five more than three times a number is 23. Find the number.

Practice and Applications

Solve each equation. Check your solution.

- $3x + 1 = 10$
- $5x + 4 = 19$
- $2t + 7 = -1$
- $6m + 1 = -23$
- $-4w - 4 = 8$
- $-7y + 3 = -25$
- $-8s + 1 = 33$
- $-2x + 5 = -13$
- $3 + 8n = -5$
- $5 + 4d = 37$
- $14 + 2p = 8$
- $25 + 2y = 47$
- $2 = 3t - 13$
- $57 = -8x - 7$
- $18 = 9d - 18$
- $4 = 4 + 7f$
- $21 + 11x = -1$
- $15x + 4 = 49$

- Three more than the product of a number and 4 is 15. Find the number.
- Five less than three times a number is 1. Find the number.
- The product of 2 and a number is increased by 9. The result is -17 . Find the number.
- If you subtract 3 from twice a number, the result is 25. Find the number.

Solve each equation. Check your solution.

- $2r - 3.1 = 1.7$
- $4t + 3.5 = 12.5$
- $16b - 6.5 = 9.5$
- $5w + 9.2 = 19.7$
- $16 = 0.5r - 8$
- $0.2n + 3 = 8.6$
- $7.5s - 2 = 28$
- $1.5v - 16 = 8$

- MONEY MATTERS** Joshua has saved \$74 toward a new sound system that costs \$149. He plans on saving an additional \$15 each week. How many weeks will it take Joshua to save enough money to buy the sound system?
- WEATHER** The temperature is 20°F . It is expected to rise at a rate of 4° each hour for the next several hours. In how many hours will the temperature be 32° ?

HOMEWORK HELP

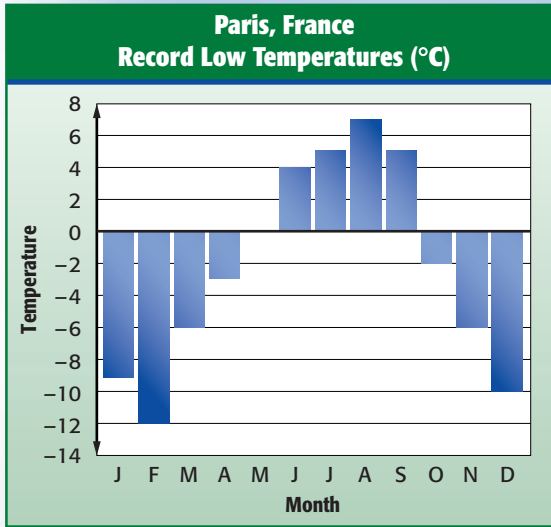
For Exercises	See Examples
8–11	1
12–15	2
16–19	3
26–29, 38–41	4

Extra Practice
See pages 573, 599.

TEMPERATURE For Exercises 40 and 41, use the following information and the graph.

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.

40. The highest temperature ever recorded in Virginia Beach, Virginia, was 104°F . Find this temperature in degrees Celsius.
41. **MULTI STEP** The lowest temperature ever recorded in Virginia Beach was -3°F . Is this temperature greater or less than the lowest temperature ever recorded in Paris, France?



Data Update What are the record high and low temperatures for a large city near you? Visit msmath2.net/data_update to learn more.

42. **CRITICAL THINKING** 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.

Spiral Review with Standardized Test Practice

43. **MULTIPLE CHOICE** A taxi driver charges $\$2.00$ plus $\$0.80$ for each mile traveled. Which expression could be used to find the cost of a taxi ride if m miles are traveled?
- (A) $2.80m$ (B) $2m + 0.80$ (C) $2 + 0.80m$ (D) $2m + 0.80m$
44. **SHORT RESPONSE** In 2004, the first-class postage rates were $\$0.37$ for the first ounce plus an additional cost for each ounce.

Weight (oz)	1	2	3	4	5	6
Postage (dollars)	0.37	0.60	0.83	1.06	1.29	1.52

What is the cost, in dollars, for a 12-ounce letter?

ALGEBRA Solve each equation. Check your solution. (Lessons 4-2 and 4-3)

45. $4f = 28$ 46. $6p = -72$ 47. $p - 14 = 27$ 48. $26 = n + 2$
49. **DIVING** Find the distance between two divers if one diver is 27 feet below sea level and the other diver is 13 feet below sea level. (Lesson 3-5)

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Replace each \bullet with $<$ or $>$ to make a true sentence. (Lesson 3-2)

50. $-3 \bullet -12$ 51. $1 \bullet -1$ 52. $7 \bullet -18$ 53. $-120 \bullet -30$



Mid-Chapter Practice Test

Vocabulary and Concepts

1. **State** the property of equality used to solve $a - 7 = -2$. (Lesson 4-2)
2. **Write** a two-step equation. Then solve your equation. (Lesson 4-4)
3. **Define** *inverse operation* and give an example. (Lesson 4-2)

Skills and Applications

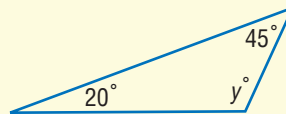
Write each sentence as an algebraic equation. (Lesson 4-1)

4. The product of a number and 3 is -16 .
5. 10 less than a number is 45.

Solve each equation. Check your solution. (Lessons 4-2, 4-3, and 4-4)

- | | | |
|-------------------|-------------------|--------------------|
| 6. $21 + m = 33$ | 7. $a - 5 = -12$ | 8. $7y = 63$ |
| 9. $5f = -75$ | 10. $-28 = -2d$ | 11. $-1.6w = 4.8$ |
| 12. $3z - 7 = 17$ | 13. $2g - 9 = -5$ | 14. $-4c - 1 = 11$ |

15. **FLYING** An airplane is flying at an altitude of t feet before it increases its altitude by 1,000 feet. Write an expression for its new altitude. (Lesson 4-1)
16. **GEOMETRY** The sum of the measures of the angles of a triangle is 180° . Find the missing measure. (Lesson 4-2)



LAWN SERVICE For Exercises 17 and 18, use the following information.

Alex earned \$326 this summer mowing lawns. The total was 4 times more than what he earned last summer. (Lesson 4-3)

17. Write a multiplication equation to find how much Alex earned last summer.
18. Solve the equation.

Standardized Test Practice

19. **MULTIPLE CHOICE** Kim's time for the 5K race was four minutes less than Tanya's time. If Tanya's time is t , which expression represents Kim's time? (Lesson 4-1)

(A) $4 - t$	(B) $t - 4$
(C) $t + 4$	(D) $4t$
20. **GRID IN** Last baseball season, Ryan had four less than twice the number of hits that Marcus had. Ryan had 48 hits. How many hits did Marcus have last season? (Lesson 4-4)

The Game Zone

A Place To Practice Your Math Skills

Math Skill
Solving Equations



Math-O

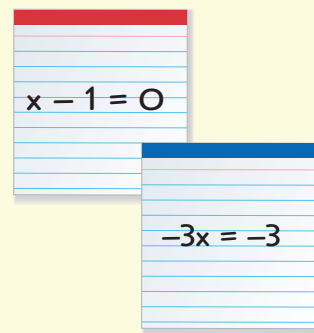
● GET READY!

