

## Dear Family,

This week your student is learning how to write and solve equations that represent real-world situations.

For example, Miguel buys a pack of granola bars that costs \$3.26 and a drink. The cashier says his total is \$5.25. You can use the equation  $3.26 + x = 5.25$ , where  $x$  is the cost of the drink, to represent this situation.

**Subtracting 3.26** from both sides of the equation shows that Miguel's drink costs \$1.99.

$$\begin{aligned} 3.26 + x &= 5.25 \\ 3.26 + x - 3.26 &= 5.25 - 3.26 \\ x &= 1.99 \end{aligned}$$

Your student will be learning to solve problems like the one below.

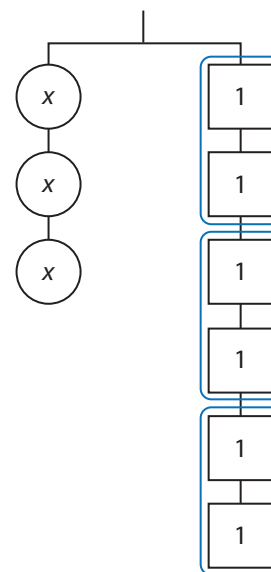
Kendra has \$6 to spend on comic books. Each comic book costs \$3. Solve the equation  $3x = 6$  to find the number of comic books,  $x$ , that Kendra can buy.

- ▶ **ONE WAY** to solve a multiplication equation is to use a hanger diagram.

The hanger diagram shows each side of the equation  $3x = 6$  as shapes that represent weights.

The hanger is balanced, so the weight of each  $x$  balances the weight of two 1s.

The model shows that  $x = 2$ .



- ▶ **ANOTHER WAY** is to use the inverse operation, division.

$$3x = 6$$

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

$$x = 2$$

Divide both sides by 3.

Using either method, the solution of the equation  $3x = 6$  is 2. Kendra can buy 2 comic books.



Use the next page to start a conversation about equations.

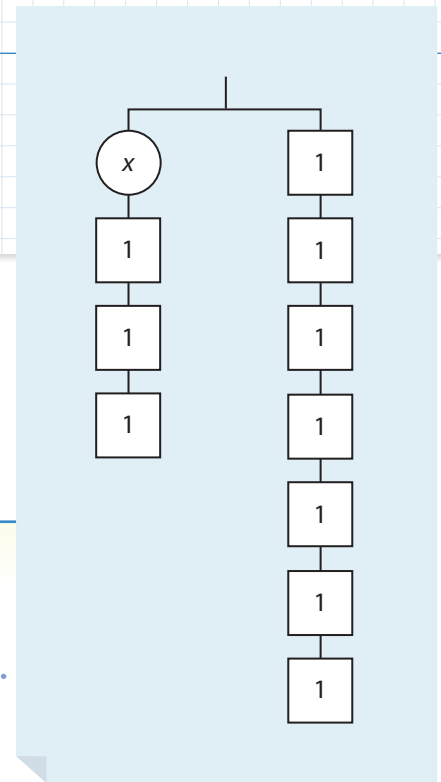


# Explore One-Variable Equations

Previously, you learned about solutions of equations. In this lesson, you will learn how to solve addition and multiplication equations in one variable.

► Use what you know to try to solve the problem below.

What is the value of  $x$  in the hanger diagram? How do you know?



**TRY IT**



**Math Toolkit** algebra tiles, counters, grid paper

## DISCUSS IT

**Ask:** How can you verify that you found the correct value of  $x$ ?

**Share:** I know my answer makes sense because ...

**Learning Target** SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7

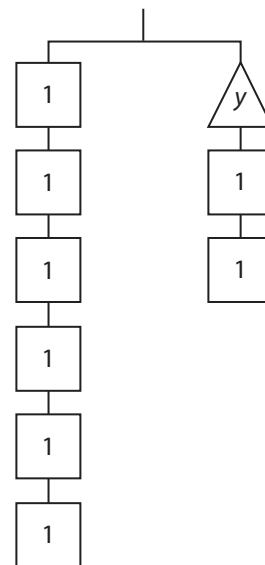
Solve real-world and mathematical problems by writing and solving equations of the form  $x + p = q$  and  $px = q$  for cases in which  $p, q$  and  $x$  are all nonnegative rational numbers.

## CONNECT IT

**1 Look Back** What is the value of  $x$  in the hanger diagram? Explain how you could find the value of  $x$ .

**2 Look Ahead** Use the hanger diagram.

- What expression does the left side of the hanger represent? What expression does the right side of the hanger represent?
- The hanger is balanced. What does that tell you about the two expressions you wrote in problem 2a? What equation does the hanger diagram represent?



