Chapter 1 Vocabulary Check

Fill in each blank with one of the words or phrases listed below.

distributive	real	reciprocals	absolute value	opposite	associative
inequality	commutative	whole	algebraic expression	exponent	variable

1. A(n) _____ is formed by numbers and variables connected by the operations of addition, subtraction, multiplication, division, raising to powers, and/or taking roots.
2. The _____ of a number a is $-a$.
3. $3(x - 6) = 3x - 18$ by the _____ property.
4. The _____ of a number is the distance between that number and 0 on the number line.
5. A(n) _____ is a shorthand notation for repeated multiplication of the same factor.
6. A letter that represents a number is called a(n) _____.
7. The symbols $<$ and $>$ are called _____ symbols.
8. If a is not 0, then a and $\frac{1}{a}$ are called _____.
9. A + B = B + A by the _____ property.
10. (A + B) + C = A + (B + C) by the _____ property.
11. The numbers 0, 1, 2, 3, . . . are called _____ numbers.
12. If a number corresponds to a point on the number line, we know that number is a _____ number.

Chapter 1 Highlights

Section 1.2 Algebraic Expressions and Sets of Numbers

Letters that represent numbers are called **variables.**

Examples of variables are

$$x, a, m, y$$

An **algebraic expression** is formed by numbers and variables connected by the operations of addition, subtraction, multiplication, division, raising to powers, and/or taking roots.

Examples of algebraic expressions are

$$7y, -3, \frac{x^2 - 9}{-2} + 14x, \sqrt{3} + \sqrt{m}$$

To **evaluate** an algebraic expression containing variables, substitute the given numbers for the variables and simplify. The result is called the **value** of the expression.

Evaluate $2.7x$ if $x = 3$.

$$2.7x = 2.7(3)$$
$$= 8.1$$

Natural numbers: $\{1, 2, 3, \ldots\}$

Whole numbers: $\{0, 1, 2, 3, \ldots\}$

Integers: $\{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$

Each listing of three dots above is called an **ellipsis,** which means the pattern continues.

The members of a set are called its **elements.**

Given the set $\left\{-9.6, -5, -\sqrt{2}, 0, \frac{2}{5}, 101\right\}$ list the elements that belong to the set of

Natural numbers: 101

Whole numbers: 0, 101

Integers: -5, 0, 101

Real numbers: $-9.6, -5, -\sqrt{2}, 0, \frac{2}{5}, 101$

Set builder notation describes the elements of a set but does not list them.

Real numbers: $\{x | x$ corresponds to a point on the number line$\}$.

Rational numbers: $-9.6, -5, 0, \frac{2}{5}, 101$

Rational numbers: $\left\{\frac{a}{b} \middle| a \text{ and } b \text{ are integers and } b \neq 0\right\}$.

Irrational numbers: $-\sqrt{2}$

(*continued*)

DEFINITIONS AND CONCEPTS	EXAMPLES
Section 1.2 Algebraic Expressions and Sets of Numbers (continued)	
Irrational numbers: $\{x \mid x$ is a real number and x is not a rational number$\}$.	List the elements in the set $\{x \mid x$ is an integer between -2 and $5\}$. $\{-1, 0, 1, 2, 3, 4\}$
If 3 is an element of set A, we write $3 \in A$.	$\{1, 2, 4\} \subseteq \{1, 2, 3, 4\}$.
If all the elements of set A are also in set B, we say that set A is a **subset** of set B, and we write $A \subseteq B$.	
Absolute value: $\lvert a \rvert = \begin{cases} a \text{ if } a \text{ is 0 or a positive number} \\ -a \text{ if } a \text{ is a negative number} \end{cases}$	$\lvert 3 \rvert = 3, \lvert 0 \rvert = 0, \lvert -7.2 \rvert = 7.2$
The opposite of a number a is the number $-a$.	The opposite of 5 is -5. The opposite of -11 is 11.
Section 1.3 Operations on Real Numbers and Order of Operations	
Adding real numbers	$\frac{2}{7} + \frac{1}{7} = \frac{3}{7}$
1. To add two numbers with the same sign, add their absolute values and attach their common sign.	$-5 + (-2.6) = -7.6$
2. To add two numbers with different signs, subtract the smaller absolute value from the larger absolute value and attach the sign of the number with the larger absolute value.	$-18 + 6 = -12$
	$20.8 + (-10.2) = 10.6$
Subtracting real numbers: $a - b = a + (-b)$	$18 - 21 = 18 + (-21) = -3$
Multiplying and dividing real numbers: The product or quotient of two numbers with the same sign is positive.	$(-8)(-4) = 32$ $\quad \frac{-8}{-4} = 2$
The product or quotient of two numbers with different signs is negative.	$8 \cdot 4 = 32$ $\quad \frac{8}{4} = 2$
	$-17 \cdot 2 = -34$ $\quad \frac{-14}{2} = -7$
	$4(-1.6) = -6.4$ $\quad \frac{22}{-2} = -11$
A natural number **exponent** is a shorthand notation for repeated multiplication of the same factor.	$3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 81$
The notation $\sqrt{a}$ denotes the **positive,** or **principal, square root** of a nonnegative number a.	$\sqrt{49} = 7$
$\sqrt{a} = b$ if $b^2 = a$ and b is positive.	$\sqrt[3]{64} = 4$
Also,	$\sqrt[4]{16} = 2$
$\sqrt[3]{a} = b$ if $b^3 = a$	
$\sqrt[4]{a} = b$ if $b^4 = a$ and b is positive	
Order of Operations	Simplify $\frac{42 - 2(3^2 - \sqrt{16})}{-8}$.
Simplify expressions using the order that follows. If grouping symbols such as parentheses are present, simplify expressions within those first, starting with the innermost set. If fraction bars are present, simplify the numerator and denominator separately.	$\frac{42 - 2(3^2 - \sqrt{16})}{-8} = \frac{42 - 2(9 - 4)}{-8}$
1. Raise to powers or take roots in order from left to right.	$= \frac{42 - 2(5)}{-8}$
2. Multiply or divide in order from left to right.	$= \frac{42 - 10}{-8}$
3. Add or subtract in order from left to right.	$= \frac{32}{-8} = -4$

