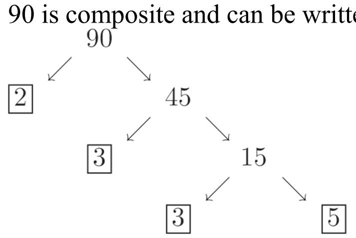
Chapter R
Prealgebra Review

R.1 Fractions

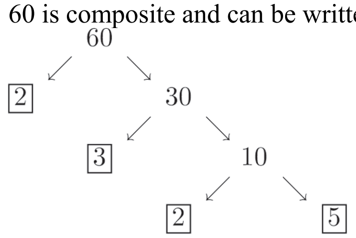
Classroom Examples, Now Try Exercises

1. 90 is composite and can be written as



Writing 90 as the product of primes gives us $90 = 2 \cdot 3 \cdot 3 \cdot 5$.

N1. 60 is composite and can be written as



Writing 60 as the product of primes gives us $60 = 2 \cdot 2 \cdot 3 \cdot 5$.

2. **(a)** $\frac{12}{20} = \frac{3 \cdot 4}{5 \cdot 4} = \frac{3}{5} \cdot \frac{4}{4} = \frac{3}{5} \cdot 1 = \frac{3}{5}$

(b) $\frac{8}{48} = \frac{8}{6 \cdot 8} = \frac{1}{6 \cdot 1} = \frac{1}{6}$

(c) $\frac{90}{162} = \frac{5 \cdot 18}{9 \cdot 18} = \frac{5}{9} \cdot 1 = \frac{5}{9}$

N2. **(a)** $\frac{30}{42} = \frac{5 \cdot 6}{7 \cdot 6} = \frac{5}{7} \cdot \frac{6}{6} = \frac{5}{7} \cdot 1 = \frac{5}{7}$

(b) $\frac{10}{70} = \frac{10}{7 \cdot 10} = \frac{1}{7 \cdot 1} \cdot = \frac{1}{7}$

(c) $\frac{72}{120} = \frac{3 \cdot 24}{5 \cdot 24} = \frac{3}{5} \cdot 1 = \frac{3}{5}$

3. The fraction bar represents division. Divide the numerator of the improper fraction by the denominator.

$$\begin{array}{r} 3 \\ 10\overline{)37} \\ \underline{30} \\ 7 \end{array}$$

Thus, $\frac{37}{10} = 3\frac{7}{10}$.

N3. The fraction bar represents division. Divide the numerator of the improper fraction by the denominator.

$$\begin{array}{r} 18 \\ 5\overline{)92} \\ \underline{5} \\ 42 \\ \underline{40} \\ 2 \end{array}$$

Thus, $\frac{92}{5} = 18\frac{2}{5}$.

4. Multiply the denominator of the fraction by the natural number and then add the numerator to obtain the numerator of the improper fraction.
$5 \cdot 3 = 15$ and $15 + 4 = 19$
The denominator of the improper fraction is the same as the denominator in the mixed number.

Thus, $3\frac{4}{5} = \frac{19}{5}$.

N4. Multiply the denominator of the fraction by the natural number and then add the numerator to obtain the numerator of the improper fraction.
$3 \cdot 11 = 33$ and $33 + 2 = 35$
The denominator of the improper fraction is the same as the denominator in the mixed number.

Thus, $11\frac{2}{3} = \frac{35}{3}$.

5. **(a)** To multiply two fractions, multiply their numerators and then multiply their denominators. Then simplify and write the answer in lowest terms.

$$\frac{5}{9} \cdot \frac{18}{25} = \frac{5 \cdot 18}{9 \cdot 25} = \frac{90}{225} = \frac{2 \cdot 45}{5 \cdot 45} = \frac{2}{5}$$

(b) To multiply two mixed numbers, first write them as improper fractions. Multiply their numerators and then multiply their denominators. Then simplify and write the answer as a mixed number in lowest terms.

$$3\frac{1}{3}\cdot 1\frac{3}{4} = \frac{10}{3}\cdot\frac{7}{4} = \frac{10\cdot 7}{3\cdot 4} = \frac{2\cdot 5\cdot 7}{3\cdot 2\cdot 2} = \frac{35}{6},\text{ or } 5\frac{5}{6}$$

N5. **(a)** To multiply two fractions, multiply their numerators and then multiply their denominators. Then simplify and write the answer in lowest terms.

$$\frac{4}{7}\cdot\frac{5}{8} = \frac{4\cdot 5}{7\cdot 8} = \frac{20}{56} = \frac{5\cdot 4}{14\cdot 4} = \frac{5}{14}$$

(b) To multiply two mixed numbers, first write them as improper fractions. Multiply their numerators and then multiply their denominators. Then simplify and write the answer as a mixed number in lowest terms.

$$3\frac{2}{5}\cdot 6\frac{2}{3} = \frac{17}{5}\cdot\frac{20}{3} = \frac{17\cdot 20}{5\cdot 3} = \frac{17\cdot 5\cdot 4}{5\cdot 3} = \frac{68}{3},\text{ or } 22\frac{2}{3}$$

6. **(a)** To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{9}{10}\div\frac{3}{5} = \frac{9}{10}\cdot\frac{5}{3} = \frac{3\cdot 3\cdot 5}{2\cdot 5\cdot 3} = \frac{3}{2},\text{ or } 1\frac{1}{2}$$

(b) Change both mixed numbers to improper fractions. Then multiply by the reciprocal of the second fraction.

$$2\frac{3}{4}\div 3\frac{1}{3} = \frac{11}{4}\div\frac{10}{3} = \frac{11}{4}\cdot\frac{3}{10} = \frac{33}{40}$$

N6. **(a)** To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{2}{7}\div\frac{8}{9} = \frac{2}{7}\cdot\frac{9}{8} = \frac{2\cdot 3\cdot 3}{7\cdot 2\cdot 4} = \frac{9}{28}$$

(b) To divide fractions, multiply by the reciprocal of the divisor.

$$3\frac{3}{4}\div 4\frac{2}{7} = \frac{15}{4}\div\frac{30}{7} = \frac{15}{4}\cdot\frac{7}{30} = \frac{15\cdot 7}{4\cdot 2\cdot 15} = \frac{7}{8}$$

7. To find the sum of two fractions having the same denominator, add the numerators and keep the same denominator.

$$\frac{1}{9}+\frac{5}{9} = \frac{1+5}{9} = \frac{6}{9} = \frac{2\cdot 3}{3\cdot 3} = \frac{2}{3}$$

N7. To find the sum of two fractions having the same denominator, add the numerators and keep the same denominator.

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

8. (a) Since $30=2\cdot 3\cdot 5$ and $45=3\cdot 3\cdot 5$, the least common denominator must have one factor of 2 (from 30), two factors of 3 (from 45), and one factor of 5 (from either 30 or 45), so it is $2\cdot 3\cdot 3\cdot 5=90$.
Write each fraction with a denominator of 90.

$$\frac{7}{30}=\frac{7}{30}\cdot\frac{3}{3}=\frac{21}{90} \text{ and } \frac{2}{45}=\frac{2}{45}\cdot\frac{2}{2}=\frac{4}{90}$$

Now add.

$$\frac{7}{30}+\frac{2}{45}=\frac{21}{90}+\frac{4}{90}=\frac{21+4}{90}=\frac{25}{90}$$

Write $\frac{25}{90}$ in lowest terms.

$$\frac{25}{90}=\frac{5\cdot 5}{18\cdot 5}=\frac{5}{18}$$

(b) Write each mixed number as an improper fraction.

$$4\frac{5}{6}+2\frac{1}{3}=\frac{29}{6}+\frac{7}{3}$$

The least common denominator is 6, so write each fraction with a denominator of 6.

$$\frac{29}{6} \text{ and } \frac{7}{3}=\frac{7}{3}\cdot\frac{2}{2}=\frac{14}{6}$$

Now add.

$$\frac{29}{6}+\frac{7}{3}=\frac{29}{6}+\frac{14}{6}=\frac{29+14}{6}=\frac{43}{6}, \text{ or } 7\frac{1}{6}$$

N8. (a) Since $12=2\cdot 2\cdot 3$ and $8=2\cdot 2\cdot 2$, the least common denominator must have three factors of 2 (from 8) and one factor of 3 (from 12), so it is $2\cdot 2\cdot 2\cdot 3=24$.
Write each fraction with a denominator of 24.

$$\frac{5}{12}=\frac{5}{12}\cdot\frac{2}{2}=\frac{10}{24} \text{ and } \frac{3}{8}=\frac{3}{8}\cdot\frac{3}{3}=\frac{9}{24}$$

Now add.

$$\frac{5}{12}+\frac{3}{8}=\frac{10}{24}+\frac{9}{24}=\frac{10+9}{24}=\frac{19}{24}$$

(b) Write each mixed number as an improper fraction.

$$3\frac{1}{4}+5\frac{5}{8}=\frac{13}{4}+\frac{45}{8}$$

The least common denominator is 8, so write each fraction with a denominator of 8.

$$\frac{45}{8} \text{ and } \frac{13}{4}=\frac{13}{4}\cdot\frac{2}{2}=\frac{26}{8}$$

Now add.

$$\frac{13}{4}+\frac{45}{8}=\frac{26}{8}+\frac{45}{8}=\frac{26+45}{8}=\frac{71}{8}, \text{ or } 8\frac{7}{8}$$

9. (a) Since $10=2\cdot 5$ and $4=2\cdot 2$, the least common denominator is $2\cdot 2\cdot 5=20$. Write each fraction with a denominator of 20.

$$\frac{3}{10}=\frac{3}{10}\cdot\frac{2}{2}=\frac{6}{20} \text{ and } \frac{1}{4}=\frac{1}{4}\cdot\frac{5}{5}=\frac{5}{20}$$

Now subtract.

$$\frac{3}{10}-\frac{1}{4}=\frac{6}{20}-\frac{5}{20}=\frac{1}{20}$$

(b) Write each mixed number as an improper fraction.

$$3\frac{3}{8}-1\frac{1}{2}=\frac{27}{8}-\frac{3}{2}$$

The least common denominator is 8. Write each fraction with a denominator of 8. $\frac{27}{8}$ remains unchanged, and $\frac{3}{2}=\frac{3}{2}\cdot\frac{4}{4}=\frac{12}{8}$.

Now subtract.

$$\frac{27}{8}-\frac{3}{2}=\frac{27}{8}-\frac{12}{8}=\frac{27-12}{8}=\frac{15}{8}, \text{ or } 1\frac{7}{8}$$

N9. (a) Since $11=11$ and $9=3\cdot 3$, the least common denominator is $3\cdot 3\cdot 11=99$. Write each fraction with a denominator of 99.

$$\frac{5}{11}=\frac{5}{11}\cdot\frac{9}{9}=\frac{45}{99} \text{ and } \frac{2}{9}=\frac{2}{9}\cdot\frac{11}{11}=\frac{22}{99}$$

Now subtract.

$$\frac{5}{11}-\frac{2}{9}=\frac{45}{99}-\frac{22}{99}=\frac{23}{99}$$

(b) Write each mixed number as an improper fraction.

$$4\frac{1}{3}-2\frac{5}{6}=\frac{13}{3}-\frac{17}{6}$$

The least common denominator is 6. Write each fraction with a denominator of 6. $\frac{17}{6}$ remains unchanged, and $\frac{13}{3}=\frac{13}{3}\cdot\frac{2}{2}=\frac{26}{6}$.

Now subtract.

$$\frac{13}{3}-\frac{17}{6}=\frac{26}{6}-\frac{17}{6}=\frac{26-17}{6}=\frac{9}{6}$$

Now reduce.

$$\frac{9}{6}=\frac{3\cdot 3}{2\cdot 3}=\frac{3}{2},\ \text{or}\ 1\frac{1}{2}$$

10. To find out how many yards of fabric Jen should buy, add the lengths needed for each piece to obtain the total length. The common denominator is 12.

$$1\frac{1}{4}+1\frac{2}{3}+2\frac{1}{2}=1\frac{3}{12}+1\frac{8}{12}+2\frac{6}{12}=4\frac{17}{12}$$

Because $\frac{17}{12}=1\frac{5}{12}$, we have $4\frac{17}{12}=4+1\frac{5}{12}=5\frac{5}{12}$. Jen should buy $5\frac{5}{12}$ yd of fabric.

N10. To find out how long each piece must be, divide the total length by the number of pieces.

$$10\frac{1}{2}\div 4=\frac{21}{2}\div\frac{4}{1}=\frac{21}{2}\cdot\frac{1}{4}=\frac{21}{8},\ \text{or}\ 2\frac{5}{8}$$

Each piece should be $2\frac{5}{8}$ feet long.

11. **(a)** In the circle graph, the sector for Other is the second largest, so Other had the second largest share of Internet users, $\frac{23}{100}$.

(b) The total number of Internet users, 3900 million, can be rounded to 4000 million (or 4 billion). Multiply $\frac{1}{10}$ by 4000.

$$\frac{1}{10}\cdot 4000=400\ \text{million}$$

(c) Multiply the fraction from the graph for Africa by the actual number of users.

$$\frac{1}{10}\cdot 3900=390\ \text{million}$$

N11. **(a)** In the circle graph, the sector for Africa is the smallest, so Africa had the least number of Internet users.

(b) The total number of Internet users, 3900 million, can be rounded to 4000 million (or 4 billion). Multiply $\frac{1}{2}$ by 4000.

$$\frac{1}{2}\cdot 4000=2000\ \text{million, or 2 billion}$$

(c) Multiply the fraction from the graph for Asia by the actual number of users.

$$\frac{1}{2}\cdot 3900=1950\ \text{million, or 1.95 billion}$$

Exercises

1. True; the number above the fraction bar is called the numerator and the number below the fraction bar is called the denominator.

2. True; 5 divides the 31 six times with a remainder of one, so $\frac{31}{5}=6\frac{1}{5}$.

3. False; this is an improper fraction. Its value is 1.

4. False; the number 1 is neither prime nor composite.

5. False; the fraction $\frac{13}{39}$ can be written in lowest terms as $\frac{1}{3}$ since $\frac{13}{39}=\frac{13\cdot 1}{13\cdot 3}=\frac{1}{3}$.

6. False; the reciprocal of $\frac{6}{2}=3$ is $\frac{2}{6}=\frac{1}{3}$.

7. False; *product* refers to multiplication, so the product of 10 and 2 is 20. The *sum* of 10 and 2 is 12.

8. False; *difference* refers to subtraction, so the difference between 10 and 2 is 8. The *quotient* of 10 and 2 is 5.

9. $\frac{16}{24}=\frac{2\cdot 8}{3\cdot 8}=\frac{2}{3}$

Therefore, C is correct.

10. Simplify each fraction to find which are equal to $\frac{5}{9}$.

$\frac{15}{27} = \frac{3 \cdot 5}{3 \cdot 9} = \frac{5}{9}$

$\frac{30}{54} = \frac{6 \cdot 5}{6 \cdot 9} = \frac{5}{9}$

$\frac{40}{74} = \frac{2 \cdot 20}{2 \cdot 37} = \frac{20}{37}$

$\frac{55}{99} = \frac{11 \cdot 5}{11 \cdot 9} = \frac{5}{9}$

Therefore, C is correct.

11. A common denominator for $\frac{p}{q}$ and $\frac{r}{s}$ must be a multiple of both denominators, q and s. Such a number is $q \cdot s$. Therefore, A is correct.

12. We need to multiply 8 by 3 to get 24 in the denominator, so we must multiply 5 by 3 as well.

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

Therefore, B is correct.

13. Since 19 has only itself and 1 as factors, it is a prime number.

14. Since 31 has only itself and 1 as factors, it is a prime number.

15. $30 = 2 \cdot 15$
$= 2 \cdot 3 \cdot 5$

Since 30 has factors other than itself and 1, it is a composite number.

16. $50 = 2 \cdot 25$
$= 2 \cdot 5 \cdot 5,$

so 50 is a composite number.

17. $64 = 2 \cdot 32$
$= 2 \cdot 2 \cdot 16$
$= 2 \cdot 2 \cdot 2 \cdot 8$
$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 4$
$= 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

Since 64 has factors other than itself and 1, it is a composite number.

18. $81 = 3 \cdot 27$
$= 3 \cdot 3 \cdot 9$
$= 3 \cdot 3 \cdot 3 \cdot 3$

Since 81 has factors other than itself and 1, it is a composite number.

19. As stated in the text, the number 1 is neither prime nor composite, by agreement.

20. The number 0 is not a natural number, so it is neither prime nor composite.

21. $57 = 3 \cdot 19$, so 57 is a composite number.

22. $51 = 3 \cdot 17$, so 51 is a composite number.

23. Since 79 has only itself and 1 as factors, it is a prime number.

24. Since 83 has only itself and 1 as factors, it is a prime number.

25. $124 = 2 \cdot 62$
$= 2 \cdot 2 \cdot 31,$

so 124 is a composite number.

26. $138 = 2 \cdot 69$
$= 2 \cdot 3 \cdot 23,$

so 138 is a composite number.

27. $500 = 2 \cdot 250$
$= 2 \cdot 2 \cdot 125$
$= 2 \cdot 2 \cdot 5 \cdot 25$
$= 2 \cdot 2 \cdot 5 \cdot 5 \cdot 5,$

so 500 is a composite number.

28. $700 = 2 \cdot 350$
$= 2 \cdot 2 \cdot 175$
$= 2 \cdot 2 \cdot 5 \cdot 35$
$= 2 \cdot 2 \cdot 5 \cdot 5 \cdot 7,$

so 700 is a composite number.

29. $3458 = 2 \cdot 1729$
$= 2 \cdot 7 \cdot 247$
$= 2 \cdot 7 \cdot 13 \cdot 19$

Since 3458 has factors other than itself and 1, it is a composite number.

30. $1025 = 5 \cdot 205$
$= 5 \cdot 5 \cdot 41$

Since 1025 has factors other than itself and 1, it is a composite number.

31. $\frac{8}{16} = \frac{1 \cdot 8}{2 \cdot 8} = \frac{1}{2} \cdot \frac{8}{8} = \frac{1}{2} \cdot 1 = \frac{1}{2}$

32. $\frac{4}{12} = \frac{1 \cdot 4}{3 \cdot 4} = \frac{1}{3} \cdot \frac{4}{4} = \frac{1}{3} \cdot 1 = \frac{1}{3}$

33. $\frac{15}{18} = \frac{3 \cdot 5}{3 \cdot 6} = \frac{3}{3} \cdot \frac{5}{6} = 1 \cdot \frac{5}{6} = \frac{5}{6}$

34. $\frac{16}{20}=\frac{4\cdot 4}{5\cdot 4}=\frac{4}{5}\cdot\frac{4}{4}=\frac{4}{5}\cdot 1=\frac{4}{5}$

35. $\frac{90}{150}=\frac{3\cdot 30}{5\cdot 30}=\frac{3}{5}\cdot\frac{30}{30}=\frac{3}{5}\cdot 1=\frac{3}{5}$

36. $\frac{100}{140}=\frac{5\cdot 20}{7\cdot 20}=\frac{5}{7}\cdot\frac{20}{20}=\frac{5}{7}\cdot 1=\frac{5}{7}$

37. $\frac{18}{90}=\frac{1\cdot 18}{5\cdot 18}=\frac{1}{5}\cdot\frac{18}{18}=\frac{1}{5}\cdot 1=\frac{1}{5}$

38. $\frac{16}{64}=\frac{1\cdot 16}{4\cdot 16}=\frac{1}{4}\cdot\frac{16}{16}=\frac{1}{4}\cdot 1=\frac{1}{4}$

39. $\frac{144}{120}=\frac{6\cdot 24}{5\cdot 24}=\frac{6}{5}\cdot\frac{24}{24}=\frac{6}{5}\cdot 1=\frac{6}{5}$

40. $\frac{132}{77}=\frac{12\cdot 11}{7\cdot 11}=\frac{12}{7}\cdot\frac{11}{11}=\frac{12}{7}\cdot 1=\frac{12}{7}$

41.
$$\begin{array}{r} 1 \\ 7\overline{)12} \\ \underline{7} \\ 5 \end{array}$$
Therefore, $\frac{12}{7}=1\frac{5}{7}$.

42.
$$\begin{array}{r} 1 \\ 9\overline{)16} \\ \underline{9} \\ 7 \end{array}$$
Therefore, $\frac{16}{9}=1\frac{7}{9}$.

43.
$$\begin{array}{r} 6 \\ 12\overline{)77} \\ \underline{72} \\ 5 \end{array}$$
Therefore, $\frac{77}{12}=6\frac{5}{12}$.

44.
$$\begin{array}{r} 6 \\ 15\overline{)101} \\ \underline{90} \\ 11 \end{array}$$
Therefore, $\frac{101}{15}=6\frac{11}{15}$.

45.
$$\begin{array}{r} 7 \\ 11\overline{)83} \\ \underline{77} \\ 6 \end{array}$$
Therefore, $\frac{83}{11}=7\frac{6}{11}$.

46.
$$\begin{array}{r} 5 \\ 13\overline{)67} \\ \underline{65} \\ 2 \end{array}$$
Therefore, $\frac{67}{13}=5\frac{2}{13}$.

47. Multiply the denominator of the fraction by the natural number and then add the numerator to obtain the numerator of the improper fraction.
$5\cdot 2=10$ and $10+3=13$
The denominator of the improper fraction is the same as the denominator in the mixed number.
Thus, $2\frac{3}{5}=\frac{13}{5}$.

48. Multiply the denominator of the fraction by the natural number and then add the numerator to obtain the numerator of the improper fraction.
$7\cdot 5=35$ and $35+6=41$
The denominator of the improper fraction is the same as the denominator in the mixed number.
Thus, $5\frac{6}{7}=\frac{41}{7}$.

49. Multiply the denominator of the fraction by the natural number and then add the numerator to obtain the numerator of the improper fraction.
$8\cdot 10=80$ and $80+3=83$
The denominator of the improper fraction is the same as the denominator in the mixed number.
Thus, $10\frac{3}{8}=\frac{83}{8}$.

50. Multiply the denominator of the fraction by the natural number and then add the numerator to obtain the numerator of the improper fraction.
$3\cdot 12=36$ and $36+2=38$
The denominator of the improper fraction is the same as the denominator in the mixed number.
Thus, $12\frac{2}{3}=\frac{38}{3}$.

51. Multiply the denominator of the fraction by the natural number and then add the numerator to obtain the numerator of the improper fraction.
$5 \cdot 10 = 50$ and $50 + 1 = 51$
The denominator of the improper fraction is the same as the denominator in the mixed number.
Thus, $10\frac{1}{5} = \frac{51}{5}$.

52. Multiply the denominator of the fraction by the natural number and then add the numerator to obtain the numerator of the improper fraction.
$6 \cdot 18 = 108$ and $108 + 1 = 109$
The denominator of the improper fraction is the same as the denominator in the mixed number.
Thus, $18\frac{1}{6} = \frac{109}{6}$.

