

Creating Expressions and Equations



MCC9-12.A.SSE.1

MCC9-12.A.REI.1

MCC9-12.A.CED.1, MCC9-12.A.CED.3,
MCC9-12.N.Q.2MCC9-12.A.CED.1, MCC9-12.A.CED.3,
MCC9-12.N.Q.2

MCC9-12.A.REI.11

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The Common Core Georgia Performance Standards for Mathematical Practice describe varieties of expertise that all students should seek to develop.

Opportunities to develop these practices are integrated throughout this program.

- 1 Make sense of problems and persevere in solving them.
- 2 Reason abstractly and quantitatively.
- 3 Construct viable arguments and critique the reasoning of others.
- 4 Model with mathematics.
- 5 Use appropriate tools strategically.
- 6 Attend to precision.
- 7 Look for and make use of structure.
- 8 Look for and express regularity in repeated reasoning.

Unpacking the Standards



Understanding the standards and the vocabulary terms in the standards will help you know exactly what you are expected to learn in this chapter.



MCC9-12.A.SSE.1

Interpret expressions that represent a quantity in terms of its context.

Key Vocabulary

expression (expresión)

A mathematical phrase that contains operations, numbers, and/or variables.

What It Means For You

Variables in formulas and other math expressions are used to represent specific quantities.

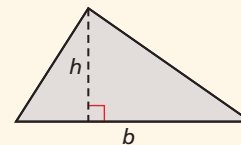
EXAMPLE

$$A = \frac{1}{2}bh$$

A = area of the triangle

b = length of the base

h = height



MCC9-12.A.CED.1

Create equations ... in one variable and use them to solve problems.

Key Vocabulary

equation (ecuación)

A mathematical statement that two expressions are equivalent.

variable (variable)

A symbol used to represent a quantity that can change.



What It Means For You

You can write an equation to represent a real-world problem and then use algebra to solve the equation and find the answer.

EXAMPLE

Michael is saving money to buy a trumpet. The trumpet costs \$670. He has \$350 saved, and each week he adds \$20 to his savings. How long will it take him to save enough money to buy the trumpet?

Let w represent the number of weeks.

cost of trumpet	=	current savings	+	additional savings
670	=	350	+	$20w$
320	=	$20w$		
16	=	w		

It will take Michael 16 weeks to save enough money.

1-1

Variables and Expressions

Essential Question: How can you use variables to write an expression that represents a quantity in terms of its context?

Objectives

Translate between words and algebra.

Evaluate algebraic expressions.

Vocabulary

variable
constant
numerical expression
algebraic expression
evaluate

Why learn this?

Variables and expressions can be used to determine how many plastic drink bottles must be recycled to make enough carpet for a house.

A home that is “green built” uses many recycled products, including carpet made from recycled plastic drink bottles. You can determine how many square feet of carpet can be made from a certain number of plastic drink bottles by using *variables*, *constants*, and *expressions*.

A **variable** is a letter or symbol used to represent a value that can change.

A **constant** is a value that does not change.

A **numerical expression** may contain only constants and/or operations.

An **algebraic expression** may contain variables, constants, and/or operations.

You will need to translate between algebraic expressions and words to be successful in math. The diagram below shows some of the ways to write mathematical operations with words.



Container City, in East London, UK, is a development of buildings made from recycled shipping containers.

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EXAMPLE 1

MCC9-12.A.SSE.1

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Translating from Algebraic Symbols to Words

Give two ways to write each algebraic expression in words.

- | | |
|--|---|
| <p>A $x + 3$
the sum of x and 3
x increased by 3</p> <p>C $2 \cdot y$
2 times y
the product of 2 and y</p> | <p>B $m - 7$
the difference of m and 7
7 less than m</p> <p>D $k \div 5$
k divided by 5
the quotient of k and 5</p> |
|--|---|



Give two ways to write each algebraic expression in words.

- 1a. $4 - n$ 1b. $\frac{t}{5}$ 1c. $9 + q$ 1d. $3(h)$

To translate words into algebraic expressions, look for words that indicate the action that is taking place.



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EXAMPLE
MCC9-12.N.Q.1

2

Translating from Words to Algebraic Symbols

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- A** Eve reads 25 pages per hour. Write an expression for the number of pages she reads in h hours.
 h represents the number of hours that Eve reads.
 $25 \cdot h$ or $25h$ *Think: h groups of 25 pages.*
- B** Sam is 2 years younger than Sue, who is y years old. Write an expression for Sam's age.
 y represents Sue's age.
 $y - 2$ *Think: "younger than" means "less than."*
- C** William runs a mile in 12 minutes. Write an expression for the number of miles that William runs in m minutes.
 m represents the total time William runs.
 $\frac{m}{12}$ *Think: How many groups of 12 are in m ?*



- 2a.** Lou drives at 65 mi/h. Write an expression for the number of miles that Lou drives in t hours.
- 2b.** Miriam is 5 cm taller than her sister, who is m cm tall. Write an expression for Miriam's height in centimeters.
- 2c.** Elaine earns \$32 per day. Write an expression for the amount that she earns in d days.

To **evaluate** an expression is to find its value. To evaluate an algebraic expression, substitute numbers for the variables in the expression and then simplify the expression.

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EXAMPLE
MCC9-12.A.SSE.1a

3

Evaluating Algebraic Expressions

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Evaluate each expression for $x = 8$, $y = 5$, and $z = 4$.

- A** $x + y$
 $x + y = 8 + 5$ *Substitute 8 for x and 5 for y .*
 $= 13$ *Simplify.*
- B** $\frac{x}{z}$
 $\frac{x}{z} = \frac{8}{4}$ *Substitute 8 for x and 4 for z .*
 $= 2$ *Simplify.*



- Evaluate each expression for $m = 3$, $n = 2$, and $p = 9$.
- 3a.** mn **3b.** $p - n$ **3c.** $p \div m$

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4 Recycling Application

Approximately fourteen 20-ounce plastic drink bottles must be recycled to produce 1 square foot of carpet.

- a. Write an expression for the number of bottles needed to make c square feet of carpet.

The expression $14c$ models the number of bottles needed to make c square feet of carpet.

- b. Find the number of bottles needed to make 40, 120, and 224 square feet of carpet.

Evaluate $14c$ for $c = 40, 120,$ and 224 .

c	$14c$
40	$14(40) = 560$
120	$14(120) = 1680$
224	$14(224) = 3136$

To make 40 ft² of carpet, 560 bottles are needed.
 To make 120 ft² of carpet, 1680 bottles are needed.
 To make 224 ft² of carpet, 3136 bottles are needed.



Helpful Hint

A *replacement set* is a set of numbers that can be substituted for a variable. The replacement set in Example 4 is {40, 120, 224}.



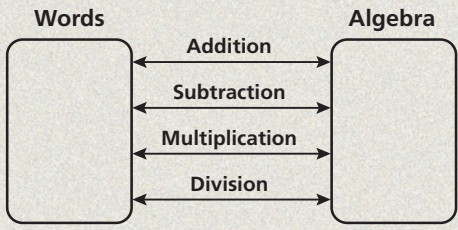
- 4. To make one sweater, sixty-three 20-ounce plastic drink bottles must be recycled.
 - a. Write an expression for the number of bottles needed to make s sweaters.
 - b. Find the number of bottles needed to make 12, 25, and 50 sweaters.

THINK AND DISCUSS

- 1. Write two ways to suggest each of the following, using words or phrases: addition, subtraction, multiplication, division.
- 2. Explain the difference between a numerical expression and an algebraic expression.



- 3. **GET ORGANIZED** Copy and complete the graphic organizer. Next to each operation, write a word phrase in the left box and its corresponding algebraic expression in the right box.