Players: two, three, or four

Materials: scissors, 26 index cards, and 4 different colored markers

● GET SET!

- Cut each index card in half, making 52 cards.
- To make a set of four cards, use the markers to put a different-colored stripe at the top of each card.
- Then write a different equation on each card. The solution of each equation should be 1.
- Continue to make sets of four cards having equations with solutions of 2, 3, 4, 5, 6, 0, -1, -2, -3, -4, and -5.
- Mark the remaining set of four cards "Wild."



● GO!

- The dealer shuffles the cards and deals five to each person. The remaining cards are placed in a pile facedown in the middle of the table. The dealer turns the top card faceup.
- The player to the left of the dealer plays a card with the same color or solution as the faceup card. Wild cards can be played any time. If the player cannot play a card, he or she takes a card from the pile and plays it, if possible. If it is not possible to play, the player places the card in his or her hand, and it is the next player's turn.
- **Who Wins?** The first person to play all cards in his or her hand is the winner.

4-5

Inequalities

What You'll LEARN

Solve inequalities.

NEW Vocabulary

inequality

MATH Symbols

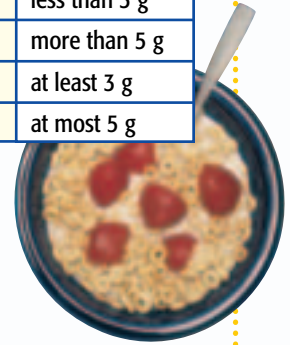
- $<$ is less than
- $>$ is greater than
- \leq is less than or equal to
- \geq is greater than or equal to

WHEN am I ever going to use this?

BREAKFAST The table shows the nutrition requirements for a healthy breakfast cereal with milk.

- Suppose your favorite cereal has 2 grams of fat, 7 grams of protein, 4 grams of fiber, and 3 grams of sugar. Is it a healthy cereal? Explain.
- Is a cereal with 3 grams of fiber considered healthy? Explain.
- Is a cereal with 5 grams of sugar considered healthy? Explain.

Healthy Breakfast Cereals (per serving)	
Fat	less than 3 g
Protein	more than 5 g
Fiber	at least 3 g
Sugar	at most 5 g



An **inequality** is a mathematical sentence that contains the symbols $<$, $>$, \leq , or \geq .

Inequalities				
Words	is less than	is greater than	is less than or equal to is at most	is greater than or equal to is at least
Symbols	$<$	$>$	\leq	\geq

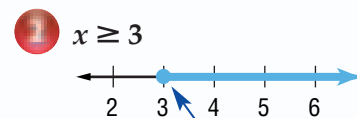
Any number that makes the inequality true is a solution of the inequality. Inequalities may have many solutions. The solutions are shown by shading a number line.

EXAMPLES Graph Solutions of Inequalities

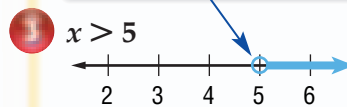
Graph each inequality on a number line.



The open circle means the number is *not* included in the solution.



The closed circle means the number *is* included in the solution.



Your Turn Graph each inequality on a number line.

- a. $x < -1$ b. $x \geq -2$ c. $x > 0$ d. $x \leq 3$

To solve an inequality, follow the same steps you use to solve an equation.

STUDY TIP

Checking Solutions

You may also want to check $x = 5$. The solution of the equation is the *boundary* between numbers that are solutions and numbers that are not solutions.

EXAMPLES

Solve One-Step Inequalities

- 5 Solve $x + 4 > 9$. Check your solution. Then graph the solution.

$$x + 4 > 9 \quad \text{Write the inequality.}$$

$$\underline{-4} = \underline{-4} \quad \text{Subtract 4 from each side.}$$

$$x > 5 \quad \text{Simplify.}$$

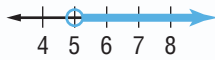
Check Try 6, a number greater than 5.

$$x + 4 > 9 \quad \text{Write the inequality.}$$

$$6 + 4 \stackrel{?}{>} 9 \quad \text{Replace } x \text{ with 6. Is this sentence true?}$$

$$10 > 9 \quad \checkmark$$

The solution is all numbers greater than 5.



- 6 Solve $4y \leq 8$. Graph the solution.

$$4y \leq 8 \quad \text{Write the inequality.}$$

$$\frac{4y}{4} \leq \frac{8}{4} \quad \text{Divide each side by 4.}$$

$$y \leq 2 \quad \text{Check this solution.}$$

The solution is all numbers less than or equal to 2.



- 7 **Your Turn** Solve each inequality. Graph the solution.

e. $x + 6 > 8$

f. $x - 4 \geq -7$

g. $5x < 25$

REAL-LIFE CAREERS

How Does a Nurse Use Math?

Nurses use inequalities when they record test results like a person's blood pressure.



Research

For information about a career as a nurse, visit: msmath2.net/careers



EXAMPLE

Use an Inequality to Solve a Problem

- 7 **HEALTH** The formula $110 + 0.5A < P$ is used to estimate whether a person has high blood pressure. In the formula, A is the person's age and P is the blood pressure. For which ages is a blood pressure of 120 considered high?

$$110 + 0.5A < P \quad \text{Write the formula.}$$

$$110 + 0.5A < 120 \quad \text{Replace } P \text{ with 120.}$$

$$\underline{-110} = \underline{-110} \quad \text{Subtract 110 from each side.}$$

$$0.5A < 10 \quad \text{Simplify.}$$

$$\frac{0.5A}{0.5} < \frac{10}{0.5} \quad \text{Divide each side by 0.5.}$$

$$A < 20 \quad 10 \div 0.5 = 20$$

A blood pressure of 120 is considered high for a person who is younger than 20 years old.



msmath2.net/extra_examples



Skill and Concept Check

1. Draw a number line that shows all numbers less than or equal to -4 .
2. **Writing Math** Explain the difference between $x > 3$ and $x \geq 3$.
3. **OPEN ENDED** Write two different inequalities whose solution is $x < 2$.
4. **FIND THE ERROR** Courtney and Diego are writing an inequality for the expression *at least 2 hours of homework*. Who is correct? Explain.

Courtney
 $h \leq 2$

Diego
 $h \geq 2$

GUIDED PRACTICE

Graph each inequality on a number line.

5. $y > -3$

6. $x \geq 0$

7. $d < 7$

Solve each inequality.

8. $x + 3 > -4$

9. $6d \geq 24$

10. $3x + 8 < 15$

Practice and Applications

Graph each inequality on a number line.

11. $s > -4$

12. $y > 3$

13. $t \geq -4$

14. $a \geq 3$

15. $h < 2$

16. $g < -5$

17. $z \leq -1$

18. $p \leq 0$

19. $w \leq -6$

Solve each inequality.

