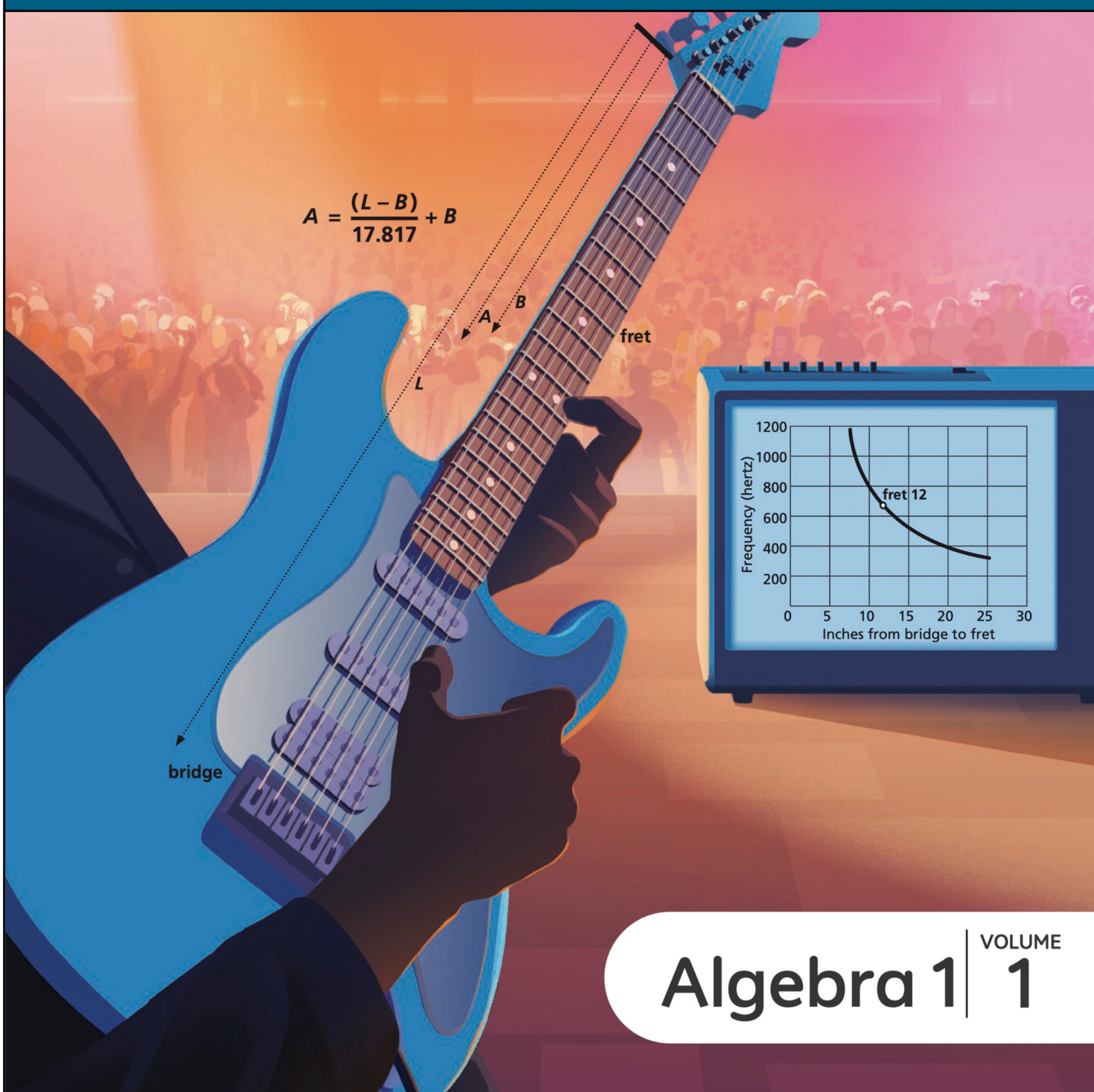
TRY IT NOW
LESSON SAMPLER

HMH Into Math®

STUDENT EDITION



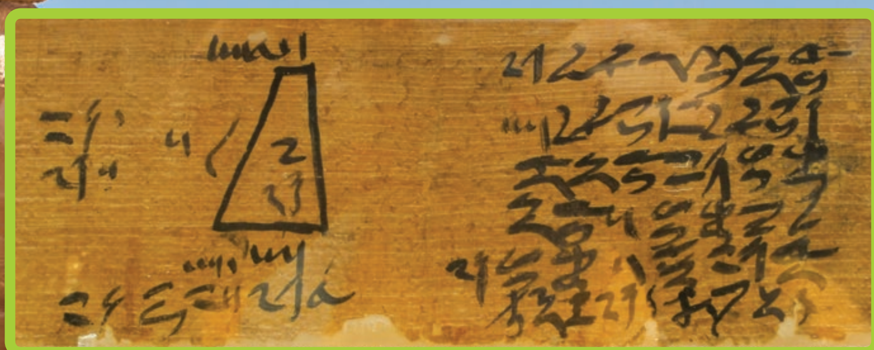
Algebra 1 | VOLUME 1

Ruins of the ancient Egyptian Temple of Hibis

Egyptians used logic to solve simple math problems.

How do we know what math ancient Egyptians knew?

The ancient Egyptian empire prospered over three thousand years ago! Many documents written by the ancient Egyptians have been lost to time. The remaining documents are difficult to read because parts have faded or disintegrated. The parts that are readable are written in hieroglyphics, an ancient written language. Scholars have worked for decades to analyze these documents to figure out what math ancient Egyptians knew!



Fragment of the Moscow Mathematical Papyrus

The Moscow Mathematical Papyrus is one of several surviving Egyptian scrolls that shows ancient Egyptian knowledge of math. It includes calculations of area and volume of two- and three-dimensional shapes. It also contains some of the earliest solutions to linear equations. These problems are called *aha* problems and represent problems where an unknown quantity is found when the sum of the quantity and parts of the quantity are given. Do you think there is more to discover about ancient Egyptian math?

A photo of the Pushkin Museum of Fine Arts in Moscow, Russia

Turn & Talk Egyptians did not use the same symbols for math as we use today. What knowledge do you think scholars needed to understand the Moscow Mathematical Papyrus?

Name ______________________________

Prerequisite Check

Complete these problems to review prior concepts and skills you will need for this module.

Solve Two-Step Equations

Solve each equation.

1. $5c - 7 = 18$

$c =$ ______

2. $52 = 7 + 5y$

$y =$ ______

3. $\frac{2}{3}k + \frac{5}{6} = \frac{7}{2}$

$k =$ ______

4. $-3m + 4.2 = 1.8$

$m =$ ______

Write Two-Step Inequalities

Write an inequality to model each situation.

5. Sasha has two 8-foot sections of prebuilt fencing left over from a previous fencing project. She plans to buy *s* 6-foot sections of fencing so that she will have more than 40 feet of fencing.

6. Vijay has loaded 35 pounds of soil onto a cart. He will add *b* bricks that each weigh 4 pounds, but he does not want to exceed a total weight of 100 pounds in the cart.

7. Ana is baking cookies for a cookie exchange. She will bake 1 dozen cookies at a time in each of *b* batches and place them in bags of 2 cookies each. She wants to take at least 60 cookies to the exchange.

Solve Two-Step Inequalities

Find the solution for each two-step inequality.

8. $2x - 1 \geq 9$

$x \geq$ ______

9. $\frac{x-4}{5} > 8$

$x >$ ______

10. $-3x + 6 < -15$

$x >$ ______

11. $\frac{x+3}{4} \leq -2$

$x \leq$ ______

Name ____________________

Lesson 2.1

Solve Linear Equations in One Variable

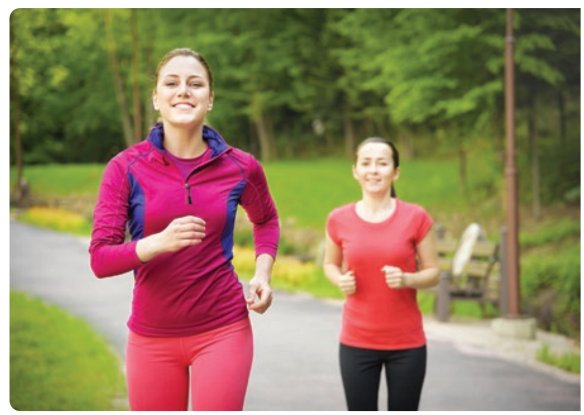
Learning Goal

I can use the properties of equality and the Distributive Property to solve an equation with the variable on both sides.

Rate yourself on this learning goal:

◯ **I don't understand.** ◯ **I need more practice.** ◯ **I've got it.**

Spark Your Learning



Lynn and Anna are joggers who use the same running trail. Lynn starts jogging on the trail at 4:00 p.m. She jogs at an average speed of 5.4 miles per hour. Anna starts jogging from the same location and in the same direction as Lynn but at 4:06 p.m. Anna jogs at an average speed of 6.0 miles per hour.

At what time will Anna catch up with Lynn? Explain your reasoning.

Show your thinking.

Turn & Talk

Predict how your answer would change for each of the following changes in the situation:

- Anna starts jogging 3 minutes earlier.
- Lynn's average jogging speed is 0.2 mile per hour faster.
- Lynn and Anna jog at the same constant speed.

Investigate Properties of Equality

Solving an equation involves using properties of equality to write simpler **equivalent equations**, which all have the same solution of an equation in one variable as the original equation. In the Symbols column of the table shown, a, b, and c are real numbers.

Vocabulary

A **solution of an equation in one variable** is a number that when substituted for the variable in the equation produces a true statement.

Properties of Equality

Property	Words	Symbols
Addition Property of Equality	Adding the same number to both sides of an equation produces an equivalent equation.	If $a = b$, then $a + c = b + c$. **Example:** If $x - 2 = 3$, then $x - 2 + \mathbf{2} = 3 + \mathbf{2}$.
Subtraction Property of Equality	Subtracting the same number from both sides of an equation produces an equivalent equation.	If $a = b$, then $a - c = b - c$. **Example:** If $x + 4 = -1$, then $x + 4 - \mathbf{4} = -1 - \mathbf{4}$.
Multiplication Property of Equality	Multiplying both sides of an equation by the same nonzero number produces an equivalent equation.	If $a = b$ and $c \neq 0$, then $ac = bc$. **Example:** If $\frac{x}{3} = 2$, then $\frac{x}{3} \cdot \mathbf{3} = 2 \cdot \mathbf{3}$.
Division Property of Equality	Dividing both sides of an equation by the same nonzero number produces an equivalent equation.	If $a = b$ and $c \neq 0$. then $\frac{a}{c} = \frac{b}{c}$. **Example:** If $-2.5x = 10$, then $\frac{-2.5x}{\mathbf{-2.5}} = \frac{10}{\mathbf{-2.5}}$.

Task 1

Using a spreadsheet, create a table like the one shown for the equation $x = -1$. The formula in cell B2 is an if-then-else statement that checks the value in cell A2.

B2 | f_x | = IF(A2 = −1,"YES", "NO")

	A	B	C	D	E
1	*x*	Is *x* a solution?			
2	−3	NO			
3	−2				
4	−1				
5	0				
6	1				
7	2				
8	3				

If the number in cell A2 equals −1, then the word YES is shown in cell B2. Otherwise, the word NO is shown in cell B2.

A. Fill down the formula from cell B2 to cell B8. What do you observe?

B. Suppose you use the Multiplication Property of Equality to rewrite the equation $x = -1$ as $2x = -2$. Use the new equation in the if-then-else statements you enter in cells C2 through C8. What do you observe?

Task 1, *CONTINUED* →

Name ____________________

Task 1, *CONTINUED*

C. Suppose you use the Addition Property of Equality to rewrite the equation $2x = -2$ as $2x + 3 = 1$. Use the new equation in the if-then-else statements you enter in cells D2 through D8. What do you observe?

Turn & Talk You used properties of equality to build the equation $2x + 3 = 1$ from $x = -1$. How can you use properties of equality to solve the equation $2x + 3 = 1$?

