Beginning Algebra 8th edition Martin Gay Solutions Manual

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INSTRUCTOR'S SOLUTIONS MANUAL

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BEGINNING ALGEBRA

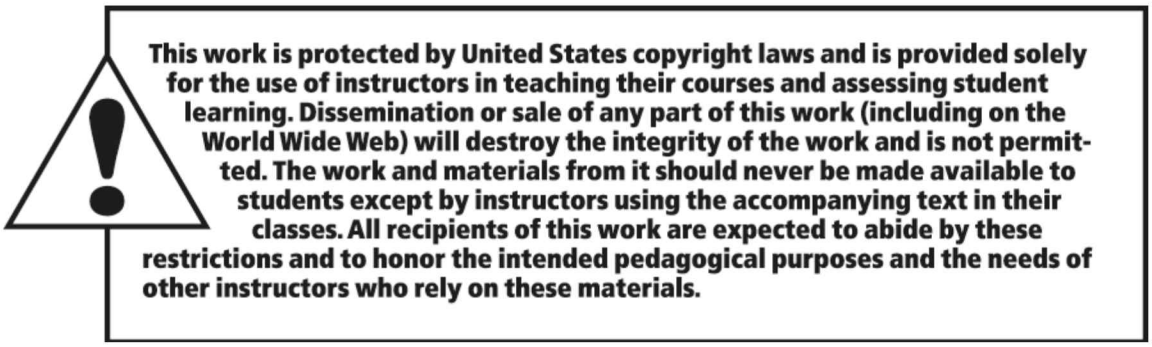
EIGHTH EDITION

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Beginning Algebra 8th edition Martin Gay Solutions Manual

Contents

Chapter 1	1
Chapter 2	34
Chapter 3	104
Chapter 4	160
Chapter 5	212
Chapter 6	253
Chapter 7	295
Chapter 8	368
Chapter 9	410
Appendix A	467
Appendix B	469
Appendix C	471
Appendix D	473
Practice Final Exam	475

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Chapter 1

Section 1.2 Practice Exercises

1. a. $5 < 8$ since 5 is to the left of 8 on the number line.

b. $6 > 4$ since 6 is to the right of 4 on the number line.

c. $16 < 82$ since 16 is to the left of 82 on the number line.

2. a. $9 \geq 3$ is true, since $9 > 3$ is true.

b. $3 \geq 8$ is false, since neither $3 > 8$ nor $3 = 8$ is true.

c. $25 \leq 25$ is true, since $25 = 25$ is true.

d. $4 \leq 14$ is true, since $4 < 14$ is true.

3. a. $3 < 8$

b. $15 \geq 9$

c. $6 \neq 7$

4. The integer -10 represents 10 meters below sea level.

5. a. The natural number is 25.

b. The whole number is 25.

c. The integers are 25, -15, -99.

d. The rational numbers are $25, \frac{7}{3}, -15, -\frac{3}{4}, -3.7, 8.8, -99$.

e. The irrational number is $\sqrt{5}$.

f. The real numbers are $25, \frac{7}{3}, -15, -\frac{3}{4}, \sqrt{5}, -3.7, 8.8, -99$.

6. a. $0 < 3$ since 0 is to the left of 3 on a number line.

b. $15 > -5$ since 15 is to the right of -5 on a number line.

c. $3 = \frac{12}{4}$ since $\frac{12}{4}$ simplifies to 3.

7. a. $|-8| = 8$ since -8 is 8 units from 0 on a number line.

b. $|9| = 9$ since 9 is 9 units from 0 on a number line.

c. $|-2.5| = 2.5$ since -2.5 is 2.5 units from 0 on a number line.

d. $\left|\frac{5}{11}\right| = \frac{5}{11}$ since $\frac{5}{11}$ is $\frac{5}{11}$ unit from 0 on a number line.

e. $\left|-\frac{1}{2}\right| = \frac{1}{2}$ since $-\frac{1}{2}$ is $\frac{1}{2}$ unit from 0 on a number line.

8. a. $|8| = |-8|$ since $8 = 8$.

b. $|-3| > 0$ since $3 > 0$.

c. $|-7| < |-11|$ since $7 < 11$.

d. $|3| > |2|$ since $3 > 2$.

e. $|0| < |-4|$ since $0 < 4$.

Vocabulary, Readiness & Video Check 1.2

1. The whole numbers are $\{0, 1, 2, 3, 4, \ldots\}$.

2. The natural numbers are $\{1, 2, 3, 4, 5, \ldots\}$.

3. The symbols $\neq$, $\leq$, and $>$ are called inequality symbols.

4. The integers are $\{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$.

5. The real numbers are {all numbers that correspond to points on a number line}.

6. The rational numbers are $\left\{\frac{a}{b} \middle| a \text{ and } b \text{ are integers, } b \neq 0\right\}$.

7. The irrational numbers are {nonrational numbers that correspond to points on a number line}.

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8. The distance between a number b and 0 on a number line is $|b|$.

9. To form a true statement: $0 < 7$.

10. Five is greater than or equal to four; $5 \geq 4$

11. 0 belongs to the whole numbers, the integers, the rational numbers, and the real numbers; since 0 is a rational number, it cannot also be an irrational number.

12. The absolute value of a real number a, denoted by $|a|$, is the distance between a and 0 on a number line.

Exercise Set 1.2

2. $9 < 15$ since 9 is to the left of 15 on a number line.

4. $2.13 > 1.13$ since 2.13 is to the right of 1.13 on a number line.

6. $20 > 0$ since 20 is to the right of 0 on a number line.

8. $-4 > -6$ since -4 is to the right of -6 on a number line.

10. $0 < 100$ since 0 is to the left of 100 on a number line.

12. $360 \geq 180$ since 360 is to the right of 180 on a number line.

14. $4 \geq 7$ is false, since 4 is to the left of 7 on a number line.

16. $17 > 16$ is true, since 17 is to the right of 16 on a number line.

18. $8 \cdot 8 \leq 8 \cdot 7$ is false, since 56 is to the left of 64 on a number line.

20. $4 < 7$ is true, since 4 is to the left of 7 on a number line.

22. $0 < -15$ is false, since 0 is to the right of -15 on a number line.

24. Fifteen is greater than five is written as $15 > 5$.

26. Negative ten is less than or equal to thirty-seven is written as $-10 \leq 37$.

28. Negative seven is not equal to seven is written as $-7 \neq 7$.

30. The integer 535 represents 535 feet above sea level. The integer -8 represents 8 feet below sea level.

32. The integer $-11{,}496$ represents 11,496 fewer students.

34. 30 represents an ascent of feet. -50 represents a descent of 50 feet.

36. The number $\frac{1}{4}$ belongs to the sets of: rational numbers and real numbers.

38. The number $-\frac{1}{2}$ belongs to the sets of: rational numbers and real numbers.

40. The number 5 belongs to the sets of: natural numbers, whole numbers, integers, rational numbers, and real numbers.

42. The number $\sqrt{3}$ belongs to the sets of: irrational numbers and real numbers.

44. The number $-1\frac{5}{9}$ belongs to the sets of: rational numbers and real numbers.

46. False; negative numbers may be irrational.

48. True

50. False; irrational numbers are real.

52. False; $\frac{1}{2}$ is not an integer.

54. False; 0 is a whole number that is not positive.

56. $-200 < -20$ since -200 is to the left of -20 on a number line.

58. $7.1 > -7$ since 7.1 is to the right of -7 on a number line.

60. $\frac{18}{3} < \frac{24}{3}$ since $6 < 8$.

62. $|-20| > -200$ since $20 > 200$.

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64. $0 = |0|$ since $0 = 0$.

66. $\left|\frac{2}{5}\right| = \left|-\frac{2}{5}\right|$ since $\frac{2}{5} = \frac{2}{5}$.

68. $-500 < |-50|$ since $-500 < 50$.

70. $|-12| = \frac{24}{2}$ since $12 = \frac{24}{2}$.

72. The 2020 blueberry production in Michigan was 74 million pounds, while the 2020 blueberry production in Washington was 168 million pounds.
74 million < 168 million

74. The 2020 blueberry production in Oregon was 154 million pounds, while the 2020 blueberry production in Washington was 168 million pounds.
168 – 154 = 14
The production in Oregon was 14 million pounds less or –14 million.

76. The tallest bar represents 55 players admitted.

78. Look for the bars that have heights less than 30; 1931–1940 and 1951–1960.

80. answers may vary

82. 0.96 < 0.98 since 0.96 is to the left of 0.98 on the number line.

84. Spica is dimmer since 0.98 > 0.96.

86. Regulus is dimmest since 1.35 is to the right of all other numbers listed.

88. $13 \geq -13$ has the same meaning as $-13 \leq 13$.

90. $73 < 75$ has the same meaning as $75 > 73$.

92. $-2 > -4$ has the same meaning as $-4 < -2$.

94. answers may vary

Section 1.3 Practice Exercises

1. a. $36 = 4 \cdot 9 = 2 \cdot 2 \cdot 3 \cdot 3$

b. $200 = 2 \cdot 100 = 2 \cdot 4 \cdot 25 = 2 \cdot 2 \cdot 2 \cdot 5 \cdot 5$

2. a. $\frac{63}{72} = \frac{3 \cdot 3 \cdot 7}{2 \cdot 2 \cdot 2 \cdot 3 \cdot 3} = \frac{7}{2 \cdot 2 \cdot 2} = \frac{7}{8}$

b. $\frac{64}{12} = \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 3} = \frac{2 \cdot 2 \cdot 2 \cdot 2}{3} = \frac{16}{3}$

c. $\frac{7}{25} = \frac{7}{5 \cdot 5}$
There are no common factors other than 1, so $\frac{7}{25}$ is already in lowest terms.

3. $\frac{3}{8} \cdot \frac{7}{9} = \frac{3 \cdot 7}{8 \cdot 9} = \frac{3 \cdot 7}{2 \cdot 2 \cdot 2 \cdot 3 \cdot 3} = \frac{7}{2 \cdot 2 \cdot 2 \cdot 3} = \frac{7}{24}$

4. a. $\frac{3}{4} \div \frac{4}{9} = \frac{3}{4} \cdot \frac{9}{4} = \frac{3 \cdot 9}{4 \cdot 4} = \frac{27}{16}$

b. $\frac{5}{12} \div 15 = \frac{5}{12} \cdot \frac{1}{15} = \frac{5 \cdot 1}{12 \cdot 15} = \frac{5}{12 \cdot 3 \cdot 5} = \frac{1}{36}$

c. $\frac{7}{6} \div \frac{7}{15} = \frac{7}{6} \cdot \frac{15}{7} = \frac{7 \cdot 15}{6 \cdot 7} = \frac{15}{6} = \frac{3 \cdot 5}{2 \cdot 3} = \frac{5}{2}$

5. a. $\frac{8}{5} - \frac{3}{5} = \frac{8-3}{5} = \frac{5}{5} = 1$

b. $\frac{8}{5} - \frac{2}{5} = \frac{8-2}{5} = \frac{6}{5}$

c. $\frac{3}{5} + \frac{1}{5} = \frac{3+1}{5} = \frac{4}{5}$

d. $\frac{5}{12} + \frac{1}{12} = \frac{5+1}{12} = \frac{6}{12} = \frac{1}{2}$

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

7. a. $\frac{5}{11} + \frac{1}{7} = \frac{5 \cdot 7}{11 \cdot 7} + \frac{1 \cdot 11}{7 \cdot 11}$
$= \frac{35}{77} + \frac{11}{77}$
$= \frac{35+11}{77}$
$= \frac{46}{77}$

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b.
$$\begin{array}{rcl} \frac{5}{21} & = & \frac{10}{42} \\ -\frac{1}{6} & = & -\frac{7}{42} \\ \hline \frac{3}{42} & = & \frac{1}{14} \end{array}$$

c.
$$\begin{aligned} \frac{1}{3}+\frac{29}{30}-\frac{4}{5} &= \frac{10}{30}+\frac{29}{30}-\frac{4\cdot 6}{5\cdot 6} \\ &= \frac{10+29}{30}-\frac{24}{30} \\ &= \frac{39-24}{30} \\ &= \frac{15}{30} \\ &= \frac{1}{2} \end{aligned}$$

8.
$$\begin{aligned} 5\frac{1}{6}\cdot 4\frac{2}{5} &= \frac{31}{6}\cdot\frac{22}{5} \\ &= \frac{31\cdot 22}{6\cdot 5} \\ &= \frac{31\cdot 2\cdot 11}{2\cdot 3\cdot 5} \\ &= \frac{341}{15} \\ &= 22\frac{11}{15} \end{aligned}$$

9.
$$\begin{array}{rcl} 76\frac{1}{12} & = & 76\frac{1}{12} & = & 75\frac{13}{12} \\ -35\frac{1}{4} & = & -35\frac{3}{12} & = & -35\frac{3}{12} \\ \hline & & & & 40\frac{10}{12}=40\frac{5}{6} \end{array}$$

Vocabulary, Readiness & Video Check 1.3

1. A quotient of two numbers, such as $\frac{5}{8}$, is called a fraction.

2. In the fraction $\frac{3}{11}$, the number 3 is called the numerator and the number 11 is called the denominator.

3. To factor a number means to write it as a product.

4. A fraction is said to be simplified when the numerator and the denominator have no common factors other than 1.

5. In $7 \cdot 3 = 21$, the numbers 7 and 3 are called factors and the number 21 is called the product.

6. The fractions $\frac{2}{9}$ and $\frac{9}{2}$ are called reciprocals.

7. Fractions that represent the same quantity are called equivalent fractions.

8. 5, Fundamental Principle of Fractions

9. The division operation changes to multiplication and the second fraction $\frac{1}{20}$ changes to its reciprocal $\frac{20}{1}$.

10. Find the LCD; two fractions must have the same or common denominator before you can subtract (or add).

11. The number $4\frac{7}{6}$ is not in proper mixed number form as the fraction part, $\frac{7}{6}$, should not be an improper fraction.

