Algebra A Combined Approach 6th edition Martin Gay Solutions Manual

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INSTRUCTOR'S SOLUTIONS MANUAL

ALGEBRA: A COMBINED APPROACH

SIXTH EDITION

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Pearson

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Algebra A Combined Approach 6th edition Martin Gay Solutions Manual

Contents

Chapter R	1
Chapter 1	23
Chapter 2	55
Chapter 3	118
Chapter 4	171
Chapter 5	215
Chapter 6	259
Chapter 7	300
Chapter 8	355
Chapter 9	388
Chapter 10	429
Chapter 11	477
Chapter 12	583
Chapter 13	642
Appendices	699
Practice Final Exam	724

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Chapter R

Section R.1 Practice Exercises

1. $10 = 1 \cdot 10$, $10 = 2 \cdot 5$
The factors of 10 are 1, 2, 5, and 10.

2. $18 = 1 \cdot 18$, $18 = 2 \cdot 9$, $18 = 3 \cdot 6$
The factors of 18 are 1, 2, 3, 6, 9, and 18.

3. 5 is a prime number. Its factors are 1 and 5 only.
16 is a composite number. Its factors are 1, 2, 4, 8, and 16.
23 is a prime number. Its factors are 1 and 23 only.
42 is a composite number. Its factors are 1, 2, 3, 6, 7, 14, 21, and 42.

4. $44 = 4 \cdot 11 = 2 \cdot 2 \cdot 11$
The prime factorization of 44 is $2 \cdot 2 \cdot 11$.

5. $60 = 4 \cdot 15 = 2 \cdot 2 \cdot 3 \cdot 5$
The prime factorization of 60 is $2 \cdot 2 \cdot 3 \cdot 5$.

6.
$$3\overline{)\,33}\quad 11$$
$$3\overline{)\,99}$$
$$3\overline{)297}$$
The prime factorization of 297 is $3 \cdot 3 \cdot 3 \cdot 11$.

7. $14 = 2 \cdot 7$
$35 = 5 \cdot 7$
LCM $= 2 \cdot 5 \cdot 7 = 70$

8. $5 = 5$
$9 = 3 \cdot 3$
LCM $= 3 \cdot 3 \cdot 5 = 45$

9. $4 = 2 \cdot 2$
$15 = 3 \cdot 5$
$10 = 2 \cdot 5$
LCM $= 2 \cdot 2 \cdot 3 \cdot 5 = 60$

Vocabulary, Readiness & Video Check R.1

1. The number 40 equals $2 \cdot 2 \cdot 2 \cdot 5$. Since each factor is prime, we call $2 \cdot 2 \cdot 2 \cdot 5$ the prime factorization of 40.

2. A natural number, other than 1, that is not prime is called a composite number.

3. A natural number that has exactly two different factors, 1 and itself, is called a prime number.

4. The least common multiple of a list of numbers is the smallest number that is a multiple of all the numbers in the list.

5. To factor means to write as a product.

6. A multiple of a number is the product of that number and any natural number.

7. No, the natural number 1 is neither prime nor composite.

8. We may write factors in different order, but every natural number has only one prime factorization.

9. The least common multiple, LCM, of a list of numbers is the smallest number that is a multiple of each number in the list.

Exercise Set R.1

2. $8 = 1 \cdot 8$, $8 = 2 \cdot 4$
The factors of 8 are 1, 2, 4, and 8.

4. $36 = 1 \cdot 36$, $36 = 2 \cdot 18$, $36 = 3 \cdot 12$, $36 = 4 \cdot 9$, $36 = 6 \cdot 6$
The factors of 36 are 1, 2, 3, 4, 6, 9, 12, 18, and 36.

6. $63 = 1 \cdot 63$, $63 = 3 \cdot 21$, $63 = 7 \cdot 9$
The factors of 63 are 1, 3, 7, 9, 21, and 63.

8. $50 = 1 \cdot 50$, $50 = 2 \cdot 25$, $50 = 5 \cdot 10$
The factors of 50 are 1, 2, 5, 10, 25, and 50.

10. $31 = 1 \cdot 31$
The factors of 31 are 1 and 31.

12. 21 is a composite number. Its factors are 1, 3, 7, and 21.

14. 53 is a prime number. Its factors are only 1 and 53.

16. 51 is a composite number. Its factors are 1, 3, 17, and 51.

18. 307 is a prime number. Its factors are only 1 and 307.

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20. 1798 is a composite number. Its factors are 1, 2, 29, 31, 58, 62, 899, and 1798.

22. $28 = 2 \cdot 14 = 2 \cdot 2 \cdot 7$
The prime factorization of 28 is $2 \cdot 2 \cdot 7$.

24. $30 = 2 \cdot 15 = 2 \cdot 3 \cdot 5$
The prime factorization of 30 is $2 \cdot 3 \cdot 5$.

26. $48 = 2 \cdot 24$
$= 2 \cdot 2 \cdot 12$
$= 2 \cdot 2 \cdot 2 \cdot 6$
$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3$
The prime factorization of 48 is $2 \cdot 2 \cdot 2 \cdot 2 \cdot 3$.

28. $64 = 4 \cdot 4 \cdot 4 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
The prime factorization of 64 is $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$.

30.
$$5\overline{)\,25}\quad 5$$
$$5\overline{)125}$$
$$2\overline{)250}$$
$$2\overline{)500}$$
The prime factorization of 500 is $2 \cdot 2 \cdot 5 \cdot 5 \cdot 5$.

32.
$$5\overline{)\,35}\quad 7$$
$$3\overline{)105}$$
$$3\overline{)315}$$
The prime factorization of 315 is $3 \cdot 3 \cdot 5 \cdot 7$.

34. $63 = 3 \cdot 21 = 3 \cdot 3 \cdot 7$
The prime factorization of 63 is $3 \cdot 3 \cdot 7$, which is choice **c**.

36. $4 = 2 \cdot 2$
$5 = 5$
LCM $= 2 \cdot 2 \cdot 5 = 20$

38. $9 = 3 \cdot 3$
$15 = 3 \cdot 5$
LCM $= 3 \cdot 3 \cdot 5 = 45$

40. $30 = 2 \cdot 3 \cdot 5$
$40 = 2 \cdot 2 \cdot 2 \cdot 5$
LCM $= 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5 = 120$

42. $2 = 2$
$11 = 11$
LCM $= 2 \cdot 11 = 22$

44. $4 = 2 \cdot 2$
$18 = 2 \cdot 3 \cdot 3$
LCM $= 2 \cdot 2 \cdot 3 \cdot 3 = 36$

46. $18 = 2 \cdot 3 \cdot 3$
$30 = 2 \cdot 3 \cdot 5$
LCM $= 2 \cdot 3 \cdot 3 \cdot 5 = 90$

48. $50 = 2 \cdot 5 \cdot 5$
$70 = 2 \cdot 5 \cdot 7$
LCM $= 2 \cdot 5 \cdot 5 \cdot 7 = 350$

50. $21 = 3 \cdot 7$
$28 = 2 \cdot 2 \cdot 7$
LCM $= 2 \cdot 2 \cdot 3 \cdot 7 = 84$

52. $3 = 3$
$9 = 3 \cdot 3$
$20 = 2 \cdot 2 \cdot 5$
LCM $= 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 = 180$

54. $3 = 3$
$5 = 5$
$7 = 7$
LCM $= 3 \cdot 5 \cdot 7 = 105$

56. $9 = 3 \cdot 3$
$36 = 2 \cdot 2 \cdot 3 \cdot 3$
$72 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3$
LCM $= 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 = 72$

58. $4 = 2 \cdot 2$
$14 = 2 \cdot 7$
$35 = 5 \cdot 7$
LCM $= 2 \cdot 2 \cdot 5 \cdot 7 = 140$

60. answers may vary

62. $35 = 5 \cdot 7$
$20 = 2 \cdot 2 \cdot 5$
LCM $= 2 \cdot 2 \cdot 5 \cdot 7 = 140$
They are in New Orleans on the same day every 140 days.

64. $1000 = 25 \cdot 40 = 25 \cdot 5 \cdot 8$
$1125 = 25 \cdot 45 = 25 \cdot 5 \cdot 9$
LCM $= 25 \cdot 5 \cdot 8 \cdot 9 = 9000$

Section R.2 Practice Exercises

1. $\frac{4}{4} = 1$ since $4 \div 4 = 1$.

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2. $\frac{9}{3} = 3$ since $9 \div 3 = 3$.

3. $\frac{10}{10} = 1$ since $10 \div 10 = 1$.

4. $\frac{5}{1} = 5$ since $5 \div 1 = 5$.

5. $\frac{0}{11} = 0$ since $0 \cdot 11 = 0$.

6. $\frac{11}{0}$ is undefined because there is no number that when multiplied by 0 gives 11.

7. $\frac{1}{4} = \frac{1}{4} \cdot \frac{5}{5} = \frac{1 \cdot 5}{4 \cdot 5} = \frac{5}{20}$

8. $\frac{20}{35} = \frac{2 \cdot 2 \cdot 5}{5 \cdot 7} = \frac{4}{7}$

9. $\frac{7}{20}$ is already simplified.

10. $\frac{12}{40} = \frac{4 \cdot 3}{4 \cdot 10} = \frac{3}{10}$

11. $\frac{3}{4} \cdot \frac{8}{9} = \frac{3 \cdot 8}{4 \cdot 9} = \frac{3 \cdot 4 \cdot 2}{4 \cdot 3 \cdot 3} = \frac{2}{3}$

12. $\frac{2}{9} \div \frac{3}{4} = \frac{2}{9} \cdot \frac{4}{3} = \frac{2 \cdot 4}{9 \cdot 3} = \frac{8}{27}$

13. $\frac{8}{11} \div 24 = \frac{8}{11} \div \frac{24}{1} = \frac{8}{11} \cdot \frac{1}{24} = \frac{8 \cdot 1}{11 \cdot 8 \cdot 3} = \frac{1}{33}$

14. $\frac{5}{4} \div \frac{15}{8} = \frac{5}{4} \cdot \frac{8}{15} = \frac{5 \cdot 4 \cdot 2}{4 \cdot 5 \cdot 3} = \frac{2}{3}$

15. $\frac{2}{11} + \frac{5}{11} = \frac{2+5}{11} = \frac{7}{11}$

16. $\frac{1}{8} + \frac{3}{8} = \frac{1+3}{8} = \frac{4}{8} = \frac{4}{2 \cdot 4} = \frac{1}{2}$

17. $\frac{7}{6} - \frac{2}{6} = \frac{7-2}{6} = \frac{5}{6}$

18. $\frac{13}{10} - \frac{3}{10} = \frac{13-3}{10} = \frac{10}{10} = 1$

19. $\frac{3}{8} + \frac{1}{20} = \frac{3}{8} \cdot \frac{5}{5} + \frac{1}{20} \cdot \frac{2}{2} = \frac{15}{40} + \frac{2}{40} = \frac{17}{40}$

20. $\frac{8}{15} - \frac{1}{3} = \frac{8}{15} - \frac{1}{3} \cdot \frac{5}{5} = \frac{8}{15} - \frac{5}{15} = \frac{3}{15} = \frac{3}{3 \cdot 5} = \frac{1}{5}$

21. $5\frac{1}{6} = \frac{6 \cdot 5 + 1}{6} = \frac{31}{6}$; $4\frac{2}{5} = \frac{5 \cdot 4 + 2}{5} = \frac{22}{5}$

$5\frac{1}{6} \cdot 4\frac{2}{5} = \frac{31}{6} \cdot \frac{22}{5} = \frac{31 \cdot 2 \cdot 11}{2 \cdot 3 \cdot 5} = \frac{341}{15} = 22\frac{11}{15}$

22. $7\frac{3}{8} + 6\frac{3}{4} = \frac{59}{8} + \frac{27}{4} = \frac{59}{8} + \frac{54}{8} = \frac{113}{8} = 14\frac{1}{8}$

23.

