

Glencoe McGraw-Hill

Chapter 1 Resource Masters

Algebra 1



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CONSUMABLE WORKBOOKS Many of the worksheets contained in the Chapter Resource Masters booklets are available as consumable workbooks in both English and Spanish.

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<i>Study Guide and Intervention Workbook</i>	0-07-660292-3	978-0-07-660292-6
<i>Homework Practice Workbook</i>	0-07-660291-5	978-0-07-660291-9
<i>Spanish Version</i>		
<i>Homework Practice Workbook</i>	0-07-660294-X	978-0-07-660294-0

Answers For Workbooks The answers for Chapter 1 of these workbooks can be found in the back of this Chapter Resource Masters booklet.

ConnectED All of the materials found in this booklet are included for viewing, printing, and editing at connected.mcgraw-hill.com.

Spanish Assessment Masters (MHID: 0-07-660289-3, ISBN: 978-0-07-660289-6) These masters contain a Spanish version of Chapter 1 Test Form 2A and Form 2C.

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Teacher's Guide to Using the Chapter 1 Resource Masters

The *Chapter 1 Resource Masters* includes the core materials needed for Chapter 1. These materials include worksheets, extensions, and assessment options. The answers for these pages appear at the back of this booklet.

All of the materials found in this booklet are included for viewing, printing, and editing at connectED.mcgraw-hill.com.

Chapter Resources

Student-Built Glossary (pages 1–2) These masters are a student study tool that presents up to twenty of the key vocabulary terms from the chapter. Students are to record definitions and/or examples for each term. You may suggest that students highlight or star the terms with which they are not familiar. Give this to students before beginning Lesson 1-1. Encourage them to add these pages to their mathematics study notebooks. Remind them to complete the appropriate words as they study each lesson.

Anticipation Guide (pages 3–4) This master, presented in both English and Spanish, is a survey used before beginning the chapter to pinpoint what students may or may not know about the concepts in the chapter. Students will revisit this survey after they complete the chapter to see if their perceptions have changed.

Lesson Resources

Study Guide and Intervention These masters provide vocabulary, key concepts, additional worked-out examples and Check Your Progress exercises to use as a reteaching activity. It can also be used in conjunction with the Student Edition as an instructional tool for students who have been absent.

Skills Practice This master focuses more on the computational nature of the lesson. Use as an additional practice option or as homework for second-day teaching of the lesson.

Practice This master closely follows the types of problems found in the Exercises section of the Student Edition and includes word problems. Use as an additional practice option or as homework for second-day teaching of the lesson.

Word Problem Practice This master includes additional practice in solving word problems that apply the concepts of the lesson. Use as an additional practice or as homework for second-day teaching of the lesson.

Enrichment These activities may extend the concepts of the lesson, offer an historical or multicultural look at the concepts, or widen students' perspectives on the mathematics they are learning. They are written for use with all levels of students.

Graphing Calculator, TI-Nspire or Spreadsheet Activities

These activities present ways in which technology can be used with the concepts in some lessons of this chapter. Use as an alternative approach to some concepts or as an integral part of your lesson presentation.

Assessment Options

The assessment masters in the **Chapter 1 Resource Masters** offer a wide range of assessment tools for formative (monitoring) assessment and summative (final) assessment.

Student Recording Sheet This master corresponds with the standardized test practice at the end of the chapter.

Extended Response Rubric This master provides information for teachers and students on how to assess performance on open-ended questions.

Quizzes Four free-response quizzes offer assessment at appropriate intervals in the chapter.

Mid-Chapter Test This 1-page test provides an option to assess the first half of the chapter. It parallels the timing of the Mid-Chapter Quiz in the Student Edition and includes both multiple-choice and free-response questions.

Vocabulary Test This test is suitable for all students. It includes a list of vocabulary words and 11 questions to assess students' knowledge of those words. This can also be used in conjunction with one of the leveled chapter tests.

Leveled Chapter Tests

- **Form 1** contains multiple-choice questions and is intended for use with below grade level students.
- **Forms 2A and 2B** contain multiple-choice questions aimed at on grade level students. These tests are similar in format to offer comparable testing situations.
- **Forms 2C and 2D** contain free-response questions aimed at on grade level students. These tests are similar in format to offer comparable testing situations.
- **Form 3** is a free-response test for use with above grade level students.

All of the above mentioned tests include a free-response Bonus question.

Extended-Response Test Performance assessment tasks are suitable for all students. Sample answers and a scoring rubric are included for evaluation.

Standardized Test Practice These three pages are cumulative in nature. It includes three parts: multiple-choice questions with bubble-in answer format, griddable questions with answer grids, and short-answer free-response questions.

Answers

- The answers for the Anticipation Guide and Lesson Resources are provided as reduced pages.
- Full-size answer keys are provided for the assessment masters.

1 Student-Built Glossary

This is an alphabetical list of the key vocabulary terms you will learn in Chapter 1. As you study the chapter, complete each term's definition or description. Remember to add the page number where you found the term. Add these pages to your Algebra Study Notebook to review vocabulary at the end of the chapter.

Vocabulary Term	Found on Page	Definition/Description/Example
coefficient (koh·uh·FIH·shuhnt)		
continuous function		
coordinate system		
dependent variable		
domain		
end behavior		
function		
identity		
independent variable		
intercept		

(continued on the next page)

1 Student-Built Glossary *(continued)*

Vocabulary Term	Found on Page	Definition/Description/Example
like terms		
line symmetry		
open sentence		
order of operations		
power		
range		
relative maximum		
relative minimum		
replacement set		
solution set		
variable		

1 Anticipation Guide

Expressions, Equations, and Functions

Step 1 Before you begin Chapter 1

- Read each statement.
- Decide whether you Agree (A) or Disagree (D) with the statement.
- Write A or D in the first column OR if you are not sure whether you agree or disagree, write NS (Not Sure).

STEP 1 A, D, or NS	Statement	STEP 2 A or D
	1. An algebraic expression contains one or more numbers, variables, and arithmetic operations.	
	2. The expression x^4 means $x + x + x + x$.	
	3. According to the order of operations, all multiplication and division should be done before anything else.	
	4. Since 2 makes the equation $3t - 1 = 5$ true, {2} is the solution set for the equation.	
	5. Because of the Reflexive Property of Equality, if $a + b = c$ then $c = a + b$.	
	6. The multiplicative inverse of 23 is $\frac{1}{23}$.	
	7. The Distributive Property states that $a(b + c)$ will equal $ab + c$.	
	8. The order in which you add or multiply numbers does not change their sum or product.	
	9. A graph has symmetry in a line if each half of the graph on either side of the line matches exactly.	
	10. In the coordinate plane, the x -axis is horizontal and the y -axis is vertical.	

Step 2 After you complete Chapter 1

- Reread each statement and complete the last column by entering an A or a D.
- Did any of your opinions about the statements change from the first column?
- For those statements that you mark with a D, use a piece of paper to write an example of why you disagree.

1 Ejercicios preparatorios

Expressions, Equations, and Functions

Paso 1 *Antes de comenzar el Capítulo 1*

- Lee cada enunciado.
- Decide si estás de acuerdo (A) o en desacuerdo (D) con el enunciado.
- Escribe A o D en la primera columna O si no estás seguro(a) de la respuesta, escribe NS (No estoy seguro(a)).

PASO 1 A, D o NS	Enunciado	PASO 2 A o D
	1. Una expresión matemática contiene uno o más números, variables y operaciones aritméticas.	
	2. La expresión x^4 significa $x + x + x + x$.	
	3. Según el orden de las operaciones, se debe realizar toda multiplicación y división antes que cualquier otra operación.	
	4. Puesto que 2 hace verdadera la ecuación $3t - 1 = 5$, $\{2\}$ es el conjunto solución para la ecuación.	
	5. Debido a la propiedad reflexiva de la igualdad, si $a + b = c$ entonces $c = a + b$.	
	6. El inverso multiplicativo de 23 es $\frac{1}{23}$.	
	7. La propiedad distributiva dice que $a(b + c)$ es igual a $ab + c$.	
	8. El orden en el cual sumas o multiplicas números no altera su suma o su producto.	
	9. Una gráfica tiene simetría en una línea si cada uno la mitad de la gráfica a cada lado de la línea corresponde exactamente.	
	10. En el plano de coordenadas, el eje x es horizontal y el eje y es vertical.	

Paso 2 *Después de completar el Capítulo 1*

- Vuelve a leer cada enunciado y completa la última columna con una A o una D.
- ¿Cambió cualquiera de tus opiniones sobre los enunciados de la primera columna?
- En una hoja de papel aparte, escribe un ejemplo de por qué estás en desacuerdo con los enunciados que marcaste con una D.

1-1 Study Guide and Intervention**Variables and Expressions**

Write Verbal Expressions An **algebraic expression** consists of one or more numbers and variables along with one or more arithmetic operations. In algebra, **variables** are symbols used to represent unspecified numbers or values. Any letter may be used as a variable.

Example Write a verbal expression for each algebraic expression.

a. $6n^2$

the product of 6 and n squared

b. $n^3 - 12m$

the difference of n cubed and twelve times m

Exercises

Write a verbal expression for each algebraic expression.

1. $w - 1$

2. $\frac{1}{3}a^3$

3. $81 + 2x$

4. $12d$

5. 8^4

6. 6^2

7. $2n^2 + 4$

8. $a^3 \cdot b^3$

9. $2x^3 - 3$

10. $\frac{6k^3}{5}$

11. $\frac{1}{4}b^2$

12. $7n^5$

13. $3x + 4$

14. $\frac{2}{3}k^5$

15. $3b^2 + 2a^3$

16. $4(n^2 + 1)$

1-1 Study Guide and Intervention *(continued)****Variables and Expressions***

Write Algebraic Expressions Translating verbal expressions into algebraic expressions is an important algebraic skill.

Example Write an algebraic expression for each verbal expression.

a. four more than a number n

The words *more than* imply addition.

four more than a number n

$$4 + n$$

The algebraic expression is $4 + n$.

b. the difference of a number squared and 8

The expression *difference of* implies subtraction.

the difference of a number squared and 8

$$n^2 - 8$$

The algebraic expression is $n^2 - 8$.

Exercises

Write an algebraic expression for each verbal expression.

1. a number decreased by 8
2. a number divided by 8
3. a number squared
4. four times a number
5. a number divided by 6
6. a number multiplied by 37
7. the sum of 9 and a number
8. 3 less than 5 times a number
9. twice the sum of 15 and a number
10. one-half the square of b
11. 7 more than the product of 6 and a number
12. 30 increased by 3 times the square of a number

1-1 Skills Practice***Variables and Expressions***

Write a verbal expression for each algebraic expression.

1. $9a^2$

2. 5^2

3. $c + 2d$

4. $4 - 5h$

5. $2b^2$

6. $7x^3 - 1$

7. $p^4 + 6r$

8. $3n^2 - x$

Write an algebraic expression for each verbal expression.

9. the sum of a number and 10

10. 15 less than k 11. the product of 18 and q 12. 6 more than twice m

13. 8 increased by three times a number

14. the difference of 17 and 5 times a number

15. the product of 2 and the second power of y 16. 9 less than g to the fourth power

1-1 Practice***Variables and Expressions***

Write a verbal expression for each algebraic expression.

1. $23f$

2. 7^3

3. $5m^2 + 2$

4. $4d^3 - 10$

5. $x^3 \cdot y^4$

6. $b^2 - 3c^3$

7. $\frac{k^5}{6}$

8. $\frac{4n^2}{7}$

Write an algebraic expression for each verbal expression.

9. the difference of 10 and u

10. the sum of 18 and a number

11. the product of 33 and j

12. 74 increased by 3 times y

13. 15 decreased by twice a number

14. 91 more than the square of a number

15. three fourths the square of b

16. two fifths the cube of a number

17. **BOOKS** A used bookstore sells paperback fiction books in excellent condition for \$2.50 and in fair condition for \$0.50. Write an expression for the cost of buying x excellent-condition paperbacks and f fair-condition paperbacks.

18. **GEOMETRY** The surface area of the side of a right cylinder can be found by multiplying twice the number π by the radius times the height. If a circular cylinder has radius r and height h , write an expression that represents the surface area of its side.

1-1 Word Problem Practice**Variables and Expressions**

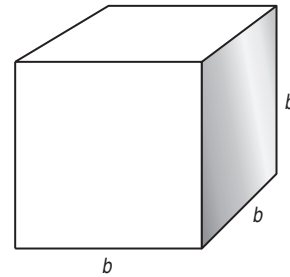
1. SOLAR SYSTEM It takes Earth about 365 days to orbit the Sun. It takes Uranus about 85 times as long. Write a numerical expression to describe the number of days it takes Uranus to orbit the Sun.

2. TECHNOLOGY There are 1024 bytes in a kilobyte. Write an expression that describes the number of bytes in a computer chip with n kilobytes.

3. THEATER H. Howard Hughes, Professor Emeritus of Texas Wesleyan College and his wife Erin Connor Hughes attended a record 6136 theatrical shows. Write an expression for the average number of shows they attended per year if they accumulated the record over y years.

4. TIDES The difference between high and low tides along the Maine coast in November is 19 feet on Monday and x feet on Tuesday. Write an expression to show the average rise and fall of the tide for Monday and Tuesday.

5. BLOCKS A toy manufacturer produces a set of blocks that can be used by children to build play structures. The product packaging team is analyzing different arrangements for packaging their blocks. One idea they have is to arrange the blocks in the shape of a cube, with b blocks along one edge.



a. Write an expression representing the total number of blocks packaged in a cube measuring b blocks on one edge.

b. The packaging team decides to take one layer of blocks off the top of this package. Write an expression representing the number of blocks in the top layer of the package.

c. The team finally decides that their favorite package arrangement is to take 2 layers of blocks off the top of a cube measuring b blocks along one edge. Write an expression representing the number of blocks left behind after the top two layers are removed.

1-1 Enrichment

Toothpick Triangles

Variable expressions can be used to represent patterns and help solve problems. Consider the problem of creating triangles out of toothpicks shown below.

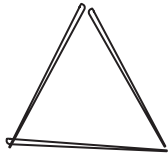


Figure 1

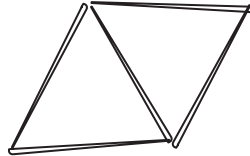


Figure 2

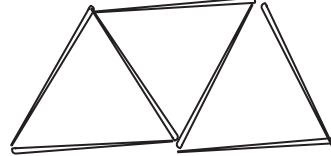


Figure 3

- How many toothpicks does it take to create each figure?
- How many toothpicks does it take to make up the perimeter of each image?
- Sketch the next three figures in the pattern.

4. Continue the pattern to complete the table.

Image Number	1	2	3	4	5	6	7	8	9	10
Number of toothpicks	3	5	7							
Number of toothpicks in Perimeter	3	4	5							

- Let the variable n represent the figure number. Write an expression that can be used to find the number of toothpicks needed to create figure n .
- Let the variable n represent the figure number. Write an expression that can be used to find the number of toothpicks in the perimeter of figure n .

1-2 Study Guide and Intervention

Order of Operations

Evaluate Numerical Expressions Numerical expressions often contain more than one operation. To evaluate them, use the rules for order of operations shown below.

Order of Operations	<p>Step 1 Evaluate expressions inside grouping symbols.</p> <p>Step 2 Evaluate all powers.</p> <p>Step 3 Do all multiplication and/or division from left to right.</p> <p>Step 4 Do all addition and/or subtraction from left to right.</p>
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Example 1 Evaluate each expression.

a. 3^4
 $3^4 = 3 \cdot 3 \cdot 3 \cdot 3$ Use 3 as a factor 4 times.
 $= 81$ Multiply.

b. 6^3
 $6^3 = 6 \cdot 6 \cdot 6$ Use 6 as a factor 3 times.
 $= 216$ Multiply.

Example 2 Evaluate each expression.

a. $3[2 + (12 \div 3)^2]$
 $3[2 + (12 \div 3)^2] = 3(2 + 4^2)$ Divide 12 by 3.
 $= 3(2 + 16)$ Find 4 squared.
 $= 3(18)$ Add 2 and 16.
 $= 54$ Multiply 3 and 18.

b. $\frac{3 + 2^3}{4^2 \cdot 3}$
 $\frac{3 + 2^3}{4^2 \cdot 3} = \frac{3 + 8}{4^2 \cdot 3}$ Evaluate power in numerator.
 $= \frac{11}{4^2 \cdot 3}$ Add 3 and 8 in the numerator.
 $= \frac{11}{16 \cdot 3}$ Evaluate power in denominator.
 $= \frac{11}{48}$ Multiply.

Exercises

Evaluate each expression.

1. 5^2

2. 3^3

3. 10^4

4. 12^2

5. 8^3

6. 2^8

7. $(8 - 4) \cdot 2$

8. $(12 + 4) \cdot 6$

9. $10 + 8 \cdot 1$

10. $15 - 12 \div 4$

11. $12(20 - 17) - 3 \cdot 6$

12. $24 \div 3 \cdot 2 - 3^2$

13. $3^2 \div 3 + 2^2 \cdot 7 - 20 \div 5$

14. $\frac{4 + 3^2}{12 + 1}$

15. $250 \div [5(3 \cdot 7 + 4)]$

16. $\frac{2 \cdot 4^2 - 8 \div 2}{(5 + 2) \cdot 2}$

17. $\frac{4(5^2) - 4 \cdot 3}{4(4 \cdot 5 + 2)}$

18. $\frac{5^2 - 3}{20(3) + 2(3)}$

1-2 Study Guide and Intervention *(continued)***Order of Operations**

Evaluate Algebraic Expressions Algebraic expressions may contain more than one operation. Algebraic expressions can be evaluated if the values of the variables are known. First, replace the variables with their values. Then use the order of operations to calculate the value of the resulting numerical expression.

Example Evaluate $x^3 + 5(y - 3)$ if $x = 2$ and $y = 12$.

$$\begin{aligned} x^3 + 5(y - 3) &= 2^3 + 5(12 - 3) && \text{Replace } x \text{ with } 2 \text{ and } y \text{ with } 12. \\ &= 8 + 5(12 - 3) && \text{Evaluate } 2^3. \\ &= 8 + 5(9) && \text{Subtract } 3 \text{ from } 12. \\ &= 8 + 45 && \text{Multiply } 5 \text{ and } 9. \\ &= 53 && \text{Add } 8 \text{ and } 45. \end{aligned}$$

The solution is 53.

Exercises

Evaluate each expression if $x = 2$, $y = 3$, $z = 4$, $a = \frac{4}{5}$, and $b = \frac{3}{5}$.

1. $x + 7$

2. $3x - 5$

3. $x + y^2$

4. $x^3 + y + z^2$

5. $6a + 8b$

6. $23 - (a + b)$

7. $\frac{y^2}{x^2}$

8. $2xyz + 5$

9. $x(2y + 3z)$

10. $(10x)^2 + 100a$

11. $\frac{3xy - 4}{7x}$

12. $a^2 + 2b$

13. $\frac{z^2 - y^2}{x^2}$

14. $6xz + 5xy$

15. $\frac{(z - y)^2}{x}$

16. $\frac{25ab + y}{xz}$

17. $\frac{5a^2b}{y}$

18. $(z \div x)^2 + ax$

19. $\left(\frac{x}{z}\right)^2 + \left(\frac{y}{z}\right)^2$

20. $\frac{x + z}{y + 2z}$

21. $\left(\frac{z \div x}{y}\right) + \left(\frac{y \div x}{z}\right)$

1-2 Skills Practice**Order of Operations****Evaluate each expression.**

1. 8^2

2. 3^4

3. 5^3

4. 3^3

5. $(5 + 4) \cdot 7$

6. $(9 - 2) \cdot 3$

7. $4 + 6 \cdot 3$

8. $12 + 2 \cdot 2$

9. $(3 + 5) \cdot 5 + 1$

10. $9 + 4(3 + 1)$

11. $30 - 5 \cdot 4 + 2$

12. $10 + 2 \cdot 6 + 4$

13. $14 \div 7 \cdot 5 - 3^2$

14. $4[30 - (10 - 2) \cdot 3]$

15. $5 + [30 - (6 - 1)^2]$

16. $2[12 + (5 - 2)^2]$

Evaluate each expression if $x = 6$, $y = 8$, and $z = 3$.

17. $xy + z$

18. $yz - x$

19. $2x + 3y - z$

20. $2(x + z) - y$

21. $5z + (y - x)$

22. $5x - (y + 2z)$

23. $x^2 + y^2 - 10z$

24. $z^3 + (y^2 - 4x)$

25. $\frac{y + xz}{2}$

26. $\frac{3y + x^2}{z}$

1-2 Practice**Order of Operations**

Evaluate each expression.

1. 11^2

2. 8^3

3. 5^4

4. $(15 - 5) \cdot 2$

5. $9 \cdot (3 + 4)$

6. $5 + 7 \cdot 4$

7. $4(3 + 5) - 5 \cdot 4$

8. $22 \div 11 \cdot 9 - 3^2$

9. $6^2 + 3 \cdot 7 - 9$

10. $3[10 - (27 \div 9)]$

11. $2[5^2 + (36 \div 6)]$

12. $162 \div [6(7 - 4)^2]$

13. $\frac{5^2 \cdot 4 - 5 \cdot 4^2}{5(4)}$

14. $\frac{(2 \cdot 5)^2 + 4}{3^2 - 5}$

15. $\frac{7 + 3^2}{4^2 \cdot 2}$

Evaluate each expression if $a = 12$, $b = 9$, and $c = 4$.

16. $a^2 + b - c^2$

17. $b^2 + 2a - c^2$

18. $2c(a + b)$

19. $4a + 2b - c^2$

20. $(a^2 \div 4b) + c$

21. $c^2 \cdot (2b - a)$

22. $\frac{bc^2 + a}{c}$

23. $\frac{2c^3 - ab}{4}$

24. $2(a - b)^2 - 5c$

25. $\frac{b^2 - 2c^2}{a + c - b}$

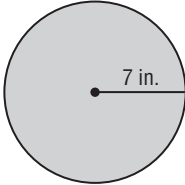
26. CAR RENTAL Ann Carlyle is planning a business trip for which she needs to rent a car. The car rental company charges \$36 per day plus \$0.50 per mile over 100 miles. Suppose Ms. Carlyle rents the car for 5 days and drives 180 miles.

- Write an expression for how much it will cost Ms. Carlyle to rent the car.
- Evaluate the expression to determine how much Ms. Carlyle must pay the car rental company.

27. GEOMETRY The length of a rectangle is $3n + 2$ and its width is $n - 1$. The perimeter of the rectangle is twice the sum of its length and its width.

- Write an expression that represents the perimeter of the rectangle.
- Find the perimeter of the rectangle when $n = 4$ inches.

1-2 Word Problem Practice**Order of Operations**

- 1. SCHOOLS** Jefferson High School has 100 less than 5 times as many students as Taft High School. Write and evaluate an expression to find the number of students at Jefferson High School if Taft High School has 300 students.
- 2. GEOGRAPHY** Guadalupe Peak in Texas has an altitude that is 671 feet more than double the altitude of Mount Sunflower in Kansas. Write and evaluate an expression for the altitude of Guadalupe Peak if Mount Sunflower has an altitude of 4039 feet.
- 3. TRANSPORTATION** The Plaid Taxi Cab Company charges \$1.75 per passenger plus \$3.45 per mile for trips less than 10 miles. Write and evaluate an expression to find the cost for Max to take a Plaid taxi 8 miles to the airport.
- 4. GEOMETRY** The area of a circle is related to the radius of the circle such that the product of the square of the radius and a number π gives the area. Write and evaluate an expression for the area of a circular pizza below. Approximate π as 3.14.
- 
- 5. BIOLOGY** Lavania is studying the growth of a population of fruit flies in her laboratory. She notices that the number of fruit flies in her experiment is five times as large after any six-day period. She observes 20 fruit flies on October 1. Write and evaluate an expression to predict the population of fruit flies Lavania will observe on October 31.
- 6. CONSUMER SPENDING** During a long weekend, Devon paid a total of x dollars for a rental car so he could visit his family. He rented the car for 4 days at a rate of \$36 per day. There was an additional charge of \$0.20 per mile after the first 200 miles driven.
- Write an algebraic expression to represent the amount Devon paid for additional mileage only.
 - Write an algebraic expression to represent the number of miles over 200 miles that Devon drove the rented car.
 - How many miles did Devon drive overall if he paid a total of \$174 for the car rental?

1-2 Enrichment

The Four Digits Problem

One well-known mathematics problem is to write expressions for consecutive numbers beginning with 1. On this page, you will use the digits 1, 2, 3, and 4. Each digit is used only once. You may use addition, subtraction, multiplication (not division), exponents, and parentheses in any way you wish. Also, you can use two digits to make one number, such as 12 or 34.

Express each number as a combination of the digits 1, 2, 3, and 4.

- | | | |
|------------------------------|--------------------------|----------------------|
| $1 = (3 \times 1) - (4 - 2)$ | $18 =$ _____ | $35 = 2^{(4+1)} + 3$ |
| $2 =$ _____ | $19 = 3(2 + 4) + 1$ | $36 =$ _____ |
| $3 =$ _____ | $20 =$ _____ | $37 =$ _____ |
| $4 =$ _____ | $21 =$ _____ | $38 =$ _____ |
| $5 =$ _____ | $22 =$ _____ | $39 =$ _____ |
| $6 =$ _____ | $23 = 31 - (4 \times 2)$ | $40 =$ _____ |
| $7 =$ _____ | $24 =$ _____ | $41 =$ _____ |
| $8 =$ _____ | $25 =$ _____ | $42 =$ _____ |
| $9 =$ _____ | $26 =$ _____ | $43 = 42 + 1^3$ |
| $10 =$ _____ | $27 =$ _____ | $44 =$ _____ |
| $11 =$ _____ | $28 =$ _____ | $45 =$ _____ |
| $12 =$ _____ | $29 =$ _____ | $46 =$ _____ |
| $13 =$ _____ | $30 =$ _____ | $47 =$ _____ |
| $14 =$ _____ | $31 =$ _____ | $48 =$ _____ |
| $15 =$ _____ | $32 =$ _____ | $49 =$ _____ |
| $16 =$ _____ | $33 =$ _____ | $50 =$ _____ |
| $17 =$ _____ | $34 =$ _____ | |

Does a calculator help in solving these types of puzzles? Give reasons for your opinion.

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1-2 TI-Nspire® Activity**Using the Store Key**

When evaluating algebraic expressions, it is sometimes helpful to use the store key on the calculator, especially to check solutions, evaluate several expressions for the same values of variables, or evaluate the same expression for multiple values of the variables.

Example 1 Evaluate $a^2 - 4a + 6$ if $a = 8$.

First, open a new **Calculator** page on the TI-Nspire.

Then, delete any instances of stored variables by entering CLEARAZ.

Store 8 as the value for a .

Finally enter the expression, including the variables, to evaluate.

The answer is 38.

**Example 2 Evaluate $xy - \frac{4y}{5x}$ if $x = 4$ and $y = 12$.**

Enter 4 as the value for x and 12 as the value for y .

Evaluate the expression. The TI-Nspire will display the answer as a fraction.

The answer is $\frac{228}{5}$.

**Exercises**

Evaluate each expression if $a = 4$, $b = 6$, $x = 8$, and $y = 12$. Express answers as integers or fractions.

1. $bx - ay \div b$

2. $a[x + (y \div a)^2]$

3. $a^3 - (y - b)^2 + x^2$

4. $\frac{b + a^2}{x^2 - b^2}$

5. $\frac{2a(x - b)}{xy} - 9b$

6. $\frac{b^3 - [3(a + b^2) + 5b]}{y \div a(x - 1)}$

1-3 Study Guide and Intervention**Properties of Numbers**

Identity and Equality Properties The identity and equality properties in the chart below can help you solve algebraic equations and evaluate mathematical expressions.

Additive Identity	For any number a , $a + 0 = a$.
Additive Inverse	For any number a , $a + (-a) = 0$.
Multiplicative Identity	For any number a , $a \cdot 1 = a$.
Multiplicative Property of 0	For any number a , $a \cdot 0 = 0$.
Multiplicative Inverse Property	For every number $\frac{a}{b}$, where $a, b \neq 0$, there is exactly one number $\frac{b}{a}$ such that $\frac{a}{b} \cdot \frac{b}{a} = 1$.
Reflexive Property	For any number a , $a = a$.
Symmetric Property	For any numbers a and b , if $a = b$, then $b = a$.
Transitive Property	For any numbers a, b , and c , if $a = b$ and $b = c$, then $a = c$.
Substitution Property	If $a = b$, then a may be replaced by b in any expression.

Example Evaluate $24 \cdot 1 - 8 + 5(9 \div 3 - 3)$. Name the property used in each step.

$$\begin{aligned}
 24 \cdot 1 - 8 + 5(9 \div 3 - 3) &= 24 \cdot 1 - 8 + 5(3 - 3) && \text{Substitution; } 9 \div 3 = 3 \\
 &= 24 \cdot 1 - 8 + 5(0) && \text{Substitution; } 3 - 3 = 0 \\
 &= 24 - 8 + 5(0) && \text{Multiplicative Identity; } 24 \cdot 1 = 24 \\
 &= 24 - 8 + 0 && \text{Multiplicative Property of Zero; } 5(0) = 0 \\
 &= 16 + 0 && \text{Substitution; } 24 - 8 = 16 \\
 &= 16 && \text{Additive Identity; } 16 + 0 = 16
 \end{aligned}$$

Exercises

Evaluate each expression. Name the property used in each step.

1. $2 \left[\frac{1}{4} + \left(\frac{1}{2} \right)^2 \right]$

2. $15 \cdot 1 - 9 + 2(15 \div 3 - 5)$

3. $2(3 \cdot 5 \cdot 1 - 14) - 4 \cdot \frac{1}{4}$

4. $18 \cdot 1 - 3 \cdot 2 + 2(6 \div 3 - 2)$

1-3 Study Guide and Intervention *(continued)***Properties of Numbers**

Commutative and Associative Properties The Commutative and Associative Properties can be used to simplify expressions. The Commutative Properties state that the order in which you add or multiply numbers does not change their sum or product. The Associative Properties state that the way you group three or more numbers when adding or multiplying does not change their sum or product.

Commutative Properties	For any numbers a and b , $a + b = b + a$ and $a \cdot b = b \cdot a$.
Associative Properties	For any numbers a , b , and c , $(a + b) + c = a + (b + c)$ and $(ab)c = a(bc)$.

Example 1 Evaluate $6 \cdot 2 \cdot 3 \cdot 5$ using properties of numbers. Name the property used in each step.

$$\begin{aligned} 6 \cdot 2 \cdot 3 \cdot 5 &= 6 \cdot 3 \cdot 2 \cdot 5 && \text{Commutative Property} \\ &= (6 \cdot 3)(2 \cdot 5) && \text{Associative Property} \\ &= 18 \cdot 10 && \text{Multiply.} \\ &= 180 && \text{Multiply.} \end{aligned}$$

The product is 180.

Example 2 Evaluate $8.2 + 2.5 + 2.5 + 1.8$ using properties of numbers. Name the property used in each step.

$$\begin{aligned} 8.2 + 2.5 + 2.5 + 1.8 &= 8.2 + 1.8 + 2.5 + 2.5 && \text{Commutative Prop.} \\ &= (8.2 + 1.8) + (2.5 + 2.5) && \text{Associative Prop.} \\ &= 10 + 5 && \text{Add.} \\ &= 15 && \text{Add.} \end{aligned}$$

The sum is 15.

Exercises

Evaluate each expression using properties of numbers. Name the property used in each step.

1. $12 + 10 + 8 + 5$

2. $16 + 8 + 22 + 12$

3. $10 \cdot 7 \cdot 2.5$

4. $4 \cdot 8 \cdot 5 \cdot 3$

5. $12 + 20 + 10 + 5$

6. $26 + 8 + 4 + 22$

7. $3\frac{1}{2} + 4 + 2\frac{1}{2} + 3$

8. $\frac{3}{4} \cdot 12 \cdot 4 \cdot 2$

9. $3.5 + 2.4 + 3.6 + 4.2$

10. $4\frac{1}{2} + 5 + \frac{1}{2} + 3$

11. $0.5 \cdot 2.8 \cdot 4$

12. $2.5 + 2.4 + 2.5 + 3.6$

13. $\frac{4}{5} \cdot 18 \cdot 25 \cdot \frac{2}{9}$

14. $32 \cdot \frac{1}{5} \cdot \frac{1}{2} \cdot 10$

15. $\frac{1}{4} \cdot 7 \cdot 16 \cdot \frac{1}{7}$

16. $3.5 + 8 + 2.5 + 2$

17. $18 \cdot 8 \cdot \frac{1}{2} \cdot \frac{1}{9}$

18. $\frac{3}{4} \cdot 10 \cdot 16 \cdot \frac{1}{2}$

1-3 Skills Practice***Properties of Numbers***

Evaluate each expression. Name the property used in each step.

