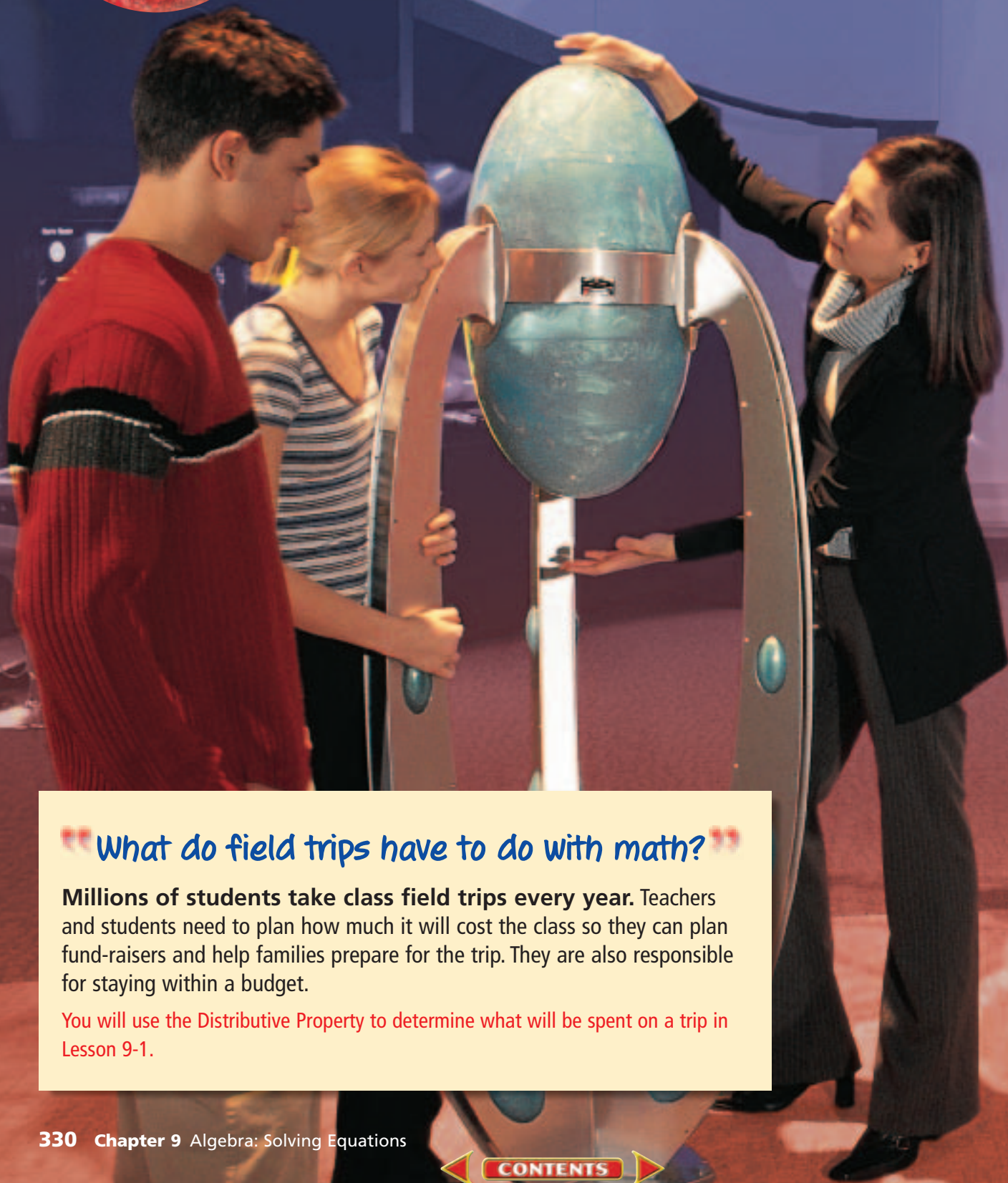


Algebra: Solving Equations



“What do field trips have to do with math?”

Millions of students take class field trips every year. Teachers and students need to plan how much it will cost the class so they can plan fund-raisers and help families prepare for the trip. They are also responsible for staying within a budget.

You will use the **Distributive Property** to determine what will be spent on a trip in **Lesson 9-1**.

GETTING STARTED

► Diagnose Readiness

Take this quiz to see if you are ready to begin Chapter 9. Refer to the lesson number in parentheses for review.

Vocabulary Review

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

1. A letter used to represent a number is called a variable. (Lesson 1-6)
2. An expression is a mathematical sentence that contains an equals sign. (Lesson 1-7)

Prerequisite Skills

Find the value of each expression.

(Lesson 1-4)

3. $3(5) - 9$
4. $8(2) + 4$
5. $1 + 6(4)$
6. $17 - 2(3)$

Add or subtract. (Lessons 8-2 and 8-3)

7. $2 - 4$
8. $-4 + 8$
9. $-3 + 9$
10. $6 - 9$
11. $7 - 8$
12. $-1 + 5$

Divide. (Lesson 8-5)

13. $-32 \div 4$
14. $56 \div 2$
15. $72 \div 8$
16. $-18 \div 3$
17. $36 \div (-9)$
18. $-24 \div (-6)$

Evaluate each expression for $a = -2$, $a = 1$, and $a = 2$. (Lessons 8-2 through 8-5)

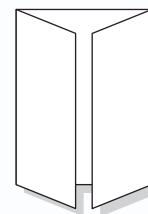
19. $3a$
20. $4 + a$
21. $a - 6$
22. $8 \div a$



Solving Equations Make this Foldable to help you organize your strategies for solving problems. Begin with a piece of $11'' \times 17''$ paper.

STEP 1 Fold

Fold lengthwise so the sides meet in the middle.



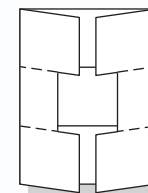
STEP 2 Fold Again

Fold in 3 equal sections widthwise.



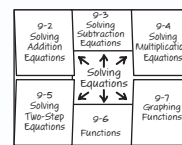
STEP 3 Cut

Unfold. Cut to make three tabs on each side. Cut the center flaps as shown to leave a rectangle showing in the center.



STEP 4 Rotate and Label

Label the center "Solving Equations."
Label each tab 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 msmath1.net/chapter_readiness

What You'll LEARN

Illustrate the Distributive Property using models.

The Distributive Property

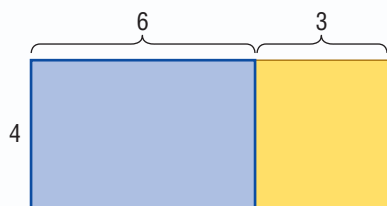
To find the area of a rectangle, multiply the length and width.
To find the area of a rectangle formed by two smaller rectangles, you can use either one of two methods.

ACTIVITY

Work with a partner.

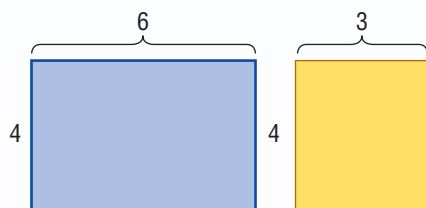
Find the area of the blue and yellow rectangles.

Method 1 Add the lengths. Then multiply.



$$\begin{aligned} 4(6 + 3) &= 4(9) && \text{Add.} \\ &= 36 && \text{Simplify.} \end{aligned}$$

Method 2 Find each area. Then add.



$$\begin{aligned} 4 \cdot 6 + 4 \cdot 3 &= 24 + 12 && \text{Multiply.} \\ &= 36 && \text{Simplify.} \end{aligned}$$

In Method 1, you found that $4(6 + 3) = 36$. In Method 2, you found that $4 \cdot 6 + 4 \cdot 3 = 36$. So, $4(6 + 3) = 4 \cdot 6 + 4 \cdot 3$.

Your Turn Draw a model showing that each equation is true.

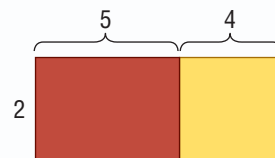
a. $2(4 + 6) = (2 \cdot 4) + (2 \cdot 6)$ b. $4(3 + 2) = (4 \cdot 3) + (4 \cdot 2)$

Writing Math

1. Write two expressions for the total area of the rectangle at the right.

2. **OPEN ENDED** Draw any two rectangles that have the same width. Find the total area in two ways.

3. **MAKE A CONJECTURE** Write an expression that has the same value as $2(4 + 3)$. Explain your reasoning.



9-1

Properties

What You'll LEARN

Use the Commutative, Associative, Identity, and Distributive Properties.

Link to READING

Everyday Meaning of Distribute: to divide among several people or things

HANDS-ON Mini Lab

Work with a partner.

Materials

- calculator



- Copy and complete the table below.

	multiplication expression	product	multiplication expression	product
a.	5×8		6×12	
b.	5×40		6×200	
c.	5×48		6×212	

- What do you notice about each set of expressions?
- How does each product in row c compare to the sum of the products in rows a and b?

The expressions $5(40 + 8)$ and $5(40) + 5(8)$ illustrate how the **Distributive Property** combines addition and multiplication.

Noteables™

Key Concept: Distributive Property

Words To multiply a sum by a number, multiply each addend of the sum by the number outside the parentheses.

Symbols

Arithmetic

$$2(7 + 4) = 2 \times 7 + 2 \times 4$$

$$(5 + 6)3 = 5 \times 3 + 6 \times 3$$

Algebra

$$a(b + c) = ab + ac$$

$$(b + c)a = ba + ca$$

You can use the Distributive Property to solve some multiplication problems mentally.

EXAMPLE

Use the Distributive Property

- Find 4×58 mentally using the Distributive Property.

$$4 \times 58 = 4(50 + 8) \quad \text{Write 58 as } 50 + 8.$$

$$= 4(50) + 4(8) \quad \text{Distributive Property}$$

$$= 200 + 32 \quad \text{Multiply 4 and 50 mentally.}$$

$$= 232 \quad \text{Add 200 and 32 mentally.}$$

- Your Turn** Rewrite each expression using the Distributive Property. Then find each product mentally.

a. 5×84

b. 12×32

c. 2×3.6

REAL-LIFE MATH

FIELD TRIPS Nearly 400,000 children in school groups and youth organizations visited the Chicago Museum of Science and Industry in one year.

Source: MSI, Chicago



EXAMPLE Apply the Distributive Property

- 1 FIELD TRIPS** Suppose admission to a museum costs \$5 and bus tickets are \$2.50 per student. What is the cost for 30 students?

Method 1 Find the cost of 30 admissions and 30 bus tickets. Then add.

$$\begin{array}{ccc} 30(\$5) & + & 30(\$2.50) \\ \uparrow & & \downarrow \\ \text{cost of 30 admissions} & & \text{cost of 30 bus tickets} \end{array}$$

Method 2 Find the cost for 1 person. Then multiply by 30.

$$\begin{array}{c} 30(\$5 + \$2.50) \\ \downarrow \\ \text{cost for 1 person} \end{array}$$

Evaluate either expression.

$$\begin{aligned} 30(5 + 2.50) &= 30(5) + 30(2.50) && \text{Distributive Property} \\ &= 150 + 75 && \text{Multiply.} \\ &= 225 && \text{Add.} \end{aligned}$$

The total cost is \$225.

Other properties of addition and multiplication are given below.

Noteables™

Key Concept: Properties

Commutative Property The order in which numbers are added or multiplied does not change the sum or product.

Examples $4 + 3 = 3 + 4$ $5 \times 4 = 4 \times 5$

Associative Property The way in which numbers are grouped when added or multiplied does not change the sum or product.

Examples $(3 + 4) + 5 = 3 + (4 + 5)$ $(2 \times 3) \times 4 = 2 \times (3 \times 4)$

Additive Identity The sum of any number and 0 is the number.

Examples $5 + 0 = 5$ $a + 0 = a$

Multiplicative Identity The product of any number and 1 is the number.

Examples $7 \times 1 = 7$ $1 \times n = n$

EXAMPLE Identify Properties

Identify the property shown by each equation.

1 $25 \times 15 = 15 \times 25$

The order in which the numbers are multiplied changes. This is the Commutative Property of Multiplication.