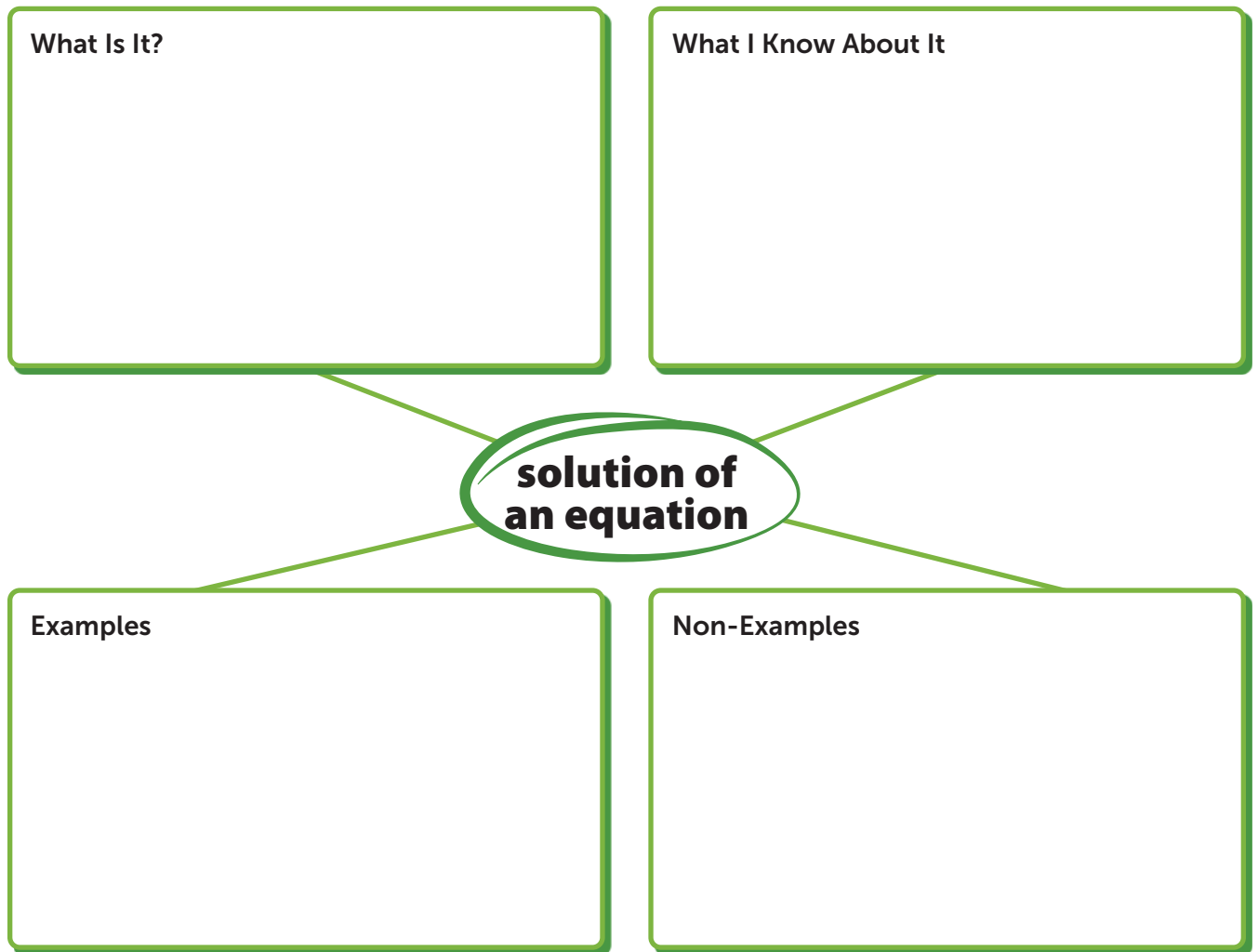
- Draw two more 1s on each side of the hanger. Why is the hanger still balanced? What equation does the hanger represent now?

- Suppose you remove three 1s from the right side of the hanger. What should you do to keep the hanger balanced?

**3 Reflect** To keep a hanger diagram balanced, what must you do when adding and removing amounts on the sides of the hanger? Why?

## Prepare for Writing and Solving One-Variable Equations

- 1 Think about what you know about solutions of equations. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.



- 2 Circle the equations for which 6 is a solution of the equation.