(c) Sam Dudgeon/HMH, (r) Thinkstock/Getty



GUIDED PRACTICE

1. **Vocabulary** A(n) _____? _____ is a value that can change. (*algebraic expression, constant, or variable*)

SEE EXAMPLE 1

- Give two ways to write each algebraic expression in words.

2. $n - 5$ 3. $\frac{f}{3}$ 4. $c + 15$ 5. $9 - y$
6. $\frac{x}{12}$ 7. $t + 12$ 8. $8x$ 9. $x - 3$

SEE EXAMPLE 2

10. George drives at 45 mi/h. Write an expression for the number of miles George travels in h hours.
11. The length of a rectangle is 4 units greater than its width w . Write an expression for the length of the rectangle.

SEE EXAMPLE 3

- Evaluate each expression for $a = 3$, $b = 4$, and $c = 2$.

12. $a - c$ 13. ab 14. $b \div c$ 15. ac

SEE EXAMPLE 4

16. Brianna practices the piano 30 minutes each day.
a. Write an expression for the number of hours she practices in d days.
b. Find the number of hours Brianna practices in 2, 4, and 10 days.

PRACTICE AND PROBLEM SOLVING

Independent Practice

For Exercises	See Example
17–24	1
25–26	2
27–30	3
31	4

- Give two ways to write each algebraic expression in words.

17. $5p$ 18. $4 - y$ 19. $3 + x$ 20. $3y$
21. $-3s$ 22. $r \div 5$ 23. $14 - t$ 24. $x + 0.5$

25. Friday's temperature was 20° warmer than Monday's temperature t . Write an expression for Friday's temperature.
26. Ann sleeps 8 hours per night. Write an expression for the number of hours Ann sleeps in n nights.

- Evaluate each expression for $r = 6$, $s = 5$, and $t = 3$.

27. $r - s$ 28. $s + t$ 29. $r \div t$ 30. sr

31. Jim is paid for overtime when he works more than 40 hours per week.
a. Write an expression for the number of hours he works overtime when he works h hours.
b. Find the number of hours Jim works overtime when he works 40, 44, 48, and 52 hours.

- HOT** 32. **Write About It** Write a paragraph that explains to another student how to evaluate an expression.

Write an algebraic expression for each verbal expression. Then write a real-world situation that could be modeled by the expression.

33. the product of 2 and x 34. b less than 17 35. 10 more than y



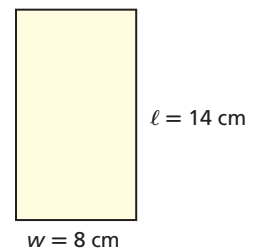
Real-World Connections



36. The air around you puts pressure on your body equal to 14.7 pounds per square inch (psi). When you are underwater, the water exerts additional pressure on your body. For each foot you are below the surface of the water, the pressure increases by 0.445 psi.
- What does 14.7 represent in the expression $14.7 + 0.445d$?
 - What does d represent in the expression?
 - What is the total pressure exerted on a person's body when $d = 8$ ft?

37. **Geometry** The length of a rectangle is 9 inches. Write an expression for the area of the rectangle if the width is w inches. Find the area of the rectangle when the width is 1, 8, 9, and 11 inches.

38. **Geometry** The perimeter of any rectangle is the sum of its lengths and widths. The area of any rectangle is the length ℓ times the width w .
- Write an expression for the perimeter of a rectangle.
 - Find the perimeter of the rectangle shown.
 - Write an expression for the area of a rectangle.
 - Find the area of the rectangle shown.



Complete each table. Evaluate the expression for each value of x .

39.

x	$x + 12$
1	■
2	■
3	■
4	■

40.

x	$10x$
1	■
5	■
10	■
15	■

41.

x	$x \div 2$
12	■
20	■
26	■
30	■

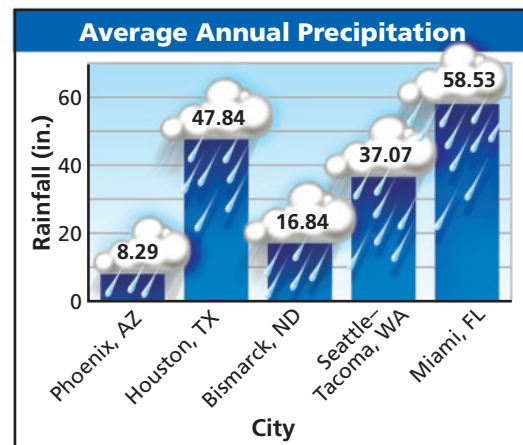


Astronomy



A crater on Canada's Devon Island is geologically similar to the surface of Mars. However, the temperature on Devon Island is about 37°F in summer, and the average summer temperature on Mars is -85°F .

42. **Astronomy** An object's weight on Mars can be found by multiplying 0.38 by the object's weight on Earth.
- An object weighs p pounds on Earth. Write an expression for its weight on Mars.
 - Dana weighs 120 pounds, and her bicycle weighs 44 pounds. How much would Dana and her bicycle together weigh on Mars?
43. **Meteorology** Use the bar graph to write an expression for the average annual precipitation in New York, New York.
- The average annual precipitation in New York is m inches more than the average annual precipitation in Houston, Texas.
 - The average annual precipitation in New York is s inches less than the average annual precipitation in Miami, Florida.

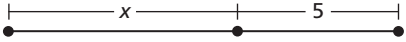
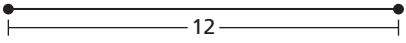


44. **Critical Thinking** Compare algebraic expressions and numerical expressions. Give examples of each.

Write an algebraic expression for each verbal expression. Then evaluate the algebraic expression for the given values of x .

	Verbal	Algebraic	$x = 12$	$x = 14$
	x reduced by 5	$x - 5$	$12 - 5 = 7$	$14 - 5 = 9$
45.	7 more than x	■	■	■
46.	The quotient of x and 2	■	■	■
47.	The sum of x and 3	■	■	■

TEST PREP

48. Claire has had her driver's license for 3 years. Bill has had his license for b fewer years than Claire. Which expression can be used to show the number of years Bill has had his driver's license?
- (A) $3 + b$ (B) $b + 3$ (C) $3 - b$ (D) $b - 3$
49. Which expression represents x ?
- (F) $12 - 5$ (H) $12(5)$ 
- (G) $12 + 5$ (J) $12 \div 5$ 
50. Which situation is best modeled by the expression $25 - x$?
- (A) George places x more video games on a shelf with 25 games.
 (B) Sarah has driven x miles of a 25-mile trip.
 (C) Amelia paid 25 dollars of an x dollar lunch that she shared with Ariel.
 (D) Jorge has 25 boxes full of x baseball cards each.

CHALLENGE AND EXTEND

Evaluate each expression for the given values of the variables.

51. $2ab$; $a = 6$, $b = 3$ 52. $2x + y$; $x = 4$, $y = 5$ 53. $3x \div 6y$; $x = 6$, $y = 3$
54. **Multi-Step** An Internet service provider charges \$9.95/month for the first 20 hours and \$0.50 for each additional hour. Write an expression representing the charges for h hours of use in one month when h is more than 20 hours. What is the charge for 35 hours?

MATHEMATICAL PRACTICES

FOCUS ON MATHEMATICAL PRACTICES

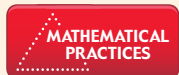
- H.O.T.** 55. **Reasoning** Are there any values of x and y for which $x + y$ is equal to $x - y$? If so, give an example.
- H.O.T.** 56. **Patterns** $x + 2$ is an odd number. Write an expression for each of the next 4 odd numbers. Is $x + 75$ even or odd? Explain.
- H.O.T.** 57. **Error Analysis** One insect crawled for 5 minutes at a rate of 2.5 inches per minute while another insect crawled the same amount of time at a rate of 2.5 inches per second. Kevin used the variable t for the time (in minutes) each insect crawled, wrote the expression $2.5t$ for each insect's distance, and found that each insect crawled the same distance. Explain Kevin's error.