Exercise Set 1.3

2. 1 of the 4 equal parts are shaded; $\frac{1}{4}$

4. 2 of the 5 equal parts are shaded; $\frac{2}{5}$

6. $60 = 4 \cdot 15 = 2 \cdot 2 \cdot 3 \cdot 5$

8. $27 = 3 \cdot 9 = 3 \cdot 3 \cdot 3$

10. $56 = 4 \cdot 14 = 2 \cdot 2 \cdot 2 \cdot 7$

12. $32 = 4 \cdot 8 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

14. $24 = 4 \cdot 6 = 2 \cdot 2 \cdot 2 \cdot 3$

16. $\frac{3}{6}=\frac{1\cdot 3}{2\cdot 3}=\frac{1}{2}$

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18. $\frac{15}{20}=\frac{3\cdot 5}{4\cdot 5}=\frac{3}{4}$

20. $\frac{5}{9}=\frac{5}{9}$

22. $\frac{42}{45}=\frac{2\cdot 3\cdot 7}{3\cdot 3\cdot 5}=\frac{14}{15}$

24. $\frac{360}{700}=\frac{2\cdot 2\cdot 2\cdot 3\cdot 3\cdot 5}{2\cdot 2\cdot 5\cdot 5\cdot 7}=\frac{2\cdot 3\cdot 3}{5\cdot 7}=\frac{18}{35}$

26. $\frac{7}{11}\cdot\frac{3}{5}=\frac{7\cdot 3}{11\cdot 5}=\frac{21}{55}$

28. $\frac{7}{8}\cdot\frac{3}{21}=\frac{7\cdot 3}{8\cdot 21}=\frac{7\cdot 3}{8\cdot 3\cdot 7}=\frac{1}{8}$

30. $\frac{7}{12}\div\frac{1}{2}=\frac{7}{12}\cdot\frac{2}{1}=\frac{7\cdot 2}{12\cdot 1}=\frac{7\cdot 2}{2\cdot 6\cdot 1}=\frac{7}{6}$

32. $\frac{3}{5}\div\frac{9}{10}=\frac{3}{5}\cdot\frac{10}{9}=\frac{3\cdot 10}{5\cdot 9}=\frac{3\cdot 2\cdot 5}{5\cdot 3\cdot 3}=\frac{2}{3}$

34. $\frac{3}{35}\cdot\frac{10}{63}=\frac{3\cdot 10}{35\cdot 63}=\frac{3\cdot 2\cdot 5}{5\cdot 7\cdot 3\cdot 3\cdot 7}=\frac{2}{3\cdot 7\cdot 7}=\frac{2}{147}$

36. $\frac{1}{4}\cdot\frac{19}{6}=\frac{1\cdot 19}{4\cdot 6}=\frac{1\cdot 19}{2\cdot 2\cdot 2\cdot 3}=\frac{19}{24}$

38. Area $=\frac{1}{2}bh=\frac{1}{2}\cdot\frac{5}{4}\cdot\frac{1}{2}=\frac{5}{2\cdot 4\cdot 2}=\frac{5}{16}$ sq m

40. Area $=l\cdot w=\frac{2}{5}\cdot\frac{3}{11}=\frac{2\cdot 3}{5\cdot 11}=\frac{6}{55}$ square meters

42. $\frac{6}{7}-\frac{1}{7}=\frac{6-1}{7}=\frac{5}{7}$

44. $\frac{6}{7}+\frac{1}{7}=\frac{6+1}{7}=\frac{7}{7}=1$

46. $\frac{18}{35}-\frac{11}{35}=\frac{18-11}{35}=\frac{7}{35}=\frac{7}{5\cdot 7}=\frac{1}{5}$

48.
$$\begin{aligned}\frac{13}{132}+\frac{35}{132}&=\frac{13+35}{132}\\&=\frac{48}{132}\\&=\frac{2\cdot 2\cdot 2\cdot 2\cdot 3}{2\cdot 2\cdot 3\cdot 11}\\&=\frac{2\cdot 2}{11}\\&=\frac{4}{11}\end{aligned}$$

50. $\frac{2}{3}=\frac{2\cdot 3}{3\cdot 3}=\frac{6}{9}$

52. $\frac{8}{7}=\frac{8\cdot 8}{7\cdot 8}=\frac{64}{56}$

54. $\frac{4}{5}=\frac{4\cdot 5}{5\cdot 5}=\frac{20}{25}$

56. $\frac{3}{4}+\frac{1}{6}=\frac{3\cdot 3}{4\cdot 3}+\frac{1\cdot 2}{6\cdot 2}=\frac{9}{12}+\frac{2}{12}=\frac{11}{12}$

58. $\frac{11}{12}-\frac{1}{16}=\frac{44}{48}-\frac{3}{48}=\frac{44-3}{48}=\frac{41}{48}$

60.
$$\begin{aligned}\frac{7}{10}-\frac{8}{15}&=\frac{7\cdot 3}{10\cdot 3}-\frac{8\cdot 2}{15\cdot 2}\\&=\frac{21}{30}-\frac{16}{30}\\&=\frac{21-16}{30}\\&=\frac{5}{30}\\&=\frac{1}{6}\end{aligned}$$

62. $2-\frac{3}{8}=\frac{16}{8}-\frac{3}{8}=\frac{16-3}{8}=\frac{13}{8}$

64. $1-\frac{3}{11}-\frac{2}{11}=\frac{11}{11}-\frac{3}{11}-\frac{2}{11}=\frac{11-3-2}{11}=\frac{6}{11}$

The unknown part is $\frac{6}{11}$.

66. $1-\frac{1}{10}-\frac{3}{5}=\frac{10}{10}-\frac{1}{10}-\frac{3\cdot 2}{5\cdot 2}=\frac{10-1-6}{10}=\frac{3}{10}$

The unknown part is $\frac{3}{10}$.

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68. $1-\frac{1}{6}-\frac{1}{3}-\frac{5}{12}=\frac{12}{12}-\frac{1\cdot 2}{6\cdot 2}-\frac{1\cdot 4}{3\cdot 4}-\frac{5}{12}$
$=\frac{12-2-4-5}{12}$
$=\frac{1}{12}$

The unknown part is $\frac{1}{12}$.

70. $2\frac{3}{4}\cdot 1\frac{7}{8}=\frac{11}{4}\cdot\frac{15}{8}=\frac{165}{32}=5\frac{5}{32}$

72. $1\frac{7}{8}\div 3\frac{8}{9}=\frac{15}{8}\div\frac{35}{9}=\frac{15}{8}\cdot\frac{9}{35}=\frac{3\cdot 5\cdot 9}{8\cdot 5\cdot 7}=\frac{27}{56}$

74. $26\frac{11}{20}+40\frac{7}{10}=26\frac{11}{20}+40\frac{14}{20}$
$=66\frac{25}{20}$
$=67\frac{5}{20}$
$=67\frac{1}{4}$

76.
$$\begin{array}{r} 4\frac{3}{16} \\ -\,2\frac{7}{8} \\ \hline \end{array} \qquad \begin{array}{r} 4\frac{3}{16} \\ -\,2\frac{14}{16} \\ \hline \end{array} \qquad \begin{array}{r} 3\frac{19}{16} \\ -\,2\frac{14}{16} \\ \hline 1\frac{5}{16} \end{array}$$

78. $\frac{11}{35}+\frac{3}{35}=\frac{11+3}{35}=\frac{14}{35}=\frac{2\cdot 7}{5\cdot 7}=\frac{2}{5}$

80. $\frac{11}{7}-\frac{3}{35}=\frac{11\cdot 5}{7\cdot 5}-\frac{3}{35}=\frac{55}{35}-\frac{3}{35}=\frac{52}{35}$

82. $\frac{3}{4}\cdot\frac{7}{12}=\frac{3\cdot 7}{4\cdot 12}=\frac{3\cdot 7}{2\cdot 2\cdot 2\cdot 2\cdot 3}=\frac{7}{2\cdot 2\cdot 2\cdot 2}=\frac{7}{16}$

84. $\frac{3}{4}\div\frac{7}{12}=\frac{3}{4}\cdot\frac{12}{7}=\frac{3\cdot 12}{4\cdot 7}=\frac{3\cdot 3\cdot 4}{4\cdot 7}=\frac{9}{7}$

86. $7+\frac{1}{10}=\frac{70}{10}+\frac{1}{10}=\frac{70+1}{10}=\frac{71}{10}$

88. $9\frac{5}{6}\div\frac{1}{6}=\frac{59}{6}\div\frac{1}{6}=\frac{59}{6}\cdot\frac{6}{1}=\frac{59\cdot 6}{6\cdot 1}=\frac{59}{1}=59$

90. $\frac{7}{15}-\frac{7}{25}=\frac{7\cdot 5}{15\cdot 5}-\frac{7\cdot 3}{23\cdot 3}=\frac{35}{75}-\frac{21}{75}=\frac{35-21}{75}=\frac{14}{75}$

92. $\frac{57}{132}-\frac{13}{132}=\frac{57-13}{132}=\frac{44}{132}=\frac{4\cdot 11}{3\cdot 4\cdot 11}=\frac{1}{3}$

94. $2\frac{3}{5}+4\frac{7}{10}=\frac{13}{5}+\frac{47}{10}$
$=\frac{13\cdot 2}{5\cdot 2}+\frac{47}{10}$
$=\frac{26}{10}+\frac{47}{10}$
$=\frac{26+47}{10}$
$=\frac{73}{10}$
$=7\frac{3}{10}$

96. $\frac{8}{11}-\frac{1}{4}+\frac{1}{2}=\frac{8\cdot 4}{11\cdot 4}-\frac{1\cdot 11}{4\cdot 11}+\frac{1\cdot 22}{2\cdot 22}$
$=\frac{32}{44}-\frac{11}{44}+\frac{22}{44}$
$=\frac{32-11+22}{44}$
$=\frac{43}{44}$

98. $2\left(16\frac{1}{2}\right)+2\left(12\frac{3}{8}\right)=\frac{2}{1}\cdot\frac{33}{2}+\frac{2}{1}\cdot\frac{99}{8}$
$=\frac{33}{1}+\frac{99}{4}$
$=\frac{33\cdot 4}{1\cdot 4}+\frac{99}{4}$
$=\frac{132}{4}+\frac{99}{4}$
$=\frac{132+99}{4}$
$=\frac{231}{4}$
$=57\frac{3}{4}$ feet

100. answers may vary

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102. $3\frac{1}{2}+5\frac{1}{2}+2\frac{1}{8}+1\frac{3}{4}=\frac{7}{2}+\frac{11}{2}+\frac{17}{8}+\frac{7}{4}$

$$=\frac{7\cdot4}{2\cdot4}+\frac{11\cdot4}{2\cdot4}+\frac{17}{8}+\frac{7\cdot2}{4\cdot2}$$
$$=\frac{28}{8}+\frac{44}{8}+\frac{17}{8}+\frac{14}{8}$$
$$=\frac{28+44+17+14}{8}$$
$$=\frac{103}{8}$$
$$=12\frac{7}{8}$$

The distance for all 4 trails is $12\frac{7}{8}$ mi.

104. The sector for digital 3D is labeled $\frac{147}{250}$.

106. $\frac{1}{50}+\frac{147}{250}=\frac{1\cdot5}{50\cdot5}+\frac{147}{250}$

$$=\frac{5}{250}+\frac{147}{250}$$
$$=\frac{152}{250}$$
$$=\frac{2\cdot76}{2\cdot125}$$
$$=\frac{76}{125}$$

$\frac{76}{125}$ of movie screens were analog or digital 3D.

108. The work is correct.

110. The work is incorrect.

$\frac{16}{28}=\frac{2\cdot2\cdot2\cdot2}{2\cdot2\cdot7}=\frac{4}{7}$

Section 1.4 Practice Exercises

1. a. $1^3=1\cdot1\cdot1=1$

b. $5^2=5\cdot5=25$

c. $\left(\frac{1}{10}\right)^2=\left(\frac{1}{10}\right)\left(\frac{1}{10}\right)=\frac{1}{100}$

d. $9^1=9$

e. $\left(\frac{2}{5}\right)^3=\left(\frac{2}{5}\right)\left(\frac{2}{5}\right)\left(\frac{2}{5}\right)=\frac{8}{125}$

2. a. $6+3\cdot9=6+27=33$

b. $4^3\div8+3=64\div8+3=8+3=11$

c. $\left(\frac{2}{3}\right)^2\cdot|-8|=\frac{4}{9}\cdot8=\frac{32}{9}$ or $3\frac{5}{9}$

d. $\frac{9(14-6)}{|-2|}=\frac{9(8)}{2}=\frac{72}{2}=36$

e. $\frac{7}{4}\cdot\frac{1}{4}-\frac{1}{4}=\frac{7}{16}-\frac{4}{16}=\frac{3}{16}$

3. $\frac{6^2-5}{3+|6-5|\cdot8}=\frac{36-5}{3+|1|\cdot8}=\frac{31}{3+8}=\frac{31}{11}$

4. $4[25-3(5+3)]=4[25-3(8)]$

$$=4[25-24]$$
$$=4[1]$$
$$=4$$

5. $\frac{36\div9+5}{5^2-3}=\frac{4+5}{25-3}=\frac{9}{22}$

6. a. $2x+y=2(2)+5=4+5=9$

b. $\frac{4x}{3y}=\frac{4(2)}{3(5)}=\frac{8}{15}$

c. $\frac{3}{x}+\frac{x}{y}=\frac{3}{2}+\frac{2}{5}=\frac{15}{10}+\frac{4}{10}=\frac{19}{10}$

d. $x^3+y^2=2^3+5^2=8+25=33$

7. $9x-6=7x$

$9(4)-6\stackrel{?}{=}7(4)$

$36-6\stackrel{?}{=}28$

$30=28$ False

4 is not a solution of $9x-6=7x$.

8. a. Six times a number is $6\cdot x$ or $6x$, since $6x$ denotes the product of 6 and x.

b. A number decreased by 8 is $x-8$ because "decreased by" means subtract.

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c. The product of a number and 9 is $x \cdot 9$ or $9x$.

d. Two times a number is $2x$, plus 3 is $2x + 3$.

e. The sum of 7 and a number x is $7 + x$.

9. a. A number x increased by 7 is $x + 7$, so $x + 7 = 13$.

b. Two less than a number x is $x - 2$, so $x - 2 = 11$.

c. Double a number x is $2x$, added to 9 is $2x + 9$, so $2x + 9 \neq 25$.

d. Five times 11 is 5(11), so $5(11) \geq x$, where x is an unknown number.

Calculator Explorations

1. $5^4 = 625$

2. $7^4 = 2401$

3. $9^5 = 59,049$

4. $8^6 = 262,144$

5. $2(20 - 5) = 30$

6. $3(14 - 7) + 21 = 3(7) + 21 = 21 + 21 = 42$

7. $24(862 - 455) + 89 = 9857$

8. $99 + (401 + 962) = 1462$

9. $\frac{4623 + 129}{36 - 34} = 2376$

10. $\frac{956 - 452}{89 - 86} = 168$

Vocabulary, Readiness & Video Check 1.4

1. In 2^5, the 2 is called the base and the 5 is called the exponent.

2. "2^5 means $2 \cdot 5$" is a false statement: 2^5 means 5 factors of 2 or $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$.

3. To simplify $8 + 2 \cdot 6$, the operation that should be performed first is multiplication.

4. To simplify $(8 + 2) \cdot 6$, the operation that should be performed first is addition.

5. To simplify $9(3 - 2) \div 3 + 6$, the operation that should be performed first is subtraction.

6. To simplify $8 \div 2 \cdot 6$, the operation that should be performed first is division.

7. A combination of operations on letters (variables) and numbers is an expression.

8. A letter that represents a number is a variable.

9. $3x - 2y$ is called an expression, and the letters x and y are variables.

10. Replacing a variable in an expression by a number and then finding the value of the expression is called evaluating the expression.

