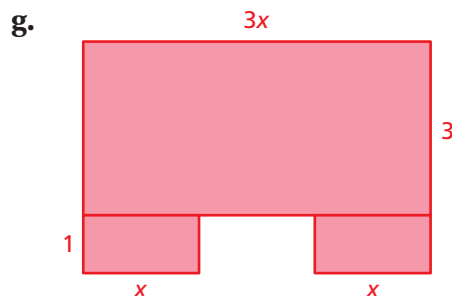
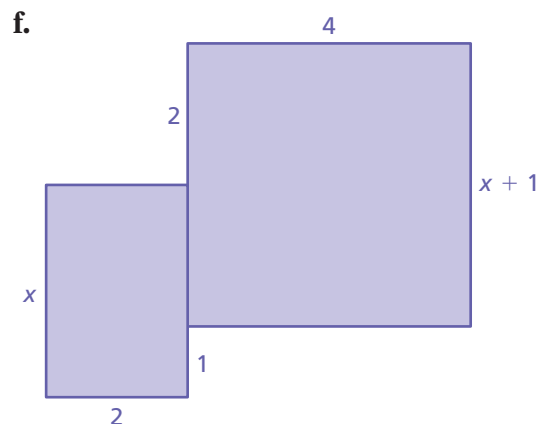
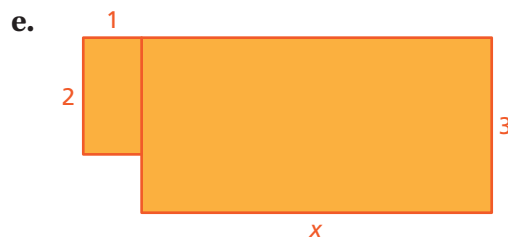
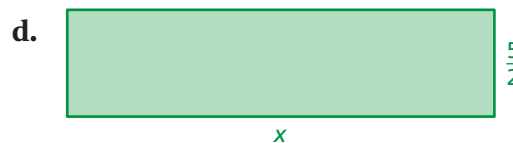
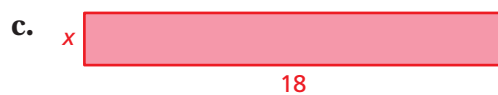
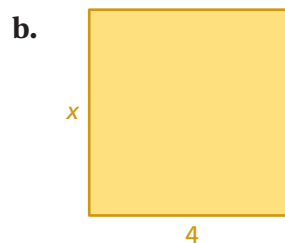
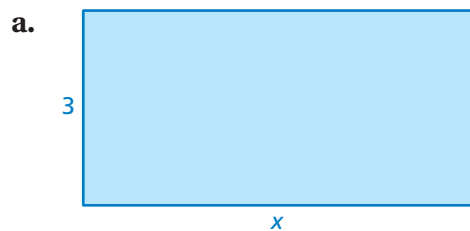


Essential Question How can you solve an equation that has variables on both sides?

1 ACTIVITY: Perimeter and Area

Work with a partner. Each figure has the unusual property that the value of its perimeter (in feet) is equal to the value of its area (in square feet).

- Write an equation (value of perimeter = value of area) for each figure.
- Solve each equation for x .
- Use the value of x to find the perimeter and area of each figure.
- Check your solution by comparing the value of the perimeter and the value of the area of each figure.



COMMON
CORE

Solving Equations

In this lesson, you will

- write and solve equations with variables on both sides of the equal sign.
- solve real-life problems.

