# Solutions for Introductory and Intermediate Algebra for College Students 6th Edition by Blitzer

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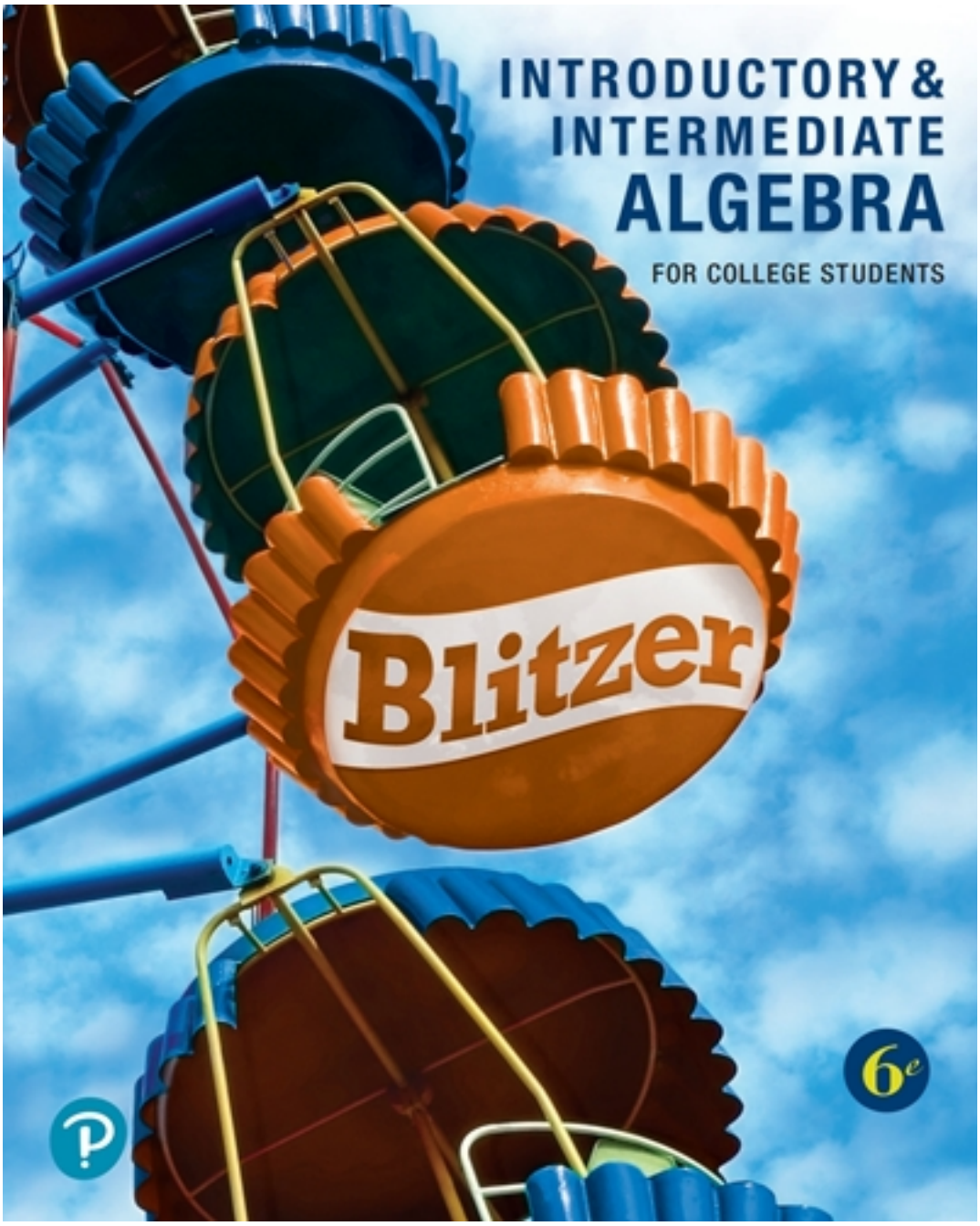



# Solutions

# INSTRUCTOR'S RESOURCE MANUAL

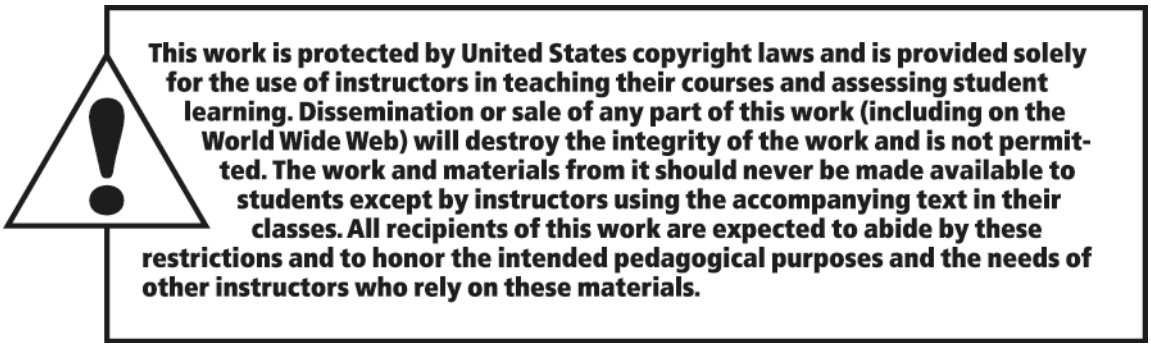
# INTRODUCTORY & INTERMEDIATE ALGEBRA FOR COLLEGE STUDENTS

SIXTH EDITION

Robert Blitzer

*Miami Dade College*

Pearson



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# Instructor's Resource Manual with Tests

***Introductory & Intermediate Algebra for College Students, Sixth Edition***
**Robert Blitzer**

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**Mini Lecture 1.1**

Introduction to Algebra: Variables and Mathematical Models

**Learning Objectives:**

1. Evaluate algebraic expressions.
2. Translate English phrases into algebraic expressions.
3. Determine whether a number is a solution of an equation.
4. Translate English sentences into algebraic equations.
5. Evaluate formulas.

**Examples:**

1. Evaluate each expression for $x = 5$.

   a. $4(x-3)$ b. $\dfrac{6x-15}{3x}$

2. Evaluate each expression for $x = 3$ and $y = 6$.

   a. $5(x+y)$ b. $\dfrac{2x+3y}{2y}$

3. Write each English phrase as an algebraic expression. Let $x$ represent the number.
   a. the difference of a number and six
   b. eight more than four times a number
   c. four less than the quotient of a number and twelve

4. Determine whether the given number is a solution of the equation.
   a. $x - 8 = 12$; 20 b. $4x - 7 = 9$; 3 c. $3(y-5) = 6$; 7

5. Write each English sentence as an equation. Let $x$ represent the number.
   a. The product of a number and seven is twenty-one.
   b. The difference of twice a number and three is equal to twenty-seven.
   c. Six less than three times a number is the same as the number increased by twelve.

**Teaching Notes:**

- It may be helpful to draw students' attention to the word "evaluate." Help them see the letters v – a – l – u . This will help them remember that evaluate means to find the value of an expression.
- Students often make mistakes with the phrase "less than" so they should be cautioned about the order of the subtraction.
- Translating from English to algebra is an important skill that will be used often.

Answers: 1a. 8 b. 1 2a. 45 b. 2 3a. $x-6$ b. $4x+8$ c. $\dfrac{x}{12}-4$ 4a. yes b. not a solution c. yes 5a. $7x = 21$ b. $2x - 3 = 27$ c. $3x - 6 = x + 12$

**Mini Lecture 1.2**

Fractions in Algebra

**Learning Objectives:**

1. Convert between mixed numbers and improper fractions.
2. Write the prime factorization of a composite number.
3. Reduce or simplify fractions.
4. Multiply fractions.
5. Divide fractions.
6. Add and subtract fractions with identical denominators.
7. Add and subtract fractions with unlike denominators.
8. Solve problems involving fractions in algebra.

**Examples:**

1. Convert each mixed number to an improper fraction.

a. $3\frac{7}{10}$ b. $8\frac{3}{7}$ c. $5\frac{2}{3}$ d. $9\frac{1}{4}$

2. Convert each improper fraction to a mixed number.

a. $\frac{13}{8}$ b. $\frac{12}{11}$ c. $\frac{25}{3}$ d. $\frac{37}{7}$

3. Give the prime factorization of each of the following composite numbers.

a. 24 b. 48 c. 90 d. 108

4. What makes a number a prime?

5. Reduce the following fractions to lowest terms by factoring each numerator and denominator and dividing out common factors.

a. $\frac{10}{12}$ b. $\frac{32}{48}$ c. $\frac{24}{50}$ d. $\frac{77}{98}$

6. Perform the indicated operation. Always reduce answer, if possible.

a. $\frac{3}{4} + \frac{1}{6}$ b. $8\frac{1}{8} + 3\frac{1}{3}$ c. $\frac{7}{10} - \frac{3}{8}$

d. $10\frac{11}{12} - 4\frac{1}{4}$ e. $\left(\frac{7}{9}\right)\left(\frac{18}{19}\right)$ f. $\left(6\frac{2}{3}\right)\left(2\frac{1}{4}\right)$

g. $\frac{7}{8} \div \frac{3}{4}$ h. $5\frac{3}{8} \div 2\frac{1}{4}$

**Teaching Notes:**

- When teaching factorization, it is often helpful to review divisibility rules.
- To add or subtract fractions, you must have a LCD.
- To divide fractions, multiply by the reciprocal of the divisor.
- To multiply or divide mixed numbers, change to improper fractions first.

Answers: 1. a. 37/10 b. 59/7 c. 17/3 d. 37/4 2. a. 1 5/8 b. 1 1/11 c. 8 1/3 d. 5 2/7
3. a. $2 \cdot 2 \cdot 2 \cdot 3$ b. $2 \cdot 2 \cdot 2 \cdot 2 \cdot 3$ c. $2 \cdot 3 \cdot 3 \cdot 5$ d. $2 \cdot 2 \cdot 3 \cdot 3 \cdot 3$
4. a number whose only factors are 1 and itself 5. a. 5/6 b. 2/3 c. 12/25 d. 11/14 6. a. 11/12
b. $\frac{275}{24}$ or 11 11/24 c. 13/40 d. $\frac{20}{3}$ or 6 2/3 e. 14/19 f. 15 g. 7/6 or 1 1/6 h. 43/18 or 2 7/18

**Mini Lecture 1.3**
The Real Numbers

**Learning Objectives:**

1. Define the sets that make up the set of real numbers.
2. Graph numbers on a number line.
3. Express rational numbers as decimals.
4. Classify numbers as belonging to one or more sets of the real numbers.
5. Understand and use inequality symbols.
6. Find the absolute value of a real number.

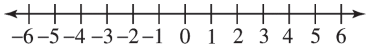
**Examples:**

1. Answer the following questions about each number:

   Is it a natural number? Is it rational?
   Is it a whole number? Is it irrational?
   Is it an integer? Is it a real number?

   a. 18 b. –3.5 c. $\sqrt{5}$ d. 0 e. $-\frac{3}{4}$ f. $\pi$ g. –5 h. 0.45

2. Graph each number on the number line.




   a. 5.5 b. $-\frac{16}{4}$ c. $2\frac{1}{4}$ d. –3.2

3. Express each rational number as a decimal.

   a. $\frac{7}{8}$ b. $\frac{9}{11}$ c. $\frac{5}{3}$ d. $\frac{1}{4}$

4. Use $>$ or $<$ to compare the numbers.

   a. 18 □ –20 b. –16 □ –13 c. –4.3 □ –6.2

   d. $\frac{4}{7}$ □ $\frac{8}{11}$ e. $-\frac{3}{5}$ □ $\frac{2}{3}$

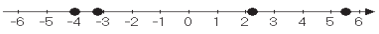
5. Give the absolute value.

   a. $|8|$ b. $|-5|$ c. $|-3.2|$ d. $|22|$

**Teaching Notes:**

- Make sure the students have minimal understanding of square roots.
- Absolute value is ALWAYS POSITIVE because it measures distance from zero.
- Remind students that a number cannot be rational and irrational.
- To change a rational number to a decimal, divide the numerator by the denominator.

Answers: 1. a. natural, whole, integer, rational , real b. rational, real c. irrational, real d. whole, integer, rational, real e. rational, real f. irrational, real g., integer, rational, real h. rational, real 2. See below 3. a. 0.875 b. 0.81 c. 0.6 d. 0.25 4. a. > b. < c. > d. < e. < 5. a. 8 b. 5 c. 3.2 d. 22



**Mini Lecture 1.4**
Basic Rules of Algebra

**Learning Objectives:**

1. Understand and use the vocabulary of algebraic expressions.
2. Use commutative properties.
3. Use associative properties.
4. Use the distributive property.
5. Combine like terms.
6. Simplify algebraic expressions.

**Examples:**

1. Fill in the blanks.

| Algebraic Expression | # of terms | coefficients | like terms |
|---|---|---|---|
| a. $6y - 3x - 4y + 8$ | _____ | _____ | _____ |
| b. $5x^2 + 2y - 2x^2 + 9 - 3y$ | _____ | _____ | _____ |
| c. $6x^2 - 9y + 4x + 8 - y + 5$ | _____ | _____ | _____ |

2. Name the property being illustrated and then simplify if possible.
   a. $6(x + 2) = 6x + 12$ _____
   b. $(9 \cdot 12)5 = 9(12 \cdot 5)$ _____
   c. $(x + 4) + 8 = x + (4 + 8)$ _____
   d. $(2)(3.14)(5) = 2(5)(3.14)$ _____

3. Simplify.
   a. $6x - x + 2x =$ _____ b. $3a - 8 + 2a + 10 =$ _____
   c. $6(x + 3) - 5 =$ _____ d. $2(x - 4) - (x - 2) =$ _____
   e. $5(y - 2) + 3(4 - y) =$ _____

**Teaching Notes:**

- A coefficient is the number factor of a term.
- Like terms have the very same variables raised to the same exponents.
- When applying the commutative property, only the order changes.
- The commutative property holds for addition and multiplication only.
- When applying the associative property the grouping changes.
- The associative property holds for addition and multiplication only.
- When combining like terms, add or subtract the coefficients, the variable part remains the same.
- Always use parentheses when substituting a value for a variable.

Answers: 1 a. 4; 6, –3, –4, 8; $6y$ and $–4y$ b. 5; 5, 2, –2, 9, –3; $5x^2$ and $–2x^2$; $2y$ and $–3y$
c. 6; 6, –9, 4, 8, –1, 5; $9y$ and $–y$; 8 and 5 2. a. distributive b. associative of multiplication
c. associative of addition d. commutative of multiplication 3. a. $7x$ b. $5a + 2$ c. $6x + 13$
d. $x - 6$ e. $2y + 2$

**Mini Lecture 1.5**
Addition of Real Numbers

**Learning Objectives:**

1. Add numbers with a number line.
2. Find sums using identity and inverse properties.
3. Add numbers without a number line.
4. Use addition rules to simplify algebraic expressions.
5. Solve applied problems using a series of additions.

**Examples:**

1. Find each sum using a number line.

   a. $3 + -5$ b. $-4 + -6$ c. $-1 + 2$ d. $5 + 4$

2. Add without using a number line.

   a. $-7 + -11$ b. $-0.4 + -3.2$ c. $-\frac{4}{5} + -\frac{3}{10}$ d. $-15 + 4$

   e. $7.1 + 8.5$ f. $-8 + 25$ g. $-6.4 + 6.1$ h. $\frac{5}{8} + -\frac{3}{4}$

3. Simplify the following.

   a. $-30x + 5x$ b. $-2y + 5x + 8x + 3y$ c. $-2(3x + 5y) + 6(x + 2y)$

4. Write a sum of signed numbers that represents the following situation. Then, add to find the overall change.

   If the stock you purchased last week rose 2 points, then fell 4, rose 1, fell 2, and rose 1, what was the overall change for the week?

**Teaching Notes:**

- When adding numbers with like signs, add and take the sign.
- When adding numbers with unlike signs, subtract the smaller absolute value from the larger absolute value, and the answer will have the sign of the number with the larger absolute value.

Answers: 1. a. $-2$ b. $-10$ c. 1 d. 9 2. a. $-18$ b. $-3.6$ c. $-\frac{11}{10}$ or $-1\frac{1}{10}$ d. $-11$ e. 15.6
f. 17 g. $-0.3$ h. $-\frac{1}{8}$ 3. a. $-25x$ b. $13x + y$ c. $2y$
4. $2 + (-4) + 1 + (-2) + 1 = -2$; fell 2 points

**Mini Lecture 1.6**
Subtraction of Real Numbers

**Learning Objectives:**

1. Subtract real numbers.
2. Simplify a series of additions and subtractions.
3. Use the definition of subtraction to identify terms.
4. Use the subtraction definition to simplify algebraic expressions.
5. Solve problems involving subtraction.

**Examples:**

1. Subtract by changing each subtraction to addition of the opposite first.

   a. $6 - 12$ b. $-15 - 15$ c. $13 - 21$ d. $\frac{2}{5} - \frac{5}{6}$

   e. $4.2 - 6.8$ f. $25 - (-25)$ g. $-51 - (-13)$ h. $14 - (-13)$

2. Simplify.

   a. $-16 - 14 - (-10)$ b. $-20.3 - (-40.1) - 18$

   c. $15 - (-3) - 10 - 18$ d. $-11 - 21 - 31 - 41$

3. Identify the number of terms in each expression; then name the terms.

   a. $4x - 6y + 12 - 3y$ b. $16 - 2x - 15$

   c. $15a - 2ab + 3b - 6a + 18$ d. $5y - x + 3y - 14xy$

4. Simplify each algebraic expression.

   a. $8x + 7 - x$ b. $-11y - 14 + 2y - 10$

   c. $15a - 10 - 12a + 12$ d. $25 - (-3x) - 15 - (-2x)$

5. Applications.

   a. The temperature at dawn was –7 degrees but fortunately the sun came out and by 4:00 p.m. the temperature had reached 38 degrees. What was the difference in the temperature at dawn and 4:00 p.m.?

   b. Express 214 feet below sea level as a negative integer. Express 10,510 above sea level as a positive integer. What is the difference between the two elevations?

**Teaching Notes:**

- Say the problem to yourself. When you hear the word "minus", immediately make a "change-change". That means to "change" the subtraction to addition and "change" the sign of the number that follows to its opposite.
- Remember, the sign in front of a term goes with the term.
- The symbol "–"can have different meanings:
  1. subtract or "minus" only when it is between 2 terms
  2. the opposite of
  3. negative

Answers: 1. a. –6 b. –30 c. –8 d. $-\frac{13}{30}$ e. –2.6 f. 50 g. –38 h. 27 2. a. –20 b. 1.8 c. –10 d. –104 3. a. 4 terms; $4x$,$-6y$, 12, $-3y$ b. 3 terms; 16, $-2x$ , –15 c. 5 terms; $15a$, $-2ab$, $3b$, $-6a$, 18 d. 4 terms; $5y$, $-x$, $3y$, $-14xy$ 4. a. $7x + 7$ b. $-9y - 24$ c. $3a + 2$ d. $5x + 10$ 5. a. 45 degrees b. –214 feet. 10,500 feet; 10, 724 feet

**Mini Lecture 1.7**
Multiplication and Division of Real Numbers

**Learning Objectives:**

1. Multiply real numbers.
2. Multiply more than two real numbers.
3. Find multiplicative inverses.
4. Use the definition of division.
5. Divide real numbers.
6. Simplify algebraic expressions involving multiplication.
7. Determine whether a number is a solution of an equation.
8. Use mathematical models involving multiplication and division.

**Examples:**

1. Multiply.

   a. $(3)(-4)$ b. $(-6)(-5)$ c. $(-8)(0)$ d. $(-3.2)(-1.1)$ e. $\left(-\frac{3}{4}\right)\left(\frac{2}{9}\right)$

   f. $(-5)(2)(-1)$ g. $(-2)(2)(-3)(-3)$

2. Find the multiplicative inverse of each number.

   a. $-8$ b. $\frac{2}{5}$ c. $-7$ d. $\frac{1}{4}$

3. Use the definition of division to find each quotient.

   a. $-49 \div 7$ b. $\frac{-24}{-4}$

4. Divide or state that the expression is undefined.

   a. $\frac{-18}{0}$ b. $-\frac{4}{5} \div \frac{20}{25}$ c. $-32.4 \div 8$ d. $0 \div -8$

5. Simplify.

   a. $-3(2x)$ b. $9x + x$ c. $-12a + 4a$ d. $-(5x - 3)$

   e. $-2(3y + 4)$ f. $2(3x + 4) - (4x - 6)$

**Teaching Notes:**

- The product of an even number of negative numbers is positive.
- The product of an odd number of negative numbers is negative.
- Any product using zero as a factor will equal zero.
- The quotient of two real numbers with different signs is negative.
- The quotient of two real numbers with same signs is positive.
- Division of a non-zero number by zero is undefined.
- Any non-zero number divided into 0 is 0.

Answers: 1. a. $-12$ b. 30 c. 0 d. 3.52 e. $-\frac{1}{6}$ f. 10 g. $-36$ 2. a. $-\frac{1}{8}$ b. $\frac{5}{2}$ c. $-\frac{1}{7}$ d. $\frac{4}{1}$
3. a. $-7$ b. 6 4. a. undefined b. $-1$ c. $-4.05$ d. 0 5.a. $-6x$ b. $10x$ c. $-8a$ d. $-5x + 3$
e. $-6y - 8$ f. $2x + 14$

**Mini Lecture 1.8**
Exponents and Order of Operations

**Learning Objectives:**

1. Evaluate exponential expressions.
2. Simplify algebraic expressions with exponents.
3. Use order of operations agreement.
4. Evaluate mathematical models.

**Examples:**

1. Identify the base and the exponent, then evaluate.
   a. $3^4$ b. $(-4)^3$ c. $-8^2$ d. $(-8)^2$

2. Evaluate.
   a. $13^2$ b. $2^5$ c. $(-3)^3$ d. $5^2$

3. Simplify if possible.
   a. $6x^2 - x^2$ b. $5y^3 + 2y - 3y^3$ c. $6a^2 + 2a - 4a^2 - 6a$
   d. $10p^3 - 8p^2$

4. Simplify by using the order of operations.
   a. $30 \div 2 \cdot 3 - 52$ b. $14 - (33 \div 11) + 4$
   c. $(5 + 2)^2$ d. $10 - 7(32 \div 8) + 5 \cdot 3$
   e. $\left(\frac{1}{4}\right) + \left(\frac{1}{3}\right)^2$ f. $15 - 3[8 - (-12 \div 2^2) - 4^2]$
   g. $\frac{16 + 4^2 \div 8}{-2 - (-5)}$ h. $22 + 5(x + 7) - 3x - 10$

5. 5. Evaluate each expression for the given value.
   a. $-a - a^2$ if $a = -3$ b. $-a - a^2$ if $a = 3$ c. $4x^2 - x + 3x$ if $x = -1$

6. Use the formula for perimeter of a rectangle, $P = 2w + 2l$ to find the perimeter of a rectangle if the length is 28 cm and the width is 15 cm.

**Teaching Notes:**

- If the negative sign is part of the base, it will be inside the parentheses.
- **NEVER** multiply the base and the exponent together.
- The exponent tells how many times to write the base as a factor.
- Always use parentheses when substituting a value for a variable.
- The Order of Operations must be followed on every problem.

Answers: 1. a. 81 b. –64 c. –64 d. 64 2. a. 169 b. 32 c. –27 d. 25 3. a. $5x^2$ b. $2y^3 + 2y$ c. $2a^2 - 4a$ d. $10p^3 - 8p^2$ 4. a. –7 b. 15 c. 49 d. –3 e. $\frac{13}{36}$ f. 30 g. 6 h. 2x + 47 5. a. –6 b. –12 c. 2 6. 86 cm

**Mini Lecture 2.1**
The Addition Property of Equality

**Learning Objectives:**

1. Identify linear equations in one variable.
2. Use the addition property of equality to solve equations.
3. Solve applied problems using formulas.

**Examples:**

1. Identify the linear equations in one variable.
   a. $x + 7 = 10$
   b. $x^2 - 2 = 7$
   c. $\frac{3}{x} = 5$
   d. $|x + 1| = 6$
2. Solve the following equations using the addition property of equality. Be sure to check your proposed solution.
   a. $x + 2 = 17$

   b. $-12 = x - 9$

   c. $x - \frac{1}{2} = 4$

   d. $3x - 2x = 8$

   e. $5x + 1 = 4(x - 2)$

   f. $x + 3.5 = 4.8$

   g. $2x + 5 = x - 2$

   h. $3x + 5 = 2x + 5$

   3. If Sue is 2 years older than John then we will use S to represent Sue's age and J to represent John's age. Use the equation $S = J + 2$ to find John's age if Sue is 41.

**Teaching Notes:**

- Solving an equation is the process of finding the number (or numbers) that make the equation a true statement. These numbers are called the solutions, or roots, or the equation.
- To apply the addition property of equality, one must add the same number or expression to both sides of the equation.
- Equivalent equations are equations that have the same solution.

Answers: 1. a. linear b. not linear c. not linear d. not linear 2. a. 15 b. -3 c. $4\frac{1}{2}$ or $\frac{9}{2}$ d. 8 e. -9 f. 1.3 g. -7 h. 0 3. 39

**Mini Lecture 2.2**
The Multiplication Property of Equality

**Learning Objectives:**

1. Use multiplication property of equality to solve equations.
2. Solve equations in the form $-x = c$.
3. Use addition and multiplication properties to solve equations.
4. Solve applied problems using formulas.

**Examples:**

1. Multiply both sides of the equation by the reciprocal of the coefficient of the variable to solve for the variable.

   a. $\frac{x}{3} = 6$ b. $\frac{x}{-2} = -7$ c. $\frac{y}{15} = -10$ d. $8 = \frac{x}{-3}$

2. Divide both sides of the equation by the coefficient of the variable to solve for the variable.

   a. $6x = 18$ b. $-2x = -14$ c. $15y = -10$ d. $24 = -3x$

Both of the above methods of isolating the variable are effective for solving equations.

3. Solve each equation by multiplying or dividing.

   a. $18y = -108$ b. $\frac{3}{5}x = 12$ c. $124 = \frac{x}{3}$ d. $-7x = -63$

4. Multiply or divide both sides of each equation by –1 to get a positive $x$.

   a. $-x = -7$ b. $82 = -x$ c. $-a = -\frac{3}{7}$ d. $14 = -x$

5. Solve each equation using both the addition and multiplication properties of equality.

   a. $3x - 5 = 13$ b. $18 - 6x = 14 - 2x$ c. $23 = 2a - 7$

   d. $-6y - 21 = 21$ e. $33 - x = 3x - 11$ f. $\frac{2}{3}x - 6 = 12$

**Teaching Notes:**

- Remind students that reciprocals always have the same sign.
- When students see $-x$ they must realize the coefficient is –1.

Answers: 1. a. $x = 18$ b. $x = 14$ c. $y = -150$ d. $x = -24$ 2. a. $x = 3$ b. $x = 7$ c. $y = -\frac{2}{3}$ d. $x = -8$

3. a. $y = -6$ b. $x = 20$ c. $x = 372$ d. $x = 9$ 4. a. $x = 7$ b. $x = -82$ c. $a = \frac{3}{7}$ d. $x = -14$

5. a. $x = 6$ b. $x = 1$ c. $a = 15$ d. $y = -7$ e. $x = 11$ f. $x = 27$

**Mini Lecture 2.3**
Solving Linear Equations

**Learning Objectives:**

1. Solve linear equations.
2. Solve linear equations containing fractions.
3. Solve linear equations containing decimals.
4. Identify equations with no solution or infinitely many solutions.
5. Solve applied problems using formulas.

**Examples:**

1. $3x + 2x + 8 = -7 + x + 11$

2. $6x = 3(x + 9)$

3. $5(2x - 1) - 15 = 3(4x + 2) + 4$

4. $\frac{x}{5} = \frac{2x}{3} + \frac{7}{15}$

5. $1.2x + 1.8 = 0.6x$

6. $1.3x + 1.7 = -1 - 1.4x$

7. $2x + 9 = 2(x + 4)$

8. $4(x + 2) + 5 = 5(x + 1) + 8$

9. Use the formula $P = 4s$ to find the length of a side of a square whose perimeter is 32 in.

**Teaching Notes:**

- Simplify the algebraic expression on each side of the equal sign.
- Collect variable terms on one side of the equal sign and all constant terms on the other side of the equal sign.
- Isolate the variable and solve.
- Check your solution in the original expression.

Answers: 1. –1 2. 9 3. –15 4. –1 5. –3 6. –1 7. inconsistent, no solution 8. 0 9. 8 inches

**Mini Lecture 2.4**
Formulas and Percents

**Learning Objectives:**

1. Solve a formula for a variable.
2. Use the percent formula.
3. Solve applied problems involving percent change.

**Examples:**

1. Solve the formula for the indicated variable by isolating the variable.

   a. $A = \frac{B_1 + B_2}{2}$ for $B_1$

   b. $P = a + b + c$ for $c$

   c. $A = \pi r^2 h$ for $h$

   d. $4p + H = M$ for $p$

   e $Ax + By = C$ for $A$

   f. $y = mx + b$ for $b$

2. Translate each question into an equation using the percent formula, $A = PB$, then solve the equation.

   a. What is 15 percent of 60?

   b. 62% of what number is 31?

   c. What percent of 132 is 33?

   d. 60 is what percent of 500?

3. The average, or mean $A$ of the three exam grades, $x$, $y$, $z$, is given by formula $A = \frac{x + y + z}{3}$.

   a. Solve the formula for $z$.

   b. If your first two exams are 75% and 83% ($x = 75$, $y = 83$), what must you get on the third exam to have an average of 80%?

**Teaching Notes:**

- Many students have trouble solving formulas for a letter and need to be reminded the same steps are used when solving for a letter in a formula as are used when solving any equation for a variable.
- When changing a decimal to a percent, move the decimal point two places to the right and use the % symbol.
- When changing a percent to a decimal, move the decimal point two places to the left and drop the % symbol.
- When translating English into a mathematical equation, the word "is" translates to equals and the word "of" means multiply.

Answers: 1. a. $B_1 = 2A - B_2$ b. $c = P - a - b$ c. $h = \frac{A}{\pi r^2}$ d. $p = \frac{M - H}{4}$ e. $A = \frac{C - By}{x}$ f. $b = y - mx$ 2. a. $x = 0.15(60)$; 9 b. $0.62x = 31$; 50 c. $x \cdot 132 = 33$; 25% d. $60 = x \cdot 500$; 12% 3. a. $z = 3A - x - y$ b. 82%

**Mini Lecture 2.5**
An Introduction to Problem Solving

**Learning Objectives:**

1. Translate English phrases into algebraic expressions.
2. Solve algebraic word problems using linear equations.

**Examples:**

1. Translate each English phrase into an algebraic expression. Let "$x$" represent the unknown.
   a. Three times a number decreased by 11.
   b. The product of seven and a number increased by 2.
   c. Eight more than a number.

2. Translate each sentence into an algebraic equation and then solve the equation.
   a. Twice a number less five is eleven.
   b. Five times the sum of a number and eight is 30.

3. Identify all unknowns, set up an equation, and then solve.
   a. Bill earns five dollars more per hour than Joe. Together their pay for one hour totals $21. How much does each man earn per hour?
   b. Two consecutive even integers equal 42. Find the integers.

**Teaching Notes for solving algebraic equations:**

- Make sure to familiarize all students with basic mathematical terms and the proper way to translate to algebraic terms.
- First, read the problem carefully and assign a variable for one of the unknown quantities.
- Write expressions if necessary for any other unknown quantities in terms of same variable.
- Write an equation for the stated problem.
- Solve the equation and answer the question.
- Check the solution in the original stated problem.

Answers: 1. a. $3x - 11$
b. $7x + 2$
c. $x + 8$

2. a. $2x - 5 = 11$
$x = 8$
b. $5(x + 8) = 30$
$x = -2$

3. a. $x$ = Joe
$x + 5$ = Bill
$x + (x + 5) = 21$
$x$ = \$8 (Joe)
$x + 5$ = \$13 (Bill)

b. $x = 1^{st}$ even integer
$x + 2 = 2^{nd}$ even integer
$x + (x + 2) = 42$
$x = 20$
$x + 2 = 22$

**Mini Lecture 2.6**
Problem Solving in Geometry

**Learning Objectives:**

1. Solve problems using formulas for perimeter and area.
2. Solve problems using formulas for a circle's area and circumference.
3. Solve problems using formulas for volume.
4. Solve problems involving the angles of a triangle.
5. Solve problems involving complementary and supplementary angles.

**Examples:**

1. A triangular flower bed has an area of 48 square feet and a height of 12 feet. Find the base of the flower bed.

2. The diameter of a fish pond is 6 feet. Find the area and circumference of the fish pond. First express answer in terms of $\pi$, then round both answers to the nearest square foot and foot respectively.

3. Which is the better buy: a 3 liter bottle of soft drink for \$2.99 or a 1.2 liter bottle for \$1.10?

4. Find the volume of a cylinder with a radius of 2 inches and height of 6 inches. Give answer in $\pi$ form and then round answer to nearest cubic inch.

5. A volleyball has a radius of 3 inches. Find how much air is needed to fill the ball. Give answer in $\pi$ form and then round answer to nearest cubic inch.

6. Given a right triangle and knowing that the two acute angles are complementary, find the measure of each if one angle is twice the measure of the other.

**Teaching Notes:**

- Make sure to emphasize the formulas outlined in the section.
- Write formula, substitute the given values, and solve for the unknown.

Answers: 1. base = 8 ft. 2. area = $9\pi$ ft$^2$, 28 ft$^2$ ; circumference = $6\pi$ ft., 19 ft. 3. 1.2 liter bottle 4. $24\pi$ in$^3$, 75 ft$^3$ 5. $36\pi$ in$^3$, 113 in$^3$ 6. 30°, 60°

Express the sum using summation notation. Use 1 as the lower limit of summation and $i$ for the index of summation.

10. $1^4 + 2^4 + 3^4 + ... + 8^4$ 10. _____

11. $1 + 4 + 9 + ... + 36$ 11. _____

12. $2 + 4 + 6 + ... + 10$ 12. _____

13. $5 + 8 + 11 + ... + 20$ 13. _____

14. The finite sequence whose general term is $a_n = 0.18n^2 - 1.08n + 6.62$ where $n = 1, 2, 3, \ldots, 9$ models the total operating costs, in millions of dollars, for a company from 2008 through 2016. Find $\sum_{i=1}^{4} a_i$. 14. _____

15. A deposit of \$7000 is made in an account that earns 6% interest compounded quarterly. The balance in the account after $n$ quarters is given by the sequence $a_n = 7000\left(1 + \frac{0.06}{4}\right)^n$, $n = 1, 2, 3, \ldots$ Find the balance in the account after one year by computing $a_4$. 15. _____

Name _____ Date _____

**Additional Exercises 14.1**
**Form II**
Sequences and Summation Notation

Write the first four terms of the sequence whose general term is given.

1. $a_n = n - 4$ 1. _____

2. $a_n = n^2 - n$ 2. _____

3. $a_n = 3^n$ 3. _____

4. $a_n = \dfrac{n!}{n+1}$ 4. _____

Find the indicated sum.

5. $\sum_{i=1}^{6} i^2 + 1$ 5. _____

6. $\sum_{i=1}^{6} i^2 + 1$ 6. _____

7. $\sum_{i=4}^{8} 9$ 7. _____

8. $\sum_{i=1}^{5} \dfrac{(-1)i + 1}{(i-1)!}$ 8. _____

9. $\sum_{i=1}^{5} \dfrac{(i-1)!}{(i+1)!}$ 9. _____

Express the sum using summation notation.

10. $\frac{1}{3}+\frac{2}{4}+\frac{3}{5}+\ldots+\frac{12}{14}$ 10. _____

11. $9+10+11+12+\ldots+38$ 11. _____

12. $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ldots+\frac{1}{64}$ 12. _____

13. $16+-64+256+\ldots+4096$ 13. _____

14. The finite sequence whose general term is $a_n = 0.18n^2 - 1.08n + 6.62$ where $n = 1, 2, 3, \ldots, 9$ models the total operating costs, in millions of dollars, for a company from 2010 through 2016. Find $\sum_{i=1}^{5} a_i$. 14. _____

15. A deposit of $7000 is made in an account that earns 6% interest compounded quarterly. The balance in the account after $n$ quarters is given by the sequence $a_n = 7000\left(1+\frac{0.06}{4}\right)^n$, $n = 1, 2, 3, \ldots$ Find the balance in the account after one year and a half by computing $a_6$. 15. _____

Name _____ Date _____

**Additional Exercises 14.1**
**Form III**
Sequences and Summation Notation

Write the first four terms of the sequence whose general term is given.

1. $a_n = 2n + 1$ 1. _____

2. $a_n = (-4)^n$ 2. _____

3. $a_n = \left(-\frac{3}{4}\right)^n$ 3. _____

4. $a_n = 3(n+2)!$ 4. _____

Find the indicated sum.

5. $\sum_{i=3}^{4}(3i-2)$ 5. _____

6. $\sum_{i=1}^{4} 3i$ 6. _____

7. $\sum_{i=1}^{4}\frac{1}{i}$ 7. _____

8. $\sum_{i=1}^{5}(-1)^i(2i+3)$ 8. _____

9. $\sum_{i=2}^{4} i(i+5)$ 9. _____

Express the sum using summation notation.

10. $1+8+27+\ldots+512$ 10. _____

11. $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ldots+\frac{1}{64}$ 11. _____

12. $1+2+6+\ldots+5040$ 12. _____

13. $a+ar+ar^2+\ldots+ar^{10}$ 13. _____

14. The finite sequence whose general term is $a_n = 0.18n^2 - 1.08n + 6.62$ where $n = 1, 2, 3, \ldots, 9$ models the total operating costs, in millions of dollars, for a company from 2007 through 2013. Find $\sum_{i=1}^{6} a_i$. 14. _____

15. A deposit of \$7000 is made in an account that earns 6% interest compounded quarterly. The balance in the account after $n$ quarters is given by the sequence $a_n = 7000\left(1+\frac{0.06}{4}\right)^n$, $n = 1, 2, 3, \ldots$ Find the balance in the account after two years by computing $a_8$. 15. _____

Name _____ Date _____

**Additional Exercises 14.2**
**Form I**
Arithmetic Sequences

Find the common difference for each arithmetic sequence.

1. 8, 12, 16, 20, … 1. _____

2. 2, –1, –4, –7, … 2. _____

Write the first five terms of the arithmetic sequence whose first term, $a_1$, and common difference, $d$, are given.

3. $a_1 = 10; d = 4$ 3. _____

4. $a_1 = 6; d = -1$ 4. _____

5. $a_1 = 1; d = 5$ 5. _____

6. $a_1 = 2; d = 0.5$ 6. _____

Use the formula for the general term of an arithmetic sequence to find the indicated term of each sequence with the given first term, $a_1$, and common difference, $d$.

7. Find $a_5$ when $a_1 = -3, d = -3$ 7. _____

8. Find $a_7$ when $a_1 = -5, d = -\frac{1}{3}$ 8. _____

9. Find $a_{10}$ when $a_1 = 1, d = 6$ 9. _____

Write a formula for the general term (the nth term) of each arithmetic sequence.