$4 = x + 2$

$y - 2 = 4$

$6z = 36$

$12 \div w = 6$

$x + 2 = 6$

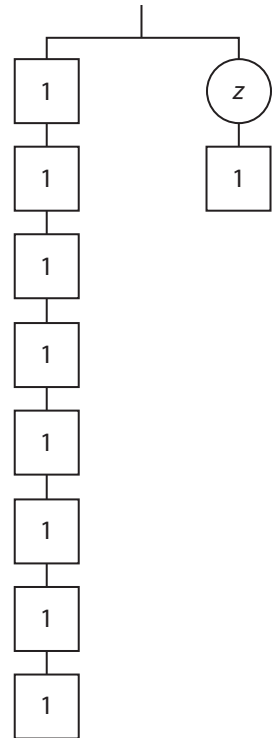
$56 = 5y$

$8 + z = 14$

$2 = \frac{w}{12}$

3 Look at the hanger diagram.

a. What is the value of  $z$  in the hanger diagram? Show your work.



**SOLUTION** \_\_\_\_\_

b. Check your answer to problem 3a. Show your work.

## Develop Solving One-Variable Addition Equations



► Read and try to solve the problem below.

An animal rescue group in Africa is taking care of 5 injured baby pixie frogs. They plan to release them back into the wild when they are healthy. Each pixie frog needs its own terrarium. One of the rescue volunteers checks and sees that there are only 3 terrariums. Solve the equation  $t + 3 = 5$  to find how many more terrariums,  $t$ , the rescue center needs.

**TRY  
IT**



**Math Toolkit** algebra tiles, counters, grid paper

**DISCUSS IT**

**Ask:** What did you do first to solve the problem?

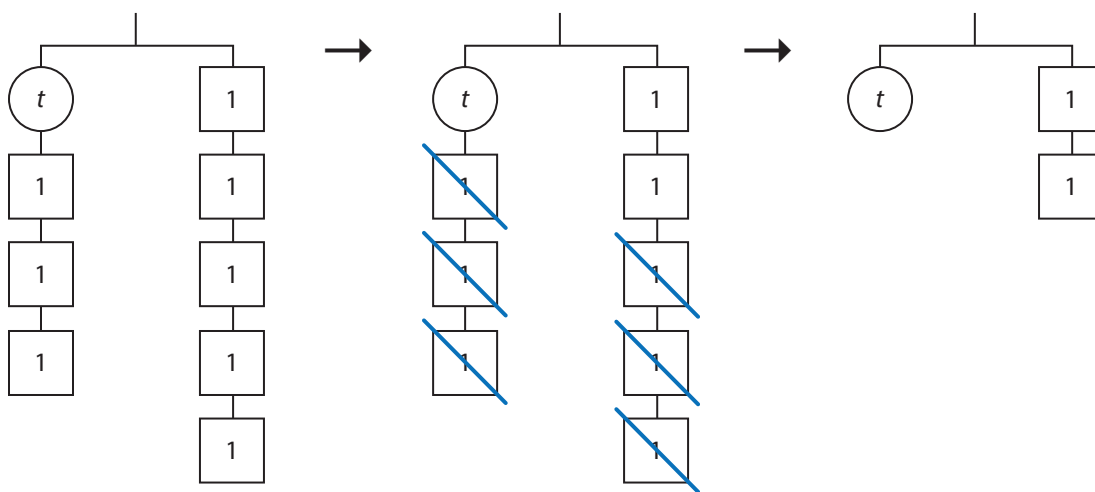
**Share:** The first thing I did was ...

► Explore different ways to solve a one-variable addition equation.

An animal rescue group in Africa is taking care of 5 injured baby pixie frogs. They plan to release them back into the wild when they are healthy. Each pixie frog needs its own terrarium. One of the rescue volunteers checks and sees that there are only 3 terrariums. Solve the equation  $t + 3 = 5$  to find how many more terrariums,  $t$ , the rescue center needs.

**Model It**

You can use a hanger diagram to model and solve an addition equation.



**Analyze It**

You can use subtraction to solve for a variable in an addition equation.

$$t + 3 = 5$$

$$t + 3 - 3 = 5 - 3 \quad \leftarrow \text{Subtract 3 from both sides of the equation.}$$

$$t = 2$$





## CONNECT IT

► Use the problem from the previous page to help you understand how to solve a one-variable addition equation.

1 Look at **Model It**. Why are three 1s removed from each side of the hanger diagram?

2 Look at **Analyze It**. How are the steps for solving the equation similar to the steps for solving the equation with the hanger diagram?

3 How many more terrariums does the rescue center need? How can you use substitution to verify that your answer is correct?

