Name____ Date__________

Chapter 1 Solving Linear Equations

Dear Family,

Solving equations is an important skill in the math classroom, but how about in everyday life? Have you ever considered how you may use this skill in real life?

Consider the following scenario:

- You and your family want to purchase a new video game system. The system costs \$400. You already have \$250 saved to put toward the system. How much money do you still need to save to buy the system?

You could simply subtract \$250 from \$400 to get your answer. Consider writing an equation instead. What would that look like? The unknown, in this case, the amount of money left to save, can be represented by a *variable*. One example of an equation is $y + 250 = 400$, where y is the unknown value. Discuss how you would find the unknown value.

Now, as a family, brainstorm ways you could earn the money. Will you earn the money working together? Or will you divide the remaining amount that needs to be earned among the members of your family and work independently?

Next, write an equation for each scenario. How are the equations the same? How are they different? Is the value of the variable the same for both scenarios?

As your child works through Chapter 1, he or she will learn how to solve similar types of equations. Share together other ways you as a family use equations in everyday life, maybe without even realizing it.

Name ____ Date __________

Chapter 1 Solving Linear Equations (continued)

	Learning Target	Success Criteria
Chapter 1 Solving Linear Equations	Understand solving linear equations.	• I can solve simple and multi-step equations. • I can describe how to solve equations. • I can analyze the measurements used to solve a problem and judge the level of accuracy appropriate for the solution. • I can apply equation-solving techniques to solve real-life problems.
1.1 Solving Simple Equations	Write and solve one-step linear equations.	• I can apply properties of equality to produce equivalent equations. • I can solve linear equations using addition, subtraction, multiplication, or division. • I can write linear equations that model real-life situations.
1.2 Solving Multi-Step Equations	Write and solve multi-step linear equations.	• I can apply more than one property of equality to produce equivalent equations. • I can solve multi-step linear equations using inverse operations. • I can write multi-step linear equations that model real-life situations.
1.3 Modeling Quantities	Use proportional reasoning and analyze units when solving problems.	• I can use ratios to solve real-life problems. • I can use rates to solve real-life problems. • I can convert units and rates.
1.4 Accuracy with Measurements	Choose an appropriate level of accuracy when calculating with measurements.	• I can choose an appropriate level of accuracy when measuring to solve real-life problems. • I can determine where to round numbers when finding estimates.
1.5 Solving Equations with Variables on Both Sides	Write and solve equations with variables on both sides.	• I can apply properties of equality using variable terms. • I can solve equations with variables on both sides. • I can recognize when an equation has zero, one, or infinitely many solutions.
1.6 Solving Absolute Value Equations	Write and solve equations involving absolute value.	• I can write the two linear equations related to a given absolute value equation. • I can solve equations involving one or two absolute values. • I can identify special solutions of absolute value equations.
1.7 Rewriting Equations and Formulas	Solve literal equations for given variables.	• I can identify a literal equation. • I can use properties of equality to rewrite literal equations. • I can use rewritten formulas to solve problems.

Nombre ____ Fecha_________

Capítulo 1 Resolver ecuaciones lineales

Estimada familia:

Resolver ecuaciones es una destreza importante en la clase de matemáticas, pero ¿qué pasa en la vida cotidiana? ¿Alguna vez han considerado cómo pueden usar esta destreza en la vida real?

Consideren la siguiente situación:

- Usted y su familia quieren comprar un nuevo sistema de videojuegos. El sistema cuesta $400. Ya han ahorrado $250 para el sistema. ¿Cuánto dinero aún necesitan ahorrar para comprar el sistema?

Podrían simplemente restar $250 de $400 para obtener la respuesta. En cambio, consideren escribir una ecuación. ¿Cómo sería? En este caso, la incógnita, la cantidad de dinero que falta ahorrar, puede representarse con una *variable*. Un ejemplo de la ecuación sería $y + 250 = 400$, donde y es el valor desconocido. Comenten cómo hallarían el valor desconocido.

Ahora, en familia, propongan maneras en que podrían ganar el dinero. ¿Ganarán el dinero trabajando juntos? ¿O dividirán la cantidad restante que deben ahorrar entre los integrantes de su familia y trabajarán por separado?

Luego, escriban una ecuación para cada situación. ¿En qué se parecen las ecuaciones? ¿En qué se diferencian? ¿El valor de la variable es igual para ambas situaciones?

A medida que su hijo avanza en el capítulo 1, aprenderá cómo resolver tipos de ecuaciones semejantes. Compartan otras maneras en que su familia usa ecuaciones en la vida cotidiana, quizás sin ni siquiera darse cuenta.

Nombre ____ Fecha ________

Capítulo 1 Resolver ecuaciones lineales (continuación)

	Objetivo de aprendizaje	**Criterios de éxito**
Capítulo 1 Resolver ecuaciones lineales	Comprender cómo resolver ecuaciones lineales.	• Puedo resolver ecuaciones simples y de varios pasos. • Puedo describir cómo se resuelven las ecuaciones. • Puedo analizar las mediciones que se usan para resolver un problema y juzgar el nivel de precisión adecuado para la solución. • Puedo aplicar técnicas de resolución de ecuaciones para resolver problemas de la vida real.
1.1 Resolver ecuaciones simples	Escribir y resolver ecuaciones lineales de un paso.	• Puedo aplicar propiedades de igualdad para producir ecuaciones equivalentes. • Puedo resolver ecuaciones lineales con sumas, restas, multiplicaciones o divisiones. • Puedo escribir ecuaciones lineales que reflejen situaciones de la vida real.
1.2 Resolver ecuaciones de varios pasos	Escribir y resolver ecuaciones lineales de varios pasos.	• Puedo aplicar más de una propiedad de igualdad para producir ecuaciones equivalentes. • Puedo resolver ecuaciones de varios pasos con operaciones inversas. • Puedo escribir ecuaciones lineales de varios pasos que reflejen situaciones de la vida real.
1.3 Representar cantidades	Usar el razonamiento proporcional y analizar las unidades al resolver los problemas.	• Puedo usar proporciones para resolver problemas de la vida real. • Puedo usar tasas para resolver problemas de la vida real. • Puedo convertir unidades y tasas.
1.4 Precisión con mediciones	Elegir un nivel de precisión adecuado al calcular con mediciones.	• Puedo elegir un nivel de precisión adecuado al medir para resolver problemas de la vida real. • Puedo determinar cuándo redondear números para encontrar una estimación.
1.5 Resolver ecuaciones con variables de ambos lados	Escribir y resolver ecuaciones con variables en ambos lados.	• Puedo aplicar propiedades de igualdad con términos variables. • Puedo resolver ecuaciones con variables en ambos lados. • Puedo reconocer si una ecuación tiene ninguna, una o infinitas soluciones.
1.6 Resolver ecuaciones de valor absoluto	Escribir y resolver ecuaciones que involucren valor absolute.	• Puedo escribir dos ecuaciones lineales relacionadas con una ecuación de valor absoluto dada. • Puedo resolver ecuaciones que involucren uno o más valores absolutos. • Puedo identificar soluciones especiales de ecuaciones de valor absoluto.
1.7 Reescribir ecuaciones y fórmulas	Resolver ecuaciones literales para variables dadas.	• Puedo identificar una ecuación literal. • Puedo usar propiedades de igualdad para reescribir ecuaciones literales. • Puedo usar fórmulas reescritas para resolver problemas.

Name____ Date __________

1.1 Cumulative Practice
For use before Lesson 1.1

1. Tell whether $a = 7$ is a solution of $a + 5 = 12$.

2. Tell whether $c = 88$ is a solution of $c \div 11 = 8$.

1.1 Prerequisite Skills Practice
For use before Lesson 1.1

Simplify the expression.

1. $5 + (-15)$

2. $10 \bullet (-1)$

Name ____ Date __________

1.1 Extra Practice

In Exercises 1–6, solve the equation. Justify each step. Check your solution.

1. $p + 7 = -9$

2. $0 = k - 2$

3. $-10 = w + 1$

4. $g + (-3) = 4$

5. $-14 = -9 + q$

6. $s - (-12) = 15$

7. Shopping online, you find a skateboard that costs \$124.99, which is \$42.50 less than the price at a local store. Write and solve an equation to find the price at the local store.

In Exercises 8–13, solve the equation. Justify each step. Check your solutions.

8. $-32 = 4y$

9. $r \div (-8) = 5$

10. $\frac{k}{3} = 4$

11. $\frac{z}{-2} = 7$

12. $9 = b \div (-1)$

13. $-100 = \frac{p}{10}$

In Exercises 14–19, solve the equation. Check your solution.

14. $k - \frac{4}{7} = \frac{2}{7}$

15. $-\frac{2}{9}d = 18$

16. $h + \frac{\pi}{2} = \frac{3\pi}{2}$

17. $5t = -7.5$

18. $4 + 12 \div 2 = -5v$

19. $a + 8 = 9 \times 3 - 10$

20. Describe and correct the error in solving the equation.

✗

$$-\frac{2}{3}p = 4$$
$$-\frac{2}{3}p + \frac{2}{3} = 4 + \frac{2}{3}$$
$$p = 4\frac{2}{3}$$

21. As c decreases, does the value of x *increase, decrease,* or *stay the same* for each equation? Assume c is positive.