53. $\frac{4}{5} \cdot \frac{6}{7} = \frac{4 \cdot 6}{5 \cdot 7} = \frac{24}{35}$

54. $\frac{5}{9} \cdot \frac{2}{7} = \frac{5 \cdot 2}{9 \cdot 7} = \frac{10}{63}$

55. $\frac{2}{15} \cdot \frac{3}{8} = \frac{2 \cdot 3}{15 \cdot 8} = \frac{6}{120} = \frac{1 \cdot 6}{20 \cdot 6} = \frac{1}{20}$

56. $\frac{3}{20} \cdot \frac{5}{21} = \frac{3 \cdot 5}{20 \cdot 21} = \frac{15}{420} = \frac{1 \cdot 15}{28 \cdot 15} = \frac{1}{28}$

57. $\frac{1}{10} \cdot \frac{12}{5} = \frac{1 \cdot 12}{10 \cdot 5} = \frac{1 \cdot 2 \cdot 6}{2 \cdot 5 \cdot 5} = \frac{6}{25}$

58. $\frac{1}{8} \cdot \frac{10}{7} = \frac{1 \cdot 10}{8 \cdot 7} = \frac{1 \cdot 2 \cdot 5}{2 \cdot 4 \cdot 7} = \frac{5}{28}$

59.
$$\begin{aligned} \frac{15}{4} \cdot \frac{8}{25} &= \frac{15 \cdot 8}{4 \cdot 25} \\ &= \frac{3 \cdot 5 \cdot 4 \cdot 2}{4 \cdot 5 \cdot 5} \\ &= \frac{3 \cdot 2}{5} \\ &= \frac{6}{5}, \text{ or } 1\frac{1}{5} \end{aligned}$$

60.
$$\begin{aligned} \frac{21}{8} \cdot \frac{4}{7} &= \frac{21 \cdot 4}{8 \cdot 7} \\ &= \frac{3 \cdot 7 \cdot 4}{4 \cdot 2 \cdot 7} \\ &= \frac{3}{2}, \text{ or } 1\frac{1}{2} \end{aligned}$$

61.
$$\begin{aligned} 21 \cdot \frac{3}{7} &= \frac{21}{1} \cdot \frac{3}{7} \\ &= \frac{21 \cdot 3}{1 \cdot 7} \\ &= \frac{3 \cdot 7 \cdot 3}{1 \cdot 7} \\ &= \frac{3 \cdot 3}{1} = 9 \end{aligned}$$

62.
$$\begin{aligned} 36 \cdot \frac{4}{9} &= \frac{36}{1} \cdot \frac{4}{9} \\ &= \frac{36 \cdot 4}{1 \cdot 9} \\ &= \frac{4 \cdot 9 \cdot 4}{1 \cdot 9} \\ &= \frac{4 \cdot 4}{1} = 16 \end{aligned}$$

63. Change both mixed numbers to improper fractions.
$$\begin{aligned} 3\frac{1}{4} \cdot 1\frac{2}{3} &= \frac{13}{4} \cdot \frac{5}{3} \\ &= \frac{13 \cdot 5}{4 \cdot 3} \\ &= \frac{65}{12}, \text{ or } 5\frac{5}{12} \end{aligned}$$

64. Change both mixed numbers to improper fractions.
$$\begin{aligned} 2\frac{2}{3} \cdot 1\frac{3}{5} &= \frac{8}{3} \cdot \frac{8}{5} \\ &= \frac{8 \cdot 8}{3 \cdot 5} \\ &= \frac{64}{15}, \text{ or } 4\frac{4}{15} \end{aligned}$$

65. Change both mixed numbers to improper fractions.
$$\begin{aligned} 2\frac{3}{8} \cdot 3\frac{1}{5} &= \frac{19}{8} \cdot \frac{16}{5} \\ &= \frac{19 \cdot 16}{8 \cdot 5} \\ &= \frac{19 \cdot 2 \cdot 8}{8 \cdot 5} \\ &= \frac{38}{5}, \text{ or } 7\frac{3}{5} \end{aligned}$$

66. Change both mixed numbers to improper fractions.

$$3\frac{3}{5}\cdot 7\frac{1}{6}=\frac{18}{5}\cdot\frac{43}{6}$$
$$=\frac{18\cdot 43}{5\cdot 6}$$
$$=\frac{3\cdot 6\cdot 43}{5\cdot 6}$$
$$=\frac{3\cdot 43}{5}$$
$$=\frac{129}{5},\text{ or }25\frac{4}{5}$$

67. Change both numbers to improper fractions.

$$5\cdot 2\frac{1}{10}=\frac{5}{1}\cdot\frac{21}{10}$$
$$=\frac{5\cdot 21}{1\cdot 10}$$
$$=\frac{5\cdot 21}{1\cdot 2\cdot 5}$$
$$=\frac{21}{1\cdot 2}$$
$$=\frac{21}{2},\text{ or }10\frac{1}{2}$$

68. Change both numbers to improper fractions.

$$3\cdot 4\frac{2}{9}=\frac{3}{1}\cdot\frac{38}{9}$$
$$=\frac{3\cdot 38}{1\cdot 9}$$
$$=\frac{3\cdot 38}{1\cdot 3\cdot 3}$$
$$=\frac{38}{1\cdot 3}$$
$$=\frac{38}{3},\text{ or }12\frac{2}{3}$$

69. To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{7}{9}\div\frac{3}{2}=\frac{7}{9}\cdot\frac{2}{3}$$
$$=\frac{7\cdot 2}{9\cdot 3}$$
$$=\frac{14}{27}$$

70. To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{6}{11}\div\frac{5}{4}=\frac{6}{11}\cdot\frac{4}{5}$$
$$=\frac{6\cdot 4}{11\cdot 5}$$
$$=\frac{24}{55}$$

71. To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{5}{4}\div\frac{3}{8}=\frac{5}{4}\cdot\frac{8}{3}$$
$$=\frac{5\cdot 8}{4\cdot 3}$$
$$=\frac{5\cdot 4\cdot 2}{4\cdot 3}$$
$$=\frac{5\cdot 2}{3}$$
$$=\frac{10}{3},\text{ or }3\frac{1}{3}$$

72. To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{7}{5}\div\frac{3}{10}=\frac{7}{5}\cdot\frac{10}{3}$$
$$=\frac{7\cdot 10}{5\cdot 3}$$
$$=\frac{7\cdot 2\cdot 5}{5\cdot 3}$$
$$=\frac{14}{3},\text{ or }4\frac{2}{3}$$

73. To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{32}{5}\div\frac{8}{15}=\frac{32}{5}\cdot\frac{15}{8}$$
$$=\frac{32\cdot 15}{5\cdot 8}$$
$$=\frac{8\cdot 4\cdot 3\cdot 5}{1\cdot 5\cdot 8}$$
$$=\frac{4\cdot 3}{1}=12$$

74. To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{24}{7} \div \frac{6}{21} = \frac{24}{7} \cdot \frac{21}{6} = \frac{24 \cdot 21}{7 \cdot 6} = \frac{4 \cdot 6 \cdot 3 \cdot 7}{1 \cdot 7 \cdot 6} = \frac{4 \cdot 3}{1} = 12$$

75. To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{3}{4} \div 12 = \frac{3}{4} \cdot \frac{1}{12} = \frac{3 \cdot 1}{4 \cdot 12} = \frac{3 \cdot 1}{4 \cdot 3 \cdot 4} = \frac{1}{4 \cdot 4} = \frac{1}{16}$$

76. To divide fractions, multiply by the reciprocal of the divisor.

$$\frac{2}{5} \div 30 = \frac{2}{5} \cdot \frac{1}{30} = \frac{2 \cdot 1}{5 \cdot 30} = \frac{2 \cdot 1}{5 \cdot 2 \cdot 15} = \frac{1}{5 \cdot 15} = \frac{1}{75}$$

77. To divide fractions, multiply by the reciprocal of the divisor.

$$6 \div \frac{3}{5} = \frac{6}{1} \cdot \frac{5}{3} = \frac{6 \cdot 5}{1 \cdot 3} = \frac{2 \cdot 3 \cdot 5}{1 \cdot 3} = \frac{2 \cdot 5}{1} = 10$$

78. To divide fractions, multiply by the reciprocal of the divisor.

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

79. Change the first number to an improper fraction, and then multiply by the reciprocal of the divisor.

$$6\frac{3}{4} \div \frac{3}{8} = \frac{27}{4} \div \frac{3}{8} = \frac{27}{4} \cdot \frac{8}{3} = \frac{27 \cdot 8}{4 \cdot 3} = \frac{3 \cdot 9 \cdot 2 \cdot 4}{4 \cdot 3} = \frac{9 \cdot 2}{1} = 18$$

80. Change the first number to an improper fraction, and then multiply by the reciprocal of the divisor.

$$5\frac{3}{5} \div \frac{7}{10} = \frac{28}{5} \div \frac{7}{10} = \frac{28}{5} \cdot \frac{10}{7} = \frac{28 \cdot 10}{5 \cdot 7} = \frac{4 \cdot 7 \cdot 2 \cdot 5}{5 \cdot 7} = \frac{4 \cdot 2}{1} = 8$$

81. Change both mixed numbers to improper fractions, and then multiply by the reciprocal of the divisor.

$$2\frac{1}{2} \div 1\frac{5}{7} = \frac{5}{2} \div \frac{12}{7} = \frac{5}{2} \cdot \frac{7}{12} = \frac{5 \cdot 7}{2 \cdot 12} = \frac{35}{24}, \text{ or } 1\frac{11}{24}$$

82. Change both mixed numbers to improper fractions, and then multiply by the reciprocal of the divisor.

$$2\frac{2}{9} \div 1\frac{2}{5} = \frac{20}{9} \div \frac{7}{5}$$
$$= \frac{20}{9} \cdot \frac{5}{7}$$
$$= \frac{20 \cdot 5}{9 \cdot 7}$$
$$= \frac{100}{63}, \text{ or } 1\frac{37}{63}$$

83. Change both mixed numbers to improper fractions, and then multiply by the reciprocal of the divisor.

$$2\frac{5}{8} \div 1\frac{15}{32} = \frac{21}{8} \div \frac{47}{32}$$
$$= \frac{21}{8} \cdot \frac{32}{47}$$
$$= \frac{21 \cdot 32}{8 \cdot 47}$$
$$= \frac{21 \cdot 8 \cdot 4}{8 \cdot 47}$$
$$= \frac{21 \cdot 4}{47}$$
$$= \frac{84}{47}, \text{ or } 1\frac{37}{47}$$

84. Change both mixed numbers to improper fractions, and then multiply by the reciprocal of the divisor.

$$2\frac{3}{10} \div 1\frac{4}{5} = \frac{23}{10} \div \frac{9}{5}$$
$$= \frac{23}{10} \cdot \frac{5}{9}$$
$$= \frac{23 \cdot 5}{2 \cdot 5 \cdot 9}$$
$$= \frac{23}{18}, \text{ or } 1\frac{5}{8}$$

85. $\frac{7}{15} + \frac{4}{15} = \frac{7+4}{15} = \frac{11}{15}$

86. $\frac{2}{9} + \frac{5}{9} = \frac{2+5}{9} = \frac{7}{9}$

87.
$$\frac{7}{12} + \frac{1}{12} = \frac{7+1}{12}$$
$$= \frac{8}{12}$$
$$= \frac{2 \cdot 4}{3 \cdot 4}$$
$$= \frac{2}{3}$$

88. $\frac{3}{16} + \frac{5}{16} = \frac{3+5}{16} = \frac{8}{16} = \frac{1}{2}$

89. Since $9 = 3 \cdot 3$, and 3 is prime, the LCD (least common denominator) is $3 \cdot 3 = 9$.

$$\frac{1}{3} = \frac{1}{3} \cdot \frac{3}{3} = \frac{3}{9}$$

Now add the two fractions with the same denominator.

$$\frac{5}{9} + \frac{1}{3} = \frac{5}{9} + \frac{3}{9} = \frac{8}{9}$$

90. To add $\frac{4}{15}$ and $\frac{1}{5}$, first find the LCD. Since $15 = 3 \cdot 5$ and 5 is prime, the LCD is 15.

$$\frac{4}{15} + \frac{1}{5} = \frac{4}{15} + \frac{1}{5} \cdot \frac{3}{3}$$
$$= \frac{4}{15} + \frac{3}{15}$$
$$= \frac{4+3}{15}$$
$$= \frac{7}{15}$$

91. Since $8 = 2 \cdot 2 \cdot 2$ and $6 = 2 \cdot 3$, the LCD is $2 \cdot 2 \cdot 2 \cdot 3 = 24$.

$$\frac{3}{8} = \frac{3}{8} \cdot \frac{3}{3} = \frac{9}{24} \text{ and } \frac{5}{6} = \frac{5}{6} \cdot \frac{4}{4} = \frac{20}{24}$$

Now add fractions with the same denominator.

$$\frac{3}{8} + \frac{5}{6} = \frac{9}{24} + \frac{20}{24} = \frac{29}{24}, \text{ or } 1\frac{5}{24}$$

92. Since $6 = 2 \cdot 3$ and $9 = 3 \cdot 3$, the LCD is $2 \cdot 3 \cdot 3 = 18$.

$$\frac{5}{6} = \frac{5}{6} \cdot \frac{3}{3} = \frac{15}{18} \text{ and } \frac{2}{9} = \frac{2}{9} \cdot \frac{2}{2} = \frac{4}{18}$$

Now add fractions with the same denominator.

$$\frac{5}{6} + \frac{2}{9} = \frac{15}{18} + \frac{4}{18} = \frac{19}{18}, \text{ or } 1\frac{1}{18}$$

93. Since $9 = 3\cdot 3$ and $16 = 4\cdot 4$, the LCD is $3\cdot 3\cdot 4\cdot 4 = 144.$

$\frac{5}{9} = \frac{5}{9}\cdot\frac{16}{16} = \frac{80}{144}$ and $\frac{3}{16} = \frac{3}{16}\cdot\frac{9}{9} = \frac{27}{144}$

Now add fractions with the same denominator.

$\frac{5}{9} + \frac{3}{16} = \frac{80}{144} + \frac{27}{144} = \frac{107}{144}$

94. Since $4 = 2\cdot 2$ and $25 = 5\cdot 5$, the LCD is $2\cdot 2\cdot 5\cdot 5 = 100.$

$\frac{3}{4} = \frac{3}{4}\cdot\frac{25}{25} = \frac{75}{100}$ and $\frac{6}{25} = \frac{6}{25}\cdot\frac{4}{4} = \frac{24}{100}$

Now add fractions with the same denominator.

$\frac{3}{4} + \frac{6}{25} = \frac{75}{100} + \frac{24}{100} = \frac{99}{100}$

95.

$$3\frac{1}{8} = 3 + \frac{1}{8} = \frac{24}{8} + \frac{1}{8} = \frac{25}{8}$$

$$2\frac{1}{4} = 2 + \frac{1}{4} = \frac{8}{4} + \frac{1}{4} = \frac{9}{4}$$

$$3\frac{1}{8} + 2\frac{1}{4} = \frac{25}{8} + \frac{9}{4}$$

Since $8 = 2\cdot 2\cdot 2$ and $4 = 2\cdot 2$, the LCD is $2\cdot 2\cdot 2$ or 8.

$$\begin{aligned} 3\frac{1}{8} + 2\frac{1}{4} &= \frac{25}{8} + \frac{9}{4}\cdot\frac{2}{2} \\ &= \frac{25}{8} + \frac{18}{8} \\ &= \frac{43}{8}, \text{ or } 5\frac{3}{8} \end{aligned}$$

96.

$$4\frac{2}{3} = 4 + \frac{2}{3} = \frac{12}{3} + \frac{2}{3} = \frac{14}{3}$$

$$2\frac{1}{6} = 2 + \frac{1}{6} = \frac{12}{6} + \frac{1}{6} = \frac{13}{6}$$

Since $6 = 2\cdot 3$, the LCD is 6.

$$\begin{aligned} 4\frac{2}{3} + 2\frac{1}{6} &= \frac{14}{3}\cdot\frac{2}{2} + \frac{13}{6} \\ &= \frac{28}{6} + \frac{13}{6} \\ &= \frac{41}{6}, \text{ or } 6\frac{5}{6} \end{aligned}$$

97.

$$3\frac{1}{4} = 3 + \frac{1}{4} = \frac{12}{4} + \frac{1}{4} = \frac{13}{4}$$

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

Since $4 = 2\cdot 2$, and 5 is prime, the LCD is $2\cdot 2\cdot 5 = 20.$

$$\begin{aligned} 3\frac{1}{4} + 1\frac{4}{5} &= \frac{13}{4}\cdot\frac{5}{5} + \frac{9}{5}\cdot\frac{4}{4} \\ &= \frac{65}{20} + \frac{36}{20} \\ &= \frac{101}{20}, \text{ or } 5\frac{1}{20} \end{aligned}$$

98. To add $5\frac{3}{4}$ and $1\frac{1}{3}$, first change to improper fractions then find the LCD, which is 12.

$$\begin{aligned} 5\frac{3}{4} + 1\frac{1}{3} &= \frac{23}{4} + \frac{4}{3} \\ &= \frac{23}{4}\cdot\frac{3}{3} + \frac{4}{3}\cdot\frac{4}{4} \\ &= \frac{69}{12} + \frac{16}{12} \\ &= \frac{85}{12}, \text{ or } 7\frac{1}{12} \end{aligned}$$

99. $\frac{7}{9} - \frac{2}{9} = \frac{7-2}{9} = \frac{5}{9}$

100. $\frac{8}{11} - \frac{3}{11} = \frac{8-3}{11} = \frac{5}{11}$

101.

$$\begin{aligned} \frac{13}{15} - \frac{3}{15} &= \frac{13-3}{15} \\ &= \frac{10}{15} \\ &= \frac{2\cdot 5}{3\cdot 5} = \frac{2}{3} \end{aligned}$$

102.

$$\begin{aligned} \frac{11}{12} - \frac{3}{12} &= \frac{11-3}{12} \\ &= \frac{8}{12} \\ &= \frac{2\cdot 4}{3\cdot 4} = \frac{2}{3} \end{aligned}$$

103. Since $12 = 4\cdot 3$ (12 is a multiple of 3), the LCD is 12.

$\frac{1}{3}\cdot\frac{4}{4} = \frac{4}{12}$

Now subtract fractions with the same denominator.

$\frac{7}{12} - \frac{1}{3} = \frac{7}{12} - \frac{4}{12} = \frac{3}{12} = \frac{1\cdot 3}{4\cdot 3} = \frac{1}{4}$

104. Since $6=3\cdot 2$ (6 is a multiple of 2), the LCD is 6.

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

Now subtract fractions with the same denominator.

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

105. Since $12=2\cdot 2\cdot 3$ and $9=3\cdot 3$, the LCD is $2\cdot 2\cdot 3\cdot 3=36$.

$\frac{7}{12}=\frac{7}{12}\cdot\frac{3}{3}=\frac{21}{36}$ and $\frac{1}{9}\cdot\frac{4}{4}=\frac{4}{36}$

Now subtract fractions with the same denominator.

$\frac{7}{12}-\frac{1}{9}=\frac{21}{36}-\frac{4}{36}=\frac{17}{36}$

106. $\frac{11}{16}-\frac{1}{12}=\frac{11}{16}\cdot\frac{3}{3}-\frac{1}{12}\cdot\frac{4}{4}$ The LCD of 12 and 16 is 48.

$=\frac{33}{48}-\frac{4}{48}$

$=\frac{29}{48}$

107. $4\frac{3}{4}=4+\frac{3}{4}=\frac{16}{4}+\frac{3}{4}=\frac{19}{4}$

$1\frac{2}{5}=1+\frac{2}{5}=\frac{5}{5}+\frac{2}{5}=\frac{7}{5}$

Since $4=2\cdot 2$, and 5 is prime, the LCD is $2\cdot 2\cdot 5=20$.

$4\frac{3}{4}-1\frac{2}{5}=\frac{19}{4}\cdot\frac{5}{5}-\frac{7}{5}\cdot\frac{4}{4}$

$=\frac{95}{20}-\frac{28}{20}$

$=\frac{67}{20}$, or $3\frac{7}{20}$

108. Change both numbers to improper fractions then add, using 45 as the common denominator.

$3\frac{4}{5}-1\frac{4}{9}=\frac{19}{5}-\frac{13}{9}$

$=\frac{19}{5}\cdot\frac{9}{9}-\frac{13}{9}\cdot\frac{5}{5}$

$=\frac{171}{45}-\frac{65}{45}$

$=\frac{106}{45}$, or $2\frac{16}{45}$

109. $6\frac{1}{4}=6+\frac{1}{4}=\frac{24}{4}+\frac{1}{4}=\frac{25}{4}$

$5\frac{1}{3}=5+\frac{1}{3}=\frac{15}{3}+\frac{1}{3}=\frac{16}{3}$

Since $4=2\cdot 2$, and 3 is prime, the LCD is $2\cdot 2\cdot 3=12$.

$6\frac{1}{4}-5\frac{1}{3}=\frac{25}{4}-\frac{16}{3}$

$=\frac{25}{4}\cdot\frac{3}{3}-\frac{16}{3}\cdot\frac{4}{4}$

$=\frac{75}{12}-\frac{64}{12}$

$=\frac{11}{12}$

110. $5\frac{1}{3}=5+\frac{1}{3}=\frac{15}{3}+\frac{1}{3}=\frac{16}{3}$

$4\frac{1}{2}=4+\frac{1}{2}=\frac{8}{2}+\frac{1}{2}=\frac{9}{2}$

2 and 3 are prime, so the LCD is $2\cdot 3=6$.

$5\frac{1}{3}-4\frac{1}{2}=\frac{16}{3}\cdot\frac{2}{2}-\frac{9}{2}\cdot\frac{3}{3}$

$=\frac{32}{6}-\frac{27}{6}$

$=\frac{5}{6}$

111. $8\frac{2}{9}=8+\frac{2}{9}=\frac{72}{9}+\frac{2}{9}=\frac{74}{9}$

$4\frac{2}{3}=4+\frac{2}{3}=\frac{12}{3}+\frac{2}{3}=\frac{14}{3}$

Since $9=3\cdot 3$, and 3 is prime, the LCD is $3\cdot 3=9$.

$8\frac{2}{9}-4\frac{2}{3}=\frac{74}{9}-\frac{14}{3}\cdot\frac{3}{3}$

$=\frac{74}{9}-\frac{42}{9}$

$=\frac{32}{9}$, or $3\frac{5}{9}$

112. $7\frac{5}{12} = 7 + \frac{5}{12} = \frac{84}{12} + \frac{5}{12} = \frac{89}{12}$

$4\frac{5}{6} = 4 + \frac{5}{6} = \frac{24}{6} + \frac{5}{6} = \frac{29}{6}$

Since $12 = 2 \cdot 2 \cdot 3$ and $6 = 2 \cdot 3$, the LCD is $2 \cdot 2 \cdot 3 = 12$.

$$\begin{aligned} 7\frac{5}{12} - 4\frac{5}{6} &= \frac{89}{12} - \frac{29}{6} \cdot \frac{2}{2} \\ &= \frac{89}{12} - \frac{58}{12} \\ &= \frac{31}{12}, \text{ or } 2\frac{7}{12} \end{aligned}$$

113. Observe that there are 24 dots in the entire figure, 6 dots in the triangle, 12 dots in the rectangle, and 2 dots in the overlapping region.

(a) $\frac{12}{24} = \frac{1}{2}$ of all the dots are in the rectangle.

(b) $\frac{6}{24} = \frac{1}{4}$ of all the dots are in the triangle.

(c) $\frac{2}{6} = \frac{1}{3}$ of the dots in the triangle are in the overlapping region.

(d) $\frac{2}{12} = \frac{1}{6}$ of the dots in the rectangle are in the overlapping region.

114. **(a)** 12 is $\frac{1}{3}$ of 36, so Maureen got a hit in exactly $\frac{1}{3}$ of her at-bats.

(b) 5 is a little less than $\frac{1}{2}$ of 11, so Chase got a hit in just less than $\frac{1}{2}$ of his at-bats.

(c) 1 is a little less than $\frac{1}{10}$ of 11, so Chase got a home run in just less than $\frac{1}{10}$ of his at-bats.

(d) 9 is a little less than $\frac{1}{4}$ of 40, so Christine got a hit in just less than $\frac{1}{4}$ of her at-bats.

(e) 8 is $\frac{1}{2}$ of 16, and 10 is $\frac{1}{2}$ of 20, so Joe and Greg each got hits $\frac{1}{2}$ of the time they were at bat.

115. Multiply the number of cups of water per serving by the number of servings.

$$\begin{aligned} \frac{3}{4} \cdot 8 &= \frac{3}{4} \cdot \frac{8}{1} \\ &= \frac{3 \cdot 8}{4 \cdot 1} \\ &= \frac{24}{4} \\ &= 6 \text{ cups} \end{aligned}$$

For 8 microwave servings, 6 cups of water will be needed.

116. Four stove-top servings require $\frac{1}{4}$ tsp, or $\frac{2}{8}$ tsp, of salt. Six stove-top servings require $\frac{1}{2}$ tsp, or $\frac{4}{8}$ tsp, of salt. Five is halfway between 4 and 6, and $\frac{3}{8}$ is halfway between $\frac{2}{8}$ and $\frac{4}{8}$. Therefore, 5 stove-top servings would require $\frac{3}{8}$ tsp of salt.

117. The difference in length is found by subtracting.

$$\begin{aligned} 3\frac{1}{4} - 2\frac{1}{8} &= \frac{13}{4} - \frac{17}{8} \\ &= \frac{13}{4} \cdot \frac{2}{2} - \frac{17}{8} \quad \text{LCD} = 8 \\ &= \frac{26}{8} - \frac{17}{8} \\ &= \frac{9}{8}, \text{ or } 1\frac{1}{8} \end{aligned}$$

The difference is $1\frac{1}{8}$ inches.