1 $55 + (5 + 12) = (55 + 5) + 12$

The grouping of the numbers to be added changes. This is the Associative Property of Addition.

You can use properties to find sums and products mentally.

EXAMPLE Apply Properties

5 Find $15 + 28 + 25$ mentally.

Since you can easily add 25 and 15, change the order.

$$15 + 28 + 25 = 15 + 25 + 28 \quad \text{Commutative Property}$$

Now group the numbers. The parentheses tell you which to perform first.

$$15 + 25 + 28 = (15 + 25) + 28 \quad \text{Associative Property}$$

$$= 40 + 28 \quad \text{Add 15 and 25 mentally.}$$

$$= 68 \quad \text{Add 40 and 28 mentally.}$$

Your Turn Find each sum or product mentally.

d. $5 \times 26 \times 2$

e. $37 + 98 + 63$

Skill and Concept Check

- Writing Math** Explain how to use the Distributive Property to find a product mentally.
- OPEN ENDED** Write four equations that show each of the Commutative and Associative Properties of Addition and Multiplication.
- Determine** if the Commutative and Associate Properties of Addition are true for fractions. Explain using examples or counterexamples.
- FIND THE ERROR** Brian and Courtney are using the Distributive Property to simplify $5(4 + 2)$. Who is correct? Explain.

Brian
 $(5 \times 4) + (5 \times 2)$

Courtney
 $(5 + 4) \times (5 + 2)$

GUIDED PRACTICE

Find each product mentally. Use the Distributive Property.

5. 5×84

6. 10×2.3

7. 4.2×4

Rewrite each expression using the Distributive Property. Then evaluate.

8. $3(20 + 4)$

9. $(60 + 5)5$

10. $(12.5 \times 10) + (12.5 \times 8)$

Identify the property shown by each equation.

11. $17 \times 2 = 2 \times 17$

12. $(3 + 6) + 10 = 3 + (6 + 10)$

13. $24 \times 1 = 24$

14. $(6 + 16) + 0 = (6 + 16)$

Find each sum or product mentally.

15. $35 + 8 + 5$

16. $86 + 28 + 14$

17. $6 \times 8 \times 5$

18. $5 \times 30 \times 4$



Practice and Applications

Find each product mentally. Use the Distributive Property.

19. 7×15 20. 3×72 21. 25×12
 22. 15×11 23. 30×7.2 24. 60×2.5

Rewrite each expression using the Distributive Property. Then evaluate.

25. $7(30 + 6)$ 26. $12(40 + 7)$ 27. $(50 + 4)2$ 28. $(30 + 8)13$

Identify the property shown by each equation.

29. $90 + 2 = 2 + 90$ 30. $8 \times 4 = 4 \times 8$
 31. $(19 + 76) + 24 = 19 + (76 + 24)$ 32. $9 \times (10 \times 6) = (9 \times 10) \times 6$
 33. $55 + 0 = 55$ 34. $40 \times 1 = 40$
 35. $5 + (85 + 16) = (85 + 16) + 5$ 36. $(3 \times 15)4 = 3(15 \times 4)$

Find each sum or product mentally.

37. $15 + 9 + 35$ 38. $12 + 45 + 18$ 39. $4 \times 7 \times 25$
 40. $2 \times 34 \times 5$ 41. $115 + 20 + 15$ 42. $5 \times 87 \times 20$

FOOD For Exercises 43 and 44, use the table.

43. What is the total price of 25 burgers at each fast food restaurant?
 44. **MULTI STEP** Which fast food restaurant would be a better deal for 25 students if everyone ordered a burger, fries, and a soda?
 45. **CRITICAL THINKING** Evaluate each expression.

	Fast Food A	Fast Food B
Burger	\$2.00	\$2.25
Fries	\$1.50	\$1.25
Soda	\$1.19	\$0.99



- a. $0.2(2 - 0.4)$ b. $0.1(1 - 0.5)$ c. $0.8(10 - 0.25)$

Spiral Review with Standardized Test Practice

46. **MULTIPLE CHOICE** Which expression is equivalent to $(2 \times 4) + (6 \times 4)$?
 (A) $4(2 \times 6)$ (B) $6(2 + 4)$ (C) $4(2 + 6)$ (D) $2(4 + 6)$
 47. **SHORT RESPONSE** What property can be used to find the missing number in $10 \times (5 \times 25) = (\square \times 5) \times 25$?
 48. **GEOMETRY** Graph $X(2, -3)$ and $Y(-3, 2)$. (Lesson 8-6)

Divide. (Lesson 8-5)

49. $10 \div (-2)$ 50. $-24 \div 6$ 51. $-36 \div (-6)$ 52. $-81 \div (-9)$

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Subtract. (Lesson 8-3)

53. $2 - 3$ 54. $4 - 7$ 55. $6 - 8$ 56. $2 - 9$

HOMEWORK HELP

For Exercises	See Examples
19–28	1
29–36	3, 4
37–42	5
43	2

Extra Practice
See pages 611, 632.

What You'll LEARN

Solve addition equations using models.

REVIEW Vocabulary

equation: a sentence that contains an equals sign, = (Lesson 1-7)

Materials

- cups
- counters
- equation mat

Solving Addition Equations Using Models

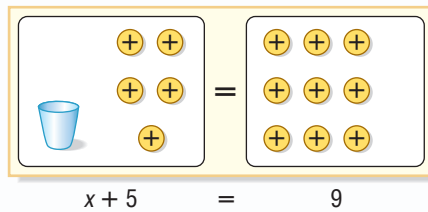
An equation is like a balance scale. The quantity on the left side of the equals sign is *balanced* with the quantity on the right. When you solve an equation, you need to keep the equation *balanced*.

To solve an equation using cups and counters, remember to add or subtract the same number of counters from each side of the mat, so that it remains *balanced*.

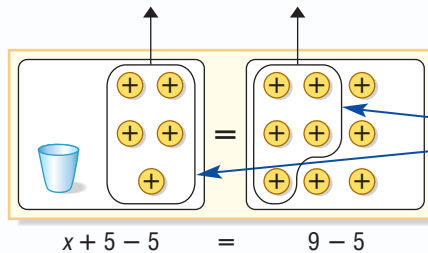
ACTIVITY

Work with a partner.

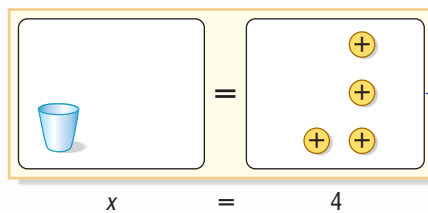
1 Solve $x + 5 = 9$ using models.



Model the equation.



Remove 5 counters from each side to get the cup by itself.



There are 4 counters remaining on the right side, so $x = 4$.

The solution is 4.

Check Replace x with 4 in the original equation.

$$x + 5 = 9$$

$$4 + 5 \stackrel{?}{=} 9$$

$$9 = 9 \quad \checkmark \quad \text{So, the solution is correct.}$$

Your Turn Solve each equation using models.

a. $1 + x = 8$

b. $x + 2 = 7$

c. $9 = x + 3$

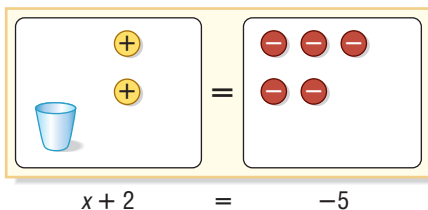
Sometimes you will use zero pairs to solve equations. You can add or subtract a zero pair from each side of the mat without changing its value because the value of a zero pair is zero.

STUDY TIP

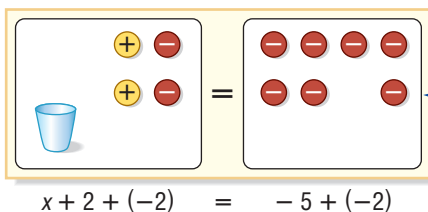
Look Back To review zero pairs, see Lesson 8-2.

ACTIVITY Work with a partner.

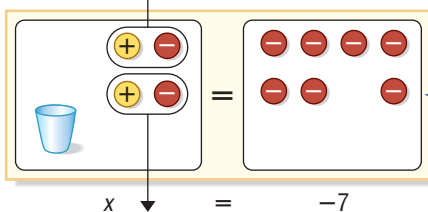
1 Solve $x + 2 = -5$ using models.



Model the equation.



You cannot remove 2 positive counters from each side. Add 2 negative counters to each side of the mat. The left side now has two zero pairs.



Remove the zero pairs from the left side of the mat. There are 7 negative counters on the right side, so $x = -7$.

So, $x = -7$.

Check Replace x with -7 in the original equation.

$$\begin{aligned} x + 2 &= -5 \\ -7 + 2 &\stackrel{?}{=} -5 \\ -5 &= -5 \quad \checkmark \end{aligned}$$

So, the solution is correct.

Your Turn Solve each equation using models.

- d. $x + 3 = -7$ e. $2 + x = -5$ f. $-3 = x + 3$

Writing Math

1. **Explain** how you decide how many counters to add or subtract from each side.
2. **Write** an equation in which you need to remove zero pairs in order to solve it.
3. **Model** the equation *some number plus 5 is equal to -2*. Then solve the equation.
4. **MAKE A CONJECTURE** Write a rule that you can use to solve an equation like $x + 3 = 6$ without using models.

Solving Addition Equations

What You'll LEARN

Solve addition equations.

NEW Vocabulary

inverse operations

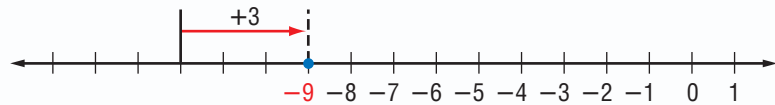
REVIEW Vocabulary

solve: find the value of the variable that results in a true sentence

(Lesson 1-7)

WHEN am I ever going to use this?

WEATHER A forecaster reported that although an additional 3 inches of rain had fallen, the total rainfall was still 9 inches below normal for the year. This is shown on the number line.



1. Write an expression to represent 3 more inches of rain.
2. Write an addition equation you could use to find the rainfall before the additional 3 inches.
3. You could solve the addition equation by counting back on the number line. What operation does counting back suggest?

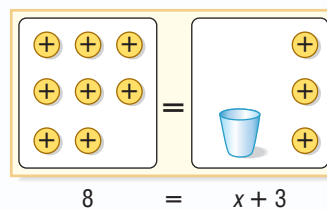
When you solve an equation, the goal is to get the variable by itself on one side of the equation. One way to do this is to use inverse operations. **Inverse operations** *undo* each other. For example, to solve an addition equation, use subtraction.

EXAMPLE Solve an Equation By Subtracting

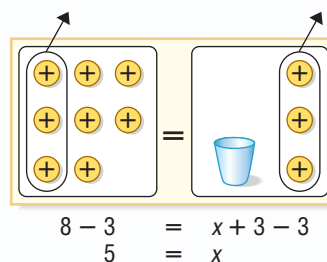
1 Solve $8 = x + 3$.

Method 1 Use models.

Model the equation.



Remove 3 counters from each side of the mat.



The solution is 5.

Method 2 Use symbols.

$8 = x + 3$ Write the equation.

$$\begin{array}{r}
 8 = x + 3 \\
 -3 = -3 \\
 \hline
 5 = x + 0 \quad 8 - 3 = 5, \\
 \quad \quad \quad 3 - 3 = 0 \\
 5 = x
 \end{array}$$

Subtract 3 from each side to "undo" the addition of 3 on the right.

READING
in the Content Area

For strategies in reading this lesson, visit msmath1.net/reading.

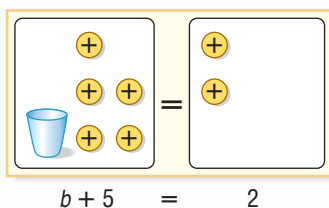


EXAMPLE Solve an Equation Using Zero Pairs

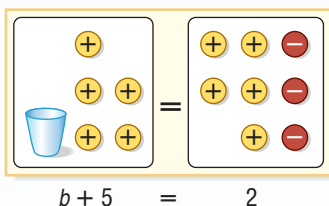
1 Solve $b + 5 = 2$. Check your solution.

