Lesson 7-3
Solve Multistep Equations

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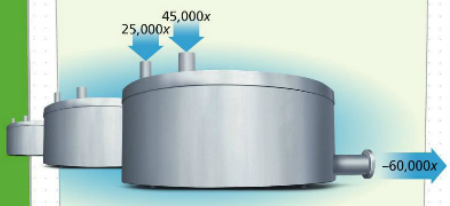
I can...
solve multistep equations and pairs of equations using more than one approach.

Solve & Discuss It!

A water tank fills through two pipes. Water flows through one pipe at a rate of 25,000 gallons an hour and through the other pipe at 45,000 gallons an hour. Water leaves the system at a rate of 60,000 gallons an hour.



There are 3 of these tanks, and each tank holds 1 million gallons. Each tank is half full. Water is entering and leaving a tank at the maximum amounts. Determine the number of hours, x, it will take to fill all 3 tanks one at a time.

Reasoning Can you solve the problem in more than one way?

Focus on math practices

Use Structure What are two different ways to simplify the expression $4(3x + 7x + 5)$ so that it equals $40x - 20$? Explain.

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Essential Question How can you use the Distributive Property to solve multistep equations?

EXAMPLE 1 Use the Distributive Property to Solve a Multistep Equation

Scan for Multimedia

A math teacher recorded the distances he rode his bike last week. He challenged his class to find the number of miles he rode on Thursday. How far did he ride on Thursday?

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	$4x + 3$		x	$x + 7$	$x + 7$

The total number of miles he rode on Monday through Wednesday is the same as the total number of miles he rode on Thursday through Saturday.

Draw a bar diagram to represent the situation, and use it to write an equation

$4x + 3$		
x	$x + 7$	$x + 7$

$4x + 3 = x + 2(x + 7)$

The quantity $x + 7$ appears twice, so you can write $2(x + 7)$.

Model with Math How can you find the solution of the equation using the bar diagram?

Solve the equation.

$4x + 3 = x + 2(x + 7)$
$4x + 3 = x + 2 \cdot x + 2 \cdot 7$ — Distribute the 2 to the terms inside the parentheses.
$4x + 3 = x + 2x + 14$
$4x + 3 = 3x + 14$
$4x - 3x + 3 = 3x - 3x + 14$
$x + 3 = 14$
$x + 3 - 3 = 14 - 3$
$x = 11$

Check your answer.

$4(11) + 3 \stackrel{?}{=} 11 + 2(11 + 7) \longrightarrow 47 = 47$ ✔

The teacher rode 11 miles on Thursday.

Try It!

Solve the equation $3(x - 5) - 5x = -25 + 6x$.

$3\square + 3 \cdot \square - 5x = -25 + 6x$
$\square - 5x = -25 + 6x$
$\square x - 15 = -25 + 6x$
$-15 = -25 + \square x$
$\square = \square x$
$x = \square$ or $\square$

Convince Me! Can you add x to $-5x$ on the left side of the equation as the first step? Explain.

EXAMPLE 2 Distribute a Negative Coefficient to Solve Equations

Solve each equation.

A. $-5(x-2)=-25$

$-5 \cdot x + -5 \cdot -2 = -25$ — Distribute the -5 to the terms inside the parentheses.

$-5x + 10 = -25$

$-5x + 10 - 10 = -25 - 10$

$-5x = -35$

$\frac{-5x}{-5} = \frac{-35}{-5}$

$x = 7$

B. $3-(x-3)=25$

$3 + -1 \cdot x + -1 \cdot -3 = 25$ — Distribute the -1 to the terms inside the parentheses.

$3 - x + 3 = 25$

$-x + 6 = 25$

$-x + 6 - 6 = 25 - 6$

$-x = 19$

$\frac{-x}{-1} = \frac{19}{-1}$

$x = -19$

EXAMPLE 3 Use the Distributive Property on Both Sides of an Equation

Solve the equation $\frac{1}{4}(x+3)=\frac{1}{2}(x+2)$.

$\frac{1}{4}(x+3)=\frac{1}{2}(x+2)$

$\frac{1}{4} \cdot x + \frac{1}{4} \cdot 3 = \frac{1}{2} \cdot x + \frac{1}{2} \cdot 2$ — Use the Distributive Property on both sides.