DEFINITIONS AND CONCEPTS	EXAMPLES
Section 1.4 Properties of Real Numbers and Algebraic Expressions	
Symbols: $=$ is equal to	$-5 = -5$
$\neq$ is not equal to	$-5 \neq -3$
$>$ is greater than	$1.7 > 1.2$
$<$ is less than	$-1.7 < -1.2$
$\geq$ is greater than or equal to	$\frac{5}{3} \geq \frac{5}{3}$
$\leq$ is less than or equal to	$-\frac{1}{2} \leq \frac{1}{2}$
Identity:	
$a + 0 = a \quad 0 + a = a$	$3 + 0 = 3 \quad 0 + 3 = 3$
$a \cdot 1 = a \quad 1 \cdot a = a$	$-1.8 \cdot 1 = -1.8 \quad 1 \cdot -1.8 = -1.8$
Inverse:	
$a + (-a) = 0 \quad -a + a = 0$	$7 + (-7) = 0 \quad -7 + 7 = 0$
$a \cdot \frac{1}{a} = 1 \quad \frac{1}{a} \cdot a = 1, a \neq 0$	$5 \cdot \frac{1}{5} = 1 \quad \frac{1}{5} \cdot 5 = 1$
Commutative:	
$a + b = b + a$	$x + 7 = 7 + x$
$a \cdot b = b \cdot a$	$9 \cdot y = y \cdot 9$
Associative:	
$(a + b) + c = a + (b + c)$	$(3 + 1) + 10 = 3 + (1 + 10)$
$(a \cdot b) \cdot c = a \cdot (b \cdot c)$	$(3 \cdot 1) \cdot 10 = 3 \cdot (1 \cdot 10)$
Distributive:	
$a(b + c) = ab + ac$	$6(x + 5) = 6 \cdot x + 6 \cdot 5$ $= 6x + 30$

Chapter 1 Review

(1.2) *Find the value of each algebraic expression at the given replacement values.*

1. $7x$ when $x = 3$

2. st when $s = 1.6$ and $t = 5$

The hummingbird has an average wing speed of 70 beats per second. The expression $70t$ gives the number of wingbeats in t seconds.

3. Calculate the number of wingbeats in 1 *minute*. (*Hint:* How many seconds are in 1 minute?)

4. Calculate the number of wingbeats in *1 hour* for the hummingbird. (See the Hint for Exercise 3.)

List the elements in each set.

5. $\{x | x \text{ is an odd integer between } -2 \text{ and } 4\}$

6. $\{x | x \text{ is an even integer between } -3 \text{ and } 7\}$

7. $\{x | x \text{ is a negative whole number}\}$

8. $\{x | x \text{ is a natural number that is not a rational number}\}$

9. $\{x | x \text{ is a whole number greater than } 5\}$

10. $\{x | x \text{ is an integer less than } 3\}$

Determine whether each statement is true or false if $A = \{6, 10, 12\}$, $B = \{5, 9, 11\}$, $C = \{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$, $D = \{2, 4, 6, \ldots, 16\}$ $E = \{x | x \text{ is a rational number}\}$, $F = \{\ }$, $G = \{x | x \text{ is an irrational number}\}$, *and* $H = \{x | x \text{ is a real number}\}$.