20. $y + 5 < 14$

21. $x + 6 < 0$

22. $a - 3 \geq -5$

23. $g - 5 > 2$

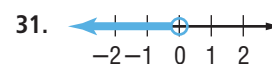
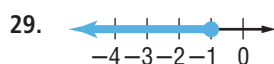
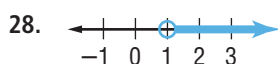
24. $3r \leq 18$

25. $6u \geq 36$

26. $2x + 8 < 24$

27. $3y + 1 \leq 5$

Write the inequality for each graph.



Write an inequality for each sentence. Then solve the inequality.

32. Five times a number is greater than 25.

33. The sum of a number and 1 is at least 5.

34. **WEATHER** A tropical depression has maximum sustained winds of less than 39 miles per hour. Write an inequality showing the wind speeds.

35. **DRIVING** In Ohio, you can get a driver's license if you are at least 16 years old. Write an inequality showing the age of all drivers in Ohio.

HOMEWORK HELP

For Exercises	See Examples
11–19	1–4
20–25, 32–33	5–6
26–27, 40–41	7

Extra Practice
See pages 573, 599.



Data Update What are the minimum ages for getting a driver's license in other states? Visit msmath2.net/data_update to learn more.

SPORTS For Exercises 36–39, use the graphic.

36. In which sport(s) are more than 400,000 children hurt?
37. In which sport(s) are at least 185,000 children hurt?
38. Of the sports listed, which have less than 300,000 injuries?
39. Write an inequality that describes the number of children hurt each year playing sports.

SHOPPING For Exercises 40 and 41, use the following information.

Suppose a pair of jeans costs \$29 and a necklace costs \$8. You have \$70 to spend on both.

40. Write an inequality to find how many pairs of jeans you can buy along with one necklace.
41. Solve the inequality.

42. **CRITICAL THINKING** A *compound inequality* is formed by two inequalities connected by the words *and* or *or*.

Type	Example	Solution	Graph
Intersection	$x > -3$ and $x < 4$	Both inequalities are true. $\{x \mid -3 < x < 4\}$	
Union	$x < 2$ or $x > 5$	Either inequality is true. $\{x \mid x < 2$ or $x > 5\}$	

Identify each compound inequality as an intersection or union. Then find and graph the solution.

- a. $x > 2$ and $x < 7$ b. $x < -4$ or $x > 4$ c. $x \geq -3$ or $x < -6$ d. $x \leq 10$ and $x > 0$

Spiral Review with Standardized Test Practice

43. **MULTIPLE CHOICE** Which inequality is graphed on the number line?

- Ⓐ $x < 3,000$ Ⓑ $x \leq 3,000$
 Ⓒ $x > 3,000$ Ⓓ $x \geq 3,000$



44. **MULTIPLE CHOICE** Ayano has \$26 to spend. A hat costs \$8. Which inequality shows how much he can spend for a T-shirt?

- Ⓕ $s + 8 < 26$ Ⓖ $s + 8 > 26$ Ⓗ $s + 8 \leq 26$ Ⓘ $s + 8 \geq 26$

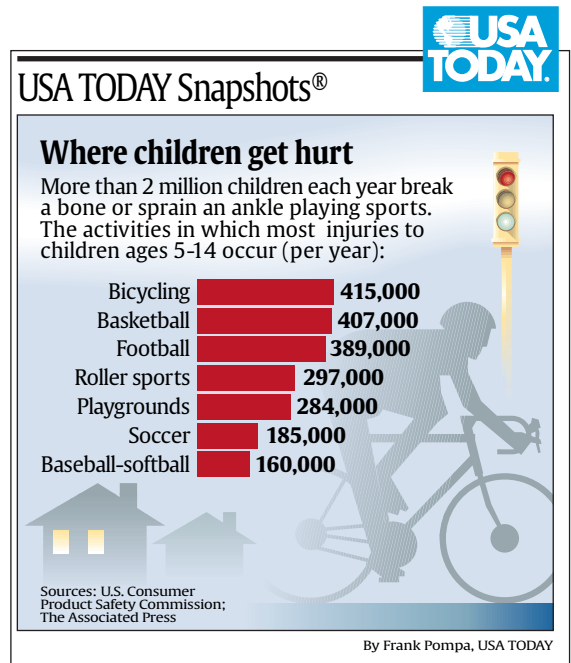
ALGEBRA Solve each equation. Check your solution. (Lessons 4-2, 4-3, and 4-4)

45. $13 = s + 5$ 46. $18x = -54$ 47. $2q + 6 = -20$ 48. $-7q + 4.6 = -0.3$

GETTING READY FOR THE NEXT LESSON

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

49. $(-4, 2)$ 50. $(3, -1)$ 51. $(-3, -4)$ 52. $(2, 0)$



What You'll LEARN

Graph a function on a scatter plot.

Materials

- stopwatch
- grid paper
- uncooked spaghetti

Functions and Graphs**INVESTIGATE** *Work as a class.*

Have you ever been at a sporting event when the crowd does the “wave”? In this Lab, you will investigate how long it would take the students at your school to complete the “wave.”



STEP 1 Begin with five students sitting in a row.

STEP 2 At the timer's signal, the first student stands up, waves his or her arms overhead, and sits down. Each student repeats the wave in order.

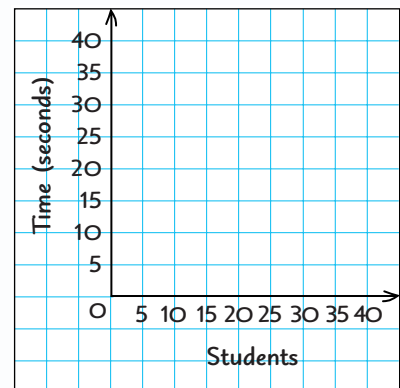
STEP 3 When the last student sits down, the timer records the time in seconds.

STEP 4 Repeat for 6, 7, 8, and so on, up to 25 students.

Writing Math

Work with a partner.

- Graph** the ordered pairs (number of students, time) on a coordinate grid like the one at the right.
- Describe** how the points appear on your graph.
- Place one piece of uncooked spaghetti on your graph so that it covers as many of the points as possible. **Predict** how long it would take 30 students to complete the “wave.” Make a prediction for 50 students.
- Find a pattern** in the data and use the pattern to predict how long it would take the students in your school to complete the “wave.” Explain your reasoning.
- A *function* describes the relationship between two quantities. In a function, one quantity *depends on* the other. **Complete the sentence:** The time it takes to do the “wave” depends on ?



4-6

Functions and Linear Equations



What You'll LEARN

Graph linear equations.

NEW Vocabulary

function
function table
domain
range
linear equation

REVIEW Vocabulary

ordered pair: a pair of numbers used to locate a point in a coordinate system (Lesson 3-3)

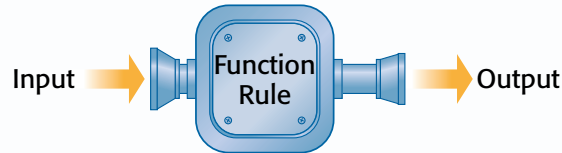
WHEN am I ever going to use this?

FAST FOOD Suppose you can buy hamburgers for \$2 each.

