2.8 Rewrite Equations and Formulas

Before You wrote functions and used formulas.
Now You will rewrite equations and formulas.
Why? So you can solve a problem about bowling, as in Ex. 33.

Key Vocabulary
- **literal equation**
- **formula**

The equations $2x + 5 = 11$ and $6x + 3 = 15$ have the general form $ax + b = c$. The equation $ax + b = c$ is called a **literal equation** because the coefficients and constants have been replaced by letters. When you solve a literal equation, you can use the result to solve any equation that has the same form as the literal equation.

COMMON CORE

CC.9-12.A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.*

EXAMPLE 1 Solve a literal equation

Solve $ax + b = c$ for x. Then use the solution to solve $2x + 5 = 11$.

Solution

STEP 1 **Solve** $ax + b = c$ for x.

$ax + b = c$ — Write original equation.

$ax = c - b$ — Subtract b from each side.

$x = \frac{c - b}{a}$ — Assume $a \neq 0$. Divide each side by a.

STEP 2 **Use** the solution to solve $2x + 5 = 11$.

$x = \frac{c - b}{a}$ — Solution of literal equation

$= \frac{11 - 5}{2}$ — Substitute 2 for a, 5 for b, and 11 for c.

$= 3$ — Simplify.

▶ The solution of $2x + 5 = 11$ is 3.

VARIABLES IN DENOMINATORS In Example 1, you must assume that $a \neq 0$ in order to divide by a. In general, if you have to divide by a variable when solving a literal equation, you should assume that the variable does not equal 0.

GUIDED PRACTICE for Example 1

Solve the literal equation for x. Then use the solution to solve the specific equation.

1. $a - bx = c$; $12 - 5x = -3$
2. $ax = bx + c$; $11x = 6x + 20$

TWO OR MORE VARIABLES An equation in two variables, such as $3x + 2y = 8$, or a formula in two or more variables, such as $A = \frac{1}{2}bh$, can be rewritten so that one variable is a function of the other variable(s).

EXAMPLE 2 Rewrite an equation

Write $3x + 2y = 8$ so that y is a function of x.

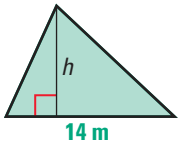
$3x + 2y = 8$ — Write original equation.

$2y = 8 - 3x$ — Subtract $3x$ from each side.

$y = 4 - \frac{3}{2}x$ — Divide each side by 2.

EXAMPLE 3 Solve and use a geometric formula

The area A of a triangle is given by the formula $A = \frac{1}{2}bh$ where b is the base and h is the height.



a. Solve the formula for the height h.

b. Use the rewritten formula to find the height of the triangle shown, which has an area of 64.4 square meters.

Solution

a. $A = \frac{1}{2}bh$ — Write original formula.

$2A = bh$ — Multiply each side by 2.

$\frac{2A}{b} = h$ — Divide each side by b.

b. Substitute 64.4 for A and 14 for b in the rewritten formula.

$h = \frac{2A}{b}$ — Write rewritten formula.

$= \frac{2(64.4)}{14}$ — Substitute 64.4 for A and 14 for b.

$= 9.2$ — Simplify.

▶ The height of the triangle is 9.2 meters.

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USE UNIT ANALYSIS
When area is measured in square meters and the base is measured in meters, dividing twice the area by the base gives a result measured in meters.

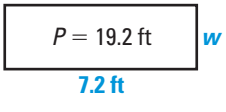
GUIDED PRACTICE for Examples 2 and 3

3. Write $5x + 4y = 20$ so that y is a function of x.

4. The perimeter P of a rectangle is given by the formula $P = 2\ell + 2w$ where ℓ is the length and w is the width.

a. Solve the formula for the width w.

b. Use the rewritten formula to find the width of the rectangle shown.



EXAMPLE 4 Solve a multi-step problem

TEMPERATURE You are visiting Toronto, Canada, over the weekend. A website gives the forecast shown. Find the low temperatures for Saturday and Sunday in degrees Fahrenheit. Use the formula $C = \frac{5}{9}(F - 32)$ where C is the temperature in degrees Celsius and F is the temperature in degrees Fahrenheit.

REWRITE FORMULAS
When using a formula for multiple calculations, you may find it easier to rewrite the formula first.

Solution

STEP 1 **Rewrite** the formula. In the problem, degrees Celsius are given and degrees Fahrenheit need to be calculated. The calculations will be easier if the formula is written so that F is a function of C.

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

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

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

$\frac{9}{5}C + 32 = F$ Add 32 to each side.

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

STEP 2 **Find** the low temperatures for Saturday and Sunday in degrees Fahrenheit.

Saturday (low of 14°C)

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

$= \frac{9}{5}(14) + 32$

$= 25.2 + 32$

$= 57.2$

▶ The low for Saturday is 57.2°F.

Sunday (low of 10°C)

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

$= \frac{9}{5}(10) + 32$

$= 18 + 32$

$= 50$

▶ The low for Sunday is 50°F.