10. 4, 20, 36, 52, 68, … 10. _____

11. $-13, -22, -31, -40, \ldots$ 11. _____

12. $a_1 = 6, d = -3$ 12. _____

13. $a_1 = -5, d = -7$ 13. _____

14. Find the sum of the first eight terms of the arithmetic sequence 3, 8, 13, … 14. _____

15. Find the sum of the first 10 terms of the arithmetic sequence –7, –3. 1. 5. … 15. _____

16. Find the sum of the even integers between 17 and 45. 16. _____

For problems 17-18, write out the first three terms and the last term. Then use the formula for the sum of the first *n* terms of an arithmetic sequence to find the indicated sum.

17. $\sum_{i=1}^{10}(2i-1)$ 17. _____

18. $\sum_{i=1}^{40}-2i$ 18. _____

Solve the problem.

19. Jacie is considering a job that offers a monthly starting salary of $4000 and guarantees her a monthly raise of $110 during her first year on the job. Find the general term of the arithmetic sequence and her monthly salary at the end of her first year. 19. _____

20. A theater has 12 rows with 25 seats in the first row, 29 in the second row, 33 in the third row, and so forth. How many seats are in the theater? 20. _____

Name _____ Date _____

**Additional Exercises 14.2**
**Form II**
Arithmetic Sequences

Find the common difference.

1. 6, 8, 10, 12, … 1. _____

2. 5, 3, 1, –1, … 2. _____

Write the first five terms of the arithmetic sequence whose first term, $a_1$, and common difference, $d$, are given.

3. $a_1 = 15; d = 3$ 3. _____

4. $a_1 = 100; d = 25$ 4. _____

5. $a_1 = 2.2; d = 0.4$ 5. _____

6. $a_1 = \frac{1}{2}; d = \frac{1}{2}$ 6. _____

Use the formula for the general term of an arithmetic sequence to find the indicated term of each sequence with the given first term, $a_1$, and common difference, $d$.

7. Find $a_8$ when $a_1 = -3, d = -3$ 7. _____

8. Find $a_{12}$ when $a_1 = -5, d = -\frac{1}{3}$ 8. _____

9. Find $a_{13}$ when $a_1 = 1, d = 6$ 9. _____

Write a formula for the general term (the nth term) of each arithmetic sequence.

10. 1, –7, –15, –23, –31, … 10. _____

11. $100,\ 99\frac{1}{2},\ 99,\ 98\frac{1}{2},\ 98,\ \ldots$ 11. _____

12. $a_1 = \frac{1}{2}, d = \frac{1}{2}$ 12. _____

13. $a_1 = .5, d = .2$ 13. _____

14. Find the sum of the first twelve terms of the arithmetic sequence 3, 8, 13, … 14. _____

15. Find the sum of the first 17 terms of the arithmetic sequence –7, –3. 1. 5. … 15. _____

16. Find the sum of the even integers between 21 and 53. 16. _____

For problems 17-18, write out the first three terms and the last term. Then use the formula for the sum of the first *n* terms of an arithmetic sequence to find the indicated sum.

17. $\sum_{i=1}^{15}(2i-1)$ 17. _____
Find the indicated sum.

18. $\sum_{i=1}^{40} -2i+5$ 18. _____
Write out the first three terms and the last term.

Solve the problem.

19. Jacie is considering a job that offers a monthly starting salary of $3500 and guarantees her a monthly raise of $90 during her first year on the job. Find the general term of the arithmetic sequence and her monthly salary at the end of her first year. 19. _____

20. A theater has 15 rows with 25 seats in the first row, 29 in the second row, 33 in the third row, and so forth. How many seats are in the theater? 20. _____

Name _____ Date _____

**Additional Exercises 14.2**
**Form III**
Arithmetic Sequences

Find the common difference.

1. 24, 30, 36, 42, … 1. _____

2. 8, 4, 0, –4, … 2. _____

Write the first five terms of the arithmetic sequence whose first term, $a_1$, and common difference, $d$, are given.

3. $a_1 = \frac{-3}{4}; d = \frac{1}{4}$ 3. _____

4. $a_1 =$ 4. _____

5. $a_1 = \frac{7}{5}; d = 1$ 5. _____

6. $a_1 = 1.5; d = 1.6$ 6. _____

Use the formula for the general term of an arithmetic sequence to find the indicated term of each sequence with the given first term, $a_1$, and common difference, $d$.

7. Find $a_{14}$ when $a_1 = -3, d = -3$ 7. _____

8. Find $a_{16}$ when $a_1 = -5, d = -\frac{1}{3}$ 8. _____

9. Find $a_{17}$ when $a_1 = 1, d = 6$ 9. _____

Write a formula for the general term (the nth term) of each arithmetic sequence.

10. 2, 7, 12, 17, 22, … 10. _____

11. –8, –1, 6, 13, 20, … 11. _____

12. $a_1 = \frac{3}{4}, d = \frac{1}{2}$ 12. _____

13. $a_1 = 8, d = -0.3$ 13. _____

14. Find the sum of the first sixteen terms of the arithmetic sequence 3, 8, 13, … 14. _____

15. Find the sum of the first 30 terms of the arithmetic sequence –7, –3. 1. 5. … 15. _____

16. Find the sum of the even integers between 15 and 59. 16. _____

For problems 17-18, write out the first three terms and the last term. Then use the formula for the sum of the first *n* terms of an arithmetic sequence to find the indicated sum.

17. $\sum_{i=1}^{24}(2i-1)$ 17. _____

18. $\sum_{i=1}^{40}-2i^2$ 18. _____

Solve the problem.

19. Jacie is considering a job that offers a monthly starting salary of $3250 and guarantees her a monthly raise of $95 during her first year on the job. Find the general term of the arithmetic sequence and her monthly salary at the end of her first year. 19. _____

20. A theater has 20 rows with 25 seats in the first row, 29 in the second row, 33 in the third row, and so forth. How many seats are in the theater? 20. _____

Name _____ Date _____

**Additional Exercises 14.3**
**Form I**
Geometric Sequences and Series

Find the common ratio for the geometric sequence.

1. 4, –12, 36, –108, 324, … 1. _____

2. 10, 5, $\frac{5}{2}, \frac{5}{4}, \frac{5}{8}, \ldots$ 2. _____

3. 2. 0.2, 0.02, 0.002, 0.0002, … 3. _____

Write the first four terms of the geometric sequence whose first term, $a_1$, and common ratio, $r$, are given.

4. $a_1 = -2;\ r = 3$ 4. _____

5. $a_1 = -4;\ r = -3$ 5. _____

Use the formula for the general term (the $n^{th}$ term) of a geometric sequence to find the indicated term of the sequence with the given first term, $a_1$, and the common ratio, $r$.

6. Find $a_4$ when $a_1 = 6$, $r = 4$ 6. _____

7. Find $a_5$ when $a_1 = 4$, $r = 3$ 7. _____

Write a formula for the general term, $a_n$, of each geometric sequence.

8. 5, 10, 20, 40, 80, … 8. _____

9. $3, \frac{3}{2}, \frac{3}{4}, \frac{3}{8}, \frac{3}{16}, \ldots$ 9. _____

10. 2, 4, 8, 16, 32, … 10. _____

11. 0.1, 0.5, 2.5, 12.5, 62.5, … 11. _____

Use the formula for the sum of the first $n$ terms of a geometric sequence to solve.

12. Find the sum of the first five terms of the geometric sequence $\frac{1}{3}, \frac{2}{3}, \frac{4}{3}, \ldots$ 12. _____

13. Find the sum of the first six terms of the geometric sequence, –5, –10, –20, … 13. _____

14. $\sum_{i=1}^{6} (2)^i$ 14. _____

Find the sum of each infinite geometric series.

15. $4, 2, 1, \frac{1}{2}, \ldots$ 15. _____

16. $\frac{3}{4}, \frac{9}{16}, \frac{27}{64}, \frac{81}{256}, \ldots$ 16. _____

Express the repeating decimal as a fraction in lowest terms.

17. $0.\overline{4} = \frac{4}{10} + \frac{4}{100} + \frac{4}{1000} + \frac{4}{10,000} + \ldots$ 17. _____

18. $0.\overline{57} = \frac{57}{100} + \frac{57}{10,000} + \frac{57}{1,000,000} + \ldots$ 18. _____

Determine whether the given sequence is arithmetic, geometric, or neither. If arithmetic, find the common difference. If geometric, find the common ratio.

19. $a_n = \left(\frac{3}{5}\right)^n$ 19. _____

20. $a_n = n + 4$ 20. _____

Name _____ Date _____

**Additional Exercises 14.3**
**Form II**
Geometric Sequences and Series

Find the common ratio for the geometric sequence.

1. 8, 16, 32, 64, 128, … 1. _____

2. 40, 20, 10, 5, 2.5, … 2. _____

3. –.6, –6, 60, –600, –6000, … 3. _____

Write the first four terms of the geometric sequence whose first term, $a_1$, and common ratio, $r$, are given.

4. $a_1 = 36;\ r = \frac{1}{3}$ 4. _____

5. $a_1 = -8;\ r = 4$ 5. _____

Use the formula for the general term (the $n^{th}$ term) of a geometric sequence to find the indicated term of the sequence with the given first term, $a_1$, and the common ratio, $r$.

6. Find $a_7$ when $a_1 = 6$, $r = 4$ 6. _____

7. Find $a_8$ when $a_1 = 4$, $r = 3$ 7. _____

Write a formula for the general term, $a_n$, of each geometric sequence.

8. 4, 16, 64, 256, 1024, … 8. _____

9. $\frac{1}{5}, \frac{1}{35}, \frac{1}{245}, \frac{1}{1715}, \ldots$ 9. _____

10. $-\frac{1}{6}, \frac{1}{30}, -\frac{1}{150}, \frac{1}{750}, \ldots$ 10. _____

11. 0.0009, 0.18, 3.6, 72, … 11. _____

Use the formula for the sum of the first $n$ terms of a geometric sequence to solve.

12. Find the sum of the first five terms of the geometric sequence $\frac{1}{2}, 1, 2, \ldots$ 12. _____

13. Find the sum of the first six terms of the geometric sequence, $3, -12, 48, \ldots$ 13. _____

14. $\sum_{i=1}^{6}(-3)^i$ 14. _____

Find the sum of each infinite geometric series.

15. $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \ldots$ 15. _____

16. $\frac{2}{5}, \frac{4}{25}, \frac{8}{125}, \frac{16}{625}, \ldots$ 16. _____

Express the repeating decimal as a fraction in lowest terms.

17. $0.\overline{3} = \frac{3}{10} + \frac{3}{100} + \frac{3}{1000} + \frac{3}{10,000} + \ldots$ 17. _____

18. $0.\overline{45} = \frac{45}{100} + \frac{45}{10,000} + \frac{45}{1,000,000} + \ldots$ 18. _____

Determine whether the given sequence is arithmetic, geometric, or neither. If arithmetic, find the common difference. If geometric, find the common ratio.

19. $a_n = n + 7$ 19. _____

20. $a_n = n^2 + 1$ 20. _____

Name _____ Date _____

**Additional Exercises 14.3**
**Form III**
Geometric Sequences and Series

Find the common ratio for the geometric sequence.

1. 20, 40, 80, 160, 320, … 1. _____

2. $-5, \frac{5}{3}, \frac{-5}{9}, \frac{5}{27}, \frac{-5}{81}, \ldots$ 2. _____

3. 3, –1.2, 0.48, –0.192, … 3. _____

Write the first four terms of the geometric sequence whose first term, $a_1$, and common ratio, $r$, are given.

4. $a_1 = \frac{1}{3};\ r = 2$ 4. _____

5. $a_1 = \frac{-1}{7};\ r = -3$ 5. _____

Use the formula for the general term (the $n^{th}$ term) of a geometric sequence to find the indicated term of the sequence, with the given term, $a_1$, and the common ratio, $r$.

6. Find $a_9$ when $a_1 = 6$, $r = 4$ 6. _____

7. Find $a_{10}$ when $a_1 = 4$, $r = 3$ 7. _____

Write a formula for the general term, $a_n$, of each geometric sequence.

8. –5, 25, –125, 625, –3125, … 8. _____

9. $2, \frac{2}{3}, \frac{2}{9}, \frac{2}{27}, \frac{2}{81}, \ldots$ 9. _____

10. $\frac{1}{4}, \frac{1}{8}, -\frac{1}{16}, \frac{1}{32}, \frac{1}{64}, \ldots$ 10. _____

11. 0.032, 0.48, 7.2, 108, 1620, … 11. _____

Use the formula for the sum of the first $n$ terms of a geometric sequence to solve.

12. Find the sum of the first five terms of the geometric sequence $\frac{1}{8}, \frac{1}{4}, \frac{1}{2}, \ldots$ 12. _____

13. Find the sum of the first six terms of the geometric sequence, $\frac{2}{5}, \frac{6}{5}, \frac{18}{5}, \ldots$ 13. _____

14. $\sum_{i=1}^{6}\left(\frac{2}{3}\right)^{i}$ 14. _____

Find the sum of each infinite geometric series.

15. $2, -\frac{2}{3}, \frac{2}{9}, -\frac{2}{27}, \ldots$ 15. _____

16. 108, 18, 3, $\frac{1}{2}, \ldots$ 16. _____

Express the repeating decimal as a fraction in lowest terms.

17. $0.\overline{6} = \frac{6}{10} + \frac{6}{100} + \frac{6}{1000} + \frac{6}{10,000} + \ldots$ 17. _____

18. $0.\overline{69} = \frac{69}{100} + \frac{69}{10,000} + \frac{69}{1,000,000} + \ldots$ 18. _____

Determine whether the given sequence is arithmetic, geometric, or neither. If arithmetic, find the common difference. If geometric, find the common ratio.

19. $a_n = 4n^2 - 5$ 19. _____

20. $a_n = \left(\frac{5}{4}\right)^n$ 20. _____

Name _____ Date _____

**Additional Exercises 14.4**
**Form I**
The Binomial Theorem

Evaluate the given binomial coefficient.

1. $\binom{10}{4}$ 1. _____

2. $\binom{7}{7}$ 2. _____

3. $\binom{7}{1}$ 3. _____

4. $\binom{12}{4}$ 4. _____

Use the Binomial Theorem to expand each binomial and express the result in simplified form.

5. $(x+y)^5$ 5. _____

6. $(x+2)^4$ 6. _____

7. $(2x-3)^5$ 7. _____

8. $(x+3y)^3$ 8. _____

Write the first three terms in each binomial expansion, expressing the result in simplified form.

9. $(x+2)^9$ 9. _____

10. $(x-y)^{10}$ 10. _____

11. $(x+1)^{15}$ 11. _____

12. $(x+2y)^{10}$ 12. _____

Find the indicated term of the binomial expansion.

13. $(x-3y)^{11}$; 4th term 13. _____

14. $(x-y)^{15}$; 12th term 14. _____

15. $(x+3y)^{12}$; 4th term 15. _____

Name _____ Date _____

**Additional Exercises 14.4**
**Form II**
The Binomial Theorem

Evaluate the given binomial coefficient.

1. $\binom{8}{5}$ 1. _____

2. $\binom{9}{7}$ 2. _____

3. $\binom{12}{6}$ 3. _____

4. $\binom{15}{11}$ 4. _____

Use the Binomial Theorem to expand each binomial and express the result in simplified form.

5. $(2x+1)^5$ 5. _____

6. $(x-2y)^5$ 6. _____

7. $(3x-2)^4$ 7. _____

8. $(x^2+2)^4$ 8. _____

Write the first three terms in each binomial expansion, expressing the result in simplified form.

9. $(x+2)^{20}$ 9. _____

10. $(x-4)^{17}$ 10. _____

11. $(x^2 + 6)^9$ 11. _____

12. $(x + 2)^{14}$ 12. _____

Find the indicated term of the binomial expansion.

13. $(x^3 - 5)^6$; 3rd term 13. _____

14. $(4x + 5)^5$; 5th term 14. _____

15. $(x^2 + y^3)^6$; 3rd term 15. _____

Name _____ Date _____

**Additional Exercises 14.4**
**Form III**
The Binomial Theorem

Evaluate the given binomial coefficient.

1. $\binom{20}{12}$ 1. _____

2. $\binom{24}{18}$ 2. _____

3. $\binom{103}{2}$ 3. _____

4. $\binom{145}{143}$ 4. _____

Use the Binomial Theorem to expand each and express the result in simplified form.

5. $(3x-4y)^3$ 5. _____

6. $(2x-2)^4$ 6. _____

7. $(2x+3)^5$ 7. _____

8. $(x^5+2y)^4$ 8. _____

Write the first three terms in each binomial expansion, expressing the result in simplified form.

9. $(x^2+y^2)^3$ 9. _____

10. $\left(\frac{1}{2}x-4\right)^3$ 10. _____

11. $(2x+3y)^8$ 11. _____

12. $\left(\frac{1}{3}x+\frac{1}{2}y\right)^4$ 12. _____

Find the indicated term of the binomial expansion.

13. $(x+y)^{34}$; 17th term 13. _____

14. $(x-y)^{12}$; 13th term 14. _____

15. $(3x^2-2y^3)^7$; 4th term 15. _____

# Additional Exercises Answers

## 1.1 Form I

1. 13 2. –5 3. 14 4. 32 5. 12 6. $x+12$ 7. $x-9$ 8. $6x+15$ 9. $\frac{2x}{7}$ 10. $3x+5$

11. No 12. Yes 13. No 14. Yes 15. Yes 16. $6x=42$ 17. $3x=24$ 18. $x-8=3x$

19. $x-14=15$ 20. $\frac{x}{10}=4$

## 1.1 Form II

1. 11 2. 9 3. 5 4. 115 5. 6 6. $x-10$ 7. $\frac{x}{16}$ 8. $5x+4$ 9. $7x+8$ 10. $2(x+17)$

11. Yes 12. Yes 13. No 14. No 15. Yes 16. $x+17=40$ 17. $2x+13=59$ 18. $\frac{x}{16}=48$

19. $x-8=12$ 20. $4(x+9)=54$

## 1.1 Form III

1. 48 2. 4 3. 4 4. 36 5. 3 6. $3x-9$ 7. $2(x+32)$ 8. $\frac{x}{8}+2x$ 9. $2x-63$ 10. $x-14$

11. Yes 12. No 13. Yes 14. $2(x-18)=4$ 15. $\frac{3x}{15}=2x-7$ 16. $x-21=12$

17. $3(10+x)=45$ 18. $6x+11=35$ 19. 85 20. 7

## 1.2 Form I

1. $\frac{10}{3}$ 2. $\frac{47}{8}$ 3. $\frac{43}{4}$ 4. $2\frac{2}{3}$ 5. $4\frac{2}{5}$ 6. $21\frac{1}{2}$ 7. $\frac{5}{9}$ 8. $\frac{2}{3}$ 9. $\frac{3}{7}$ 10. $\frac{2}{35}$ 11. $\frac{2}{7}$

12. 8 13. $\frac{15}{16}$ 14. $\frac{3}{4}$ 15. $7\frac{7}{8}$ 16. $3\frac{69}{85}$ 17. $\frac{6}{7}$ 18. $\frac{11}{12}$ 19. $\frac{23}{30}$ 20. $\frac{2}{11}$ 21. $\frac{2}{15}$

22. $\frac{11}{15}$ 23. $5\frac{1}{2}$ 24. $4\frac{9}{16}$ 25. Yes

## 1.2 Form II

1. $\frac{53}{12}$ 2. $\frac{123}{10}$ 3. $\frac{250}{16}$ 4. $14\frac{1}{3}$ 5. $13\frac{5}{7}$ 6. $11\frac{2}{3}$ 7. $\frac{5}{8}$ 8. $\frac{4}{15}$ 9. $\frac{23}{24}$ 10. $\frac{3}{10}$ 11. $\frac{2}{9}$

12. 160 13. $\frac{9}{4}$ 14. 32 15. $2\frac{33}{34}$ 16. $23\frac{3}{5}$ 17. $\frac{4}{5}$ 18. $1\frac{7}{8}$ *or* $\frac{25}{18}$ 19. $\frac{13}{72}$ 20. $\frac{13}{28}$

21. $5\frac{4}{5}$ 22. $6\frac{13}{24}$ 23. Yes 24. $\frac{3}{4}x$ 25. $x+\frac{5}{8}x$

## 1.2 Form III

1. $\frac{83}{8}$ 2. $\frac{284}{17}$ 3. $\frac{5089}{108}$ 4. $9\frac{5}{9}$ 5. $8\frac{4}{7}$ 6. $4\frac{10}{13}$ 7. $\frac{40}{71}$ 8. $\frac{3}{4}$ 9. $\frac{19}{75}$ 10. $\frac{25}{64}$ 11. 280

12. $25\frac{4}{5}$ 13. $\frac{72}{95}$ 14. $1\frac{34}{35}$ 15. $\frac{19}{24}$ 16. $10\frac{1}{2}$ 17. $\frac{25}{36}$ 18. $\frac{7}{36}$ 19. $8\frac{1}{2}$ 20. $29\frac{2}{15}$

21. Yes 22. Yes 23. $\frac{4}{5}x-6$ 24. $\frac{3}{8}x+4$ 25. $\frac{3}{5}x+\frac{1}{2}x=11$

## 1.3 Form I

1. 371 feet 2. –$420 3.  4. 

5. 0.2 6. 0.8 7. 7.25 8. 10.125 9a. 0, 2 b. $-16, -7, 0, 2, 14\frac{1}{2}$ c. $\sqrt{10}$ 10a. –14, 0, 10 b. $3\pi, \sqrt{5}$ c. 10 11. < 12. > 13. < 14. < 15. 11 16. 11 17. False 18. False 19. False 20. True

## 1.3 Form II

1. 7042 feet 2. –$62.53 3.  4. 0.6 5. $0.8\overline{3}$ 6. 1.375

7. 19.45 8a. 3 b. –11, 0, 3 c. $-11, -\frac{5}{9}, 0, 3, 12.6$ 9a. 1, 9 b. $4\pi, \sqrt{6}$ c. $-6.8, -4, -\frac{1}{2}, 1, 4\pi, \sqrt{6}, 9$ 10. 4.5 11. 4.5 12. < 13. > 14. < 15. > 16. False 17. False 18. True 19. False 20. False

## 1.3 Form III

1. –$12.82 2. 3050 feet 3. –6° 4. 0.375 5. 0.45 6. 16.75 7. $25.8\overline{3}$ 8a. 0, 15 b. $-9, -3.7, 0, 2\frac{7}{9}, \sqrt{16}, 15$ c. $-9, 0, \sqrt{16}, 15$ 9a. $\frac{\pi}{2}, -\sqrt{15}$ b. $-8.1, -\frac{3}{11}, -2, 6, 7\frac{5}{9}$ c. $-8.1, -\sqrt{15}, -\frac{3}{11}, -2, 6, \frac{\pi}{2}, 7\frac{5}{9}$ 10. $8\frac{3}{5}$ 11. 6.47 12. < 13. < 14. > 15. < 16. False 17. True 18. True 19. Answers will vary 20. 0

## 1.4 Form I

1a. 2 terms b. 4, 5 c. 5 d. None 2a. 3 terms b. 6, 3 c. 10 d. None 3a. 4 terms b. 3, 1, 5, 7 c. Not one d. $3x$ and $5x$ 4. $8+6x$ 5. $7y$ 6. $x+(12+18)$ 7. $(6\cdot 3)a$ 8. $5x+35$ 9. $18x-27$ 10. $4x+8y+12$ 11. $2a+5$ 12. $17x$ 13. $16y+5x$ 14. $16a+6$ 15. $6x+2y$ 16. $17y+18$ 17. $10m+2$ 18. $8x+10$ 19. $8x+16$ 20. $3x+x;\ 4x$ 21. $4x-x;\ 3x$ 22. $5(x\cdot 8);\ 40x$ 23. $6(x+12);\ 6x+72$ 24. $9(7-x);\ 63-9x$

## 1.4 Form II

1a. 3 terms b. 12, 3 c. 8 d. $12x$ and $3x$ 2a. 4 terms b. 7, $\frac{1}{4}$, 2 c. 5 d. $7x$ and $2y$

3a. 4 terms b. $\frac{1}{5}, \frac{1}{3}, \frac{3}{5}, \frac{1}{6}$ c. Not one d. $\frac{1}{5}x$ and $\frac{3}{5}y$ 4. $4x+9$ 5. $12a$

6. $y+(25+15)$ 7. $(7\cdot 15)a$ 8. $12x+9$ 9. $36x-42$ 10. $9x+9y+45$ 11. $x-2y-3$

12. $17x$ 13. $18y+9$ 14. $6a+1$ 15. $3.4x+4.7y+13$ 16. $15x+53$

17. $2(x+10)$; $2x+20$ 18. $8(6x)$; $48x$ 19. $14+18x$ 20. $5(x+8)+3(x-3)$; $8x+31$

## 1.4 Form III

1a. 3 terms b. 8, 3 c. –15 d. None 2a. 4 terms b. 12, 10, –3 c. 12 d. $10y$ and $-3y$

3a. 5 terms b. $\frac{1}{4}, \frac{3}{4}, \frac{1}{8}, \frac{1}{2}$ c. 8 d. $\frac{1}{4}a$ and $\frac{1}{8}a$; $\frac{3}{4}b$ and $\frac{1}{2}b$ 4. Distributive Property

5. Commutative Property of Addition 6. Commutative Property of Addition

7. Associative Property of Addition 8. $35+42y$ 9. $36-24x$ 10. $15a-15b-15c$

11. $9x+12y+3$ 12. $9x+2$ 13. $0.2a+0.3b$ 14. $7x+17$ 15. $2x+6$ 16. $15x+12$

17. $7(x+3)+4(x-1)$; $11x+17$ 18. $5x+\frac{1}{2}(8x)$; $9x$ 19. $0.9x+36{,}000$ 20. \$90,000

## 1.5 Form I

1. 6 2. 5 3. –4 4. 20 5. 13 6. –30 7. –59 8. –41 9. $-\frac{1}{11}$ 10. –17.9 11. $-\frac{1}{2}$

12. $-\frac{3}{5}$ 13. –37 14. 7 15. –17 16. $-7x$ 17. $-13a$ 18. $16y$ 19. $-5x$ 20. $4m+11$

## 1.5 Form II

1. –3 2. 64 3. 39 4. –14 5. –62 6. –213 7. $\frac{4}{13}$ 8. $-\frac{1}{2}$ 9. –2.797 10. –20 11. 21

12. –3.1 13. $-25\frac{2}{3}$ 14. –62 15. $-8x$ 16. $10b+5$ 17. $-4y+40$ 18. $10y+6$ 19. 13°

20. –52 feet

## 1.5 Form III

1. 32 2. 28 3. –43 4. 28 5. –88 6. –494 7. $-\frac{13}{15}$ 8. 26.4 9. $\frac{1}{8}$ 10. $-\frac{3}{4}$ 11. 1.52

12. –13 13. 10 14. $4a$ 15. $-12y+15$ 16. $9y$ 17. $-12m+(-30)$ 18. –\$2 billion

19. 8 under par 20. He took home \$54.

## 1.6 Form I

1. –3 2. –29 3. 29 4. –50 5. 5 6. $-\frac{1}{2}$ 7. –10.1 8. 74 9. 1 10. –0.65 11. 7.321

12. –113 13. –5 14. –6 15. 4 16. $-6x$ 17. $18+4x$ 18. $-3a-30$ 19. 5 inches 20. 38°

### 1.6 Form II

1. 77 2. 8 3. 26 4. –36 5. –89 6. 73 7. –1 8. $-\frac{5}{7}$ 9. 6.494 10. –10.5 11. –24.4
12. –21.3 13. –5 14. –22 15. 4 16. $-15y-15x$ 17. $-2a-20$ 18. $-6y-2$
19. 1966 feet 20. 5° F.

### 1.6 Form III

1. –84 2. –48 3. –16 4. 0 5. $-\frac{11}{12}$ 6. 11.6 7. –10.537 8. –2 9. –4.09 10. –77
11. $-13\pi$ 12. $\frac{1}{6}$ 13. 6 14. $\frac{7}{8}$ 15. –22.23 16. $-2x+38$ 17. $3x-5y+5$
18. $8x-4x;\ 4x$ 19. $6x-\frac{3}{5}x;\ \frac{27}{5}x$ 20. 5191 ft

### 1.7 Form I

1. –24 2. –42 3. 20 4. $-\frac{1}{20}$ 5. 3 6. –0.052 7. 24 8. –720 9. –5 10. Undefined
11. 9 12. 0 13. $\frac{1}{6}$ 14. –126 15. 8.2 16. –64 17. $-18x$ 18. $y$ 19. $-15x+10$ 20. No

### 1.7 Form II

1. 35 2. –72 3. –63 4. 3.45 5. $-\frac{15}{44}$ 6. 288 7. –200 8. –4 9. 12 10. Undefined
11. $\frac{9}{10}$ 12. –125 13. –1 14. 7.3 15. $x$ 16. $-18x+24$ 17. $-7x+7$ 18. $2x-12$
19. Yes 20. No

### 1.7 Form III

1. 72 2. –200 3. 21 4. –14 5. 21.142 6. $-\frac{9}{20}$ 7. –25 8. $\frac{1}{45}$ 9. Undefined
10. –320 11. $\frac{15}{2}$ or $7\frac{1}{2}$ 12. 0 13. $\frac{27}{16}$ 14. $3x$ 15. $32x-56$ 16. $2x+18$ 17. $x+1$
18. $4x-4$ 19. Yes 20. No

### 1.8 Form I

1. 64 2. 64 3. –64 4. $16x^2$ 5. $10x^4$ 6. $13x^3$ 7. 6 8. –1 9. –38 10. 8 11. 16
12. 27 13. –144 14. –12 15. 0 16. 62 17. –6 18. 2 19. 5 20. $21x-91$

### 1.8 Form II

1. –81 2. 81 3. –343 4. $12x^3$ 5. $16x^2$ 6. can't be simplified 7. –16 8. –44 9. 1
10. 198 11. 64 12. –81 13. 77 14. 24 15. 192 16. –300 17. –3 18. –5
19. $-10x+36$ 20. $16x+84$

## 1.8 Form III

1. 121 2. –196 3. –512 4. can't be simplified 5. $5x^3$ 6. $5x^2$ 7. 6 8. –18 9. 3
10. –3 11. –228 12. –4 13. $\frac{1}{24}$ 14. –46 15. –2 16. –2 17. $-45x+60$
18. $63+21x$ 19. 68º 20. 38.02 seconds

# Additional Exercises Answers

## 2.1 Form I

1. linear 2. not linear 3. not linear 4. not linear 5. {12} 6. {11} 7. {13} 8. {23}
9. {0} 10. {0.8} 11. {22} 12. {–17} 13. {–26.7} 14. {13} 15. {–8.8} 16. $74
17. $53,865 18. $11.95 19. 80 ounces 20. 4982 feet

## 2.1 Form II

1. linear 2. not linear 3. not linear 4. linear 5. {–14} 6. {19} 7. $\left\{\frac{1}{3}\right\}$ 8. $\left\{\frac{14}{5}\right\}$
9. {1.2} 10. $\left\{-\frac{3}{20}\right\}$ 11. {17.9} 12. $\left\{-\frac{15}{4}\right\}$ 13. {310} 14. {14.2} 15. {0} 16. $101
17. $67,290 18. $13.35 19. 45 ounces 20. 6382 feet

## 2.1 Form III

1. linear 2. not linear 3. not linear 4. not linear 5. $\left\{\frac{7}{5}\right\}$ 6. $\left\{-\frac{7}{12}\right\}$ 7. {–1315}
8. {5.7} 9. {–13.5} 10. {–20} 11. {6} 12. {–61} 13. {–2} 14. {–3} 15. {0}
16. $221 17. $112,935 18. $18.95 19. 31 ounces 20. 9882 feet

## 2.2 Form I

1. {20} 2. {–21} 3. {3} 4. {8} 5. $\left\{-\frac{1}{4}\right\}$ 6. {–11} 7. {10} 8. {6} 9. {4}
10. {–6} 11. {7} 12. {–7} 13. {0} 14. {1} 15. {–1} 16. 150 miles 17. 14 miles
18. 7.0 meters 19. 6000 joules 20. 288 ft/sec

## 2.2 Form II

1. {–24} 2. {–44} 3. {22} 4. $\left\{-\frac{1}{3}\right\}$ 5. {5} 6. $\left\{\frac{2}{5}\right\}$ 7. {36} 8. $\left\{-\frac{16}{5}\right\}$ 9. {15}
10. $\left\{\frac{8}{5}\right\}$ 11. {10} 12. $\left\{-\frac{4}{5}\right\}$ 13. $\left\{-\frac{11}{2}\right\}$ 14. $\left\{-\frac{9}{7}\right\}$ 15. $\left\{\frac{1}{2}\right\}$ 16. 247.5 miles
17. 15.0 meters 18. 7.9 meters 19. 6600 joules 20. 256 ft/sec

## 2.2 Form III

1. {91} 2. {0} 3. {–32} 4. {–9} 5. $\left\{\frac{25}{4}\right\}$ 6. $\left\{\frac{3}{5}\right\}$ 7. {–35} 8. {3} 9. {12}
10. {5} 11. $\left\{\frac{33}{4}\right\}$ 12. {–3} 13. {–4} 14. {–1} 15. $\left\{\frac{16}{5}\right\}$ 16. 437.5 miles
17. 22.4 meters 18. 8.2 meters 19. 8250 joules 20. 384 ft/sec

### 2.3 Form I

1. $\left\{\frac{1}{4}\right\}$ 2. $\left\{\frac{5}{4}\right\}$ 3. $\left\{-\frac{5}{2}\right\}$ 4. $\{1\}$ 5. $\{6\}$ 6. $\left\{\frac{3}{2}\right\}$ 7. $\{-8\}$ 8. $\{2\}$ 9. $\{25\}$ 10. $\{45\}$
11. $\{21\}$ 12. $\left\{\frac{6}{5}\right\}$ 13. $\{5\}$ 14. $\{10\}$ 15. $\{1\}$ 16. 201.25 cm 17. 4 18. 89 mph
19. 5.5% 20. 30°

### 2.3 Form II

1. $\{-4\}$ 2. $\{-8\}$ 3. $\{9\}$ 4. $\left\{\frac{89}{70}\right\}$ 5. $\{47\}$ 6. $\{x \mid x \text{ is a real number}\}$ 7. $\{-6\}$ 8. $\{2\}$
9. $\{3\}$ 10. $\left\{\frac{1}{2}\right\}$ 11. $\{-14\}$ 12. $\{28\}$ 13. $\{75\}$ 14. $\left\{\frac{1}{2}\right\}$ 15. $\{12\}$ 16. 196.77 cm
17. 3 18. 85 mph 19. 6.5% 20. 35°

### 2.3 Form III

1. Ø 2. $\{2\}$ 3. $\{-5\}$ 4. $\{4\}$ 5. $\{x \mid x \text{ is a real number}\}$ 6. $\{-12\}$ 7. $\{-16\}$ 8. $\{3\}$
9. $\{-2\}$ 10. $\{-10\}$ 11. $\{4\}$ 12. $\{3\}$ 13. $\left\{\frac{1}{2}\right\}$ 14. $\{-1\}$ 15. $\left\{\frac{11}{18}\right\}$ 16. 187.81 cm
17. 5 18. 91 mph 19. 7.5% 20. 25°

### 2.4 Form I

1. $t = \frac{I}{\text{Pr}}$ 2. $h = \frac{3V}{B}$ 3. $s_3 = P - s_1 - s_2$ 4. $b = y - mx$ 5. $y = \frac{C - Ax}{B}$
6. $b = 25 - a - c$ 7. 15 8. 200 9. 20% 10. 0.36 11. 50 12. 2% 13. 20.52 14. 7.37
15. 250 16. 25% 17. \$45.60 18. 23% 19. 34,650 people 20. 560 students

### 2.4 Form II

1. $A = \frac{C - By}{x}$ 2. $B = \frac{3V}{h}$ 3. $C = \frac{5}{9}(F - 32)$ 4. $w = \frac{P - 2l}{2}$ 5. $r = \frac{I}{Pt}$ 6. $x = \frac{y - b}{m}$
7. 2 8. 200 9. 25% 10. 6.48 500 6 12. 800 13. 95.2 14. 72 15. 60 16. 120%
17. \$63.75 18. 77.8% 19. 24,150 people 20. 1225 students

### 2.4 Form III

1. $h = \frac{S - 2\pi r^2}{2\pi r}$ 2. $B = \frac{C - Ax}{y}$ 3. $a = 2s - b - c$ 4. $R = \frac{PV}{nT}$ 5. $s_1 = P - s_2 - s_3$
6. $l = \frac{P - 2w}{2}$ 7. 27 8. 85 9. 12.5% 10. 700 11. 10% 12. 49 13. 95.2 14. 72
15. 85 16. 120% 17. \$74.63 18. 26.5% 19. 31,115 people 20. 1040 students

## 2.5 Form I

1. $11x + 13$ 2. $7x - 59$ 3. $\frac{42}{-7x}$ 4. $-27(x + 25)$ 5. $2(x + -41)$ 6. $\frac{25x}{-8}$

7a. $4x + 7x = 44$ b. 4 8a. $\frac{3}{4}x = \frac{1}{2}$ b. $\frac{2}{3}$ 9a. $\frac{x}{42} + 7 = 13$ b. 252 10a. $x + 3x = 180000$

b. \$45,000, \$135,000 11a. $x + 3x + 2x = 30$ b. 5, 15, 10 marbles 12a. $15 + 0.05x = 55$

b. 800 minutes

## 2.5 Form II

1. $3x + 11$ 2. $8x - 9$ 3. $\frac{7}{9x}$ 4. $14(x - 5)$ 5. $\frac{x}{8} - 2$ 6. $\frac{2}{5}x + 3$ 7a. $7x - 3x = 44$ b. 11

8a. $4x + 7 = 2x - 8$ b. $-\frac{15}{2}$ 9a. $9x - 6 = 3x$ b. 1 10a. $x + 3x - 2 = 90$ b. 23º, 67º

11a. $2x = 120$ b. 60 sq ft 12a. $2x + 2(2x) = 120$ b. 20 meters, 40 meters

## 2.5 Form III

1. $\frac{3}{7}x + 4$ 2. $13 - 4x$ 3. $\frac{19}{-2x}$ 4. $-11(x - 8)$ 5. $2(x + 9)$ 6. $3x + 40$ 7a. $5x + -6 = 11x$

b. $-1$ 8a. $6(x + 2) = 48$ b. 6 9a. $7x + 5 = 2x + 10$ b. 1 10a. $x + x + (x - 45) = 180$

b. 75º, 75º, 30º 11a. $x + (x + 18) = 108$ b. 45 juniors, 63 sophomores 12a. $2x + 2(5x) = 144$

b. 12 inches, 60 inches

## 2.6 Form I

1a. 22 inches b. 28 in.$^2$ 2a. 24 inches b. 24 ft.$^2$ 3a. 54 inches b. 216 in.$^2$

4. 64π square centimeters; 113 cm.$^2$ 5. 36π square inches; 113 in.$^2$ 6. 8π square ft.; 25 feet

7. 20π cm.; 63 cm. 8. 12π cubic inches; 38 in.$^3$ 9. 64π cubic centimeters; 201 cm.$^3$

10. 20π cubic inches; 63 in.$^3$ 11. 105 cubic inches 12. 138º 13. 53º

14. Width 7 feet; length 11 feet 15. 5 inches, 11 inches and 15 inches 16. 55º, 57º, and 68º

## 2.6 Form II

1a. 37 inches b. 78 sq. in. 2a. 40 cm. b. 64 sq. cm. 3. 296 sq. in.