- Copy and complete the table to find the cost of 2, 3, and 4 hamburgers.
- On grid paper, graph the ordered pairs (number, cost). Describe how the points appear on the grid.
- What happens to the cost as the number of hamburgers increases?

Hamburgers		
Number	Multiply by 2	Cost (\$)
1	2×1	2
2		
3		
4		

The total cost of the hamburgers depends on the number of hamburgers. A relationship where one thing depends on another is called a **function**. In a function, you start with an *input* number, perform one or more operations on it, and get an *output* number.



You can organize the input numbers, output numbers, and the function rule in a **function table**.

EXAMPLE Make a Function Table

- MONEY MATTERS** Suppose you earn \$5 each week. Make a function table that shows your total earnings after 1, 2, 3, and 4 weeks.

Input	Function Rule	Output
Number of Weeks	Multiply by 5	Total Earnings (\$)
1	5×1	5
2	5×2	10
3	5×3	15
4	5×4	20

The set of input values is called the **domain**, and the set of output values is called the **range**. In Example 1, the domain is {1, 2, 3, 4}, and the range is {5, 10, 15, 20}.

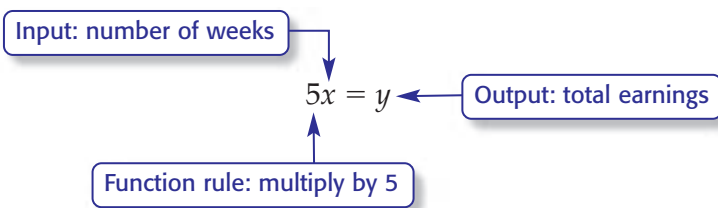


Functions are often written as equations with two variables—one to represent the input and one to represent the output. Here’s an equation for the situation in Example 1.

STUDY TIP

Input and Output

When x and y are used in an equation, x usually represents the input, and y usually represents the output.



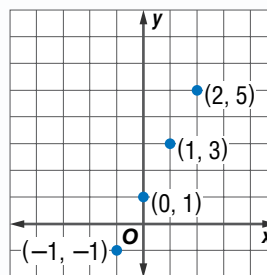
The solution of an equation with two variables consists of two numbers, one for each variable, that make the equation true. The solution is usually written as an ordered pair (x, y) , which can be graphed.

EXAMPLE Graph Solutions of Linear Equations

1 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	$(-1, -1)$



Four solutions are $(2, 5)$, $(1, 3)$, $(0, 1)$, and $(-1, -1)$. The graph is shown above at the right.

2 Your Turn Graph each equation.

a. $y = x - 3$

b. $y = -3x$

c. $y = -3x + 2$

STUDY TIP

Graphing Equations

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

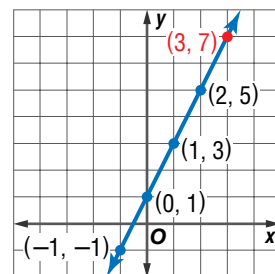
Notice that all four points in the graph lie on a line. Draw a line through the points to graph *all* solutions of the equation $y = 2x + 1$. The graph of $(3, 7)$ is also on the line.

$y = 2x + 1$ 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.

EXAMPLE

Represent Real-World Functions

REAL-LIFE MATH

SKATEBOARDING

About one fourth of all skateboarding purchases are made by teenagers from 14 to 17 years old.

Source: Statistical Abstract of the United States

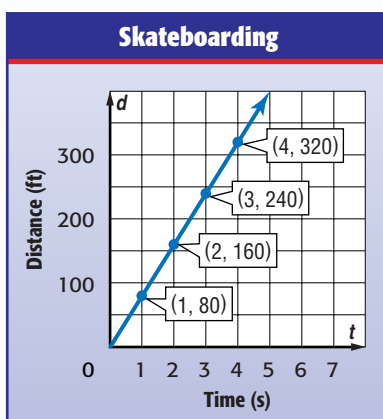


1 SKATEBOARDING The top speed reached by a standing skateboarder is 80 feet per second. The equation $d = 80t$ describes the distance d that a skateboarder can travel in time t . Represent the function with a graph.

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

t	$80t$	d	(t, d)
1	$80(1)$	80	(1, 80)
2	$80(2)$	160	(2, 160)
3	$80(3)$	240	(3, 240)
4	$80(4)$	320	(4, 320)

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



Skill and Concept Check

- OPEN ENDED** Write an equation that has $(1, 2)$ as a solution.
- Writing Math** Explain the relationship among *input*, *output*, and *function rule*.

GUIDED PRACTICE

Copy and complete each function table. Identify the domain and range.

3. $y = x - 2$

x	$x - 2$	y
1		
2		
3		
4		

4. $y = 4x$

x	$4x$	y
-1		
0		
1		
2		

Graph each equation.

5. $y = x - 1$

6. $y = -1x$

7. $y = -2x + 3$



Practice and Applications

Copy and complete each function table. Identify the domain and range.

8. $y = x - 4$

x	$x - 4$	y
1		
2		
3		
4		

9. $y = x + 5$

x	$x + 5$	y
1		
2		
3		
4		

10. $y = 2x$

x	$2x$	y
-1		
0		
1		
2		

11. $y = -6x$

x	$-6x$	y
-1		
0		
1		
2		

12. $y = 2x - 1$

x	$2x - 1$	y
1		
2		
3		
4		

13. $y = -2x - 2$

x	$-2x - 2$	y
-1		
0		
1		
2		

Graph each equation.

14. $y = x + 1$

15. $y = x + 3$

16. $y = x$

17. $y = -2x$

18. $y = 2x + 3$

19. $y = 3x - 1$

20. $y = 4x - 2$

21. $y = 2x + 5$

22. $y = x + 0.5$

23. $y = 0.25x$

24. $y = 0.5x - 1$

25. $y = 2x - 1.5$

Make a function table for each sentence. Then write an equation using x to represent the first number and y to represent the second number.

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

27. The second number is five less than the first number.

28. The second number is ten times the first number.

SPENDING For Exercises 29–31, use the graph.

29. Make a function table that shows the total average defense spending per person for 1, 2, 3, and 4 days.

30. Write an equation in which x represents the days and y represents the total spending.

31. Graph the equation.

INTERNET For Exercises 32–34, use the following information.

An Internet provider charges \$20 each month.

32. Make a function table that shows the total charge for 1, 2, 3, and 4 months of service.

33. Write an equation in which x represents months and y represents the total charge.

34. Graph the equation.

HOMEWORK HELP

For Example See Examples

8–13 1

14–25 2

29–35 3

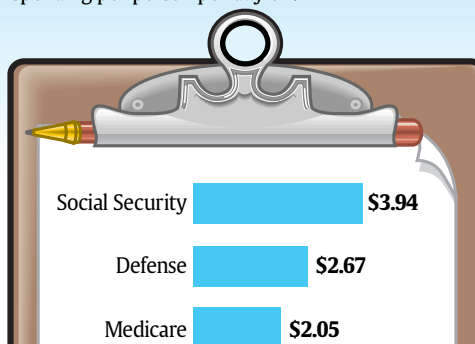
Extra Practice
See pages 573, 599.