Solve Equations Using the Distributive Property

Previously, you solved one-step and two-step equations. Now you will solve multistep equations. Such equations may contain grouping symbols. In order to free the terms in an equation that contains grouping symbols, you can use the Distributive Property.

Task 2

MP Use Structure The steps for solving the equation $5(2x - 3) + 4 = -6$ and checking the solution are shown, but the steps have been scrambled.

A. Complete the solution steps in the correct order. Step 1 is already placed.

Step 1 $5(2x - 3) + 4 = -6$

Step 2 ____________________

Step 3 $10x - 11 = -6$

Step 4 ____________________

Step 5 ____________________

B. Complete the check steps in the correct order. Step 1 is already placed.

Step 1 $5(2(0.5) - 3) + 4 = -6$

Step 2 $5(1 - 3) + 4 = -6$

Step 3 ____________________

Step 4 ____________________

Step 5 $-6 = -6$

Turn & Talk Can you solve the equation $5(2x - 3) + 4 = -6$ *without* using the Distributive Property as one of the steps? Show how or explain why not.

Task 3

Recall that the Distributive Property also allows you to combine like terms.

MP **Use Structure** The steps for solving the equation $-2x + \frac{1}{2}(6x - 5) = \frac{3}{2}$ are shown, but some justifications are missing.

$-2x + \frac{1}{2}(6x - 5) = \frac{3}{2}$	Given equation
$-2x + 3x - \frac{5}{2} = \frac{3}{2}$	______?
$(-2 + 3)x - \frac{5}{2} = \frac{3}{2}$	______?
$x - \frac{5}{2} = \frac{3}{2}$	Simplify the coefficient of *x*.
$x = 4$	______?

A. Which property justifies rewriting $\frac{1}{2}(6x - 5)$ as $3x - \frac{5}{2}$?

B. Which property justifies rewriting $-2x + 3x$ as $(-2 + 3)x$?

C. Which property justifies adding $\frac{5}{2}$ to each side of the equation?

Turn & Talk Is it possible to eliminate the fractions as a first step in solving the equation $-2x + \frac{1}{2}(6x - 5) = \frac{3}{2}$? Show how or explain why not.

Solve Equations with a Variable on Both Sides

When a variable appears on both sides of an equation, you can use the Addition Property of Equality or the Subtraction Property of Equality to move the variable from one side to the other. Doing so allows you to isolate the variable on one side.

Task 4

MP **Use Structure** The steps for solving the equation $4(x + 1) + 1 = -3(x + 3)$ are shown, but some justifications are missing.

$4(x + 1) + 1 = -3(x + 3)$	Given equation
$4x + 4 + 1 = -3x - 9$	______?
$4x + 5 = -3x - 9$	Combine constants.
$4x + 5 + 3x = -3x - 9 + 3x$	______?

Task 4, *CONTINUED* →

Name ______________________________

Task 4, *CONTINUED*

$7x + 5 = -9$	Combine like terms.
$7x = -14$	______?
$x = -2$	Division Property of Equality

A. Which property lets you rewrite each side without grouping symbols?

B. Which property justifies adding $3x$ to each side?

C. Which property justifies subtracting 5 from each side?

Turn & Talk How is solving $4(x + 1) + 1 = 4(x + 3)$ different from solving $4(x + 1) + 1 = -3(x + 3)$? What is different about solving $4(x + 1) + 8 = 4(x + 3)$?

Use an Equation to Solve a Real-World Problem

When solving a real-world problem, you may have to use a formula, such as the formula $P = 2\ell + 2w$ for the perimeter of a rectangle or the formula $d = rt$ for the distance traveled at a constant rate. When using a formula, you should pay attention to the units of measurement associated with the variables to ensure that the units are consistent.

Perimeter ?	$= 2 \bullet$	Length (meters)	$+ 2 \bullet$	Width ?

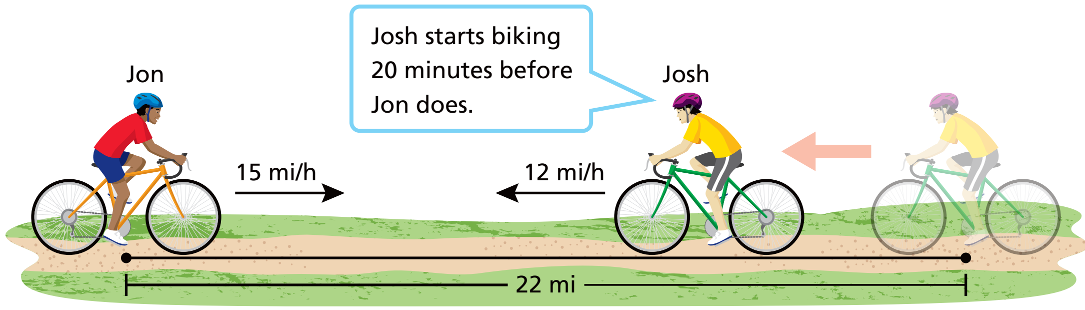
Since the length is in meters, the width must also be in meters so you can add the units on the right side. This means the perimeter is in meters because meters + meters + meters.

Distance (feet)	$=$	Rate ?	$\bullet$	Time (seconds)

For the units to be consistent in this equation, the rate must be measure in *feet per second* and not, for example, *miles per hour*.

Task 5

MP Model with Mathematics Two friends, Jon and Josh, live at opposite ends of a trail. They bike toward each other at the speeds shown. At what distance along the trail, measured from Jon's starting point, will the two friends meet?



A. Describe the relationship between the distances traveled by the cyclists and the total distance.

B. Express the distance in terms of time. Let t represent the time in *hours* that Jon spends biking. Why is the expression $t + \frac{1}{3}$ and not $t + 20$?

Jon's distance (mi)				Josh's distance (mi)				
Jon's rate (mi/h)	•	Jon's time (h)	+	Josh's rate (mi/h)	•	Josh's time (h)	=	Distance (mi)
15		***t***		**12**		$t + \frac{1}{3}$		**22**

Task 5, CONTINUED →

Name

Task 5, *CONTINUED*

C. Use the information in the equation and the solution to answer the question.

Write an equation.

$15t + 12\left(t + \frac{1}{3}\right) = 22$

Solve the equation.

$15t + 12\left(t + \frac{1}{3}\right) = 22$	Given equation.
$15t + 12t + 4 = 22$	Distributive Property
$27t + 4 = 22$	Combine like terms.
$27t = 18$	Subtraction Property of Equality
$t = \frac{2}{3}$	Division Property of Equality

Answer the question.

The two friends will meet at a distance of $15\left(\frac{2}{3}\right) =$ _____ miles from Jon's starting point on the trail.

Turn & Talk Suppose the trail in this task is only 3 miles long. Write and solve a new equation to find the time Jon spends biking. Does your solution make sense? Explain.

Review Spark Your Learning

Think about how you solved the Spark Your Learning at the beginning of the session. How would you find out when Anna catches up with Lynn now? What steps would you take that would be different from the way you solved the problem at the beginning?

Quick Check

1. Which two of the equations are equivalent? Explain your reasoning.

$2x + 7 = 1$ $\quad -3x + 4 = 12$ $\quad x = -3$

______________ and ______________ because both equations have

______________ solution(s).

2. Solve the equation $6(2x - 5) - 8 = 4$ and give a justification for one step.

A. $x =$ __________

B. For the first step, use the ______________ Property to get $12x - 30 - 8 = 4$.

3. Solve the equation $\frac{1}{2}(4x - 3) = \frac{3}{4}(4x - 5)$ and give a justification for one step.

A. $x =$ __________

B. For the solution step between $8x - 6 = 12x - 15$ and $9 = 4x$,

use the ______________ Property of Equality and the

______________ Property of Equality.

4. The local art center sells two types of memberships each year. The premium membership is $90, and the regular membership is $60. The center wants to sell a total of 100 memberships. How many premium memberships must the center sell in order to earn $7260 in membership sales?

______ premium memberships

Learning Goal

I can use the properties of equality and the Distributive Property to solve an equation with the variable on both sides.

Rate yourself on this learning goal:

○ **I don't understand.** ○ **I need more practice.** ○ **I've got it.**

Pause for your next steps.

Name ______________________________

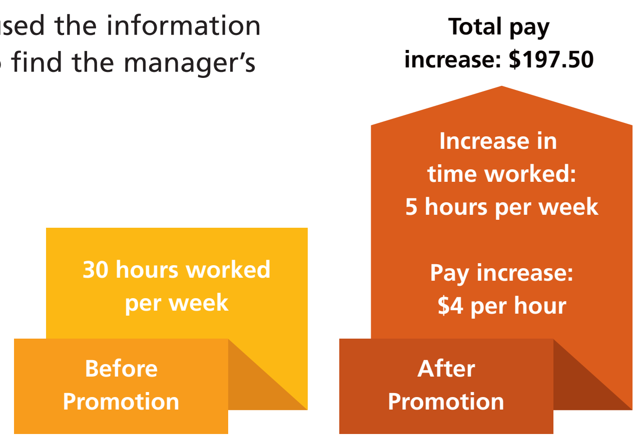
Practice on Your Own

1. Mark solved the equation $\frac{2}{3}x = 9$ by using the Division Property of Equality to get $x = 6$. Did Mark solve the equation correctly? Explain why or why not.

Mark ______________ solve the equation correctly. He ________

9 by $\frac{2}{3}$ instead of ______________ 9 by $\frac{2}{3}$.

2. MP **Model with Mathematics** Melissa used the information shown and the guess and check method to find the manager's new pay rate after being promoted.



A. Melissa's work is shown in the table. Explain how she can generalize what she has done by defining a variable and then writing and solving an equation using that variable.

New pay rate guess	Calculated new weekly pay	Calculated old weekly pay	Calculated increase in weekly pay
\$12.00 per hour	35(\$12.00) = \$420.00	30(\$12.00 − \$4.00) = \$240.00	\$420.00 − \$240.00 = \$180.00 ✗
\$15.00 per hour	35(\$15.00) = \$525.00	30(\$15.00 − \$4.00) = \$330.00	\$525.00 − \$330.00 = \$195.00 ✗
\$16.00 per hour	35(\$16.00) = \$560.00	30(\$16.00 − \$4.00) = \$360.00	\$560.00 − \$360.00 = \$200.00 ✗
\$15.50 per hour	35(\$15.50) = \$542.50	30(\$15.50 − \$4.00) = \$345.00	\$542.50 − \$345.00 = \$197.50 ✓

Let p represent the manager's new pay rate. Then, in terms of p,

______________ represents the manager's old pay rate;

_____ p – 30 ______________ = \$______________.

The solution to this equation is p = \$______________ per hour.

B. Suppose the question had been, "What was the manager's old pay rate?" Define the variable in a way that will answer this question. Then write and solve a new equation to show that you get a solution that is consistent with the one from Part A.

Let the variable p represent the manager's old pay rate. Then $p + 4$ represents the manager's new pay rate.

35 ________ $-$ ________

$p =$ \$________. The solution to this equation is

$p =$ \$________ per hour.

Solve the equation.

3. $4(3x - 10) + 7 = 15$

$x =$ ______

4. $6 - 5(2x + 1) = 21$

$x =$ ______

5. $2 - \frac{3}{4}(8x - 6) = 11$

$x =$ ______

6. $0.2(4 - 5x) + 1 = 2.4$

$x =$ ______

7. $5(x + 1) - 2(3x - 4) = 14$

$x =$ ______

8. $2(5 - x) + 3(4x - 1) = -6$

$x =$ ______

9. $4x - 3 = 7x + 6$

$x =$ ______

10. $-2x + 5 = 3x + 1$

$x =$ ______

11. $5(2x + 3) - 7 = -2(x + 2)$

$x =$ ______

12. $8 - 3(2x - 5) = 4(x + 2)$

$x =$ ______

13. $0.4(2x + 3) = 0.3x + 0.8$

$x =$ ______

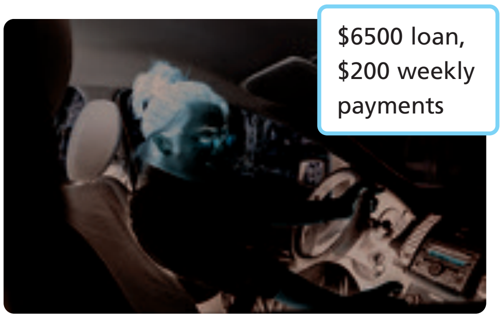
14. $\frac{1}{2}(6x - 5) = x - \frac{3}{2}$

$x =$ ______

Name ________________________________

15. Kiera recently bought a used car from a relative, who agreed to let her pay for the car over time. She also borrowed money from her parents for a summer internship in Washington, D.C. She is paying off both loans in equal weekly payments. Use the information to determine how many weeks it take for the balances of the loans to be the same.

