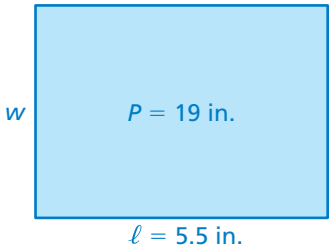
1.4 Rewriting Equations and Formulas

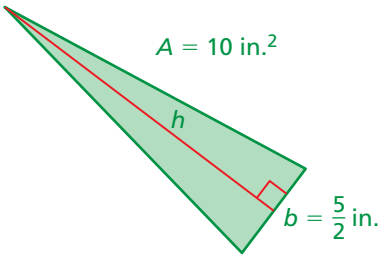
Essential Question How can you use a formula for one measurement to write a formula for a different measurement?

1 ACTIVITY: Using Perimeter and Area Formulas

Work with a partner.

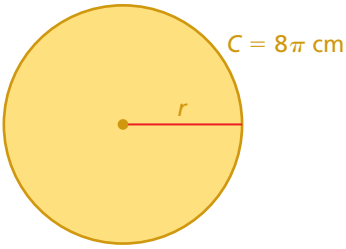
a.
- Write a formula for the perimeter P of a rectangle.
- Solve the formula for w.
- Use the new formula to find the width of the rectangle.

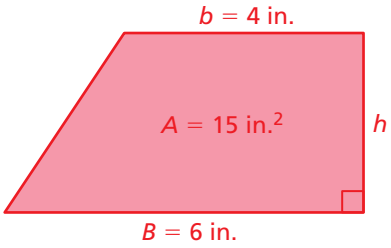




b.
- Write a formula for the area A of a triangle.
- Solve the formula for h.
- Use the new formula to find the height of the triangle.

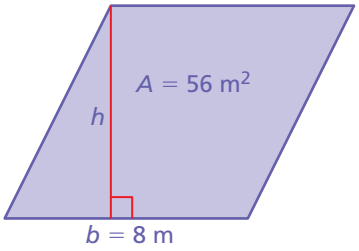
c.
- Write a formula for the circumference C of a circle.
- Solve the formula for r.
- Use the new formula to find the radius of the circle.





d.
- Write a formula for the area A of a trapezoid.
- Solve the formula for h.
- Use the new formula to find the height of the trapezoid.

e.
- Write a formula for the area A of a parallelogram.
- Solve the formula for h.
- Use the new formula to find the height of the parallelogram.



Common Core

Rewriting Equations

In this lesson, you will
- rewrite equations to solve for one variable in terms of the other variable(s).

Learning Standard
A.CED.4

2 ACTIVITY: Using Volume Formulas

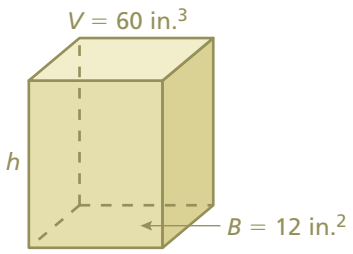
Math Practice 7

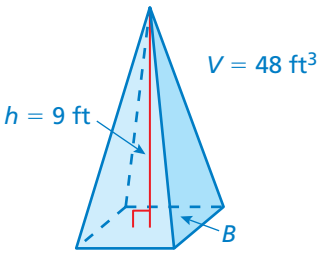
Look for Structure

What values in the formula do you know? What value are you trying to find?

Work with a partner.

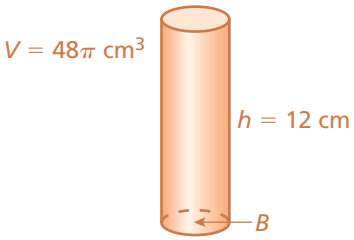
a.
- Write a formula for the volume V of a prism.
- Solve the formula for h.
- Use the new formula to find the height of the prism.