4. 49π square inches; 154 in.$^2$ 5. 20.25π square centimeters; 64 cm.$^2$ 6. 4.8π feet; 15 feet

7. 16π cubic centimeters; 50 cm.$^3$ 8. 4608π cubic inches; 147 in.$^3$

9. 4.5π cubic decimeters; 14 dm.$^3$ 10. 3 meters 11. 34º and 56º

12. Width 5.5 feet; length 11 feet 13. 240 cubic feet 14. 38º, 59º and 83º

15. 36.2º, 41.2º and 102.6º 16. 17 inches by 92 inches

## 2.6 Form III

1a. 34.08 in. b. 58.752 in.$^2$ 2a. 38.63 cm. b. 63.44 cm$^2$ 3. 331.2 in.$^2$

4. 331.24π mm$^2$; 1041 mm$^2$ 5. 24.8π inches; 78 inches 6. 8π cubic inches; 25 in.$^3$

7. 370.301π cubic centimeters 8. 47.916π in.$^3$ 9. 1444 ft.$^2$ 10. 14 meters 11. 8 inches

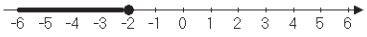
12. 39.68 ft.$^3$ 13. 65º and 115º 14. 39º and 102º 15. 20.5º, 41º and 118.5º

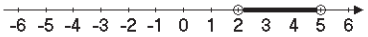
16. 979 square feet

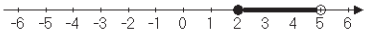
## 2.7 Form I

1. 


2. 

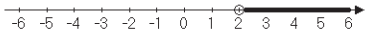

3. 


4. 

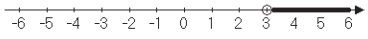

5. 


6. $(1, \infty)$ $\{x \mid x > 1\}$ 7. $[2, \infty)$ $\{x \mid x \geq 2\}$

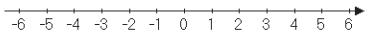
8. $(-\infty, -1]$ 9. $(-\infty, 1)$ 10. $(-2, \infty)$ 


11. $(2, \infty)$ 


12. $(-4, \infty)$ 

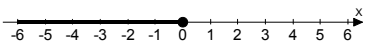

13. $(3, \infty)$ 

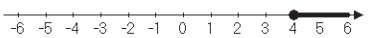

14. $(-2, \infty)$ 


15. Ø 


## 2.7 Form II

1. 

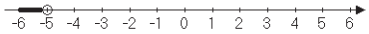

2. 


3. 

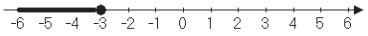

4. 

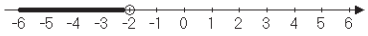
5. 


6. $(-2, \infty)$ $\{x \mid x > -2\}$ 7. $[0, \infty)$

8. $(-\infty, -3]$ $\{x \mid x \le -3\}$ 9. $(-\infty, 4]$ $\{x \mid x \le 4\}$ 10. $(-\infty, -5)$ 


11. $(-\infty, 4)$ 


12. $(-\infty, -3]$ 


13. 


$(-\infty, -2)$ 


14. $(-\infty, 5)$

15. $(-\infty, \infty)$ 


## 2.7 Form III

1. 

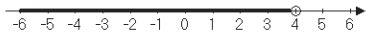

2. 


3. 


4. 


5. 

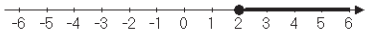

6. $(-4, \infty)$ 7. $[-2, \infty)$ 8. $(-\infty, 3)$ 9. $(-\infty, -2]$

10a. $(-\infty, 4)$ b. 


11a. $[-5, \infty)$ b. 


12a. $(-\infty, 6]$ b. 

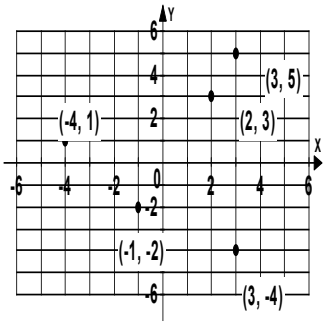

13a. $[-2, \infty)$ b. 


14a. $[2, \infty)$ b. 


15a. $(-\infty, \infty)$ b. 

## Additional Exercises Answers

### 3.1 Form I




1. I 2. II 3. III 4. I 5. IV

6. yes 7. yes 8. no

9.

| $x$ | (x, y) |
|---|---|
| –2 | (–2, –6) |
| –1 | (–1, –3) |
| 0 | (0, 0) |
| 1 | (1, 3) |
| 2 | (2, 6) |

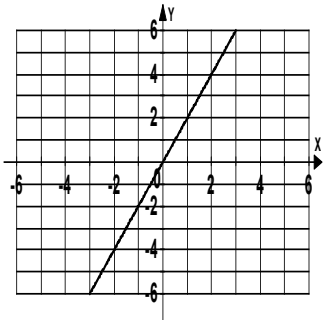
10.

| $x$ | (x, y) |
|---|---|
| –2 | (–2, 1) |
| –1 | (–1, 3) |
| 0 | (0, 5) |
| 1 | (1, 7) |
| 2 | (2, 9) |

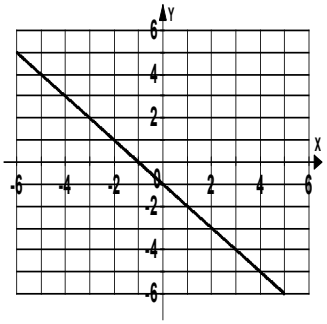
11.

| $x$ | (x, y) |
|---|---|
| –2 | (–2, 2) |
| –1 | (–1, –1) |
| 0 | (0, –4) |
| 1 | (2, –10) |
| 2 | (3, –13) |

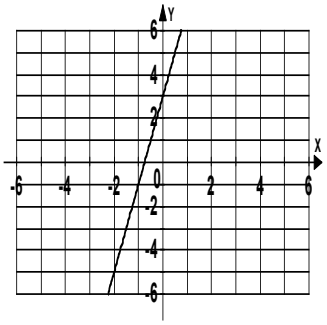
12.



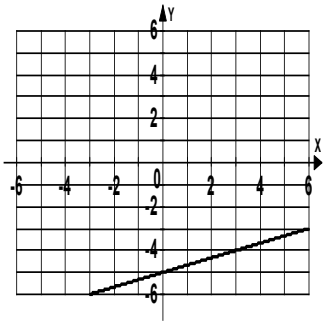
13.

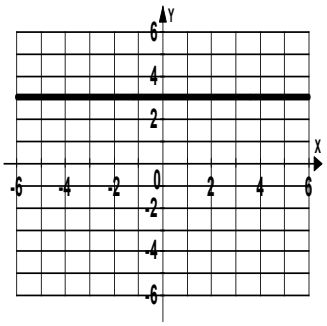


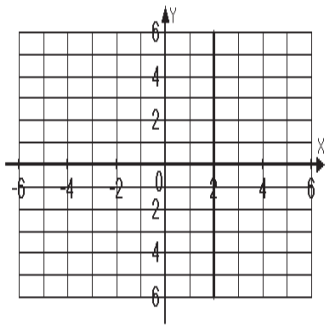
14.



15.

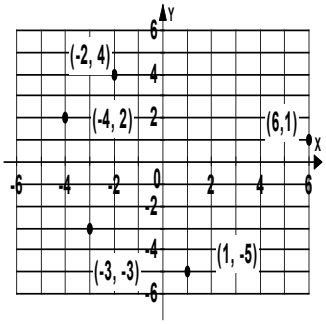


16. 

17. 

18. $193.50 19. 96 ft. 20. 3 min – 100 oz; 5 min – 84 oz; 10 min – 44 oz; 15 min – 4 oz

## 3.1 Form II




1. IV 2. II 3. III 4. I 5. II

6. no 7. no 8. yes 9.

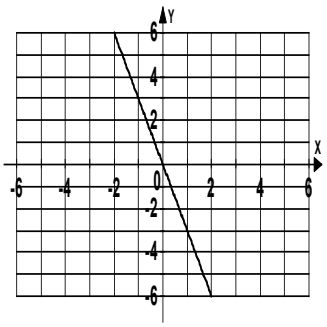
| $x$ | (x, y) |
|---|---|
| –2 | (–2, 16) |
| –1 | (–1, 8) |
| 0 | (0, 0) |
| 1 | (1, –8) |
| 2 | (2, –16) |

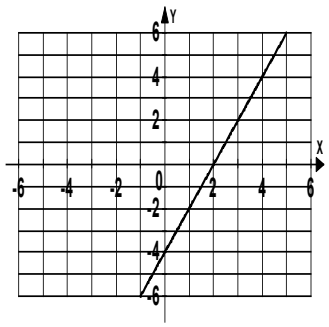
10.

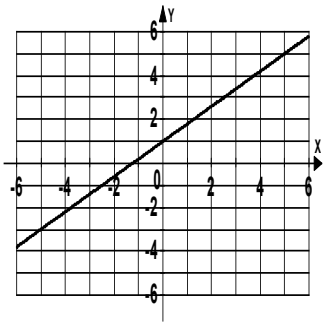
| $x$ | (x, y) |
|---|---|
| –2 | (–2, 12) |
| –1 | (–1, 9) |
| 0 | (0, 6) |
| 1 | (1, 3) |
| 2 | (2, 0) |

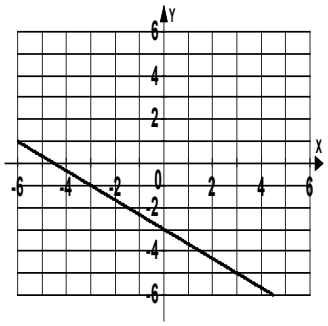
11.

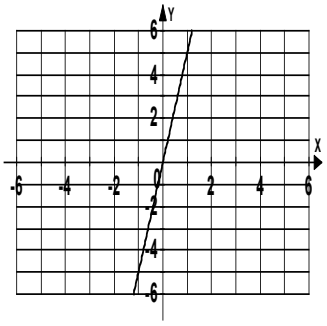
| $x$ | (x, y) |
|---|---|
| –2 | (–2, 9) |
| –1 | (–1, 3) |
| 0 | (0, –3) |
| 1 | (1, –9) |
| 2 | (2, –15) |

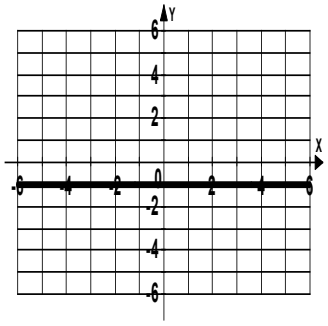
12. 

13. 

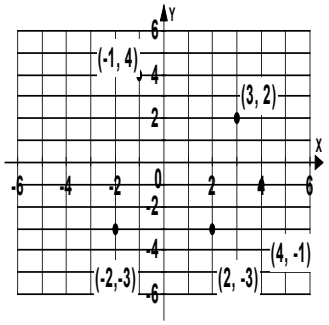
14. 

15. 

16. 

17. 

18. \$46 19. \$23.20 20. 10 miles – \$60; 20 miles – \$80; 25 miles – \$90; 50 miles – \$140




**3.1 Form III**

1. IV 2. III 3. I 4. IV 5. II

6. yes 7. no 8. no 9.

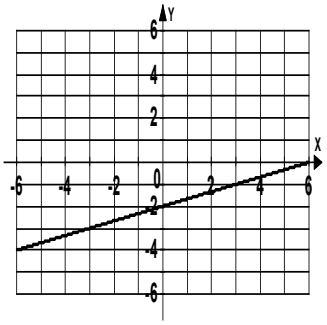
| $x$ | (x, y) |
|---|---|
| –2 | $\left(-2, -\frac{4}{3}\right)$ |
| –1 | $\left(-1, -\frac{2}{3}\right)$ |
| 0 | (0, 0) |
| 1 | $\left(1, \frac{2}{3}\right)$ |
| 2 | $\left(2, \frac{4}{3}\right)$ |

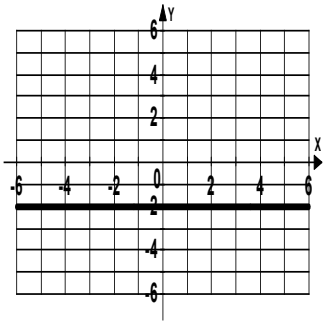
10.

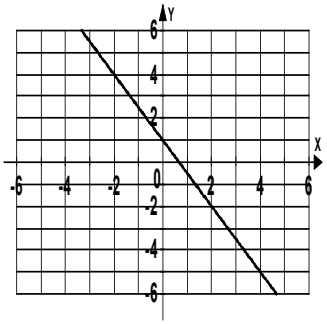
| $x$ | (x, y) |
|---|---|
| –2 | (–2, 2) |
| –1 | (–1, –1) |
| 0 | (0, –4) |
| 1 | (1, –7) |
| 2 | (2, –10) |

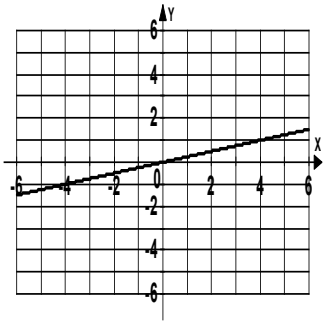
11.

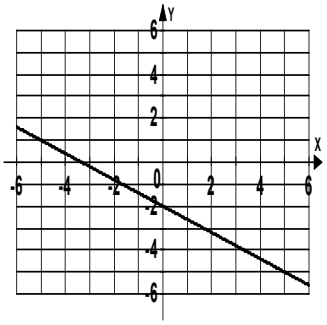
| $x$ | (x, y) |
|---|---|
| –2 | (–2, 1) |
| –1 | $\left(-1, 2\frac{1}{2}\right)$ |
| 0 | (0, 4) |
| 1 | $\left(-1, 5\frac{1}{2}\right)$ |
| 2 | (2, 7) |

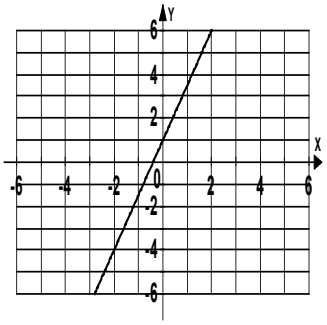
12. 

13. 

14. 

15. 

16. 

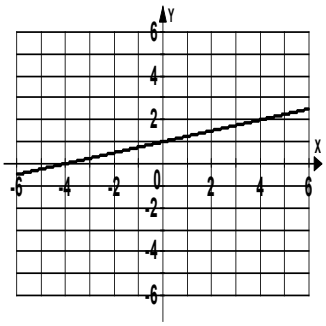
17. 

18. $203.75  19. $75  20. 5 miles – $95; 15 miles – $125; 25 miles – $155; 85 miles – $335

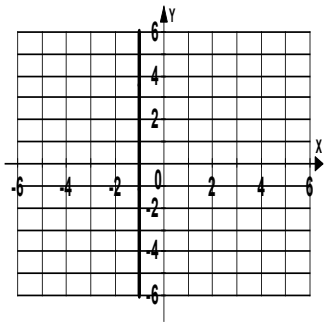
**3.2 Form I**

1. $x$-int (6, 0) ; $y$-int (0, 6)  2. $x$-int (4, 0) ; $y$-int (0, 2)  3. $x$-int (4, 0) ; $y$-int (0, –3)
4. $x$-int none ; $y$- int (0, 5)  5. $x$-int (3, 0) ; $y$-int (0, 3)  6. $x$-int ( –3, 0) ; $y$-int (0, –6)
7. $x$-int (5, 0) ; $y$-int (0, –2)  8. $x$-int (2, 0) ; $y$-int (0, –2)

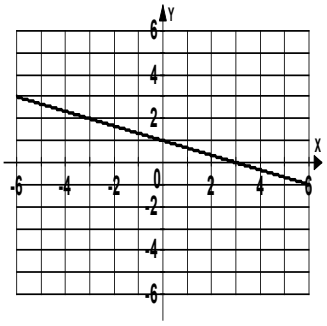
9a. $x$-int (–4, 0) ; $y$-int (0, 1)

b. 

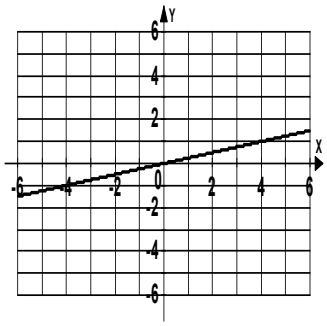
10a. $x$- int (–1, 0) ; $y$- int none

b. 

11a. $x$-int (3, 0) ; $y$- int (0,1)

b. 

12a. $x$-int (0, 0) ; $y$-int (0,0)

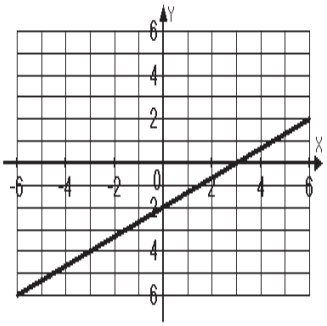
b. 

13. $y = -2$ 14. $x = -3$

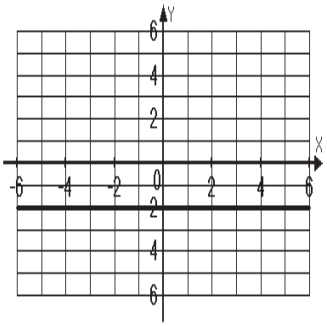
## 3.2 Form II

1. $x$-int (1, 0) ; $y$-int (0, 2) 2. $x$-int (2, 0) ; $y$-int (0, –6) 3. $x$-int (3, 0) ; $y$-int none
4. $x$-int (0, 0) ; $y$- int (0, 0) 5. $x$-int (6, 0) ; $y$-int (0, 6) 6. $x$-int ( 4, 0) ; $y$-int (0, –8)
7. $x$-int (–10, 0) ; $y$-int (0, –6) 8. $x$-int $\left(\frac{9}{2},\ 0\right)$ ; $y$-int (0, –6)

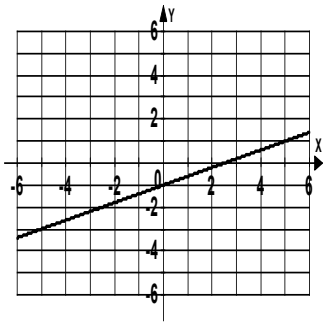
9a. $x$-int (3, 0) ; $y$-int (0, –2)

b. 

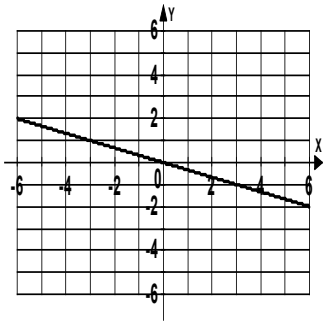
10a. $x$- int none ; $y$- int (0, –2)

b. 

11a. $x$-int $\left(\frac{5}{2},\ 0\right)$ ; $y$- int (0,–1)

b. 

12a. $x$-int (0, 0) ; $y$-int (0,0)

b. 

13. $x = 3$ 14. $y = 4$

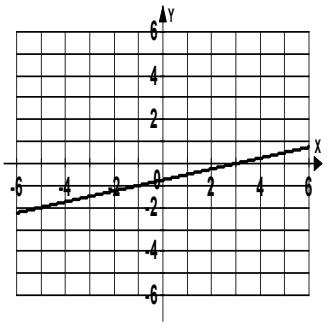
## 3.2 Form III

1. $x$-int (0, 0) ; $y$-int (0, 0) 2. $x$-int (–3, 0) ; $y$-int (0, –3) 3. $x$-int (–4, 0) ; $y$-int none

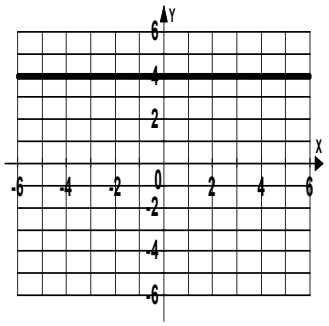
4. $x$-int (5, 0) ; $y$- int (0, –4 ) 5. $x$-int $\left(\frac{15}{2},\ 0\right)$ ; $y$-int (0, –5) 6. $x$-int ( 3, 0) ; $y$-int $\left(0,\ \frac{9}{4}\right)$

7. $x$-int $\left(\frac{12}{5},\ 0\right)$ ; $y$-int (0, 4) 8. $x$-int $\left(4,\ 0\right)$ ; $y$-int $\left(0,\ -\frac{24}{5}\right)$

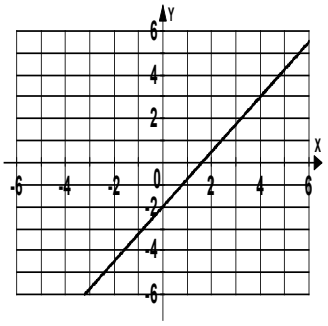
9a. $x$-int $\left(-\frac{3}{4},\ 0\right)$ ; $y$-int (0, 3)

b. 

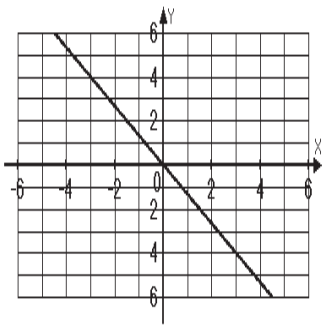
10a. $x$- int none ; $y$- int (0, –2)

b. 

11a. $x$-int $\left(\frac{8}{5},\ 0\right)$ ; $y$- int (0,–2)

b. 

12a. $x$-int (0, 0) ; $y$-int (0,0)

b. 

13. $x = 1$ 14. $y = -2$

## 3.3 Form I

1a. $m = \frac{2}{11}$ b. rises 2a. $m = \frac{21}{5}$ b. rises 3a. $m = -\frac{3}{7}$ b. falls

4a. $m$ is undefined b. vertical 5a. $m = 0$ b. horizontal 6. $m = 1$ 7. $m = 3$ 8. $m = -4$

9. $m = 0$ 10. $m$ is undefined 11. parallel 12. perpendicular 13. neither 14. 43% 15. 3 ft.

## 3.3 Form II

1a. $m = \frac{1}{2}$ b. rises 2a. $m$ is undefined b. vertical 3a. $m = \frac{3}{5}$ b. rises 4a. $m = -\frac{3}{5}$ b. falls

5a. $m = 0$ b. horizontal 6. $m = \frac{2}{3}$ 7. $m$ is undefined 8. $m = -\frac{3}{5}$ 9. $m = 0$ 10. $m = -3$

11. neither 12. parallel 13. perpendicular 14. $m = \frac{4}{3}$ 15. 55%

## 3.3 Form III

1a. $m$ is undefined b. vertical 2a. $m = -\frac{1}{5}$ b. falls 3a. $m = -3$ b. falls

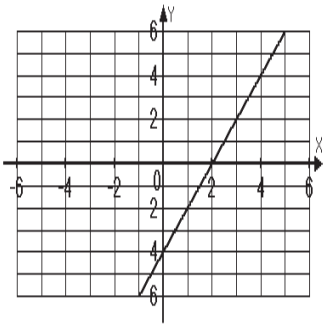
4a. $m = 0$ b. horizontal 5a. $m = \frac{4}{13}$ b. rises 6. $m = 0$ 7. $m = -\frac{3}{2}$ 8. $m$ is undefined

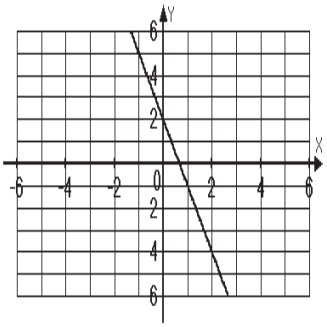
9. $m = 2$ 10. $m = -\frac{5}{3}$ 11. neither 12. perpendicular 13. parallel 14. 46% 15. 58%

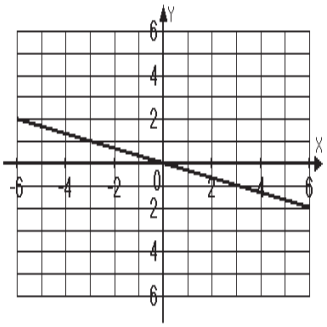
## 3.4 Form I

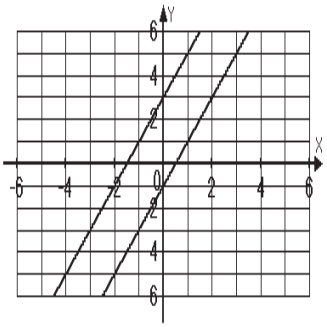
1. $m = -8$ 2. $m = 6$ 3. $m = 0$ 4. $m = \frac{1}{4}$ 5. $m = -1$ 6. $m = -3$; (0, 8) 7. $m = -2$; (0, 0)

8. $m = 4$; (0, –7) 9. $m = 0$; (0, 2) 10. $m = -\frac{2}{3}$; (0, 2)

11. 

12. 

13. 

14. 

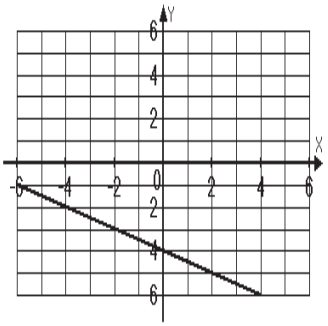
parallel

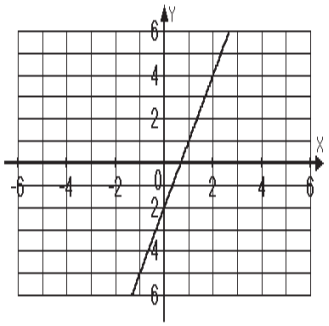
15. $m = 3$; The cost of the service increases \$3 every mile the car is towed. b = 65; The cost of the service is \$65 if the car is not towed.

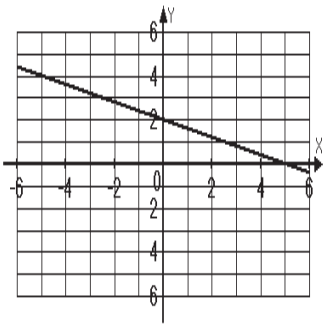
## 3.4 Form II

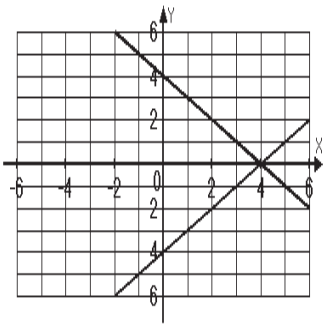
1. $m = -\frac{2}{3}$ 2. $m = \frac{3}{5}$ 3. $m = 0$ 4. $m = 5$ 5. $m = -2$ 6. $m = -\frac{3}{4}$; (0, 4)

7. $m = \frac{1}{2}$; (0, –1) 8. $m = \frac{1}{6}$; (0, –2) 9. $m = 0$; (0, –3) 10. $m = -\frac{1}{2}$; $\left(0, -\frac{1}{2}\right)$

11. 

12. 

13. 

14. 

perpendicular

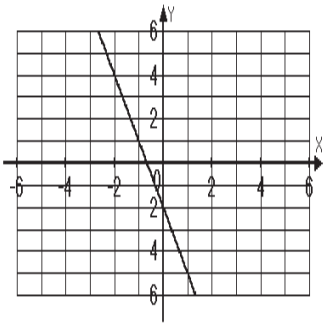
15. $m = -3$; The amount of water in the bucket decreases 3 ounces every minute. $b = 110$; at $x = 0$, the amount of water in the bucket was 110 ounces.

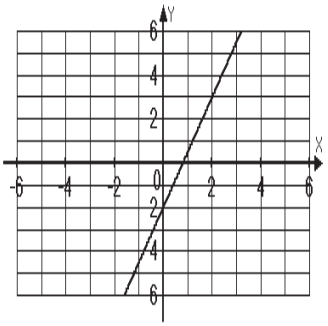
## 3.4 Form III

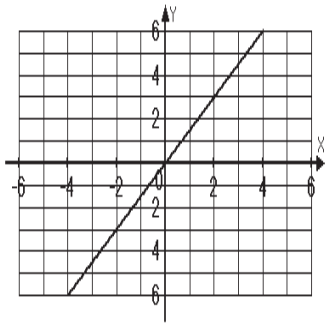
1. $m = \frac{4}{3}$; (0, 5) 2. $m = -3$; (0, –7) 3. $m = 1$; (0, 0) 4. $m = 0$; (0, 8) 5. $m = -\frac{1}{3}$; (0, 6)

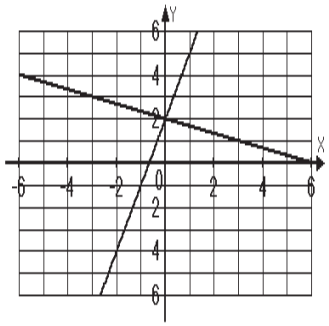
6. $m = 2$; (0, –11) 7. $m = -\frac{2}{3}; \left(0, -\frac{5}{3}\right)$ 8. $m = \frac{1}{4}$; (0, –1) 9. $m = 0$; (0, 4)

10. $m = \frac{3}{4}$; (0, 1)

11. 

12. 

13. 

14. 

15. $m = 32$; The speed of the ball increases 32 feet per second every second. $b = 0$; The speed of the ball was 0 the moment it was dropped.

## 3.5 Form I

1a. $y-1=1(x-2)$ b. $y=x-1$ 2a. $y-4=-2(x-4)$ b. $y=-2x+12$

3a. $y-2=4(x-0)$ b. $y=4x+2$ 4a. $y-2=8(x-4)$ b. $y=8x-30$

5a. $y-3=-9(x-4)$ b. $y=-9x+39$ 6a. $y+4=5(x+3)$ b. $y=5x+11$

7a. $y-1=1(x-0)$ or $y-5=1(x-4)$ b. $y=x+1$

8a. $y-8=-1(x-0)$ or $y-6=-1(x-2)$ b. $y=-x+8$

9a. $y-0=1(x-2)$ or $y-2=1(x-4)$ b. $y=x-2$

10a. $y-1=1(x+4)$ or $y-4=1(x+1)$ b. $y=x+5$

11a. $y-16=1(x-12)$ or $y-5=1(x-1)$ b. $y=x+4$

12a. $y-2=2(x+1)$ or $y+2=2(x+3)$ b. $y=2x+4$

13a. $y-5=-1(x+3)$ or $y-3=-1(x+1)$ b. $y=-x+2$ 14. $y=4x+2$

15. $y=-40x+175$

## 3.5 Form II

1a. $y-5=\frac{5}{3}(x-0)$ b. $y=\frac{5}{3}x+5$ 2a. $y-2=-\frac{2}{3}(x-0)$ b. $y=-\frac{2}{3}x+2$

3a. $y-3=-\frac{3}{5}(x-10)$ b. $y=-\frac{3}{5}x+9$ 4a. $y-5=\frac{5}{3}(x-0)$ b. $y=\frac{5}{3}x+5$

5a. $y-10=-\frac{4}{5}(x+5)$ b. $y=-\frac{4}{5}x+6$ 6a. $y+8=\frac{3}{4}(x-8)$ b. $y=\frac{3}{4}x-14$

7a. $y+5=-1(x-1)$ or $y-1=-1(x+5)$ b. $y=-x-4$

8a. $y+3=3(x-0)$ or $y-6=3(x-3)$ b. $y=3x-3$

9a. $y+9=3(x+1)$ or $y+15=3(x+3)$ b. $y=3x-6$

10a. $y-3=\frac{1}{4}(x-2)$ or $y-1=\frac{1}{4}(x+6)$ b. $y=\frac{1}{4}x+\frac{5}{2}$

11a. $y-2=-\frac{1}{2}(x-4)$ or $y-4=-\frac{1}{2}(x-0)$ b. $y=-\frac{1}{2}x+4$

12a. $y-0=5(x-0)$ or $y-5=5(x-1)$ b. $y=5x$

13a. $y-0=\frac{4}{3}(x-3)$ or $y+4=\frac{4}{3}(x-0)$ b. $y=\frac{4}{3}x-4$ 14. $y=0.2x+0.45$

15. $y=-52x+198$

## 3.5 Form III

1a. $y+5=-\frac{1}{3}(x-1)$ b. $y=-\frac{1}{3}x+\frac{16}{3}$ 2a. $y-4=-\frac{2}{7}(x-2)$ b. $y=-\frac{2}{7}x+\frac{32}{7}$

3a. $y-2=-\frac{4}{5}(x+1)$ b. $y=-\frac{4}{5}x+\frac{6}{5}$ 4a. $y-0=\frac{3}{4}(x-1)$ b. $y=\frac{3}{4}x-\frac{3}{4}$

5a. $y+5=\frac{1}{2}(x-2)$ b. $y=\frac{1}{2}x-6$ 6a. $y-4=\frac{3}{5}(x+1)$ b. $y=\frac{3}{5}x+\frac{23}{5}$

7a. $y-2=-\frac{3}{4}(x-1)$ or $y-5=-\frac{3}{4}(x+3)$ b. $y=-\frac{3}{4}x+\frac{11}{4}$

8a. $y-7=\frac{1}{5}(x-4)$ or $y-6=\frac{1}{5}(x+1)$ b. $y=\frac{1}{5}x+\frac{31}{5}$

9a. $y-5=\frac{1}{6}(x+2)$ or $y-6=\frac{1}{6}(x-4)$ b. $y=\frac{1}{6}x+\frac{16}{3}$

10a. $y-3=-\frac{1}{2}(x-3)$ or $y-7=-\frac{1}{2}(x+5)$ b. $y=-\frac{1}{2}x+\frac{9}{2}$

11a. $y+5=1(x-3)$ or $y+6=1(x-2)$ b. $y=x-8$

12a. $y-2=-\frac{1}{2}(x-0)$ or $y-1=-\frac{1}{2}(x-2)$ b. $y=-\frac{1}{2}x+2$

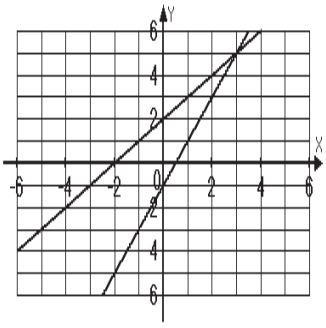
13a. $y-7=\frac{4}{5}(x-15)$ or $y+1=\frac{4}{5}(x-5)$ b. $y=\frac{4}{5}x-5$ 14. $y=-2860x+13{,}440$

15. $y=397x+2342$

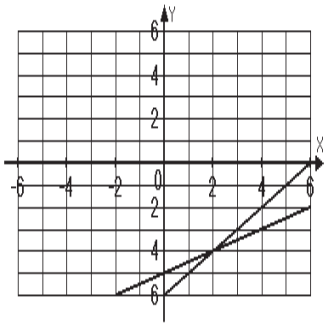
## Additional Exercises Answers

### 4.1 Form I

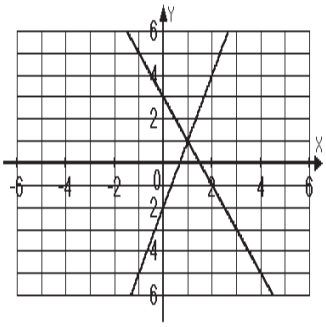
1. Yes 2. No 3. No

4. 

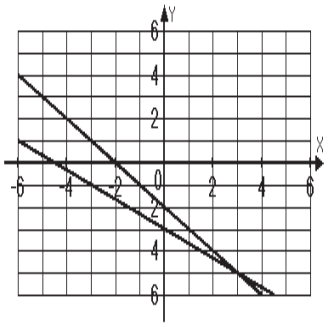
{(3, 5)}

5. 

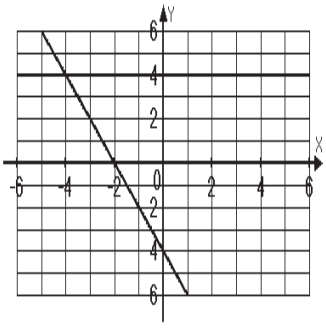
{(2, –4)}

6. 

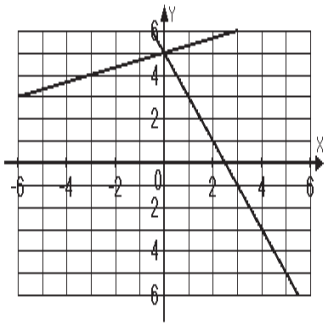
{(1, 1)}

7. 

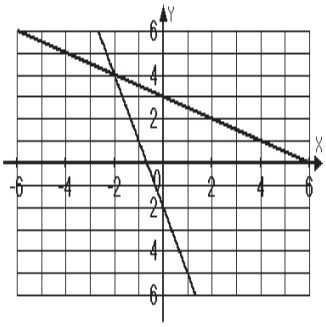
{3, –5}

8. 

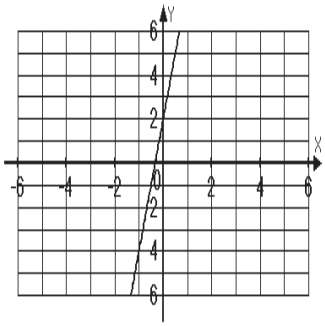
{(–4, 4)}

9. 

{(0, 5)}

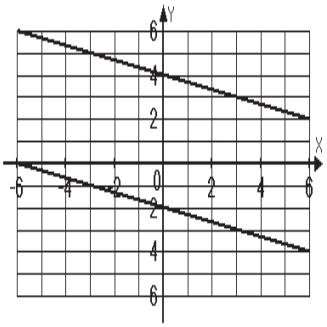
10. 

{(–2, 4)}

11. 

Infinitely many solutions

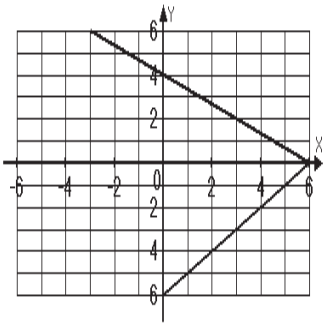
$\{(x, y) \mid y - 6x = 2\}$ $\{(x, y) \mid 2y = 12x + 4\}$

12. 

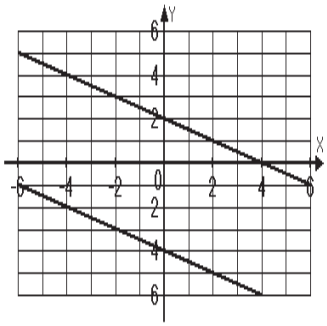
No Solution; Ø

**4.1 Form II**

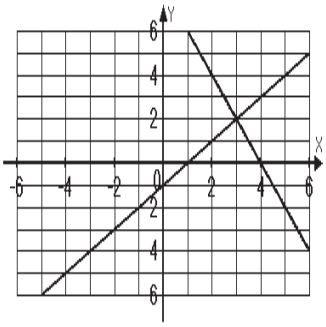
1. No 2. Yes 3. Yes

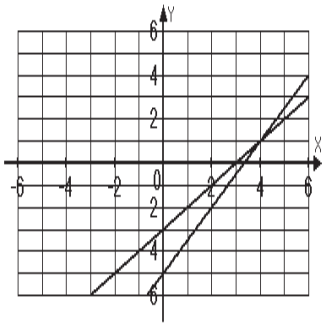
4. 