______ weeks



16. Jan noticed the equation $3(4x - 7) + 2(4x - 7) = 5$ has the form

$3■ + 2■ = 5$ where $■ = 4x - 7$.

A. Explain how Jan can use this information to solve the equation $3(4x - 7) + 2(4x - 7) = 5$.

For $3(4x - 7) + 2(4x - 7) = 5$, $3■ + 2■ = 5$ implies that $5■ = 5$,

or $■ =$ ______. If $■ = 4x - 7$, this means that $4x - 7 =$ ______.

This simplifiles to $4x =$ ______, so $x =$ ______.

B. Now, use the same method to solve the equations $2(3x + 4) - 5(3x + 4) = 33$.

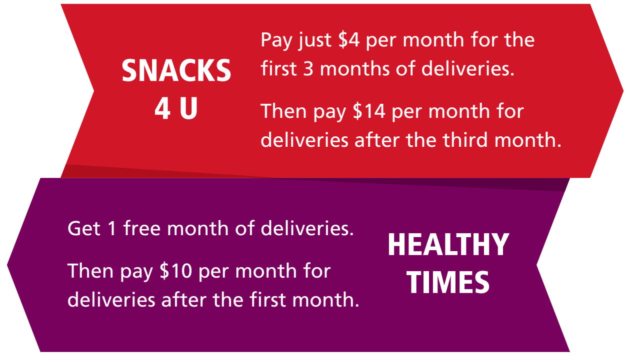
For $2(3x + 4) - 5(3x + 4) = 33$, $2■ - 5■ = 33$ implies that

$-3■ = 33$, or $■ =$ ______. If $■ = 3x + 4$, this means that

$3x + 4 =$ ______. This simplifiles to $3x =$ ______, so $x =$ ______.

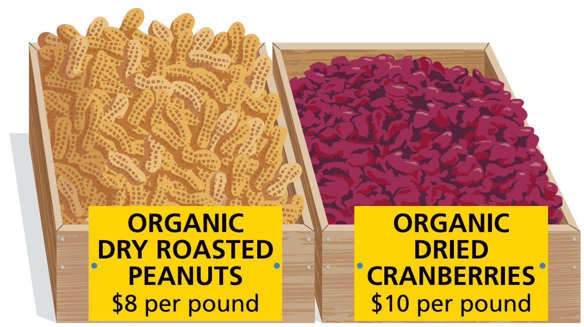
17. Show two ways to solve the equation $4(2x - 3) = 2x - 3$ algebraically. Construct a viable argument to justify each solution method.

18. Two subscription services offer deliveries of boxes of nutritious, organic snack foods each month. For how many months of deliveries will the two plans cost the same?



_______ months

19. Luke wants to mix dry roasted peanuts and dried cranberries to make a trail mix. He wants to make 20 ounces of trail mix and spend $11. What weight of peanuts does he need to buy?



_____________ ounces, or

_____________ lb, of peanuts

20. MP **Use Structure** Consider the equation $3(2x - 5) = ax + b$ where a and b represent constants.

A. For what values of a and b would any value of x be a solution of the equation?

$a =$ _______

$b =$ _______

B. Given $b = 20$, for what value of a is there no solution to this equation?

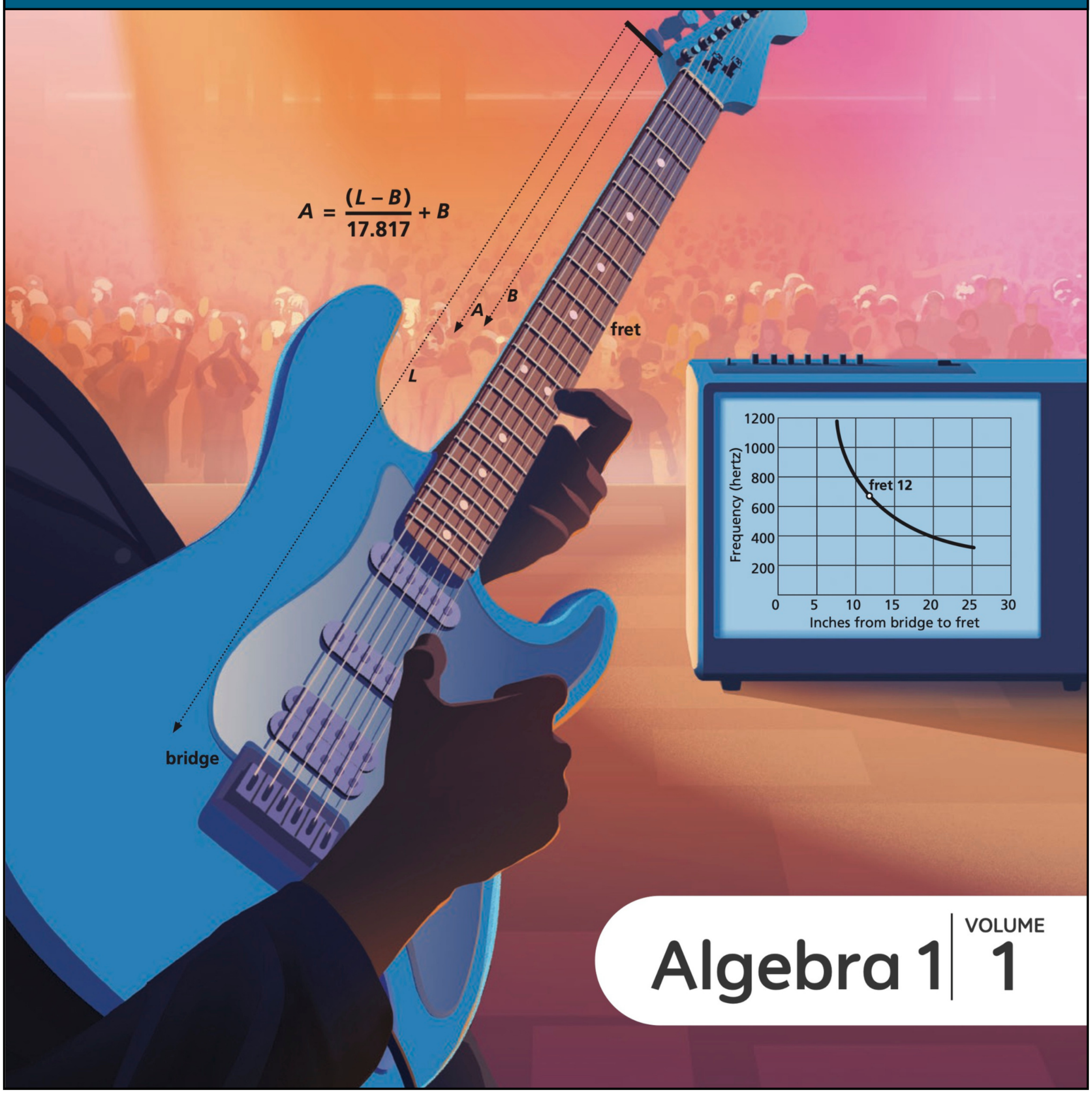
$a =$ _______

C. Given $a = 5$ and $b = 20$, what is the solution to the equation?

$x =$ _______

HMH Into Math®

PRACTICE PLUS



Algebra 1 | VOLUME 1

Name ______________________________

Solve Linear Equations in One Variable

Worked Example

1. Solve $-4(-2x + 1) + 5 = 3$.

Justify your solution steps and check the solution.

A. Justify each solution step.

$-4(-2x + 1) + 5 = 3$	*Given equation*
$8x - 4 + 5 = 3$	*Distributive Property*
$8x + 1 = 3$	*Combine constants*
$8x = 2$	*Subtraction Property of Equality*
$x = 0.25$	*Division Property of Equality*

B. Check your solution.

$$-4(-2(0.25) + 1) + 5 = 3$$
$$-4(0.5) + 5 = 3$$
$$-2 + 5 = 3$$
$$3 = 3 \ \checkmark$$

Practice

2. Which justification belongs in the blank?

$8x + 3 = 5x - 3$	Given equation
$3x + 3 = -3$	?
$3x = -6$	Subtraction Property of Equality
$x = -2$	Division Property of Equality

Ⓐ Subtraction Property of Equality

Ⓑ Addition Property of Equality

Ⓒ Combine constants

Ⓓ Distributive Property

3. Which solution step belongs in the blank?

$-2(3x - 4) + 12 = -16$	Given equation
$-6x + 8 + 12 = -16$	Distributive Property
?	Combine constants
$-6x = -36$	Subtraction Property of Equality
$x = 6$	Division Property of Equality

Ⓐ $-6x - 20 = -16$

Ⓑ $6x + 20 = -16$

Ⓒ $-6x + 16 = -16$

Ⓓ $-6x + 20 = -16$

4. Which step is incorrectly paired with its justification?

Step 1:	$\frac{1}{2}(2x - 4) + 2 = 4(x + 2) - 11$	Given equation
Step 2:	$x - 2 + 2 = 4x + 8 - 11$	Distributive Property
Step 3:	$x = 4x - 3$	Combine constants
Step 4:	$-3x = -3$	Subtraction Property of Equality
	$x = 1$	Addition Property of Equality

Ⓐ Step 1

Ⓑ Step 2

Ⓒ Step 3

Ⓓ Step 4

For Problems 5–8, solve each equation.

5. $4 - 3x = 2x - 11$

$x =$ _____

6. $0.8 + 0.3(2 - 3x) = 1.4$

$x =$ _____

7. $2x - \frac{1}{3}(9x + 5) = \frac{10}{3}$

$x =$ _____

8. $2(x - 3) - 4(x + 3) = -24$

$x =$ _____

9. Miguel and Alina canoe toward each other on a river, starting from points 12 miles apart. Miguel begins paddling at 9:00 a.m., and Alina begins at 10:00 a.m. Their paddling speeds in calm water are 3 miles per hour for Miguel and 4 miles per hour for Alina, but Miguel paddles with the current and Alina paddles against the current. They meet at 11:00 a.m. What is the speed of the current?

   A. Write an equation to model the situation. Let c equal the speed of the current in miles per hour.

   ____

   B. What is the speed of the current?

   _____ mi/h

10. A group of friends are going camping and decide to take two cars to the campsite. The first car leaves 15 minutes before the other and travels at an average speed of 50 miles per hour. The second car travels at an average speed of 55 miles per hour. If t represents the time (in hours) since the first car left, which equation could be used to find the time when the second car catches up with the first (assuming that the cars have not yet reached the campsite)?

   (A) $50t = 55(t - 15)$
   (B) $50(t - 15) = 55t$
   (C) $50t = 55(t - 0.25)$
   (D) $50(t - 0.25) = 55t$

11. A company spends 12% of its annual budget on travel for sales. Their total budget this year is $1500 more than last year, and this year they plan to spend $5640 on travel. What was the company's total budget last year?

   $_______

12. Two families decide to drive to a state park and spend the day together there. The Patel family leaves first and travels at an average speed of 48 miles per hour. The Franklin family leaves 30 minutes later and travels at an average speed of 54 miles per hour. After how many hours do the two families meet? Let t represent the time in hours.

   Complete the statements.

   An equation that models the situation is ____________________.