1. $7(16 \div 4^2)$

2. $2[5 - (15 \div 3)]$

3. $4 - 3[7 - (2 \cdot 3)]$

4. $4[8 - (4 \cdot 2)] + 1$

5. $6 + 9[10 - 2(2 + 3)]$

6. $2(6 \div 3 - 1) \cdot \frac{1}{2}$

7. $16 + 8 + 14 + 12$

8. $36 + 23 + 14 + 7$

9. $5 \cdot 3 \cdot 4 \cdot 3$

10. $2 \cdot 4 \cdot 5 \cdot 3$

1-3 Practice***Properties of Numbers***

Evaluate each expression. Name the property used in each step.

1. $2 + 6(9 - 3^2) - 2$

2. $5(14 - 39 \div 3) + 4 \cdot \frac{1}{4}$

Evaluate each expression using properties of numbers. Name the property used in each step.

3. $13 + 23 + 12 + 7$

4. $6 \cdot 0.7 \cdot 5$

5. SALES Althea paid \$5.00 each for two bracelets and later sold each for \$15.00. She paid \$8.00 each for three bracelets and sold each of them for \$9.00.

- Write an expression that represents the profit Althea made.
- Evaluate the expression. Name the property used in each step.

6. SCHOOL SUPPLIES Kristen purchased two binders that cost \$1.25 each, two binders that cost \$4.75 each, two packages of paper that cost \$1.50 per package, four blue pens that cost \$1.15 each, and four pencils that cost \$0.35 each.

- Write an expression to represent the total cost of supplies before tax.
- What was the total cost of supplies before tax?

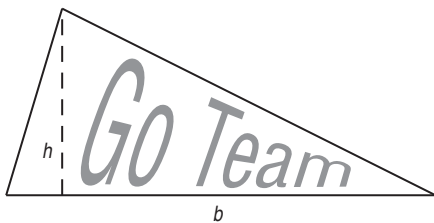
1-3 Word Problem Practice

Properties of Numbers

1. EXERCISE Annika goes on a walk every day in order to get the exercise her doctor recommends. If she walks at a rate of 3 miles per hour for $\frac{1}{3}$ of an hour, then she will have walked $3 \times \frac{1}{3}$ miles. Evaluate the expression and name the property used.

2. SCHOOL SUPPLIES At a local school supply store, a highlighter costs \$1.25, a ballpoint pen costs \$0.80, and a spiral notebook costs \$2.75. Use mental math and the Associative Property of Addition to find the total cost if one of each item is purchased.

3. MENTAL MATH The triangular banner has a base of 9 centimeters and a height of 6 centimeters. Using the formula for area of a triangle, the banner's area can be expressed as $\frac{1}{2} \times 9 \times 6$. Gabrielle finds it easier to write and evaluate $(\frac{1}{2} \times 6) \times 9$ to find the area. Is Gabrielle's expression equivalent to the area formula? Explain.



4. ANATOMY The human body has 60 bones in the arms and hands, 84 bones in the upper body and head, and 62 bones in the legs and feet. Use the Associative Property to write and evaluate an expression that represents the total number of bones in the human body.

5. TOLL ROADS Some toll highways assess tolls based on where a car entered and exited. The table below shows the highway tolls for a car entering and exiting at a variety of exits. Assume that the toll for the reverse direction is the same.

Entered	Exited	Toll
Exit 5	Exit 8	\$0.50
Exit 8	Exit 10	\$0.25
Exit 10	Exit 15	\$1.00
Exit 15	Exit 18	\$0.50
Exit 18	Exit 22	\$0.75

a. Running an errand, Julio travels from Exit 8 to Exit 5. What property would you use to determine the toll?

b. Gordon travels from home to work and back each day. He lives at Exit 15 on the toll road and works at Exit 22. Write and evaluate an expression to find his daily toll cost. What property or properties did you use?

1-3 **Enrichment*****Properties of Operations***

Let's make up a new operation and denote it by \otimes , so that $a \otimes b$ means b^a .

$$2 \otimes 3 = 3^2 = 9$$

$$(1 \otimes 2) \otimes 3 = 2^1 \otimes 3 = 3^2 = 9$$

1. What number is represented by $2 \otimes 3$?
2. What number is represented by $3 \otimes 2$?
3. Does the operation \otimes appear to be commutative?
4. What number is represented by $(2 \otimes 1) \otimes 3$?
5. What number is represented by $2 \otimes (1 \otimes 3)$?
6. Does the operation \otimes appear to be associative?

Let's make up another operation and denote it by \oplus , so that

$$a \oplus b = (a + 1)(b + 1).$$

$$3 \oplus 2 = (3 + 1)(2 + 1) = 4 \cdot 3 = 12$$

$$(1 \oplus 2) \oplus 3 = (2 \cdot 3) \oplus 3 = 6 \oplus 3 = 7 \cdot 4 = 28$$

7. What number is represented by $2 \oplus 3$?
8. What number is represented by $3 \oplus 2$?
9. Does the operation \oplus appear to be commutative?
10. What number is represented by $(2 \oplus 3) \oplus 4$?
11. What number is represented by $2 \oplus (3 \oplus 4)$?
12. Does the operation \oplus appear to be associative?
13. What number is represented by $1 \otimes (3 \oplus 2)$?
14. What number is represented by $(1 \otimes 3) \oplus (1 \otimes 2)$?
15. Does the operation \otimes appear to be distributive over the operation \oplus ?
16. Let's explore these operations a little further. What number is represented by $3 \otimes (4 \oplus 2)$?
17. What number is represented by $(3 \otimes 4) \oplus (3 \otimes 2)$?
18. Is the operation \otimes actually distributive over the operation \oplus ?

1-4 Study Guide and Intervention***The Distributive Property***

Evaluate Expressions The Distributive Property can be used to help evaluate expressions.

Distributive Property	For any numbers a , b , and c , $a(b + c) = ab + ac$ and $(b + c)a = ba + ca$ and $a(b - c) = ab - ac$ and $(b - c)a = ba - ca$.
------------------------------	---

Example 1 Use the Distributive Property to rewrite $6(8 + 10)$. Then evaluate.

$$\begin{aligned} 6(8 + 10) &= 6 \cdot 8 + 6 \cdot 10 && \text{Distributive Property} \\ &= 48 + 60 && \text{Multiply.} \\ &= 108 && \text{Add.} \end{aligned}$$

Example 2 Use the Distributive Property to rewrite $-2(3x^2 + 5x + 1)$. Then simplify.

$$\begin{aligned} -2(3x^2 + 5x + 1) &= -2(3x^2) + (-2)(5x) + (-2)(1) && \text{Distributive Property} \\ &= -6x^2 + (-10x) + (-2) && \text{Multiply.} \\ &= -6x^2 - 10x - 2 && \text{Simplify.} \end{aligned}$$

Exercises

Use the Distributive Property to rewrite each expression. Then evaluate.

1. $20(31)$

2. $12 \cdot 4\frac{1}{2}$

3. $5(311)$

4. $5(4x - 9)$

5. $3(8 - 2x)$

6. $12\left(6 - \frac{1}{2}x\right)$

7. $12\left(2 + \frac{1}{2}x\right)$

8. $\frac{1}{4}(12 - 4t)$

9. $3(2x - y)$

10. $2(3x + 2y - z)$

11. $(x - 2)y$

12. $2(3a - 2b + c)$

13. $\frac{1}{4}(16x - 12y + 4z)$

14. $(2 - 3x + x^2)3$

15. $-2(2x^2 + 3x + 1)$

1-4 Study Guide and Intervention *(continued)***The Distributive Property**

Simplify Expressions A **term** is a number, a variable, or a product or quotient of numbers and variables. **Like terms** are terms that contain the same variables, with corresponding variables having the same powers. The Distributive Property and properties of equalities can be used to simplify expressions. An expression is in **simplest form** if it is replaced by an **equivalent** expression with no like terms or parentheses.

Example Simplify $4(a^2 + 3ab) - ab$.

$$\begin{aligned}
 4(a^2 + 3ab) - ab &= 4(a^2 + 3ab) - 1ab && \text{Multiplicative Identity} \\
 &= 4a^2 + 12ab - 1ab && \text{Distributive Property} \\
 &= 4a^2 + (12 - 1)ab && \text{Distributive Property} \\
 &= 4a^2 + 11ab && \text{Substitution}
 \end{aligned}$$

Exercises

Simplify each expression. If not possible, write *simplified*.

1. $12a - a$

2. $3x + 6x$

3. $3x - 1$

4. $20a + 12a - 8$

5. $3x^2 + 2x^2$

6. $-6x + 3x^2 + 10x^2$

7. $2p + \frac{1}{2}q$

8. $10xy - 4(xy + xy)$

9. $21a + 18a + 31b - 3b$

10. $4x + \frac{1}{4}(16x - 20y)$

11. $2 - 1 - 6x + x^2$

12. $4x^2 + 3x^2 + 2x$

Write an algebraic expression for each verbal expression. Then simplify, indicating the properties used.

13. six times the difference of $2a$ and b , increased by $4b$

14. two times the sum of x squared and y squared, increased by three times the sum of x squared and y squared

1-4 Skills Practice***The Distributive Property***

Use the Distributive Property to rewrite each expression. Then evaluate.

1. $4(3 + 5)$

2. $2(6 + 10)$

3. $5(7 - 4)$

4. $(6 - 2)8$

5. $5 \cdot 89$

6. $9 \cdot 99$

7. $15 \cdot 104$

8. $15\left(2\frac{1}{3}\right)$

Use the Distributive Property to rewrite each expression. Then evaluate.

9. $(a + 7)2$

10. $7(h - 10)$

11. $3(m + n)$

12. $2(x - y + 1)$

Simplify each expression. If not possible, write *simplified*.

13. $2x + 8x$

14. $17g + g$

15. $2x^2 + 6x^2$

16. $7a^2 - 2a^2$

17. $3y^2 - 2y$

18. $2(n + 2n)$

19. $4(2b - b)$

20. $3q^2 + q - q^2$

Write an algebraic expression for each verbal expression. Then simplify, indicating the properties used.

21. The product of 9 and t squared, increased by the sum of the square of t and 2

22. 3 times the sum of r and d squared minus 2 times the sum of r and d squared

1-4 Practice**The Distributive Property**

Use the Distributive Property to rewrite each expression. Then evaluate.

1. $9(7 + 8)$

2. $7(6 - 4)$

3. $(4 + 6)11$

4. $9 \cdot 499$

5. $7 \cdot 110$

6. $16\left(4\frac{1}{4}\right)$

Use the Distributive property to rewrite each expression. Then simplify.

7. $(9 - p)3$

8. $(5y - 3)7$

9. $15\left(f + \frac{1}{3}\right)$

10. $16(3b - 0.25)$

11. $m(n + 4)$

12. $(c - 4)d$

Simplify each expression. If not possible, write *simplified*.

13. $w + 14w - 6w$

14. $3(5 + 6h)$

15. $12b^2 + 9b^2$

16. $25t^3 - 17t^3$

17. $3a^2 + 6a + 2b^2$

18. $4(6p + 2q - 2p)$

Write an algebraic expression for each verbal expression. Then simplify, indicating the properties used.

19. 4 times the difference of f squared and g , increased by the sum of f squared and $2g$

20. 3 times the sum of x and y squared plus 5 times the difference of $2x$ and y

21. **DINING OUT** The Ross family recently dined at an Italian restaurant. Each of the four family members ordered a pasta dish that cost \$11.50, a drink that cost \$1.50, and dessert that cost \$2.75.

a. Write an expression that could be used to calculate the cost of the Ross' dinner before adding tax and a tip.

b. What was the cost of dining out for the Ross family?

1-4 Word Problem Practice

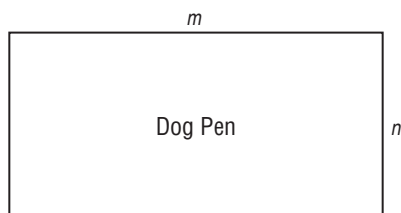
The Distributive Property

- OPERA** Mr. Delong’s drama class is planning a field trip to see Mozart’s famous opera *Don Giovanni*. Tickets cost \$39 each, and there are 23 students and 2 teachers going on the field trip. Write and evaluate an expression to find the group’s total ticket cost.

- SALARY** In a recent year, the median salary for an engineer in the United States was \$55,000 and the median salary for a computer programmer was \$52,000. Write and evaluate an expression to estimate the total cost for a business to employ an engineer and a programmer for 5 years.

- COSTUMES** Isabella’s ballet class is performing a spring recital for which they need butterfly costumes. Each butterfly costume is made from $3\frac{3}{5}$ yards of fabric. Use the Distributive Property to find the number of yards of fabric needed for 5 costumes. (*Hint: A mixed number can be written as the sum of an integer and a fraction.*)

- FENCES** Demonstrate the Distributive Property by writing two equivalent expressions to represent the perimeter of the fenced dog pen below.



- MENTAL MATH** During a math facts speed contest, Jamal calculated the following expression faster than anyone else in his class.

$$197 \times 4$$

When classmates asked him how he was able to answer so quickly, he told them he used the Distributive Property to think of the problem differently. Write and evaluate an expression using the Distributive Property that would help Jamal perform the calculation quickly.

- INVESTMENTS** Letisha and Noel each opened a checking account, a savings account, and a college fund. The chart below shows the amounts that they deposited into each account.

	Checking	Savings	College
Letisha	\$125	\$75	\$50
Noel	\$250	\$50	\$50

- If Noel used only \$50 bills when he deposited the money to open his accounts, how many \$50 bills did he deposit?

- If all accounts earn 1.5% interest per year and no further deposits are made, how much interest will Letisha have earned one year after her accounts were opened?

1-4 Enrichment

The Maya

The Maya were a Native American people who lived from about 1500 B.C. to about 1500 A.D. in the region that today encompasses much of Central America and southern Mexico. Their many accomplishments include exceptional architecture, pottery, painting, and sculpture, as well as significant advances in the fields of astronomy and mathematics.

The Maya developed a system of numeration that was based on the number twenty. The basic symbols of this system are shown in the table at the right. The places in a Mayan numeral are written vertically—the bottom place represents *ones*, the place above represents *twenties*, the place above that represents 20×20 , or *four hundreds*, and so on. For instance, this is how to write the number 997 in Mayan numerals.

0	⊙	10	=====
1	•	11	====•
2	••	12	====••
3	•••	13	====•••
4	••••	14	====••••
5	—	15	=====
6	—•	16	====•
7	—••	17	====••
8	—•••	18	====•••
9	—••••	19	====••••

$$\begin{array}{l} \bullet\bullet \leftarrow 2 \times \boxed{400} = 800 \\ \bullet\bullet\bullet\bullet \leftarrow 9 \times \boxed{20} = 180 \\ \text{=====} \leftarrow 17 \times \boxed{1} = \underline{17} \\ \hspace{10em} 997 \end{array}$$

Evaluate each expression when $v = \text{—}\bullet\text{—}$, $w = \text{====}$, $x = \bullet\bullet\bullet$, $y = \odot$, and $z = \bullet\bullet$. Then write the answer in Mayan numerals. Exercise 5 is done for you.

1. $\frac{z}{w}$

2. $\frac{v + w + z}{x}$

3. xv

4. vxy

5. $wx - z \odot$

6. $vz + xy$

7. $w(v + x + z)$

8. vwz

9. $z(wx - x)$

Tell whether each statement is *true* or *false*.

10. $\text{====} + \text{—}\bullet\text{—} = \text{—}\bullet\text{—} + \text{====}$

11. $\frac{\text{====}}{\text{—}\bullet\text{—}} = \frac{\bullet}{\text{====}}$

12. $\frac{\text{====}}{\text{====}} = \frac{\text{====}}{\text{====}}$

13. $(\bullet\bullet\bullet + \text{—}) + \text{====} = \bullet\bullet\bullet + (\text{—} + \text{====})$

14. How are Exercises 10 and 11 alike? How are they different?

1-5 Study Guide and Intervention

Equations

Solve Equations A mathematical sentence with one or more variables is called an **open sentence**. Open sentences are **solved** by finding replacements for the variables that result in true sentences. The set of numbers from which replacements for a variable may be chosen is called the **replacement set**. The set of all replacements for the variable that result in true statements is called the **solution set** for the variable. A sentence that contains an equal sign, =, is called an **equation**.

Example 1 Find the solution set of $3a + 12 = 39$ if the replacement set is $\{6, 7, 8, 9, 10\}$.

Replace a in $3a + 12 = 39$ with each value in the replacement set.

$$3(6) + 12 \stackrel{?}{=} 39 \rightarrow 30 \neq 39 \quad \text{false}$$

$$3(7) + 12 \stackrel{?}{=} 39 \rightarrow 33 \neq 39 \quad \text{false}$$

$$3(8) + 12 \stackrel{?}{=} 39 \rightarrow 36 \neq 39 \quad \text{false}$$

$$3(9) + 12 \stackrel{?}{=} 39 \rightarrow 39 = 39 \quad \text{true}$$

$$3(10) + 12 \stackrel{?}{=} 39 \rightarrow 42 \neq 39 \quad \text{false}$$

Since $a = 9$ makes the equation $3a + 12 = 39$ true, the solution is 9.

The solution set is $\{9\}$.

Example 2 Solve $\frac{2(3 + 1)}{3(7 - 4)} = b$.

$$\frac{2(3 + 1)}{3(7 - 4)} = b \quad \text{Original equation}$$

$$\frac{2(4)}{3(3)} = b \quad \text{Add in the numerator; subtract in the denominator.}$$

$$\frac{8}{9} = b \quad \text{Simplify.}$$

The solution is $\frac{8}{9}$.

Exercises

Find the solution of each equation if the replacement sets are $x = \left\{\frac{1}{4}, \frac{1}{2}, 1, 2, 3\right\}$ and $y = \{2, 4, 6, 8\}$.

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

2. $x + 8 = 11$

3. $y - 2 = 6$

4. $x^2 - 1 = 8$

5. $y^2 - 2 = 34$

6. $x^2 + 5 = 5\frac{1}{16}$

7. $2(x + 3) = 7$

8. $(y + 1)^2 = 9$

9. $y^2 + y = 20$

Solve each equation.

10. $a = 2^3 - 1$

11. $n = 6^2 - 4^2$

12. $w = 6^2 \cdot 3^2$

13. $\frac{1}{4} + \frac{5}{8} = k$

14. $\frac{18 - 3}{2 + 3} = p$

15. $t = \frac{15 - 6}{27 - 24}$

16. $18.4 - 3.2 = m$

17. $k = 9.8 + 5.7$

18. $c = 3\frac{1}{2} + 2\frac{1}{4}$

1-5 Study Guide and Intervention *(continued)***Equations**

Solve Equations with Two Variables Some equations contain two variables. It is often useful to make a table of values in which you can use substitution to find the corresponding values of the second variable.

Example

MUSIC DOWNLOADS Emily belongs to an Internet music service that charges \$5.99 per month and \$0.89 per song. Write and solve an equation to find the total amount Emily spends if she downloads 10 songs this month.

The cost of the music service is a flat rate. The variable is the number of songs she downloads. The total cost is the price of the service plus \$0.89 times the number of songs.

$$C = 0.89n + 5.99$$

To find the total cost for the month, substitute 10 for n in the equation.

$C = 0.89n + 5.99$	Original equation
$= 0.89(10) + 5.99$	Substitute 10 for n .
$= 8.90 + 5.99$	Multiply.
$= 14.89$	Add.

Emily spent \$14.89 on music downloads in one month.

Exercises

- 1. AUTO REPAIR** A mechanic repairs Mr. Estes' car. The amount for parts is \$48.00 and the rate for the mechanic is \$40.00 per hour. Write and solve an equation to find the total cost of repairs to Mr. Estes' car if the mechanic works for 1.5 hours.
- 2. SHIPPING FEES** Mr. Moore purchases an inflatable kayak weighing 30 pounds from an online company. The standard rate to ship his purchase is \$2.99 plus \$0.85 per pound. Write and solve an equation to find the total amount Mr. Moore will pay to have the kayak shipped to his home.
- 3. SOUND** The speed of sound is 1088 feet per second at sea level at 32° F. Write and solve an equation to find the distance sound travels in 8 seconds under these conditions.
- 4. VOLLEYBALL** Your town decides to build a volleyball court. If the court is approximately 40 by 70 feet and its surface is of sand, one foot deep, the court will require about 166 tons of sand. A local sand pit sells sand for \$11.00 per ton with a delivery charge of \$3.00 per ton. Write and solve an equation to find the total cost of the sand for this court.

1-5 Skills Practice**Equations**

Find the solution of each equation if the replacement sets are $A = \{4, 5, 6, 7, 8\}$ and $B = \{9, 10, 11, 12, 13\}$.

1. $5a - 9 = 26$

2. $4a - 8 = 16$

3. $7a + 21 = 56$

4. $3b + 15 = 48$

5. $4b - 12 = 28$

6. $\frac{36}{b} - 3 = 0$

Find the solution of each equation using the given replacement set.

7. $\frac{1}{2} + x = \frac{5}{4}; \left\{ \frac{1}{2}, \frac{3}{4}, 1, \frac{5}{4} \right\}$

8. $x + \frac{2}{3} = \frac{13}{9}; \left\{ \frac{5}{9}, \frac{2}{3}, \frac{7}{9} \right\}$

9. $\frac{1}{4}(x + 2) = \frac{5}{6}; \left\{ \frac{2}{3}, \frac{3}{4}, \frac{5}{4}, \frac{4}{3} \right\}$

10. $0.8(x + 5) = 5.2; \{1.2, 1.3, 1.4, 1.5\}$

Solve each equation.

11. $10.4 - 6.8 = x$

12. $y = 20.1 - 11.9$

13. $\frac{46 - 15}{3 + 28} = a$

14. $c = \frac{6 + 18}{31 - 25}$

15. $\frac{2(4) + 4}{3(3 - 1)} = b$

16. $\frac{6(7 - 2)}{3(8) + 6} = n$

17. SHOPPING ONLINE Jennifer is purchasing CDs and a new CD player from an online store. She pays \$10 for each CD, as well as \$50 for the CD player. Write and solve an equation to find the total amount Jennifer spent if she buys 4 CDs and a CD player from the store.

18. TRAVEL An airplane can travel at a speed of 550 miles per hour. Write and solve an equation to find the time it will take to fly from London to Montreal, a distance of approximately 3300 miles.

1-5 Practice**Equations**

Find the solution of each equation if the replacement sets are $a = \{0, \frac{1}{2}, 1, \frac{3}{2}, 2\}$ and $b = \{3, 3.5, 4, 4.5, 5\}$.

1. $a + \frac{1}{2} = 1$

2. $4b - 8 = 6$

3. $6a + 18 = 27$

4. $7b - 8 = 16.5$

5. $120 - 28a = 78$

6. $\frac{28}{b} + 9 = 16$

Solve each equation.

7. $x = 18.3 - 4.8$

8. $w = 20.2 - 8.95$

9. $\frac{37 - 9}{18 - 11} = d$

10. $\frac{97 - 25}{41 - 23} = k$

11. $y = \frac{4(22 - 4)}{3(6) + 6}$

12. $\frac{5(2^2) + 4(3)}{4(2^3 - 4)} = p$

13. TEACHING A teacher has 15 weeks in which to teach six chapters. Write and then solve an equation that represents the number of lessons the teacher must teach per week if there is an average of 8.5 lessons per chapter.

14. CELL PHONES Gabriel pays \$40 a month for basic cell phone service. In addition, Gabriel can send text messages for \$0.20 each. Write and solve an equation to find the total amount Gabriel spent this month if he sends 40 text messages.

1-5 Word Problem Practice

Equations

1. TIME There are 6 time zones in the United States. The eastern part of the U.S., including New York City, is in the Eastern Time Zone. The central part of the U.S., including Dallas, is in the Central Time Zone, which is one hour behind Eastern Time. San Diego is in the Pacific Time Zone, which is 3 hours behind Eastern Time. Write and solve an equation to determine what time it is in California if it is noon in New York.

2. FOOD Part of the Nutrition Facts label from a box of macaroni and cheese is shown below.

Nutrition Facts	
Serving Size 1 cup (228g)	
Servings Per Container 2	
Amount Per Serving	
Calories 250	Calories from Fat 110
	% Daily Value *
Total Fat 12g	18 %
Saturated Fat 3g	15 %
Trans Fat 3g	
Cholesterol 30mg	10 %

Write and solve an equation to determine how many servings of this item Alisa can eat each day if she wants to consume exactly 45 grams of cholesterol.

3. CRAFTS You need 30 yards of yarn to crochet a small scarf. Cheryl bought a 100-yard ball of yarn and has already used 10 yards. Write and solve an equation to find how many scarves she can crochet if she plans on using up the entire ball.

4. POOLS There are approximately 202 gallons per cubic yard of water. Write and solve an equation for the number of gallons of water that fill a pool with a volume of 1161 cubic feet. (*Hint:* There are 27 cubic feet per cubic yard.)

5. VEHICLES Recently developed hybrid cars contain both an electric and a gasoline engine. Hybrid car batteries store extra energy, such as the energy produced by braking. Since the car can use this stored energy to power the car, the hybrid uses less gasoline per mile than cars powered only by gasoline. Suppose a new hybrid car is rated to drive 45 miles per gallon of gasoline.

a. It costs \$40 to fill the gasoline tank with gas that costs \$3.00 per gallon. Write and solve an equation to find the distance the hybrid car can go using one tank of gas.

b. Write and solve an equation to find the cost of gasoline per mile for this hybrid car. Round to the nearest cent.

1-5 Enrichment**Solution Sets**

Consider the following open sentence.

It is the name of a month between March and July.

You know that a replacement for the variable *It* must be found in order to determine if the sentence is true or false. If *It* is replaced by either April, May, or June, the sentence is true. The set {April, May, June} is called the solution set of the open sentence given above. This set includes all replacements for the variable that make the sentence true.

Write the solution set for each open sentence.

1. It is the name of a state beginning with the letter A.
2. It is a primary color.
3. Its capital is Harrisburg.
4. It is a New England state.
5. $x + 4 = 10$
6. It is the name of a month that contains the letter *r*.
7. She was the wife of a U.S. President who served in the years 2000–2010.
8. It is an even number between 1 and 13.
9. $31 = 72 - k$
10. It is the square of 2, 3, or 4.

Write an open sentence for each solution set.

11. {A, E, I, O, U}
12. {1, 3, 5, 7, 9}
13. {June, July, August}
14. {Atlantic, Pacific, Indian, Arctic}

1-5 Spreadsheet Activity

Solving Open Sentences

A spreadsheet is a tool for working with and analyzing numerical data. The data is entered into a table in which each row is numbered and each column is labeled by a letter. You can use a spreadsheet to find solutions of open sentences.

Example Use a spreadsheet to find the solution for $4(x - 3) = 32$ if the replacement set is {7, 8, 9, 10, 11, 12}.

You can solve the open sentence by replacing x with each value in the replacement set.

Step 1 Use the first column of the spreadsheet for the replacement set. Enter the numbers using the formula bar. Click on a cell of the spreadsheet, type the number and press **ENTER**.

Step 2 The second column contains the formula for the left side of the open sentence. To enter a formula, enter an equals sign followed by the formula. Use the name of the cell containing each replacement value to evaluate the formula for that value. For example, in cell B2, the formula contains A2 in place of x .

The solution is the value of x for which the formula in column B returns 32. The solution is 11.

	A	B	C
1	x	$4(x - 3)$	
2	7	$=4*(A2-3)$	
3	8	$=4*(A3-3)$	
4	9	$=4*(A4-3)$	
5	10	$=4*(A5-3)$	
6	11	$=4*(A6-3)$	
7	12	$=4*(A7-3)$	

	A	B	C
1	x	$4(x - 3)$	
2	7	16	
3	8	20	
4	9	24	
5	10	28	
6	11	32	
7	12	36	

Exercises

Use a spreadsheet to find the solution of each equation using the given replacement set.

- $x + 7.5 = 18.3$; {8.8, 9.8, 10.8, 11.8}
- $6(x + 2) = 18$; {0, 1, 2, 3, 4, 5}
- $4x + 1 = 17$; {0, 1, 2, 3, 4, 5}
- $4.9 - x = 2.2$; {2.6, 2.7, 2.8, 2.9, 3.0}
- $2.6x = 16.9$; {6.1, 6.3, 6.5, 6.7, 6.9}
- $12x - 8 = 22$; {2.1, 2.2, 2.3, 2.4, 2.5, 2.6}

1-6 Study Guide and Intervention

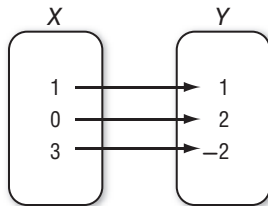
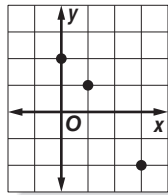
Relations

Represent a Relation A **relation** is a set of ordered pairs. A relation can be represented by a set of ordered pairs, a table, a graph, or a **mapping**. A mapping illustrates how each element of the domain is paired with an element in the range. The set of first numbers of the ordered pairs is the **domain**. The set of second numbers of the ordered pairs is the **range** of the relation.

Lesson 1-6

Example a. Express the relation $\{(1, 1), (0, 2), (3, -2)\}$ as a table, a graph, and a mapping.

x	y
1	1
0	2
3	-2



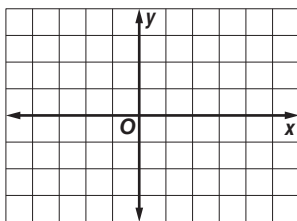
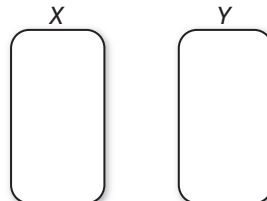
b. Determine the domain and the range of the relation.

The domain for this relation is $\{0, 1, 3\}$. The range for this relation is $\{-2, 1, 2\}$.

Exercises

1A. Express the relation $\{(-2, -1), (3, 3), (4, 3)\}$ as a table, a graph, and a mapping.

x	y



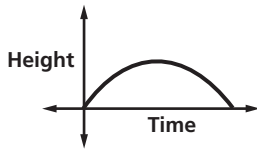
1B. Determine the domain and the range of the relation.

1-6 Study Guide and Intervention *(continued)*

Relations

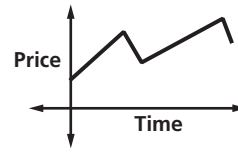
Graphs of a Relation The value of the variable in a relation that is subject to choice is called the **independent variable**. The variable with a value that is dependent on the value of the independent variable is called the **dependent variable**. These relations can be graphed without a scale on either axis, and interpreted by analyzing the shape.

Example 1 The graph below represents the height of a football after it is kicked downfield. Identify the independent and the dependent variable for the relation. Then describe what happens in the graph.



The independent variable is time, and the dependent variable is height. The football starts on the ground when it is kicked. It gains altitude until it reaches a maximum height, then it loses altitude until it falls to the ground.

Example 2 The graph below represents the price of stock over time. Identify the independent and dependent variable for the relation. Then describe what happens in the graph.

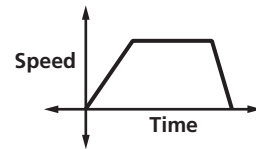


The independent variable is time and the dependent variable is price. The price increases steadily, then it falls, then increases, then falls again.

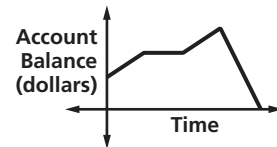
Exercises

Identify the independent and dependent variables for each relation. Then describe what is happening in each graph.

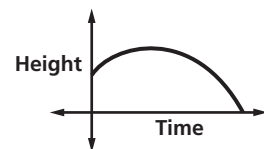
- The graph represents the speed of a car as it travels to the grocery store.



- The graph represents the balance of a savings account over time.



- The graph represents the height of a baseball after it is hit.



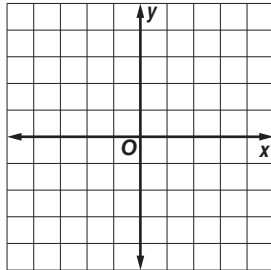
1-6 Skills Practice

Relations

Express each relation as a table, a graph, and a mapping. Then determine the domain and range.

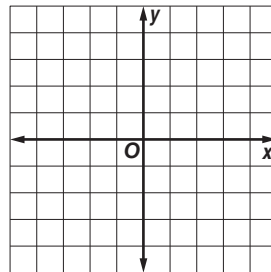
1. $\{(-1, -1), (1, 1), (2, 1), (3, 2)\}$

x	y



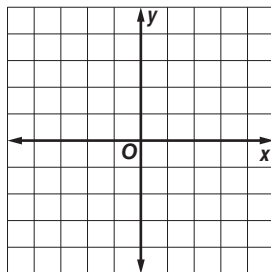
2. $\{(0, 4), (-4, -4), (-2, 3), (4, 0)\}$

x	y



3. $\{(3, -2), (1, 0), (-2, 4), (3, 1)\}$

x	y



Identify the independent and dependent variables for each relation.