$\frac{x}{4} + \frac{3}{4} = \frac{x}{2} + 1$

$\frac{x}{4} - \frac{x}{2} + \frac{3}{4} = \frac{x}{2} - \frac{x}{2} + 1$

$-\frac{x}{4} + \frac{3}{4} = 1$

$-\frac{x}{4} + \frac{3}{4} - \frac{3}{4} = 1 - \frac{3}{4}$

$-\frac{x}{4} = \frac{1}{4}$

$-4 \cdot -\frac{x}{4} = -4 \cdot \frac{1}{4}$

$x = -1$

Use Structure Be sure to use the Distributive Property on both sides of the equation.

Try It!

Solve the equation $-3(-7-x)=\frac{1}{2}(x+2)$.

KEY CONCEPT

When solving multistep equations, sometimes you distribute first, and then combine like terms.

$7(5+2x)+x=65$

$35+14x+x=65$

Sometimes you combine like terms first, and then distribute.

$8(5x+9x+6)=160$

$8(14x+6)=160$

Do You Understand?

1. **Essential Question** How can you use the Distributive Property to solve multistep equations?

2. **Reasoning** What is the first step when solving the equation $3(3x-5x)+2=-8$?

3. **Use Structure** How can you use the order of operations to explain why you cannot combine the the variable terms before using the Distributive Property when solving the equation $7(x+5)-x=42$?

Do You Know How?

4. Solve the equation $3x+2=x+4(x+2)$.

$3x+2=x+4(x+2)$

$3x+2=x+4x+8$

$3x+2=+5x+8$

$+-3x \quad =+-3x$

$2 = 2x + 8$

$+-8 = +-8$

$-6 = 2x$

$\frac{-6}{2} = \frac{2x}{2}$

$-3 = x$

$x = -3$

✓ $-7 = -7$

5. Solve the equation $-3(x-1)+7x=27$.

6. Solve the equation $\frac{1}{3}(x+6)=\frac{1}{2}(x-3)$.

see notes

7. Solve the equation $0.25(x+4)-3=28$.

c) $\frac{1}{3}(x+6) = \frac{1}{2}(x+3)$

$\frac{1}{3}x + \frac{1}{3}\cdot\frac{6}{1} = \frac{1}{2}x + \frac{1}{2}\cdot\frac{3}{1}$

$\frac{1}{3}x + 2 = \frac{1}{2}x + 1\frac{1}{2}$

$-\frac{1}{2}x \quad -\frac{1}{2}x$

$-\frac{1}{6}x + 2 = 1\frac{1}{2}$

$-2 \quad -2$

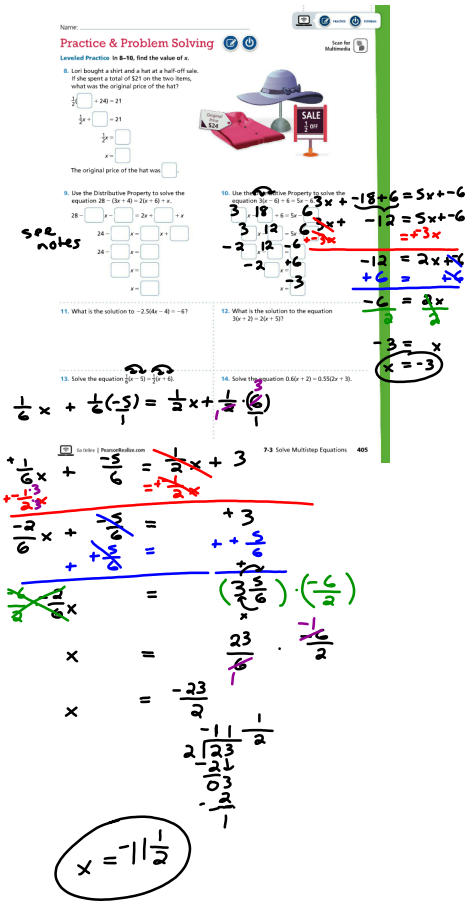
$-\frac{1}{6}x = -\frac{1}{2}$

$-6\left(-\frac{1}{6}x\right) = \left(-\frac{1}{2}\right)\cdot\frac{-6}{1}$

$x = \frac{3}{1}$

$x = +21$

$x = +21$



$\frac{1}{6}x + \frac{1}{6}\left(\frac{-5}{1}\right) = \frac{1}{2}x + \frac{1}{2}\cdot\frac{3}{1}$