$76\frac{1}{12}$	$76\frac{1}{12}$	$75\frac{13}{12}$
$-35\frac{1}{4}$	$-35\frac{3}{12}$	$-35\frac{3}{12}$
		$40\frac{10}{12} = 40\frac{5}{6}$

Vocabulary. Readiness & Video Check R.2

1. The number $\frac{17}{31}$ is called a fraction. The number 31 is called its denominator and 17 is called its numerator.

2. The fraction $\frac{8}{3}$ is called an improper fraction, the fraction $\frac{3}{8}$ is called a proper fraction, and $10\frac{3}{8}$ is called a mixed number.

3. In $\frac{11}{48}$, since 11 and 48 have no common factors other than 1, $\frac{11}{48}$ is in simplest form.

4. Fractions that represent the same portion of a whole are called equivalent fractions.

5. To multiply two fractions, we write $\frac{a}{b} \cdot \frac{c}{d} = \frac{a \cdot c}{b \cdot d}$.

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6. Two numbers are reciprocals of each other if their product is 1.

7. To divide two fractions, we write $\frac{a}{b} \div \frac{c}{d} = \frac{a \cdot d}{b \cdot c}$.

8. $\frac{a}{b} + \frac{c}{b} = \frac{a+c}{b}$ and $\frac{a}{b} - \frac{c}{b} = \frac{a-c}{b}$.

9. The smallest positive number divisible by all the denominators of a list of fractions is called the least common denominator (LCD).

10. The LCD for $\frac{1}{6}$ and $\frac{5}{8}$ is 24.

11. The fraction is equal to 1.

12. Equivalent fractions represent the same quantity.

13. wrote both the numerator and denominator as products of prime numbers

14. $\frac{20}{1}$ or 20

15. When adding or subtracting fractions, we must have a common denominator. When multiplying or dividing fractions, we do not.

16. Our original sum, $4\frac{7}{6}$, is not in proper form because the fraction part, $\frac{7}{6}$, is an improper fraction.

Exercise Set R.2

2. $\frac{19}{19} = 1$ since $19 \cdot 1 = 19$.

4. $\frac{30}{5} = 6$ since $5 \cdot 6 = 30$.

6. $\frac{21}{1} = 21$ since $1 \cdot 21 = 21$.

8. $\frac{0}{15} = 0$ since $15 \cdot 0 = 0$.

10. $\frac{15}{0}$ is undefined.

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

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

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

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

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

22. $\frac{5}{9}$ cannot be simplified further.

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

26. $\frac{8}{40} = \frac{1 \cdot 8}{5 \cdot 8} = \frac{1}{5}$

28. $\frac{64}{24} = \frac{8 \cdot 8}{3 \cdot 8} = \frac{8}{3}$

30. $\frac{360}{700} = \frac{18 \cdot 20}{35 \cdot 20} = \frac{18}{35}$

32. $\frac{455}{525} = \frac{13 \cdot 35}{15 \cdot 35} = \frac{13}{15}$

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

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

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

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

42. $2\frac{3}{4} \cdot 1\frac{7}{8} = \frac{11}{4} \cdot \frac{15}{8} = \frac{165}{32} = 5\frac{5}{32}$

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44. $1\frac{7}{8} \div 3\frac{8}{9} = \frac{15}{8} \div \frac{35}{9} = \frac{15}{8} \cdot \frac{9}{35} = \frac{3 \cdot 5 \cdot 9}{8 \cdot 5 \cdot 7} = \frac{27}{56}$

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

48. $\frac{11}{12} - \frac{1}{16} = \frac{11 \cdot 4}{12 \cdot 4} - \frac{1 \cdot 3}{16 \cdot 3} = \frac{44}{48} - \frac{3}{48} = \frac{44-3}{48} = \frac{41}{48}$

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

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

54.
$$\begin{array}{r} 5\frac{2}{5} \\ -\,3\frac{4}{5} \\ \hline \end{array} \qquad \begin{array}{r} 4\frac{7}{5} \\ -\,3\frac{4}{5} \\ \hline 1\frac{3}{5} \end{array}$$

56.
$$\begin{array}{r} 7\frac{3}{20} \\ +\,2\frac{13}{15} \\ \hline \end{array} \qquad \begin{array}{r} 7\frac{9}{60} \\ +\,2\frac{52}{60} \\ \hline 9\frac{61}{60} = 9 + 1\frac{1}{60} = 10\frac{1}{60} \end{array}$$

58. $\frac{13}{132} + \frac{35}{132} = \frac{13+35}{132} = \frac{48}{132} = \frac{4 \cdot 12}{11 \cdot 12} = \frac{4}{11}$

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

62. $\frac{3}{35} \cdot \frac{10}{63} = \frac{3 \cdot 10}{35 \cdot 63} = \frac{3 \cdot 5 \cdot 2}{7 \cdot 5 \cdot 3 \cdot 21} = \frac{2}{147}$

64. $\frac{25}{36} \div 10 = \frac{25}{36} \div \frac{10}{1} = \frac{25}{36} \cdot \frac{1}{10} = \frac{5 \cdot 5 \cdot 1}{36 \cdot 5 \cdot 2} = \frac{5}{72}$

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

68.
$$\begin{aligned} 26\frac{11}{20} + 40\frac{7}{10} &= 26\frac{11}{20} + 40\frac{14}{20} \\ &= 66\frac{25}{20} \\ &= 67\frac{5}{20} \\ &= 67\frac{1}{4} \end{aligned}$$

70. $9\frac{5}{6} \div \frac{1}{6} = \frac{59}{6} \div \frac{1}{6} = \frac{59}{6} \cdot \frac{6}{1} = \frac{59 \cdot 6}{6 \cdot 1} = \frac{59}{1} = 59$

72. $6\frac{6}{7} \cdot 3\frac{1}{2} = \frac{48}{7} \cdot \frac{7}{2} = \frac{2 \cdot 24 \cdot 7}{7 \cdot 2} = 24$

74. $2 - \frac{3}{8} = \frac{2}{1} \cdot \frac{8}{8} - \frac{3}{8} = \frac{16}{8} - \frac{3}{8} = \frac{13}{8}$

76.
$$\begin{array}{r} 4\frac{7}{8} \\ -\,2\frac{3}{16} \\ \hline \end{array} \qquad \begin{array}{r} 4\frac{14}{16} \\ -\,2\frac{3}{16} \\ \hline 2\frac{11}{16} \end{array}$$

78.
$$\begin{aligned} \frac{8}{11} - \frac{1}{4} + \frac{1}{2} &= \frac{8 \cdot 4}{11 \cdot 4} - \frac{1 \cdot 11}{4 \cdot 11} + \frac{1 \cdot 22}{2 \cdot 22} \\ &= \frac{32}{44} - \frac{11}{44} + \frac{22}{44} \\ &= \frac{32-11+22}{44} \\ &= \frac{43}{44} \end{aligned}$$

80. The work is correct.

82. The work is incorrect.
$\frac{16}{28} = \frac{2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 7} = \frac{4}{7}$

84. answers may vary

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86. $1-\frac{1}{4}-\frac{3}{8}=\frac{8}{8}-\frac{1\cdot 2}{4\cdot 2}-\frac{3}{8}$

$=\frac{8}{8}-\frac{2}{8}-\frac{3}{8}$

$=\frac{8-2-3}{8}$

$=\frac{3}{8}$

The unknown part is $\frac{3}{8}$.

88. $1-\frac{3}{10}-\frac{5}{10}=\frac{10}{10}-\frac{3}{10}-\frac{5}{10}$

$=\frac{10-3-5}{10}$

$=\frac{2}{10}$

$=\frac{1\cdot 2}{5\cdot 2}$

$=\frac{1}{5}$

The unknown part is $\frac{1}{5}$.

90.
$$\begin{array}{r} 43 \\ -\,41\frac{5}{8} \end{array} \qquad \begin{array}{r} 42\frac{8}{8} \\ -\,41\frac{5}{8} \\ \hline 1\frac{3}{8} \end{array}$$

The short crutch should be lengthened by $1\frac{3}{8}$ inches.

92. The piece representing engineering is labeled $\frac{10}{100}$.

$\frac{10}{100}=\frac{10\cdot 1}{10\cdot 10}=\frac{1}{10}$

$\frac{1}{10}$ of entering college freshmen plan to major in engineering.

94. answers may vary

96. The piece representing is labeled $\frac{16}{100}$.

$\frac{16}{100}=\frac{4\cdot 4}{4\cdot 25}=\frac{4}{25}$

$\frac{4}{25}$ of National Park Service areas are Parks.

98. answers may vary

100. $A=\frac{1}{2}bh$

$=\frac{1}{2}\cdot\frac{7}{8}\cdot\frac{4}{9}$

$=\frac{1\cdot 7\cdot 4}{2\cdot 8\cdot 9}$

$=\frac{1\cdot 7\cdot 2\cdot 2}{2\cdot 2\cdot 2\cdot 2\cdot 3\cdot 3}$

$=\frac{7}{36}$

The area is $\frac{7}{36}$ square foot.

