1.5 Rewriting Equations and Formulas

Literal Equation: an equation that has two or more variables.

Example 1: Rewriting a Literal Equation
Solve the literal equation for y.

$$3y + 4x = 9$$

Example 2: Rewriting a Literal Equation
Solve the literal equation for x.

$$y = 3x + 5xz$$

Try on your own!
Solve for y

1) $3y - x = 9$

2) $2x - 2y = 5$

3) $20 = 8x + 4y$

Solve for x

4) $y = 5x - 4x$

5) $2x + kx = m$

6) $3 + 5x - kx = y$

Example 3: Rewriting a Formula
The formula for the surface area S of a rectangular prism is $S = 2lw + 2lh + 2wh$. Solve for the length.

Example 4: Rewriting a formula

Solve the formula for F: $C = \frac{5}{9}(F - 32)$

Example 5: Using the Formula for Temperature.

The surface temperature on Mercury has a temperature of 427°C and Venus's surface has a temperature of 864°F. Which has a greater surface temperature?

Example 6: Simple Interest

You deposit $5,000 in an account that earns simple interest. After 6 months, the account earns $162.50 in interest. What is the annual interest rate?

Example 7: Solving a Real-Life Problem

Mr. Cohen and Mr. Maher are on a road trip together. Mr. Cohen drives 60 miles per hour while delivering a package to a customer. On the return trip Mr. Maher drives an average of 50 miles per hour due to construction. The total driving time is 6.6 hours. How long does each trip take?

Homework:

5, 11, 13, 21., 23, 28, 29, 32, 36*, 37*, 41

1.5 Exercises

Dynamic Solutions available at *BigIdeasMath.com*

Vocabulary and Core Concept Check

1. **VOCABULARY** Is $9r + 16 = \frac{\pi}{5}$ a literal equation? Explain.

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

   Solve $3x + 6y = 24$ for x.

   Solve $24 - 3x = 6y$ for x.

   Solve $6y = 24 - 3x$ for y in terms of x.

   Solve $24 - 6y = 3x$ for x in terms of y.

Monitoring Progress and Modeling with Mathematics

In Exercises 3–12, solve the literal equation for y. *(See Example 1.)*

3. $y - 3x = 13$
4. $2x + y = 7$
5. $2y - 18x = -26$
6. $20x + 5y = 15$
7. $9x - y = 45$
8. $6x - 3y = -6$
9. $4x - 5 = 7 + 4y$
10. $16x + 9 = 9y - 2x$
11. $2 + \frac{1}{6}y = 3x + 4$
12. $11 - \frac{1}{2}y = 3 + 6x$

In Exercises 13–22, solve the literal equation for x. *(See Example 2.)*

13. $y = 4x + 8x$
14. $m = 10x - x$
15. $a = 2x + 6xz$
16. $y = 3bx - 7x$
17. $y = 4x + rx + 6$
18. $z = 8 + 6x - px$
19. $sx + tx = r$
20. $a = bx + cx + d$
21. $12 - 5x - 4kx = y$
22. $x - 9 + 2wx = y$

23. **MODELING WITH MATHEMATICS** The total cost C (in dollars) to participate in a ski club is given by the literal equation $C = 85x + 60$, where x is the number of ski trips you take.

    a. Solve the equation for x.

    b. How many ski trips do you take if you spend a total of \$315? \$485?

24. **MODELING WITH MATHEMATICS** The penny size of a nail indicates the length of the nail. The penny size d is given by the literal equation $d = 4n - 2$, where n is the length (in inches) of the nail.

    a. Solve the equation for n.

    b. Use the equation from part (a) to find the lengths of nails with the following penny sizes: 3, 6, and 10.