118. The difference in length is found by subtracting.

$$4-2\frac{1}{8}=\frac{4}{1}-\frac{17}{8}$$
$$=\frac{4}{1}\cdot\frac{8}{8}-\frac{17}{8}\quad \text{LCD}=8$$
$$=\frac{32}{8}-\frac{17}{8}$$
$$=\frac{15}{8},\text{ or }1\frac{7}{8}$$

The difference is $1\frac{7}{8}$ inches.

119. The difference between the two measures is found by subtracting, using 16 as the LCD.

$$\frac{3}{4}-\frac{3}{16}=\frac{3}{4}\cdot\frac{4}{4}-\frac{3}{16}$$
$$=\frac{12}{16}-\frac{3}{16}$$
$$=\frac{12-3}{16}$$
$$=\frac{9}{16}$$

The difference is $\frac{9}{16}$ inch.

120. The difference between the two measures is found by subtracting, using 16 as a common denominator.

$$\frac{9}{16}-\frac{3}{8}=\frac{9}{16}-\frac{3}{8}\cdot\frac{2}{2}$$
$$=\frac{9}{16}-\frac{6}{16}$$
$$=\frac{9-6}{16}$$
$$=\frac{3}{16}$$

The difference is $\frac{3}{16}$ inch.

121. The perimeter is the sum of the measures of the 5 sides.

$$196+98\frac{3}{4}+146\frac{1}{2}+100\frac{7}{8}+76\frac{5}{8}$$
$$=196+98\frac{6}{8}+146\frac{4}{8}+100\frac{7}{8}+76\frac{5}{8}$$
$$=196+98+146+100+76+\frac{6+4+7+5}{8}$$
$$=616+\frac{22}{8}\quad\left(\frac{22}{8}=2\frac{6}{8}=2\frac{3}{4}\right)$$
$$=618\frac{3}{4}\text{ feet}$$

The perimeter is $618\frac{3}{4}$ feet.

122. To find the perimeter of a triangle, add the lengths of the three sides.

$$5\frac{1}{4}+7\frac{1}{2}+10\frac{1}{8}=5\frac{2}{8}+7\frac{4}{8}+10\frac{1}{8}$$
$$=22\frac{7}{8}$$

The perimeter of the triangle is $22\frac{7}{8}$ feet.

123. Divide the total board length by 3.

$$15\frac{5}{8}\div 3=\frac{125}{8}\div\frac{3}{1}$$
$$=\frac{125}{8}\cdot\frac{1}{3}$$
$$=\frac{125\cdot 1}{8\cdot 3}$$
$$=\frac{125}{24},\text{ or }5\frac{5}{24}$$

The length of each of the three pieces must be $5\frac{5}{24}$ inches.

124. Divide the total amount of tomato sauce by the number of servings.

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

For 1 serving of barbecue sauce, $\frac{1}{3}$ cup of tomato sauce is needed.

125. To find the number of cakes the caterer can make, divide $15\frac{1}{2}$ by $1\frac{3}{4}$.

$$\begin{aligned}15\frac{1}{2}\div 1\frac{3}{4}&=\frac{31}{2}\div\frac{7}{4}\\&=\frac{31}{2}\cdot\frac{4}{7}\\&=\frac{31\cdot 2\cdot 2}{2\cdot 7}\\&=\frac{62}{7},\ \text{or}\ 8\frac{6}{7}\end{aligned}$$

There is not quite enough sugar for 9 cakes. The caterer can make 8 cakes with some sugar left over.

126. Divide the total amount of fabric by the amount of fabric needed to cover one chair.

$$\begin{aligned}23\frac{2}{3}\div 2\frac{1}{4}&=\frac{71}{3}\div\frac{9}{4}\\&=\frac{71}{3}\cdot\frac{4}{9}\\&=\frac{71\cdot 4}{3\cdot 9}\\&=\frac{284}{27},\ \text{or}\ 10\frac{14}{27}\end{aligned}$$

Kyla can cover 10 chairs. There will be some fabric left over.

127. Multiply the amount of fabric it takes to make one costume by the number of costumes.

$$\begin{aligned}2\frac{3}{8}\cdot 7&=\frac{19}{8}\cdot\frac{7}{1}\\&=\frac{19\cdot 7}{8\cdot 1}\\&=\frac{133}{8},\ \text{or}\ 16\frac{5}{8}\ \text{yd}\end{aligned}$$

For 7 costumes, $16\frac{5}{8}$ yards of fabric would be needed.

128. Multiply the amount of sugar for one batch times the number of batches.

$$\begin{aligned}2\frac{2}{3}\cdot 4&=\frac{8}{3}\cdot\frac{4}{1}\\&=\frac{8\cdot 4}{3\cdot 1}\\&=\frac{32}{3},\ \text{or}\ 10\frac{2}{3}\end{aligned}$$

$10\frac{2}{3}$ cups of sugar are required to make four batches of cookies.

129. Subtract the heights to find the difference.

$$\begin{aligned}10\frac{1}{2}-7\frac{1}{8}&=\frac{21}{2}-\frac{57}{8}\\&=\frac{21}{2}\cdot\frac{4}{4}-\frac{57}{8}\qquad \text{LCD}=8\\&=\frac{84}{8}-\frac{57}{8}\\&=\frac{27}{8},\ \text{or}\ 3\frac{3}{8}\end{aligned}$$

The difference in heights is $3\frac{3}{8}$ inches.

130. Subtract $\frac{3}{8}$ from $\frac{11}{16}$ using 16 as the LCD.

$$\begin{aligned}\frac{11}{16}-\frac{3}{8}&=\frac{11}{16}-\frac{3}{8}\cdot\frac{2}{2}\\&=\frac{11}{16}-\frac{6}{16}\\&=\frac{5}{16}\end{aligned}$$

Thus, $\frac{3}{8}$ inch is $\frac{5}{16}$ inch smaller than $\frac{11}{16}$ inch.

131. A share of $\frac{11}{100}$ can be rounded to $\frac{10}{100}=\frac{1}{10}$.
Multiply by the total number of foreign-born people in the U.S., approximately 40 million.

$$\frac{1}{10}\cdot 40=\frac{1}{10}\cdot\frac{40}{1}=\frac{4\cdot 10}{1\cdot 10}=\frac{4}{1}=4,$$

There were approximately 4 million (or 4,000,000) foreign-born people in the U.S. who were born in Europe.
For the actual number:

$$\frac{11}{100}\cdot 40=\frac{11}{100}\cdot\frac{40}{1}=\frac{11\cdot 2\cdot 20}{5\cdot 20\cdot 1}=\frac{22}{5},\ \text{or}\ 4\frac{2}{5}$$

The actual number who were born in Europe was $4\frac{2}{5}$ million (or 4,400,000) people.

132. Multiply the fraction representing the U.S. foreign-born population from Latin America, $\frac{13}{25}$, by the total number of foreign-born people in the U.S., approximately 40 million.

$$\frac{13}{25}\cdot 40=\frac{13}{25}\cdot\frac{40}{1}=\frac{13\cdot 5\cdot 8}{5\cdot 5\cdot 1}=\frac{104}{5},\ \text{or}\ 20\frac{4}{5}$$

There were approximately $20\frac{4}{5}$ million (or 20,800,000) foreign-born people in the U.S. who were born in Latin America.

133. The sum of the fractions representing the U.S. foreign-born population from Latin America, Asia, or Europe is

$$\frac{13}{25}+\frac{29}{100}+\frac{11}{100}=\frac{13}{25}\cdot\frac{4}{4}+\frac{29}{100}+\frac{11}{100}$$
$$=\frac{52+29+11}{100}$$
$$=\frac{92}{100}$$
$$=\frac{23\cdot 4}{25\cdot 4}$$
$$=\frac{23}{25}.$$

So the fraction representing the U.S. foreign-born population from other regions is

$$1-\frac{23}{25}=\frac{25}{25}-\frac{23}{25}$$
$$=\frac{2}{25}.$$

134. The sum of the fractions representing the U.S. foreign-born population from Latin America or Asia is

$$\frac{13}{25}+\frac{29}{100}=\frac{13}{25}\cdot\frac{4}{4}+\frac{29}{100}$$
$$=\frac{52+29}{100}$$
$$=\frac{81}{100}.$$

135. Estimate each fraction. $\frac{14}{26}$ is about $\frac{1}{2}$, $\frac{98}{99}$ is about 1, $\frac{100}{51}$ is about 2, $\frac{90}{31}$ is about 3, and $\frac{13}{27}$ is about $\frac{1}{2}$.

Therefore, the sum is approximately

$$\frac{1}{2}+1+2+3+\frac{1}{2}=7.$$

The correct choice is C.

136. Estimate each fraction. $\frac{202}{50}$ is about 4, $\frac{99}{100}$ is about 1, $\frac{21}{40}$ is about $\frac{1}{2}$, and $\frac{75}{36}$ is about 2.

Therefore, the product is approximately

$$4\cdot 1\cdot\frac{1}{2}\cdot 2=4$$

The correct choice is B.

R.2 Decimals and Percents

Classroom Examples, Now Try Exercises

1. **(a)** $0.15=\frac{15}{100}$

(b) $0.009=\frac{9}{1000}$

(c) $2.5=2\frac{5}{10}=\frac{25}{10}$

N1. **(a)** $0.8=\frac{8}{10}$

(b) $0.431=\frac{431}{1000}$

(c) $2.58=2\frac{58}{100}=\frac{258}{100}$

2. **(a)**

$$\begin{array}{r} 42.830 \\ 71.000 \\ +\ \ 3.074 \\ \hline 116.904 \end{array}$$

(b)

$$\begin{array}{r} 32.50 \\ -\ 21.72 \\ \hline 10.78 \end{array}$$

N2. **(a)**

$$\begin{array}{r} 68.900 \\ 42.720 \\ +\ \ 8.973 \\ \hline 120.593 \end{array}$$

(b)

$$\begin{array}{r} 351.800 \\ -\ \ \ 2.706 \\ \hline 349.094 \end{array}$$

3. **(a)**

$$\begin{array}{rr} 30.2 & \text{1 decimal place} \\ \times 0.052 & \text{3 decimal places} \\ \hline 604 & \downarrow \\ 1510 & 1+3=4 \\ \hline 1.5704 & \text{4 decimal places} \end{array}$$

(b)

$$\begin{array}{rr} 0.06 & \text{2 decimal places} \\ \times 0.12 & \text{2 decimal places} \\ \hline 12 & \downarrow \\ 6 & 2+2=4 \\ \hline 0.0072 & \text{4 decimal places} \end{array}$$

N3. (a)

$$\begin{array}{rl} 9.32 & \text{2 decimal places} \\ \times\ 1.4 & \text{1 decimal place} \\ \hline 3728 & \qquad\qquad\downarrow \\ 932 & \qquad 2+1=3 \\ \hline 13.048 & \text{3 decimal places} \end{array}$$

(b)

$$\begin{array}{rl} 0.6 & \text{1 decimal place} \\ \times 0.004 & \text{3 decimal places} \\ \hline 24 & \qquad 1+3=4 \\ \hline 0.0024 & \text{4 decimal places} \end{array}$$

4. (a) To change the divisor 0.37 into a whole number, move each decimal point two places to the right. Move the decimal point straight up and divide as with whole numbers.

$$\begin{array}{r} 14.8 \\ 37\overline{)547.6} \\ \underline{37} \\ 177 \\ \underline{148} \\ 296 \\ \underline{296} \\ 0 \end{array}$$

Therefore, $5.476 \div 0.37 = 14.8$.

(b) To change the divisor 3.1 into a whole number, move each decimal point one place to the right. Move the decimal point straight up and divide as with whole numbers.

$$\begin{array}{r} 1.21 \\ 31\overline{)37.60} \\ \underline{31} \\ 66 \\ \underline{62} \\ 40 \\ \underline{31} \\ 9 \end{array}$$

We carried out the division to 2 decimal places so that we could round to 1 decimal place. Therefore, $3.76 \div 3.1 \approx 1.2$.

N4. (a) To change the divisor 14.9 into a whole number, move each decimal point one place to the right. Move the decimal point straight up and divide as with whole numbers.

$$\begin{array}{r} 30.3 \\ 149\overline{)4514.7} \\ \underline{447} \\ 447 \\ \underline{447} \\ 0 \end{array}$$

Therefore, $451.47 \div 14.9 = 30.3$.

(b) To change the divisor 1.3 into a whole number, move each decimal point one place to the right. Move the decimal point straight up and divide as with whole numbers.

$$\begin{array}{r} 5.641 \\ 13\overline{)73.340} \\ \underline{65} \\ 83 \\ \underline{78} \\ 54 \\ \underline{52} \\ 20 \\ \underline{13} \\ 7 \end{array}$$

We carried out the division to 3 decimal places so that we could round to 2 decimal places. Therefore, $7.334 \div 1.3 \approx 5.64$.

5. (a) Move the decimal point three places to the right.
$19.5 \times 1000 = 19{,}500$

(b) Move the decimal point one place to the left.
$960.1 \div 10 = 96.01$

N5. (a) Move the decimal point one place to the right.
$294.72 \times 10 = 2947.2$

(b) Move the decimal point two places to the left. Insert a 0 in front of the 4 to do this.
$4.793 \div 100 = 0.04793$

6. **(a)** Divide 3 by 50. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.06 \\ 50\overline{)3.00} \\ \underline{3\ 00} \\ 0 \end{array}$$

Therefore, $\frac{3}{50} = 0.06.$

(b) Divide 11 by 1. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.090909... \\ 11\overline{)1.000000...} \\ \underline{99} \\ 100 \\ \underline{99} \\ 100 \\ \underline{99} \\ 1 \end{array}$$

Note that the pattern repeats. Therefore, $\frac{1}{11} = 0.\overline{09},$ or about $0.091.$

N6. **(a)** Divide 20 by 17. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.85 \\ 20\overline{)17.00} \\ \underline{160} \\ 100 \\ \underline{100} \\ 0 \end{array}$$

Therefore, $\frac{17}{20} = 0.85.$

(b) Divide 2 by 9. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.222... \\ 9\overline{)2.000...} \\ \underline{18} \\ 20 \\ \underline{18} \\ 20 \\ \underline{18} \\ 2 \end{array}$$

Note that the pattern repeats. Therefore, $\frac{2}{9} = 0.\overline{2},$ or $0.222.$

7. **(a)** $5\frac{1}{4}\% = 5.25\%$

$= \frac{5.25}{100}$

$= 0.0525$

(b) $200\% = \frac{200}{100} = 2.00,$ or 2

N7. **(a)** $23\% = \frac{23}{100} = 0.23$

(b) $350\% = \frac{350}{100} = 3.50,$ or 3.5

8. **(a)** $0.06 = 0.06 \cdot 100\% = 6\%$

(b) $1.75 = 1.75 \cdot 100\% = 175\%$

N8. **(a)** $0.31 = 0.31 \cdot 100\% = 31\%$

(b) $1.32 = 1.32 \cdot 100\% = 132\%$

9. **(a)** $85\% = 0.85$

(b) $110\% = 1.10,$ or 1.1

(c) $0.30 = 30\%$

(d) $0.165 = 16.5\%$

N9. **(a)** $52\% = 0.52$

(b) $2\% = 02\% = 0.02$

(c) $0.45 = 45\%$

(d) $3.5 = 3.50 = 350\%$

10. **(a)** $65\% = \frac{65}{100}$

In lowest terms,

$\frac{65}{100} = \frac{13 \cdot 5}{20 \cdot 5} = \frac{13}{20}$

(b) $1.5\% = \frac{1.5}{100} = \frac{1.5}{100} \cdot \frac{10}{10} = \frac{15}{1000} = \frac{3}{200}$

N10. **(a)** $20\% = \frac{20}{100}$

In lowest terms,

$\frac{20}{100} = \frac{1 \cdot 20}{5 \cdot 20} = \frac{1}{5}$

(b) $160\% = \frac{160}{100}$

In lowest terms,

$\frac{160}{100} = \frac{8 \cdot 20}{5 \cdot 20} = \frac{8}{5},$ or $1\frac{3}{5}$

11. **(a)** $\frac{3}{50}=\frac{3}{50}\cdot 100\%$
$=\frac{3}{50}\cdot\frac{100}{1}\%$
$=\frac{3\cdot 50\cdot 2}{50}\%$
$=6\%$

(b) $\frac{1}{3}=\frac{1}{3}\cdot 100\%$
$=\frac{1}{3}\cdot\frac{100}{1}\%$
$=\frac{100}{3}\%$
$=33\frac{1}{3}\%,$ or $33.\overline{3}\%$

N11. **(a)** $\frac{6}{25}=\frac{6}{25}\cdot 100\%$
$=\frac{6}{25}\cdot\frac{100}{1}\%$
$=\frac{6\cdot 25\cdot 4}{25}\%$
$=24\%$

(b) $\frac{7}{9}=\frac{7}{9}\cdot 100\%$
$=\frac{7}{9}\cdot\frac{100}{1}\%$
$=\frac{700}{9}\%$
$=77\frac{7}{9}\%,$ or $77.\overline{7}\%$

12. The discount is 30% of \$69. The word *of* here means multiply.
30% of 69
↓ ↓ ↓
$0.30 \cdot 69 = 20.7$
The discount is \$20.70. The sale price is found by subtracting.
$\$69.00-\$20.70=\$48.30$

N12. The discount is 60% of \$120. The word *of* here means multiply.
60% of 120
↓ ↓ ↓
$0.60 \cdot 120 = 72$
The discount is \$72. The sale price is found by subtracting.
$\$120.00-\$72=\$48$

Exercises

1. 367.9412
(a) Tens: 6
(b) Tenths: 9
(c) Thousandths: 1
(d) Ones: 7
(e) Hundredths: 4

2. Answers will vary. One example is 5243.0164.

3. 46.249
(a) 46.25
(b) 46.2
(c) 46
(d) 50

4. **(a)** 0.889
(b) 0.444
(c) 0.976
(d) 0.865

5. $0.4=\frac{4}{10}$

6. $0.6=\frac{6}{10}$

7. $0.64=\frac{64}{100}$

8. $0.82=\frac{82}{100}$

9. $0.138=\frac{138}{1000}$

10. $0.104=\frac{104}{1000}$

11. $0.043=\frac{43}{1000}$

12. $0.087=\frac{87}{1000}$

13. $3.805=3\frac{805}{1000}=\frac{3805}{1000}$

14. $5.166=5\frac{166}{1000}=\frac{5166}{1000}$

15.
$$\begin{array}{r} 25.320 \\ 109.200 \\ +\ \ 8.574 \\ \hline 143.094 \end{array}$$

16.
$$\begin{array}{r} 90.527 \\ 32.430 \\ +589.800 \\ \hline 712.757 \end{array}$$

17.
$$\begin{array}{r} 28.73 \\ -\ \ 3.12 \\ \hline 25.61 \end{array}$$

18.
$$\begin{array}{r} 46.88 \\ -13.45 \\ \hline 33.43 \end{array}$$

19.
$$\begin{array}{r} 43.50 \\ -28.17 \\ \hline 15.33 \end{array}$$

20.
$$\begin{array}{r} 345.10 \\ -\ \ 56.31 \\ \hline 288.79 \end{array}$$

21.
$$\begin{array}{r} 3.87 \\ 15.00 \\ +\ \ 2.90 \\ \hline 21.77 \end{array}$$

22.
$$\begin{array}{r} 8.20 \\ 1.09 \\ +12.00 \\ \hline 21.29 \end{array}$$

23.
$$\begin{array}{r} 32.560 \\ 47.356 \\ +\ \ 1.800 \\ \hline 81.716 \end{array}$$

24.
$$\begin{array}{r} 75.200 \\ 123.960 \\ +\ \ 3.897 \\ \hline 203.057 \end{array}$$

25.
$$\begin{array}{r} 18.000 \\ -\ \ 2.789 \\ \hline 15.211 \end{array}$$

26.
$$\begin{array}{r} 29.000 \\ -\ \ 8.582 \\ \hline 20.418 \end{array}$$

27.
$$\begin{array}{rr} 12.8 & \text{1 decimal place} \\ \times\ 9.1 & \text{1 decimal place} \\ \hline 128 & \downarrow \\ 1152 & 1+1=2 \\ \hline 116.48 & \text{2 decimal places} \end{array}$$

28.
$$\begin{array}{rr} 34.04 & \text{2 decimal places} \\ \times\ 0.56 & \text{2 decimal places} \\ \hline 20424 & \downarrow \\ 17020 & 2+2=4 \\ \hline 19.0624 & \text{4 decimal places} \end{array}$$

29.
$$\begin{array}{rr} 22.41 & \text{2 decimal places} \\ \times\ 33 & \text{0 decimal places} \\ \hline 6723 & \downarrow \\ 6723 & 2+0=2 \\ \hline 739.53 & \text{2 decimal places} \end{array}$$

30.
$$\begin{array}{rr} 55.76 & \text{2 decimal places} \\ \times\ 72 & \text{0 decimal places} \\ \hline 11152 & \downarrow \\ 39032 & 2+0=2 \\ \hline 4014.72 & \text{2 decimal places} \end{array}$$

31.
$$\begin{array}{rr} 0.2 & \text{1 decimal place} \\ \times 0.03 & \text{2 decimal places} \\ \hline 6 & 1+2=3 \\ \hline 0.006 & \text{3 decimal places} \end{array}$$

32.
$$\begin{array}{rr} 0.07 & \text{2 decimal places} \\ \times 0.004 & \text{3 decimal places} \\ \hline 28 & 2+3=5 \\ \hline 0.00028 & \text{5 decimal places} \end{array}$$

33.
$$\begin{array}{r} 7.15 \\ 11\overline{)78.65} \\ \underline{77} \\ 16 \\ \underline{11} \\ 55 \\ \underline{55} \\ 0 \end{array}$$

34. $$\begin{array}{r} 5.24 \\ 14\overline{)73.36} \\ \underline{70} \\ 33 \\ \underline{28} \\ 56 \\ \underline{56} \\ 0 \end{array}$$

35. To change the divisor 11.6 into a whole number, move each decimal point one place to the right. Move the decimal point straight up and divide as with whole numbers.

$$\begin{array}{r} 2.8 \\ 116\overline{)324.8} \\ \underline{232} \\ 928 \\ \underline{928} \\ 0 \end{array}$$

Therefore, $32.48 \div 11.6 = 2.8$.

36. To change the divisor 17.4 into a whole number, move each decimal point one place to the right. Move the decimal point straight up and divide as with whole numbers.

$$\begin{array}{r} 4.9 \\ 174\overline{)852.6} \\ \underline{696} \\ 1566 \\ \underline{1566} \\ 0 \end{array}$$

Therefore, $85.26 \div 17.4 = 4.9$.

37. To change the divisor 9.74 into a whole number, move each decimal point two places to the right. Move the decimal point straight up and divide as with whole numbers.

$$\begin{array}{r} 2.05 \\ 974\overline{)1996.70} \\ \underline{1948} \\ 4870 \\ \underline{4870} \\ 0 \end{array}$$

Therefore, $19.967 \div 9.74 = 2.05$.

38. To change the divisor 5.27 into a whole number, move each decimal point two places to the right. Move the decimal point straight up and divide as with whole numbers.

$$\begin{array}{r} 8.44 \\ 527\overline{)4447.88} \\ \underline{4216} \\ 2318 \\ \underline{2108} \\ 2108 \\ \underline{2108} \\ 0 \end{array}$$

Therefore, $44.4788 \div 5.27 = 8.44$.

39. Move the decimal point one place to the right.
$123.26 \times 10 = 1232.6$

40. Move the decimal point one place to the right.
$785.91 \times 10 = 7859.1$

41. Move the decimal point two places to the right.
$57.116 \times 100 = 5711.6$

42. Move the decimal point two places to the right.
$82.053 \times 100 = 8205.3$

43. Move the decimal point three places to the right.
$0.094 \times 1000 = 94$

44. Move the decimal point three places to the right.
$0.025 \times 1000 = 25$

45. Move the decimal point one place to the left.
$1.62 \div 10 = 0.162$

46. Move the decimal point one place to the left.
$8.04 \div 10 = 0.804$

47. Move the decimal point two places to the left.
$124.03 \div 100 = 1.2403$

48. Move the decimal point two places to the left.
$490.35 \div 100 = 4.9035$

49. Move the decimal point three places to the left.
$23.29 \div 1000 = 023.29 \div 1000 = 0.02329$

50. Move the decimal point three places to the left.
$59.8 \div 1000 = 059.8 \div 1000 = 0.0598$

51. Convert from a decimal to a percent.
$0.01 = 0.01 \cdot 100\% = 1\%$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{1}{100}$	0.01	1%

52. Convert from a percent to a decimal.

$2\% = \frac{2}{100} = 0.02$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{1}{50}$	0.02	2%

53. Convert from a percent to a fraction.

$5\% = \frac{5}{100}$

In lowest terms,

$\frac{5}{100} = \frac{1 \cdot 5}{20 \cdot 5} = \frac{1}{20}$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{1}{20}$	0.05	5%

54. Convert to a decimal first. Divide 1 by 10. Move the decimal point one place to the left.

$1 \div 10 = 0.1$

Convert the decimal to a percent.