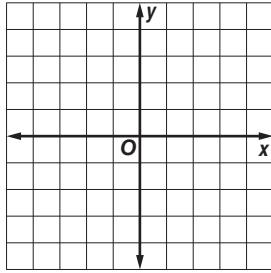
4. The more hours Maribel works at her job, the larger her paycheck becomes.

5. Increasing the price of an item decreases the amount of people willing to buy it.

1-6 Practice

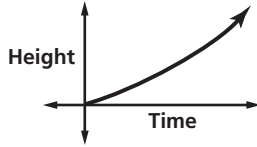
Relations

1. Express $\{(4, 3), (-1, 4), (3, -2), (-2, 1)\}$ as a table, a graph, and a mapping. Then determine the domain and range.

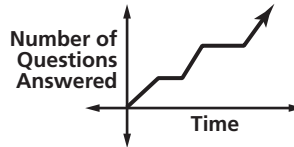


Describe what is happening in each graph.

2. The graph below represents the height of a tsunami as it travels across an ocean.



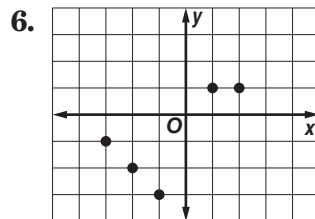
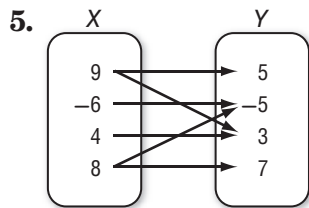
3. The graph below represents a student taking an exam.



Express the relation shown in each table, mapping, or graph as a set of ordered pairs.

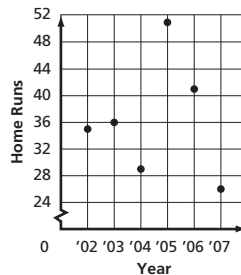
4.

X	Y
0	9
-8	3
2	-6
1	4



7. **BASEBALL** The graph shows the number of home runs hit by Andruw Jones of the Atlanta Braves. Express the relation as a set of ordered pairs. Then describe the domain and range.

Andruw Jones' Home Runs



1-6 Word Problem Practice

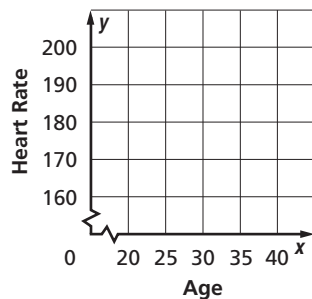
Relations

1. HEALTH The American Heart Association recommends that your target heart rate during exercise should be between 50% and 75% of your maximum heart rate. Use the data in the table below to graph the approximate maximum heart rates for people of given ages.

Age (years)	20	25	30	35	40
Maximum Heart Rate (beats per minute)	200	195	190	185	180

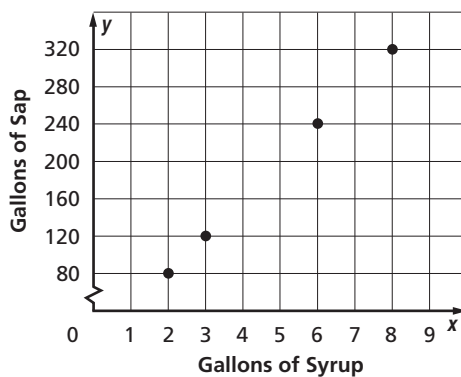
Source: American Heart Association

Maximum Heart Rate



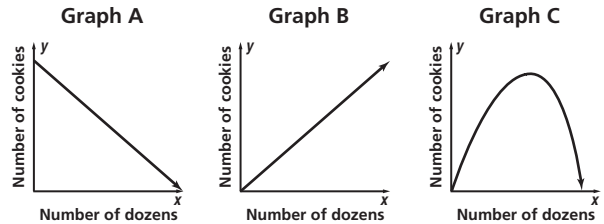
2. NATURE Maple syrup is made by collecting sap from sugar maple trees and boiling it down to remove excess water. The graph shows the number of gallons of tree sap required to make different quantities of maple syrup. Express the relation as a set of ordered pairs.

Maple Sap to Syrup

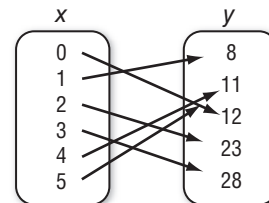


Source: Vermont Maple Sugar Makers' Association

3. BAKING Identify the graph that best represents the relationship between the number of cookies and the equivalent number of dozens.



4. DATA COLLECTION Margaret collected data to determine the number of books her schoolmates were bringing home each evening. She recorded her data as a set of ordered pairs. She let x be the number of textbooks brought home after school, and y be the number of students with x textbooks. The relation is shown in the mapping.



a. Express the relation as a set of ordered pairs.

b. What is the domain of the relation?

c. What is the range of the relation?

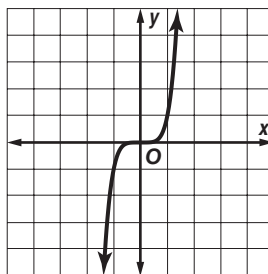
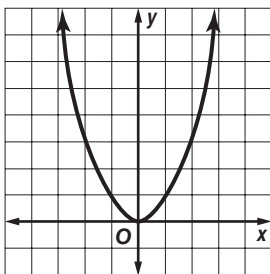
1-6 Enrichment

Even and Odd Functions

We know that numbers can be either even or odd. It is also true that functions can be defined as even or odd. For a function to be even means that it is symmetric about the y -axis. That is, if you fold the graph along the y -axis, the two halves of the graph match exactly. For a function to be odd means that the function is symmetric about the origin. This means if you rotate the graph using the origin as the center, it will match its original position before completing a full turn.

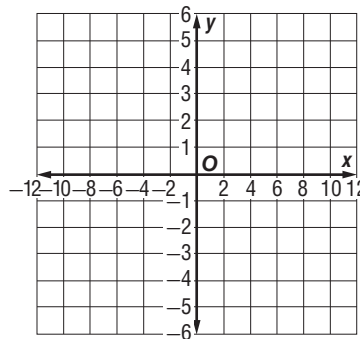
The function $y = x^2$ is an even function.

The function $y = x^5$ is an odd function. If you rotate the graph 180° the graph will lie on itself.



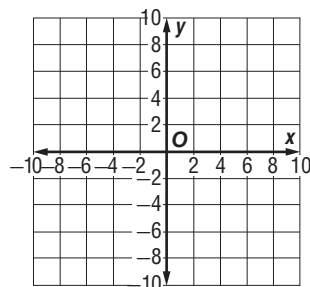
1. The table below shows the ordered pairs of an even function. Complete the table. Plot the points and sketch the graph.

x	-12	-5	-1	1	5	12
y	6	3	1			



2. The table below shows the ordered pairs of an odd function. Complete the table. Plot the points and sketch the graph.

x	-10	-4	-2	2	4	10
y	8	4	2			



1-7 Study Guide and Intervention

Functions

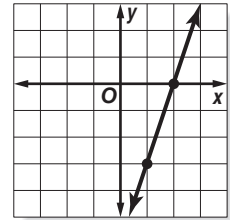
Identify Functions Relations in which each element of the domain is paired with exactly one element of the range are called **functions**.

Example 1 Determine whether the relation $\{(6, -3), (4, 1), (7, -2), (-3, 1)\}$ is a function. Explain.

Since each element of the domain is paired with exactly one element of the range, this relation is a function.

Example 2 Determine whether $3x - y = 6$ is a function.

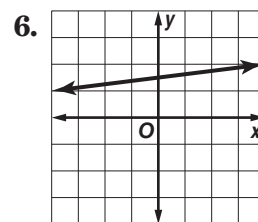
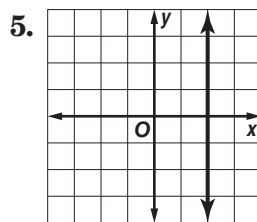
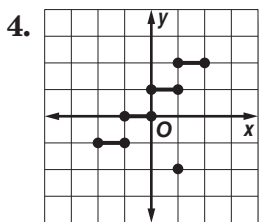
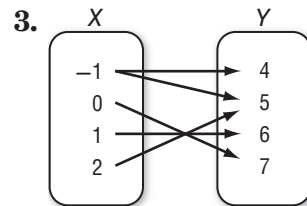
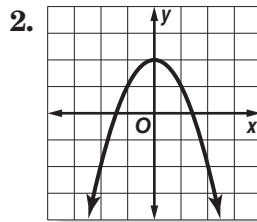
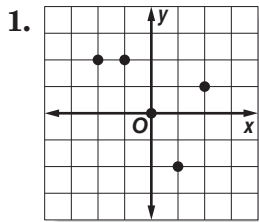
Since the equation is in the form $Ax + By = C$, the graph of the equation will be a line, as shown at the right.



If you draw a vertical line through each value of x , the vertical line passes through just one point of the graph. Thus, the line represents a function.

Exercises

Determine whether each relation is a function.



7. $\{(4, 2), (2, 3), (6, 1)\}$

8. $\{(-3, -3), (-3, 4), (-2, 4)\}$

9. $\{(-1, 0), (1, 0)\}$

10. $-2x + 4y = 0$

11. $x^2 + y^2 = 8$

12. $x = -4$

1-7 Study Guide and Intervention *(continued)***Functions**

Find Function Values Equations that are functions can be written in a form called **function notation**. For example, $y = 2x - 1$ can be written as $f(x) = 2x - 1$. In the function, x represents the elements of the domain, and $f(x)$ represents the elements of the range. Suppose you want to find the value in the range that corresponds to the element 2 in the domain. This is written $f(2)$ and is read “ f of 2.” The value of $f(2)$ is found by substituting 2 for x in the equation.

Example If $f(x) = 3x - 4$, find each value.

a. $f(3)$

$$\begin{aligned} f(3) &= 3(3) - 4 && \text{Replace } x \text{ with } 3. \\ &= 9 - 4 && \text{Multiply.} \\ &= 5 && \text{Simplify.} \end{aligned}$$

b. $f(-2)$

$$\begin{aligned} f(-2) &= 3(-2) - 4 && \text{Replace } x \text{ with } -2. \\ &= -6 - 4 && \text{Multiply.} \\ &= -10 && \text{Simplify.} \end{aligned}$$

Exercises

If $f(x) = 2x - 4$ and $g(x) = x^2 - 4x$, find each value.

1. $f(4)$

2. $g(2)$

3. $f(-5)$

4. $g(-3)$

5. $f(0)$

6. $g(0)$

7. $f(3) - 1$

8. $f\left(\frac{1}{4}\right)$

9. $g\left(\frac{1}{4}\right)$

10. $f(a^2)$

11. $f(k + 1)$

12. $g(2n)$

13. $f(3x)$

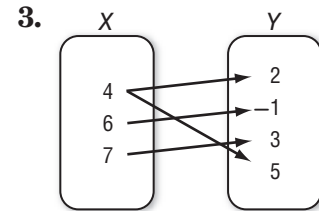
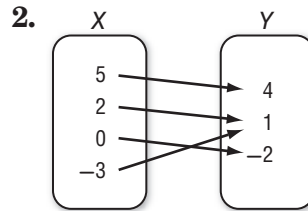
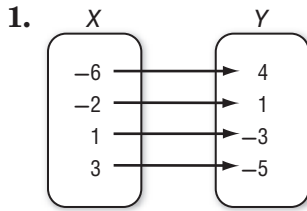
14. $f(2) + 3$

15. $g(-4)$

1-7 Skills Practice

Functions

Determine whether each relation is a function.



4.

x	y
4	-5
-1	-10
0	-9
1	-7
9	1

5.

x	y
2	7
5	-3
3	5
-4	-2
5	2

6.

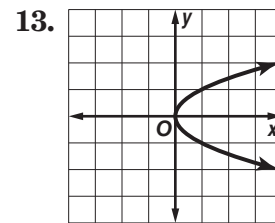
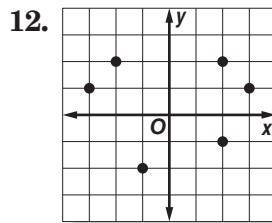
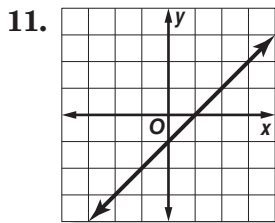
x	y
3	7
-1	1
1	0
3	5
7	3

7. $\{(2, 5), (4, -2), (3, 3), (5, 4), (-2, 5)\}$

8. $\{(6, -1), (-4, 2), (5, 2), (4, 6), (6, 5)\}$

9. $y = 2x - 5$

10. $y = 11$



If $f(x) = 3x + 2$ and $g(x) = x^2 - x$, find each value.

14. $f(4)$

15. $f(8)$

16. $f(-2)$

17. $g(2)$

18. $g(-3)$

19. $g(-6)$

20. $f(2) + 1$

21. $f(1) - 1$

22. $g(2) - 2$

23. $g(-1) + 4$

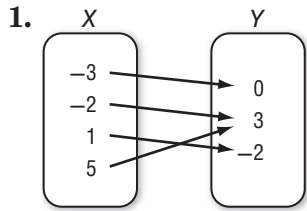
24. $f(x + 1)$

25. $g(3b)$

1-7 Practice

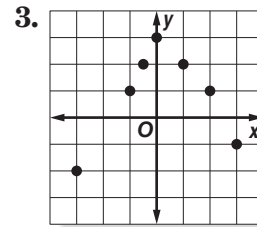
Functions

Determine whether each relation is a function.



2.

X	Y
1	-5
-4	3
7	6
1	-2



4. $\{(1, 4), (2, -2), (3, -6), (-6, 3), (-3, 6)\}$ 5. $\{(6, -4), (2, -4), (-4, 2), (4, 6), (2, 6)\}$

6. $x = -2$ 7. $y = 2$

If $f(x) = 2x - 6$ and $g(x) = x - 2x^2$, find each value.

8. $f(2)$ 9. $f\left(-\frac{1}{2}\right)$ 10. $g(-1)$
 11. $g\left(-\frac{1}{3}\right)$ 12. $f(7) - 9$ 13. $g(-3) + 13$
 14. $f(h + 9)$ 15. $g(3y)$ 16. $2[g(b) + 1]$

17. **WAGES** Martin earns \$7.50 per hour proofreading ads at a local newspaper. His weekly wage w can be described by the equation $w = 7.5h$, where h is the number of hours worked.

- a. Write the equation in function notation.
 b. Find $f(15)$, $f(20)$, and $f(25)$.

18. **ELECTRICITY** The table shows the relationship between resistance R and current I in a circuit.

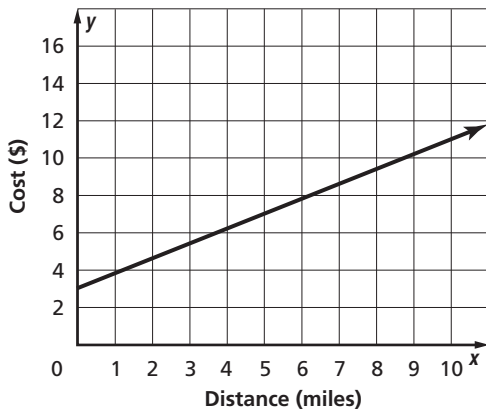
Resistance (ohms)	120	80	48	6	4
Current (amperes)	0.1	0.15	0.25	2	3

- a. Is the relationship a function? Explain.
 b. If the relation can be represented by the equation $IR = 12$, rewrite the equation in function notation so that the resistance R is a function of the current I .
 c. What is the resistance in a circuit when the current is 0.5 ampere?

1-7 Word Problem Practice

Functions

- 1. TRANSPORTATION** The cost of riding in a cab is \$3.00 plus \$0.75 per mile. The equation that represents this relation is $y = 0.75x + 3$, where x is the number of miles traveled and y is the cost of the trip. Look at the graph of the equation and determine whether the relation is a function.



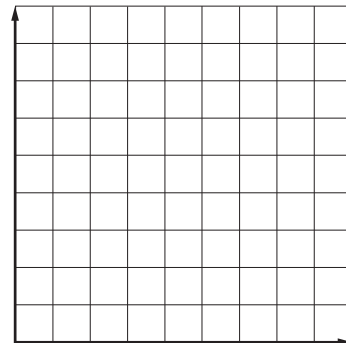
- 2. TEXT MESSAGING** Many cell phones have a text messaging option in addition to regular cell phone service. The function for the monthly cost of text messaging service from Noline Wireless Company is $f(x) = 0.10x + 2$, where x is the number of text messages that are sent. Find $f(10)$ and $f(30)$, the cost of 10 text messages in a month and the cost of 30 text messages in a month.

- 3. GEOMETRY** The area of any square is given by the function $y = x^2$, where x is the length of a side of the square and y is the area of the square. Write the equation in function notation and find the area of a square with a side length of 3.5 inches.

- 4. TRAVEL** The cost for cars entering President George Bush Turnpike at Beltline road is given by the relation $x = 0.75y$, where x is the dollar amount for entrance to the toll road and y is the number of passengers. Determine if this relation is a function. Explain.

- 5. CONSUMER CHOICES** Aisha just received a \$40 paycheck from her new job. She spends some of it buying music online and saves the rest in a bank account. Her savings is given by $f(x) = 40 - 1.25x$, where x is the number of songs she downloads at \$1.25 per song.

- a. Graph the function.



- b. Find $f(3)$, $f(18)$, and $f(36)$. What do these values represent?

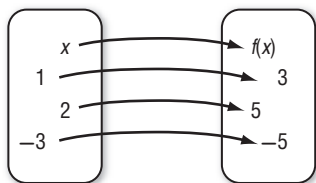
- c. How many songs can Aisha buy if she wants to save \$30?

1-7 Enrichment

Composite Functions

Three things are needed to have a function—a set called the domain, a set called the range, and a rule that matches each element in the domain with only one element in the range. Here is an example.

Rule: $f(x) = 2x + 1$



$$f(x) = 2x + 1$$

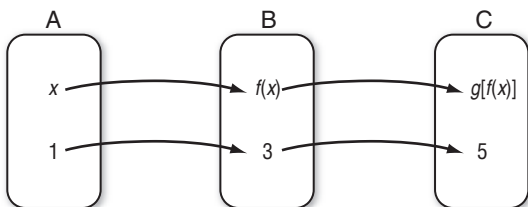
$$f(1) = 2(1) + 1 = 2 + 1 = 3$$

$$f(2) = 2(2) + 1 = 4 + 1 = 5$$

$$f(-3) = 2(-3) + 1 = -6 + 1 = -5$$

Suppose we have three sets A, B, and C and two functions described as shown below.

Rule: $f(x) = 2x + 1$ Rule: $g(y) = 3y - 4$



$$g(y) = 3y - 4$$

$$g(3) = 3(3) - 4 = 5$$

Let's find a rule that will match elements of set A with elements of set C without finding any elements in set B. In other words, let's find a rule for the **composite function $g[f(x)]$** .

Since $f(x) = 2x + 1$, $g[f(x)] = g(2x + 1)$.

Since $g(y) = 3y - 4$, $g(2x + 1) = 3(2x + 1) - 4$, or $6x - 1$.

Therefore, $g[f(x)] = 6x - 1$.

Find a rule for the composite function $g[f(x)]$.

1. $f(x) = 3x$ and $g(y) = 2y + 1$

2. $f(x) = x^2 + 1$ and $g(y) = 4y$

3. $f(x) = -2x$ and $g(y) = y^2 - 3y$

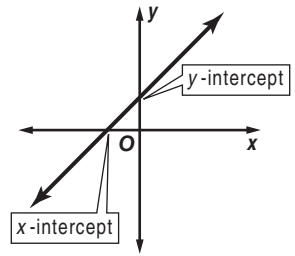
4. $f(x) = \frac{1}{x-3}$ and $g(y) = y^{-1}$

5. Is it always the case that $g[f(x)] = f[g(x)]$? Justify your answer.

1-8 Study Guide and Intervention

Interpreting Graphs of Functions

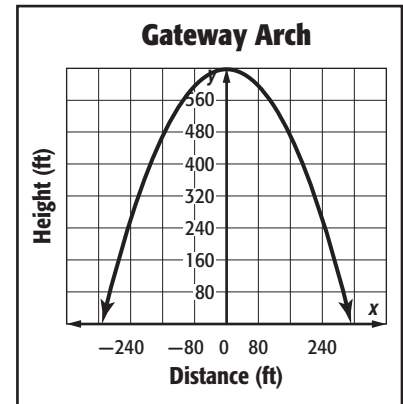
Interpret Intercepts and Symmetry The **intercepts** of a graph are points where the graph intersects an axis. The y -coordinate of the point at which the graph intersects the y -axis is called a **y -intercept**. Similarly, the x -coordinate of the point at which a graph intersects the x -axis is called an **x -intercept**.



A graph possesses **line symmetry** in a line if each half of the graph on either side of the line matches exactly.

Example

ARCHITECTURE The graph shows a function that approximates the shape of the Gateway Arch, where x is the distance from the center point in feet and y is the height in feet. Identify the function as *linear* or *nonlinear*. Then estimate and interpret the intercepts, and describe and interpret any symmetry.



Linear or Nonlinear: Since the graph is a curve and not a line, the graph is nonlinear.

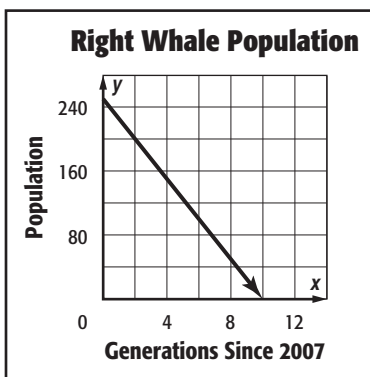
y -Intercept: The graph intersects the y -axis at about $(0, 630)$, so the y -intercept of the graph is about 630. This means that the height of the arch is 630 feet at the center point.

x -Intercept(s): The graph intersects the x -axis at about $(-320, 0)$ and $(320, 0)$. So the x -intercepts are about -320 and 320 . This means that the object touches the ground to the left and right of the center point.

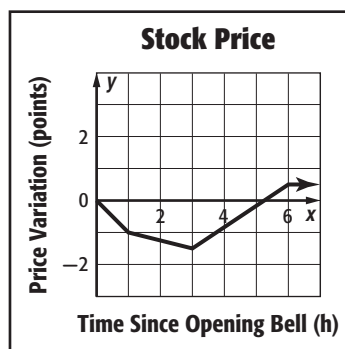
Symmetry: The right half of the graph is the mirror image of the left half in the y -axis. In the context of the situation, the symmetry of the graph tells you that the arch is symmetric. The height of the arch at any distance to the right of the center is the same as its height that same distance to the left.

Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph and any symmetry.

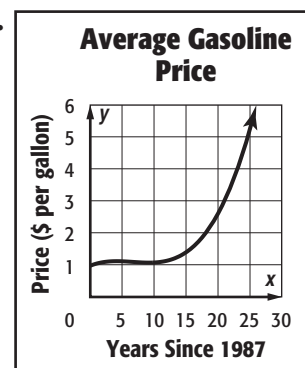
1.



2.



3.



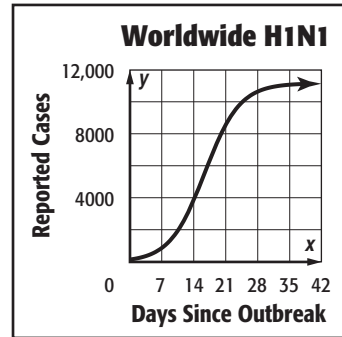
1-8 Study Guide and Intervention *(continued)*

Interpreting Graphs of Functions

Interpret Extrema and End Behavior Interpreting a graph also involves estimating and interpreting where the function is increasing, decreasing, positive, or negative, and where the function has any extreme values, either high or low.

Example

HEALTH The outbreak of the H1N1 virus can be modeled by the function graphed at the right. Estimate and interpret where the function is positive, negative, increasing, and decreasing, the x -coordinates of any relative extrema, and the end behavior of the graph.



Positive: for x between 0 and 42

Negative: no parts of domain

This means that the number of reported cases was always positive. This is reasonable because a negative number of cases cannot exist in the context of the situation.

Increasing: for x between 0 and 42

Decreasing: no parts of domain

The number of reported cases increased each day from the first day of the outbreak.

Relative Maximum: at about $x = 42$

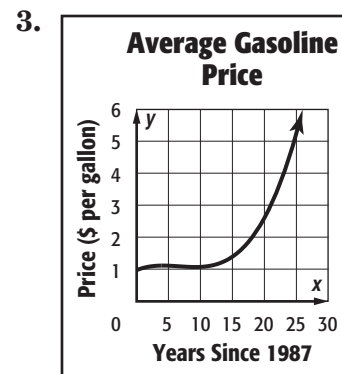
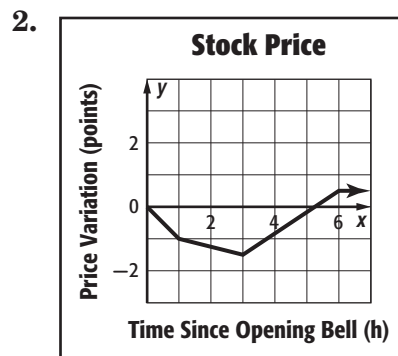
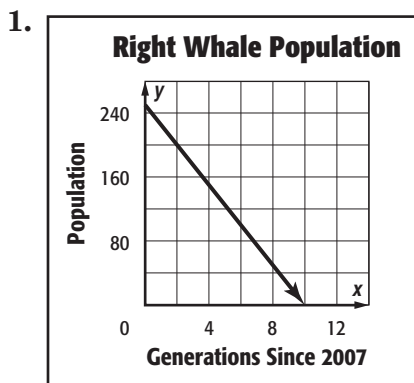
Relative Minimum: at $x = 0$

The extrema of the graph indicate that the number of reported cases peaked at about day 42.

End Behavior: As x increases, y appears to approach 11,000. As x decreases, y decreases.

The end behavior of the graph indicates a maximum number of reported cases of 11,000.

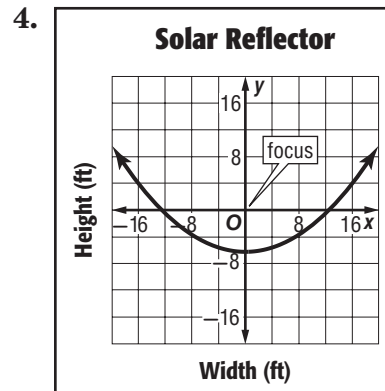
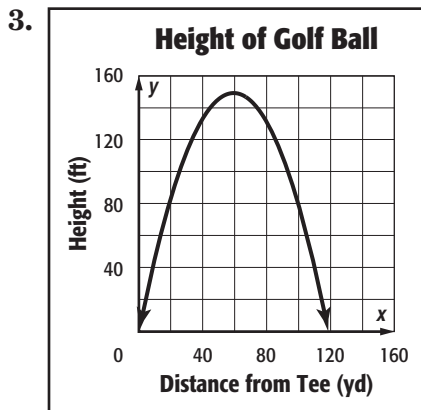
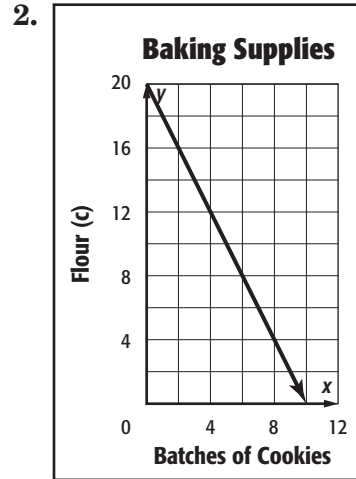
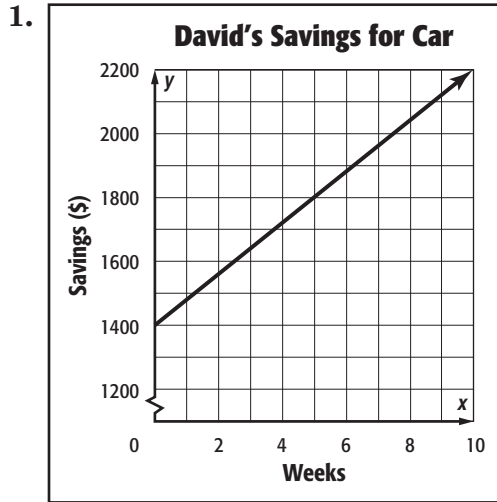
Estimate and interpret where the function is positive, negative, increasing, and decreasing, the x -coordinate of any relative extrema, and the end behavior of the graph.



1-8 Skills Practice

Interpreting Graphs of Functions

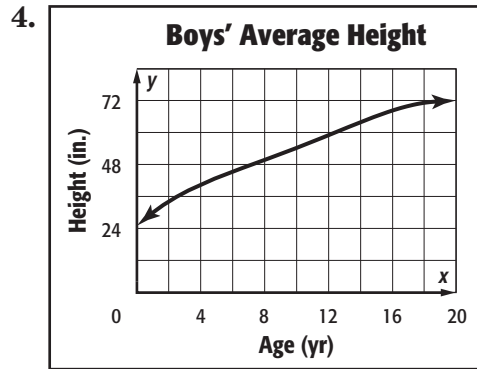
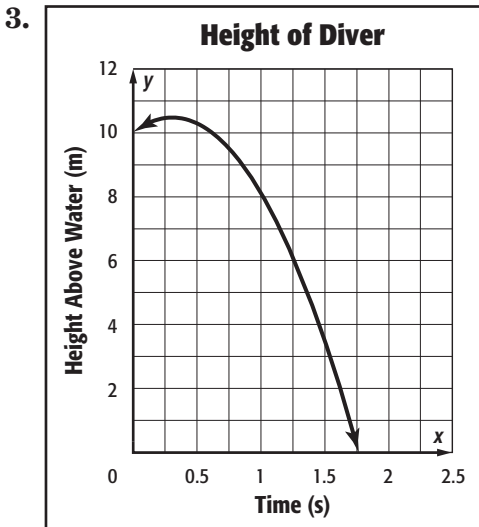
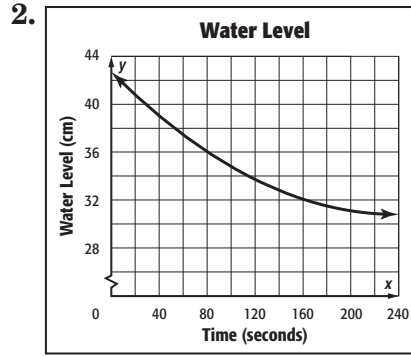
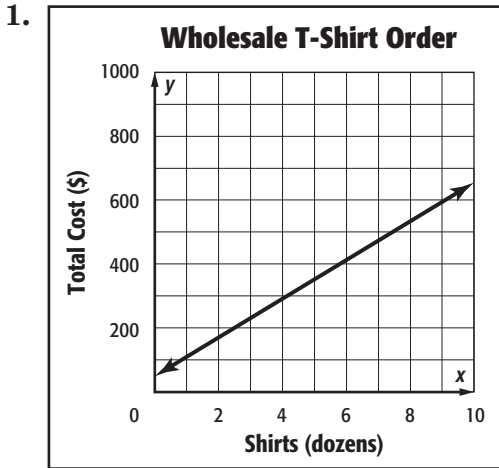
Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph, any symmetry, where the function is positive, negative, increasing, and decreasing, the x -coordinate of any relative extrema, and the end behavior of the graph.



1-8 Practice

Interpreting Graphs of Functions

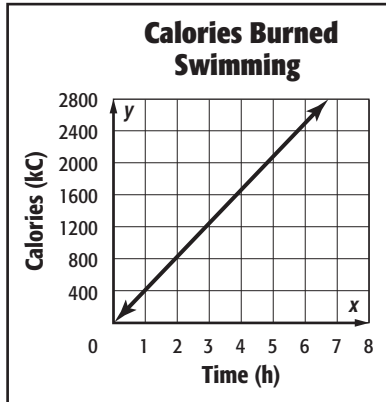
Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph, any symmetry, where the function is positive, negative, increasing, and decreasing, the x -coordinate of any relative extrema, and the end behavior of the graph.



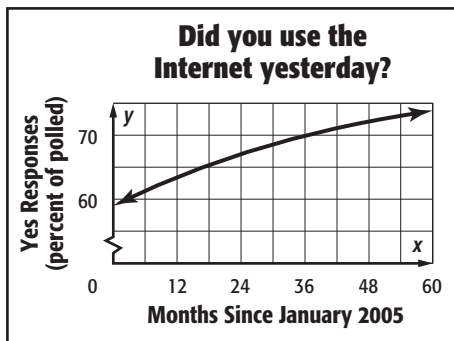
1-8 Word Problem Practice

Interpreting Graphs of Functions

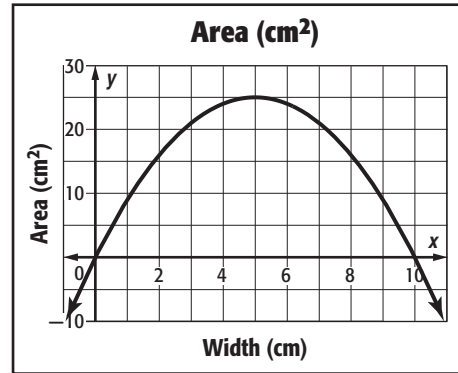
1. **HEALTH** The graph shows the Calories y burned by a 130-pound person swimming freestyle laps as a function of time x . Identify the function as *linear* or *nonlinear*. Then estimate and interpret the intercepts.