Method 1 Use models.

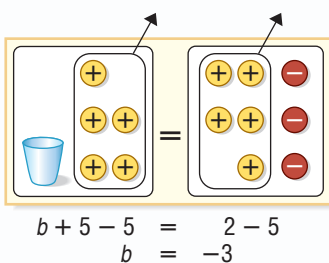
Model the equation.



Add 3 zero pairs to the right side so there are 5 positive counters.



Remove 5 positive counters from each side.



The solution is -3 .

Method 2 Use symbols.

$b + 5 = 2$ Write the equation.

Subtract 5 from each side to undo b plus 5.

$$\begin{array}{r}
 b + 5 = 2 \\
 \underline{-5 \quad -5} \\
 b + 0 = -3 \\
 b = -3
 \end{array}$$

Subtract 5 from each side.

$5 - 5 = 0,$
 $2 - 5 = -3$

Check

$b + 5 = 2$ Write the equation.

$-3 + 5 \stackrel{?}{=} 2$ Replace b with -3 .

$2 = 2$ ✓ This sentence is true.

STUDY TIP

Checking Solutions

You should always check your solution. You will know immediately whether your solution is correct or not.

2 **Your Turn** Solve each equation. Use models if necessary.

a. $c + 2 = 5$

b. $3 + y = 12$

c. $2 = x + 6$

d. $c + 4 = 3$

e. $x + 3 = -2$

f. $2 + g = -4$

When you solve an equation by subtracting the same number from each side of the equation, you are using the **Subtraction Property of Equality**.

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

$$5 = 5$$

$$x + 2 = 3$$

$$\underline{-3 \quad -3}$$

$$\underline{-2 \quad -2}$$

$$2 = 2$$

$$x = 1$$

Skill and Concept Check

1. **Show** how to model the equation $x + 4 = 2$. Then explain how to solve the equation using models.
2. **OPEN ENDED** Write a problem that can be represented by the equation $x + 2 = 7$. Explain the meaning of the equation.
3. **Writing Math** Without solving, tell whether the solution to $a + 14 = -2$ will be positive or negative. Explain your answer.

GUIDED PRACTICE

Solve each equation. Use models if necessary. Check your solution.

4. $x + 3 = 5$
5. $2 + m = 7$
6. $c + 6 = -3$
7. $-4 = 6 + e$
8. Find the value of n if $n + 12 = 6$.
9. **HOT AIR BALLOONING** A hot air balloon is 200 feet in the air. A few minutes later it ascends to 450 feet. Write and solve an addition equation to find the change of altitude of the hot air balloon.

Practice and Applications

Solve each equation. Use models if necessary. Check your solution.

10. $y + 7 = 10$
11. $x + 5 = 11$
12. $9 = 2 + x$
13. $7 = 4 + y$
14. $9 + a = 7$
15. $6 + g = 5$
16. $d + 3 = -5$
17. $x + 4 = -2$
18. $-5 = 3 + f$
19. $-1 = g + 7$
20. $b + 4 = -3$
21. $h + (-4) = 2$
22. Find the value of x if $x + 3 = 7$.
23. If $c + 6 = 2$, what is the value of c ?

Solve each equation. Check your solution.

24. $t + 1.9 = 3.8$
25. $1.8 + n = -0.3$
26. $a + 6.1 = -2.3$
27. $c + 2.5 = -4.2$
28. $7.8 = x + 1.5$
29. $5.6 = y + 2.7$
30. $m + \frac{1}{3} = \frac{2}{3}$
31. $t + \frac{1}{4} = -\frac{1}{2}$

32. **PETS** Zane and her dog weigh 108 pounds. Zane weighs 89 pounds. Write and solve an addition equation to find the dog's weight.

33. **EXERCISE** On average, men burn 180 more Calories per hour running than women do. If a man burns 600 Calories per hour running, write and solve an addition equation to find how many Calories a woman burns running one hour.

34. **GAMES** In the card game Clubs, it is possible to have a negative score. Suppose your friend had a score of -5 in the second hand. This made her total score after two hands equal to -2 . What was her score in the first hand?

HOMEWORK HELP

For Exercises 10–23	See Examples 1, 2
------------------------	----------------------

Extra Practice
See pages 611, 632.



35. **ROADS** A typical log truck weighs 30,000 pounds empty. What is the maximum weight of lumber that the truck can carry and not exceed the weight limit?



36. **PROPERTIES** How does the Subtraction Property of Equality help you solve the equation $x + 8 = 13$?

CRITICAL THINKING The solution of the equation $x + 7 = -3$ is shown. Match each step with the property used.

$$x + 7 = -3$$

37. $x + 7 - 7 = -3 - 7$ a. Associative Property of Addition

38. $x + 0 = -10$ b. Additive Identity

39. $x = -10$ c. Subtraction Property of Equality

Spiral Review with Standardized Test Practice

40. **MULTIPLE CHOICE** It was 3°F before an Arctic cold front came through and dropped the temperature to -9°F on New Year's Eve. The equation $3 + d = -9$ is used to find how many degrees the temperature dropped. What is the value of d ?

(A) -12°

(B) -6°

(C) 6°

(D) 12°

41. **SHORT RESPONSE** Sabrina collected 6 silver dollars. Her friend Logan gave her some more, and then she had 15. To find out how many silver dollars she was given, Sabrina wrote $s + 6 = 15$. What is the value of s ?

Rewrite each expression using the Distributive Property. Then evaluate. (Lesson 9-1)

42. $6(20 + 4)$

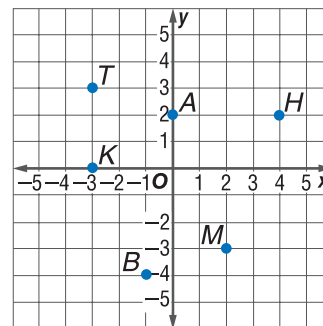
43. $(30 \times 4) + (30 \times 0.5)$

Refer to the coordinate plane to identify the point for each ordered pair. (Lesson 8-6)

44. $(4, 2)$

45. $(-3, 0)$

46. $(-1, -4)$



Refer to the coordinate plane to write the ordered pair that names each point. Then identify the quadrant where each point is located. (Lesson 8-6)

47. T

48. M

49. A

Multiply or divide. (Lessons 8-4 and 8-5)

50. -4×9

51. $-8(-3)$

52. $-18 \div (-6)$

53. $25 \div (-5)$

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Add. (Lesson 8-2)

54. $-2 + 6$

55. $-9 + 3$

56. $-8 + 5$

57. $-7 + 9$

What You'll LEARN

Solve subtraction equations using models.

Materials

- cups
- counters
- equation mat

Solving Subtraction Equations Using Models

Recall that subtracting an integer is the same as adding its opposite. For example, $4 - 7 = 4 + (-7)$ or $x - 3 = x + (-3)$.

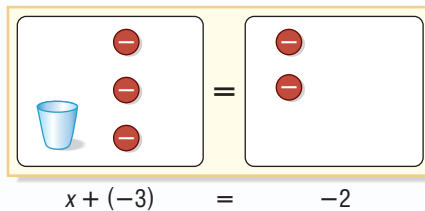
ACTIVITY

Work with a partner.

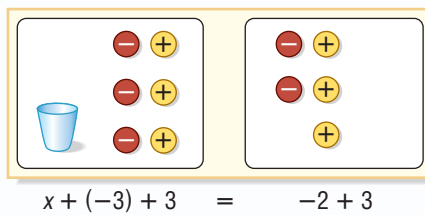
Solve $x - 3 = -2$ using models.

$$x - 3 = -2 \rightarrow x + (-3) = -2$$

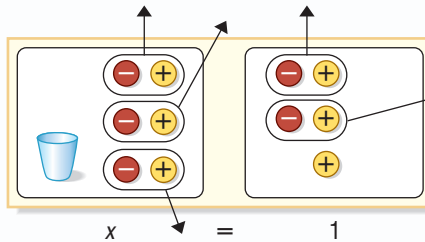
Rewrite the equation.



Model the addition equation.



Add 3 positive counters to each side of the mat to make 3 zero pairs on the left side.



Remove 3 zero pairs from the left side and 2 zero pairs from the right side. There is one positive counter on the right side. So, $x = 1$.

The solution is 1. **Check** $1 - 3 = 1 + (-3)$ or -2 ✓

Your Turn Solve each equation using models.

a. $x - 4 = 2$

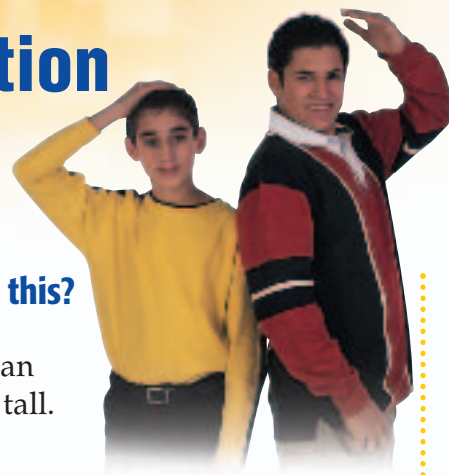
b. $-3 = x - 1$

c. $x - 5 = -1$

Writing Math

1. **Explain** why it is helpful to rewrite a subtraction problem as an addition problem when solving equations using models.
2. **MAKE A CONJECTURE** Write a rule for solving equations like $x - 7 = -5$ without using models.

Solving Subtraction Equations



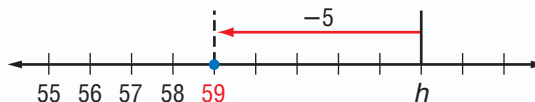
What You'll LEARN

Solve subtraction equations.

WHEN am I ever going to use this?

GROWTH Luis is 5 inches shorter than his brother Lucas. Luis is 59 inches tall.

- Let h represent Lucas' height. Write an expression for 5 inches shorter than Lucas.
- Write an equation for 5 inches shorter than Lucas is equal to 59 inches.
- You could find Lucas' height by counting forward. What operation does counting forward suggest?
- How tall is Lucas?



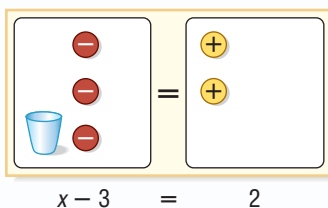
Addition and subtraction are inverse operations. So, you can solve a subtraction equation by adding.

EXAMPLE Solve an Equation by Adding

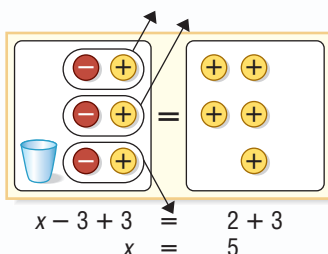
1 Solve $x - 3 = 2$.

Method 1 Use models.

Model the equation.



Add 3 positive counters to each side of the mat. Remove the zero pairs.



The solution is 5.

Method 2 Use symbols.

$x - 3 = 2$ Write the equation.

$$x - 3 = 2$$

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

$$x + 0 = 5$$

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

Add 3 to each side to undo the subtraction of 3 on the left.

STUDY TIP

Using Counters

The expression $x - 3$ is the same as $x + (-3)$. To model the expression, use one cup and three negative counters.

Skill and Concept Check

1. Tell how to check your solution to an equation.
2. **OPEN ENDED** Write two different subtraction equations that have 5 as the solution.
3. **FIND THE ERROR** Diego and Marcus are explaining how to solve the equation $d - 6 = 4$. Who is correct? Explain.

Diego
Subtract 6 from each side.

Marcus
Add 6 to each side.

4. **Writing Math** Without solving the equation, what do you know about the value of x in $x - 5 = -3$? Is x greater than 5 or less than 5? Explain your reasoning.

GUIDED PRACTICE

Solve each equation. Use models if necessary. Check your solution.

5. $a - 5 = 9$
6. $b - 3 = 7$
7. $x - 4 = -1$
8. $4 = y - 8$
9. $x - 2 = -7$
10. $-3 = n - 2$

11. **DIVING** A diver is swimming below sea level. A few minutes later the diver descends 35 feet until she reaches a depth of 75 feet below sea level. Write and solve a subtraction equation to find the diver's original position.