Learning Standards

A.CED.1

A.REI.1

A.REI.3

2 ACTIVITY: Surface Area and Volume

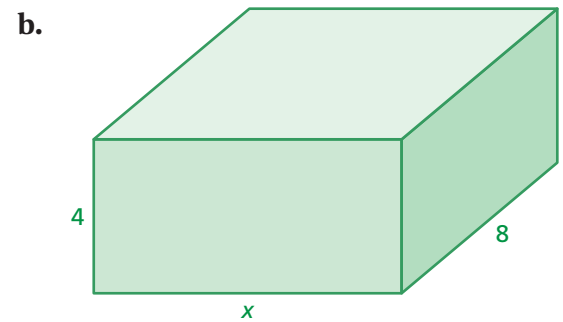
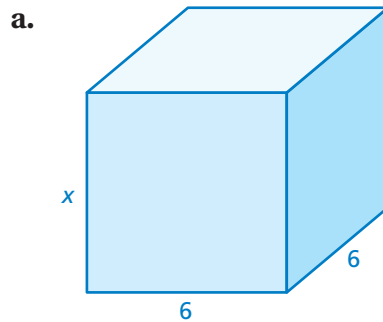
Math Practice 2

Understand Quantities

What is the value of each quantity?
What does each quantity represent?

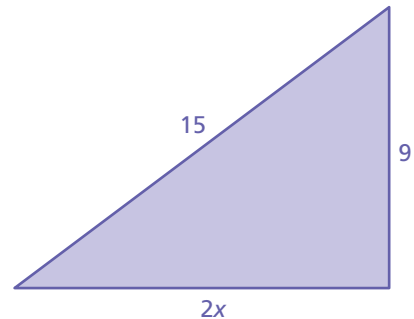
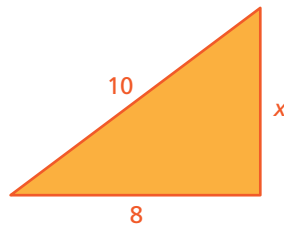
Work with a partner. Each solid has the unusual property that the value of its surface area (in square inches) is equal to the value of its volume (in cubic inches).

- Write an equation (value of surface area = value of volume) for each solid.
- Solve each equation for x .
- Use the value of x to find the surface area and volume of each solid.
- Check your solution by comparing the value of the surface area and the value of the volume of each solid.



3 ACTIVITY: Puzzle

Work with a partner. The two triangles are similar. The perimeter of the larger triangle is 150% of the perimeter of the smaller triangle. Find the dimensions of each triangle.



What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you solve an equation that has variables on both sides? Write an equation that has variables on both sides. Solve the equation.

Practice

Use what you learned about solving equations with variables on both sides to complete Exercises 3–5 on page 22.

Key Idea
Solving Equations with Variables on Both Sides

To solve equations with variables on both sides, collect the variable terms on one side and the constant terms on the other side.

EXAMPLE 1 Solving an Equation with Variables on Both Sides

Solve $15 - 2x = -7x$. Check your solution.

$$15 - 2x = -7x$$

Write the equation.

Undo the subtraction.

$$\rightarrow +2x \quad +2x$$

Add $2x$ to each side.

$$15 = -5x$$

Simplify.

Undo the multiplication.

$$\rightarrow \frac{15}{-5} = \frac{-5x}{-5}$$

Divide each side by -5 .

$$-3 = x$$

Simplify.

Check

$$15 - 2x = -7x$$

$$15 - 2(-3) \stackrel{?}{=} -7(-3)$$

$$21 = 21 \quad \checkmark$$

∴ The solution is $x = -3$.

EXAMPLE 2 Solving Equations with Variables on Both Sides**Remember**

When solving a linear equation that has no solution, you will obtain an equivalent equation that is not true for any value of x . When the equation has infinitely many solutions, you will obtain an equivalent equation that is true for all values of x .

a. Solve $3(5x + 2) = 15x$.

$$3(5x + 2) = 15x$$

$$15x + 6 = 15x$$

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

$$6 = 0 \quad \times$$

∴ The equation $6 = 0$ is never true. So, the equation has no solution.

b. Solve $-2(4y + 1) = -8y - 2$.

$$-2(4y + 1) = -8y - 2$$

$$-8y - 2 = -8y - 2$$

$$\underline{+8y} \quad \underline{+8y}$$

$$-2 = -2$$

∴ The equation $-2 = -2$ is always true. So, the equation has infinitely many solutions.