$0.1 = 0.1 \cdot 100\% = 10\%$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{1}{10}$	0.1	10%

55. Convert the decimal to a percent.

$0.125 = 0.125 \cdot 100\% = 12.5\%$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{1}{8}$	0.125	12.5%

56. Convert the percent to a decimal first.

$20\% = 0.20$, or 0.2

Convert from a percent to a fraction.

$20\% = \frac{20}{100}$

In lowest terms,

$\frac{20}{100} = \frac{1 \cdot 20}{5 \cdot 20} = \frac{1}{5}$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{1}{5}$	0.2	20%

57. Convert to a decimal first. Divide 1 by 4. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.25 \\ 4\overline{)1.00} \\ \underline{8} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

Convert the decimal to a percent.

$0.25 = 0.25 \cdot 100\% = 25\%$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{1}{4}$	0.25	25%

58. Convert to a decimal first. Divide 1 by 3. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.33... \\ 3\overline{)1.00...} \\ \underline{9} \\ 10 \\ \underline{9} \\ 1 \end{array}$$

Note that the pattern repeats. Therefore,

$\frac{1}{3} = 0.\overline{3}.$

Convert the decimal to a percent.

$0.33\overline{3} = 0.33\overline{3} \cdot 100\% = 33.\overline{3}\%$, or $33\frac{1}{3}\%$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{1}{3}$	$0.\overline{3}$	$33.\overline{3}\%$ or $33\frac{1}{3}\%$

59. Convert the percent to a decimal first.
$50\% = 0.50, \text{ or } 0.5$
Convert from a percentl to a fraction.
$50\% = \frac{50}{100}$
In lowest terms,
$\frac{50}{100} = \frac{1 \cdot 50}{2 \cdot 50} = \frac{1}{2}$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{1}{2}$	0.5	50%

60. Divide 2 by 3. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.66... \\ 3\overline{)2.00...} \\ \underline{18} \\ 20 \\ \underline{18} \\ 2 \end{array}$$

Note that the pattern repeats. Therefore,
$\frac{2}{3} = 0.\overline{6}.$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{2}{3}$	$0.\overline{6}$	$66.\overline{6}\%$ or $66\frac{2}{3}\%$

61. Convert the decimal to a percent first.
$0.75 = 0.75 \cdot 100\% = 75\%$
Convert from a percent to a fraction.
$75\% = \frac{75}{100}$
In lowest terms,
$\frac{75}{100} = \frac{3 \cdot 25}{4 \cdot 25} = \frac{3}{4}$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
$\frac{3}{4}$	0.75	75%

62. Convert the decimal to a percent.
$1.0 = 1.0 \cdot 100\% = 100\%$

Fraction in Lowest Terms (or Whole Number)	Decimal	Percent
1	1.0	100%

63. Divide 21 by 5. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 4.2 \\ 5\overline{)21.0} \\ \underline{20} \\ 10 \\ \underline{10} \\ 0 \end{array}$$

64. Divide 9 by 5. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 1.8 \\ 5\overline{)9.0} \\ \underline{5} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

65. Divide 9 by 4. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 2.25 \\ 4\overline{)9.00} \\ \underline{8} \\ 10 \\ \underline{8} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

66. Divide 15 by 4. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 3.75 \\ 4\overline{)15.00} \\ \underline{12} \\ 30 \\ \underline{28} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

67. Divide 3 by 8. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.375 \\ 8\overline{)3.000} \\ \underline{24} \\ 60 \\ \underline{56} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

68. Divide 7 by 8. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.875 \\ 8\overline{)7.000} \\ \underline{64} \\ 60 \\ \underline{56} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

69. Divide 5 by 9. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.555... \\ 9\overline{)5.000...} \\ \underline{45} \\ 50 \\ \underline{45} \\ 50 \\ \underline{45} \\ 5 \end{array}$$

Note that the pattern repeats. Therefore, $\frac{5}{9} = 0.\overline{5}$, or about 0.556.

70. Divide 8 by 9. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.888... \\ 9\overline{)8.000...} \\ \underline{72} \\ 80 \\ \underline{72} \\ 80 \\ \underline{72} \\ 8 \end{array}$$

Note that the pattern repeats. Therefore, $\frac{8}{9} = 0.\overline{8}$, or about 0.889.

71. Divide 1 by 6. Add a decimal point and as many 0s as necessary.

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

Note that the pattern repeats. Therefore, $\frac{1}{6} = 0.1\overline{6}$, or about 0.167.

72. Divide 5 by 6. Add a decimal point and as many 0s as necessary.

$$\begin{array}{r} 0.833... \\ 6\overline{)5.000...} \\ \underline{48} \\ 20 \\ \underline{18} \\ 20 \\ \underline{18} \\ 2 \end{array}$$

Note that the pattern repeats. Therefore,
$\frac{5}{6} = 0.8\overline{3}$, or about 0.833.

73. $54\% = 0.54$

74. $39\% = 0.39$

75. $7\% = 07\% = 0.07$

76. $4\% = 04\% = 0.04$

77. $117\% = 1.17$

78. $189\% = 1.89$

79. $2.4\% = 02.4\% = 0.024$

80. $3.1\% = 03.1\% = 0.031$

81. $6\frac{1}{4}\% = 6.25\% = 06.25\% = 0.0625$

82. $5\frac{1}{2}\% = 5.5\% = 05.5\% = 0.055$

83. $0.8\% = 00.8\% = 0.008$

84. $0.9\% = 00.9\% = 0.009$

85. $0.79 = 79\%$

86. $0.83 = 83\%$

87. $0.02 = 2\%$

88. $0.08 = 8\%$

89. $0.004 = 0.4\%$

90. $0.005 = 0.5\%$

91. $1.28 = 128\%$

92. $2.35 = 235\%$

93. $0.40 = 40\%$

94. $0.6 = 0.60 = 60\%$

95. $6 = 6.00 = 600\%$

96. $10 = 10.00 = 1000\%$

97. $51\% = \frac{51}{100}$

98. $47\% = \frac{47}{100}$

99. $15\% = \frac{15}{100}$
In lowest terms,
$\frac{15}{100} = \frac{3 \cdot 5}{20 \cdot 5} = \frac{3}{20}$

100. $35\% = \frac{35}{100}$
In lowest terms,
$\frac{35}{100} = \frac{7 \cdot 5}{20 \cdot 5} = \frac{7}{20}$

101. $2\% = \frac{2}{100}$
In lowest terms,
$\frac{2}{100} = \frac{1 \cdot 2}{50 \cdot 2} = \frac{1}{50}$

102. $8\% = \frac{8}{100}$
In lowest terms,
$\frac{8}{100} = \frac{2 \cdot 4}{25 \cdot 4} = \frac{2}{25}$

103. $140\% = \frac{140}{100}$
In lowest terms,
$\frac{140}{100} = \frac{7 \cdot 20}{5 \cdot 20} = \frac{7}{5}$, or $1\frac{2}{5}$

104. $180\% = \frac{180}{100}$
In lowest terms,
$\frac{180}{100} = \frac{9 \cdot 20}{5 \cdot 20} = \frac{9}{5}$, or $1\frac{4}{5}$

105. $7.5\% = \frac{7.5}{100} = \frac{7.5}{100} \cdot \frac{10}{10} = \frac{75}{1000}$
In lowest terms,
$\frac{75}{1000} = \frac{3 \cdot 25}{40 \cdot 25} = \frac{3}{40}$

106. $2.5\% = \frac{2.5}{100} = \frac{2.5}{100}\cdot\frac{10}{10} = \frac{25}{1000}$

In lowest terms,

$\frac{25}{1000} = \frac{1\cdot 25}{40\cdot 25} = \frac{1}{40}$

107. $\frac{4}{5} = \frac{4}{5}\cdot 100\% = \frac{4}{5}\cdot\frac{100}{1}\% = \frac{4\cdot 5\cdot 20}{5}\% = 80\%$

108. $\frac{3}{25} = \frac{3}{25}\cdot 100\%$
$= \frac{3}{25}\cdot\frac{100}{1}\%$
$= \frac{3\cdot 4\cdot 25}{25}\%$
$= 12\%$

109. $\frac{7}{50} = \frac{7}{50}\cdot 100\%$
$= \frac{7}{50}\cdot\frac{100}{1}\%$
$= \frac{7\cdot 2\cdot 50}{50}\%$
$= 14\%$

110. $\frac{9}{20} = \frac{9}{20}\cdot 100\%$
$= \frac{9}{20}\cdot\frac{100}{1}\%$
$= \frac{9\cdot 5\cdot 20}{20}\%$
$= 45\%$

111. $\frac{2}{11} = \frac{2}{11}\cdot 100\%$
$= \frac{2}{11}\cdot\frac{100}{1}\%$
$= \frac{200}{11}\%$
$= 18.\overline{18}\%$

112. $\frac{4}{9} = \frac{4}{9}\cdot 100\% = \frac{4}{9}\cdot\frac{100}{1}\% = \frac{400}{9}\% = 44.\overline{4}\%$

113. $\frac{9}{4} = \frac{9}{4}\cdot 100\% = \frac{9}{4}\cdot\frac{100}{1}\% = \frac{9\cdot 4\cdot 25}{4}\% = 225\%$

114. $\frac{8}{5} = \frac{8}{5}\cdot 100\% = \frac{8}{5}\cdot\frac{100}{1}\% = \frac{8\cdot 5\cdot 20}{5}\% = 160\%$

115. $\frac{13}{6} = \frac{13}{6}\cdot 100\%$
$= \frac{13}{6}\cdot\frac{100}{1}\%$
$= \frac{13\cdot 2\cdot 50}{2\cdot 3}\%$
$= 216.\overline{6}\%$

116. $\frac{31}{9} = \frac{31}{9}\cdot 100\%$
$= \frac{31}{9}\cdot\frac{100}{1}\%$
$= \frac{3100}{9}\%$
$= 344.\overline{4}\%$

117. The word *of* here means multiply.

$$\begin{array}{cccc} 50\% & \text{of} & 320 & \\ \downarrow & \downarrow & \downarrow & \\ 0.50 & \cdot & 320 & = 160 \end{array}$$

118. The word *of* here means multiply.

$$\begin{array}{cccc} 25\% & \text{of} & 120 & \\ \downarrow & \downarrow & \downarrow & \\ 0.25 & \cdot & 120 & = 30 \end{array}$$

119. The word *of* here means multiply.

$$\begin{array}{cccc} 6\% & \text{of} & 80 & \\ \downarrow & \downarrow & \downarrow & \\ 0.06 & \cdot & 80 & = 4.8 \end{array}$$

120. The word *of* here means multiply.

$$\begin{array}{cccc} 5\% & \text{of} & 70 & \\ \downarrow & \downarrow & \downarrow & \\ 0.05 & \cdot & 70 & = 3.5 \end{array}$$

121. The word *of* here means multiply.

$$\begin{array}{cccc} 14\% & \text{of} & 780 & \\ \downarrow & \downarrow & \downarrow & \\ 0.14 & \cdot & 780 & = 109.2 \end{array}$$

122. The word *of* here means multiply.

$$\begin{array}{cccc} 26\% & \text{of} & 480 & \\ \downarrow & \downarrow & \downarrow & \\ 0.26 & \cdot & 480 & = 124.8 \end{array}$$

123. The tip is 20% of \$89. The word *of* here means multiply.

$$\begin{array}{cccc} 20\% & \text{of} & \$89 & \\ \downarrow & \downarrow & \downarrow & \\ 0.20 & \cdot & \$89 & = \$17.80 \end{array}$$

The tip is \$17.80. The total bill is found by adding.

$\$89 + \$17.80 = \$106.80$

124. The raise is 7% of \$15. The word *of* here means multiply.

$$\begin{array}{cccc} 7\% & \text{of} & \$15 & \\ \downarrow & \downarrow & \downarrow & \\ 0.07 & \cdot & \$15 & = \$1.05 \end{array}$$

The amount of the raise is \$1.05 per hour. The new hourly rate is found by adding.

$\$15 + \$1.05 = \$16.05$

125. The discount is 15% of \$795. The word *of* here means multiply.

$$\begin{array}{cccc} 15\% & \text{of} & \$795 & \\ \downarrow & \downarrow & \downarrow & \\ 0.15 & \cdot & \$795 & = \$119.25 \end{array}$$

The amount of the discount is \$119.25. The sale price is found by subtracting.

$\$795 - \$119.25 = \$675.75$

126. The discount is 20% of \$597. The word *of* here means multiply.

$$\begin{array}{cccc} 20\% & \text{of} & \$597 & \\ \downarrow & \downarrow & \downarrow & \\ 0.20 & \cdot & \$597 & = \$119.40 \end{array}$$

The amount of the discount is \$119.40. The sale price is found by subtracting.

$\$597 - \$119.40 = \$477.60$

127. The portion of the circle graph showing the number of travelers from Canada is 26% of the circle. Find 26% of 76 million.

$$\begin{array}{cccc} 26\% & \text{of} & 76 \text{ million} & \\ \downarrow & \downarrow & \downarrow & \\ 0.26 & \cdot & 76 \text{ million} & = 19.76 \text{ million}, \end{array}$$

or approximately 19,760,000 travelers.

128. The portion of the circle graph showing the number of travelers from Mexico is 25% of the circle. Find 25% of 76 million.

$$\begin{array}{cccc} 25\% & \text{of} & 76 \text{ million} & \\ \downarrow & \downarrow & \downarrow & \\ 0.25 & \cdot & 76 \text{ million} & = 19 \text{ million}, \end{array}$$

or approximately 19,000,000 travelers.

129. First, find the portion of the circle graph that represents "Other."

$100\% - (26\% + 25\% + 19\% + 15\%) = 15\%$

The portion of the circle graph showing the number of travelers from "Other" countries is 15% of the circle.

130. The portion of the circle graph showing the number of travelers from "Other" countries is 15% of the circle. Find 15% of 76 million.

$$\begin{array}{cccc} 15\% & \text{of} & 76 \text{ million} & \\ \downarrow & \downarrow & \downarrow & \\ 0.15 & \cdot & 76 \text{ million} & = 11.4 \text{ million}, \end{array}$$

or approximately 11,400,000 travelers.

Chapter 1
The Real Number System

1.1 Exponents, Order of Operations, and Inequality

Classroom Examples, Now Try Exercises

1. **(a)** $9^2 = 9 \cdot 9 = 81$

(b) $\left(\frac{1}{2}\right)^4 = \underbrace{\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}}_{} = \frac{1}{16}$

$\frac{1}{2}$ is used as a factor 4 times.

(c) $(0.5)^2 = 0.5 \cdot 0.5 = 0.25$

N1. **(a)** $6^2 = 6 \cdot 6 = 36$

(b) $\left(\frac{4}{5}\right)^3 = \underbrace{\frac{4}{5} \cdot \frac{4}{5} \cdot \frac{4}{5}}_{} = \frac{64}{125}$

$\frac{4}{5}$ is used as a factor 3 times.

(c) $(0.7)^2 = 0.7 \cdot 0.7 = 0.49$

2. **(a)** $10 - 6 \div 2$

$= 10 - 3$ Divide.
$= 7$ Subtract.

(b) $18 + 2(6 - 3)$

$= 18 + 2(3)$ Subtract inside parentheses.
$= 18 + 6$ Multiply.
$= 24$ Add.

(c) $7 \cdot 6 - 3(8 + 1)$

$= 7 \cdot 6 - 3(9)$ Add inside parentheses.
$= 42 - 27$ Multiply.
$= 15$ Subtract.

(d) $2 + 3^2 - 5 \cdot 2$

$= 2 + 9 - 5 \cdot 2$ Apply exponents.
$= 2 + 9 - 10$ Multiply.
$= 11 - 10$ Add.
$= 1$ Subtract.

N2. **(a)** $15 - 2 \cdot 6$

$= 15 - 12$ Multiply.
$= 3$ Subtract.

(b) $8 + 2(5 - 1)$

$= 8 + 2(4)$ Subtract inside parentheses.
$= 8 + 8$ Multiply.
$= 16$ Add.

(c) $6(2 + 4) - 7 \cdot 5$

$= 6(6) - 7 \cdot 5$ Add inside parentheses.
$= 36 - 35$ Multiply.
$= 1$ Subtract.

(d) $8 \cdot 10 \div 4 - 2^3 + 3 \cdot 4^2$

$= 8 \cdot 10 \div 4 - 8 + 3 \cdot 16$ Apply exponents.
$= 80 \div 4 - 8 + 3 \cdot 16$ Multiply.
$= 20 - 8 + 48$ Divide/multiply.
$= 12 + 48$ Subtract.
$= 60$ Add.

3. **(a)** $9[36 - 2(4 + 8)]$

$= 9[36 - 2(12)]$ Add inside parentheses.
$= 9[36 - 24]$ Multiply inside brackets.
$= 9[12]$ Subtract inside brackets.
$= 108$ Multiply.

(b) $\frac{2(7 + 8) + 2}{3 \cdot 5 + 1}$

$= \frac{2(15) + 2}{3 \cdot 5 + 1}$ Add inside parentheses.
$= \frac{30 + 2}{15 + 1}$ Multiply.
$= \frac{32}{16}$ Add.
$= 2$ Divide.

N3. **(a)** $7[3(3 - 1) + 4]$

$= 7[3(2) + 4]$ Subtract inside parentheses.
$= 7[6 + 4]$ Multiply inside brackets.
$= 7[10]$ Add inside brackets.
$= 70$ Multiply.

(b) $\dfrac{9(14-4)-2}{4+3\cdot 6}$

$=\dfrac{9(10)-2}{4+3\cdot 6}$ Subtract inside parentheses.

$=\dfrac{90-2}{4+18}$ Multiply.

$=\dfrac{88}{22}$ Subtract and add.

$=4$ Divide.

4. **(a)** The statement $12>6$ is *true* because 12 is greater than 6. Note that the inequality symbol points to the lesser number.

(b) The statement $28\neq 4\cdot 7$ is *false* because 28 *is equal to* $4\cdot 7$.

(c) The statement $\dfrac{1}{10}\leq 0.1$ is *true* because

$\dfrac{1}{10}=0.1$

(d) Write the fractions with a common denominator. The statement $\dfrac{1}{3}<\dfrac{1}{4}$ is equivalent to the statement $\dfrac{4}{12}<\dfrac{3}{12}$. Because 4 is *greater* than 3, the original statement is *false.*

N4. **(a)** The statement $12\neq 10-2$ is *true* because 12 *is not equal to* 8.

(b) The statement $5>4\cdot 2$ is *false* because 5 *is less than* 8.

(c) The statement $\dfrac{1}{4}\leq 0.25$ is *true* because

$\dfrac{1}{4}=0.25$

(d) Write the fractions with a common denominator. The statement $\dfrac{5}{9}>\dfrac{7}{11}$ is equivalent to the statement $\dfrac{55}{99}>\dfrac{63}{99}$. Because 55 is *less* than 63, the original statement is *false.*

5. **(a)** "Nine is equal to eleven minus two" is written as $9=11-2$.

(b) "Fourteen is greater than twelve" is written as $14>12$.

(c) "Two is greater than or equal to two" is written as $2\geq 2$.

N5. **(a)** "Ten is not equal to eight minus two" is written as $10\neq 8-2$.

(b) "Fifty is greater than fifteen" is written as $50>15$.

(c) "Eleven is less than or equal to twenty" is written as $11\leq 20$.

6. $9\leq 15$ is equivalent to $15\geq 9$.

N6. $8<9$ is equivalent to $9>8$.

Exercises

1. False; $3^2=3\cdot 3=9$.

2. False; 1 raised to *any* power is 1. Here, $1^3=1\cdot 1\cdot 1=1$.

3. False; a number raised to the first power is that number, so $3^1=3$.

4. False; 6^2 means that 6 is used as a factor 2 times, so $6^2=6\cdot 6=36$.

5. False; the common error leading to 42 is adding 4 to 3 and then multiplying by 6. One must follow the rules for order of operations.

$4+3(8-2)$

$=4+3(6)$

$=4+18$

$=22$

6. False; multiplications and divisions are performed *in order from left to right.*

$12\div 2\cdot 3$

$=6\cdot 3$

$=18$

7. Additions and subtractions are performed in order from left to right.

$18\underbrace{-}_{1}2\underbrace{+}_{2}3$

8. Multiplications and divisions are performed in order from left to right, and then additions and subtractions are performed in order from left to right.

$28\underbrace{-}_{2}6\underbrace{\div}_{1}2$

9. Multiplications and divisions are performed in order from left to right, and then additions and subtractions are performed in order from left to right.
$\underbrace{2\cdot 8}_{1}\underbrace{-}_{3}6\underbrace{\div}_{2}3$

10. Multiplications and divisions are performed in order from left to right, and then additions and subtractions are performed in order from left to right. If grouping symbols are present, work within them first, starting with the innermost.
$40\underbrace{+}_{3}\underbrace{6(}_{2}3\underbrace{-}_{1}1)$

11. Multiplications and divisions are performed in order from left to right, and then additions and subtractions are performed in order from left to right. If grouping symbols are present, work within them first, starting with the innermost.
$\underbrace{3\cdot 5}_{2}\underbrace{-}_{4}\underbrace{2(}_{3}4\underbrace{+}_{1}2)$

12. Apply all exponents. Then, multiplications and divisions are performed in order from left to right, and additions and subtractions are performed in order from left to right.
$9\underbrace{-}_{3}\underbrace{2^3}_{1}\underbrace{+}_{4}3\underbrace{\cdot}_{2}4$

13. $7^2 = 7\cdot 7 = 49$

14. $8^2 = 8\cdot 8 = 64$

15. $12^2 = 12\cdot 12 = 144$

16. $14^2 = 14\cdot 14 = 196$

17. $4^3 = 4\cdot 4\cdot 4 = 64$

18. $5^3 = 5\cdot 5\cdot 5 = 125$

19. $10^3 = 10\cdot 10\cdot 10 = 1000$

20. $11^3 = 11\cdot 11\cdot 11 = 1331$

21. $3^4 = 3\cdot 3\cdot 3\cdot 3 = 81$

22. $6^4 = 6\cdot 6\cdot 6\cdot 6 = 1296$

23. $4^5 = 4\cdot 4\cdot 4\cdot 4\cdot 4 = 1024$

24. $3^5 = 3\cdot 3\cdot 3\cdot 3\cdot 3 = 243$

25. $\left(\frac{1}{6}\right)^2 = \frac{1}{6}\cdot\frac{1}{6} = \frac{1}{36}$

26. $\left(\frac{1}{3}\right)^2 = \frac{1}{3}\cdot\frac{1}{3} = \frac{1}{9}$

27. $\left(\frac{2}{3}\right)^4 = \frac{2}{3}\cdot\frac{2}{3}\cdot\frac{2}{3}\cdot\frac{2}{3} = \frac{16}{81}$

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

29. $(0.6)^2 = 0.6\cdot 0.6 = 0.36$

30. $(0.9)^2 = 0.9\cdot 0.9 = 0.81$

31. $(0.4)^3 = 0.4\cdot 0.4\cdot 0.4 = 0.064$

32. $(0.5)^4 = 0.5\cdot 0.5\cdot 0.5\cdot 0.5 = 0.0625$

33. The multiplication should be performed before the addition.
$8 + 2\cdot 3 = 8 + 6$ Multiply.
$= 14$ Add.
The correct value of the expression is 14.

34. When cubing 2, the correct value is $2\cdot 2\cdot 2 = 8$, *not* $2\cdot 3 = 6$.
$16 - 2^3 + 5 = 16 - 8 + 5$ Apply exponents.
$= 8 + 5$ Subtract.
$= 13$ Add.
The correct value of the expression is 13.

35. $64 \div 4\cdot 2 = 16\cdot 2$ Divide.
$= 32$ Multiply.

36. $250 \div 5\cdot 2 = 50\cdot 2$ Divide.
$= 100$ Multiply.

37. $13 + 9\cdot 5 = 13 + 45$ Multiply.
$= 58$ Add.

38. $11 + 7\cdot 6 = 11 + 42$ Multiply.
$= 53$ Add.