Practice and Applications

Solve each equation. Use models if necessary. Check your solution.

12. $c - 1 = 8$
13. $f - 1 = 5$
14. $2 = e - 1$
15. $1 = g - 3$
16. $r - 3 = -1$
17. $t - 2 = -2$
18. $t - 4 = -1$
19. $h - 2 = -9$
20. $-3 = u - 8$
21. $-5 = v - 6$
22. $x - 3 = -5$
23. $y - 4 = -7$

24. Find the value of t if $t - 7 = -12$.
25. If $b - 10 = 5$, what is the value of b ?

Solve each equation. Check your solution.

26. $-6 + a = -8$
27. $-1 + c = -8$
28. $a - 1.1 = 2.3$
29. $b - 2.7 = 1.6$
30. $-4.6 = e - 3.2$
31. $-4.3 = f - 7.8$
32. $m - \frac{1}{3} = \frac{2}{3}$
33. $n - \frac{1}{4} = -\frac{1}{2}$

34. **PETS** Mika's cat lost 3 pounds. It now weighs 12 pounds. Write and solve an equation to find its original weight.

HOMWORK HELP

For Exercises	See Examples
12–15, 25	1
16–24	2
34, 35	3

Extra Practice
See pages 612, 632.

35. **FOOTBALL** After a play resulting in the loss of 8 yards, the Liberty Middle School team's ball was 15 yards away from the goal line. Write and solve a subtraction equation to find the position of the ball at the start of the play.
36. **WEATHER** The difference between the record high and record low temperatures for September in Bryce Canyon, Utah, is 29°F . Use the information at the right to find the record high temperature.
37. **WRITE A PROBLEM** Write a real-life problem that can be solved by using a subtraction equation.
38. **CRITICAL THINKING** Describe how you would solve $6 - x = -3$.

Bryce Canyon, Utah	
Record Temperatures in September	
High	?
Low	60°F

Spiral Review with Standardized Test Practice

39. **MULTIPLE CHOICE** A scuba diver is 84 feet below the surface of the water when she begins to swim back up. She then stops to observe a school of fish at 39 feet below the surface of the water. How many feet did she rise before stopping?
- (A) -123 ft (B) -45 ft (C) 45 ft (D) 123 ft

40. **GRID IN** Find the value of b if $b - 8 = -5$.

41. **BASEBALL** Refer to the graphic. Write and solve an addition equation to find how many more people can be seated at Dodger Stadium than at Yankee Stadium. (Lesson 9-2)



Data Update Find the capacity of a baseball stadium not listed in the graphic. Visit msmath1.net/data_update to learn more.

42. Find 8×15 mentally. Use the Distributive Property. (Lesson 9-1)

Multiply. Write in simplest form. (Lesson 7-3)

43. $2\frac{3}{4} \times 3\frac{1}{3}$ 44. $3\frac{2}{3} \times 1\frac{2}{7}$
45. $7\frac{3}{5} \times \frac{8}{19}$ 46. $1\frac{3}{7} \times 2\frac{11}{12}$

47. **LIFE SCIENCE** Jamil's leaf collection includes 15 birch, 8 willow, 5 oak, 10 maple, and 8 miscellaneous leaves. Make a bar graph of this data. (Lesson 2-2)

USA TODAY

USA TODAY Snapshots®

The Vet is baseball's biggest stadium

Philadelphia's Veterans Stadium, built in 1971, is the majors' largest ballpark in terms of capacity. The "Vet" is also one of only a few stadiums used for both baseball and football. Major League Baseball stadiums with the largest capacity:

Veterans Stadium (Philadelphia)	62,409
Qualcomm Stadium (San Diego)	56,133
Dodger Stadium (Los Angeles)	56,000
Shea Stadium (New York)	55,775
Yankee Stadium (New York)	55,070

Source: Major League Baseball

By Ellen J. Horrow and Bob Laird, USA TODAY

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Divide. (Lesson 8-5)

48. $-8 \div 2$ 49. $42 \div 3$ 50. $36 \div 3$ 51. $-24 \div 8$



msmath1.net/self_check_quiz



Mid-Chapter Practice Test

Vocabulary and Concepts

1. **State** the Distributive Property. (Lesson 9-1)
2. **Explain** how you can use the Associative Properties of Addition and Multiplication to find sums and products mentally. (Lesson 9-1)
3. **Explain** how to solve an addition equation. (Lesson 9-2)

Skills and Applications

Rewrite each expression using the Distributive Property. Then evaluate. (Lesson 9-1)

4. $4(12 + 9)$

5. $(7 + 30)5$

6. 7×23

Identify the property shown by each equation. (Lesson 9-1)

7. $14 \times 6 = 6 \times 14$

8. $(4 + 9) + 11 = 4 + (9 + 11)$

9. $1 \times a = a$

10. $2 \times (5 \times 9) = (2 \times 5) \times 9$

Find each sum or product mentally. (Lesson 9-1)

11. $23 + 9 + 7$

12. $20 \times 38 \times 5$

13. $34 + 76 + 19$

Solve each equation. Use models if necessary. Check your solution. (Lesson 9-2 and 9-3)

14. $w + 8 = 5$

15. $7 = 2 + p$

16. $-3 + x = 11$

17. $3.4 = y + 2.1$

18. $m - 6 = 5$

19. $-8 = d - 9$

20. $k - 4 = -2$

21. $5 = a - 10$

22. $z - 3 = -6$

23. **MONEY MATTERS** Liliana bought a backpack for \$28. This was \$8 less than the regular price. Write and solve a subtraction equation to find the regular price. (Lesson 9-3)

Standardized Test Practice

24. **SHORT RESPONSE** The Huskies football team gained 15 yards after a loss of 11 yards on the previous play. Write a subtraction equation to find how many yards they gained before the 11-yard loss. (Lesson 9-3)
25. **MULTIPLE CHOICE** Jason and Tia have a total of 20 tadpoles and frogs. Of these, 12 are tadpoles, and the rest are frogs. Use the equation $f + 12 = 20$ to find how many frogs they have. (Lesson 9-2)
- (A) 8 (B) 12 (C) 20 (D) 32

The Game Zone

A Place To Practice your Math Skills

Math Skill
Solving Equations



Four in a Line

● GET READY!

Players: two to ten

Materials: 12 index cards, scissors, poster board, beans

● GET SET!

- Cut all 12 index cards in half. Your teacher will give you a list of 24 equations. Label each card with a different equation.
- Cut one 6-inch by 5-inch playing board for each player from the poster board.
- For each playing board, copy the grid shown. Complete each column by choosing from the solutions below so that no two cards are identical.

a	b	c	d
			Free
	Free		

Solutions

a: -9, -3, 4, 6, 11, 16

b: -3, -1, 1, 5, 10, 12

c: -6, 2, 3, 7, 8, 12

d: -3, -2, 0, 1, 3, 8

● GO!

- Mix the equation cards and place the deck facedown.
- After an equation card is turned up, all players solve the equation.
- If a player finds a solution on the board, he or she covers it with a bean.
- **Who Wins?** The first player to cover four spaces in a row either vertically, horizontally, or diagonally is the winner.

Solving Multiplication Equations

What You'll LEARN

Solve multiplication equations.

NEW Vocabulary

coefficient

WHEN am I ever going to use this?

BABY-SITTING Kara baby-sat for 3 hours and earned \$12. How much did she make each hour?

1. Let x = the amount Kara earns each hour. Write an expression for the amount Kara earns after 3 hours.
2. Explain how the equation $3x = 12$ represents the situation.



The equation $3x = 12$ is a multiplication equation. In $3x$, 3 is the **coefficient** of x because it is the number by which x is multiplied. To solve a multiplication equation, use division.

EXAMPLE Solve a Multiplication Equation

1 Solve $3x = 12$. Check your solution.

$3x = 12$

$\frac{3x}{3} = \frac{12}{3}$
 $x = 4$

Check $3x = 12$ Write the original equation.

$3(4) \stackrel{?}{=} 12$ Replace x with 4.

$12 = 12$ This sentence is true. ✓

The solution is 4.

Your Turn Solve each equation. Use models if necessary.

a. $3x = 15$

b. $8 = 4x$

c. $2x = -10$

STUDY TIP

Dividing Integers

Recall that the quotient of a negative integer and a negative integer is positive.

EXAMPLE

Solve a Multiplication Equation

1 Solve $-2x = 10$.

$$-2x = 10 \quad \text{Write the equation.}$$

$$\frac{-2x}{-2} = \frac{10}{-2} \quad \text{Divide each side by } -2.$$

$$1x = -5 \quad -2 \div (-2) = 1, 10 \div (-2) = -5$$

$$x = -5 \quad 1x = x$$

The solution is -5 . Check this solution.

2 **Your Turn** Solve each equation.

d. $-2x = 12$

e. $-4t = -16$

f. $24 = -3c$

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

EXAMPLE

Use an Equation to Solve a Problem

1 **EXERCISE** Tyrese jogged 2.75 miles on a treadmill at a rate of 5.5 miles per hour. How long did he jog on the treadmill?

$$\text{distance} = \text{rate} \times \text{time}$$

$$2.75 = 5.5 \times t$$

$$2.75 = 5.5t \quad \text{Write the equation.}$$

$$\frac{2.75}{5.5} = \frac{5.5t}{5.5} \quad \text{Divide each side by } 5.5.$$

$$0.5 = t \quad \text{Simplify.}$$

Tyrese jogged on the treadmill for 0.5 hour. **Check** $2.75 = 5.5(0.5)$ is true. ✓

Skill and Concept Check

1. Make a model to represent the equation $2x = -12$. Then solve the equation.
2. **OPEN ENDED** Write two different multiplication equations that have 5 as the solution.
3. **Which One Doesn't Belong?** Identify the equation that does not have the same solution as the other three. Explain your reasoning.

$$2x = 24$$

$$6a = 72$$

$$3c = 4$$

$$5y = 60$$

GUIDED PRACTICE

Solve each equation. Use models if necessary.

4. $2a = 6$

5. $3b = 9$

6. $-20 = 4c$

7. $-16 = 8b$

8. $-4d = 12$

9. $-6c = 24$

10. $-5f = -20$

11. $-3g = -21$



Practice and Applications

Solve each equation. Use models if necessary.

- | | | |
|-----------------|-----------------|-----------------|
| 12. $5d = 30$ | 13. $4c = 16$ | 14. $36 = 6e$ |
| 15. $21 = 3g$ | 16. $3f = -12$ | 17. $4g = -24$ |
| 18. $7h = -35$ | 19. $9m = -72$ | 20. $-5a = 15$ |
| 21. $-6x = 12$ | 22. $-2g = 22$ | 23. $-3h = 12$ |
| 24. $-5t = -25$ | 25. $-32 = -4s$ | 26. $-6n = -36$ |
| 27. $-7 = -14x$ | 28. $2c = -7$ | 29. $4m = -10$ |

30. Solve the equation $4t = 64$.

31. What is the solution of the equation $6x = 90$?

32. Ciro's father is 3 times as old as Ciro. If Ciro's father is 39, how old is Ciro?

33. Mrs. Wolfram drove 203 miles in 3.5 hours. What was her average speed?

Solve each equation. Check your solution.

- | | | |
|-----------------|-------------------|-------------------|
| 34. $1.5x = 3$ | 35. $2.5y = 5$ | 36. $8.1 = 0.9a$ |
| 37. $39 = 1.3b$ | 38. $0.5e = 0.25$ | 39. $0.4g = -0.6$ |

40. **SCIENCE** An object on Earth weighs six times what it would weigh on the moon. If an object weighs 72 pounds on Earth, what is its weight on the moon?



Data Update Find how an object's weight on Mars compares to its weight on Earth. Visit msmath1.net/data_update to learn more.

41. **LANGUAGE** Refer to the graphic. Write and solve an equation to find how many times more Americans speak Spanish than German.