Equation	Value of x
$x + c = 0$	
$-cx = -c$	
$\frac{x}{c} = 1$	

22. One-fifth of the plants in a garden are grape tomato plants. Two-ninths of the plants in the garden are cherry tomato plants. The garden has 18 grape tomato plants and 20 cherry tomato plants. How many other plants are in the garden? Explain.

Name____ Date ___________

1.1 Reteach

An **equation** is a statement that two expressions are equal. A **linear equation in one variable** is an equation that can be written in the form $ax + b = 0$, where a and b are constants and $a \neq 0$. When you solve an equation, you use properties of real numbers to find a **solution**, which is a value that makes the equation true.

Equivalent equations are equations that have the same solution(s). When you perform the same operation on each side of an equation, you produce an equivalent equation.

Key Idea

Addition, Subtraction, and Substitution Properties of Equality

Adding or subtracting the same number on each side of an equation produces an equivalent equation.

Addition Property of Equality If $a = b$, then $a + c = b + c$.

Subtraction Property of Equality If $a = b$, then $a - c = b - c$.

Substitution Property of Equality If $a = b$, then a can be substituted for b (or b for a) in any equation or expression.

EXAMPLE Solving Equations Using Addition or Subtraction

Solve each equation. Justify each step. Check your solution.

a. $x - 4 = 7$ **b.** $2.4 = y + 3.5$

SOLUTION

a.

$x - 4 = 7$	Write the equation.
$\underline{+4} = \underline{+4}$	Addition Property of Equality: Undo the subtraction by adding 4 to each side.
$x = 11$	Simplify.

▶ The solution is $x = 11$.

Check

$x - 4 = 7$

$11 - 4 \stackrel{?}{=} 7$

$7 = 7$ ✓

b.

$2.4 = y + 3.5$	Write the equation.
$\underline{-3.5} = \underline{-3.5}$	Subtraction Property of Equality: Undo the addition by subtracting 3.5 from each side.
$-1.1 = y$	Simplify.

▶ The solution is $y = -1.1$.

Check

$2.4 = y + 3.5$

$2.4 \stackrel{?}{=} -1.1 + 3.5$

$2.4 = 2.4$ ✓

Name ____ Date __________

1.1 Reteach (continued)

Key Idea

Multiplication and Division Properties of Equality

Multiplying or dividing each side of an equation by the same nonzero number produces an equivalent equation.

Multiplication Property of Equality If $a = b$, then $a \bullet c = b \bullet c$, $c \neq 0$.

Division Property of Equality If $a = b$, then $\frac{a}{c} = \frac{b}{c}$, $c \neq 0$.

EXAMPLE Solving Equations Using Multiplication or Division

Solve each equation. Justify each step. Check your solution.

a. $\frac{n}{4} = -5$

b. $-6z = 18$

SOLUTION

a. $\frac{n}{4} = -5$ Write the equation.

$4 \bullet \left(\frac{n}{4}\right) = 4 \bullet (-5)$ Multiplication Property of Equality: Undo the division by multiplying each side by 4.

$n = -20$ Simplify.

▶ The solution is $n = -20$.

Check

$\frac{n}{4} = -5$

$\frac{-20}{4} \stackrel{?}{=} -5$

$-5 = -5$ ✓

b. $-6z = 18$ Write the equation.

$\frac{-6z}{-6} = \frac{18}{-6}$ Division Property of Equality: Undo the multiplication by dividing each side by -6.

$z = -3$ Simplify.

▶ The solution is $z = -3$.

Check

$-6z = 18$

$-6(-3) \stackrel{?}{=} 18$

$18 = 18$ ✓

In Exercises 1–12, solve the equation. Justify each step. Check your solution.

1. $x + 2 = 5$ **2.** $g - 4 = 3$ **3.** $m - 1 = 8$ **4.** $d + 4 = -2$

5. $p + 7 = 5$ **6.** $k - 6 = -4$ **7.** $3t = 24$ **8.** $7p = 28$

9. $s \div 4 = 3$ **10.** $j \div 5 = 2$ **11.** $-6q = 54$ **12.** $\frac{c}{-9} = 2$

Name____ Date __________

1.1 Enrichment and Extension

Solving Simple Equations

Solve the equation. Justify each step. Check your solution.

1. $x + \frac{4}{5} = \frac{5}{2}$

2. $\frac{9}{16} = \frac{3}{4}t$

3. $w - \frac{1}{2} = 2\frac{2}{3}$

4. $\frac{m}{-7} = 1\frac{1}{4}$

5. $\frac{\pi}{2}t = \frac{5\pi}{6}$

6. $x \div \frac{4}{5} = -\frac{7}{8}$

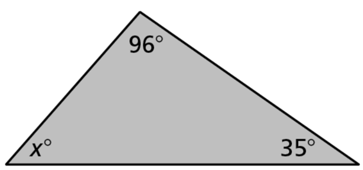
7. $3.2t = 6.4$

8. $150 = 7.5x$

9. $w \div 2.4 = 6.52$

The sum of the angle measures of a polygon follows the general rule of $(n - 2) \bullet 180°$, where the variable *n* represents the number of sides. In Exercises 10–15, write and solve an equation to find the value of *x*. Use a protractor to check the reasonableness of your answer.

10.



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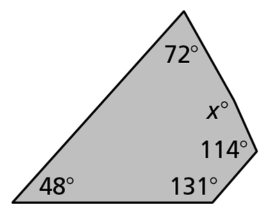

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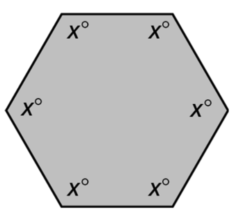

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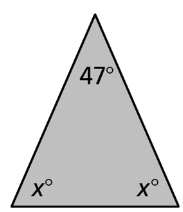

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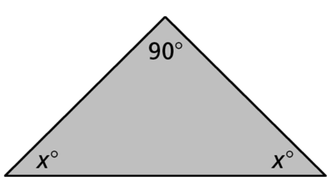

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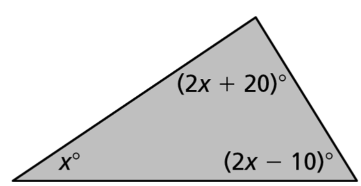


16. It takes a plane 4 hours and 15 minutes to fly from Orlando, Florida, to Boston, Massachusetts. The distance between the two cities is 1114 miles.

a. What is the average speed of the plane in miles per hour? Round your answer to the nearest hundredth.

b. If every mile is approximately 1.6 kilometers, what is the speed of the airplane in kilometers per hour? Round your answer to the nearest hundredth.

Name ______________________________ Date __________

1.1 Puzzle Time

Did You Hear About The Tree's Birthday?

Circle the letter of each correct answer in the boxes below. The circled letters will spell out the answer to the riddle.

Solve the equation.

1. $m + 7 = 9$

2. $x + 11 = 4$

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

4. $-18 = r - 12$

5. $s - (-10) = 2$

6. $6.3 = b - 1.5$

7. $1.4h = 5.6$

8. $y \div 9 = -3$

9. $-7c = -63$

10. $\frac{x}{8} = -3$

11. $-\frac{6}{7}a = 18$

12. $-144\pi = -12\pi k$

Write and solve an equation to answer the question.

13. The students on a decorating committee create a banner. The length of the banner is 2.5 times its width. The length of the banner is 20 feet. What is the width (in feet) of the banner?

14. The student council consists of 32 members. There are 27 members decorating for the dance. How many members are not decorating?

B 15	**L** –18	**I** 4	**B** 2.1	**M** 13	**T** –16	**T** –21	**C** 4.6	**N** 17	**W** 9	**D** –13	**A** 5	**O** 9.1	**E** 8.2	**S** 7.8	**P** 11.6
A –8	**Q** 20	**G** –17	**U** 16	**S** 2	**A** –24	**H** 14	**P** 1	**R** 18	**I** –14	**P** –27	**Y** –7	**O** 8	**J** –20	**N** 12	**E** –6

Name____ Date__________

1.2 Cumulative Practice

For use before Lesson 1.2

Solve the equation.

1. $x + \frac{1}{5} = \frac{2}{5}$

2. $x + 4.8 = 9.4$

1.2 Prerequisite Skills Practice

For use before Lesson 1.2

Simplify the expression.

1. $(2x^2 - 6x) - (-2x^2 + 3x)$

2. $(2y^2 + 9xy) + (3y^2 - 2xy)$

Name ____ Date __________

1.2 Extra Practice

In Exercises 1–6, solve the equation. Check your solution.

1. $8 = \frac{t}{-3} + 4$

2. $\frac{p + 5}{-2} = 9$

3. $3k + 2k = 60$

4. $-43 = 12 - 6p + p$

5. $28 = 8b + 13b - 35$

6. $-11j - 6 + 3j = -30$

7. A bill to landscape your yard is $720. The materials cost $375 and the labor is $34.50 per hour. Write and solve an equation to find the number of hours of labor spent landscaping your yard.

In Exercises 8–11, solve the equation. Check your solution.

8. $12 - 5(3r + 2) = 17$

9. $3(x - 2) + 5(2 - x) = 16$

10. $3 = -1(v - 4) + 4(2v - 9)$

11. $6(q - 7) - 3(4 - q) = 0$

In Exercises 12–14, write and solve an equation to find the number.