GUIDED PRACTICE for Example 4

5. Use the information in Example 4 to find the high temperatures for Saturday and Sunday in degrees Fahrenheit.

2.8 EXERCISES

HOMEWORK KEY

- ◯ = See **WORKED-OUT SOLUTIONS** Exs. 17 and 33
- ★ = **STANDARDIZED TEST PRACTICE** Exs. 2, 23, 29, 35, and 36
- ◆ = **MULTIPLE REPRESENTATIONS** Ex. 34

SKILL PRACTICE

1. **VOCABULARY** Copy and complete: When you write the equation $3x + 2 = 8$ as $ax + b = c$, the equation $ax + b = c$ is called a(n) ___?___ because the coefficients and constants have been replaced by letters.

2. ★ **WRITING** *Describe* the steps you would take to solve $I = prt$ for t.

EXAMPLE 1 for Exs. 3–10

LITERAL EQUATIONS **Solve the literal equation for x. Then use the solution to solve the specific equation.**

3. $ax = bx - c$; $8x = 3x - 10$
4. $a(x + b) = c$; $2(x + 1) = 9$
5. $c = \frac{x + a}{b}$; $2 = \frac{x + 5}{7}$
6. $\frac{x}{a} = \frac{b}{c}$; $\frac{x}{8} = \frac{4.5}{12}$
7. $\frac{x}{a} + b = c$; $\frac{x}{4} + 6 = 13$
8. $ax + b = cx - d$; $2x + 9 = 7x - 1$

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

9. $ax + b = 0$

$ax = b$

$x = \frac{b}{a}$ ✗

10. $c = ax - bx$

$c = (a - b)x$

$c(a - b) = x$ ✗

EXAMPLE 2 for Exs. 11–19

REWRITING EQUATIONS **Write the equation so that y is a function of x.**

11. $2x + y = 7$
12. $5x + 4y = 10$
13. $12 = 9x + 3y$
14. $18x - 2y = 26$
15. $14 = 7y - 6x$
16. $8x - 8y = 5$
17. $30 = 9x - 5y$
18. $3 + 6x = 11 - 4y$
19. $2 + 6y = 3x + 4$

EXAMPLE 3 for Exs. 20–23

REWRITING FORMULAS **Solve the formula for the indicated variable.**

20. Volume of a rectangular prism: $V = \ell wh$. Solve for w.
21. Surface area of a prism: $S = 2B + Ph$. Solve for h.
22. Length of movie projected at 24 frames per second: $\ell = 24f$. Solve for f.

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23. ★ **MULTIPLE CHOICE** The formula for the area of a trapezoid is $A = \frac{1}{2}(b_1 + b_2)h$. Which equation is *not* equivalent to the formula?

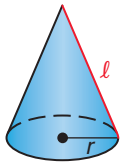
Ⓐ $h = \frac{2A}{b_1 + b_2}$ Ⓑ $b_1 = \frac{2A}{h} - b_2$ Ⓒ $b_2 = \frac{2A}{b_1} - h$ Ⓓ $b_2 = \frac{2A}{h} - b_1$

REWRITING EQUATIONS **Write the equation so that y is a function of x.**

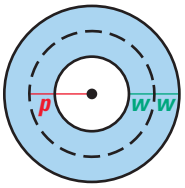
24. $4.2x - 2y = 16.8$
25. $9 - 0.5y = 2.5x$
26. $8x - 5x + 21 = 36 - 6y$

GEOMETRY **Solve the formula for the indicated variable. Then evaluate the rewritten formula for the given values. (Use 3.14 for π.)**

27. Surface area of a cone: $S = \pi r\ell + \pi r^2$. Solve for ℓ. Find ℓ when $S = 283$ cm^2 and $r = 5$ cm.



28. Area of a circular ring: $A = 4\pi pw$. Solve for p. Find p when $A = 905$ ft^2 and $w = 9$ ft.



29. ★ **OPEN-ENDED** *Describe* a real-world situation where you would want to solve the distance traveled formula $d = rt$ for t.

CHALLENGE **Solve the literal equation for a.**

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

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

PROBLEM SOLVING

EXAMPLE 4 for Exs. 32–34

32. **CARPENTRY** The penny size d of a nail is given by $d = 4n - 2$ where n is the length (in inches) of the nail.

a. Solve the formula for n.

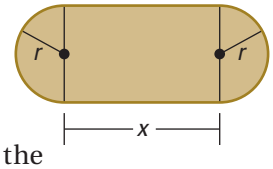
b. Use the new formula to find the lengths of nails with the following penny sizes: 5, 12, 16, and 20.

33. **BOWLING** To participate in a bowling league, you pay a \$25 sign-up fee and \$12 for each league night that you bowl. So, the total cost C (in dollars) is given by the equation $C = 12x + 25$ where x is the number of league nights you bowled.

a. Solve the equation for x.

b. How many league nights have you bowled if you spent a total of \$145? \$181? \$205?

34. **MULTIPLE REPRESENTATIONS** An athletic facility is building an indoor track like the one shown. The perimeter P (in feet) of the track is given by $P = 2\pi r + 2x$.



a. Writing an Equation Solve the formula for x.

b. Making a Table The perimeter of the track will be 660 feet. Use the rewritten formula to make a table that shows values of x to the nearest foot when r is 50 feet, 51 feet, 52 feet, and 53 feet. (Use 3.14 for π.)

c. Drawing a Graph Plot the ordered pairs from your table. Look for a pattern in the points. Use the pattern to find x when r is 54 feet.