   Solving this equation results in $t =$ _____, so the families would have to drive for _____ hours before they meet.

13. A student attempted to solve this problem: The hands of a clock coincide at 12:00. At what time, to the nearest second, do the hands again coincide?

The student wrote this explanation:

The minute hand of a clock makes 1 revolution in an hour, so it moves through 360° every hour. The hour hand makes only $\frac{1}{12}$ of a revolution in an hour, so it moves through 30° every hour. If I let t represent the time (in hours) since 12:00, then $360t$ represents the number of degrees through which the minute hand moves and $30t$ represents the number of degrees through which the hour hand moves. When the minute hand catches up with the hour hand for the first time, it has completed 1 revolution more than the hour hand, so I must subtract 1 from $360t$ before setting it equal to $30t$. So, $360t - 1 = 30t$.

Explain the error in this reasoning. Then correct the error and finish solving the problem.

____

____

____

____

____

____

____

____

Train Your Memory

14. A cylinder and a cone each have a radius of 6 inches and a height of 10 inches. How many times greater is the volume of the cylinder compared to the volume of the cone? *(Grade 8, Lesson 14.1)*

____

15. Simplify the expression $4^0 + \frac{4^2}{(4^3)^2}$. *(Grade 8, Lesson 12.1)*

____

16. Which set of numbers could be the sides of a right triangle? *(Grade 8, Lesson 7.7)*

Ⓐ 15, 15, and 30

Ⓑ 20, 25, and 40

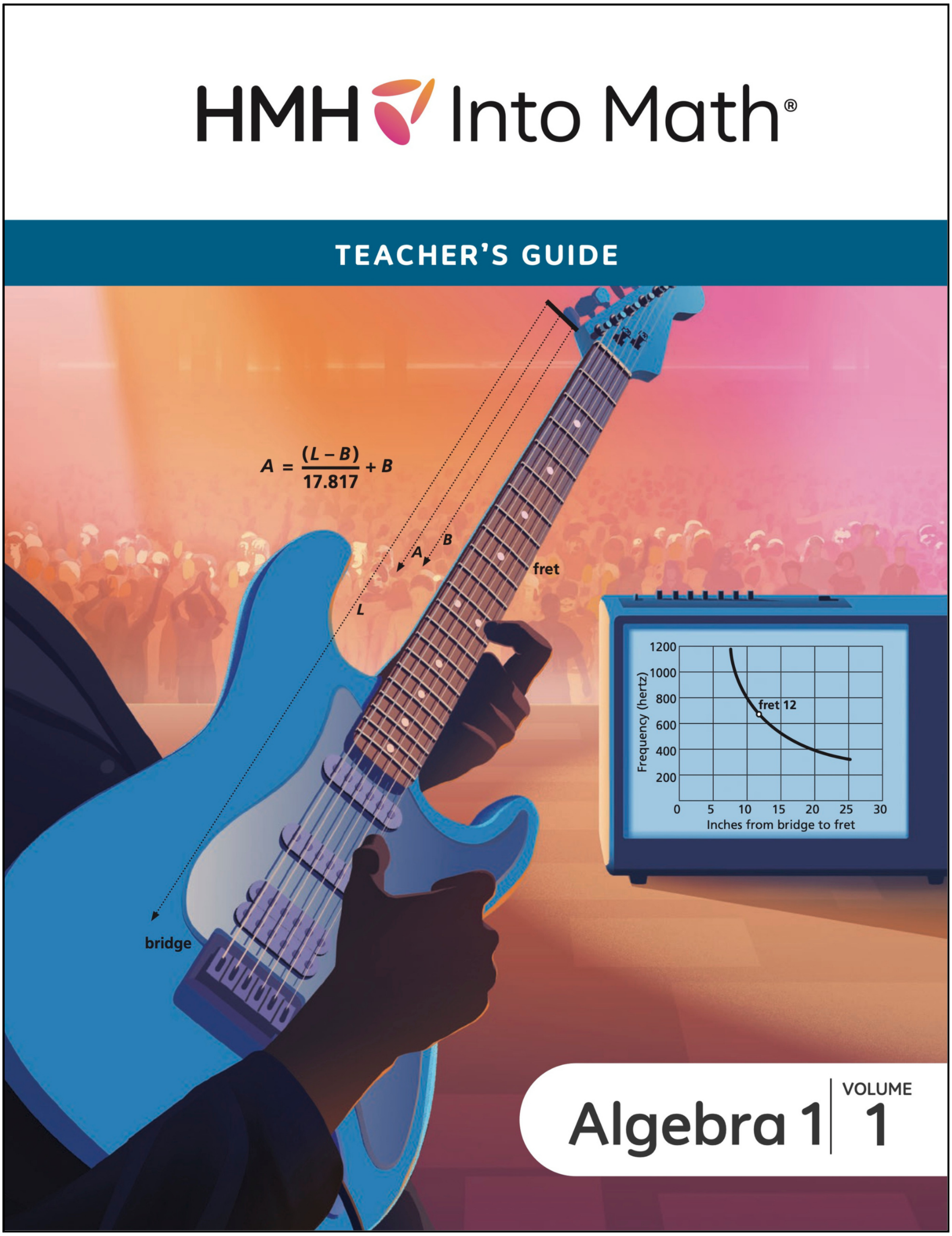
Ⓒ 60, 80, and 120

Ⓓ 90, 120, and 150

17. What is 334,014 ÷ 622? *(Fluency)*

____

TRY IT NOW
LESSON SAMPLER



World of Math

15 minutes

Use this activity after students complete the Prerequisite Check or when you have 15 minutes of time.

STUDENT CONTENT

Egyptians used logic to solve simple math problems.

How do we know what math ancient Egyptians knew?

The ancient Egyptian empire prospered over three thousand years ago! Many documents written by the ancient Egyptians have been lost to time. The remaining documents are difficult to read because parts have faded or disintegrated. The parts that are readable are written in hieroglyphics, an ancient written language. Scholars have worked for decades to analyze these documents to figure out what math ancient Egyptians knew!

The *Moscow Mathematical Papyrus* is one of several surviving Egyptian scrolls that shows ancient Egyptian knowledge of math. It includes calculations of area and volume of two- and three-dimensional shapes. It also contains some of the earliest solutions to linear equations. These problems are called *aha* problems and represent problems where an unknown quantity is found when the sum of the quantity and parts of the quantity are given. Do you think there is more to discover about ancient Egyptian math?

Turn & Talk **Egyptians did not use the same symbols for math as we use today. What knowledge do you think scholars needed to understand the Moscow Mathematical Papyrus?**

TEACHER GUIDE

Display the digital version of World of Math from HMH Ed, or have students read along from their books.

FIRST, have students analyze the image of the Moscow Mathematical Papyrus.

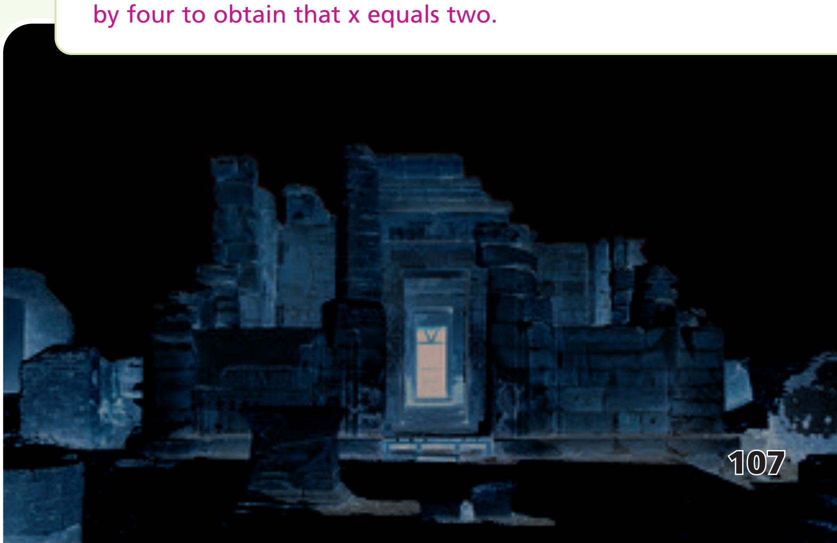
THEN, ask students to read the passage to themselves. Give an example of a simple linear equation such as $4x + 4 = 12$. Have volunteers represent this equation using only words.

ASK How does the equation written in words compare with the equation written using mathematical symbols? Possible answers: The equation written in words is longer than the symbolic representation. It is easier to manipulate the symbolic equation to solve it.

NEXT, have students complete the **Turn & Talk** routine. Have students share some of their answers with the whole class.

ASK What would scholars need to know to decipher an ancient Egyptian mathematical scroll? Possible answers: They would need to understand hieroglyphics. They would also need logic and mathematical understanding to figure out the meaning of what was written and fill in gaps.

FINALLY, have students revisit the equation $4x + 4 = 12$ discussed earlier, which is an equation similar to the ones in the *aha* problem set. Have them describe how to solve the problem using only words. Lead a discussion about how their written solutions are similar to how the ancient Egyptians wrote their solutions. Possible answer: To solve, first, subtract four from both sides of the equation. Then, divide both sides by four to obtain that x equals two.



Prerequisite Check

1 Day

- Assign **Prerequisite Check** to determine student readiness for this module.
- Use the Data-Driven Support table to support prerequisite understanding.
- To administer offline, have students complete page 60 in the Student Edition.

STUDENT CONTENT

Complete these problems to review prior concepts and skills you will need for this module.

Solve Two-Step Equations

Solve each equation.

1. $5c - 7 = 18$
$c =$ 5

2. $52 = 7 + 5y$
$y =$ 9

3. $\frac{2}{3}k + \frac{5}{6} = \frac{7}{2}$
$k =$ 4

4. $-3m + 4.2 = 1.8$
$m =$ 0.8

Write Two-Step Inequalities

Write an inequality to model each situation.

5. Sasha has two 8-foot sections of prebuilt fencing left over from a previous fencing project. She plans to buy s 6-foot sections of fencing so that she will have more than 40 feet of fencing.
$6s + 16 > 40$

6. Vijay has loaded 35 pounds of soil onto a cart. He will add b bricks that each weigh 4 pounds, but he does not want to exceed a total weight of 100 pounds in the cart.
$4b + 35 \leq 100$

7. Ana is baking cookies for a cookie exchange. She will bake 1 dozen cookies at a time in each of b batches and place them in bags of 2 cookies each. She wants to take at least 60 cookies to the exchange.
$\frac{12b}{2} \geq 60$

Solve Two-Step Inequalities

Find the solution for each two-step inequality.

8. $2x - 1 \geq 9$
$x \geq$ 5

9. $\frac{x-4}{5} > 8$
$x >$ 44

10. $-3x + 6 < -15$
$x >$ 7

11. $\frac{x+3}{4} \leq -2$
$x \leq$ −11

LESSON 1

Solve Linear Equations in One Variable

What should I understand about the math?

- Solve linear equations with grouping symbols or with the variable on both sides.
- Explain and justify each step required to solve a linear equation.
- Use linear equations to represent and solve real-world problems.

MP **Mathematical Practice**

[4] Model with mathematics.
[5] Use appropriate tools strategically.
[7] Look for and make use of structure.

What will students learn in this lesson?

PRIOR LEARNING

Students:

- wrote and interpreted algebraic expressions that represent real-world quantities.
- wrote and solved equations in the form $px + q = r$ and $p(x + q) = r$ where p, q, and r are specific rational numbers.

THIS LESSON

Mathematical Concepts and Skills

Students:

- **Focus** Define appropriate quantities for the purpose of descriptive modeling.
- **Focus** Create equations . . . in one variable . . . and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
- **Focus** 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.
- **Focus** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Learning Objective: Solve linear equations with grouping symbols or with variables on both sides, and use linear equations to model and solve real-world problems.

Language Objective: Write to explain the steps to solve a linear equation with grouping symbols or variables on both sides by using symbols and academic language such as *equivalent* and *distributive*.

FUTURE CONNECTIONS

Students:

- will solve linear equations with coefficients represented by letters.
- will write and solve linear inequalities.