On Your Own

Solve the equation. Check your solution, if possible.

1. $-3x = 2x + 19$

2. $4(1 - p) = -4p + 4$

3. $6m - m = \frac{5}{6}(6m - 10)$

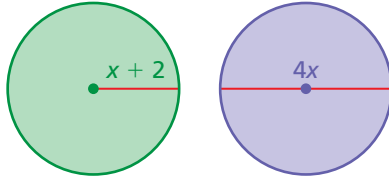
4. $10k + 7 = -3 - 10k$

Now You're Ready
Exercises 6–14

EXAMPLE 3 Writing and Solving an Equation

The circles are identical. What is the area of each circle?

- (A) 2 (B) 4 (C) 16π (D) 64π



The circles are identical, so the radius of each circle is the same.

$$x + 2 = 2x$$

Write an equation. The radius of the purple circle is $2x$.

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

Subtract x from each side.

$$2 = x$$

Simplify.

∴ The area of each circle is $\pi r^2 = \pi(4)^2 = 16\pi$. So, the correct answer is (C).

EXAMPLE 4 Real-Life Application

A boat travels x miles per hour upstream on the Mississippi River. On the return trip, the boat travels 2 miles per hour faster. How far does the boat travel upstream?



The speed of the boat on the return trip is $(x + 2)$ miles per hour.

$$\text{Distance upstream} = \text{Distance of return trip}$$

$$3x = 2.5(x + 2)$$

Write an equation.

$$3x = 2.5x + 5$$

Use Distributive Property.

$$\begin{array}{r} 3x = 2.5x + 5 \\ -2.5x \quad -2.5x \\ \hline \end{array}$$

Subtract $2.5x$ from each side.

$$0.5x = 5$$

Simplify.

$$\frac{0.5x}{0.5} = \frac{5}{0.5}$$

Divide each side by 0.5.

$$x = 10$$

Simplify.

∴ The boat travels 10 miles per hour for 3 hours upstream. So, it travels 30 miles upstream.

On Your Own

- WHAT IF?** In Example 3, the diameter of the purple circle is $3x$. What is the area of each circle?
- A boat travels x miles per hour from one island to another island in 2.5 hours. The boat travels 5 miles per hour faster on the return trip of 2 hours. What is the distance between the islands?

1.3 Exercises

Vocabulary and Concept Check

- WRITING** Is $x = 3$ a solution of the equation $3x - 5 = 4x - 9$? Explain.
- OPEN-ENDED** Write an equation that has variables on both sides and has a solution of -3 .

Practice and Problem Solving

The value of the solid's surface area is equal to the value of the solid's volume. Find the value of x .



Solve the equation. Check your solution, if possible.

- | | | | | |
|---|---|--|-------------------------------|---|
| 1 | 2 | 6. $m - 4 = 2m$ | 7. $3k - 1 = 7k + 2$ | 8. $-2x + 10 = -2(x + 5)$ |
| | | 9. $-24 - \frac{1}{8}p = \frac{3}{8}p$ | 10. $5(4w - 20) = 4(5w - 25)$ | 11. $\frac{3}{2}(16n + 3) = 24n$ |
| | | 12. $3(4z - 7) = -21 + 12z$ | 13. $0.1x = 0.2(x + 2)$ | 14. $\frac{1}{6}d + \frac{2}{3} = \frac{1}{4}(d - 2)$ |

15. **ERROR ANALYSIS** Describe and correct the error in solving the equation.