12. Seven plus the quotient of a number and 5 is -12.

13. The difference of three times a number and half the number is 60.

14. Eight times the difference of a number and 3 is 40.

15. Justify each step of the solution.

$7 - 2(x - 10) = 15$	Write the equation.
$7 - 2(x) - 2(-10) = 15$	
$7 - 2x + 20 = 15$	
$-2x + 27 = 15$	
$-2x = -12$	
$x = 6$	

16. Solve the equation $-2 = 12 + 4(2x + 7) + 6$ using two different methods. Which method do you prefer? Explain.

17. Find three consecutive odd integers that have the same sum of -51. Explain your reasoning.

Name______________________________ Date __________

1.2 Reteach

Key Idea

Solving Multi-Step Equations

To solve a multi-step equation, simplify each side of the equation, if necessary. Then use inverse operations to isolate the variable.

EXAMPLE Solving a Two-Step Equation

Solve $4x - 14 = 18$. Check your solution.

SOLUTION

First, undo the subtraction to isolate the x-term. Then, divide to solve for x.

$4x - 14 = 18$	Write the equation.
$\underline{+14} \quad \underline{+14}$	Addition Property of Equality: Undo the subtraction by adding 14 to each side.
$4x = 32$	Simplify.
$\dfrac{4x}{4} = \dfrac{32}{4}$	Division Property of Equality: Undo the multiplication by dividing each side by 4.
$x = 8$	Simplify.

Check

$4x - 14 = 18$

$4(8) - 14 \stackrel{?}{=} 18$

$32 - 14 \stackrel{?}{=} 18$

$18 = 18$ ✓

▶ The solution is $x = 8$.

EXAMPLE Combining Like Terms to Solve an Equation

Solve $-4x - 20x + 12 = 36$. Check your solution.

SOLUTION

$-4x - 20x + 12 = 36$	Write the equation.
$-24x + 12 = 36$	Combine like terms.
$\underline{-12}$	Subtraction Property of Equality: Undo the addition by subtracting 12 from each side.
$-24x = 24$	Simplify.
$\dfrac{-24x}{-24} = \dfrac{24}{-24}$	Division Property of Equality: Undo the multiplication by dividing each side by –24.
$x = -1$	Simplify.

Check

$-4x - 20x + 12 = 36$

$-4(-1) - 20(-1) + 12 \stackrel{?}{=} 36$

$4 + 20 + 12 \stackrel{?}{=} 36$

$36 = 36$ ✓

▶ The solution is $x = -1$.

Name ______________________________ Date __________

1.2 Reteach (continued)

EXAMPLE Using Structure to Solve a Multi-Step Equation

Solve $6(z - 1) + 14 = -40$. Check the solution.

SOLUTION

One way to solve the equation is to first solve for the expression $z - 1$ and then solve for z.

$6(z - 1) + 14 = -40$	Write the equation.
$\underline{-14} \quad \underline{-14}$	Subtraction Property of Equality: Undo the addition by subtracting 14 from each side.
$6(z - 1) = -54$	Simplify.
$\dfrac{6(z-1)}{6} = \dfrac{-54}{6}$	Division Property of Equality: Undo the multiplication by dividing each side by 6.
$z - 1 = -9$	Simplify.
$\underline{+1} \quad \underline{+1}$	Addition Property of Equality: Undo the subtraction by adding 1 to each side.
$z = -8$	Simplify.

▶ The solution is $z = -8$.

Check

$6(z - 1) + 14 = -40$

$6(-8 - 1) + 14 \stackrel{?}{=} -40$

$-54 + 14 \stackrel{?}{=} -40$

$-40 = -40$ ✓

In Exercises 1–18, solve the equation. Check your solution.

1. $4x - 6 = -18$

2. $4y - 26 = 6$

3. $9h + 21 = 57$

4. $-20 = -14 + 2n$

5. $\dfrac{b}{6} - 2 = 3$

6. $\dfrac{c}{2} + 6 = -10$

7. $2a + 3a - 43 = -18$

8. $-6d - 9d + 15 = 60$

9. $4 = -3f + 2f - 5$

10. $14 = 4 + 8h - 18h + 5$

11. $39 = -6j + 9j + 24$

12. $9q + 9 + 3q = -27$

13. $2(s - 5) + 4 = -6$

14. $-7(n + 5) - 2 = 40$

15. $-16(r + 2) = 64$

16. $24 + 20(t - 3) = 104$

17. $10 + 4(11 - h) = -10$

18. $-2 - 13(x - 7) = -54$

Name____ Date__________

1.2 Enrichment and Extension

Consecutive Integers

In algebra, there are many problems that involve working with consecutive integers. To solve this type of problem, you must first know how to represent these numbers algebraically.

Example: Find three consecutive odd integers with a sum of 57.

A common way to represent any odd integer is to write the number as $2n + 1$, where n is any integer. Notice the expression $2n$ always results in an even integer. So, when you add 1, the integer is odd. If $2n + 1$ is the first odd integer, then add 2 to get to the next consecutive odd integer, $2n + 3$, and so on.

$$(2n + 1) + (2n + 3) + (2n + 5) = 57$$

Write and solve an equation for the consecutive integer problem.

1. Find four consecutive even integers with a sum of −52.

2. Find two consecutive integers with a sum of 29.

3. Find four consecutive odd integers with a sum of 200.

4. If the lesser of two consecutive even integers is five more than half the greater, what are the two integers?

5. If the sum of the first two consecutive even integers is equal to three times the third, what are the three integers?

6. Find four consecutive integers such that three times the sum of the first two integers exceeds the sum of the last two by 70.

7. Find a set of five consecutive integers such that the greatest integer is three times the least.

Name ______________________________ Date __________

1.2 Puzzle Time

Why Did The Muffler Quit The Car Business?

Write the letter of each answer in the box containing the exercise number.

Solve the equation.

1. $4a - 5 = 11$

2. $16 = 17 - t$

3. $8 = \frac{k}{-3} - 2$

4. $\frac{b + 7}{4} = 9$

5. $12c + 6c = 36$

6. $14x + 11x + 10 = 85$

7. $19w - 13 - 6w = -39$

8. $-4(2n - 5) = -28$

9. $8s + 3(12 - 7s) = 49$

10. $-18 = 15z - 9(2z - 2)$

Write and solve an equation to find the number.

11. The difference of six times a number and 7 is -49.

12. Negative sixteen plus the quotient of a number and -4 is -3.

13. The sum of two times a number and 11 is -7.

14. The total cost for a week at camp is \$220. You have \$140. You earn \$16 for every item you sell in a fundraiser. Write and solve an equation to find the number of items you need to sell to pay for a week at camp.

Answers

E. -7

T. 1

I. 6

E. 2

X. 5

D. -1

S. -30

A. 29

H. -2

W. 12

T. -52

A. 3

S. 4

U. -9

8	2		10	4	1		11	14	7	6	13	3	12	5	9

Name____ Date__________

1.3 Cumulative Practice

For use before Lesson 1.3

1. Tell whether 17 : 4 and 6 : 7 form a proportion.

2. Tell whether 15 : 5 and 12 : 4 form a proportion.

1.3 Prerequisite Skills Practice

For use before Lesson 1.3

1. A person bikes $3\frac{1}{8}$ miles in $\frac{1}{4}$ hour. What is the unit rate in miles per hour?

2. The cost of 3.5 pounds of apples is \$8.75. What is the unit rate in dollars per pound?

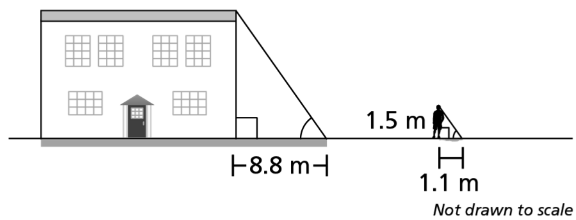
Name ____ Date __________

1.3 Extra Practice

In Exercises 1–4, solve the proportion.

1. $\frac{a}{24} = \frac{54}{72}$ **2.** $\frac{4}{1.2} = \frac{y}{10.8}$ **3.** $\frac{13}{q} = \frac{5}{4}$ **4.** $\frac{14}{56} = \frac{10}{x}$

5. You need to climb to the top of a house. You take the measurements shown. The right triangles created by each object and its shadow are similar. Can you use a ladder that reaches heights of up to 13 meters?



6. The table shows statistics for a basketball player. Use rates to compare the player's performance between the two seasons.

Season	Total 2-point attempts	2-point attempts made	Total 3-point attempts	3-point attempts made
1st	292	131	139	51
2nd	185	72	205	61

In Exercises 7–10, complete the statement. Round to the nearest hundredth, if necessary.

7. 30.9 in. = ▒ mm **8.** 64 qt = ▒ fl oz **9.** 44 L ≈ ▒ gal **10.** 0.2 mi = ▒ in.

11. Lake A evaporates at an average rate of 18 quarts per day. Lake B evaporates at an average rate of 0.005 gallons per minute. Which lake evaporates at a faster rate?