Section R.3 Practice Exercises

1. $0.27=\frac{27}{100}$

2. $5.1=\frac{51}{10}$

3. $7.685=\frac{7685}{1000}$

4. a.
$$\begin{array}{r} 7.19 \\ 19.782 \\ +\,1.006 \\ \hline 27.978 \end{array}$$

b.
$$\begin{array}{r} 12. \\ 0.79 \\ +\,0.03 \\ \hline 12.82 \end{array}$$

5. a.
$$\begin{array}{r} 84.230 \\ -\,26.982 \\ \hline 57.248 \end{array}$$

b.
$$\begin{array}{r} 90.00 \\ -\,0.19 \\ \hline 89.81 \end{array}$$

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6. a.
$$\begin{array}{r} 0.31 \\ \times\ 4.6 \\ \hline 186 \\ 1\,24 \\ \hline 1.426 \end{array}$$

b.
$$\begin{array}{r} 1.26 \\ \times\ 0.03 \\ \hline 0.0378 \end{array}$$

7. a.
$$\begin{array}{r} 43.5 \\ 0.5\overline{)\ 21.75} \\ -20 \\ \hline 1\,7 \\ -1\,5 \\ \hline 25 \\ -25 \\ \hline 0 \end{array}$$

b.
$$\begin{array}{r} 2600 \\ 0.006\overline{)\ 15.600} \\ -12 \\ \hline 3\,6 \\ -3\,6 \\ \hline 0 \end{array}$$

8. 12.9187 rounded to the nearest hundredth is 12.92.

9. 245.348 rounded to the nearest tenth is 245.3.

10.
$$\begin{array}{r} 0.4 \\ 5\overline{)\ 2.0} \\ -2\,0 \\ \hline 0 \end{array}$$

$\frac{2}{5} = 0.4$

11.
$$\begin{array}{r} 0.833 \\ 6\overline{)\ 5.000} \\ -4\,8 \\ \hline 20 \\ -18 \\ \hline 20 \\ -18 \\ \hline 2 \end{array}$$

$\frac{5}{6} = 0.833\ldots = 0.8\overline{3}$

12.
$$\begin{array}{r} 0.1111 \\ 9\overline{)\ 1.0000} \\ -9 \\ \hline 10 \\ -9 \\ \hline 10 \\ -9 \\ \hline 10 \\ -9 \\ \hline 1 \end{array}$$

$\frac{1}{9} = 0.1111\ldots \approx 0.111$

13. a. $20\% = 20.\% = 0.20$

b. $1.2\% = 01.2\% = 0.012$

c. $465\% = 465.\% = 4.65$

14. a. $0.42 = 0.42 = 42\%$

b. $0.003 = 0.003 = 0.3\%$

c. $2.36 = 2.36 = 236\%$

d. $0.7 = 0.70 = 70\%$

Vocabulary, Readiness & Video Check R.3

1. Like fractional notation, decimal notation is used to denote a part of a whole.

2. To write fractions as decimals, divide the numerator by the denominator.

3. To add or subtract decimals, write the decimals so that the decimal points line up vertically.

4. When multiplying decimals, the decimal point in the product is placed so that the number of decimal places in the product is equal to the sum of the number of decimal places in the factors.

5. Percent means "per hundred."

6. 100% = 1

7. The % symbol is read as percent.

8. To write a percent as a *decimal*, drop the % symbol and move the decimal point two places to the left.

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9. To write a decimal as a *percent*, move the decimal point two places to the right and attach the % symbol.

10. Reading a decimal correctly gives us the correct place value, which tells us the denominator of our equivalent fraction.

11. When adding or subtracting decimal numbers, we do line up decimal points. When multiplying decimal numbers, we do not need to line up decimal points.

12. when rounding whole numbers, digits to the right of the rounding place are replaced by zeros; when rounding decimal numbers to the right of the decimal point, digits to the right of the rounding place are not replaced by zeros

13. To write a fraction as a decimal, we divide the numerator by the denominator.

14. 1

Exercise Set R.3

2. $0.9 = \frac{9}{10}$

4. $7.23 = \frac{723}{100}$

6. $0.239 = \frac{239}{1000}$

8. $892.7 = \frac{8927}{10}$

10.
$$\begin{array}{r} 2.31 \\ +\ 6.4 \\ \hline 8.71 \end{array}$$

12.
$$\begin{array}{r} 32.4 \\ 1.58 \\ +\ 0.0934 \\ \hline 34.0734 \end{array}$$

14.
$$\begin{array}{r} 7.6 \\ -\ 2.1 \\ \hline 5.5 \end{array}$$

16.
$$\begin{array}{r} 28.00 \\ -\ 3.31 \\ \hline 24.69 \end{array}$$

18.
$$\begin{array}{r} 0.7 \\ \times\ 0.9 \\ \hline 0.63 \end{array}$$

20.
$$\begin{array}{r} 0.079 \\ \times\ \ 3.6 \\ \hline 474 \\ 237 \\ \hline 0.2844 \end{array}$$

22.
$$\begin{array}{r} 5.85 \\ 2\overline{)\ 11.70} \\ -10 \\ \hline 17 \\ -16 \\ \hline 10 \\ -10 \\ \hline 0 \end{array}$$

24.
$$\begin{array}{r} 3.6 \\ 0.92\overline{)\ 3.312} \\ -276 \\ \hline 552 \\ -552 \\ \hline 0 \end{array}$$

26.
$$\begin{array}{r} 65.0028 \\ 5.0903 \\ +\ 6.9 \\ \hline 76.9931 \end{array}$$

28.
$$\begin{array}{r} 8.91 \\ \times\ 100 \\ \hline 891 \end{array}$$

30.
$$\begin{array}{r} 40. \\ 0.9\overline{)\ 36.0} \\ -36 \\ \hline 00 \end{array}$$

32.
$$\begin{array}{r} 863.20 \\ -\ 39.45 \\ \hline 823.75 \end{array}$$

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34.
$$\begin{array}{r} 8.03 \\ \times\ \ 5.5 \\ \hline 4\ 015 \\ 40\ 15 \\ \hline 44.165 \end{array}$$

36.
$$\begin{array}{r} 960. \\ 0.054\overline{)\ 51.840} \\ -48\ 6 \\ \hline 3\ 24 \\ -3\ 24 \\ \hline 00 \end{array}$$

38.
$$\begin{array}{r} 31.006 \\ \times\ \ 3.71 \\ \hline 31006 \\ 21\ 7042 \\ +\ 93\ 018 \\ \hline 115.03226 \end{array}$$

40. 0.75 rounded to the nearest tenth is 0.8.

42. 0.452 rounded to the nearest hundredth is 0.45.

44. 63.4529 rounded to the nearest thousandth is 63.453.

46. 68,936.543 rounded to the nearest tenth is 68,936.5.

48. 42.9878 rounded to the nearest thousandth is 42.988.

50. $\frac{9}{25} = \frac{9 \cdot 4}{25 \cdot 4} = \frac{36}{100} = 0.36$

52.
$$\begin{array}{r} 0.777... \\ 9\overline{)\ 7.000} \\ -6\ 3 \\ \hline 70 \\ -63 \\ \hline 70 \\ -63 \\ \hline 7 \end{array}$$

$\frac{7}{9} = 0.\overline{7} \approx 0.78$

54. $\frac{5}{8} = \frac{5 \cdot 125}{8 \cdot 125} = \frac{625}{1000} = 0.625$

56.
$$\begin{array}{r} 0.166... \\ 6\overline{)1.000} \\ -6 \\ \hline 40 \\ -36 \\ \hline 40 \\ -36 \\ \hline 4 \end{array}$$

$\frac{1}{6} = 0.1\overline{6} \approx 0.17$

58.
$$\begin{array}{r} 3.77... \\ 9\overline{)\ 34.00} \\ -27 \\ \hline 7\ 0 \\ -6\ 3 \\ \hline 70 \\ -63 \\ \hline 7 \end{array}$$

$\frac{34}{9} = 3.\overline{7} \approx 3.78$

60. 36% = 0.36

62. 2.2% = 0.022

64. 417% = 4.17

66. 700% = 7.00 or 7

68. 81.49% = 0.8149

70. 0.6% = 0.006

72. 73.2% = 0.732

74. 0.32 = 32%

76. 0.521 = 52.1%

78. 3 = 3.00 = 300%

80. 0.1 = 10%

82. 2.15 = 215%

84. 0.005 = 0.5%

86. 0.142 = 14.2%

88. 11% = 0.11

$11\% = \frac{11}{100}$

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90. $60.6\% = 0.606$

$$60.6\% = \frac{60.6}{100} = \frac{606}{1000} = \frac{303}{500}$$

92. The two digits 67 repeat in $0.\overline{67}$, so the choice is **c**. 0.6767...

94. answers may vary

96.
$$\begin{array}{r} 149.0 \\ 39.1 \\ +\ 5.7 \\ \hline 193.8 \end{array}$$

The average U.S. citizen consumes 193.8 pounds of these milk products annually.

98. a. 0.5269% rounded to the nearest tenth percent is 0.5%.

b. 0.5269% rounded to the nearest hundredth percent is 0.53%.

100. a. $0.231 = 23.1\%$

b. $5.12 = 512\% \neq 0.0512\%$

c. $3.2 = 320\%$

d. $0.0175 = 1.75\% \neq 0.175\%$

a and **c** are correct.

102. $45\% + 30\% + 20\% = 95\%$
$100\% - 95\% = 5\%$
The missing percent is 5%.

104. The second longest bar corresponds to physical therapy assistant, so that is predicted to be the second fastest growing occupation.

106. $34\% = 0.34$

108. answers may vary

Section R.4 Practice Exercises

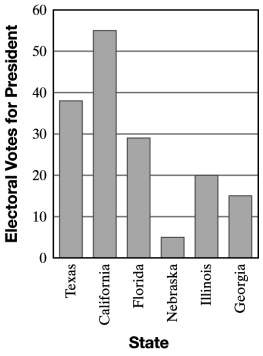
1. a. Spanish has 9 symbols and each symbol represents 50 million speakers, so Spanish is spoken by 9(50) = 450 million people.

b. Arabic has 6 symbols, or 6(50) = 300 million speakers. So, 450 million − 300 million = 150 million more people speak Spanish than Arabic.

2. a. The height of the bar for fishes is 164, so approximately 164 endangered species are fishes.

b. The shortest bar corresponds to arachnids, so arachnids have the fewest endangered species.

3.



4. The height of the bar for 80–89 is 12, so 12 students scored 80–89 on the test.

5. The height of the bar for 40–49 is 1, for 50–59 is 3, for 60–69 is 2, for 70–79 is 10. So, 1 + 3 + 2 + 10 = 16 students scored less than 80 on the test.

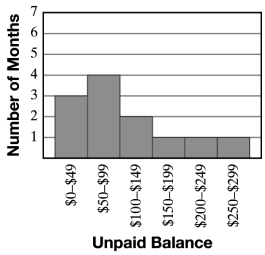
6.

Class Interval (Credit Card Balances)	Tally	Class Frequency (Number of Months)
\$0–\$49	|||	3
\$50–\$99	||||	4
\$100–\$149	||	2
\$150–\$199	|	1
\$200–\$249	|	1
\$250–\$299	|	1

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7.



8. a. The lowest point on the graph corresponds to January, so the average daily temperature is the lowest during January.

b. The point on the graph that corresponds to 25 is December, so the average daily temperature is 25°F in December.

c. The points on the graph that are greater than 70 are June, July, and August. So, the average daily temperature is greater than 70°F in June, July, and August.

