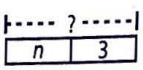
1 Chapter Review

Connecting BIG ideas and Answering the Essential Questions

1 Variable
You can use variables to represent quantities and to write algebraic expressions and equations.

Variables and Expressions (Lesson 1-1)
a number n plus 3
$n + 3$



Patterns and Equations (Lessons 1-8 and 1-9)
1 variable: $x + 3 = 5$
2 variables: $y = 2x$

2 Properties
The properties of real numbers describe relationships that are always true. You can use them to rewrite expressions.

Operations With Real Numbers (Lessons 1-2, 1-5, and 1-6)
2^5 $0 \cdot 3$ $2 + (-5)$ $7(-3)$

Properties (Lessons 1-4 and 1-7)
$a \cdot b = b \cdot a$ $(a \cdot b) \cdot c = a \cdot (b \cdot c)$
$a(b + c) = ab + ac$

Chapter Vocabulary

- absolute value (p. 31)
- additive inverse (p. 32)
- algebraic expression (p. 4)
- base (p. 10)
- coefficient (p. 48)
- constant (p. 48)
- counterexample (p. 25)
- deductive reasoning (p. 25)
- Distributive Property (p. 46)
- element of the set (p. 17)
- equation (p. 53)
- equivalent expressions (p. 23)
- evaluate (p. 12)
- exponent (p. 10)
- inductive reasoning (p. 63)
- inequality (p. 19)
- integer (p. 18)
- irrational number (p. 18)
- like terms (p. 48)
- multiplicative inverse (p. 40)
- natural number (p. 18)
- numerical expression (p. 4)
- open sentence (p. 53)
- opposite (p. 32)
- order of operations (p. 11)
- perfect square (p. 17)
- power (p. 10)
- quantity (p. 4)
- radical (p. 16)
- radicand (p. 16)
- rational number (p. 18)
- real number (p. 18)
- reciprocal (p. 41)
- set (p. 17)
- simplify (p. 10)
- solution of an equation (p. 54, 61)
- square root (p. 16)
- subset (p. 17)
- term (p. 48)
- variable (p. 4)
- whole number (p. 18)

Choose the correct term to complete each sentence.

1. Real numbers that you cannot represent as a quotient of two integers are _?_ numbers.
2. The sum of a number and its _?_ equals zero.
3. You can simplify an expression by combining _?_.
4. _?_ is a number's distance from zero on a number line.
5. When you make conclusions based on patterns you observe, you use _?_.

1-1 Variables and Expressions

Quick Review

A **variable** is a symbol, usually a letter, that represents values of a variable quantity. For example, d often represents distance. An **algebraic expression** is a mathematical phrase that includes one or more variables. A **numerical expression** is a mathematical phrase involving numbers and operation symbols, but no variables.

Example

What is an algebraic expression for the word phrase *3 less than half a number x*?

You can represent "half a number x" as $\frac{x}{2}$. Then subtract 3 to get $\frac{x}{2} - 3$.

Exercises

Write an algebraic expression for each word phrase.

6. the product of a number w and 737
7. the difference of a number q and 8
8. the sum of a number x and 84
9. 9 more than the product of 51 and a number t
10. 14 less than the quotient of 63 and a number h
11. a number b less the quotient of a number k and 5

Write a word phrase for each algebraic expression.

12. $12 + a$
13. $r - 31$
14. $19t$
15. $b \div 3$
16. $7c - 3$
17. $2 + \frac{x}{8}$
18. $\frac{y}{11} - 6$
19. $21d + 13$

1-2 Order of Operations and Evaluating Expressions

Quick Review

To **evaluate** an algebraic expression, first substitute a given number for each variable. Then simplify the numerical expression using the order of operations.

1. Do operation(s) inside grouping symbols.
2. Simplify powers.
3. Multiply and divide from left to right.
4. Add and subtract from left to right.

Example

A student studies with a tutor for 1 hour each week and studies alone for h hours each week. What is an expression for the total hours spent studying each week? Evaluate the expression for $h = 5$.

The expression is $h + 1$. To evaluate the expression for $h = 5$, substitute 5 for h: $(5) + 1 = 6$.

Exercises

Simplify each expression.