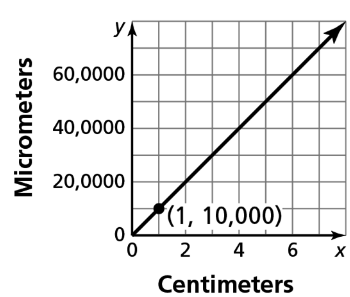
12. Describe and correct the error in converting 3 feet to centimeters.

✗ $3 \text{ ft} = 3 \cancel{\text{ft}} \times \frac{12 \cancel{\text{in.}}}{1 \cancel{\text{ft}}} \times \frac{1 \text{ cm}}{2.54 \cancel{\text{in.}}} \approx 14.2 \text{ cm}$

13. The graph shows the relationship between centimeters and micrometers. Use the graph to convert each measurement.

a. 7 centimeters to micrometers

b. 35,000 micrometers to centimeters



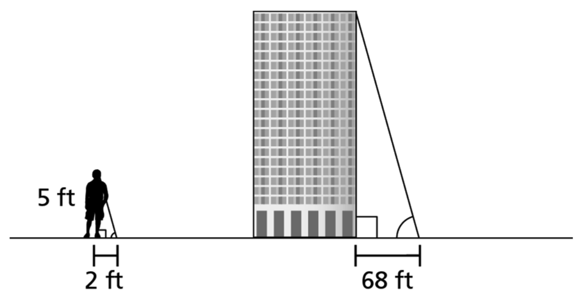
1.3 Reteach

A **ratio** is a comparison of two quantities. A **proportion** is an equation stating that two ratios are equivalent.

	Numbers	Algebra
Equivalent ratios:	2 : 3 and 4 : 6	$a : b$ and $c : d$
Proportion:	$\frac{2}{3} = \frac{4}{6}$	$\frac{a}{b} = \frac{c}{d}$

EXAMPLE Using Ratios

You take the measurements shown in the diagram. The right triangles created by each object and its shadow are similar. Find the height of the building.



SOLUTION

Let h represent the building height.

$$\frac{5}{2} = \frac{h}{68}$$ Write a proportion.

$$68 \bullet \left(\frac{5}{2}\right) = 68 \bullet \left(\frac{h}{68}\right)$$ Multiplication Property of Equality: Undo the division by multiplying each side by 68.

$$170 = h$$ Simplify.

▶ The height of the building is 170 feet.

A **rate** is a ratio of two quantities using different units.

EXAMPLE Using Rates

The table shows sales data for two salespeople at a cell phone store. Use rates to compare the performances of the salespeople.

Salesperson	Months employed	Cell phones sold
A	9	146
B	12	182

SOLUTION

Compare using cell phones sold per month employed.

Salesperson A: rate: $\frac{146}{9} \approx 16$ cell phones sold per month employed

Salesperson B: rate: $\frac{182}{12} \approx 15$ cell phones sold per month employed

▶ Since $16 > 15$, Salesperson A sold more cell phones per month employed.

Name ____ Date__________

1.3 Reteach (continued)

You can use *unit analysis* to help convert units.

$$45 \text{ ft} \div \frac{1 \text{ ft}}{12 \text{ in.}} = 45 \cancel{\text{ft}} \times \frac{12 \text{ in.}}{1 \cancel{\text{ft}}} = 540 \text{ in.}$$

EXAMPLE Converting Units of Measure

Convert 3000 inches to meters. Round to the nearest hundredth, if necessary.

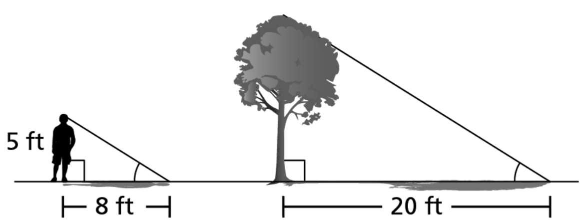
SOLUTION

There are 2.54 centimeters in 1 inch and 100 centimeters in 1 meter. Use these rates to convert from inches to meters.

$$3000 \text{ in.} = 3000 \cancel{\text{in.}} \times \frac{2.54 \cancel{\text{cm}}}{1 \cancel{\text{in.}}} \times \frac{1 \text{ m}}{100 \cancel{\text{cm}}} = 76.2 \text{ m}$$

▶ So, 3000 inches is 76.2 meters.

1. You take the measurements shown in the diagram. The right triangles created by each object and its shadow are similar. Find the height of the tree.



2. The table shows the numbers of students and teachers at two schools. Use rates to compare the two schools.

School	Students	Teachers
C	438	21
D	546	24

In Exercises 3–8, complete the statement. Round to the nearest hundredth, if necessary.

3. 320 fl oz = ▢ qt

4. 0.6 km = ▢ cm

5. 8.89 cm = ▢ in.

6. 12.3 kg ≈ ▢ oz

7. 1500 m ≈ ▢ mi

8. 0.6 pt = ▢ fl oz

Name____ Date __________

1.3 Enrichment and Extension

Using Unit Analysis

1. A box in the shape of a rectangular prism has a length of 1 foot, a width of $\frac{1}{2}$ foot, and a height of $\frac{1}{2}$ foot. Is the volume of the box greater than 440 cubic inches? Explain.

2. You have 2 square yards of fabric. Do you have enough fabric to cover the surface of a cube that has a side length of 18 inches? Explain.

3. You are putting up a tent canopy for an event. To anchor the tent in case of wind gusts, you need to have at least 50 pounds of weight at each corner of the tent. You plan to use buckets of water for the weights at the corners.

   a. One gallon of water weighs about 8.34 pounds. How many gallons of water do you need in each bucket? Round your answer to the nearest whole number.

   b. A standard bucket has a diameter of 10.5 inches and a height of 14.5 inches. How many cubic feet of water does a standard bucket hold? Round your answer to the nearest hundredth. Explain.

   c. One gallon of water is equal to about 0.134 cubic foot. How many gallons of water will a standard bucket hold? Round your answer to the nearest hundredth. Explain.

   d. Will the standard bucket hold enough water to weigh down each corner of the tent? Explain.

Name ____ Date __________

1.3 Puzzle Time

How Do You Talk to Giants?

Write the letter of each answer in the box containing the exercise number.

Solve the proportion.

1. $\dfrac{x}{4} = \dfrac{21}{28}$

2. $\dfrac{51}{21} = \dfrac{17}{c}$

3. $\dfrac{33}{12} = \dfrac{y}{8}$

4. $\dfrac{4}{d} = \dfrac{5}{8}$

5. A toddler is 3 feet tall and casts a shadow 10 inches long. A nearby truck casts a shadow 38 inches long. An overpass has a clearance of 12 feet. Can the truck fit under the overpass?

6. The table shows some information about two jars of pasta sauce. Use rates to compare the two sauces. Do you get more sauce for your money with Sauce B?

Sauce	Price	Volume (fl oz)	Sodium per jar (mg)
A	$1.79	14	1680
B	$3.40	23.75	2730

Answers

E. yes

S. no

G. 3

W. 7

U. 22

R. 64

O. 0.92

B. 1.70

I. 6.4

D. 16.55

Complete the statement. Round to the nearest hundredth, if necessary.

7. $4 \text{ gal} = \square \text{ c}$

8. $67 \text{ in.} \approx \square \text{ m}$

9. $\dfrac{0.63 \text{ mi}}{\text{hr}} \approx \dfrac{\square \text{ ft}}{\text{sec}}$

10. $\dfrac{37 \text{ mi}}{\text{hr}} \approx \dfrac{\square \text{ m}}{\text{sec}}$

11. A baseball pitch traveled 128 feet per second. During a golfer's drive, the club head speed was 99 miles per hour. Was the baseball faster than the club head?

3	11	5		8	4	1		2	9	7	10	6

1.4 Cumulative Practice

For use before Lesson 1.4

1. The population of Country A is about 1,003,000 and the population of Country B is about 1,207,000,000. Approximately how many times greater is the population of Country B than the population of the Country A? Write your answer as a power of ten.

2. The population of Country A is about 11,926,000 and the population of Country B is about 1,244,000,000. Approximately how many times greater is the population of Country B than the population of the Country A? Write your answer as a power of ten.

1.4 Prerequisite Skills Practice

For use before Lesson 1.4

Find the volume. Round to the nearest tenth, if necessary.

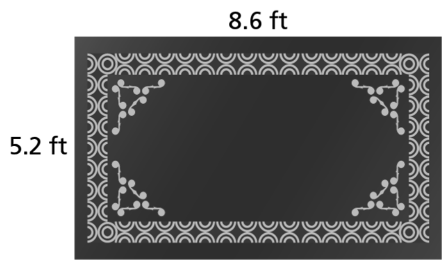
1. A rectangular prism has a length of 8.7 centimeters, a width of 4.8 centimeters, and a height of 3.3 centimeters.

2. A cylinder has a diameter of 4 inches and a height of 6 inches. Use 3.14 for π.

Name ____ Date __________

1.4 Extra Practice

1. You use a tape measure to measure the dimensions of a rug, as shown. Estimate the area of the rug.

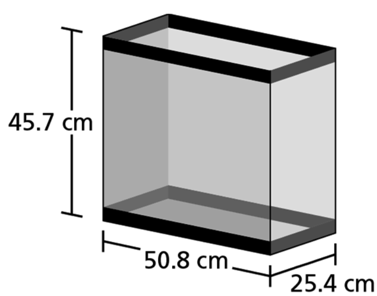


2. Recently, the land area in France was reported as 547,557 square kilometers. The population at the time was about 66,316,100.

a. Estimate the population per square kilometer.

b. The Gross Domestic Product (GDP) in France at the time was worth 2,778,999,000,000 US dollars. Estimate the GDP per capita.