11. $10 \in D$

12. $59 \in B$

13. $\sqrt{169} \notin G$

14. $0 \notin F$

15. $\pi \in E$

16. $\pi \in H$

17. $\sqrt{4} \in G$

18. $-9 \in E$

19. $A \subseteq D$

20. $C \not\subseteq B$

21. $C \not\subseteq E$

22. $F \subseteq H$

List the elements of the set $\left\{5, -\frac{2}{3}, \frac{8}{2}, \sqrt{9}, 0.3, \sqrt{7}, 1\frac{5}{8}, -1, \pi\right\}$ *that are also elements of each given set.*

23. Whole numbers

24. Natural numbers

25. Rational numbers

26. Irrational numbers

27. Real numbers

28. Integers

Find the opposite.

29. $-\frac{3}{4}$ **30.** 0.6

31. 0 **32.** 1

(1.3) *Find the reciprocal.*

33. $-\frac{3}{4}$ **34.** 0.6

35. 0 **36.** 1

Simplify.

37. $-7 + 3$ **38.** $-10 + (-25)$

39. $5(-0.4)$ **40.** $(-3.1)(-0.1)$

41. $-7 - (-15)$ **42.** $9 - (-4.3)$

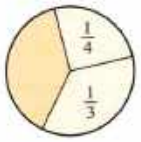
43. $(-6)(-4)(0)(-3)$ **44.** $(-12)(0)(-1)(-5)$

45. $(-24) \div 0$ **46.** $0 \div (-45)$

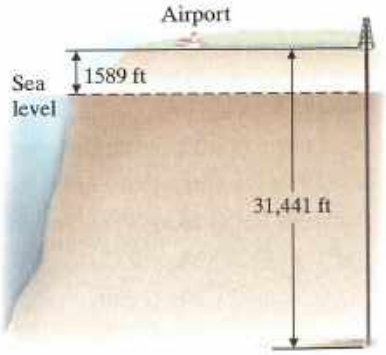
47. $(-36) \div (-9)$ **48.** $60 \div (-12)$

49. $\left(-\frac{4}{5}\right) - \left(-\frac{2}{3}\right)$ **50.** $\left(\frac{5}{4}\right) - \left(-2\frac{3}{4}\right)$

51. Determine the unknown fractional part.



52. The Bertha Rogers gas well in Washita County, Oklahoma, is the deepest well in the United States. From the surface, this now-capped well extends 31,441 feet into the earth. The elevation of the nearby Cordell Municipal Airport is 1589 feet above sea level. Assuming that the surface elevation of the well is the same as at the Cordell Municipal Airport, find the elevation relative to sea level of the *bottom* of the Bertha Rogers gas well. *(Sources:* U.S. Geological Survey, Oklahoma Department of Transportation)



Simplify.

53. $-5 + 7 - 3 - (-10)$ **54.** $8 - (-3) + (-4) + 6$

55. $3(4 - 5)^4$ **56.** $6(7 - 10)^2$

57. $\left(-\frac{8}{15}\right) \cdot \left(-\frac{2}{3}\right)^2$ **58.** $\left(-\frac{3}{4}\right)^2 \cdot \left(-\frac{10}{21}\right)$

59. $-\frac{6}{15} \div \frac{8}{25}$ **60.** $\frac{4}{9} \div -\frac{8}{45}$

61. $-\frac{3}{8} + 3(2) \div 6$ **62.** $5(-2) - (-3) - \frac{1}{6} + \frac{2}{3}$

63. $|2^3 - 3^2| - |5 - 7|$ **64.** $|5^2 - 2^2| + |9 \div (-3)|$

65. $(2^3 - 3^2) - (5 - 7)$ **66.** $(5^2 - 2^4) + [9 \div (-3)]$

67. $\dfrac{(8 - 10)^3 - (-4)^2}{2 + 8(2) \div 4}$ **68.** $\dfrac{(2 + 4)^2 + (-1)^5}{12 \div 2 \cdot 3 - 3}$

69. $\dfrac{(4 - 9) + 4 - 9}{10 - 12 \div 4 \cdot 8}$ **70.** $\dfrac{3 - 7 - (7 - 3)}{15 + 30 \div 6 \cdot 2}$

71. $\dfrac{\sqrt{25}}{4 + 3 \cdot 7}$ **72.** $\dfrac{\sqrt{64}}{24 - 8 \cdot 2}$

Find the value of each expression when $x = 0, y = 3$, *and* $z = -2$.

73. $x^2 - y^2 + z^2$ **74.** $\dfrac{5x + z}{2y}$

75. $\dfrac{-7y - 3z}{-3}$ **76.** $(x - y + z)^2$

The algebraic expression $2\pi r$ *represents the circumference of (distance around) a circle of radius* r.