Manipulatives & Materials

Per student
- Spreadsheet Software

Per group
- Algebra Tiles

Vocabulary
- equivalent equations
- solution of an equation in one variable
- equation

Use the **WTL** routine within the lesson, where it makes sense to support all students

What does this lesson look like in my classroom?

FIRST, launch the **Classcraft Essential Session** to teach the lesson.

Whole-Class Interactive Presentation

HMH Classcraft™
- ✓ Presentation Slides
- ✓ Interactive Tasks
- ✓ Teacher Notes
- ✓ Real-Time Data

TEACHERS present the session.

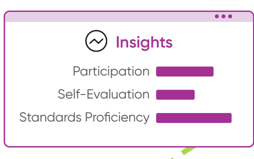
STUDENTS participate using books or devices.

Learning Goal: **I can** use the properties of equality and the Distributive Property to solve an equation with the variable on both sides.

SESSION 1 | SESSION 2

Get Ready	Learn		Assess
• Learning Goal routine	• **Spark Your Learning:** Three Reads routine • **Task 1:** Collect and Display routine • **Task 2:** Stronger and Clearer Each Time routine	• **Task 3:** Compare and Connect routine • **Task 4:** Stronger and Clearer Each Time routine • **Task 5:** Three Reads and Discussion Supports routines • **Review Spark Your Learning**	• Quick Check routine • Learning Goal routine

+ Turn & Talk routines



USE the **Program Activity Report** to differentiate instruction.

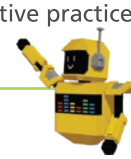
Teacher-Led Small-Group Activities

Independent Practice

Collaborative Groups

★ RECOMMENDED FOR ALL STUDENTS:
Practice on Your Own*

Personalized adaptive practice
HMH Waggle®



* Find all resources for differentiation and practice on page 131.

Lesson 2.1: Solve Linear Equations in One Variable

Begin Essential Sessions

90 minutes

STUDENTS

Use books and/or devices. Devices generate insights.

TEACHERS

Launch the lesson with Classcraft from Ed.

Get Ready

Learning Goal

Student Edition p. 61

STUDENT CONTENT

I can use the properties of equality and the Distributive Property to solve an equation with the variable on both sides.

Rate yourself on this learning goal:

- ◯ **I don't understand.**
- ◯ **I need more practice.**
- ◯ **I've got it.**

TEACHER GUIDE

START the session by using the **Learning Goal** routine to assess students' confidence with the lesson objective.

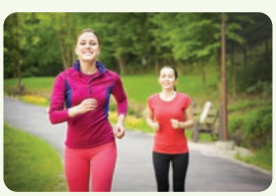
1. Read aloud the **I Can** statement. Give students time to think about what the statement means.
2. Connect to students' prior knowledge by having them describe methods of finding solutions of an equation with one variable.
3. Students will individually assess their content knowledge based on the **I Can** statement.
4. Review student responses to see how they rate themselves for today's learning.
5. Tell students they will revisit the **I Can** statement at the end of the session.

Learn

Spark Your Learning

Student Edition p. 61

STUDENT CONTENT



Lynn and Anna are joggers who use the same running trail. Lynn starts jogging on the trail at 4:00 p.m. She jogs at an average speed of 5.4 miles per hour. Anna starts jogging from the same location and in the same direction as Lynn but at 4:06 p.m. Anna jogs at an average speed of 6.0 miles per hour.

At what time will Anna catch up with Lynn? Explain your reasoning.

TEACHER GUIDE

FIRST, review the problem and the **Spark Discussions** table on the following page. This prepares you to know what students are asked to do and what they might do when solving the problem.

NOW, use the **Three Reads** routine to support students in understanding the problem.

1. **First Read:** Students read or listen to the problem with a focus on the context of the problem. Discuss the problem with students to be sure they understand the context.

   ASK What is the problem about? determining when one jogger will catch up to another jogger when they start at different times and run at different rates of speed

TEACHER GUIDE, *CONTINUED*

2. **Second Read:** Reread the problem with a focus on what the quantities represent.

   ASK What numbers are important? Why are they important? The numbers that are important are 5.4 miles per hour, 6.0 miles per hour, 4:00 p.m., and 4:06 p.m. They show how fast each woman jogs and what time each woman started jogging.

3. **Third Read:** Reread the problem for the third time with a focus on the question being asked: *At what time will Anna catch up with Lynn?*

   Have students brainstorm possible strategies and engage in independent think time before solving the problem.

   NEXT, have students solve the problem. As students solve the problem, monitor their responses and use the **Spark Discussions** table to provide common-error support and to encourage students who used correct strategies to share their thinking.

ASK: At what time will Anna catch up with Lynn? Explain your reasoning.
Anna catches up with Lynn at 5:00.
Let t = Lynn's jogging time in hours. Then the distance that Lynn jogs is $5.4t$ miles.
Let $t - 0.1$ = Anna's jogging time in hours. Then the distance that Anna jogs is $6(t - 0.1)$ miles.
When Anna catches up with Lynn, they have each jogged the same distance. Set the expressions for the distances jogged equal to each other to get the equation $5.4t = 6(t - 0.1)$. Solving for t gives $t = 1$. So, Anna will catch up with Lynn 1 hour after Lynn starts jogging, or at 5:00 p.m.

Learn | Essential Sessions

Spark Discussions

Ask students whether it makes sense to use different units of time for quantities in the equation. Watch for students who use a value of 6 in the expression for Anna's jogging time in hours.

Addressing Common Errors Students may not convert 6 minutes to 0.1 hour when writing an expression for Anna's jogging time or may not understand that the same units for time must be used for all quantities in the equation. Use the scripting to provide support for this error.

Let t = Lynn's jogging time in hours.

Let $t - 6$ = Anna's jogging time in hours

$$5.4t = 6(t - 6)$$
$$5.4t = 6t - 36$$
$$-0.6t = -36$$
$$t = 60$$

Anna catches up with Lynn 60 hours after Lynn starts jogging.

ASK The speeds in the problem are given in miles per hour. If you use these speeds in your equation, in what units must you express the jogging times?
in minutes

ASK If you calculate that Anna takes 60 hours to catch up with Lynn, why might you think you have made a mistake?
60 hours is an unreasonable amount of time to jog.

ASK Do you have any experience jogging or keeping track of your speed for any activity?
Possible answer: I use a fitness watch to track my speed, distance, and time when I am running.

Deepening Student Thinking If students use an equation to solve the problem correctly, then use the scripting to help students explain their thinking.

Let t = Lynn's jogging time in hours.

Let $t - 0.1$ = Anna's jogging time in hours

$$5.4t = 6(t - 0.1)$$
$$5.4t = 6t - 0.6$$
$$-0.6t = -0.6$$
$$t = 1$$

Anna catches up with Lynn 1 hour after Lynn starts jogging, or at 5:00 p.m.

ASK How did you use the given information and the relationship between speed, time, and distance to write your equation?
I wrote the product of the person's speed and her jogging time. I used a variable or a variable expression for the jogging time since this information is unknown.

ASK How can you use your expressions for the distances Lynn and Anna jog to solve the problem?
Possible answer: I can set the expressions equal to each other to form an equation. I can then solve the equation to find the time when Anna catches up with Lynn.

ASK What properties did you use to solve your equation?
Possible answer: the Distributive Property, the Subtraction Property of Equality, and the Division Property of Equality

STUDENT CONTENT

Turn & Talk **Predict how your answer would change for each of the following changes in the situation:**

- **Anna starts jogging 3 minutes earlier.**
- **Lynn's average jogging speed is 0.2 mile per hour faster.**
- **Lynn and Anna jog at the same constant speed.**

Possible answer: If Anna starts jogging 3 minutes earlier, she will catch up with Lynn sooner. If Lynn's average jogging speed is 0.2 mi/h faster, Anna will take longer to catch up with her. If Lynn and Anna jog at the same constant speed, Anna will never catch up with Lynn.

TEACHER GUIDE

FINALLY, have students complete the **Turn & Talk** routine.

When predicting how their answers would change, students should use reasoning to determine the direction of the change rather than compute the new answers.

TEACHING STRATEGY

Multilingual Learners: Supporting All Language Learners

Students may choose to create and label their own visual models to support writing an equation to solve the problem.

Use the Supporting All Language Learners chart to let students choose the language scaffolding that they need.

Language Proficiency Level	Scaffolding Examples
↗ **Substantial** Have students write phrases using mathematical vocabulary.	Write the terms $-2x$ and $3x$. Say, "These are like terms because each term has the same variable x raised to the same power—the first power." Then write the term $4m^2$ and ask students to write a like term for $4m^2$.
→ **Moderate** Write simple sentences with mathematical notation to demonstrate understanding.	Have students work in groups. Provide students with two terms, such as $5x$ and $-3x$ or $6y^3$ and $6y^2$. Ask students to explain why the terms either *are* or *are not* like terms.
↘ **Light** Write complex or combined sentences using mathematical vocabulary.	Have students explain how to use the Distributive Property to combine like terms.

Learn | Essential Sessions

Task 1

Student Edition p. 62

STUDENT CONTENT

Investigate Properties of Equality

Solving an equation involves using properties of equality to write simpler **equivalent equations**, which all have the same solution of an equation in one variable as the original equation. In the Symbols column of the table shown, a, b, and c are real numbers.

VOCABULARY

A **solution of an equation in one variable** is a number that when substituted for the variable in the equation produces a true statement.

Properties of Equality

Property	Words	Symbols
Addition Property of Equality	Adding the same number to both sides of an equation produces an equivalent equation.	If $a = b$, then $a + c = b + c$. **Example:** If $x - 2 = 3$, then $x - 2 + 2 = 3 + 2$.
Subtraction Property of Equality	Subtracting the same number from both sides of an equation produces an equivalent equation.	If $a = b$, then $a - c = b - c$. **Example:** If $x + 4 = -1$, then $x + 4 - 4 = -1 - 4$.
Multiplication Property of Equality	Multiplying both sides of an equation by the same nonzero number produces an equivalent equation.	If $a = b$ and $c \neq 0$, then $ac = bc$. **Example:** If $\frac{x}{3} = 2$, then $\frac{x}{3} \cdot 3 = 2 \cdot 3$.
Division Property of Equality	Dividing both sides of an equation by the same nonzero number produces an equivalent equation.	If $a = b$ and $c \neq 0$. then $\frac{a}{c} = \frac{b}{c}$. **Example:** If $-2.5x = 10$, then $\frac{-2.5x}{-2.5} = \frac{10}{-2.5}$.

TEACHER GUIDE

CONSIDER using the **Words to Learn** routine for **equivalent equations** and **solution of an equation in one variable** when students need to describe their thinking. Or if there are ML students in your class, you may use the routine before instruction begins.

START the task by making sure the students understand the problem.

MP **NEXT,** have students refer to the **Mathematical Practice: Use Tools**.

Students use the if-then-else statements in the spreadsheet as a means of building equivalent expressions using properties of equality.

NOW, have students solve the problem.

ASK In Part B, the spreadsheet shows that $x = -1$ and $2x = -2$ have the same solution, -1. Why would you expect this? The equation $2x = -2$ was obtained by multiplying each side of $x = -1$ by 2. The Multiplication Property of Equality says that both equations are equivalent, so they have the same solution.

Task 1, *continued*

STUDENT CONTENT, *CONTINUED*

Using a spreadsheet, create a table like the one shown for the equation $x = -1$. The formula in cell B2 is an if-then-else statement that checks the value in cell A2.

B2 | f_x | = IF(A2 = −1,"YES", "NO")

	A	B	C	D	E
1	x	Is x a solution?			
2	−3	NO			
3	−2				
4	−1				
5	0				
6	1				
7	2				
8	3				

If the number in cell A2 equals −1, then the word YES is shown in cell B2. Otherwise, the word NO is shown in cell B2.

A. Fill down the formula from cell B2 to cell B8. What do you observe?
Possible answer: The word *yes* is shown only in cell B4, so the equation $x = -1$ is true only for the value of -1.