3. You use a centimeter ruler to measure the dimensions of the fish tank, as shown.



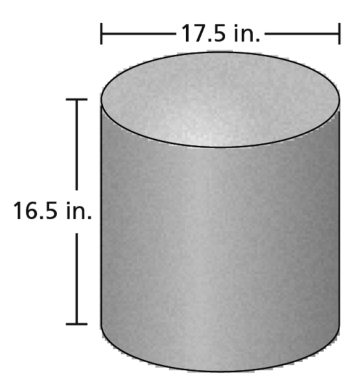
a. Estimate the volume of the tank.

b. One liter of water has a volume of 1000 cubic centimeters. About how many liters of water would fill the tank?

4. You use an inch ruler to measure the dimensions of a large concrete cylinder, as shown.

a. Estimate the volume of the cylinder.

b. If one cubic inch equals 0.087 pounds of concrete, estimate the weight of the cylinder in pounds.



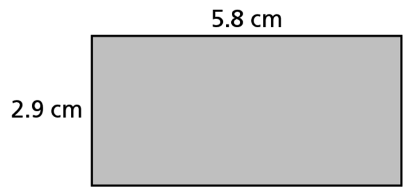
Name______________________________ Date __________

1.4 Reteach

When measuring, **precision** is the level of detail of the measurement. When performing calculations with measurements, the calculated value is no more *precise* than the original measurements.

You measure the sides of the rectangular eraser shown to estimate its area.

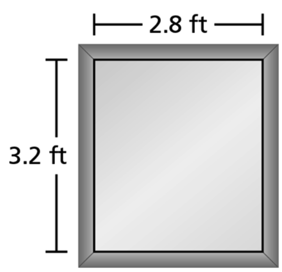
$$A = \ell w$$
$$= (5.8 \text{ cm})(2.9 \text{ cm})$$
$$= 16.82 \text{ cm}^2$$



Because the dimensions are measured in tenths of a centimeter, you should not state the area beyond tenths of a square centimeter. So, the area is about 16.8 square centimeters.

EXAMPLE Estimating Measurements

You use a tape measure to measure the dimensions of the glass that is placed inside a rectangular window frame, as shown. Estimate the area of the glass.



SOLUTION

The length of the glass is 3.2 feet, and the width is 2.8 feet. Substitute these values into the formula for the area of a rectangle.

$A = \ell w$	Area of rectangle
$= (3.2 \text{ ft})(2.8 \text{ ft})$	Substitute 3.2 for ℓ and 2.8 for w.
$= 8.96 \text{ ft}^2$	Multiply.

Because the dimensions are measured in tenths of a foot, you should not state the volume beyond tenths of a square foot.

▶ So, the area is about 9 square feet.

Name ____ Date__________

1.4 Reteach (continued)

Accuracy refers to how close a measured value is to the actual value. The accuracy of measurements may affect how you decide to state answers when performing calculations with them.

For example, the speed of light is about 670,616,629 miles per hour. A local news article may report the speed as about 670 million miles per hour since accuracy might be less important in the article.

EXAMPLE Estimating Results

The distance from the Sun to Earth is about 92,955,807 miles. The distance from the Sun to Neptune is about 2,798,310,156 miles. About how many times larger is the distance from the Sun to Neptune compared to the distance from the Sun to Earth?

SOLUTION

Because the distances from the Sun to Earth or from the Sun to Neptune vary as each planet orbits the Sun, the distances are not the same at different times. You can round the distances to less accurate values before making your calculation.

$92{,}955{,}807 \text{ miles} \approx 90{,}000{,}000 \text{ miles}$ Round to the nearest 10 million miles.

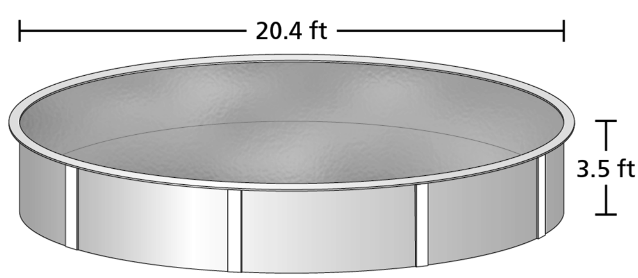
$2{,}798{,}310{,}156 \text{ miles} \approx 2{,}800{,}000{,}000 \text{ miles}$ Round to the nearest 100 million miles.

$$\frac{\text{Distance from the Sun to Neptune}}{\text{Distance from the Sun to Earth}} \approx \frac{2{,}800{,}000{,}000 \text{ miles}}{90{,}000{,}000 \text{ miles}}$$

$$\approx 31.111\ldots$$

▶ Because the measurements were rounded, it is not reasonable to express the quotient of the distances as $31.\overline{1}$. So, you can estimate that the distance from the Sun to Neptune is about 30 times greater than the distance from the Sun to Earth.

1. You use a tape measure to measure the dimensions of a circular pool, as shown. Estimate the volume of the pool.



2. The recent population of Canada was about 37,476,654. At about the same time, the national debt of Canada was reported to be about 693,033,807,440 Canadian dollars. Estimate the Canadian national debt per capita.

Name____ Date__________

1.4 Enrichment and Extension

Accuracy with Measurements

Accurate measurements are very important when baking, but the measurements you use are limited by the accuracy of the instruments used to measure the ingredients. For example, a digital scale that gives weights in tenths of an ounce rounds weights to the nearest tenth of an ounce. This means that a measurement of 2.3 ounces could range from 2.25 ounces to 2.34 ounces.

Example: A recipe calls for 100 grams of flour, but your digital scale only measures weights in ounces to the nearest tenth of an ounce. How many ounces of flour should you measure on your scale? Could this amount differ from 100 grams by more than 1%? If so, would you be adding more flour or less flour than the recipe calls for?

Convert 100 grams to ounces.

$$100\text{ g} \approx 100\ \cancel{\text{g}} \times \frac{0.035\text{ oz}}{1\ \cancel{\text{g}}} \approx 3.5\text{ oz}$$

A measurement of 3.5 ounces on your scale could range from 3.45 ounces to 3.54 ounces. Convert these measurements to grams.

$$3.45\text{ oz} \approx 3.45\ \cancel{\text{oz}} \times \frac{28.3\text{ g}}{1\ \cancel{\text{oz}}} \approx 97.635\text{ g}$$

$$3.54\text{ oz} \approx 3.54\ \cancel{\text{oz}} \times \frac{28.3\text{ g}}{1\ \cancel{\text{oz}}} \approx 100.182\text{ g}$$

One percent of 100 grams is 1 gram. So, 1% less than 100 grams is 99 grams and 1% more than 100 grams is 101 grams. Because $97.635 < 99$ and $99 < 100.82 < 101$, the amount could differ from 100 grams by more than 1% and you would be adding less flour than the recipe calls for.

1. A recipe calls for 50 grams of sugar, but your digital scale only measures weights in ounces to the nearest tenth of an ounce. How many ounces of sugar should you measure on your scale? Could this amount differ from 50 grams by more than 1%? If so, would you be adding more sugar or less sugar than the recipe calls for?

2. A recipe calls for 500 grams of walnuts, but your digital scale only measures weights in ounces to the nearest tenth of an ounce. How many ounces of walnuts should you measure on your scale? Could this amount differ from 500 grams by more than 1%? If so, would you be adding more walnuts or less walnuts than the recipe calls for?

Name ____ Date __________

1.4 Puzzle Time

What Do You Call an Old Snowman?

Circle the letter of each correct answer in the boxes below. The circled letters will spell out the answer to the riddle.

1. You measure a crate in the shape of a rectangular prism. The crate has a length of 20.625 inches, a width of 14 inches, and a height of 11.375 inches. Estimate the volume (in cubic inches) of the crate.

2. You measure a foam roller in the shape of a cylinder. The foam roller has a diameter of 5.9375 inches and a height of 35.5 inches. About how many cubic inches of foam were used to make the roller?

3. At one point, Hawaii's largest island had an area of about 4028 square miles and a population of 191,482. Estimate the population per square mile of Hawaii's largest island.

4. You measure a rectangular rug. The rug has a length of 7.75 feet and a width of 5.25 feet. Estimate the area (in square feet) of the rug.

5. You are tiling the floor of a bathroom. The area of the floor is 3.6 square meters. About how many tiles of the size shown do you need to tile the floor?

C	**R**	**W**	**L**	**A**	**T**	**D**	**G**	**U**	**O**	**E**	**V**
3200	1080	3300	330	980	2800	982.94	3000	47.75	660	764	0.02
A	**T**	**L**	**E**	**D**	**I**	**M**	**R**	**P**	**T**	**K**	**S**
0.02094	48	30	41	4.1	40	1035	19	28	3900	8200	207,000

Name____ Date __________

1.5 Cumulative Practice

For use before Lesson 1.5

Solve the equation.