35. ★ **WRITING** You work as a server at a restaurant. During your shift, you keep track of the bills that you give the tables you serve and the tips you receive from the tables. You want to calculate the tip received from each table as a percent of the bill. *Explain* how to rewrite the percent equation to make it easier to calculate the percent tip from each table.

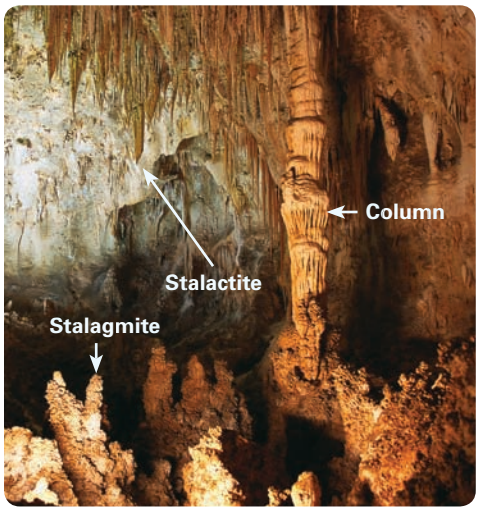
○ = See WORKED-OUT SOLUTIONS in Student Resources ★ = STANDARDIZED TEST PRACTICE = MULTIPLE REPRESENTATIONS

36. ★ **EXTENDED RESPONSE** One type of stone formation found in Carlsbad Caverns in New Mexico is called a column. This cylindrical stone formation is connected to the ceiling and the floor of a cave.

a. Rewrite the formula for the circumference of a circle, $C = 2\pi r$, 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? (Use 3.14 for π.)

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



37. **CHALLENGE** The distance d (in miles) traveled by a car is given by $d = 55t$ where t is the time (in hours) the car has traveled. The distance d (in miles) traveled is also given by $d = 20g$ where g is the number of gallons of gasoline used by the car. Write an equation that expresses g as a function of t.

QUIZ

Solve the proportion. Check your solution.

1. $\frac{24}{20} = \frac{x}{5}$

2. $\frac{6}{-7} = \frac{3z}{42}$

3. $\frac{14}{12} = \frac{w + 11}{18}$

4. $\frac{18}{5a} = \frac{3}{-5}$

5. $\frac{10}{17} = \frac{k}{2k - 3}$

6. $\frac{h - 1}{3} = \frac{2h + 1}{9}$

Write the equation so that y is a function of x.

7. $5x - 3y = 9$

8. $3x + 2y + 5x = 12$

9. $4(2x - y) = 6$

10. **GEOMETRY** The volume V of a cylinder is given by the formula $V = \pi r^2 h$ where r is the radius of the cylinder and h is the height of the cylinder. Solve the formula for h.

MIXED REVIEW of Problem Solving

MATHEMATICAL PRACTICES Make sense of problems and persevere in solving them.

1. MULTI-STEP PROBLEM The table below shows the results of a survey in which students at a school were asked to name their favorite sport to watch on TV.

Sport	Students
Baseball	7
Basketball	6
Football	10
Other	8

a. There are 1209 students at the school. Write a proportion that you can use to predict the number of students at the school who would name baseball as their favorite sport to watch on TV.

b. Solve the proportion.

2. MULTI-STEP PROBLEM The ratio of male students to female students in the freshman class at a high school is 4:5. There are 216 students in the freshman class.

a. Find the ratio of female students to all students.

b. Use the ratio to find the number of female students in the freshman class.

3. SHORT RESPONSE During a vacation, your family's car used 7 gallons of gasoline to travel 154 miles. Your family is planning another vacation in which you will travel 770 miles by car. If gasoline costs about $2 per gallon, how much money should your family budget for gasoline for this vacation? *Explain* your reasoning.

4. SHORT RESPONSE In biology, the surface-area-to-volume quotient Q of a single spherical cell is given by the formula $Q = \frac{3}{r}$ where r is the radius of the cell. Suppose you need to calculate the diameters of cells given the surface-area-to-volume quotients of the cells. Given that $d = 2r$, explain how to write a formula for the diameter d of a cell given its surface-area-to-volume quotient.

5. GRIDDED ANSWER A basketball player made 60% of his free-throws during a season. The player made 84 free-throws. How many free-throw attempts did he have?

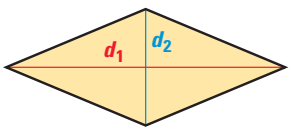
6. EXTENDED RESPONSE When a real estate agent sells a house, the agent receives 6% of the sale price as a commission. The agent lists the sale price for a house as $208,000.

a. How much of a commission should the agent expect to receive for selling this house at full price?

b. The house actually sells for $205,000. How much of a commission does the agent receive?

c. The real estate agent gives 10% of her commission to her assistant. What percent of the selling price does the agent's assistant receive? *Explain* your reasoning.

