


### Explain It!

Six friends go white-water rafting. The total cost for the adventure is \$683.88, including a \$12 fee per person to rent flotation vests. Marcella says they can use the equation  $6r + 12 = 683.88$  to find the rafting cost,  $r$ , per person. Julia says they need to use the equation  $6(r + 12) = 683.88$ .



### Lesson 5-3

#### Solve Equations Using the Distributive Property

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**I can...**  
use the Distributive Property to solve equations.

**A. Construct Arguments** Whose equation accurately represents the situation? Construct an argument to support your response.

**B.** What error in thinking might explain the inaccurate equation?

**Focus on math practices**

**Use Structure** How can you use the correct equation to determine the rafting cost per person?

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### Essential Question


How does the Distributive Property help you solve equations?

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### EXAMPLE 1

#### Solve Equations Using the Distributive Property

Each of the graphic novels in Chen's collection increased in value by \$3.50 in the last few years. If each graphic novel has the same value, what was the original value of one graphic novel?




10 graphic novels  
Current total value: \$75

**Model with Math** How can you write an equation in the form  $px + q = r$  to relate the quantities in the problem?

Use an area model to represent the situation and write an equation.

Let  $g$  represent the original value of a graphic novel.



$10(g + 3.50) = 75$

Solve for  $g$  to find the original cost of each graphic novel.

$$10(g + 3.50) = 75$$

$$(10 \cdot g) + (10 \cdot 3.50) = 75$$

Use the Distributive Property.

$$10g + 35 = 75$$

$$10g + 35 - 35 = 75 - 35$$

$$\frac{10g}{10} = \frac{40}{10}$$

$$g = 4$$

Use mental math to check that the solution is reasonable. Think:  $10(4 + 3.50)$  is  $10(7.5)$ , or 75.

The original value of one graphic novel was \$4.00.

**Try It!**

A collector has a box of 32 figurines. The value of each figurine increased by \$2.32 over the past year. The box of figurines is now worth \$114.24. What was the original cost,  $x$ , of one figurine? The original cost of one figurine was \_\_\_\_\_.

**Convince Me!** Can the equation  $32x + 2.32 = 114.24$  be used to find the original cost of each figurine in the problem above? Explain.

$(\quad) \cdot (x + \quad) = \quad$   
 $(\quad) \cdot (x) + (\quad) \cdot (\quad) = \quad$   
 $\quad + \quad = \quad$   
 $\quad = \quad - \quad$   
 $x = \quad \div \quad$   
 $x = \quad$

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**EXAMPLE 2** Solve Equations by Distributing a Negative Number

Solve the equation  $-5(s + 30) = -17$ .

$$\begin{aligned}
 -5(s + 30) &= -17 \\
 -5s + (-5)(30) &= -17 && \text{Use the Distributive Property to distribute the negative number.} \\
 -5s - 150 &= -17 \\
 -5s - 150 + 150 &= -17 + 150 && \text{Remember the rules for multiplying negative integers.} \\
 -5s &= 133 \\
 \frac{-5s}{-5} &= \frac{133}{-5} \\
 s &= -26\frac{3}{5}
 \end{aligned}$$

**EXAMPLE 3** Solve Equations by Distributing a Rational Number

The cheerleading squad received  $\frac{1}{4}$  of the total sales of foam fingers and pom-poms at a pep rally. The squad received a total of \$136.75. What was the value of the pom-poms sales,  $p$ ?

Write and solve an equation.

$$\begin{aligned}
 \frac{1}{4}(\text{pom-pom sales} + \text{foam finger sales}) &= \text{total amount squad received} \\
 \frac{1}{4}(p + 258) &= 136.75 \\
 \frac{1}{4}p + \frac{1}{4}(258) &= 136.75 && \text{Use the Distributive Property.} \\
 \frac{1}{4}p + 64.5 &= 136.75 \\
 \frac{1}{4}p + 64.5 - 64.5 &= 136.75 - 64.5 \\
 \frac{1}{4}p &= 72.25 \\
 \left(\frac{4}{4}\right)\frac{1}{4}p &= 72.25\left(\frac{4}{4}\right) \\
 p &= 289
 \end{aligned}$$

\$258 in sales of foam fingers



The total received from pom-pom sales was \$289.