11. A statement of the form "expression = expression" is called an equation.

12. A value for the variable that makes an equation a true statement is called a solution.

13. The order in which we perform operations does matter! We came up with an order of operations to avoid getting more than one answer when evaluating an expression.

14. The replacement value for z is not used because it's not needed—there is no variable z in the given algebraic expression.

15. No; the variable was replaced with 0 in the equation to see if a true statement occurred, and it did not.

16. We translate phrases to mathematical expressions and sentences to mathematical equations.

Exercise Set 1.4

2. $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$

4. $4^4 = 4 \cdot 4 \cdot 4 \cdot 4 = 256$

6. $1^8 = 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 = 1$

8. $8^1 = 8$

10. $9^2 = 9 \cdot 9 = 81$

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12. $\left(\frac{6}{11}\right)^2 = \left(\frac{6}{11}\right)\left(\frac{6}{11}\right) = \frac{6 \cdot 6}{11 \cdot 11} = \frac{36}{121}$

14. $\left(\frac{1}{2}\right)^5 = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)$
$= \frac{1 \cdot 1 \cdot 1 \cdot 1 \cdot 1}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}$
$= \frac{1}{32}$

16. $(1.5)^2 = (1.5)(1.5) = 2.25$

18. $(0.03)^3 = (0.03)(0.03)(0.03) = 0.000027$

20. $8 + 5 \cdot 3 = 8 + 15 = 23$

22. $12 \cdot 5 - 3 \cdot 6 = 60 - 18 = 42$

24. $5(6 - 2) = 5(4) = 20$

26. $6 - 2 \cdot 2 + 2^5 = 6 - 2 \cdot 2 + 32 = 6 - 4 + 32 = 34$

28. $2 \cdot 5^2 = 2 \cdot 25 = 50$

30. $\frac{3}{4} \cdot \frac{1}{2} + \frac{2}{3} = \frac{3}{8} + \frac{2}{3} = \frac{9}{24} + \frac{16}{24} = \frac{25}{24}$

32. $3[4 + 3(6 - 4)] = 3[4 + 3(2)]$
$= 3[4 + 6]$
$= 3[10]$
$= 30$

34. $\frac{4 \cdot 3 + 2}{4 + 3 \cdot 2} = \frac{12 + 2}{4 + 6} = \frac{14}{10} = \frac{7}{5}$

36. $\frac{15 - |3 - 1|}{12 - 3 \cdot 2} = \frac{15 - |2|}{12 - 6} = \frac{15 - 2}{6} = \frac{13}{6}$

38. $\frac{3 + 6(8 - 5)}{4^2 + 2} = \frac{3 + 6(3)}{4^2 + 2}$
$= \frac{3 + 6(3)}{16 + 2}$
$= \frac{3 + 18}{16 + 2}$
$= \frac{21}{18}$
$= \frac{7}{6}$

40. $\frac{16 + |13 - 5| + 4^2}{17 - 5} = \frac{16 + |8| + 4^2}{17 - 5}$
$= \frac{16 + 8 + 4^2}{17 - 5}$
$= \frac{16 + 8 + 16}{17 - 5}$
$= \frac{40}{12}$
$= \frac{4 \cdot 10}{4 \cdot 3}$
$= \frac{10}{3}$

42. $3 + 4[8(5 \cdot 5 - 20) - 39] = 3 + 4[8(25 - 20) - 39]$
$= 3 + 4[8(5) - 39]$
$= 3 + 4[40 - 39]$
$= 3 + 4[1]$
$= 3 + 4$
$= 7$

44. $\left(\frac{3}{8}\right)^2 + \frac{1}{4} + \frac{1}{8} \cdot \frac{3}{2} = \frac{9}{64} + \frac{1}{4} + \frac{1}{8} \cdot \frac{3}{2}$
$= \frac{9}{64} + \frac{1}{4} + \frac{3}{16}$
$= \frac{9}{64} + \frac{16}{64} + \frac{12}{64}$
$= \frac{37}{64}$

46. a. $(1 + 4) \cdot 6 - 3 = 5 \cdot 6 - 3 = 30 - 3 = 27$

b. $1 + 4 \cdot (6 - 3) = 1 + 4 \cdot 3 = 1 + 12 = 13$

c. $1 + 4 \cdot 6 - 3 = 1 + 24 - 3 = 22$

d. $(1 + 4) \cdot (6 - 3) = 5 \cdot 3 = 15$

48. Let $x = 1$.
$4x = 4(1) = 4$

50. Let $y = 3$ and $z = 5$.
$\frac{y}{2z} = \frac{3}{2(5)} = \frac{3}{10}$

52. Let $y = 3$.
$6y - 8 = 6(3) - 8 = 18 - 8 = 10$

54. Let $y = 3$ and $z = 5$.
$|5z - 2y| = |5(5) - 2(3)| = |25 - 6| = |19| = 19$

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56. Let $x = 1$, $y = 3$, and $z = 5$.

$$yz - x = 3 \cdot 5 - 1 = 15 - 1 = 14$$

58. Let $z = 5$.

$$2z^2 = 2(5)^2 = 2(25) = 50$$

60. Let $x = 12$, $y = 8$, and $z = 4$.

$$\frac{y}{z} + 8x = \frac{8}{4} + 8(12) = 2 + 96 = 98$$

62. Let $x = 12$ and $y = 8$.

$$y^2 - 3x + y = (8)^2 - 3(12) + 8 = 64 - 36 + 8 = 36$$

64. Let $x = 12$ and $y = 8$.

$$\frac{y^2 + x}{x^2 + 3y} = \frac{(8)^2 + 12}{(12)^2 + 3(8)} = \frac{64 + 12}{144 + 24} = \frac{76}{168} = \frac{19}{42}$$

66. No; answers may vary.

68. Let $x = 6$.

$$\begin{aligned} 2x + 7 &= 3x \\ 2(6) + 7 &\stackrel{?}{=} 3(6) \\ 12 + 7 &\stackrel{?}{=} 18 \\ 19 &= 18, \text{ false} \end{aligned}$$

6 is not a solution of the equation.

70. Let $x = 2$.

$$\begin{aligned} 4x + 2 &= x + 8 \\ 4(2) + 2 &\stackrel{?}{=} 2 + 8 \\ 8 + 2 &\stackrel{?}{=} 10 \\ 10 &= 10, \text{ true} \end{aligned}$$

2 is a solution of the equation.

72. Let $x = 6$.

$$\begin{aligned} 3x - 10 &= 8 \\ 3(6) - 10 &\stackrel{?}{=} 8 \\ 18 - 10 &\stackrel{?}{=} 8 \\ 8 &= 8, \text{ true} \end{aligned}$$

6 is a solution of the equation.

74. Let $x = 10$.

$$\begin{aligned} x + 6 &= x + 6 \\ 10 + 6 &\stackrel{?}{=} 10 + 6 \\ 16 &= 16, \text{ true} \end{aligned}$$

10 is a solution of the equation.

76. Let $x = 1$.

$$\begin{aligned} 4 &= 1 - x \\ 4 &\stackrel{?}{=} 1 - 1 \\ 4 &= 0, \text{ false} \end{aligned}$$

1 is not a solution of the equation.

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78. A number increased by 9 is written as $x + 9$.

80. Five decreased by a number is written as $5 - x$.

82. The quotient of a number and 9 is written as $\frac{x}{9}$.

84. Twice a number, decreased by 72 is written as $2x - 72$.

86. Four subtracted from eight is equal to two squared is written as $8 - 4 = 2^2$.

88. The difference of sixteen and four is greater than ten is written as $16 - 4 > 10$.

90. Seven subtracted from a number is 0 is written as $x - 7 = 0$.

92. 9.1 times a number equals 4 is written as $9.1x = 4$.

94. Eight added to twice a number is 42 is written as $2x + 8 = 42$.

96. To simplify the expression $(1 + 3) \cdot 6$, first add.

98. To simplify the expression $20 - 4 \div 2$, first divide.

100. Yes; answers may vary.

	Length, l	Width, w	Perimeter of Rectangle: $2l + 2w$	Area of Rectangle: lw
102.	6 in.	1 in.	$2l + 2w$ $= 2(6 \text{ in.}) + 2(1 \text{ in.})$ $= 12 \text{ in.} + 2 \text{ in.}$ $= 14 \text{ in.}$	lw $= (6 \text{ in.})(1 \text{ in.})$ $= 6 \text{ sq in.}$
104.	4.6 in.	2.4 in.	$2l + 2w$ $= 2(4.6 \text{ in.}) + 2(2.4 \text{ in.})$ $= 9.2 \text{ in.} + 4.8 \text{ in.}$ $= 14 \text{ in.}$	lw $= (4.6 \text{ in.})(2.4 \text{ in.})$ $= 11.04 \text{ sq in.}$

106. answers may vary

108. $2 \cdot (5 + 3^2) = 2 \cdot (5 + 9) = 2 \cdot 14 = 28$

110. a. $3x^2 - 26$ is an expression since it does not contain an equal sign.

b. $3x^2 - 26 = 1$ is an equation since it contains an equal sign.

c. $2x - 5 = 7x - 5$ is an equation since it contains an equal sign.

d. $9y + x - 8$ is an expression since it does not contain an equal sign.

e. $3^2 - 4(5 - 3)$ is an expression since it does not contain an equal sign.

112. answers may vary

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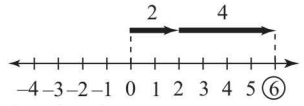
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114. answers may vary, for example, $2(10-7)+1$:
$2(10-7)+1=2(3)+1=6+1=7$

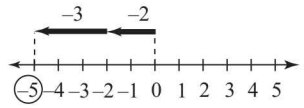
116. Let $h=5$, $B=15$, and $b=7$.
$$A=\frac{1}{2}h(B+b)=\frac{1}{2}(5)(15+7)=\frac{1}{2}(5)(22)=55$$
The area is 55 sq in.

118. Let $P=650$, $T=3$, and $I=126.75$.
$$\frac{I}{PT}=\frac{126.75}{(650)(3)}=\frac{126.75}{1950}=0.065=6.5\%$$

Section 1.5 Practice Exercises

1.


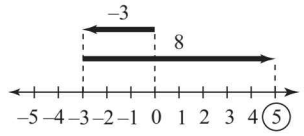
$2+4=6$

2.


$-2+(-3)=-5$

3. a. $-5+(-8)$
Add the absolute values.
$5+8=13$
The common sign is negative, so
$-5+(-8)=-13$.

b. $-31+(-1)$
Add the absolute values.
$31+1=32$
The common sign is negative, so
$-31+(-1)=-32$.

4.


$-3+8=5$

5. a. $15+(-18)$
Subtract the absolute values.
$18-15=3$
Use the sign of the number with the largest absolute value.
$15+(-18)=-3$

b. $-19+20=20-19=1$

c. $-0.6+0.4=-(0.6-0.4)=-(0.2)=-0.2$

6. a. $-\frac{3}{5}+\left(-\frac{2}{5}\right)=-\frac{5}{5}=-1$

b. $3+(-9)=-6$

c. $2.2+(-1.7)=0.5$

d. $-\frac{2}{7}+\frac{3}{10}=-\frac{20}{70}+\frac{21}{70}=\frac{1}{70}$

7. a. $8+(-5)+(-9)=3+(-9)=-6$

b. $[-8+5]+\left[-5+\left|-2\right|\right]=[-3]+[-5+2]$
$=-3+[-3]$
$=-6$

8. $-7+4+7=-3+7=4$
The temperature at 8 A.M. was 4°F.

9. a. The opposite of $-\frac{5}{9}$ is $\frac{5}{9}$.

b. The opposite of 8 is –8.

c. The opposite of 6.2 is –6.2.

d. The opposite of –3 is 3.

10. a. Since $|-15|=15$, $-|-15|=-15$.

b. $-\left(-\frac{3}{5}\right)=\frac{3}{5}$

c. $-(-5y)=5y$

d. $-(-8)=8$

Vocabulary, Readiness & Video Check 1.5

1. Two numbers that are the same distance from 0 but lie on opposite sides of 0 are called opposites.

2. If n is a number, then $n+(-n)=0$.

3. If n is a number, then $-(-n)=n$.

4. The sum of two negative numbers is always a negative number.

5. To add two numbers with the same sign, add their absolute values and use their common sign as the sign of the sum.

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6. Negative; when you add two numbers with different signs, the sign of the sum is the same as the sign of the number with the larger absolute value and −8.4 has a larger absolute value than 6.3.

7. Elevations below sea level; the ending elevation is −95 m or 95 meters below sea level.

8. Example 13 is an example of the opposite of the *absolute value* of $-a$, not the opposite of $-a$. The absolute value of $-a$ is positive, so its opposite is negative, therefore the answers to Examples 12 and 13 have different signs.

Exercise Set 1.5

2. $9 + (-12) = -3$

4. $-6 + (-14) = -20$

6. $6 + (-4) = 2$

8. $-10 + 5 = -5$

10. $-7 + (-4) = -11$

12. $7 + (-5) = 2$

14. $-5 + 9 = 4$

16. $8 + (-6) = 2$

18. $3 + (-6) = -3$

20. $23 + (-23) = 0$

22. $53 + (-37) = 16$

24. $-26 + 14 = -12$

26. $-18 + (-26) = -44$

28. $9.2 + (-11.4) = -2.2$

30. $|-6| + (-61) = 6 + (-61) = -55$

32. $144 + (-88) = 56$

34. $-6.7 + (-7.6) = -14.3$

36. $-\frac{5}{12} + \frac{7}{12} = \frac{2}{12} = \frac{1}{6}$

38. $-\frac{5}{9} + \frac{1}{3} = -\frac{5}{9} + \frac{1 \cdot 3}{3 \cdot 3} = -\frac{5}{9} + \frac{3}{9} = -\frac{2}{9}$

40. $$\begin{aligned} -\frac{5}{6} + \left(-\frac{2}{3}\right) &= -\frac{5}{6} + \left(-\frac{2 \cdot 2}{3 \cdot 2}\right) \\ &= -\frac{5}{6} + \left(-\frac{4}{6}\right) \\ &= -\frac{9}{6} \\ &= -\frac{3}{2} \end{aligned}$$

42. $-9 + 15 + (-5) = 6 + (-5) = 1$

44. $-18 + (-6) + (-40) = -24 + (-40) = -64$

46. $-14 + (-3) + 11 = -17 + 11 = -6$

48. $|7 + (-17)| = |-10| = 10$

50. $8 + (-2) + 7 = 6 + 7 = 13$

52. $[-2 + (-7)] + [-11 + 22] = [-9] + [11] = 2$

54. $|43 + (-73)| + |-20| = |-30| + 20 = 30 + 20 = 50$

56. $$\begin{aligned} -3.7 + [0.1 + (-0.6) + 8.1] &= -3.7 + [-0.5 + 8.1] \\ &= -3.7 + [7.6] \\ &= 3.9 \end{aligned}$$

58. $-35 + 142 = 107$
The highest recorded temperature in Massachusetts is 107°F.

60. $-52 + 439 = 387$
Your elevation is 387 feet.