{(6, 0)}

5. 

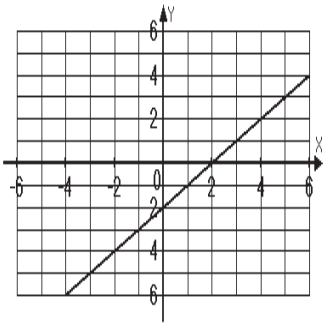
No Solution; Ø

6. 

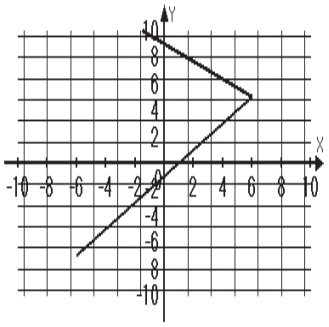
7. 

{(3, 2)}

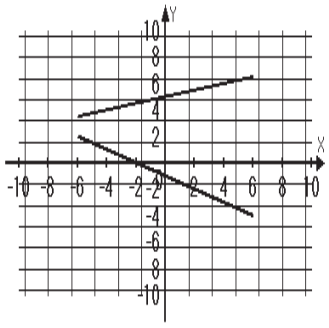
{(4, 1)}

8. 

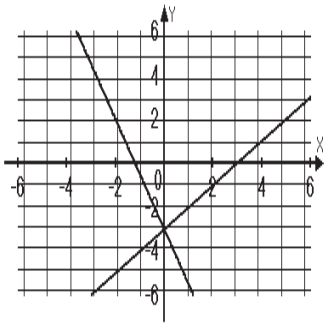
Infinitely many solutions
$\{(x,\ y) \mid y = x - 2\}$

9. 

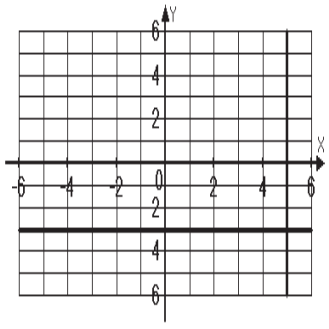
{(6, 5)}

10. 

{(–4, 1)}

11. 

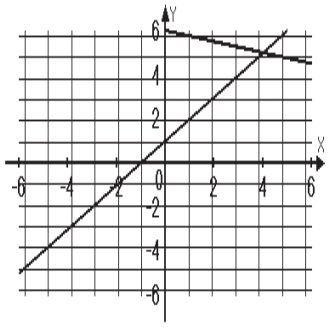
{(0, –3)}

12. 

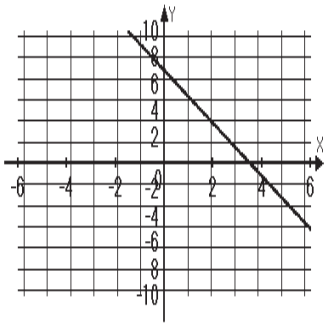
{(5, –3)}

**4.1 Form III**

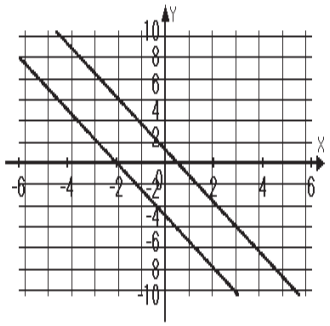
1. No 2. Yes 3. No

4. 

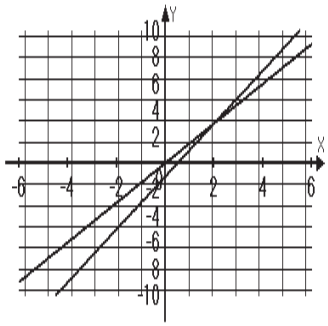
{(4, 5)}

5. 

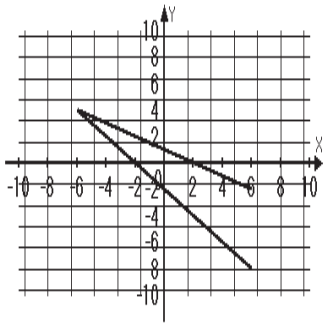
Infinitely many solutions
$\{(x,\ y) \mid 2x + y = 7\}$ $\{(x,\ y) \mid 6x + 3y = 21\}$

6. 

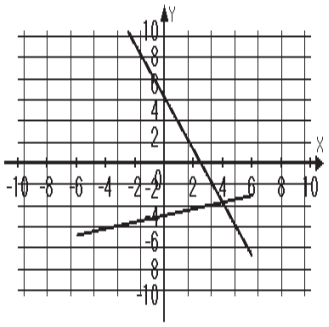
No Solution; Ø

7. 

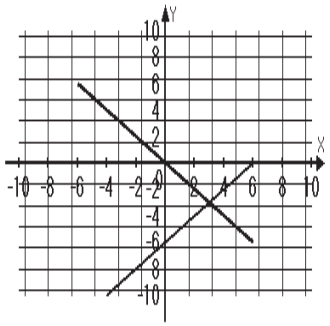
{(2, 3)}

8. 

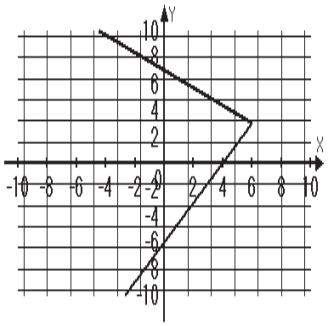
{(–6, 4)}

9. 

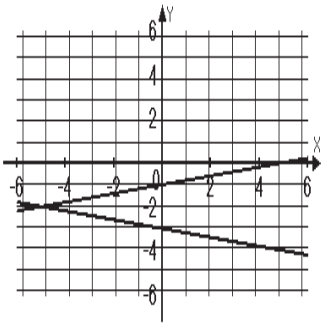
{(4, –3)}

10. 

{3, –3}

11. 

{(6, 3)}

12. 

{(–5, –2)}

## 4.2 Form I

1. $\{(4, 7)\}$ 2. $\{(-3, -4)\}$ 3. $\{(1, -3)\}$ 4. $\{(10, 5)\}$ 5. Infinitely many solutions; $\{(x, y) \mid 3x + 3y = 12\}$ or $\{(x, y) \mid x = 4 - y\}$ 6. $\{(2, 4)\}$ 7. $\{(5, -6)\}$ 8. No Solution; Ø
9. $\{(2, 0)\}$ 10. $\{(0, -7)\}$ 11. $\{(-4, 3)\}$ 12. $\{(5, -5)\}$ 13. $\{(-3, 5)\}$ 14. No Solution, Ø
15. $\{(-2, 2)\}$ 16. $\{(-2, -1)\}$

## 4.2 Form II

1. $\{(7, -1)\}$ 2. $\{(4, 16)\}$ 3. Infinitely many solutions; $\{(x, y) \mid 6x - 2y = 14\}$ or $\{(x, y) \mid 3x - y = 7\}$ 4. $\{(8, 2)\}$ 5. $\{(-4, 12)\}$ 6. No Solution; Ø 7. $\{(1, 0)\}$ 8. $\{(5, 4)\}$
9. $\{(5, -2)\}$ 10. $\left\{\left(\frac{1}{2}, 4\right)\right\}$ 11. $\left\{\left(\frac{4}{5}, -\frac{1}{5}\right)\right\}$ 12. $\left\{\left(1, \frac{1}{3}\right)\right\}$ 13. No Solution; Ø
14. $\{(8, 6)\}$ 15. $\{(11, 15)\}$ 16. $\{(-9, 5)\}$

## 4.2 Form III

1. $\{(5, -3)\}$ 2. $\{(-2, -7)\}$ 3. $\{(-2, -1)\}$ 4. $\{(-5, 6)\}$ 5. Infinitely many solutions; $\{(x, y) \mid 2x + y = 14\}$ or $\{(x, y) \mid 4x + 2y = 28\}$ 6. $\{(-2, 2)\}$ 7. $\{(12, 10)\}$
8. No Solution; Ø 9. $\{(-4, 9)\}$ 10. $\left\{\left(\frac{1}{8}, -\frac{3}{8}\right)\right\}$ 11. $\left\{\left(\frac{2}{3}, -4\right)\right\}$ 12. $\{(5, 4)\}$
13. $\{(7, -7)\}$ 14. $\{(14, 12)\}$ 15. After 2 ½ years, 869 thousand of Product A and 869 thousand of Product B would be sold. 16. The numbers are 7 and 8.

## 4.3 Form I

1. $\{(-4, 3)\}$ 2. $\{(4, 2)\}$ 3. $\{(5, -4)\}$ 4. No Solution; Ø 5. $\{(-5, -6)\}$ 6. $\{(1, 2)\}$
7. $\{(0, 2)\}$ 8. $\{(8, 3)\}$ 9. $\{(-2, -2)\}$ 10. $\{(6, 1)\}$ 11. $\{(-3, 10)\}$
12. Infinitely many solutions; $\{(x, y) \mid 4x - 6y = 10\}$ or $\{(x, y) \mid 6x - 9y = 15\}$ 13. $\left\{\left(\frac{1}{3}, -2\right)\right\}$
14. $\{(8, 14)\}$ 15. $\left\{\left(\frac{2}{5}, -\frac{3}{5}\right)\right\}$ 16. $\{(1, -3)\}$

## 4.3 Form II

1. $\{(4, 4)\}$ 2. $\{(-3, -2)\}$ 3. $\{(1, -6)\}$ 4. $\{(0, 4)\}$ 5. $\{(-2, -5)\}$
6. Infinitely many solutions; $\{(x, y) \mid 6x + 3y = 27\}$ or $\{(x, y) \mid 2x + y = 9\}$ 7. $\{(5, -12)\}$
8. $\left\{\left(\frac{1}{5}, 2\right)\right\}$ 9. $\left\{\left(\frac{1}{4}, -\frac{7}{4}\right)\right\}$ 10. No Solution; Ø 11. $\left\{\left(-\frac{1}{3}, -\frac{5}{4}\right)\right\}$ 12. $\{(-5, 3)\}$
13. $\{(-4, -7)\}$ 14. No Solution; Ø 15. $\{(1, 2)\}$ 16. $\{(20, -16)\}$

## 4.3 Form III

1. $\{(36, -9)\}$ 2. $\{(-7, -10)\}$ 3. No Solution; Ø 4. Infinitely many solutions; $\{(x, y) \mid 6x - 4y = -4\}$ or $\{(x, y) \mid 12x - 8y = -8\}$ 5. $\{(-1, 3)\}$ 6. $\{(13, 0)\}$ 7. No Solution; Ø
8. $\{(6, 4)\}$ 9. $\left\{\left(-\frac{2}{9}, \frac{14}{9}\right)\right\}$ 10. $\left\{\left(-\frac{4}{5}, \frac{3}{8}\right)\right\}$ 11. $\{(5, -1)\}$ 12. $\{(-4, -16)\}$
13. $\{(10, 4)\}$ 14. $\{(-15, -2)\}$ 15. $\{(3, 1)\}$ 16. $\{(-4, -1)\}$

### 4.4 Form I

1. 4 and 8 2. 24 and 28 3. 8 and 12 4. 30 and 126 5. A shirt costs $26. Pants cost $32. 6. 50 bracelets and 30 necklaces 7. 35 geraniums and 45 daisies 8. The width is 7 inches. The length is 11 inches. 9. The width is 121 cm. The length is 363 cm. 10. 29º and 111º

### 4.4 Form II

1. –4 and 8 2. 17 and 24 3. 14 and –6 4. 18 adult tickets and 15 children's tickets 5. 98 dimes; 14 nickels 6. 382 hardback books and 451 paperback books 7. 8º, 40º, and 132º 8. The width is 5 inches. The length is 16 inches 9. The width is 7 feet. The length is 40 feet. 10. Popcorn, $1.50, Juice, $1.25

### 4.4 Form III

1. 22 and 70 2. 6 and –5 3. 12 and 15 4. Hot dogs, $4.50; Sodas, $3.00 5. 13 nickels, 52 quarters 6. 1272 adult tickets; 526 children's tickets 7. 47º and 90º 8. 40º, 40º and 100º 9. The width is 15.8 feet. The length is 24.2 feet. 10. After driving 50 miles the plan would be equal. The cost would be $33.00.

### 4.5 Form I

1. Yes 2. No 3. Yes 4. Yes 5. No 6. $\{(1,4,1)\}$ 7. $\{(1,2,1)\}$ 8. $\{(3,4,1)\}$ 9. $\{(2,0,1)\}$ 10. $\{(-2,-4,-1)\}$ 11. $\{(-2,3,5)\}$ 12. Infinitely many solution 13. No Solution 14. No Solution

### 4.5 Form II

1. Yes 2. No 3. No 4. No 5. $\{(5,8,-9)\}$ 6. $\{(-2,4,-3)\}$ 7. $\{(6,0,-3)\}$ 8. Infinitely many solutions 9. $\left\{\left(0,-4,\frac{1}{4}\right)\right\}$ 10. No Solution 11. Infinitely many solutions 12. $\{(4,3,-4)\}$ 13. $\left\{\left(\frac{1}{5},\frac{2}{5},\frac{3}{5}\right)\right\}$ 14. $\left\{\left(7,2,\frac{-3}{2}\right)\right\}$ 15. The numbers are 4, 8 and 3 16. 4 free throws; 5 two-point field goals; 2 three-point field goals

### 4.5 Form III

1. Yes 2. No 3. No 4. $\{(2,0,1)\}$ 5. $\{(-1,3,4)\}$ 6. No Solution 7. $\left\{\left(\frac{1}{3},\frac{1}{6},\frac{1}{2}\right)\right\}$ 8. $\{(4,-3,0)\}$ 9. Infinitely many solutions 10. $\{(2,-1,-2)\}$ 11. $\{(0,-2,4)\}$ 12. $\{(5,-3,4)\}$ 13. 52 Seniors; 88 ages 16-60; 116 children 14. Hot dogs, $1.75, chips, 50¢, soft drinks, $1.50

# INSTRUCTOR'S SOLUTIONS MANUAL

DANIEL S. MILLER

*Niagara County Community College*

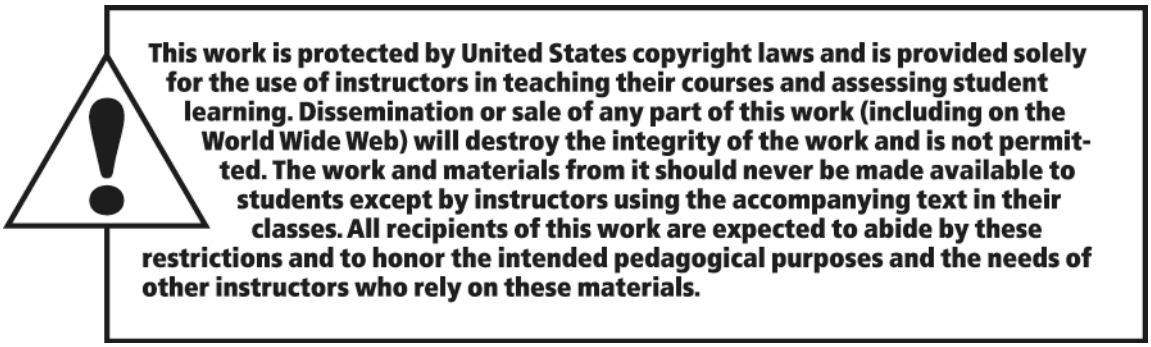
# INTRODUCTORY & INTERMEDIATE ALGEBRA FOR COLLEGE STUDENTS

SIXTH EDITION

Robert Blitzer

*Miami Dade College*

Pearson



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# Chapter 1
# Variables, Real Numbers, and Mathematical Models

## 1.1 Check Points

**1. a.** $6+2x=6+2(10)=26$

**b.** $2(x+6)=2(10+6)=32$

**2. a.** $7x+2y=7\cdot 3+2\cdot 8=21+16=37$

**b.** $\dfrac{6x-y}{2y-x-8}=\dfrac{6\cdot 3-8}{2\cdot 8-3-8}=\dfrac{10}{5}=2$

**3. a.** $6x$

**b.** $4+x$

**c.** $3x+5$

**d.** $12-2x$

**e.** $\dfrac{15}{x}$

**4. a.** $9x-3=42$
$9(6)-3=42$
$54-3=42$
$51=42,$ false
6 is not a solution.

**b.** $2(y+3)=5y-3$
$2(3+3)=5(3)-3$
$2(6)=15-3$
$12=12,$ true
3 is a solution.

**5. a.** $\dfrac{x}{6}=5$

**b.** $7-2x=1$

**6. a.** $d=4n+5$
$d=4(15)+5=65$
65% of marriages end in divorce after 15 years when the wife is under 18 at the time of marriage.

**b.** According to the line graph, 60% of marriages end in divorce after 15 years when the wife is under 18 at the time of marriage.

**c.** The mathematical model overestimates the actual percentage shown in the graph by 5%.

## 1.1 Concept and Vocabulary Check

**1.** variable

**2.** expression

**3.** substituting; evaluating

**4.** equation; solution

**5.** formula; modeling; models

## 1.1 Exercise Set

**1.** $x+8=4+8=12$

**2.** $x+10=4+10=14$

**3.** $12-x=12-4=8$

**4.** $16-x=16-4=12$

**5.** $5x=5\cdot 4=20$

**6.** $6x=6\cdot 4=24$

**7.** $\dfrac{28}{x}=\dfrac{28}{4}=7$

**8.** $\dfrac{36}{x}=\dfrac{36}{4}=9$

**9.** $5+3x=5+3\cdot 4=5+12=17$

**10.** $3+5x=3+5\cdot 4=3+20=23$

**11.** $2(x+5)=2(4+5)=2(9)=18$

**12.** $5(x+3)=5(4+3)=5(7)=35$

**13.** $\dfrac{12x-8}{2x}=\dfrac{12\cdot 4-8}{2\cdot 4}=\dfrac{48-8}{8}=\dfrac{40}{8}=5$

**14.** $\dfrac{5x+52}{3x}=\dfrac{5\cdot 4+52}{3\cdot 4}=\dfrac{20+52}{12}=\dfrac{72}{12}=6$

**15.** $2x+y=2\cdot 7+5=14+5=19$

**16.** $3x+y=3\cdot 7+5=21+5=26$

**17.** $2(x+y)=2(7+5)=2(12)=24$

**18.** $3(x+y)=3(7+5)=3(12)=36$

**19.** $4x-3y=4\cdot 7-3\cdot 5=28-15=13$

**20.** $5x-4y=5\cdot 7-4\cdot 5=35-20=15$

**21.** $\dfrac{21}{x}+\dfrac{35}{y}=\dfrac{21}{7}+\dfrac{35}{5}=3+7=10$

**22.** $\dfrac{50}{y}-\dfrac{14}{x}=\dfrac{50}{5}-\dfrac{14}{7}=10-2=8$

**23.** $\dfrac{2x-y+6}{2y-x}=\dfrac{2\cdot 7-5+6}{2\cdot 5-7}=\dfrac{14-5+6}{10-7}=\dfrac{15}{3}=5$

**24.** $\dfrac{2y-x+24}{2x-y}=\dfrac{2\cdot 5-7+24}{2\cdot 7-5}=\dfrac{10-7+24}{14-5}=\dfrac{27}{9}=3$

**25.** $x+4$

**26.** $x+6$

**27.** $x-4$

**28.** $x-6$

**29.** $x+4$

**30.** $x+6$

**31.** $x-9$

**32.** $x-3$

**33.** $9-x$

**34.** $3-x$

**35.** $3x-5$

**36.** $5x-3$

**37.** $12x-1$

**38.** $13x-3$

**39.** $\dfrac{10}{x}+\dfrac{x}{10}$

**40.** $\dfrac{20}{x}+\dfrac{x}{20}$

**41.** $\dfrac{x}{30}+6$

**42.** $\dfrac{30}{x}+4$

**43.** $x+14=20$

$6+14=20$

$20=20,$ true

The number is a solution.

**44.** $x+17=22$

$5+17=22$

$22=22,$ true

The number is a solution.

**45.** $30-y=10$

$30-20=10$

$10=10,$ true

The number is a solution.

**46.** $50-y=20$

$50-30=20$

$20=20,$ true

The number is a solution.

**47.** $4z=20$

$4(10)=20$

$40=20,$ false

The number is not a solution.

**48.** $5z=30$

$5(8)=30$

$40=30,$ false

The number is not a solution.

**49.** $\dfrac{r}{6}=8$

$\dfrac{48}{6}=8$

$8=8,$ true

The number is a solution.

**50.** $\dfrac{r}{9}=7$

$\dfrac{63}{9}=7$

$7=7,$ true

The number is a solution.

**51.** $4m+3=23$
$4(6)+3=23$
$24+3=23$
$27=23,$ false
The number is not a solution.

**52.** $3m+4=19$
$3(6)+4=19$
$18+4=19$
$22=19,$ false
The number is not a solution.

**53.** $5a-4=2a+5$
$5(3)-4=2(3)+5$
$15-4=6+5$
$11=11,$ true
The number is a solution.

**54.** $5a-3=2a+6$
$5(3)-3=2(3)+6$
$15-3=6+6$
$12=12,$ true
The number is a solution.

**55.** $6(p-4)=3p$
$6(8-4)=3(8)$
$6(4)=24$
$24=24,$ true
The number is a solution.

**56.** $4(p+3)=6p$
$4(6+3)=6(6)$
$4(9)=36$
$36=36,$ true
The number is a solution.

**57.** $2(w+1)=3(w-1)$
$2(7+1)=3(7-1)$
$2(8)=3(6)$
$16=18,$ false
The number is not a solution.

**58.** $3(w+2)=4(w-3)$
$3(10+2)=4(10-3)$
$3(12)=4(7)$
$36=28,$ false
The number is not a solution.

**59.** $4x=28$

**60.** $5x=35$

**61.** $\frac{14}{x}=\frac{1}{2}$

**62.** $\frac{x}{8}=\frac{1}{4}$

**63.** $20-x=5$

**64.** $40-x=10$

**65.** $2x+6=16$

**66.** $2x+9=29$

**67.** $3x-5=7$

**68.** $4x-3=29$

**69.** $4x+5=33$

**70.** $6x+3=33$

**71.** $4(x+5)=33$

**72.** $6(x+3)=33$

**73.** $5x=24-x$

**74.** $4x=25-x$

**75.** First find $x$.
$x=7y+2$
$x=7(5)+2=37$
Evaluate the expression.
$\frac{x-y}{4}=\frac{37-5}{4}=\frac{32}{4}=8$

**76.** First find $x$.
$x=5y+2$
$x=5(4)+2=22$
Evaluate the expression.
$\frac{x-y}{3}=\frac{22-4}{3}=\frac{18}{3}=6$

**77.** First find $x$.

$$x = \frac{y}{4} - 1$$

$$x = \frac{12}{4} - 1 = 3 - 1 = 2$$

Evaluate the expression.

$$\begin{aligned} 4x + 3(y+5) &= 4(2) + 3(12+5) \\ &= 8 + 3(17) \\ &= 8 + 51 \\ &= 59 \end{aligned}$$

**78.** First find $x$.

$$x = \frac{y}{3} - 1$$

$$x = \frac{15}{3} - 1 = 5 - 1 = 4$$

Evaluate the expression.

$$\begin{aligned} 3x + 4(y+6) &= 3(4) + 4(15+6) \\ &= 12 + 4(21) \\ &= 12 + 84 \\ &= 96 \end{aligned}$$

**79. a.** $2(x+3y) = 2(4+3\cdot 1) = 2(7) = 14$

**b.**
$$\begin{aligned} 5z - 30 &= 40 \\ 5(14) - 30 &= 40 \\ 70 - 30 &= 40 \\ 40 &= 40, \text{ true} \end{aligned}$$

Yes, it is a solution.

**80. a.** $3(2x+y) = 3(2\cdot 1 + 5) = 3(7) = 21$

**b.**
$$\begin{aligned} 4z - 30 &= 54 \\ 4(21) - 30 &= 54 \\ 84 - 30 &= 54 \\ 54 &= 54, \text{ true} \end{aligned}$$

Yes, it is a solution.

**81. a.** $6x - 2y = 6\cdot 3 - 2\cdot 6 = 18 - 12 = 6$

**b.**
$$\begin{aligned} 7w &= 45 - 2w \\ 7(6) &= 45 - 2(6) \\ 42 &= 45 - 12 \\ 42 &= 33, \text{ false} \end{aligned}$$

No, it is not a solution.

**82. a.** $5x - 14y = 5\cdot 3 - 14\cdot\frac{1}{2} = 15 - 7 = 8$

**b.**
$$\begin{aligned} 4w &= 54 - 5w \\ 4(8) &= 54 - 5(8) \\ 32 &= 54 - 40 \\ 32 &= 14, \text{ false} \end{aligned}$$

No, it is not a solution.

**83. a.**
$$\begin{aligned} T &= 0.16n + 2.83 \\ T &= 0.16(10) + 2.83 \\ &= 4.43 \end{aligned}$$

According to the formula, the average price in 1990 was \$4.43.
The model overestimates the actual amount shown in the bar graph by \$0.20.

**b.**
$$\begin{aligned} T &= 0.16n + 2.83 \\ T &= 0.16(30) + 2.83 \\ &= 7.63 \end{aligned}$$

According to the formula, the average price in 2010 was \$7.63.
The bar graph shows a price in 2010 of \$7.89.
$\$7.89 - \$7.63 = \$0.26$
The model underestimates the actual amount shown in the bar graph by \$0.26.

**84. a.**
$$\begin{aligned} T &= 0.16n + 2.83 \\ T &= 0.16(5) + 2.83 \\ &= 3.63 \end{aligned}$$

According to the formula, the average price in 1985 was \$3.63.
The model overestimates the actual amount shown in the bar graph by \$0.08.

**b.**
$$\begin{aligned} T &= 0.16n + 2.83 \\ T &= 0.16(25) + 2.83 \\ &= 6.83 \end{aligned}$$

According to the formula, the average price in 2005 was \$6.83.
The bar graph shows a price in 2005 of \$6.41.
$\$6.83 - \$6.41 = \$0.42$
The model overestimates the actual amount shown in the bar graph by \$0.42.

**85.**
$$\begin{aligned} p &= 52 - 0.3a \\ p &= 52 - 0.3(24) \\ &= 44.8 \end{aligned}$$

According to the formula, 44.8% of 24-year-olds say that marriage is obsolete.
The model overestimates the actual percentage shown in the bar graph by 0.8%.

**86.** $p = 52 - 0.3a$

$p = 52 - 0.3(66)$

$= 32.2$

According to the formula, 32.2% of 66-year-olds say that marriage is obsolete.
The model overestimates the actual percentage shown in the bar graph by 0.2%.

**87. a.** $H = 0.8(200 - A)$

$H = 0.8(200 - 145)$

$= 44$

A bowler with an average score of 145 will have a handicap of 44.

**b.** The bowler's final score will be $120 + 44$, or 164.

**88. a.** $H = 0.8(200 - A)$

$H = 0.8(200 - 165)$

$= 28$

A bowler with an average score of 165 will have a handicap of 28.

**b.** The bowler's final score will be $140 + 28$, or 168.

**89. – 97.** Answers will vary.

**98.** $H = 0.8(200 - A)$

$H = 0.8(200 - 200) = 0$

A bowler with an average score of 200 will have no handicap.

**99.** makes sense

**100.** does not make sense; Explanations will vary.
Sample explanation: $4x + 7$ is not an equation.

**101.** makes sense

**102.** makes sense

**103.** true

**104.** false; Changes to make the statement true will vary.
A sample change is: Equations contain the equality symbol, =.

**105.** true

**106.** false; Changes to make the statement true will vary.
A sample change is: Hard work combined with a willingness to use available learning resources can greatly improve your chances of learning the material in this book.

**107.** Choices of variables may vary.
Let $h$ = hours worked.
Let $s$ = salary.
$s = 20h$

**108.** Choices of variables may vary.
Let $w$ = number of workers.
Let $t$ = number of televisions assembled.
$t = 10w$

**109.** $\frac{3}{7} \cdot \frac{2}{5} = \frac{3 \cdot 2}{7 \cdot 5} = \frac{6}{35}$

**110.** $\frac{2}{3} \div \frac{7}{5} = \frac{2}{3} \cdot \frac{5}{7} = \frac{2 \cdot 5}{3 \cdot 7} = \frac{10}{21}$

**111.** $\frac{9}{17} - \frac{5}{17} = \frac{9 - 5}{17} = \frac{4}{17}$

**1.2 Check Points**

**1.** $2\frac{5}{8} = \frac{2 \cdot 8 + 5}{8} = \frac{16 + 5}{8} = \frac{21}{8}$

**2.** 5 divided by 3 is 1 with a remainder of 2, so $\frac{5}{3} = 1\frac{2}{3}$.

**3.** Begin by selecting any two numbers whose product is 36.
Here is one possibility: $36 = 4 \cdot 9$
Because the factors 4 and 9 are not prime, factor each of these composite numbers.
$36 = 4 \cdot 9$

$= 2 \cdot 2 \cdot 3 \cdot 3$

Notice that 2 and 3 are both prime. The prime factorization of 36 is $2 \cdot 2 \cdot 3 \cdot 3$.

**4. a.** $\frac{10}{15} = \frac{2 \cdot \cancel{5}}{3 \cdot \cancel{5}} = \frac{2}{3}$

**b.** $\frac{42}{24} = \frac{\cancel{2} \cdot \cancel{3} \cdot 7}{2 \cdot 2 \cdot \cancel{2} \cdot \cancel{3}} = \frac{7}{4}$

When reducing fractions, it may not be necessary to write prime factorizations. We can use the greatest common factor to reduce this fraction.

$\frac{42}{24} = \frac{7 \cdot \cancel{6}}{4 \cdot \cancel{6}} = \frac{7}{4}$

**c.** $\frac{13}{15}$; Because 13 and 15 share no common factors (other than 1), $\frac{13}{15}$ is already reduced to its lowest terms.

**d.** $\frac{9}{45}=\frac{1\cdot\cancel{9}}{5\cdot\cancel{9}}=\frac{1}{5}$

**5. a.** $\frac{4}{11}\cdot\frac{2}{3}=\frac{4\cdot 2}{11\cdot 3}=\frac{8}{33}$

**b.** $6\cdot\frac{3}{5}=\frac{6}{1}\cdot\frac{3}{5}=\frac{18}{5}=3\frac{3}{5}$

**c.** $\frac{3}{7}\cdot\frac{2}{3}=\frac{3\cdot 2}{7\cdot 3}=\frac{6}{21}=\frac{2\cdot\cancel{3}}{7\cdot\cancel{3}}=\frac{2}{7}$

Remember that you can divide numerators and denominators by common factors before performing multiplication.

$\frac{3}{7}\cdot\frac{2}{3}=\frac{\cancel{3}}{7}\cdot\frac{2}{\cancel{3}}=\frac{2}{7}$

**d.** $\left(3\frac{2}{5}\right)\left(1\frac{1}{2}\right)=\frac{17}{5}\cdot\frac{3}{2}=\frac{51}{10}=5\frac{1}{10}$

**6. a.** $\frac{5}{4}\div\frac{3}{8}=\frac{5}{4}\cdot\frac{8}{3}=\frac{5}{\cancel{4}}\cdot\frac{\cancel{4}\cdot 2}{3}=\frac{10}{3}=3\frac{1}{3}$

**b.** $\frac{2}{3}\div 3=\frac{2}{3}\div\frac{3}{1}=\frac{2}{3}\cdot\frac{1}{3}=\frac{2}{9}$

**c.** $3\frac{3}{8}\div 2\frac{1}{4}=\frac{27}{8}\div\frac{9}{4}=\frac{27}{8}\cdot\frac{4}{9}=\frac{\cancel{9}\cdot 3}{\cancel{4}\cdot 2}\cdot\frac{\cancel{4}}{\cancel{9}}=\frac{3}{2}=1\frac{1}{2}$

**7. a.** $\frac{2}{11}+\frac{3}{11}=\frac{5}{11}$

**b.** $\frac{5}{6}-\frac{1}{6}=\frac{4}{6}=\frac{2}{3}$

**c.** $3\frac{3}{8}-1\frac{1}{8}=\frac{27}{8}-\frac{9}{8}=\frac{18}{8}=\frac{9}{4}=2\frac{1}{4}$

**8.** $\frac{2}{3}=\frac{2\cdot 7}{3\cdot 7}=\frac{14}{21}$

**9. a.** $\frac{1}{2}+\frac{3}{5}=\frac{1\cdot 5}{2\cdot 5}+\frac{3\cdot 2}{5\cdot 2}=\frac{5}{10}+\frac{6}{10}=\frac{11}{10}$ or $1\frac{1}{10}$

**b.** $\frac{4}{3}-\frac{3}{4}=\frac{4\cdot 4}{3\cdot 4}-\frac{3\cdot 3}{4\cdot 3}=\frac{16}{12}-\frac{9}{12}=\frac{7}{12}$

**c.** $3\frac{1}{6}-1\frac{11}{12}=\frac{19}{6}-\frac{23}{12}=\frac{19\cdot 2}{6\cdot 2}-\frac{23}{12}$

$=\frac{38}{12}-\frac{23}{12}=\frac{15}{12}$

$=\frac{5}{4}$ or $1\frac{1}{4}$

**10.** $10=2\cdot 5$

$12=2\cdot 2\cdot 3$

$\text{LCD}=2\cdot 2\cdot 3\cdot 5=60$

$\frac{3}{10}+\frac{7}{12}=\frac{3\cdot 6}{10\cdot 6}+\frac{7\cdot 5}{12\cdot 5}=\frac{18}{60}+\frac{35}{60}=\frac{53}{60}$

**11. a.** $x-\frac{2}{9}x=1$

$1\frac{2}{7}-\frac{2}{9}\left(1\frac{2}{7}\right)=1$

$\frac{9}{7}-\frac{2}{9}\left(\frac{9}{7}\right)=1$

$\frac{9}{7}-\frac{2}{7}=1$

$\frac{7}{7}=1$

$1=1,\ \text{true}$

The given fraction is a solution.

**b.** $\frac{1}{5}-w=\frac{1}{3}w$

$\frac{1}{5}-\frac{3}{20}=\frac{1}{3}\left(\frac{3}{20}\right)$

$\frac{4}{20}-\frac{3}{20}=\frac{1}{20}$

$\frac{1}{20}=\frac{1}{20},\ \text{true}$

The given fraction is a solution.

**12. a.** $\frac{2}{3}(x-6)$

**b.** $\frac{3}{4}x-2=\frac{1}{5}x$

**13.** $C=\frac{5}{9}(F-32)$

$C=\frac{5}{9}(77-32)=\frac{5}{9}(45)=25$

77°F is equivalent to 25°C.