1. $\frac{7}{8}x - 9 = -2$

2. $9x + 13 = 4$

1.5 Prerequisite Skills Practice

For use before Lesson 1.5

Use the Distributive Property to simplify the expression.

1. $5(u - 5)$

2. $-3(t + 7)$

Name ____ Date __________

1.5 Extra Practice

In Exercises 1–8, solve the equation. Check your solution.

1. $5t + 7 = 3t - 9$

2. $-8u + 3 = 2u - 17$

3. $6w + 3 - 10w = 7w - 8$

4. $-a + 4a - 9 = 8a + 6$

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

6. $-2(x - 4) = 7(x - 4)$

7. $\frac{2}{3}(3 - 6x) = -3(8x - 4)$

8. $8(3g + 2) - 3g = 3(5g - 4) - 2$

In Exercises 9–12, solve the equation.

9. $5(2f + 3) = 2(5f - 1)$

10. $\frac{1}{3}(12 - 24v) = -2(4v - 2)$

11. $3(k + 1) + 11k = 2(4 + 5k) + 3$

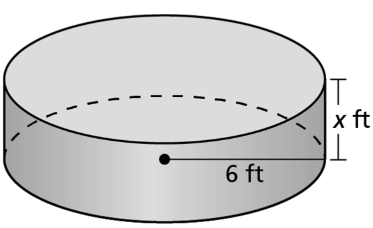
12. $-4(-m + 2) + 2m = -\frac{1}{2}(10 - 12m) - 3$

13. The table shows pricing information for two pizzas. How many toppings would make the costs the same for both pizzas?

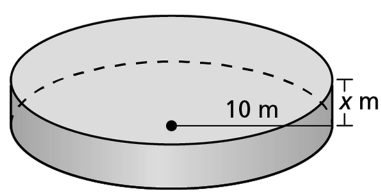
	Cheese pizza	**Price per topping**
Pizza A	\$10	\$1.50
Pizza B	\$12.50	\$1.00

In Exercises 14 and 15, the value of the surface area of the cylinder is equal to the value of the volume of the cylinder. Find the surface area and volume of the cylinder.

14.



15.



16. Four times the greater of two consecutive integers is 18 more than three times the lesser integer. What are the integers?

Name____ Date __________

1.5 Reteach

Key Idea

Solving Equations with Variables on Both Sides

To solve an equation with variables on both sides, use inverse operations to collect the variable terms on one side and the constant terms on the other side. Then isolate the variable.

EXAMPLE Solving an Equation with Variables on Both Sides

Solve $3t = 8t - 25$. Check your solution.

SOLUTION

The left side of the equation has a variable term, and the right side has both a variable term and a constant term.

One way to solve the equation is by leaving the constant term on the right side and collecting the variable terms on the left side. This way uses fewer steps.

$3t = 8t - 25$	Write the equation.
$\underline{-8t} \quad \underline{-8t}$	Subtraction Property of Equality
$-5t = -25$	Simplify.
$\frac{-5t}{-5} = \frac{-25}{-5}$	Division Property of Equality
$t = 5$	Simplify.

Another way to solve the equation is by collecting the variable terms on the right side and moving the constant term to the left side. This way gives you a positive variable term on the right side.

$3t = 8t - 25$	Write the equation.
$\underline{-3t} \quad \underline{-3t}$	Subtraction Property of Equality
$0 = 5t - 25$	Simplify.
$\underline{+25} \quad \underline{+25}$	Addition Property of Equality
$25 = 5t$	Simplify.
$\frac{25}{5} = \frac{5t}{5}$	Division Property of Equality
$5 = t$	Simplify.

▶ The solution is $t = 5$.

Check

$3t = 8t - 25$

$3(5) \stackrel{?}{=} 8(5) - 25$

$15 \stackrel{?}{=} 40 - 25$

$15 = 15$ ✓

Name ____ Date __________

1.5 Reteach (continued)

Equations do not always have one solution. An equation that is true for all values of the variable is an **identity** and has *infinitely many solutions*. All real numbers are solutions of any identity. An equation that is not true for any value of the variable has *no solution*.

EXAMPLE Solving Equations with Variables on Both Sides

Solve each equation.

a. $2(4x - 1) = 8x$ **b.** $9 - 6r = 3(3 - 2r)$

SOLUTION

Both equations have grouping symbols. Remember to account for the grouping symbols before you collect terms on either side of the equal sign.

a. $2(4x - 1) = 8x$ Write the equation.

$8x - 2 = 8x$ Distributive Property

$\underline{-8x} \qquad \underline{-8x}$ Subtraction Property of Equality

$-2 = 0$ ✗ Simplify.

▶ The statement $-2 = 0$ is never true. So, the equation has no solution.

b. $9 - 6r = 3(3 - 2r)$ Write the equation.

$9 - 6r = 9 - 6r$ Distributive Property

$\underline{+6r} \qquad \underline{+6r}$ Addition Property of Equality

$9 = 9$ Simplify.

▶ The statement $9 = 9$ is always true. So, the solution is all real numbers.

In Exercises 1–9, solve the equation. Check your solution.

1. $4x - 7 = -3x$ **2.** $6a = 5 - 4a$ **3.** $c = 3c - 12$

4. $8b + 2 = 3b + 12$ **5.** $7k + 24 = -16 - 3k$ **6.** $-5t + 7 = 11t - 25$

7. $6n + 1 = 2n - 7$ **8.** $-3(w + 4) = 4w - 5$ **9.** $5(h + 1) = 4(2h - 1)$

In Exercises 10–15, solve the equation.

10. $7y + 13 = 5y - 3$ **11.** $8 + 9p = 9p - 7$ **12.** $3(7r - 2) = 21r - 6$

13. $10h + 5 = 5(2h + 1)$ **14.** $2(z + 6) = 3z + 12$ **15.** $2(3x + 6) = 3(2x - 6)$

Name____ Date__________

1.5 Enrichment and Extension

Identities and No-Solution Equations

An *identity* is an equation that is true for every value of the variable. When you solve an identity equation, your result will be a true statement. On the other hand, if an equation results in an untrue statement, there is no possible solution.

Example:

Solve $5x - (3x + 7) = 9 + 2(x - 8)$.

$$5x - (3x + 7) = 9 + 2(x - 8)$$
$$5x - 3x - 7 = 9 + 2x - 16$$
$$2x - 7 = 2x - 7$$

Example:

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

$$x - (5x + 2) = -4(x - 3)$$
$$x - 5x - 2 = -4x + 12$$
$$-4x - 2 = -4x + 12$$
$$-2 \neq 12$$

In Exercises 1–4, determine whether the equation is an identity or a no-solution equation. If the equation is neither, find the solution.

1. $-5(2 - 3x) = 3(1 - 5x) + 1$

2. $4(5p + 7) - 4p = 6(5 + 3p) - 2(p + 1)$

3. $2(7w - 1) + 5w = w + 3(4w + 3) + 2(3w - 9)$

4. $9 - (9 - y) - 9 = 9(9 + y) - 9$

5. Use the true statement $5x - 3 = 5x - 3$ to write your own identity.

6. Use the false statement $5 \neq 7$ to write your own no-solution equation.

7. Create an equation with a solution of $x = 5$.

Name ______________________________ Date __________

1.5 Puzzle Time

What Is The Best Way To Communicate With A Fish?

Write the letter of each answer in the box containing the exercise number.

Solve the equation.

1. $14 - 3x = 4x$

2. $6a - 10 = 3a + 17$

3. $9 + 5w - 14w = 12 - 6w$

4. $12(b + 2) = 8(b + 5)$

5. $6(y + 8) = 3(2y - 7)$

6. $\frac{3}{4}(12c - 4) = 15c + 15$

7. $11(4p + 4) - 4p = 4(7p - 7)$

8. $3(2d - 8) = 11d - 18(d - 3)$

9. $5(4 + r) = \frac{1}{2}(40 + 10r)$

10. $\frac{3}{5}e - 6 = -\frac{2}{5}(e - 10) - 7$

11. Three consecutive integers are n, $n + 1$, and $n + 2$. Four times the sum of the least and greatest integers is 12 less than three times the least integer. What is the least integer?

Answers

P. 4

L. 3

E. 9

I. 6

N. no solution

A. 2

D. infinitely many solutions

T. −6

R. −4

I. −1

O. −3

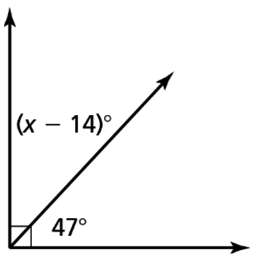
9	11	6	4		3	7		1		10	8	5	2

Name____ Date__________

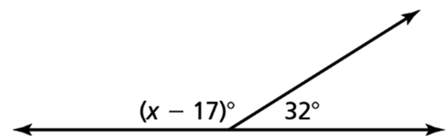
1.6 Cumulative Practice
For use before Lesson 1.6

Find the value of *x*.

1.



2.



1.6 Prerequisite Skills Practice
For use before Lesson 1.6

Copy and complete the statement using $<$, $>$, or $=$.

1. $|-82| \; \underline{\ ?\ } \; |57|$

2. $|-70| \; \underline{\ ?\ } \; |-91|$

Name ______________________________ Date __________

1.6 Extra Practice

In Exercises 1–10, solve the equation. Graph the solution(s), if possible.