ERROR ANALYSIS **In Exercises 25 and 26, describe and correct the error in solving the equation for x.**

25.

$$12 - 2x = -2(y - x)$$
$$-2x = -2(y - x) - 12$$
$$x = (y - x) + 6$$

26.

$$10 = ax - 3b$$
$$10 = x(a - 3b)$$
$$\frac{10}{a - 3b} = x$$

In Exercises 27–30, solve the formula for the indicated variable. *(See Examples 3 and 5.)*

27. Profit: $P = R - C$; Solve for C.
28. Surface area of a cylinder: $S = 2\pi r^2 + 2\pi rh$; Solve for h.
29. Area of a trapezoid: $A = \frac{1}{2}h(b_1 + b_2)$; Solve for b_2.
30. Average acceleration of an object: $a = \frac{v_1 - v_0}{t}$; Solve for v_1.

31. REWRITING A FORMULA A common statistic used in professional football is the quarterback rating. This rating is made up of four major factors. One factor is the completion rating given by the formula

$$R = 5\left(\frac{C}{A} - 0.3\right)$$

where C is the number of completed passes and A is the number of attempted passes. Solve the formula for C.

32. REWRITING A FORMULA Newton's law of gravitation is given by the formula

$$F = G\left(\frac{m_1 m_2}{d^2}\right)$$

where F is the force between two objects of masses m_1 and m_2, G is the gravitational constant, and d is the distance between the two objects. Solve the formula for m_1.

33. MODELING WITH MATHEMATICS The sale price S (in dollars) of an item is given by the formula $S = L - rL$, where L is the list price (in dollars) and r is the discount rate (in decimal form). *(See Examples 4 and 6.)*

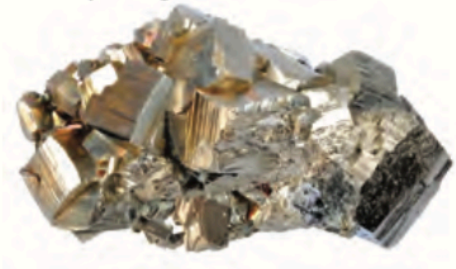
a. Solve the formula for r.

b. The list price of the shirt is \$30. What is the discount rate?

34. MODELING WITH MATHEMATICS The density d of a substance is given by the formula $d = \frac{m}{V}$, where m is its mass and V is its volume.

Pyrite

Density: 5.01g/cm³ Volume: 1.2 cm³



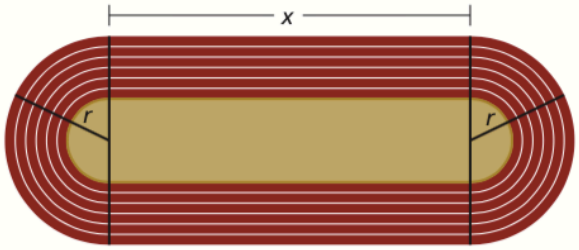
a. Solve the formula for m.

b. Find the mass of the pyrite sample.

35. PROBLEM SOLVING You deposit \$2000 in an account that earns simple interest at an annual rate of 4%. How long must you leave the money in the account to earn \$500 in interest? *(See Example 7.)*

36. PROBLEM SOLVING A flight averages 460 miles per hour. The return flight averages 500 miles per hour due to a tailwind. The total flying time is 4.8 hours. How long is each flight? Explain. *(See Example 8.)*

37. USING STRUCTURE An athletic facility is building an indoor track. The track is composed of a rectangle and two semicircles, as shown.

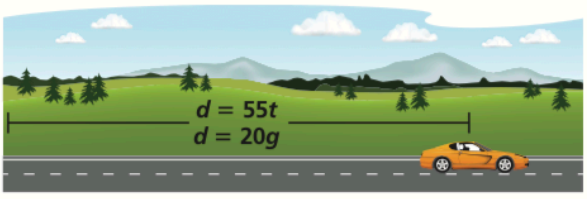


a. Write a formula for the perimeter of the indoor track.

b. Solve the formula for x.

c. The perimeter of the track is 660 feet, and r is 50 feet. Find x. Round your answer to the nearest foot.