USA TODAY Snapshots®

Health research spending small

About 4.6 cents of each U.S. health-care dollar is spent on medical/health research. By comparison, federal spending per person per day on:



Source: Research America

By Lori Joseph, Keith Simmons and Marcy E. Mullins, USA TODAY

35. **GEOMETRY** The formula for the area A of a rectangle whose length is 5 units is $A = 5w$, where w is the width. Graph the function.
36. **WRITE A PROBLEM** Write about a real-life situation that can be represented by the equation $y = 3x$.

CRITICAL THINKING For Exercises 37–40, write an equation for the function shown in each function table.

37.

x	y
1	3
2	4
3	5
4	6

38.

x	y
2	6
4	12
6	18
8	24

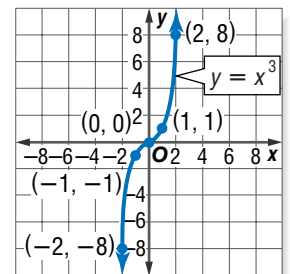
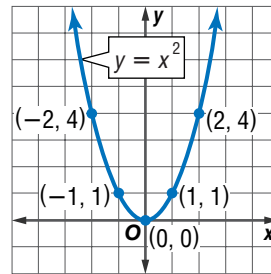
39.

x	y
-1	4
0	0
1	-4
2	-8

40.

x	y
1	3
2	5
3	7
4	9

EXTENDING THE LESSON Not all equations have graphs that are straight lines. The graphs at the right show two *nonlinear equations*.



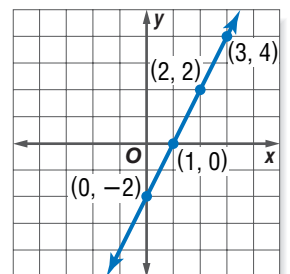
Graph each equation. Determine whether it is *linear* or *nonlinear*.

41. $y = x^2 - 1$ 42. $y = x + 1$
 43. $y = 2x$ 44. $xy = 12$
 45. $y = 2x^2$ 46. $y = x^3 - 1$

Spiral Review with Standardized Test Practice

47. **MULTIPLE CHOICE** Choose the equation that is graphed at the right.

- (A) $y = 2x$ (B) $y = x$
 (C) $y = x - 1$ (D) $y = 2x - 2$



48. **MULTIPLE CHOICE** Which ordered pairs are solutions of the equation $y = 2x - 4$?

- (F) $(-2, -3), (0, 2)$ (G) $(-2, -1), (2, -3)$
 (H) $(1, -2), (3, 2)$ (I) $(-3, 2), (0, -4)$

49. **CIVICS** To serve as a U.S. Representative, a person must be at least 25 years old and a citizen of the United States for at least 7 years. Write an inequality showing the age of a person who may be a U.S. Representative. (Lesson 4-5)

ALGEBRA Solve each equation. Check your solution. (Lesson 4-4)

50. $8 = 3h - 1$ 51. $2q + 6 = -20$ 52. $32 = -4 + 9m$

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Divide. (Lesson 3-7)

53. $-4 \div 2$ 54. $10 \div (-5)$ 55. $-12 \div (-4)$ 56. $-16 \div 16$



Lines and Slope

What You'll LEARN

Find the slope of a line.

NEW Vocabulary

slope

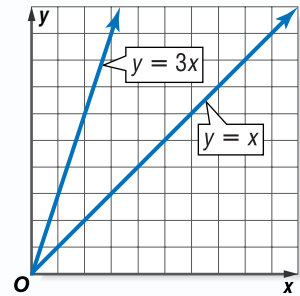
Link to READING

Everyday Meaning of Slope: ground that forms an incline, as in a ski slope

WHEN am I ever going to use this?

COST OF GASOLINE In recent years, the cost of one gallon of gasoline has varied from a low of about \$1 per gallon to a high of about \$3 per gallon. The equations $y = 1x$ and $y = 3x$ are graphed.

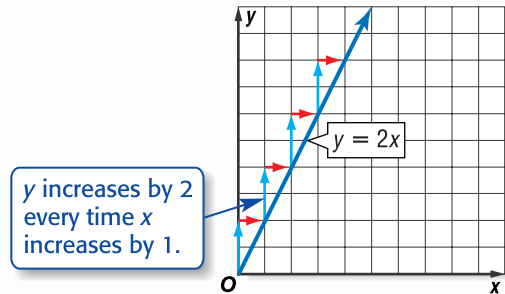
1. Which line is steeper?
2. What causes one line to be steeper?
3. **Make a conjecture** about where the line showing a cost of \$2 per gallon would be graphed. Explain.



The function table shows the total cost y of x gallons of gasoline at \$2 per gallon. The equation $y = 2x$ is graphed below.

x	$2x$	y
1	$2(1)$	2
2	$2(2)$	4
3	$2(3)$	6
4	$2(4)$	8

Annotations: On the left, three upward arrows labeled '+1' indicate the change in x from 1 to 2, 2 to 3, and 3 to 4. On the right, three upward arrows labeled '+2' indicate the change in y from 2 to 4, 4 to 6, and 6 to 8.



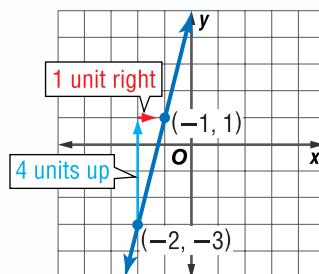
The change in y with respect to the change in x is called the **slope** of a line. Slope is a number that tells how steep the line is.

$$\begin{aligned} \text{slope} &= \frac{\text{change in } y}{\text{change in } x} \quad \leftarrow \text{vertical change} \\ &\quad \quad \quad \leftarrow \text{horizontal change} \\ &= \frac{2}{1} \text{ or } 2 \end{aligned}$$

The slope is the same for any two points on a straight line.

EXAMPLE Positive Slope

- 1 Find the slope of the line.



$$\begin{aligned} \text{slope} &= \frac{\text{change in } y}{\text{change in } x} \\ &= \frac{4}{1} \text{ or } 4 \end{aligned}$$

The slope of the line is 4.

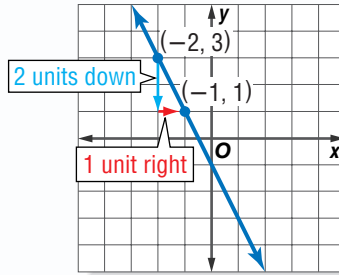
When the value of y decreases as the value of x increases, the slope is a negative number. The slope of a line can also be a fraction.

STUDY TIP

Slope A line with a *positive slope* rises to the right. A line with a *negative slope* falls to the right.