1. $|p - 3| = 10$

2. $|-2k| = 6$

3. $|6f| = -2$

4. $\left|\frac{q}{5}\right| = 3$

5. $|-a + 2| + 9 = 6$

6. $3|4 - 3m| = 30$

7. $-4|5g - 12| = -12$

8. $|x - 3| + 9 = 30$

9. $3|2d - 6| + 2 = 2$

10. $7|2c - 6| + 4 = 32$

11. A company manufactures penny number 2 nails that are 1 inch in length. The actual length is allowed to vary by up to $\frac{1}{32}$ inch.

a. Write and solve an absolute value equation to find the minimum and maximum acceptable nail length.

b. A penny number 2 nail is 1.05 inches long. Is the nail acceptable? Explain.

In Exercises 12–17, solve the equation. Check your solutions.

12. $|9w - 4| = |2w + 10|$

13. $2|n + 7| = |4n + 8|$

14. $3|3t + 1| = 2|6t + 3|$

15. $|5r + 3| = 2r$

16. $|j - 5| = |j + 9|$

17. $|2k + 4| = |2k + 3|$

In Exercises 18–20, write an absolute value equation that has the given solutions.

18. $x = 3$ and $x = 9$

19. $x = -5$ and $x = 15$

20. $x = 4$ and $x = 11$

21. You conduct a random survey of your small town about having a townwide garage sale. Of those surveyed, 56% are in favor and 44% are opposed. The actual percent could be 5% more or 5% less than the acquired results.

a. Write and solve an absolute value equation to find the least and greatest percents of your town population that could be opposed to a townwide garage sale.

b. A friend claims that half the town is actually opposed to a townwide garage sale. Does this statement conflict with the survey data? Explain.

Name____ Date __________

1.6 Reteach

An **absolute value equation** is an equation that contains an absolute value expression. You can solve these types of equations by solving two related linear equations.

Key Ideas

Properties of Absolute Value

Let a and b be real numbers. Then the following properties are true.

1. $|a| \geq 0$

2. $|-a| = |a|$

3. $|ab| = |a||b|$

4. $\left|\frac{a}{b}\right| = \frac{|a|}{|b|}, b \neq 0$

Solving Absolute Value Equations

To solve $|ax + b| = c$ when $c \geq 0$, solve the related linear equations

$ax + b = c$ *or* $ax + b = -c.$

When $c < 0$, the absolute value equation $|ax + b| = c$ has no solution because absolute value represents a distance and cannot be negative.

EXAMPLE Solving Absolute Value Equations

Solve each equation. Graph the solutions, if possible.

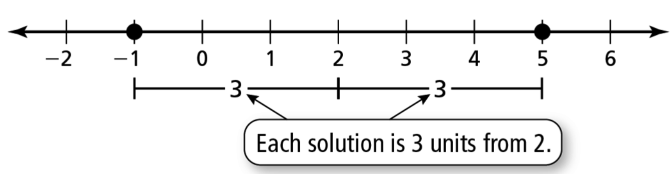
a. $|x - 2| = 3$ **b.** $|4x + 7| = -6$

SOLUTION

a. Write the two related linear equations for $|x - 2| = 3$. Then solve.

$x - 2 = 3$	*or*	$x - 2 = -3$	Write related linear equations.
$x = 5$		$x = -1$	Add 2 to each side.

▶ So, the solutions are $x = 5$ and $x = -1$.



b. The absolute value of an expression must be greater than or equal to 0, so $|4x + 7|$ cannot equal –6.

▶ So, $|4x + 7| = -6$ has no solution.

Name ______________________________ Date__________

1.6 Reteach (continued)

If the absolute values of two algebraic expressions are equal, then they must either be equal to each other or be opposites of each other.

> ## *Key Idea*
> ### Solving Equations with Two Absolute Values
> To solve $|ax + b| = |cx + d|$, solve the related linear equations
>
> $$ax + b = cx + d \quad or \quad ax + b = -(cx + d).$$

EXAMPLE Solving Equations with Two Absolute Values

Solve $|4x - 24| = |2x|$. Check your solutions.

SOLUTION

Write the two related linear equations for $|4x - 24| = |2x|$. Then solve.

$$\begin{aligned} 4x - 24 &= 2x \\ -2x \quad & \quad -2x \\ 2x - 24 &= 0 \\ +24 \quad & \quad +24 \\ 2x &= 24 \\ \frac{2x}{2} &= \frac{24x}{2} \\ x &= 12 \end{aligned} \qquad or \qquad \begin{aligned} 4x - 24 &= -2x \\ +2x \quad & \quad +2x \\ 6x - 24 &= 0 \\ +24 \quad & \quad +24 \\ 6x &= 24 \\ \frac{6x}{6} &= \frac{24x}{6} \\ x &= 4 \end{aligned}$$

Check

$$|4x - 24| = |2x|$$
$$|4(12) - 24| \stackrel{?}{=} |2(12)|$$
$$24 = 24 \checkmark$$

$$|4x - 24| = |2x|$$
$$|4(4) - 24| \stackrel{?}{=} |2(4)|$$
$$8 = 8 \checkmark$$

▶ The solutions are $x = 12$ and $x = 4$.

In Exercises 1–8, solve the equation. Graph the solution(s), if possible.

1. $|b - 2| = 5$ **2.** $|k + 6| = 9$ **3.** $|-5p| = 35$ **4.** $\left|\frac{q}{3}\right| = 4$

5. $|8y - 3| = 13$ **6.** $|-2a + 1| = 3$ **7.** $|x + 4| + 7 = 3$ **8.** $|d - 11| - 8 = 5$

In Exercises 9–14, solve the equation. Check your solutions.

9. $|2j + 3| = |j|$ **10.** $|3f - 6| = |9f|$ **11.** $|b + 3| = |2b - 2|$

12. $|4h - 2| = 2|h + 3|$ **13.** $3|w - 5| = |2w + 10|$ **14.** $|2y + 5| = \frac{1}{2}|3y - 3|$

Name____ Date__________

1.6 Enrichment and Extension

Extraneous Solutions in Algebra

In many algebraic problems, there is the possibility of finding an apparent solution to a problem that does not solve the equation correctly. These solutions are called *extraneous solutions*. When solving absolute value equations, you see extraneous solutions for the first time, and they continue to come up as you continue through algebra. Solving square root equations is another time when you may find extraneous solutions. Recall that you cannot have a negative value under the radical, and when you take the square root of a number, the answer is never negative.

Example: Solve $\sqrt{12 - x} = x$.

$\sqrt{12 - x} = x$	Write the equation.
$\left(\sqrt{12 - x}\right)^2 = x^2$	Square each side.
$12 - x = x^2$	Simplify.
$x^2 + x - 12 = 0$	Write in standard form.
$(x + 4)(x - 3) = 0$	Factor.
$x + 4 = 0$	Set each factor equal to zero and solve.
$x = -4$	
$x - 3 = 0$	
$x = 3$	

Check

$\sqrt{12 - (-4)} \stackrel{?}{=} (-4)$

$\sqrt{16} \stackrel{?}{=} -4$

$4 \neq -4$ ✗

$\sqrt{12 - (3)} \stackrel{?}{=} 3$

$\sqrt{9} \stackrel{?}{=} 3$

$2 = 3$ ✓

The apparent solution, $x = -4$ is extraneous. So, the only solution of the equation is $x = 3$.

Solve the equation. Check your answer for extraneous solutions.

1. $|x - 2| = 3x - 4$

2. $\dfrac{x + 3}{x + 2} = 1 - \dfrac{x + 1}{x + 2}$

3. $m = \sqrt{56 - m}$

4. $\dfrac{k + 8}{k} - \dfrac{k - 4}{k} = 3$

5. $|3 + x| = 3x + 5$

6. $\sqrt{90 - n} = n$

7. $\dfrac{y - 3}{y - 1} + \dfrac{2y}{y - 1} = 2$

8. $|-3x| = x$

Name ____ Date __________

1.6 Puzzle Time

Did You Hear About The Two Ducks In A Race?

A	B	C	D	E	F
G	H	I	J	K	L
M	N				

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

5, 9 FEET
−7, 7 THRILL
4 THE
−3, 3 AND
3 OF
−14, 7 FAST
17 RESULTED
$-\frac{1}{2}, \frac{1}{4}$ TIE
−11, 6 THE

Simplify the expression.

A. $\lvert -7 \rvert$

B. $\lvert -17 \rvert$

C. $\lvert 16 \rvert - \lvert -16 \rvert$

D. $\left\lvert -\frac{36}{9} \right\rvert$

Solve the equation. Check your solutions.

E. $\lvert x \rvert = 7$

F. $\lvert b \rvert = -19$

G. $\lvert w - 4 \rvert = 11$

H. $\lvert -8e \rvert = 24$

I. $\lvert 2q + 5 \rvert = 17$

J. $6\lvert 5p + 4 \rvert - 16 = 20$

K. $\lvert c - 24 \rvert = 7c$

L. $\lvert 3s - 11 \rvert = \lvert s + 9 \rvert$

M. $\lvert h - 8 \rvert = \lvert h + 10 \rvert$

N. During last year's volleyball season, the coach concluded that the number of points scored in each game could be given by the equation $\lvert x - 7 \rvert = 2$. How many points were scored in each game?