1-2 Algebra TASK

Model One-Step Equations

You can use algebra tiles and an equation mat to model and solve equations. To find the value of the variable, place or remove tiles to get the x -tile by itself on one side of the mat. You must place or remove the same number of yellow tiles or the same number of red tiles on both sides.

Use with Solving Equations by Adding or Subtracting



Use appropriate tools strategically.

MCC9-12.A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. Also **MCC9-12.A.REI.3**

KEY	REMEMBER
$\begin{matrix} + & = & 1 \\ - & = & -1 \end{matrix}$	$+ + - = 0$
$\begin{matrix} \text{yellow } + & = & x \end{matrix}$	

Activity

Use algebra tiles to model and solve $x + 6 = 2$.

MODEL	ALGEBRA
<p>Model $x + 6$ on the left side of the mat and 2 on the right side of the mat.</p>	$x + 6 = 2$
<p>Place 6 red tiles on both sides of the mat. This represents adding -6 to both sides of the equation.</p>	$x + 6 + (-6) = 2 + (-6)$
<p>Remove zero pairs from both sides of the mat.</p>	$x + 0 = 0 + (-4)$
<p>One x-tile is equivalent to 4 red tiles.</p>	$x = -4$

Try This

Use algebra tiles to model and solve each equation.

1. $x + 2 = 5$

2. $x - 7 = 8$

3. $x - 5 = 9$

4. $x + 4 = 7$

1-2

Solving Equations by Adding or Subtracting



Essential Question: How can you use addition or subtraction to solve equations?

Objective

Solve one-step equations in one variable by using addition or subtraction.

Vocabulary

equation
solution of an equation

Animated Math

Who uses this?

Athletes can use an equation to estimate their maximum heart rates. (See Example 4.)

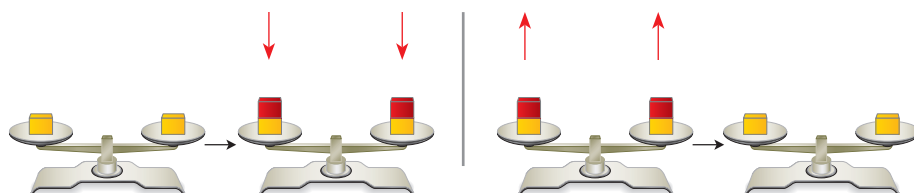
An **equation** is a mathematical statement that two expressions are equal. A **solution of an equation** is a value of the variable that makes the equation true.

To find solutions, *isolate the variable*. A variable is isolated when it appears by itself on one side of an equation, and not at all on the other side. Isolate a variable by using inverse operations, which “undo” operations on the variable.

An equation is like a balanced scale. To keep the balance, perform the same operation on both sides.

Inverse Operations

Add x . \longleftrightarrow Subtract x .



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EXAMPLE 1

MCC9-12.A.REI.3

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Solving Equations by Using Addition

Solve each equation.

A $x - 10 = 4$

$$x - 10 = 4$$

$$\begin{array}{r} + 10 \quad + 10 \\ x - 10 = 4 \\ \hline x = 14 \end{array}$$

Since 10 is subtracted from x , add 10 to both sides to undo the subtraction.

Check $x - 10 = 4$

$$\begin{array}{r|l} 14 - 10 & 4 \\ \hline 4 & 4 \checkmark \end{array}$$

To check your solution, substitute 14 for x in the original equation.

B $\frac{2}{5} = m - \frac{1}{5}$

$$\frac{2}{5} = m - \frac{1}{5}$$

$$\begin{array}{r} + \frac{1}{5} \quad + \frac{1}{5} \\ \frac{2}{5} = m - \frac{1}{5} \\ \hline \frac{3}{5} = m \end{array}$$

Since $\frac{1}{5}$ is subtracted from m , add $\frac{1}{5}$ to both sides to undo the subtraction.

Writing Math

Solutions are sometimes written in a *solution set*. For Example 1A, the solution set is $\{14\}$. For Example 1B, the solution set is $\{\frac{3}{5}\}$.



Solve each equation. Check your answer.

1a. $n - 3.2 = 5.6$

1b. $-6 = k - 6$

1c. $16 = m - 9$

Solving Equations by Using Subtraction

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Solve each equation. Check your answer.

A $x + 7 = 9$

$x + 7 = 9$

$$\begin{array}{r} -7 \quad -7 \\ x = 2 \end{array}$$

Since 7 is added to x , subtract 7 from both sides to undo the addition.

Check $x + 7 = 9$
$$\begin{array}{r|l} 2 + 7 & 9 \\ \hline 9 & 9 \checkmark \end{array}$$

To check your solution, substitute 2 for x in the original equation.

B $0.7 = r + 0.4$

$0.7 = r + 0.4$

$$\begin{array}{r} -0.4 \quad -0.4 \\ 0.3 = r \end{array}$$

Since 0.4 is added to r , subtract 0.4 from both sides to undo the addition.

Check $0.7 = r + 0.4$
$$\begin{array}{r|l} 0.7 & 0.3 + 0.4 \\ \hline 0.7 & 0.7 \checkmark \end{array}$$

To check your solution, substitute 0.3 for r in the original equation.

Solve each equation. Check your answer.

2a. $d + \frac{1}{2} = 1$

2b. $-5 = k + 5$

2c. $6 + t = 14$

Remember that subtracting is the same as adding the opposite. When solving equations, you will sometimes find it easier to add an opposite to both sides instead of subtracting. For example, this method may be useful when the equation contains negative numbers.

Solving Equations by Adding the Opposite

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Solve $-8 + b = 2$.

$-8 + b = 2$

$$\begin{array}{r} +8 \quad +8 \\ b = 10 \end{array}$$

Since -8 is added to b , add 8 to both sides.

Solve each equation. Check your answer.

3a. $-2.3 + m = 7$

3b. $-\frac{3}{4} + z = \frac{5}{4}$

3c. $-11 + x = 33$

Student to Student**Zero As a Solution****Ama Walker**

Carson High School

I used to get confused when I got a solution of 0. But my teacher reminded me that 0 is a number just like any other number, so it can be a solution of an equation. Just check your answer and see if it works.

$$\begin{array}{r} x + 6 = 6 \\ -6 \quad -6 \\ \hline x = 0 \end{array}$$

Check $x + 6 = 6$
$$\begin{array}{r|l} 0 + 6 & 6 \\ \hline 6 & 6 \checkmark \end{array}$$

4 Fitness Application

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A person's maximum heart rate is the highest rate, in beats per minute, that the person's heart should reach. One method to estimate maximum heart rate states that your age added to your maximum heart rate is 220. Using this method, write and solve an equation to find the maximum heart rate of a 15-year-old.

Age	added to	maximum heart rate	is	220.
-----	----------	--------------------	----	------

a	+	r	=	220
-----	---	-----	---	-----

$$a + r = 220$$

$$15 + r = 220$$

$$\underline{-15} \quad \underline{-15}$$

$$r = 205$$

Write an equation to represent the relationship.

Substitute 15 for a . Since 15 is added to r , subtract 15 from both sides to undo the addition.

The maximum heart rate for a 15-year-old is 205 beats per minute. Since age added to maximum heart rate is 220, the answer should be less than 220. So 205 is a reasonable answer.



- 4. What if...?** Use the method above to find a person's age if the person's maximum heart rate is 185 beats per minute.

The properties of equality allow you to perform inverse operations, as in the previous examples. These properties say that you can perform the same operation on both sides of an equation.