16. **TRAIL MIX** The equation $4.05p + 14.40 = 4.50(p + 3)$ represents the number p of pounds of peanuts you need to make trail mix. How many pounds of peanuts do you need for the trail mix?



$$\begin{aligned} 3x - 4 &= 2x + 1 \\ 3x - 4 - 2x &= 2x + 1 - 2x \\ x - 4 &= 1 \\ x - 4 + 4 &= 1 - 4 \\ x &= -3 \end{aligned}$$

17. **CARS** Write and solve an equation to find the number of miles you must drive to have the same cost for each of the car rentals.



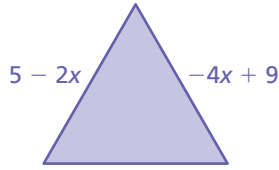
\$15 plus \$0.50 per mile



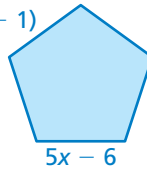
\$25 plus \$0.25 per mile

A polygon is *regular* if each of its sides has the same length. Find the perimeter of the regular polygon.

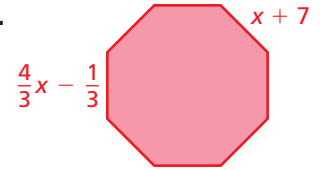
18.



19. $3(x - 1)$



20.

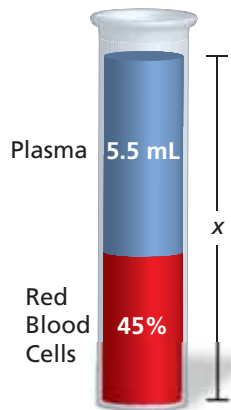


21. **WRITING** Write a linear equation that has (a) no solution and (b) infinitely many solutions. Justify your answers.

22. **PRECISION** The cost of mailing a DVD in an envelope by Express Mail® is equal to the cost of mailing a DVD in a box by Priority Mail®.

What is the weight of the DVD with its packing material?

	Packing Material	Priority Mail®	Express Mail®
Box	\$2.25	\$2.50 per lb	\$8.50 per lb
Envelope	\$1.10	\$2.50 per lb	\$8.50 per lb

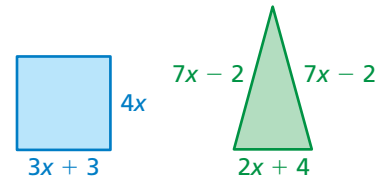


23. **STRUCTURE** Would you solve the equation $0.25x + 7 = \frac{1}{3}x - 8$ using fractions or decimals? Explain.

24. **BLOOD SAMPLE** The amount of red blood cells in a blood sample is equal to the total amount in the sample minus the amount of plasma. What is the total amount x of blood drawn?

25. **NUTRITION** One serving of oatmeal provides 16% of the fiber you need daily. You must get the remaining 21 grams of fiber from other sources. How many grams of fiber should you consume daily?

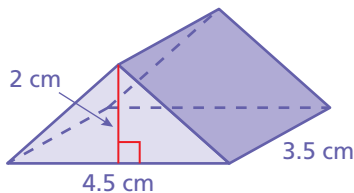
26. **Geometry** The perimeter of the square is equal to the perimeter of the triangle. What are the side lengths of each figure?



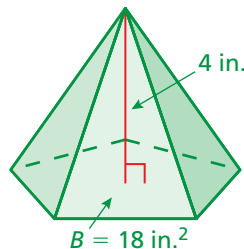
Fair Game Review what you learned in previous grades & lessons

Find the volume of the figure. Use 3.14 for π . (*Skills Review Handbook*)

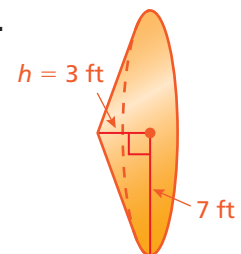
27.



28.



29.



30. **MULTIPLE CHOICE** A car travels 480 miles on 15 gallons of gasoline. How many miles does the car travel per gallon? (*Section 1.1*)

(A) 28 mi/gal

(B) 30 mi/gal

(C) 32 mi/gal

(D) 35 mi/gal