**Try It!**

Use the Distributive Property to solve each equation.

- a.  $-\frac{1}{2}(b - 6) = 5$       b.  $0.4(x - 0.45) = 9.2$       c.  $-4(p - 212) = 44$

**KEY CONCEPT**

When solving equations written in the form  $p(x + q) = r$ , you can use the Distributive Property to multiply the two terms in the parentheses by the term outside the parentheses.

$$\begin{aligned}
 6(x + 8.5) &= 123 \\
 6x + 51 &= 123 \\
 6x &= 72 \\
 x &= 12
 \end{aligned}$$



**Do You Understand?**

- Essential Question** How does the Distributive Property help you solve equations?
- Make Sense and Persevere** How are the terms in parentheses affected when multiplied by a negative coefficient when the Distributive Property is applied?
- Reasoning** How can an area model help you set up an equation for a problem situation?

**Do You Know How?**

- A family of 7 bought tickets to the circus. Each family member also bought a souvenir that cost \$6. The total amount they spent was \$147. How much did one ticket cost?

- David reads the problem: *Ally bought a T-shirt and a pair of shorts on sale, which reduced prices to  $\frac{1}{4}$  of the total savings on the two garments was \$10.25. Find the original price for the pair of shorts.*



$$\begin{aligned}
 T + S \\
 \frac{1}{4}(18 + 41)
 \end{aligned}$$

David says that the original price of the shorts was \$41. Does his answer seem reasonable? Defend your answer by writing and solving an equation that represents the situation.

$$\begin{aligned}
 \frac{1}{4}(59) \\
 4 \overline{) 59} & \frac{3}{4} = 14.75 \\
 \underline{-14} & \text{Savings} \\
 19 & \\
 \underline{-16} & \\
 3 &
 \end{aligned}$$

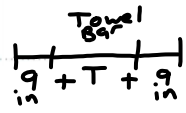
- Which of the following shows the correct use of the Distributive Property when solving  $\frac{1}{3}(33 - x) = 135.2$ ?
  - $(33 - x) = \frac{1}{3} \cdot 135.2$
  - $\frac{1}{3} \cdot 33 - \frac{1}{3}x = \frac{1}{3} \cdot 135.2$
  - $\frac{1}{3} \cdot 33 + \frac{1}{3}x = 135.2$
  - $\frac{1}{3} \cdot 33 - \frac{1}{3}x = 135.2$



14. The solution shown for the equation is incorrect.
- What is the correct solution?
  - What was the likely error?

$$\begin{array}{r} -3(6 - r) = 6 \\ -18 - 3r = 6 \\ -3r = 24 \\ r = -8 \end{array}$$

15. Vita wants to center a towel bar on her door that is  $27\frac{1}{2}$  inches wide. She determines that the distance from each end of the towel bar to the end of the door is 9 inches. Write and solve an equation to find the length of the towel bar.



16. Higher Order Thinking A cell phone plan is shown at the right. The rates, which include an unlimited data plan, are the same each month for 7 months. The total cost for all 7 months is \$180.39. Let  $m$  represent the average number of minutes that exceeds 700 minutes each month.
- Write an equation to represent the given situation.
  - Solve the equation to determine how many additional minutes, on average, you use each month.

Call Phone Plan Summary

- 700 minutes of talk time: \$19.70 per month
- Each minute over 700 minutes: \$0.09 per minute
- Unlimited data plan: \$1.07 per month

$$27\frac{1}{2} \text{ in}$$

$$T + 9 + 9 = 27\frac{1}{2}$$

$$T + 18 = 27\frac{1}{2}$$

$$\underline{+18} \quad \underline{+18}$$

$$T = 27\frac{1}{2} - 18$$

$$T = 9\frac{1}{2} \text{ in}$$

The length of the towel bar is  $9\frac{1}{2}$  in.

**Assessment Practice**

17. Fidel earns a fixed amount,  $m$ , for each television he sells, and an additional \$15 if the buyer gets an extended warranty. Fidel sells 12 televisions with extended warranties, earning \$900. Write an equation to represent the situation. Then solve the equation to find the amount earned for each television sold.