39. $25.2 - 12.6 \div 4.2 = 25.2 - 3$ Divide.
$= 22.2$ Subtract.

40. $12.4 - 9.3 \div 3.1 = 12.4 - 3$ Divide.
$= 9.4$ Subtract.

41. $9\cdot 4 - 8\cdot 3 = 36 - 24$ Multiply.
$= 12$ Subtract.

42. $11 \cdot 4 + 10 \cdot 3 = 44 + 30$ Multiply.
$= 74$ Add.

43. $\frac{1}{4} \cdot \frac{2}{3} + \frac{2}{5} \cdot \frac{11}{3} = \frac{1}{6} + \frac{22}{15}$ Multiply.
$= \frac{5}{30} + \frac{44}{30}$ LCD = 30
$= \frac{49}{30}$, or $1\frac{19}{30}$ Add.

44. $\frac{9}{4} \cdot \frac{2}{3} + \frac{4}{5} \cdot \frac{5}{3} = \frac{3}{2} + \frac{4}{3}$ Multiply.
$= \frac{9}{6} + \frac{8}{6}$ LCD = 6
$= \frac{17}{6}$, or $2\frac{5}{6}$ Add.

45. $20 - 4 \cdot 3 + 5 = 20 - 12 + 5$ Multiply.
$= 8 + 5$ Subtract.
$= 13$ Add.

46. $18 - 7 \cdot 2 + 6 = 18 - 14 + 6$ Multiply.
$= 4 + 6$ Subtract.
$= 10$ Add.

47. $10 + 40 \div 5 \cdot 2 = 10 + 8 \cdot 2$ Divide.
$= 10 + 16$ Multiply.
$= 26$ Add.

48. $12 + 64 \div 8 - 4 = 12 + 8 - 4$ Divide.
$= 20 - 4$ Add.
$= 16$ Subtract.

49. $18 - 2(3 + 4)$
$= 18 - 2(7)$ Add inside parentheses.
$= 18 - 14$ Multiply.
$= 4$ Subtract.

50. $30 - 3(4 + 2)$
$= 30 - 3(6)$ Add inside parentheses.
$= 30 - 18$ Multiply.
$= 12$ Subtract.

51. $3(4 + 2) + 8 \cdot 3 = 3 \cdot 6 + 8 \cdot 3$ Add.
$= 18 + 24$ Multiply.
$= 42$ Add.

52. $9(1 + 7) + 2 \cdot 5 = 9 \cdot 8 + 2 \cdot 5$ Add.
$= 72 + 10$ Multiply.
$= 82$ Add.

53. $18 - 4^2 + 3 = 18 - 16 + 3$ Apply exponents.
$= 2 + 3$ Subtract.
$= 5$ Add.

54. $22 - 2^3 + 9 = 22 - 8 + 9$ Apply exponents.
$= 14 + 9$ Subtract.
$= 23$ Add.

55. $2 + 3[5 + 4(2)] = 2 + 3[5 + 8]$ Multiply.
$= 2 + 3[13]$ Add.
$= 2 + 39$ Multiply.
$= 41$ Add.

56. $5 + 4[1 + 7(3)] = 5 + 4[1 + 21]$ Multiply.
$= 5 + 4[22]$ Add.
$= 5 + 88$ Multiply.
$= 93$ Add.

57. $5[3 + 4(2^2)] = 5[3 + 4(4)]$ Apply exponents.
$= 5(3 + 16)$ Multiply.
$= 5(19)$ Add.
$= 95$ Multiply.

58. $6[2 + 8(3^3)]$
$= 6[2 + 8 \cdot 27]$ Apply exponents.
$= 6(2 + 216)$ Multiply.
$= 6 \cdot 218$ Add.
$= 1308$ Multiply.

59. $3^2[(11 + 3) - 4]$
$= 3^2[14 - 4]$ Add inside parentheses.
$= 3^2[10]$ Subtract.
$= 9[10]$ Apply exponents.
$= 90$ Multiply.

60. $4^2[(13 + 4) - 8]$
$= 4^2[17 - 8]$ Add inside parentheses.
$= 4^2[9]$ Subtract.
$= 16[9]$ Apply exponents.
$= 144$ Multiply.

61. Simplify the numerator and denominator separately, and then divide.

$$\frac{6\left(3^2-1\right)+8}{8-2^2}=\frac{6(9-1)+8}{8-4}=\frac{6(8)+8}{4}=\frac{48+8}{4}=\frac{56}{4}=14$$

62. Simplify the numerator and denominator separately, and then divide.

$$\frac{2\left(8^2-4\right)+8}{29-3^3}=\frac{2(64-4)+8}{29-27}=\frac{2(60)+8}{2}=\frac{120+8}{2}=\frac{128}{2}=64$$

63. Simplify the numerator and denominator separately, and then divide.

$$\frac{4(6+2)+8(8-3)}{6(4-2)-2^2}=\frac{4(8)+8(5)}{6(2)-2^2}=\frac{4(8)+8(5)}{6(2)-4}=\frac{32+40}{12-4}=\frac{72}{8}=9$$

64. Simplify the numerator and denominator separately, and then divide.

$$\frac{6(5+1)-9(1+1)}{5(8-6)-2^3}=\frac{6(6)-9(2)}{5(2)-2^3}=\frac{36-18}{10-8}=\frac{18}{2}=9$$

65. $3\cdot 6+4\cdot 2=60$

Listed below are some possibilities. Use trial and error until you get the desired result.

$(3\cdot 6)+4\cdot 2=18+8=26\neq 60$

$(3\cdot 6+4)\cdot 2=22\cdot 2=44\neq 60$

$3\cdot(6+4\cdot 2)=3\cdot 14=42\neq 60$

$3\cdot(6+4)\cdot 2=3\cdot 10\cdot 2=30\cdot 2=60$

66. $2\cdot 8-1\cdot 3=42$

$2\cdot(8-1)\cdot 3=2\cdot 7\cdot 3=14\cdot 3=42$

67. $10-7-3=6$

$10-(7-3)=10-4=6$

68. $8+2^2=100$

$(8+2)^2=10^2=10\cdot 10=100$

69. $9\cdot 3-11\leq 16$

$27-11\leq 16$

$16\leq 16$

The statement is true since $16=16$.

70. $6\cdot 5-12\leq 18$

$30-12\leq 18$

$18\leq 18$

The statement is true since $18=18$.

71. $5\cdot 11+2\cdot 3\leq 60$

$55+6\leq 60$

$61\leq 60$

The statement is false since 61 *is greater than* 60.

72. $9\cdot 3+4\cdot 5\geq 48$

$27+20\geq 48$

$47\geq 48$

The statement is false since 47 *is less than* 48.

73. $0\geq 12\cdot 3-6\cdot 6$

$0\geq 36-36$

$0\geq 0$

The statement is true since $0=0$.

74. $10\leq 13\cdot 2-15\cdot 1$

$10\leq 26-15$

$10\leq 11$

The statement is true since $10<11$.

75. $45\geq 2[2+3(2+5)]$

$45\geq 2[2+3(7)]$

$45\geq 2[2+21]$

$45\geq 2[23]$

$45\geq 46$

The statement is false since 45 *is less than* 46.

76. $55 \geq 3[4+3(4+1)]$
$55 \geq 3[4+3(5)]$
$55 \geq 3[4+15]$
$55 \geq 3[19]$
$55 \geq 57$
The statement is false since 55 *is less than* 57.

77. $[3 \cdot 4+5(2)] \cdot 3 > 72$
$[12+10] \cdot 3 > 72$
$[22] \cdot 3 > 72$
$66 > 72$
The statement is false since 66 *is less than* 72.

78. $2 \cdot [7 \cdot 5-3(2)] \leq 58$
$2 \cdot [35-6] \leq 58$
$2[29] \leq 58$
$58 \leq 58$
The statement is true since $58 = 58$.

79. $\frac{3+5(4-1)}{2 \cdot 4+1} \geq 3$
$\frac{3+5(3)}{8+1} \geq 3$
$\frac{3+15}{9} \geq 3$
$\frac{18}{9} \geq 3$
$2 \geq 3$
The statement is false since 2 *is less than* 3.

80. $\frac{7(3+1)-2}{3+5 \cdot 2} \leq 2$
$\frac{7(4)-2}{3+10} \leq 2$
$\frac{28-2}{13} \leq 2$
$\frac{26}{13} \leq 2$
$2 \leq 2$
The statement is true since $2 = 2$.

81. $3 \geq \frac{2(5+1)-3(1+1)}{5(8-6)-4 \cdot 2}$
$3 \geq \frac{2(6)-3(2)}{5(2)-8}$
$3 \geq \frac{12-6}{10-8}$
$3 \geq \frac{6}{2}$
$3 \geq 3$
The statement is true since $3 = 3$.

82. $7 \leq \frac{3(8-3)+2(4-1)}{9(6-2)-11(5-2)}$
$7 \leq \frac{3(5)+2(3)}{9(4)-11(3)}$
$7 \leq \frac{15+6}{36-33}$
$7 \leq \frac{21}{3}$
$7 \leq 7$
The statement is true since $7 = 7$.

83. "$5 < 17$" means "five is less than seventeen." The statement is true.

84. "$8 < 12$" means "eight is less than twelve." The statement is true.

85. "$5 \neq 8$" means "five is not equal to eight." The statement is true.

86. "$6 \neq 9$" means "six is not equal to nine." The statement is true.

87. "$7 \geq 14$" means "seven is greater than or equal to fourteen." The statement is false.

88. "$6 \geq 12$" means "six is greater than or equal to twelve." The statement is false.

89. "$15 \leq 15$" means "fifteen is less than or equal to fifteen." The statement is true.

90. "$21 \leq 21$" means "twenty-one is less than or equal to twenty-one." The statement is true.

91. "$\frac{1}{3} = \frac{3}{10}$" means "one-third is equal to three-tenths." The statement is false.

92. "$\frac{10}{6} = \frac{3}{2}$" means "ten-sixths is equal to three-halves." The statement is false.

93. "$2.5 > 2.50$" means "two and five-tenths is greater than two and fifty-hundredths." The statement is false.

94. "$1.80 > 1.8$" means "one and eighty-hundredths is greater than one and eight-tenths." The statement is false.

95. "Fifteen is equal to five plus ten" is written as $15 = 5 + 10$.

96. "Twelve is equal to twenty minus eight" is written as $12 = 20 - 8$.

97. "Nine is greater than five minus four" is written as $9 > 5 - 4$.

98. "Ten is greater than six plus one" is written as $10 > 6 + 1$.

99. "Sixteen is not equal to nineteen" is written as $16 \neq 19$.

100. "Three is not equal to four" is written as $3 \neq 4$.

101. "One-half is less than or equal to two-fourths" is written as $\frac{1}{2} \leq \frac{2}{4}$.

102. "One-third is less than or equal to three-ninths" is written as $\frac{1}{3} \leq \frac{3}{9}$.

103. $5 < 20$ becomes $20 > 5$ when the inequality symbol is reversed.

104. $30 > 9$ becomes $9 < 30$ when the inequality symbol is reversed.

105. $\frac{4}{5} > \frac{3}{4}$ becomes $\frac{3}{4} < \frac{4}{5}$ when the inequality symbol is reversed.

106. $\frac{5}{4} < \frac{3}{2}$ becomes $\frac{3}{2} > \frac{5}{4}$ when the inequality symbol is reversed.

107. $2.5 \geq 1.3$ becomes $1.3 \leq 2.5$ when the inequality symbol is reversed.

108. $4.1 \leq 5.3$ becomes $5.3 \geq 4.1$ when the inequality symbol is reversed.

109. **(a)** Substitute "40" for "age" in the expression for women.
$14.7 - 40 \cdot 0.13$

(b)
$$\begin{aligned} 14.7 - 40 \cdot 0.13 &= 14.7 - 5.2 && \text{Multiply.} \\ &= 9.5 && \text{Subtract.} \end{aligned}$$

(c) 85% of 9.5 is $0.85(9.5) = 8.075$.
Walking at 5 mph is associated with 8.0 METs, which is the table value closest to 8.075.

(d) Substitute "55" for "age" in the expression for men.
$14.7 - 55 \cdot 0.11$

$$\begin{aligned} 14.7 - 55 \cdot 0.11 &= 14.7 - 6.05 && \text{Multiply.} \\ &= 8.65 && \text{Subtract.} \end{aligned}$$

85% of 8.65 is $0.85(8.65) = 7.3525$.
Swimming is associated with 7.0 METs, which is the table value closest to 7.3525.

110. Answers will vary.

111. The states that had a number greater than 12.6 are Alaska (16.4), Texas (15.2), California (22.5), and Idaho (19.7).

112. The states that had a number that was at most 15.2 are Texas (15.2), Virginia (12.6), Maine (12.4), and Missouri (12.1).

113. The states that had a number *not* less than 12.6, which is the same as greater than or equal to 12.6, are Alaska (16.4), Texas (15.2), California (22.5), Virginia (12.6), and Idaho (19.7).

114. The states that had a number less than 13.0 are Virginia (12.6), Maine (12.4), and Missouri (12.1).

1.2 Variables, Expressions, and Equations

Classroom Examples, Now Try Exercises

1. **(a)**
$$\begin{aligned} 16p - 8 &= 16 \cdot 3 - 8 && \text{Replace } p \text{ with 3.} \\ &= 48 - 8 && \text{Multiply.} \\ &= 40 && \text{Subtract.} \end{aligned}$$

(b)
$$\begin{aligned} 2p^3 &= 2 \cdot 3^3 && \text{Replace } p \text{ with 3.} \\ &= 2 \cdot 27 && \text{Cube 3.} \\ &= 54 && \text{Multiply.} \end{aligned}$$

N1. **(a)**
$$\begin{aligned} 9x - 5 &= 9 \cdot 6 - 5 && \text{Replace } x \text{ with 6.} \\ &= 54 - 5 && \text{Multiply.} \\ &= 49 && \text{Subtract.} \end{aligned}$$

(b)
$$\begin{aligned} 4x^2 &= 4 \cdot 6^2 && \text{Replace } x \text{ with 6.} \\ &= 4 \cdot 36 && \text{Square 6.} \\ &= 144 && \text{Multiply.} \end{aligned}$$

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

$=24+45$ Multiply.

$=69$ Add.

(b) $\frac{4x-2y}{x+1}=\frac{4\cdot 6-2\cdot 9}{6+1}$

$=\frac{24-18}{6+1}$ Multiply.

$=\frac{6}{7}$ Subtract and add.

(c) $2x^2+y^2=2\cdot 6^2+9^2$

$=2\cdot 36+81$ Use exponents.

$=72+81$ Multiply.

$=153$ Add.

N2. **(a)** $3x+4y=3\cdot 4+4\cdot 7$

$=12+28$ Multiply.

$=40$ Add.

(b) $\frac{6x-2y}{2y-9}=\frac{6\cdot 4-2\cdot 7}{2\cdot 7-9}$

$=\frac{24-14}{14-9}$ Multiply.

$=\frac{10}{5}=2$ Subtract; reduce.

(c) $4x^2-y^2=4\cdot 4^2-7^2$

$=4\cdot 16-49$ Use exponents.

$=64-49$ Multiply.

$=15$ Subtract.

3. **(a)** "The difference of" indicates subtraction. Using *x* as the variable to represent the number, "the difference of 48 and a number" translates as $48-x$.

(b) "Divided by" indicates division. Using *x* as the variable to represent the number, "6 divided by a number" translates as $6\div x$ or $\frac{6}{x}$.

(c) "The sum of a number and 5" suggests a number plus 5. Using *x* as the variable to represent the number, "9 multiplied by the sum of a number and 5" translates as $9(x+5)$.

N3. **(a)** Using *x* as the variable to represent the number, "the sum of a number and 10" translates as $x+10$, or $10+x$.

(b) "A number divided by 7" translates as $x\div 7$, or $\frac{x}{7}$.

(c) "The difference between 9 and a number" translates as $9-x$. Thus, "the product of 3 and the difference between 9 and a number" translates as $3(9-x)$.

4. **(a)** $8p-10=5$

$8\cdot 2-10\stackrel{?}{=}5$ Replace *p* with 2.

$16-10\stackrel{?}{=}5$ Multiply.

$6=5$ False

The number 2 is not a solution of the equation.

(b) $0.1(x+3)=0.8$

$0.1(5+3)\stackrel{?}{=}0.8$ Replace *x* with 5.

$0.1(8)\stackrel{?}{=}0.8$ Add.

$0.8=0.8$ True

The number 5 is a solution of the equation.

N4. $8k+5=61$

$8\cdot 7+5\stackrel{?}{=}61$ Replace *k* with 7.

$56+5\stackrel{?}{=}61$ Multiply.

$61=61$ True

The number 7 is a solution of the equation.

5. Using *x* as the variable to represent the number, "three times a number is subtracted from 21, giving 15" translates as $21-3x=15$. Now try each number from the set {0, 2, 4, 6, 8, 10}.

$x=0:\quad 21-3(0)\stackrel{?}{=}15$

$21=15$ False

$x=2:\quad 21-3(2)\stackrel{?}{=}15$

$15=15$ True

$x=4:\quad 21-3(4)\stackrel{?}{=}15$

$9=15$ False

Similarly, $x=6, 8,$ or 10 result in false statements. Thus, 2 is the only solution.

N5. Using x as the variable to represent the number, "the sum of a number and nine is equal to the difference between 25 and the number" translates as $x+9=25-x$. Now try each number from the set {0, 2, 4, 6, 8, 10}.

$x=4$: $4+9\overset{?}{=}25-4$
$13=21$ False

$x=6$: $6+9\overset{?}{=}25-6$
$15=19$ False

$x=8$: $8+9\overset{?}{=}25-8$
$17=17$ True

Similarly, $x=0, 2,$ or 10 result in false statements. Thus, 8 is the only solution.

6. **(a)** $\frac{3x-1}{5}$ has no equality symbol, so this is an expression.

(b) $\frac{3x}{5}=1$ has an equality symbol, so this is an equation.

N6. **(a)** $2x+5=6$ has an equality symbol, so this is an equation.

(b) $2x+5-6$ has no equality symbol, so this is an expression.

Exercises

1. The expression $8x^2$ means $8\cdot x\cdot x$. The correct choice is B.

2. If $x=2$ and $y=1$, then the value of xy is $2\cdot 1=2$. The correct choice is C.

3. The sum of 15 and a number x is represented by the expression $15+x$. The correct choice is A.

4. 7 less than a number x is represented by the expression $x-7$. The correct choice is D.

5. Try each number in the equation $3x-1=5$.

$x=0$: $3\cdot 0-1\overset{?}{=}5$
$0-1\overset{?}{=}5$
$-1=5$ False

$x=2$: $3\cdot 2-1\overset{?}{=}5$
$6-1\overset{?}{=}5$
$5=5$ False

6. There is no equality symbol in $6x+7$ or $6x-7$, so those are expressions. $6x=7$ and $6x-7=0$ have equality symbols, so those are equations.

7. The exponent refers only to the 4.

$$\begin{aligned} 5x^2 &= 5\cdot 4^2 \\ &= 5\cdot 16 \\ &= 80 \end{aligned}$$

The correct value is 80.

8. Addition in the numerator comes before division.

$$\begin{aligned} \frac{x+3}{5} &= \frac{10+3}{5} \\ &= \frac{13}{5} \end{aligned}$$

The correct value is $\frac{13}{5}$.

9. **(a)** $x+7=4+7$
$=11$

(b) $x+7=6+7$
$=13$

10. **(a)** $x-3=4-3$
$=1$

(b) $x-3=6-3$
$=3$

11. **(a)** $4x=4\cdot 4=16$

(b) $4x=4\cdot 6=24$

12. **(a)** $6x=6\cdot 4=24$

(b) $6x=6\cdot 6=36$

13. **(a)** $5x-4=5\cdot 4-4$
$=20-4$
$=16$

(b) $5x-4=5\cdot 6-4$
$=30-4$
$=26$

14. **(a)** $7x-9=7\cdot 4-9$
$=28-9$
$=19$

(b) $7x-9=7\cdot 6-9$
$=42-9$
$=33$

15. **(a)** $4x^2 = 4 \cdot 4^2 = 4 \cdot 16 = 64$

(b) $4x^2 = 4 \cdot 6^2 = 4 \cdot 36 = 144$

16. **(a)** $5x^2 = 5 \cdot 4^2 = 5 \cdot 16 = 80$

(b) $5x^2 = 5 \cdot 6^2 = 5 \cdot 36 = 180$

17. **(a)** $\frac{x+1}{3} = \frac{4+1}{3} = \frac{5}{3}$

(b) $\frac{x+1}{3} = \frac{6+1}{3} = \frac{7}{3}$

18. **(a)** $\frac{x+2}{5} = \frac{4+2}{5} = \frac{6}{5}$

(b) $\frac{x+2}{5} = \frac{6+2}{5} = \frac{8}{5}$

19. **(a)** $\frac{3x-5}{2x} = \frac{3 \cdot 4 - 5}{2 \cdot 4} = \frac{12-5}{8} = \frac{7}{8}$

(b) $\frac{3x-5}{2x} = \frac{3 \cdot 6 - 5}{2 \cdot 6} = \frac{18-5}{12} = \frac{13}{12}$

20. **(a)** $\frac{4x-1}{3x} = \frac{4 \cdot 4 - 1}{3 \cdot 4} = \frac{16-1}{12} = \frac{15}{12} = \frac{5}{4}$

(b) $\frac{4x-1}{3x} = \frac{4 \cdot 6 - 1}{3 \cdot 6} = \frac{24-1}{18} = \frac{23}{18}$

21. **(a)** $3x^2 + x = 3 \cdot 4^2 + 4 = 3 \cdot 16 + 4 = 48 + 4 = 52$

(b) $3x^2 + x = 3 \cdot 6^2 + 6 = 3 \cdot 36 + 6 = 108 + 6 = 114$

22. **(a)** $2x + x^2 = 2 \cdot 4 + 4^2 = 8 + 16 = 24$

(b) $2x + x^2 = 2 \cdot 6 + 6^2 = 12 + 36 = 48$

23. **(a)** $6.459x = 6.459 \cdot 4 = 25.836$

(b) $6.459x = 6.459 \cdot 6 = 38.754$

24. **(a)** $3.275x = 3.275 \cdot 4 = 13.1$

(b) $3.275x = 3.275 \cdot 6 = 19.65$

25. **(a)** $8x + 3y + 5 = 8 \cdot 2 + 3 \cdot 1 + 5 = 16 + 3 + 5 = 19 + 5 = 24$

(b) $8x + 3y + 5 = 8 \cdot 1 + 3 \cdot 5 + 5 = 8 + 15 + 5 = 23 + 5 = 28$

26. **(a)** $4x+2y+7=4(2)+2(1)+7$
$=8+2+7$
$=17$

(b) $4x+2y+7=4(1)+2(5)+7$
$=4+10+7$
$=21$

27. **(a)** $3(x+2y)=3(2+2\cdot 1)$
$=3(2+2)$
$=3(4)$
$=12$

(b) $3(x+2y)=3(1+2\cdot 5)$
$=3(1+10)$
$=3(11)$
$=33$

28. **(a)** $2(2x+y)=2\left[2(2)+1\right]$
$=2(4+1)$
$=2(5)$
$=10$

(b) $2(2x+y)=2\left[2(1)+5\right]$
$=2(2+5)$
$=2(7)$
$=14$

29. **(a)** $x+\frac{4}{y}=2+\frac{4}{1}$
$=2+4$
$=6$

(b) $x+\frac{4}{y}=1+\frac{4}{5}$
$=\frac{5}{5}+\frac{4}{5}$
$=\frac{9}{5}$

30. **(a)** $y+\frac{8}{x}=1+\frac{8}{2}$
$=1+4$
$=5$

(b) $y+\frac{8}{x}=5+\frac{8}{1}$
$=5+8$
$=13$

31. **(a)** $\frac{x}{2}+\frac{y}{3}=\frac{2}{2}+\frac{1}{3}$
$=\frac{6}{6}+\frac{2}{6}$
$=\frac{8}{6}=\frac{4}{3}$

(b) $\frac{x}{2}+\frac{y}{3}=\frac{1}{2}+\frac{5}{3}$
$=\frac{3}{6}+\frac{10}{6}$
$=\frac{13}{6}$

32. **(a)** $\frac{x}{5}+\frac{y}{4}=\frac{2}{5}+\frac{1}{4}$
$=\frac{8}{20}+\frac{5}{20}$
$=\frac{13}{20}$

(b) $\frac{x}{5}+\frac{y}{4}=\frac{1}{5}+\frac{5}{4}$
$=\frac{4}{20}+\frac{25}{20}$
$=\frac{29}{20}$

33. **(a)** $\frac{2x+4y}{5x+2y}=\frac{2\cdot 2+4\cdot 1}{5\cdot 2+2\cdot 1}$
$=\frac{4+4}{10+2}$
$=\frac{8}{12}$
$=\frac{2}{3}$

(b) $\frac{2x+4y}{5x+2y}=\frac{2\cdot 1+4\cdot 5}{5\cdot 1+2\cdot 5}$
$=\frac{2+20}{5+10}$
$=\frac{22}{15}$

34. **(a)** $\frac{7x+5y}{8x+y} = \frac{7(2)+5(1)}{8(2)+1}$

$= \frac{14+5}{16+1}$

$= \frac{19}{17}$

(b) $\frac{7x+5y}{8x+y} = \frac{7(1)+5(5)}{8(1)+5}$

$= \frac{7+25}{8+5}$

$= \frac{32}{13}$

35. **(a)** $3x^2 + y^2 = 3\cdot 2^2 + 1^2$

$= 3\cdot 4 + 1$

$= 12 + 1$

$= 13$

(b) $3x^2 + y^2 = 3\cdot 1^2 + 5^2$

$= 3\cdot 1 + 25$

$= 3 + 25$

$= 28$

36. **(a)** $4x^2 + 2y^2 = 4\cdot 2^2 + 2\cdot 1^2$

$= 4\cdot 4 + 2\cdot 1$

$= 16 + 2$

$= 18$

(b) $4x^2 + 2y^2 = 4\cdot 1^2 + 2\cdot 5^2$

$= 4\cdot 1 + 2\cdot 25$

$= 4 + 50$

$= 54$

37. **(a)** $\frac{3x+y^2}{2x+3y} = \frac{3\cdot 2+1^2}{2\cdot 2+3\cdot 1}$

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

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

$= \frac{7}{7}$

$= 1$

(b) $\frac{3x+y^2}{2x+3y} = \frac{3\cdot 1+5^2}{2\cdot 1+3\cdot 5}$

$= \frac{3\cdot 1+25}{2+15}$

$= \frac{3+25}{17}$

$= \frac{28}{17}$

38. **(a)** $\frac{x^2+1}{4x+5y} = \frac{2^2+1}{4(2)+5(1)}$

$= \frac{4+1}{8+5}$

$= \frac{5}{13}$

(b) $\frac{x^2+1}{4x+5y} = \frac{1^2+1}{4(1)+5(5)}$

$= \frac{1+1}{4+25}$

$= \frac{2}{29}$

39. **(a)** $0.841x^2 + 0.32y^2$

$= 0.841\cdot 2^2 + 0.32\cdot 1^2$

$= 0.841\cdot 4 + 0.32\cdot 1$

$= 3.364 + 0.32$

$= 3.684$

(b) $0.841x^2 + 0.32y^2$

$= 0.841\cdot 1^2 + 0.32\cdot 5^2$

$= 0.841\cdot 1 + 0.32\cdot 25$

$= 0.841 + 8$

$= 8.841$

40. **(a)** $0.941x^2 + 0.25y^2$

$= 0.941(2)^2 + 0.25(1)^2$

$= 0.941(4) + 0.25(1)$

$= 3.764 + 0.25$

$= 4.014$

(b) $0.941x^2 + 0.25y^2$

$= 0.941(1)^2 + 0.25(5)^2$

$= 0.941(1) + 0.25(25)$

$= 0.941 + 6.25$

$= 7.191$

41. "Twelve times a number" translates as $12 \cdot x$, or $12x$.