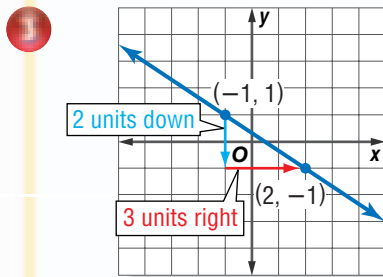
EXAMPLES Negative Slope

1 Find the slope of each line.



$$\begin{aligned} \text{slope} &= \frac{\text{change in } y}{\text{change in } x} \\ &= \frac{-2}{1} \text{ or } -2 \end{aligned}$$

The slope of the line is -2 .



$$\begin{aligned} \text{slope} &= \frac{\text{change in } y}{\text{change in } x} \\ &= \frac{-2}{3} \text{ or } -\frac{2}{3} \end{aligned}$$

The slope of the line is $-\frac{2}{3}$.

2 **Your Turn** Find the slope of the line that passes through each pair of points.

- a. $(-2, -4), (1, 5)$ b. $(0, 3), (4, -1)$ c. $(2, 2), (5, 3)$



EXAMPLE Compare Slopes

1 **MULTIPLE-CHOICE TEST ITEM** The table shows information about the rise and run of three ski slopes in Pennsylvania. Which has the steepest slope?

Ski Slope	Rise (ft)	Run (ft)
Giant Boulder	750	4,000
Giant Steps	750	3,200
Gunner	750	3,360

- (A) Giant Boulder (B) Giant Steps
(C) Gunner (D) They have the same slope.

Read the Test Item

The *rise* corresponds to the vertical change, or change in y .
The *run* corresponds to the horizontal change, or change in x .

Solve the Test Item

Giant Boulder: $\frac{750}{4,000}$ Giant Steps: $\frac{750}{3,200}$ Gunner: $\frac{750}{3,360}$

All three fractions have the same rise. But Giant Steps has the shortest run. Therefore, its slope is greater. The answer is B.

Test-Taking Tip

Make a Drawing

Whenever possible, make a drawing of the problem. Then use the drawing to estimate the answer.



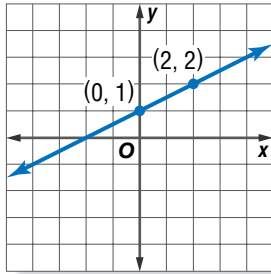
Skill and Concept Check

1. Define *slope*.
2. **Writing Math** Explain how a line can have a negative slope.
3. **OPEN ENDED** On a coordinate plane, draw a line with a slope of $\frac{1}{2}$.

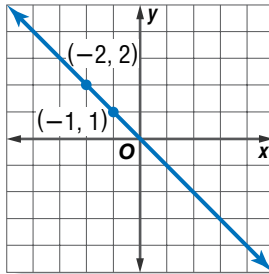
GUIDED PRACTICE

Find the slope of the line that passes through each pair of points.

4.



5.

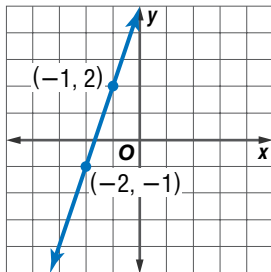


6. $(0, 0), (1, 3)$

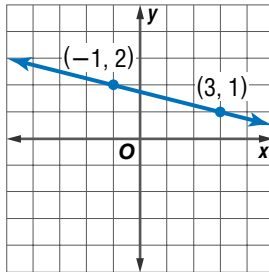
Practice and Applications

Find the slope of the line that passes through each pair of points.

7.



8.



9. $(-2, 0), (1, 3)$

10. $(3, 4), (4, 6)$

11. $(1, 0), (2, -3)$

12. $(-2, 2), (-1, -2)$

13. $(1, 1), (4, 2)$

14. $(-2, 1), (3, 3)$

15. $(1, -1), (3, -2)$

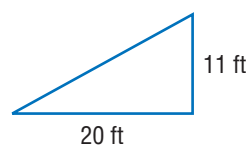
16. $(0, 0), (3, -2)$

EARNINGS For Exercises 17–19, use the table at the right.

17. Suppose each of the functions in the table was graphed on a coordinate plane. Which line is steeper? Explain.
18. Find the slope of each line.
19. What does the slope of each line represent?

Hours Worked	Earnings (\$)	
	Greg	Monica
1	4	5
2	8	10
3	12	15
4	16	20

20. **SKIING** Aerial skiers launch themselves into the air from a ramp like the one shown at the right. Is the slope of the ramp greater than one or less than one?



HOMEWORK HELP

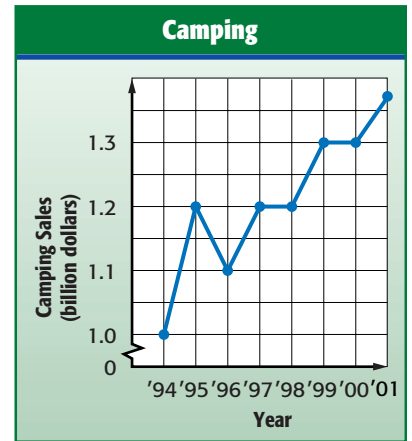
For Exercises	See Examples
7–16	1–3
17–20	4

Extra Practice
See pages 574, 599.



CAMPING For Exercises 21–23, use the graph.

- Which section of the graph shows the greatest increase in sales of camping gear? Describe the slope of this part of the graph.
- What happened to sales between 1995 and 1996? Describe the slope of this part of the graph.
- What happened to sales between 1997 and 1998? Describe the slope of this part of the graph.



Source: National Sporting Goods Association

CRITICAL THINKING A linear function has a constant slope. Determine whether each function is *linear* or *nonlinear*.

24.

x	y
1	5
2	6
3	7
4	8

25.

x	y
1	3
2	4
3	6
4	9

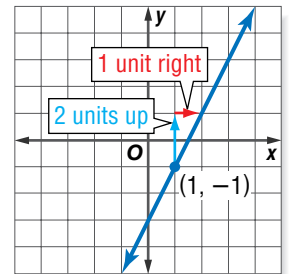
26.

x	y
-1	1
0	0
1	1
2	4

EXTENDING THE LESSON You can graph a line if you know the slope and the coordinates of a point on the line. The figure at the right shows how to graph a line with slope 2 that passes through (1, -1).

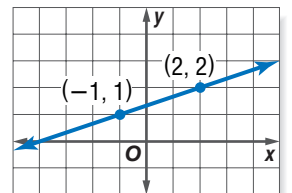
Graph each line with the given slope that passes through the given point.

- slope = 3; (2, 3)
- slope = -1; (-3, 2)
- slope = -2; (-4, -1)
- slope = 5; (0, -4)



Spiral Review with Standardized Test Practice

- MULTIPLE CHOICE** What is the slope of the line in the graph?
 A 3 B -3 C $\frac{1}{3}$ D $-\frac{1}{3}$
- GRID IN** The graph of a straight line contains the points (0, -3), (1, 2), and (2, y). What is the value of y?