20. 9^2
21. 5^3
22. $\left(\frac{1}{6}\right)^2$
23. $7^2 \div 5$
24. $(2^4 - 6)^2$
25. $(3^3 - 4) + 5^2$

Evaluate each expression for $c = 3$ and $d = 5$.

26. $d^3 \div 15$
27. $(2 + d)^2 - 3^2$
28. $cd^2 + 4$
29. $(3c^2 - 3d)^2 - 21$
30. The expression $6s^2$ represents the surface area of a cube with edges of length s.
    a. What is the cube's surface area when $s = 6$?
    b. **Reasoning** Explain how a cube's surface area changes if you divide s by 2 in the expression $6s^2$.
31. A race car travels at 205 mi/h. How far does the car travel in 3 h?

1-3 Real Numbers and the Number Line

Quick Review

The rational numbers and irrational numbers form the **set of real numbers.**

A **rational number** is any number that you can write as $\frac{a}{b}$, where a and b are integers and $b \neq 0$. The rational numbers include all positive and negative integers, as well as fractions, mixed numbers, and terminating and repeating decimals.

Irrational numbers cannot be represented as the quotient of two integers. They include the square roots of all positive integers that are not perfect squares.

Example

Is the number rational or irrational?

A -5.422 rational

B $\sqrt{7}$ irrational

Exercises

Tell whether each number is rational or irrational.

32. π **33.** $-\frac{1}{2}$

34. $\sqrt{\frac{2}{3}}$ **35.** $0.\overline{57}$

Estimate each square root. Round to the nearest integer.

36. $\sqrt{99}$ **37.** $\sqrt{48}$ **38.** $\sqrt{30}$

Name the subset(s) of the real numbers to which each number belongs.

39. -17 **40.** $\frac{13}{62}$ **41.** $\sqrt{94}$

42. $\sqrt{100}$ **43.** 4.288 **44.** $1\frac{2}{3}$

Order the numbers in each exercise from least to greatest.

45. $-1\frac{2}{3}, 1.6, -1\frac{4}{5}$ **46.** $\frac{7}{9}, -0.8, \sqrt{3}$

1-4 Properties of Real Numbers

Quick Review

You can use properties such as the ones below to simplify and evaluate expressions.

Commutative Properties $-2 + 7 = 7 + (-2)$

$3 \times 4 = 4 \times 3$

Associative Properties $2 \times (14 \times 3) = (2 \times 14) \times 3$

$3 + (12 + 2) = (3 + 12) + 2$

Identity Properties $-6 + 0 = -6$

$21 \times 1 = 21$

Zero Property of Multiplication $-7 \times 0 = 0$

Multiplication Property of −1 $6 \cdot (-1) = -6$

Example

Use an identity property to simplify $-\frac{7ab}{a}$.

$-\frac{7ab}{a} = -7b \cdot \frac{a}{a} = -7b \cdot 1 = -7b$

Exercises

Simplify each expression. Justify each step.

47. $-8 + 9w + (-23)$

48. $\frac{6}{5} \cdot (-10 \cdot 8)$

49. $\left(\frac{4}{3} \cdot 0\right) \cdot (-20)$

50. $53 + (-12) + (-4t)$

51. $\frac{6+3}{9}$

Tell whether the expressions in each pair are equivalent.

52. $(5 - 2)c$ and $c \cdot 3$

53. $41 + z + 9$ and $41 \cdot z \cdot 9$

54. $\frac{81xy}{3x}$ and $9xy$

55. $\frac{11t}{(5 + 7 - 11)}$ and t

1-5 and 1-6 Operations With Real Numbers

Quick Review

To add numbers with different signs, find the difference of their **absolute values.** Then use the sign of the addend with the greater absolute value.

$3 + (-4) = -(4 - 3) = -1$

To subtract, add the opposite.

$9 - (-5) = 9 + 5 = 14$

The product or quotient of two numbers with the same sign is positive: $5 \cdot 5 = 25$ $(-5) \cdot (-5) = 25$

The product or quotient of two numbers with different signs is negative: $6 \cdot (-6) = -36$ $-36 \div 6 = -6$

Example

Cave explorers descend to a site that has an elevation of -1.3 km. (Negative elevation means below sea level.) The explorers descend another 0.6 km before they stop to rest. What is the elevation at their resting point?