42. "Fifteen times a number" translates as $15 \cdot x$, or $15x$.

43. "Added to" indicates addition. "Nine added to a number" translates as $x+9$.

44. "Six added to a number" translates as $x+6$.

45. "Two subtracted from a number" translates as $x-2$.

46. "Seven subtracted from a number" translates as $x-7$.

47. "A number subtracted from seven" translates as $7-x$.

48. "A number subtracted from four" translates as $4-x$.

49. "The difference between a number and 8" translates as $x-8$.

50. "The difference between 8 and a number" translates as $8-x$.

51. "18 divided by a number" translates as $\frac{18}{x}$.

52. "A number divided by 18" translates as $\frac{x}{18}$.

53. "The product of 6 and four less than a number" translates as $6(x-4)$.

54. "The product of 9 and five more than a number" translates as $9(x+5)$.

55. $4m+2=6; 1$

$$4 \cdot 1 + 2 \stackrel{?}{=} 6 \qquad \text{Let } m=1.$$
$$4+2 \stackrel{?}{=} 6$$
$$6=6 \qquad \text{True}$$

Because substituting 1 for m results in a true statement, 1 is a solution of the equation.

56. $2r+6=8; 1$

$$2(1)+6 \stackrel{?}{=} 8 \qquad \text{Let } r=1.$$
$$2+6 \stackrel{?}{=} 8$$
$$8=8 \qquad \text{True}$$

The true result shows that 1 is a solution of the equation.

57. $2y+3(y-2)=14; 3$

$$2 \cdot 3+3(3-2) \stackrel{?}{=} 14 \qquad \text{Let } y=3.$$
$$2 \cdot 3+3 \cdot 1 \stackrel{?}{=} 14$$
$$6+3 \stackrel{?}{=} 14$$
$$9=14 \qquad \text{False}$$

Because substituting 3 for y results in a false statement, 3 is not a solution of the equation.

58. $6x+2(x+3)=14; 2$

$$6(2)+2(2+3) \stackrel{?}{=} 14 \qquad \text{Let } x=2.$$
$$6(2)+2(5) \stackrel{?}{=} 14$$
$$12+10 \stackrel{?}{=} 14$$
$$22=14 \qquad \text{False}$$

The false result shows that 2 is not a solution of the equation.

59. $6p+4p+9=11; \frac{1}{5}$

$$6 \cdot \frac{1}{5}+4 \cdot \frac{1}{5}+9 \stackrel{?}{=} 11 \qquad \text{Let } p=\frac{1}{5}.$$
$$\frac{6}{5}+\frac{4}{5}+9 \stackrel{?}{=} 11$$
$$\frac{10}{5}+9 \stackrel{?}{=} 11$$
$$2+9 \stackrel{?}{=} 11$$
$$11=11 \qquad \text{True}$$

The true result shows that $\frac{1}{5}$ is a solution of the equation.

60. $2x+3x+8=20; \frac{12}{5}$

$$2\left(\frac{12}{5}\right)+3\left(\frac{12}{5}\right)+8 \stackrel{?}{=} 20 \qquad \text{Let } x=\frac{12}{5}.$$
$$\frac{24}{5}+\frac{36}{5}+\frac{40}{5} \stackrel{?}{=} 20$$
$$\frac{100}{5} \stackrel{?}{=} 20$$
$$20=20 \qquad \text{True}$$

The true result shows that $\frac{12}{5}$ is a solution of the equation.

61. $3r^2 - 2 = 46;\ 4$

$3 \cdot 4^2 - 2 \stackrel{?}{=} 46$ Let $r = 4$.

$3 \cdot 16 - 2 \stackrel{?}{=} 46$

$48 - 2 \stackrel{?}{=} 46$

$46 = 46$ True

The true result shows that 4 is a solution of the equation.

62. $2x^2 + 1 = 19;\ 3$

$2(3)^2 + 1 \stackrel{?}{=} 19$ Let $x = 3$.

$2 \cdot 9 + 1 \stackrel{?}{=} 19$

$18 + 1 \stackrel{?}{=} 19$

$19 = 19$ True

The true result shows that 3 is a solution of the equation.

63. $\frac{3}{8}x + \frac{1}{4} = 1;\ 2$

$\frac{3}{8} \cdot 2 + \frac{1}{4} \stackrel{?}{=} 1$ Let $x = 2$.

$\frac{3}{4} + \frac{1}{4} \stackrel{?}{=} 1$

$1 = 1$ True

The true result shows that 2 is a solution of the equation.

64. $\frac{7}{10}x + \frac{1}{2} = 4;\ 5$

$\frac{7}{10}(5) + \frac{1}{2} \stackrel{?}{=} 4$ Let $x = 5$.

$\frac{7}{2} + \frac{1}{2} \stackrel{?}{=} 4$

$4 = 4$ True

The true result shows that 5 is a solution of the equation.

65. $0.5(x - 4) = 80;\ 20$

$0.5(20 - 4) \stackrel{?}{=} 80$ Let $x = 20$.

$0.5(16) \stackrel{?}{=} 80$

$8 = 80$ False

The false result shows that 20 is not a solution of the equation.

66. $0.2(x - 5) = 70;\ 40$

$0.2(40 - 5) \stackrel{?}{=} 70$ Let $x = 40$.

$0.2(35) \stackrel{?}{=} 70$

$7 = 70$ False

The false result shows that 40 is not a solution of the equation.

67. "The sum of a number and 8 is 18" translates as $x + 8 = 18$. Try each number from the given set, {2, 4, 6, 8, 10}, in turn.

$x + 8 = 18$ Given equation

$2 + 8 = 18$ False

$4 + 8 = 18$ False

$6 + 8 = 18$ False

$8 + 8 = 18$ False

$10 + 8 = 18$ True

The only solution is 10.

68. "A number minus three equals 1" translates as $x - 3 = 1$. Replace x with each number in the given set. The only true statement results when $x = 4$, since $4 - 3 = 1$. Thus, 4 is the only solution.

69. "One more than twice a number is 5" translates as $2x + 1 = 5$. Try each number from the given set. The only resulting true equation is $2 \cdot 2 + 1 = 5$, so the only solution is 2.

70. "The product of a number and 3 is 6" translates as $3x = 6$. The only true statement results when $x = 2$, since, $3 \cdot 2 = 6$. Thus, 2 is the only solution.

71. "Sixteen minus three-fourths of a number is 13" translates as $16 - \frac{3}{4}x = 13$. Try each number from the given set, {2, 4, 6, 8, 10}, in turn.

$16 - \frac{3}{4}x = 13$ Given equation

$16 - \frac{3}{4}(2) = 13$ False

$16 - \frac{3}{4}(4) = 13$ True

$16 - \frac{3}{4}(6) = 13$ False

$16 - \frac{3}{4}(8) = 13$ False

$16 - \frac{3}{4}(10) = 13$ False

The only solution is 4.

72. "The sum of six-fifths of a number and 2 is 14" translates as $\frac{6}{5}x+2=14$. Replace *x* with each number in the given set. The only true statement results as follows.

$\frac{6}{5}(10)+2\stackrel{?}{=}14$ Let $x=10$.

$12+2\stackrel{?}{=}14$

$14=14$ True

The only solution is 10.

73. "Three times a number is equal to 8 more than twice the number" translates as $3x=2x+8$. Try each number from the given set.

$3x=2x+8$ Given equation

$3(2)=2(2)+8$ False

$3(4)=2(4)+8$ False

$3(6)=2(6)+8$ False

$3(8)=2(8)+8$ True

$3(10)=2(10)+8$ False

The only solution is 8.

74. "Twelve divided by a number equals $\frac{1}{3}$ times that number" translates as $\frac{12}{x}=\frac{1}{3}x$. The only true statement results as follows.

$\frac{12}{6}\stackrel{?}{=}\frac{1}{3}(6)$ Let $x=6$.

$2=2$ True

The only solution is 6.

75. There is no equality symbol, so $3x+2(x-4)$ is an expression.

76. There is no equality symbol, so $8y-(3y+5)$ is an expression.

77. There is an equality symbol, so $7t+2(t+1)=4$ is an equation.

78. There is an equality symbol, so $9r+3(r-4)=2$ is an equation.

79. There is an equality symbol, so $x+y=9$ is an equation.

80. There is no equality symbol, so $x+y-9$ is an expression.

81. $y=0.157x-237$
$=0.157\cdot 1990-237$
$=75.43$

The life expectancy of an American born in 1990 is about 75 years.

82. $y=0.157x-237$
$=0.157(1995)-237$
$=76.215$

The life expectancy of an American born in 1995 is about 76 years.

83. $y=0.157x-237$
$=0.157\cdot 2005-237$
$=77.785$

The life expectancy of an American born in 2005 is about 78 years.

84. $y=0.157x-237$
$=0.157(2015)-237$
$=79.355$

The life expectancy of an American born in 2015 is about 79 years.

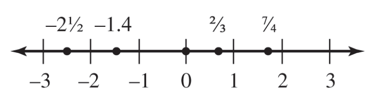
1.3 Real Numbers and the Number Line

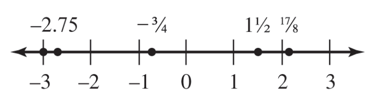
Classroom Examples, Now Try Exercises

1. **(a)** Since Erin spends $53 more than she has in her checking account, her balance is -53.

(b) Since the record high was 134° above zero, this temperature is expressed as 134°.

N1. Since the deepest point is below the water's surface, the depth is -136.

2.


N2.


3. **(a)** The whole number is 0.

(b) The integers are -5 and 0.

(c) The rational numbers are $-5, -1\frac{3}{5}\left(\text{or } -\frac{8}{5}\right)$, $0\left(\text{or } \frac{0}{1}\right)$, $0.\overline{45}\left(\text{or } \frac{5}{11}\right)$, and $\frac{5}{8}$ since each can be written as the quotient of integers.

(d) The irrational numbers are $-\pi$ and $\sqrt{11}$.

N3. **(a)** The whole numbers are 0 and 13.

(b) The integers are $-7,\ 0,$ and 13.

(c) The rational numbers are $-7, -\frac{4}{5}, 0, 2.7,$ and 13.

(d) The irrational numbers are $\sqrt{3}$ and π.

4. Since -4 lies to the left of -1 on the number line, -4 is less than -1. Therefore, the statement $-4 \geq -1$ is *false.*

N4. Since -8 lies to the right of -9 on the number line, -8 is greater than -9. Therefore, the statement $-8 \leq -9$ is *false*.

5. **(a)** $|32| = 32$

(b) $|-32| = -(-32) = 32$

(c) $-|-32| = -[-(-32)] = -32$

(d) $-|32-2| = -|30| = -30$

N5. **(a)** $|4| = 4$

(b) $|-4| = -(-4) = 4$

(c) $-|-4| = -(4) = -4$

(d) $|4-4| = |0| = 0$

6. The largest positive percent increase from 2013 to 2014 is 2.6, so the category is Housing.

N6. The category Transportation is negative in both years.

Exercises

1. The number <u>0</u> is a whole number, but not a natural number.

2. The natural numbers, their additive inverses, and 0 form the set of <u>integers</u>.

3. The additive inverse of every negative number is a *positive* number.

4. If x and y are real numbers with $x > y$, then x lies to the *right* of y on a number line.

5. A rational number is the <u>quotient</u> of two integers with the <u>denominator</u> not equal to 0.

6. Decimal numbers that neither terminate nor repeat are <u>irrational</u> numbers.

7. The additive inverse of -5 is <u>5</u>, while the additive inverse of the absolute value of -5 is <u>-5</u>.

8. If a is negative, then $|a| = \underline{-a}$.

9. **(a)** $|-9| = 9$ A

The distance between -9 and 0 on the number line is 9 units.

(b) $-(-9) = 9$ A

The opposite of -9 is 9.

(c) $-|-9| = -(9) = -9$ B

(d)
$$\begin{aligned} -|-(-9)| &= -|9| \\ &= -(9) \\ &= -9 \quad \text{(B)} \end{aligned}$$

10. The statement "Absolute value is always positive" is not true. The absolute value of 0 is 0, and 0 is not positive. We could say that absolute value is never negative, or absolute value is always nonnegative.

11. The only integer between 3.6 and 4.6 is 4.

12. A rational number between 2.8 and 2.9 is 2.85. There are others.

13. There is only one whole number that is not positive and that is less than 1: the number 0.

14. A whole number greater than 3.5 is 4. There are others.

15. An irrational number that is between $\sqrt{12}$ and $\sqrt{14}$ is $\sqrt{13}$. There are others.

16. The only real number that is neither negative nor positive is 0.

17. True; every natural number is positive.

18. False; 0 is a whole number that is not positive. In fact, it is the *only* whole number that is not positive.

19. True; every integer is a rational number. For example, 5 can be written as $\frac{5}{1}$.

20. True; every rational number is a real number.

21. False; if a number is rational, it cannot be irrational, and vice versa.

22. True; every terminating decimal is a rational number.

23. Three examples of positive real numbers that are not integers are $\frac{1}{2}, \frac{5}{8},$ and $1\frac{3}{4}$. Other examples are $0.7, 4\frac{2}{3},$ and 5.1.

24. Real numbers that are not positive numbers are 0 and all numbers to the left of 0 on the number line. Three examples are $-1, -\frac{3}{4},$ and -5. Other examples are $0, -5, -\sqrt{7}, -1\frac{1}{2},$ and -0.3.

25. Three examples of real numbers that are not whole numbers are $-3\frac{1}{2}, -\frac{2}{3},$ and $\frac{3}{7}$. Other examples are $-4.3, -\sqrt{2},$ and $\sqrt{7}$.

26. Rational numbers that are not integers are all real numbers that can be expressed as a quotient of integers (with nonzero denominators) such that in lowest terms the denominator is not 1. Three examples are $\frac{1}{2}, -\frac{2}{3},$ and $\frac{2}{7}$. Other examples are $-5.6, -4\frac{3}{4}, -\frac{1}{2}, \frac{1}{2},$ and 5.2.

27. Three examples of real numbers that are not rational numbers are $\sqrt{5}$, π, and $-\sqrt{3}$. All irrational numbers are real numbers that are not rational.

28. Rational numbers that are not negative numbers are 0 and all rational numbers to the right of zero on the number line. Three examples are $\frac{2}{3}, \frac{5}{6},$ and $\frac{5}{2}$. Other examples are $0, \frac{1}{2}, 1, 3\frac{1}{4},$ and 5.

29. Use the integer 2,216,602 since "increased by 2,216,602" indicates a positive number.

30. Use the integer 218 since "increased by 218" indicates a positive number.

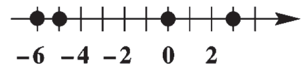
31. Use the integer $-10,971$ since "a decrease of 10,971" indicates a negative number.

32. Use the integer -9227 since "a decrease of 9227" indicates a negative number.

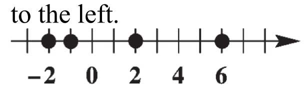
33. Use the rational number -39.73 since "closed down 39.73" indicates a negative number.

34. Use the rational number 21.34 since "closed up 21.34" indicates a positive number.

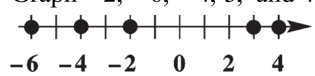
35. Graph $0, 3, -5,$ and -6.
Place a dot on the number line at the point that corresponds to each number. The order of the numbers from smallest to largest is $-6, -5, 0, 3$.



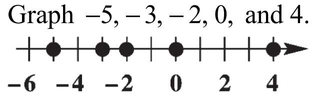
36. Graph $2, 6, -2,$ and -1.
The smallest number, -2, will be the farthest to the left.



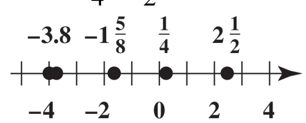
37. Graph $-2, -6, -4, 3,$ and 4.



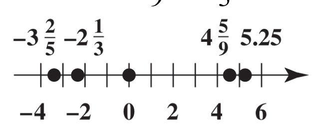
38. Graph $-5, -3, -2, 0,$ and 4.



39. Graph $\frac{1}{4}, 2\frac{1}{2}, -3.8, -4,$ and $-1\frac{5}{8}$.



40. Graph $5.25, 4\frac{5}{9}, -2\frac{1}{3}, 0,$ and $-3\frac{2}{5}$.



41. **(a)** The natural numbers in the given set are 3 and 7, since they are in the natural number set $\{1, 2, 3, \ldots\}$.

(b) The set of whole numbers includes the natural numbers and 0. The whole numbers in the given set are 0, 3, and 7.

(c) The integers are the set of numbers $\{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$. The integers in the given set are -9, 0, 3, and 7.

(d) Rational numbers are the numbers that can be expressed as the quotient of two integers, with denominators not equal to 0.
We can write numbers from the given set in this form as follows:
$-9=\frac{-9}{1}$, $-1\frac{1}{4}=\frac{-5}{4}$, $-\frac{3}{5}=\frac{-3}{5}$, $0=\frac{0}{1}$, $0.\overline{1}=\frac{1}{9}$, $3=\frac{3}{1}$, $5.9=\frac{59}{10}$, and $7=\frac{7}{1}$.
Thus, the rational numbers in the given set are $-9, -1\frac{1}{4}, -\frac{3}{5}, 0, 0.\overline{1}, 3, 5.9,$ and 7.

(e) Irrational numbers are real numbers that are not rational. $-\sqrt{7}$ and $\sqrt{5}$ can be represented by points on the number line but cannot be written as a quotient of integers. Thus, the irrational numbers in the given set are $-\sqrt{7}$ and $\sqrt{5}$.

(f) Real numbers are all numbers that can be represented on the number line. All the numbers in the given set are real.

42. **(a)** The only natural number in the given set is 3.

(b) The whole numbers in the set are 0 and 3.

(c) The integers in the set are $-5, -1, 0,$ and 3.

(d) The rational numbers are $-5.3, -5, -1, -\frac{1}{9}, 0, 0.\overline{27}, 1.2,$ and 3.

(e) The irrational numbers in the set are $-\sqrt{3}$ and $\sqrt{11}$.

(f) All the numbers in the set are real numbers.

43. **(a)** The natural number in the given set 11, since it is in the natural number set $\{1, 2, 3, \ldots\}$.

(b) The set of whole numbers includes the natural numbers and 0. The whole numbers in the given set are 0, and 11.

(c) The integers are the set of numbers $\{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$. The integers in the given set are 0, 11, and -6 .

(d) Rational numbers are the numbers that can be expressed as the quotient of two integers, with denominators not equal to 0.
We can write numbers from the given set in this form as follows:
$-2.\overline{3}=\frac{-7}{3}$, $0=\frac{0}{1}$, $-8\frac{3}{4}=\frac{-35}{4}$, $11=\frac{11}{1}$, and $-6=\frac{-6}{1}$.
Thus, the rational numbers in the given set are $\frac{7}{9}, -2.\overline{3}, 0, -8\frac{3}{4}, 11,$ and -6 .

(e) Irrational numbers are real numbers that are not rational. $\sqrt{3}$ and π can be represented by points on the number line but cannot be written as a quotient of integers. Thus, the irrational numbers in the given set are $\sqrt{3}$ and π .

(f) Real numbers are all numbers that can be represented on the number line. All the numbers in the given set are real.

44. **(a)** The only natural number in the given set is 9.

(b) The whole numbers in the set are 9 and 0.

(c) The integers in the set are 9, -12 , and 0.

(d) The rational numbers are $1\frac{5}{8}$, $-0.\overline{4}$, 9, -12 , 0, and 0.026.

(e) The irrational numbers in the set are $\sqrt{6}$ and $\sqrt{10}$.

(f) All the numbers in the set are real numbers.

45. **(a)** The additive inverse of -2 is found by changing the sign of -2 The additive inverse of -2 is 2 .

(b) The absolute value of -2 is the distance between 0 and -2 on the number line, so $|-2|=2$.

46. **(a)** The additive inverse of a number is found by changing the sign of a number, so the additive inverse of -4 is 4.

(b) The distance between -4 and 0 on the number line is 4 units, so $|-4|=4$.

47. **(a)** The additive inverse of 8 is -8.

(b) The distance between 0 and 8 on the number line is 8 units, so the absolute value of 8 is 8.

48. **(a)** The additive inverse of 10 is -10.

(b) The distance between 10 and 0 on the number line is 10 units, so $|10|=10$.

49. **(a)** The additive inverse of a number is found by changing the sign of a number, so the additive inverse of $-\frac{3}{4}$ is $\frac{3}{4}$.

(b) The distance between $-\frac{3}{4}$ and 0 on the number line is $\frac{3}{4}$ unit, so $\left|-\frac{3}{4}\right| = \frac{3}{4}$.

50. **(a)** The additive inverse of a number is found by changing the sign of a number, so the additive inverse of $-\frac{2}{5}$ is $\frac{2}{5}$.

(b) The distance between $-\frac{2}{5}$ and 0 on the number line is $\frac{2}{5}$ unit, so $\left|-\frac{2}{5}\right| = \frac{2}{5}$.