42. **GEOMETRY** The area of a rectangle is 120 square inches, and the width is 5 inches. Write a multiplication equation to find the length of the rectangle and use it to solve the problem. Describe how you can check to be sure that your answer is correct.

43. **CRITICAL THINKING** Without solving, tell which equation below has the greater solution. Explain.

$$4x = 1,000 \qquad 8x = 1,000$$

HOMEWORK HELP

For Exercises	See Examples
12–19, 28–31	1
20–27	2
32–33, 40–42	3

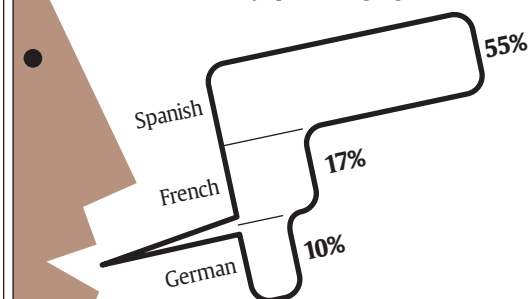
Extra Practice
See pages 612, 632.



USA TODAY Snapshots®

Many Americans bilingual

One-fourth of Americans can converse in both English and a second language. Here are the most widely spoken languages:



Source: Gallup Poll of 1,024 adults March 26–28.
Margin of error: ± 3 percentage points.

By Sam Ward, USA TODAY

EXTENDING THE LESSON In the equation $\frac{a}{2} = 8$, the expression $\frac{a}{2}$ means *a divided by 2*. To solve an equation that contains division, use multiplication, which is the inverse of division.

Example Solve $\frac{a}{2} = 8$.

$$\frac{a}{2} = 8 \quad \text{Write the equation.}$$

$$\frac{a}{2} \cdot 2 = 8 \cdot 2 \quad \text{Multiply each side by 2.}$$

$$a = 16 \quad \text{Simplify.}$$

Solve each equation.

44. $\frac{x}{3} = 6$

45. $3 = \frac{y}{4}$

46. $\frac{b}{2} = -3$

47. $\frac{c}{4} = -5$

48. $\frac{x}{-3} = 5$

49. $\frac{w}{-8} = 2$

50. $-6 = \frac{a}{-6}$

51. $-10 = \frac{x}{-9}$

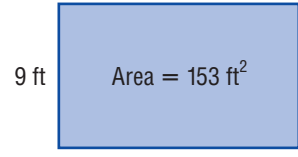
Spiral Review with Standardized Test Practice

52. **MULTIPLE CHOICE** The Romeros are driving from New York City to Miami in three days, driving an average of 365 miles each day. What is the total distance they drive?

- (A) 1,288 mi (B) 1,192 mi (C) 1,095 mi (D) 822 mi

53. **MULTIPLE CHOICE** Use the formula $A = \ell w$ to find the length of the rectangle shown.

- (F) 17 ft (G) 144 ft
(H) 162 ft (I) 1,377 ft



Solve each equation. (Lessons 9-2 and 9-3)

54. $b - 5 = -2$

55. $t - 6 = 5$

56. $g - 6 = -7$

57. $a - 2 = -2$

58. $x + 4 = 9$

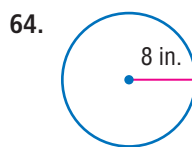
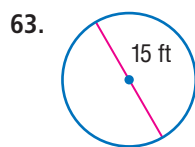
59. $p + 3 = -2$

60. $6 + r = 2$

61. $7 + q = -1$

62. Eight people borrowed a total of \$56. If each borrowed the same amount, how much did each person borrow? (Lesson 8-5)

Find the circumference of each circle shown or described. Round to the nearest tenth. (Lesson 4-6)



65. $d = 0.75$ m

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Find the value of each expression. (Lesson 1-5)

66. $2(4) + 6$

67. $4 + 3(2)$

68. $15 - 2(6)$

69. $5(4) - 6$



What You'll LEARN

Solve inequalities using models.

Materials

- cup
- counters
- equation mat

Solve Inequalities Using Models

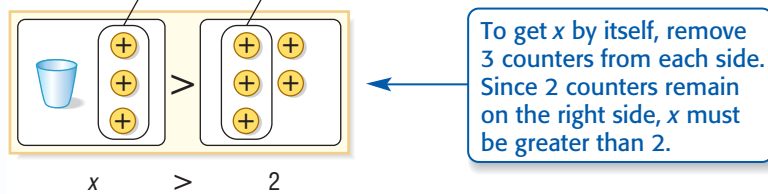
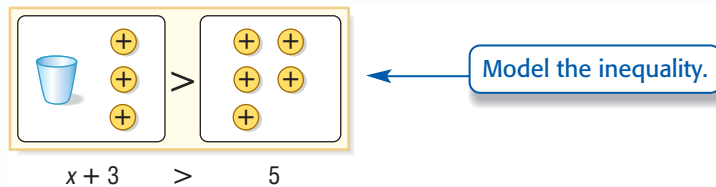
An inequality is a sentence in which the quantity on the left side may be greater than or less than the quantity on the right side.

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

- Model the inequality on the mat.
- Follow the steps for solving equations using models.

ACTIVITY *Work with a partner.*

Solve $x + 3 > 5$ using models.



Any number greater than 2 will make the inequality $x + 3 > 5$ true. Look at this solution on a number line.

The open dot at 2 means that 2 is not included in the solution.



The shading tells you that all numbers greater than 2 are solutions.

Your Turn Solve each inequality using models.

a. $x + 5 > 9$

b. $x - 7 < 3$

c. $6 < x + 1$

STUDY TIP

Inequality Symbols
 $<$ means *is less than*.
 $>$ means *is greater than*.

Writing Math

1. **Compare and contrast** solving addition and subtraction inequalities with solving addition and subtraction equations.
2. **Examine** the inequality $x + 7 > 12$. Can the solution be $x = 8.5$? Explain your reasoning.
3. **MAKE A CONJECTURE** Write a rule for solving inequalities like $x - 3 > 8$ without using models.

Solving Two-Step Equations

What You'll LEARN

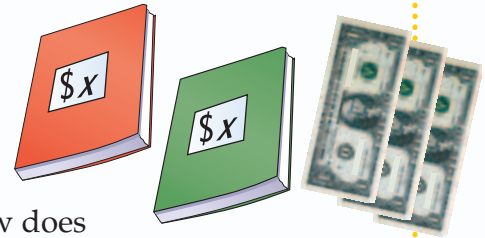
Solve two-step equations.

NEW Vocabulary

two-step equation

WHEN am I ever going to use this?

MONEY MATTERS Suppose you order two paperback books for a total price of \$11 including shipping charges of \$3. The books are the same price.

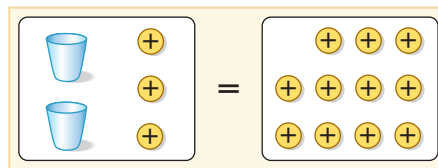


1. Let x = the cost of one book. How does the equation $2x + 3 = 11$ represent the situation?
2. Subtract 3 from each side of the equation. Write the equation that results.
3. Divide each side of the equation you wrote by 2. Write the result. What is the cost of each book?

Equations like $2x + 3 = 11$ that have two different operations are called **two-step equations**. To solve a two-step equation you need to work backward using the reverse of the order of operations.

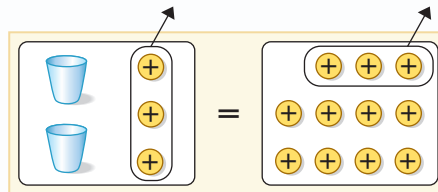
EXAMPLE Solve a Two-Step Equation

1 Solve $2x + 3 = 11$.



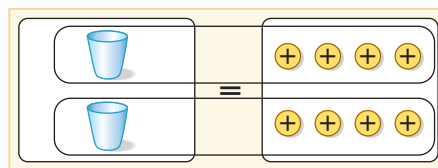
$$2x + 3 = 11$$

Model the equation.



$$2x + 3 - 3 = 11 - 3$$

Remove 3 counters from each side to get the variable by itself.



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

Divide the 8 counters equally into 2 groups. There are 4 counters in each group.

The solution is 4.



EXAMPLE**Solve a Two-Step Equation**

- 1 Solve $7 = 3x - 2$. Check your solution.

$$7 = 3x - 2 \quad \text{Write the equation.}$$

$$\underline{+ 2} = \underline{+ 2} \quad \text{Add 2 to each side.}$$

$$9 = 3x \quad \text{Simplify.}$$

$$\frac{9}{3} = \frac{3x}{3} \quad \text{Divide each side by 3.}$$

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

The solution is 3. Check this solution.

- 2 **Your Turn** Solve each equation. Check your solution.

a. $3a + 2 = 14$

b. $4c - 3 = 5$

c. $1 = 3a + 4$

REAL-LIFE MATH

ICE SKATING More than 7 million people go ice skating at least once a year. Of those participants, about 1.7 million are ages 12 through 17.

Source: Statistical Abstract of the United States

**EXAMPLE****Use an Equation to Solve a Problem**

- 1 **MONEY** John and two friends went ice skating. The admission was \$5 each. John brought his own skates, but his two friends had to rent skates. If they spent a total of \$19 to skate, how much did each friend pay for skate rental?

Words	The cost of two skate rentals plus two admissions is \$19.
Variable	Let s = cost for skate rental.
Equation	$\underbrace{\text{Two rentals at } \$s \text{ each}}_{2s} \quad \underbrace{\text{plus admission}}_{+ 3(5)} \quad \underbrace{\text{equals } \$19}_{= 19}$

$$2s + 15 = 19 \quad \text{Write the equation.}$$

$$\underline{- 15} = \underline{- 15} \quad \text{Subtract 15 from each side.}$$

$$2s = 4 \quad \text{Simplify.}$$

$$\frac{2s}{2} = \frac{4}{2} \quad \text{Divide each side by 2.}$$

$$s = 2 \quad \text{Simplify.}$$

Skate rental is \$2. Is this answer reasonable?

Skill and Concept Check

- Tell which operation to undo first in the equation $19 = 4 + 5x$.
- OPEN ENDED** Write a two-step equation using multiplication and addition. Solve your equation.

GUIDED PRACTICE

Solve each equation. Use models if necessary.

3. $2a + 5 = 13$ 4. $3y + 1 = -2$ 5. $10 = 4d - 2$ 6. $-4 = 5y + 6$

7. Three times a number n plus 8 is 44. What is the value of n ?

Practice and Applications

HOMWORK HELP

For Exercises	See Examples
8–19	1, 2
20–24	3

Extra Practice
See pages 612, 632.

Solve each equation. Use models if necessary.

8. $3a + 4 = 7$ 9. $2b + 6 = 12$ 10. $3g + 4 = -5$
11. $-1 = 3f + 2$ 12. $-8 = 6y - 2$ 13. $3 = 4h - 5$
14. $4d - 1 = 11$ 15. $5k - 3 = -13$ 16. $2x + 3 = 9$
17. $4t + 4 = 8$ 18. $10 = 2r - 8$ 19. $-7 = 4s + 1$
20. Six less than twice a number is fourteen. What is the number?
21. Ten is four more than three times a number. What is the number?
22. **GEOMETRY** The perimeter of a rectangle is 48 inches. Find its length if its width is 5 inches.
23. **MONEY** Lavone and two friends went bowling. The cost to bowl one game was \$3 each. Lavone brought his own bowling shoes, but his two friends had to rent bowling shoes. If they spent a total of \$15 to bowl one game, how much did each friend pay for shoe rental?
24. **MONEY** While on vacation, Daniella played tennis. Racket rental was \$7, and court time cost \$27 per hour. If the total cost was \$88, how many hours did Daniella play?
25. **CRITICAL THINKING** Use what you know about solving two-step equations to solve the equation $2(n - 9) = -4$.