4 How are all the equations below similar to  $t + 3 = 5$ ? Why could you solve each equation by subtracting a number from both sides of the equation?

$$8 + y = 92$$

$$50 = a + 17$$

$$n + 2.2 = 5$$

$$12.5 = 7.4 + z$$

5 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve one-variable addition equations.

## Apply It

► Use what you learned to solve these problems.

- 6 Teresa has some photos on her computer on Monday. On Tuesday, she downloads 24 new photos. Then she deletes 9 photos. She ends up with 33 photos. Explain how the equation  $p + 24 - 9 = 33$  represents the situation. Then solve the equation for the variable  $p$  and interpret the solution.

- 7 What is the solution of the equation  $7 + 5 = 4 + y$ ?

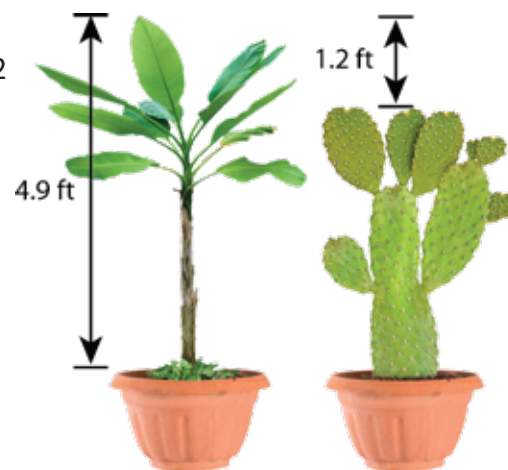
A 6

B 8

C 12

D 16

- 8 At a local gardening store, a palm tree is 1.2 ft taller than a cactus. The palm tree is 4.9 ft tall. Use the equation  $4.9 = c + 1.2$  to find the height in feet,  $c$ , of the cactus. Show your work.



## SOLUTION

## Practice Solving One-Variable Addition Equations

- Study the Example showing how to solve a one-variable addition equation. Then solve problems 1–5.

### Example

Cameron buys a stapler. Then he buys 5 notebooks that cost \$1.50 each. He spends \$13.50 in all. Use the equation  $d + 5(1.50) = 13.50$  to find the number of dollars,  $d$ , that Cameron spends on the stapler.

$$d + 5(1.50) = 13.50$$

Multiply 1.50 by 5.

$$d + 7.50 = 13.50$$

Subtract 7.50 from both sides.

$$d + 7.50 - 7.50 = 13.50 - 7.50$$

$$d = 6$$

Cameron spends \$6 on the stapler.

- 1 a. In the Example, why is 7.50 subtracted from both sides of the equation?  
  
b. Why can you replace the expression  $d + 7.50 - 7.50$  with just the variable  $d$  in the last step of solving the equation?
- 2 Solve the equation  $91 = 43 + x$ . Show your work.

### SOLUTION

- 3 On Monday, Jessica runs on a track at her school. Each day from Tuesday through Friday, she runs  $1\frac{1}{2}$  mi in a park. The total distance she runs for the week is 8 mi. Solve the equation  $m + 4\left(1\frac{1}{2}\right) = 8$  to find the number of miles,  $m$ , Jessica runs on Monday. Show your work.

**SOLUTION** \_\_\_\_\_

- 4 What operation can you use on both sides of the equation  $100 = 100 + y$  to solve the equation for  $y$ ? Solve the equation for  $y$ . Then explain how to check the solution.

- 5 Dylan has a pitcher with 1.65 L of orange juice. He pours out 0.2 L of the juice. Then he adds some sparkling water to the pitcher to make orangeade. He ends up with 1.9 L of orangeade. Solve the equation  $1.65 - 0.2 + x = 1.9$  to find the amount of sparkling water,  $x$ , Dylan adds to the pitcher. Show your work.



**SOLUTION** \_\_\_\_\_

## Develop Solving One-Variable Multiplication Equations

► Read and try to solve the problem below.

Tamera is buying party favors. She chooses pencil erasers that are shaped like pieces of sushi. Each package she buys contains the same number of erasers. She buys 2 packages and gets a total of 8 erasers. Solve the equation  $2x = 8$  to find the number of erasers,  $x$ , in each package.