62. $$\begin{aligned} 328 + (-678) + 393 + 622 &= -350 + 393 + 622 \\ &= 43 + 622 \\ &= 665 \end{aligned}$$
The total net income for fiscal year 2020 was $665 million.

64. $-4 + (-1) + 0 + 4 = -1$
His score was −1 or 1 under par.

66. The opposite of 4 is −4.

68. The opposite of −8 is 8.

70. The opposite of $-\frac{1}{4}$ is $\frac{1}{4}$.

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72. Since $|-11|$ is 11, the opposite of $|-11|$ is -11.

74. $-(-3) = 3$

76. $\left|-\frac{2}{3}\right| = \frac{2}{3}$

78. $-(-7) = 7$

80. Let $x = 10$.
$7 = -x + 3$
$7 \stackrel{?}{=} -(10) + 3$
$7 = -7$, false
10 is not a solution of the equation.

82. Let $y = -6$.
$1 = y + 7$
$1 \stackrel{?}{=} -6 + 7$
$1 = 1$, true
-6 is a solution of the equation.

84. Look for the bar that extends farthest in the negative direction. The month for which the temperature is the lowest is February.

86. Look for the bar whose length has a negative value closest to 0; November

88. $[(-19.3) + 27.0 + 8.8] \div 3 = [7.7 + 8.8] \div 3$
$= [16.5] \div 3$
$= 5.5$
The average was 5.5°F.

90. $-4 + 14 = 10$

92. $-15 + (-17) = -32$

94. Since b is a negative number, $-b$ is a positive number.

96. Since b is a negative number, $b + b$ is a negative number.

98. True

100. True

102. answers may vary

104. answers may vary

Section 1.6 Practice Exercises

1. a. $-7 - 6 = -7 + (-6) = -13$

b. $-8 - (-1) = -8 + 1 = -7$

c. $9 - (-3) = 9 + 3 = 12$

d. $5 - 7 = 5 + (-7) = -2$

2. a. $8.4 - (-2.5) = 8.4 + 2.5 = 10.9$

b. $-\frac{5}{8} - \left(-\frac{1}{8}\right) = -\frac{5}{8} + \frac{1}{8} = -\frac{4}{8} = -\frac{1}{2}$

c. $-\frac{3}{4} - \frac{1}{5} = -\frac{3}{4} + \left(-\frac{1}{5}\right)$
$= -\frac{15}{20} + \left(-\frac{4}{20}\right)$
$= -\frac{19}{20}$

3. $-2 - 5 = -2 + (-5) = -7$

4. a. $-15 - 2 - (-4) + 7 = -15 + (-2) + 4 + 7 = -6$

b. $3.5 + (-4.1) - (-6.7) = 3.5 + (-4.1) + 6.7$
$= 6.1$

5. a. $-4 + [(-8 - 3) - 5] = -4 + [(-8 + (-3)) - 5]$
$= -4 + [(-11) - 5]$
$= -4 + [-11 + (-5)]$
$= -4 + [-16]$
$= -20$

b. $|-13| - 3^2 + [2 - (-7)] = 13 - 9 + [2 + 7]$
$= 13 - 9 + 9$
$= 13$

6. a. $\frac{7 - x}{2y + x} = \frac{7 - (-3)}{2(4) + (-3)} = \frac{7 + 3}{8 + (-3)} = \frac{10}{5} = 2$

b. $y^2 + x = (4)^2 + (-3) = 16 + (-3) = 13$

7. $282 - (-75) = 282 + 75 = 357$
The overall change was $357.

8. a. $x = 90° - 62° = 28°$

b. $y = 180° - 43° = 137°$

Vocabulary, Readiness & Video Check 1.6

1. 7 minus a number $7 - x$

2. 7 subtracted from a number $x - 7$.

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3. A number decreased by 7 $x - 7$

4. 7 less a number $7 - x$

5. A number less than 7 $7 - x$

6. A number subtracted from 7 $7 - x$

7. To evaluate $x - y$ for $x = -10$ and $y = -14$, we replace x with -10 and y with -14 and evaluate $-10 - (-14)$. d

8. The expression $-5 - 10$ equals $-5 + (-10)$. c

9. To subtract two real numbers, change the operation to addition and take the opposite of the second number.

10. $-10 + (8) + (-4) + (-20)$; it's rewritten to change the subtraction operations to addition and turn the problem into an addition of real numbers problem.

11. There's a minus sign in the numerator and the replacement value is negative (notice parentheses are used around the replacement value), and it's always good to be careful when working with negative signs.

12. This means that the overall vertical altitude change of the jet is actually a decrease in altitude from when the Example started.

13. In Example 9, you have two supplementary angles and know the measure of one of them. From the definition, you know that the measures of two supplementary angles must sum to 180°. Therefore you can subtract the known angle measure from 180° to get the measure of the other angle.

Exercise Set 1.6

2. $-12 - 8 = -12 + (-8) = -20$

4. $8 - 11 = 8 + (-11) = -3$

6. $12 - (-5) = 12 + 5 = 17$

8. $$\begin{aligned}\frac{3}{4} - \frac{7}{8} &= \frac{3}{4} + \left(-\frac{7}{8}\right) \\ &= \frac{3 \cdot 2}{4 \cdot 2} + \left(-\frac{7}{8}\right) \\ &= \frac{6}{8} + \left(-\frac{7}{8}\right) \\ &= -\frac{1}{8}\end{aligned}$$

10. $-20 - (-48) = -20 + 48 = 28$

12. $-8 - 4 = -8 + (-4) = -12$

14. $3 - (-6) = 3 + 6 = 9$

16. $-4 - (-16) = -4 + 16 = 12$

18. $15 - (-33) = 15 + 33 = 48$

20. $8.3 - 11.2 = 8.3 + (-11.2) = -2.9$

22. $-36 - 51 = -36 + (-51) = -87$

24. $-17 - (-17) = -17 + 17 = 0$

26. $-6.1 - (-5.3) = -6.1 + 5.3 = -0.8$

28. $$-\frac{4}{7} - \left(-\frac{1}{7}\right) = -\frac{4}{7} + \frac{1}{7} = -\frac{3}{7}$$

30. $$\begin{aligned}-\frac{1}{10} - \frac{7}{8} &= -\frac{1}{10} + \left(-\frac{7}{8}\right) \\ &= -\frac{1 \cdot 4}{10 \cdot 4} + \left(-\frac{7 \cdot 5}{8 \cdot 5}\right) \\ &= -\frac{4}{40} + \left(-\frac{35}{40}\right) \\ &= -\frac{39}{40}\end{aligned}$$

32. $4.3 - (-0.87) = 4.3 + 0.87 = 5.17$

34. $-2 - 3 = -2 + (-3) = -5$

36. $1 - 17 = 1 + (-17) = -16$

38. $-4 - 9 = -4 + (-9) = -13$

40. $11 - (-14) = 11 + 14 = 25$

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42. $-16-(-3)+(-11)-14=-16+3+(-11)+(-14)$
$=-13+(-11)+(-14)$
$=-24+(-14)$
$=-38$

44. $7-12+(-5)-2+(-2)$
$=7+(-12)+(-5)+(-2)+(-2)$
$=-5+(-5)+(-2)+(-2)$
$=-10+(-2)+(-2)$
$=-12+(-2)$
$=-14$

46. $-9-(3-8)=-9-(-5)=-9+5=-4$

48. $2^3-6\cdot 3=8-6\cdot 3=8-18=8+(-18)=-10$

50. $4-6(7-3)=4-6(4)=4-24=4+(-24)=-20$

52. $(2-3)+5^2=[2+(-3)]+5^2$
$=[-1]+5^2$
$=[-1]+25$
$=24$

54. $-5+[(4-15)-(-6)-8]$
$=-5+[(4+(-15))+6+(-8)]$
$=-5+[(-11)+6+(-8)]$
$=-5+[(-5)+(-8)]$
$=-5+[-13]$
$=-18$

56. $|-2|+6^2+(-3-8)=2+6^2+[-3+(-8)]$
$=2+6^2+[-11]$
$=2+36+[-11]$
$=38+[-11]$
$=27$

58. Let $x=-5$ and $y=4$.
$y-x=4-(-5)=4+5=9$

60. Let $x=-5$, $y=4$, and $t=10$.
$|x+t-7y|=|-5+10-7(4)|$
$=|-5+10-28|$
$=|-5+10+(-28)|$
$=|5+(-28)|$
$=|-23|$
$=23$

62. Let $x=-5$ an $y=4$.
$\dfrac{15-x}{y+2}=\dfrac{15-(-5)}{4+2}=\dfrac{15+5}{4+2}=\dfrac{20}{6}=\dfrac{2\cdot 10}{2\cdot 3}=\dfrac{10}{3}$

64. Let $x=-5$ and $t=10$.
$t^2-x=10^2-(-5)=100+5=105$

66. Let $x=-5$, $y=4$ and $t=10$.
$\dfrac{|5y-x|}{6t}=\dfrac{|5(4)-(-5)|}{6(10)}$
$=\dfrac{|20+5|}{6(10)}$
$=\dfrac{|25|}{6(10)}$
$=\dfrac{25}{60}$
$=\dfrac{5\cdot 5}{12\cdot 5}$
$=\dfrac{5}{12}$

68. $93-18-26=93+(-18)+(-26)$
$=75+(-26)$
$=49$
She owes \$49 on her account.

70. $115-(-61)=115+61=176$
115°F is 176°F warmer than −61°F.

72. $16{,}024-(-36{,}201)=16{,}024+36{,}201=52{,}225$
Puncak Jaya is 52,225 feet higher.

74. $27-32=27+(-32)=-5$
His new score is −5.

76. $22{,}834-(-131)=22{,}834+131=22{,}965$
Mt. Aconcagua is 22,965 feet higher.

78. $x=90-50=90+(-50)=40$
The complementary angle is 40°.

80. $y=180-105=180+(-105)=75$
The supplementary angle is 75°.

82. Let $x=3$.
$x-10=-7$
$3-10\stackrel{?}{=}-7$
$-7=-7$, true
3 is a solution of the equation.

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84. Let $x = -10$.

$$\begin{aligned} -x - 6 &= -x - 1 \\ -(-10) - 6 &\stackrel{?}{=} -(-10) - 1 \\ 10 + (-6) &\stackrel{?}{=} 10 + (-1) \\ 4 &= 9, \text{ false} \end{aligned}$$

-10 is not a solution of the equation.

86. Let $x = 5$.

$$\begin{aligned} 4 &= 1 - x \\ 4 &\stackrel{?}{=} 1 - 5 \\ 4 &\stackrel{?}{=} 1 + (-5) \\ 4 &= -4, \text{ false} \end{aligned}$$

5 is not a solution of the equation.

88. The difference of -3 and a number is $-3 - x$.

90. Add a number and -36 is $x + (-36)$.

92.

Month	Monthly Increase or Decrease
July	$33.6 - 29.7 = 33.6 + (-29.7) = 3.9°F$
August	$33.3 - 33.6 = 33.3 + (-33.6) = -0.3°F$
September	$27.0 - 33.3 = 27.0 + (-33.3) = -6.3°F$
October	$8.8 - 27.0 = 8.8 + (-27.0) = -18.2°F$
November	$-6.9 - 8.8 = -6.9 + (-8.8) = -15.7°F$
December	$-17.2 - (-6.9) = -17.2 + 6.9 = -10.3°F$

94. The largest negative number corresponds to October.

96. answers may vary

98. $-4 - 8 = -4 + (-8) = -12$

100. $-3 - (-10) = -3 + 10 = 7$

102. true; answers may vary

104. true; answers may vary

106. Since 4.362 is less than 7.0086, the answer is negative.
$4.362 - 7.0086 = -2.6466$

Mid-Chapter Review

1. The opposite of a positive number is a negative number.

2. The sum of two negative numbers is a negative number.

3. The absolute value of a negative number is a positive number.

4. The absolute value of zero is 0.

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5. The reciprocal of a positive number is a positive number.

6. The sum of a number and its opposite is 0.

7. The absolute value of a positive number is a positive number.

8. The opposite of a negative number is a positive number.

	Number	Opposite	Absolute Value
9.	$\frac{1}{7}$	$-\frac{1}{7}$	$\frac{1}{7}$
10.	$-\frac{12}{5}$	$\frac{12}{5}$	$\frac{12}{5}$
11.	3	–3	3
12.	$-\frac{9}{11}$	$\frac{9}{11}$	$\frac{9}{11}$

13. $-19 + (-23) = -42$

14. $7 - (-3) = 7 + 3 = 10$

15. $-15 + 17 = 2$

16. $-8 - 10 = -8 + (-10) = -18$

17. $18 + (-25) = -7$

18. $-2 + (-37) = -39$

19. $-14 - (-12) = -14 + 12 = -2$

20. $5 - 14 = 5 + (-14) = -9$

21. $4.5 - 7.9 = 4.5 + (-7.9) = -3.4$

22. $-8.6 - 1.2 = -8.6 + (-1.2) = -9.8$

23. $-\frac{3}{4}-\frac{1}{7}=-\frac{21}{28}-\frac{4}{28}=-\frac{21}{28}+\left(-\frac{4}{28}\right)=-\frac{25}{28}$

24. $\frac{2}{3}-\frac{7}{8}=\frac{16}{24}-\frac{21}{24}=\frac{16}{24}+\left(-\frac{21}{24}\right)=-\frac{5}{24}$

25. $\begin{aligned}-9-(-7)+4-6 &= -9+7+4-6\\ &= -9+7+4+(-6)\\ &= -4\end{aligned}$

26. $\begin{aligned}11-20+(-3)-12 &= 11+(-20)+(-3)+(-12)\\ &= -9+(-3)+(-12)\\ &= -12+(-12)\\ &= -24\end{aligned}$

27. $\begin{aligned}24-6(14-11) &= 24-6[14+(-11)]\\ &= 24-6(3)\\ &= 24-18\\ &= 24+(-18)\\ &= 6\end{aligned}$

28. $\begin{aligned}30-5(10-8) &= 30-5[10+(-8)]\\ &= 30-5(2)\\ &= 30-10\\ &= 30+(-10)\\ &= 20\end{aligned}$

29. $(7-17)+4^2=[7+(-17)]+4^2=(-10)+16=6$

30. $\begin{aligned}9^2+(10-30) &= 9^2+[10+(-30)]\\ &= 81+(-20)\\ &= 61\end{aligned}$

31. $\begin{aligned}|-9|+3^2+(-4-20) &= 9+9+[-4+(-20)]\\ &= 9+9+(-24)\\ &= 18+(-24)\\ &= -6\end{aligned}$

32. $\begin{aligned}|-4-5|+5^2+(-50) &= |-4+(-5)|+5^2+(-50)\\ &= |-9|+25+(-50)\\ &= 9+25+(-50)\\ &= 34+(-50)\\ &= -16\end{aligned}$

33. $\begin{aligned}-7+[(1-2)+(-2-9)] &= -7+[(-1)+(-11)]\\ &= -7+[-12]\\ &= -19\end{aligned}$