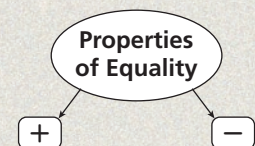
**Properties of Equality**

WORDS	NUMBERS	ALGEBRA
<p>Addition Property of Equality</p> <p>You can add the same number to both sides of an equation, and the statement will still be true.</p>	$3 = 3$ $3 + 2 = 3 + 2$ $5 = 5$	$a = b$ $a + c = b + c$
<p>Subtraction Property of Equality</p> <p>You can subtract the same number from both sides of an equation, and the statement will still be true.</p>	$7 = 7$ $7 - 5 = 7 - 5$ $2 = 2$	$a = b$ $a - c = b - c$

MCC.MP.3

MATHEMATICAL
PRACTICES**THINK AND DISCUSS**

- Describe how the Addition and Subtraction Properties of Equality are like a balanced scale.
- GET ORGANIZED** Copy and complete the graphic organizer. In each box, write an example of an equation that can be solved by using the given property, and solve it.





GUIDED PRACTICE

1. **Vocabulary** Will the *solution of an equation* such as $x - 3 = 9$ be a variable or a number? Explain.

Solve each equation. Check your answer.

SEE EXAMPLE 1

2. $s - 5 = 3$

3. $17 = w - 4$

4. $k - 8 = -7$

5. $x - 3.9 = 12.4$

6. $8.4 = y - 4.6$

7. $\frac{3}{8} = t - \frac{1}{8}$

SEE EXAMPLE 2

8. $t + 5 = -25$

9. $9 = s + 9$

10. $42 = m + 36$

11. $2.8 = z + 0.5$

12. $b + \frac{2}{3} = 2$

13. $n + 1.8 = 3$

SEE EXAMPLE 3

14. $-10 + d = 7$

15. $20 = -12 + v$

16. $-46 + q = 5$

17. $2.8 = -0.9 + y$

18. $-\frac{2}{3} + c = \frac{2}{3}$

19. $-\frac{5}{6} + p = 2$

SEE EXAMPLE 4

20. **Geology** In 1673, the Hope diamond was reduced from its original weight by about 45 carats, resulting in a diamond weighing about 67 carats. Write and solve an equation to find how many carats the original diamond weighed. Show that your answer is reasonable.

PRACTICE AND PROBLEM SOLVING

Independent Practice

For Exercises	See Example
21–30	1
31–40	2
41–48	3
49	4

Solve each equation. Check your answer.

21. $1 = k - 8$

22. $u - 15 = -8$

23. $x - 7 = 10$

24. $-9 = p - 2$

25. $\frac{3}{7} = p - \frac{1}{7}$

26. $q - 0.5 = 1.5$

27. $6 = t - 4.5$

28. $4\frac{2}{3} = r - \frac{1}{3}$

29. $6 = x - 3$

30. $1.75 = k - 0.75$

31. $19 + a = 19$

32. $4 = 3.1 + y$

33. $m + 20 = 3$

34. $-12 = c + 3$

35. $v + 2300 = -800$

36. $b + 42 = 300$

37. $3.5 = n + 4$

38. $b + \frac{1}{2} = \frac{1}{2}$

39. $x + 5.34 = 5.39$

40. $2 = d + \frac{1}{4}$

41. $-12 + f = 3$

42. $-9 = -4 + g$

43. $-1200 + j = 345$

44. $90 = -22 + a$

45. $26 = -4 + y$

46. $1\frac{3}{4} = -\frac{1}{4} + w$

47. $-\frac{1}{6} + h = \frac{1}{6}$

48. $-5.2 + a = -8$

49. **Finance** Luis deposited \$500 into his bank account. He now has \$4732. Write and solve an equation to find how much was in his account before the deposit. Show that your answer is reasonable.

50. **/// ERROR ANALYSIS ///** Below are two possible solutions to $x + 12.5 = 21.6$. Which is incorrect? Explain the error.

A

$x + 12.5 = 21.6$
$- 12.5 \quad - 12.5$
$x = 9.1$

B

$x + 12.5 = 21.6$
$+ 12.5 \quad + 12.5$
$x = 34.1$

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Online Extra Practice

Write an equation to represent each relationship. Then solve the equation.

51. Ten less than a number is equal to 12.
52. A number decreased by 13 is equal to 7.
53. Eight more than a number is 16.
54. A number minus 3 is -8 .
55. The sum of 5 and a number is 6.
56. Two less than a number is -5 .
57. The difference of a number and 4 is 9.



Geology

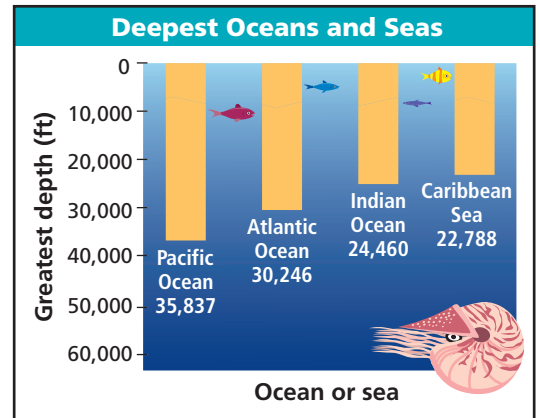


The ocean depths are home to many odd-looking creatures. The anglerfish pictured above, known as the common black devil, may appear menacing but reaches a maximum length of only about 5 inches.

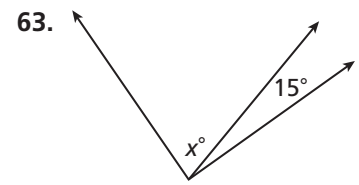
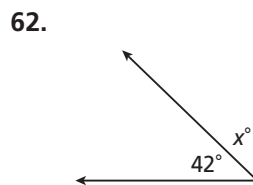
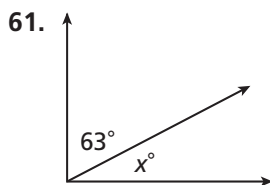
58. Geology The sum of the Atlantic Ocean's average depth (in feet) and its greatest depth is 43,126. Use the information in the graph to write and solve an equation to find the average depth of the Atlantic Ocean. Show that your answer is reasonable.

59. School Helene's marching band needs money to travel to a competition. Band members have raised \$560. They need to raise a total of \$1680. Write and solve an equation to find how much more they need. Show that your answer is reasonable.

60. Economics When you receive a loan to make a purchase, you often must make a down payment in cash. The amount of the loan is the purchase cost minus the down payment. Riva made a down payment of \$1500 on a used car. She received a loan of \$2600. Write and solve an equation to find the cost of the car. Show that your answer is reasonable.



Geometry The angles in each pair are complementary. Write and solve an equation to find each value of x . (*Hint: The measures of complementary angles add to 90° .*)



Real-World Connections



- 64. Rates** are often used to describe how quickly something is moving or changing.
- a. A wildfire spreads at a rate of 1000 acres per day. How many acres will the fire cover in 2 days? Show that your answer is reasonable.
 - b. How many acres will the fire cover in 5 days? Explain how you found your answer.
 - c. Another wildfire spread for 7 days and covered a total of 780 square miles. How can you estimate the number of square miles the fire covered per day?

65. **Statistics** The range of a set of scores is 28, and the lowest score is 47. Write and solve an equation to find the highest score. (*Hint:* In a data set, the range is the difference between the highest and the lowest values.) Show that your answer is reasonable.
- H.O.T.** 66. **Write About It** Describe a real-world situation that can be modeled by $x + 5 = 25$. Tell what the variable represents in your situation. Then solve the equation and tell what the solution means in the context of your problem.
- H.O.T.** 67. **Critical Thinking** Without solving, tell whether the solution of $-3 + z = 10$ will be greater than 10 or less than 10. Explain.