51. **(a)** The additive inverse of a number is found by changing the sign of a number, so the additive inverse of 5.6 is -5.6.

(b) The distance between 5.6 and 0 on the number line is 5.6 units, so $|5.6| = 5.6$.

52. **(a)** The additive inverse of a number is found by changing the sign of a number, so the additive inverse of 8.1 is -8.1.

(b) The distance between 8.1 and 0 on the number line is 8.1 unit, so $|8.1| = 8.1$.

53. Since -6 is a negative number, its absolute value is the additive inverse of -6 — that is, $|-6| = -(-6) = 6$.

54. $|-14| = -(-14) = 14$

55. $-|12| = -(12) = -12$

56. $-|19| = -(19) = -19$

57. $-\left|-\frac{2}{3}\right| = -\left(\frac{2}{3}\right) = -\frac{2}{3}$

58. $-\left|-\frac{4}{5}\right| = -\left(\frac{4}{5}\right) = -\frac{4}{5}$

59. $|6-3| = |3| = 3$

60. $|9-4| = |5| = 5$

61. $-|6-3| = -|3| = -3$

62. $-|9-4| = -|5| = -5$

63. Since -11 is located to the left of -4 on the number line, -11 is the lesser number.

64. Since -13 is located to the left of -8 on the number line, -13 is the lesser number.

65. Since $-\frac{2}{3}$ is located to the left of $-\frac{1}{4}$ on the number line, $-\frac{2}{3}$ is the lesser number.

66. Since $-\frac{9}{16}$ is located to the left of $-\frac{3}{8}$ on the number line, $-\frac{9}{16}$ is the lesser number.

67. Since $|-5| = 5$, 4 is the lesser of the two numbers.

68. Since $|-3| = 3, |-3|$ or 3 is the lesser of the two numbers.

69. Since $|-3.5| = 3.5$ and $|-4.5| = 4.5, |-3.5|$ or 3.5 is the lesser number.

70. Since $|-8.9| = 8.9$ and $|-9.8| = 9.8, |-8.9|$ or 8.9 is the lesser number.

71. Since $-|-6| = -6$ and $-|-4| = -4, -|-6|$ is to the left of $-|-4|$ on the number line, so $-|-6|$ or -6 is the lesser number.

72. $-|-2| = -2$ and $-|-3| = -3$, so $-|-3|$ is to the left of $-|-2|$ on the number line; $-|-3|$ or -3 is the lesser number.

73. Since $|5-3| = |2| = 2$ and $|6-2| = |4| = 4, |5-3|$ or 2 is the lesser number.

74. Since $|7-2| = |5| = 5$ and $|8-1| = |7| = 7, |7-2|$ or 5 is the lesser number.

75. Since -5 is to the *left* of -2 on the number line, -5 is *less than* -2, and the statement $-5 < -2$ is true.

76. Since -8 is to the *left* of -2 on the number line, -8 is *less than* -2, and the statement $-8 > -2$ is false.

77. Since $-(-5) = 5$ and $-4 < 5, -4 \le -(-5)$ is true.

78. Since $-(-3)=3$ and $-6\le 3$, $-6\le -(-3)$ is true.

79. Since $|-6|=6$ and $|-9|=9$, and $6<9$, $|-6|<|-9|$ is true.

80. Since $|-12|=12$ and $|-20|=20$, and $12<20$, $|-12|<|-20|$ is true.

81. Since $-|8|=-8$ and $|-9|=-(-9)=9$, $-|8|<|-9|$, so $-|8|>|-9|$ is false.

82. Since $-|12|=-12$ and $|-15|=-(-15)=15$, $-|12|<|-15|$, so $-|12|>|-15|$ is false.

83. Since $-|-5|=-5, -|-9|=-9$, and $-5>-9, -|-5|\ge -|-9|$ is true.

84. Since $-|-12|=-12, -|-15|=-15$, and $-12>-15, -|-12|\le -|-15|$ is false.

85. Since $|6-5|=|1|=1$ and $|6-2|=|4|=4, |6-5|<|6-2|$, so $|6-5|\ge|6-2|$ is false.

86. Since $|13-8|=|5|=5$ and $|7-4|=|3|=3$, $|13-8|>|7-4|$, so $|13-8|\le|7-4|$ is false.

87. The number that represents the greatest percentage increase is 2.2, which corresponds to Natural gas service from March to April.

88. The negative number with the largest absolute value in the table is -6.4, so the greatest percentage decrease is Gasoline from April to May.

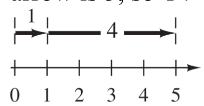
89. The number with the smallest absolute value in the table is 0.2, so the least change corresponds to Shelter from April to May.

90. The categories with two negative entries (representing a decrease for both time periods) are Apparel and Fuel oil.

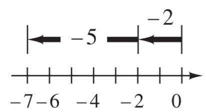
1.4 Adding and Subtracting Real Numbers

Classroom Examples, Now Try Exercises

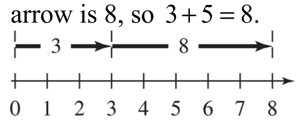
1. (a) Start at 0 on a number line. Draw an arrow 1 unit to the right to represent the positive number 1. From the right end of this arrow, draw a second arrow 4 units to the right to represent the addition of a positive number. The number below the end of this second arrow is 5, so $1+4=5$.



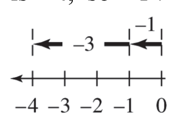
(b) Start at 0 on a number line. Draw an arrow 2 units to the left to represent the negative number -2. From the left end of this arrow, draw a second arrow 5 units to the left to represent the addition of a negative number. The number below the end of this second arrow is -7, so $-2+(-5)=-7$.



N1. (a) Start at 0 on a number line. Draw an arrow 3 units to the right to represent the positive number 3. From the right end of this arrow, draw a second arrow 5 units to the right to represent the addition of a positive number. The number below the end of this second arrow is 8, so $3+5=8$.



(b) Start at 0 on a number line. Draw an arrow 1 unit to the left to represent the negative number -1. From the left end of this arrow, draw a second arrow 3 units to the left. The number below the end of this second arrow is -4, so $-1+(-3)=-4$.



2. (a) $-15+(-4)=-19$

The sum of two negative numbers is negative.

(b) $-1.27+(-5.46)=-6.73$

The sum of two negative numbers is negative.

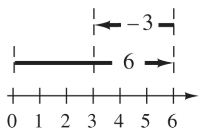
N2. (a) $-6+(-11)=-17$

The sum of two negative numbers is negative.

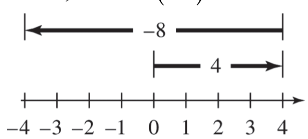
(b) $-\frac{2}{5}+\left(-\frac{1}{2}\right)=-\frac{9}{10}$

The sum of two negative numbers is negative.

3. Start at 0 on a number line. Draw an arrow 6 units to the right. From the right end of this arrow, draw a second arrow 3 units to the left. The number below the end of this second arrow is 3, so $6+(-3)=3$.



N3. Start at 0 on a number line. Draw an arrow 4 units to the right. From the right end of this arrow, draw a second arrow 8 units to the left. The number below the end of this second arrow is -4, so $4+(-8)=-4$.



4. **(a)** Since the numbers have different signs, find the difference between their absolute values: $17-10=7$. Because 17 has the larger absolute value, the sum is negative: $-10+17=7$.

(b) $\frac{3}{4}+\left(-1\frac{3}{8}\right)=-\frac{5}{8}$

(c) $-3.8+9.5=5.7$

(d) $25+(-25)=0$

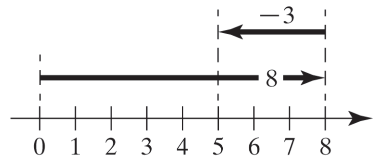
N4. **(a)** Since the numbers have different signs, find the difference between their absolute values: $7-4=3$. Because 7 has the larger absolute value, the sum is positive: $7+(-4)=3$.

(b)
$$\begin{aligned}\frac{2}{3}+\left(-2\frac{1}{9}\right)&=\frac{2}{3}+\left(-\frac{19}{9}\right)\\&=\frac{6}{9}+\left(-\frac{19}{9}\right)\\&=-\left(\frac{19}{9}-\frac{6}{9}\right)\\&=-\frac{13}{9}\text{ or }-1\frac{4}{9}\end{aligned}$$

(c) $-5.7+3.7=-(5.7-3.7)=-2$

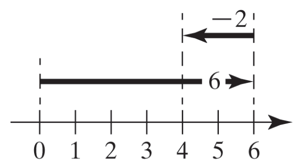
(d) $-10+10=0$

5. Use a number line to find the difference $8-3$.
Step 1 Start at 0 and draw an arrow 8 units to the *right.*
Step 2 From the right end of the first arrow, draw a second arrow 3 units to the *left* to represent the *subtraction*.



The number below the end of the second arrow is 5, so $8-3=5$.

N5. Use a number line to find the difference $6-2$.
Step 1 Start at 0 and draw an arrow 6 units to the *right.*
Step 2 From the right end of the first arrow, draw a second arrow 2 units to the *left* to represent the *subtraction*.



The number below the end of the second arrow is 4, so $6-2=4$.

6. **(a)** $10-4=10+(-4)$ Add the opposite.
$=6$

(b) $4-10=4+(-10)$ Add the opposite.
$=-6$

(c) $-8-5=-8+(-5)$ Add the opposite.
$=-13$

(d) $-8-(-12)=-8+(12)$ Add the opposite.
$=4$

(e) $\frac{5}{4}-\left(-\frac{3}{7}\right)=\frac{5}{4}+\frac{3}{7}=\frac{35}{28}+\frac{12}{28}=\frac{47}{28}$, or $1\frac{19}{28}$

(f) $7.5-9.2=-1.7$

N6. **(a)** $-5-(-11)=-5+(11)$ Add the opposite.
$=6$

(b) $4-15=4+(-15)$ Add the opposite.
$=-11$

(c) $-\frac{5}{7}-\frac{1}{3}=-\frac{5}{7}+\left(-\frac{1}{3}\right)$ Add the opposite.

$=-\frac{15}{21}+\left(-\frac{7}{21}\right)$

$=-\frac{22}{21}$, or $-1\frac{1}{21}$

(d) $5.25-(-3.24)=5.25+3.24$

$=8.49$

7. **(a)** $6+\left[(-1-4)-2\right]$

$=6+\left\{\left[-1+(-4)\right]-2\right\}$

$=6+(-5-2)$

$=6+\left[-5+(-2)\right]$

$=6+(-7)$

$=-1$

(b) $\left|-\frac{1}{6}-\left(-\frac{1}{3}\right)\right|-\frac{1}{4}$

$=\left|-\frac{2}{12}-\left(-\frac{4}{12}\right)\right|-\frac{3}{12}$

$=\left|-\frac{2}{12}+\frac{4}{12}\right|-\frac{3}{12}$

$=\left|\frac{2}{12}\right|-\frac{3}{12}$

$=\frac{2}{12}+\left(-\frac{3}{12}\right)$

$=-\frac{1}{12}$

N7. **(a)** $8-[(-3+7)-(3-9)]$

$=8-[(4)-(3+(-9))]$

$=8-[4-(-6)]$

$=8-[4+6]$

$=8-10$

$=8+(-10)$

$=-2$

(b) $3|6-9|-|4-12|$

$=3|6+(-9)|-|4+(-12)|$

$=3|-3|-|-8|$

$=3\cdot 3-8$

$=9-8$

$=1$

8. "7 is increased by the sum of 8 and -3" is written $7+\left[8+(-3)\right]$.

$7+\left[8+(-3)\right]=7+5=12$

N8. "The sum of -3 and 7, increased by 10" is written $(-3+7)+10$.

$(-3+7)+10=4+10=14$

9. **(a)** "The difference between -5 and -12" is written $-5-(-12)$.

$-5-(-12)=-5+12$

$=7$

(b) "-2 subtracted from the sum of 4 and -4" is written $\left[4+(-4)\right]-(-2)$.

$\left[4+(-4)\right]-(-2)=0-(-2)$

$=0+2$

$=2$

N9. **(a)** "The difference between 5 and -8, decreased by 4" is written $[5-(-8)]-4$.

$[5-(-8)]-4=[5+8]-4$

$=13-4$

$=9$

(b) "7 less than -2" is written $-2-7$.

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

$=-9$

10. The difference between the highest and lowest temperatures is given by

$79-(-56)=79+56$

$=135.$

The difference is 135°F.

N10. The difference between a gain of 226 yards and a loss of 7 yards is given by

$226-(-7)=226+7$

$=233.$

The difference is 233 yards.

11. Subtract the enrollment number for 1995 from the enrollment number for 2000.

$13.52-12.5=13.52+(-12.5)=1.02$ million

A positive result indicates an increase.

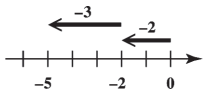
N11. Subtract the enrollment number for 1985 from the enrollment number for 1990.

$11.34-12.39=-1.05$ million

A negative result indicates a decrease.

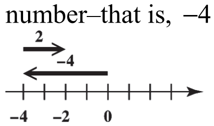
Exercises

1. The sum of two negative numbers will always be a *negative* number. In the illustration, we have $-2+(-3)=-5$.



2. The sum of a number and its opposite will always be $\underline{\text{zero (0)}}$.

3. When adding a positive number and a negative number, where the negative number has the greater absolute value, the sum will be a *negative* number. In the illustration, the absolute value of -4 is larger than the absolute value of 2, so the sum is a negative number–that is, $-4+2=-2$.



4. To simplify the expression $8+\left[-2+\left(-3+5\right)\right]$, one should begin by adding $\underline{-3}$ and $\underline{5}$, according to the rules for order of operations.

5. By the definition of subtraction, in order to perform the subtraction $-6-(-8)$, we must add the opposite of $\underline{-8}$ to $\underline{-6}$ to obtain $\underline{2}$.

6. "The difference of 7 and 12" translates as $\underline{7-12}$, while "the difference of 12 and 7" translates as $\underline{12-7}$.

7. The expression $x-y$ would have to be positive since subtracting a negative number from a positive number is the same as adding a positive number to a positive number, which is a positive number.

8. $y-x=y+(-x)$
If x is a positive number and y is a negative number, $y-x$ will be the sum of two negative numbers, which is a negative number.

9. $|x|=x$, since x is a positive number.
$y-|x|=y-x$, which is a negative number.
(See Exercise 8.)

10. Since $|y|$ is positive, $x+|y|$ is the sum of two positive numbers, which is positive.

11. The sum of two negative numbers is negative.
$-6+(-2)=-8$

12. Since the numbers have the same sign, add their absolute values: $9+2=11$. Since both numbers are negative, their sum is negative:
$-9+(-2)=-11$.

13. Because the numbers have the same sign, add their absolute values: $5+7=12$. Because both numbers are negative, their sum is negative:
$-5+(-7)=-12$.

14. Because the numbers have the same sign, add their absolute values: $11+5=16$. Because both numbers are negative, their sum is negative:
$-11+(-5)=-16$.

15. To add $6+(-4)$, find the difference between the absolute values of the numbers.
$|6|=6$ and $|-4|=4$
$6-4=2$
Since $|6|>|-4|$, the sum will be positive:
$6+(-4)=2$.

16. Since the numbers have different signs, find the difference between their absolute values: $11-8=3$. Since 11 has the larger absolute value, the answer is positive: $11+(-8)=3$.

17. Since the numbers have different signs, find the difference between their absolute values: $15-12=3$. Because -15 has the larger absolute value, the sum is negative:
$12+(-15)=-3$.

18. Since the numbers have different signs, find the difference between their absolute values: $7-3=4$. Since -7 has the larger absolute value, the sum is negative: $3+(-7)=-4$.

19. Since the numbers have different signs, find the difference between their absolute values: $16-7=9$. Since -16 has the larger absolute value, the answer is negative: $-16+7=-9$.

20. Since the numbers have different signs, find the difference between their absolute values: $13-6=7$. Since -13 has the larger absolute value, the answer is negative: $-13+6=-7$.

21. $6+(-6)=0$

22. $-11+11=0$

23. $-\frac{1}{3}+\left(-\frac{4}{15}\right)=-\frac{5}{15}+\left(-\frac{4}{15}\right)=-\frac{9}{15}=-\frac{3}{5}$

24. $-\frac{1}{4}+\left(-\frac{5}{12}\right)=-\frac{3}{12}+\left(-\frac{5}{12}\right)=-\frac{8}{12}=-\frac{2}{3}$

25. $-\frac{1}{6}+\frac{2}{3}=-\frac{1}{6}+\frac{4}{6}=\frac{3}{6}=\frac{1}{2}$

26. $$\begin{aligned}-\frac{6}{25}+\frac{19}{20}&=-\frac{6\cdot 4}{25\cdot 4}+\frac{19\cdot 5}{20\cdot 5}\\&=-\frac{24}{100}+\frac{95}{100}\\&=\frac{71}{100}\end{aligned}$$

27. Since $8=2\cdot 2\cdot 2$ and $12=2\cdot 2\cdot 3$, the LCD is $2\cdot 2\cdot 2\cdot 3=24$.
$$\begin{aligned}\frac{5}{8}+\left(-\frac{17}{12}\right)&=\frac{5\cdot 3}{8\cdot 3}+\left(-\frac{17\cdot 2}{12\cdot 2}\right)\\&=\frac{15}{24}+\left(-\frac{34}{24}\right)\\&=-\frac{19}{24}\end{aligned}$$

28. $$\begin{aligned}\frac{9}{10}+\left(-\frac{11}{8}\right)&=\frac{9\cdot 4}{10\cdot 4}+\left(-\frac{11\cdot 5}{8\cdot 5}\right)\\&=\frac{36}{40}+\left(-\frac{55}{40}\right)\\&=-\frac{19}{40}\end{aligned}$$

29. $$\begin{aligned}2\frac{1}{2}+\left(-3\frac{1}{4}\right)&=\frac{5}{2}+\left(-\frac{13}{4}\right)\\&=\frac{10}{4}+\left(-\frac{13}{4}\right)\\&=-\frac{3}{4}\end{aligned}$$

30. $$\begin{aligned}1\frac{3}{8}+\left(-2\frac{1}{4}\right)&=\frac{11}{8}+\left(-\frac{9}{4}\right)\\&=\frac{11}{8}+\left(-\frac{18}{8}\right)\\&=-\frac{7}{8}\end{aligned}$$

31. $-3.5+12.4=+(12.4-3.5)=8.9$

32. $-12.5+21.3=+(21.3-12.5)=8.8$

33. $-2.34+(-3.67)=-(2.34+3.67)=-6.01$

34. $-1.25+(-6.88)=-(6.88+1.25)=-8.13$

35. $4+[13+(-5)]=4+[8]=12$

36. $6+[12+(-3)]=6+[9]=15$

37. $8+[-2+(-1)]=8+[-3]=5$

38. $12+[-3+(-4)]=12+[-7]=5$

39. $-2+[5+(-1)]=-2+[4]=2$

40. $-8+[9+(-2)]=-8+[7]=-1$

41. $-6+[6+(-9)]=-6+[-3]=-9$

42. $-3+[3+(-8)]=-3+[-5]=-8$

43. $[(-9)+(-3)]+12=[-12]+12=0$

44. $[(-8)+(-6)]+14=[-14]+14=0$

45. $$\begin{aligned}-6.1+[3.2+(-4.8)]&=-6.1+[-1.6]\\&=-7.7\end{aligned}$$

46. $$\begin{aligned}-9.4+[5.8+(-7.9)]&=-9.4+[-2.1]\\&=-11.5\end{aligned}$$

47. $$\begin{aligned}[-3+(-4)]+[5+(-6)]&=[-7]+[-1]\\&=-8\end{aligned}$$

48. $$\begin{aligned}[-8+(-3)]+[4+(-6)]&=[-11]+[-2]\\&=-13\end{aligned}$$

49. $$\begin{aligned}[-4+(-3)]+[8+(-1)]&=[-7]+[7]\\&=0\end{aligned}$$

50. $$\begin{aligned}[-5+(-9)]+[16+(-2)]&=[-14]+[14]\\&=0\end{aligned}$$

51. $$\begin{aligned}&[-4+(-6)]+[-3+(-8)]+[12+(-11)]\\&=([-10]+[-11])+[1]\\&=(-21)+1\\&=-20\end{aligned}$$

52. $$\begin{aligned}&[-2+(-11)]+[-12+(-2)]+[18+(-6)]\\&=([-13]+[-14])+[12]\\&=(-27)+12\\&=-15\end{aligned}$$

53. $4-7=4+(-7)=-3$

54. $8-13=8+(-13)=-5$

55. $5-9=5+(-9)=-4$

56. $6-11=6+(-11)=-5$

57. $-7-1=-7+(-1)=-8$

58. $-9-4=-9+(-4)=-13$

59. $-8-6=-8+(-6)=-14$

60. $-9-5=-9+(-5)=-14$

61. $7-(-3)=7+(3)=10$

62. $9-(-2)=9+(2)=11$

63. $-6-(-2)=-6+(2)=-4$

64. $-7-(-5)=-7+(5)=-2$

65. $$\begin{aligned}2-(3-5)&=2-[3+(-5)]\\&=2-[-2]\\&=2+(2)\\&=4\end{aligned}$$

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

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

68. $\frac{1}{3}-\left(-\frac{1}{12}\right)=\frac{4}{12}+\frac{1}{12}=\frac{5}{12}$

69. $$\begin{aligned}-\frac{3}{4}-\frac{5}{8}&=-\frac{3}{4}+\left(-\frac{5}{8}\right)\\&=-\frac{6}{8}+\left(-\frac{5}{8}\right)\\&=-\frac{11}{8},\quad\text{or}\quad -1\frac{3}{8}\end{aligned}$$

70. $$\begin{aligned}-\frac{5}{6}-\frac{1}{2}&=-\frac{5}{6}+\left(-\frac{1}{2}\right)\\&=-\frac{5}{6}+\left(-\frac{3}{6}\right)\\&=-\frac{8}{6}\\&=-\frac{4}{3},\quad\text{or}\quad -1\frac{1}{3}\end{aligned}$$

71. $$\begin{aligned}\frac{5}{8}-\left(-\frac{1}{2}-\frac{3}{4}\right)&=\frac{5}{8}-\left[-\frac{1}{2}+\left(-\frac{3}{4}\right)\right]\\&=\frac{5}{8}-\left[-\frac{2}{4}+\left(-\frac{3}{4}\right)\right]\\&=\frac{5}{8}-\left(-\frac{5}{4}\right)\\&=\frac{5}{8}+\frac{5}{4}\\&=\frac{5}{8}+\frac{10}{8}\\&=\frac{15}{8},\quad\text{or}\quad 1\frac{7}{8}\end{aligned}$$

72. $$\begin{aligned}&\frac{9}{10}-\left(\frac{1}{8}-\frac{3}{10}\right)\\&=\frac{9}{10}-\left[\frac{1}{8}+\left(-\frac{3}{10}\right)\right]\\&=\frac{9}{10}-\left[\frac{5}{40}+\left(-\frac{12}{40}\right)\right]\\&=\frac{9}{10}-\left(-\frac{7}{40}\right)\\&=\frac{9}{10}+\frac{7}{40}\\&=\frac{36}{40}+\frac{7}{40}\\&=\frac{43}{40},\quad\text{or}\quad 1\frac{3}{40}\end{aligned}$$

73. $$\begin{aligned}3.4-(-8.2)&=3.4+8.2\\&=11.6\end{aligned}$$

74. $$\begin{aligned}5.7-(-11.6)&=5.7+11.6\\&=17.3\end{aligned}$$

75. $$\begin{aligned}-6.4-3.5&=-6.4+(-3.5)\\&=-9.9\end{aligned}$$

76. $$\begin{aligned}-4.4-8.6&=-4.4+(-8.6)\\&=-13\end{aligned}$$

77. $$\begin{aligned}(4-6)+12&=[4+(-6)]+12\\&=[-2]+12\\&=10\end{aligned}$$

78. $$\begin{aligned}(3-7)+4&=[3+(-7)]+4\\&=[-4]+4\\&=0\end{aligned}$$

79. $(8-1)-12=[8+(-1)]+(-12)$
$=[7]+(-12)$
$=-5$

80. $(9-3)-15=\left[9+(-3)\right]+(-15)$
$=[6]+(-15)$
$=-9$

81. $6-(-8+3)=6-(-5)$
$=6+5$
$=11$

82. $8-(-9+5)=8-(-4)$
$=8+4$
$=12$

83. $2+(-4-8)=2+[-4+(-8)]$
$=2+[-12]$
$=-10$

84. $6+(-9-2)=6+\left[-9+(-2)\right]$
$=6+[-11]$
$=-5$

85. $|-5-6|+|9+2|=|-5+(-6)|+|11|$
$=|-11|+|11|$
$=-(-11)+11$
$=11+11$
$=22$

86. $|-4+8|+|6-1|=|4|+|5|$
$=4+5$
$=9$

87. $|-8-2|-|-9-3|$
$=|-8+(-2)|-|-9+(-3)|$
$=|-10|-|-12|$
$=-(-10)-[-(-12)]$
$=10-[12]$
$=-2$