9. Eight of the 100 adults prefer golf. The ratio is

$$\frac{\text{adults preferring golf}}{\text{total adults}} = \frac{8}{100} = \frac{2}{25}$$

10. Add the percents corresponding to Europe, Asia, and South America.
19% + 18% + 9% = 46%

11. $\text{amount} = \text{percent} \cdot \text{base}$
$= 0.22 \cdot 89,000,000$
$= 19,580,000$
Thus, 19,580,000 tourists might come from Mexico in 2022.

Vocabulary, Readiness & Video Check R.4

1. A bar graph presents data using vertical or horizontal bars.

2. A pictograph is a graph in which pictures or symbols are used to visually present data.

3. A line graph displays information with a line that connects data points.

4. A histogram is a special bar graph in which the width of each bar represents a class interval and the height of each bar represents the class frequency.

5. In a circle graph, each section (shaped like a piece of pie) shows a category and the relative size of the category.

6. A circle graph contains pie-shaped sections, each called a sector.

7. If a circle graph has percent labels, the percents should add up to 100%.

8. If a circle graph has fraction labels, the fractions should add to 1.

9. Count the number of symbols and multiply this number by how much each symbol stands for (from the key).

10. A bar graph lets you visually see and compare the data.

11. A histogram is a special kind of bar graph.

12. 2009; 8.7 goals per game

13. 100%

Exercise Set R.4

2. South Dakota and Washington have the least number of wheat symbols, so the least amount of wheat acreage was planted in South Dakota and Washington.

4. Kansas is represented by 7.5 wheat symbols, and each symbol represents 1 million acres, so there were approximately 7.5(1 million) = 7.5 million or 7,500,000 acres of wheat planted in Kansas.

6. Each wheat symbol represents 1 million acres, so look for any states that have more than $\frac{7 \text{ million}}{1 \text{ million}} = 7$ wheat symbols. Kansas has more than 7 wheat symbols, so Kansas plants more than 7,000,000 acres of wheat.

8. Colorado has 2.5 wheat symbols, while Washington has 2 wheat symbols. Since Colorado has more wheat symbols, Colorado plants more wheat than Washington.

10. 2012 has 5.5 flames and each flame represents 12,000 wildfires, so there were approximately 5.5(12,000) = 66,000 wildfires in 2012.

12. Since each fire represents 12,000 wildfires, look for the years that have more than $\frac{72,000}{12,000} = 6$ flames. The years 2011 and 2016 had more than 72,000 wildfires.

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14. 2015 has $5\frac{3}{4}$ flames and 2016 has $7\frac{3}{4}$ flames, which is 2 more. Thus, the increase in wildfires from 2015 to 2016 was 2(12,000) = 24,000.

16. answers may vary

18. The shortest bar corresponds to June, so the month in which the fewest hurricanes made landfall is June.

20. The length of the bar for September is 109, so approximately 109 hurricanes made landfall in September.

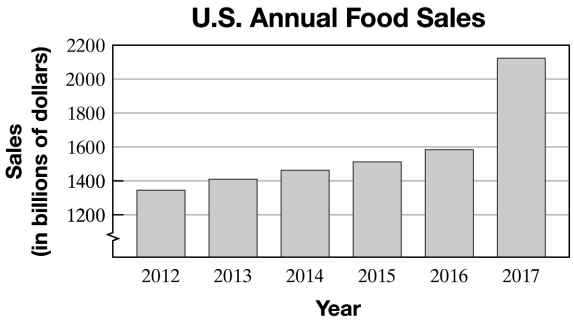
22. One of 109 hurricanes made landfall in September 2007. The percent is $\frac{1}{109} \approx 0.009$ or about 0.9%.

24. The bar between 26 million and 27 million corresponds to Delhi, India.

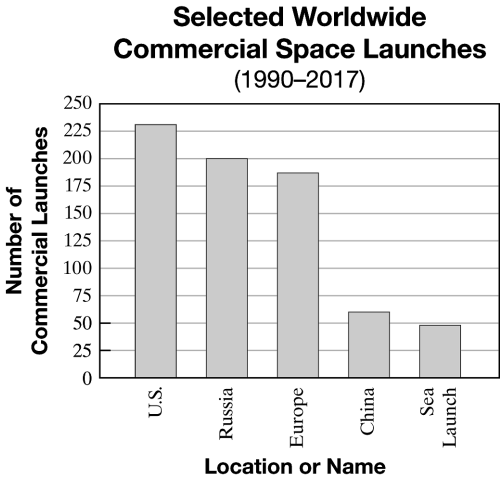
26. The two bars that are approximately 24 million correspond to Manila, Philippines and Seoul, South Korea. Thus, two cities whose populations are approximately 24 million are Manila, Philippines and Seoul, South Korea.

28. The bar corresponding to Jakarta, Indonesia has length about 31.5 and the bar corresponding to Delhi, India has length about 26.5. Thus, Jakarta, Indonesia is about 31.5 − 26.5 = 5 million larger than Delhi, India.

30.



32.



34. The height of the bar for 200–249 miles per week is 9, so 9 of the adults drive 200–249 miles per week.

36. 9 of the adults drive 200–249 miles per week and 21 of the adults drive 250–299 miles per week, so 9 + 21 = 30 of the adults drive 200 miles or more per week.

38. 9 of the adults drive 150–199 miles per week and 9 of the adults drive 200–249 miles per week, so 9 + 9 = 18 of the adults drive 150–249 miles per week.

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40. 29 of the adults drive 0–49 miles per week and 17 of the adults drive 50–99 miles per week, so 29 – 17 = 12 more adults drive 0–49 miles per week than 50–99 miles per week.

42. 17 of the 100 adults surveyed drive 50–99 miles per week, so the ratio is $\frac{17}{100}$.

44. The shortest bar in the histogram represents the 85 plus age range, so the 85 plus age range will be the smallest population group in 2020.

46. The population of 45-to-64 year olds is expected to be 84 million in 2020.

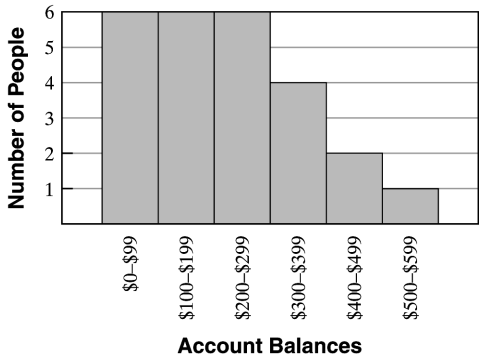
48. The population of 5-to-19 year olds is expected to be 66 million in 2020.

50. The population of 20-to-44 year olds is expected to be 109 million and the population of 45-to-64 year olds is expected to be 84 million, so 109 – 84 = 25 million more 20-to-44 year olds are expected to be there than 45-64 year olds in 2020.

	Class Interval (Scores)	Tally	Class Frequency (Number of Games)
52.	80–89	𝍸	4
54.	100–109	||	2

	Class Interval (Account Balances)	Tally	Class Frequency (Number of People)
56.	\$100–\$199	𝍸 |	6
58.	\$300–\$399	𝍸	4
60.	\$500–\$599	|	1

62.



64. The point on the graph corresponding to 2013 is 7.6, so the average number of goals per game in 2013 was 7.6.

66. The lowest point on the graph corresponds to 2013, so the average number of goals per game was the lowest in 2013.

68. The graph decreases between 2011 and 2013, so the average number of goals per game decreased from 2011 to 2013.

70. The dots for 2009, 2011, and 2017 are above the 8-level, so the average number of goals per game was greater than 8 in 2009, 2011, and 2017.

72. The smallest sector corresponds to the category "own off-campus housing," thus the least of these college students own off-campus housing.

74. 124 of the 700 total students live in off-campus rentals.

$$\frac{124}{700} = \frac{31}{175}$$

The ratio is $\frac{31}{175}$.

76. 124 of the students live in off-campus rentals while 320 live in a parent or guardian's home.

$$\frac{124}{320} = \frac{31}{80}$$

The ratio is $\frac{31}{80}$.

78. The smallest sector corresponds to Australia. Thus, the smallest continent is Australia.

80. 16% + 12% = 28%
28% of the land on Earth is accounted for by North and South America.

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82. South America accounts for 12% of the land on Earth.
12% of $57{,}000{,}000 = 0.12 \cdot 57{,}000{,}000$
$= 6{,}840{,}000$
South America is 6,840,000 square miles.

84. Europe accounts for 7% of the land on Earth.
7% of $57{,}000{,}000 = 0.07 \cdot 57{,}000{,}000$
$= 3{,}990{,}000$
Europe is 3,990,000 square miles.

86. Add the percent for nonfiction (25%) to the percent for reference (17%).
$25\% + 17\% = 42\%$
Thus, 42% of books are nonfiction or reference.

88. The third-largest sector corresponds to children's fiction, so the third-largest category of books is children's fiction.

90. Reference accounts for 17% of the books.
17% of $125{,}600 = 0.17 \cdot 125{,}600 = 21{,}352$
The library has 21,352 reference books.

92. Adult's fiction accounts for 33% of the books.
33% of $125{,}600 = 0.33 \cdot 125{,}600 = 41{,}448$
The library has 41,448 adult fiction books.

94. Nonfiction or other accounts for
$25\% + 3\% = 28\%$ of the books.
28% of $125{,}600 = 0.28 \cdot 125{,}600 = 35{,}168$
The library has 35,168 nonfiction or other books

96. The point on the low temperature graph corresponding to Thursday is 74, so the low temperature reading on Thursday was 74°F.

98. The highest point on the graph of high temperature corresponds to Tuesday. The high temperature on Tuesday was 86°F.

100. The difference between the graphs is the least for Friday. The high temperature was 76°F and the low temperature was 70°F, so the difference is $76 - 70 = 6$°F.

102. Kansas is represented by 7.5 wheat symbols, and each symbol represents 1 million acres, so there were approximately 7.5(1 million) = 7.5 million or 7,500,000 acres of wheat planted. This represents 24% of the wheat acreage in the U.S., so $\frac{7.5 \text{ million}}{0.24} \approx 31$ million acres of wheat were planted in the U.S.