38. MODELING WITH MATHEMATICS The distance d (in miles) you travel in a car is given by the two equations shown, where t is the time (in hours) and g is the number of gallons of gasoline the car uses.

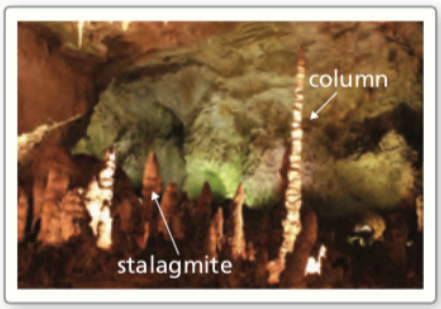


a. Write an equation that relates g and t.

b. Solve the equation for g.

c. You travel for 6 hours. How many gallons of gasoline does the car use? How far do you travel? Explain.

39. MODELING WITH MATHEMATICS One type of stone formation found in Carlsbad Caverns in New Mexico is called a column. This cylindrical stone formation connects to the ceiling and the floor of a cave.

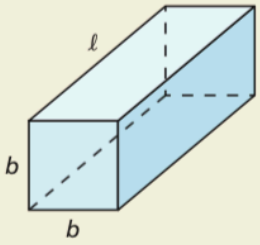


a. Rewrite the formula for the circumference of a circle, so that you can easily calculate the radius of a column given its circumference.

b. What is the radius (to the nearest tenth of a foot) of a column that has a circumference of 7 feet? 8 feet? 9 feet?

c. Explain how you can find the area of a cross section of a column when you know its circumference.

40. HOW DO YOU SEE IT? The rectangular prism shown has bases with equal side lengths.



a. Use the figure to write a formula for the surface area S of the rectangular prism.

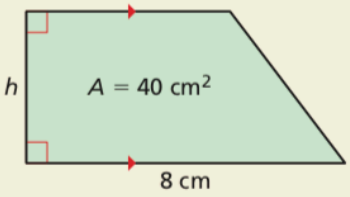
b. Your teacher asks you to rewrite the formula by solving for one of the side lengths, b or ℓ. Which side length would you choose? Explain your reasoning.

41. MAKING AN ARGUMENT Your friend claims that Thermometer A displays a greater temperature than Thermometer B. Is your friend correct? Explain your reasoning.

Thermometer A

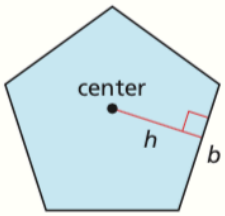
Thermometer B

42. THOUGHT PROVOKING Give a possible value for h. Justify your answer. Draw and label the figure using your chosen value of h.

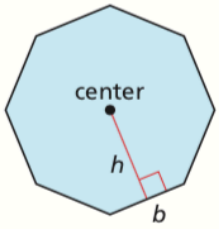


MATHEMATICAL CONNECTIONS **In Exercises 43 and 44, write a formula for the area of the regular polygon. Solve the formula for the height h.**

43.



44.



REASONING **In Exercises 45 and 46, solve the literal equation for a.**

45. $x = \dfrac{a + b + c}{ab}$

46. $y = x\left(\dfrac{ab}{a - b}\right)$

Maintaining Mathematical Proficiency

Reviewing what you learned in previous grades and lessons

Evaluate the expression. *(Skills Review Handbook)*

47. $15 - 5 + 5^2$ **48.** $18 \cdot 2 - 4^2 \div 8$ **49.** $3^3 + 12 \div 3 \cdot 5$ **50.** $2^5(5 - 6) + 9 \div 3$

Solve the equation. Graph the solutions, if possible. *(Section 1.4)*

51. $|x - 3| + 4 = 9$ **52.** $|3y - 12| - 7 = 2$ **53.** $2|2r + 4| = -16$ **54.** $-4|s + 9| = -24$