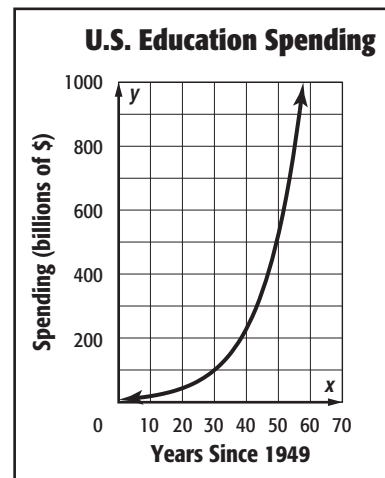
2. **TECHNOLOGY** The graph below shows the results of a poll that asks Americans whether they used the Internet yesterday. Estimate and interpret where the function is positive, negative, increasing, and decreasing, the x -coordinates of any relative extrema, and the end behavior of the graph.



3. **GEOMETRY** The graph shows the area y in square centimeters of a rectangle with perimeter 20 centimeters and width x centimeters. Describe and interpret any symmetry in the graph.



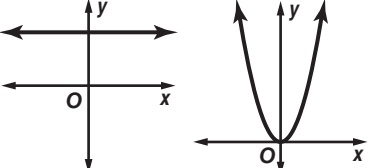
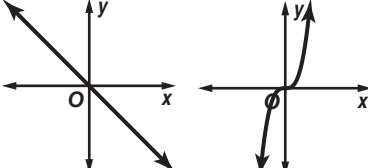
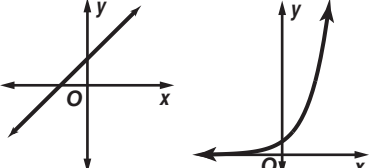
4. **EDUCATION** Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph, any symmetry, where the function is positive, negative, increasing, and decreasing, the x -coordinate of any relative extrema, and the end behavior of the graph.



1-8 Enrichment

Symmetry in Graphs of Functions

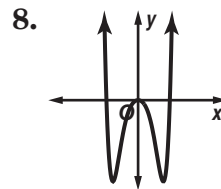
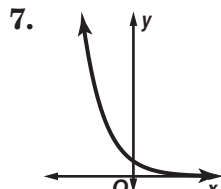
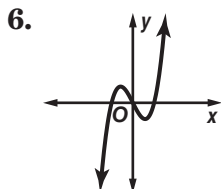
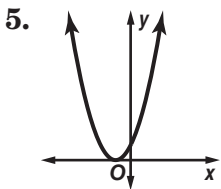
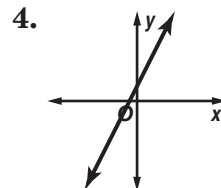
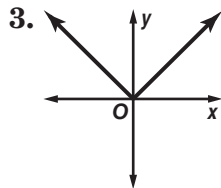
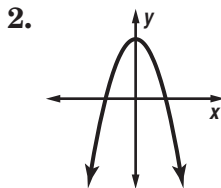
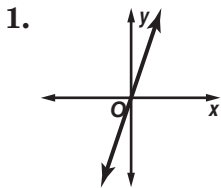
You have seen that the graphs of some functions have line symmetry. Functions that have line symmetry in the y -axis are called **even functions**. The graph of a function can also have point symmetry. Recall that a figure has point symmetry if it can be rotated less than 360° about the point so that the image matches the original figure. Functions that are symmetric about the origin are called **odd functions**.

Even Functions	Odd Functions	Neither Even nor Odd
		

The graph of a function cannot be symmetric about the x -axis because the graph would fail the Vertical Line Test.

Exercises

Identify the function graphed as *even*, *odd*, or *neither*.



1 Student Recording Sheet

Use this recording sheet with pages 70–71 of the Student Edition.

Multiple Choice

Read each question. Then fill in the correct answer.

1. Ⓐ Ⓑ Ⓒ Ⓓ

4. Ⓕ Ⓖ Ⓗ Ⓙ

6. Ⓕ Ⓖ Ⓗ Ⓙ

2. Ⓕ Ⓖ Ⓗ Ⓙ

5. Ⓐ Ⓑ Ⓒ Ⓓ

7. Ⓐ Ⓑ Ⓒ Ⓓ

3. Ⓐ Ⓑ Ⓒ Ⓓ

Short Response/Gridded Response

Record your answer in the blank.

For gridded response questions, also enter your answer in the grid by writing each number or symbol in a box. Then fill in the corresponding circle for that number or symbol.

8a. _____

8b. _____

8c. _____

9a. _____

9b. _____

10. _____ (grid in)

11a. _____

11b. _____

11c. _____

10.

	⊗	⊗	⊗	
⊙	⊙	⊙	⊙	⊙
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Extended Response

Record your answers for Question 12 on the back of this paper.

1 Rubric for Scoring Extended Response

General Scoring Guidelines

- If a student gives only a correct numerical answer to a problem but does not show how he or she arrived at the answer, the student will be awarded only 1 credit. All extended response questions require the student to show work.
- A fully correct answer for a multiple-part question requires correct responses for all parts of the question. For example, if a question has three parts, the correct response to one or two parts of the question that required work to be shown is not considered a fully correct response.
- Students who use trial and error to solve a problem must show their method. Merely showing that the answer checks or is correct is not considered a complete response for full credit.

Exercise 12 Rubric

Score	Specific Criteria
4	In part a , the student correctly writes the expression for the volume of a sphere as $\frac{4}{3}\pi r^3$. In part b , the student substitutes 6 for the variable r . The student then takes 6 to the third power. The result is multiplied by 4 and then divided by three to give $288\pi \text{ cm}^3$. Pi is irrational so it appears in the answer.
3	A generally correct solution, but may contain minor flaws in reasoning or computation.
2	A partially correct interpretation and/or solution to the problem.
1	A correct solution with no evidence or explanation.
0	An incorrect solution indicating no mathematical understanding of the concept or task, or no solution is given.

1 Chapter 1 Quiz 1

SCORE _____

*(Lessons 1-1 and 1-2)*1. Write a verbal expression for the algebraic expression $2 + 5p$. 1. _____2. Write an algebraic expression for the verbal expression
8 to the fourth power increased by 6. 2. _____**Evaluate each expression.**3. $62 - 3^2 \cdot 8 + 11$ 3. _____4. $4^3 \div 8$ 4. _____5. **MULTIPLE CHOICE** Evaluate $a(4b + c^2)$ if $a = 2$, $b = 5$,
and $c = 1$.

A 41 B 42 C 44 D 45 5. _____

1 Chapter 1 Quiz 2

SCORE _____

*(Lessons 1-3 and 1-4)*1. Name the property that is used in $5 \cdot n \cdot 2 = 0$.
Then find the value of n . 1. _____2. The equation $\frac{2}{3}[3 \div (10 - 8)] = \frac{2}{3}(3 \div 2)$ is an example of
which property of equality? 2. _____3. Evaluate $7 \cdot 2 \cdot 7 \cdot 5$ using properties of numbers.
Name the property used in each step. 3. _____4. Use the Distributive Property to rewrite $7 \cdot 98$. Then evaluate. 4. _____5. **MULTIPLE CHOICE** Simplify $16a^2 - 7b^2 + 3b - 2a^2$.A $14 - 4b$ B $14a^2 - 7b^2 + 3b$ C $10b$ D simplified 5. _____

1 Chapter 1 Quiz 3

SCORE _____

(Lessons 1-5 and 1-6)

1. Find the solution of $\frac{1}{2}(x - 3) = 4$ if the replacement set is {8, 9, 10, 11, 12}.

1. _____

2. **MULTIPLE CHOICE** Solve $r = \frac{7(16 - 5)}{3 + 4(2)}$.

A $5\frac{1}{2}$

B 7

C 11

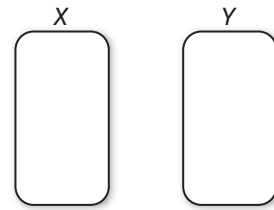
D 77

2. _____

3. Candice is typing an average of 40 words per minute. Write and solve an equation to find the time it will take her to type 1000 words.

3. _____

4. Express the relation {(3, 5), (-4, 6), (3, 8), (2, 4), (1, 3)} as a mapping. Then determine the domain and range.



4. _____

1 Chapter 1 Quiz 4

SCORE _____

(Lessons 1-7 and 1-8)

1. Determine whether the relation is a function.

x	y
0	1
-2	-1
-4	1

1. _____

2. If $g(x) = x^2 - 3x + 2$, find $g(-4)$.

2. _____

3. **MULTIPLE CHOICE** Which represents *For every hour that Samuel works, he earns \$8.50?*

A $f(h) = 8.5h$

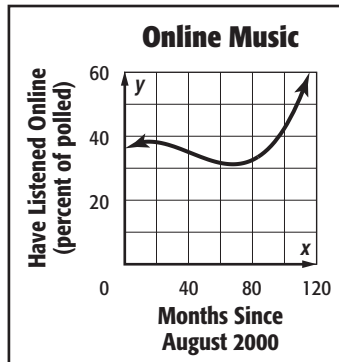
C $f(h) = 8.5 - h$

B $f(h) = 8.5 + h$

D $f(h) = h \div 8.5$

3. _____

4. Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph.



4. _____

1 Chapter 1 Mid-Chapter Test

SCORE _____

*(Lessons 1-1 through 1-4)***Part I** Write the letter for the correct answer in the blank at the right of each question.

1. Write an algebraic expression for *12 less than a number times 7*.
 A $12 < 7n$ B $12 > 7n$ C $12 - 7n$ D $7n - 12$ 1. _____

2. Evaluate $20 + 3(8 - 5)$.
 F 29 G 39 H 180 J 26 2. _____

Evaluate each expression if $a = 4$, $b = 6$, and $c = 2$.

3. $ab - c$
 A 12 B 16 C 22 D 8 3. _____

4. $3a + b^2c$
 F 36 G 84 H 96 J 240 4. _____

5. Simplify $4(w - 9)$.
 A $4w - 9$ B $4w - 13$ C $w - 5$ D $4w - 36$ 5. _____

6. Simplify $3r + 2(t + 5r)$.
 F $15r + 2t$ G $8r + 2t$ H $15r$ J $13r + 2t$ 6. _____

7. Name the property used in $(5 + 2) + n = 7 + n$.
 A Additive Identity C Reflexive Property
 B Multiplicative Identity D Substitution Property 7. _____

Part II

Evaluate each expression using properties of numbers. Name the property used in each step.

8. $6.4 + 2.7 + 1.6 + 5.3$ 9. $\frac{4}{3} \cdot 7 \cdot 3 \cdot 10$ 8. _____

For Questions 10 and 11, write a verbal expression for each algebraic expression.

10. $18p$ 11. $x^2 - 5$ 9. _____

12. Name two properties used to evaluate $7 \cdot 1 - 4 \cdot \frac{1}{4}$. 10. _____

13. Rewrite $6(10 + 2)$ using the Distributive Property. 11. _____
 Then simplify. 12. _____

14. Simplify $6b + 7b + 2b^2$. 13. _____

15. Felicity put down \$800 on a used car. She took out 14. _____
 a loan to pay off the balance of the cost of the car.

Her monthly payment will be \$175. After 9 months 15. _____
 how much will she have paid for the car?

1 Chapter 1 Vocabulary Test

algebraic expression
coefficient
continuous function
coordinate system
dependent variable
discrete function
domain

end behavior
exponent
factors
function
identity
independent variable
intercept

like terms
multiplicative inverses
open sentences
order of operations
power
range
replacement set

reciprocal
solution set
symmetry
variable

Choose a term from the vocabulary list above to complete the sentence.

1. In the algebraic expression $8q$, the letter q is called a(n) _____ 1. _____
2. An expression like c^3 is an example of a(n) _____ and is read “ c cubed.” 2. _____
3. A function graphed with a line or smooth curve is called a(n) _____. 3. _____
4. The process of finding a value for a variable that results in a true sentence is called solving the _____. 4. _____
5. _____ are terms that contain the same variables, with corresponding variables having the same power. 5. _____
6. The _____ of a term is the numerical factor. 6. _____
7. The set of the first number of the ordered pairs of a function is the _____. 7. _____
8. In a(n) _____, there is exactly one output for each input. 8. _____
9. The set of second numbers of the ordered pairs in a relation is the _____ of the relation. 9. _____

Define each term in your own words.

10. end behavior 10. _____
11. solution set 11. _____

1 Chapter 1 Test, Form 1

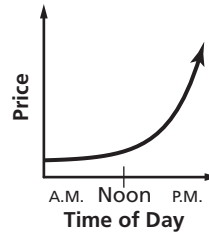
SCORE _____

Write the letter for the correct answer in the blank at the right of each question.

1. Write an algebraic expression for *the sum of a number and 8*.
 A $8x$ B $x - 8$ C $x + 8$ D $x \div 8$ 1. _____
2. Write an algebraic expression for *27 decreased by a number*.
 F $27 + m$ G $27 - m$ H $m - 27$ J $\frac{27}{m}$ 2. _____
3. Write a verbal expression for $19a$.
 A the sum of 19 and a number C the quotient of 19 and a number
 B the difference of 19 and a number D the product of 19 and a number 3. _____
4. Write a verbal expression for $x + y$.
 F the sum of x and y H the difference of x and y
 G the quotient of x and y J the product of x and y 4. _____
5. Evaluate $6(8 - 3)$.
 A 45 B 30 C 11 D 66 5. _____
6. Evaluate $2k + m$ if $k = 11$ and $m = 5$.
 F 32 G 216 H 27 J 18 6. _____
7. Name the property used in $n + 0 = 7$.
 A Multiplicative Inverse Property C Additive Identity Property
 B Substitution Property D Multiplicative Identity Property 7. _____
8. Evaluate $13 + 6 + 7 + 4$.
 F 2184 G 29 H 20 J 30 8. _____
9. Simplify $7b + 2b + 3c$.
 A $12bc$ B $9b + 3c$ C $7b + 5c$ D $5b + 3c$ 9. _____
10. Simplify $5(2g + 3)$.
 F $10g + 3$ G $7g + 3$ H $10g + 15$ J $7g + 8$ 10. _____
11. Evaluate $4 \cdot 1 + 6 \cdot 16 + 0$.
 A 100 B 0 C 8 D 185 11. _____
12. Which of the following uses the Distributive Property to determine the product $12(185)$?
 F $12(100) + 12(13)$ H $12(18) + 12(5)$
 G $12(1) + 12(8) + 12(5)$ J $12(100) + 12(80) + 12(5)$ 12. _____
13. Find the solution of $x + 4 = 7$ if the replacement set is $\{1, 2, 3, 4, 5\}$.
 A 1 B 3 C 4 D 2 13. _____
14. A car rental company charges a rental fee of \$20 per day in addition to a charge of \$0.30 per mile driven. How much does it cost to rent a car for a day and drive it 25 miles?
 F \$45.30 G \$20.30 H \$27.50 J \$26.00 14. _____

1 Chapter 1 Test, Form 1 *(continued)*

15. Which statement best describes the graph of the price of one share of a company's stock shown at the right?

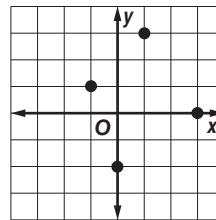


- A The price increased more in the morning than in the afternoon.
- B The price decreased more in the morning than in the afternoon.
- C The price increased more in the afternoon than in the morning.
- D The price decreased more in the afternoon than in the morning.

15. _____

16. What is the domain of the relation?

- F $\{-1, 0, 1, 3\}$
- G $\{-2, 0, 1, 3\}$
- H $\{-2, -1, 0, 1, 2, 3\}$
- J $\{0, 1, 2, 3\}$



16. _____

17. Determine which relation is a function.

- A

X	Y
2	1
4	3
-2	5
- B $y = \frac{1}{5}x + 2$
- C

x	3	4	4	5
y	-1	2	3	6
- D $\{(3, 0), (-2, -2), (7, -2), (-2, 0)\}$

17. _____

18. If $h(r) = \frac{2}{3}r - 6$, what is the value of $h(-9)$?

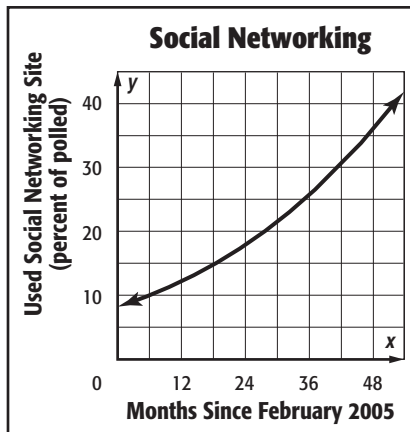
- F 12
- G 0
- H $-6\frac{2}{3}$
- J -12

18. _____

For Questions 19 and 20, use the graph.

19. Interpret the y-intercept of the graph.

- A All those polled used a social networking site 8 months after February 2005.
- B About 8% of those polled used a social networking site in February 2005.
- C No one used a social networking site in February 2005.
- D There were 8 social networking sites in February 2005.



19. _____

20. Interpret the end behavior of the function in terms of social networking.

- F expected to decrease
- G expected to increase
- H expected to level off at 55%
- J expected to level off at 8%

20. _____

Bonus Simplify $(4x + 2)3$.

B: _____

1 Chapter 1 Test, Form 2A

SCORE _____

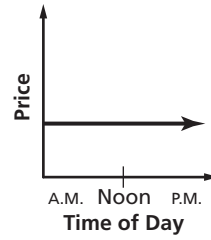
Write the letter for the correct answer in the blank at the right of each question.

- Write an algebraic expression for *nine times of the square of a number*.
 A $9 + x^2$ B $9 - x^2$ C $9x^2$ D $x^2 - 9$ 1. _____
- Write a verbal expression for $2n + 7$.
 F the product of 2, n , and 7 H 7 less than a number times 2
 G 7 more than twice a number J 7 more than n and 2 2. _____
- Evaluate $6 + 2 \cdot 3 - 1$.
 A 23 B 10 C 16 D 11 3. _____
- Evaluate $2(11 - 5) + 9 \div 3$.
 F 18 G 15 H 30 J 11 4. _____
- Evaluate $x^2 + xyz$ if $x = 3$, $y = 5$, and $z = 4$.
 A 69 B 63 C 85 D 21 5. _____
- Which equation illustrates the Multiplicative Inverse Property?
 F $0 \cdot 16 = 0$ H $3 \cdot \frac{1}{3} = 1$
 G $1(48) = 48$ J $9(1 + 0) = 9(1)$ 6. _____
- Evaluate $29 \cdot 1 + 2(20 \div 4 - 5)$.
 A 0 B 30 C 29 D 28 7. _____
- Simplify $r^2 - 2r^3 + 3r^2$.
 F $4r^2 - 2r^3$ G $2r$ H $3r^2 - 2r^3$ J $4r^2$ 8. _____
- Simplify $3(2x + 4y - y)$.
 A $5x + 6y$ B $6x + 9y$ C $6x + 3y$ D $5x + 11y$ 9. _____
- Use the Distributive Property to find $6(14 + 7)$.
 F 91 G 126 H 42 J 56 10. _____
- Simplify $2(a + 3b) + 3(4a + b)$.
 A $6a + 6b$ B $14a + 9b$ C $14a + 4b$ D $6a + 7b$ 11. _____
- Evaluate $3\frac{2}{5} + 7 + 4\frac{1}{5}$.
 F $7\frac{3}{2} + 7$ G $14\frac{3}{10}$ H $84\frac{3}{5}$ J $14\frac{3}{5}$ 12. _____
- Find the solution of $\frac{n}{2} - 11 = 3$ if the replacement set is {26, 28, 29, 30, 31}.
 A 26 B 28 C 30 D 31 13. _____
- Somerville High School raised \$740 to buy winter coats for the homeless at \$46.25 each. How many coats can they buy?
 F 12 G 16 H 24 J 34,225 14. _____

1 Chapter 1 Test, Form 2A *(continued)*

15. Which statement best describes a daily stock price?

- A The price increased.
- B The price decreased.
- C The price did not change.
- D The price increased then decreased.

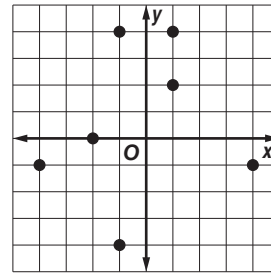


15. _____

For Questions 16 and 17, use the graph.

16. What is the domain of the relation?

- F $\{-4, -1, 0, 2, 4\}$
- G $\{-4, -2, -1, 1, 4\}$
- H $\{-4, -2, -1, 0, 1, 2, 4\}$
- J $\{-1, 1\}$



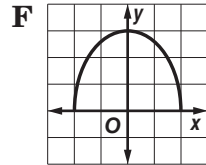
16. _____

17. Which is a true statement about the relation?

- A The relation is a linear function.
- B The value of x increases as y decreases.
- C The value of x increases as y increases.
- D The relation is not a function.

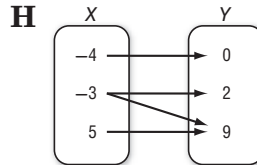
17. _____

18. Determine which relation is *not* a function.



G

x	y
-2	0
0	0
1	2
3	1



J

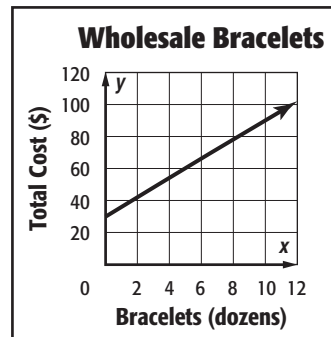
x	y
-4	0
-3	9
5	2
6	9

18. _____

For Questions 19 and 20, use the graph.

19. Interpret the y -intercept of the graph.

- A 0 bracelets cost about \$30.
- B 1 dozen bracelets cost about \$30.
- C 28 dozen bracelets cost \$0.
- D Each dozen bracelets costs about \$5.



19. _____

20. Interpret the end behavior of the function.

- F The total cost decreases.
- G The cost per dozen decreases.
- H The total cost increases.
- J The cost per dozen increases.

20. _____

Bonus Find the value of f in the equation $f = \frac{4}{5}(200 - m) + a$ if $m = 100$ and $a = 132$.

B: _____

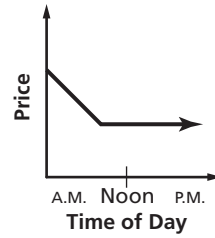
1 Chapter 1 Test, Form 2B

Write the letter for the correct answer in the blank at the right of each question.

1. Write an algebraic expression for *3 times x squared minus 4 times x*.
A $3(2x) - 4x$ **B** $4 - 3x$ **C** $3x^2 - 4x$ **D** $3(x^2 - 4x)$ 1. _____
2. Write a verbal expression for $3n - 8$.
F the product of 3, n , and 8 **H** 3 times n less than 8
G 8 less than the product of 3 and n **J** n minus 8 times 3 2. _____
3. Evaluate $4 + 5 \cdot 7 - 1$.
A 139 **B** 15 **C** 34 **D** 38 3. _____
4. Evaluate $3(16 - 9) + 12 \div 3$.
F 33 **G** 25 **H** 41 **J** 28 4. _____
5. Evaluate $m^2 + mtp$ if $m = 3$, $t = 4$, and $p = 7$.
A 93 **B** 87 **C** 100 **D** 23 5. _____
6. Which equation illustrates the Additive Identity Property?
F $8(9 + 0) = 8(9)$ **H** $8 \cdot 1 = 8$ 6. _____
G $4(0) = 0$ **J** $\frac{1}{4} \cdot 4 = 1$
7. Evaluate $16 \cdot 1 + 4(18 \div 2 - 9)$.
A 20 **B** 0 **C** 16 **D** 80 7. _____
8. Simplify $7x^2 + 10x^2 + 5y^3$.
F $22x^2y^3$ **G** $17x^2 + 5y^3$ **H** $22x^4 + y^3$ **J** $17x^4y^3 + 5$ 8. _____
9. Simplify $2(7n + 5m - 3m)$.
A $14n + 2m$ **B** $9n + 7m$ **C** $9n + m$ **D** $14n + 4m$ 9. _____
10. Use the Distributive Property to find $7(11 - 8)$.
F 133 **G** 21 **H** 69 **J** 85 10. _____
11. Simplify $3(5a + b) + 4(a + 2b)$.
A $9a + 5b$ **B** $19a + 3b$ **C** $19a + 11b$ **D** $9a + 9b$ 11. _____
12. Evaluate $4\frac{1}{5} + 9 + 2\frac{3}{5}$.
F $15\frac{4}{5}$ **G** $15\frac{2}{5}$ **H** $17\frac{4}{5}$ **J** $17\frac{3}{10}$ 12. _____
13. Find the solution of $3n - 13 = 38$ if the replacement set is $\{12, 14, 15, 17, 18\}$.
A 12 **B** 15 **C** 17 **D** 18 13. _____
14. Ari is jogging at an average rate of 2.25 meters per second. Find the time it will take him to jog 270 meters.
F 1 minute **G** 2 minutes **H** 3 minutes **J** 12 minutes 14. _____

1 Chapter 1 Test, Form 2B *(continued)*

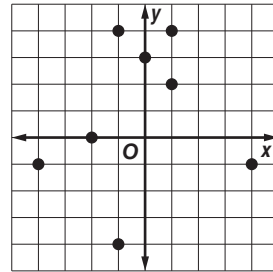
15. Which statement best describes a daily stock price?
- A The price was unchanged then increased sharply.
 - B The price was unchanged then decreased sharply.
 - C The price rose sharply then leveled off.
 - D The price declined sharply then leveled off.



15. _____

For Questions 16 and 17, use the graph.

16. What is the domain of the relation?
- F $\{-4, -2, -1, 0, 1, 2, 3, 4\}$
 - G $\{-4, -1, 0, 2, 3, 4\}$
 - H $\{-4, -2, -1, 0, 1, 4\}$
 - J $\{-4, 4\}$

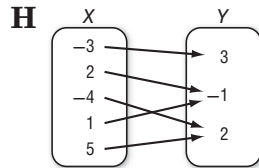
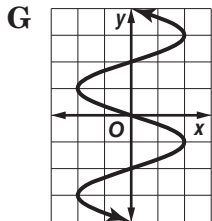
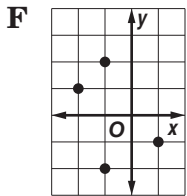


16. _____

17. Which is a true statement about the relation?
- A The relation is not a function.
 - B The value of x increases as y decreases.
 - C The value of x increases as y increases.
 - D The relation is a linear function.

17. _____

18. Determine which relation is a function.



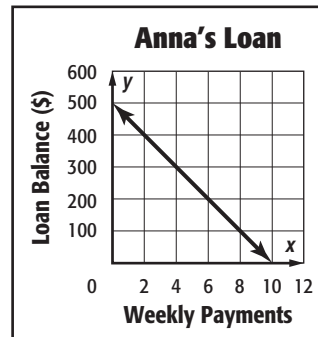
J

x	y
-2	7
0	0
1	-2
1	3

18. _____

For Questions 19 and 20, use the graph.

19. Interpret the y -intercept of the graph.
- A Anna owes \$10 before any payments.
 - B Each payment Anna makes is \$50.
 - C Anna owes \$500 before any payments.
 - D Anna pays off the loan in 10 payments.



19. _____

20. Interpret the end behavior of the function.
- F The amount owed decreases.
 - G The payment amount decreases.
 - H The amount owed increases.
 - J The payment amount increases.

20. _____

Bonus Simplify $8(a^2 + 3b^2) - 24b^2$.

B: _____

1 Chapter 1 Test, Form 2C

Write an algebraic expression for each verbal expression.

1. the sum of the square of a number and 34 1. _____
2. the product of 5 and twice a number 2. _____
3. Write a verbal expression for $4n^3 + 6$. 3. _____
4. Evaluate $2^3[(15 - 7)(4 \div 2)]$. 4. _____
5. Evaluate $3w + (8 - v)t$ if $w = 4$, $v = 5$ and $t = 2$. 5. _____

For Questions 6 and 7, name the property used in each equation. Then find the value of n .

6. $5 + 0 = n$ 6. _____
7. $7 + (4 + 6) = 7 + n$ 7. _____

8. Evaluate $4(5 \cdot 1 \div 20)$. Name the property used in each step. 8. _____

9. Rewrite $3(14 - 5)$ using the Distributive Property. Then simplify. 9. _____

Simplify each expression.

10. $15w - 6w + 14w^2$ 10. _____
11. $7(2y + 1) + 3y$ 11. _____

For Questions 12 and 13, evaluate each expression.

12. $32 + 5 + 8 + 15$ 12. _____

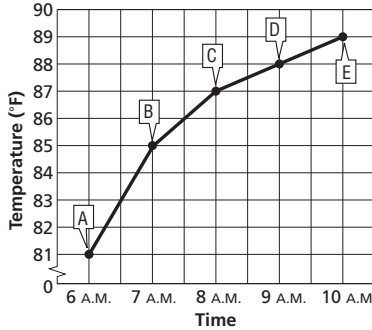
13. $\frac{1}{3} \cdot 4 \cdot 9 \cdot \frac{1}{2}$ 13. _____

14. Find the solution of $5b - 13 = 22$ if the replacement set is $\{5, 6, 7, 8, 9\}$. 14. _____

15. Solve $\frac{6 + 3^2(4)}{7} - 1 = y$. 15. _____

1 Chapter 1 Test, Form 2C *(continued)*

For Questions 16 and 17, use the graph that shows temperature as a function of time.



16. Identify the independent and dependent variables.

16. _____

17. Name the ordered pair at point C and explain what it represents.

17. _____

For Questions 18–20, use the table that shows airmail letter rates to Greenland.

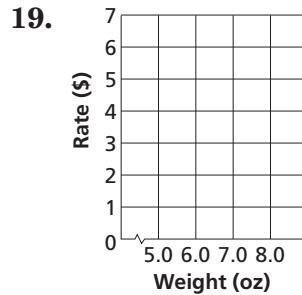
Weight (oz)	Rate (\$)
5.0	4.20
6.0	5.05
7.0	5.90
8.0	6.75

18. Write the data as a set of ordered pairs.

18. _____

Source: *World Almanac*

19. Draw a graph that shows the relationship between the weight of a letter sent airmail and the total cost.



19. _____

20. Interpret the end behavior of the function.

20. _____

Bonus Use grouping symbols, exponents, and symbols for addition, subtraction, multiplication, and division with the digits 1, 9, 8, and 7 (in that order) to form expressions that will yield each value.

B: a. _____

b. _____

- a. 6 b. 7 c. 9

c. _____

1 Chapter 1 Test, Form 2D

SCORE _____

Write an algebraic expression for each verbal expression.

1. the sum of one-third of a number and 27 1. _____
2. the product of a number squared and 4 2. _____
3. Write a verbal expression for $5n^3 + 9$. 3. _____
4. Evaluate $3^2[(12 - 4) \div 2]$. 4. _____
5. Evaluate $4w + (v - 5)t$ if $w = 2$, $v = 8$, and $t = 4$. 5. _____

Name the property used in each equation. Then find the value of n .

6. $11 \cdot n = 1$ 6. _____
7. $7 + n = 7 + 3$ 7. _____
8. Evaluate $6(6 \cdot 1 \div 36)$. Name the property used in each step. 8. _____
9. Rewrite $(10 + 3)5$ using the Distributive Property. Then simplify. 9. _____

Simplify each expression.

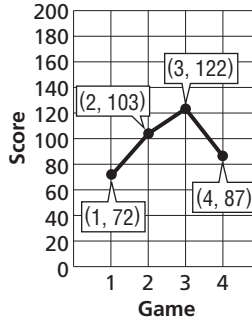
10. $4w^2 + 7w^2 + 7z^2$ 10. _____
11. $3x + 4(5x + 2)$ 11. _____

Evaluate each expression.

12. $5 \cdot 13 \cdot 4 \cdot 1$ 12. _____
13. $17 + 6 + 3 + 14$ 13. _____
14. Find the solution of $3x - 8 = 16$ if the replacement set is $\{5, 6, 7, 8, 9\}$. 14. _____
15. Solve $\frac{6 + 4^2 \cdot 3}{10 - 1} = y$. 15. _____

1 Chapter 1 Test, Form 2D *(continued)*

Use the graph that shows Robert's bowling scores for his last four games.