TEST PREP

68. Which situation is best represented by $x - 32 = 8$?
- (A) Logan withdrew \$32 from her bank account. After her withdrawal, her balance was \$8. How much was originally in her account?
- (B) Daniel has 32 baseball cards. Joseph has 8 fewer baseball cards than Daniel. How many baseball cards does Joseph have?
- (C) Room A contains 32 desks. Room B has 8 fewer desks. How many desks are in Room B?
- (D) Janelle bought a bag of 32 craft sticks for a project. She used 8 craft sticks. How many craft sticks does she have left?
69. For which equation is $a = 8$ a solution?
- (F) $15 - a = 10$ (G) $10 + a = 23$ (H) $a - 18 = 26$ (J) $a + 8 = 16$
70. **Short Response** Julianna used a gift card to pay for an \$18 haircut. The remaining balance on the card was \$22.
- a. Write an equation that can be used to determine the original value of the card.
- b. Solve your equation to find the original value of the card.

CHALLENGE AND EXTEND

Solve each equation. Check your answer.

71. $3\frac{1}{5} + b = \frac{4}{5}$ 72. $x - \frac{7}{4} = \frac{2}{3}$ 73. $x + \frac{7}{4} = \frac{2}{3}$ 74. $x - \frac{4}{9} = \frac{4}{9}$

75. If $p - 4 = 2$, find the value of $5p - 20$. 76. If $t + 6 = 21$, find the value of $-2t$.

77. If $x + 3 = 15$, find the value of $18 + 6x$. 78. If $2 + n = -11$, find the value of $6n$.

MATHEMATICAL
PRACTICES

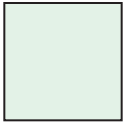

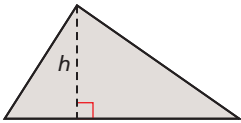
FOCUS ON MATHEMATICAL PRACTICES

- H.O.T.** 79. **Reasoning** Compare the equations $w + 3 = 65$ and $3 = w + 65$. How are the solutions related?
- H.O.T.** 80. **Make a Conjecture** Consider the equation $8 = 8$.
- a. How can you obtain the equation $3 = 3$ by using the Subtraction Property of Equality? How can you obtain the equation $3 = 3$ by using the Addition Property of Equality?
- b. Is the Subtraction Property of Equality ever *needed* to solve an equation? Explain.



Area of Composite Figures

Review the area formulas for squares, rectangles, and triangles in the table below.

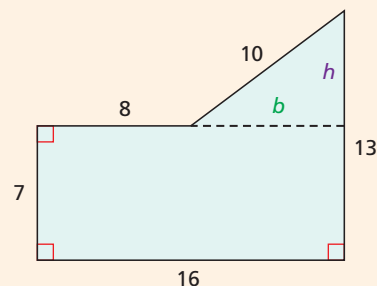
Squares	Rectangles	Triangles
 <p>$A = s^2$</p>	 <p>$A = \ell w$</p>	 <p>$A = \frac{1}{2}bh$</p>

A *composite figure* is a figure that is composed of basic shapes. You can divide composite figures into combinations of squares, rectangles, and triangles to find their areas.

Example

Find the area of the figure shown.

Divide the figure into a rectangle and a right triangle. Notice that you do not know the base or the height of the triangle. Use b and h to represent these lengths.



The bottom of the rectangle is 16 units long; the top of the rectangle is 8 units long plus the base of the triangle. Use this information to write and solve an equation.

$$\begin{array}{r} b + 8 = 16 \\ \underline{-8 \quad -8} \\ b = 8 \end{array}$$

The right side of the figure is 13 units long; 7 units from the rectangle plus the height of the triangle. Use this information to write and solve an equation.

$$\begin{array}{r} h + 7 = 13 \\ \underline{-7 \quad -7} \\ h = 6 \end{array}$$

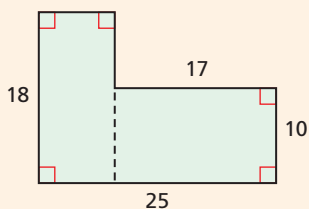
The area of the figure is the sum of the areas of the rectangle and the triangle.

$$\begin{aligned} &\begin{array}{l} \text{Area of rectangle} \\ \downarrow \\ \text{Area of triangle} \end{array} \\ A &= \ell w + \frac{1}{2}bh \\ A &= 16(7) + \frac{1}{2}(8)(6) \\ A &= 112 + 24 \\ A &= 136 \text{ square units} \end{aligned}$$

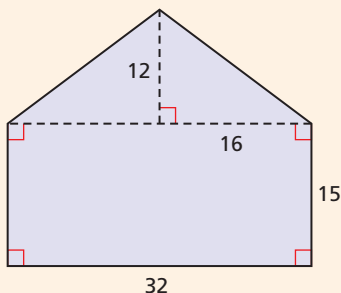
Try This

Find the area of each composite figure.

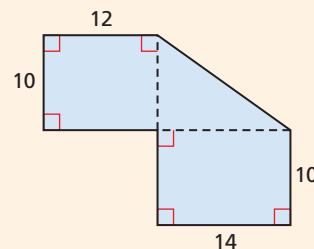
1.



2.



3.



1-3

Solving Equations by Multiplying or Dividing

Essential Question: How can you use multiplication or division to solve equations?

Objective

Solve one-step equations in one variable by using multiplication or division.

Who uses this?

Pilots can make quick calculations by solving one-step equations. (See Example 4.)



Solving an equation that contains multiplication or division is similar to solving an equation that contains addition or subtraction. Use inverse operations to undo the operations on the variable.

Remember that an equation is like a balanced scale. To keep the balance, whatever you do on one side of the equation, you must also do on the other side.

Inverse Operations

Multiply by x . \longleftrightarrow Divide by x .

COMMON CORE GPS

EXAMPLE

MCC9-12.A.REI.3

1

Solving Equations by Using Multiplication

Solve each equation. Check your answer.

$$\begin{aligned} \text{A} \quad -4 &= \frac{k}{-5} \\ (-5)(-4) &= (-5)\left(\frac{k}{-5}\right) \\ 20 &= k \end{aligned}$$

Since k is divided by -5 , multiply both sides by -5 to undo the division.

$$\begin{array}{r} \text{Check} \quad -4 = \frac{k}{-5} \\ -4 \quad \left| \quad \frac{20}{-5} \\ -4 \quad \left| \quad -4 \quad \checkmark \end{array}$$

To check your solution, substitute 20 for k in the original equation.

$$\begin{aligned} \text{B} \quad \frac{m}{3} &= 1.5 \\ (3)\left(\frac{m}{3}\right) &= (3)(1.5) \\ m &= 4.5 \end{aligned}$$

Since m is divided by 3, multiply both sides by 3 to undo the division.

$$\begin{array}{r} \text{Check} \quad \frac{m}{3} = 1.5 \\ \frac{4.5}{3} \quad \left| \quad 1.5 \\ 1.5 \quad \left| \quad 1.5 \quad \checkmark \end{array}$$

To check your solution, substitute 1.5 for m in the original equation.



Solve each equation. Check your answer.

1a. $\frac{p}{5} = 10$

1b. $-13 = \frac{y}{3}$

1c. $\frac{c}{8} = 7$

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Solving Equations by Using Division

Solve each equation. Check your answers.



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A $7x = 56$

$$\frac{7x}{7} = \frac{56}{7}$$

$$x = 8$$

Since x is multiplied by 7, divide both sides by 7 to undo the multiplication.

Check $7x = 56$

$$\begin{array}{r|l} 7(8) & 56 \\ \hline 56 & 56 \checkmark \end{array}$$

To check your solution, substitute 8 for x in the original equation.