B. Suppose you use the Multiplication Property of Equality to rewrite the equation $x = -1$ as $2x = -2$. Use the new equation in the if-then-else statements you enter in cells C2 through C8. What do you observe?
Possible answer: The word *yes* is shown only in the fourth row, so the equations are equivalent.

C. Suppose you use the Addition Property of Equality to rewrite the equation $2x = -2$ as $2x + 3 = 1$. Use the new equation in the if-then-else statements you enter in cells D2 through D8. What do you observe?
Possible answer: The word *yes* is shown only in the fourth row, so the equations are true for $x = -1$ and are equivalent.

TEACHER GUIDE, *CONTINUED*

THEN, have students use the **Collect and Display** routine to discuss their thinking.

As students work, write common or important words, phrases, sketches, or diagrams on a visual display for students to see. Refer to the display during whole-class discussion to help students communicate ideas more precisely.

TEACHING STRATEGY

Common Error

For students who need support remembering to apply the properties of equality to both sides of the equation, have them create and refer to anchor charts with the properties written clearly and the like operations highlighted.

Learn | Essential Sessions

Task 1, *continued*

STUDENT CONTENT

Turn & Talk **You used properties of equality to build the equation $2x + 3 = 1$ from $x = -1$. How can you use properties of equality to solve the equation $2x + 3 = 1$?**

Starting with $2x + 3 = 1$, I can first use the Subtraction Property of Equality to subtract 3 from each side of the equation, giving me $2x = -2$. I can then use the Division Property of Equality to divide each side of the equation by 2, giving me $x = -1$. So, the solution of $2x + 3 = 1$ is -1.

TEACHER GUIDE

FINALLY, have students use the **Turn & Talk** routine.

Help students understand that to solve $2x + 3 = 1$, they need to reverse the steps they used in Task 1. They should realize that subtracting "undoes" addition and that division "undoes" multiplication.

TEACHING STRATEGY

Multilingual Learners

Encourage students to engage in listening to a speaker describe their work to check for accuracy, then switch and explain their own work. Using if-then-else statements expressed as equations is one way to demonstrate the effect of the properties of equality.

Depth of Knowledge Leveled Questions

If time allows, use these questions to progress students through levels of understanding.

Level 1: Recall

What property allows you to subtract 1 from each side of $3x + 1 = -5$ to obtain the equivalent equation $3x = -6$?

Subtraction Property of Equality

Level 2: Basic Application of Skills & Concepts

How can you solve the equation $3x + 1 = -5$?

I can use the Subtraction Property of Equality to subtract 1 from each side, giving $3x = -6$. Then I can use the Division Property of Equality to divide each side by 3, giving the solution $x = -2$.

Level 3: Strategic Thinking and Complex Reasoning

How can you show that $3x + 1 = -5$ and $4x + 3 = -9$ are *not* equivalent solutions?

Possible answer: I can solve $3x + 1 = 5$ to get $x = -2$ and $4x + 3 = -9$ to get $x = -3$. The solutions are different, so the equations are not equivalent.

Students get opportunities to work in Depth of Knowledge 4 in the Module Project.

Task 2

Student Edition p. 63

STUDENT CONTENT

Solve Equations Using the Distributive Property

Previously, you solved one-step and two-step equations. Now you will solve multistep equations. Such equations may contain grouping symbols. In order to free the terms in an equation that contains grouping symbols, you can use the Distributive Property.

MP **Use Structure** The steps for solving the equation $5(2x - 3) + 4 = -6$ and checking the solution are shown, but the steps have been scrambled.

A. Complete the solution steps in the correct order. Step 1 is already placed.

Step 1:	$5(2x - 3) + 4 = -6$
Step 2:	$10x - 15 + 4 = -6$
Step 3:	$10x - 11 = -6$
Step 4:	$10x = 5$
Step 5:	$x = 0.5$

B. Complete the check steps in the correct order. Step 1 is already placed.

Step 1:	$5(2(0.5) - 3) + 4 \stackrel{?}{=} -6$
Step 2:	$5(1 - 3) + 4 \stackrel{?}{=} -6$
Step 3:	$5(-2) + 4 \stackrel{?}{=} -6$
Step 4:	$-10 + 4 \stackrel{?}{=} -6$
Step 5:	$-6 = -6$

TEACHER GUIDE

START the task by making sure the students understand the problem.

MP **NEXT,** have students use the **Mathematical Practice: Use Structure**.

Have students check whether the Distributive Property works for subtraction. By writing subtraction as adding the opposite of a number, students can demonstrate that the Distributive Property also holds for a product of a number and a difference of two numbers.

$a(b - c) = a[b + (-c)] = ab + a(-c) = ab - ac$

NOW, have students solve the problem.

ASK What will be the last equation in the sequence of solution steps? Why? The equation $x = 0.5$ will be last because it is the only equation that has the variable by itself on one side.

ASK Why do you substitute the solution you found into the original equation to check your work? Possible answer: I could have made a mistake when solving the original equation. If so, some of my intermediate equations may contain errors.

THEN, have students use the **Stronger and Clearer Each Time** routine to discuss their thinking.

Have students write down their reasoning for solving the multistep equation and any questions about it. Then have students work in pairs and share their thinking. Remind them to ask each other questions that focus on describing their thinking, especially related to grouping symbols and the Distributive Property, and to then use insights from the discussion to refine their answers or reasoning.

TEACHING STRATEGY

Common Error

If students need support to complete the multistep problem in the correct order, work with them to take notes outlining each step used for solving.

Learn | Essential Sessions

Task 2, *continued*

STUDENT CONTENT

Turn & Talk **Can you solve the equation $5(2x - 3) + 4 = -6$ *without* using the Distributive Property as one of the steps? Show how or explain why not.**

yes; I can subtract 4 from each side to get $5(2x - 3) = -10$. Then I can divide each side by 5 to get $2x - 3 = -2$. Next, I can add 3 to each side to get $2x - 1$. Finally, I can divide each side by 2 to get $x = 0.5$.

TEACHER GUIDE

FINALLY, have students use the **Turn & Talk** routine.

Students may not know how to solve the equation without the Distributive Property. Point out that they can first follow steps to isolate the expression in parentheses, and then work to isolate the variable.

TEACHING STRATEGY

Multilingual Learners

To present, describe, and explain ideas and information, encourage students to share the examples of their work with classmates and discuss the different approaches each student takes to solve the problem. As they share, provide models of how to develop complexity in linguistic structures, such as progressing from phrases to simple sentences to complex or combined sentences.

End Session 1

Begin Session 2

Task 3

Student Edition p. 64

STUDENT CONTENT

Recall that the Distributive Property also allows you to combine like terms.

MP **Use Structure** The steps for solving the equation $-2x + \frac{1}{2}(6x - 5) = \frac{3}{2}$ are shown, but some justifications are missing.

$-2x + \frac{1}{2}(6x - 5) = \frac{3}{2}$	Given equation
$-2x + 3x - \frac{5}{2} = \frac{3}{2}$	?
$(-2 + 3)x - \frac{5}{2} = \frac{3}{2}$	?
$x - \frac{5}{2} = \frac{3}{2}$	Simplify the coefficient of x.
$x = 4$	?

A. Which property justifies rewriting $\frac{1}{2}(6x - 5)$ as $3x - \frac{5}{2}$? Distributive Property

B. Which property justifies rewriting $-2x + 3x$ as $(-2 + 3)x$? Distributive Property

C. Which property justifies adding $\frac{5}{2}$ to each side of the equation? Addition Property of Equality

TEACHER GUIDE

START the task by making sure the students understand the problem.

MP **NEXT,** have students use the **Mathematical Practice: Use Structure**.

Have students use the Distributive Property and the properties of equality to justify each step in the solution.

NOW, have students solve the problem.

ASK On the left side of the second equation, why is $\frac{5}{2}$ being subtracted instead of 5? When you use the Distributive Property to rewrite $\frac{1}{2}(6x - 5)$, you must multiply both terms inside the parentheses by $\frac{1}{2}$, not just the first term.

THEN, have students use the **Compare and Connect** routine to discuss their thinking.

Invite students to describe their justifications and the steps they would take to solve the problem in their own words, and then discuss their descriptions.

TEACHING STRATEGY

Multilingual Learners

To present, describe, and explain ideas and information, use sentence frames to support students to write about complex concepts in complete sentences: The _______ Property of _______ justifies _______.

Learn | Essential Sessions

Task 3, *continued*

STUDENT CONTENT

Turn & Talk **Is it possible to eliminate the fractions as a first step in solving the equation $-2x + \frac{1}{2}(6x - 5) = \frac{3}{2}$? Show how or explain why not.**

yes; I can multiply both sides of the equation by 2 to eliminate the fractions. This gives the equation $-4x + 6x - 5 = 3$.

TEACHER GUIDE

FINALLY, have students use the **Turn & Talk** routine.

Help students realize that they can eliminate the fractions from an equation by multiplying each side by the least common denominator of the fractions.

TEACHING STRATEGY

Multilingual Learners

To present, describe, and explain ideas and information, allow students processing time to write their ideas in whatever form makes the most sense to them (sentences, pictures, mathematical notation) before they turn to a partner to share their ideas. Students will then have a visual representation to help with their sharing, and they will practice writing.

Task 4

Student Edition p. 65

STUDENT CONTENT

Solve Equations with a Variable on Both Sides

When a variable appears on both sides of an equation, you can use the Addition Property of Equality or the Subtraction Property of Equality to move the variable from one side to the other. Doing so allows you to isolate the variable on one side.

MP **Use Structure** The steps for solving the equation $4(x + 1) + 1 = -3(x + 3)$ are shown, but some justifications are missing.

$4(x + 1) + 1 = -3(x + 3)$	Given equation
$4x + 4 + 1 = -3x - 9$	?
$4x + 5 = -3x - 9$	Combine constants.
$4x + 5 + 3x = -3x - 9 + 3x$	?
$7x + 5 = -9$	Combine like terms.
$7x = -14$	?
$x = -2$	Division Property of Equality

A. Which property lets you rewrite each side without grouping symbols? Distributive Property

B. Which property justifies adding $3x$ to each side? Addition Property

C. Which property justifies subtracting 5 from each side? Subtraction Property

TEACHING STRATEGY

UDL Support: Engagement

Before having students discuss the Turn and Talk, remind them of the Learning Goal and how it is related to the task they just completed.

TEACHER GUIDE

START the task by making sure the students understand the problem.

MP **NEXT,** have students use the **Mathematical Practice: Use Structure**.

Emphasize to students that they are using the structure of the properties of equality to isolate the variable on one side of an equation. Point out to students that when solving an equation with the variable on both sides, they can isolate the variable on either the left or the right side. Some students may prefer always to isolate the variable on the left side. Others may find it helpful to choose the side that makes the coefficient of the variable positive when the variable term is isolated on that side.

NOW, have students solve the problem.

ASK How are the first and second equations in the solution different? How does this suggest the property that was used to obtain the second equation? The first equation has parentheses, while the second equation does not; This suggests that the Distributive Property was used to eliminate the parentheses.

ASK For the equation $4x + 5 = -3x - 9$, what operation do you need to perform so that the variable appears only on the left side? Which property are you using? Add $3x$ to each side; Addition Property of Equality

THEN, have students use the **Stronger and Clearer Each Time** routine to discuss their thinking.

Have students share how they determined which justifications were for each step. Remind students to ask each other questions that focus on how they approached the problem. Then have students refine their answers.

Learn | Essential Sessions

Task 4, *continued*

STUDENT CONTENT

Turn & Talk **How is solving $4(x + 1) + 1 = 4(x + 3)$ different from solving $4(x + 1) + 1 = -3(x + 3)$? What is different about solving $4(x + 1) + 8 = 4(x + 3)$?**

The original equation, $4(x + 1) + 1 = -3(x + 3)$ has one solution, $x = -2$. When I try to solve $4(x + 1) + 1 = 4(x + 3)$ for x, I get the false equation $5 = 12$, which means this equation has no solution; When I try to solve $4(x + 1) + 8 = 4(x + 3)$ for x, I get the true equation $12 = 12$, which means that any real number is a solution of this equation.