7. SHORT RESPONSE The area A of a rhombus is given by the formula $A = \frac{1}{2}d_1d_2$ where d_1 and d_2 are the lengths of the diagonals.



Suppose you need to find d_1 for different values of A and d_2. *Explain* how to rewrite the area formula to make it easier to find values for d_1.

8. OPEN-ENDED *Describe* how the dimensions of the rectangular garden below can be altered to increase the area of the garden by 25%.

2 CHAPTER SUMMARY

BIG IDEAS

For Your Notebook

Big Idea 1 Solving Equations in One Variable

You can solve equations in one variable by adding, subtracting, multiplying by, or dividing by the same number on each side.

Property	Words	Algebra
Addition Property of Equality	Add the same number to each side.	If $x - a = b$, then $x - a + a = b + a$, or $x = b + a$.
Subtraction Property of Equality	Subtract the same number from each side.	If $x + a = b$, then $x + a - a = b - a$, or $x = b - a$.
Multiplication Property of Equality	Multiply each side by the same nonzero number.	If $\frac{x}{a} = b$ and $a \neq 0$, then $a \cdot \frac{x}{a} = a \cdot b$, or $x = ab$.
Division Property of Equality	Divide each side by the same nonzero number.	If $ax = b$ and $a \neq 0$, then $\frac{ax}{a} = \frac{b}{a}$, or $x = \frac{b}{a}$.

Big Idea 2 Solving Proportions

When solving a proportion, you can take the cross products, then use properties of equality.

$\frac{x-3}{40} = \frac{4}{5}$ **Original proportion**

$5(x-3) = 40 \cdot 4$ **Cross products property**

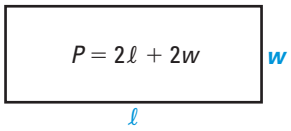
$5x - 15 = 160$ **Simplify.**

$5x = 175$ **Addition property of equality: Add 15 to each side.**

$x = 35$ **Division property of equality: Divide each side by 5.**

Big Idea 3 Rewriting Equations in Two or More Variables

If you have an equation in two or more variables, you can solve for one variable in terms of the others using properties of equality. For example, the formula for the perimeter P of a rectangle can be solved for the length ℓ.



$P = 2\ell + 2w$ **Original formula**

$P - 2w = 2\ell$ **Subtraction property of equality: Subtract $2w$ from each side.**

$\frac{P-2w}{2} = \ell$ **Division property of equality: Divide each side by 2.**

2 CHAPTER REVIEW

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- Multi-Language Glossary
- Vocabulary practice

REVIEW KEY VOCABULARY

- square root
- radicand
- perfect square
- irrational number
- real numbers
- inverse operations
- equivalent equations
- identity
- ratio
- proportion
- cross product
- scale drawing
- scale model
- scale
- literal equation

VOCABULARY EXERCISES

1. Copy and complete: A(n) __?__ is a two-dimensional drawing of an object in which the dimensions of the drawing are in proportion to the dimensions of the object.
2. Copy and complete: When you perform the same inverse operation on each side of an equation, you produce a(n) __?__ equation.
3. *Explain* why the equation $2x + 8x = 3x + 7x$ is an identity.
4. Copy and complete: In the proportion $\frac{7}{8} = \frac{28}{32}$, $7 \cdot 32$ and $8 \cdot 28$ are __?__.
5. *Describe* the steps you would take to write the equation $6x - 2y = 16$ in function form.

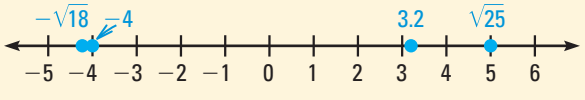
REVIEW EXAMPLES AND EXERCISES

Use the review examples and exercises below to check your understanding of the concepts you have learned in each lesson of this chapter.

2.1 Find Square Roots and Compare Real Numbers

EXAMPLE

Order the following numbers from least to greatest: $\sqrt{25}$, $-\sqrt{18}$, -4, 3.2.



From least to greatest, the numbers are $-\sqrt{18}$, -4, 3.2, and $\sqrt{25}$.

EXERCISES

EXAMPLES 1, 2, and 4 for Exs. 6–15

Evaluate the expression.

6. $\sqrt{121}$ **7.** $-\sqrt{36}$ **8.** $\pm\sqrt{81}$ **9.** $\pm\sqrt{225}$

Approximate the square root to the nearest integer.

10. $\sqrt{97}$ **11.** $-\sqrt{48}$ **12.** $-\sqrt{142}$ **13.** $\sqrt{300}$

Order the numbers in the list from least to greatest.

14. $-\sqrt{49}$, -6.8, 2, $\sqrt{3}$, 1.58 **15.** 1.25, $\sqrt{11}$, -0.3, 0, $-\sqrt{4}$

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Chapter Review Practice

2.2 Solve One-Step Equations

EXAMPLE

Solve $\frac{x}{5} = 14$.

$\frac{x}{5} = 14$ Write original equation.

$5 \cdot \frac{x}{5} = 5 \cdot 14$ Multiply each side by 5.

$x = 70$ Simplify.