104. Arctic; answers may vary

106. Atlantic Ocean:
$26\% \cdot 264{,}489{,}800 = 0.26 \cdot 264{,}489{,}800$
$= 68{,}767{,}348$ square kilometers

108. Arctic Ocean:
$4\% \cdot 264{,}489{,}800 = 0.04 \cdot 264{,}489{,}800$
$= 10{,}579{,}592$ square kilometers

110. 62% of 2800 = 0.62 · 2800 = 1736 people

112. 62% + 14% = 76%
0.76 · 2800 = 2128 people

114. $\frac{\text{percent of respondents who spend \$101-\$1000}}{\text{percent of respondents who spend \$1-\$100}}$
$= \frac{14}{62}$
$= \frac{2 \cdot 7}{2 \cdot 31}$
$= \frac{7}{31}$

116. true; answers may vary

118. answers may vary

Chapter R Vocabulary Check

1. To factor means to write as a product.

2. A multiple of a number is the product of that number and any natural number.

3. A composite number is a natural number greater than 1 that is not prime.

4. The word percent means per 100.

5. Fractions that represent the same portion of a whole are called equivalent fractions.

6. An improper fraction is a fraction whose numerator is greater than or equal to its denominator.

7. A prime number is a natural number greater than 1 whose only factors are 1 and itself.

8. A fraction is simplified when the numerator and the denominator have no factors in common other than 1.

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9. A proper fraction is one whose numerator is less than its denominator.

10. A mixed number contains a whole number part and a fraction part.

11. A bar graph presents data using vertical or horizontal bars.

12. A pictograph is a graph in which pictures or symbols are used to visually present data.

13. A line graph displays information with a line that connects data points.

14. In a circle graph, each section (shaped like a piece of pie) shows a category and the relative size of the category.

15. A histogram is a special bar graph in which the width of each bar represents a class interval and the height of each bar represents the class frequency.

Chapter R Review

1. $42 = 2 \cdot 21 = 2 \cdot 3 \cdot 7$

2. $800 = 2 \cdot 400$
$= 2 \cdot 2 \cdot 200$
$= 2 \cdot 2 \cdot 2 \cdot 100$
$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 50$
$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 25$
$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 5 \cdot 5$

3. $12 = 2 \cdot 2 \cdot 3$
$30 = 2 \cdot 3 \cdot 5$
LCM $= 2 \cdot 2 \cdot 3 \cdot 5 = 60$

4. $7 = 7$
$42 = 2 \cdot 3 \cdot 7$
LCM $= 2 \cdot 3 \cdot 7 = 42$

5. $4 = 2 \cdot 2$
$6 = 2 \cdot 3$
$10 = 2 \cdot 5$
LCM $= 2 \cdot 2 \cdot 3 \cdot 5 = 60$

6. $2 = 2$
$5 = 5$
$7 = 7$
LCM $= 2 \cdot 5 \cdot 7 = 70$

7. $\frac{5}{8} = \frac{5 \cdot 3}{8 \cdot 3} = \frac{15}{24}$

8. $\frac{2}{3} = \frac{2 \cdot 20}{3 \cdot 20} = \frac{40}{60}$

9. $\frac{8}{20} = \frac{2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 5} = \frac{2}{5}$

10. $\frac{15}{100} = \frac{3 \cdot 5}{2 \cdot 2 \cdot 5 \cdot 5} = \frac{3}{20}$

11. $\frac{12}{6} = \frac{2 \cdot 6}{6} = 2$

12. $\frac{8}{8} = 1$

13. $\frac{1}{7} \cdot \frac{8}{11} = \frac{1 \cdot 8}{7 \cdot 11} = \frac{8}{77}$

14. $\frac{5}{12} + \frac{2}{15} = \frac{5 \cdot 5}{12 \cdot 5} + \frac{2 \cdot 4}{15 \cdot 4}$
$= \frac{25}{60} + \frac{8}{60}$
$= \frac{25 + 8}{60}$
$= \frac{33}{60}$
$= \frac{11 \cdot 3}{20 \cdot 3}$
$= \frac{11}{20}$

15. $\frac{3}{10} \div 6 = \frac{3}{10} \div \frac{6}{1} = \frac{3}{10} \cdot \frac{1}{6} = \frac{3 \cdot 1}{10 \cdot 6} = \frac{3 \cdot 1}{10 \cdot 2 \cdot 3} = \frac{1}{20}$

16. $\frac{7}{9} - \frac{1}{6} = \frac{7 \cdot 2}{9 \cdot 2} - \frac{1 \cdot 3}{6 \cdot 3} = \frac{14}{18} - \frac{3}{18} = \frac{14 - 3}{18} = \frac{11}{18}$

17. $3\frac{3}{8} \cdot 4\frac{1}{4} = \frac{27}{8} \cdot \frac{17}{4} = \frac{27 \cdot 17}{8 \cdot 4} = \frac{459}{32} = 14\frac{11}{32}$

18. $2\frac{1}{3} - 1\frac{5}{6} = \frac{7}{3} - \frac{11}{6} = \frac{14}{6} - \frac{11}{6} = \frac{14 - 11}{6} = \frac{3}{6} = \frac{1}{2}$

19. $16\frac{9}{10} + 3\frac{2}{3}$ $\quad$ $16\frac{27}{30} + 3\frac{20}{30}$

$19\frac{47}{30} = 19 + 1\frac{17}{30} = 20\frac{17}{30}$

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20. $6\frac{2}{7} \div 2\frac{1}{5} = \frac{44}{7} \div \frac{11}{5}$
$= \frac{44}{7} \cdot \frac{5}{11}$
$= \frac{44 \cdot 5}{7 \cdot 11}$
$= \frac{4 \cdot 11 \cdot 5}{7 \cdot 11}$
$= \frac{20}{7}$
$= 2\frac{6}{7}$

21. $A = lw = \frac{11}{12} \cdot \frac{3}{5} = \frac{11 \cdot 3}{12 \cdot 5} = \frac{11 \cdot 3}{3 \cdot 4 \cdot 5} = \frac{11}{20}$

The area is $\frac{11}{20}$ square mile.

22. $A = \frac{1}{2}bh = \frac{1}{2} \cdot \frac{5}{4} \cdot \frac{1}{2} = \frac{1 \cdot 5 \cdot 1}{2 \cdot 4 \cdot 2} = \frac{5}{16}$

The area is $\frac{5}{16}$ square meter.

23. $1.81 = \frac{181}{100}$

24. $0.035 = \frac{35}{1000}$

25.
$$\begin{array}{r} 76.358 \\ +\ 18.76 \\ \hline 95.118 \end{array}$$

26.
$$\begin{array}{r} 35 \\ 0.02 \\ +\ 1.765 \\ \hline 36.785 \end{array}$$

27.
$$\begin{array}{r} 18.00 \\ -\ 4.62 \\ \hline 13.38 \end{array}$$

28.
$$\begin{array}{r} 804.062 \\ -\ 112.489 \\ \hline 691.573 \end{array}$$

29.
$$\begin{array}{r} 7.6 \\ \times 12 \\ \hline 15\ 2 \\ 76 \\ \hline 91.2 \end{array}$$

30.
$$\begin{array}{r} 14.63 \\ \times\ \ 3.2 \\ \hline 2\ 926 \\ 43\ 89 \\ \hline 46.816 \end{array}$$

31.
$$\begin{array}{r} 28.6 \\ 27\overline{)\ 772.2} \\ -54 \\ \hline 232 \\ -216 \\ \hline 16\ 2 \\ -16\ 2 \\ \hline 0 \end{array}$$

32.
$$\begin{array}{r} 230. \\ 0.06\overline{)\ 13.80} \\ -12 \\ \hline 1\ 8 \\ -1\ 8 \\ \hline 00 \end{array}$$

33. 0.7652 rounded to the nearest hundredth is 0.77.

34. 25.6293 rounded to the nearest tenth is 25.6.

35. $\frac{1}{2} = \frac{1 \cdot 5}{2 \cdot 5} = \frac{5}{10} = 0.5$

36. $\frac{3}{8} = \frac{3 \cdot 125}{8 \cdot 125} = \frac{375}{1000} = 0.375$

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37.
$$\begin{array}{r} 0.3636\ldots \\ 11\overline{)\ 4.0000} \\ -33 \\ \hline 70 \\ -66 \\ \hline 40 \\ -33 \\ \hline 70 \\ -66 \\ \hline 4 \end{array}$$

$\frac{4}{11} = 0.\overline{36} \approx 0.364$

38.
$$\begin{array}{r} 0.833\ldots \\ 6\overline{)\ 5.000} \\ -48 \\ \hline 20 \\ -18 \\ \hline 20 \\ -18 \\ \hline 2 \end{array}$$

$\frac{5}{6} = 0.8\overline{3} \approx 0.833$

39. 29% = 0.29

40. 1.4% = 0.014

41. 0.39 = 39%

42. 1.2 = 120%

43. 64.3% = 0.643
The decimal is 0.643.

44. 2.3% = 0.023
5 = 500%
40% = 0.4
The true statement is **b**.

45. Midwest has $3\frac{1}{2}$ houses, and each house represents 50,000 homes, so there were $3\frac{1}{2}(50,000) = 175,000$ new homes constructed in the Midwest.

46. South has 12 houses, and each house represents 50,000 homes, so there were 12(50,000) = 600,000 new homes constructed in the South.

47. South has the greatest number of houses, so the most new homes constructed were in the South.

48. Northeast has the least number of houses, so the fewest new homes constructed were in the Northeast.

49. Each house represents 50,000 homes, so look for the regions with $\frac{250,000}{50,000} = 5$ or more houses.
The South and West had 250,000 or more new homes constructed.

50. Each house represents 50,000 homes, so look for the regions with fewer than $\frac{200,000}{50,000} = 4$ houses. The Northeast and Midwest had fewer than 200,000 new homes constructed.

51. The height of the bar representing 2010 is 30. Thus, approximately 30% of persons completed four or more years of college in 2010.

52. The tallest bar corresponds to 2017. Thus, the greatest percent of persons completing four or more years of college was in 2017.

53. The bars whose height is at a level of 20 or more are 1990, 2000, 2010, and 2017. Thus, 20% or more persons completed four or more years of college in 1990, 2000, 2010, and 2017.

54. answers may vary

55. The point on the graph corresponding to 2012 is about 962. Thus, there were approximately 962 medals awarded at the Summer Olympics in 2012.

56. The point on the graph corresponding to 2000 is about 927. Thus, there were approximately 927 medals awarded at the Summer Olympics in 2000.

57. The point on the graph corresponding to 2008 is about 958. Thus, there were approximately 958 medals awarded at the Summer Olympics in 2008.

58. The point on the graph corresponding to 1996 is about 842. Thus, there were approximately 842 medals awarded at the Summer Olympics in 1996.

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59. The points on the graph corresponding to 2008 and 2004 are 961 and 930, respectively. Thus, there were 961 − 930 = 31 more medals awarded in 2008 than in 2004.

60. answers may vary

61. The height of the bar corresponding to 41–45 is 1. Thus, 1 employee works 41–45 hours per week.

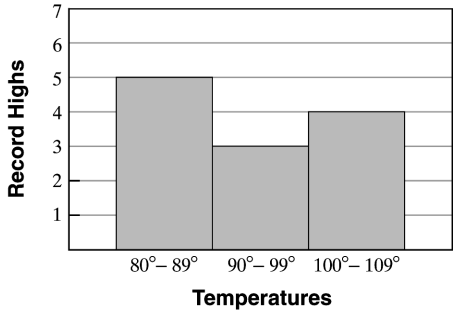
62. The height of the bar corresponding to 21–25 is 4. Thus, 4 employees work 21–25 hours per week.