### 1.2 Concept and Vocabulary Check

**1.** numerator; denominator

**2.** mixed; improper

**3.** 5; 3; 2; 5

**4.** natural

**5.** prime

**6.** factors; product

**7.** $\frac{a}{b}$

**8.** $\frac{a\cdot c}{b\cdot d}$

**9.** reciprocals

**10.** $\frac{d}{c}$

**11.** $\frac{a+c}{b}$

**12.** least common denominator

### 1.2 Exercise Set

**1.** $2\frac{3}{8}=\frac{2\cdot 8+3}{8}=\frac{16+3}{8}=\frac{19}{8}$

**2.** $2\frac{7}{9}=\frac{2\cdot 9+7}{9}=\frac{18+7}{9}=\frac{25}{9}$

**3.** $7\frac{3}{5}=\frac{7\cdot 5+3}{5}=\frac{35+3}{5}=\frac{38}{5}$

**4.** $6\frac{2}{5}=\frac{6\cdot 5+2}{5}=\frac{30+2}{5}=\frac{32}{5}$

**5.** $8\frac{7}{16}=\frac{8\cdot 16+7}{16}=\frac{128+7}{16}=\frac{135}{16}$

**6.** $9\frac{5}{16}=\frac{9\cdot 16+5}{16}=\frac{144+5}{16}=\frac{149}{16}$

**7.** 23 divided by 5 is 4 with a remainder of 3, so $\frac{23}{5}=4\frac{3}{5}$.

**8.** 47 divided by 8 is 5 with a remainder of 7, so $\frac{47}{8}=5\frac{7}{8}$.

**9.** 76 divided by 9 is 8 with a remainder of 4, so $\frac{76}{9}=8\frac{4}{9}$.

**10.** 59 divided by 9 is 6 with a remainder of 5, so $\frac{59}{9}=6\frac{5}{9}$.

**11.** 711 divided by 20 is 35 with a remainder of 11, so $\frac{711}{20}=35\frac{11}{20}$.

**12.** 788 divided by 25 is 31 with a remainder of 13, so $\frac{788}{25}=31\frac{13}{25}$.

**13.** composite; $22=2\cdot 11$

**14.** composite; $15=3\cdot 5$

**15.** composite; $20=4\cdot 5=2\cdot 2\cdot 5$

**16.** composite; $75=3\cdot 25=3\cdot 5\cdot 5$

**17.** 37 has no factors other than 1 and 37, so 37 is prime.

**18.** 23 has no factors other than 1 and 23, so 23 is prime.

**19.** composite; $36=4\cdot 9=2\cdot 2\cdot 3\cdot 3$

**20.** composite; $100=4\cdot 25=2\cdot 2\cdot 5\cdot 5$

**21.** composite; $140=10\cdot 14=2\cdot 5\cdot 2\cdot 7$
$=2\cdot 2\cdot 5\cdot 7$

**22.** composite; $110=10\cdot 11=2\cdot 5\cdot 11$

**23.** 79 has no factors other than 1 and 79, so 79 is prime.

**24.** 83 has no factors other than 1 and 83, so 83 is prime.

**25.** composite; $81 = 9 \cdot 9 = 3 \cdot 3 \cdot 3 \cdot 3$

**26.** composite; $64 = 8 \cdot 8 = 2 \cdot 4 \cdot 2 \cdot 4$
$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

**27.** composite; $240 = 10 \cdot 24$
$= 2 \cdot 5 \cdot 2 \cdot 12$
$= 2 \cdot 5 \cdot 2 \cdot 3 \cdot 4$
$= 2 \cdot 5 \cdot 2 \cdot 3 \cdot 2 \cdot 2$
$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5$

**28.** composite; $360 = 10 \cdot 36$
$= 2 \cdot 5 \cdot 6 \cdot 6$
$= 2 \cdot 5 \cdot 2 \cdot 3 \cdot 2 \cdot 3$
$= 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5$

**29.** $\dfrac{10}{16} = \dfrac{\cancel{2} \cdot 5}{\cancel{2} \cdot 8} = \dfrac{5}{8}$

**30.** $\dfrac{8}{14} = \dfrac{\cancel{2} \cdot 4}{\cancel{2} \cdot 7} = \dfrac{4}{7}$

**31.** $\dfrac{15}{18} = \dfrac{\cancel{3} \cdot 5}{\cancel{3} \cdot 6} = \dfrac{5}{6}$

**32.** $\dfrac{18}{45} = \dfrac{\cancel{9} \cdot 2}{\cancel{9} \cdot 5} = \dfrac{2}{5}$

**33.** $\dfrac{35}{50} = \dfrac{\cancel{5} \cdot 7}{\cancel{5} \cdot 10} = \dfrac{7}{10}$

**34.** $\dfrac{45}{50} = \dfrac{\cancel{5} \cdot 9}{\cancel{5} \cdot 10} = \dfrac{9}{10}$

**35.** $\dfrac{32}{80} = \dfrac{\cancel{16} \cdot 2}{\cancel{16} \cdot 5} = \dfrac{2}{5}$

**36.** $\dfrac{75}{80} = \dfrac{\cancel{5} \cdot 15}{\cancel{5} \cdot 16} = \dfrac{15}{16}$

**37.** $\dfrac{44}{50} = \dfrac{\cancel{2} \cdot 22}{\cancel{2} \cdot 25} = \dfrac{22}{25}$

**38.** $\dfrac{38}{50} = \dfrac{\cancel{2} \cdot 19}{\cancel{2} \cdot 25} = \dfrac{19}{25}$

**39.** $\dfrac{120}{86} = \dfrac{\cancel{2} \cdot 60}{\cancel{2} \cdot 43} = \dfrac{60}{43}$

**40.** $\dfrac{116}{86} = \dfrac{\cancel{2} \cdot 58}{\cancel{2} \cdot 43} = \dfrac{58}{43}$

**41.** $\dfrac{2}{5} \cdot \dfrac{1}{3} = \dfrac{2 \cdot 1}{5 \cdot 3} = \dfrac{2}{15}$

**42.** $\dfrac{3}{7} \cdot \dfrac{1}{4} = \dfrac{3 \cdot 1}{7 \cdot 4} = \dfrac{3}{28}$

**43.** $\dfrac{3}{8} \cdot \dfrac{7}{11} = \dfrac{3 \cdot 7}{8 \cdot 11} = \dfrac{21}{88}$

**44.** $\dfrac{5}{8} \cdot \dfrac{3}{11} = \dfrac{5 \cdot 3}{8 \cdot 11} = \dfrac{15}{88}$

**45.** $9 \cdot \dfrac{4}{7} = \dfrac{9}{1} \cdot \dfrac{4}{7} = \dfrac{9 \cdot 4}{1 \cdot 7} = \dfrac{36}{7}$ or $5\dfrac{1}{7}$

**46.** $8 \cdot \dfrac{3}{7} = \dfrac{8}{1} \cdot \dfrac{3}{7} = \dfrac{8 \cdot 3}{1 \cdot 7} = \dfrac{24}{7}$ or $3\dfrac{3}{7}$

**47.** $\dfrac{1}{10} \cdot \dfrac{5}{6} = \dfrac{1 \cdot 5}{10 \cdot 6} = \dfrac{5}{60} = \dfrac{5 \cdot 1}{5 \cdot 12} = \dfrac{1}{12}$

**48.** $\dfrac{1}{8} \cdot \dfrac{2}{3} = \dfrac{1 \cdot 2}{8 \cdot 3} = \dfrac{2}{24} = \dfrac{\cancel{2} \cdot 1}{\cancel{2} \cdot 12} = \dfrac{1}{12}$

**49.** $\dfrac{5}{4} \cdot \dfrac{6}{7} = \dfrac{5 \cdot 6}{4 \cdot 7} = \dfrac{30}{28} = \dfrac{2 \cdot 15}{2 \cdot 14} = \dfrac{15}{14}$ or $1\dfrac{1}{14}$

**50.** $\dfrac{7}{4} \cdot \dfrac{6}{11} = \dfrac{7 \cdot 6}{4 \cdot 11} = \dfrac{42}{44} = \dfrac{\cancel{2} \cdot 21}{\cancel{2} \cdot 22} = \dfrac{21}{22}$

**51.** $\left(3\dfrac{3}{4}\right)\left(1\dfrac{3}{5}\right) = \dfrac{15}{4} \cdot \dfrac{8}{5} = \dfrac{120}{20} = \dfrac{\cancel{20} \cdot 6}{\cancel{20} \cdot 1} = 6$

**52.** $\left(2\dfrac{4}{5}\right)\left(1\dfrac{1}{4}\right) = \dfrac{14}{5} \cdot \dfrac{5}{4} = \dfrac{70}{20} = \dfrac{\cancel{10} \cdot 7}{\cancel{10} \cdot 2}$
$= \dfrac{7}{2}$ or $3\dfrac{1}{2}$

**53.** $\dfrac{5}{4} \div \dfrac{4}{3} = \dfrac{5}{4} \cdot \dfrac{3}{4} = \dfrac{5 \cdot 3}{4 \cdot 4} = \dfrac{15}{16}$

**54.** $\dfrac{7}{8} \div \dfrac{2}{3} = \dfrac{7}{8} \cdot \dfrac{3}{2} = \dfrac{7 \cdot 3}{8 \cdot 2} = \dfrac{21}{16}$ or $1\dfrac{5}{16}$

**55.** $\frac{18}{5} \div 2 = \frac{18}{5} \cdot \frac{1}{2}$

$= \frac{18 \cdot 1}{5 \cdot 2} = \frac{18}{10} = \frac{\cancel{2} \cdot 9}{\cancel{2} \cdot 5} = \frac{9}{5}$ or $1\frac{4}{5}$

**56.** $\frac{12}{7} \div 3 = \frac{12}{7} \cdot \frac{1}{3}$

$= \frac{12 \cdot 1}{7 \cdot 3} = \frac{12}{21} = \frac{\cancel{3} \cdot 4}{\cancel{3} \cdot 7} = \frac{4}{7}$

**57.** $2 \div \frac{18}{5} = \frac{2}{1} \cdot \frac{5}{18} = \frac{10}{18} = \frac{\cancel{2} \cdot 5}{\cancel{2} \cdot 9} = \frac{5}{9}$

**58.** $3 \div \frac{12}{7} = \frac{3}{1} \cdot \frac{7}{12} = \frac{21}{12} = \frac{\cancel{3} \cdot 7}{\cancel{3} \cdot 4} = \frac{7}{4}$ or $1\frac{3}{4}$

**59.** $\frac{3}{4} \div \frac{1}{4} = \frac{3}{4} \cdot \frac{4}{1} = \frac{3 \cdot 4}{4 \cdot 1} = \frac{12}{4} = 3$

**60.** $\frac{3}{7} \div \frac{1}{7} = \frac{3}{7} \cdot \frac{7}{1} = \frac{3 \cdot 7}{7 \cdot 1} = \frac{21}{7} = 3$

**61.** $\frac{7}{6} \div \frac{5}{3} = \frac{7}{6} \cdot \frac{3}{5} = \frac{7 \cdot 3}{6 \cdot 5} = \frac{21}{30} = \frac{\cancel{3} \cdot 7}{\cancel{3} \cdot 10} = \frac{7}{10}$

**62.** $\frac{7}{4} \div \frac{3}{8} = \frac{7}{4} \cdot \frac{8}{3} = \frac{7 \cdot 8}{4 \cdot 3} = \frac{56}{12} = \frac{\cancel{4} \cdot 14}{\cancel{4} \cdot 3}$

$= \frac{14}{3}$ or $4\frac{2}{3}$

**63.** $\frac{1}{14} \div \frac{1}{7} = \frac{1}{14} \cdot \frac{7}{1} = \frac{7}{14} = \frac{\cancel{7} \cdot 1}{\cancel{7} \cdot 2} = \frac{1}{2}$

**64.** $\frac{1}{8} \div \frac{1}{4} = \frac{1}{8} \cdot \frac{4}{1} = \frac{4}{8} = \frac{\cancel{4} \cdot 1}{\cancel{4} \cdot 2} = \frac{1}{2}$

**65.** $6\frac{3}{5} \div 1\frac{1}{10} = \frac{33}{5} \div \frac{11}{10}$

$= \frac{33}{5} \cdot \frac{10}{11} = \frac{\cancel{11} \cdot 3}{\cancel{5}} \cdot \frac{\cancel{5} \cdot 2}{\cancel{11}} = \frac{6}{1} = 6$

**66.** $1\frac{3}{4} \div 2\frac{5}{8} = \frac{7}{4} \div \frac{21}{8}$

$= \frac{7}{4} \cdot \frac{8}{21} = \frac{56}{84} = \frac{\cancel{28} \cdot 2}{\cancel{28} \cdot 3} = \frac{2}{3}$

**67.** $\frac{2}{11} + \frac{4}{11} = \frac{2+4}{11} = \frac{6}{11}$

**68.** $\frac{5}{13} + \frac{2}{13} = \frac{5+2}{13} = \frac{7}{13}$

**69.** $\frac{7}{12} + \frac{1}{12} = \frac{8}{12} = \frac{\cancel{4} \cdot 2}{\cancel{4} \cdot 3} = \frac{2}{3}$

**70.** $\frac{5}{16} + \frac{1}{16} = \frac{6}{16} = \frac{\cancel{2} \cdot 3}{\cancel{2} \cdot 8} = \frac{3}{8}$

**71.** $\frac{5}{8} + \frac{5}{8} = \frac{10}{8} = \frac{\cancel{2} \cdot 5}{\cancel{2} \cdot 4} = \frac{5}{4}$ or $1\frac{1}{4}$

**72.** $\frac{3}{8} + \frac{3}{8} = \frac{6}{8} = \frac{\cancel{2} \cdot 3}{\cancel{2} \cdot 4} = \frac{3}{4}$

**73.** $\frac{7}{12} - \frac{5}{12} = \frac{2}{12} = \frac{\cancel{2} \cdot 1}{\cancel{2} \cdot 6} = \frac{1}{6}$

**74.** $\frac{13}{18} - \frac{5}{18} = \frac{8}{18} = \frac{\cancel{2} \cdot 4}{\cancel{2} \cdot 9} = \frac{4}{9}$

**75.** $\frac{16}{7} - \frac{2}{7} = \frac{14}{7} = \frac{\cancel{7} \cdot 2}{\cancel{7} \cdot 1} = 2$

**76.** $\frac{17}{5} - \frac{2}{5} = \frac{15}{5} = 3$

**77.** $\frac{1}{2} + \frac{1}{5} = \frac{1}{2} \cdot \frac{5}{5} + \frac{1}{5} \cdot \frac{2}{2}$

$= \frac{5}{10} + \frac{2}{10} = \frac{5+2}{10} = \frac{7}{10}$

**78.** $\frac{1}{3} + \frac{1}{5} = \frac{1}{3} \cdot \frac{5}{5} + \frac{1}{5} \cdot \frac{3}{3}$

$= \frac{5}{15} + \frac{3}{15} = \frac{5+3}{15} = \frac{8}{15}$

**79.** $\frac{3}{4} + \frac{3}{20} = \frac{3}{4} \cdot \frac{5}{5} + \frac{3}{20}$

$= \frac{15}{20} + \frac{3}{20}$

$= \frac{18}{20} = \frac{\cancel{2} \cdot 9}{\cancel{2} \cdot 10} = \frac{9}{10}$

**80.** $\frac{2}{5} + \frac{2}{15} = \frac{2}{5} \cdot \frac{3}{3} + \frac{2}{15}$

$= \frac{6}{15} + \frac{2}{15} = \frac{8}{15}$

**81.** $\frac{3}{8}+\frac{5}{12}=\frac{3}{8}\cdot\frac{3}{3}+\frac{5}{12}\cdot\frac{2}{2}$

$=\frac{9}{24}+\frac{10}{24}=\frac{19}{24}$

**82.** $\frac{3}{10}+\frac{2}{15}=\frac{3}{10}\cdot\frac{3}{3}+\frac{2}{15}\cdot\frac{2}{2}$

$=\frac{9}{30}+\frac{4}{30}=\frac{13}{30}$

**83.** $\frac{11}{18}-\frac{2}{9}=\frac{11}{18}-\frac{2}{9}\cdot\frac{2}{2}=\frac{11}{18}-\frac{4}{18}=\frac{7}{18}$

**84.** $\frac{17}{18}-\frac{4}{9}=\frac{17}{18}-\frac{4}{9}\cdot\frac{2}{2}=\frac{17}{18}-\frac{8}{18}=\frac{9}{18}$

$=\frac{\cancel{9}\cdot 1}{\cancel{9}\cdot 2}=\frac{1}{2}$

**85.** $\frac{4}{3}-\frac{3}{4}=\frac{4}{3}\cdot\frac{4}{4}-\frac{3}{4}\cdot\frac{3}{3}$

$=\frac{16}{12}-\frac{9}{12}=\frac{7}{12}$

**86.** $\frac{3}{2}-\frac{2}{3}=\frac{3}{2}\cdot\frac{3}{3}-\frac{2}{3}\cdot\frac{2}{2}$

$=\frac{9}{6}-\frac{4}{6}=\frac{5}{6}$

**87.** $\frac{7}{10}-\frac{3}{16}=\frac{7}{10}\cdot\frac{8}{8}-\frac{3}{16}\cdot\frac{5}{5}$

$=\frac{56}{80}-\frac{15}{80}=\frac{41}{80}$

**88.** $\frac{7}{30}-\frac{5}{24}=\frac{7}{30}\cdot\frac{4}{4}-\frac{5}{24}\cdot\frac{5}{5}$

$=\frac{28}{120}-\frac{25}{120}=\frac{3}{120}$

$=\frac{\cancel{3}\cdot 1}{\cancel{3}\cdot 40}=\frac{1}{40}$

**89.** $3\frac{3}{4}-2\frac{1}{3}=\frac{15}{4}-\frac{7}{3}$

$=\frac{15}{4}\cdot\frac{3}{3}-\frac{7}{3}\cdot\frac{4}{4}$

$=\frac{45}{12}-\frac{28}{12}=\frac{17}{12}$ or $1\frac{5}{12}$

**90.** $3\frac{2}{3}-2\frac{1}{2}=\frac{11}{3}-\frac{5}{2}$

$=\frac{11}{3}\cdot\frac{2}{2}-\frac{5}{2}\cdot\frac{3}{3}$

$=\frac{22}{6}-\frac{15}{6}=\frac{7}{6}$ or $1\frac{1}{6}$

**91.** $\frac{7}{2}x=28$

$\frac{7}{2}\cdot 8=28$

$\frac{7}{2}\cdot\frac{8}{1}=28$

$\frac{7}{\cancel{2}}\cdot\frac{4\cdot\cancel{2}}{1}=28$

$28=28,$ true

The given number is a solution.

**92.** $\frac{5}{3}x=30$

$\frac{5}{3}\cdot 18=30$

$\frac{5}{3}\cdot\frac{18}{1}=30$

$\frac{5}{\cancel{3}}\cdot\frac{6\cdot\cancel{3}}{1}=30$

$30=30,$ true

The given number is a solution.

**93.** $w-\frac{2}{3}=\frac{3}{4}$

$1\frac{5}{12}-\frac{2}{3}=\frac{3}{4}$

$\frac{17}{12}-\frac{2}{3}=\frac{3}{4}$

$\frac{17}{12}-\frac{8}{12}=\frac{3}{4}$

$\frac{9}{12}=\frac{3}{4}$

$\frac{3}{4}=\frac{3}{4},$ true

The given number is a solution.

**94.** $w-\frac{3}{4}=\frac{7}{4}$

$2\frac{1}{2}-\frac{3}{4}=\frac{7}{4}$

$\frac{5}{2}-\frac{3}{4}=\frac{7}{4}$

$\frac{10}{4}-\frac{3}{4}=\frac{7}{4}$

$\frac{7}{4}=\frac{7}{4}$, true

The given number is a solution.

**95.** $20-\frac{1}{3}z=\frac{1}{2}z$

$20-\frac{1}{3}\cdot 12=\frac{1}{2}\cdot 12$

$20-\frac{1}{3}\cdot\frac{12}{1}=\frac{1}{2}\cdot\frac{12}{1}$

$20-4=12$

$16=12$, false

The given number is not a solution.

**96.** $12-\frac{1}{4}z=\frac{1}{2}z$

$12-\frac{1}{4}\cdot 20=\frac{1}{2}\cdot 20$

$12-\frac{1}{4}\cdot\frac{20}{1}=\frac{1}{2}\cdot\frac{20}{1}$

$12-5=10$

$7=10$, false

The given number is not a solution.

**97.** $\frac{2}{9}y+\frac{1}{3}y=\frac{3}{7}$

$\frac{2}{9}\cdot\frac{27}{35}+\frac{1}{3}\cdot\frac{27}{35}=\frac{3}{7}$

$\frac{2}{\cancel{9}}\cdot\frac{\cancel{9}\cdot 3}{35}+\frac{1}{\cancel{3}}\cdot\frac{\cancel{3}\cdot 9}{35}=\frac{3}{7}$

$\frac{6}{35}+\frac{9}{35}=\frac{3}{7}$

$\frac{15}{35}=\frac{3}{7}$

$\frac{3\cdot\cancel{5}}{7\cdot\cancel{5}}=\frac{3}{7}$

$\frac{3}{7}=\frac{3}{7}$, true

The given number is a solution.

**98.** $\frac{2}{3}y+\frac{5}{6}y=2$

$\frac{2}{3}\left(1\frac{1}{3}\right)+\frac{5}{6}\left(1\frac{1}{3}\right)=2$

$\frac{2}{3}\left(\frac{4}{3}\right)+\frac{5}{6}\left(\frac{4}{3}\right)=2$

$\frac{8}{9}+\frac{20}{18}=2$

$\frac{8}{9}+\frac{10}{9}=2$

$\frac{18}{9}=2$

$2=2$, true

The given number is a solution.

**99.** $\frac{1}{3}(x-2)=\frac{1}{5}(x+4)$

$\frac{1}{3}(26-2)=\frac{1}{5}(26+4)$

$\frac{1}{3}(24)=\frac{1}{5}(30)$

$8=6$, false

The given number is not a solution.

**100.** $\frac{1}{2}(x-2)+3=\frac{3}{8}(3x-4)$

$\frac{1}{2}(4-2)+3=\frac{3}{8}(3\cdot 4-4)$

$\frac{1}{2}(2)+3=\frac{3}{8}(12-4)$

$1+3=\frac{3}{8}(8)$

$4=3$, false

The given number is not a solution.

**101.** $(y \div 6) + \frac{2}{3} = (y \div 2) - \frac{7}{9}$

$$\left(4\frac{1}{3} \div 6\right) + \frac{2}{3} = \left(4\frac{1}{3} \div 2\right) - \frac{7}{9}$$

$$\left(\frac{13}{3} \div \frac{6}{1}\right) + \frac{2}{3} = \left(\frac{13}{3} \div \frac{2}{1}\right) - \frac{7}{9}$$

$$\left(\frac{13}{3} \cdot \frac{1}{6}\right) + \frac{2}{3} = \left(\frac{13}{3} \cdot \frac{1}{2}\right) - \frac{7}{9}$$

$$\frac{13}{18} + \frac{2}{3} = \frac{13}{6} - \frac{7}{9}$$

$$\frac{13}{18} + \frac{12}{18} = \frac{39}{18} - \frac{14}{18}$$

$$\frac{25}{18} = \frac{25}{18}, \text{ true}$$

The given number is a solution.

**102.** $(y \div 6) + \frac{1}{3} = (y \div 2) - \frac{5}{9}$

$$\left(2\frac{2}{3} \div 6\right) + \frac{1}{3} = \left(2\frac{2}{3} \div 2\right) - \frac{5}{9}$$

$$\left(\frac{8}{3} \div \frac{6}{1}\right) + \frac{1}{3} = \left(\frac{8}{3} \div \frac{2}{1}\right) - \frac{5}{9}$$

$$\left(\frac{8}{3} \cdot \frac{1}{6}\right) + \frac{1}{3} = \left(\frac{8}{3} \cdot \frac{1}{2}\right) - \frac{5}{9}$$

$$\frac{8}{18} + \frac{1}{3} = \frac{8}{6} - \frac{5}{9}$$

$$\frac{8}{18} + \frac{6}{18} = \frac{24}{18} - \frac{10}{18}$$

$$\frac{14}{18} = \frac{14}{18}, \text{ true}$$

The given number is a solution.

**103.** $\frac{1}{5}x$

**104.** $\frac{1}{6}x$

**105.** $x - \frac{1}{4}x$

**106.** $x - \frac{1}{3}x$

**107.** $x - \frac{1}{4} = \frac{1}{2}x$

**108.** $x - \frac{1}{3} = \frac{1}{2}x$

**109.** $\frac{1}{7}x + \frac{1}{8}x = 12$

**110.** $\frac{1}{9}x + \frac{1}{10}x = 15$

**111.** $\frac{2}{3}(x+6)$

**112.** $\frac{3}{4}(x+9)$

**113.** $\frac{2}{3}x + 6 = x - 3$

**114.** $\frac{3}{4}x + 9 = x - 2$

**115.** $\frac{3}{4} \cdot \frac{a}{5} = \frac{3 \cdot a}{4 \cdot 5} = \frac{3a}{20}$

**116.** $\frac{2}{3} \div \frac{a}{7} = \frac{2}{3} \cdot \frac{7}{a} = \frac{2 \cdot 7}{3 \cdot a} = \frac{14}{3a}$

**117.** $\frac{11}{x} + \frac{9}{x} = \frac{11+9}{x} = \frac{20}{x}$

**118.** $\frac{10}{y} - \frac{6}{y} = \frac{10-6}{y} = \frac{4}{y}$

**119.** $\left(\frac{1}{2} - \frac{1}{3}\right) \div \frac{5}{8} = \left(\frac{3}{6} - \frac{2}{6}\right) \div \frac{5}{8}$

$$= \frac{1}{6} \div \frac{5}{8}$$

$$= \frac{1}{6} \cdot \frac{8}{5} = \frac{8}{30} = \frac{\cancel{2} \cdot 4}{\cancel{2} \cdot 15} = \frac{4}{15}$$

**120.** $\left(\frac{1}{2} + \frac{1}{4}\right) \div \left(\frac{1}{2} + \frac{1}{3}\right) = \left(\frac{2}{4} + \frac{1}{4}\right) \div \left(\frac{3}{6} + \frac{2}{6}\right)$

$$= \frac{3}{4} \div \frac{5}{6}$$

$$= \frac{3}{4} \cdot \frac{6}{5}$$

$$= \frac{18}{20} = \frac{\cancel{2} \cdot 9}{\cancel{2} \cdot 10} = \frac{9}{10}$$

**121.** $\frac{1}{5}(x+2)=\frac{1}{2}\left(x-\frac{1}{5}\right)$

$\frac{1}{5}\left(\frac{5}{8}+2\right)=\frac{1}{2}\left(\frac{5}{8}-\frac{1}{5}\right)$

$\frac{1}{5}\left(\frac{5}{8}+\frac{2}{1}\right)=\frac{1}{2}\left(\frac{5}{8}-\frac{1}{5}\right)$

$\frac{1}{5}\left(\frac{5}{8}+\frac{16}{8}\right)=\frac{1}{2}\left(\frac{25}{40}-\frac{8}{40}\right)$

$\frac{1}{5}\left(\frac{21}{8}\right)=\frac{1}{2}\left(\frac{17}{40}\right)$

$\frac{21}{40}=\frac{17}{80}$

$\frac{42}{80}=\frac{17}{80}$, false

The given number is not a solution.

**122.** $12-3(x-2)=4x-(x+3)$

$12-3\left(3\frac{1}{2}-2\right)=4\cdot 3\frac{1}{2}-\left(3\frac{1}{2}+3\right)$

$\frac{12}{1}-\frac{3}{1}\left(\frac{7}{2}-\frac{2}{1}\right)=\frac{4}{1}\cdot\frac{7}{2}-\left(\frac{7}{2}+\frac{3}{1}\right)$

$\frac{12}{1}-\frac{3}{1}\left(\frac{7}{2}-\frac{4}{2}\right)=\frac{2\cdot\cancel{2}}{1}\cdot\frac{7}{\cancel{2}}-\left(\frac{7}{2}+\frac{6}{2}\right)$

$\frac{12}{1}-\frac{3}{1}\left(\frac{3}{2}\right)=\frac{14}{1}-\frac{13}{2}$

$\frac{24}{2}-\frac{9}{2}=\frac{28}{2}-\frac{13}{2}$

$\frac{15}{2}=\frac{15}{2}$, true

The given number is a solution.

**123.** $C=\frac{5}{9}(F-32)$

$C=\frac{5}{9}(68-32)=\frac{5}{9}(36)=20$

68°F is equivalent to 20°C.

**124.** $C=\frac{5}{9}(F-32)$

$C=\frac{5}{9}(41-32)=\frac{5}{9}(9)=5$

41°F is equivalent to 5°C.

**125. a.** $H=\frac{7}{10}(220-a)$

$H=\frac{7}{10}(220-20)$

$=\frac{7}{10}(200)$

$=140$

The lower limit of the heart rate for a 20-year-old with this exercise goal is 140 beats per minute.

**b.** $H=\frac{4}{5}(220-a)$

$H=\frac{4}{5}(220-20)$

$=\frac{4}{5}(200)$

$=160$

The upper limit of the heart rate for a 20-year-old with this exercise goal is 160 beats per minute.

**126. a.** $H=\frac{1}{2}(220-a)$

$H=\frac{1}{2}(220-30)$

$=\frac{1}{2}(190)$

$=95$

The lower limit of the heart rate for a 30-year-old with this exercise goal is 95 beats per minute.

**b.** $H=\frac{3}{5}(220-a)$

$H=\frac{3}{5}(220-30)$

$=\frac{3}{5}(190)$

$=114$

The upper limit of the heart rate for a 30-year-old with this exercise goal is 114 beats per minute.

**127. a.** $H=\frac{9}{10}(220-a)$

**b.** $H=\frac{9}{10}(220-a)$

$H=\frac{9}{10}(220-40)$

$=\frac{9}{10}(180)$

$=162$

The heart rate for a 40-year-old with this exercise goal is 162 beats per minute.

**128. a.** $H=\frac{7}{8}(220-a)$

**b.** $H=\frac{7}{8}(220-a)$

$H=\frac{7}{8}(220-20)$

$=\frac{7}{8}(200)$

$=175$

The heart rate for a 20-year-old with this exercise goal is 175 beats per minute.

**129. a.** 2010 is 10 years after 2000.

$I=\frac{3}{100}x+\frac{1}{2}$

$I=\frac{3}{100}(10)+\frac{1}{2}$

$=\frac{30}{100}+\frac{1}{2}$

$=\frac{3}{10}+\frac{1}{2}$

$=\frac{4}{5}$

The formula estimates that $\frac{4}{5}$ of adults used the internet in 2010.

**b.** $\frac{4}{5}=\frac{4}{5}$; they are equal

**c.** 2020 is 20 years after 2000.

$I=\frac{3}{100}x+\frac{1}{2}$

$I=\frac{3}{100}(20)+\frac{1}{2}$

$=\frac{60}{100}+\frac{1}{2}$

$=\frac{3}{5}+\frac{1}{2}$

$=\frac{11}{10}$

Model breakdown has occurred as the fraction is larger than 1.

**130. a.** 2014 is 14 years after 2000.

$I=\frac{3}{100}x+\frac{1}{2}$

$I=\frac{3}{100}(14)+\frac{1}{2}$

$=\frac{42}{100}+\frac{1}{2}$

$=\frac{21}{50}+\frac{1}{2}$

$=\frac{23}{25}$

The formula estimates that $\frac{23}{25}$ of adults used the internet in 2014.

**b.** $\frac{23}{25}=\frac{46}{50}$

$\frac{46}{50}>\frac{45}{50}$

The model overestimates by $\frac{1}{50}$.

**c.** 2030 is 30 years after 2000.

$$I = \frac{3}{100}x + \frac{1}{2}$$

$$I = \frac{3}{100}(30) + \frac{1}{2}$$

$$= \frac{90}{100} + \frac{1}{2}$$

$$= \frac{9}{10} + \frac{1}{2}$$

$$= \frac{7}{5}$$

Model breakdown has occurred as the fraction is larger than 1.

**131. – 140.** Answers will vary.

**141.** makes sense

**142.** does not make sense; Explanations will vary.
Sample explanation: Fractions are often used in algebra.

**143.** makes sense

**144.** does not make sense; Explanations will vary.
Sample explanation: The fraction $\frac{3}{2}$ is greater than 1 and thus this fraction would cause the price to be higher than the original price.

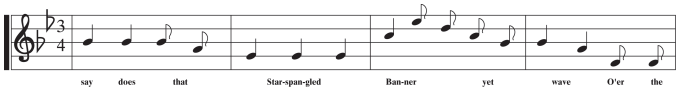
**145.** false; Changes to make the statement true will vary.
A sample change is: $\frac{1}{2} + \frac{1}{5} = \frac{5}{10} + \frac{2}{10} = \frac{7}{10}$.

**146.** false; Changes to make the statement true will vary.
A sample change is: $\frac{1}{2} \div 4 = \frac{1}{2} \div \frac{4}{1} = \frac{1}{2} \cdot \frac{1}{4} = \frac{1}{8}.$

**147.** true

**148.** false; Changes to make the statement true will vary.
A sample change is: $\frac{3+7}{30} = \frac{10}{30} = \frac{1}{3}$.

**149.**




**150.** 5

**151.** $2\frac{1}{2}$ or $\frac{5}{2}$

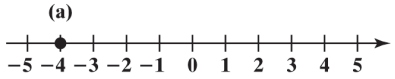
**152.** $-4$

### 1.3 Check Points

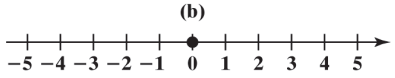
**1. a.** $-500$

**b.** $-282$

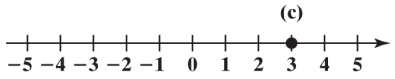
**2. a.**



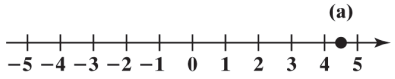

**b.**



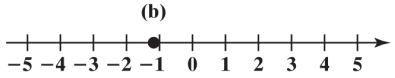

**c.**




**3. a.**




**b.**




**4. a.**

$$8\overline{)3.000}\quad 0.375$$

$$\underline{24}$$
$$60$$
$$\underline{56}$$
$$40$$
$$\underline{40}$$
$$0$$

$$\frac{3}{8} = 0.375$$

**b.**

$$11\overline{)5.000\ldots}\quad 0.454\ldots$$

$$\underline{44}$$
$$60$$
$$\underline{55}$$
$$50$$
$$\underline{44}$$
$$60$$

$$\frac{5}{11} = 0.\overline{45}$$

**5. a.** $\sqrt{9}$

**b.** $0, \sqrt{9}$

**c.** $-9, 0, \sqrt{9}$

**d.** $-9, -1.3, 0, 0.\overline{3}, \sqrt{9}$

**e.** $\frac{\pi}{2}, \sqrt{10}$

**f.** $-9, -1.3, 0, 0.\overline{3}, \frac{\pi}{2}, \sqrt{9}, \sqrt{10}$

**6. a.** $14 > 5$ since 14 is to the right of 5 on the number line.

**b.** $-5.4 < 2.3$ since $-5.4$ is to the left of 2.3 on the number line.

**c.** $-19 < -6$ since $-19$ is to the left of $-6$ on the number line.

**d.** $\frac{1}{4} < \frac{1}{2}$ since $\frac{1}{4}$ is to the left of $\frac{1}{2}$ on the number line.

**7. a.** $-2 \le 3$ is true because $-2 < 3$ is true.

**b.** $-2 \ge -2$ is true because $-2 = -2$ is true.

**c.** $-4 \ge 1$ is false because neither $-4 > 1$ nor $-4 = 1$ is true.

**8. a.** $|-4| = 4$

**b.** $|6| = 6$

**c.** $\left|-\sqrt{2}\right| = \sqrt{2}$

### 1.3 Concept and Vocabulary Check

**1.** natural

**2.** whole

**3.** integers

**4.** rational

**5.** irrational

**6.** rational; irrational

**7.** left

**8.** absolute value; $|a|$

### 1.3 Exercise Set

**1.** $-20$

**2.** 65

**3.** 8

**4.** $-12{,}500$

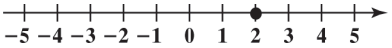
**5.** $-3000$

**6.** $-3$

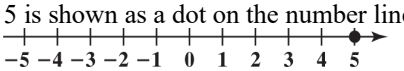
**7.** $-4$ billion

**8.** $-14$

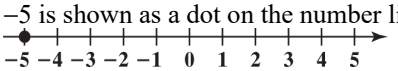
**9.** 2 is shown as a dot on the number line.



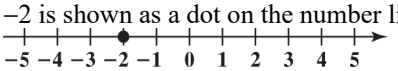

**10.** 5 is shown as a dot on the number line.



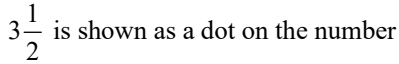

**11.** $-5$ is shown as a dot on the number line.



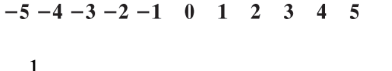

**12.** $-2$ is shown as a dot on the number line. q



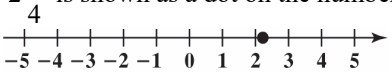

**13.** $3\frac{1}{2}$ is shown as a dot on the number line.



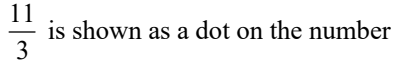

**14.** $2\frac{1}{4}$ is shown as a dot on the number line.



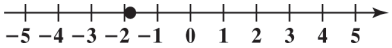

**15.** $\frac{11}{3}$ is shown as a dot on the number line.



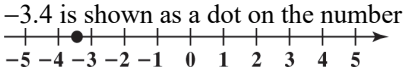

**16.** $\frac{7}{3}$ is shown as a dot on the number line.



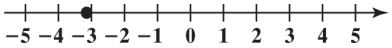
**17.** $-1.8$ is shown as a dot on the number line.



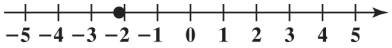

**18.** $-3.4$ is shown as a dot on the number line.




**19.** $-\frac{16}{5}$ is shown as a dot on the number line.




**20.** $-\frac{11}{5}$ is shown as a dot on the number line.




**21.**
$$\begin{array}{r} 0.75 \\ 4\overline{)3.00} \\ \underline{28} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

$\frac{3}{4} = 0.75$

**22.**
$$\begin{array}{r} 0.6 \\ 5\overline{)3.0} \\ \underline{30} \\ 0 \end{array}$$

$\frac{3}{5} = 0.6$

**23.**
$$\begin{array}{r} 0.35 \\ 20\overline{)7.00} \\ \underline{60} \\ 100 \\ \underline{100} \\ 0 \end{array}$$

$\frac{7}{20} = 0.35$

**24.**
$$\begin{array}{r} 0.15 \\ 20\overline{)3.00} \\ \underline{20} \\ 100 \\ \underline{100} \\ 0 \end{array}$$

$\frac{3}{20} = 0.15$

**25.**
$$\begin{array}{r} 0.875 \\ 8\overline{)7.000} \\ \underline{64} \\ 60 \\ \underline{56} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

$\frac{7}{8} = 0.875$

**26.**
$$\begin{array}{r} 0.3125 \\ 16\overline{)5.0000} \\ \underline{48} \\ 20 \\ \underline{16} \\ 40 \\ \underline{32} \\ 80 \\ \underline{80} \\ 0 \end{array}$$

$\frac{5}{16} = 0.3125$

**27.**
$$\begin{array}{r} 0.818... \\ 11\overline{)9.000...} \\ \underline{88} \\ 20 \\ \underline{11} \\ 90 \\ \underline{88} \\ 20 \end{array}$$

$\frac{9}{11} = 0.\overline{81}$

**28.**
$$\begin{array}{r} 0.272... \\ 11\overline{)3.000...} \\ \underline{22} \\ 80 \\ \underline{77} \\ 30 \\ \underline{22} \\ 80 \end{array}$$

$\frac{3}{11} = 0.\overline{27}$

**29.**
$$2\overline{)1.0}\ 0.5$$
$$\underline{1.0}$$
$$0$$
$$-\frac{1}{2} = -0.5$$

**30.**
$$4\overline{)1.00}\ 0.25$$
$$\underline{8}$$
$$20$$
$$\underline{20}$$
$$0$$
$$-\frac{1}{4} = -0.25$$

**31.**
$$6\overline{)5.000\ldots}\ 0.833\ldots$$
$$\underline{48}$$
$$20$$
$$\underline{18}$$
$$20$$
$$\underline{18}$$
$$20$$
$$\frac{5}{6} = 0.8\overline{3}$$

**32.**
$$6\overline{)7.000\ldots}\ 1.166\ldots$$
$$\underline{6}$$
$$10$$
$$\underline{6}$$
$$40$$
$$\underline{36}$$
$$40$$
$$-\frac{7}{6} = -1.1\overline{6}$$

**33.** **a.** $\sqrt{100}$ (=10)

**b.** $0, \sqrt{100}$

**c.** $-9, 0, \sqrt{100}$

**d.** $-9, -\frac{4}{5}, 0, 0.25, 9.2, \sqrt{100}$

**e.** $\sqrt{3}$

**f.** $-9, -\frac{4}{5}, 0, 0.25, \sqrt{3}, 9.2, \sqrt{100}$

**34.** **a.** $\sqrt{49}$ (=7)

**b.** $0, \sqrt{49}$

**c.** $-7, 0, \sqrt{49}$

**d.** $-7, -0.\overline{6}, 0, \sqrt{49}$

**e.** $\sqrt{50}$

**f.** $-7, -0.\overline{6}, 0, \sqrt{49}, \sqrt{50}$

**35.** **a.** $\sqrt{64}$ (= 8)

**b.** $0, \sqrt{64}$

**c.** $-11, 0, \sqrt{64}$

**d.** $-11, -\frac{5}{6}, 0, 0.75, \sqrt{64}$

**e.** $\sqrt{5}, \pi$

**f.** $-11, -\frac{5}{6}, 0, 0.75, \sqrt{5}, \pi, \sqrt{64}$

**36.** **a.** $\sqrt{4}$ (= 2)

**b.** $0, \sqrt{4}$

**c.** $-5, 0, \sqrt{4}$

**d.** $-5, -0.\overline{3}, 0, \sqrt{4}$

**e.** $\sqrt{2}$

**f.** $-5, -0.\overline{3}, 0, \sqrt{2}, \sqrt{4}$

**37.** The only whole number that is not a natural number is 0.

**38.** Answers will vary. As an example, one integer that is not a whole number is –3.

**39.** Answers will vary. As an example, one rational number that is not an integer is $\frac{1}{2}$.

**40.** Answers will vary. As an example, one rational number that is not a natural number is –5.

**41.** Answers will vary. As an example, 6 is a number that is an integer, a whole number, and a natural number.

**42.** Answers will vary. As an example, 5 is a number that is a rational number, an integer, and a real number.

**43.** Answers will vary. As an example, one number that is an irrational number and a real number is $\pi$.

**44.** Answers will vary. As an example, one number that is a real number but not an irrational number is $\sqrt{4}$.

**45.** $\frac{1}{2} < 2$ since $\frac{1}{2}$ is to the left of 2 on the number line.

**46.** $4 > -3$ since 4 is to the right of –3 on the number line.

**47.** $3 > -\frac{5}{2}$ since 3 is to the right of $-\frac{5}{2} = -2\frac{1}{2}$.

**48.** $3 > \frac{3}{2}$ since 3 is to the right of $\frac{3}{2} = 1\frac{1}{2}$.

**49.** $-4 > -6$ since –4 is to the right of –6.

**50.**

$$-\frac{5}{2} < -\frac{5}{3} \text{ since } -\frac{5}{2} = -2\frac{1}{2} \text{ is to the left of } -\frac{5}{3} = -1\frac{2}{3}.$$

**51.** $-2.5 < 1.5$ since –2.5 is to the left of 1.5.

**52.** $-1.25 < -0.5$ since –1.25 is to the left of –0.5.

**53.** $-\frac{3}{4} > -\frac{5}{4}$ since $-\frac{3}{4}$ is to the right of $-\frac{5}{4}$.

**54.** $0 > -\frac{1}{2}$ since 0 is to the right of $-\frac{1}{2}$.

**55.** $-4.5 < 3$ since –4.5 is to the left of 3.

**56.** $-5.5 < 2.5$ since –5.5 is to the left of 2.5.

**57.** $\sqrt{2} < 1.5$ since $\sqrt{2} \approx 1.414$ is to the left of 1.5.

**58.** $\sqrt{3} < 2$ since $\sqrt{3} \approx 1.732$ is to the left of 2.

**59.** $0.\overline{3} > 0.3$ since $0.\overline{3} = 0.333...$ is to the right of 0.3.

**60.** $0.6 < 0.\overline{6}$ since 0.6 is to the left of $0.\overline{6} = 0.666...$

**61.** $-\pi > -3.5$ since $-\pi \approx -3.14$ is to the right of –3.5.

**62.** $-\frac{\pi}{2} > -2.3$ since $-\frac{\pi}{2} \approx -1.57$ is to the right of –2.3.

**63.** $-5 \geq -13$ is true because $-5 > -13$ is true.

**64.** $-5 \leq -8$ is false because neither $-5 < -8$ nor $-5 = -8$ is true.

**65.** $-9 \geq -9$ is true because $-9 = -9$ is true.

**66.** $-14 \leq -14$ is true because $-14 = -14$ is true.

**67.** $0 \geq -6$ is true because $0 > -6$ is true.

**68.** $0 \geq -13$ is true because $0 > -13$ is true.

**69.** $-17 \geq 6$ is false because neither $-17 > 6$ nor $-17 = 6$ is true.

**70.** $-14 \geq 8$ is false because neither $-14 > 8$ nor $-14 = 8$ is true.

**71.** $|6| = 6$ because the distance between 6 and 0 on the number line is 6 units.

**72.** $|3| = 3$ because the distance between 3 and 0 on the number line is 3 units.

**73.** $|-7| = 7$ because the distance between –7 and 0 on the number line is 7 units.

**74.** $|-9| = 9$ because the distance between –9 and 0 on the number line is 9 units.

**75.** $\left|\frac{5}{6}\right| = \frac{5}{6}$ because the distance between $\frac{5}{6}$ and 0 on the number line is $\frac{5}{6}$ units.