34. $\begin{aligned}-6+[(-3+7)+(4-15)] &= -6+[(4)+(-11)]\\ &= -6+(-7)\\ &= -13\end{aligned}$

35. $1 - 5 = 1 + (-5) = -4$

36. $-3 - (-2) = -3 + 2 = -1$

37. $\frac{1}{4}-\left(-\frac{2}{5}\right)=\frac{1}{4}+\frac{2}{5}=\frac{5}{20}+\frac{8}{20}=\frac{13}{20}$

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38. $-\frac{5}{8}-\left(\frac{1}{10}\right)=-\frac{25}{40}-\frac{4}{40}=-\frac{25}{40}+\left(-\frac{4}{40}\right)=-\frac{29}{40}$

39. $2(19-17)^3-3(-7+9)^2$
$=2[19+(-17)]^3-3(-7+9)^2$
$=2(2)^3-3(2)^2$
$=2(8)-3(4)$
$=16-12$
$=16+(-12)$
$=4$

40. $3(10-9)^2+6(20-19)^3$
$=3[10+(-9)]^2+6[20+(-19)]^3$
$=3(1)^2+6(1)^3$
$=3+6$
$=9$

41. $x-y=-2-(-1)=-2+1=-1$

42. $x+y=-2+(-1)=-3$

43. $y+z=-1+9=8$

44. $z-y=9-(-1)=9+1=10$

45. $\frac{|5z-x|}{y-x}=\frac{|5(9)-(-2)|}{-1-(-2)}=\frac{|45+2|}{-1+2}=\frac{|47|}{1}=47$

46. $\frac{|-x-y+z|}{2z}=\frac{|-(-2)-(-1)+9|}{2(9)}$
$=\frac{|2+1+9|}{18}$
$=\frac{|12|}{18}$
$=\frac{12}{18}$
$=\frac{2}{3}$

Section 1.7 Practice Exercises

1. a. $8(-5)=-40$

b. $(-3)(-4)=12$

c. $(-6)(9)=-54$

2. a. $(-1)(-5)(-6)=5(-6)=-30$

b. $(-3)(-2)(4)=6(4)=24$

c. $(-4)(0)(5)=0(5)=0$

d. $(-2)(-3)-(-4)(5)=6-(-20)$
$=6+20$
$=26$

3. a. $(0.23)(-0.2)=-[(0.23)(0.2)]=-0.046$

b. $\left(-\frac{3}{5}\right)\cdot\left(\frac{4}{9}\right)=-\frac{3\cdot4}{5\cdot9}=-\frac{12}{45}=-\frac{4}{15}$

c. $\left(-\frac{7}{12}\right)(-24)=\frac{7\cdot24}{12\cdot1}=7\cdot2=14$

4. a. $(-6)^2=(-6)(-6)=36$

b. $-6^2=-(6\cdot6)=-(36)=-36$

c. $(-4)^3=(-4)(-4)(-4)=16(-4)=-64$

d. $-4^3=-(4\cdot4\cdot4)=-[16(4)]=-64$

5. a. The reciprocal of $\frac{8}{3}$ is $\frac{3}{8}$ since $\frac{8}{3}\cdot\frac{3}{8}=1$.

b. The reciprocal of 15 is $\frac{1}{15}$ since $15\cdot\frac{1}{15}=1$.

c. The reciprocal of $-\frac{2}{7}$ is $-\frac{7}{2}$ since $\left(-\frac{2}{7}\right)\left(-\frac{7}{2}\right)=1$.

d. The reciprocal of -5 is $-\frac{1}{5}$ since $(-5)\left(-\frac{1}{5}\right)=1$.

6. a. $\frac{16}{-2}=16\left(-\frac{1}{2}\right)=-8$

b. $24\div(-6)=24\left(-\frac{1}{6}\right)=-4$

c. $\frac{-35}{-7}=\frac{35}{7}=\frac{5\cdot7}{7}=5$

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7. a. $\frac{-18}{-6}=\frac{18}{6}=\frac{3\cdot 6}{6}=3$

b. $\frac{-48}{3}=-\frac{48}{3}=-\frac{3\cdot 16}{3}=-16$

c. $\frac{3}{5}\div\left(-\frac{1}{2}\right)=\frac{3}{5}\cdot(-2)=-\frac{6}{5}$

d. $-\frac{4}{9}\div 8=-\frac{4}{9}\cdot\frac{1}{8}=-\frac{4}{9\cdot 4\cdot 2}=-\frac{1}{9\cdot 2}=-\frac{1}{18}$

8. a. $\frac{0}{-2}=0$

b. $\frac{-4}{0}$ is undefined.

c. $\frac{-5}{6(0)}=\frac{-5}{0}$ is undefined.

9. a. $\frac{(-8)(-11)-4}{-9-(-4)}=\frac{88-4}{-9+4}=\frac{84}{-5}=-\frac{84}{5}$

b. $\frac{3(-2)^3-9}{-6+3}=\frac{3(-8)-9}{-3}$
$=\frac{-24-9}{-3}$
$=\frac{-33}{-3}$
$=11$

10. a. $7y-x=7(-2)-(-5)=-14+5=-9$

b. $x^2-y^3=(-5)^2-(-2)^3$
$=25-(-8)$
$=25+8$
$=33$

c. $\frac{2x}{3y}=\frac{2(-5)}{3(-2)}=\frac{-10}{-6}=\frac{5}{3}$

11. total score $=4\cdot(-13)=-52$
The card player's total score was -52.

Calculator Explorations

1. $-38(26-27)=38$

2. $-59(-8)+1726=2198$

3. $134+25(68-91)=-441$

4. $45(32)-8(218)=-304$

5. $\frac{-18(817)}{175-265}=163.4$

6. $\frac{-444-444.8}{-181-324}=1.76$

7. $9^5-4550=54,499$

8. $5^8-6259=384,366$

9. $(-125)^2=15,625$

10. $-125^2=-15,625$

Vocabulary, Readiness & Video Check 1.7

1. If n is a real number, then $n\cdot 0=$ 0 and $0\cdot n=$ 0.

2. If n is a real number, but not 0, then $\frac{0}{n}=$ 0 and we say $\frac{n}{0}$ is undefined.

3. The product of two negative numbers is a positive number.

4. The quotient of two negative numbers is a positive number.

5. The quotient of a positive number and a negative number is a negative number.

6. The product of a positive number and a negative number is a negative number.

7. The reciprocal of a positive number is a positive number.

8. The opposite of a positive number is a negative number.

9. The parentheses, or lack of them, determine the base of the expression. In Example 6, $(-2)^4$, the base is -2 and all of -2 is raised to the fourth power. In Example 7, -2^4, the base is 2 and only 2 is raised to the fourth power.

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10. Remember, the product of a number and its reciprocal is 1, *not* -1. $\frac{2}{3}\cdot\frac{3}{2}=1$, as needed.

11. Yes; because division of real numbers is defined in terms of multiplication.

12. The replacement values are negative and both will be squared. Therefore they must be placed in parentheses so the entire value, including the negative, is squared.

13. The football team lost 4 yards on each play and a loss of yardage is represented by a negative number.

Exercise Set 1.7

2. $-8(5)=-40$

4. $9(-4)=-36$

6. $-6(-11)=66$

8. $-2\cdot 8=-16$

10. $-6\cdot 0=0$

12. $3(-5)=-15$

14. $-\frac{1}{8}\left(-\frac{1}{3}\right)=\frac{1\cdot 1}{8\cdot 3}=\frac{1}{24}$

16. $-\frac{5}{6}\left(-\frac{3}{10}\right)=\frac{5\cdot 3}{6\cdot 10}=\frac{15}{60}=\frac{15}{15\cdot 4}=\frac{1}{4}$

18. $6(-2.5)=-15$

20. $-0.5(-0.3)=0.15$

22. $-20(60)=-1200$

24. $5(-9)=-45$

26. $(-7)(-7)=49$

28. $\frac{2}{7}\left(-\frac{2}{11}\right)=-\frac{2\cdot 2}{7\cdot 11}=-\frac{4}{77}$

30. $-12(12)=-144$

32. $-\frac{25}{36}\left(\frac{6}{15}\right)=-\frac{25\cdot 6}{36\cdot 15}=-\frac{150}{480}=-\frac{5}{18}$

34. $(-2)(-3)(-4)(-2)=6(-4)(-2)=-24(-2)=48$

36. $8(-3)-4(-5)=-24-(-20)=-24+20=-4$

38. $20-(-4)(3)(-2)=20-(24)=20+(-24)=-4$

40. True; example: $2\cdot 2\cdot 2=8$

42. True; example: $2\cdot 2\cdot 2\cdot 2=16$

44. $-2^4=-(2\cdot 2\cdot 2\cdot 2)=-16$

46. $(-1)^5=(-1)(-1)(-1)(-1)(-1)=-1$

48. $-5^2=-(5\cdot 5)=-25$

50. $(-7)^2=(-7)(-7)=49$

52. Reciprocal of 100 is $\frac{1}{100}$ since $100\cdot\frac{1}{100}=1$.

54. Reciprocal of $\frac{1}{7}$ is 7 since $\frac{1}{7}\cdot 7=1$.

56. Reciprocal of -8 is $-\frac{1}{8}$ since $-8\cdot-\frac{1}{8}=1$.

58. Reciprocal of $-\frac{6}{13}$ is $-\frac{13}{6}$ since $-\frac{6}{13}\cdot-\frac{13}{6}=1$.

60. Reciprocal of 1.5 is $\frac{1}{1.5}$ since $1.5\cdot\frac{1}{1.5}=1$.

62. Reciprocal of $\frac{1}{-8.9}$ is -8.9 since $\frac{1}{-8.9}\cdot-8.9=1$.

64. $\frac{20}{-10}=20\cdot-\frac{1}{10}=-2$

66. $\frac{-18}{-6}=-18\cdot-\frac{1}{6}=3$

68. $\frac{-60}{5}=-60\cdot\frac{1}{5}=-12$

70. $\frac{0}{-9}=0\cdot-\frac{1}{9}=0$

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72. $-\frac{24}{8} = -24 \cdot \frac{1}{8} = -3$

74. $\frac{3}{0}$ is undefined.

76. $\frac{-45}{-9} = -45 \cdot -\frac{1}{9} = 5$

78. $\frac{14}{-2} = 14 \cdot -\frac{1}{2} = -7$

80. $\frac{4}{5} \div \left(-\frac{1}{2}\right) = \frac{4}{5} \cdot \left(-\frac{2}{1}\right) = -\frac{4 \cdot 2}{5 \cdot 1} = -\frac{8}{5}$

82. $-\frac{1}{10} \div \left(-\frac{8}{11}\right) = -\frac{1}{10} \cdot \left(-\frac{11}{8}\right) = \frac{1 \cdot 11}{10 \cdot 8} = \frac{11}{80}$

84. $-\frac{5}{12} \div \frac{5}{12} = -\frac{5}{12} \cdot \frac{12}{5} = -\frac{5 \cdot 12}{12 \cdot 5} = -1$

86. $\frac{-6(-3)}{-4} = \frac{18}{-4} = -\frac{9}{2}$

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

90. $\frac{-3^2 + 4}{-5} = \frac{-9 + 4}{-5} = \frac{-5}{-5} = 1$

92. $\frac{6 + (-2)^2}{4 - 9} = \frac{6 + 4}{4 - 9} = \frac{10}{-5} = -2$

94. $\frac{-20 + (-4)(3)}{1 - 5} = \frac{-20 + (-12)}{1 - 5} = \frac{-32}{-4} = 8$

96. $\frac{-2 - 4^2}{3(-6)} = \frac{-2 - 16}{3(-6)} = \frac{-2 + (-16)}{-18} = \frac{-18}{-18} = 1$

98. $\frac{8 - 3(-2)}{2 - 5(-4)} = \frac{8 - (-6)}{2 - (-20)} = \frac{8 + 6}{2 + 20} = \frac{14}{22} = \frac{7}{11}$

100. $\frac{-4 - 8(-2)}{-9 - 2(-3)} = \frac{-4 - (-16)}{-9 - (-6)} = \frac{-4 + 16}{-9 + 6} = \frac{12}{-3} = -4$

102. $\frac{|-3 + 6| + |-2 + 7|}{|-2 \cdot 2|} = \frac{|3| + |5|}{|-4|} = \frac{3 + 5}{4} = \frac{8}{4} = 2$

104. Let $x = -5$ and $y = -3$.
$4x + 5y = 4(-5) + 5(-3) = -20 + (-15) = -35$

106. Let $x = -5$ and $y = -3$.
$$\begin{aligned} x^2 - 2y^2 &= (-5)^2 - 2(-3)^2 \\ &= 25 - 2(9) \\ &= 25 + (-18) \\ &= 7 \end{aligned}$$

108. Let $x = -5$ and $y = -3$.
$y^3 + 3x = (-3)^3 + 3(-5) = -27 + (-15) = -42$

110. Let $x = -5$ and $y = -3$.
$\frac{2y - 12}{x - 4} = \frac{2(-3) - 12}{-5 - 4} = \frac{-6 - 12}{-5 - 4} = \frac{-18}{-9} = 2$

112. Let $x = -5$ and $y = -3$.
$\frac{4 - 2x}{y + 3} = \frac{4 - 2(-5)}{-3 + 3} = \frac{4 + 10}{0}$ is undefined.

114. The quotient of -8 and a number is $\frac{-8}{x}$ or $-8 \div x$.

116. The sum of a number and -12 is $x + (-12)$.

118. The difference of a number and -10 is $x - (-10)$.

120. Multiply a number by -17 is $x \cdot (-17)$ or $-17x$.

122. A loss of \$400 is represented by -400.
$7 \cdot (-400) = -2800$
The total loss was \$2800.

124. A drop of 5 degrees is represented by -5.
$6 \cdot (-5) = -30$
The total drop in temperature was 30 degrees.

126. Let $x = -4$.
$2x = x - 1$
$2(-4) \stackrel{?}{=} -4 - 1$
$-8 = -5$, false
-4 is not a solution of the equation.

128. Let $x = -3$.
$\frac{45}{x} = -15$
$\frac{45}{-3} \stackrel{?}{=} -15$
$-15 = -15$, true
-3 is a solution of the equation.

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130. Let $x = -4$.

$$2x+4 = x+8$$
$$2(-4)+4 \stackrel{?}{=} -4+8$$
$$-8+4 \stackrel{?}{=} 4$$
$$-4 = 4, \text{ false}$$

-4 is not a solution of the equation.

132. $\dfrac{330}{-1} = -330$

The surface temperature of Neptune is $-330°$F.