63. Add the heights of the bars corresponding to 16–20, 21–25, and 26–30. Thus, 6 + 4 + 8 = 18 employees work 30 hours or less per week.

64. Add the heights of the bars corresponding to 36–40 and 41–45. Thus, 8 + 1 = 9 employees work 36 or more hours per week.

	Class Interval (Temperatures)	Tally	Class Frequency (Number of Months)
65.	80°–89°	𝍸	5
66.	90°–99°	|||	3
67.	100°–109°	||||	4

68.



69. The largest sector corresponds to the category "Mortgage payment," thus the largest budget item is mortgage payment.

70. The smallest sector corresponds to the category "Utilities," thus the smallest budget item is utilities.

71. Add the amounts for mortgage payment and utilities. Thus, \$975 + \$250 = \$1225 is budgeted for the mortgage payment and utilities.

72. Add the amounts for savings and contributions. Thus, \$400 + \$300 = \$700 is budgeted for savings and contributions.

73. $$\frac{\text{mortgage payment}}{\text{total}} = \frac{\$975}{\$4000} = \frac{39 \cdot 25}{160 \cdot 25} = \frac{39}{160}$$

The ratio is $\frac{39}{160}$.

74. $$\frac{\text{food}}{\text{total}} = \frac{\$700}{\$4000} = \frac{7 \cdot 100}{40 \cdot 100} = \frac{7}{40}$$

The ratio is $\frac{7}{40}$.

75. The sector corresponding to China is 56.4%.
56.4% of 133 = 0.564 · 133 ≈ 75
75 of the completed tall buildings are in China.

76. The sector corresponding to Asia (not China) is 21.0%.
21.0% of 133 = 0.21 · 133 ≈ 28
28 of the completed tall buildings are in the rest of Asia.

77. The sector corresponding to Oceania is 1.5%.
1.5% of 133 = 0.015 · 133 ≈ 2
2 of the completed tall buildings are in Oceania.

78. The sector corresponding to the Middle East is 6.8%.
6.8% of 133 = 0.068 · 133≈ 9
9 of the completed tall buildings are in the Middle East.

Chapter R Getting Ready for the Test

1. $\frac{-2}{-2} = 1$; A

2. $\frac{-2}{2} = \frac{-1 \cdot 2}{2} = -1$; B

3. $\frac{2}{0}$ is undefined; D

4. $\frac{0}{-2} = 0$; C

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5. $4\frac{3}{5}=\frac{5\cdot 4+3}{5}=\frac{20+3}{5}=\frac{23}{5}$; C

6.
$$8\overline{)\,23}\quad 2$$
$$\underline{-16}$$
$$7$$

$\frac{23}{8}=2\frac{7}{8}$; B

7. Since $\frac{8}{11}\cdot\frac{2}{11}=\frac{8\cdot 2}{11\cdot 11}=\frac{16}{121}$, the operation is multiplication; C.

8. Since $\frac{8}{11}\div\frac{2}{11}=\frac{8}{11}\cdot\frac{11}{2}=\frac{8\cdot 11}{11\cdot 2}=\frac{8}{2}=\frac{2\cdot 4}{2}=4$, the operation is division; D.

9. Since $\frac{8}{11}-\frac{2}{11}=\frac{8-2}{11}=\frac{6}{11}$, the operation is subtraction; B.

10. Since $\frac{8}{11}+\frac{2}{11}=\frac{8+2}{11}=\frac{10}{11}$, the operation is addition; A.

11. $\frac{5}{7}+\frac{1}{7}=\frac{5+1}{7}=\frac{6}{7}$; F

12. $\frac{5}{7}\cdot\frac{1}{7}=\frac{5\cdot 1}{7\cdot 7}=\frac{5}{49}$; H

13. $\frac{5}{7}\div\frac{1}{7}=\frac{5}{7}\cdot\frac{7}{1}=\frac{5\cdot 7}{7\cdot 1}=\frac{5}{1}=5$; B

14. $\frac{5}{7}-\frac{1}{7}=\frac{5-1}{7}=\frac{4}{7}$; D

15. 8603.3 is 8603.2855 rounded to the nearest tenth; C.

16. 8600 is 8603.2855 rounded to the nearest ten; B.

17. 8603.286 is 8603.2855 rounded to the nearest thousandth; E.

18. 8603.29 is 8603.2855 rounded to the nearest hundredth; D.

19.
$$\begin{array}{r} 10.00 \\ -\ 0.08 \\ \hline 9.92 \end{array}$$
Choice D is correct.

20.
$$\begin{array}{r} 10.00 \\ +\ 0.08 \\ \hline 10.08 \end{array}$$
Choice A is corrects.

21.
$$\begin{array}{r} 37.0 \\ +\ 2.1 \\ \hline 39.1 \end{array}$$
Choice B is correct.

22. There are three decimal places in 2.326 and one decimal place in 1.5. Since 3 + 1 = 4, there should be four decimal places in the product of 2.326 and 1.5. Thus, $2.326 \times 1.5 = 3.4890$; C.

23. In a division problem, the decimal point in the quotient should be lined up with the moved decimal point in the dividend.
$0.38\overline{)7.068}$ becomes $38\overline{)706.8}$
Thus the correct quotient is 18.6; C.

24. Since "percent" means "per hundred," 12% is $\frac{12}{100}=0.12$. Also, $\frac{3}{25}=\frac{3\cdot 4}{25\cdot 4}=\frac{12}{100}=12\%$.
Thus, 1.2 does not equal 12%; D.

25. Since "percent" means "per hundred," $100\%=\frac{100}{100}=1.00=1$. Thus, 10 does not equal 100%; A.

26. Orchard 1 has 7 symbols, and each symbol represents 4 thousand bushels, so Orchard 1 produced $7 \cdot 4 = 28$ thousand bushels.
28 thousand = 28,000; C.

27. Orchard 5 has the most symbols, so Orchard 5 produced the most bushels; C.

28. Orchard 4 has 2.5 symbols and each symbol corresponds to 28 thousand bushels, so Orchard 4 produced 2.5(4) = 10 thousand bushels; D.

29. Orchard 2 has 8.5 symbols and Orchard 4 has 2.5 symbols, which is 6 fewer symbols. Each symbol represents 4 thousand bushels, so Orchard 2 produced 6(4) = 24 thousand bushels more than Orchard 4. 24 thousand = 24,000; C.

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30. A whole circle contains 360°.
$90° + 10° + 20° + 100° + 100° = 320°$
The unknown sector must contain
$360° - 320° = 40°$; C.

Chapter R Test

1.
$3\overline{)9}$ 3
$2\overline{)18}$ 3
$2\overline{)36}$ 2
$2\overline{)72}$ 2

The prime factorization of 72 is $2 \cdot 2 \cdot 2 \cdot 3 \cdot 3$.

2. $5 = 5$
$18 = 2 \cdot 3 \cdot 3$
$20 = 2 \cdot 2 \cdot 5$
$\text{LCM} = 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 = 180$

3. $\frac{5}{12} = \frac{5 \cdot 5}{12 \cdot 5} = \frac{25}{60}$

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

5. $\frac{48}{100} = \frac{4 \cdot 12}{4 \cdot 25} = \frac{12}{25}$

6. $1.3 = 1\frac{3}{10} = \frac{13}{10}$

7. $\frac{5}{8} + \frac{7}{10} = \frac{5 \cdot 5}{8 \cdot 5} + \frac{7 \cdot 4}{10 \cdot 4} = \frac{25}{40} + \frac{28}{40} = \frac{25 + 28}{40} = \frac{53}{40}$

8. $\frac{2}{3} \cdot \frac{27}{49} = \frac{2 \cdot 27}{3 \cdot 49} = \frac{2 \cdot 3 \cdot 9}{3 \cdot 49} = \frac{18}{49}$

9. $\frac{9}{10} \div 18 = \frac{9}{10} \div \frac{18}{1}$
$= \frac{9}{10} \cdot \frac{1}{18}$
$= \frac{9 \cdot 1}{10 \cdot 18}$
$= \frac{9 \cdot 1}{10 \cdot 9 \cdot 2}$
$= \frac{1}{20}$

10. $\frac{8}{9} - \frac{1}{12} = \frac{8 \cdot 4}{9 \cdot 4} - \frac{1 \cdot 3}{12 \cdot 3} = \frac{32}{36} - \frac{3}{36} = \frac{32 - 3}{36} = \frac{29}{36}$

11. $1\frac{2}{9} + 3\frac{2}{3} = \frac{11}{9} + \frac{11}{3} = \frac{11}{9} + \frac{33}{9} = \frac{11 + 33}{9} = \frac{44}{9} = 4\frac{8}{9}$

12.
$5\frac{6}{11}$ $5\frac{12}{22}$
$-3\frac{7}{22}$ $-3\frac{7}{22}$
$2\frac{5}{22}$

13. $6\frac{7}{8} \div \frac{1}{8} = \frac{55}{8} \div \frac{1}{8} = \frac{55}{8} \cdot \frac{8}{1} = \frac{55 \cdot 8}{8 \cdot 1} = \frac{55}{1} = 55$

14. $2\frac{1}{10} \cdot 6\frac{1}{2} = \frac{21}{10} \cdot \frac{13}{2} = \frac{21 \cdot 13}{10 \cdot 2} = \frac{273}{20} = 13\frac{13}{20}$

15.
43
0.21
$+\ 1.9$
45.11

16.
123.60
$-\ 57.72$
65.88

17.
7.93
$\times\ \ 1.6$
4758
793
12.688

18.
$0.25\overline{)80.00}$ $320.$
-75
$5\,0$
$-5\,0$
00

19. 23.7272 rounded to the nearest hundredth is 23.73.

20. $\frac{7}{8} = \frac{7 \cdot 125}{8 \cdot 125} = \frac{875}{1000} = 0.875$

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21.
$$\begin{array}{r} 0.166\ldots \\ 6\overline{)1.000} \\ \underline{-6} \\ 40 \\ \underline{-36} \\ 40 \\ \underline{-36} \\ 4 \end{array}$$

$\frac{1}{6} = 0.1\overline{6} \approx 0.167$

22. $63.2\% = 0.632$

23. $0.09 = 9\%$

24. $\frac{3}{4} = \frac{3 \cdot 25}{4 \cdot 25} = \frac{75}{100} = 0.75 = 75\%$

25. $\frac{3}{4}$ of the fresh water is icecaps and glaciers.

26. $\frac{1}{200}$ of the fresh water is active water.