16. Identify the independent and dependent variables.

16. _____

17. Describe what may have happened between the first and fourth games.

17. _____

For Questions 18–20, use the table that shows 2006 airmail letter rates to New Zealand.

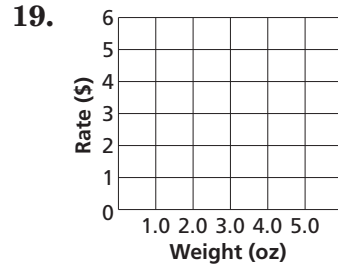
Weight (oz)	Rate (\$)
2.0	1.80
3.0	2.75
4.0	3.70
5.0	4.65

18. Write the data as a set of ordered pairs.

18. _____

Source: *World Almanac*

19. Draw a graph that shows the relationship between the weight of a letter sent airmail and the total cost.



19. _____

20. Interpret the end behavior of the function.

20. _____

Bonus Insert brackets, parentheses, and the symbols for addition, subtraction, and division in the following sequence of numbers to create an expression whose value is 4.

2 5 1 4 1

B: _____

1 Chapter 1 Test, Form 3

SCORE _____

Write an algebraic expression for each verbal expression.

1. the sum of the cube of a number and 12

1. _____

2. 42 decreased by twice some number

2. _____

3. Write a verbal expression for $\frac{6g^2}{5}$.

3. _____

4. Evaluate $\frac{4[3^3 - 5(8 - 6)]}{3^2 - 7} + 11$.

4. _____

5. _____

Evaluate each expression if $w = 4$, $n = 8$, $v = 5$, and $t = 2$.5. $w^2 + n(v^2 - t)$ 6. $3nw - w^2 + t^3$

6. _____

For Questions 7 and 8, name the property used in each equation. Then find the value of n .7. $7y + y = 7y + ny$ 8. $(6 + n)x = 15x$

7. _____

8. _____

9. Evaluate $\frac{2}{3}(3 \div 2) + (3^2 - 9)$. Name the property used in each step.

9. _____

10. Rewrite $2(x + 3y - 2z)$ using the Distributive Property. Then simplify.

10. _____

Simplify each expression. If not possible, write *simplified*.11. $3 + 6(5a + 4an) + 9na$

11. _____

12. $7a + 7a^2 + 14b^2$

12. _____

Evaluate each expression.13. $6 \cdot 8 + 29 + 7 + 3 \cdot 7$

13. _____

14. $32 + 6 \cdot 4 + 7 \cdot 4 + 16$

14. _____

15. Solve $\frac{5 \cdot 2^3 - 4 \cdot 3^2}{1 + 3} = x$.

15. _____

16. Find the solution of $2b + \frac{1}{2} = 3$ if the replacement set is $\left\{\frac{1}{2}, \frac{3}{4}, 1, \frac{5}{4}, \frac{3}{2}, \frac{7}{4}\right\}$.

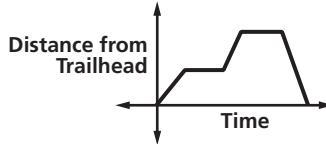
16. _____

1 Chapter 1 Test, Form 3 *(continued)*

17. Some warehouse stores charge members an annual fee to shop there. On his first trip to a warehouse store, Mr. Marsh pays a \$50 membership fee. Cases of bottled water cost \$4 at the warehouse store. Write and solve an equation to find the total amount Mr. Marsh spent on his first trip before tax if he bought 8 cases of water.

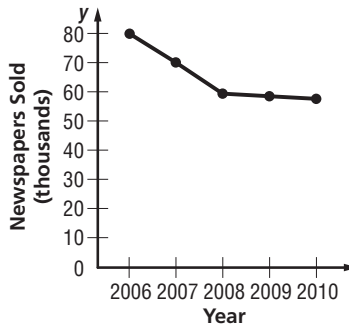
17. _____

18. The graph shown represents a puppy exploring a trail. Describe what is happening in the graph. Is the function discrete or continuous?



18. _____

For Questions 19 and 20, use the graph that shows the average daily circulation of the *Evening Telegraph*.



19. _____

19. Identify the independent and dependent variables.

20. Write a description of what the graph displays.

20. _____

21. Each day David drives to work in the morning, returns home for lunch, drives back to work, and then goes to a gym to exercise before he returns home for the evening. Draw a reasonable graph to show the distance David is from his home for a two-day period.

21. _____

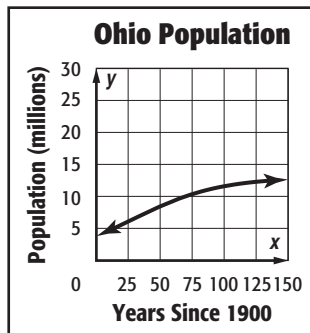
22. Determine whether $-\frac{1}{2}x + 4y = 6$ represents a function.

22. _____

23. If $f(x) = -3x^2 - 2x + 1$, find $2[f(r)]$.

23. _____

For Questions 24 and 25, use the graph at the right.



24. Interpret the y -intercept of the graph.

24. _____

25. Interpret the end behavior of the function

25. _____

Bonus Simplify $\frac{6^2 + (3 + 4)^2 - (21 \div 3 + 4 \cdot 2)}{14 - 3 \cdot 1^4 + 2^3 - (5 + 1) \cdot 2}$.

B: _____

1 Chapter 1 Extended-Response Test

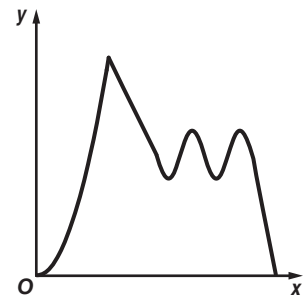
Demonstrate your knowledge by giving a clear, concise solution to each problem. Be sure to include all relevant drawings and justify your answers. You may show your solution in more than one way or investigate beyond the requirements of the problem.

1. **a.** Write an algebraic expression that includes a sum and a product.
Write a verbal expression for your algebraic expression.
- b.** Write a verbal expression that includes a difference and a quotient.
Write an algebraic expression for your verbal expression.

2. Explain how a replacement set and a solution set are used with an open sentence.

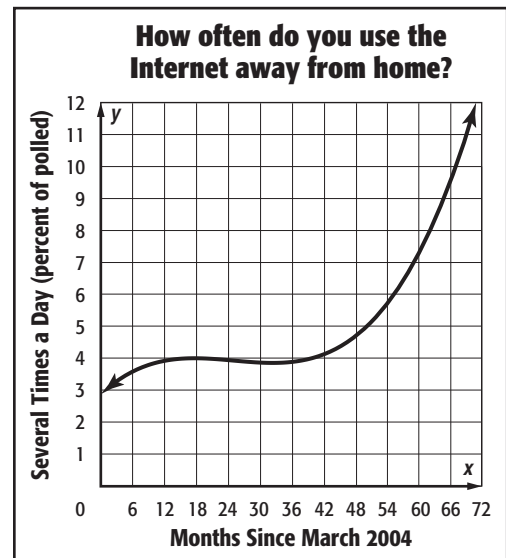
3. **a.** Write an equation that demonstrates one of the identity properties.
Name the property used in the equation.
- b.** Explain how to use the Distributive Property to find $7 \cdot 23$.
- c.** Describe how to use the Commutative and Associative Properties to simplify the evaluation of $18 + 33 + 82 + 67$.

4. Think of a situation that could be modeled by this graph. Then label the axes of the graph and write several sentences describing the situation.



5. Use the set $\{-1, 0, 1, 2\}$ as a domain and the set $\{-3, -1, 4, 5\}$ as a range.
 - a.** Create a relation. Express the relation as a set of ordered pairs.
 - b.** Create a relation that is *not* a function. Express the relation as a table, a graph, and a mapping.
 - c.** Explain why the relation created for part **b** is not a function.

6. Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret key features of the graph.



1

Standardized Test Practice

SCORE _____

(Chapter 1)

Part 1: Multiple Choice

Instructions: Fill in the appropriate circle for the best answer.

1. Write an algebraic expression to represent the number of pens that can be bought with 30 cents if each pen costs c cents. (Lesson 1-1)
 A $30 - c$ B $\frac{30}{c}$ C $30 + c$ D $30c$ 1. Ⓐ Ⓑ Ⓒ Ⓓ
2. Evaluate $\frac{7a + b}{b + c}$ if $a = 2$, $b = 6$, and $c = 4$. (Lesson 1-2)
 F $3\frac{1}{3}$ G $1\frac{1}{2}$ H 3 J 2 2. Ⓕ Ⓖ Ⓗ Ⓙ
3. Find the solution of $3(y + 7) \leq 39$ if the replacement set is $\{2, 4, 6, 8, 10, 12\}$. (Lesson 1-5)
 A $\{2, 4\}$ B $\{6, 8, 10, 12\}$ C $\{8, 10, 12\}$ D $\{2, 4, 6\}$ 3. Ⓐ Ⓑ Ⓒ Ⓓ
4. The equation $4 + 9 = 4 + 9$ is an example of which property of equality? (Lesson 1-3)
 F Substitution G Reflexive H Symmetric J Transitive 4. Ⓕ Ⓖ Ⓗ Ⓙ
5. Simplify $7x^2 + 5x + 4x$. (Lesson 1-4)
 A $7x^2 + 9x$ B $16x^4$ C $12x^3 + 4x$ D $7x^2 + x$ 5. Ⓐ Ⓑ Ⓒ Ⓓ
6. Simplify $7(2x + y) + 6(x + 5y)$. (Lesson 1-4)
 F $20x + 37y$ G $20x + 6y$ H $13x + 42y$ J $15x + 6y$ 6. Ⓕ Ⓖ Ⓗ Ⓙ
- For Questions 7 and 8, use the following statement.**
If x is a multiple of 2, then x is divisible by 4.
7. Identify the hypothesis of the statement. (Lesson 1-8)
 A x is a multiple of 2 C x is divisible by 4
 B $x = 2$ D $x = 4$ 7. Ⓐ Ⓑ Ⓒ Ⓓ
8. Which number is a counterexample for the statement? (Lesson 1-8)
 F 20 G 4 H 32 J 10 8. Ⓕ Ⓖ Ⓗ Ⓙ
9. The distance an airplane travels increases as the duration of the flight increases. Identify the dependent variable. (Lesson 1-6)
 A time B direction C airplane D distance 9. Ⓐ Ⓑ Ⓒ Ⓓ
10. Omari drives a car that gets 18 miles per gallon of gasoline. The car's gasoline tank holds 15 gallons. The distance Omari drives before refueling is a function of the number of gallons of gasoline in the tank. Identify a reasonable domain for this situation. (Lesson 1-6)
 F 0 to 18 miles H 0 to 270 miles
 G 0 to 15 gallons J 0 to 60 mph 10. Ⓕ Ⓖ Ⓗ Ⓙ

1 Standardized Test Practice *(continued)*

Part 3: Short Response

Instructions: Write your answers in the space.

Find each product or quotient.

(Prerequisite Skill)

18. $17 \cdot 8$

19. $84 \div 7$

20. $0.9 \cdot 5.6$

21. $\frac{8}{9} \div \frac{16}{3}$

22. Write an algebraic expression for *six less than twice a number*. (Lesson 1-1)

23. Write a verbal expression for $4m^2 + 2$. (Lesson 1-1)

24. Evaluate $13 - \frac{1}{3}(11 - 5)$. (Lesson 1-2)

25. Evaluate $\frac{2b + c^2}{a}$, if $a = 2$, $b = 4$, and $c = 6$. (Lesson 1-2)

26. Evaluate $3(5 \cdot 2 - 9) + 2 \cdot \frac{1}{2}$. (Lesson 1-2)

27. Evaluate $\frac{1}{3} \cdot 20 \cdot 6 \cdot \frac{1}{5}$ using the properties of numbers. (Lesson 1-3)

Simplify each expression.

28. $7n + 4n$
(Lesson 1-4)

29. $5y + 3(2y + 1)$
(Lesson 1-4)

30. Solve $2(7) + 4 = x$. (Lesson 1-5)

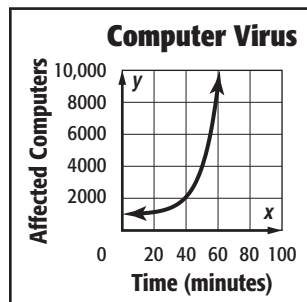
31. Find the solution of $3x - 4 = 2$ if the replacement set is $\{0, 1, 2, 3, 4, 5\}$. (Lesson 1-5)

32. Alvin is mowing his front lawn. His mailbox is on the edge of the lawn. Draw a reasonable graph that shows the distance Alvin is from the mailbox as he mows. Let the horizontal axis show the time and the vertical axis show the distance from the mailbox. (Lesson 1-6)

33. Identify and interpret each feature of the graph shown. (Lesson 1-8)

a. intercept(s)

b. end behavior



18. _____

19. _____

20. _____

21. _____

22. _____

23. _____

24. _____

25. _____

26. _____

27. _____

28. _____

29. _____

30. _____

31. _____

32. _____

33a. _____

33b. _____

NAME _____ DATE _____ PERIOD _____

1 Anticipation Guide

Expressions, Equations, and Functions

Step 1 Before you begin Chapter 1

- Read each statement.
- Decide whether you Agree (A) or Disagree (D) with the statement.
- Write A or D in the first column OR if you are not sure whether you agree or disagree, write NS (Not Sure).

STEP 1 A, D, or NS	Statement	STEP 2 A or D
	1. An algebraic expression contains one or more numbers, variables, and arithmetic operations.	A
	2. The expression x^4 means $x + x + x + x$.	D
	3. According to the order of operations, all multiplication and division should be done before anything else.	D
	4. Since 2 makes the equation $3t - 1 = 5$ true, {2} is the solution set for the equation.	A
	5. Because of the Reflexive Property of Equality, if $a + b = c$ then $c = a + b$.	D
	6. The multiplicative inverse of 23 is $\frac{1}{23}$.	A
	7. The Distributive Property states that $a(b + c)$ will equal $ab + c$.	D
	8. The order in which you add or multiply numbers does not change their sum or product.	A
	9. A graph has symmetry in a line if each half of the graph on either side of the line matches exactly.	A
	10. In the coordinate plane, the x-axis is horizontal and the y-axis is vertical.	A

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Step 2 After you complete Chapter 1

- Reread each statement and complete the last column by entering an A or a D.
- Did any of your opinions about the statements change from the first column?
- For those statements that you mark with a D, use a piece of paper to write an example of why you disagree.

Chapter 1

3

Glencoe Algebra 1

NAME _____ DATE _____ PERIOD _____

1-1 Study Guide and Intervention

Variables and Expressions

Write Verbal Expressions An algebraic expression consists of one or more numbers and variables along with one or more arithmetic operations. In algebra, variables are symbols used to represent unspecified numbers or values. Any letter may be used as a variable.

Example Write a verbal expression for each algebraic expression.

- $6n^2$
the product of 6 and n squared
- $n^3 - 12m$
the difference of n cubed and twelve times m

Exercises

Write a verbal expression for each algebraic expression. 1–16. Sample answers are given.

- $w - 1$
one less than w
- $\frac{1}{3}a^3$
one third the cube of a
- $81 + 2x$
eighty-one increased by twice x
- 6^2
the square of 6
- $2n^2 + 4$
the sum of 4 and twice the square of n
- $a^3 \cdot b^3$
a cubed times b cubed
- $2x^3 - 3$
the difference of twice a number cubed and 3
- $7n^5$
seven times the fifth power of n
- $3x + 4$
the sum of three times a number and 4
- $3b^2 + 2a^3$
3 times b squared plus 2 times a cubed
- $4(n^2 + 1)$
4 times the sum of the square of n and 1

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Chapter 1

5

Glencoe Algebra 1

NAME _____ DATE _____ PERIOD _____

1-1 Study Guide and Intervention (continued)

Variables and Expressions

Write Algebraic Expressions Translating verbal expressions into algebraic expressions is an important algebraic skill.

Example Write an algebraic expression for each verbal expression.

- a.** four more than a number n **b.** the difference of a number squared and 8
 The words *more than* imply addition. The expression *difference of* implies subtraction.
 four more than a number n the difference of a number squared and 8
 $4 + n$ $n^2 - 8$
 The algebraic expression is $4 + n$. The algebraic expression is $n^2 - 8$.

Exercises

Write an algebraic expression for each verbal expression.

1. a number decreased by 8 $b - 8$
2. a number divided by 8 $\frac{h}{8}$
3. a number squared n^2
4. four times a number $4n$
5. a number divided by 6 $\frac{n}{6}$
6. a number multiplied by 37 $37n$
7. the sum of 9 and a number $9 + n$
8. 3 less than 5 times a number $5n - 3$
9. twice the sum of 15 and a number $2(15 + n)$
10. one-half the square of b $\frac{1}{2}b^2$
11. 7 more than the product of 6 and a number $6n + 7$
12. 30 increased by 3 times the square of a number $30 + 3n^2$

Chapter 1

Glencoe Algebra 1

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NAME _____ DATE _____ PERIOD _____

1-1 Skills Practice

Variables and Expressions

Write a verbal expression for each algebraic expression.

1. $9a^2$ the product of 9 and a squared
2. 5^2 5 squared
3. $c + 2d$ the sum of c and twice d
4. $4 - 5h$ the difference of 4 and 5 times h
5. $2b^2$ 2 times b squared
6. $7x^3 - 1$ 1 less than 7 times x cubed
7. $p^4 + 6r$ p to the fourth power plus 6 times r
8. $3n^2 - x$ 3 times n squared minus x

Write an algebraic expression for each verbal expression.

9. the sum of a number and 10 $x + 10$
10. 15 less than k $k - 15$
11. the product of 18 and q $18q$
12. 6 more than twice m $2m + 6$
13. 8 increased by three times a number $8 + 3x$
14. the difference of 17 and 5 times a number $17 - 5x$
15. the product of 2 and the second power of y $2y^2$
16. 9 less than g to the fourth power $g^4 - 9$

Chapter 1

Glencoe Algebra 1

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Lesson 1-1

NAME _____ DATE _____ PERIOD _____

1-1 Practice

Variables and Expressions

Write a verbal expression for each algebraic expression. 1–8. Sample answers are given.

1. $23f$
the product of 23 and f
2. 7^3
seven cubed
3. $5m^2 + 2$
2 more than 5 times m squared
4. $4d^3 - 10$
4 times d cubed minus 10
5. $x^3 \cdot y^4$
 x cubed times y to the fourth power
6. $b^2 - 3c^3$
 b squared minus 3 times c cubed
7. $\frac{4n^2}{7}$
one sixth of the fifth power of n
8. $\frac{4n^2}{7}$
one seventh of 4 times n squared

Write an algebraic expression for each verbal expression.

9. the difference of 10 and u
 $10 - u$
10. the sum of 18 and a number
 $18 + x$
11. the product of 33 and j
 $33j$
12. 74 increased by 3 times y
 $74 + 3y$
13. 15 decreased by twice a number
 $15 - 2x$
14. 91 more than the square of a number
 $x^2 + 91$
15. three fourths the square of b
 $\frac{3}{4}b^2$
16. two fifths the cube of a number
 $\frac{2}{5}x^3$
17. BOOKS A used bookstore sells paperback fiction books in excellent condition for \$2.50 and in fair condition for \$0.50. Write an expression for the cost of buying x excellent-condition paperbacks and f fair-condition paperbacks. $2.50x + 0.50f$
18. GEOMETRY The surface area of the side of a right cylinder can be found by multiplying twice the number π by the radius times the height. If a circular cylinder has radius r and height h , write an expression that represents the surface area of its side. $2\pi rh$

Chapter 1

8

Glencoe Algebra 1

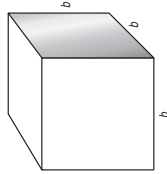
NAME _____ DATE _____ PERIOD _____

1-1 Word Problem Practice

Variables and Expressions

1. SOLAR SYSTEM It takes Earth about 365 days to orbit the Sun. It takes Uranus about 85 times as long. Write a numerical expression to describe the number of days it takes Uranus to orbit the Sun. 365×85

5. BLOCKS A toy manufacturer produces a set of blocks that can be used by children to build play structures. The product packaging team is analyzing different arrangements for packaging their blocks. One idea they have is to arrange the blocks in the shape of a cube, with b blocks along one edge.



2. TECHNOLOGY There are 1024 bytes in a kilobyte. Write an expression that describes the number of bytes in a computer chip with n kilobytes.
 $1024 \times n$ or $1024n$

a. Write an expression representing the total number of blocks packaged in a cube measuring b blocks on one edge.
 b^3

b. The packaging team decides to take one layer of blocks off the top of this package. Write an expression representing the number of blocks in the top layer of the package. b^2

c. The team finally decides that their favorite package arrangement is to take 2 layers of blocks off the top of a cube measuring b blocks along one edge. Write an expression representing the number of blocks left behind after the top two layers are removed.
 $b^3 - 2b^2$ or $(b - 2) \times b^2$

Lesson 1-1

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Chapter 1

9

Glencoe Algebra 1

1-1 Enrichment

Toothpick Triangles

Variable expressions can be used to represent patterns and help solve problems. Consider the problem of creating triangles out of toothpicks shown below.

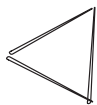


Figure 1

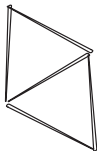


Figure 2

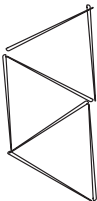


Figure 3

1. How many toothpicks does it take to create each figure? **3; 5; 7**

2. How many toothpicks does it take to make up the perimeter of each image? **3; 4; 5**

3. Sketch the next three figures in the pattern.



Figure 4



Figure 5



Figure 6

4. Continue the pattern to complete the table.

Image Number	1	2	3	4	5	6	7	8	9	10
Number of toothpicks	3	5	7	9	11	13	15	17	19	21
Number of toothpicks in Perimeter	3	4	5	6	7	8	9	10	11	12

5. Let the variable n represent the figure number. Write an expression that can be used to find the number of toothpicks needed to create figure n . **$2n + 1$**

6. Let the variable n represent the figure number. Write an expression that can be used to find the number of toothpicks in the perimeter of figure n . **$n + 2$**

1-2 Study Guide and Intervention

Order of Operations

Evaluate Numerical Expressions Numerical expressions often contain more than one operation. To evaluate them, use the rules for order of operations shown below.

- Step 1** Evaluate expressions inside grouping symbols.
- Step 2** Evaluate all powers.
- Step 3** Do all multiplication and/or division from left to right.
- Step 4** Do all addition and/or subtraction from left to right.

Example 1 Evaluate each expression.

- a.** $3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 81$ Use 3 as a factor 4 times. Multiply.
- b.** $6^3 = 6 \cdot 6 \cdot 6 = 216$ Use 6 as a factor 3 times. Multiply.

Example 2 Evaluate each expression.

- a.** $3[2 + (12 \div 3)^2]$
 $3[2 + (12 \div 3)^2] = 3(2 + 4^2)$ Divide 12 by 3.
 $= 3(2 + 16)$ Find 4 squared.
 $= 3(18)$ Add 2 and 16.
 $= 54$ Multiply 3 and 18.
- b.** $\frac{3 + 2^3}{4^2 \cdot 3}$
 $\frac{3 + 2^3}{4^2 \cdot 3} = \frac{3 + 8}{4^2 \cdot 3}$ Evaluate power in numerator.
 $= \frac{11}{4^2 \cdot 3}$ Add 3 and 8 in the numerator.
 $= \frac{11}{16 \cdot 3}$ Evaluate power in denominator.
 $= \frac{11}{48}$ Multiply.

Exercises

Evaluate each expression.

1. 5^2 **25**
2. 3^3 **27**
3. 10^4 **10,000**
4. 12^2 **144**
5. 8^3 **512**
6. 2^8 **256**
7. $(8 - 4) \cdot 2$ **8**
8. $(12 + 4) \cdot 6$ **96**
9. $10 + 8 \cdot 1$ **18**
10. $15 - 12 \div 4$ **12**
11. $12(20 - 17) - 3 \cdot 6$ **18**
12. $24 \div 3 \cdot 2 - 3^2$ **7**
13. $3^2 \div 3 + 2^2 \cdot 7 - 20 \div 5$ **1**
14. $\frac{4 + 3^2}{12 + 1}$ **27**
15. $250 \div [5(3 \cdot 7 + 4)]$ **2**
16. $\frac{2 \cdot 4^2 - 8 \div 2}{(5 + 2) \cdot 2}$ **2**
17. $\frac{4(5^2) - 4 \cdot 3}{4(4 \cdot 5 + 2)}$ **1**
18. $\frac{5^2 - 3}{20(3) + 2(3)}$ **3**

NAME _____ DATE _____ PERIOD _____

1-2 Study Guide and Intervention *(continued)*

Order of Operations

Evaluate Algebraic Expressions Algebraic expressions may contain more than one operation. Algebraic expressions can be evaluated if the values of the variables are known. First, replace the variables with their values. Then use the order of operations to calculate the value of the resulting numerical expression.

Example Evaluate $x^3 + 5(y - 3)$ if $x = 2$ and $y = 12$.

$$\begin{aligned} x^3 + 5(y - 3) &= 2^3 + 5(12 - 3) && \text{Replace } x \text{ with 2 and } y \text{ with 12.} \\ &= 8 + 5(12 - 3) && \text{Evaluate } 2^3. \\ &= 8 + 5(9) && \text{Subtract 3 from 12.} \\ &= 8 + 45 && \text{Multiply 5 and 9.} \\ &= 53 && \text{Add 8 and 45.} \end{aligned}$$

The solution is 53.

Exercises

Evaluate each expression if $x = 2$, $y = 3$, $z = 4$, $a = \frac{4}{3}$, and $b = \frac{3}{5}$.

1. $x + 7$ **9**
2. $3x - 5$ **1**
3. $x + y^2$ **11**
4. $x^3 + y + z^2$ **27**
5. $6a + 8b$ **$9\frac{3}{5}$**
6. $23 - (a + b)$ **$21\frac{3}{5}$**
7. $\frac{y^2}{x^2}$ **$\frac{9}{4}$**
8. $2xyz + 5$ **53**
9. $x(2y + 3z)$ **36**
10. $(10x)^2 + 100a$ **480**
11. $\frac{3xy - 4}{7x}$ **1**
12. $a^2 + 2b$ **$1\frac{21}{25}$**
13. $\frac{z^2 - y^2}{x^2}$ **$\frac{7}{4}$**
14. $6xz + 5xy$ **78**
15. $\frac{(z - y)^2}{x}$ **$\frac{1}{2}$**
16. $\frac{25ab + y}{xz}$ **$1\frac{7}{8}$**
17. $\frac{5x^2b}{y}$ **$\frac{16}{25}$**
18. $(z + x)^2 + ax$ **$5\frac{3}{5}$**
19. $(\frac{x}{z})^2 + (\frac{y}{z})^2$ **$\frac{13}{16}$**
20. $\frac{x + z}{y + 2z}$ **$\frac{6}{11}$**
21. $(\frac{z + x}{y}) + (\frac{y + x}{z})$ **$1\frac{1}{24}$**

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LESSON 1-2

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1-2 Skills Practice

Order of Operations

Evaluate each expression.

1. 8^2 **64**
 2. 3^4 **81**
 3. 5^3 **125**
 4. 3^3 **27**
 5. $(5 + 4) \cdot 7$ **63**
 6. $(9 - 2) \cdot 3$ **21**
 7. $4 + 6 \cdot 3$ **22**
 8. $12 + 2 \cdot 2$ **16**
 9. $(3 + 5) \cdot 5 + 1$ **41**
 10. $9 + 4(3 + 1)$ **25**
 11. $30 - 5 \cdot 4 + 2$ **12**
 12. $10 + 2 \cdot 6 + 4$ **26**
 13. $14 \div 7 \cdot 5 - 3^2$ **1**
 14. $4[30 - (10 - 2) \cdot 3]$ **24**
 15. $5 + [30 - (6 - 1)^2]$ **10**
 16. $2[12 + (5 - 2)^2]$ **42**
- Evaluate each expression if $x = 6$, $y = 8$, and $z = 3$.
17. $xy + z$ **51**
 18. $yz - x$ **18**
 19. $2x + 3y - z$ **33**
 20. $2(x + z) - y$ **10**
 21. $5z + (y - x)$ **17**
 22. $5x - (y + 2z)$ **16**
 23. $x^2 + y^2 - 10z$ **70**
 24. $z^3 + (y^2 - 4x)$ **67**
 25. $\frac{y + xz}{2}$ **13**
 26. $\frac{3y + x^2}{z}$ **20**

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1-2 Word Problem Practice

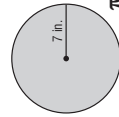
Order of Operations

1. SCHOOLS Jefferson High School has 100 less than 5 times as many students as Taft High School. Write and evaluate an expression to find the number of students at Jefferson High School if Taft High School has 300 students.
 $5t - 100$; 1400 students

2. GEOGRAPHY Guadalupe Peak in Texas has an altitude that is 671 feet more than double the altitude of Mount Sunflower in Kansas. Write and evaluate an expression for the altitude of Guadalupe Peak if Mount Sunflower has an altitude of 4039 feet.
 $2n + 671$; 8749 ft

3. TRANSPORTATION The Plaid Taxi Cab Company charges \$1.75 per passenger plus \$3.45 per mile for trips less than 10 miles. Write and evaluate an expression to find the cost for Max to take a Plaid taxi 8 miles to the airport.
 $\$1.75 + \$3.45m$; \$29.35

4. GEOMETRY The area of a circle is related to the radius of the circle such that the product of the square of the radius and a number π gives the area. Write and evaluate an expression for the area of a circular pizza below. Approximate π as 3.14.



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1-2 Practice

Order of Operations

Evaluate each expression.

- 1. 11^2 **121**
- 2. 8^3 **512**
- 3. 5^4 **625**
- 4. $(15 - 5) \cdot 2$ **20**
- 5. $9 \cdot (3 + 4)$ **63**
- 6. $5 + 7 \cdot 4$ **33**
- 7. $4(3 + 5) - 5 \cdot 4$ **12**
- 8. $22 \div 11 \cdot 9 - 3^2$ **9**
- 9. $6^2 + 3 \cdot 7 - 9$ **48**
- 10. $3[10 - (27 \div 9)]$ **21**
- 11. $2[5^3 + (36 \div 6)]$ **62**
- 12. $162 \div [6(7 - 4)^2]$ **3**
- 13. $\frac{5^2 \cdot 4 - 5 \cdot 4^2}{5(4)}$ **1**
- 14. $\frac{(2 \cdot 5)^2 + 4}{3^2 - 5}$ **26**
- 15. $\frac{7 + 3^2}{4^2 \cdot 2}$ **2**

Evaluate each expression if $a = 12$, $b = 9$, and $c = 4$.

- 16. $a^2 + b - c^2$ **137**
- 17. $b^2 + 2a - c^2$ **89**
- 18. $2c(a + b)$ **168**
- 19. $4a + 2b - c^2$ **50**
- 20. $(a^2 \div 4b) + c$ **8**
- 21. $c^2 \cdot (2b - a)$ **96**
- 22. $\frac{b^2 + a}{c}$ **39**
- 23. $\frac{2c^2 - ab}{4}$ **5**
- 24. $2(a - b)^2 - 5c$ **-2**
- 25. $\frac{b^2 - 2c^2}{a + c - b}$ **7**

26. CAR RENTAL Ann Carlyle is planning a business trip for which she needs to rent a car. The car rental company charges \$36 per day plus \$0.50 per mile over 100 miles. Suppose Ms. Carlyle rents the car for 5 days and drives 180 miles.

- a. Write an expression for how much it will cost Ms. Carlyle to rent the car.
 $5(36) + 0.5(180 - 100)$
- b. Evaluate the expression to determine how much Ms. Carlyle must pay the car rental company. **\$220.00**

27. GEOMETRY The length of a rectangle is $3n + 2$ and its width is $n - 1$. The perimeter of the rectangle is twice the sum of its length and its width.

- a. Write an expression that represents the perimeter of the rectangle.
 $2[(3n + 2) + (n - 1)]$
- b. Find the perimeter of the rectangle when $n = 4$ inches. **34 in.**

5. BIOLOGY Lavania is studying the growth of a population of fruit flies in her laboratory. She notices that the number of fruit flies in her experiment is five times as large after any six-day period. She observes 20 fruit flies on October 1. Write and evaluate an expression to predict the population of fruit flies Lavania will observe on October 31.
 20×5^6 ; 62,500 flies

6. CONSUMER SPENDING During a long weekend, Devon paid a total of x dollars for a rental car so he could visit his family. He rented the car for 4 days at a rate of \$36 per day. There was an additional charge of \$0.20 per mile after the first 200 miles driven.

a. Write an algebraic expression to represent the amount Devon paid for additional mileage only.
 $x - (36 \times 4)$

b. Write an algebraic expression to represent the number of miles over 200 miles that Devon drove the rented car.

$$\frac{x - (36 \times 4)}{0.20}$$

c. How many miles did Devon drive overall if he paid a total of \$174 for the car rental? **350 mi**

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1-2 Enrichment

The Four Digits Problem

One well-known mathematics problem is to write expressions for consecutive numbers beginning with 1. On this page, you will use the digits 1, 2, 3, and 4. Each digit is used only once. You may use addition, subtraction, multiplication (not division), exponents, and parentheses in any way you wish. Also, you can use two digits to make one number, such as 12 or 34.