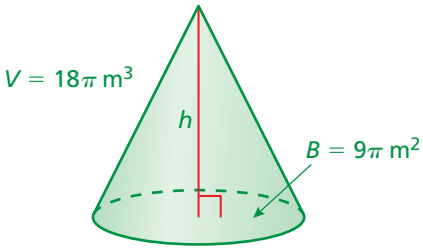




b.
- Write a formula for the volume V of a pyramid.
- Solve the formula for B.
- Use the new formula to find the area of the base of the pyramid.

c.
- Write a formula for the volume V of a cylinder.
- Solve the formula for B.
- Use the new formula to find the area of the base of the cylinder.





d.
- Write a formula for the volume V of a cone.
- Solve the formula for h.
- Use the new formula to find the height of the cone.

What Is Your Answer?

3. IN YOUR OWN WORDS How can you use a formula for one measurement to write a formula for a different measurement? Give an example that is different from the examples on these two pages.

Practice Use what you learned about rewriting equations and formulas to complete Exercises 3 and 4 on page 30.

1.4 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
literal equation, *p. 28*

An equation that has two or more variables is called a **literal equation**. To rewrite a literal equation, solve for one variable in terms of the other variable(s).

EXAMPLE 1 Rewriting an Equation

Solve the equation $2y + 5x = 6$ for y.

$2y + 5x = 6$ — Write the equation.

Undo the addition. → $2y + 5x - 5x = 6 - 5x$ — Subtract $5x$ from each side.

$2y = 6 - 5x$ — Simplify.

Undo the multiplication. → $\frac{2y}{2} = \frac{6 - 5x}{2}$ — Divide each side by 2.

$y = 3 - \frac{5}{2}x$ — Simplify.

On Your Own

Now You're Ready
Exercises 5–10

Solve the equation for y.

1. $5y - x = 10$
2. $4x - 4y = 1$
3. $12 = 6x + 3y$

EXAMPLE 2 Rewriting a Formula

The formula for the surface area S of a cone is $S = \pi r^2 + \pi r\ell$. Solve the formula for the slant height ℓ.

Remember
A *formula* shows how one variable is related to one or more other variables. A formula is a type of literal equation.

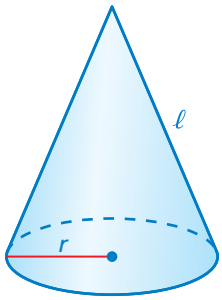
$S = \pi r^2 + \pi r\ell$ — Write the equation.

$S - \pi r^2 = \pi r^2 - \pi r^2 + \pi r\ell$ — Subtract πr^2 from each side.

$S - \pi r^2 = \pi r\ell$ — Simplify.

$\frac{S - \pi r^2}{\pi r} = \frac{\pi r\ell}{\pi r}$ — Divide each side by πr.

$\frac{S - \pi r^2}{\pi r} = \ell$ — Simplify.



On Your Own

Now You're Ready
Exercises 14–19

Solve the formula for the red variable.

4. Area of rectangle: $A = bh$
5. Simple interest: $I = Prt$
6. Surface area of cylinder: $S = 2\pi r^2 + 2\pi rh$

Key Idea

Temperature Conversion

A formula for converting from degrees Fahrenheit F to degrees Celsius C is

$$C = \frac{5}{9}(F - 32).$$

EXAMPLE 3 Rewriting the Temperature Formula

Solve the temperature formula for F.

$$C = \frac{5}{9}(F - 32)$$ Write the temperature formula.

Use the reciprocal. → $\frac{9}{5} \cdot C = \frac{9}{5} \cdot \frac{5}{9}(F - 32)$ Multiply each side by $\frac{9}{5}$, the reciprocal of $\frac{5}{9}$.

$$\frac{9}{5}C = F - 32$$ Simplify.

Undo the subtraction. → $\frac{9}{5}C + 32 = F - 32 + 32$ Add 32 to each side.

$$\frac{9}{5}C + 32 = F$$ Simplify.

∴ The rewritten formula is $F = \frac{9}{5}C + 32$.

EXAMPLE 4 Real-Life Application

Which has the greater temperature?

Convert the Celsius temperature of lightning to Fahrenheit.

$$F = \frac{9}{5}C + 32$$ Write the rewritten formula from Example 3.

$$= \frac{9}{5}(30{,}000) + 32$$ Substitute 30,000 for C.

$$= 54{,}032$$ Simplify.