Spiral Review with Standardized Test Practice

26. **MULTIPLE CHOICE** Seven less than four times a number is negative nineteen. What is the number?
(A) -3 (B) -1 (C) 1 (D) 3
27. **MULTIPLE CHOICE** Carter bought 3 pounds of peppers, 2 pounds of onions, 1 pound of lettuce, and 4 potatoes. If he had a total of 8 pounds of vegetables, how much did the 4 potatoes weigh?
(F) $\frac{1}{2}$ lb (G) 2 lb (H) 1 lb (I) 4 lb
28. **MONEY** Last week, Emilio spent 3 times as much on lunch as he spent on snacks. If he spent \$12 on lunch, how much did he spend on snacks? (Lesson 9-4)
29. **ALGEBRA** Solve $y - 11 = -8$. (Lesson 9-3)

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILLS Evaluate each expression if $n = -3$, $n = 0$, and $n = 3$. (Lesson 1-6)

30. $n - 5$

31. $n + 2$

32. $2n$

33. $\frac{1}{3}n$



What You'll LEARN

Solve problems by writing an equation.

Write an Equation

Mario, are you going to get your first draft of the 1,000-word English assignment done in 3 days?

Well, Ashley, at last count, I had 400 words. If I subtract 400 from 1,000, I'll know the number of words left to write. Then if I divide by the 3 days left, I'll know the number of words to write each day.

**Explore**

We know the total number of words needed, how many have been written, and how many days are left.

Plan

We can write an equation.

Let w = the words to be written each day.

3 days times w words a day plus 400 must equal 1,000 words.
 $3w$ $+ 400$ $= 1,000$

Solve

$3w + 400 - 400 = 1,000 - 400$ Subtract 400 from each side.
 $3w = 600$ Simplify.
 $\frac{3w}{3} = \frac{600}{3}$ Divide each side by 3.
 $w = 200$

Mario needs to write 200 words each day.

Examine

Check the answer in the original situation. If Mario writes 200 words a day for 3 days, he will have written 600 words. Add the 400 words he has already written to 600 to get 1,000. The answer checks.

Apply the Strategy

1. **Explain** how each equation represents the situation above.

Equation A: $1,000 - 400 - 3w = 0$

Equation B: $1,000 = 400 + 3w$

2. **Write** an equation to describe the following situation. There are 1,200 words in an assignment, 500 words are completed, and there are 4 days left to work.

Apply the Strategy

Solve. Use the write an equation strategy.

- MONEY** Taylor thinks she was overcharged when she bought 8 CD's at \$2 each and a CD player for \$15 at a garage sale. She paid a total of \$39. Write the equation that describes this problem and solve. Was she overcharged? Explain.
- NUMBER THEORY** A number is multiplied by 2. Then 7 is added to the product. After subtracting 3, the result is 0. Write and solve an equation for this problem.

Mixed Problem Solving

Solve. Use any strategy.

- SPORTS** Violetta, Brian, and Shanté play volleyball, soccer, and basketball. One of the girls is Brian's next-door neighbor. No person's sport begins with the same letter as his or her first name. Brian's neighbor plays volleyball. Which sport does each person play?
- TEMPERATURE** The table shows temperatures in degrees Celsius and Kelvins.

	Degrees Celsius (°C)	Kelvins (K)
water freezes	0	273
human body temperature	37	310
water boils	100	373

Write an equation that can be used to convert temperatures from degrees Celsius to Kelvins. If average room temperature is between 20°C and 25°C, what is it in Kelvins?

- ANIMALS** The table shows the weights of various animals. If there are 2,000 pounds in one ton, how many bobcats would it take to equal 2 tons?

Animal Weights	
Animal	Weight (lb)
zebra	600
anteater	100
bonobo	80
bobcat	20

Source: www.colszoo.org

- TRANSPORTATION** The sixth grade class is planning a field trip. 348 students and 18 teachers will be going on the field trip. If each bus holds 48 people, how many buses will they need?

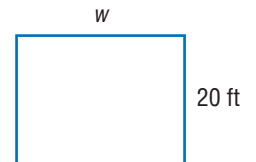
- SPORTS** Anoki is on the school swim team. His best time for the 100-meter freestyle race is 47.45 seconds. What was his speed in meters per second for this race? Round to the nearest tenth.
- PATTERNS** Draw the next two figures in the pattern shown below.



- MONEY** Wesley wants to collect all 50 U.S. special edition quarters. Five quarters are released each year. He has already collected the first four years. Write an equation to find the number of years that Wesley still has to collect quarters to have all 50.

12. STANDARDIZED TEST PRACTICE

The perimeter of a rectangular garden is 72 feet. The length of the garden is 20 feet. Which equation *cannot* be used to find the width, w ?



- (A) $72 = 2w + 2 \times 20$
- (B) $72 = 2(w + 20)$
- (C) $72 - 2 \times 20 = 2w$
- (D) $w = 72 - 2 \times 20$

What You'll LEARN

Illustrate functions using function machines.

Materials

- scissors
- tape

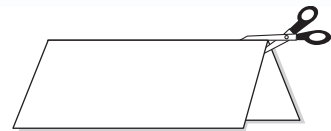
Function Machines

A *function machine* takes a number called the *input* and performs one or more operations on it to produce a new value called the *output*.

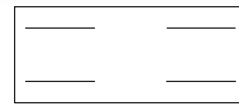
ACTIVITY *Work in small groups.*

Make a function machine for the rule $n - 4$.

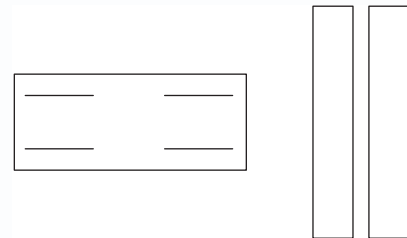
STEP 1 Cut a sheet of paper in half lengthwise.



STEP 2 Cut four slits into one of the halves of paper as shown. The slits should be at least one inch wide.



STEP 3 Using the other half of the paper, cut two narrow strips. These strips should be able to slide through the slits you cut on the first sheet of paper.



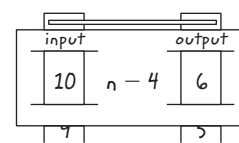
STEP 4 On one of the narrow strips, write the numbers 10 through 6 as shown. On the other strip, write the numbers 6 through 2 as shown.

The numbers on both strips should align.

10	6
9	5
8	4
7	3
6	2

STEP 5 Place the strips into the slits so that the numbers 10 and 6 can be seen. Then tape the ends of the strips together at the top. When you pull the strips, they should move together.

Mark columns *input* and *output*.



STEP 6 Write the function rule $n - 4$ between the input and output as shown.

STEP 7

Use the function machine to find the output value for each input value. Copy and complete the function table showing the input and output.

Input	Output
10	6
9	■
8	■
7	■
6	■

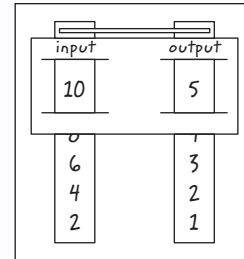
Your Turn Make a function machine for each rule. Use the input values 0, 1, 2, and 3 for n . Record the input and output in a function table.

- a. $n + 3$ b. $n + 5$ c. $n - 2$
 d. $n - 3$ e. $n \times 2$ f. $n \times 3$

Writing Math

Work in small groups.

1. **Explain** what a function machine would do for the rule $n \times 4$.
2. Use the function machine at the right. Copy and complete the function table. Then write the function rule for the table.
3. **Explain** how a function machine would evaluate the rule $n \times 3 + 4$.



Input	Output
10	5
8	■
6	■
4	■
2	■

4. **Make** a function machine using the rule $n \times 3 + 4$. Use the numbers 1–5 as the input values. Record the input and output values in a function table.
5. **Create** your own function machine. Write pairs of inputs and outputs and have the other members of your group determine the rule.
6. **Tell** what the function rule is for each set of input and output values.

a.

Input	Output
3	-2
4	-1
5	0
6	1
7	2

b.

Input	Output
2	4
3	6
4	8
5	10
6	12

7. **Explain** why using a function machine is like finding a pattern.

9-6

Functions

What You'll LEARN

Complete function tables and find function rules.

NEW Vocabulary

function
function table
function rule

WHEN am I ever going to use this?

LIFE SCIENCE A brown bat can eat 600 mosquitoes an hour.



1. Write an expression to represent the number of mosquitoes a brown bat can eat in 2 hours.
2. Write an expression to represent the number of mosquitoes a brown bat can eat in 5 hours.
3. Write an expression to represent the number of mosquitoes a brown bat can eat in t hours.

The number of mosquitoes eaten by a bat is a **function** of the number of hours. The results can be organized in a **function table**.

Input	Function Rule	Output
Number of Hours (t)	$600t$	Mosquitoes Eaten
1	$600(1)$	600
2	$600(2)$	1,200
3	$600(3)$	1,800

The **function rule** describes the relationship between each input and output.

EXAMPLE Complete a Function Table

1 Complete the function table.

The function rule is $x + 4$. Add 4 to each input.

Input (x)	Output ($x + 4$)
-2	■
1	■
4	■

Input Output

-2 + 4 → 2

1 + 4 → 5

4 + 4 → 8

Input (x)	Output ($x + 4$)
-2	2
1	5
4	8

2 **Your Turn** Copy and complete each function table.

a.

Input (x)	Output ($x - 2$)
-2	■
1	■
4	■

b.

Input (x)	Output ($2x$)
-1	■
0	■
3	■

EXAMPLE**Find the Rule for a Function Table**

1 Find the rule for the function table.

Input (x)	Output (y)
-3	-1
1	$\frac{1}{3}$
6	2

Study the relationship between each input and output.

Input		Output
-3	$\times \frac{1}{3} \rightarrow$	-1
1	$\times \frac{1}{3} \rightarrow$	$\frac{1}{3}$
6	$\times \frac{1}{3} \rightarrow$	2

The output is one-third of the input.

So, the function rule is $\frac{1}{3}x$, or $\frac{x}{3}$.

Your Turn Find the rule for each function table.

c.

Input (x)	Output (y)
-3	-12
1	4
4	16

d.

Input (x)	Output (y)
4	-1
8	3
10	5

REAL-LIFE CAREERS**How Does a Criminalist Use Math?**

Criminalists can determine the height of a victim by measuring certain bones and using formulas to make predictions.

**Research**

For more information about a career as a criminalist, visit: msmath1.net/careers

**EXAMPLE****Solve a Problem Using a Function**

1 CRIMINOLOGY A criminalist knows that an adult male's height, in centimeters, is about 72 centimeters more than 2.5 times the length of his tibia, t (shin bone). How tall is a man whose tibia is 30 centimeters?

First, determine the function rule.

Let t = length of tibia.

The function rule is $2.5t + 72$.

72 centimeters more than means to add 72.

Then, replace t in the rule $2.5t + 72$ with the length of the tibia, 30.

$$\begin{aligned}
 2.5t + 72 &= 2.5(30) + 72 && \text{Replace } t \text{ with 30.} \\
 &= 75 + 72 && \text{Multiply 2.5 and 30.} \\
 &= 147 && \text{Add 75 and 72.}
 \end{aligned}$$

The man is about 147 centimeters tall.



msmath1.net/extra_examples

Skill and Concept Check

1. **Make** a function table for the function rule $4x$. Use inputs of -4 , -2 , 0 , and 4 .
2. **OPEN ENDED** Make a function table. Then write a function rule. Choose three input values and find the output values.
3. **FIND THE ERROR** Nicole and Olivia are finding the function rule when each output is 5 less than the input. Who is correct? Explain.

Nicole
Function rule: $5 - x$

Olivia
Function rule: $x - 5$

GUIDED PRACTICE

Copy and complete each function table.

4.

Input (x)	Output ($x + 3$)
-2	■
0	■
2	■

5.

Input (x)	Output ($3x$)
-3	■
0	■
6	■

Find the rule for each function table.

6.

x	■
0	-1
2	1
4	3

7.

x	■
-3	6
1	-2
4	-8

8. If the input values are -3 , 0 , and 6 and the corresponding outputs are 1 , 4 , and 10 , what is the function rule?

Practice and Applications

Copy and complete each function table.

9.

Input (x)	Output ($x - 4$)
-2	■
0	■
8	■

10.

Input (x)	Output ($\frac{1}{2}x$)
-6	■
0	■
3	■

HOMEWORK HELP

For Exercises	See Examples
9–10, 19–20	1
11–18	2
21–22	3

Extra Practice
See pages 613, 632.