Graph each equation. (Lesson 4-6)

- $y = 2x - 1$
- $y = -3x$
- $y = x + 4$
- Solve $2x + 6 < 8$. (Lesson 4-5)

INTERDISCIPLINARY PROJECT

The Wide World of Soccer

Math and Geography It is time to complete your project. Use the information and data you have gathered about countries where soccer is a favorite sport to prepare a Web page or poster. Be sure to include a graph with your project.



msmath2.net/webquest



msmath2.net/self_check_quiz



Vocabulary and Concept Check

domain (p. 177)

function (p. 177)

function table (p. 177)

inequality (p. 172)

inverse operations (p. 156)

linear equation (p. 178)

range (p. 177)

slope (p. 182)

two-step equation (p. 166)

work backward strategy (p. 164)

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

- Inverse operations “undo” each other.
- The words “more than” sometimes suggest the operation of multiplication.
- An inequality is a mathematical sentence that contains the symbols $<$, $>$, \leq , or \geq .
- When graphing $t < 2$ on a number line, an open circle should be used to show that 2 is not included in the solution.
- Slope is a number that tells how steep a line is.
- An equation is called a linear equation if its graph is a point.
- The solution of $m + 5 = 12$ is 17.
- The solution of $g - 4 = 18$ is 22.
- Six is the solution of $-8w = 48$.
- The solution of $2y \leq 18$ is $y \leq 16$.

Lesson-by-Lesson Exercises and Examples

4-1

Writing Expressions and Equations (pp. 150–152)

Write each phrase as an algebraic expression.

- the sum of a number and 5
- six inches less than her height
- twice as many apples
- four times the number of dollars

Write each sentence as an algebraic equation.

- Ten years older than Theresa’s age is 23.
- Four less than a number is 19.
- The quotient of 56 and a number is 14.
- Eight times the number of students is 64.

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 $c - 6 = 24$.

4-2 Solving Addition and Subtraction Equations (pp. 156–159)

Solve each equation. Check your solution.

- | | |
|------------------|-------------------|
| 19. $x + 5 = 8$ | 20. $y + 4 = 12$ |
| 21. $a + 6 = 5$ | 22. $r + 8 = 2$ |
| 23. $p + 9 = -4$ | 24. $d + 14 = 23$ |
| 25. $s - 8 = 15$ | 26. $t - 6 = 7$ |
| 27. $n - 1 = -3$ | 28. $w - 9 = 28$ |

Example 3 Solve $x + 6 = 4$.

$$\begin{array}{r} x + 6 = 4 \\ \underline{-6 = -6} \quad \text{Subtract 6 from each side.} \\ x = -2 \end{array}$$

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

$$\begin{array}{r} y - 3 = -2 \\ \underline{+3 = +3} \quad \text{Add 3 to each side.} \\ y = 1 \end{array}$$

4-3 Solving Multiplication Equations (pp. 160–163)

Solve each equation. Check your solution.

- | | |
|-------------------|------------------|
| 29. $7c = 28$ | 30. $9y = 45$ |
| 31. $-2h = 24$ | 32. $-8w = 72$ |
| 33. $10y = -90$ | 34. $6q = -18$ |
| 35. $-11f = -121$ | 36. $-12r = -36$ |

Example 5 Solve $-4b = 32$.

$$\begin{array}{r} -4b = 32 \\ \underline{-4 = -4} \quad \text{Divide each side by } -4. \\ b = -8 \end{array}$$

4-4 Solving Two-Step Equations (pp. 166–169)

Solve each equation. Check your solution.

- | | |
|--------------------|--------------------|
| 37. $3y - 12 = 6$ | 38. $6x - 4 = 20$ |
| 39. $2x + 5 = 3$ | 40. $5m + 6 = -4$ |
| 41. $10c - 8 = 90$ | 42. $3r - 20 = -5$ |
43. Ten more than five times a number is 25. Find the number.

Example 6 Solve $3p - 4 = 8$.

$$\begin{array}{r} 3p - 4 = 8 \\ \underline{+4 = +4} \quad \text{Add 4 to each side.} \\ 3p = 12 \\ \underline{\frac{3p}{3} = \frac{12}{3}} \quad \text{Divide each side by 3.} \\ p = 4 \end{array}$$

4-5 Inequalities (pp. 172–175)

Solve each inequality. Graph the solution.

- | | |
|----------------------|----------------------|
| 44. $x + 3 < 8$ | 45. $y + 2 > 5$ |
| 46. $a + 4 \geq 10$ | 47. $d + 1 \leq 6$ |
| 48. $h - 5 \geq 7$ | 49. $s - 2 \leq 9$ |
| 50. $y + 2 < -3$ | 51. $m - 7 > -10$ |
| 52. $b + 9 \leq -11$ | 53. $t - 10 \geq -8$ |

Example 7 Solve $g + 8 \leq 10$. Graph your solution.

$$\begin{array}{r} g + 8 \leq 10 \\ \underline{-8 = -8} \quad \text{Subtract 8 from each side.} \\ g \leq 2 \end{array}$$

Mixed Problem Solving

 For mixed problem-solving practice,
see page 599.

4-6 Functions and Linear Equations (pp. 177–181)

Graph each equation.

54. $y = x + 5$
55. $y = x - 4$
56. $y = 2x$
57. $y = -1x$
58. $y = 3x + 2$
59. $y = -2x + 3$

MONEY MATTERS For Exercises 60–62,
use the following information.

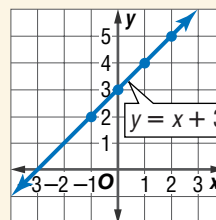
 Angel earns \$6 per hour working at the
Ice Cream Shop.

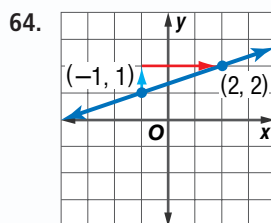
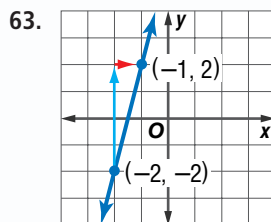
60. Make a table that shows her total earnings for working 3, 5, 7, and 9 hours.
61. Write an equation in which x represents the number of hours and y represents Angel's total earnings.
62. Graph the equation.

Example 8 Graph $y = x + 3$.

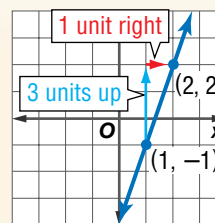
 Select four values for x . Substitute these values for x to find values for y .

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.

4-7 Lines and Slope (pp. 182–185)

 Find the slope of the line that passes
through each pair of points.


65. $(1, 1)$, $(2, 0)$
66. $(2, 3)$, $(4, -1)$

Example 9 Find the slope of the line.


$$\begin{aligned} \text{slope} &= \frac{\text{change in } y}{\text{change in } x} \\ &= \frac{3}{1} \text{ or } 3 \end{aligned}$$

The slope of the line is 3.

Practice Test

Vocabulary and Concepts

1. Explain the difference between an equation and an inequality.
2. Define *function* and give an example.

Skills and Applications

Write each phrase as an algebraic expression.

3. \$5 less than Matt has
4. 4 years older than Hana

Solve each equation. Check your solution.

5. $x + 5 = -8$
6. $y - 11 = 15$
7. $9z = -81$
8. $-6k - 4 = 38$

Solve each inequality. Graph the solution.