**TRY  
IT**



**Math Toolkit** algebra tiles, counters, grid paper

**DISCUSS IT**

**Ask:** How is your strategy similar to mine? How is it different?

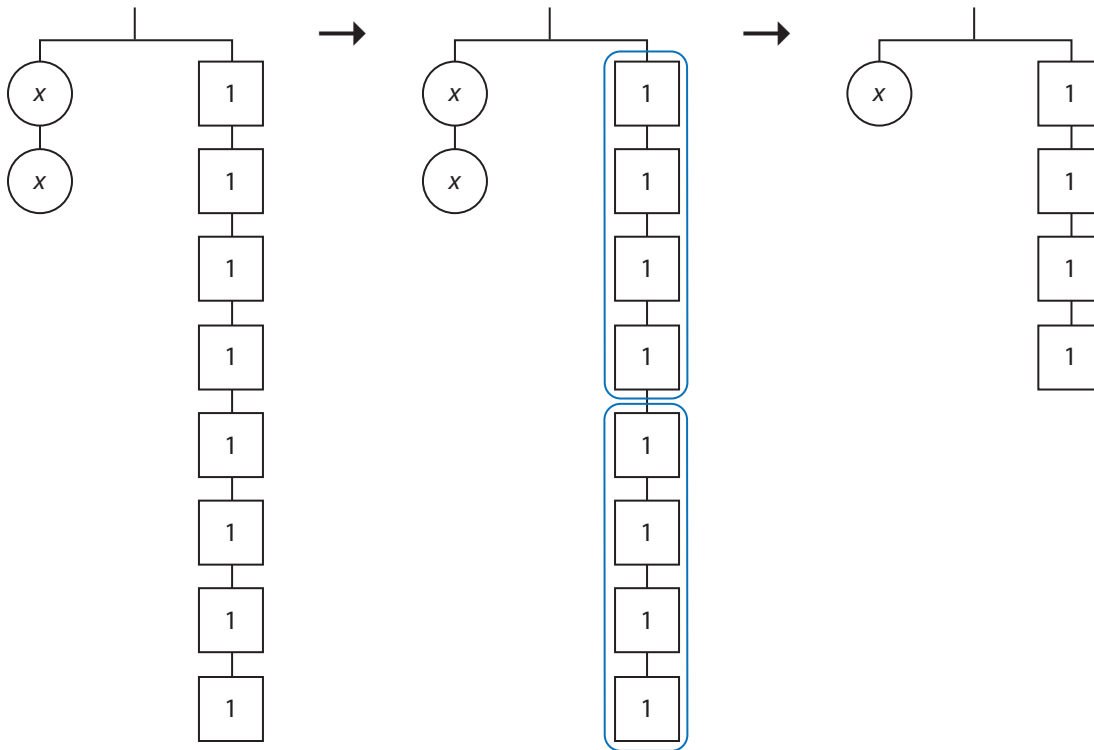
**Share:** My strategy is similar because . . . It is different because . . .

➤ Explore different ways to solve a one-variable multiplication equation.

Tamera is buying party favors. She chooses pencil erasers that are shaped like pieces of sushi. Each package she buys contains the same number of erasers. She buys 2 packages and gets a total of 8 erasers. Solve the equation  $2x = 8$  to find the number of erasers,  $x$ , in each package

**Model It**

You can use a hanger diagram to model and solve a multiplication equation.



**Analyze It**

You can use division to solve for a variable in a multiplication equation.

$$2x = 8$$

$$\frac{2x}{2} = \frac{8}{2} \quad \leftarrow \text{Divide both sides of the equation by 2.}$$

$$x = 4$$



## CONNECT IT

► Use the problem from the previous page to help you understand how to solve a one-variable multiplication equation.

- 1 Look at the second hanger diagram in **Model It**. Why are the 1s separated into two equal groups?
- 2 Look at **Analyze It**. Why can you use the fractions  $\frac{2x}{2}$  and  $\frac{8}{2}$  to show dividing both sides of the equation  $2x = 8$  by 2?
- 3 How are the steps for solving the equation similar to the steps for solving the problem with the hanger diagram?
- 4 How many erasers are in each package? How you can use substitution to check your answer?
- 5 How is solving  $2x = 8$  similar to solving  $2 + x = 8$ ? How is it different?
- 6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand solving one-variable multiplication equations.

## Apply It

► Use what you learned to solve these problems.

- 7 Four friends go on a camping trip. They decide to share the cost equally. They spend \$27.68 on food and \$42 to reserve the campsite. You can use the equation  $4c = 42 + 27.68$  to find each person's share of the cost.

a. What does the variable  $c$  represent? Explain how the equation  $4c = 42 + 27.68$  represents the situation.

b. Solve the equation for  $c$  and interpret the solution. Show your work.



### SOLUTION

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- 8 What is the solution of the equation  $12\left(\frac{1}{2}\right)y = 2$ ?

A  $\frac{1}{6}$

B  $\frac{1}{3}$

C 3

D 6

- 9 Benjamin ran a total of 21 miles last month. This is 75% of the number of miles he wants to run this month. Solve the equation  $0.75m = 21$  to find out how many miles,  $m$ , Benjamin wants to run this month. Show your work.