Find the rule for each function table.

11.

x	■
-1	1
0	2
6	8

12.

x	■
-1	-6
1	-4
3	-2

13.

x	■
-1	-2
0	0
6	12

14.

x	■
-2	$-\frac{2}{5}$
0	0
10	2

Find the rule for each function table.

15.

x	y
-2	6
1	-3
3	-9

16.

x	y
-2	12
1	9
4	6

17.

x	y
0	-1.6
2	0.4
4	2.4

18.

x	y
-2	4
1	1
4	16

19. If a function rule is $2x + 2$, what is the output for an input of 3?

20. If a function rule is $5x - 3$, what is the output for -2 ?

MONEY MATTERS For Exercises 21 and 22, use the following information.

For a school project, Sarah and her friends made hair scrunchies to sell for \$3 each and friendship bracelets to sell for \$4 each.



21. Write a function rule to represent the total selling price of scrunchies (s) and bracelets (b).

22. What is the price of 10 scrunchies and 12 bracelets?

23. **MONEY** Suppose the estimated 223 million Americans who have jugs or bottles of coins around their homes put coins back into circulation at a rate of \$10 a year. Make a function table showing the amount that would be recirculated in 1, 2, and 3 years.

24. **CRITICAL THINKING** Find the rule for the function table.

x	-2	-1	2	3
y	-2	0	6	8

Spiral Review with Standardized Test Practice

25. **MULTIPLE CHOICE** Find the rule for the function table shown.

- (A) $x \div 8$ (B) $\frac{1}{8}x$ (C) $8 - x$ (D) $8 + x$

x	y
1	7
4	4
10	-2

26. **MULTIPLE CHOICE** The school store makes a profit of 5¢ for each pencil sold. Which expression best represents the profit on 25 pencils?

- (F) 0.05×25 (G) 5×0.25 (H) $25 \div 5$ (I) $25 - 5$

27. **SHOPPING** Ping bought 3 T-shirts. His cost after using a \$5-off total purchase coupon was \$31. How much did each T-shirt cost? (Lesson 9-5)

Solve each equation. Use models if necessary. (Lesson 9-4)

28. $6x = 24$

29. $7y = -42$

30. $-12 = 5m$

31. $4p = 11$

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Graph each point on a coordinate plane. (Lesson 8-6)

32. $A(4, -2)$

33. $B(3, 4)$

34. $C(-5, 0)$

35. $D(-1, -3)$



Graphing Functions



WHEN am I ever going to use this?

What You'll LEARN

Graph functions from function tables.

REVIEW Vocabulary

ordered pair: a pair of numbers used to locate a point in a coordinate system (Lesson 8-6)

SAVINGS Suppose you put \$2 a week in savings.

- Copy and complete the table to find the amount you would save in 2, 3, and 6 weeks.
- On grid paper, graph the ordered pairs (number, amount saved).
- Describe how the points appear on the grid.
- What happens to the amount saved as the number of weeks increases?

Savings		
Number of Weeks	Multiply by 2.	Amount Saved
1	2×1	\$2
2		
3		
6		

The amount saved depends on the number of weeks. You can represent the function “multiply by 2” with an equation.

$$\begin{array}{ccc} \text{amount saved} & \xrightarrow{\quad} & \xrightarrow{\quad} \text{number of months} \\ & \searrow & \swarrow \\ & y = 2x & \end{array}$$

EXAMPLE Graph a Function

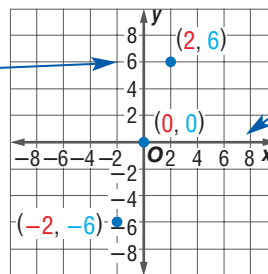
- 1** Make a function table for the rule $y = 3x$. Use input values of $-2, 0,$ and 2 . Then graph the function.

Step 1 Record the input and output in a function table. List the input and output as ordered pairs.

Input	Function Rule	Output	Ordered Pairs
(x)	$(3x)$	(y)	(x, y)
-2	$3(-2)$	-6	$(-2, -6)$
0	$3(0)$	0	$(0, 0)$
2	$3(2)$	6	$(2, 6)$

Step 2 Graph the ordered pairs on the coordinate plane.

The y-coordinates represent the output values.



The x-coordinates represent the input values.

STUDY TIP

Relation

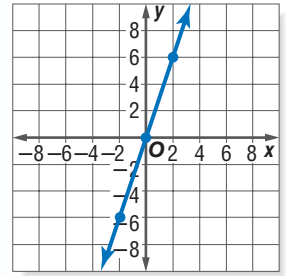
In Example 1, the set of ordered pairs $\{(-2, -6), (0, 0), (2, 6)\}$ is called a relation.

STUDY TIP

Line Graphs

The arrowheads indicate that the line extends in both directions.

Step 3 The points appear to lie on a line. Draw the line that contains these points. The line is the graph of $y = 3x$. For any point on this line, $y = 3x$.



Your Turn

- a. Make a function table for the rule $y = x - 4$ using input values of 0, 2, and 4. Then graph the function.

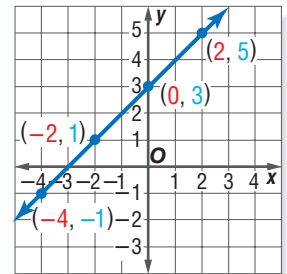
EXAMPLE

Make a Function Table for a Graph

- 1 Make a function table for the graph. Then determine the function rule.

Use the ordered pairs to make a function table.

Input (x)	Output (y)	(x, y)
-4	-1	(-4, -1)
-2	1	(-2, 1)
0	3	(0, 3)
2	5	(2, 5)



Study the input and output. Look for a rule.

Input **Output**

-4 + 3 -1

-2 + 3 1

0 + 3 3

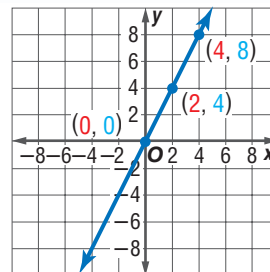
2 + 3 5

3 is added to each input to get the output.

The function rule is $y = x + 3$.

Your Turn

- b. Make a function table for the graph. Then determine the function rule.



Skill and Concept Check

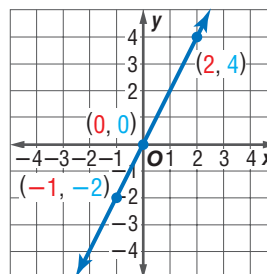
- Writing Math** Explain the difference between a function table and the graph of a function.
- OPEN ENDED** Draw the graph of a function that passes through the point $(0, 0)$. Name three points on the graph.

GUIDED PRACTICE

Make a function table for each rule with the given input values. Then graph the function.

3. $y = x + 5$; $-2, 0, 2$ 4. $y = \frac{x}{2}$; $-4, 0, 4$

5. Make a function table for the graph at the right. Then determine the function rule.



6. Make a function table for the rule $y = x - 5$ using 1, 3, and 6 as the input. Then graph the function.

Practice and Applications

Make a function table for each rule with the given input values. Then graph the function.

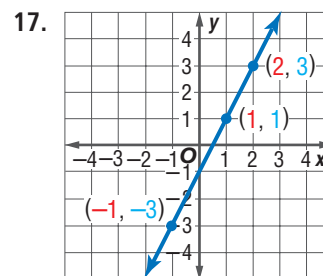
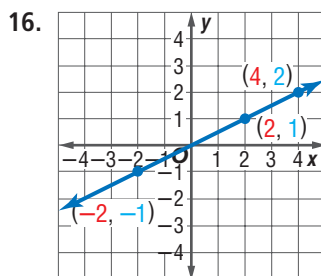
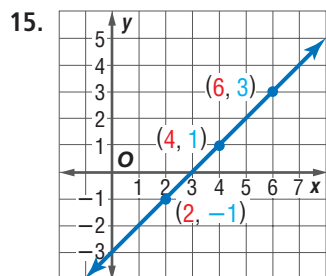
- | | |
|-------------------------------|-----------------------------------------|
| 7. $y = x - 2$; $0, 2, 4$ | 8. $y = 2x$; $-1, 1, 2$ |
| 9. $y = 2n - 3$; $-3, 0, 4$ | 10. $y = 2n + 3$; $2, \frac{1}{2}, 0$ |
| 11. $y = x + 4$; $-5, -2, 1$ | 12. $y = 2x + 4$; $-2, 1, 3$ |
| 13. $y = -4x$; $2, 0, -2$ | 14. $y = \frac{1}{2}x + 1$; $-2, 0, 4$ |

HOMEWORK HELP

For Exercises	See Examples
7-14	1
15-17	2

Extra Practice
See pages 613, 632.

Make a function table for each graph. Then determine the function rule.



18. **MONEY** A catalog that sells gift wrap charges \$3 for each roll of gift wrap ordered and an additional \$1 for shipping of each roll. Write a function rule that can be used to find the cost, including shipping, of any number of rolls of gift wrap.

MONEY MATTERS For Exercises 19–21, use the following information.

Ben’s summer job pays \$50 a week, and he must pay \$30 for a uniform.

Rachel earns \$45 a week and does not need a uniform.

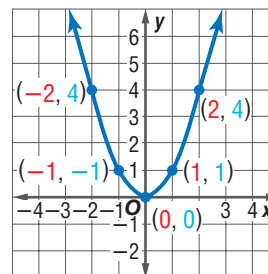
19. Write the function rule for each person’s wages.
 20. Graph each function on the same coordinate plane.
 21. What does the intersection of the two graphs represent?
22. **CRITICAL THINKING** Determine the rule for the line that passes through $A(-2, -1)$ and $B(3, 9)$.

EXTENDING THE LESSON

Some function rules result in a curved line on the graph. A function whose graph is not a straight line is called a *nonlinear function*.

Example $y = x^2$

Input (x)	Output (x^2)
-2	4
-1	1
0	0
1	1
2	4



Make a function table for each rule with the given input values. Then graph the function.

23. $y = n^3$; -2, -1, 0, 1, 2

24. $y = n^2 - 2$; -2, -1, 0, 1, 2

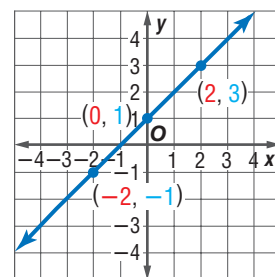
Spiral Review with Standardized Test Practice

25. **MULTIPLE CHOICE** Which is the output for the input -1 using the rule $y = 2x - 3$?

- Ⓐ -5 Ⓑ -4 Ⓒ -3 Ⓓ -1

26. **SHORT RESPONSE** Find a function rule for the graph at the right.

27. If input values are 3, 5, and 8 and the corresponding outputs are 5, 7, and 10, what is the function rule? (Lesson 9-6)



Solve each equation. Check your solution. (Lesson 9-5)

28. $4t - 1 = 11$


29. $7x - 10 = -38$

30. $-4 = 2y + 8$

INTERDISCIPLINARY PROJECT

Weather Watchers

Math and Science It’s time to complete your project. Use the data you have gathered about weather patterns in your state to prepare a Web page or poster. Be sure to include two graphs and a report with your project.


msmath1.net/webquest

Vocabulary and Concept Check

Addition Property of Equality (p. 345)

Additive Identity (p. 334)

Associative Property (p. 334)

coefficient (p. 350)

Commutative Property (p. 334)

Distributive Property (p. 333)

function (p. 362)

function rule (p. 362)

function table (p. 362)

inverse operations (p. 339)

Multiplicative Identity (p. 334)

Subtraction Property of

Equality (p. 340)

two-step equation (p. 355)

Choose the correct term or number to complete each sentence.

- The (Commutative, Associative) Property states that the order in which numbers are added or multiplied does not change the sum or product.
- To solve a multiplication equation, you can (divide, multiply) to undo the multiplication.
- A(n) (function, output) describes a relationship between two quantities.
- The equation $2b + 3 = 11$ is an example of a (one-step, two-step) equation.
- A (function rule, coordinate system) describes the relationship between each input and output.
- The Distributive Property states that when (multiplying, dividing) a number by a sum, multiply each number inside the parentheses by the number outside the parentheses.