B $13 = -2w$

$$\frac{13}{-2} = \frac{-2w}{-2}$$

$$-6.5 = w$$

Since w is multiplied by -2 , divide both sides by -2 to undo the multiplication.

Check $13 = -2w$

$$\begin{array}{r|l} 13 & -2(-6.5) \\ \hline 13 & 13 \checkmark \end{array}$$

To check your solution, substitute -6.5 for w in the original equation.

Solve each equation. Check your answer.

2a. $16 = 4c$

2b. $0.5y = -10$

2c. $15k = 75$

Remember that dividing is the same as multiplying by the reciprocal. When solving equations, you will sometimes find it easier to multiply by a reciprocal instead of dividing. This is often true when an equation contains fractions.

Solving Equations That Contain Fractions

Solve each equation.



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A $\frac{5}{9}v = 35$

$$\left(\frac{9}{5}\right)\frac{5}{9}v = \left(\frac{9}{5}\right)35$$

$$v = 63$$

The reciprocal of $\frac{5}{9}$ is $\frac{9}{5}$. Since v is multiplied by $\frac{5}{9}$, multiply both sides by $\frac{9}{5}$.

B $\frac{5}{2} = \frac{4y}{3}$

$$\frac{5}{2} = \frac{4y}{3}$$

$$\frac{5}{2} = \frac{4}{3}y$$

$$\left(\frac{3}{4}\right)\frac{5}{2} = \left(\frac{3}{4}\right)\frac{4}{3}y$$

$$\frac{15}{8} = y$$

 *$\frac{4y}{3}$ is the same as $\frac{4}{3}y$.**The reciprocal of $\frac{4}{3}$ is $\frac{3}{4}$. Since y is multiplied by $\frac{4}{3}$, multiply both sides by $\frac{3}{4}$.*

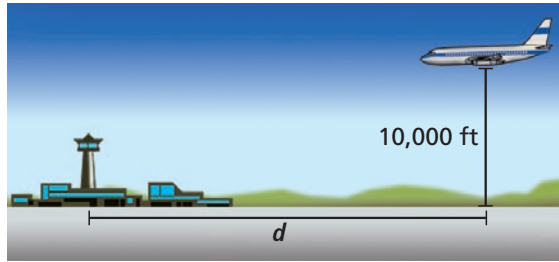
Solve each equation. Check your answer.

3a. $-\frac{1}{4} = \frac{1}{5}b$

3b. $\frac{4j}{6} = \frac{2}{3}$

3c. $\frac{1}{6}w = 102$

Aviation Application



The distance in miles from the airport that a plane should begin descending, divided by 3, equals the plane's height above the ground in thousands of feet. If a plane is 10,000 feet above the ground, write and solve an equation to find the distance at which the pilot should begin descending.

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Distance divided by 3 equals height in thousands of feet.

$$\frac{d}{3} = h$$

Write an equation to represent the relationship.

$$\frac{d}{3} = 10$$

Substitute 10 for h. Since d is divided by 3, multiply both sides by 3 to undo the division.

$$(3)\frac{d}{3} = (3)10$$

$$d = 30$$

The pilot should begin descending 30 miles from the airport.

Caution!
The equation uses the plane's height above the ground in *thousands* of feet. So substitute 10 for *h*, not 10,000.

- CHECK IT OUT!** 4. **What if...?** A plane began descending 45 miles from the airport. Use the equation above to find how high the plane was flying when the descent began.

You have now used four properties of equality to solve equations. These properties are summarized in the box below.



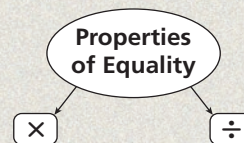
Properties of Equality

WORDS	NUMBERS	ALGEBRA
Addition Property of Equality You can add the same number to both sides of an equation, and the statement will still be true.	$3 = 3$ $3 + 2 = 3 + 2$ $5 = 5$	$a = b$ $a + c = b + c$
Subtraction Property of Equality You can subtract the same number from both sides of an equation, and the statement will still be true.	$7 = 7$ $7 - 5 = 7 - 5$ $2 = 2$	$a = b$ $a - c = b - c$
Multiplication Property of Equality You can multiply both sides of an equation by the same number, and the statement will still be true.	$6 = 6$ $6(3) = 6(3)$ $18 = 18$	$a = b$ $ac = bc$
Division Property of Equality You can divide both sides of an equation by the same nonzero number, and the statement will still be true.	$8 = 8$ $\frac{8}{4} = \frac{8}{4}$ $2 = 2$	$a = b$ $(c \neq 0)$ $\frac{a}{c} = \frac{b}{c}$

THINK AND DISCUSS



- Tell how the Multiplication and Division Properties of Equality are similar to the Addition and Subtraction Properties of Equality.
- GET ORGANIZED** Copy and complete the graphic organizer. In each box, write an example of an equation that can be solved by using the given property, and solve it.



1-3

Exercises



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Homework Help

GUIDED PRACTICE

Solve each equation. Check your answer.

SEE EXAMPLE 1

1. $\frac{k}{4} = 8$

2. $\frac{z}{3} = -9$

3. $-2 = \frac{w}{-7}$

4. $6 = \frac{t}{-5}$

5. $\frac{g}{1.9} = 10$

6. $2.4 = \frac{b}{5}$

SEE EXAMPLE 2

7. $4x = 28$

8. $-64 = 8c$

9. $-9j = -45$

10. $84 = -12a$

11. $4m = 10$

12. $2.8 = -2h$

SEE EXAMPLE 3

13. $\frac{1}{2}d = 7$

14. $15 = \frac{5}{6}f$

15. $\frac{2}{3}s = -6$

16. $9 = -\frac{3}{8}r$

17. $\frac{1}{10} = \frac{4}{5}y$

18. $\frac{1}{4}v = -\frac{3}{4}$

SEE EXAMPLE 4

19. **Recreation** The Baseball Birthday Batter Package at a minor league ballpark costs \$192. The package includes tickets, drinks, and cake for a group of 16 children. Write and solve an equation to find the cost per child.

20. **Nutrition** An orange contains about 80 milligrams of vitamin C, which is 10 times as much as an apple contains. Write and solve an equation to find the amount of vitamin C in an apple.

PRACTICE AND PROBLEM SOLVING

Solve each equation. Check your answer.

21. $\frac{x}{2} = 12$

22. $-40 = \frac{b}{5}$

23. $-\frac{j}{6} = 6$

24. $-\frac{n}{3} = -4$

25. $-\frac{q}{5} = 30$

26. $1.6 = \frac{d}{3}$

27. $\frac{v}{10} = 5.5$

28. $\frac{h}{8.1} = -4$

29. $5t = -15$

30. $49 = 7c$

31. $-12 = -12u$

32. $-7m = 63$

33. $-52 = -4c$

34. $11 = -2z$

35. $5f = 1.5$

36. $-8.4 = -4n$

Independent Practice

For Exercises	See Example
21–28	1
29–36	2
37–44	3
45	4



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Online Extra Practice

Solve each equation. Check your answer.

37. $\frac{5}{2}k = 5$ 38. $-9 = \frac{3}{4}d$ 39. $-\frac{5}{8}b = 10$ 40. $-\frac{4}{5}g = -12$
 41. $\frac{4}{7}t = -2$ 42. $-\frac{4}{5}p = \frac{2}{3}$ 43. $\frac{2}{3} = -\frac{1}{3}q$ 44. $-\frac{5}{8} = -\frac{3}{4}a$

45. **Finance** After taxes, Alexandra's take-home pay is $\frac{7}{10}$ of her salary before taxes. Write and solve an equation to find Alexandra's salary before taxes for the pay period that resulted in \$392 of take-home pay.
 46. **Earth Science** Your weight on the Moon is about $\frac{1}{6}$ of your weight on Earth. Write and solve an equation to show how much a person weighs on Earth if he weighs 16 pounds on the Moon. How could you check that your answer is reasonable?
 47. **///ERROR ANALYSIS///** For the equation $\frac{x}{3} = 15$, a student found the value of x to be 5. Explain the error. What is the correct answer?