### SOLUTION

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## Practice Solving One-Variable Multiplication Equations

- **Study the Example showing how to solve a one-variable multiplication equation. Then solve problems 1–5.**

### Example

Miyako is making potato pancakes. She has  $4\frac{3}{4}$  lb of shredded potatoes. She uses  $\frac{1}{4}$  lb to make each pancake. Solve the equation  $4\frac{3}{4} = \frac{1}{4}p$  to find the number of potato pancakes,  $p$ , Miyako can make.

You can divide by the coefficient of the variable to solve the equation for  $p$ .

$$4\frac{3}{4} = \frac{1}{4}p$$

$$4\frac{3}{4} \cdot 4 = \frac{1}{4}p \cdot 4 \quad \leftarrow \text{To divide by } \frac{1}{4}, \text{ multiply by the reciprocal, } 4.$$

$$\frac{19}{4} \cdot \frac{4}{1} = p$$

$$19 = p$$

Miyako can make 19 potato pancakes.

- 1 In the Example, why can you replace the expression  $\frac{1}{4}p \cdot 4$  on the right side of the equation with just the variable  $p$ ?
- 2 Mindy has a piece of string that is  $5\frac{1}{2}$  yd long. She cuts it into pieces that are each  $\frac{1}{2}$  yd long. Solve the equation  $5\frac{1}{2} = \frac{1}{2}x$  to find out how many pieces of string,  $x$ , she gets. Show your work.

### SOLUTION

- 3 Khalid plans to save the same amount of money each month for 6 months to buy a remote control helicopter. The helicopter costs \$112.75 plus \$8.75 for delivery. Khalid has a coupon for \$18 off the price of the helicopter.
- a. Use the equation  $6m = 112.75 - 18 + 8.75$  to find out how much money,  $m$ , Khalid should save each month. Show your work.



### Hover Copter II

**\$112.75** + \$8.75 delivery fee



Add to Cart

## SOLUTION

- b. How much money would Khalid need to save each month if he did not have the \$18 coupon? Explain your reasoning.
- 4 What operation would you use to solve  $10 = 6y$ ? Explain your reasoning.
- 5 A can of tomato sauce contains 8 oz of sauce. A case contains 12 cans. Chef Hugo orders some cases of tomato sauce and gets a total of 480 oz of sauce. Use  $12(8)x = 480$  to find out how many cases of tomato sauce Chef Hugo orders,  $x$ . Show your work.

## SOLUTION

## Develop Writing and Solving One-Variable Equations

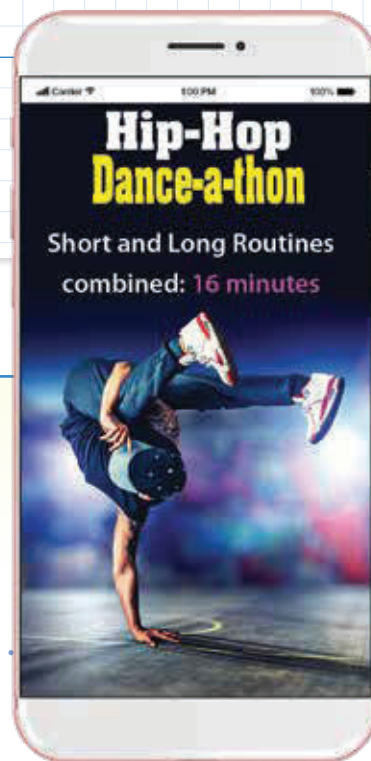
► Read and try to solve the problem below.

A dance crew is entering a hip-hop dance contest with a short routine and a long routine. The combined length of the two routines must be 16 min. The crew's long routine is 3 times as long as the short routine. Write and solve an equation to find the lengths of the crew's two routines.

TRY  
IT



**Math Toolkit** algebra tiles, grid paper, number lines



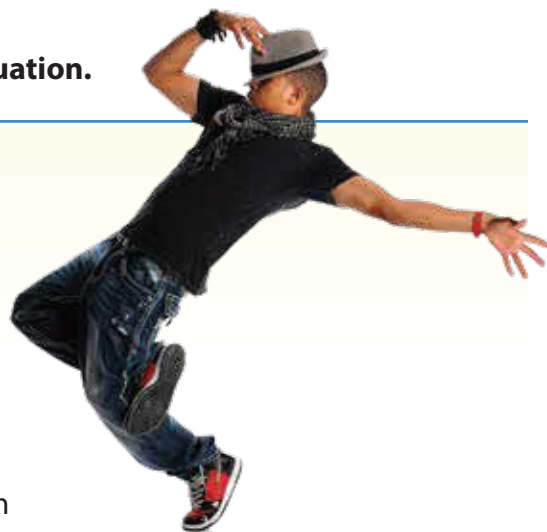
### DISCUSS IT

**Ask:** What does each side of your equation represent?

**Share:** The left side of my equation shows ...  
The right side of my equation shows ...

► Explore different ways to write and solve a one-variable equation.