$+\frac{1}{6}x \quad +\frac{5}{6} \quad -\frac{1}{2}x \quad +3$

$-\frac{2}{6}x + \frac{5}{6} = +3$

$+\frac{5}{6} \quad +\frac{5}{6}$

$-\frac{2}{6}x = \left(3\frac{5}{6}\right)\cdot\left(\frac{-6}{2}\right)$

$x = \frac{23}{6}\cdot\frac{-6}{2}$

$x = -\frac{23}{2}$

$x = -11\frac{1}{2}$

9)

$28 + 1(3x+4) = 2(x+6) + x$

$28 + -3x + -4 = 2x + 12 + x$

$-3x + 24 = +3x + 12$

$+-3x \quad = +-3x$

$-6x + 24 = 0x + 12$

PEMDAS

M (-6) ✓

A 24 ✓

Start

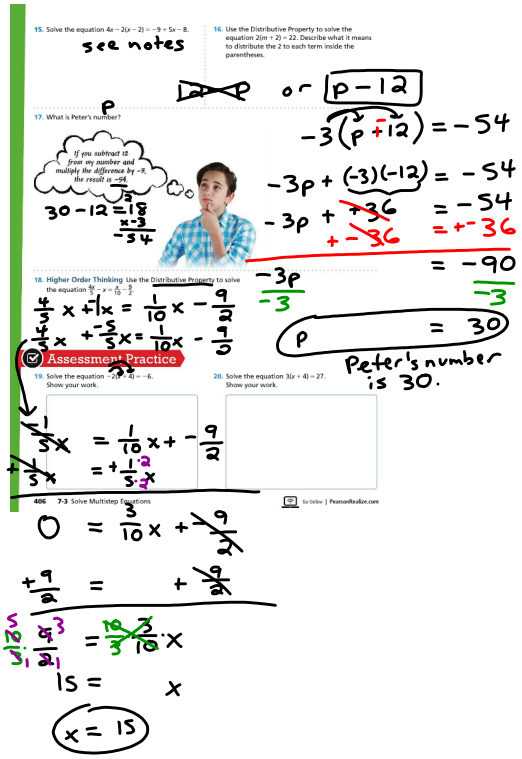
$-6x + 24 = +12$

$+-24 \quad +-24$

$-6x = -12$

$\frac{-6x}{-6} = \frac{-12}{-6}$

$x = 2$



15. Solve the equation $4x - 2(x - 2) = -9 + 5x - 8$.

see notes

16. Use the Distributive Property to solve the equation $2(m + 2) = 22$. Describe what it means to distribute the 2 to each term inside the parentheses.

~~p~~ or p − 12

17. What is Peter's number?

p

If you subtract 12 from my number and multiply the difference by −3, the result is −54.

$-3(p + -12) = -54$

$30 - 12 = 18$

$\frac{x-3}{-54}$

$-3p + (-3)(-12) = -54$

$-3p + +36 = -54$

$+-36 \quad +-36 \quad = +-36$

$= -90$

$\frac{-3p}{-3} \quad \frac{-90}{-3}$

$p = 30$

Peter's number is 30.

18. Higher Order Thinking Use the Distributive Property to solve the equation $\frac{4}{5}x - \frac{1}{10}x = \frac{1}{10}x - \frac{9}{2}$.

$\frac{4}{5}x + \frac{-1}{10}x = \frac{1}{10}x - \frac{9}{2}$

$\frac{4}{5}x + \frac{-2}{5}x = \frac{1}{10}x - \frac{9}{2}$

$\frac{2}{5}x = \frac{1}{10}x - \frac{9}{2}$

Assessment Practice

19. Solve the equation $-2(r + 4) = -6$. Show your work.

20. Solve the equation $3(r + 4) = 27$. Show your work.

$\frac{1}{5}x = \frac{1}{10}x + -\frac{9}{2}$

$+\frac{1}{5}x \quad = +\frac{1}{10}x$

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$0 = \frac{3}{10}x + \frac{9}{2}$

$+\frac{9}{2} \quad = \quad +\frac{9}{2}$

$\frac{5}{2} \cdot \frac{9}{2} = \frac{10}{3} \cdot \frac{3}{10}x$

$15 = x$

$x = 15$

15) $4x + 2(x + 2) = -9 + 5x + 8$

$4x + 2x + 4 = 5x + 17$

$6x + 4 = 5x + 17$

$-2x \quad -2x$

$4 = 3x + 17$

$-17 \quad -17$

$\frac{-13}{3} = \frac{3x}{3}$

$-13 = x$

$x = -13$