EXERCISES

EXAMPLES 1, 2, 3, 4 and 5 for Exs. 16–22

Solve the equation. Check your solution.

16. $x - 4 = 3$ **17.** $-8 + a = 5$ **18.** $4m = -84$

19. $-5z = 75$ **20.** $11 = \frac{r}{6}$ **21.** $-27 = \frac{3}{4}w$

22. PARKS A rectangular city park has an area of 211,200 square feet. If the length of the park is 660 feet, what is the width of the park?

2.3 Solve Two-Step Equations

EXAMPLE

Solve $4x - 9 = 3$.

$4x - 9 = 3$ Write original equation.

$4x - 9 + 9 = 3 + 9$ Add 9 to each side.

$4x = 12$ Simplify.

$\frac{4x}{4} = \frac{12}{4}$ Divide each side by 4.

$x = 3$ Simplify.

EXERCISES

EXAMPLES 1 and 2 for Exs. 23–28

Solve the equation. Check your solution.

23. $9b + 5 = 23$ **24.** $11 = 5y - 4$ **25.** $\frac{n}{3} - 4 = 2$

26. $\frac{3}{2}v + 2 = 20$ **27.** $3t + 9t = 60$ **28.** $-110 = -4c - 6c$

2 CHAPTER REVIEW

2.4 Solve Multi-Step Equations

EXAMPLE

Solve $5x - 2(4x + 3) = 9$.

$5x - 2(4x + 3) = 9$ — Write original equation.

$5x - 8x - 6 = 9$ — Distributive property

$-3x - 6 = 9$ — Combine like terms.

$-3x = 15$ — Add 6 to each side.

$x = -5$ — Divide each side by -3.

EXERCISES

EXAMPLES 1, 2, 3 and 4 for Exs. 29–37

Solve the equation. Check your solution.

29. $3w + 4w - 2 = 12$

30. $z + 5 - 4z = 8$

31. $c + 2c - 5 - 5c = 7$

32. $4y - (y - 4) = -20$

33. $8a - 3(2a + 5) = 13$

34. $16h - 4(5h - 7) = 4$

35. $\frac{3}{2}(b + 1) = 3$

36. $\frac{4}{3}(2x - 1) = -12$

37. $\frac{6}{5}(8k + 2) = -36$

2.5 Solve Equations with Variables on Both Sides

EXAMPLE

Solve the equation, if possible.

$-2(x - 5) = 7 - 2x$ — Original equation

$-2x + 10 = 7 - 2x$ — Distributive property

$-2x + 3 = -2x$ — Subtract 7 from each side.

▶ The equation $-2x + 3 = -2x$ is not true because the number $-2x$ cannot be equal to 3 more than itself. So, the equation has no solution.

EXERCISES

Solve the equation, if possible.

38. $-3z - 1 = 8 - 3z$

39. $16 - 2m = 5m + 9$

40. $2.9w + 5 = 4.7w - 7.6$

41. $2y + 11.4 = 2.6 - 0.2y$

42. $4(x - 3) = -2(6 - 2x)$

43. $6(2a + 10) = 5(a + 5)$

EXAMPLES 1, 2, and 4 for Exs. 38–46

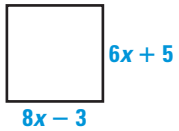
44. $\frac{1}{12}(48 + 24b) = 2(17 - 4b)$

45. $1.5(n + 20) = 0.5(n + 60)$

46. **GEOMETRY** Refer to the square shown.

a. Find the value of x.

b. Find the perimeter of the square.



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Chapter Review Practice

2.6 Write Ratios and Proportions

EXAMPLE

You know that 5 pizzas will feed 20 people. How many pizzas do you need to order to feed 88 people?

$\frac{5}{20} = \frac{x}{88}$ ← number of pizzas
← number of people

$88 \cdot \frac{5}{20} = 88 \cdot \frac{x}{88}$ Multiply each side by 88.

$22 = x$ Simplify.

▸ You need to order 22 pizzas.

EXERCISES

EXAMPLES 2 and 3 for Exs. 47–53

Solve the proportion. Check your solution.

47. $\frac{56}{16} = \frac{x}{2}$

48. $\frac{y}{9} = \frac{25}{15}$

49. $\frac{2}{7} = \frac{m}{91}$

50. $\frac{5z}{3} = \frac{105}{6}$

51. $\frac{9}{4} = \frac{3a}{20}$

52. $\frac{c+2}{45} = \frac{8}{5}$

53. PAINTING The label on a can of paint states that one gallon of the paint will cover 560 square feet. How many gallons of that paint are needed to cover 1400 square feet?

2.7 Solve Proportions Using Cross Products

EXAMPLE

Solve the proportion $\frac{3}{10} = \frac{12}{x}$.

$\frac{3}{10} = \frac{12}{x}$ Write original proportion.

$3 \cdot x = 10 \cdot 12$ Cross products property

$3x = 120$ Simplify.

$x = 40$ Divide each side by 3.

EXERCISES

EXAMPLES 1 and 4 for Exs. 54–60

Solve the proportion. Check your solution.

