

1.4 Rewriting Equations and Formulas



STATE STANDARDS

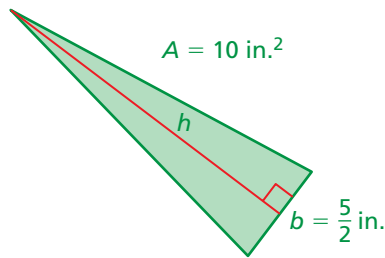
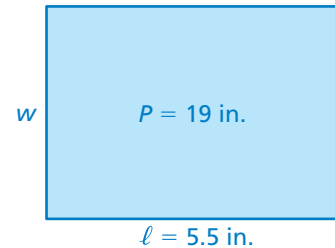
MA.8.A.4.1
MA.8.G.5.1

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

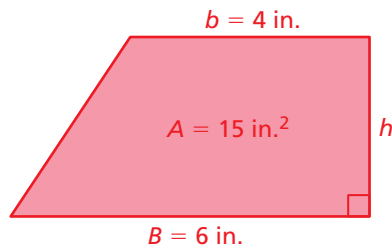
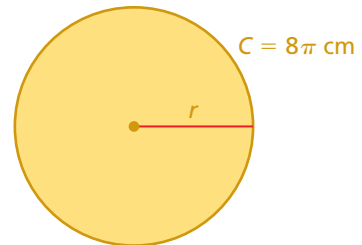
Work with a partner.

- 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.



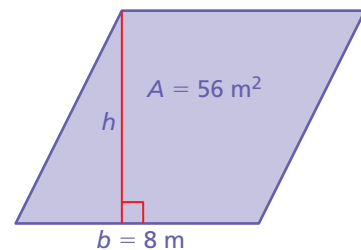
- b.
- Write a formula for the area A of a triangle.
 - Solve the formula for h .
 - Use the new formula to find the height of the triangle.

- 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.

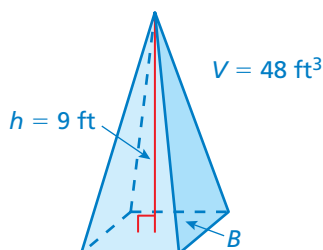
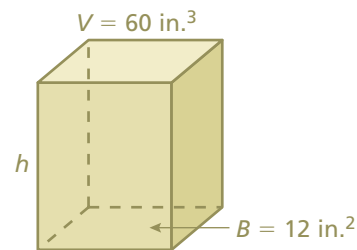


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ACTIVITY: Using Volume Formulas

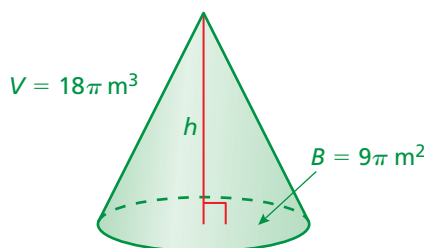
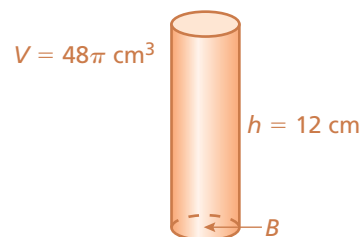
Work with a partner.

- 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 28.

Key Vocabulary

literal equation, p. 26

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. $\rightarrow 2y + 5x - 5x = 6 - 5x$

Subtract $5x$ from each side.

$$2y = 6 - 5x$$

Simplify.

Undo the multiplication. $\rightarrow \frac{2y}{2} = \frac{6 - 5x}{2}$

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 .

$$S = \pi r^2 + \pi r\ell$$

Write the equation.

$$S - \pi r^2 = \pi r^2 - \pi r^2 + \pi r\ell$$

Subtract πr^2 from each side.

$$S - \pi r^2 = \pi r\ell$$

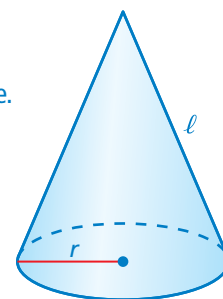
Simplify.

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

Divide each side by πr .

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

Simplify.



Remember

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

On Your Own

Solve the formula for the red variable.

4. Area of rectangle: $A = bh$ 5. Simple interest: $I = Prt$

6. Surface area of cylinder: $S = 2\pi r^2 + 2\pi rh$

Now You're Ready

Exercises 14–19

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 .

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

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

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

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

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

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

EXAMPLE 4 Real-Life Application



Lightning
30,000°C



Which has the greater temperature?

Convert the Celsius temperature of lightning to Fahrenheit.

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

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

$$= 54,032 \quad \text{Simplify.}$$

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

On Your Own

7. Lake Kissimmee has a water temperature of 85°F. Lake Okeechobee has a water temperature of 30°C. Which lake has the greater water temperature? Explain.

1.4 Exercises

Vocabulary and Concept Check

- VOCABULARY** Is $-2x = \frac{3}{8}$ a literal equation? Explain.
- DIFFERENT WORDS, SAME QUESTION** Which is different? Find “both” answers.

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

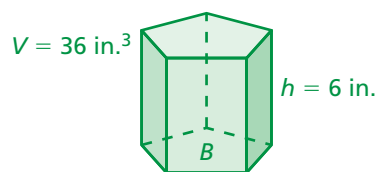
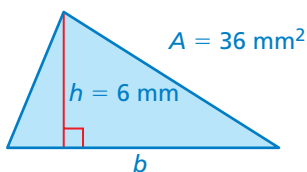
Solve $6 = 4x - 2y$ for y .

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

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

Practice and Problem Solving

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



Solve the equation for y .

1 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.

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

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

- Solve the formula for C .
- Convert 300 K to Celsius.

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

- Solve the formula for t .
- 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.

2 14. $d = rt$

15. $e = mc^2$

16. $R - C = P$

17. $A = \frac{1}{2}\pi w^2 + 2lw$

18. $B = 3\frac{V}{h}$

19. $g = \frac{1}{6}(w + 40)$

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

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

- Solve the formula for F .
- The freezing point of water is 273.15 Kelvin. What is this temperature in Fahrenheit?
- 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.

- What is the radius of the Navy Pier Ferris Wheel?
- What was the radius of the first Ferris wheel?
- The first Ferris wheel took 9 minutes to make a complete revolution. How fast was the wheel moving?

23. **Geometry** 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.



$V = 381.51 \text{ in.}^3$ |— r —|



Fair Game Review

What you learned in previous grades & lessons

Multiply.

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 $\frac{3}{4}$?

(A) 0.75

(B) 3:4

(C) 75%

(D) 4:3