$-1.3 + (-0.6) = -1.9$

The elevation at their resting point is -1.9 km.

Exercises

Find each sum. Use a number line.

56. $1 + 4$ **57.** $3 + (-8)$ **58.** $-2 + (-7)$

Simplify each expression.

59. $-5.6 + 7.4$ **60.** -12^2

61. $-5(-8)$ **62.** $4.5 \div (-1.5)$

63. $-13 + (-6)$ **64.** $-9 - (-12)$

65. $(-2)(-2)(-2)$ **66.** $-54 \div (-0.9)$

Evaluate each expression for $p = 5$ and $q = -3$.

67. $-3q + 7$ **68.** $-(4q)$

69. $q - 8$ **70.** $5p - 6$

71. $-(2p)^2$ **72.** $7q - 7p$

73. $(pq)^2$ **74.** $2q \div (4p)$

1-7 The Distributive Property

Quick Review

Terms with exactly the same variable factors are **like terms.** You can combine like terms and use the Distributive Property to simplify expressions.

Distributive Property $a(b + c) = ab + ac$

$a(b - c) = ab - ac$

Example

Simplify $7t + (3 - 4t)$.

$7t + (3 - 4t) = 7t + (-4t + 3)$ Commutative Property

$= (7t + (-4t)) + 3$ Associative Property

$= (7 + (-4))t + 3$ Distributive Property

$= 3t + 3$ Simplify.

Exercises

Simplify each expression.

75. $5(2x - 3)$ **76.** $-2(7 - a)$

77. $(-j + 8)\frac{1}{2}$ **78.** $3v^2 - 2v^2$

79. $2(3y - 3)$ **80.** $(6y - 1)\frac{1}{4}$

81. $(24 - 24y)\frac{1}{4}$ **82.** $6y - 3 - 5y$

83. $\frac{1}{3}y + 6 - \frac{2}{3}y$ **84.** $-ab^2 - ab^2$

85. Music All 95 members of the jazz club pay \$30 each to go see a jazz performance. What is the total cost of tickets? Use mental math.

86. Reasoning Are $8x^2y$ and $-5yx^2$ like terms? Explain.

1-8 An Introduction to Equations

Quick Review

An **equation** can be true or false, or it can be an **open sentence** with a variable. A **solution** of an equation is the value (or values) of the variable that makes the equation true.

Example

Is $c = 6$ a solution of the equation $25 = 3c - 2$?

$25 = 3c - 2$

$25 \stackrel{?}{=} 3 \cdot 6 - 2$ Substitute 6 for c.

$25 \neq 16$ Simplify.

No, $c = 6$ is not a solution of the equation $25 = 3c - 2$.

Exercises

Tell whether the given number is a solution of each equation.

87. $17 = 37 + 4f; f = -5$

88. $-3a^2 = 27; a = 3$

89. $3b - 9 = 21; b = -10$

90. $-2b + 4 = 3; b = \frac{1}{2}$

Use a table to find or estimate the solution of each equation.

91. $x + (-2) = 8$

92. $3m - 13 = 24$

93. $4t - 2 = 9$

94. $6b - 3 = 17$

1-9 Patterns, Equations, and Graphs

Quick Review

You can represent the relationship between two varying quantities in different ways, including tables, equations, and graphs. A **solution of an equation** with two variables is an **ordered pair** (x, y) that makes the equation true.

Example

Bo makes \$15 more per week than Sue. How can you represent this with an equation and a table?

First write an equation. Let b = Bo's earnings and s = Sue's earnings. Bo makes \$15 more than Sue, so $b = s + 15$. You can use the equation to make a table for $s = 25$, 50, 75, and 100.

Sue's Earnings (s)	25	50	75	100
Bo's Earnings (b)	40	65	90	115

Exercises

Tell whether the given ordered pair is a solution of each equation.

95. $3x + 5 = y; (1, 8)$

96. $y = -2(x + 3); (-6, 0)$

97. $y = (x - 1.2)(-3); (0, 1.2)$

98. $10 - 5x = y; (-4, 10)$

99. Describe the pattern in the table using words, an equation, and a graph. Extend the pattern for $x = 5$, 6, and 7.

x	y
1	15
2	25
3	35
4	45