Answers will vary. Sample answers are given. Express each number as a combination of the digits 1, 2, 3, and 4.

- | | | |
|------------------------------------|------------------------------------|--------------------------------|
| 1 = $(3 \times 1) - (4 - 2)$ | 18 = $(2 \times 3) \times (4 - 1)$ | 35 = $2^{(4+1)} + 3$ |
| 2 = $(4 - 3) + (2 - 1)$ | 19 = $3(2 + 4) + 1$ | 36 = $34 + (2 \times 1)$ |
| 3 = $(4 - 3) + (2 \times 1)$ | 20 = $21 - (4 - 3)$ | 37 = $31 + 2 + 4$ |
| 4 = $(4 - 2) + (3 - 1)$ | 21 = $(4 + 3) \times (2 + 1)$ | 38 = $42 - (3 + 1)$ |
| 5 = $(4 - 2) + (3 \times 1)$ | 22 = $21 + (4 - 3)$ | 39 = $42 - (3 \times 1)$ |
| 6 = $4 + 3 + 1 - 2$ | 23 = $31 - (4 \times 2)$ | 40 = $41 - (3 - 2)$ |
| 7 = $3(4 - 1) - 2$ | 24 = $(2 + 4) \times (3 + 1)$ | 41 = $43 - (2 \times 1)$ |
| 8 = $4 + 3 + 2 - 1$ | 25 = $(2 + 3) \times (4 + 1)$ | 42 = $43 - (2 - 1)$ |
| 9 = $4 + 2 + (3 \times 1)$ | 26 = $24 + (3 - 1)$ | 43 = $42 + 1^3$ |
| 10 = $4 + 3 + 2 + 1$ | 27 = $3^2 \times (4 - 1)$ | 44 = $43 + (2 - 1)$ |
| 11 = $(4 \times 3) - (2 - 1)$ | 28 = $21 + 3 + 4$ | 45 = $43 + (2 \times 1)$ |
| 12 = $(4 \times 3) \times (2 - 1)$ | 29 = $2^{(4+1)} - 3$ | 46 = $43 + (2 + 1)$ |
| 13 = $(4 \times 3) + (2 - 1)$ | 30 = $(2 \times 3) \times (4 + 1)$ | 47 = $31 + 4^2$ |
| 14 = $(4 \times 3) + (2 \times 1)$ | 31 = $34 - (2 + 1)$ | 48 = $4^2 \times (3 \times 1)$ |
| 15 = $2(3 + 4) + 1$ | 32 = $4^2 \times (3 - 1)$ | 49 = $41 + 2^3$ |
| 16 = $(4 \times 2) \times (3 - 1)$ | 33 = $21 + (3 \times 4)$ | 50 = $41 + 3^2$ |
| 17 = $3(2 + 4) - 1$ | 34 = $2 \times (14 + 3)$ | |

Does a calculator help in solving these types of puzzles? Give reasons for your opinion.

Answers will vary. Using a calculator is a good way to check your solutions.

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1-2 TI-Nspire® Activity

Using the Store Key

When evaluating algebraic expressions, it is sometimes helpful to use the store key on the calculator, especially to check solutions, evaluate several expressions for the same values of variables, or evaluate the same expression for multiple values of the variables.

Example 1 Evaluate $a^2 - 4a + 6$ if $a = 8$.

First, open a new **Calculator** page on the TI-Nspire.

Then, delete any instances of stored variables by entering **CLEARAZ**.

Store 8 as the value for a .

Finally enter the expression, including the variables, to evaluate.

The answer is 38.



Example 2 Evaluate $xy - \frac{4y}{5x}$ if $x = 4$ and $y = 12$.

Enter 4 as the value for x and 12 as the value for y .

Evaluate the expression. The TI-Nspire will display the answer as a fraction.

The answer is $\frac{228}{5}$.

Exercises

Evaluate each expression if $a = 4$, $b = 6$, $x = 8$, and $y = 12$. Express answers as integers or fractions.

1. $bx - ay \div b$

40

2. $a[x + (y \div a)^2]$

68

3. $a^3 - (y - b)^2 + x^2$

92

4. $\frac{b + a^2}{x^2 - b^2}$

$\frac{11}{14}$

5. $\frac{2a(x - b)}{xy} - 9b$

$\frac{8}{21}$

6. $\frac{b^3 - [3(a + b^2) + 5b]}{y \div a(x - 1)}$

$\frac{22}{7}$

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1-3 Study Guide and Intervention

Properties of Numbers

Identity and Equality Properties The identity and equality properties in the chart below can help you solve algebraic equations and evaluate mathematical expressions.

Additive Identity	For any number a , $a + 0 = a$.
Additive Inverse	For any number a , $a + (-a) = 0$.
Multiplicative Identity	For any number a , $a \cdot 1 = a$.
Multiplicative Property of 0	For any number a , $a \cdot 0 = 0$.
Multiplicative Inverse Property	For every number $\frac{a}{b}$, where $a, b \neq 0$, there is exactly one number $\frac{b}{a}$ such that $\frac{a}{b} \cdot \frac{b}{a} = 1$.
Reflexive Property	For any number a , $a = a$.
Symmetric Property	For any numbers a and b , if $a = b$, then $b = a$.
Transitive Property	For any numbers a, b , and c , if $a = b$ and $b = c$, then $a = c$.
Substitution Property	If $a = b$, then a may be replaced by b in any expression.

Example Evaluate $24 \cdot 1 - 8 + 5(9 \div 3 - 3)$. Name the property used in each step.

$$\begin{aligned}
 24 \cdot 1 - 8 + 5(9 \div 3 - 3) &= 24 \cdot 1 - 8 + 5(3 - 3) && \text{Substitution; } 9 \div 3 = 3 \\
 &= 24 \cdot 1 - 8 + 5(0) && \text{Substitution; } 3 - 3 = 0 \\
 &= 24 - 8 + 5(0) && \text{Multiplicative Identity; } 24 \cdot 1 = 24 \\
 &= 24 - 8 + 0 && \text{Multiplicative Property of Zero; } 5(0) = 0 \\
 &= 16 + 0 && \text{Substitution; } 24 - 8 = 16 \\
 &= 16 && \text{Additive Identity; } 16 + 0 = 16
 \end{aligned}$$

Exercises

Evaluate each expression. Name the property used in each step.

$$\begin{aligned}
 1. \quad & 2 \left[\frac{1}{4} + \left(\frac{1}{2} \right)^2 \right] && \text{Substitution; } 9 \div 3 = 3 \\
 &= 2 \left(\frac{1}{4} + \frac{1}{4} \right) && \text{Substitution} \\
 &= 2 \left(\frac{1}{2} \right) && \text{Substitution} \\
 &= 1 && \text{Mult. Inverse} \\
 \\
 2. \quad & 15 \cdot 1 - 9 + 2(15 \div 3 - 5) && \text{Substitution; } 9 \div 3 = 3 \\
 &= 15 \cdot 1 - 9 + 2(5 - 5) && \text{Substitution} \\
 &= 15 \cdot 1 - 9 + 2(0) && \text{Mult. Prop. Zero} \\
 &= 15 - 9 + 0 && \text{Mult. Identity} \\
 &= 6 - 0 && \text{Substitution} \\
 &= 6 && \text{Substitution}
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & 2(3 \cdot 5 \cdot 1 - 14) - 4 \cdot \frac{1}{4} && \text{Substitution; } 9 \div 3 = 3 \\
 &= 2(15 \cdot 1 - 14) - 4 \cdot \frac{1}{4} && \text{Subst.} \\
 &= 2(15 - 14) - 4 \cdot \frac{1}{4} && \text{Mult. Identity} \\
 &= 2(1) - 4 \cdot \frac{1}{4} && \text{Substitution} \\
 &= 2 - 4 \cdot \frac{1}{4} && \text{Mult. Identity} \\
 &= 2 - 1 && \text{Mult. Inverse} \\
 &= 1 && \text{Substitution} \\
 \\
 4. \quad & 18 \cdot 1 - 3 \cdot 2 + 2(6 \div 3 - 2) && \text{Substitution} \\
 &= 18 \cdot 1 - 3 \cdot 2 + 2(2 - 2) && \text{Subst.} \\
 &= 18 \cdot 1 - 3 \cdot 2 + 2(0) && \text{Substitution} \\
 &= 18 - 3 \cdot 2 + 2(0) && \text{Mult. Identity} \\
 &= 18 - 6 + 2(0) && \text{Substitution} \\
 &= 18 - 6 + 0 && \text{Mult. Prop. Zero} \\
 &= 12 + 0 && \text{Substitution} \\
 &= 12 && \text{Add. Identity}
 \end{aligned}$$

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1-3 Study Guide and Intervention

Properties of Numbers

Commutative and Associative Properties The Commutative and Associative Properties can be used to simplify expressions. The Commutative Properties state that the order in which you add or multiply numbers does not change their sum or product. The Associative Properties state that the way you group three or more numbers when adding or multiplying does not change their sum or product.

Commutative Properties	For any numbers a and b , $a + b = b + a$ and $a \cdot b = b \cdot a$.
Associative Properties	For any numbers a, b , and c , $(a + b) + c = a + (b + c)$ and $(ab)c = a(bc)$.

Example 1 Evaluate $6 \cdot 2 \cdot 3 \cdot 5$ using properties of numbers. Name the property used in each step.

$$\begin{aligned}
 6 \cdot 2 \cdot 3 \cdot 5 &= 6 \cdot 3 \cdot 2 \cdot 5 && \text{Commutative Property} \\
 &= (6 \cdot 3)(2 \cdot 5) && \text{Associative Property} \\
 &= 18 \cdot 10 && \text{Multiply.} \\
 &= 180 && \text{Multiply.}
 \end{aligned}$$

The product is 180.

Example 2 Evaluate

$$\begin{aligned}
 & 8.2 + 2.5 + 2.5 + 1.8 && \text{Commutative Prop.} \\
 &= 8.2 + 1.8 + 2.5 + 2.5 && \text{Associative Prop.} \\
 &= (8.2 + 1.8) + (2.5 + 2.5) && \text{Add.} \\
 &= 10 + 5 && \text{Add.} \\
 &= 15 && \text{Add.}
 \end{aligned}$$

The sum is 15.

Exercises

Evaluate each expression using properties of numbers. Name the property used in each step. Properties will vary. See students' work.

$$\begin{aligned}
 1. \quad & 12 + 10 + 8 + 5 && \text{3. } 10 \cdot 7 \cdot 2.5 && \text{175} \\
 & \text{2. } 16 + 8 + 22 + 12 && \text{58} \\
 \\
 4. \quad & 4 \cdot 8 \cdot 5 \cdot 3 && \text{480} && \text{6. } 26 + 8 + 4 + 22 && \text{60} \\
 \\
 7. \quad & 3 \frac{1}{2} + 4 + 2 \frac{1}{2} + 3 && \text{13} && \text{8. } \frac{3}{4} \cdot 12 \cdot 4 \cdot 2 && \text{72} && \text{9. } 3.5 + 2.4 + 3.6 + 4.2 && \text{13.7} \\
 \\
 10. \quad & 4 \frac{1}{2} + 5 + \frac{1}{2} + 3 && \text{13} && \text{11. } 0.5 \cdot 2.8 \cdot 4 && \text{5.6} && \text{12. } 2.5 + 2.4 + 2.5 + 3.6 && \text{11} \\
 \\
 13. \quad & \frac{4}{5} \cdot 18 \cdot 25 \cdot \frac{2}{9} && \text{80} && \text{14. } 32 \cdot \frac{1}{5} \cdot \frac{1}{2} \cdot 10 && \text{32} && \text{15. } \frac{1}{4} \cdot 7 \cdot 16 \cdot \frac{1}{7} && \text{4} \\
 \\
 16. \quad & 3.5 + 8 + 2.5 + 2 && \text{16} && \text{17. } 18 \cdot 8 \cdot \frac{1}{2} \cdot \frac{1}{9} && \text{8} && \text{18. } \frac{3}{4} \cdot 10 \cdot 16 \cdot \frac{1}{2} && \text{60}
 \end{aligned}$$

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1-3 Skills Practice

Properties of Numbers

Evaluate each expression. Name the property used in each step.

- $7(16 \div 4^2)$
 $= 7(16 \div 16)$ Substitution
 $= 7(1)$ Substitution
 $= 7$ Mult. Prop. of Zero
- $2[5 - (15 \div 3)]$
 $= 2(5 - 5)$ Substitution
 $= 2(0)$ Substitution
 $= 0$ Mult. Prop. of Zero
- $4 - 3(7 - 2 \cdot 3)$
 $= 4 - 3(7 - 6)$ Substitution
 $= 4 - 3(1)$ Substitution
 $= 4 - 3$ Multiplicative Identity
 $= 1$ Substitution
- $4[8 - (4 \cdot 2)] + 1$
 $= 4(8 - 8) + 1$ Substitution
 $= 4(0) + 1$ Substitution
 $= 0 + 1$ Mult. Prop. of Zero
 $= 1$ Additive Identity
- $6 + 9[10 - 2(2 + 3)]$
 $= 6 + 9[10 - 2(5)]$ Substitution
 $= 6 + 9(10 - 10)$ Substitution
 $= 6 + 9(0)$ Substitution
 $= 6 + 0$ Mult. Prop. of Zero
 $= 6$ Additive Identity
- $2(6 \div 3 - 1) \cdot \frac{1}{2}$
 $= 2(2 - 1) \cdot \frac{1}{2}$ Substitution
 $= 2(1) \cdot \frac{1}{2}$ Substitution
 $= 2 \cdot \frac{1}{2}$ Multiplicative Identity
 $= 1$ Multiplicative Inverse
- $16 + 8 + 14 + 12$
 $= 16 + 14 + 8 + 12$ Commutative (+)
 $= (16 + 14) + (8 + 12)$ Associative (+)
 $= 30 + 20$ or 50 Substitution
 $= 50 + 30$ or 80 Substitution
- $36 + 23 + 14 + 7$
 $= 36 + 14 + 23 + 7$ Commutative (+)
 $= (36 + 14) + (23 + 7)$ Associative (+)
 $= 50 + 30$ or 80 Substitution
- $2 \cdot 4 \cdot 5 \cdot 3$
 $= 5 \cdot 4 \cdot 3 \cdot 3$ Commutative (x)
 $= (5 \cdot 4) \cdot (3 \cdot 3)$ Associative (x)
 $= 20 \cdot 9$ or 180 Substitution
- $2 \cdot 5 \cdot 3 \cdot 4 \cdot 3$
 $= 2(5 - 3) - 2$
 $= 2(2) - 2$ Additive Identity
 $= 4 - 2$ Substitution
 $= 2$ Multiplicative Identity
- $2(15 - 5) + 3(9 - 8)$
 $= 2(10) + 3(1)$ Substitution
 $= 20 + 3(1)$ Substitution
 $= 20 + 3$ Multiplicative Identity
 $= 23$ Substitution

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1-3 Practice

Properties of Numbers

Evaluate each expression. Name the property used in each step.

- $2 + 6(9 - 3^2) - 2$
 $= 2 + 6(9 - 9) - 2$ Substitution
 $= 2 + 6(0) - 2$ Substitution
 $= 2 + 0 - 2$ Mult. Prop. of Zero
 $= 2 - 2$ Additive Identity
 $= 0$ Substitution
- $2 \cdot 5(14 - 39 \div 3) + 4 \cdot \frac{1}{4}$
 $= 2 + 6(9 - 9) - 2$ Substitution
 $= 2 + 6(0) - 2$ Substitution
 $= 2 + 0 - 2$ Mult. Prop. of Zero
 $= 2 - 2$ Additive Identity
 $= 0$ Substitution
- $13 + 23 + 12 + 7$
 $= (13 + 12) + (23 + 7)$ Commu. Prop.
 $= 25 + 30$ Substitution
 $= 55$ Substitution
- $6 \cdot 0 \cdot 7 \cdot 5$
 $= (6 \cdot 5) \cdot (0 \cdot 7)$ Assoc. Prop.
 $= 30 \cdot 0$ Substitution
 $= 0$ Substitution
- SALES Althea paid \$5.00 each for two bracelets and later sold each for \$15.00. She paid \$8.00 each for three bracelets and sold each of them for \$9.00.

a. Write an expression that represents the profit Althea made. $2(15 - 5) + 3(9 - 8)$

b. Evaluate the expression. Name the property used in each step.

 $2(15 - 5) + 3(9 - 8) = 2(10) + 3(1)$ Substitution
 $= 20 + 3(1)$ Substitution
 $= 20 + 3$ Multiplicative Identity
 $= 23$ Substitution
- SCHOOL SUPPLIES Kristen purchased two binders that cost \$1.25 each, two binders that cost \$4.75 each, two packages of paper that cost \$1.50 per package, four blue pens that cost \$1.15 each, and four pencils that cost \$0.35 each.

a. Write an expression to represent the total cost of supplies before tax.
 $2(1.25 + 4.75 + 1.50) + 4(1.15 + 0.35)$

b. What was the total cost of supplies before tax?
 $\$21.00$

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1-3 Word Problem Practice

Properties of Numbers

1. EXERCISE Annika goes on a walk every day in order to get the exercise her doctor recommends. If she walks at a rate of 3 miles per hour for $\frac{1}{3}$ of an hour, then she will have walked $3 \times \frac{1}{3}$ miles. Evaluate the expression and name the property used.

1 mi; Multiplicative Inverse

2. SCHOOL SUPPLIES At a local school supply store, a highlighter costs \$1.25, a ballpoint pen costs \$0.80, and a spiral notebook costs \$2.75. Use mental math and the Associative Property of Addition to find the total cost if one of each item is purchased. **\$4.80**

3. MENTAL MATH The triangular banner has a base of 9 centimeters and a height of 6 centimeters. Using the formula for area of a triangle, the banner's area can be expressed as $\frac{1}{2} \times 9 \times 6$. Gabrielle finds it easier to write and evaluate $(\frac{1}{2} \times 6) \times 9$ to find the area. Is Gabrielle's expression equivalent to the area formula? Explain.



Yes; the Commutative and Associative Properties of Multiplication allow it to be rewritten.

4. ANATOMY The human body has 60 bones in the arms and hands, 84 bones in the upper body and head, and 62 bones in the legs and feet. Use the Associative Property to write and evaluate an expression that represents the total number of bones in the human body.

Sample answer: $(60 + 84) + 62 = 84 + (60 + 62) = 206$

5. TOLL ROADS Some toll highways assess tolls based on where a car entered and exited. The table below shows the highway tolls for a car entering and exiting at a variety of exits. Assume that the toll for the reverse direction is the same.

Entered	Exited	Toll
Exit 5	Exit 8	\$0.50
Exit 8	Exit 10	\$0.25
Exit 10	Exit 15	\$1.00
Exit 15	Exit 18	\$0.50
Exit 18	Exit 22	\$0.75

a. Running an errand, Julio travels from Exit 8 to Exit 5. What property would you use to determine the toll?

Symmetric Property of Equality

b. Gordon travels from home to work and back each day. He lives at Exit 15 on the toll road and works at Exit 22. Write and evaluate an expression to find his daily toll cost. What property or properties did you use?

**$t = 2 \times (\$0.50 + \$0.75)$;
 $t = \$2.50$; Substitution**

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1-3 Enrichment

Properties of Operations

Let's make up a new operation and denote it by \otimes , so that $a \otimes b$ means b^a .

$2 \otimes 3 = 3^2 = 9$

$(1 \otimes 2) \otimes 3 = 2^1 \otimes 3 = 3^2 = 9$

1. What number is represented by $2 \otimes 3$? **$3^2 = 9$**

2. What number is represented by $3 \otimes 2$? **$2^3 = 8$**

3. Does the operation \otimes appear to be commutative? **no**

4. What number is represented by $(2 \otimes 1) \otimes 3$? **3**

5. What number is represented by $2 \otimes (1 \otimes 3)$? **9**

6. Does the operation \otimes appear to be associative? **no**

Let's make up another operation and denote it by \oplus , so that

$a \oplus b = (a + 1)(b + 1)$.

$3 \oplus 2 = (3 + 1)(2 + 1) = 4 \cdot 3 = 12$

$(1 \oplus 2) \oplus 3 = (2 \cdot 3) \oplus 3 = 6 \oplus 3 = 7 \cdot 4 = 28$

7. What number is represented by $2 \oplus 3$? **12**

8. What number is represented by $3 \oplus 2$? **12**

9. Does the operation \oplus appear to be commutative? **yes**

10. What number is represented by $(2 \oplus 3) \oplus 4$? **65**

11. What number is represented by $2 \oplus (3 \oplus 4)$? **63**

12. Does the operation \oplus appear to be associative? **no**

13. What number is represented by $1 \otimes (3 \oplus 2)$? **12**

14. What number is represented by $(1 \otimes 3) \oplus (1 \otimes 2)$? **12**

15. Does the operation \otimes appear to be distributive over the operation \oplus ? **yes**

16. Let's explore these operations a little further. What number is represented by $3 \otimes (4 \oplus 2)$? **3375**

17. What number is represented by $(3 \otimes 4) \oplus (3 \otimes 2)$? **585**

18. Is the operation \otimes actually distributive over the operation \oplus ? **no**

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1-4 Study Guide and Intervention

The Distributive Property

Evaluate Expressions The Distributive Property can be used to help evaluate expressions.

Distributive Property $a(b - c) = ab - ac$ and $(b - c)a = ba - ca$

Example 1 Use the Distributive Property to rewrite $6(8 + 10)$. Then evaluate.

$$\begin{aligned} 6(8 + 10) &= 6 \cdot 8 + 6 \cdot 10 && \text{Distributive Property} \\ &= 48 + 60 && \text{Multiply.} \\ &= 108 && \text{Add.} \end{aligned}$$

Example 2 Use the Distributive Property to rewrite $-2(3x^2 + 5x + 1)$. Then simplify.

$$\begin{aligned} -2(3x^2 + 5x + 1) &= -2(3x^2) + (-2)(5x) + (-2)(1) && \text{Distributive Property} \\ &= -6x^2 + (-10x) + (-2) && \text{Multiply.} \\ &= -6x^2 - 10x - 2 && \text{Simplify.} \end{aligned}$$

Exercises

Use the Distributive Property to rewrite each expression. Then evaluate.

- $20(31)$ 620
- $12 \cdot 4\frac{1}{2}$ 54
- $5(311)$ 1555
- $5(4x - 9)$ $20x - 45$
- $3(8 - 2x)$ $24 - 6x$
- $12\left(6 - \frac{1}{2}x\right)$ $72 - 6x$
- $12\left(2 + \frac{1}{2}x\right)$ $24 + 6x$
- $\frac{1}{4}(12 - 4t)$ $3 - t$
- $3(2x - y)$ $6x - 3y$
- $2(3x + 2y - z)$ $6x + 4y - 2z$
- $(x - 2)y$ $xy - 2y$
- $2(3a - 2b + c)$ $6a - 4b + 2c$
- $\frac{1}{4}(16x - 12y + 4z)$ $4x - 3y + z$
- $(2 - 3x + x^2)3$ $6 - 9x + 3x^2$
- $-2(2x^2 + 3x + 1)$ $-4x^2 - 6x - 2$

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1-4 Study Guide and Intervention

The Distributive Property

Simplify Expressions A term is a number, a variable, or a product or quotient of numbers and variables. Like terms are terms that contain the same variables, with corresponding variables having the same powers. The Distributive Property and properties of equalities can be used to simplify expressions. An expression is in **simplest form** if it is replaced by an equivalent expression with no like terms or parentheses.

Example Simplify $4(a^2 + 3ab) - ab$.

$$\begin{aligned} 4(a^2 + 3ab) - ab &= 4a^2 + 3ab - 1ab && \text{Multiplicative Identity} \\ &= 4a^2 + 12ab - 1ab && \text{Distributive Property} \\ &= 4a^2 + (12 - 1)ab && \text{Distributive Property} \\ &= 4a^2 + 11ab && \text{Substitution} \end{aligned}$$

Exercises

Simplify each expression. If not possible, write *simplified*.

- $12a - a$ 11a
- $3x + 6x$ 9x
- $3x - 1$ **simplified**
- $20a + 12a - 8$ 32a - 8
- $3x^2 + 2x^2$ 5x²
- $-6x + 3x^2 + 10x^2$ $-6x + 13x^2$
- $2p + \frac{1}{2}q$ **simplified**
- $10xy - 4(xy + xy)$ 2xy
- $21a + 18a + 31b - 3b$ 39a + 28b
- $4x + \frac{1}{4}(16x - 20y)$ 8x - 5y
- $2 - 1 - 6x + x^2$ 1 - 6x + x²
- $4x^2 + 3x^2 + 2x$ $7x^2 + 2x$

Write an algebraic expression for each verbal expression. Then simplify, indicating the properties used.

- six times the difference of $2a$ and b , increased by $4b$
 $= 6(2a - b) + 4b$
 $= 12a - 6b + 4b$
 $= 12a - 2b$
Distributive Property
Substitution

two times the sum of x squared and y squared, increased by three times the sum of x squared and y squared

$$\begin{aligned} &2(x^2 + y^2) + 3(x^2 + y^2) \\ &2x^2 + 2y^2 + 3x^2 + 3y^2 \\ &5x^2 + 5y^2 \end{aligned}$$

Distributive Property
Substitution

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1-4 Skills Practice

The Distributive Property

Use the Distributive Property to rewrite each expression. Then evaluate.

1. $4(3 + 5)$ $4 \cdot 3 + 4 \cdot 5$; 32
2. $2(6 + 10)$ $2 \cdot 6 + 2 \cdot 10$; 32
3. $5(7 - 4)$ $5 \cdot 7 - 5 \cdot 4$; 15
4. $(6 - 2)8$ $6 \cdot 8 - 2 \cdot 8$; 32
5. $5 \cdot 89$ $5(90 - 1)$; 445
6. $9 \cdot 99$ $9(100 - 1)$; 891
7. $15 \cdot 104$ $15(100 + 4)$; 1560
8. $15\left(2\frac{1}{3}\right)$ $15\left(2 + \frac{1}{3}\right)$; 35

Use the Distributive Property to rewrite each expression. Then evaluate.

9. $(a + 7)2$
 $a \cdot 2 + 7 \cdot 2$; $2a + 14$
10. $7(h - 10)$
 $7 \cdot h - 7 \cdot 10$; $7h - 70$
11. $3(m + n)$
 $3 \cdot m + 3 \cdot n$; $3m + 3n$
12. $2(x - y + 1)$
 $2 \cdot x - 2 \cdot y + 2 \cdot 1$; $2x - 2y + 2$

Simplify each expression. If not possible, write *simplified*.

13. $2x + 8x$ **10x**
14. $17g + g$ **18g**
15. $2x^2 + 6x^2$ **$8x^2$**
16. $7a^2 - 2a^2$ **$5a^2$**
17. $3y^2 - 2y$ **simplified**
18. $2(n + 2n)$ **$6n$**
19. $4(2b - b)$ **$4b$**
20. $3q^2 + q - q^2$ **$2q^2 + q$**

Write an algebraic expression for each verbal expression. Then simplify, indicating the properties used.

21. The product of 9 and t squared, increased by the sum of the square of t and 2
 $9t^2 + (t^2 + 2) = (9t^2 + t^2) + 2$
Associative (+)
Substitution
 $= 10t^2 + 2$

22. 3 times the sum of r and d squared minus 2 times the sum of r and d squared

$$3(r + d)^2 - 2(r + d)^2 = 3r^2 + 3d^2 - 2r^2 - 2d^2$$

Distributive

$$= (3d^2 - 2d^2) + (3r^2 - 2r^2)$$

Associative

$$= d^2 + r$$

Substitution

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1-4 Practice

The Distributive Property

Use the Distributive Property to rewrite each expression. Then evaluate.

1. $9(7 + 8)$
 $9 \cdot 7 + 9 \cdot 8$; 135
2. $7(6 - 4)$
 $7 \cdot 6 - 7 \cdot 4$; 14
3. $(4 + 6)11$
 $4 \cdot 11 + 6 \cdot 11$; 110
4. $9 \cdot 499$
 $5 \cdot 7 \cdot 110$
5. $16\left(\frac{4}{4}\right)$
 $16\left(4 + \frac{1}{4}\right)$; 68
6. $7(100 + 10)$; 770

Use the Distributive property to rewrite each expression. Then simplify.

7. $(9 - p)3$
 $9 \cdot 3 - p \cdot 3$; $27 - 3p$
8. $(5y - 3)7$
 $5y \cdot 7 - 3 \cdot 7$; $35y - 21$
9. $15\left(f + \frac{1}{3}\right)$
 $15 \cdot f + 15 \cdot \frac{1}{3}$; $15f + 5$
10. $16(3b - 0.25)$
 $16 \cdot 3b - 16 \cdot 0.25$; $m \cdot n + m \cdot 4$; $15f + 5$
11. $m(n + 4)$
 $m \cdot n + m \cdot 4$; $c \cdot d - 4 \cdot d$; $cd - 4d$
12. $(c - 4)d$
 $cd - 4d$

Simplify each expression. If not possible, write *simplified*.

13. $w + 14w - 6w$ **$9w$**
14. $3(5 + 6h)$ **$15 + 18h$**
15. $12b^2 + 9b^2$ **$21b^2$**
16. $25p^3 - 17p^3$ **$8p^3$**
17. $3a^2 + 6a + 2b^2$
simplified
18. $4(6p + 2q - 2p)$
 $16p + 8q$

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Write an algebraic expression for each verbal expression. Then simplify, indicating the properties used.

19. 4 times the difference of f squared and g , increased by the sum of f squared and $2g$
 $= 4(f^2 - g) + (f^2 + 2g)$
Distributive Property
 $= 4f^2 - 4g + f^2 + 2g$
Substitution
 $= 5f^2 - 2g$

20. 3 times the sum of x and y squared plus 5 times the difference of $2x$ and y

$$= 3(x + y)^2 + 5(2x - y)$$

Distributive Property

$$= 3x^2 + 3y^2 + 10x - 5y$$

Distributive Property

$$= 3y^2 - 5y + 13x$$

Substitution

21. **DINING OUT** The Ross family recently dined at an Italian restaurant. Each of the four family members ordered a pasta dish that cost \$11.50, a drink that cost \$1.50, and dessert that cost \$2.75.

a. Write an expression that could be used to calculate the cost of the Ross' dinner before adding tax and a tip. **$4(11.5 + 1.5 + 2.75)$**

b. What was the cost of dining out for the Ross family? **\$63.00**

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1-4 Word Problem Practice

The Distributive Property

1. **OPERA** Mr. Delong's drama class is planning a field trip to see Mozart's famous opera *Don Giovanni*. Tickets cost \$39 each, and there are 23 students and 2 teachers going on the field trip. Write and evaluate an expression to find the group's total ticket cost.
 $\$39(23 + 2) = \975
5. **MENTAL MATH** During a math facts speed contest, Jamal calculated the following expression faster than anyone else in his class.
 197×4

When classmates asked him how he was able to answer so quickly, he told them he used the Distributive Property to think of the problem differently. Write and evaluate an expression using the Distributive Property that would help Jamal perform the calculation quickly.

$$4(200 - 3) = 800 - 12 = 788$$

6. **INVESTMENTS** Letisha and Noel each opened a checking account, a savings account, and a college fund. The chart below shows the amounts that they deposited into each account.

	Checking	Savings	College
Letisha	\$125	\$75	\$50
Noel	\$250	\$50	\$50

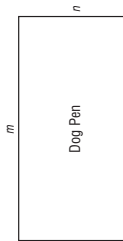
- a. If Noel used only \$50 bills when he deposited the money to open his accounts, how many \$50 bills did he deposit? **7 \$50 bills**
- b. If all accounts earn 1.5% interest per year and no further deposits are made, how much interest will Letisha have earned one year after her accounts were opened? **\$3.75**

2. **SALARY** In a recent year, the median salary for an engineer in the United States was \$55,000 and the median salary for a computer programmer was \$52,000. Write and evaluate an expression to estimate the total cost for a business to employ an engineer and a programmer for 5 years.
 $5(55,000 + 52,000) = \$535,000$

3. **COSTUMES** Isabella's ballet class is performing a spring recital for which they need butterfly costumes. Each butterfly costume is made from $3\frac{3}{5}$ yards of fabric. Use the Distributive Property to find the number of yards of fabric needed for 5 costumes. (*Hint:* A mixed number can be written as the sum of an integer and a fraction.)
 $5(3\frac{3}{5}) = 5(3 + \frac{3}{5}) = 5(3) + 5(\frac{3}{5}) = 15 + 3 = 18$

4. **FENCES** Demonstrate the Distributive Property by writing two equivalent expressions to represent the perimeter of the fenced dog pen below.

$$2n + 2m \text{ and } 2(n + m)$$



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1-4 Enrichment

The Maya

The Maya were a Native American people who lived from about 1500 B.C. to about 1500 A.D. in the region that today encompasses much of Central America and southern Mexico. Their many accomplishments include exceptional architecture, pottery, painting, and sculpture, as well as significant advances in the fields of astronomy and mathematics.