54. $\frac{5}{7} = \frac{20}{r}$

55. $\frac{6}{z} = \frac{12}{5}$

56. $\frac{126}{56} = \frac{9}{4b}$

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

58. $\frac{n+8}{5n-2} = \frac{3}{8}$

59. $\frac{5-c}{3} = \frac{2c+2}{-4}$

60. MAPS A map has a scale of 1 cm : 12 km. The distance between two cities on the map is 6.8 centimeters. Estimate the actual distance between the cities.

2 CHAPTER REVIEW

2.8 Rewrite Equations and Formulas

EXAMPLE

Write $5x + 4y - 7 = 5$ so that y is a function of x.

$5x + 4y - 7 = 5$	Write original equation.
$5x + 4y = 12$	Add 7 to each side.
$4y = 12 - 5x$	Subtract $5x$ from each side.
$y = 3 - \frac{5}{4}x$	Divide each side by 4.

EXERCISES

EXAMPLES 2 and 3 for Exs. 61–64

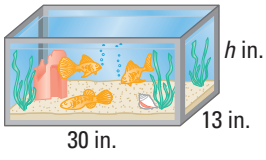
Write the equation so that y is a function of x.

61. $x + 7y = 0$ **62.** $3x = 2y - 18$ **63.** $4y - x = 20 - y$

64. AQUARIUMS A pet store sells aquariums that are rectangular prisms. The volume V of an aquarium is given by the formula $V = \ell wh$ where ℓ is the length, w is the width, and h is the height.

a. Solve the formula for h.

b. Use the rewritten formula to find the height of the aquarium shown, which has a volume of 5850 cubic inches.



2 CHAPTER TEST

Tell whether the number is a real number, a rational number, an irrational number, an integer, or a whole number.

1. $-\frac{1}{4}$ **2.** $\sqrt{90}$ **3.** $-\sqrt{144}$ **4.** 8.95

Order the numbers in the list from least to greatest.

5. $-\frac{5}{3}, -2, 3, \frac{1}{2}, -1.07$ **6.** $\sqrt{15}, -4.3, 4.2, 0, -\sqrt{25}$

Solve the equation. Check your solution.

7. $5 + r = -19$ **8.** $z - 8 = -12$ **9.** $-11x = -77$

10. $\frac{a}{9} = 6$ **11.** $15q - 17 = 13$ **12.** $3y + 2 = 26$

13. $\frac{b}{4} + 5 = 14$ **14.** $\frac{m}{10} - 6 = 20$ **15.** $6j + 5j = 33$

16. $4k - 9k = 10$ **17.** $14c - 8c + 7 = 37$ **18.** $4w - 21 + 5w = 51$

19. $-19.4 - 15d + 22d = 4.4$ **20.** $-12h + 39 = -4h - 17$ **21.** $-5.7v - 44.2 = -8.3v$

22. $-6.5t + 15 = -9.7t + 43.8$ **23.** $3(3n + 4) = 54 + 6n$ **24.** $\frac{1}{3}(24p - 66) = 3p + 43$

Solve the proportion. Check your solution.

25. $\frac{3}{4} = \frac{z}{16}$ **26.** $\frac{72}{45} = \frac{8}{w}$ **27.** $\frac{k}{9} = \frac{63}{81}$

28. $\frac{-5n}{4} = \frac{15}{2}$ **29.** $\frac{34}{6} = \frac{2x + 1}{3}$ **30.** $\frac{-4a - 1}{-10a} = \frac{3}{8}$

Write the equation so that y is a function of x.

31. $8x + y = 14$ **32.** $-9x + 3y = 18$ **33.** $4x = -2y + 26$

34. MOVIES The ticket prices at a movie theater are shown in the table. A family purchases tickets for 2 adults and 3 children, and the family purchases 3 boxes of popcorn of the same size. The family spent a total of $40.25. How much did each box of popcorn cost?

Ticket	Price
Adults	$8.50
Children	$5.50

35. ICE SKATING To become a member of an ice skating rink, you have to pay a $30 membership fee. The cost of admission to the rink is $5 for members and $7 for nonmembers. After how many visits to the rink is the total cost for members, including the membership fee, the same as the total cost for nonmembers?

36. SCALE DRAWING You are making a scale drawing of your classroom using the scale 1 inch : 3 feet. The floor of your classroom is a rectangle with a length of 21 feet and a width of 18 feet. What should the length and width of the floor in your drawing be?

2 ★ Standardized TEST PREPARATION

MULTIPLE CHOICE QUESTIONS

If you have difficulty solving a multiple choice problem directly, you may be able to use another approach to eliminate incorrect answer choices and obtain the correct answer.

PROBLEM 1

Sid's car gets 34 miles per gallon when driven on the highway and 26 miles per gallon when driven in the city. If Sid drove 414 miles on 13 gallons of gas, how many highway miles and how many city miles did Sid drive?

(A) 91 highway miles, 323 city miles

(B) 182 highway miles, 232 city miles

(C) 232 highway miles, 182 city miles

(D) 323 highway miles, 91 city miles

METHOD 1

SOLVE DIRECTLY Write and solve an equation for the situation.