Lesson-by-Lesson Exercises and Examples

9-1

Properties (pp. 333–336)

Rewrite each expression using the Distributive Property. Then evaluate.

7. $4(7 + 2)$

8. $(14 + 9)8$

9. $(3 \times 8) + (3 \times 12)$

10. $(9 \times 6) + (9 \times 13)$

Identify the property shown by each equation.

11. $14 + (11 + 7) = (14 + 11) + 7$

12. $(7 \times 4)3 = 3(7 \times 4)$

13. $12 + 15 + 28 = 12 + 28 + 15$

14. $(2 \times 28) \times 3 = 2 \times (28 \times 3)$

Example 1 Rewrite $4(2 + 9)$ using the Distributive Property. Then evaluate.

$$\begin{aligned} 4(2 + 9) &= 4(2) + 4(9) && \text{Distributive Property} \\ &= 8 + 36 && \text{Multiply.} \\ &= 44 && \text{Add.} \end{aligned}$$

Example 2 Identify the property shown by $8 + (7 + 13) = (8 + 7) + 13$.

The grouping of the numbers to be added changes. This is the Associative Property of Addition.

9-2 Solving Addition Equations (pp. 339–342)

Solve each equation. Use models if necessary.

15. $c + 8 = 11$ 16. $x + 15 = 14$
17. $54 = m - 9$ 18. $-5 = -2 + x$
19. $w + 13 = -25$ 20. $17 + d = -2$
21. $23 = h + 11$ 22. $19 + r = 11$

23. **WEATHER** In the morning, the temperature was -8°F . By noon, the temperature had risen 14° . What was the temperature at noon?

Example 3 Solve $x + 8 = 10$.

$$\begin{array}{r} x + 8 = 10 \\ -8 = -8 \quad \text{Subtract 8 from each side.} \\ \hline x = 2 \quad \text{Simplify.} \end{array}$$

Example 4 Solve $y + 7 = 3$.

$$\begin{array}{r} y + 7 = 3 \\ -7 = -7 \quad \text{Subtract 7 from each side.} \\ \hline y = -4 \quad \text{Simplify.} \end{array}$$

9-3 Solving Subtraction Equations (pp. 344–347)

Solve each equation. Use models if necessary.

24. $z - 7 = 11$ 25. $s - 9 = -12$
26. $14 = m - 5$ 27. $-4 = y - 9$
28. $h - 2 = -9$ 29. $-6 = g - 4$
30. $p - 22 = -7$ 31. $d - 3 = -14$

32. Find the value of c if $c - 9 = -3$.
33. If $d - 1.2 = 6$, what is the value of d ?

Example 5 Solve $a - 5 = -3$.

$$\begin{array}{r} a - 5 = -3 \\ +5 = +5 \quad \text{Add 5 to each side.} \\ \hline a = 2 \quad \text{Simplify.} \end{array}$$

Example 6 Solve $4 = m - 9$.

$$\begin{array}{r} 4 = m - 9 \\ +9 = +9 \quad \text{Add 9 to each side.} \\ \hline 13 = m \quad \text{Simplify.} \end{array}$$

9-4 Solving Multiplication Equations (pp. 350–353)

Solve each equation. Use models if necessary.

34. $4b = 32$ 35. $5y = 60$
36. $-3m = 21$ 37. $-18 = -6c$
38. $7a = -35$ 39. $28 = -2d$
40. $-4x = 10$ 41. $-6y = -9$

42. **ALGEBRA** The product of a number and 8 is -56 . What is the number?

Example 7 Solve $-6y = 24$.

$$\begin{array}{r} -6y = 24 \quad \text{Write the equation.} \\ \frac{-6y}{-6} = \frac{24}{-6} \quad \text{Divide each side by } -6. \\ \hline y = -4 \quad \text{Simplify.} \end{array}$$

Mixed Problem Solving

For mixed problem-solving practice, see page 632.

9-5 Solving Two-Step Equations (pp. 355–357)

Solve each equation. Use models if necessary.

43. $3p - 4 = 8$ 44. $2x + 5 = 3$
 45. $8 + 6w = 50$ 46. $5m + 6 = -9$
 47. $6 = 3y - 12$ 48. $-15 = 5 + 2t$

Example 8 Solve $4x - 9 = 15$.

$$4x - 9 = 15 \quad \text{Write the equation.}$$

$$\underline{\quad + 9 = + 9} \quad \text{Add 9 to each side.}$$

$$4x = 24 \quad \text{Simplify.}$$

$$\frac{4x}{4} = \frac{24}{4} \quad \text{Divide each side by 4.}$$

$$x = 6 \quad \text{Simplify.}$$

9-6 Functions (pp. 362–365)

Copy and complete the function table.

49.

Input (x)	Output ($x + 3$)
-2	■
1	■
5	■

Find the rule for each function table.

50.

x	■
-2	2
1	5
4	8

51.

x	■
-5	-11
0	-1
2	3

Example 9 Complete the function table.

Input (x)	Output ($x - 4$)
-5	■
1	■
3	■

The function rule is $x - 4$. Subtract 4 from each input value.

Input		Output
-5	$-4 \rightarrow$	-9
1	$-4 \rightarrow$	-3
3	$-4 \rightarrow$	-1

9-7 Graphing Functions (pp. 366–369)

Copy and complete each function table. Then graph the function.

52.

Input (x)	Output ($x + 3$)
-2	■
0	■
3	■

53.

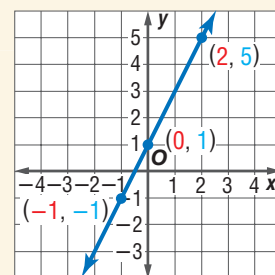
Input (x)	Output ($-2x$)
-3	■
-1	■
2	■

54. Make a function table for the rule $y = x - 1$ using input values of -2, 0, and 2. Graph the function.

Example 10 Graph the function represented by the function table.

Input (x)	Output ($2x + 1$)
-1	-1
0	1
2	5

Graph the ordered pairs $(-1, -1)$, $(0, 1)$, and $(2, 5)$. Draw the line that contains the points.



Practice Test

Vocabulary and Concepts

1. Explain the Commutative Property. Give an example using addition.
2. Describe the process used to solve a two-step equation.
3. Explain how to graph the function $y = 2x + 1$.

Skills and Applications

Identify the property shown by each equation.

4. $5 \times (3 \times 2) = (5 \times 3) \times 2$ 5. $14 + 9 = 9 + 14$

Rewrite each expression using the Distributive Property. Then evaluate.

6. $2(12 + 5)$ 7. $16(12) + 16(8)$

Solve each equation. Use models if necessary.

8. $-5 = x + 11$ 9. $w + 17 = 29$ 10. $m - 9 = 3$
 11. $p - 5 = -1$ 12. $-6d = 42$ 13. $12 = c + (-2)$
 14. $2b = -8$ 15. $15 = 3n$ 16. $g - 4 = -3$
 17. $6x + 4 = 10$ 18. $24 = 3y - 6$ 19. $-5m = -30$

20. Copy and complete the function table.

Input (x)	Output ($2x + 3$)
-2	■
1	■
2	■

21. Find the rule for the function table.

x	■
-3	-1
0	2
1	3

Make a function table for each given rule and input values. Then graph the function.

22. $y = x - 4$; -1, 2, 6 23. $y = 3x$; -2, 1, 4 24. $y = -2x - 2$; -3, 0, 1

Standardized Test Practice

25. **MULTIPLE CHOICE** Fresno, California, f , and Buffalo, New York, b , are 3 time zones apart. Use the function rule $f = b - 3$ to find the time in Buffalo when it is 3:30 P.M. in Fresno.

- (A) 4:30 P.M. (B) 6:30 P.M. (C) 9:30 P.M. (D) 12:30 P.M.



PART 1 Multiple Choice

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

1. What is the sum of 27 and 59? (Prerequisite Skill, p. 589)

(A) 76 (B) 86
(C) 96 (D) 906

2. Juan earned \$37.00 baby-sitting last week. If he had not baby-sat on Friday, about how much money would he have earned? (Lesson 3-4)

Money Earned Baby-Sitting	
Day	Amount Earned
Monday	\$4.50
Wednesday	\$4.50
Friday	\$12.75
Saturday	\$15.25

(F) about \$13 (G) about \$24
(H) about \$25 (I) about \$37

3. Which of the following is the least common multiple of 12 and 8? (Lesson 5-4)

(A) 24 (B) 48
(C) 72 (D) 96

4. Dion has 60 baseball cards. He gave away $\frac{3}{4}$ of them to Amy. How many did he give to Amy? (Lesson 7-2)

(F) 15 (G) 20
(H) 30 (I) 45

5. Which of the following represents 20 feet above sea level? (Lesson 8-1)

(A) -20 ft (B) -2 ft
(C) +2 ft (D) +20 ft

TEST-TAKING TIP

Questions 7 and 8 On multiple choice test items involving solving equations, you can replace the variable in the equation with the values given in each answer choice. The answer choice that results in a true statement is the correct answer.

6. Which of the following shows another way to write $6(2 + 8)$? (Lesson 9-1)

(F) $6 - 2 - 8$
(G) $6 + 2 + 8$
(H) $6 \times 2 + 6 \times 8$
(I) 12×48

7. What is the value of b in the equation $22 + b = 34$? (Lesson 9-2)

(A) 6 (B) 12
(C) 20 (D) 56

8. After giving 16 comic books to her friends, Carmen had 64 comic books left. She used the equation $x - 16 = 64$ to figure out how many comic books she started with. What is the value of x in the equation? (Lesson 9-3)

(F) 4 (G) 48
(H) 76 (I) 80

9. What is the function rule that relates the input and output values in the function table? (Lesson 9-6)

(A) $n + 1$
(B) $n - 1$
(C) $2n + 1$
(D) $2n - 1$

n	\square
0	1
1	3
2	5
3	7
4	9

PART 2 Short Response/Grid In

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

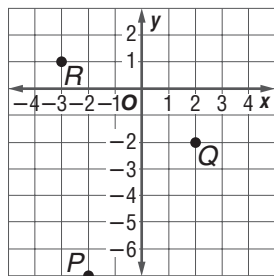
- If Jim rounds the weight of $3\frac{7}{8}$ pounds of green beans to the nearest pound to estimate the price, what weight will he use? (Lesson 6-1)
- Sakowski Tailors are sewing band uniforms. They need $5\frac{1}{4}$ yards of fabric for each uniform. How many yards of fabric are needed for 12 uniforms? (Lesson 7-3)
- What rule was used to create the following pattern? (Lesson 7-6)

56, 48, 40, 32, ?

- The table shows the lowest extreme temperatures for four U.S. cities. Order the temperatures from least to greatest. (Lesson 8-1)

Lowest Extreme Temperatures	
City	Temp. (°F)
Anchorage	-34
Chicago	-27
Los Angeles	28
Duluth	-39

- A football team lost 8 yards on their first play. If they gained 9 yards on the next play, how many total yards did they advance? (Lesson 8-2)
- Find the value of m that makes $-32 \div m = -8$ true. (Lesson 8-5)
- What ordered pair names point P on the coordinate grid? (Lesson 8-6)



- Gloria had 24 coins in her collection. At a yard sale, Gloria bought a tin filled with coins. She now has 39 coins in her collection. Use $24 + y = 39$ to find the number of coins she added to her collection. (Lesson 9-2)

- What is the value of m if $m - 5 = -7$? (Lesson 9-3)

- What output value completes the following function table? (Lesson 9-6)

Input	Output
1	4
2	7
3	10
4	13
5	■

PART 3 Extended Response

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

- Three friends went to the skateboard arena. The admission was \$3.50 each. Two people had to rent boards. The total cost for the three to skateboard was \$15.50. What was the cost to rent a skateboard? Explain how you found the solution. (Lesson 9-5)
- The values of a function are shown below. (Lessons 9-6 and 9-7)

x	y
0	-2
1	3
2	8
3	13

- Graph the function on a coordinate plane.
- Identify the corresponding y -values for $x = 4$ and $x = 5$.
- What is the function rule?