**76.** $\left|\frac{4}{5}\right| = \frac{4}{5}$ because the distance between $\frac{4}{5}$ and 0 on the number line is $\frac{4}{5}$ units.

**77.** $\left|-\sqrt{11}\right| = \sqrt{11}$ because the distance between $-\sqrt{11}$ and 0 on the number line is $\sqrt{11}$ units.

**78.** $\left|-\sqrt{29}\right| = \sqrt{29}$ because the distance between $-\sqrt{29}$ and 0 on the number line is $\sqrt{29}$ units.

**79.** $|-6| \square |-3|$

$6 \square 3$

$6 > 3$

Since $6 > 3$, $|-6| > |-3|$.

**80.** $|-20| \square |-50|$

$20 \square 50$

$20 < 50$

Since $20 < 50$, $|-20| < |-50|$.

**81.** $\left|\frac{3}{5}\right| \square |-0.6|$

$|0.6| \square |-0.6|$

$0.6 \square 0.6$

$0.6 = 0.6$

Since $0.6 = 0.6$, $\left|\frac{3}{5}\right| = |-0.6|$.

**82.** $\left|\frac{5}{2}\right| \square |-2.5|$

$|2.5| \square |-2.5|$

$2.5 \square 2.5$

$2.5 = 2.5$

Since $2.5 = 2.5$, $\left|\frac{5}{2}\right| = |-2.5|$.

**83.** $\frac{30}{40} - \frac{3}{4} \square \frac{14}{15} \cdot \frac{15}{14}$

$\frac{30}{40} - \frac{30}{40} \square \frac{\cancel{14}}{\cancel{15}} \cdot \frac{\cancel{15}}{\cancel{14}}$

$0 \square 1$

$0 < 1$

Since $0 < 1$, $\frac{30}{40} - \frac{3}{4} < \frac{14}{15} \cdot \frac{15}{14}$.

**84.** $\frac{17}{18} \cdot \frac{18}{17} \square \frac{50}{60} - \frac{5}{6}$

$\frac{\cancel{17}}{\cancel{18}} \cdot \frac{\cancel{18}}{\cancel{17}} \square \frac{50}{60} - \frac{50}{60}$

$1 \square 0$

$1 > 0$

Since $1 > 0$, $\frac{17}{18} \cdot \frac{18}{17} > \frac{50}{60} - \frac{5}{6}$.

**85.** $\frac{8}{13} \div \frac{8}{13} \square |-1|$

$\frac{8}{13} \cdot \frac{13}{8} \square 1$

$1 \square 1$

$1 = 1$

Since $1 = 1$, $\frac{8}{13} \div \frac{8}{13} = |-1|$.

**86.** $|-2| \square \frac{4}{17} \div \frac{4}{17}$

$2 \square \frac{4}{17} \cdot \frac{17}{4}$

$2 \square 1$

$2 > 1$

Since $2 > 1$, $|-2| > \frac{4}{17} \div \frac{4}{17}$.

**87.** rational numbers

**88.** rational numbers

**89.** integers

**90.** natural numbers

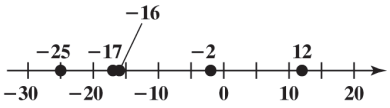
**91.** all real numbers

**92.** all real numbers

**93.** whole numbers

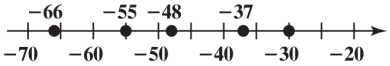
**94.** whole numbers

**95. a.**




**b.** Rhode Island, Georgia, Louisiana, Florida, Hawaii

**96. a.**




**b.** Wyoming, Wisconsin, Washington, West Virginia, Virginia

**97. – 107.** Answers will vary

**108.** does not make sense; Explanations will vary. Sample explanation: Pi is an irrational number so it cannot be represented by decimals that come to an end.

**109.** does not make sense; Explanations will vary. Sample explanation: The Bismarck's resting place is lower because it is further below sea level.

**110.** does not make sense; Explanations will vary. Sample explanation: All rational numbers either terminate or repeat.

**111.** makes sense

**112.** false; Changes to make the statement true will vary. A sample change is: $\frac{2}{3}$ is an example of a rational number that is not an integer.

**113.** false; Changes to make the statement true will vary. A sample change is: All whole numbers are integers.

**114.** true

**115.** false; Changes to make the statement true will vary. A sample change is: Irrational numbers can be negative.

**116.** true

**117.** false; Changes to make the statement true will vary. A sample change is: All integers are rational numbers.

**118.** $-\frac{1}{3}d$

**119.** $-\frac{1}{2}d$

**120.** $\sqrt{3} \approx 1.732$ and should be graphed between 1 and 2.

**121.** $-\sqrt{12} \approx -3.464$ and should be graphed between -4 and -3.

**122.** $1-\sqrt{2} \approx -0.414$ and should be graphed between $-1$ and 0.

**123.** $2-\sqrt{5} \approx -0.236$ and should be graphed between $-1$ and 0.

**124.** $3(x+5) = 3(4+5) = 3(9) = 27$
and
$3x+15 = 3(4)+15 = 12+15 = 27$
Both expressions have the same value.

**125.** $3x+5x = 3(4)+5(4) = 12+20 = 32$
and
$8x = 8(4) = 32$
Both expressions have the same value.

**126.** $9x-2x = 9(4)-2(4) = 36-8 = 28$
and
$7x = 7(4) = 28$
Both expressions have the same value.

### 1.4 Check Points

**1.** **a.** 3 terms

**b.** 6

**c.** 11

**d.** $6x$ and $2x$

**2.** **a.** $x+14 = 14+x$

**b.** $7y = y7$

**3.** **a.** $5x+17 = 17+5x$

**b.** $5x+17 = x5+17$

**4.** **a.** $8+(12+x) = (8+12)+x$
$= 20+x$ or $x+20$

**b.** $6(5x) = (6\cdot 5)x = 30x$

**5.** $8+(x+4) = 8+(4+x)$
$= (8+4)+x$
$= 12+x$ or $x+12$

**6.** $5(x+3) = 5\cdot x+5\cdot 3$
$= 5x+15$

**7.** $6(4y+7) = 6\cdot 4y+6\cdot 7$
$= 24y+42$

**8.** **a.** $7x+3x = (7+3)x = 10x$

**b.** $9a-4a = (9-4)a = 5a$

**9. a.** $8x+7+10x+3=(8x+10x)+(7+3)$
$=18x+10$

**b.** $9x+6y+5x+2y=(9x+5x)+(6y+2y)$
$=14x+8y$

**10.** $7(2x+3)+11x=7\cdot 2x+7\cdot 3+11x$
$=14x+21+11x$
$=(14x+11x)+21$
$=25x+21$

**11.** $7(4x+3y)+2(5x+y)=7\cdot 4x+7\cdot 3y+2\cdot 5x+2\cdot y$
$=28x+21y+10x+2y$
$=(28x+10x)+(21y+2y)$
$=38x+23y$

### 1.4 Concept and Vocabulary Check

**1.** like

**2.** $b+a$

**3.** $ab$

**4.** $a+(b+c)$

**5.** $(ab)c$

**6.** $ab+ac$

**7.** simplified

### 1.4 Exercise Set

**1.** $3x + 5$

**a.** 2 terms
**b.** 3
**c.** 5
**d.** no like terms

**2.** $9x + 4$

**a.** 2 terms
**b.** 9
**c.** 4
**d.** no like terms

**3.** $x + 2 + 5x$

**a.** 3 terms
**b.** 1
**c.** 2
**d.** $x$ and $5x$ are like terms.

**4.** $x + 6 + 7x$

**a.** 3 terms
**b.** 1
**c.** 6
**d.** $x$ and $7x$ are like terms.

**5.** $4y + 1 + 3$

**a.** 3 terms
**b.** 4
**c.** 1
**d.** no like terms

**6.** $8y + 1 + 10x$

**a.** 3 terms
**b.** 8
**c.** 1
**d.** no like terms

**7.** $y+4=4+y$

**8.** $x+7=7+x$

**9.** $5+3x=3x+5$

**10.** $4+9x=9x+4$

**11.** $4x+5y=5y+4x$

**12.** $10x+9y=9y+10x$

**13.** $5(x+3)=5(3+x)$

**14.** $6(x+4)=6(4+x)$

**15.** $9x=x\cdot 9$ or $x9$

**16.** $8x=x\cdot 8$ or $x8$

**17.** $x+y6=x+6y$

**18.** $x+y7=x+7y$

**19.** $7x+23=x7+23$

**20.** $13x+11=x13+11$

**21.** $5(x+3)=(x+3)5$

**22.** $6(x+4)=(x+4)6$

**23.** $7+(5+x)=(7+5)+x=12+x$

**24.** $9+(3+x)=(9+3)+x=12+x$

**25.** $7(4x)=(7\cdot 4)x=28x$

**26.** $8(5x)=(8\cdot 5)x=40x$

**27.** $3(x+5)=3(x)+3(5)=3x+15$

**28.** $4(x+6)=4(x)+4(6)=4x+24$

**29.** $8(2x+3)=8(2x)+8(3)=16x+24$

**30.** $9(2x+5)=9(2x)+9(5)=18x+45$

**31.** $\frac{1}{3}(12+6r)=\frac{1}{3}(12)+\frac{1}{3}(12)+\frac{1}{3}(6r)$
$=4+2r$

**32.** $\frac{1}{4}(12+8r)=\frac{1}{4}(12)+\frac{1}{4}(8r)=3+2r$

**33.** $5(x+y)=5x+5y$

**34.** $7(x+y)=7x+7y$

**35.** $3(x-2)=3(x)-3(2)=3x-6$

**36.** $4(x-5)=4(x)-4(5)=4x-20$

**37.** $2(4x-5)=2(4x)-2(5)=8x-10$

**38.** $6(3x-2)=6(3x)-6(2)=18x-12$

**39.** $\frac{1}{2}(5x-12)=\frac{1}{2}(5x)+\frac{1}{2}(-12)$
$=\frac{5}{2}x-6$

**40.** $\frac{1}{3}(7x-21)=\frac{1}{3}(7x)+\frac{1}{3}(-21)=\frac{7}{3}x-7$

**41.** $(2x+7)4=2x(4)+7(4)=8x+28$

**42.** $(5x+3)6=5x(6)+3(6)=30x+18$

**43.** $6(x+3+2y)=6(x)+6(3)+6(2y)$
$=6x+18+12y$

**44.** $7(2x+4+y)=7(2x)+7(4)+7(y)$
$=14x+28+7y$

**45.** $5(3x-2+4y)=5(3x)-5(2)+5(4y)$
$=15x-10+20y$

**46.** $4(5x-3+7y)=4(5x)-4(3)+4(7y)$
$=20x-12+28y$

**47.** $7x+10x=(7+10)x=17x$

**48.** $5x+13x=(5+13)x=18x$

**49.** $11a-3a=(11-3)a=8a$

**50.** $14b-5b=(14-5)b=9b$

**51.** $3+(x+11)=(3+11)+x=14+x$

**52.** $7+(x+10)=(7+10)+x=17+x$

**53.** $5y+3+6y=(5y+6y)+3=11y+3$

**54.** $8y+7+10y=(8y+10y)+7=18y+7$

**55.** $2x+5+7x-4=(2x+7x)+(5-4)$
$=9x+1$

**56.** $7x+8+2x-3=(7x+2x)+(8-3)$
$=9x+5$

**57.** $11a+12+3a+2=(11a+3a)+(12+2)$
$=14a+14$

**58.** $13a+15+2a+11=(13a+2a)+(15+11)$
$=15a+26$

**59.** $5(3x+2)-4=15x+10-4=15x+6$

**60.** $2(5x+4)-3=10x+8-3=10x+5$

**61.** $12+5(3x-2)=12+15x-10$
$=15x+12-10=15x+2$

**62.** $14+2(5x-1)=14+10x-2$
$=10x+14-2=10x+12$

**63.** $7(3a+2b)+5(4a+2b)$
$=21a+14b+20a+10b$
$=21a+20a+14b+10b$
$=41a+24b$

**64.** $11(6a+3b)+4(12a+5b)$
$=66a+33b+48a+20b$
$=66a+48a+33b+20b$
$=114a+53b$

**65.** $7+2(x+9)$
$=7+(2x+18)$ Distributive Property
$=7+(18+2x)$ Commutative Property of Addition
$=(7+18)+2x$ Associative Property of Addition
$=25+2x$
$=2x+25$ Commutative Property of Addition

**66.** $5(x+4)+3x$
$=(5x+20)+3x$ Distributive Property
$=(20+5x)+3x$ Commutative Property of Addition
$=20+(5x+3x)$ Associative Property of Addition
$=20+(5+3)x$ Distributive Property
$=20+8x$
$=8x+20$ Commutative Property of Addition

**67.** $7x+2x$
$7x+2x=9x$

**68.** $8x+2x$
$8x+2x=10x$

**69.** $12x-3x$
$12x-3x=9x$

**70.** $11x-5x$
$11x-5x=6x$

**71.** $6(4x)$
$6(4x)=24x$

**72.** $9(3x)$
$9(3x)=27x$

**73.** $6(4+x)$
$6(4+x)=24+6x$

**74.** $9(3+x)$
$9(3+x)=27+9x$

**75.** $8+5(x-1)$
$8+5(x-1)=8+5x-5=5x+3$

**76.** $9+3(x-2)$
$9+3(x-2)=9+3x-6=3x+3$

**77. a.** $C=\frac{1}{4}(n+12)+3\left(\frac{1}{12}n+4\right)$
$=\frac{1}{4}n+3+\frac{1}{4}n+12$
$=\frac{1}{2}n+15$

**b.** $C=\frac{1}{2}n+15$
$=\frac{1}{2}(40)+15$
$=35$
According to the formula, there are 35% college graduates in 2020.
This overestimates the value shown in the bar graph by 1%.

**78. a.** $H=\frac{1}{2}(n+100)+5\left(\frac{1}{40}n+3\right)$
$=\frac{1}{2}n+50+\frac{1}{8}n+15$
$=\frac{5}{8}n+65$

**b.** $H=\frac{5}{8}n+65$
$=\frac{5}{8}(40)+65$
$=90$
According to the formula, there are 90% high school graduates in 2020.
This underestimates the value shown in the bar graph by 1%.

**79. – 88.** Answers will vary.

**89.** does not make sense; Explanations will vary.
Sample explanation: Subtraction does not have a commutative property.

**90.** does not make sense; Explanations will vary. Sample explanation: The commutative properties change order and the associative properties change groupings.

**91.** makes sense

**92.** makes sense

**93.** false; Changes to make the statement true will vary. A sample change is: $(24 \div 6) \div 2 \neq 24 \div (6 \div 2)$.

**94.** false; Changes to make the statement true will vary. A sample change is: $2x + 5 = 5 + 2x$.

**95.** false; Changes to make the statement true will vary. A sample change is: Addition cannot be distributed over multiplication.

**96.** false; Changes to make the statement true will vary. A sample change is: Like terms contain the same variables to the same exponents.

**97.** 60 because $150 - 90 = 60$

**98.** $-60$ because $-50 - 10 = -60$

**99.** $-5$ because $30 - 35 = -5$

**Mid-Chapter Check Point – Chapter 1**

**1.** $$\begin{aligned} 2 + 10x &= 2 + 10(6) \\ &= 2 + 60 \\ &= 62 \end{aligned}$$

**2.** $$\begin{aligned} 10x - 4 &= 10\left(\frac{3}{5}\right) - 4 \\ &= 6 - 4 \\ &= 2 \end{aligned}$$

**3.** $$\begin{aligned} \frac{xy}{2} + 4(y - x) &= \frac{3 \cdot 10}{2} + 4(10 - 3) \\ &= \frac{30}{2} + 4(7) \\ &= 15 + 28 \\ &= 43 \end{aligned}$$

**4.** $\frac{1}{4}x - 2$

**5.** $\frac{x}{6} + 5 = 19$

**6.** $$\begin{aligned} 3(x + 2) &= 4x - 1 \\ 3(6 + 2) &= 4 \cdot 6 - 1 \\ 3(8) &= 24 - 1 \\ 24 &= 23, \text{ false} \end{aligned}$$

The number is not a solution.

**7.** $$\begin{aligned} 8y &= 12\left(y - \frac{1}{2}\right) \\ 8 \cdot \frac{3}{4} &= 12\left(\frac{3}{4} - \frac{1}{2}\right) \\ 6 &= 12\left(\frac{3}{4} - \frac{2}{4}\right) \\ 6 &= 12\left(\frac{1}{4}\right) \\ 6 &= 3, \text{ false} \end{aligned}$$

The number is not a solution.

**8. a.** $$\begin{aligned} S &= \frac{5}{2}n + 37 \\ &= \frac{5}{2}(12) + 37 \\ &= 67 \end{aligned}$$

The formula indicates 67% of U.S. adults support same-sex marriage in 2019. This is the actual number shown in the bar graph.

**b.** $$\begin{aligned} S &= \frac{5}{2}n + 37 \\ &= \frac{5}{2}(20) + 37 \\ &= 87 \end{aligned}$$

If trends continue, 87% of U.S. adults will support same-sex marriage in 2027.

**9.** $$\begin{aligned} \frac{7}{10} - \frac{8}{15} &= \frac{7}{10} \cdot \frac{3}{3} - \frac{8}{15} \cdot \frac{2}{2} \\ &= \frac{21}{30} - \frac{16}{30} = \frac{5}{30} = \frac{1}{6} \end{aligned}$$

**10.** $$\frac{2}{3} \cdot \frac{3}{4} = \frac{2}{\cancel{3}} \cdot \frac{\cancel{3}}{4} = \frac{2}{4} = \frac{1}{2}$$

**11.** $$\frac{5}{22} + \frac{5}{33} = \frac{5}{22} \cdot \frac{3}{3} + \frac{5}{33} \cdot \frac{2}{2} = \frac{15}{66} + \frac{10}{66} = \frac{25}{66}$$

**12.** $\frac{3}{5} \div \frac{9}{10} = \frac{3}{5} \cdot \frac{10}{9} = \frac{3}{5} \cdot \frac{2 \cdot 5}{3 \cdot 3} = \frac{\cancel{3}}{\cancel{5}} \cdot \frac{2 \cdot \cancel{5}}{\cancel{3} \cdot 3} = \frac{2}{3}$

**13.** $\frac{23}{105} - \frac{2}{105} = \frac{21}{105} = \frac{\cancel{3} \cdot \cancel{7}}{\cancel{3} \cdot 5 \cdot \cancel{7}} = \frac{1}{5}$

**14.** $2\frac{7}{9} \div 3 = \frac{25}{9} \div \frac{3}{1} = \frac{25}{9} \cdot \frac{1}{3} = \frac{25}{27}$

**15.** $5\frac{2}{9} - 3\frac{1}{6} = \frac{47}{9} - \frac{19}{6}$

$= \frac{47}{9} \cdot \frac{2}{2} - \frac{19}{6} \cdot \frac{3}{3}$

$= \frac{94}{18} - \frac{57}{18} = \frac{37}{18}$ or $2\frac{1}{18}$

**16.** $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(50 - 32) = \frac{5}{9}(18) = 10$

50°F is equivalent to 10°C.

**17.** $-8000 < -8\frac{1}{4}$

**18.** $\frac{1}{11} = 0.\overline{09}$

**19.** $|-19.3| = 19.3$

**20.** $-11$, $-\frac{3}{7}$, 0, 0.45, and $\sqrt{25}$ are rational numbers.

**21.** $5(x+3) = (x+3)5$

**22.** $5(x+3) = 5(3+x)$

**23.** $5(x+3) = 5x+15$

**24.** $7(9x+3) + \frac{1}{3}(6x) = 63x + 21 + 2x$

$= 65x + 21$

**25.** $2(3x+5y) + 4(x+6y) = 6x + 10y + 4x + 24y$

$= 10x + 34y$

## 1.5 Check Points

**1.** $4 + (-7) = -3$

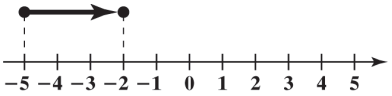
Start at 4 and move 7 units to the left.


**2. a.** $-1 + (-3) = -4$

Start at $-1$ and move 3 units to the left.


**b.** $-5 + 3 = -2$

Start at $-5$ and move 3 units to the right.




**3. a.** $-10 + (-25) = -35$

**b.** $-0.3 + (-1.2) = -1.5$

**c.** $-\frac{2}{3} + \left(-\frac{1}{6}\right) = -\frac{4}{6} + \left(-\frac{1}{6}\right) = -\frac{5}{6}$

**4. a.** $-15 + 2 = -13$

**b.** $-0.4 + 1.6 = 1.2$

**c.** $-\frac{2}{3} + \frac{1}{6} = -\frac{4}{6} + \frac{1}{6} = -\frac{3}{6} = -\frac{1}{2}$

**5. a.** $-20x + 3x = (-20 + 3)x = -17x$

**b.** $3y + (-10z) + (-10y) + 16z$

$= 3y + (-10y) + (-10z) + 16z$

$= [3 + (-10)]y + [(-10) + 16]z$

$= -7y + 6z$

**c.** $5(2x+3) + (-30x) = 10x + 15 + (-30x)$

$= 10x + (-30x) + 15$

$= [10 + (-30)]x + 15$

$= -20x + 15$

**6.** $2 + (-4) + 1 + (-5) + 3 = (2 + 1 + 3) + [(-4) + (-5)]$

$= 6 + (-9)$

$= -3$

At the end of 5 months the water level was down 3 feet.

### 1.5 Concept and Vocabulary Check

**1.** additive inverses

**2.** zero

**3.** negative number

**4.** positive number

**5.** 0

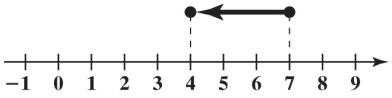
**6.** negative number

**7.** positive number

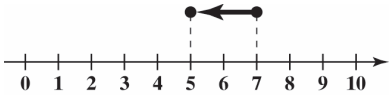
**8.** 0

### 1.5 Exercise Set

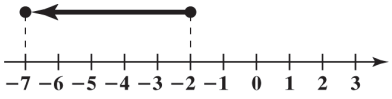
**1.** $7+(-3)=4$



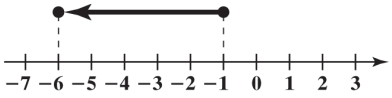

**2.** $7+(-2)=5$



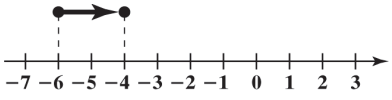

**3.** $-2+(-5)=-7$



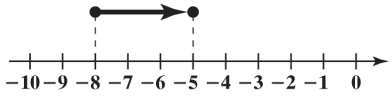

**4.** $-1+(-5)=-6$



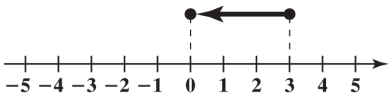

**5.** $-6+2=-4$



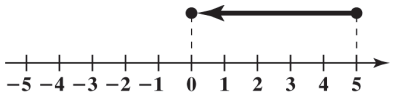

**6.** $-8+3=-5$




**7.** $3+(-3)=0$




**8.** $5+(-5)=0$




**9.** $-7+0=-7$

**10.** $-5+0=-5$

**11.** $30+(-30)=0$

**12.** $15+(-15)=0$

**13.** $-30+(-30)=-60$

**14.** $-15+(-15)=-30$

**15.** $-8+(-10)=-18$

**16.** $-4+(-6)=-10$

**17.** $-0.4+(-0.9)=-1.3$

**18.** $-1.5+(-5.3)=-6.8$

**19.** $-\frac{7}{10}+\left(-\frac{3}{10}\right)=-\frac{10}{10}=-1$

**20.** $-\frac{7}{8}+\left(-\frac{1}{8}\right)=-\frac{8}{8}=-1$

**21.** $-9+4=-5$

**22.** $-7+3=-4$

**23.** $12+(-8)=4$

**24.** $13+(-5)=8$

**25.** $6+(-9)=-3$

**26.** $3+(-11)=-8$

**27.** $-3.6+2.1=-1.5$

**28.** $-6.3+5.2=-1.1$

**29.** $-3.6+(-2.1)=-5.7$

**30.** $-6.3+(-5.2)=-11.5$

**31.** $\frac{9}{10}+\left(-\frac{3}{5}\right)=\frac{9}{10}+\left(-\frac{6}{10}\right)=\frac{3}{10}$

**32.** $\frac{7}{10}+\left(-\frac{2}{5}\right)=\frac{7}{10}+\left(-\frac{4}{10}\right)=\frac{3}{10}$

**33.** $-\frac{5}{8}+\frac{3}{4}=-\frac{5}{8}+\frac{6}{8}=\frac{1}{8}$

**34.** $-\frac{5}{6}+\frac{1}{3}=-\frac{5}{6}+\frac{2}{6}=-\frac{3}{6}=-\frac{1}{2}$

**35.** $-\frac{3}{7}+\left(-\frac{4}{5}\right)=-\frac{15}{35}+\left(-\frac{28}{35}\right)=-\frac{43}{35}$

**36.** $-\frac{3}{8}+\left(-\frac{2}{3}\right)=-\frac{9}{24}+\left(-\frac{16}{24}\right)=-\frac{25}{24}$

**37.** $4+(-7)+(-5)=\left[4+(-7)\right]+(-5)$
$=-3+(-5)$
$=-8$

**38.** $10+(-3)+(-8)=\left[10+(-3)\right]+(-8)$
$=7+(-8)=-1$

**39.** $85+(-15)+(-20)+12$
$=\left[85+(-15)\right]+(-20)+12$
$=70+(-20)+12$
$=\left[70+(-20)\right]+12$
$=50+12$
$=62$

**40.** $60+(-50)+(-30)+25$
$=\left[60+(-50)\right]+(-30)+25$
$=10+(-30)+25$
$=\left[10+(-30)\right]+25=-20+25=5$

**41.** $17+(-4)+2+3+(-10)$
$=13+2+3+(-10)$
$=15+3+(-10)$
$=18+(-10)$
$=8$

**42.** $19+(-5)+1+8+(-13)$
$=14+1+8+(-13)$
$=15+8+(-13)=23+(-13)=10$

**43.** $-45+\left(-\frac{3}{7}\right)+25+\left(-\frac{4}{7}\right)$
$=(-45+25)+\left[-\frac{3}{7}+\left(-\frac{4}{7}\right)\right]$
$=-20+\left(-\frac{7}{7}\right)$
$=-20+(-1)$
$=-21$

**44.** $-50+\left(-\frac{7}{9}\right)+35+\left(-\frac{11}{9}\right)$
$=(-50+35)+\left[-\frac{7}{9}+\left(-\frac{11}{9}\right)\right]$
$=-15+\left(-\frac{18}{9}\right)=-15+(-2)=-17$

**45.** $3.5+(-45)+(-8.4)+72$
$=\left[3.5+(-8.4)\right]+(-45+72)$
$=-4.9+27$
$=22.1$

**46.** $6.4+(-35)+(-2.6)+14$
$=\left[6.4+(-2.6)\right]+(-35+14)$
$=3.8+(-21)$
$=-17.2$

**47.** $-10x+2x=(-10+2)x=-8x$

**48.** $-19x+10x=(-19+10)x=-9x$

**49.** $25y+(-12y)=\left[25+(-12)\right]y=13y$

**50.** $26y+(-14y)=\left[26+(-14)\right]y=12y$

**51.** $-8a+(-15a)=\left[-8+(-15)\right]a$
$=-23a$

**52.** $-9a+(-13a)=\left[-9+(-13)\right]a$
$=-22a$

**53.** $4y+(-13z)+(-10y)+17z$
$=4y+(-10y)+(-13z)+17z$
$=-6y+4z$

**54.** $5y+(-11z)+(-15y)+20z$
$=5y+(-15y)+(-11z)+20z$
$=-10y+9z$

**55.** $-7b+10+(-b)+(-6)$
$=-7b+(-b)+10+(-6)$
$=-8b+4$

**56.** $-10b+13+(-b)+(-4)$
$=-10b+(-b)+13+(-4)$
$=-11b+9$

**57.** $7x+(-5y)+(-9x)+19y$
$=7x+(-9x)+(-5y)+19y$
$=-2x+14y$

**58.** $13x+(-9y)+(-17x)+20y$
$=13x+(-17x)+(-9y)+20y$
$=-4x+11y$

**59.** $8(4y+3)+(-35y)$
$=32y+24+(-35y)$
$=32y+(-35y)+24$
$=-3y+24$

**60.** $7(3y+5)+(-25y)$
$=21y+35+(-25y)$
$=21y+(-25y)+35$
$=-4y+35$

**61.** $|-3+(-5)|+|2+(-6)|=|-8|+|-4|$
$=8+4$
$=12$

**62.** $|4+(-11)|+|-3+(-4)|=|-7|+|-7|$
$=7+7$
$=14$

**63.** $-20+\left[-|15+(-25)|\right]$
$=-20+\left[-|-10|\right]$
$=-20+[-10]$
$=-30$

**64.** $-25+\left[-|18+(-26)|\right]$
$=-25+\left[-|-8|\right]$
$=-25+[-8]$
$=-33$

**65.** $6+\left[2+(-13)\right]\square-3+\left[4+(-8)\right]$
$6+[-11]\square-3+[-4]$
$-5\square-7$
$-5>-7$

**66.** $\left[(-8)+(-6)\right]+10\ \square\ -8+\left[9+(-2)\right]$
$-14+10\ \square\ -8+7$
$-4\ \square\ -1$
$-4<-1$

**67.** $-6x+(-13x)$
$-6x+(-13x)=-19x$

**68.** $-9x+(-11x)$
$-9x+(-11x)=-20x$

**69.** $\dfrac{-20}{x}+\dfrac{3}{x}$
$\dfrac{-20}{x}+\dfrac{3}{x}=\dfrac{-17}{x}$

**70.** $\dfrac{-15}{x}+\dfrac{4}{x}$
$\dfrac{-15}{x}+\dfrac{4}{x}=\dfrac{-11}{x}$

**71.** $-56+100=44$
The high temperature was 44°F.

**72.** $-4+49=45$
The high temperature was 45°F.

**73.** $-1312+712=-600$
The elevation of the person is 600 feet below sea level.

**74.** $-512+642=130$
The elevation of the person is 130 feet above sea level.

**75.** $-7+15-5=3$
The temperature at 4:00 P.M. was 3°F.

**76.** $-15+13+(-4)=-6$
The team had a total loss of 6 yards.

**77.** $27+4-2+8-12$
$=(27+4+8)+(-2-12)$
$=34-14$
$=25$
The location of the football at the end of the fourth play is at the 25-yard line.

**78.** $20+3+(-2)+(-1)+(-4)+2$
$=(20+3+2)+(-2+(-1)+(-4))$
$=25-7$
$=18$
The level of the reservoir is 18 feet.

**79.** **a.** $2775+(-3455)=-680$
The deficit in 2013 was $-\$680$ billion.

**b.** $3460+(-4062)=-602$
The deficit in 2017 was $-\$602$ billion.

**c.** $-680+(-602)=-1282$
The combined deficit in 2013 and 2017 was $-\$1282$ billion.

**80.** **a.** $2154+(-2472)=-\$318$
The deficit in 2005 was $-\$318$ billion.

**b.** $2105+(-3518)=-\$1413$
The deficit in 2009 was $-\$1413$ billion.

**c.** $-318+(-1413)=-\$1731$
The combined deficit in 2005 and 2009 was $-\$1731$ billion.

**81. – 87.** Answers will vary.

**88.** makes sense

**89.** makes sense

**90.** does not make sense; Explanations will vary.
Sample explanation: The sum of two negative numbers is a negative number.

**91.** makes sense

**92.** false; Changes to make the statement true will vary.
A sample change is:
$\frac{3}{4}+\left(-\frac{3}{5}\right)=\frac{15}{20}+\left(-\frac{12}{20}\right)=\frac{3}{20}$.

**93.** true

**94.** false; Changes to make the statement true will vary.
A sample change is: If one number is positive and the other negative, then the absolute value of their sum equals the difference of their absolute values.

**95.** false; Changes to make the statement true will vary.
A sample change is: The sum of a positive number and a negative number is sometimes negative.

**96.** The sum is negative. The sum of two negative numbers is always a negative number.

**97.** The sum is negative. When finding the sum of numbers with different signs, use the sign of the number with the greater absolute value as the sign of the sum. Since $a$ is further from 0 than $c$, we use a negative sign.

**98.** The sum is positive. When finding the sum of numbers with different signs, use the sign of the number with the greater absolute value as the sign of the sum. Since $c$ is further from 0 than $b$, we use a positive sign.