∴ Because 54,032 °F is greater than 11,000 °F, lightning has the greater temperature.

On Your Own

7. Room temperature is considered to be 70 °F. Suppose the temperature is 23 °C. Is this greater than or less than room temperature?

1.4 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. VOCABULARY Is $-2x = \frac{3}{8}$ a literal equation? Explain.

2. DIFFERENT WORDS, SAME QUESTION Which is different? Find "both" answers.

Solve $4x - 2y = 6$ for y.

Solve $6 = 4x - 2y$ for y.

Solve $4x - 2y = 6$ for y in terms of x.

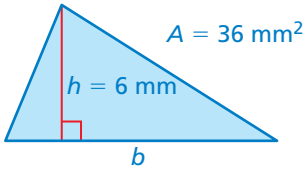
Solve $4x - 2y = 6$ for x in terms of y.

Practice and Problem Solving

3. **a.** Write a formula for the area A of a triangle.

b. Solve the formula for b.

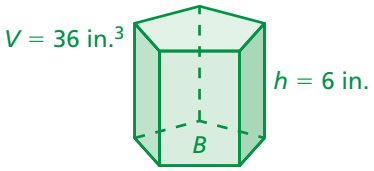
c. Use the new formula to find the base of the triangle.



4. **a.** Write a formula for the volume V of a prism.

b. Solve the formula for B.

c. Use the new formula to find the area of the base of the prism.



Solve the equation for y.

5. $\frac{1}{3}x + y = 4$

6. $3x + \frac{1}{5}y = 7$

7. $6 = 4x + 9y$

8. $\pi = 7x - 2y$

9. $4.2x - 1.4y = 2.1$

10. $6y - 1.5x = 8$

11. ERROR ANALYSIS Describe and correct the error in rewriting the equation.

$2x - y = 5$
$y = -2x + 5$

12. TEMPERATURE The formula $K = C + 273.15$ converts temperatures from Celsius C to Kelvin K.

a. Solve the formula for C.

b. Convert 300 K to Celsius.

13. INTEREST The formula for simple interest is $I = Prt$.

a. Solve the formula for t.

b. Use the new formula to find the value of t in the table.

I	\$75
P	\$500
r	5%
t	

Solve the equation for the red variable.

14. $d = rt$ **15.** $e = mc^2$ **16.** $R - C = P$

17. $A = \frac{1}{2}\pi w^2 + 2\ell w$ **18.** $B = 3\frac{V}{h}$ **19.** $g = \frac{1}{6}(w + 40)$

20. LOGIC Why is it useful to rewrite a formula in terms of another variable?

21. REASONING The formula $K = \frac{5}{9}(F - 32) + 273.15$ converts temperatures from Fahrenheit F to Kelvin K.

a. Solve the formula for F.

b. The freezing point of water is 273.15 Kelvin. What is this temperature in Fahrenheit?

c. The temperature of dry ice is -78.5 °C. Which is colder, dry ice or liquid nitrogen?

Navy Pier Ferris Wheel

22. FERRIS WHEEL The Navy Pier Ferris Wheel in Chicago has a circumference that is 56% of the circumference of the first Ferris wheel built in 1893.

a. What is the radius of the Navy Pier Ferris Wheel?

b. What was the radius of the first Ferris wheel?

c. The first Ferris wheel took 9 minutes to make a complete revolution. How fast was the wheel moving?

23. Repeated Reasoning The formula for the volume of a sphere is $V = \frac{4}{3}\pi r^3$. Solve the formula for r^3. Use guess, check, and revise to find the radius of the sphere.

Fair Game Review What you learned in previous grades & lessons

Multiply. *(Skills Review Handbook)*

24. $5 \times \frac{3}{4}$ **25.** $2.4 \times \frac{8}{3}$ **26.** $\frac{1}{4} \times \frac{3}{2} \times \frac{8}{9}$ **27.** $25 \times \frac{3}{5} \times \frac{1}{12}$

28. MULTIPLE CHOICE Which of the following is not equivalent to $\frac{3}{4}$? *(Skills Review Handbook)*

(A) 0.75 (B) 3:4 (C) 75% (D) 4:3