TEACHER GUIDE

FINALLY, have students use the **Turn & Talk** routine.

The equations that students have seen so far in this lesson have one solution. In this problem, students analyze equations that have no solution or infinitely many solutions.

TEACHING STRATEGY

Multilingual Learners

Group students with a different-language speaker group. Have students talk about the mathematics task in a combination of their home language and English before they record their ideas in writing. Encourage the use of mathematical notation and drawings as well as sentences in their writing.

Task 5

Student Edition p. 66

STUDENT CONTENT

Use an Equation to Solve a Real-World Problem

When solving a real-world problem, you may have to use a formula, such as the formula $P = 2\ell + 2w$ for the perimeter of a rectangle or the formula $d = rt$ for the distance traveled at a constant rate. When using a formula, you should pay attention to the units of measurement associated with the variables to ensure that the units are consistent.

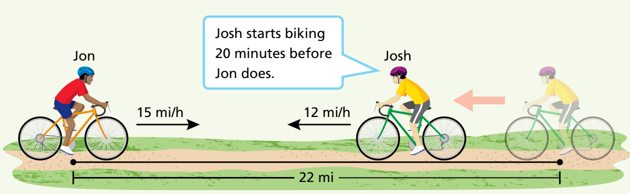
Perimeter ?	= 2 •	Length (meters)	+ 2 •	Width ?

Since the length is in meters, the width must also be in meters so you can add the units on the right side. This means the perimeter is in meters because meters + meters = meters.

Distance (feet)	=	Rate ?	•	Time (seconds)

For the units to be consistent in this equation, the rate must be measured in *feet per second* and not, for example, *miles per hour*.

MP **Model with Mathematics** Two friends, Jon and Josh, live at opposite ends of a trail. They bike toward each other at the speeds shown. At what distance along the trail, measured from Jon's starting point, will the two friends meet?



A. Describe the relationship between the distances traveled by the cyclists and the total distance.
The sum of the distances traveled by the cyclists when they meet equals the total distance.

TEACHER GUIDE

START the task by making sure the students understand the problem. The **Three Reads** routine can help support students in making sense of the problem.

ASK What is the problem about? This problem is about determining when two friends will meet if they start at opposite ends of a trail and bike toward each other.

ASK What numbers are important? Why are they important? 15 mi/h, 12 mi/h, 22 miles, 20 minutes; These values represent the speeds the friends bike, the total distance of the trail, and the amount of time Josh starts biking before Jon.

MP **NEXT,** have students use the **Mathematical Practice: Model with Mathematics**.

Encourage students to use a verbal model to help them write a mathematical model for a real-world situation.

NOW, have students solve the problem. As students work, monitor their responses. Provide support and encourage students who used correct strategies to share their thinking.

ASK What is true about the sum of Jon's biking distance and Josh's biking distance? The sum of the distance is 22 miles.

ASK How can you express the biking distances in terms of time? You can write each distance as the product of speed and time.

ASK How can you convert 20 minutes to hours? Possible answer: I can multiply 20 minutes by the conversion factor $\frac{1 \text{ hour}}{60 \text{ minutes}}$ to obtain the equivalent time $\frac{1}{3}$ hour.

ASK The solution of the equation in the problem is $t = \frac{2}{3}$. Is this the answer to the question asked in the problem? Explain. no; The problem asks for the distance from Jon's starting point at which Jon and Josh meet. You need to multiply the solution of the equation by Jon's speed, 15 mi/h, to find this distance and answer the question.

Learn | Essential Sessions

Task 5, *continued*

STUDENT CONTENT, *CONTINUED*

B. Express the distance in terms of time. Let t represent the time in *hours* that Jon spends biking. Why is the expression $t + \frac{1}{3}$ and not $t + 20$?

Josh's time is measured in hours, not minutes. Josh's head start of 20 minutes is equal to $\frac{1}{3}$ hour.

Jon's distance (mi)				Josh's distance (mi)				
Jon's rate (mi/h)	•	Jon's time (h)	+	Josh's rate (mi/h)	•	Josh's time (h)	=	Distance (mi)
15		t		12		$t + \frac{1}{3}$		22

Write and solve an equation.

C. Use the information in the equation and the solution to answer the question.

Write an equation.

$15t + 12\left(t + \frac{1}{3}\right) = 22$

Solve the equation.

$15t + 12\left(t + \frac{1}{3}\right) = 22$	Given equation.
$15t + 12t + 4 = 22$	Distributive Property
$27t + 4 = 22$	Combine like terms.
$27t = 18$	Subtraction Property of Equality
$t = \frac{2}{3}$	Division Property of Equality

Answer the question.

The two friends will meet at a distance of $15\left(\frac{2}{3}\right) = \underline{10}$ miles from Jon's starting point on the trail.

TEACHER GUIDE, *CONTINUED*

THEN, use the **Discussion Supports** routine to help students discuss their thinking. Revoice student discussion to model precise mathematical language use when explaining their thinking, strategies, or reasoning of when the two friends will meet. Ask clarifying questions to help students apply appropriate language.

TEACHING STRATEGY

UDL Support: Representation

Read through the word problem with the students. Rephrase the problem using only the important information required for solving.

STUDENT CONTENT

Turn & Talk **Suppose the trail in this task is only 3 miles long. Write and solve a new equation to find the time Jon spends biking. Does your solution make sense? Explain.**

The equation would be $15t + 12\left(t + \frac{1}{3}\right) = 3$, so $27t + 4 = 3$, and $t = -\frac{1}{27}$; So, Jon and Josh cannot be 3 miles apart when they start.

TEACHER GUIDE

FINALLY, have students use the **Turn & Talk** routine.

If students do not notice that the solution of the equation makes no sense, ask them if time can be negative.

TEACHING STRATEGY

UDL Support: Action & Expression

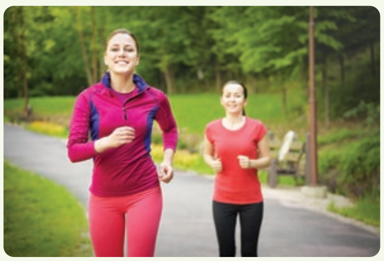
To assist students with managing information, guide them to understand how a math concept is or is not applicable to real-world situations. In the Turn & Talk example, the students should realize that the mathematical solution to the equation is not a viable solution in a real-world context.

Review Spark Your Learning

Student Edition p. 67

STUDENT CONTENT

Lynn and Anna are joggers who use the same running trail. Lynn starts jogging on the trail at 4:00 p.m. She jogs at an average speed of 5.4 miles per hour. Anna starts jogging from the same location and in the same direction as Lynn but at 4:06 p.m. Anna jogs at an average speed of 6.0 miles per hour.



At what time will Anna catch up with Lynn? Explain your reasoning.

Think about how you solved the Spark Your Learning at the beginning of the session. How would you find out when Anna catches up with Lynn now? What steps would you take that would be different from the way you solved the problem at the beginning?

TEACHER GUIDE

NOW, review **Spark Your Learning**.

Allow students to work with partners to discuss how they might solve the problem.

ASK How could you use what you learned about solving problems in one variable to solve the problem? Possible answer: I would first define variables and expressions to model the times spent jogging and write an equation, Next, I would use the properties of equality to write a simpler equivalent equation to find the solution to the original equation.

Use the feedback from student answers to inform your next steps in Differentiation and Practice.

TEACHING STRATEGY
Multilingual Learners

When reviewing students' writing to present, describe, and explain ideas and information, respond to their work by suggesting alternative phrasing instead of deeming their phrasing incorrect. For example, say, "I see what you are saying here. A mathematical way to label that rule would be 'the Addition Property of Equality.'"

Learn | Essential Sessions

Assess

Quick Check

Student Edition p. 68

STUDENT CONTENT

1. Which two of the equations are equivalent? Explain your reasoning.

$2x + 7 = 1$ $\quad -3x + 4 = 12$ $\quad x = -3$

$2x + 7 = 1$ and $x = -3$ because both equations have the same solution.

2. Solve the equation $6(2x - 5) - 8 = 4$ and give a justification for one step.

A. $x = \frac{7}{2}$

B. For the first step, use the Distributive Property to get $12x - 30 - 8 = 4$.

3. Solve the equation $\frac{1}{2}(4x - 3) = \frac{3}{4}(4x - 5)$ and give a justification for one step.

A. $x = \frac{9}{4}$

B. For the solution step between $8x - 6 = 12x - 15$ and $9 = 4x$, use the Addition Property of Equality and the Subtraction Property of Equality.

4. The local art center sells two types of memberships each year. The premium membership is \$90, and the regular membership is \$60. The center wants to sell a total of 100 memberships. How many premium memberships must the center sell in order to earn \$7260 in membership sales?

42 premium memberships

TEACHER GUIDE

NOW, use the **Quick Check** to determine students' mastery of the lesson objectives.

To measure all students' mastery of the language objective, ask them to write to explain the steps to solve a linear equation with grouping symbols or variables on both sides. See the Language Development Resource Guide for a sample answer.

TEACHING STRATEGY

Multilingual Learners

Use similar scaffolds to those provided in the Multilingual Learners Teaching Strategy for Spark Your Learning to ensure the students have appropriate writing supports.

Students may choose to create and label their own visual models to support writing an equation to solve the problem.

Learning Goal

STUDENT CONTENT

I can use the properties of equality and the Distributive Property to solve an equation with the variable on both sides.

Rate yourself on this learning goal:

- ◯ **I don't understand.**
- ◯ **I need more practice.**
- ◯ **I've got it.**

TEACHER GUIDE

FINALLY, use the **Learning Goal** routine to assess students' confidence with the lesson objective.

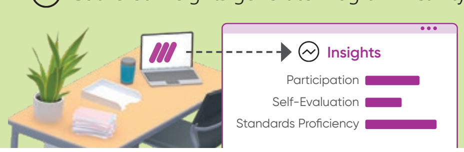
1. Share the **I Can** statement with students again. Ask students to assess their learning individually.
2. Review the class results and discuss how the data changed from the beginning of the session.
3. Use these results and other data from today to plan differentiated instruction and future learning.

End Essential Sessions

UP NEXT: Differentiation and Practice

HMH Ed **Program Activity Report**

Gathered Insights generate Program Activity Report



★ RECOMMENDED FOR ALL STUDENTS

Practice on Your Own

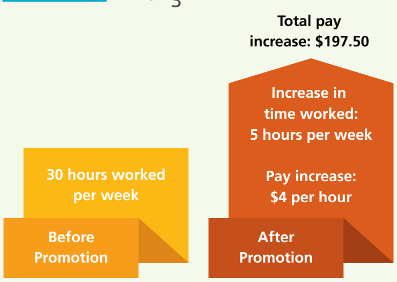
Assign these problems to your students to solve independently.
Insights available from Assessment Report on Ed.

Student Edition p. 69

STUDENT CONTENT

1. Mark solved the equation $\frac{2}{3}x = 9$ by using the Division Property of Equality to get $x = 6$. Did Mark solve the equation correctly? Explain why or why not.

no; Mark multiplied 9 by $\frac{2}{3}$ instead of dividing 9 by $\frac{2}{3}$.



2. MP **Model with Mathematics** Melissa used the information shown and the guess and check method to find the manager's new pay rate after being promoted.

New pay rate guess	Calculated new weekly pay	Calculated old weekly pay	Calculated increase in weekly pay
\$12.00 per hour	35(\$12.00) = \$420.00	30(\$12.00 − \$4.00) = \$240.00	\$420.00 − \$240.00 = \$180.00 ✗
\$15.00 per hour	35(\$15.00) = \$525.00	30(\$15.00 − \$4.00) = \$330.00	\$525.00 − \$330.00 = \$195.00 ✗
\$16.00 per hour	35(\$16.00) = \$560.00	30(\$16.00 − \$4.00) = \$360.00	\$560.00 − \$360.00 = \$200.00 ✗
\$15.50 per hour	35(\$15.50) = \$542.50	30(\$15.50 − \$4.00) = \$345.00	\$542.50 − \$345.00 = \$197.50 ✓

A. Melissa's work is shown in the table. Explain how she can generalize what she has done by defining a variable and then writing and solving an equation using that variable.