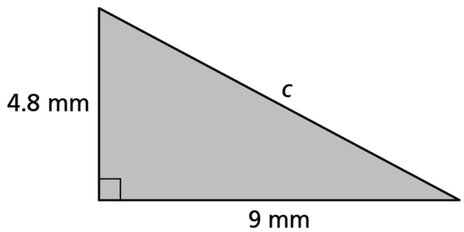
0 IN
$\frac{1}{2}$, 10 SEVERAL
7 IT
−2, 2 WINNER
$-2, \frac{2}{5}$ AGONY
no solution OF
−1 WEBBED
−7, 15 VICTORY
−11 SECOND

Name____ Date __________

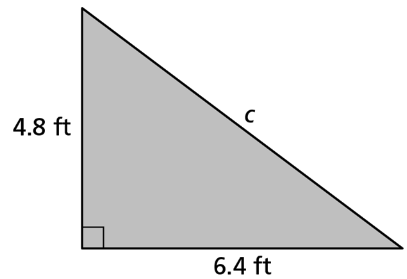
1.7 Cumulative Practice
For use before Lesson 1.7

Find the length of the hypotenuse of the triangle.

1.



2.



1.7 Prerequisite Skills Practice
For use before Lesson 1.7

Solve the equation.

1. $6h = 18$

2. $\frac{x}{-2} = 5$

Name ____ Date __________

1.7 Extra Practice

In Exercises 1–6, solve the literal equation for *y*.

1. $3y - 9x = 24$

2. $10 - 2y = 46$

3. $3x + 5 = 9 - 4y$

4. $-5x + 7y = 8x + 7$

5. $3 + \frac{1}{5}y = 2x + 4$

6. $10 - \frac{1}{3}y = 4 + 6x$

In Exercises 7–14, solve the literal equation for *x*.

7. $g = 4x + 5xy$

8. $w = 4ax - 9x$

9. $z = 6x + px + 2$

10. $t = 10 + 7x - qx$

11. $ax - bx = k$

12. $p = qx + rx + s$

13. $11 - 4x - 3jx = w$

14. $x - 8 + 3vx = y$

15. Describe and correct the error in solving the equation for x.

✗

$$k = ax + bx + d$$
$$k = x(a + b + d)$$
$$x = \frac{k}{a + b + d}$$

In Exercises 16–18, solve the equation for the indicated variable.

16. Simple interest: $I = Prt$; Solve for t.

17. Volume of a box: $V = \ell wh$; Solve for w.

18. Heron's formula: $S = \frac{1}{2}(a + b + c)$; Solve for b.

19. Coulomb's Law is given by the formula

$$F = k\frac{q_1 q_2}{d^2}.$$

The force F between two charges q_1 and q_2 in a vacuum is proportional to the product of the charges, and is inversely proportional to the square of the distance d between the two charges. Solve the formula for k.

20. You deposit \$800 in an account that earns simple interest at an annual rate of 5%. How long must you leave the money in the account to earn \$100 in interest?

Name____ Date__________

1.7 Reteach

An equation that has two or more variables is called a **literal equation**.

To solve a literal equation for one of the variables, you need to get that variable all by itself (isolate it) on one side of the equation.

EXAMPLE Rewriting a Literal Equation

Solve the literal equation $6y + 5x = 12$ for y.

SOLUTION

$6y + 5x = 12$	Write the equation.
$6y + 5x - 5x = 12 - 5x$	Subtraction Property of Equality: Subtract 5*x* from each side.
$6y = 12 - 5x$	Simplify.
$\frac{6y}{6} = \frac{12 - 5x}{6}$	Division Property of Equality: Divide each side by 6.
$\frac{6y}{6} = \frac{12}{6} - \frac{5x}{6}$	Rewrite $\frac{12 - 5x}{6}$ as $\frac{12}{6} - \frac{5x}{6}$.
$y = 2 - \frac{5}{6}x$	Simplify.

▶ The rewritten literal equation is $y = 2 - \frac{5}{6}x$.

EXAMPLE Rewriting a Literal Equation

Solve the literal equation $y = 7x - xz$ for x.

SOLUTION

$y = 7x - xz$	Write the equation.
$y = x(7 - z)$	Distributive Property
$\frac{y}{7 - z} = \frac{x(7 - z)}{7 - z}$	Division Property of Equality: Divide each side by $7 - z$ to isolate *x*.
$\frac{y}{7 - z} = x$	Simplify.

▶ The rewritten literal equation is $x = \frac{y}{7 - z}$.

Name ____ Date __________

1.7 Reteach (continued)

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

EXAMPLE Rewriting a Formula for Volume

The formula for the volume of a pyramid is $V = \frac{1}{3}Bh$. Solve the formula for the area of the base B.

SOLUTION

$V = \frac{1}{3}Bh$	Write the volume of a pyramid formula.
$3 \bullet V = 3 \bullet \frac{1}{3}Bh$	Multiplication Property of Equality: Multiply each side by 3.
$3V = Bh$	Simplify.
$\frac{3V}{h} = \frac{Bh}{h}$	Division Property of Equality: Divide each side by *h* to isolate *B*.
$\frac{3V}{h} = B$	Simplify.

▶ The rewritten formula is $B = \frac{3V}{h}$.

In Exercises 1–6, solve the literal equation for *y*.

1. $4x + y = 7$ **2.** $y - 5x = 9$ **3.** $3y - 15x = 12$

4. $8x + 2y = 18$ **5.** $7x - y = 35$ **6.** $4x + 1 = 9 + 4y$

In Exercises 7–12, solve the literal equation for *x*.

7. $y = 5x - 2x$ **8.** $r = x + 9x$ **9.** $b = 3x + 9xy$

10. $w = 2hx - 11x$ **11.** $p = 4x + qx - 5$ **12.** $m = 9 + 3x - dx$

In Exercises 13–16, solve the formula for the indicated variable.

13. Force: $f = ma$; Solve for m.

14. Volume of a cylinder: $V = \pi r^2 h$; Solve for h.

15. Perimeter of a triangle: $P = a + b + c$; Solve for b.

16. Baseball batting average: $A = \frac{h}{b}$; Solve for b.

Name____ Date__________

1.7 Enrichment and Extension

Draining a Bathtub

Evangelista Torricelli was an Italian mathematician and physicist. He is best known for his invention of the barometer, but he is also well known for his law regarding the speed of fluid flowing out of an opening. For a bathtub with a rectangular base, *Torricelli's Law* implies that the current height h of the water in the tub t seconds after it begins draining is given by the equation

$$h = \left[\sqrt{h_0} - \frac{2\pi d^2\sqrt{3}}{\ell w}t\right]^2$$

where ℓ is the length of the tub, w is the width of the tub, d is the diameter of the drain, and h_0 is the water's initial height. (All measurements are in inches.)

Suppose you fill a tub completely with water. The tub is 60 inches long by 30 inches wide by 25 inches high, and has a drain with a 2-inch diameter. Use the equation above to answer the following questions. Round to the nearest hundredth.

1. Solve for t.

2. **a.** Find the time it takes for the tub to go from being full to half full.

b. Find the time it takes for the tub to go from being half full to empty.

3. Find the time it takes for the tub to go from being full to empty.

4. Use a graphing calculator to graph the height of the water versus time. (The y-axis is the height (in inches), and the x-axis is the time (in seconds) in intervals of 30 seconds.)

5. Based on your results from Exercises 1–4, what general statement can you make about the speed at which the water drains? Explain your answer.

Bonus: Is it possible to *rationalize* the denominator, that is, have only rational numbers in the denominator, after solving for t?

Name ______________________________ Date __________

1.7 Puzzle Time

What Happened To The Shark Who Swallowed A Bunch Of Keys?

Write the letter of each answer in the box containing the exercise number.

Solve the literal equation for *y*.

1. $y + 5x = 17$
2. $4y - 36x = 28$
3. $8x - 11 = 13 + 8y$
4. $6 + \frac{1}{3}y = 10 + 12x$

Solve the literal equation for *x*.

5. $y = 9x - 2x$
6. $d = 5x + 10xf$
7. $rx - sx = p$
8. $3j = 4kx + 7mx + n$

Solve the formula for the indicated variable.

9. Volume of a cone: $V = \frac{1}{3}\pi r^2 h$; Solve for h.
10. Perimeter of a rectangle: $P = 2\ell + 2w$; Solve for w.
11. Area of a rectangle: $A = \ell w$; Solve for ℓ.
12. The surface area of a right circular cylinder is given by the formula $S = 2\pi rh + 2\pi r^2$. Solve the equation for h.

Answers

O. $y = x - 3$

W. $x = \frac{3j - n}{4k + 7m}$

T. $x = \frac{d}{5 + 10f}$

O. $y = 9x + 7$

E. $y = -5x + 17$

G. $h = \frac{3V}{\pi r^2}$

K. $y = 36x + 12$

H. $x = \frac{p}{r - s}$

L. $\ell = \frac{A}{w}$

A. $x = \frac{1}{7}y$

C. $w = \frac{P - 2\ell}{2}$

J. $h = \frac{S - 2\pi r^2}{2\pi r}$

7	1		9	3	6		11	2	10	4	12	5	8