**99.** Though the sum inside the absolute value is negative, the absolute value of this sum is positive.

**100.** The calculator verifies your results.

**101.** The calculator verifies your results.

**102.** **a.** $\sqrt{4}\,(=2)$
**b.** $0,\sqrt{4}$
**c.** $-6,0,\sqrt{4}$
**d.** $-6,0,0.\overline{7},\sqrt{4}$
**e.** $-\pi,\sqrt{3}$
**f.** $-6,-\pi,0,0.\overline{7},\sqrt{3},\sqrt{4}$

**103.** $19\geq -18$ is true because 19 is to the right of $-18$ on the number line.

**104.** $16=2(x-1)-x$
$16=2(18-1)-18$
$16=2(17)-18$
$16=34-18$
$16=16$, true
3 is a solution.

**105.** $7-10=7+(-10)=-3$

**106.** $-8-13=-8+(-13)=-21$

**107.** $-8-(-13)=-8+13=5$

### 1.6 Check Points

**1.** **a.** $3-11=3+(-11)=-8$

**b.** $4-(-5)=4+5=9$

**c.** $-7-(-2)=-7+2=-5$

**2.** **a.** $-3.4-(-12.6)=-3.4+12.6=9.2$

**b.** $-\frac{3}{5}-\frac{1}{3}=-\frac{3}{5}+\left(-\frac{1}{3}\right)=-\frac{9}{15}+\left(-\frac{5}{15}\right)=-\frac{14}{15}$

**c.** $5\pi-(-2\pi)=5\pi+2\pi=7\pi$

**3.** $10-(-12)-4-(-3)-6$
$=10+12+(-4)+3+(-6)$
$=(10+12+3)+[(-4)+(-6)]$
$=25+(-10)$
$=15$

**4.** $-6+4a-7ab$ has terms of $-6$, $4a$, and $-7ab$.

**5.** **a.** $4+2x-9x=4+(2-9)x$
$=4+[2+(-9)]x$
$=4-7x$

**b.** $-3x-10y-6x+14y=-3x-6x-10y+14y$
$=(-3-6)x+(-10+14)y$
$=-9x+4y$

**6.** **a.** $3-(-5)=3+5=8$
The difference in lifespan is 8 years.

**b.** $-1-(-15)=-1+15=14$
The difference in lifespan is 14 years.

### 1.6 Concept and Vocabulary Check

**1.** $(-14)$

**2.** 14

**3.** 14

**4.** $-8$; $(-14)$

**5.** 3; $(-12)$; $(-23)$

**6.** $(-4y)$; 6

**7.** three; addition

### 1.6 Exercise Set

**1.** **a.** $-12$
**b.** $5-12=5+(-12)$

**2.** **a.** $-10$
**b.** $4-10=4+(-10)$

**3.** **a.** 7
**b.** $5-(-7)=5+7$

**4.** **a.** 8
**b.** $2-(-8)=2+8$

**5.** $14-8=14+(-8)=6$

**6.** $15-2=15+(-2)=13$

**7.** $8-14=8+(-14)=-6$

**8.** $2-15=2+(-15)=-13$

**9.** $3-(-20)=3+20=23$

**10.** $5-(-17)=5+17=22$

**11.** $-7-(-18)=-7+18=11$

**12.** $-5-(-19)=-5+19=14$

**13.** $-13-(-2)=-13+2=-11$

**14.** $-21-(-3)=-21+3=-18$

**15.** $-21-17=-21+(-17)=-38$

**16.** $-29-21=-29+(-21)=-50$

**17.** $-45-(-45)=-45+45=0$

**18.** $-65-(-65)=-65+65=0$

**19.** $23-23=23+(-23)=0$

**20.** $26-26=26+(-26)=0$

**21.** $13-(-13)=13+13=26$

**22.** $15-(-15)=15+15=30$

**23.** $0-13=0+(-13)=-13$

**24.** $0-15=0+(-15)=-15$

**25.** $0-(-13)=0+13=13$

**26.** $0-(-15)=0+15=15$

**27.** $\frac{3}{7}-\frac{5}{7}=\frac{3}{7}+\left(-\frac{5}{7}\right)=-\frac{2}{7}$

**28.** $\frac{4}{9}-\frac{7}{9}=\frac{4}{9}+\left(-\frac{7}{9}\right)=-\frac{3}{9}=-\frac{1}{3}$

**29.** $\frac{1}{5}-\left(-\frac{3}{5}\right)=\frac{1}{5}+\frac{3}{5}=\frac{4}{5}$

**30.** $\frac{1}{7}-\left(-\frac{3}{7}\right)=\frac{1}{7}+\frac{3}{7}=\frac{4}{7}$

**31.** $-\frac{4}{5}-\frac{1}{5}=-\frac{4}{5}+\left(-\frac{1}{5}\right)=-\frac{5}{5}=-1$

**32.** $-\frac{4}{9}-\frac{1}{9}=-\frac{4}{9}+\left(-\frac{1}{9}\right)=-\frac{5}{9}$

**33.** $-\frac{4}{5}-\left(-\frac{1}{5}\right)=-\frac{4}{5}+\frac{1}{5}=-\frac{3}{5}$

**34.** $-\frac{4}{9}-\left(-\frac{1}{9}\right)=-\frac{4}{9}+\frac{1}{9}=-\frac{3}{9}=-\frac{1}{3}$

**35.** $\frac{1}{2}-\left(-\frac{1}{4}\right)=\frac{1}{2}+\frac{1}{4}=\frac{2}{4}+\frac{1}{4}=\frac{3}{4}$

**36.** $\frac{2}{5}-\left(-\frac{1}{10}\right)=\frac{2}{5}+\frac{1}{10}=\frac{4}{10}+\frac{1}{10}=\frac{5}{10}=\frac{1}{2}$

**37.** $\frac{1}{2}-\frac{1}{4}=\frac{1}{2}+\left(-\frac{1}{4}\right)=\frac{2}{4}+\left(-\frac{1}{4}\right)=\frac{1}{4}$

**38.** $\frac{2}{5}-\frac{1}{10}=\frac{2}{5}+\left(-\frac{1}{10}\right)=\frac{4}{10}+\left(-\frac{1}{10}\right)=\frac{3}{10}$

**39.** $9.8-2.2=9.8+(-2.2)=7.6$

**40.** $5.7-3.3=5.7+(-3.3)=2.4$

**41.** $-3.1-(-1.1)=-3.1+1.1=-2$

**42.** $-4.6-(-1.1)=-4.6+1.1=-3.5$

**43.** $1.3-(-1.3)=1.3+1.3=2.6$

**44.** $1.4-(-1.4)=1.4+1.4=2.8$

**45.** $-2.06-(-2.06)=-2.06+2.06=0$

**46.** $-3.47-(-3.47)=-3.47+3.47=0$

**47.** $5\pi-2\pi=5\pi+(-2\pi)=3\pi$

**48.** $9\pi-7\pi=9\pi+(-7\pi)=2\pi$

**49.** $3\pi-(-10\pi)=3\pi+10\pi=13\pi$

**50.** $4\pi-(-12\pi)=4\pi+12\pi=16\pi$

**51.**
$$\begin{aligned}13-2-(-8)&=13+(-2)+8\\&=(13+8)+(-2)\\&=21+(-2)\\&=19\end{aligned}$$

**52.**
$$\begin{aligned}14-3-(-7)&=14+(-3)+7\\&=(14+7)+(-3)\\&=21+(-3)\\&=18\end{aligned}$$

**53.** $9-8+3-7=9+(-8)+3+(-7)$
$=(9+3)+[(-8)+(-7)]$
$=12+(-15)$
$=-3$

**54.** $8-2+5-13=8+(-2)+5+(-13)$
$=(8+5)+[(-2)+(-13)]$
$=13+(-15)$
$=-2$

**55.** $-6-2+3-10$
$=-6+(-2)+3+(-10)$
$=[(-6)+(-2)+(-10)]+3$
$=-18+3$
$=-15$

**56.** $-9-5+4-17$
$=-9+(-5)+4+(-17)$
$=[(-9)+(-5)+(-17)]+4$
$=-31+4$
$=-27$

**57.** $-10-(-5)+7-2$
$=-10+5+7+(-2)$
$=[(-10)+(-2)]+(5+7)$
$=-12+12$
$=0$

**58.** $-6-(-3)+8-11$
$=-6+3+8+(-11)$
$=[(-6)+(-11)]+(3+8)$
$=-17+11$
$=-6$

**59.** $-23-11-(-7)+(-25)$
$=(-23)+(-11)+7+(-25)$
$=[(-23)+(-11)+(-25)]+7$
$=-59+7$
$=-52$

**60.** $-19-8-(-6)+(-21)$
$=(-19)+(-8)+6+(-21)$
$=[(-19)+(-8)+(-21)]+6$
$=-48+6$
$=-42$

**61.** $-823-146-50-(-832)$
$=-823+(-146)+(-50)+832$
$=[(-823)+(-146)+(-50)]+832$
$=-1019+832$
$=-187$

**62.** $-726-422-921-(-816)$
$=-726+(-422)+(-921)+816$
$=[(-726)+(-422)+(-921)]+816$
$=-2069+816$
$=-1253$

**63.** $1-\frac{2}{3}-\left(-\frac{5}{6}\right)=1+\left(-\frac{2}{3}\right)+\frac{5}{6}$
$=\left(1+\frac{5}{6}\right)+\left(-\frac{2}{3}\right)$
$=\left(\frac{6}{6}+\frac{5}{6}\right)+\left(-\frac{2}{3}\right)$
$=\frac{11}{6}+\left(-\frac{2}{3}\cdot\frac{2}{2}\right)$
$=\frac{11}{6}+\left(-\frac{4}{6}\right)$
$=\frac{7}{6}$ or $1\frac{1}{6}$

**64.** $2-\frac{3}{4}-\left(-\frac{7}{8}\right)=2+\left(-\frac{3}{4}\right)+\frac{7}{8}$
$=\left(2+\frac{7}{8}\right)+\left(-\frac{3}{4}\right)$
$=\left(\frac{16}{8}+\frac{7}{8}\right)+\left(-\frac{3}{4}\right)$
$=\frac{23}{8}+\left(-\frac{3}{4}\cdot\frac{2}{2}\right)$
$=\frac{23}{8}+\left(-\frac{6}{8}\right)$
$=\frac{17}{8}$ or $2\frac{1}{8}$

**65.** $-0.16-5.2-(-0.87)$
$=-0.16+(-5.2)+0.87$
$=[(-0.16)+(-5.2)]+0.87$
$=-5.36+0.87$
$=-4.49$

**66.** $-1.9-3-(-0.26)$
$=-1.9+(-3)+0.26$
$=[(-1.9)+(-3)]+0.26$
$=-4.9+0.26$
$=-4.64$

**67.** $-\frac{3}{4}-\frac{1}{4}-\left(-\frac{5}{8}\right)=-\frac{3}{4}+\left(-\frac{1}{4}\right)+\frac{5}{8}$
$=-\frac{4}{4}+\frac{5}{8}$
$=-\frac{8}{8}+\frac{5}{8}=-\frac{3}{8}$

**68.** $-\frac{1}{2}-\frac{2}{3}-\left(-\frac{1}{3}\right)=-\frac{1}{2}+\left(-\frac{2}{3}\right)+\frac{1}{3}$
$=\left(-\frac{3}{6}+\left(-\frac{4}{6}\right)\right)+\frac{1}{3}$
$=-\frac{7}{6}+\frac{1}{3}=-\frac{7}{6}+\frac{2}{6}$
$=-\frac{5}{6}$

**69.** $-3x-8y=-3x+(-8y)$
The terms are $-3x$ and $-8y$.

**70.** $-9a-4b=-9a+(-4b)$
The terms are $-9a$ and $-4b$.

**71.** $12x-5xy-4=12x+(-5xy)+(-4)$
The terms are $12x$, $-5xy$, and $-4$.

**72.** $8a-7ab-13=8a+(-7ab)+(-13)$
The terms are $8a$, $-7ab$, and $-13$.

**73.** $3x-9x=3x+(-9x)$
$=[3+(-9)]x=-6x$

**74.** $2x-10x=2x+(-10x)$
$=[2+(-10)]x=-8x$

**75.** $4+7y-17y=4+7y+(-17y)$
$=4+[7+(-17)]y$
$=4-10y$

**76.** $5+9y-29y=5+9y+(-29y)$
$=5+[9+(-29)]y$
$=5-20y$

**77.** $2a+5-9a=2a+5+(-9a)$
$=2a+(-9a)+5$
$=[2+(-9)]a+5$
$=-7a+5$ or $5-7a$

**78.** $3a+7-11a=3a+7+(-11a)$
$=3a+(-11a)+7$
$=[3+(-11)]a+7$
$=-8a+7$ or $7-8a$

**79.** $4-6b-8-3b$
$=4+(-6b)+(-8)+(-3b)$
$=4+(-8)+(-6b)+(-3b)$
$=4+(-8)+[-6+(-3)]b$
$=-4-9b$

**80.** $5-7b-13-4b$
$=5+(-7b)+(-13)+(-4b)$
$=5+(-13)+(-7b)+(-4b)$
$=5+(-13)+[-7+(-4)]b$
$=-8-11b$

**81.** $13-(-7x)+4x-(-11)$
$=13+7x+4x+11$
$=13+11+7x+4x$
$=24+11x$

**82.** $15-(-3x)+8x-(-10)$
$=15+3x+8x+10$
$=15+10+3x+8x$
$=25+11x$

**83.** $-5x-10y-3x+13y$
$=-5x+(-10y)+(-3x)+13y$
$=-5x+(-3x)+(-10y)+13y$
$=[-5+(-3)]x+(-10+13)y$
$=-8x+3y$ or $3y-8x$

**84.** $-6x-9y-4x+15y$
$=-6x+(-9y)+(-4x)+15y$
$=-6x+(-4x)+(-9y)+15y$
$=[-6+(-4)]x+(-9+15)y$
$=-10x+6y$ or $6y-10x$

**85.** $-|-9-(-6)|-(-12)=-|-9+6|+12$
$=-|-3|+12$
$=-3+12$
$=9$

**86.** $-|-8-(-2)|-(-6)=-|-8+2|+6$
$=-|-6|+6$
$=-6+6$
$=0$

**87.** $\frac{5}{8}-\left(\frac{1}{2}-\frac{3}{4}\right)=\frac{5}{8}-\left(\frac{1}{2}\cdot\frac{2}{2}-\frac{3}{4}\right)$
$=\frac{5}{8}-\left(\frac{2}{4}+\left(-\frac{3}{4}\right)\right)$
$=\frac{5}{8}-\left(-\frac{1}{4}\right)$
$=\frac{5}{8}+\frac{1}{4}$
$=\frac{5}{8}+\frac{1}{4}\cdot\frac{2}{2}$
$=\frac{5}{8}+\frac{2}{8}$
$=\frac{7}{8}$

**88.** $\frac{9}{10}-\left(\frac{1}{4}-\frac{7}{10}\right)=\frac{9}{10}-\left(\frac{1}{4}\cdot\frac{5}{5}-\frac{7}{10}\cdot\frac{2}{2}\right)$
$=\frac{9}{10}-\left(\frac{5}{20}-\frac{14}{20}\right)$
$=\frac{9}{10}-\left[\frac{5}{20}+\left(-\frac{14}{20}\right)\right]$
$=\frac{9}{10}-\left(-\frac{9}{20}\right)$
$=\frac{9}{10}\cdot\frac{2}{2}+\frac{9}{20}$
$=\frac{18}{20}+\frac{9}{20}$
$=\frac{27}{20}$ or $1\frac{7}{20}$

**89.** $|-9-(-3+7)|-|-17-(-2)|$
$=|-9-4|-|-17+2|$
$=|-9+(-4)|-|-17+2|$
$=|-13|-|-15|$
$=13+(-15)$
$=-2$

**90.** $|24-(-16)|-|-51-(-31+2)|$
$=|24+16|-|-51-(-29)|$
$=|24+16|-|-51+29|$
$=|40|-|-22|$
$=40-22$
$=18$

**91.** $6x-(-5x)$
$6x-(-5x)=6x+5x=11x$

**92.** $9x-(-4x)$
$9x-(-4x)=9x+4x=13x$

**93.** $\frac{-5}{x}-\left(\frac{-2}{x}\right)$
$\frac{-5}{x}-\left(\frac{-2}{x}\right)=\frac{-5}{x}+\frac{2}{x}=\frac{-3}{x}$

**94.** $\frac{-12}{x}-\left(\frac{-7}{x}\right)$
$\frac{-12}{x}-\left(\frac{-7}{x}\right)=\frac{-12}{x}+\frac{7}{x}=\frac{-5}{x}$

**95.** Elevation of Mount Kilimanjaro – elevation of Qattara Depression
$= 19{,}321 - (-436) = 19{,}757$
The difference in elevation between the two geographic locations is 19,757 feet.

**96.** Elevation of Mount Whitney – elevation of Death Valley
$= 14{,}494 - (-282) = 14{,}776$
The difference in elevation between the two geographic locations is 14,776 feet.

**97.** $10 + (-15) = -5$
shrink by 5 years

**98.** $2 + (-5) = -3$
shrink by 3 years

**99.** $-5 + (-6) = -11$
shrink by 11 years

**100.** $-1 + (-15) = -16$
shrink by 16 years

**101.** $5 + (-5) = 0$
no change

**102.** $5 + (-5) = 0$
no change

**103.** $10 - (-15) = 10 + 15 = 25$
25 years

**104.** $10 - (-6) = 10 + 6 = 16$
16 years

**105.** $-5 - (-6) = -5 + 6 = 1$
1 year

**106.** $-1 - (-5) = -1 + 5 = 4$
4 years

**107.** $-100 - (-2992) = 2892$
2892 meters

**108.** $-1080 - (-2133) = 1053$
1053 meters

**109.** $-2000 + 400 - 500 = -2100$
–2100 meters

**110.** $-900 + 300 - 200 = -800$
–800 meters

**111. – 115.** Answers will vary.

**116.** makes sense

**117.** makes sense

**118.** makes sense

**119.** makes sense

**120.** true

**121.** false; Changes to make the statement true will vary. A sample change is: $7 - (-2) = 7 + 2 = 9$

**122.** true

**123.** true

**124.** $c - a = \overbrace{(\text{positive number})}^{c} - \overbrace{(\text{negative number})}^{a}$
$= (\text{positive number}) + (\text{positive number})$
$= \text{positive number}$

**125.** $a - b = \overbrace{(\text{negative number})}^{a} - \overbrace{(\text{negative number})}^{b}$
$= \overbrace{(\text{negative number})}^{a \text{ has the greater absolute value}} + (\text{positive number})$
$= \text{negative number}$

**126.** $b - c = \overbrace{(\text{negative number})}^{b} - \overbrace{(\text{positive number})}^{c}$
$= (\text{negative number}) + (\text{negative number})$
$= \text{negative number}$

**127.** $0 - b = 0 - \overbrace{(\text{negative number})}^{b}$
$= 0 + (\text{positive number})$
$= \text{positive number}$

**128.** Least to greatest:

$$\begin{aligned}|x|-|y| &= |-6|-|-8| \\ &= 6-8 \\ &= -2\end{aligned}$$

$$\begin{aligned}|x-y| &= |-6-(-8)| \\ &= |-6+8| \\ &= |2| \\ &= 2\end{aligned}$$

$$\begin{aligned}|x+y| &= |-6+(-8)| \\ &= |-14| \\ &= 14\end{aligned}$$

**129.** The calculator verifies your results.

**130.** The calculator verifies your results.

**131.**
$$\begin{aligned}13x+3 &= 3(5x-1) \\ 13\cdot 2+3 &= 3(5\cdot 2-1) \\ 26+3 &= 3(10-1) \\ 29 &= 3(9) \\ 29 &= 27, \text{ false}\end{aligned}$$

The number is not a solution.

**132.**
$$\begin{aligned}5(3x+2y)+6(5y) &= 15x+10y+30y \\ &= 15x+40y\end{aligned}$$

**133.** Answers will vary. $-17$ is an example of an integer that is not a natural number.

**134.** $4(-3) = (-3)+(-3)+(-3)+(-3) = -12$

**135.** $3(-3) = (-3)+(-3)+(-3) = -9$

**136.**
$$\begin{aligned}2(-3) &= -6 \\ 1(-3) &= -3 \\ 0(-3) &= 0 \\ -1(-3) &= 3 \\ -2(-3) &= 6 \\ -3(-3) &= 9 \\ -4(-3) &= \boxed{12}\end{aligned}$$

**1.7 Check Points**

**1.** **a.** $8(-5) = -40$

**b.** $-\frac{1}{3}\cdot\frac{4}{7} = -\frac{4}{21}$

**c.** $(-12)(-3) = 36$

**d.** $(-1.1)(-5) = 5.5$

**e.** $(-543)(0) = 0$

**2.** **a.** $(-2)(3)(-1)(4) = 24$

**b.** $(-1)(-3)(2)(-1)(5) = -30$

**3.** **a.** The multiplicative inverse of 7 is $\frac{1}{7}$ because $7\cdot\frac{1}{7} = 1$.

**b.** The multiplicative inverse of $\frac{1}{8}$ is 8 because $\frac{1}{8}\cdot 8 = 1$.

**c.** The multiplicative inverse of $-6$ is $-\frac{1}{6}$ because $(-6)\left(-\frac{1}{6}\right) = 1$.

**d.** The multiplicative inverse of $-\frac{7}{13}$ is $-\frac{13}{7}$ because $\left(-\frac{7}{13}\right)\left(-\frac{13}{7}\right) = 1$.

**4.** **a.** $-28\div 7 = -28\cdot\frac{1}{7} = -4$

**b.** $\frac{-16}{-2} = -16\cdot\left(-\frac{1}{2}\right) = 8$

**5. a.** $\dfrac{-32}{-4}=8$

**b.** $-\dfrac{2}{3}\div\dfrac{5}{4}=-\dfrac{2}{3}\cdot\dfrac{4}{5}=-\dfrac{8}{15}$

**c.** $\dfrac{21.9}{-3}=-7.3$

**d.** $\dfrac{0}{-5}=0$

**6. a.** $-4(5x)=(-4\cdot 5)x=-20x$

**b.** $9x+x=9x+1x=(9+1)x=10x$

**c.** $13b-14b=(13-14)b=-1b=-b$

**d.** $-7(3x-4)=-7(3x)-7(-4)=-21x+28$

**e.** $-(7y-6)=-(7y)-(-6)=-7y+6$

**7.** $\begin{aligned}4(3y-7)-(13y-2)&=12y-28-13y+2\\&=12y-13y-28+2\\&=-1y-26\\&=-y-26\end{aligned}$

**8.** $\begin{aligned}2x-5&=8x+7\\2(-3)-5&=8(-3)+7\\-6-5&=-24+7\\-11&=-17,\ \text{false}\end{aligned}$

The number is not a solution.

**9.** $\begin{aligned}M&=-0.6n+64.4\\M&=-0.6(25)+64.4\\&=-15+64.4\\&=49.4\end{aligned}$

According to this model, 49.4% of doctorate degrees were awarded to men in 2014.
This overestimates the actual value shown in the bar graph by 0.4%.

### 1.7 Concept and Vocabulary Check

**1.** positive

**2.** negative

**3.** negative

**4.** positive

**5.** 0

**6.** negative

**7.** negative

**8.** positive

**9.** 0

**10.** undefined

**11.** positive

### 1.7 Exercise Set

**1.** $5(-9)=-(5\cdot 9)=-45$

**2.** $10(-7)=-(10\cdot 7)=-70$

**3.** $(-8)(-3)=+(8\cdot 3)=24$

**4.** $(-9)(-5)=+(9\cdot 5)=45$

**5.** $(-3)(7)=-21$

**6.** $(-4)(8)=-32$

**7.** $(-19)(-1)=19$

**8.** $(-11)(-1)=11$

**9.** $0(-19)=0$

**10.** $0(-11)=0$

**11.** $\dfrac{1}{2}(-24)=-12$

**12.** $\dfrac{1}{3}(-21)=-7$

**13.** $\left(-\dfrac{3}{4}\right)(-12)=\dfrac{3\cdot 12}{4\cdot 1}=9$

**14.** $\left(-\dfrac{4}{5}\right)(-30)=\dfrac{4\cdot 30}{5\cdot 1}=24$

**15.** $-\dfrac{3}{5}\cdot\left(-\dfrac{4}{7}\right)=\dfrac{3\cdot 4}{5\cdot 7}=\dfrac{12}{35}$

**16.** $-\frac{5}{7}\cdot\left(-\frac{3}{8}\right)=\frac{5\cdot 3}{7\cdot 8}=\frac{15}{56}$

**17.** $-\frac{7}{9}\cdot\frac{2}{3}=-\frac{7\cdot 2}{9\cdot 3}=-\frac{14}{27}$

**18.** $-\frac{5}{11}\cdot\frac{2}{7}=-\frac{5\cdot 2}{11\cdot 7}=-\frac{10}{77}$

**19.** $3(-1.2)=-3.6$

**20.** $4(-1.2)=-4.8$

**21.** $-0.2(-0.6)=0.12$

**22.** $-0.3(-0.7)=0.21$

**23.** $(-5)(-2)(3)=30$

**24.** $(-6)(-3)(10)=180$

**25.** $(-4)(-3)(-1)(6)=-72$

**26.** $(-2)(-7)(-1)(3)=-42$

**27.** $-2(-3)(-4)(-1)=24$

**28.** $-3(-2)(-5)(-1)=30$

**29.** $(-3)(-3)(-3)=9(-3)=-27$

**30.** $(-4)(-4)(-4)=16(-4)=-64$

**31.** $5(-3)(-1)(2)(3)=90$

**32.** $2(-5)(-2)(3)(1)=60$

**33.** $(-8)(-4)(0)(-17)(-6)=0$

**34.** $(-9)(-12)(-18)(0)(-3)=0$

**35.** The multiplicative inverse of 4 is $\frac{1}{4}$.

**36.** The multiplicative inverse of 3 is $\frac{1}{3}$.

**37.** The multiplicative inverse of $\frac{1}{5}$ is 5.

**38.** The multiplicative inverse of $\frac{1}{7}$ is 7.

**39.** The multiplicative inverse of $-10$ is $-\frac{1}{10}$.

**40.** The multiplicative inverse of $-12$ is $-\frac{1}{12}$.

**41.** The multiplicative inverse of $-\frac{2}{5}$ is $-\frac{5}{2}$.

**42.** The multiplicative inverse of $-\frac{4}{9}$ is $-\frac{9}{4}$.

**43. a.** $-32\div 4=-32\cdot\frac{1}{4}$

**b.** $-32\cdot\frac{1}{4}=-8$

**44. a.** $-18\div 6=-18\cdot\frac{1}{6}$

**b.** $-18\cdot\frac{1}{6}=-3$

**45. a.** $\frac{-60}{-5}=-60\cdot\left(-\frac{1}{5}\right)$

**b.** $-60\cdot\left(-\frac{1}{5}\right)=12$

**46. a.** $\frac{-30}{-5}=-30\cdot\left(-\frac{1}{5}\right)$

**b.** $-30\cdot\left(-\frac{1}{5}\right)=6$

**47.** $\frac{12}{-4}=12\cdot\left(-\frac{1}{4}\right)=-3$

**48.** $\frac{40}{-5}=40\cdot\left(-\frac{1}{5}\right)=-8$

**49.** $\frac{-21}{3}=-21\cdot\frac{1}{3}=-7$

**50.** $\frac{-60}{6}=-60\cdot\frac{1}{6}=-10$

**51.** $\frac{-90}{-3}=-90\cdot\left(-\frac{1}{3}\right)=30$

**52.** $\dfrac{-66}{-6} = -66 \cdot \left(-\dfrac{1}{6}\right) = 11$

**53.** $\dfrac{0}{-7} = 0$

**54.** $\dfrac{0}{-8} = 0$

**55.** $\dfrac{7}{0}$ is undefined.

**56.** $\dfrac{-8}{0}$ is undefined.

**57.** $-15 \div 3 = -15 \cdot \dfrac{1}{3} = -5$

**58.** $-80 \div 8 = -80 \cdot \dfrac{1}{8} = -10$

**59.** $12 \div (-10) = 120 \cdot \left(-\dfrac{1}{10}\right) = -12$

**60.** $130 \div (-10) = 130 \cdot \left(-\dfrac{1}{10}\right) = -13$

**61.** $(-180) \div (-30) = -180 \cdot \left(-\dfrac{1}{30}\right) = 6$

**62.** $(-150) \div (-25) = -150 \cdot \left(-\dfrac{1}{25}\right) = 6$

**63.** $0 \div (-4) = 0$

**64.** $0 \div (-10) = 0$

**65.** $-4 \div 0$ is undefined.

**66.** $-10 \div 0$ is undefined.

**67.** $\dfrac{-12.9}{3} = -12.9 \cdot \dfrac{1}{3} = -4.3$

**68.** $\dfrac{-21.6}{3} = -21.6 \cdot \dfrac{1}{3} = -7.2$

**69.** $-\dfrac{1}{2} \div \left(-\dfrac{3}{5}\right) = -\dfrac{1}{2} \cdot \left(-\dfrac{5}{3}\right) = \dfrac{5}{6}$

**70.** $-\dfrac{1}{2} \div \left(-\dfrac{7}{9}\right) = -\dfrac{1}{2} \cdot \left(-\dfrac{9}{7}\right) = \dfrac{9}{14}$

**71.** $-\dfrac{14}{9} \div \dfrac{7}{8} = -\dfrac{14}{9} \cdot \dfrac{8}{7}$

$= -\dfrac{112}{63} = \dfrac{\cancel{7} \cdot 16}{\cancel{7} \cdot 9} = -\dfrac{16}{9}$

**72.** $-\dfrac{5}{16} \div \dfrac{25}{8} = -\dfrac{5}{16} \cdot \dfrac{8}{25}$

$= -\dfrac{40}{400} = -\dfrac{\cancel{40} \cdot 1}{\cancel{40} \cdot 10} = -\dfrac{1}{10}$

**73.** $\dfrac{1}{3} \div \left(-\dfrac{1}{3}\right) = \dfrac{1}{3} \cdot (-3) = -1$

**74.** $\dfrac{1}{5} \div \left(-\dfrac{1}{5}\right) = \dfrac{1}{5} \cdot (-5) = -1$

**75.** $6 \div \left(-\dfrac{2}{5}\right) = 6 \cdot \left(-\dfrac{5}{2}\right) = -\dfrac{30}{2} = -15$

**76.** $8 \div \left(-\dfrac{2}{9}\right) = 8 \cdot \left(-\dfrac{9}{2}\right) = -\dfrac{72}{2} = -36$

**77.** $-5(2x) = (-5 \cdot 2)x = -10x$

**78.** $-9(3x) = (-9 \cdot 3)x = -27x$

**79.** $-4\left(-\dfrac{3}{4}y\right) = \left[-4 \cdot \left(-\dfrac{3}{4}\right)\right]y = 3y$

**80.** $-5\left(-\dfrac{3}{5}y\right) = \left[-5 \cdot \left(-\dfrac{3}{5}\right)\right]y = 3y$

**81.** $8x + x = 8x + 1x = (8+1)x = 9x$

**82.** $12x + x = 12x + 1x = (12+1)x = 13x$

**83.** $-5x + x = -5x + 1x = (-5+1)x = -4x$

**84.** $-6x + x = -6x + 1x = (-6+1)x = -5x$

**85.** $6b - 7b = (6-7)b = -1b = -b$

**86.** $12b - 13b = (12-13)b = -1b = -b$

**87.** $-y+4y=-1y+4y=(-1+4)y=3y$

**88.** $-y+9y=-1y+9y=(-1+9)y=8y$

**89.** $-4(2x-3)=-4(2x)-4(-3)=-8x+12$

**90.** $-3(4x-5)=-3(4x)-3(-5)=-12x+15$

**91.** $-3(-2x+4)=-3(-2x)-3(4)=6x-12$

**92.** $-4(-3x+2)=-4(-3x)-4(2)=12x-8$

**93.** $-(2y-5)=-2y+5$

**94.** $-(3y-1)=-3y+1$

**95.** $4(2y-3)-(7y+2)$
$=4(2y)+4(-3)-7y-2$
$=8y-12+7y-2$
$=8y-7y-12-2$
$=y-14$

**96.** $5(3y-1)-(14y-2)$
$=5(3y)+5(-1)-14y-(-2)$
$=15y-5-14y+2$
$=15y-14y-5+2$
$=y-3$

**97.** $4x=2x-10$
$4(-5)=2(-5)-10$
$-20=-10-10$
$-20=-20$, true
The number is a solution.

**98.** $5x=3x-6$
$5(-3)=3(-3)-6$
$-15=-9-6$
$-15=-15$, true
The number is a solution.

**99.** $-7y+18=-10y+6$
$-7(-4)+18=-10(-4)+6$
$28+18=40+6$
$46=46$, true
The number is a solution.

**100.** $-4y+21=-7y+15$
$-4(-2)+21=-7(-2)+15$
$8+21=14+15$
$29=29$, true
The number is a solution.

**101.** $5(w+3)=2w-21$
$5(-10+3)=2(-10)-21$
$5(-7)=-20-21$
$-35=-41$, false
The number is not a solution.

**102.** $6(w+2)=4w-10$
$6(-9+2)=4(-9)-10$
$6(-7)=-36-10$
$-42=-46$, false
The number is not a solution.

**103.** $4(6-z)+7z=0$
$4(6-(-8))+7(-8)=0$
$4(6+8)-56=0$
$4(14)-56=0$
$56-56=0$
$0=0$, true
The number is a solution.

**104.** $5(7-z)+12z=0$
$5(7-(-5))+12(-5)=0$
$5(7+5)-60=0$
$5(12)-60=0$
$60-60=0$
$0=0$, true
The number is a solution.

**105.** $14-2x=-4x+7$
$14-2\left(-2\frac{1}{2}\right)=-4\left(-2\frac{1}{2}\right)+7$
$14-2\left(-\frac{5}{2}\right)=-4\left(-\frac{5}{2}\right)+7$
$14+5=10+7$
$19=17$, false
The number is not a solution.

**106.** $16-4x=-2x+21$

$16-4\left(-3\frac{1}{2}\right)=-2\left(-3\frac{1}{2}\right)+21$

$16-4\left(-\frac{7}{2}\right)=-2\left(-\frac{7}{2}\right)+21$

$16+14=7+21$

$30=28,$ false

The number is not a solution.

**107.** $\frac{5m-1}{6}=\frac{3m-2}{4}$

$\frac{5(-4)-1}{6}=\frac{3(-4)-2}{4}$

$\frac{-20-1}{6}=\frac{-12-2}{4}$

$\frac{-21}{6}=\frac{-14}{4}$

$\frac{-7}{2}=\frac{-7}{2},$ true

The number is a solution.

**108.** $\frac{6m-5}{11}=\frac{3m-2}{5}$

$\frac{6(-1)-5}{11}=\frac{3(-1)-2}{5}$

$\frac{-6-5}{11}=\frac{-3-2}{5}$

$\frac{-11}{11}=\frac{-5}{5}$

$-1=-1,$ true

The number is a solution.

**109.** $4(-10)+8=-40+8=-32$

**110.** $3(-15)+14=-45+14=-31$

**111.** $(-9)(-3)-(-2)=27+2=29$

**112.** $(-6)(-4)-(-5)=24+5=29$

**113.** $\frac{-18}{-15+12}=\frac{-18}{-3}=6$

**114.** $\frac{-25}{-21+16}=\frac{-25}{-5}=5$

**115.** $-6-\left(\frac{12}{-4}\right)=-6-(-3)=-6+3=-3$

**116.** $-11-\left(\frac{20}{-5}\right)=-11-(-4)$

$=-11+4=-7$

**117.** $C=\frac{5}{9}(F-32)$

$C=\frac{5}{9}(-22-32)=\frac{5}{9}(-54)=-30$

$-22°\text{F}$ is equivalent to $-30°\text{C}$.

**118.** $C=\frac{5}{9}(F-32)$

$C=\frac{5}{9}(-31-32)=\frac{5}{9}(-63)=-35$

$-31°\text{F}$ is equivalent to $-35°\text{C}$.

**119.** **a.** 2015 is 20 years after 1995.

$C=-0.5x+25$

$C=-0.5(20)+25$

$=15$

According to the formula, about 15% of American adults smoked in 2015.
This is the actual amount shown in the bar graph.

**b.** 2025 is 30 years after 1995.

$C=-0.5x+25$

$C=-0.5(30)+25$

$=10$

According to the formula, about 10% of American adults will smoke in 2025.

**120.** **a.** 2010 is 15 years after 1995.

$C=-0.5x+25$

$C=-0.5(15)+25$

$=17.5$

According to the formula, about 17.5% of American adults smoked in 2010.
This underestimates the actual amount shown in the bar graph by 1.5%.

**b.** 2035 is 40 years after 1995.

$C=-0.5x+25$

$C=-0.5(40)+25$

$=5$

According to the formula, about 5% of American adults will smoke in 2035.

**121. a.** According to the graph, about 25% of Americans in 2020 preferred larger families.

**b.** $L = -0.7n + 39$
$= -0.7(20) + 39$
$= 25$
According to the formula, 25% of Americans in 2020 preferred larger families.
This is the same as the estimate in part a.

**c.** $R = \dfrac{-0.7n + 39}{0.6n + 53}$

**d.** $R = \dfrac{-0.7n + 39}{0.6n + 53}$.
$= \dfrac{-0.7(20) + 39}{0.6(20) + 53}$
$= \dfrac{5}{13}$

**122. a.** According to the graph, about 65% of Americans in 2020 preferred smaller families.

**b.** $L = 0.6n + 53$
$= 0.6(20) + 53$
$= 65$
According to the formula, 65% of Americans in 2020 preferred smaller families.
This is the same as the estimate in part a.

**c.** $D = (0.6n + 53) - (-0.7n + 39)$
$= 1.3n + 14$

**d.** $D = 1.3n + 14$
$= 1.3(20) + 14$
$= 40$
According to the formula, there is a 40% difference.
This is about the same difference displayed on the graphs.

**123. – 130.** Answers will vary.

**131.** does not make sense; Explanations will vary. Sample explanation: The sign rules for dividing real numbers and multiplying real numbers are the same.

**132.** makes sense

**133.** makes sense

**134.** does not make sense; Explanations will vary. Sample explanation: The numerator and denominator of this formula are both positive.

**135.** false; Changes to make the statement true will vary. A sample change is: The sum of two negative numbers is a negative number.

**136.** false; Changes to make the statement true will vary. A sample change is: If the number is multiplied by 0, which is nonnegative, the result is 0.

**137.** false; Changes to make the statement true will vary.
A sample change is: $0 \div \left(-\sqrt{2}\right) = \dfrac{0}{-\sqrt{2}} = 0$

**138.** true

**139.** $5x$

**140.** $50x$

**141.** $\dfrac{x}{12}$

**142.** $\dfrac{40}{x + 40}$

**143.** The calculator verifies your results.

**144.** The calculator verifies your results.

**145.** $0.3(4.7x - 5.9) - 0.07(3.8x - 61)$
$= 0.3(4.7x) + 0.3(-5.9) - (0.07)(3.8x) - (0.07)(-61)$
$= 1.41x - 1.77 - 0.266x + 4.27$
$= [1.41x + (-0.266x)] + (-1.77 + 4.27)$
$= 1.144x + 2.5$

**146.** Answers will vary.

**147.** $-6 + (-3) = -9$

**148.** $-6 - (-3) = -6 + 3 = -3$

**149.** $-6 \div (-3) = -6\left(-\dfrac{1}{3}\right) = 2$

**150.** $(-6)^2 = (-6)(-6) = 36$

**151.** $(-5)^3 = (-5)(-5)(-5) = -125$

**152.** $(-2)^4 = (-2)(-2)(-2)(-2) = 16$

**1.8 Check Points**

**1. a.** $6^2 = 6 \cdot 6 = 36$

**b.** $(-4)^3 = (-4)(-4)(-4) = -64$

**c.** $(-1)^4 = (-1)(-1)(-1)(-1) = 1$

**d.** $-1^4 = -(1 \cdot 1 \cdot 1 \cdot 1) = -1$

**2. a.** $16x^2 + 5x^2 = (16+5)x^2 = 21x^2$

**b.** $7x^3 + x^3 = 7x^3 + 1x^3 = (7+1)x^3 = 8x^3$

**c.** $10x^2 + 8x^3$ cannot be simplified.

**3.** $20 + 4 \cdot 3 - 17 = 20 + 12 - 17$
$= 20 + 12 - 17$
$= 15$

**4.** $7^2 - 48 \div 4^2 \cdot 5 - 2 = 49 - 48 \div 16 \cdot 5 - 2$
$= 49 - 3 \cdot 5 - 2$
$= 49 - 15 - 2$
$= 34 - 2$
$= 32$

**5. a.** $(3 \cdot 2)^2 = 6^2 = 36$

**b.** $3 \cdot 2^2 = 3 \cdot 4 = 12$

**6.** $\left(-\frac{1}{2}\right)^2 - \left(\frac{7}{10} - \frac{8}{15}\right)^2 (-18) = \left(-\frac{1}{2}\right)^2 - \left(\frac{1}{6}\right)^2 (-18)$
$= \frac{1}{4} - \frac{1}{36} \cdot \frac{-18}{1}$
$= \frac{1}{4} + \frac{1}{2}$
$= \frac{3}{4}$

**7.** $4[3(6-11)+5] = 4[3(-5)+5]$
$= 4[-15+5]$
$= 4[-10]$
$= -40$

**8.** $25 \div 5 + 3[4 + 2(7-9)^3] = 25 \div 5 + 3[4 + 2(-2)^3]$
$= 25 \div 5 + 3[4 + 2(-8)]$
$= 25 \div 5 + 3[4 - 16]$
$= 25 \div 5 + 3[-12]$
$= 5 + (-36)$
$= -31$

**9.** $\frac{5(4-9)+10 \cdot 3}{2^3 - 1} = \frac{5(-5)+10 \cdot 3}{8-1}$
$= \frac{-25+30}{7}$
$= \frac{5}{7}$

**10.** $-x^2 - 4x = -(-5)^2 - 4(-5)$
$= -25 + 20$
$= -5$

**11.** $14x^2 + 5 - [7(x^2 - 2) + 4] = 14x^2 + 5 - [7x^2 - 14 + 4]$
$= 14x^2 + 5 - [7x^2 - 10]$
$= 14x^2 + 5 - 7x^2 + 10$
$= 14x^2 - 7x^2 + 5 + 10$
$= 7x^2 + 15$

**12.** $M = -120x^2 + 998x + 590$
$M = -120(4)^2 + 998(4) + 590$
$= 2662$
According to the model, males between the ages of 19 and 30 with this lifestyle need 2662 calories per day. This underestimates the actual value shown in the bar graph by 38 calories.