134. answers may vary

136. answers may vary

138. Since q is negative, r is negative, and t is positive, then $q^2 \cdot r \cdot t$ is negative.

140. Not possible to determine whether $t + r$ is positive or negative.

142. Since q is negative, r is negative, and t is positive, then $r(q - t)$ is positive.

144. $1 + (-8)(-5) = 1 + 40 = 41$

146. $\dfrac{0}{5} - 7 = 0 - 7 = -7$

Section 1.8 Practice Exercises

1. a. $x \cdot 8 = \underline{8 \cdot x}$

b. $x + 17 = \underline{17 + x}$

2. a. $(2 + 9) + 7 = \underline{2 + (9 + 7)}$

b. $-4 \cdot (2 \cdot 7) = \underline{(-4 \cdot 2) \cdot 7}$

3. a. $(5+x)+9 = (x+5)+9 = x+(5+9) = x+14$

b. $5(-6x) = [5 \cdot (-6)]x = -30x$

4. a. $5(x - y) = 5(x) - 5(y) = 5x - 5y$

b. $-6(4 + 2t) = -6(4) + (-6)(2t) = -24 - 12t$

c. $2(3x-4y-z) = 2(3x)+2(-4y)+2(-z)$
$= 6x-8y-2z$

d. $(3 - y) \cdot (-1) = 3(-1) + (-y)(-1) = -3 + y$

e. $-(x-7+2s) = (-1)(x-7+2s)$
$= (-1)x+(-1)(-7)+(-1)(2s)$
$= -x+7-2s$

f. $\dfrac{1}{2}(2x+4)+9 = \dfrac{1}{2}(2x)+\dfrac{1}{2}(4)+9$
$= x+2+9$
$= x+11$

5. a. $5 \cdot w + 5 \cdot 3 = 5(w + 3)$

b. $9w + 9z = 9 \cdot w + 9 \cdot z = 9(w + z)$

6. a. $(7 \cdot 3x) \cdot 4 = (3x \cdot 7) \cdot 4$; commutative property of multiplication

b. $6 + (3 + y) = (6 + 3) + y$; associative property of addition

c. $8 + (t + 0) = 8 + t$; identity element for addition

d. $-\dfrac{3}{4} \cdot \left(-\dfrac{4}{3}\right) = 1$; multiplicative inverse property

e. $(2 + x) + 5 = 5 + (2 + x)$; commutative property of addition

f. $3 + (-3) = 0$; additive inverse property

g. $(-3b) \cdot 7 = (-3 \cdot 7) \cdot b$; commutative and associative properties of multiplication

Vocabulary, Readiness & Video Check 1.8

1. $x + 5 = 5 + x$ is a true statement by the commutative property of addition.

2. $x \cdot 5 = 5 \cdot x$ is a true statement by the commutative property of multiplication.

3. $3(y + 6) = 3 \cdot y + 3 \cdot 6$ is true by the distributive property.

4. $2 \cdot (x \cdot y) = (2 \cdot x) \cdot y$ is a true statement by the associative property of multiplication.

5. $x + (7 + y) = (x + 7) + y$ is a true statement by the associative property of addition.

6. The numbers $-\dfrac{2}{3}$ and $-\dfrac{3}{2}$ are called reciprocals or multiplicative inverses.

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7. The numbers $-\frac{2}{3}$ and $\frac{2}{3}$ are called opposites or additive inverses.

8. order; grouping

9. 2 is outside the parentheses, so the point is made that you should only distribute the –9 to the terms within the parentheses and not also to the 2.

10. The identity element for addition is 0 because if we add 0 to any real number, the result is that real number.
The identity element for multiplication is 1 because any real number times 1 gives a result of that original real number.

Exercise Set 1.8

2. $4 + y = y + 4$

4. $-2 \cdot x = x \cdot (-2)$

6. $ab = ba$

8. $19 + 3y = 3y + 19$

10. $3 \cdot (xy) = (3x) \cdot y$

12. $(y + 4) + z = y + (4 + z)$

14. $(-3y) \cdot z = -3 \cdot (yz)$

16. $6 + (r + s) = (6 + r) + s$

18. $(r + 3) + 11 = r + (3 + 11) = r + 14$

20. $2(42x) = (2 \cdot 42)x = 84x$

22. $\frac{1}{8}(8z) = \left(\frac{1}{8} \cdot 8\right)z = 1 \cdot z = z$

24. $7 + (x + 4) = 7 + (4 + x) = (7 + 4) + x = 11 + x$

26. $-3(12y) = (-3 \cdot 12)y = -36y$

28. $\frac{2}{7}\left(\frac{7}{2}r\right) = \left(\frac{2}{7} \cdot \frac{7}{2}\right)r = 1r = r$

30.
$$\begin{aligned}\frac{7}{9} + \left(\frac{2}{9} + y\right) &= \frac{7}{9} + \frac{2}{9} + y \\ &= \frac{9}{9} + y \\ &= 1 + y\end{aligned}$$

32. $7(a + b) = 7a + 7b$

34. $11(y - 4) = 11y - 11 \cdot 4 = 11y - 44$

36. $5(7 + 8y) = 5(7) + 5(8y) = 35 + 40y$

38. $3(8x - 1) = 3(8x) - 3(1) = 24x - 3$

40. $2(x + 5) = 2(x) + 2(5) = 2x + 10$

42. $-3(z - y) = -3z - (-3)y = -3z + 3y$

44. $-5(2r + 11) = -5(2r) + (-5)(11) = -10r - 55$

46. $8(3y + z - 6) = 8(3y) + 8z - 8(6) = 24y + 8z - 48$

48.
$$\begin{aligned}-4(4 + 2p + 5q) &= -4(4) + (-4)(2p) + (-4)(5q) \\ &= -16 - 8p - 20q\end{aligned}$$

50.
$$\begin{aligned}-(9r + 5) &= -1(9r + 5) \\ &= -1(9r) + (-1)(5) \\ &= -9r - 5\end{aligned}$$

52.
$$\begin{aligned}-(q - 2 + 6r) &= -1(q - 2 + 6r) \\ &= -1q - (-1)(2) + (-1)(6r) \\ &= -q + 2 - 6r\end{aligned}$$

54.
$$\begin{aligned}\frac{1}{4}(4x - 2) &= \frac{1}{4}(4x) - \frac{1}{4}(2) \\ &= \left(\frac{1}{4} \cdot 4\right)x - \left(\frac{1}{4} \cdot 2\right) \\ &= x - \frac{1}{2}\end{aligned}$$

56.
$$\begin{aligned}-\frac{1}{5}(10a - 25b) &= -\frac{1}{5}(10a) - \left(-\frac{1}{5}\right)(25b) \\ &= \left(-\frac{1}{5} \cdot 10\right)a - \left(-\frac{1}{5} \cdot 25\right)b \\ &= -2 \cdot a + 5 \cdot b \\ &= -2a + 5b\end{aligned}$$

58.
$$\begin{aligned}10(4s + 6) - 40 &= 10(4s) + 10(6) - 40 \\ &= 40s + 60 + (-40) \\ &= 40s + 20\end{aligned}$$

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60. $-11(5x+3)+10 = -11(5x)+(-11)(3)+10$
$= -55x-33+10$
$= -55x-23$

62. $-6(2x+1)-1 = -6(2x)+(-6)(1)-1$
$= -12x+(-6)-1$
$= -12x-7$

64. $14 \cdot z + 14 \cdot 5 = 14(z+5)$

66. $9a + 9b = 9(a+b)$

68. $(-3)a + (-3)b = -3(a+b)$

70. $25x + 25y = 25(x+y)$

72. $4(3+8) = 4 \cdot 3 + 4 \cdot 8$; distributive property

74. $(x+9)+3 = (9+x)+3$; commutative property of addition

76. $1 \cdot 9 = 9$; identity element for multiplication

78. $6 \cdot \frac{1}{6} = 1$; multiplicative inverse property

80. $(a+9)+6 = a+(9+6)$; associative property of addition

82. $(11+r)+8 = (r+11)+8$; commutative property of addition

84. $r+0=r$; identity element for addition

	Expression	Opposite	Reciprocal
86.	$-\frac{2}{3}$	$\frac{2}{3}$	$-\frac{3}{2}$
88.	$4y$	$-4y$	$\frac{1}{4y}$
90.	$-7x$	$7x$	$-\frac{1}{7x}$

92. False; the reciprocal of $-\frac{a}{2}$ is $-\frac{2}{a}$.

The opposite of $-\frac{a}{2}$ is $\frac{a}{2}$.

94. "Putting on your shoes" and "putting on your socks" are not commutative, since the order in which they are performed affects the outcome.

96. "Reading the sports section" and "reading the comics section" are commutative, since the order in which they are performed does not affect the outcome.

98. "Baking a cake" and "eating the cake" are not commutative, since the order in which they are performed affects the outcome.

100. "Feeding the dog" and "feeding the cat" are commutative, since the order in which they are performed does not affect the outcome.

102. a. The property illustrated is the associative property of addition since the grouping of addition changed.

b. The property illustrated is the commutative property of addition since the order in which they are added changed.

c. The property illustrated is the commutative property of addition since the order in which they are added changed.

104. answers may vary

106. answers may vary

Chapter 1 Vocabulary Check

1. The symbols $\neq$, $<$, and $>$ are called inequality symbols.

2. A mathematical statement that two expressions are equal is called an equation.

3. The absolute value of a number is the distance between that number and 0 on a number line.

4. A symbol used to represent a number is called a variable.

5. Two numbers that are the same distance from 0 but lie on opposite sides of 0 are called opposites.

6. The number in a fraction above the fraction bar is called the numerator.

7. A solution of an equation is a value for the variable that makes the equation a true statement.

8. Two numbers whose product is 1 are called reciprocals.

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9. In 2^3, the 2 is called the base and the 3 is called the exponent.

10. The number in a fraction below the fraction bar is called the denominator.

11. Parentheses and brackets are examples of grouping symbols.

12. A set is a collection of objects.

Chapter 1 Review

1. $8 < 10$ since 8 is to the left of 10 on a number line.

2. $7 > 2$ since 7 is to the right of 2 on a number line.

3. $-4 > -5$ since -4 is to the right of -5 on a number line.

4. $\frac{12}{2} > -8$ since $6 > -8$.

5. $|-7| < |-8|$ since $7 < 8$.

6. $|-9| > -9$ since $9 > -9$.

7. $-|-1| = -1$ since $-1 = -1$.

8. $|-14| = -(-14)$ since $14 = 14$.

9. $1.2 > 1.02$ since 1.2 is to the right of 1.02 on a number line.

10. $-\frac{3}{2} < \frac{3}{4}$ since $-\frac{3}{2}$ is to the left of $\frac{3}{4}$ on a number line.

11. Four is greater than or equal to negative three is written as $4 \geq -3$.

12. Six is not equal to five is written as $6 \neq 5$.

13. 0.03 is less than 0.3 is written as $0.03 < 0.3$.

14. $155 < 400$

15. a. The natural numbers are 1 and 3.

b. The whole numbers are 0, 1, and 3.

c. The integers are -6, 0, 1, and 3.

d. The rational numbers are -6, 0, 1, $1\frac{1}{2}$, 3, and 9.62.

e. The irrational number is π.

f. The real numbers are all numbers in the given set.

16. a. The natural numbers are 2 and 5.

b. The whole numbers are 2 and 5.

c. The integers are -3, 2, and 5.

d. The rational numbers are -3, -1.6, 2, 5, $\frac{11}{2}$, and 15.1.

e. The irrational numbers are $\sqrt{5}$ and 2π.

f. The real numbers are all numbers in the given set.

17. Look for the negative number with the greatest absolute value. The greatest loss was on Friday.

18. Look for the largest positive number. The greatest gain was on Wednesday.

19. $36 = 4 \cdot 9 = 2 \cdot 2 \cdot 3 \cdot 3$

20. $120 = 8 \cdot 15 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5$

21. $\frac{8}{15} \cdot \frac{27}{30} = \frac{8 \cdot 27}{15 \cdot 30} = \frac{2 \cdot 4 \cdot 3 \cdot 3 \cdot 3}{3 \cdot 5 \cdot 2 \cdot 3 \cdot 5} = \frac{12}{25}$

22. $\frac{7}{8} \div \frac{21}{32} = \frac{7}{8} \cdot \frac{32}{21} = \frac{7 \cdot 32}{8 \cdot 21} = \frac{7 \cdot 8 \cdot 4}{8 \cdot 3 \cdot 7} = \frac{4}{3}$

23.
$$\begin{aligned} \frac{7}{15} + \frac{5}{6} &= \frac{7 \cdot 2}{15 \cdot 2} + \frac{5 \cdot 5}{6 \cdot 5} \\ &= \frac{14}{30} + \frac{25}{30} \\ &= \frac{14 + 25}{30} \\ &= \frac{39}{30} \\ &= \frac{3 \cdot 13}{3 \cdot 10} \\ &= \frac{13}{10} \end{aligned}$$

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24. $\frac{3}{4}-\frac{3}{20}=\frac{3\cdot5}{4\cdot5}-\frac{3}{20}$
$=\frac{15}{20}-\frac{3}{20}$
$=\frac{15-3}{20}$
$=\frac{12}{20}$
$=\frac{3\cdot4}{5\cdot4}$
$=\frac{3}{5}$

25. $2\frac{3}{4}+6\frac{5}{8}=\frac{11}{4}+\frac{53}{8}$
$=\frac{11\cdot2}{4\cdot2}+\frac{53}{8}$
$=\frac{22}{8}+\frac{53}{8}$
$=\frac{22+53}{8}$
$=\frac{75}{8}$
$=9\frac{3}{8}$

26. $7\frac{1}{6}-2\frac{2}{3}=\frac{43}{6}-\frac{8}{3}$
$=\frac{43}{6}-\frac{8\cdot2}{3\cdot2}$
$=\frac{43}{6}-\frac{16}{6}$
$=\frac{43-16}{6}$
$=\frac{27}{6}$
$=\frac{9\cdot3}{2\cdot3}$
$=\frac{9}{2}$
$=4\frac{1}{2}$

27. $5\div\frac{1}{3}=5\cdot\frac{3}{1}=15$

28. $2\cdot8\frac{3}{4}=2\cdot\frac{35}{4}=\frac{2\cdot35}{2\cdot2}=\frac{35}{2}=17\frac{1}{2}$

29. $1-\frac{1}{6}-\frac{1}{4}=\frac{12}{12}-\frac{1\cdot2}{6\cdot2}-\frac{1\cdot3}{4\cdot3}$
$=\frac{12}{12}-\frac{2}{12}-\frac{3}{12}$
$=\frac{12-2-3}{12}$
$=\frac{7}{12}$

The unknown part is $\frac{7}{12}$.

30. $1-\frac{1}{2}-\frac{1}{5}=\frac{10}{10}-\frac{5}{10}-\frac{2}{10}=\frac{10-5-2}{10}=\frac{3}{10}$

The unknown part is $\frac{3}{10}$.