The Maya developed a system of numeration that was based on the number twenty. The basic symbols of this system are shown in the table at the right. The places in a Mayan numeral are written vertically—the bottom place represents *ones*, the place above represents *twenties*, the place above that represents 20×20 , or *four hundreds*, and so on. For instance, this is how to write the number 997 in Mayan numerals.

$$\begin{array}{r} \bullet\bullet \leftarrow 2 \times 400 = 800 \\ \bullet\bullet\bullet\bullet \leftarrow 9 \times 20 = 180 \\ \bullet\bullet\bullet \leftarrow 17 \times 1 = 17 \\ \hline 997 \end{array}$$

0	⊙	10	=====
1	•	11	•=====
2	••	12	••=====
3	•••	13	•••=====
4	••••	14	••••=====
5	=====	15	=====
6	•=====	16	•=====
7	••=====	17	••=====
8	•••=====	18	•••=====
9	••••=====	19	••••=====

Evaluate each expression when $v = \frac{1}{2}$, $w = \frac{3}{4}$, $x = \frac{1}{3}$, $y = \frac{2}{5}$, and $z = \frac{1}{6}$. Then write the answer in Mayan numerals. Exercise 5 is done for you.

1. $\frac{z}{w}$ $\frac{1}{6} \div \frac{3}{4} = \frac{4}{9}$
2. $\frac{v+w+z}{x} = \frac{\frac{1}{2} + \frac{3}{4} + \frac{1}{3}}{\frac{1}{3}} = \frac{\frac{6}{12} + \frac{9}{12} + \frac{4}{12}}{\frac{4}{12}} = \frac{19}{4}$
3. $xv = \frac{1}{3} \times \frac{2}{5} = \frac{2}{15}$
4. $wxy = \frac{3}{4} \times \frac{2}{5} \times \frac{1}{3} = \frac{1}{10}$
5. $wx - z = \frac{3}{4} \times \frac{1}{3} - \frac{1}{6} = \frac{1}{4} - \frac{1}{6} = \frac{1}{12}$
6. $vz + xy = \frac{1}{2} \times \frac{1}{6} + \frac{2}{5} \times \frac{1}{3} = \frac{1}{12} + \frac{2}{15} = \frac{5}{60} + \frac{8}{60} = \frac{13}{60}$
7. $w(v + x + z) = \frac{3}{4}(\frac{1}{2} + \frac{1}{3} + \frac{1}{6}) = \frac{3}{4}(\frac{3}{6} + \frac{2}{6} + \frac{1}{6}) = \frac{3}{4}(\frac{6}{6}) = \frac{3}{4}$
8. $vuz = \frac{1}{2} \times \frac{3}{4} \times \frac{1}{6} = \frac{1}{16}$
9. $z(uz - x) = \frac{1}{6}(\frac{1}{6} \times \frac{3}{4} - \frac{1}{3}) = \frac{1}{6}(\frac{1}{8} - \frac{1}{3}) = \frac{1}{6}(\frac{3}{24} - \frac{8}{24}) = \frac{1}{6}(-\frac{5}{24}) = -\frac{5}{144}$

Tell whether each statement is true or false.

10. $\frac{1}{2} + \frac{1}{3} = \frac{1}{5}$ **false**
11. $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$ **true**
12. $\frac{1}{2} + \frac{1}{3} = \frac{1}{6}$ **false**
13. $(\frac{1}{2} + \frac{1}{3}) + \frac{1}{6} = \frac{1}{2} + (\frac{1}{3} + \frac{1}{6})$ **true**

14. How are Exercises 10 and 11 alike? How are they different?

Both involve changing the order of the symbols. Exercise 10 involves changing the order of the addends in an addition problem. Exercise 11 involves changing the order of the digits in a numeral.

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1-5 Study Guide and Intervention

Equations

Solve Equations A mathematical sentence with one or more variables is called an **open sentence**. Open sentences are **solved** by finding replacements for the variables that result in true sentences. The set of numbers from which replacements for a variable may be chosen is called the **replacement set**. The set of all replacements for the variable that result in true statements is called the **solution set** for the variable. A sentence that contains an equal sign, =, is called an **equation**.

Example 1 Find the solution set of $3a + 12 = 39$ if the replacement set is {6, 7, 8, 9, 10}.

Replace a in $3a + 12 = 39$ with each value in the replacement set.

$3(6) + 12 \stackrel{?}{=} 39 \rightarrow 30 \neq 39$ false
 $3(7) + 12 \stackrel{?}{=} 39 \rightarrow 33 \neq 39$ false
 $3(8) + 12 \stackrel{?}{=} 39 \rightarrow 36 \neq 39$ false
 $3(9) + 12 \stackrel{?}{=} 39 \rightarrow 39 = 39$ true
 $3(10) + 12 \stackrel{?}{=} 39 \rightarrow 42 \neq 39$ false

Since $a = 9$ makes the equation $3a + 12 = 39$ true, the solution is 9. The solution set is {9}.

Example 2 Solve $\frac{2(3 + 1)}{3(7 - 4)} = b$.

$$\frac{2(3 + 1)}{3(7 - 4)} = b$$

Original equation

$$\frac{2(4)}{3(3)} = b$$

Add in the numerator; subtract in the denominator.

$$\frac{8}{9} = b$$

Simplify.

The solution is $\frac{8}{9}$.

Exercises

Find the solution of each equation if the replacement sets are $x = \left\{\frac{1}{4}, \frac{1}{2}, 1, 2, 3\right\}$ and $y = \{2, 4, 6, 8\}$.

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

4. $x^2 - 1 = 8$ {3}

7. $2(x + 3) = 7\left\{\frac{1}{2}\right\}$

2. $x + 8 = 11$ {3}

5. $y^2 - 2 = 34$ {6}

8. $(y + 1)^2 = 9$ {2}

3. $y - 2 = 6$ {8}

6. $x^2 + 5 = 5 - \frac{1}{16}\left\{\frac{1}{4}\right\}$

9. $y^2 + y = 20$ {4}

10. $a = 2^3 - 1$ 7

13. $\frac{1}{4} + \frac{5}{8} = k$ $\frac{7}{8}$

16. $18.4 - 3.2 = m$ 15.2

11. $n = 6^3 - 4^2$ 20

14. $\frac{18 - 3}{2 + 3} = p$ 3

17. $k = 9.8 + 5.7$ 15.5

12. $w = 6^3 \cdot 3^2$ 324

15. $t = \frac{15 - 6}{27 - 24}$ 3

18. $c = 3\frac{1}{2} + 2\frac{1}{4}$ $5\frac{3}{4}$

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1-5 Study Guide and Intervention

Equations

Solve Equations with Two Variables Some equations contain two variables. It is often useful to make a table of values in which you can use substitution to find the corresponding values of the second variable.

Example

MUSIC DOWNLOADS Emily belongs to an Internet music service that charges \$5.99 per month and \$0.89 per song. Write and solve an equation to find the total amount Emily spends if she downloads 10 songs this month.

The cost of the music service is a flat rate. The variable is the number of songs she downloads. The total cost is the price of the service plus \$0.89 times the number of songs.

$$C = 0.89n + 5.99$$

To find the total cost for the month, substitute 10 for n in the equation.

$$C = 0.89n + 5.99$$

Original equation

$$= 0.89(10) + 5.99$$

Substitute 10 for n .

$$= 8.90 + 5.99$$

Multiply.

$$= 14.89$$

Add.

Emily spent \$14.89 on music downloads in one month.

Exercises

1. **AUTO REPAIR** A mechanic repairs Mr. Estes' car. The amount for parts is \$48.00 and the rate for the mechanic is \$40.00 per hour. Write and solve an equation to find the total cost of repairs to Mr. Estes' car if the mechanic works for 1.5 hours.
C = 48 + 40x; \$108.00

2. **SHIPPING FEES** Mr. Moore purchases an inflatable kayak weighing 30 pounds from an online company. The standard rate to ship his purchase is \$2.99 plus \$0.85 per pound. Write and solve an equation to find the total amount Mr. Moore will pay to have the kayak shipped to his home. **C = 2.99 + 0.85x; \$28.49**

3. **SOUND** The speed of sound is 1088 feet per second at sea level at 32°F. Write and solve an equation to find the distance sound travels in 8 seconds under these conditions.
d = 1088x; 8704 ft

4. **VOLLEYBALL** Your town decides to build a volleyball court. If the court is approximately 40 by 70 feet and its surface is of sand, one foot deep, the court will require about 166 tons of sand. A local sand pit sells sand for \$11.00 per ton with a delivery charge of \$3.00 per ton. Write and solve an equation to find the total cost of the sand for this court.
C = 14x; \$2324.00

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1-5 Skills Practice

Equations

Find the solution of each equation if the replacement sets are $A = \{4, 5, 6, 7, 8\}$ and $B = \{9, 10, 11, 12, 13\}$.

1. $5a - 9 = 26$ **7**

2. $4a - 8 = 16$ **6**

3. $7a + 21 = 56$ **5**

4. $3b + 15 = 48$ **11**

5. $4b - 12 = 28$ **10**

6. $\frac{36}{b} - 3 = 0$ **12**

Find the solution of each equation using the given replacement set.

7. $\frac{1}{2} + x = \frac{5}{4}$, $\left\{\frac{1}{2}, \frac{3}{4}, 1, \frac{5}{4}\right\}$ **$\frac{3}{4}$**

8. $x + \frac{2}{3} = -\frac{13}{9}$, $\left\{\frac{5}{9}, \frac{2}{3}, \frac{7}{9}\right\}$ **$\frac{7}{9}$**

9. $\frac{1}{4}(x + 2) = \frac{5}{6}$, $\left\{\frac{2}{3}, \frac{5}{4}, \frac{4}{3}\right\}$ **$\frac{4}{3}$**

10. $0.8(x + 5) = 5.2$; $\{1.2, 1.3, 1.4, 1.5\}$ **1.5**

Solve each equation.

11. $10.4 - 6.8 = x$ **3.6**

12. $y = 20.1 - 11.9$ **8.2**

13. $\frac{46 - 15}{3} = a$ **1**

14. $c = \frac{6 + 18}{31 - 25}$ **4**

15. $\frac{2(4) + 4}{3(3 - 1)} = b$ **2**

16. $\frac{6(7 - 2)}{3(8) + 6} = n$ **1**

17. SHOPPING ONLINE Jennifer is purchasing CDs and a new CD player from an online store. She pays \$10 for each CD, as well as \$50 for the CD player. Write and solve an equation to find the total amount Jennifer spent if she buys 4 CDs and a CD player from the store. **$50 + 10(4) = t$; $t = \$90$**

18. TRAVEL An airplane can travel at a speed of 550 miles per hour. Write and solve an equation to find the time it will take to fly from London to Montreal, a distance of approximately 3300 miles. **$3300 = t$; $t = 6$ hours**

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1-5 Practice

Equations

Find the solution of each equation if the replacement sets are $a = \left\{0, \frac{1}{2}, 1, \frac{3}{2}, 2\right\}$ and $b = \{3, 3.5, 4, 4.5, 5\}$.

1. $a + \frac{1}{2} = 1$ **$\frac{1}{2}$**

2. $4b - 8 = 6$ **3.5**

3. $6a + 18 = 27$ **$\frac{3}{2}$**

4. $7b - 8 = 16.5$ **3.5**

5. $120 - 28a = 78$ **$\frac{3}{2}$**

6. $\frac{28}{b} + 9 = 16$ **4**

Solve each equation.

7. $x = 18.3 - 4.8$ **13.5**

8. $w = 20.2 - 8.95$ **11.25**

9. $\frac{37 - 9}{18 - 11} = d$ **4**

10. $\frac{97 - 25}{41 - 23} = k$ **4**

11. $y = \frac{4(22 - 4)}{3(6) + 6}$ **3**

12. $\frac{5(2^2) + 4(3)}{4(2^3 - 4)} = p$ **2**

13. TEACHING A teacher has 15 weeks in which to teach six chapters. Write and then solve an equation that represents the number of lessons the teacher must teach per week if there is an average of 8.5 lessons per chapter.

$n = \frac{6(8.5)}{15}$; 3.4

14. CELL PHONES Gabriel pays \$40 a month for basic cell phone service. In addition, Gabriel can send text messages for \$0.20 each. Write and solve an equation to find the total amount Gabriel spent this month if he sends 40 text messages.

$c = 40 + 0.20(40)$; \$48.00

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1-5 Word Problem Practice

Equations

- 1. TIME** There are 6 time zones in the United States. The eastern part of the U.S., including New York City, is in the Eastern Time Zone. The central part of the U.S., including Dallas, is in the Central Time Zone, which is one hour behind Eastern Time. San Diego is in the Pacific Time Zone, which is 3 hours behind Eastern Time. Write and solve an equation to determine what time it is in California if it is noon in New York.
- 12 - c = 3; 9:00 AM**

- 2. FOOD** Part of the Nutrition Facts label from a box of macaroni and cheese is shown below.

Nutrition Facts	
Serving Size 1 cup (228g) Servings Per Container 2	
Amount Per Serving	Calories from Fat 110
Calories 250	% Daily Value *
Total Fat 12g	18 %
Saturated Fat 3g	15 %
Trans Fat 3g	6 %
Cholesterol 30mg	10 %

- Write and solve an equation to determine how many servings of this item Alisa can eat each day if she wants to consume exactly 45 grams of cholesterol.
- c = 45; 1.5 servings**

- 3. CRAFTS** You need 30 yards of yarn to crochet a small scarf. Cheryl bought a 100-yard ball of yarn and has already used 10 yards. Write and solve an equation to find how many scarves she can crochet if she plans on using up the entire ball. **100 - 10 = 30s; 3 scarves**

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1-5 Enrichment

Solution Sets

Consider the following open sentence.

It is the name of a month between March and July.

You know that a replacement for the variable *It* must be found in order to determine if the sentence is true or false. If *It* is replaced by either April, May, or June, the sentence is true. The set {April, May, June} is called the solution set of the open sentence given above. This set includes all replacements for the variable that make the sentence true.

Write the solution set for each open sentence.

- It is the name of a state beginning with the letter A.
{Alabama, Alaska, Arizona, Arkansas}
 - It is a primary color.
{red, yellow, blue}
 - Its capital is Harrisburg. **{Pennsylvania}**
 - It is a New England state. **{Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut}**
 - $x + 4 = 10$ **{6}**
 - It is the name of a month that contains the letter *r*.
{Jan, Feb, Mar, Apr, Sept, Oct, Nov, Dec}
 - She was the wife of a U.S. President who served in the years 2000–2010.
{Hillary Clinton, Laura Bush, Michelle Obama}
 - It is an even number between 1 and 13. **{2, 4, 6, 8, 10, 12}**
 - $31 = 72 - k$ **{41}**
 - It is the square of 2, 3, or 4. **{4, 9, 16}**
- Write an open sentence for each solution set.**
- {A, E, I, O, U} **It is a vowel.**
 - {1, 3, 5, 7, 9} **It is an odd number between 0 and 10.**
 - {June, July, August} **It is a summer month.**
 - {Atlantic, Pacific, Indian, Arctic} **It is an ocean.**

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1-5 Spreadsheet Activity

Solving Open Sentences

A spreadsheet is a tool for working with and analyzing numerical data. The data is entered into a table in which each row is numbered and each column is labeled by a letter. You can use a spreadsheet to find solutions of open sentences.

Example Use a spreadsheet to find the solution for $4(x - 3) = 32$ if the replacement set is $\{7, 8, 9, 10, 11, 12\}$.

You can solve the open sentence by replacing x with each value in the replacement set.

Step 1 Use the first column of the spreadsheet for the replacement set. Enter the numbers using the formula bar. Click on a cell of the spreadsheet, type the number and press **ENTER**.

	A	B	C
1	x	$4(x - 3)$	
2	7	$=4*(A2-3)$	
3	8	$=4*(A3-3)$	
4	9	$=4*(A4-3)$	
5	10	$=4*(A5-3)$	
6	11	$=4*(A6-3)$	
7	12	$=4*(A7-3)$	

Step 2 The second column contains the formula for the left side of the open sentence. To enter a formula, enter an equals sign followed by the formula. Use the name of the cell containing each replacement value to evaluate the formula for that value. For example, in cell B2, the formula contains A2 in place of x .

	A	B	C
1	x	$4(x - 3)$	
2	7	$=4*(A2-3)$	16
3	8	$=4*(A3-3)$	20
4	9	$=4*(A4-3)$	24
5	10	$=4*(A5-3)$	28
6	11	$=4*(A6-3)$	32
7	12	$=4*(A7-3)$	36

The solution is the value of x for which the formula in column B returns 32. The solution is 11.

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Exercises

Use a spreadsheet to find the solution of each equation using the given replacement set.

- $x + 7.5 = 18.3$; $\{8.8, 9.8, 10.8, 11.8\}$
- $6(x + 2) = 18$; $\{0, 1, 2, 3, 4, 5\}$
- $4x + 1 = 17$; $\{0, 1, 2, 3, 4, 5\}$
- $4.9 - x = 2.2$; $\{2.6, 2.7, 2.8, 2.9, 3.0\}$
- $2.6x = 16.9$; $\{6.1, 6.3, 6.5, 6.7, 6.9\}$
- $12x - 8 = 22$; $\{2.1, 2.2, 2.3, 2.4, 2.5, 2.6\}$

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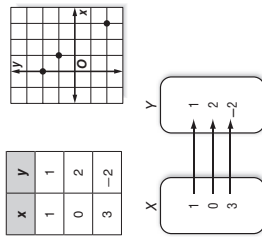
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1-6 Study Guide and Intervention

Relations

Represent a Relation A relation is a set of ordered pairs. A relation can be represented by a set of ordered pairs, a table, a graph, or a mapping. A mapping illustrates how each element of the domain is paired with an element in the range. The set of first numbers of the ordered pairs is the **domain**. The set of second numbers of the ordered pairs is the **range** of the relation.

Example a. Express the relation $\{(1, 1), (0, 2), (3, -2)\}$ as a table, a graph, and a mapping.

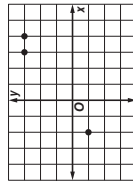
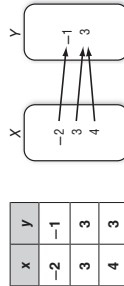


b. Determine the domain and the range of the relation.

The domain for this relation is $\{0, 1, 3\}$. The range for this relation is $\{-2, 1, 2\}$.

Exercises

1A. Express the relation $\{(-2, -1), (3, 3), (4, 3)\}$ as a table, a graph, and a mapping.



1B. Determine the domain and the range of the relation.
domain $\{-2, 3, 4\}$; **range** $\{-1, 3\}$

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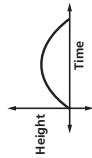
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1-6 Study Guide and Intervention *(continued)*

Relations

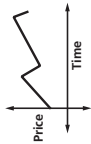
Graphs of a Relation The value of the variable in a relation that is subject to choice is called the **independent variable**. The variable with a value that is dependent on the value of the independent variable is called the **dependent variable**. These relations can be graphed without a scale on either axis, and interpreted by analyzing the shape.

Example 1 The graph below represents the height of a football after it is kicked downfield. Identify the independent and the dependent variable for the relation. Then describe what happens in the graph.



The independent variable is time, and the dependent variable is height. The football starts on the ground when it is kicked. It gains altitude until it reaches a maximum height, then it loses altitude until it falls to the ground.

Example 2 The graph below represents the price of stock over time. Identify the independent and dependent variable for the relation. Then describe what happens in the graph.

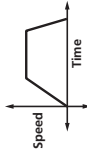


The independent variable is time and the dependent variable is price. The price increases steadily, then it falls, then increases, then falls again.

Exercises

Identify the independent and dependent variables for each relation. Then describe what is happening in each graph.

1. The graph represents the speed of a car as it travels to the grocery store.
Ind: time; **dep:** speed. The car starts from a standstill, accelerates, then travels at a constant speed for a while. Then it slows down and stops.



2. The graph represents the balance of a savings account over time.
Ind: time; **dep:** balance. The account balance has an initial value then it increases as deposits are made. It then stays the same for a while, again increases, and lastly goes to 0 as withdrawals are made.



3. The graph represents the height of a baseball after it is hit.
Ind: time; **dep:** height. The ball is hit a certain height above the ground. The height of the ball increases until it reaches its maximum value, then the height decreases until the ball hits the ground.



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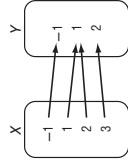
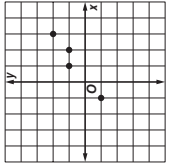
1-6 Skills Practice

Relations

Express each relation as a table, a graph, and a mapping. Then determine the domain and range.

1. $\{(-1, -1), (1, 1), (2, 1), (3, 2)\}$

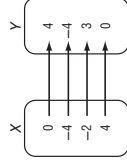
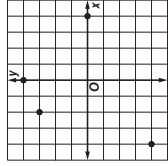
x	y
-1	-1
1	1
2	1
3	2



$D = \{-1, 1, 2, 3\}$; $R = \{-1, 1, 2\}$

2. $\{(0, 4), (-4, -4), (-2, 3), (4, 0)\}$

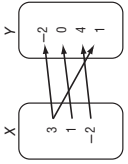
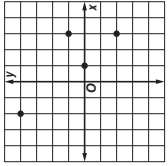
x	y
0	4
-4	-4
-2	3
4	0



$D = \{-4, -2, 0, 4\}$; $R = \{-4, 0, 3, 4\}$

3. $\{(3, -2), (1, 0), (-2, 4), (3, 1)\}$

x	y
3	-2
1	0
-2	4
3	1



$D = \{-2, 1, 3\}$; $R = \{-2, 0, 1, 4\}$

Identify the independent and dependent variables for each relation.

4. The more hours Maribel works at her job, the larger her paycheck becomes.
independent: hours worked, **dependent:** size of paycheck

5. Increasing the price of an item decreases the amount of people willing to buy it.
independent: price of an item,
dependent: number of people willing to buy it

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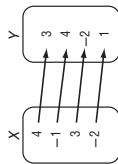
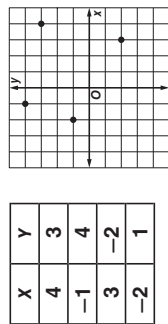
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1-6 Practice

Relations

1. Express $\{(4, 3), (-1, 4), (3, -2), (-2, 1)\}$ as a table, a graph, and a mapping. Then determine the domain and range.



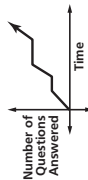
$D = \{-2, -1, 3, 4\}; R = \{-2, 1, 3, 4\}$

Describe what is happening in each graph.

2. The graph below represents the height of a tsunami as it travels across an ocean.



3. The graph below represents a student taking an exam.

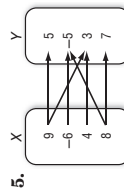


The longer it travels, the higher the tsunami becomes.

The student repeatedly answers questions and then pauses.

Express the relation shown in each table, mapping, or graph as a set of ordered pairs.

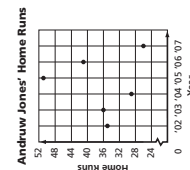
X	Y
0	9
-8	3
2	-6
1	4



$\{(0, 9), (-8, 3), (2, -6), (1, 4)\}$
 $\{(9, 5), (9, 3), (-6, -5), (4, 3), (8, -5), (8, 7)\}$

7. **BASEBALL** The graph shows the number of home runs hit by Andrew Jones of the Atlanta Braves. Express the relation as a set of ordered pairs. Then describe the domain and range.

$\{(02, 35), (03, 36), (04, 29), (05, 51), (06, 41), (07, 26)\};$
 $D = \{02, '03, '04, '05, '06, '07\};$
 $R = \{26, 29, 35, 36, 41, 51\}$



1-6 Word Problem Practice

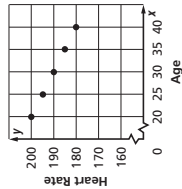
Relations

1. **HEALTH** The American Heart Association recommends that your target heart rate during exercise should be between 50% and 75% of your maximum heart rate. Use the data in the table below to graph the approximate maximum heart rates for people of given ages.

Age (years)	20	25	30	35	40
Maximum Heart Rate (beats per minute)	200	195	190	185	180

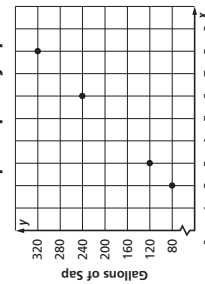
Source: American Heart Association

Maximum Heart Rate



2. **NATURE** Maple syrup is made by collecting sap from sugar maple trees and boiling it down to remove excess water. The graph shows the number of gallons of tree sap required to make different quantities of maple syrup. Express the relation as a set of ordered pairs.

Maple Sap to Syrup



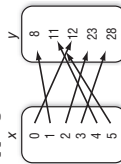
Source: Vermont Maple Sugar Makers' Association
 $\{(2, 80), (3, 120), (6, 240), (8, 320)\}$

3. **BAKING** Identify the graph that best represents the relationship between the number of cookies and the equivalent number of dozens.



Graph B

4. **DATA COLLECTION** Margaret collected data to determine the number of books her schoolmates were bringing home each evening. She recorded her data as a set of ordered pairs. She let x be the number of textbooks brought home after school, and y be the number of students with x textbooks. The relation is shown in the mapping.



- a. Express the relation as a set of ordered pairs.
 $\{(0, 12), (1, 8), (2, 23), (3, 28), (4, 11), (5, 11)\}$

- b. What is the domain of the relation?
 $\{0, 1, 2, 3, 4, 5\}$

- c. What is the range of the relation?
 $\{8, 11, 12, 23, 28\}$

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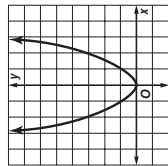
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1-6 Enrichment

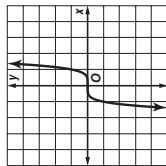
Even and Odd Functions

We know that numbers can be either even or odd. It is also true that functions can be defined as even or odd. For a function to be even means that it is symmetric about the y -axis. That is, if you fold the graph along the y -axis, the two halves of the graph match exactly. For a function to be odd means that the function is symmetric about the origin. This means if you rotate the graph using the origin as the center, it will match its original position before completing a full turn.

The function $y = x^2$ is an even function.

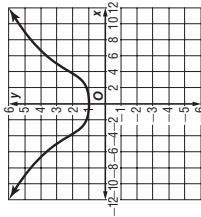


The function $y = x^3$ is an odd function. If you rotate the graph 180° the graph will lie on itself.



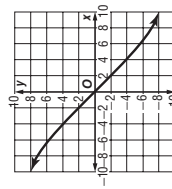
1. The table below shows the ordered pairs of an even function. Complete the table. Plot the points and sketch the graph.

x	-12	-5	-1	1	5	12
y	6	3	1	1	3	6



2. The table below shows the ordered pairs of an odd function. Complete the table. Plot the points and sketch the graph.

x	-10	-4	-2	2	4	10
y	8	4	2	-2	-4	-8



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1-7 Study Guide and Intervention Functions

Identify Functions Relations in which each element of the domain is paired with exactly one element of the range are called **functions**.

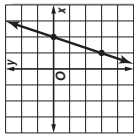
Example 1 Determine whether the relation $\{(6, -3), (4, 1), (7, -2), (-3, 1)\}$ is a function. Explain.

Since each element of the domain is paired with exactly one element of the range, this relation is a function.

Example 2 Determine whether $3x - y = 6$ is a function.

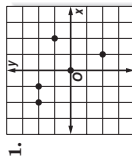
Since the equation is in the form $Ax + By = C$, the graph of the equation will be a line, as shown at the right.

If you draw a vertical line through each value of x , the vertical line passes through just one point of the graph. Thus, the line represents a function.

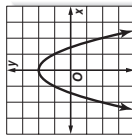


Exercises

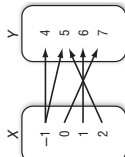
Determine whether each relation is a function.



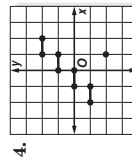
yes



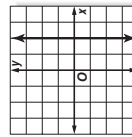
yes



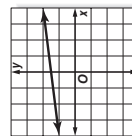
no



no



no



yes

7. $\{(4, 2), (2, 3), (6, 1)\}$
yes

8. $\{(-3, -3), (-3, 4), (-2, 4)\}$
no

9. $\{(-1, 0), (1, 0)\}$
yes

10. $-2x + 4y = 0$
yes

11. $x^2 + y^2 = 8$
no

12. $x = -4$
no

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1-7 Study Guide and Intervention (continued)

Functions

Find Function Values Equations that are functions can be written in a form called **function notation**. For example, $y = 2x - 1$ can be written as $f(x) = 2x - 1$. In the function, x represents the elements of the domain, and $f(x)$ represents the elements of the range. Suppose you want to find the value in the range that corresponds to the element 2 in the domain. This is written $f(2)$ and is read “ f of 2.” The value of $f(2)$ is found by substituting 2 for x in the equation.

Example If $f(x) = 3x - 4$, find each value.

a. $f(3)$
 $f(3) = 3(3) - 4$ Replace x with 3.
 $= 9 - 4$ Multiply.
 $= 5$ Simplify.

b. $f(-2)$
 $f(-2) = 3(-2) - 4$ Replace x with -2 .
 $= -6 - 4$ Multiply.
 $= -10$ Simplify.

Exercises

If $f(x) = 2x - 4$ and $g(x) = x^2 - 4x$, find each value.

1. $f(4)$ 4
 2. $g(2)$ -4
 3. $f(-5)$ -14
 4. $g(-3)$ 21
 5. $f(0)$ -4
 6. $g(0)$ 0
 7. $f(3) - 1$ 1
 8. $f\left(\frac{1}{4}\right)$ $-3\frac{1}{2}$
 9. $g\left(\frac{1}{4}\right)$ $\frac{15}{16}$
 10. $f(a^2)$ $2a^2 - 4$
 11. $f(k + 1)$ $2k - 2$
 12. $g(2n)$ $4n^2 - 8n$
 13. $f(3x)$ $6x - 4$
 14. $f(2) + 3$ 3
 15. $g(-4)$ 32

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Answers (Lesson 1-7)

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1-7 Skills Practice

Functions

Determine whether each relation is a function.

1. **yes**
 2. **yes**
 3. **no**

4. **yes**

x	y
4	-5
-1	-10
0	-9
1	-7
9	1

5. **no**

x	y
2	7
5	-3
3	5
-4	-2
5	2

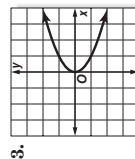
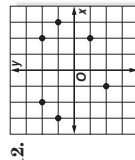
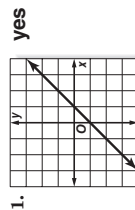
6. **no**

x	y
3	7
-1	1
1	0
3	5
7	3

7. $((2, 5), (4, -2), (3, 3), (5, 4), (-2, 5))$ **yes** $((6, -1), (-4, 2), (5, 2), (4, 6), (6, 5))$ **no**

9. $y = 2x - 5$ **yes**

10. $y = 11$ **yes**



If $f(x) = 3x + 2$ and $g(x) = x^2 - x$, find each value.

14. $f(4)$ 14
 15. $f(8)$ 26
 16. $f(-2)$ -4
 17. $g(2)$ 2
 18. $g(-3)$ 42
 19. $g(-6)$ 42
 20. $f(2) + 1$ 9
 21. $f(1) - 1$ 4
 22. $g(2) - 2$ 0
 23. $g(-1) + 4$ 6
 24. $f(x + 1)$ $3x + 5$
 25. $g(3b)$ $9b^2 - 3b$

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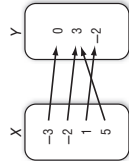
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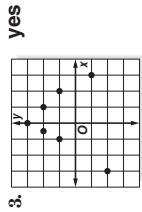
1-7 Practice Functions

Determine whether each relation is a function.



2.

X	Y
1	-5
-4	3
7	6
1	-2



4. $\{(1, 4), (2, -2), (3, -6), (-6, 3), (-3, 6)\}$ 5. $\{(6, -4), (2, -4), (-4, 2), (4, 6), (2, 6)\}$

6. $x = -2$ **no** 7. $y = 2$ **yes**

If $f(x) = 2x - 6$ and $g(x) = x - 2x^2$, find each value.