Let p represent the manager's new pay rate. Then, in terms of p, $p - 4$ represents the manager's old pay rate; $35p - 30(p - 4) = \$197.50$. The solution to this equation is $p = \$15.50$ per hour.

B. Suppose the question had been, "What was the manager's old pay rate?" Define the variable in a way that will answer this question. Then write and solve a new equation to show that you get a solution that is consistent with the one from Part A.

Let the variable p represent the manager's old pay rate. Then $p + 4$ represents the manager's new pay rate. $35(p + 4) - p = \$197.50$. The solution to this equation is $p = \$11.50$ per hour.

Solve the equation.

3. $4(3x - 10) + 7 = 15$
$x = 4$

4. $6 - 5(2x + 1) = 21$
$x = -2$

5. $2 - \frac{3}{4}(8x - 6) = 11$
$x = -\frac{3}{4}$

6. $0.2(4 - 5x) + 1 = 2.4$
$x = -0.6$

7. $5(x + 1) - 2(3x - 4) = 14$
$x = -1$

8. $2(5 - x) + 3(4x - 1) = -6$
$x = -1.3$

9. $4x - 3 = 7x + 6$
$x = -3$

10. $-2x + 5 = 3x + 1$
$x = 0.8$

11. $5(2x + 3) - 7 = -2(x + 2)$
$x = -1$

12. $8 - 3(2x - 5) = 4(x + 2)$
$x = 1.5$

13. $0.4(2x + 3) = 0.3x + 0.8$
$x = -0.8$

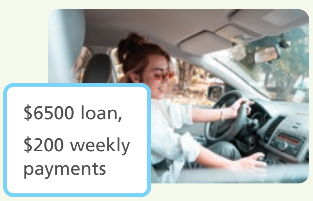
Practice on Your Own, *continued*

STUDENT CONTENT, *CONTINUED*

14. $\frac{1}{2}(6x - 5) = x - \frac{3}{2}$

$x = \underline{\ \frac{1}{2}\ }$

15. Kiera recently bought a used car from a relative, who agreed to let her pay for the car over time. She also borrowed money from her parents for a summer internship in Washington, D.C. She is paying off both loans in equal weekly payments. Use the information to determine how many weeks it take for the balances of the loans to be the same.



<u>28</u> weeks

16. Jan noticed the equation $3(4x - 7) + 2(4x - 7) = 5$ has the form $3\blacksquare + 2\blacksquare = 5\blacksquare$ where $\blacksquare = 4x - 7$.

A. Explain how Jan can use this information to solve the equation $3(4x - 4) + 2(4x - 4) = 5$.
For $3(4x - 7) + 2(4x - 7) = 5$, $3\blacksquare + 2\blacksquare = 5$ implies that $5\blacksquare = 5$, or $\blacksquare = \underline{1}$. If $\blacksquare = 4x - 7$, this means that $4x - 7 = \underline{1}$. This simplifies to $4x = \underline{8}$, so $x = \underline{2}$.

B. Now, use the same method to solve the equation $2(3x + 4) - 5(3x + 4) = 33$.
For $2(3x + 4) - 5(3x + 4) = 33$, $2\blacksquare - 5\blacksquare = 33$ implies that $-3\blacksquare = 33$, or $\blacksquare = \underline{-11}$.
If $\blacksquare = 3x + 4$, this means that $3x + 4 = \underline{-11}$.
This simplifies to $3x = \underline{-15}$, so $x = \underline{-5}$.

17. Show two ways to solve the equation $4(2x - 3) = 2x - 3$ algebraically. Construct a viable argument to justify each solution method.

18. Two subscription services offer deliveries of boxes of nutritious, organic snack foods each month. For how many months of deliveries will the two plans cost the same?

<u>5</u> months

19. Luke wants to mix dry roasted peanuts and dried cranberries to make a trail mix. He wants to make 20 ounces of trail mix and spend $11. What weight of peanuts does he need to buy?

<u>12</u> ounces, or <u>0.75</u> lb, of peanuts

20. MP **Use Structure** Consider the equation $3(2x - 5) = ax + b$ where a and b represent constants.

A. For what values of a and b would any value of x be a solution of the equation?

$a = \underline{6}$

$b = \underline{-15}$

B. Given $b = 20$, for what value of a is there no solution to this equation? $a = \underline{6}$

C. Given $a = 5$ and $b = 20$, what is the solution to the equation? $x = \underline{35}$

Practice on Your Own, *continued*

Item Guide

Item #	DOK	Aligns to
1	2	Task 1
2A, 2B	3	Task 5
3-6	1	Task 2
7-8	1	Task 3
9-14	1	Task 4
15	2	Task 5
16	2	Task 3
17	3	Task 4
18-19	2	Task 5
20A, 20B	3	Task 4
20C	2	

Rubric for Item 17

Points	Description
2	Response provides a complete and correct explanation of, or answer to, the question. **Possible answer:** Method 1: $4(2x - 3) = 2x - 3$; $8x - 12 = 2x - 3$; $6x - 12 = -3$; $6x = 9$; $x = 1.5$. Method 1 is justified by the Distributive Property and by the subtraction, addition, and division properties of equality. Method 2: $4(2x - 3) = 2x - 3$; $3(2x - 3) = 0$; $2x - 3 = 0$; $2x = 3$; $x = 1.5$. Method 2 is justified by the subtraction, division, and addition properties of equality.
1	Response provides a partially complete and correct explanation of, or answer to, the question. **Possible answer:** Method 1: $4(2x - 3) = 2x - 3$; $8x - 12 = 2x - 3$; $6x - 12 = -3$; $6x = 9$; $x = 1.5$. Method 2: $4(2x - 3) = 2x - 3$; $3(2x - 3) = 0$; $2x - 3 = 0$; $2x = 3$; $x = 1.5$.
0	Response is incorrect, irrelevant, or not provided.

Name ______________________________

Solve Linear Equations in One Variable

Worked Example

1. Solve $-4(-2x + 1) + 5 = 3$.

Justify your solution steps and check the solution.

A. Justify each solution step.

$-4(-2x + 1) + 5 = 3$	Given equation
$8x - 4 + 5 = 3$	Distributive Property
$8x + 1 = 3$	Combine constants
$8x = 2$	Subtraction Property of Equality
$x = 0.25$	Division Property of Equality

B. Check your solution.

$$-4(-2(0.25) + 1) + 5 = 3$$
$$-4(0.5) + 5 = 3$$
$$-2 + 5 = 3$$
$$3 = 3 \ \checkmark$$

Practice

2. Which justification belongs in the blank?

$8x + 3 = 5x - 3$	Given equation
$3x + 3 = -3$	?
$3x = -6$	Subtraction Property of Equality
$x = -2$	Division Property of Equality

Ⓐ Subtraction Property of Equality
Ⓑ Addition Property of Equality
Ⓒ Combine constants
Ⓓ Distributive Property

3. Which solution step belongs in the blank?

$-2(3x - 4) + 12 = -16$	Given equation
$-6x + 8 + 12 = -16$	Distributive Property
?	Combine constants
$-6x = -36$	Subtraction Property of Equality
$x = 6$	Division Property of Equality

(A) $-6x - 20 = -16$

(B) $6x + 20 = -16$

(C) $-6x + 16 = -16$

(D) $-6x + 20 = -16$

4. Which step is incorrectly paired with its justification?

Step 1:	$\frac{1}{2}(2x - 4) + 2 = 4(x + 2) - 11$	Given equation
Step 2:	$x - 2 + 2 = 4x + 8 - 11$	Distributive Property
Step 3:	$x = 4x - 3$	Combine constants
Step 4:	$-3x = -3$	Subtraction Property of Equality
	$x = 1$	Addition Property of Equality

(A) Step 1

(B) Step 2

(C) Step 3

(D) Step 4

For Problems 5–8, solve each equation.

5. $4 - 3x = 2x - 11$

$x =$ 3

6. $0.8 + 0.3(2 - 3x) = 1.4$

$x =$ 0

7. $2x - \frac{1}{3}(9x + 5) = \frac{10}{3}$

$x =$ −5

8. $2(x - 3) - 4(x + 3) = -24$

$x =$ 3

9. Miguel and Alina canoe toward each other on a river, starting from points 12 miles apart. Miguel begins paddling at 9:00 a.m., and Alina begins at 10:00 a.m. Their paddling speeds in calm water are 3 miles per hour for Miguel and 4 miles per hour for Alina, but Miguel paddles with the current and Alina paddles against the current. They meet at 11:00 a.m. What is the speed of the current?

A. Write an equation to model the situation. Let c equal the speed of the current in miles per hour.

$(3 + c)(2) + (4 - c)(1) = 12$

B. What is the speed of the current?

2 mi/h

10. A group of friends are going camping and decide to take two cars to the campsite. The first car leaves 15 minutes before the other and travels at an average speed of 50 miles per hour. The second car travels at an average speed of 55 miles per hour. If t represents the time (in hours) since the first car left, which equation could be used to find the time when the second car catches up with the first (assuming that the cars have not yet reached the campsite)?

Ⓐ $50t = 55(t - 15)$

Ⓑ $50(t - 15) = 55t$

Ⓒ $50t = 55(t - 0.25)$

Ⓓ $50(t - 0.25) = 55t$

11. A company spends 12% of its annual budget on travel for sales. Their total budget this year is \$1500 more than last year, and this year they plan to spend \$5640 on travel. What was the company's total budget last year?

\$45,500

12. Two families decide to drive to a state park and spend the day together there. The Patel family leaves first and travels at an average speed of 48 miles per hour. The Franklin family leaves 30 minutes later and travels at an average speed of 54 miles per hour. After how many hours do the two families meet? Let t represent the time in hours.

Complete the statements.

An equation that models the situation is $48t = 54(t - 0.5)$.

Solving this equation results in $t =$ 4.5, so the families would have to drive for 4.5 hours before they meet.

13. A student attempted to solve this problem: The hands of a clock coincide at 12:00. At what time, to the nearest second, do the hands again coincide?

The student wrote this explanation:

The minute hand of a clock makes 1 revolution in an hour, so it moves through 360° every hour. The hour hand makes only $\frac{1}{12}$ of a revolution in an hour, so it moves through 30° every hour. If I let t represent the time (in hours) since 12:00, then 360t represents the number of degrees through which the minute hand moves and 30t represents the number of degrees through which the hour hand moves. When the minute hand catches up with the hour hand for the first time, it has completed 1 revolution more than the hour hand, so I must subtract 1 from 360t before setting it equal to 30t. So, $360t - 1 = 30t$.

Explain the error in this reasoning. Then correct the error and finish solving the problem.

The student did not use the correct units in the equation. The student subtracted 1 because the minute hand made 1 more revolution than the hour hand, but the units in the problem are degrees, not revolutions. The student should have subtracted the revolution in degrees. The correct equation is $360t - 360 = 30t$. Solving this equation results in $t = 1.09$ hours, which is 1 hour and 5.4 minutes, or 1 hour and 324 seconds. So the next time the hands coincide is 324 seconds after 1:00.

Train Your Memory

14. A cylinder and a cone each have a radius of 6 inches and a height of 10 inches. How many times greater is the volume of the cylinder compared to the volume of the cone? *(Grade 8, Lesson 14.1)*

3

15. Simplify the expression $4^0 + \frac{4^2}{(4^3)^2}$. *(Grade 8, Lesson 12.1)*

$1\frac{1}{256}$

16. Which set of numbers could be the sides of a right triangle? *(Grade 8, Lesson 7.7)*

Ⓐ 15, 15, and 30

Ⓑ 20, 25, and 40

Ⓒ 60, 80, and 120

Ⓓ 90, 120, and 150

17. What is 334,014 ÷ 622? *(Fluency)*

537