A dance crew is entering a hip-hop dance contest with a short routine and a long routine. The combined length of the two routines must be 16 min. The crew's long routine is 3 times as long as the short routine. Write and solve an equation to find the lengths of the crew's two routines.

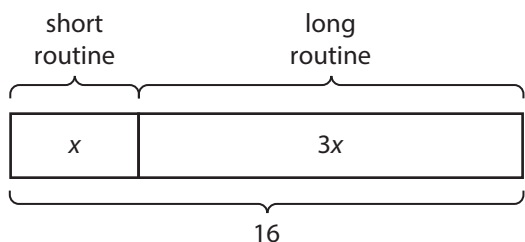


### Model It

You can use a bar model to show how the quantities in the problem are related.

Let  $x$  be the length of the short routine in minutes.

Then the length of the long routine in minutes is  $3x$ .



### Model It

You can use words to help you write an equation with a variable.

The combined length of the two routines is 16 min.

$$\begin{array}{rcccl}
 \text{length of} & & \text{length of} & = & \text{total length} \\
 \text{short routine} & + & \text{long routine} & & \text{of routines} \\
 \downarrow & & \downarrow & & \downarrow \\
 x & + & 3x & = & 16
 \end{array}$$

### Analyze It

You can use equivalent expressions and an inverse operation to solve an equation.

$$x + 3x = 16$$

$$4x = 16$$

$$\frac{4x}{4} = \frac{16}{4}$$

$$x = ?$$

## CONNECT IT

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► Use the problem from the previous page to help you understand how to write and solve a one-variable equation.

- 1 Look at the two **Model Its**. How are they similar?
- 2 How do the two **Model Its** help you write an equation?
- 3 Look at the first two equations in **Analyze It**. Why can you replace the expression  $x + 3x$  with the expression  $4x$ ? Why is this step necessary?
- 4 What are the lengths of the crew's routines? How can you use substitution to check your answer?
- 5 How can writing and solving an equation help you solve a real-world problem?
- 6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.



## Practice Writing and Solving One-Variable Equations

- Study the Example showing how to write and solve a one-variable equation. Then solve problems 1–5.

### Example

**At the grocery store, Samuel spends \$9 on fruits and vegetables. This is 80% of the money he spends in all. How much does Samuel spend?**

Let  $m$  = the amount in dollars that Samuel spends.

Write an equation.

80% of the money Sam spends is \$9.

$$0.8 \cdot m = 9$$

Solve the equation for  $m$ .

$$0.8m = 9$$

$$\frac{0.8m}{0.8} = \frac{9}{0.8}$$

$$m = 11.25$$

Samuel spends \$11.25.

- There are 12 paperback mysteries on a shelf. This is 40% of the books on the shelf. Write and solve an equation to find the number of books on the shelf. Show your work.
- Three friends play a game. Jamila has  $4\frac{1}{2}$  more points than Carter. Carter has  $7\frac{1}{2}$  more points than Aisha. Jamila has 26 points. Write and solve an equation to find the number of points Aisha has. Show your work.

**SOLUTION** \_\_\_\_\_

**SOLUTION** \_\_\_\_\_



- 3 At a theme park, the waiting time for the roller coaster is usually 3 times as long as the waiting time for the bumper cars. The park's website says that visitors who go on both rides should expect to wait a total of 30 min. What is the usual waiting time for the bumper cars? Show your work.

**SOLUTION** \_\_\_\_\_

- 4 The length of a rectangle is twice its width. The perimeter of the rectangle is 36 ft. What are the length and width of the rectangle? Show your work.

**SOLUTION** \_\_\_\_\_

- 5 Neva is training for a race. This week, she bikes 5.5 times as far as she runs. Her total distance running and biking this week is 26 mi. How far does Neva run this week? Show your work.

**SOLUTION** \_\_\_\_\_



# Refine Writing and Solving One-Variable Equations

► Complete the Example below. Then solve problems 1–9.

### Example

At Valley Middle School,  $\frac{3}{5}$  of the students study Spanish. There are 96 students who study Spanish. Solve the equation  $\frac{3}{5}n = 96$  to find the number of students,  $n$ , at the school.