27. $1 - \frac{3}{4} - \frac{1}{200} = \frac{200}{200} - \frac{150}{200} - \frac{1}{200}$
$= \frac{200 - 150 - 1}{200}$
$= \frac{49}{200}$

$\frac{49}{200}$ of the fresh water is groundwater.

28. $1 - \frac{1}{200} = \frac{200}{200} - \frac{1}{200} = \frac{200 - 1}{200} = \frac{199}{200}$

$\frac{199}{200}$ of the fresh water is groundwater or icecaps and glaciers.

29. Area $= \frac{1}{2}$(base)(height)
$= \frac{1}{2} \cdot \frac{3}{4} \cdot \frac{1}{3}$
$= \frac{1 \cdot 3 \cdot 1}{2 \cdot 4 \cdot 3}$
$= \frac{1}{8}$

The area is $\frac{1}{8}$ square foot.

30. $A = lw = \frac{9}{8} \cdot \frac{7}{8} = \frac{9 \cdot 7}{8 \cdot 8} = \frac{63}{64}$

The area is $\frac{63}{64}$ square centimeter.

31. There are $4\frac{1}{2}$ dollar symbols for the second week. Each dollar symbol corresponds to \$50.
$4\frac{1}{2} \cdot \$50 = \frac{9}{2} \cdot \$50 = \frac{\$450}{2} = \$225$
\$225 was collected during the second week.

32. Week 3 has more dollar symbols than any other week, so the most money was collected during week 3. There are 7 symbols for week 3, each representing \$50, so the amount collected in week 3 was 7 · \$50 = \$350.

33. The number of dollar symbols for all 5 weeks is 3 + 4.5 + 7 + 5.5 + 2 = 22. Each symbol represents \$50, so the total amount collected was 22 · \$50 = \$1100.

34. The bars for June, August, and September extend above the 9 cm level, so the normal amount of precipitation is more than 9 cm during those months.

35. The shortest bar corresponds to February. The normal monthly precipitation in February in Chicago is 3 centimeters.

36. The tops of the bars for March and November are at the 7 cm level, so 7 cm of precipitation normally occurs in those months.

37. The point on the graph corresponding to 2014 is at about 1.6. Thus, the annual inflation rate in 2014 was about 1.6%.

38. The line graph is above the 3 level for 2008 and 2011. Thus the inflation rate was greater than 3% in 2008 and 2011.

39. Look for the years where the line graph is decreasing. During 2008–2009, 2011–2012, 2012–2013, and 2014–2015, the inflation rate was decreasing.

40. 85 of the 200 people prefer rock music, so the ratio is $\frac{85}{200} = \frac{17}{40}$.

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41. 62 people prefer country music, and 44 prefer jazz, so the ratio is $\frac{62}{44} = \frac{31}{22}$.

42. The sector corresponding to under 18 is 22%.

$$\begin{aligned} 22\% \text{ of } 335 \text{ million} &= 0.22 \cdot 335 \text{ million} \\ &= 73.7 \text{ million} \end{aligned}$$

Thus, about 74 million people are expected to be in the under 18 age group in 2020.

43. The sector corresponding 25–44 is 27%.

$$\begin{aligned} 27\% \text{ of } 335 \text{ million} &= 0.27 \cdot 335 \text{ million} \\ &= 90.45 \text{ million.} \end{aligned}$$

Thus, about 90 million people are expected to be in the 25–44 age group in 2020.

44. The top of the bar marked $5'8" - 5'11"$ is halfway between the levels marked 8 and 10, so 9 students are $5'8" - 5'11"$ tall.

45. 5 students are $5'0" - 5'3"$ tall and 6 students are $5'4" - 5'7"$ tall, so $5 + 6 = 11$ students are $5'7"$ or shorter.

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Chapter 1

Section 1.2 Practice Exercises

1. Since 8 is to the right of 6 on a number line, the statement $8 < 6$ is false.

2. Since 100 is to the right of 10 on a number line, the statement $100 > 10$ is true.

3. Since $21 = 21$, the statement $21 \le 21$ is true.

4. Since $21 = 21$, the statement $21 \ge 21$ is true.

5. Since neither $0 > 5$ nor $0 = 5$ is true, the statement $0 \ge 5$ is false.

6. Since $25 > 22$, the statement $25 \ge 22$ is true.

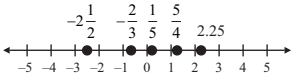
7. a. Fourteen is greater than or equal to fourteen is written as $14 \ge 14$.

b. Zero is less than five is written as $0 < 5$.

c. Nine is not equal to 10 is written as $9 \ne 10$.

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

9. $\frac{5}{4} = 1\frac{1}{4}$



10. a. $-11 < -9$ since -11 is to the left of -9 on a number line.

b. By comparing digits in the same places, we find that $4.511 > 4.151$, since $0.5 > 0.1$.

c. By dividing, we find that $\frac{7}{8} = 0.875$ and $\frac{2}{3} = 0.66....$ Since $0.875 > 0.66...$, then $\frac{7}{8} > \frac{2}{3}$.

11. a. The natural numbers are 6 and 913.

b. The whole numbers are 0, 6, and 913.

c. The integers are -100, 0, 6, and 913.

d. The rational numbers are -100, $-\frac{2}{5}$, 0, 6, and 913.

e. The irrational number is π.

f. All numbers in the given set are real numbers.

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

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

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

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

e. $|-3.06| = 3.06$

13. a. $|-4| = 4$

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

c. $|-2.7| > |-2|$ since $2.7 > 2$.

d. $|-6| \le |-16|$ since $6 < 16$.

e. $|10| < \left|-10\frac{1}{3}\right|$ since $10 < 10\frac{1}{3}$.

Vocabulary, Readiness & Video Check 1.2

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

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

3. The symbols $\ne$, $\le$, and $>$ are called inequality symbols.

4. The integers are {..., −3, −2, −1, 0, 1, 2, 3, ...}.

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

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

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7. The integer 0 is neither positive nor negative.

8. The point on a number line halfway between 0 and $\frac{1}{2}$ can be represented by $\frac{1}{4}$.

9. The distance between a real number a and 0 is called the absolute value of a.

10. The absolute value of a is written in symbols as $|a|$.

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

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

13. 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.

14. 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. Since 8 is to the right of 5 on a number line, $8 > 5$.

4. Since 9 is to the left of 15 on a number line, $9 < 15$.

6. $1.13 = 1.13$

8. Since 20 is to the right of 0 on a number line, $20 > 0$.

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

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

14. Since 8 is to the left of 9 on a number line, $8 \geq 9$ is false.

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

18. 1.02 can be written as 1.020. Then comparing digits with the same place value, we have $0.000 < 0.001$. Thus the statement $1.02 > 1.021$ is false.

20. Rewrite the fractions with a common denominator and compare numerators.

$\frac{4}{5} = \frac{44}{55}; \frac{9}{11} = \frac{45}{55}$

Since $44 < 45$, then $\frac{4}{5} \leq \frac{9}{11}$ is true.

22. $-13 \leq 13$ has the same meaning as $13 \geq -13$.

24. $5 > 3$ has the same meaning as $3 < 5$.

26. $-4 < -2$ has the same meaning as $-2 > -4$.

28. Twenty is greater than two is written as $20 > 2$.

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

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

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

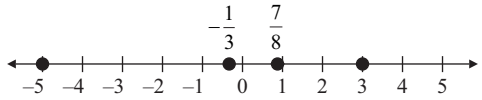
36. The integer $-79{,}647$ represents 79,647 fewer students.

38. The integer 17 represents an ascent of 17 feet. The integer -15 represents a descent of 15 feet.

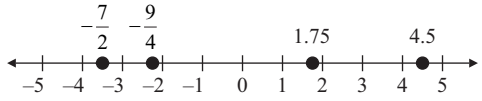
40.



42.



44.



46. $\frac{1}{4}$ is a rational number and a real number.

48. $-\frac{1}{7}$ is a rational number and a real number.

50. 7941 is a natural number, a whole number, an integer, a rational number, and a real number.

52. $\sqrt{3}$ is an irrational number and a real number.

54. True; every natural number is positive.

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

58. True; every rational number is also a real number.

60. True; every whole number is an integer.

62. $|11.2| = 11.2$ since 11.2 is 11.2 units from 0 on a number line.

64. $|-17| = 17$ since -17 is 17 units from 0 on a number line.

66. $\left|\frac{10}{7}\right| = \frac{10}{7}$ since $\frac{10}{7}$ is $\frac{10}{7}$ units from 0 on a number line.

68. $\left|-\frac{1}{15}\right| = \frac{1}{15}$ since $-\frac{1}{15}$ is $\frac{1}{15}$ unit from 0 on a number line.

70. $|-12| = 12$
$|0| = 0$
Since 12 is to the right of 0 on a number line, $|-12| > |0|$.

72. $\left|\frac{2}{5}\right| = \frac{2}{5}$
$\left|-\frac{2}{5}\right| = \frac{2}{5}$
Since $\frac{2}{5} = \frac{2}{5}$, then $\left|\frac{2}{5}\right| = \left|-\frac{2}{5}\right|$.

74. $|-5.01| = 5.01$
$|-5| = 5$
Since 5.01 is to the right of 5 on a number line, $|-5.01| > |-5|$.

76. $|-12| = 12$
$\frac{-24}{2} = -12$
Since 12 is to the right of -12 on a number line, $|-12| > \frac{-24}{2}$.

78. The corn production in Minnesota was 1550 million bushels, while the corn production in South Dakota was 825 million bushels.
1550 million > 825 million or
1,550,000,000 > 825,000,000

80. The corn production in Indiana was 950 million bushels, while the corn production in Minnesota was 1550 million bushels.
$1550 - 950 = 600$
The production in corn was 600 million bushels less or $-600{,}000{,}000$.