STEP 1 **Write** an equation. Let x represent the amount of gas (in gallons) used for highway driving. Then $13 - x$ represents the amount of gas used for city driving.

$$414 = 34x + 26(13 - x)$$

STEP 2 **Solve** the equation.

$$414 = 34x + 338 - 26x$$

$$414 = 8x + 338$$

$$76 = 8x$$

$$9.5 = x$$

STEP 3 **Calculate** the number of highway miles driven.

$$34(9.5) = 323$$

STEP 4 **Calculate** the number of city miles driven.

$$26(13 - 9.5) = 91$$

Sid drove 323 highway miles and 91 city miles.

The correct answer is D. (A) (B) (C) (D)

METHOD 2

ELIMINATE CHOICES Another method is to consider the extremes to eliminate incorrect answer choices.

STEP 1 **Consider** driving all highway miles and all city miles.

$$\text{All highway: } 13 \text{ gal} \cdot \frac{34 \text{ mi}}{1 \text{ gal}} = 442 \text{ mi}$$

$$\text{All city: } 13 \text{ gal} \cdot \frac{26 \text{ mi}}{1 \text{ gal}} = 338 \text{ mi}$$

Because 414 is closer to 442 than to 338, you know that more highway miles were driven than city miles. So, you can eliminate choices A and B.

STEP 2 **Calculate** the gallons of gas that would be used for the remaining choices.

Choice C: $232 \text{ mi} \cdot \frac{1 \text{ gal}}{34 \text{ mi}} \approx 6.8 \text{ gal}$

$$182 \text{ mi} \cdot \frac{1 \text{ gal}}{26 \text{ mi}} = 7 \text{ gal}$$

Choice D: $323 \text{ mi} \cdot \frac{1 \text{ gal}}{34 \text{ mi}} = 9.5 \text{ gal}$

$$91 \text{ mi} \cdot \frac{1 \text{ gal}}{26 \text{ mi}} = 3.5 \text{ gal}$$

In choice D, the total number of gallons of gas is 13.

The correct answer is D. (A) (B) (C) (D)

PROBLEM 2

What is the value of x in the proportion $\frac{3}{2x-10} = \frac{12}{x+9}$?

(A) 4 (B) 6 (C) 7 (D) 8

METHOD 1

SOLVE DIRECTLY Find the value of x by using the cross products property to solve the proportion.

$$\frac{3}{2x-10} = \frac{12}{x+9}$$

$$3(x+9) = (2x-10) \cdot 12$$

$$3x + 27 = 24x - 120$$

$$147 = 21x$$

$$7 = x$$

The correct answer is C. (A) (B) (C) (D)

METHOD 2

ELIMINATE CHOICES Substitute each answer choice for x in the proportion and simplify.

Choice A: $\frac{3}{2(4)-10} \stackrel{?}{=} \frac{12}{4+9}$

$$\frac{3}{-2} = \frac{12}{13} \ \text{✗}$$

Choice B: $\frac{3}{2(6)-10} \stackrel{?}{=} \frac{12}{6+9}$

$$\frac{3}{2} = \frac{4}{5} \ \text{✗}$$

Choice C: $\frac{3}{2(7)-10} \stackrel{?}{=} \frac{12}{7+9}$

$$\frac{3}{4} = \frac{3}{4} \ \text{✓}$$

The correct answer is C. (A) (B) (C) (D)

PRACTICE

Explain why you can eliminate the highlighted answer choice.

1. What is the solution of the equation $5(x + 13) = 8(4 + x)$?

(A) -11 (B) -4 (C) ~~0~~ (D) 11

2. 45 is 80% of what number?

(A) ~~36~~ (B) 56.25 (C) 60 (D) 64.5

3. A grocery store sells apples by the pound. A 3 pound bag of apples costs \$2.99. About how much does a 5 pound bag of apples cost?

(A) \$3.24 (B) \$3.45 (C) \$4.98 (D) ~~\$5.98~~

4. The surface area S of a cylinder is given by the formula $S = 2\pi rh + 2\pi r^2$ where r is the radius and h is the height of the cylinder. Which of the given formulas is *not* equivalent to the original formula?

(A) $S = 2\pi r(h + r)$ (B) $h = 2\pi rS + 2\pi r^2$

(C) ~~$h = \frac{S - 2\pi r^2}{2\pi r}$~~ (D) $h = \frac{S}{2\pi r} - r$

2 ★ Standardized TEST PRACTICE

MULTIPLE CHOICE

1. How many solutions does the equation $3(x - 3) = 3x - 6$ have?

Ⓐ None Ⓑ 1

Ⓒ 2 Ⓓ Infinitely many

2. A karate studio offers a 6 week session for $175. How much would you expect to pay for a 9 week session?

Ⓐ $117 Ⓑ $200

Ⓒ $229 Ⓓ $262.50

3. Andrew decides to get cable TV for $43 per month. Doug buys a satellite dish for $104 and pays $30 per month for satellite TV. After how many months will Andrew and Doug have paid the same amount for their TV services?

Ⓐ 7 Ⓑ 8

Ⓒ 9 Ⓓ 10

4. The rates for using a swimming facility are given below. After how many visits will a family of 4 save money by having a membership rather than paying for all 4 family members for each visit?