Look at how you could multiply by the reciprocal to solve a multiplication equation.

$$\begin{aligned} \frac{3}{5}n &= 96 \\ \frac{5}{3} \cdot \frac{3}{5}n &= \frac{5}{3} \cdot 96 \\ 1 \cdot n &= \frac{5 \cdot 96}{3} \\ n &= 5 \cdot 32 \end{aligned}$$

**SOLUTION** \_\_\_\_\_

### CONSIDER THIS . . .

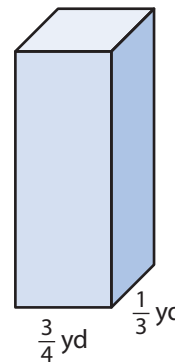
The product of a number and its reciprocal is 1.

### PAIR/SHARE

Why is  $\frac{5 \cdot 96}{3}$  equivalent to  $5 \cdot 32$ ?

### Apply It

- 1 The volume of the right rectangular prism is  $\frac{1}{2} \text{ yd}^3$ .  
What is the height of the prism? Show your work.



### CONSIDER THIS . . .

The formulas for the volume of a right rectangular prism are  $V = \ell wh$  and  $V = Bh$ .

**SOLUTION** \_\_\_\_\_

### PAIR/SHARE

How can you verify that your answer is correct?

- 2 Yukio has a checking account. On Monday, he writes 3 checks for \$65 each. His balance at the end of the day is \$330.25. Use an equation with a variable to find Yukio's balance at the start of the day. Show your work.

**CONSIDER THIS . . .**

When writing checks, your account balance decreases.

**SOLUTION** \_\_\_\_\_

- 3 Carmen and Erin collect cans of food for a food drive. Carmen collects 5 times as many cans of food as Erin. Together, they collect 60 cans of food. Which equation can you solve to find the number of cans of food Erin collects?

- A  $5x = 60$
- B  $6x = 60$
- C  $\frac{1}{5}x = 60$
- D  $x = 60 \cdot 5$

Jelani chose B as the correct answer. How might he have gotten that answer?

**PAIR/SHARE**

How can you use estimation to make sure your answer is reasonable?

**CONSIDER THIS . . .**

You can write an equation where one side is an algebraic expression for the total number of cans of food Carmen and Erin collect.

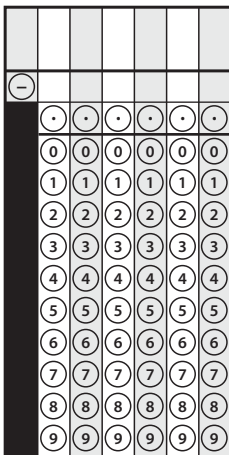
**PAIR/SHARE**

How can you find the number of cans of food Carmen collects?

- 4 Ju-long has 6 guppies in his aquarium. This is 24% of the fish in the aquarium. How many fish are in Ju-long's aquarium? Use an equation with a variable. Show your work.

**SOLUTION** \_\_\_\_\_

- 5 What is the solution of the equation  $9\frac{1}{3} = x + 9\frac{1}{3}$ ?



- 6 Consider the equation  $\frac{2}{5}y = 20$ . Tell whether each statement is *True* or *False*.

	True	False
a. You can solve the equation by multiplying both sides by $\frac{5}{2}$ .	<input type="radio"/>	<input type="radio"/>
b. You can solve the equation by dividing both sides by $\frac{2}{5}$ .	<input type="radio"/>	<input type="radio"/>
c. The equation has the same solution as $\frac{5}{2}y = 20$ .	<input type="radio"/>	<input type="radio"/>
d. The equation has the same solution as $\frac{4}{5}y = 40$ .	<input type="radio"/>	<input type="radio"/>

- 7 Each day from Monday to Friday, Enrico uses a rideshare scooter to take the same route to and from work. According to the rideshare app, the total distance he rides each week is 13 mi. Explain how to write an equation that Enrico can use to find the distance of one trip to or from work. Show how to solve the equation.



- 8 Is the value of  $w$  the same in both equations shown below? Explain how you can decide without solving the equations.

$$w + 16 = 43$$

$$w + 16 - 7 = 43 - 7$$

- 9 **Math Journal** Write an equation that you can solve by subtracting 3.2 from both sides of the equation. Then show how to solve the equation and check your solution.

### ✓ End of Lesson Checklist

- INTERACTIVE GLOSSARY** Find the entry for *equation*. Add two important things you learned about equations in this lesson.
- SELF CHECK** Go back to the Unit 5 Opener and see what you can check off.