82. Since 0.96 is to the left of 0.98 on a number line, $0.96 < 0.98$.

84. Antares: 0.96
Spica: 0.98
Since $0.96 < 0.98$, Spica is dimmer than Antares.

86. Since the dimmest star corresponds to the largest apparent magnitude, which is 1.35, the dimmest star is Regulus.

88. answers may vary

Section 1.3 Practice Exercises

1. a. $4^2 = 4 \cdot 4 = 16$

b. $2^2 = 2 \cdot 2 = 4$

c. $3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 81$

d. $9^1 = 9$

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

f. $(0.8)^2 = (0.8)(0.8) = 0.64$

2. $3 \cdot 2 + 4^2 = 3 \cdot 2 + 16 = 6 + 16 = 22$

3. $28 \div 7 \cdot 2 = 4 \cdot 2 = 8$

4. $\frac{9}{5} \cdot \frac{1}{3} - \frac{1}{3} = \frac{9}{15} - \frac{1}{3} = \frac{9}{15} - \frac{5}{15} = \frac{4}{15}$

5.
$$\begin{aligned} 5 + 3[2(3 \cdot 4 + 1) - 20] &= 5 + 3[2(12 + 1) - 20] \\ &= 5 + 3[2(13) - 20] \\ &= 5 + 3[26 - 20] \\ &= 5 + 3[6] \\ &= 5 + 18 \\ &= 23 \end{aligned}$$

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6. $$\frac{1+|7-4|+3^2}{8-5}=\frac{1+|3|+3^2}{8-5}$$
$$=\frac{1+3+3^2}{3}$$
$$=\frac{1+3+9}{3}$$
$$=\frac{13}{3}$$

7. a. Replace y with 4.
$3y^2=3\cdot(4)^2=3\cdot16=48$

b. Replace x with 1 and y with 4.
$2y-x=2(4)-1=8-1=7$

c. Replace x with 1 and y with 4.
$\frac{11x}{3y}=\frac{11\cdot1}{3\cdot4}=\frac{11}{12}$

d. Replace x with 1 and y with 4.
$\frac{x}{y}+\frac{6}{y}=\frac{1}{4}+\frac{6}{4}=\frac{7}{4}$

e. Replace x with 1 and y with 4.
$y^2-x^2=4^2-1^2=16-1=15$

8. $5x-10=x+2$
$5(3)-10\stackrel{?}{=}3+2$
$15-10\stackrel{?}{=}5$
$5=5$ True
3 is a solution.

9. a. $5\cdot x$ and $5x$ are both ways to denote the product of 5 and x.

b. A number added to 7 is denoted by $7+x$.

c. A number divided by 11.2 is denoted by $x\div11.2$ or $\frac{x}{11.2}$.

d. A number subtracted from 8 is denoted by $8-x$.

e. Twice a number, plus 1 is denoted by $2x+1$.

10. a. The ratio of a number and 6 is 24 is written as $\frac{x}{6}=24$.

b. The difference of 10 and a number is 18 is written as $10-x=18$.

c. One less than twice a number is 99 is written as $2x-1=99$.

Calculator Explorations

1. $5^3=125$

2. $7^4=2401$

3. $9^5=59,049$

4. $8^6=262,144$

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

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

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 1.3

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

2. True or false: 2^5 means 2.5. false

3. To simplify $8+2\cdot6$, which operation should be performed first? multiplication

4. To simplify $(8+2)\cdot6$, which operation should be performed first? addition

5. To simplify $9(3-2)\div3+6$, which operation should be performed first? subtraction

6. To simplify $8\div2\cdot6$, which operation should be performed first? division

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

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

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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 the equation a true statement is called a solution.

13. The order in which we perform operation 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 1.3

2. $5^4 = 5 \cdot 5 \cdot 5 \cdot 5 = 625$

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

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. $(1.5)^2 = 1.5 \cdot 1.5 = 2.25$

18. $(0.4)^3 = 0.4 \cdot 0.4 \cdot 0.4 = 0.064$

20. $9 \cdot 9 \cdot \pi = 9^2\pi$ square meters

22. $8 + 5 \cdot 3 = 8 + 15 = 23$

24. $12 \cdot 5 - 3 \cdot 6 = 60 - 18 = 42$

26. $48 \div 6 \cdot 2 = 8 \cdot 2 = 16$

28. $6 - 2 \cdot 2 + 2^5 = 6 - 2 \cdot 2 + 32$
$= 6 - 4 + 32$
$= 2 + 32$
$= 34$

30. $2 \cdot 5^2 = 2 \cdot 25 = 50$

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

34. $\frac{8-5}{24-20} = \frac{3}{4}$

36. $3[4 + 3(6 - 4)] = 3[4 + 3(2)]$
$= 3[4 + 6]$
$= 3[10]$
$= 30$

38. $\frac{14 - 2 \cdot 3}{12 - 8} = \frac{14 - 6}{4} = \frac{8}{4} = 2$

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

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

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

46. $3 + 4[9(5 \cdot 5 - 20) - 41] = 3 + 4[9(25 - 20) - 41]$
$= 3 + 4[9(5) - 41]$
$= 3 + 4[45 - 41]$
$= 3 + 4[4]$
$= 3 + 16$
$= 19$

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

50. Replace x with 1.
$4x = 4(1) = 4$

52. Replace y with 3 and z with 5.
$\frac{y}{2z}=\frac{3}{2(5)}=\frac{3}{10}$

54. Replace y with 3.
$6y - 8 = 6(3) - 8 = 18 - 8 = 10$

56. Replace y with 3 and z with 5.
$|5z - 2y| = |5(5) - 2(3)| = |25 - 6| = |19| = 19$

58. Replace x with 1, y with 3, and z with 5.
$yz - x = 3(5) - 1 = 15 - 1 = 14$

60. Replace z with 5.
$2z^2 = 2(5^2) = 2(25) = 50$

62. Replace x with 12, y with 8, and z with 4.
$\frac{y}{z}+8x=\frac{8}{4}+8(12)=2+8(12)=2+96=98$

64. Replace x with 12 and y with 8.
$y^2-3x+y=(8)^2-3(12)+8$
$=64-3(12)+8$
$=64-36+8$
$=28+8$
$=36$

66. Replace x with 12 and y with 8.
$\frac{y^2+x}{x^2+3y}=\frac{(8)^2+12}{(12)^2+3(8)}$
$=\frac{64+12}{144+3(8)}$
$=\frac{76}{144+24}$
$=\frac{76}{168}$
$=\frac{4\cdot 19}{4\cdot 42}$
$=\frac{19}{42}$

68. $2x+7=3x$
$2(6)+7 \stackrel{?}{=} 3(6)$
$12+7 \stackrel{?}{=} 18$
$19=18$ False
Since the result is false, 6 is not a solution of the given equation.

70. $4x+2=x+8$
$4(2)+2 \stackrel{?}{=} 2+8$
$8+2 \stackrel{?}{=} 2+8$
$10=10$ True
Since the result is true, 2 is a solution of the given equation.

72. $3x-10=8$
$3(6)-10 \stackrel{?}{=} 8$
$18-10 \stackrel{?}{=} 8$
$8=8$ True
Since the result is true, 6 is a solution of the given equation.

74. $x+6=x+6$
$10+6 \stackrel{?}{=} 10+6$
$16=16$ True
Since the result is true, 10 is a solution of the given equation.

76. $4=1-x$
$4 \stackrel{?}{=} 1-1$
$4=0$ False
Since the result is false, 1 is not a solution of the given equation.

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78. $\frac{2}{7}x = \frac{3}{14}$

$\frac{2}{7} \cdot 6 \stackrel{?}{=} \frac{3}{14}$

$\frac{12}{7} \stackrel{?}{=} \frac{3}{14}$

$\frac{24}{14} = \frac{3}{14}$ False

Since the result is false, 6 is not a solution of the given equation.

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

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

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

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

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

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

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

94. 9.1 times a number equals 4 is written as $9.1x = 4$.

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

98. Yes; answers may vary

100. **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. $1 + 4 \cdot 6 - 3 = 1 + 24 - 3 = 25 - 3 = 22$

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

	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

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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 the equal symbol "=."

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

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

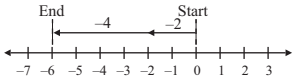
d. $9y+x-8$ is an expression since it does not contain the equal symbol.

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

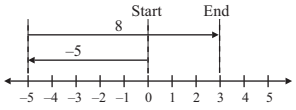
112. answers may vary

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

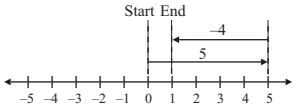
Section 1.4 Practice Exercises

1. 

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

2. 

$-5+8=3$

3. 

$5+(-4)=1$

4. $-8+(-5)=-13$

5. $(-14)+6=-8$

6. $(-17)+(-10)=-27$

7. $(-4)+12=8$

8. $1.5+(-3.2)=-1.7$

9. $-\frac{5}{12}+\left(-\frac{1}{12}\right)=-\frac{6}{12}=-\frac{6\cdot 1}{6\cdot 2}=-\frac{1}{2}$

10. $12.1+(-3.6)=8.5$

11. $-\frac{4}{5}+\frac{2}{3}=-\frac{12}{15}+\frac{10}{15}=-\frac{2}{15}$

12. a. $16+(-9)+(-9)=7+(-9)=-2$

b. $[3+(-13)]+[-4+(-7)]=[-10]+[-11]=-21$

13. The opposite of -35 is 35.

14. The opposite of 12 is -12.

15. The opposite of $-\frac{3}{11}$ is $\frac{3}{11}$.

16. The opposite of 1.9 is -1.9.

17. a. $-(-22)=22$

b. $-\left(-\frac{2}{7}\right)=\frac{2}{7}$

c. $-(-x)=x$

d. $-|-14|=-14$

e. $-|2.3|=-2.3$

18. $30+(-30)=0$

19. $-81+81=0$

20. $x+3y=-6+3(2)=-6+6=0$

21. $x+y=-13+(-9)=-22$

22. Temperature at 8 a.m. $=-7+(+11)=4$
The temperature was 4°F at 8 a.m.

Vocabulary, Readiness & Video Check 1.4

1. If n is a number, then $-n+n=\underline{0}$.

2. Since $x+n=n+x$, we say that addition is commutative.

3. If a is a number, then $-(-a)=\underline{a}$.

4. Since $n+(x+a)=(n+x)+a$, we say that addition is associative.

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. Example 12 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 11 and 12 have different signs.

8. The algebraic expressions are $x + y$ and $3x + y$. For $3x + y$, the variable x is multiplied by 3.

9. Depths below the surface; the diver's position is 231 feet below the surface.

Exercise Set 1.4

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

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

6. $16 + (-4) = 12$

8. $-10 + 5 = -5$

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

12. $-11 + (-5) = -16$

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. $144 + (-88) = 56$

32. $|-6| + (-61) = 6 + (-61) = -55$

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

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

38. $-\frac{5}{6}+\left(-\frac{2}{3}\right)=-\frac{5}{6}+\left(-\frac{4}{6}\right)=-\frac{9}{6}=-\frac{3\cdot 3}{3\cdot 2}=-\frac{3}{2}$

40. $-6\frac{7}{10}+\left(-7\frac{3}{5}\right)=-6\frac{7}{10}+\left(-7\frac{6}{10}\right)$

$=-13\frac{13}{10}$

$=-14\frac{3}{10}$

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. $-30+[1+(-6)+8]=-30+[-5+8]$

$=-30+[3]$

$=-27$

58. $-44 + 16 = -28$
The sum of −44 and 16 is −28.

60. The additive inverse of 4 is −4.

62. The additive inverse of −8 is 8.

64. The additive inverse of $-\frac{1}{4}$ is $\frac{1}{4}$.

66. Since $|-11| = 11$, the additive inverse of $|-11|$ is -11.

68. $-|-5| = -5$

70. $-(-14) = 14$

72. $-(-8.4) = 8.4$

74. $-(-7m) = 7m$

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