Geometry The perimeter of a square is given. Write and solve an equation to find the length of each side of the square.

48. $P = 36$ in. 49. $P = 84$ in. 50. $P = 100$ yd 51. $P = 16.4$ cm

Write an equation to represent each relationship. Then solve the equation.

52. Five times a number is 45.
 53. A number multiplied by negative 3 is 12.
 54. A number divided by 4 is equal to 10.
 55. The quotient of a number and 3 is negative 8.
 56. **Statistics** The mean height of the students in Marta's class is 60 in. There are 18 students in her class. Write and solve an equation to find the total measure of all students' heights. (*Hint:* The mean is found by dividing the sum of all data values by the number of data values.)
 57. **Finance** Lisa earned \$6.25 per hour at her after-school job. Each week she earned \$50. Write and solve an equation to show how many hours she worked each week.
 58. **Critical Thinking** Will the solution of $\frac{x}{2.1} = 4$ be greater than 4 or less than 4? Explain.
 59. **Consumer Economics** Dion's long-distance phone bill was \$13.80. His long-distance calls cost \$0.05 per minute. Write and solve an equation to find the number of minutes he was charged for. Show that your answer is reasonable.
 60. **Nutrition** An 8 oz cup of coffee has about 184 mg of caffeine. This is 5 times as much caffeine as in a 12 oz soft drink. Write and solve an equation to find about how much caffeine is in a 12 oz caffeinated soft drink. Round your answer to the nearest whole number. Show that your answer is reasonable.



Statistics



American Robert P. Wadlow (1918–1940) holds the record for world's tallest man—8 ft 11.1 in. He also holds world records for the largest feet and hands.

Source: Guinness World Records 2005

Use the equation $8y = 4x$ to find y for each value of x .

	x	$4x$	$8y = 4x$	y
61.	-4	$4(-4) = -16$	$8y = -16$	■
62.	-2	■	■	■
63.	0	■	■	■
64.	2	■	■	■

Real-World Connections



65. a. The formula for the mean of a data set is $\text{mean} = \frac{\text{sum of data values}}{\text{number of data values}}$. One summer, there were 1926 wildfires in Arizona. Which value does this number represent in the formula?
- b. The mean number of acres burned by each wildfire was 96.21. Which value does this number represent in the formula?
- c. Use the formula and information given to find how many acres were burned by wildfires in Arizona that summer. Round your answer to the nearest acre. Show that your answer is reasonable.

Solve each equation. Check your answer.

66. $\frac{m}{6} = 1$ 67. $4x = 28$ 68. $1.2h = 14.4$ 69. $\frac{1}{5}x = 121$
70. $2w = 26$ 71. $4b = \frac{3}{4}$ 72. $5y = 11$ 73. $\frac{n}{1.9} = 3$

Biology Use the table for Exercises 74 and 75.

Average Weight			
Animal	At Birth (g)	Adult Female (g)	Adult Male (g)
Hamster	2	130	110
Guinea pig	85	800	1050
Rat	5	275	480

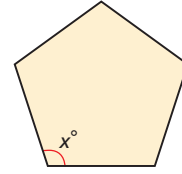


74. The mean weight of an adult male rat is 16 times the mean weight of an adult male mouse. Write and solve an equation to find the mean weight of an adult male mouse. Show that your answer is reasonable.
75. On average, a hamster at birth weighs $\frac{2}{3}$ the weight of a gerbil at birth. Write and solve an equation to find the average weight of a gerbil at birth. Show that your answer is reasonable.
- H.O.T.** 76. **Write About It** Describe a real-world situation that can be modeled by $3x = 42$. Solve the equation and tell what the solution means in the context of your problem.

TEST PREP

77. Which situation does NOT represent the equation $\frac{d}{2} = 10$?
- (A) Leo bought a box of pencils. He gave half of them to his brother. They each got 10 pencils. How many pencils were in the box Leo bought?
- (B) Kasey evenly divided her money from baby-sitting into two bank accounts. She put \$10 in each account. How much did Kasey earn?
- (C) Gilbert cut a piece of ribbon into 2-inch strips. When he was done, he had ten 2-inch strips. How long was the ribbon to start?
- (D) Mattie had 2 more CDs than her sister Leona. If Leona had 10 CDs, how many CDs did Mattie have?
78. Which equation below shows a correct first step for solving $3x = -12$?
- (F) $3x + 3 = -12 + 3$ (H) $3(3x) = 3(-12)$
- (G) $3x - 3 = -12 - 3$ (J) $\frac{3x}{3} = \frac{-12}{3}$

79. In a regular pentagon, all of the angles are equal in measure. The sum of the angle measures is 540° . Which of the following equations could be used to find the measure of each angle?



- (A) $\frac{x}{540} = 5$ (C) $540x = 5$
 (B) $5x = 540$ (D) $\frac{x}{5} = 540$

80. For which equation is $m = 10$ a solution?

- (F) $5 = 2m$ (G) $5m = 2$ (H) $\frac{m}{2} = 5$ (J) $\frac{m}{10} = 2$

81. **Short Response** Luisa bought 6 cans of cat food that each cost the same amount. She spent a total of \$4.80.

- Write an equation to determine the cost of one can of cat food. Tell what each part of your equation represents.
- Solve your equation to find the cost of one can of cat food. Show each step.

CHALLENGE AND EXTEND

Solve each equation. Check your answer.

82. $\left(3\frac{1}{5}\right)b = \frac{4}{5}$ 83. $\left(1\frac{1}{3}\right)x = 2\frac{2}{3}$ 84. $\left(5\frac{4}{5}\right)x = -52\frac{1}{5}$
 85. $\left(-2\frac{9}{10}\right)k = -26\frac{1}{10}$ 86. $\left(1\frac{2}{3}\right)w = 15\frac{1}{3}$ 87. $\left(2\frac{1}{4}\right)d = 4\frac{1}{2}$

Find each indicated value.

88. If $2p = 4$, find the value of $6p + 10$. 89. If $6t = 24$, find the value of $-5t$.
 90. If $3x = 15$, find the value of $12 - 4x$. 91. If $\frac{n}{2} = -11$, find the value of $6n$.
 92. To isolate x in $ax = b$, what should you divide both sides by?
 93. To isolate x in $\frac{x}{a} = b$, what operation should you perform on both sides of the equation?
H.O.T. 94. **Travel** The formula $d = rt$ gives the distance d that is traveled at a rate r in time t .
 a. If $d = 400$ and $r = 25$, what is the value of t ?
 b. If $d = 400$ and $r = 50$, what is the value of t ?
 c. **What if...?** How did t change when r increased from 25 to 50?
 d. **What if...?** If r is doubled while d remains the same, what is the effect on t ?

MATHEMATICAL PRACTICES

FOCUS ON MATHEMATICAL PRACTICES

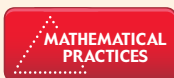
- H.O.T.** 95. **Problem Solving** Teo did not know how many ounces of liquid his rice cooker cup would hold. He used the cup to put an entire 32-oz container of broth into the cooker, filling the cup $5\frac{1}{3}$ times. How much liquid does the cup hold?
H.O.T. 96. **Communication** Suppose a and b are any nonzero numbers. Solve the equations $\frac{1}{a}x = b$ and $\frac{1}{b}x = a$ for x . Are the solutions the same? Provide an example that supports your answer.
H.O.T. 97. **Number Sense** Write four equations that each have a solution of 0 and that are solved by using a different property of equality.