**13. a.** $\bar{C} = \frac{30x + 300{,}000}{x}$
$\bar{C} = \frac{30(1000) + 300{,}000}{1000} = \frac{30{,}000 + 300{,}000}{1000}$
$= \frac{330{,}000}{1000}$
$= 330$
The average cost is \$330.

**b.** $\overline{C} = \dfrac{30x + 300,000}{x}$

$\overline{C} = \dfrac{30(10,000) + 300,000}{10,000} = \dfrac{300,000 + 300,000}{10,000}$

$= \dfrac{600,000}{10,000}$

$= 60$

The average cost is \$60.

**c.**

$\overline{C} = \dfrac{30x + 300,000}{x}$

$\overline{C} = \dfrac{30(100,000) + 300,000}{100,000} = \dfrac{3,000,000 + 300,000}{100,000}$

$= \dfrac{3,300,000}{100,000}$

$= 33$

The average cost is \$33.

### 1.8 Concept and Vocabulary Check

**1.** base; exponent

**2.** $b$ to the $n$th power

**3.** multiply

**4.** add

**5.** divide

**6.** subtract

**7.** multiply

### 1.8 Exercise Set

**1.** $9^2 = 9 \cdot 9 = 81$

**2.** $3^2 = 3 \cdot 3 = 9$

**3.** $4^3 = 4 \cdot 4 \cdot 4 = 64$

**4.** $6^3 = 6 \cdot 6 \cdot 6 = 216$

**5.** $(-4)^2 = (-4)(-4) = 16$

**6.** $(-10)^2 = (-10)(-10) = 100$

**7.** $(-4)^3 = (-4)(-4)(-4) = -64$

**8.** $(-10)^3 = (-10)(-10)(-10) = -1000$

**9.** $(-5)^4 = (-5)(-5)(-5)(-5) = 625$

**10.** $(-1)^6 = (-1)(-1)(-1)(-1)(-1)(-1) = 1$

**11.** $-5^4 = -5 \cdot 5 \cdot 5 \cdot 5 = -625$

**12.** $-1^6 = -1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 = -1$

**13.** $-10^2 = -10 \cdot 10 = -100$

**14.** $-8^2 = -8 \cdot 8 = -64$

**15.** $7x^2 + 12x^2 = (7 + 12)x^2 = 19x^2$

**16.** $6x^2 + 18x^2 = (6 + 18)x^2 = 24x^2$

**17.** $10x^3 + 5x^3 = (10 + 5)x^3 = 15x^3$

**18.** $14x^3 + 8x^3 = (14 + 8)x^3 = 22x^3$

**19.** $8x^4 + x^4 = 8x^4 + 1x^4 = (8 + 1)x^4 = 9x^4$

**20.** $14x^4 + x^4 = 14x^4 + 1x^4 = (14 + 1)x^4$

$= 15x^4$

**21.** $26x^2 - 27x^2 = 26x^2 + (-27x^2)$

$= [26 + (-27)]x^2$

$= -1x^2 = -x^2$

**22.** $29x^2 - 30x^2 = 29x^2 + (-30x^2)$

$= [29 + (-30)]x^2$

$= -1x^2 = -x^2$

**23.** $27x^3 - 26x^3 = 27x^3 + (-26x^2)$

$= 1x^3 = x^3$

**24.** $30x^3 - 29x^3 = 30x^3 + (-29x^2)$

$= 1x^3 = x^3$

**25.** $5x^2+5x^3$ cannot be simplified. The terms $5x^2$ and $5x^3$ are not like terms because they have different variable factors, namely, $x^2$ and $x^3$.

**26.** $8x^2+8x^3$ cannot be simplified. The terms $8x^2$ and $8x^3$ are not like terms because they have different variable factors, namely, $x^2$ and $x^3$.

**27.** $16x^2-16x^2=16x^2+\left(-16x^2\right)$
$=\left[16+(-16)\right]x^2$
$=0x^2=0$

**28.** $34x^2-x^2=34x^2+\left(-1x^2\right)$
$=\left[34+(-1)\right]x^2$
$=33x^2$

**29.** $7+6\cdot 3=7+18=25$

**30.** $3+4\cdot 5=3+20=23$

**31.** $45\div 5\cdot 3=9+18=27$

**32.** $40\div 4\cdot 2=10\cdot 2=20$

**33.** $6\cdot 8\div 4=48\div 4=12$

**34.** $8\cdot 6\div 2=48\div 2=24$

**35.** $14-2\cdot 6+3=14-12+3=2+3=5$

**36.** $36-12\div 4+2=36-3+2$
$=33+2=35$

**37.** $8^2-16\div 2^2\cdot 4-3=64-16\div 4\cdot 4-3$
$=64-4\cdot 4-3$
$=64-16-3$
$=48-3$
$=45$

**38.** $10^2-100\div 5^2\cdot 2-1$
$=100-100\div 25\cdot 2-1$
$=100-4\cdot 2-1$
$=100-8-1$
$=92-1$
$=91$

**39.** $3(-2)^2-4(-3)^2=3\cdot 4-4\cdot 9$
$=12-36$
$=12+(-36)$
$=-24$

**40.** $5(-3)^2-2(-4)^2=5\cdot 9-2\cdot 16$
$=45-32$
$=45+(-32)$
$=13$

**41.** $(4\cdot 5)^2-4\cdot 5^2=20^2-4\cdot 25$
$=400-100$
$=300$

**42.** $(3\cdot 5)^2-3\cdot 5^2=15^2-3\cdot 25$
$=225-75$
$=150$

**43.** $(2-6)^2-(3-7)^2=(-4)^2-(-4)^2$
$=16-16$
$=0$

**44.** $(4-6)^2-(5-9)^2=(-2)^2-(-4)^2$
$=4-16$
$=4+(-16)$
$=-12$

**45.** $6(3-5)^3-2(1-3)^3$
$=6(-2)^3-2(-2)^3$
$=6(-8)-2(-8)$
$=-48+16$
$=-32$

**46.** $-3(-6+8)^3-5(-3+5)^3$
$=-3(2)^3-5(2)^3$
$=-3(8)-5(8)$
$=-24+(-40)$
$=-64$

**47.** $\left[2(6-2)\right]^2=(2\cdot 4)^2=8^2=64$

**48.** $\left[3(4-6)\right]^3=(3(-2))^3=(-6)^3=-216$

**49.** $2\left[5+2(9-4)\right]=2\left[5+2(5)\right]$
$=2(5+10)$
$=2\cdot 15=30$

**50.** $3\left[4+3(10-8)\right]=3\left[4+3(2)\right]$
$=3(4+6)$
$=2\cdot 10=30$

**51.** $\left[7+3\left(2^3-1\right)\right]\div 21=\left[7+3(8-1)\right]\div 21$
$=(7+3\cdot 7)\div 21$
$=(7+21)\div 21$
$=28\div 21$
$=\frac{28}{21}=\frac{\cancel{7}\cdot 4}{\cancel{7}\cdot 3}$
$=\frac{4}{3}$

**52.** $\left[11-4\left(2-3^3\right)\right]\div 37$
$=\left[11-4(2-27)\right]\div 37$
$=(11-4(-25))\div 37$
$=(11+100)\div 37$
$=111\div 37$
$=3$

**53.** $\frac{10+8}{5^2-4^2}=\frac{18}{25-16}=\frac{18}{9}=2$

**54.** $\frac{6^2-4^2}{2-(-8)}=\frac{36-16}{2+8}=\frac{20}{10}=2$

**55.** $\frac{37+15\div(-3)}{2^4}=\frac{37+(-5)}{16}=\frac{32}{16}=2$

**56.** $\frac{22+20\div(-5)}{3^2}=\frac{22+(-4)}{9}=\frac{18}{9}=2$

**57.** $\frac{(-11)(-4)+2(-7)}{7-(-3)}=\frac{44+(-14)}{7+3}$
$=\frac{30}{10}=3$

**58.** $\frac{-5(7-2)-3(4-7)}{-13-(-5)}=\frac{-5(5)-3(-3)}{-13+5}$
$=\frac{-25+9}{-8}$
$=\frac{-16}{-8}$
$=2$

**59.** $4\left|10-(8-20)\right|=4\left|10-(-12)\right|=4\left|10+12\right|$
$=4\left|22\right|=4\cdot 22$
$=88$

**60.** $6\left|7-4\cdot 3\right|=6\left|7-12\right|=6\left|-5\right|=6\cdot 5=30$

**61.** $8(-10)+\left|4(-5)\right|=-80+\left|-20\right|$
$=-80+20=-60$

**62.** $4(-15)+\left|3(-10)\right|=-60+\left|-30\right|$
$=-60+30=-30$

**63.** $-2^2+4\left[16+(3-5)\right]$
$=-4+4\left[16+(-2)\right]$
$=-4+4(-8)=-4-32=-36$

**64.** $-3^2+2\left[20\div(7-11)\right]$
$=-9+2\left[20\div(-4)\right]$
$=-9+2(-5)=-9-10=-19$

**65.** $24\div\frac{3^2}{8-5}-(-6)=24\div\frac{9}{3}-(-6)$
$=24\div 3-(-6)$
$=8+6=14$

**66.** $30\div\frac{5^2}{7-12}-(-9)=30\div\frac{25}{-5}-(-9)$
$=30\div(-5)-(-9)$
$=-6+9=3$

**67.** $\frac{\frac{1}{4}-\frac{1}{2}}{\frac{1}{3}}=\frac{\frac{1}{4}-\frac{2}{4}}{\frac{1}{3}}=\frac{-\frac{1}{4}}{\frac{1}{3}}=-\frac{1}{4}\cdot\frac{3}{1}=-\frac{3}{4}$

**68.** $\dfrac{\frac{3}{5}-\frac{7}{10}}{\frac{1}{2}}=\dfrac{\frac{6}{10}-\frac{7}{10}}{\frac{1}{2}}=\dfrac{-\frac{1}{10}}{\frac{1}{2}}=-\dfrac{1}{10}\cdot\dfrac{2}{1}$

$=-\dfrac{2}{10}=-\dfrac{1}{5}$

**69.** $-\dfrac{9}{4}\left(\dfrac{1}{2}\right)+\dfrac{3}{4}\div\dfrac{5}{6}=-\dfrac{9}{4}\left(\dfrac{1}{2}\right)+\dfrac{3}{4}\cdot\dfrac{6}{5}$

$=-\dfrac{9}{8}+\dfrac{18}{20}$

$=-\dfrac{45}{40}+\dfrac{36}{40}=-\dfrac{9}{40}$

**70.** $\left[-\dfrac{4}{7}-\left(-\dfrac{2}{5}\right)\right]\left[-\dfrac{3}{8}+\left(-\dfrac{1}{9}\right)\right]$

$=\left(-\dfrac{4}{7}+\dfrac{2}{5}\right)\left[-\dfrac{27}{72}+\left(-\dfrac{8}{72}\right)\right]$

$=\left(-\dfrac{20}{35}+\dfrac{14}{35}\right)\left[-\dfrac{27}{72}+\left(-\dfrac{8}{72}\right)\right]$

$=\left(-\dfrac{6}{35}\right)\left(-\dfrac{35}{72}\right)=\dfrac{6}{72}=\dfrac{1}{12}$

**71.** $\dfrac{\frac{7}{9}-3}{\frac{5}{6}}\div\dfrac{3}{2}+\dfrac{3}{4}=\dfrac{\frac{7}{9}-\frac{27}{9}}{\frac{5}{6}}\cdot\dfrac{3}{2}+\dfrac{3}{4}$

$=\dfrac{-\frac{20}{9}}{\frac{5}{6}}\cdot\dfrac{3}{2}+\dfrac{3}{4}$

$=-\dfrac{20}{9}\cdot\dfrac{6}{5}\cdot\dfrac{2}{3}+\dfrac{3}{4}$

$=-\dfrac{240}{135}+\dfrac{3}{4}$

$=-\dfrac{15\cdot16}{15\cdot9}+\dfrac{3}{4}$

$=-\dfrac{16}{9}+\dfrac{3}{4}$

$=-\dfrac{64}{36}+\dfrac{27}{36}$

$=-\dfrac{37}{36}$ or $-1\dfrac{1}{36}$

**72.** $\dfrac{\frac{17}{25}}{\frac{3}{5}-4}\div\dfrac{1}{5}+\dfrac{1}{2}=\dfrac{\frac{17}{25}}{\frac{3}{5}-\frac{20}{5}}\div\dfrac{1}{5}+\dfrac{1}{2}$

$=\dfrac{\frac{17}{25}}{-\frac{17}{5}}\div\dfrac{1}{5}+\dfrac{1}{2}$

$=\dfrac{17}{25}\left(-\dfrac{5}{17}\right)\cdot\dfrac{5}{1}+\dfrac{1}{2}$

$=-\dfrac{425}{425}+\dfrac{1}{2}$

$=-1+\dfrac{1}{2}=-\dfrac{1}{2}$

**73.** $x^2+5x;\ x=3$

$x^2+5x=3^2+5\cdot3$

$=9+5\cdot3=9+15=24$

**74.** $x^2-2x;\ x=6$

$x^2-2x=6^2-2\cdot6$

$=36-2\cdot6=36-12=24$

**75.** $3x^2-8x;\ x=-2$

$3x^2-8x=3(-2)^2-9(-2)$

$=3\cdot4-8(-2)=12+16=28$

**76.** $4x^2-2x;\ x=-3$

$4x^2-2x=4(-3)^2-2(-3)$

$=4\cdot9-2(-3)=36+6=42$

**77.** $-x^2-10x;\ x=-1$

$-x^2-10x=-(-1)^2-10(-1)$

$=-1+10=9$

**78.** $-x^2-14x;\ x=-1$

$-x^2-14x=-(-1)^2-14(-1)$

$=-1+14=13$

**79.** $\dfrac{6y-4y^2}{y^2-15};\ y=5$

$$\frac{6y-4y^2}{y^2-15}=\frac{6(5)-4\left(5^2\right)}{5^2-15}$$
$$=\frac{6(5)-4(25)}{25-15}$$
$$=\frac{30-100}{25-15}=\frac{-70}{10}=-7$$

**80.** $\dfrac{3y-2y^2}{y(y-2)};\ y=5$

$$\frac{3y-2y^2}{y(y-2)}=\frac{3(5)-2\left(5^2\right)}{5(5-2)}$$
$$=\frac{3(5)-2(25)}{5\cdot 3}$$
$$=\frac{15-50}{15}=\frac{-35}{15}$$
$$=-\frac{\cancel{5}\cdot 7}{\cancel{5}\cdot 3}=-\frac{7}{3}\ \text{or}\ -2\frac{1}{3}$$

**81.** $3\left[5(x-2)+1\right]=3(5x-10+1)$
$=3(5x-9)$
$=15x-27$

**82.** $4\left[6(x-3)+1\right]=4(6x-18+1)$
$=4(6x-17)$
$=24x-68$

**83.** $3\left[6-(y+1)\right]=3(6-y-1)$
$=3(5-y)$
$=15-3y$

**84.** $5\left[2-(y+3)\right]=5(2-y-3)$
$=5(-1-y)$
$=-5-5y$ or $-5y-5$

**85.** $7-4\left[3-(4y-5)\right]$
$=7-4(3-4y+5)$
$=7-12+16y-20$
$=-25+16y$ or $16y-25$

**86.** $6-5\left[8-(2y-4)\right]$
$=6-5(8-2y+4)$
$=6-40+10y-20$
$=-54+10y$ or $10y-54$

**87.**
$$2\left(3x^2-5\right)-\left[4\left(2x^2-1\right)+3\right]$$
$$=6x^2-10-\left(8x^2-4+3\right)$$
$$=6x^2-10-\left(8x^2-1\right)$$
$$=6x^2-10-8x^2-1$$
$$=-2x^2-9$$

**88.**
$$4\left(6x^2-3\right)-\left[2\left(5x^2-1\right)+1\right]$$
$$=24x^2-12-\left(10x^2-2+1\right)$$
$$=24x^2-12-\left(10x^2-1\right)$$
$$=24x^2-12-10x^2+1$$
$$=14x^2-11$$

**89.** $-10-(-2)^3=-10-(-8)=-10+8=-2$

**90.** $-100-(-5)^3=-100-(-125)$
$=-100+125$
$=25$

**91.** $\left[2(7-10)\right]^2=\left[2(-3)\right]^2=\left[-6\right]^2=36$

**92.** $\left[2(9-11)\right]^4=\left[2(-2)\right]^4=\left[-4\right]^4=256$

**93.** $x-(5x+8)=x-5x-8=-4x-8$

**94.** $x-(3x+9)=x-3x-9=-2x-9$

**95.** $5\left(x^3-4\right)=5x^3-20$

**96.** $4\left(x^3-6\right)=4x^3-24$

**97.** $F=-82x^2+654x+620$

$F=-82(4)^2+654(4)+620=1924$

1924 calories per day are needed.
This underestimates the value given in the bar graph by 76 calories.

**98.** $M = -96x^2 + 802x + 660$

$M = -96(4)^2 + 802(4) + 660 = 2332$

2332 calories per day are needed.
This underestimates the value given in the bar graph by 68 calories.

**99. a.** $M = \dfrac{-2n^2 + 170n + 5115}{5}$

$= \dfrac{-2(10)^2 + 170(10) + 5115}{5}$

$= 1323$

According to the formula, the median weekly earning of a male college graduate in 2010 is \$1323.
This underestimates the earnings shown on the bar graph by \$7.

**b.** $F = \dfrac{-3n^2 + 145n + 3775}{5}$

$= \dfrac{-3(10)^2 + 145(10) + 3775}{5}$

$= 985$

According to the formula, the median weekly earning of a female college graduate in 2010 is \$985.
This underestimates the earnings shown on the bar graph by \$1.

**c.** $1323 - 985 = 338$

The difference is \$338. This is \$6 less than the difference shown by the graph.

**100. a.** $M = \dfrac{-2n^2 + 170n + 5115}{5}$

$= \dfrac{-2(15)^2 + 170(15) + 5115}{5}$

$= 1443$

According to the formula, the median weekly earning of a male college graduate in 2015 is \$1443.
This overestimates the earnings shown on the bar graph by \$23.

**b.** $F = \dfrac{-3n^2 + 145n + 3775}{5}$

$= \dfrac{-3(15)^2 + 145(15) + 3775}{5}$

$= 1055$

According to the formula, the median weekly earning of a female college graduate in 2015 is \$1055.
This underestimates the earnings shown on the bar graph by \$9.

**c.** $1443 - 1055 = 388$

The difference is \$388. This is \$32 greater than the difference shown by the graph.

**101. a.** $C = \dfrac{200x}{100 - x}$

$C = \dfrac{200(50)}{100 - 50} = 200$

It will cost \$200 tens of thousands, or \$2,000,000 to remove 50% of the contamination.

**b.** $C = \dfrac{200x}{100 - x}$

$C = \dfrac{200(80)}{100 - 80} = 800$

It will cost \$800 tens of thousands, or \$8,000,000 to remove 80% of the contamination.

**c.** The cost of cleanup increases as the percentage of contaminant removed increases.

**102. a.** $C = \dfrac{200x}{100 - x}$

$C = \dfrac{200(60)}{100 - 60} = 300$

It will cost \$300 tens of thousands, or \$3,000,000 to remove 60% of the contamination.

**b.** $C = \dfrac{200x}{100 - x}$

$C = \dfrac{200(90)}{100 - 90} = 1800$

It will cost \$1800 tens of thousands, or \$18,000,000 to remove 90% of the contamination.

**c.** The cost of cleanup increases as the percentage of contaminant removed increases.

**103. – 105.** Answers will vary.

**106.** makes sense

**107.** does not make sense; Explanations will vary.
Sample explanation: $10^4 = 10,000$

**108.** makes sense

**109.** makes sense

**110.** false; Changes to make the statement true will vary.
A sample change is: $-3(-3)-9=9-9=0$

**111.** false; Changes to make the statement true will vary.
A sample change is: $\dfrac{6(-3)+6}{-3+1}=\dfrac{-18+6}{-2}=\dfrac{-12}{-2}=6$
and $\dfrac{6(2)+6}{2+1}=\dfrac{12+6}{3}=\dfrac{18}{3}=6$

**112.** true

**113.** false; Changes to make the statement true will vary.
A sample change is:
$$\begin{aligned}-2(6-4^2)^3 &= -2(6-16)^3\\ &= -2(-10)^3\\ &= -2(-1000)\\ &= 2000\end{aligned}$$

**114.**
$$\begin{aligned}&\frac{1}{4}-6(2+8)\div\left(-\frac{1}{3}\right)\left(-\frac{1}{9}\right)\\ &=\frac{1}{4}-6(10)\div\left(-\frac{1}{3}\right)\left(-\frac{1}{9}\right)\\ &=\frac{1}{4}-60\div\left(-\frac{1}{3}\right)\left(-\frac{1}{9}\right)\\ &=\frac{1}{4}-60(-3)\left(-\frac{1}{9}\right)\\ &=\frac{1}{4}+180\left(-\frac{1}{9}\right)\\ &=\frac{1}{4}-20=\frac{1}{4}-\frac{80}{4}=-\frac{79}{4}\end{aligned}$$

**115.** $(2\cdot 3+3)\cdot 5=(6+3)\cdot 5=9\cdot 5=45$

**116.** $\left(2\cdot 5-\dfrac{1}{2}\cdot 10\right)\cdot 9=(10-5)\cdot 9=5\cdot 9=45$

**117.**
$$\begin{aligned}&-8-2-(-5)+11\\ &=-8+(-2)+5+11\\ &=\left[(-8)+(-2)\right]+(5+11)\\ &=-10+16=6\end{aligned}$$

**118.** $-4(-1)(-3)(2)=-24$

**119.** Answers will vary. One example is 5.

**120.**
$$\begin{aligned}&-\frac{1}{2}=x-\frac{2}{3}\\ &-\frac{1}{2}=\frac{1}{6}-\frac{2}{3}\\ &-\frac{1}{2}=\frac{1}{6}-\frac{4}{6}\\ &-\frac{1}{2}=-\frac{3}{6}\\ &-\frac{1}{2}=-\frac{1}{2},\ \text{true}\end{aligned}$$
The number is a solution.

**121.**
$$\begin{aligned}5y+3-4y-8&=15\\ 5(20)+3-4(20)-8&=15\\ 100+3-80-8&=15\\ 15&=15,\ \text{true}\end{aligned}$$
The number is a solution.

**122.**
$$\begin{aligned}4x+2&=3(x-6)+8\\ 4(-11)+2&=3(-11-6)+8\\ -44+2&=3(-17)+8\\ -42&=-51+8\\ -42&=-43,\ \text{false}\end{aligned}$$
The number is not a solution.

## Chapter 1 Review Exercises

**1.** $10+5x=10+5(6)=10+30=40$

**2.**
$$\begin{aligned}8(x-2)+3x&=8(6-2)+3(6)\\ &=8(4)+18\\ &=32+18\\ &=50\end{aligned}$$

**3.**
$$\begin{aligned}\frac{40}{x}-\frac{y}{5}&=\frac{40}{8}-\frac{10}{5}\\ &=\frac{200}{40}-\frac{80}{40}\\ &=\frac{120}{40}\\ &=3\end{aligned}$$

**4.** $3(2y+x) = 3(2(10)+8)$
$= 3(20+8)$
$= 3(28)$
$= 84$

**5.** $7x-6$

**6.** $\frac{x}{5}-2=18$

**7.** $9-2x=14$

**8.** $3(x+7)$

**9.** $4x+5=13$
$4(3)+5=13$
$12+5=13$
$17=13,$ false
The number is not a solution.

**10.** $2y+7=4y-5$
$2(6)+7=4(6)-5$
$12+7=24-5$
$19=19,$ true
The number is a solution.

**11.** $3(w+1)+11=2(w+8)$
$3(2+1)+11=2(2+8)$
$3(3)+11=2(10)$
$9+11=20$
$20=20,$ true
The number is a solution.

**12.** According to the line graph, the average number of Latin words that the class remembered after 5 days was about 11.

**13.** $L=\frac{5n+30}{n}$
$L=\frac{5(5)+30}{5}=\frac{25+30}{5}=\frac{55}{5}=11$
According to the mathematical model, the average number of Latin words that the class remembered after 5 days was 11. This is the same value given in the line graph.

**14. a.** $C = 692n+21{,}348$
$= 692(15)+21{,}348$
$= 31{,}728$
According to the formula, the average annual cost per federal prisoner was \$31,728 in 2015. This underestimates the actual value shown in the bar graph by \$250.

**b.** $C = 692n+21{,}348$
$= 692(20)+21{,}348$
$= 35{,}188$
According to the formula, the average annual cost per federal prisoner was \$35,188 in 2020.

**15.** $3\frac{2}{7}=\frac{3\cdot 7+2}{7}=\frac{21+2}{7}=\frac{23}{7}$

**16.** $5\frac{9}{11}=\frac{5\cdot 11+9}{11}=\frac{55+9}{11}=\frac{64}{11}$

**17.** 17 divided by 9 is 1 with a remainder of 8, so $\frac{17}{9}=1\frac{8}{9}$.

**18.** 27 divided by 5 is 5 with a remainder of 2, so $\frac{27}{5}=5\frac{2}{5}$.

**19.** Composite
$60=6\cdot 10=2\cdot 3\cdot 2\cdot 5=2\cdot 2\cdot 3\cdot 5$

**20.** Composite
$63=7\cdot 9=7\cdot 3\cdot 3=3\cdot 3\cdot 7$

**21.** 67 is a prime number.

**22.** $\frac{15}{33}=\frac{\cancel{3}\cdot 5}{\cancel{3}\cdot 11}=\frac{5}{11}$

**23.** $\frac{40}{75}=\frac{\cancel{5}\cdot 8}{\cancel{5}\cdot 15}=\frac{8}{15}$

**24.** $\frac{3}{5}\cdot\frac{7}{10}=\frac{3\cdot 7}{5\cdot 10}=\frac{21}{50}$

**25.** $\frac{4}{5}\div\frac{3}{10}=\frac{4}{5}\cdot\frac{10}{3}=\frac{40}{15}=\frac{\cancel{5}\cdot 8}{\cancel{5}\cdot 3}=\frac{8}{3}$

**26.** $1\frac{2}{3}\div 6\frac{2}{3}=\frac{5}{3}\div\frac{20}{3}$
$=\frac{5}{\cancel{3}}\cdot\frac{\cancel{3}}{20}=\frac{5}{20}=\frac{1\cdot\cancel{5}}{4\cdot\cancel{5}}=\frac{1}{4}$

**27.** $\frac{2}{9}+\frac{4}{9}=\frac{2+4}{9}=\frac{6}{9}=\frac{2\cdot\cancel{3}}{3\cdot\cancel{3}}=\frac{2}{3}$

**28.** $\frac{5}{6}+\frac{7}{9}=\frac{5}{6}\cdot\frac{3}{3}+\frac{7}{9}\cdot\frac{2}{2}$

$=\frac{15}{18}+\frac{14}{18}=\frac{29}{18}$ or $1\frac{11}{18}$

**29.** $\frac{3}{4}-\frac{2}{15}=\frac{3}{4}\cdot\frac{15}{15}-\frac{2}{15}\cdot\frac{4}{4}=\frac{45}{60}-\frac{8}{60}=\frac{37}{60}$

**30.** $x-\frac{3}{4}=\frac{7}{4}$

$2\frac{1}{2}-\frac{3}{4}=\frac{7}{4}$

$\frac{5}{2}-\frac{3}{4}=\frac{7}{4}$

$\frac{10}{4}-\frac{3}{4}=\frac{7}{4}$

$\frac{7}{4}=\frac{7}{4}$, true

The number is a solution.

**31.** $\frac{2}{3}w=\frac{1}{15}w+\frac{3}{5}$

$\frac{2}{3}\cdot 2=\frac{1}{15}\cdot 2+\frac{3}{5}$

$\frac{4}{3}=\frac{2}{15}+\frac{3}{5}$

$\frac{4}{3}=\frac{2}{15}+\frac{9}{15}$

$\frac{4}{3}=\frac{11}{15}$, false

The number is not a solution.

**32.** $2-\frac{1}{2}x=\frac{1}{4}x$

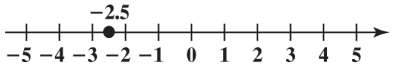
**33.** $\frac{3}{5}(x+6)$

**34.** $H=\frac{4}{5}(220-a)$

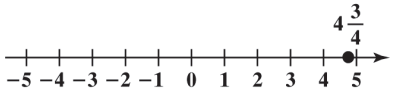
$H=\frac{4}{5}(220-30)=\frac{4}{5}(190)=152$

The target heart rate of a 30-year-old is 152 beats per minute.

**35.** $-2.5$




**36.** $4\frac{3}{4}$




**37.**
$$\begin{array}{r} 0.625 \\ 8\overline{)5.000} \\ \underline{48} \\ 20 \\ \underline{16} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

$\frac{5}{8}=0.625$

**38.**
$$\begin{array}{r} 0.2727\ldots \\ 11\overline{)3.0000\ldots} \\ \underline{22} \\ 80 \\ \underline{77} \\ 30 \\ \underline{27} \\ 30 \\ \underline{22} \\ 8 \\ \vdots \end{array}$$

$\frac{3}{11}=0.\overline{27}$

**39.** **a.** $\sqrt{81}\ (=9)$

**b.** $0,\sqrt{81}$

**c.** $-17,0,\sqrt{81}$

**d.** $-17,-\frac{9}{13},0,0.75,\sqrt{81}$

**e.** $\sqrt{2},\pi$

**f.** $-17,-\frac{9}{13},0,0.75,\sqrt{2},\pi,\sqrt{81}$

**40.** Answers will vary. One example of an integer that is not a natural number is −7.

**41.** Answers will vary. One example of a rational number that is not an integer is $\frac{3}{4}$.

**42.** Answers will vary. One example of a real number that is not a rational number is $\pi$.

**43.** $-93 < 17$; $-93$ is to the left of 17, so $-93 < 17$.

**44.** $-2 > -200$; $-2$ is to the right of $-200$, so $-2 > -200$.

**45.** $0 > -\frac{1}{3}$; 0 is to the right of $-\frac{1}{3}$, so $0 > -\frac{1}{3}$.

**46.**
$-\frac{1}{4} < -\frac{1}{5}$; $-\frac{1}{4} = -0.25$ is to the left of $-\frac{1}{5} = -0.2$, so $-\frac{1}{4} < -\frac{1}{5}$.

**47.** $-13 \geq -11$ is false because neither $-13 > -11$ nor $-13 = -11$ is true.

**48.** $-126 \leq -126$ is true because $-126 = -126$.

**49.** $|-58| = 58$ because the distance between $-58$ and 0 on the number line is 58.

**50.** $|2.75| = 2.75$ because the distance between 2.75 and 0 on the number line is 2.75.

**51.** $7 + 13y = 13y + 7$

**52.** $9(x + 7) = (x + 7)9$

**53.** $6 + (4 + y) = (6 + 4) + y = 10 + y$

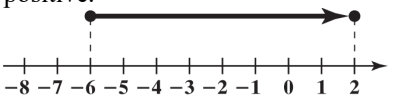
**54.** $7(10x) = (7 \cdot 10)x = 70x$

**55.** $6(4x - 2 + 5y) = 6(4x) + 6(-2) + 6(5y)$
$= 24x - 12 + 30y$

**56.** $4a + 9 + 3a - 7 = 4a + 3a + 9 - 7$
$= (4 + 3)a + (9 - 7)$
$= 7a + 2$

**57.** $6(3x + 4) + 5(2x - 1)$
$= 6(3x) + 6(4) + 5(2x) + 5(-1)$
$= 18x + 24 + 10x - 5$
$= 18x + 10x + 24 - 5$
$= (18 + 10)x + [24 + (-5)]$
$= 28x + 19$

**58.** $-6 + 8 = +2$ or 2.
Start at $-6$. Move 8 units to the right because 8 is positive.




**59.** $8 + (-11) = -3$

**60.** $-\frac{3}{4} + \frac{1}{5} = -\frac{3}{4} \cdot \frac{5}{5} + \frac{1}{5} \cdot \frac{4}{4}$
$= -\frac{15}{20} + \frac{4}{20} = -\frac{11}{20}$

**61.** $7 + (-5) + (-13) + 4$
$= [7 + (-5)] + (-13) + 4$
$= 2 + (-13) + 4$
$= [2 + (-13)] + 4 = -11 + 4 = -7$

**62.** $8x + (-6y) + (-12x) + 11y$
$= 8x + (-12x) + (-6y) + 11y$
$= [8 + (-12)]x + (-6 + 11)y$
$= -4x + 5y$ or $5y - 4x$

**63.** $10(3y + 4) + (-40y) = 30y + 40 + (-40y)$
$= 30y + (-40y) + 40$
$= -10y + 40$

**64.** $-1312 + 512 = -800$
The person's elevation is 800 feet below sea level.

**65.** $25 - 3 + 2 + 1 - 4 + 2$
$= 25 + (-3) + 2 + 1 + (-4) + 2$
$= 23$
The reservoir's water level at the end of five months is 23 feet.

**66.** $9 - 13 = 9 + (-13)$

**67.** $-9 - (-13) = -9 + 13 = 4$

**68.** $-\frac{7}{10}-\frac{1}{2}=-\frac{7}{10}-\frac{1}{2}\cdot\frac{5}{5}$
$=-\frac{7}{10}-\frac{5}{10}=-\frac{12}{10}=-\frac{6}{5}$

**69.** $-3.6-(-2.1)=-3.6+2.1=-1.5$

**70.** $-7-(-5)+11-16$
$=-7+5+11+(-16)$
$=[(-7)+(-16)]+(5+11)$
$=-23+16$
$=-7$

**71.** $-25-4-(-10)+16$
$=-25+(-4)+10+16$
$=[(-25)+(-4)]+(10+16)$
$=-29+26$
$=-3$

**72.** $3-6a-8-2a=3-8-6a-2a$
$=[3+(-8)]+[-6a-2a]$
$=-5+(-6-2)a$
$=-5-8a$

**73.** $26{,}000-(-650)=26{,}500+650$
$=27{,}150$
The difference in elevation is 27,150 feet.

**74.** $(-7)(-12)=84$

**75.** $\frac{3}{5}\left(-\frac{5}{11}\right)=-\frac{3\cdot\cancel{5}}{\cancel{5}\cdot 11}=-\frac{3}{11}$

**76.** $5(-3)(-2)(-4)=-120$

**77.** $\frac{45}{-5}=45\left(-\frac{1}{5}\right)=-9$

**78.** $-17\div 0$ is undefined.

**79.** $-\frac{4}{5}\div\left(-\frac{2}{5}\right)=-\frac{4}{5}\left(-\frac{5}{2}\right)=\frac{20}{10}=2$

**80.** $-4\left(-\frac{3}{4}x\right)=\left[-4\left(-\frac{3}{4}\right)\right]x=3x$

**81.** $-3(2x-1)-(4-5x)$
$=-3(2x)+(-3)(-1)-4+5x$
$=-6x+3-4+5x$
$=-6x+5x+3-4$
$=(-6+5)x+[3+(-4)]$
$=-1x-1$
$=-x-1$

**82.** $5x+16=-8-x$
$5(-6)+16=-8-(-6)$
$-30+16=-8+6$
$-14=-2$, false
The number is not a solution.

**83.** $2(x+3)-18=5x$
$2(-4+3)-18=5(-4)$
$2(-1)-18=-20$
$-2-18=-20$
$-20=-20$, true
The number is a solution.

**84.** **a.** $M=-0.9n+92$
$=-0.9(45)+92$
$=51.5$
According to the formula, 51.5% of M.D. degrees were awarded to men in 2015. This underestimates the actual value shown in the bar graph by 0.5%.

**b.** $W=0.9n+8$
$=0.9(45)+8$
$=48.5$
According to the formula, 48.5% of M.D. degrees were awarded to women in 2015. This overestimates the actual value shown in the bar graph by 0.5%.

**85.** $(-6)^2=(-6)(-6)=36$

**86.** $-6^2=-6\cdot 6=-36$

**87.** $(-2)^5=(-2)(-2)(-2)(-2)(-2)=-32$

**88.** $4x^3+2x^3=(4+2)x^3=6x^3$

**89.** $4x^3+4x^2$ cannot be simplified. The terms $4x^3$ and $4x^2$ are not like terms because they have different variable factors.

**90.** $-40\div 5\cdot 2=-8\cdot 2=-16$

**91.** $-6+(-2)\cdot 5=-6+(-10)=-16$

**92.** $6-5(-3+2)=6-4(-1)=6+4=10$

**93.** $28\div\left(2-4^2\right)=28\div(2-16)$
$=28\div[2+(-16)]$
$=28\div(-14)$
$=-2$

**94.** $36-24\div 4\cdot 3-1=36-6\cdot 3-1$
$=36-18-1$
$=18-1$
$=17$

**95.** $-8[-4-5(-3)]=-8(-4+15)$
$=-8(11)=-88$

**96.** $\dfrac{6(-10+3)}{2(-15)-9(-3)}=\dfrac{6(-7)}{-30+27}$
$=\dfrac{-42}{-3}=14$

**97.** $\left(\dfrac{1}{2}+\dfrac{1}{3}\right)\div\left(\dfrac{1}{4}-\dfrac{3}{8}\right)$
$=\left(\dfrac{3}{6}+\dfrac{2}{6}\right)\div\left(\dfrac{2}{8}-\dfrac{3}{8}\right)$
$=\dfrac{5}{6}\div\left(-\dfrac{1}{8}\right)=\dfrac{5}{6}\cdot\left(-\dfrac{8}{1}\right)=-\dfrac{40}{6}=-\dfrac{20}{3}$

**98.** $\dfrac{1}{2}-\dfrac{2}{3}\div\dfrac{5}{9}+\dfrac{3}{10}$
$=\dfrac{1}{2}-\dfrac{2}{\cancel{3}_1}\cdot\dfrac{\cancel{9}^3}{5}+\dfrac{3}{10}$
$=\dfrac{1}{2}-\dfrac{6}{5}+\dfrac{3}{10}$
$=\dfrac{5}{10}-\dfrac{12}{10}+\dfrac{3}{10}=-\dfrac{4}{10}=-\dfrac{2}{5}$

**99.** $x^2-2x+3;\ x=-1$
$x^2-2x+3=(-1)^2-2(-1)+3$
$=1+2+3$
$=6$

**100.** $-x^2-7x;\ x=-2$
$-x^2-7x=-(-2)^2-7(-2)$
$=-4+14$
$=10$

**101.** $4[7(a-1)+2]=4(7a-7+2)$
$=4(7a-5)$
$=4(7a)+4(-5)$
$=28a-20$

**102.** $-6[4-(y+2)]=-6(4-y-2)$
$=-6(2-y)$
$=-6(2)+(-6)(-y)$
$=-12+6y$ or $6y-12$

**103.** **a.** $D=50n^2+357n+17{,}582$
$=50(10)^2+357(10)+17{,}582$
$=26{,}152$
According to the formula, the average student loan debt in 2010 is \$26,152.
This underestimates the actual value shown in the bar graph by \$530.

**b.** $D=50n^2+357n+17{,}582$
$=50(20)^2+357(20)+17{,}582$
$=44{,}722$
According to the formula, the average student loan debt in 2020 will be \$44,722.