9. $p - 4 \geq -3$
10. $j + 5 > 2$

SHOPPING For Exercises 11 and 12, use the following information.

Suppose you want to buy 3 CDs and a new CD case that costs \$7. Each CD costs the same amount.

11. If you spend \$46, write an equation to find the cost of each CD.
12. Solve the equation.

Graph each equation.

13. $y = 3x - 2$
14. $y = -2x + 4$
15. $y = 0.5x$

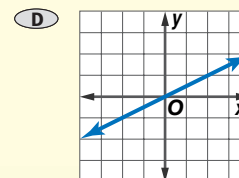
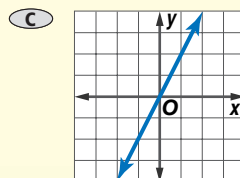
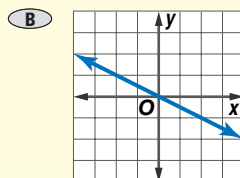
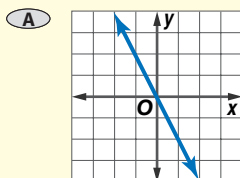
MOVIES For Exercises 16–18, use the following information.

A student ticket to the movies costs \$3.

16. Make a table that shows the total cost of 2, 4, and 6 tickets.
17. Write an equation in which x represents the number of tickets, and y represents the total cost.
18. Graph the equation.
19. Find the slope of the line that passes through $(-2, 3)$ and $(-1, 2)$.

Standardized Test Practice

20. **MULTIPLE CHOICE** Which line has a slope of 2?



PART 1 Multiple Choice

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

- Felicia's family wants to buy her a gift for \$220. Her parents will pay half. Her older sister will pay \$50. If her three other siblings split the remaining cost, how much will each pay? (Lesson 1-1)
 A \$20 B \$60 C \$130 D \$170
- Which is equivalent to 3^6 ? (Lesson 1-2)
 F 18 G 36
 H $6 \cdot 6 \cdot 6$ I $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$
- Suppose you need 0.65 liter of water for a science experiment, but the container is measured in milliliters. How many milliliters of water do you need? (Lesson 1-5)
 A 0.0065 mL B 0.65 mL
 C 6.5 mL D 650 mL
- If 18 is added to the data set below, which statement is true? (Lesson 2-4)

16, 14, 22, 16, 16, 18, 15, 25

- F The mode increases.
 G The mean decreases.
 H The mean increases.
 I The median increases.
- The stem-and-leaf plot shows the number of points scored by the Bears in each of their basketball games this season. In how many games did they score at least 30 points? (Lesson 2-5)
 A 8 B 9 C 11 D 20

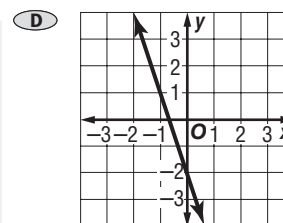
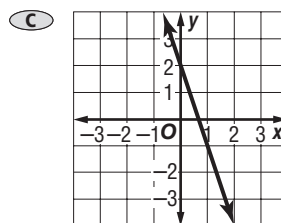
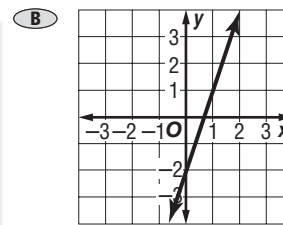
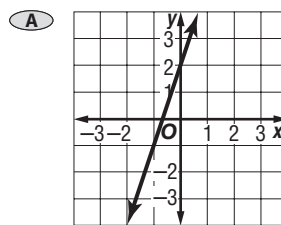
Stem	Leaf
1	8 9
2	0 2 3 3 6 8 8 9
3	0 1 4 4 5 6 8 9
4	0 1 2

$1 | 8 = 18 \text{ points}$

- Suppose points given by (x, y) in the table are graphed. Which statement is true about the graphs? (Lesson 3-3)

x	y
-4	5
-5	10
-2	6

- F The graphs of the points are located in Quadrant I.
 G The graphs of the points are located in Quadrant II.
 H The graphs of the points are located in Quadrant III.
 I The graphs of the points are located in Quadrant IV.
- The temperature at 6:00 A.M. was -5°F . What was the temperature at 8:00 A.M. if it had risen 7 degrees? (Lesson 3-4)
 A -12°F B -2°F
 C 2°F D 12°F
 - The Tigers scored four more runs than the Giants scored. Which expression represents the number of runs the Giants scored if the Tigers scored n runs? (Lesson 4-1)
 F $n + 4$ G $n - 4$
 H $4 - n$ I $4n$
 - Which is the graph of the equation $y = 3x - 2$? (Lesson 4-6)



PART 2 Short Response/Grid In

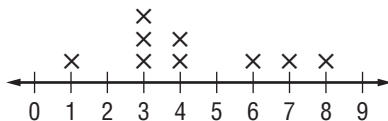
Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

10. The charge to enter a park is a flat amount per vehicle plus a fee for each person in the vehicle. The table shows the charge for vehicles holding up to 4 people.

Number of people	Charge (dollars)
1	2.00
2	2.50
3	3.00
4	3.50

What is the charge, in dollars, for a vehicle holding 8 people? (Lesson 1-1)

11. Evaluate $2(8 + 5^2)$. (Lesson 1-3)
12. The line plot shows how far in kilometers some students live from the school. How many students are represented in the plot? (Lesson 2-3)



13. The ordered pairs $(1, 2)$, $(6, 2)$, and $(1, -5)$ are coordinates of three of the vertices of a rectangle. What is the y -coordinate of the ordered pair that represents the fourth vertex? (Lesson 3-3)
14. What number should replace y in the table? (Lesson 3-6)

x	$2x - 5$
1	-3
2	y
4	3
8	11
16	27

TEST-TAKING TIP

Question 13 This question does not include a drawing. Make one. It can help you quickly see how to solve the problem.

15. What value of x makes $x - 2 = -4$ a true statement? (Lesson 4-2)
16. Twice a number plus 7 is 35. Find the number. (Lesson 4-4)
17. Winston earns \$7 an hour landscaping. He wants to buy a DVD player that costs \$140. Write an inequality for the least number of hours h he needs to work to reach his goal. (Lesson 4-5)
18. The graph of a line contains $(1, 2)$ and $(3, y)$. What is the value of y if the slope of the line is 2? (Lesson 4-7)

PART 3 Extended Response

Record your answers on a sheet of paper. Show your work.

19. Pete's Paints charges a \$20 fee plus \$7.50 per hour to rent a paint sprayer.
- Write an equation that could be used to determine the cost c of renting a paint sprayer for h hours.
 - Suppose you want to spend no more than \$50 to rent the paint sprayer. Write an inequality for this situation.
 - Solve the inequality in part b. Explain the meaning of the solution.
20. The distances traveled by a bicycle rider are given in the table. (Lesson 4-6)
- Graph the ordered pairs.
 - Write an equation that relates the time t to the distance d .
 - Use your equation to predict the distance traveled in 3.5 hours.

Time (hours)	Distance (miles)
1	10
2	20
3	30
4	40
5	50