1-3 Technology TASK

Solve Equations by Graphing

You can use graphs to solve equations. As you complete this activity, you will learn some of the connections between graphs and equations.

Use with Solving Equations by Multiplying or Dividing



Use appropriate tools strategically.

MCC9-12.A.REI.11 Explain why the x -coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, ... * Also **MCC9-12.A.REI.3**

Activity

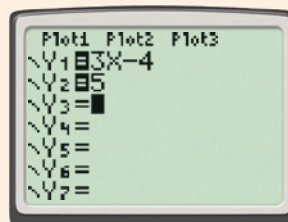
Solve $3x - 4 = 5$.

- 1 Press **Y=**. In Y_1 , enter the left side of the equation, $3x - 4$.

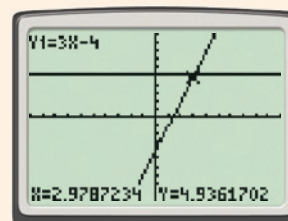
Y= 3 **X,T,0,n** - 4 **ENTER**

In Y_2 , enter the right side of the equation, 5.

Y= 5 **ENTER**

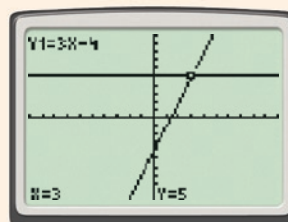


- 2 Press **GRAPH**. Press **TRACE**. The display will show the x - and y -values of a point on the first line. Press the right arrow key several times. Notice that the x - and y -values change.



- 3 Continue to trace as close as possible to the intersection of the two lines. The x -value of this point 2.9787..., is an approximation of the solution. The solution is about 3.

- 4 While still in trace mode, to check, press **3** **ENTER**. The display will show the y -value when $x = 3$. When $x = 3$, $y = 5$. So 3 is the solution. You can also check this solution by substituting 3 for x in the equation:



Check

$$\begin{array}{r|l} 3x - 4 = 5 & \\ 3(3) - 4 & 5 \\ 9 - 4 & 5 \\ 5 & 5 \checkmark \end{array}$$

Try This

- Solve $3x - 4 = 2$, $3x - 4 = 17$, and $3x - 4 = -7$ by graphing.
- What does each line represent?
- Describe a procedure for finding the solution of $3x - 4 = y$ for any value of y .
- Solve $\frac{1}{2}x - 7 = -4$, $\frac{1}{2}x - 7 = 0$, and $\frac{1}{2}x - 7 = 2$ by graphing.

Ready to Go On?



1-1 Variables and Expressions

Give two ways to write each algebraic expression in words.

1. $4 + n$
2. $m - 9$
3. $\frac{g}{2}$
4. $4z$
5. Grapes cost \$1.99 per pound. Write an expression for the cost of g pounds of grapes.
6. Today's temperature is 3 degrees warmer than yesterday's temperature t . Write an expression for today's temperature.

Evaluate each expression for $p = 5$ and $q = 1$.

7. qp
8. $p \div q$
9. $q + p$
10. Each member of the art club will make the same number of posters to advertise their club. They will make 150 posters total. Write an expression for how many posters each member will make if there are m members. Find how many posters each member will make if there are 5, 6, and 10 members.

1-2 Solving Equations by Adding or Subtracting

Solve each equation.

11. $x - 32 = -18$
12. $1.1 = m - 0.9$
13. $j + 4 = -17$
14. $\frac{9}{8} = g + \frac{1}{2}$

Solve each equation. Check your answer.

15. $b - 16 = 20$
16. $4 + x = 2$
17. $9 + a = -12$
18. $z - \frac{1}{4} = \frac{7}{8}$

19. When she first purchased it, Soledad's computer had 400 GB of hard drive space. After six months, there were only 313 GB available. Write and solve an equation to find the amount of hard drive space that Soledad used in the first six months.
20. Robin needs 108 signatures for her petition. So far, she has 27. Write and solve an equation to determine how many more signatures she needs.

1-3 Solving Equations by Multiplying or Dividing

Solve each equation.

21. $\frac{h}{3} = -12$
22. $-2.8 = \frac{w}{-3}$
23. $42 = 3c$
24. $-0.1b = 3.7$

Solve each equation. Check your answer.

25. $35 = 5x$
26. $-30 = \frac{n}{3}$
27. $5y = 0$
28. $-4.6r = 9.2$
29. A fund-raiser raised \$2400, which was $\frac{3}{5}$ of the goal. Write and solve an equation to find the amount of the goal.

Selected Response

- Give two ways to write the algebraic expression $p \div 10$ in words.
 - (A) the product of p and 10; p times 10
 - (B) the quotient of p and 10; p divided by 10
 - (C) the quotient of 10 and p ; 10 divided by p
 - (D) p subtracted from 10; p less than 10
- Julia wrote 14 letters to friends each month for y months in a row. Write an expression to show how many total letters Julia wrote.
 - (F) $14y$
 - (G) $14 + y$
 - (H) $14 - y$
 - (J) $\frac{14}{y}$
- Solve $p - 6 = 16$. Check your answer.
 - (A) $p = 22$
 - (B) $p = -22$
 - (C) $p = 10$
 - (D) $p = -10$
- Solve $\frac{q}{5} = 41$. Check your answer.
 - (F) $q = 8\frac{1}{5}$
 - (G) $q = 36$
 - (H) $q = 205$
 - (J) $q = 46$
- Salvador's class has collected 88 cans in a food drive. They plan to sort the cans into x bags, with an equal number of cans in each bag. Write an expression to show how many cans there will be in each bag.
 - (A) $88 - x$
 - (B) $88x$
 - (C) $88 + x$
 - (D) $\frac{88}{x}$
- Evaluate the expression xy for $x = 6$ and $y = 3$.
 - (F) 9
 - (G) 24
 - (H) 18
 - (J) 21
- Evaluate the expression $a \div b$ for $a = 24$ and $b = 8$.
 - (A) 3
 - (B) 4
 - (C) 16
 - (D) 192
- Evaluate the expression $2m + n$ for $m = 7$ and $n = 9$.
 - (F) 25
 - (G) 18
 - (H) 23
 - (J) 32
- The range of a set of scores is 23, and the lowest score is 33. Write and solve an equation to find the highest score. (*Hint:* In a data set, the range is the difference between the highest and the lowest values.)
 - (A) $h - 33 = 2 \cdot 23$ The highest score is 79.
 - (B) $h + 23 = 33$ The highest score is 10.
 - (C) $h + 33 = 23$ The highest score is -10 .
 - (D) $h - 33 = 23$ The highest score is 56.
- The time between a flash of lightning and the sound of its thunder can be used to estimate the distance from a lightning strike. The distance from the strike is the number of seconds between seeing the flash and hearing the thunder divided by 5. Suppose you are 17 miles from a lightning strike. Write and solve an equation to find how many seconds there would be between the flash and thunder.
 - (F) $\frac{5}{t} = d$, so t is about 0.3 seconds.
 - (G) $t = \frac{d}{5}$, so t is about 3.4 seconds.
 - (H) $t - 5 = d$, so t is about 22 seconds.
 - (J) $\frac{t}{5} = d$, so t is about 85 seconds.
- If $4x = 32$, find the value of $35 - 5x$.
 - (A) -5
 - (B) 3
 - (C) -3
 - (D) 5

Mini-Task

- Fatima enrolled in a traveler rewards program. She begins with 10,000 bonus points. For every trip she takes, she collects 3000 bonus points.
 - a. Write a rule for the number of bonus points Fatima has after x trips.
 - b. Make a table showing the number of bonus points Fatima has after 0, 1, 2, 3, 4, and 5 trips.
 - c. When Fatima has collected 20,000 bonus points, she gets a free vacation. How many trips does Fatima need to take to get a free vacation?