77. Complete the table below by evaluating the expression at the given values of r. (Use 3.14 for π.)

Radius	r	1	10	100
Circumference	$2\pi r$			

78. As the radius of a circle increases, does the circumference of the circle increase or decrease?

(1.4) *Simplify each expression.*

79. $5xy - 7xy + 3 - 2 + xy$

80. $4x + 10x - 19x + 10 - 19$

81. $6x^2 + 2 - 4(x^2 + 1)$

82. $-7(2x^2 - 1) - x^2 - 1$

83. $(3.2x - 1.5) - (4.3x - 1.2)$

84. $(7.6x + 4.7) - (1.9x + 3.6)$

Translating *Write each statement using mathematical symbols.*

85. Twelve is the product of x and negative 4.

86. The sum of n and twice n is negative fifteen.

87. Four times the sum of y and three is -1.

88. The difference of t and five, multiplied by six, is four.

89. Seven subtracted from z is six.

90. Ten less than the product of x and nine is five.

91. The difference of x and 5 is at least 12.

92. The opposite of four is less than the product of y and seven.

93. Two-thirds is not equal to twice the sum of n and one-fourth.

94. The sum of t and six is not more than negative twelve.

Name the property illustrated.

95. $(M + 5) + P = M + (5 + P)$

96. $5(3x - 4) = 15x - 20$

97. $(-4) + 4 = 0$

98. $(3 + x) + 7 = 7 + (3 + x)$

99. $(XY)Z = (YZ)X$

100. $\left(-\frac{3}{5}\right)\cdot\left(-\frac{5}{3}\right) = 1$

101. $T \cdot 0 = 0$

102. $(ab)c = a(bc)$

103. $A + 0 = A$

104. $8 \cdot 1 = 8$

Complete the equation using the given property.

105. $5x - 15z =$ _____ Distributive property

106. $(7 + y) + (3 + x) =$ _____ Commutative property

107. $0 =$ _____ Additive inverse property

108. $1 =$ _____ Multiplicative inverse property

109. $[(3.4)(0.7)]5 =$ _____ Associative property

110. $7 =$ _____ Additive identity property

Insert $<$, $>$, or $=$ to make each statement true.

111. $-9 \quad -12$

112. $0 \quad -6$

113. $-3 \quad -1$

114. $7 \quad |-7|$

115. $-5 \quad -(-5)$

116. $-(-2) \quad -2$

MIXED REVIEW

Complete the table.

	Number	*Opposite of Number*	*Reciprocal of Number*
117.	$-\frac{3}{4}$		
118.		-5	

Simplify each expression.

119. $-2\left(5x + \frac{1}{2}\right) + 7.1$

120. $\sqrt{36} \div 2 \cdot 3$

121. $-\frac{7}{11} - \left(-\frac{1}{11}\right)$

122. $10 - (-1) + (-2) + 6$

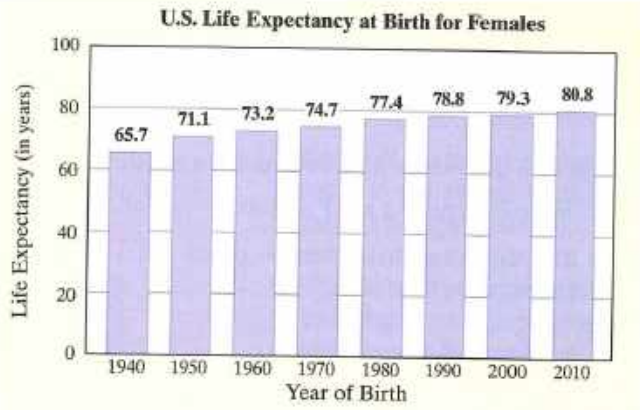
123. $\left(-\frac{2}{3}\right)^3 \div \frac{10}{9}$

124. $\frac{(3-5)^2 + (-1)^3}{1 + 2(3 - (-1))^2}$

125. $\frac{1}{3}(9x - 3y) - (4x - 1) + 4y$

126. The average price for an ounce of gold in the United States during a month in 2011 was \$1536. The algebraic expression $1536z$ gives the average cost of z ounces of gold during this period. Find the average cost if 7.5 ounces of gold was purchased during this time. (*Source:* Business News America)

The bar graph shows the U.S. life expectancy at birth for females born in the years shown. Use the graph to calculate the increase in life expectancy over each ten-year period shown. (The first row has been completed for you.)



Source: U.S. National Center for Health Statistics and wikipedia

	Year	*Increase in Life Expectancy (in years) from 10 Years Earlier*
	1950	5.4
127.	1960	
128.	1970	
129.	1980	
130.	1990	
131.	2000	
132.	2010	