31. $P=2l+2w$
$P=2\left(1\frac{1}{3}\right)+2\left(\frac{7}{8}\right)$
$=\frac{2}{1}\cdot\frac{4}{3}+\frac{2}{1}\cdot\frac{7}{8}$
$=\frac{8}{3}+\frac{14}{8}$
$=\frac{8\cdot8}{3\cdot8}+\frac{14\cdot3}{8\cdot3}$
$=\frac{64}{24}+\frac{42}{24}$
$=\frac{64+42}{24}$
$=\frac{106}{24}$
$=4\frac{10}{24}$
$=4\frac{5}{12}$ meters
$A=lw$
$A=1\frac{1}{3}\cdot\frac{7}{8}$
$=\frac{4}{3}\cdot\frac{7}{8}$
$=\frac{4\cdot7}{3\cdot2\cdot4}$
$=\frac{7}{6}$
$=1\frac{1}{6}$ sq meters

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32. P = the sum of the lengths of the sides

$$P = \frac{5}{11}+\frac{8}{11}+\frac{3}{11}+\frac{3}{11}+\frac{2}{11}+\frac{5}{11}=\frac{26}{11}=2\frac{4}{11} \text{ in.}$$

A = the sum of the two areas, each given by lw

$$A = \frac{5}{11}\cdot\frac{5}{11}+\frac{3}{11}\cdot\frac{3}{11}=\frac{25}{121}+\frac{9}{121}=\frac{34}{121} \text{ sq in.}$$

33.
$$\begin{aligned}&2\frac{1}{2}+3\frac{1}{16}+1\frac{3}{4}+2\frac{9}{16}+1\frac{13}{16}+2\frac{7}{16}\\&=\frac{5}{2}+\frac{49}{16}+\frac{7}{4}+\frac{41}{16}+\frac{29}{16}+\frac{39}{16}\\&=\frac{40}{16}+\frac{49}{16}+\frac{28}{16}+\frac{41}{16}+\frac{29}{16}+\frac{39}{16}\\&=\frac{226}{16}\\&=14\frac{2}{16}\\&=14\frac{1}{8} \text{ lb}\end{aligned}$$

34. $2\frac{1}{8}+2\frac{3}{16}=\frac{17}{8}+\frac{35}{16}=\frac{34}{16}+\frac{35}{16}=\frac{69}{16}=4\frac{5}{16}$ lb

35.
$$\begin{aligned}\text{Total weight} &= \text{weight of boys} + \text{weight of girls}\\&=\frac{226}{16}+\frac{69}{16}\\&=\frac{295}{16}\\&=18\frac{7}{16} \text{ lb}\end{aligned}$$

36. Look for the largest number. Baby C weighed the most.

37. Look for the smallest number. Baby E weighed the least.

38. $3\frac{1}{16}-1\frac{3}{4}=\frac{49}{16}-\frac{7}{4}=\frac{49}{16}-\frac{28}{16}=\frac{21}{16}=1\frac{5}{16}$ lb

39. $6\cdot 3^2+2\cdot 8=6\cdot 9+2\cdot 8=54+16=70$
The answer is c.

40. $68-5\cdot 2^3=68-5\cdot 8=68-40=68+(-40)=28$
The answer is b.

41. $\left(\frac{2}{7}\right)^2=\frac{2}{7}\cdot\frac{2}{7}=\frac{4}{49}$

42. $\left(\frac{3}{4}\right)^3=\frac{3}{4}\cdot\frac{3}{4}\cdot\frac{3}{4}=\frac{27}{64}$

43.
$$\begin{aligned}3(1+2\cdot 5)+4&=3(1+10)+4\\&=3(11)+4\\&=33+4\\&=37\end{aligned}$$

44.
$$\begin{aligned}8+3(2\cdot 6-1)&=8+3(12-1)\\&=8+3(11)\\&=8+33\\&=41\end{aligned}$$

45.
$$\begin{aligned}\frac{4+|6-2|+8^2}{4+6\cdot 4}&=\frac{4+|4|+64}{4+24}\\&=\frac{4+4+64}{4+24}\\&=\frac{72}{28}\\&=\frac{4\cdot 18}{4\cdot 7}\\&=\frac{18}{7}\end{aligned}$$

46.
$$\begin{aligned}5[3(2+5)-5]&=5[3(7)-5]\\&=5[21-5]\\&=5[16]\\&=80\end{aligned}$$

47. The difference of twenty and twelve is equal to the product of two and four is written as $20 - 12 = 2 \cdot 4$.

48. The quotient of nine and two is greater than negative five is written as $\frac{9}{2} > -5$.

49. Let $x = 6$ and $y = 2$.
$2x + 3y = 2(6) + 3(2) = 12 + 6 = 18$

50. Let $x = 6$, $y = 2$, and $z = 8$.
$x(y+2z) = 6[2+2(8)] = 6[2+16] = 6[18] = 108$

51. Let $x = 6$, $y = 2$, and $z = 8$.
$\frac{x}{y}+\frac{z}{2y}=\frac{6}{2}+\frac{8}{2(2)}=\frac{6}{2}+\frac{8}{4}=3+2=5$

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52. Let $x = 6$ and $y = 2$.

$$\begin{aligned} x^2 - 3y^2 &= (6)^2 - 3(2)^2 \\ &= 36 - 3(4) \\ &= 36 - 12 \\ &= 36 + (-12) \\ &= 24 \end{aligned}$$

53. Replace a with 37 and b with 80.

$$\begin{aligned} 180 - a - b &= 180 - 37 - 80 \\ &= 180 + (-37) + (-80) \\ &= 143 + (-80) \\ &= 63 \end{aligned}$$

The measure of the unknown angle is 63°.

54. Replace a with 93, b with 80, and c with 82.

$$\begin{aligned} 360 - a - b - c &= 360 - 93 - 80 - 82 \\ &= 360 + (-93) + (-80) + (-82) \\ &= 267 + (-80) + (-82) \\ &= 187 + (-82) \\ &= 105 \end{aligned}$$

The measure of the unknown angle is 105°.

55. Let $x = 3$.

$$\begin{aligned} 7x - 3 &= 18 \\ 7(3) - 3 &\stackrel{?}{=} 18 \\ 21 - 3 &\stackrel{?}{=} 18 \\ 18 &= 18, \text{ true} \end{aligned}$$

3 is a solution to the equation.

56. Let $x = 1$.

$$\begin{aligned} 3x + 4 &= x - 1 \\ 3(1) + 4 &\stackrel{?}{=} 1 - 1 \\ 3 + 4 &\stackrel{?}{=} 0 \\ 7 &= 0, \text{ false} \end{aligned}$$

1 is not a solution to the equation.

57. The additive inverse of –9 is 9.

58. The additive inverse of $\frac{2}{3}$ is $-\frac{2}{3}$.

59. The additive inverse of $|-2|$ is –2 since $|-2| = 2$.

60. The additive inverse of $-|-7|$ is 7 since $-|-7| = -7$.

61. $-15 + 4 = -11$

62. $-6 + (-11) = -17$

63.

$$\begin{aligned} \frac{1}{16} + \left(-\frac{1}{4}\right) &= \frac{1}{16} + \left(-\frac{1 \cdot 4}{4 \cdot 4}\right) \\ &= \frac{1}{16} + \left(-\frac{4}{16}\right) \\ &= -\frac{3}{16} \end{aligned}$$

64. $-8 + |-3| = -8 + 3 = -5$

65. $-4.6 + (-9.3) = -13.9$

66. $-2.8 + 6.7 = 3.9$

67. $6 - 20 = 6 + (-20) = -14$

68. $-3.1 - 8.4 = -3.1 + (-8.4) = -11.5$

69. $-6 - (-11) = -6 + 11 = 5$

70. $4 - 15 = 4 + (-15) = -11$

71.

$$\begin{aligned} -21 - 16 + 3(8 - 2) &= -21 + (-16) + 3[8 + (-2)] \\ &= -21 + (-16) + 3[6] \\ &= -21 + (-16) + 18 \\ &= -37 + 18 \\ &= -19 \end{aligned}$$

72.

$$\begin{aligned} \frac{11 - (-9) + 6(8 - 2)}{2 + 3 \cdot 4} &= \frac{11 + 9 + 6[8 + (-2)]}{2 + 3 \cdot 4} \\ &= \frac{11 + 9 + 6[6]}{2 + 3 \cdot 4} \\ &= \frac{11 + 9 + 36}{2 + 12} \\ &= \frac{56}{14} \\ &= 4 \end{aligned}$$

73. Replace x with 3, y with –6, and z with –9.

$$\begin{aligned} 2x^2 - y + z &= 2(3)^2 - (-6) + (-9) \\ &= 2(9) + 6 + (-9) \\ &= 18 + 6 + (-9) \\ &= 24 + (-9) \\ &= 15 \end{aligned}$$

The answer is a.

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74. Replace x with 3 and y with -6.

$$\frac{|y-4x|}{2x} = \frac{|-6-4(3)|}{2(3)} = \frac{|-6-12|}{6} = \frac{|-6+(-12)|}{6} = \frac{|-18|}{6} = \frac{18}{6} = 3$$

The answer is a.

75. $50+1+(-2)+5+1+(-4)$
$= 51+(-2)+5+1+(-4)$
$= 49+5+1+(-4)$
$= 54+1+(-4)$
$= 55+(-4)$
$= 51$
The price at the end of the week is \$51.

76. $50+1+(-2)+5 = 51+(-2)+5 = 49+5 = 54$
The price at the end of the day on Wednesday is \$54.

77. The multiplicative inverse of -6 is $-\frac{1}{6}$ since $-6\cdot-\frac{1}{6}=1$.

78. The multiplicative inverse of $\frac{3}{5}$ is $\frac{5}{3}$ since $\frac{3}{5}\cdot\frac{5}{3}=1$.

79. $6(-8) = -48$

80. $(-2)(-14) = 28$

81. $\frac{-18}{-6} = 3$

82. $\frac{42}{-3} = -14$

83. $\frac{4\cdot(-3)+(-8)}{2+(-2)} = \frac{-12+(-8)}{2+(-2)} = \frac{-20}{0}$
The expression is undefined.

84. $\frac{3(-2)^2-5}{-14} = \frac{3(4)-5}{-14} = \frac{12-5}{-14} = \frac{7}{-14} = -\frac{1}{2}$

85. $\frac{-6}{0}$ is undefined.

86. $\frac{0}{-2} = 0$

87. $-4^2-(-3+5)\div(-1)\cdot 2 = -16-(2)\div(-1)\cdot 2 = -16+2\cdot 2 = -16+4 = -12$

88. $-5^2-(2-20)\div(-3)\cdot 3 = -25-(-18)\div(-3)\cdot 3 = -25-6\cdot 3 = -25-18 = -43$

89. Let $x=-5$ and $y=-2$.
$x^2-y^4 = (-5)^2-(-2)^4 = 25-16 = 9$

90. Let $x=-5$ and $y=-2$.
$x^2-y^3 = (-5)^2-(-2)^3 = 25-(-8) = 25+8 = 33$

91. $-7x$ or $-7\cdot x$

92. $\frac{x}{-13}$ or $x\div(-13)$

93. $-20-x$

94. $-1+x$

95. $-6+5 = 5+(-6)$; commutative property of addition

96. $6\cdot 1 = 6$; identity element for multiplication

97. $3(8-5) = 3\cdot 8-3\cdot 5$; distributive property

98. $4+(-4) = 0$; additive inverse property

99. $2+(3+9) = (2+3)+9$; associative property of addition

100. $2\cdot 8 = 8\cdot 2$; commutative property of multiplication

101. $6(8+5) = 6\cdot 8+6\cdot 5$; distributive property

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102. $(3 \cdot 8) \cdot 4 = 3 \cdot (8 \cdot 4)$; associative property of multiplication

103. $4 \cdot \frac{1}{4} = 1$; multiplicative inverse property

104. $8 + 0 = 8$; identity element for addition

105. $5(y - 2) = 5(y) + 5(-2) = 5y - 10$

106. $-3(z + y) = -3(z) + (-3)(y) = -3z - 3y$

107. $-(7 - x + 4z) = (-1)(7) + (-1)(-x) + (-1)(4z)$
$= -7 + x - 4z$

108. $\frac{1}{2}(6z - 10) = \frac{1}{2}(6z) + \frac{1}{2}(-10) = 3z - 5$

109. $-4(3x + 5) - 7 = -4(3x) + (-4)(5) - 7$
$= -12x - 20 - 7$
$= -12x - 27$

110. $-8(2y + 9) - 1 = -8(2y) + (-8)(9) - 1$
$= -16y - 72 - 1$
$= -16y - 73$

111. $-|-11| < |11.4|$ since $-|-11| = -11$ and $|11.4| = 11.4$.

112. $-1\frac{1}{2} > -2\frac{1}{2}$ since $-1\frac{1}{2}$ is to the right of $-2\frac{1}{2}$ on a number line.

113. $-7.2 + (-8.1) = -15.3$

114. $14 - 20 = 14 + (-20) = -6$

115. $4(-20) = -80$

116. $\frac{-20}{4} = -5$

117. $-\frac{4}{5}\left(\frac{5}{16}\right) = -\frac{4}{16} = -\frac{1}{4}$

118. $-0.5(-0.3) = 0.15$

119. $8 \div 2 \cdot 4 = 4 \cdot 4 = 16$

120. $(-2)^4 = (-2)(-2)(-2)(-2) = 16$

121. $\frac{-3 - 2(-9)}{-15 - 3(-4)} = \frac{-3 + 18}{-15 + 12} = \frac{15}{-3} = -5$

122. $5 + 2[(7 - 5)^2 + (1 - 3)] = 5 + 2[2^2 + (-2)]$
$= 5 + 2[4 + (-2)]$
$= 5 + 2[2]$
$= 5 + 4$
$= 9$

123. $-\frac{5}{8} \div \frac{3}{4} = -\frac{5}{8} \cdot \frac{4}{3} = -\frac{20}{24} = -\frac{5}{6}$

124. $\frac{-15 + (-4)^2 + |-9|}{10 - 2 \cdot 5} = \frac{-15 + 16 + 9}{10 - 10} = \frac{1 + 9}{0}$ is undefined.

125. $7\frac{1}{2} - 6\frac{1}{8} = \frac{15}{2} - \frac{49}{8}$
$= \frac{15 \cdot 4}{2 \cdot 4} - \frac{49}{8}$
$= \frac{60}{8} - \frac{49}{8}$
$= \frac{60 - 49}{8}$
$= \frac{11}{8}$
$= 1\frac{3}{8}$ ft

Chapter 1 Getting Ready for the Test

1. For $-5 + (-3)$, the operation is addition; A.

2. For $-5(-3)$, the operation is multiplication; C.

3. $6x + 2 + 4x - 10$ is an expression since it does not contain an equal sign; B.

4. $6x + 2 = 4x - 10$ is an equation since it contains an equal sign; A.

5. $-2(x - 1) = 12$ is an equation since it contains an equal sign; A.

6. $-7\left(x + \frac{1}{2}\right) - 22$ is an expression since it does not contain an equal sign; B.

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7. Since the sum of two numbers with the same sign has the sign common to the two numbers and both a and b are negative numbers, $a + b$ is a negative number; B.