8. $f(2) = -2$ 9. $f\left(-\frac{1}{2}\right) = -7$ 10. $g(-1) = -3$
 11. $g\left(-\frac{1}{3}\right) = -\frac{5}{9}$ 12. $f(7) = -9$ -1 13. $g(-3) = 13$ -8
 14. $f(h + 9) = 2h + 12$ 15. $g(3y) = 3y - 18y^2$ 16. $2g(b) + 1 = 2b - 4b^2 + 2$

17. **WAGES** Martin earns \$7.50 per hour proofreading ads at a local newspaper. His weekly wage w can be described by the equation $w = 7.5h$, where h is the number of hours worked.

- a. Write the equation in function notation. **$f(h) = 7.5h$**
 b. Find $f(15)$, $f(20)$, and $f(25)$. **112.50, 150, 187.50**

18. **ELECTRICITY** The table shows the relationship between resistance R and current I in a circuit.

Resistance (ohms)	120	80	48	6	4
Current (amperes)	0.1	0.15	0.25	2	3

- a. Is the relationship a function? Explain. **Yes; for each value in the domain, there is only one value in the range.**
- b. If the relation can be represented by the equation $IR = 12$, rewrite the equation in function notation so that the resistance R is a function of the current I . **$f(I) = \frac{12}{I}$**
- c. What is the resistance in a circuit when the current is 0.5 ampere? **24 ohms**

Chapter 1

46

Glencoe Algebra 1

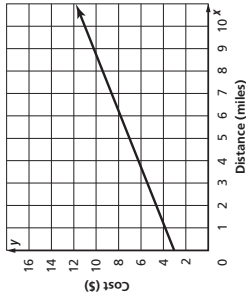
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1-7 Word Problem Practice Functions

1. **TRANSPORTATION** The cost of riding in a cab is \$3.00 plus \$0.75 per mile. The equation that represents this relation is $y = 0.75x + 3$, where x is the number of miles traveled and y is the cost of the trip. Look at the graph of the equation and determine whether the relation is a function. **yes**



2. **TEXT MESSAGING** Many cell phones have a text messaging option in addition to regular cell phone service. The function for the monthly cost of text messaging service from Noline Wireless Company is $f(x) = 0.10x + 2$, where x is the number of text messages that are sent. Find $f(10)$ and $f(30)$, the cost of 10 text messages in a month and the cost of 30 text messages in a month.

$f(10) = \$3$; $f(30) = \$5$

3. **GEOMETRY** The area for any square is given by the function $y = x^2$, where x is the length of a side of the square and y is the area of the square. Write the equation in function notation and find the area of a square with a side length of 3.5 inches.

**$f(x) = x^2$
 $f(3.5) = (3.5)^2 = 12.25 \text{ in}^2$**

Chapter 1

47

Glencoe Algebra 1

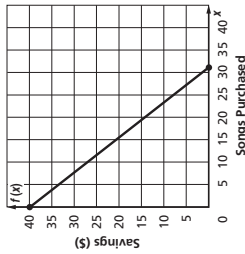
Lesson 1-7

4. **TRAVEL** The cost for cars entering Bellline road is given by the relation $x = 0.75$, where x is the dollar amount for entrance to the toll road and y is the number of passengers. Determine if this relation is a function. Explain.

This relation is not a function. The graph would be a vertical line, which would not pass the vertical line test.

5. **CONSUMER CHOICES** Aisha just received a \$40 paycheck from her new job. She spends some of it buying music online and saves the rest in a bank account. Her savings is given by $f(x) = 40 - 1.25x$, where x is the number of songs she downloads at \$1.25 per song.

a. Graph the function.



- b. Find $f(3)$, $f(18)$, and $f(36)$. What do these values represent?

**$f(3) = 36.25$; buys 3 songs, saves \$36.25
 $f(18) = 17.50$; buys 18 songs, saves \$17.50
 $f(36) = -5$; sample answer: if she wants to buy 36 songs, she needs \$5 extra**

- c. How many songs can Aisha buy if she wants to save \$30? **8 songs**

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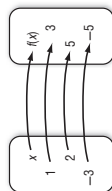
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1-7 Enrichment

Composite Functions

Three things are needed to have a function—a set called the domain, a set called the range, and a rule that matches each element in the domain with only one element in the range. Here is an example.

Rule: $f(x) = 2x + 1$



$$f(x) = 2x + 1$$

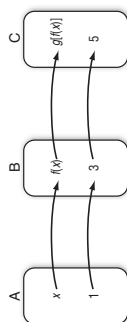
$$f(1) = 2(1) + 1 = 2 + 1 = 3$$

$$f(2) = 2(2) + 1 = 4 + 1 = 5$$

$$f(-3) = 2(-3) + 1 = -6 + 1 = -5$$

Suppose we have three sets A, B, and C and two functions described as shown below.

Rule: $f(x) = 2x + 1$ Rule: $g(y) = 3y - 4$



$$g(y) = 3y - 4$$

$$g(3) = 3(3) - 4 = 5$$

Let's find a rule that will match elements of set A with elements of set C without finding any elements in set B. In other words, let's find a rule for the **composite function** $g[f(x)]$.

Since $f(x) = 2x + 1$, $g[f(x)] = g(2x + 1)$.

Since $g(y) = 3y - 4$, $g(2x + 1) = 3(2x + 1) - 4$, or $6x - 1$.

Therefore, $g[f(x)] = 6x - 1$.

Find a rule for the composite function $g[f(x)]$.

1. $f(x) = 3x$ and $g(y) = 2y + 1$

$$g[f(x)] = 6x + 1$$

2. $f(x) = x^2 + 1$ and $g(y) = 4y$

$$g[f(x)] = 4x^2 + 4$$

3. $f(x) = -2x$ and $g(y) = y^2 - 3y$

$$g[f(x)] = 4x^2 + 6x$$

4. $f(x) = \frac{1}{x-3}$ and $g(y) = y^{-1}$

$$g[f(x)] = x - 3$$

5. Is it always the case that $g[f(x)] = f[g(x)]$? Justify your answer.

No. For example, in Exercise 1,

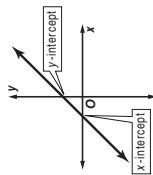
$$f[g(x)] = f(2x + 1) = 3(2x + 1) + 1 = 6x + 3, \text{ not } 6x + 1.$$

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1-8 Study Guide and Intervention

Interpreting Graphs of Functions

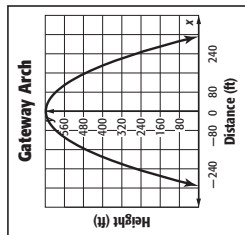
Interpret Intercepts and Symmetry The intercepts of a graph are points where the graph intersects an axis. (The y -coordinate of the point at which the graph intersects the y -axis is called a **y -intercept**. Similarly, the x -coordinate of the point at which a graph intersects the x -axis is called an **x -intercept**.)



A graph possesses **line symmetry** in a line if each half of the graph on either side of the line matches exactly.

Example

ARCHITECTURE The graph shows a function that approximates the shape of the Gateway Arch, where x is the distance from the center point in feet and y is the height in feet. Identify the function as *linear* or *nonlinear*. Then estimate and interpret the intercepts, and describe and interpret any symmetry.



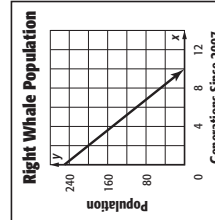
Linear or Nonlinear: Since the graph is a curve and not a line, the graph is nonlinear.

y -Intercept: The graph intersects the y -axis at about $(0, 630)$, so the y -intercept of the graph is about 630. This means that the height of the arch is 630 feet at the center point.

x -Intercept(s): The graph intersects the x -axis at about $(-320, 0)$ and $(320, 0)$. So the x -intercepts are about -320 and 320 . This means that the object touches the ground to the left and right of the center point.

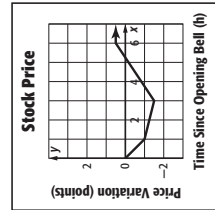
Symmetry: The right half of the graph is the mirror image of the left half in the y -axis. In the context of the situation, the symmetry of the graph tells you that the arch is symmetric. The height of the arch at any distance to the right of the center is the same as its height that same distance to the left.

Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph and any symmetry.



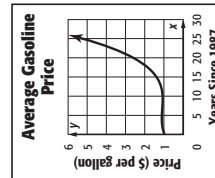
1.

Linear; the y -intercept is 250, so there were 250 right whales in 1987; x -intercept is 10, so there will be no right whales after 10 generations; no line symmetry.



2.

Nonlinear; y -intercept is 0, so there is no change in the stock value at the opening bell; x -intercepts are 0 and about 5.3, so there is no change in the value after 0 hours and about 5.3 hours after opening; no line symmetry.



3.

Nonlinear; y -intercept about 1, so the average price of gas was about \$1 per gallon in 1987; no x -intercepts, so there is no time when gas was free; no line symmetry.

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1-8 Study Guide and Intervention *(continued)*

Interpreting Graphs of Functions

Interpret Extrema and End Behavior Interpreting a graph also involves estimating and interpreting where the function is increasing, decreasing, positive, or negative, and where the function has any extreme values, either high or low.

Example

HEALTH The outbreak of the H1N1 virus can be modeled by the function graphed at the right. Estimate and interpret where the function is positive, negative, increasing, and decreasing, the x-coordinates of any relative extrema, and the end behavior of the graph.

Positive: for x between 0 and 42

Negative: no parts of domain

This means that the number of reported cases was always positive. This is reasonable because a negative number of cases cannot exist in the context of the situation.

Increasing: for x between 0 and 42

The number of reported cases increased each day from the first day of the outbreak.

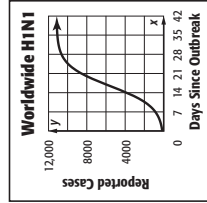
Relative Maximum: at about $x = 42$

The extrema of the graph indicate that the number of reported cases peaked at about day 42.

End Behavior: As x increases, y appears to approach 11,000. As x decreases, y decreases.

The end behavior of the graph indicates a maximum number of reported cases of 11,000.

Estimate and interpret where the function is positive, negative, increasing, and decreasing, the x-coordinate of any relative extrema, and the end behavior of the graph.



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DATE _____

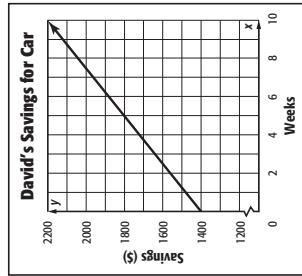
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1-8 Skills Practice

Interpreting Graphs of Functions

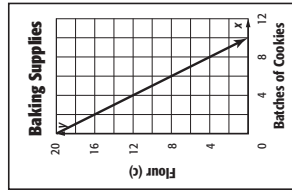
Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph, any symmetry, where the function is positive, negative, increasing, and decreasing, the x-coordinate of any relative extrema, and the end behavior of the graph.

1.



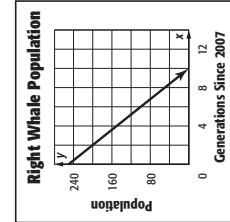
linear; y-intercept = 1400; no x-intercept; no line symmetry; positive and increasing for $x > 0$; minimum is \$1400 at time 0; savings will continue to increase; see students' work for interpretations.

2.



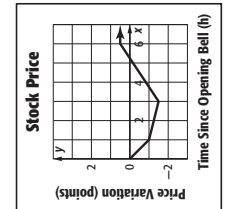
linear; y-intercept = 20; x-intercept = 10; no line symmetry; positive and decreasing for $x > 0$; maximum is 20 cups at time 0; amount of flour will decrease until it is gone; see students' work for interpretations.

1.



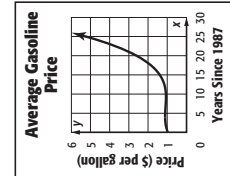
The population is above 0 for the first 10 generations, and then below 0. A negative population is not reasonable. The population is going down for the entire time. There are no extrema. As the time increases, the population will continue to drop.

2.



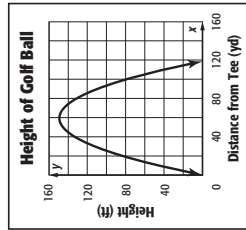
The stock went down in value for the first 3.2 hours, and then rose until the end of the day. The stock value decreases in value for the first 3.2 hours, and then goes up in value for the remainder of the day. The stock had a relative low value after 3.2 hours and then a relative high value at the end of the day. As the day goes on, the stock increases in value.

3.



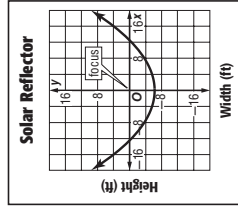
The average gasoline price is always positive. It increases for the first few years, decreases until about the 11th year, then increases. The relative minima are at 1 and about 11. The average price appears to increase as time passes.

3.



nonlinear; y-intercept ≈ 0 ; x-intercepts ≈ 0 and 120; line symmetry $x \approx 60$; height was always positive and increased until it was 60 yards from the tee and decreased 60 to 120 yards from the tee; see students' work for interpretations.

4.



nonlinear; y-intercept = -6.25; x-intercepts = -12.5 and 12.5; line symmetry about the y-axis; positive for $x < 12.5$ and $x > 12.5$; the minimum is -6.25 at 0; see students' work for interpretations.

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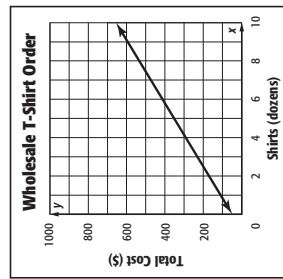
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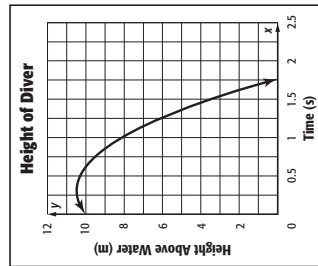
1-8 Practice

Interpreting Graphs of Functions

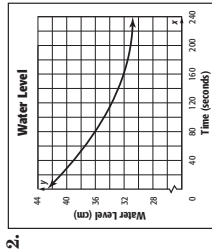
Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph, any symmetry, where the function is positive, negative, increasing, and decreasing, the x-coordinate of any relative extrema, and the end behavior of the graph.



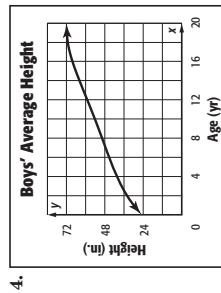
Linear: y -intercept is 50, so the set up cost is \$50; no x -intercept, so at no time is the cost \$0; no line symmetry; positive and increasing for $x > 0$, so the cost is always positive will increase as more shirts are ordered.



Nonlinear: y -intercept is 10, so diver started at 10 m; x -intercept of about 1.8, so diver entered the water after about 1.8 sec.; no line symmetry; the height was positive for $x < 1.8$ and negative for $x > 1.8$, so diver was above the water until 1.8 sec.; the height increased until max. of 10.5 at 0.3 sec., then it decreased; diver would continue to go down for some time, then would come up.



Nonlinear: y -intercept is about 43, so water level was about 43 cm when time started; no x -intercept, so the water level did not reach 0; no line symmetry; water level was always positive and decreased the entire time; graph appears to level off or begin to increase as x increases.



Nonlinear: y -intercept is 24, so the average boy is 24 inches at birth; no x -intercept; no line symmetry; always positive, so heights are always positive; appears to be a maximum of about 72 at about 19, this means that an average boy reaches his maximum height of 72 inches at age 19.

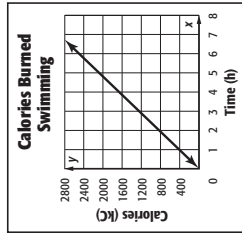
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1-8 Word Problem Practice

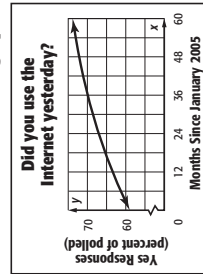
Interpreting Graphs of Functions

1. **HEALTH** The graph shows the Calories y burned by a 130-pound person swimming freestyle laps as a function of time x . Identify the function as *linear* or *nonlinear*. Then estimate and interpret the intercepts.



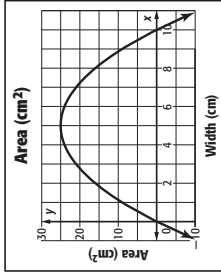
Linear: the x - and y -intercepts are 0. This means that no Calories are burned when no time is spent swimming.

2. **TECHNOLOGY** The graph below shows the results of a poll that asks Americans whether they used the Internet yesterday. Estimate and interpret where the function is positive, negative, increasing, and decreasing, the x -coordinates of any relative extrema, and the end behavior of the graph.



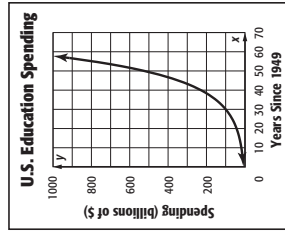
The function is positive and increasing for $x > 0$, so Internet use is increasing among those polled. There are no extrema. As x increases, y increases, so Internet use is expected to continue to increase. However since the data are percents, 100 is the maximum it could ever reach.

3. **GEOMETRY** The graph shows the area y in square centimeters of a rectangle with perimeter 20 centimeters and width x centimeters. Describe and interpret any symmetry in the graph.



The graph is symmetric in the line $x = 5$. In the context of the situation, the symmetry means that the area is the same when width is a number less than or greater than 5.

4. **EDUCATION** Identify the function graphed as *linear* or *nonlinear*. Then estimate and interpret the intercepts of the graph, any symmetry, where the function is positive, negative, increasing, and decreasing, the x -coordinate of any relative extrema, and the end behavior of the graph.



Nonlinear; y -intercept is about 10, so spending was about \$10 billion in 1949; no x -intercept; function is positive for all values of x , so education spending has never been \$0; function is increasing for all values of x , with no relative maxima or minima; as x -increases, y -increases, so the upward trend in spending is expected to continue.

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1-8 Enrichment

Symmetry in Graphs of Functions

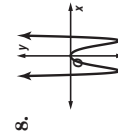
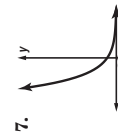
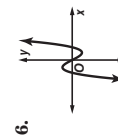
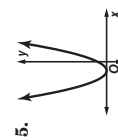
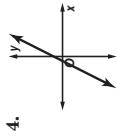
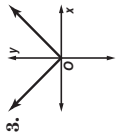
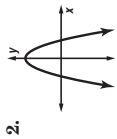
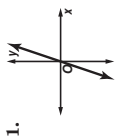
You have seen that the graphs of some functions have line symmetry. Functions that have line symmetry in the y -axis are called **even functions**. The graph of a function can also have point symmetry. Recall that a figure has point symmetry if it can be rotated less than 360° about the point so that the image matches the original figure. Functions that are symmetric about the origin are called **odd functions**.

Even Functions	Odd Functions	Neither Even nor Odd

The graph of a function cannot be symmetric about the x -axis because the graph would fail the Vertical Line Test.

Exercises

Identify the function graphed as *even*, *odd*, or *neither*.



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Chapter 1 Assessment Answer Key

Quiz 1 (Lessons 1-1 and 1-2)

Page 57

two plus the product of 5 and p

1. _____

2. $8^4 + 6$

3. 1

4. 8

5. B

Quiz 2 (Lessons 1-3 and 1-4)

Page 57

1. **Multiplicative Property of Zero; 0**

2. **Substitution**

$= 7 \cdot 7 \cdot 2 \cdot 5$ Commutative (\times)

$= (7 \cdot 7) \cdot (2 \cdot 5)$ Associative (\times)

3. $= 49 \cdot 10 = 490$ Substitution

4. $7(100-2); 686$

5. B

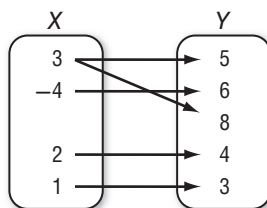
Quiz 3 (Lesson 1-5 and 1-6)

Page 58

1. 11

2. B

3. $t = \frac{1000}{40}; t = 25 \text{ min}$



4. $D = \{-4, 1, 2, 3\}$
 $R = \{3, 4, 5, 6, 8\}$

Quiz 4 (Lessons 1-7 and 1-8)

Page 58

1. **function**

2. 30

3. A

4. **Nonlinear; see students' work.**

Mid-Chapter Test

Page 59

1. D

2. F

3. C

4. G

5. D

6. J

7. D

$= 6.4 + 1.6 + 2.7 + 5.3$

Commutative (+)

$= (6.4 + 1.6) + (2.7 + 5.3)$

Associative (+)

$= 8 + 8$ Substitution

8. $= 16$ Substitution

$= \frac{4}{3} \cdot 3 \cdot 7 \cdot 10$ Commutative (\times)

$= \left(\frac{4}{3} \cdot 3\right) \cdot (7 \cdot 10)$ Associative (\times)

$= 4 \cdot 70$ Substitution

9. $= 280$ Substitution

10. **18 times p**

11. **x squared minus 5**

12. **Sample answer: Mult. Iden. and Mult. Inv.**

13. $6(10) + 6(2); 72$

14. $13b + 2b^2$

15. $\$2375$

Chapter 1 Assessment Answer Key

Vocabulary Test
Page 60

Form 1
Page 61

Page 62

1. variable

2. power

3. continuous
function

4. open sentence

5. like terms

6. coefficient

7. domain

8. function

9. range

10. the behavior of the
values of a function
at the positive and
negative extremes in its
domain

11. Sample answer: The
solution set of an open
sentence is the set
of elements from the
replacement set that make
an open sentence true.

1. C

2. G

3. D

4. F

5. B

6. H

7. C

8. J

9. B

10. H

11. A

12. J

13. B

14. H

15. C

16. F

17. B

18. J

19. B

20. G

B: $12x + 6$

Chapter 1 Assessment Answer Key

Form 2A
Page 63

1. C
2. G
3. D
4. G
5. A
6. H
7. C
8. F
9. B
10. G
11. B
12. J
13. B
14. G

Page 64

15. C
16. G
17. D
18. H
19. A
20. H
- B: 212

Form 2B
Page 65

1. C
2. G
3. D
4. G
5. A
6. F
7. C
8. G
9. D
10. G
11. C
12. F
13. C
14. G

Page 66

15. D
16. H
17. A
18. H
19. C
20. F
- B: 8a²

Chapter 1 Assessment Answer Key

Form 2C

Page 67

Page 68

1. $\frac{n^2 + 34}{5(2x)}$

2. $\frac{4 \text{ times } n \text{ cubed plus } 6}{128}$

3. $\frac{128}{18}$

4. $\frac{18}{18}$

5. $\frac{18}{18}$

6. Additive Identity; 5

7. Substitution; 10

$$4(5 \cdot 1 \div 20)$$

$$= 4(5 \div 20) \text{ (Mult. Identity)}$$

$$= 4\left(\frac{1}{4}\right) \text{ (Substitution)}$$

$$8. = 1 \text{ (Mult. Inverse)}$$

9. $3(14) - 3(5); 27$

10. $9w + 14w^2$

11. $17y + 7$

12. 60

13. 6

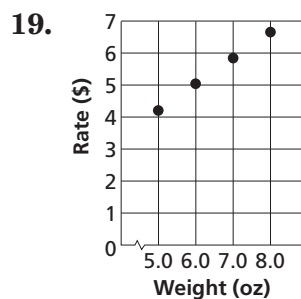
14. 7

15. 5

16. time; temperature

17. (8, 87); at 8 A.M. the temperature is 87°.

18. (5.0, 4.20), (6.0, 5.05), (7.0, 5.90), (8.0, 6.75)



20. As the weight of the letter increases, the cost increases.

B: a. $\frac{-(1 \cdot 9) + 8 + 7}{1^{98} \cdot 7}$

b. $\frac{1^{98} \cdot 7}{1 + (9 - 8) + 7}$

c. $\frac{1 + (9 - 8) + 7}{1 + (9 - 8) + 7}$

Chapter 1 Assessment Answer Key

Form 2D

Page 69

Page 70

1. $\frac{1}{3}n + 27$

2. $\frac{4n^2}{5 \text{ times a number cubed plus 9}}$

4. 36

5. 20

6. Multiplicative Inverse; $\frac{1}{11}$

7. Reflexive Property; 3

$$6(6 \cdot 1 \div 36) = 6(6 \div 36)$$

(Mult. Identity)

$$= 6\left(\frac{1}{6}\right) \text{ (Substitution)}$$

$$= 1 \text{ (Mult. Inverse)}$$

9. $10(5) + 3(5); 65$

10. $11w^2 + 7z^2$

11. $23x + 8$

12. 260

13. 40

14. 8

15. 6

16. game; score

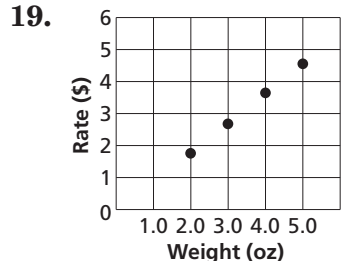
Sample answer:

Between the first and third game Robert becomes comfortable with the lane. Robert is

17. tired for the fourth game.

(2.0, 1.80), (3.0, 2.75), (4.0, 3.70), and (5.0, 4.65)

18.



As the weight of the letter increases, the

20. rate increases.

B: $2[(5 - 1) \div 4 + 1]$

Chapter 1 Assessment Answer Key

Form 3
Page 71

Page 72

1. $n^3 + 12$

2. $\frac{42 + 2n}{\text{six times a number squared divided by 5}}$

4. 45

5. 200

6. 88

7. Multi. Iden.; 1

8. Substitution; 9

$$\frac{2}{3} (3 \div 2) + (9 - 9) \text{ (Subst.)}$$

$$= \frac{2}{3} \left(\frac{3}{2}\right) + 0 \text{ (Subst.)}$$

$$= 1 + 0 \text{ (Mult. Inverse)}$$

$$= 1 \text{ (Add. Identity)}$$

9. _____

10. $\frac{(2)(x) + (2)(3y) - (2)(2z)}{2x + 6y - 4z}$

11. $3 + 30a + 33an$

12. simplified

13. 105

14. 100

15. 1

16. $\frac{5}{4}$

17. $t = 50 + 4(8);$
 $t = 82$

The puppy goes a distance on the trail, stays there for a while, goes ahead some more, stays there for a while, then goes back to the beginning of the trail. The function is continuous.

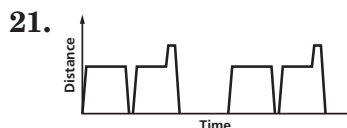
18. _____

19. year; number of newspapers sold

The number of newspapers sold was decreasing during the years 2006–2010.

20. _____

Sample answer:



22. function

23. $-6r^2 - 4r + 2$

24. The population of Ohio was about 4 million in 1900.

25. The population of Ohio will approach about 13 million.

B: 10

Chapter 1 Assessment Answer Key

Page 73, Extended-Response Test Scoring Rubric

Score	General Description	Specific Criteria
4	Superior A correct solution that is supported by well-developed, accurate explanations	<ul style="list-style-type: none"> Shows thorough understanding of the concepts of <i>translating between verbal and algebraic expressions, open sentence equations, algebraic properties, and graphs of functions.</i> Uses appropriate strategies to solve problems. Computations are correct. Written explanations are exemplary. Graphs are accurate and appropriate. Goes beyond requirements of some or all problems.
3	Satisfactory A generally correct solution, but may contain minor flaws in reasoning or computation	<ul style="list-style-type: none"> Shows an understanding of most of the concepts of <i>translating between verbal and algebraic expressions, open sentence equations, algebraic properties, and graphs of functions.</i> Uses appropriate strategies to solve problems. Computations are mostly correct. Written explanations are effective. Graphs are mostly accurate and appropriate. Satisfies all requirements of problems.
2	Nearly Satisfactory A partially correct interpretation and/or solution to the problem	<ul style="list-style-type: none"> Shows an understanding of most of the concepts of <i>translating between verbal and algebraic expressions, open sentence equations, algebraic properties, and graphs of functions.</i> May not use appropriate strategies to solve problems. Computations are mostly correct. Written explanations are satisfactory. Graphs are mostly accurate. Satisfies the requirements of most of the problems.
1	Nearly Unsatisfactory A correct solution with no supporting evidence or explanation	<ul style="list-style-type: none"> Final computation is correct. No written explanations or work shown to substantiate the final computation. Graphs may be accurate but lack detail or explanation. Satisfies minimal requirements of some of the problems.
0	Unsatisfactory An incorrect solution indicating no mathematical understanding of the concept or task, or no solution is given	<ul style="list-style-type: none"> Shows little or no understanding of most of the concepts of <i>translating between verbal and algebraic expressions, open sentence equations, algebraic properties, and graphs of functions.</i> Does not use appropriate strategies to solve problems. Computations are incorrect. Written explanations are unsatisfactory. Graphs are inaccurate or inappropriate. Does not satisfy requirements of problems. No answer may be given.

Chapter 1 Assessment Answer Key

Page 73, Extended-Response Test Sample Answers

In addition to the scoring rubric found on page A33, the following sample answers may be used as guidance in evaluating extended response assessment items.

1a. Sample answer: $2x + 1$; two times x plus 1

1b. Sample answer: the quotient of x minus 1 and 2; $\frac{x - 1}{2}$

2. The student should explain that a replacement set is a set of possible values for the variable in an open sentence. The solution set is the set of values for the variable in an open sentence that makes the open sentence true.

3a. The student should write an equation that represents the Additive Identity Property, the Multiplicative Identity Property, the Multiplicative Property of Zero, or the Multiplicative Inverse Property. The student should also name the property that is illustrated. Sample answer: $1 + 0 = 1$; Additive Identity Property

3b. Since 23 is the sum of 20 and 3, the Distributive Property allows the product of 7 and 23 to be found by calculating the sum of the products of 7 and 20, and 7 and 3.

3c. The student should explain that the Commutative and Associative Properties allow the terms in the expression $18 + 33 + 82 + 67$ to be moved and regrouped so that sums of consecutive terms are multiples of 10. Thus, after the first step of addition the remaining sums are easier to accomplish.

$$\begin{aligned} &18 + 33 + 82 + 67 \\ &= 18 + 82 + 33 + 67 && \text{Commutative (+)} \\ &= (18 + 82) + (33 + 67) && \text{Associative (+)} \\ &= 100 + 100 && \text{Substitution} \\ &= 200 && \text{Substitution} \end{aligned}$$

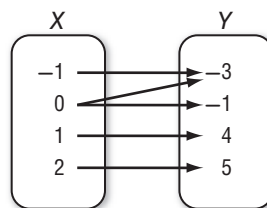
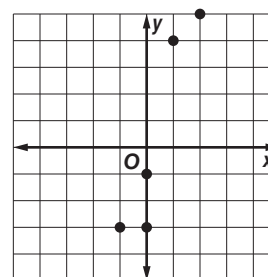
4. Sample answer: The distance a boy is from his home as a function of time. Label the vertical axis as distance and

the horizontal axis as time. The boy rides his bike to the post office to drop off a letter. He rides to his high school which is a bit closer to his house. He jogs twice around the track, then rides his bike straight home.

5a. Sample answer: $\{(-1, -3), (0, -1), (1, 4), (2, 5)\}$

5b. Sample answer:

x	y
-1	-1
0	-3
0	-1
1	4
2	5



5c. The student should identify in their relation where they used the same domain element with two or more different range elements.

6. Nonlinear; y -intercept about 2.9, so about 2.9% of polled accessed the Internet away from home several times a day in March 2004. No x -intercept, so no time when no one accessed the Internet away from home several times a day; no symmetry; positive for $x > 0$; increasing between $x = 0$ and $x \approx 15$ and between about $x \approx 38$ and $x \approx 72$, it is slightly decreasing between $x \approx 15$ and $x \approx 38$, away from home Internet use increased from March 2004 for about 15 months to about 4%, decreased slightly until March 2007 when it began to increase; appears to continue to increase.

Chapter 1 Assessment Answer Key

Standardized Test Practice

Page 74

Page 75

1. A B C D

2. F G H J

3. A B C D

4. F G H J

5. A B C D

6. A G H J

7. A B C D

8. F G H J

9. A B C D

10. F G H J

11. A B C D

12. F G H J

13. A B C D

14. F G H J

15. A B C D

16.

			5	6
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	<input checked="" type="radio"/>	5
6	6	6	6	<input checked="" type="radio"/>
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

17.

			5	2
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0	0
1	1	1	1	1
2	2	2	2	<input checked="" type="radio"/>
3	3	3	3	3
4	4	4	4	4
5	5	5	<input checked="" type="radio"/>	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Chapter 1 Assessment Answer Key

Standardized Test Practice

Page 76

18. 136

19. 12

20. 5.04

21. $\frac{1}{6}$

22. $2x - 6$

23. four times m
squared plus two

24. 11

25. 22

26. 4

27. 8

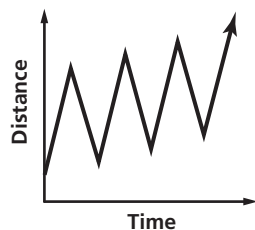
28. $11n$

29. $11y + 3$

30. $x = 18$

31. {2}

Sample answer:



32. 1000 computers

were affected when
time started.

33a. The number of

affected computers
is expected to

33b. continue to increase.