Admission Prices	
One-day visit	$3 per person
Family membership (unlimited visits)	$150

Ⓐ 12 Ⓑ 13

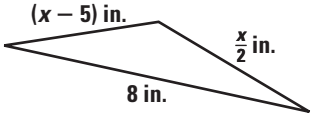
Ⓒ 38 Ⓓ 50

5. The record for the longest distance and longest time ever flown by a model airplane was set in 2003 by Maynard Hill. The airplane flew 1888 miles from Canada to Ireland in 38 hours and 53 minutes. What was the plane's average speed?

Ⓐ About 36 mi/h Ⓑ About 45 mi/h

Ⓒ About 49 mi/h Ⓓ About 71,744 mi/h

6. The perimeter of the triangle shown is 16.5 inches. What is the length of the shortest side?



Ⓐ 3.5 in. Ⓑ 4 in.

Ⓒ 4.5 in. Ⓓ 9 in.

7. Jeanie completed a 27 mile duathlon (a race that is a combination of running and biking) in exactly 2 hours. She ran an average speed of 8.5 miles per hour and biked an average speed of 16 miles per hour. For how long did Jeanie bike during the race?

Ⓐ 1 hour 20 minutes

Ⓑ 1 hour 15 minutes

Ⓒ 45 minutes

Ⓓ 40 minutes

8. A model of the Gateway Arch in St. Louis, Missouri, was built using a scale of 1 ft : 500 ft. The model is 1.26 feet tall. What is the actual height of the Gateway Arch?

Ⓐ 75.6 ft Ⓑ 396.8 ft

Ⓒ 630 ft Ⓓ 7560 ft

9. A mountain biking park has a total of 48 trails, 37.5% of which are beginner trails. The rest are divided evenly between intermediate and expert trails. How many of each kind of trail is there?

Ⓐ 12 beginner, 18 intermediate, 18 expert

Ⓑ 18 beginner, 15 intermediate, 15 expert

Ⓒ 18 beginner, 12 intermediate, 18 expert

Ⓓ 30 beginner, 9 intermediate, 9 expert

10. What percent of 256 is 140.8?

Ⓐ 45% Ⓑ 50%

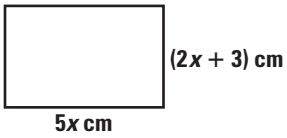
Ⓒ 52.5% Ⓓ 55%

GRIDDED ANSWER

11. The circumference of a circle is 12 feet. What is the radius (in feet) of the circle? Round your answer to the nearest tenth.

12. What is the value of x in the equation $75 = 15x - 6(x + 7)$?

13. The perimeter of the rectangle shown is 41 centimeters. What is the value of x?



14. Chris pays \$.29 for each digital photo he has printed. Debbie buys a photo printer for \$180. It costs \$.14 per photo for ink and paper to print a photo using the printer. After how many prints will Chris and Debbie have paid the same amount?

SHORT RESPONSE

15. Kendra is painting her dining room white and her living room blue. She spends a total of \$132 on 5 cans of paint. The white paint costs \$24 per can, and the blue paint costs \$28 per can.

a. Write and solve an equation to find the number of cans of each color paint that Kendra bought.

b. How much would Kendra have saved by switching the colors of the dining room and living room? *Explain*.

16. Kim and Sandy are each knitting a scarf. Kim can knit 3 rows in 5 minutes. Sandy can knit 4 rows in 6 minutes. They start knitting at the same time and do not take any breaks. Kim wants her scarf to be 84 rows long. Sandy wants her scarf to be 88 rows long. Who will finish her scarf first? *Explain*.

EXTENDED RESPONSE

17. You are shopping for tools. You find two stores at which the regular prices of the tools are the same. Store A is currently offering \$30 off any purchase of \$100 or more. Store B is currently offering 12% off any purchase.

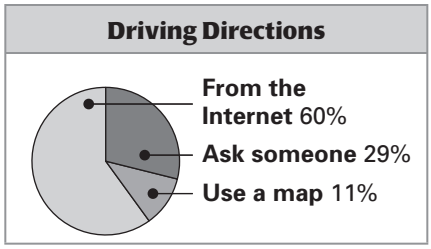
a. Compare the costs of buying \$200 worth of tools from each store.

b. Compare the costs of buying \$300 worth of tools from each store.

c. Let x be the regular price (in dollars) of your purchase, and assume that x is greater than 100. Write an equation you could use to find the value of x for which the costs of the tools after the discounts are the same. *Explain* how you wrote the equation.

d. Solve the equation from part (c). How can the solution help you to decide from which store you should buy the tools? *Explain*.

18. The circle graph shows the results of a survey that asked 225 randomly selected people how they get driving directions.



a. How many people said that they get directions from the Internet?

b. Suppose 15 more people were surveyed, and all 15 said that they get directions from the Internet. Calculate the new percent for the "From the Internet" category. *Explain* how you found your answer.

c. Instead of 15 more people, suppose x more people are surveyed and they all said that they get directions from the Internet. What value of x would make the percent for the "From the Internet" category be 70%? Your response should include a proportion and an explanation of how you used the proportion to find your answer.