8. Since the product of two numbers with the same sign is positive and both a and b are negative numbers, $a \cdot b$ is a positive number; A.

9. Since the quotient of two numbers with the same sign is positive and both a and b are negative, $\frac{a}{b}$ is a positive number; A.

10. Since 0 added to or subtracted from any number does not change the number and a is a negative number, $a - 0 = a$ is a negative number; B.

11. Since the product of 0 and any number is 0, $0 \cdot b$ is 0; C.

12. $a - b = a + (-b)$
Since b is a negative number, $-b$ is a positive number and $a - b = a + (-b)$ is the sum of two numbers with different signs. The sum will have the sign of the number with the larger absolute value. Since we do not know whether $|a|$ or $|-b| = |b|$ is larger, it is not possible to determine whether $a - b$ is positive or negative; D.

13. Since 0 added to any number does not change the number and b is a negative number, $0 + b$ is a negative number; B.

14. Since 0 divided by any nonzero number is 0 and a is not 0, $\frac{0}{a}$ is 0; C.

15. $\frac{1}{5}$ is the reciprocal of 5; B.

16. $3 + 2(-8)$ is an expression which can be evaluated or simplified; C.

17. 2^3 is an expression which can be evaluated or simplified; C.

18. 7 is the opposite of -7; A.

Chapter 1 Test

1. The absolute value of negative seven is greater than five is written as $|-7| > 5$.

2. The sum of nine and five is greater than or equal to four is written as $9 + 5 \geq 4$.

3. $-13 + 8 = -5$

4. $-13 - (-2) = -13 + 2 = -11$

5. $12 \div 4 \cdot 3 - 6 \cdot 2 = 3 \cdot 3 - 6 \cdot 2 = 9 - 12 = -3$

6. $(13)(-3) = -39$

7. $(-6)(-2) = 12$

8. $\frac{|-16|}{-8} = \frac{16}{-8} = -2$

9. $\frac{-8}{0}$ is undefined.

10. $\frac{|-6|+2}{5-6} = \frac{6+2}{5+(-6)} = \frac{8}{-1} = -8$

11. $\frac{1}{2} - \frac{5}{6} = \frac{1 \cdot 3}{2 \cdot 3} - \frac{5}{6} = \frac{3}{6} - \frac{5}{6} = \frac{3-5}{6} = \frac{-2}{6} = -\frac{1}{3}$

12.
$$\begin{aligned} 5\frac{3}{4} - 1\frac{1}{8} &= \frac{23}{4} - \frac{9}{8} \\ &= \frac{2 \cdot 23}{2 \cdot 4} - \frac{9}{8} \\ &= \frac{46}{8} - \frac{9}{8} \\ &= \frac{46 + (-9)}{8} \\ &= \frac{37}{8} \\ &= 4\frac{5}{8} \end{aligned}$$

13. $-0.6 + 1.875 = 1.275$

14. $3(-4)^2 - 80 = 3(16) - 80 = 48 + (-80) = -32$

15.
$$\begin{aligned} 6[5 + 2(3-8) - 3] &= 6\{5 + 2[3 + (-8)] + (-3)\} \\ &= 6\{5 + 2[-5] + (-3)\} \\ &= 6\{5 + (-10) + (-3)\} \\ &= 6\{-5 + (-3)\} \\ &= 6\{-8\} \\ &= -48 \end{aligned}$$

16. $\frac{-12 + 3 \cdot 8}{4} = \frac{-12 + 24}{4} = \frac{12}{4} = 3$

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17. $\frac{(-2)(0)(-3)}{-6} = \frac{0(-3)}{-6} = \frac{0}{-6} = 0$

18. $-3 > -7$ since -3 is to the right of -7 on a number line.

19. $4 > -8$ since 4 is to the right of -8 on a number line.

20. $2 < |-3|$ since $2 < 3$.

21. $|-2| = -1 - (-3)$ since $|-2| = 2$ and $-1 - (-3) = -1 + 3 = 2$.

22. $1685 < 5683$

23. **a.** The natural numbers are 1 and 7.

b. The whole numbers are 0, 1 and 7.

c. The integers are -5, -1, 0, 1, and 7.

d. The rational numbers are -5, -1, $\frac{1}{4}$, 0, 1, 7, and 11.6.

e. The irrational numbers are $\sqrt{7}$ and 3π.

f. The real numbers are all numbers in the given set.

24. Let $x = 6$ and $y = -2$.
$x^2 + y^2 = (6)^2 + (-2)^2 = 36 + 4 = 40$

25. Let $x = 6$, $y = -2$ and $z = -3$.
$x + yz = 6 + (-2)(-3) = 6 + 6 = 12$

26. Let $x = 6$ and $y = -2$.
$$\begin{aligned} 2 + 3x - y &= 2 + 3(6) - (-2) \\ &= 2 + 18 + 2 \\ &= 20 + 2 \\ &= 22 \end{aligned}$$

27. Let $x = 6$, $y = -2$ and $z = -3$.
$\frac{y + z - 1}{x} = \frac{-2 + (-3) - 1}{6} = \frac{-5 + (-1)}{6} = \frac{-6}{6} = -1$

28. $8 + (9 + 3) = (8 + 9) + 3$; associative property of addition

29. $6 \cdot 8 = 8 \cdot 6$; commutative property of multiplication

30. $-6(2 + 4) = -6 \cdot 2 + (-6) \cdot 4$; distributive property

31. $\frac{1}{6}(6) = 1$; multiplicative inverse property

32. The opposite of -9 is 9.

33. The reciprocal of $-\frac{1}{3}$ is -3.

34. Look for the negative number that has the greatest absolute value. The second down had the greatest loss of yardage.

35. Gains: 5, 29
Losses: -10, -2
$$\begin{aligned} \text{Total gain or loss} &= 5 + (-10) + (-2) + 29 \\ &= (-5) + (-2) + 29 \\ &= -7 + 29 \\ &= 22 \text{ yards gained} \end{aligned}$$
Yes, they scored a touchdown.

36. Since $-14 + 31 = 17$, the temperature at noon was 17°.

37. $356 + 460 + (-166) = 816 + (-166) = 650$
The net income was \$650 million.

38. Change in value per share $= -1.50$
Change in total value $= 280(-1.50) = -420$
She had a total loss of \$420.

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Chapter 2

Section 2.1 Practice Exercises

1. a. The numerical coefficient of t is 1, since t is $1t$.

b. The numerical coefficient of $-7x$ is -7.

c. The numerical coefficient of $-\frac{w}{5}$ is $-\frac{1}{5}$, since $-\frac{w}{5}$ means $-\frac{1}{5}\cdot w$.

d. The numerical coefficient of $43x^4$ is 43.

e. The numerical coefficient of $-b$ is -1, since $-b$ is $-1b$.

2. a. $-4xy$ and $5yx$ are like terms, since $xy = yx$ by the commutative property.

b. $5q$ and $-3q^2$ are unlike terms, since the exponents on q are not the same.

c. $3ab^2$, $-2ab^2$, and $43ab^2$ are like terms, since each variable and its exponent match.

d. y^5 and $\frac{y^5}{2}$ are like terms, since the exponents on y are the same.

3. a. $-3y + 11y = (-3 + 11)y = 8y$

b. $4x^2 + x^2 = 4x^2 + 1x^2 = (4+1)x^2 = 5x^2$

c. $5x - 3x^2 + 8x^2 = 5x + (-3+8)x^2 = 5x + 5x^2$

d. $20y^2 + 2y^2 - y^2 = 20y^2 + 2y^2 - 1y^2$
$= (20 + 2 - 1)y^2$
$= 21y^2$

4. a. $3y + 8y - 7 + 2 = (3+8)y + (-7+2) = 11y - 5$

b. $6x - 3 - x - 3 = 6x - 1x + (-3-3)$
$= (6-1)x + (-3-3)$
$= 5x - 6$

c. $\frac{3}{4}t - t = \frac{3}{4}t - 1t = \left(\frac{3}{4} - 1\right)t = -\frac{1}{4}t$

d. $9y + 3.2y + 10 + 3 = (9 + 3.2)y + (10 + 3)$
$= 12.2y + 13$

e. $5z - 3z^4$
These two terms cannot be combined because they are unlike terms.

5. a. $3(2x - 7) = 3(2x) + 3(-7) = 6x - 21$

b. $-5(x - 0.5z - 5)$
$= -5(x) + (-5)(-0.5z) + (-5)(-5)$
$= -5x + 2.5z + 25$

c. $-(2x - y + z - 2)$
$= -1(2x - y + z - 2)$
$= -1(2x) - 1(-y) - 1(z) - 1(-2)$
$= -2x + y - z + 2$

6. a. $4(9x + 1) + 6 = 36x + 4 + 6 = 36x + 10$

b. $-7(2x - 1) - (6 - 3x) = -14x + 7 - 6 + 3x$
$= -11x + 1$

c. $8 - 5(6x + 5) = 8 - 30x - 25 = -17 - 30x$ or $-30x - 17$

7. "Subtract $7x - 1$ from $2x + 3$" translates to
$(2x + 3) - (7x - 1) = 2x + 3 - 7x + 1 = -5x + 4$

8. a.

Three	added to	twice a number
↓	↓	↓
3	+	$2x$

or $2x + 3$

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b.

Six	divided by	the sum of five and a number
↓	↓	↓
6	÷	$(5+x)$

or $\frac{6}{5+x}$

c.

Two	times	the sum of 3 and a number	increased by	4
↓	↓	↓	↓	↓
2	·	$(3+x)$	+	4

$2(3+x)+4=6+2x+4=2x+10$

d.

a number	added to	half the number	added to	5 times the number
↓	↓	↓	↓	↓
x	+	$\frac{1}{2}x$	+	$5x$

$x+\frac{1}{2}x+5x=\frac{13}{2}x$

Vocabulary, Readiness & Video Check 2.1

1. $23y^2+10y-6$ is called an expression while $23y^2$, $10y$, and -6 are each called a term.

2. To simplify $x + 4x$, we combine like terms.

3. The term y has an understood numerical coefficient of 1.

4. The terms $7z$ and $7y$ are unlike terms and the terms $7z$ and $-z$ are like terms.

5. For the term $-\frac{1}{2}xy^2$, the number $-\frac{1}{2}$ is the numerical coefficient.

6. $5(3x - y)$ equals $15x - 5y$ by the distributive property.

7. Although these terms have exactly the same variables, the exponents on each are not exactly the same—the exponents on x differ in each term.

8. distributive property

9. -1

10. The sum of 5 times a number and -2, added to 7 times the number; $5x + (-2) + 7x$; because there are like terms.

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Exercise Set 2.1

2. The numerical coefficient of $3x$ is 3.

4. The numerical coefficient of $-y$ is -1, since $-y = -1y$.

6. The numerical coefficient of $1.2xyz$ is 1.2.

8. $-2x^2y$ and $6xy$ are unlike terms, since the exponents on x are not the same.

10. ab^2 and $-7ab^2$ are like terms, since each variable and its exponent match.

12. $7.4p^3q^2$ and $6.2p^3q^2r$ are unlike terms, since the exponents on r are not the same.

14. $3x + 2x = (3 + 2)x = 5x$

16. $c - 7c + 2c = (1 - 7 + 2)c = -4c$

18.
$$\begin{aligned} 6g+5-3g-7 &= 6g-3g+5-7 \\ &= (6-3)g-2 \\ &= 3g-2 \end{aligned}$$

20.
$$\begin{aligned} a+3a-2-7a &= a+3a-7a-2 \\ &= (1+3-7)a-2 \\ &= -3a-2 \end{aligned}$$

22.
$$\begin{aligned} 8p+4-8p-15 &= (8p-8p)+(4-15) \\ &= (8-8)p+(-11) \\ &= 0p-11 \\ &= -11 \end{aligned}$$

24.
$$\begin{aligned} 7.9y-0.7-y+0.2 &= 7.9y-y-0.7+0.2 \\ &= (7.9-1)y-0.5 \\ &= 6.9y-0.5 \end{aligned}$$

26.
$$\begin{aligned} 8h+13h-6+7h-h &= 8h+13h+7h-h-6 \\ &= (8+13+7-1)h-6 \\ &= 27h-6 \end{aligned}$$

28. $8x^3 + x^3 - 11x^3 = (8 + 1 - 11)x^3 = -2x^3$

30.
$$\begin{aligned} &0.4y - 6.7 + y - 0.3 - 2.6y \\ &= 0.4y + y - 2.6y - 6.7 - 0.3 \\ &= (0.4 + 1 - 2.6)y - 7.0 \\ &= -1.2y - 7 \end{aligned}$$

32. $7(r - 3) = 7(r) - 7(3) = 7r - 21$

34. $-4(y + 6) = -4(y) + (-4)(6) = -4y - 24$

36. $9(z + 7) - 15 = 9z + 63 - 15 = 9z + 48$

38.
$$\begin{aligned} -2(4x-3z-1) &= -2(4x)-(-2)(3z)-(-2)(1) \\ &= -8x+6z+2 \end{aligned}$$

40. $-(y + 5z - 7) = -y - 5z + 7$

42.
$$\begin{aligned} 4(2x-3)-2(x+1) &= 8x-12-2x-2 \\ &= 6x-14 \end{aligned}$$

44.
$$\begin{array}{ccccc} 3y-5 & & \text{added} & & y+16 \\ & & \text{to} & & \\ \downarrow & & \downarrow & & \downarrow \\ (3y-5) & & + & & (y+16) \end{array} = 3y+y-5+16 = 4y+11$$

46.
$$\begin{array}{ccccc} 12+x & & \text{minus} & & 4x-7 \\ \downarrow & & \downarrow & & \downarrow \\ (12+x) & & - & & (4x-7) \end{array} = 12+x-4x+7 = 12+7+x-4x = 19-3x$$

48.
$$\begin{array}{ccccc} 2m-6 & & \text{minus} & & m-3 \\ \downarrow & & \downarrow & & \downarrow \\ (2m-6) & & - & & (m-3) \end{array} = 2m-6-m+3 = 2m-m-6+3 = m-3$$

50. $7c - 8 - c = 7c - c - 8 = (7 - 1)c - 8 = 6c - 8$

52.
$$\begin{aligned} 5y-14+7y-20y &= 5y+7y-20y-14 \\ &= (5+7-20)y-14 \\ &= -8y-14 \end{aligned}$$

54.
$$\begin{aligned} -3(2x+5)+6x &= -3(2x)+(-3)(5)+6x \\ &= -6x-15+6x \\ &= -6x+6x-15 \\ &= 0-15 \\ &= -15 \end{aligned}$$

56.
$$\begin{aligned} 2(6x-1)-(x-7) &= 12x-2-x+7 \\ &= 11x+5 \end{aligned}$$

58. $8y - 2 - 3(y + 4) = 8y - 2 - 3y - 12 = 5y - 14$

60. $-11c - (4 - 2c) = -11c - 4 + 2c = -9c - 4$

62. $(8 - 5y) - (4 + 3y) = 8 - 5y - 4 - 3y = -8y + 4$

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