88. $|-4-2|-|-8-1|$
$=|-4+(-2)|-|-8+(-1)|$
$=|-6|-|-9|$
$=-(-6)-[-(-9)]$
$=6-[9]$
$=-3$

89. $\left(-\frac{3}{8}-\frac{2}{3}\right)-\left(-\frac{9}{8}-3\right)$
$=\left(-\frac{9}{24}-\frac{16}{24}\right)-\left(-\frac{9}{8}-\frac{24}{8}\right)$
$=-\frac{25}{24}-\left(-\frac{33}{8}\right)$
$=-\frac{25}{24}+\frac{99}{24}$
$=\frac{74}{24}=\frac{37}{12}$, or $3\frac{1}{12}$

90. $\left(-\frac{3}{4}-\frac{5}{2}\right)-\left(-\frac{1}{8}-1\right)$
$=\left(-\frac{3}{4}-\frac{10}{4}\right)-\left(-\frac{1}{8}-\frac{8}{8}\right)$
$=-\frac{13}{4}-\left(-\frac{9}{8}\right)$
$=-\frac{26}{8}+\frac{9}{8}$
$=-\frac{17}{8}$, or $-2\frac{1}{8}$

91. $\left(-\frac{1}{2}+0.25\right)-\left(-\frac{3}{4}+0.75\right)$
$=\left(-\frac{1}{2}+\frac{1}{4}\right)-\left(-\frac{3}{4}+\frac{3}{4}\right)$
$=\left(-\frac{2}{4}+\frac{1}{4}\right)-0$
$=-\frac{1}{4}$, or -0.25

92. $\left(-\frac{3}{2}-0.75\right)-\left(0.5-\frac{1}{2}\right)$
$=\left(-\frac{3}{2}-\frac{3}{4}\right)-\left(\frac{1}{2}-\frac{1}{2}\right)$
$=\left(-\frac{6}{4}-\frac{3}{4}\right)-0$
$=-\frac{9}{4}$, or -2.25

93. $-9+[(3-2)-(-4+2)]$
$=-9+[1-(-2)]$
$=-9+[1+2]$
$=-9+3$
$=-6$

94. $-8-\left[\left(-4-1\right)+\left(9-2\right)\right]$
$=-8-\left[\left(-4+\left(-1\right)\right)+7\right]$
$=-8-\left[-5+7\right]$
$=-8-\left[2\right]$
$=-8+\left(-2\right)$
$=-10$

95. $-3+[(-5-8)-(-6+2)]$
$=-3+[(-5+(-8))-(-4)]$
$=-3+[-13+4]$
$=-3+[-9]$
$=-12$

96. $-4+[(-12+1)-(-1-9)]$
$=-4+\left[\left(-11\right)-\left(-1+\left(-9\right)\right)\right]$
$=-4+\left[-11-\left(-10\right)\right]$
$=-4+\left[-11+10\right]$
$=-4+\left[-1\right]$
$=-5$

97. $-9.12+[(-4.8-3.25)+11.279]$
$=-9.12+[(-4.8+(-3.25))+11.279]$
$=-9.12+[-8.05+11.279]$
$=-9.12+3.229$
$=-5.891$

98. $-7.62+\left[\left(-3.99+1.427\right)-\left(-2.8\right)\right]$
$=-7.62-\left[-2.563+2.8\right]$
$=-7.62-\left[0.237\right]$
$=-7.62+\left(-0.237\right)$
$=-7.857$

99. "The sum of -5 and 12 and 6" is written $-5+12+6$.
$-5+12+6=[-5+12]+6$
$=7+6=13$

100. "The sum of -3 and 5 and -12" is written $-3+5+\left(-12\right)$.
$-3+5+\left(-12\right)=2+\left(-12\right)$
$=-10$

101. "14 added to the sum of -19 and -4" is written $[-19+(-4)]+14$.
$[-19+(-4)]+14=(-23)+14$
$=-9$

102. "-2 added to the sum of -18 and 11" is written $\left(-18+11\right)+\left(-2\right)$.
$\left(-18+11\right)+\left(-2\right)=-7+\left(-2\right)$
$=-9$

103. "The sum of -4 and -10, increased by 12" is written $[-4+(-10)]+12$.
$[-4+(-10)]+12=-14+12$
$=-2$

104. "The sum of -7 and -13, increased by 14" is written $\left[-7+\left(-13\right)\right]+14$.
$[-7+(-13)]+14=-20+14$
$=-6$

105. "$\frac{2}{7}$ more than the sum of $\frac{5}{7}$ and $-\frac{9}{7}$" is written $\left[\frac{5}{7}+\left(-\frac{9}{7}\right)\right]+\frac{2}{7}$.
$\left[\frac{5}{7}+\left(-\frac{9}{7}\right)\right]+\frac{2}{7}=-\frac{4}{7}+\frac{2}{7}$
$=-\frac{2}{7}$

106. "1.85 more than the sum of -1.25 and -4.75" is written $\left[-1.25+\left(-4.75\right)\right]+1.85$.
$\left[-1.25+\left(-4.75\right)\right]+1.85=-6+1.85$
$=-4.15$

107. "The difference of 4 and -8" is written $4-(-8)$.
$4-(-8)=4+8=12$

108. "The difference of 7 and -14" is written $7-\left(-14\right)$. This expression can be simplified as follows.
$7-(-14)=7+14=21$

109. "8 less than -2" is written $-2-8$.
$-2-8=-2+(-8)=-10$

110. "9 less than -13" is written $-13-9$.
$-13-9=-13+(-9)=-22$

111. "The sum of 9 and -4, decreased by 7" is written $[9+(-4)]-7$.
$[9+(-4)]-7=5+(-7)=-2$

112. "The sum of 12 and -7, decreased by 14" is written $\left[12+(-7)\right]-14$.

$$[12+(-7)]-14=5-14$$
$$=5+(-14)$$
$$=-9$$

113. "12 less than the difference of 8 and -5" is written $[8-(-5)]-12$.

$$[8-(-5)]-12=[8+(5)]-12$$
$$=13-12$$
$$=13+(-12)$$
$$=1$$

114. "19 less than the difference of 9 and -2" is written $\left[9-(-2)\right]-19$.

$$[9-(-2)]-19=(9+2)-19$$
$$=11-19$$
$$=11+(-19)$$
$$=-8$$

115. $[-3+(-5)]+[1+(-2)]=-8+(-1)$
$$=-9$$
The total score below par is 9, which can be represented by the number -9.

116. $[-1+0]+[-2+(-1)]=-1+(-3)$
$$=-4$$
The total score below par is 4, which can be represented by the number -4.

117. $[-5+7]+[-1+2]=2+1$
$$=3$$
The total score above par is 3, which can be represented by the number $+3$.

118. $[3+5]+[2+(-4)]=8+(-2)$
$$=6$$
The total score above par is 6, which can be represented by the number $+6$.

119. $[-2+(-1)]+(-1)=-3+(-1)$
$$=-4$$
The total number of seats that Illinois, Minnesota, and New York are projected to lose is 4, which can be represented by the signed number -4.

120. $\left[-1+(-1)\right]+\left[4+2\right]=-2+6$
$$=4$$
The algebraic sum of these changes can be represented by the signed number $+4$.

121. $0+(-130)+(-54)=-130+(-54)$
$$=-184$$
Their new altitude is 184 meters below the surface, which can be represented by the signed number -184 m.

122. $34,000-2100=34,000+(-2100)$
$$=31,900$$
The new altitude of the plane is 31,900 feet, which can be represented by the signed number 31,900 ft.

123. The lowest temperature is represented by $-29°$F. The highest temperature is represented by $-29+149$, or $120°$F.

124. To find the temperature, start with $-4°$F and add 49.
$-4+49=45$
The temperature 2 minutes later was $45°$F.

125. $33°$F lower than $-36°$F can be represented as
$$-36-33=-36+(-33)$$
$$=-69.$$
The record low in Utah is $-69°$F.

126. $36°$F lower than $-19°$F can be represented as
$$-19-36=-19+(-36)$$
$$=-55.$$
The record low in Wisconsin is $-55°$F.

127. Add the scores of the four turns to get the final score.
$$-19+28+(-5)+13=9+(-5)+13$$
$$=4+13$$
$$=17$$
Her final score for the four turns was 17.

128. Add the scores for the five turns to get the final score.
$$-13+15+(-12)+24+14$$
$$=2+(-12)+24+14$$
$$=-10+24+14$$
$$=14+14$$
$$=28$$
His final score for the five turns was 28.

129. **(a)** $3.1-(-0.5)=3.1+0.5$
$$=3.6$$
The difference is 3.6%.

(b) Americans spent more money than they earned, which means they had to dip into savings or increase borrowing.

130. $236-(-616)=236+616$
$=852$
The difference is \$852 billion.

131. $18,800+1400-300$
$=20,200-300$ Add.
$=19,900$ Subtract.
The average was \$19,900.

132. $1786+60-43=1846-43$ Add.
$=1803$ Subtract.
The average was \$1803.

133. Sum of withdrawals:
$\$35.84+\$26.14+\$3.12=\$61.98+\$3.12$
$=\$65.10$
Sum of deposits:
$\$85.00+\$120.76=\$205.76$
To obtain the final balance, add the deposits and subtract the withdrawals from the beginning balance.
Final balance $=\$904.89-\$65.10+\$205.76$
$=\$839.79+\$205.76$
$=\$1045.55$
Her account balance at the end of August was \$1045.55.

134. Sum of withdrawals:
$\$41.29+\$13.66+\$84.40=\$54.95+\$84.40$
$=\$139.35$
Sum of deposits:
$\$80.59+\$276.13=\$356.72$
To obtain the final balance, add the deposits and subtract the withdrawals from the beginning balance.
Final balance $=\$537.12-\$139.35+\$356.72$
$=\$397.77+\$356.72$
$=\$754.49$
His account balance at the end of September was \$754.49.

135. Linda starts with a debt of \$870.00, or $-\$870.00$. She returns two items, increasing the amount she has by $35.90+150.00=185.90$. She purchases three items, decreasing the amount she has by $82.50+10.00+10.00=102.50$.
Finally, add the payment and subtract the finance charge to calculate how much money she has.

-870.00	Amount owed
$+185.90$	Two return credits
-684.10	
-102.50	Three purchases
-786.60	
$+500.00$	Payment
-286.60	
-37.23	Finance charge
-323.83	

She still owes \$323.83.

136. Marcial starts with a debt of \$679.00, or $-\$679.00$. He returns three items, increasing the amount he has by $36.89+29.40+113.55=179.84$.
He purchases four items, decreasing the amount he has by $135.78+412.88+20.00+20.00=588.66$.
Finally, add the payment and subtract the finance charge to calculate how much money he has.

-679.00	Amount owed
$+179.84$	Three return credits
-499.16	
-588.66	Four purchases
-1087.82	
$+400.00$	Payment
-687.82	
-24.57	Finance charge
-712.39	

He still owes \$712.39.

137. The percent return for 2012 is 15.31%, and the percent return for 2013 is 31.69%. Thus, the change in percent returns is $31.69-15.31=16.38\%$ (an increase).

138. The percent return for 2013 is 31.69%, and the percent return for 2014 is 13.00%. Thus, the change in percent return is $13.00-31.69=-18.69\%$ (a decrease).

139. The percent return for 2014 is 13.00%, and the percent return for 2015 is 0.82%. Thus, the change in percent return is $0.82-13.00=-12.18\%$ (a decrease).

140. The percent return for 2012 is 15.31%, and the percent return for 2016 is 11.31%. Thus, the change in percent return is $11.31 - 15.31 = -4.00\%$ (a decrease).

141. $17{,}400 - (-32{,}995) = 17{,}400 + 32{,}995$
$= 50{,}395$
The difference between the height of Mt. Foraker and the depth of the Philippine Trench is 50,395 feet.

142. $14{,}110 - (-23{,}376) = 14{,}110 + 23{,}376$
$= 37{,}486$
The difference between the height of Pikes Peak and the depth of the Java Trench is 37,486 feet.

143. $-23{,}376 - (-24{,}721) = -23{,}376 + 24{,}721$
$= 1345$
The Cayman Trench is 1345 feet deeper than the Java Trench.

144. $-24{,}721 - (-32{,}995) = -24{,}721 + 32{,}995$
$= 8274$
The Philippine Trench is 8274 feet deeper than the Cayman Trench.

145. $14{,}246 - 14{,}110 = 14{,}246 + (-14{,}110)$
$= 136$
Mt. Wilson is 136 feet higher than Pikes Peak.

146. $(14{,}246 + 14{,}110) - 17{,}400$
$= 28{,}356 + (-17{,}400)$
$= 10{,}956$
If Mt. Wilson and Pikes Peak were stacked one on top of the other, they would be 10,956 feet higher than Mt. Foraker.

1.5 Multiplying and Dividing Real Numbers

Classroom Examples, Now Try Exercises

1. **(a)** $4(-8) = -(4 \cdot 8)$
$= -32$

(b) $-16\left(\frac{5}{32}\right) = -\left(16 \cdot \frac{5}{32}\right)$
$= -\frac{5}{2}$

N1. **(a)** $-11(9) = -(11 \cdot 9)$
$= -99$

(b) $3.1(-2.5) = -(3.1 \cdot 2.5)$
$= -7.75$

2. **(a)** $-12(-3) = 36$

(b) $-1.2(-1.1) = 1.32$

N2. **(a)** $-8(-11) = 88$

(b) $-\frac{1}{7}\left(-\frac{5}{2}\right) = \frac{5}{14}$

3. **(a)** $\frac{-16}{-2} = 8$

(b) $\frac{-16.4}{2.05} = -8$

(c) $\frac{1}{4} \div \left(-\frac{2}{3}\right) = \frac{1}{4} \cdot \left(-\frac{3}{2}\right) = -\frac{3}{8}$

N3. **(a)** $\frac{-10}{5} = -2$

(b) $\frac{-1.44}{-0.12} = 12$

(c) $-\frac{3}{8} \div \frac{7}{10} = -\frac{3}{8} \cdot \frac{10}{7} = -\frac{15}{28}$

4. **(a)** $-3(4) - 2(-6) = -12 - (-12)$
$= -12 + 12$
$= 0$

(b) $|9 - 4(5)| - 3(-4) = |9 - 20| - 3(-4)$
$= |-11| - 3(-4)$
$= 11 - 3(-4)$
$= 11 - (-12)$
$= 11 + 12$
$= 23$

(c) $\frac{-6(-8) + (-3)9}{(-2)[4 - (-3)]} = \frac{48 - 27}{-2(4 + 3)}$
$= \frac{21}{-2(7)}$
$= \frac{21}{-14}$
$= -\frac{3}{2}$

N4. **(a)** $-4(6)-(-5)5=-24-(-25)$
$=-24+25$
$=1$

(b) $\frac{12(-4)-6(-3)}{-4(7-16)}=\frac{-48-(-18)}{-4(-9)}$
$=\frac{-48+18}{36}$
$=\frac{-30}{36}$
$=-\frac{5}{6}$

5. Replace x with -2 and y with -3.

$\frac{2x-4y^2}{4}=\frac{2(-2)-4(-3)^2}{4}$
$=\frac{2(-2)-4(9)}{4}$
$=\frac{-4-36}{4}$
$=\frac{-40}{4}$
$=-10$

N5. Replace x with -4 and y with -3.

$\frac{3x^2-12}{y}=\frac{3(-4)^2-12}{-3}$
$=\frac{3(16)-12}{-3}$
$=\frac{48-12}{-3}$
$=\frac{36}{-3}$
$=-12$

6. **(a)** "Three times the difference of 4 and -11" is written $3[4-(-11)]$.
$3[4-(-11)]=3(15)=45$

(b) "Three-fifths of the sum of 2 and -7" is written $\frac{3}{5}[2+(-7)]$.
$\frac{3}{5}[2+(-7)]=\frac{3}{5}(-5)=-3$

N6. **(a)** "Twice the sum of -10 and 7" is written $2(-10+7)$.
$2(-10+7)=2(-3)=-6$

(b) "40% of the difference of 45 and 15" is written $0.40(45-15)$.
$0.40(45-15)=0.4(30)=12.$

7. "The product of -9 and 2, divided by the difference of 5 and -1" is written $\frac{-9(2)}{5-(-1)}$.

$\frac{-9(2)}{5-(-1)}=\frac{-18}{6}=-3$

N7. "The quotient of 21 and the sum of 10 and -7" is written $\frac{21}{10+(-7)}$.

$\frac{21}{10+(-7)}=\frac{21}{3}=7$

8. **(a)** "Twice a number is -10" is written $2x=-10$. Since $2(-5)=-10$, the solution is -5.

(b) "The quotient of a number and -2 is 6" is written $\frac{x}{-2}=6$. Here, x must be a negative number, since the denominator is negative and the quotient is positive. Since $\frac{-12}{-2}=6$, the solution is -12.

N8. **(a)** "The sum of a number and -4 is 7" is written $x+(-4)=7$. Here, x must be 4 more than 7, so the solution is 11.
$11+(-4)=7$

(b) "The difference of -8 and a number is -11" is written $-8-x=-11$. If we start at -8 on a number line, we must move 3 units to the left to get to -11, so the solution is 3.

Exercises

1. The product or the quotient of two numbers with the same sign is positive, since the product or quotient of two positive numbers is positive and the product or quotient of two negative numbers is positive.

2. The product or quotient of two numbers with different signs is negative, since the product or quotient is negative.

3. If three negative numbers are multiplied, the product is negative, since a negative number times a negative number is a positive number, and that positive number times a negative number is a negative number.

4. If two negative numbers are multiplied and then their product is divided by a negative number, the result is negative, since the product is a positive number, and a positive number divided by a negative number is a negative number.

5. If a negative number is squared and the result is added to a positive number, the result is positive, since a negative number squared is a positive number, and a positive number added to another positive number is a positive number.

6. The reciprocal of a negative number is negative, since it is just the number one divided by a negative number, which is negative.

7. If three positive numbers, five negative numbers, and zero are multiplied, the product is 0. Since one of the numbers is zero, the product is zero (regardless of what the other numbers are).

8. The cube power of a negative number is negative. Remember, a negative number raised to an odd power (like 3) is negative.

9. The quotient formed by any nonzero number divided by 0 is undefined, and the quotient formed by 0 divided by any nonzero number is 0. Examples include $\frac{1}{0}$, which is undefined, and $\frac{0}{1}$, which equals 0.

10. Look for the expression that has 0 in the denominator. The expression $\frac{4-4}{4-4}$, or $\frac{0}{0}$, is undefined. The correct response is C.

11. $-7(4) = -(7 \cdot 4) = -28$

Note that the product of a negative number and a positive number is negative.

12. $-8(5) = -(8 \cdot 5) = -40$

Note that the product of a negative number and a positive number is negative.

13. $-5(-6) = 30$

Note that the product of two negative numbers is positive.

14. $-3(-4) = 12$

Note that the product of two negative numbers is positive.

15. $-10(-12) = 120$

16. $-9(-5) = 45$

17. $3(-11) = -(3 \cdot 11) = -33$

18. $3(-15) = -(3 \cdot 15) = -45$

19. $-0.5(0) = 0$

20. $-0.3(0) = 0$

21. $-6.8(0.35) = -(6.8 \cdot 0.35) = -2.38$

22. $-4.6(0.24) = -(4.6 \cdot 0.24) = -1.104$

23. $$-\frac{3}{8}\left(-\frac{20}{9}\right) = \frac{3}{8} \cdot \frac{20}{9} = \frac{5}{6}$$

24. $$-\frac{5}{6}\left(-\frac{16}{15}\right) = \frac{5}{6} \cdot \frac{16}{15} = \frac{8}{9}$$

25. $$\frac{2}{15}\left(-1\frac{1}{4}\right) = -\left(\frac{2}{15} \cdot \frac{5}{4}\right) = -\frac{1}{6}$$

26. $$\frac{3}{7}\left(-1\frac{5}{9}\right) = -\left(\frac{3}{7} \cdot \frac{14}{9}\right) = -\frac{2}{3}$$

27. $-8\left(-\frac{3}{4}\right) = 6$

28. $-6\left(-\frac{2}{3}\right) = 4$

29. Using only positive integer factors, 32 can be written as $1 \cdot 32$, $2 \cdot 16$, or $4 \cdot 8$. Including the negative integer factors, we see that the integer factors of 32 are $-32, -16, -8, -4, -2, -1, 1, 2, 4, 8, 16$, and 32.

30. The integer factors of 36 are $-36, -18, -12, -9, -6, -4, -3, -2, -1, 1, 2, 3, 4, 6, 9, 12, 18$, and 36.

31. The integer factors of 40 are $-40, -20, -10, -8, -5, -4, -2, -1, 1, 2, 4, 5, 8, 10, 20$, and 40.

32. The integer factors of 50 are $-50, -25, -10, -5, -2, -1, 1, 2, 5, 10, 25,$ and 50.

33. The integer factors of 31 are $-31, -1, 1,$ and 31.

34. The integer factors of 17 are $-17, -1, 1,$ and 17.

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

36. $\frac{35}{5} = \frac{7 \cdot 5}{5} = \frac{7}{1} = 7$

37. $\frac{-42}{6} = -\frac{2 \cdot 3 \cdot 7}{2 \cdot 3} = -7$

Note that the quotient of two numbers having different signs is negative.

38. $\frac{-28}{7} = -\frac{4 \cdot 7}{7} = -4$

Note that the quotient of two numbers having different signs is negative.

39. $\frac{-32}{-4} = \frac{4 \cdot 8}{4} = 8$

Note that the quotient of two numbers having the same sign is positive.

40. $\frac{-35}{-5} = \frac{5 \cdot 7}{5} = 7$

Note that the quotient of two numbers having the same sign is positive.

41. $\frac{96}{-16} = -\frac{6 \cdot 16}{16} = -6$

42. $\frac{38}{-19} = -\frac{2 \cdot 19}{19} = -2$

43. $\frac{-8.8}{2.2} = -\frac{4(2.2)}{2.2} = -4$

44. $\frac{-4.6}{2.3} = -2$

45. Dividing by a fraction (in this case, $-\frac{1}{8}$) is the same as multiplying by the reciprocal of the fraction (in this case, $-\frac{8}{1}$).

$$-\frac{4}{3} \div \left(-\frac{1}{8}\right) = -\frac{4}{3} \cdot \left(-\frac{8}{1}\right)$$
$$= \frac{32}{3}, \text{ or } 10\frac{2}{3}$$

46. Dividing by a fraction (in this case, $-\frac{1}{3}$) is the same as multiplying by the reciprocal of the fraction (in this case, $-\frac{3}{1}$).

$$-\frac{6}{5} \div \left(-\frac{1}{3}\right) = -\frac{6}{5} \cdot \left(-\frac{3}{1}\right)$$
$$= \frac{18}{5}, \text{ or } 3\frac{3}{5}$$

47. $-\frac{5}{6} \div \frac{8}{9} = -\frac{5}{6} \cdot \frac{9}{8}$

$= -\frac{45}{48}, \text{ or } -\frac{15}{16}$

48. $-\frac{7}{10} \div \frac{3}{4} = -\frac{7}{10} \cdot \frac{4}{3}$

$= -\frac{28}{30}, \text{ or } -\frac{14}{15}$

49. $\frac{0}{-5} = 0,$ because 0 divided by any nonzero number is 0.

50. $\frac{0}{-9} = 0,$ because 0 divided by any nonzero number is 0.

51. $\frac{11.5}{0}$ is undefined, because we cannot divide by 0.

52. $\frac{15.2}{0}$ is undefined, because we cannot divide by 0.

53. $7 - 3 \cdot 6 = 7 - 18$

$= -11$

54. $8 - 2 \cdot 5 = 8 - 10$

$= -2$

55. $-10 - (-4)(2) = -10 - (-8)$

$= -10 + 8$

$= -2$

56. $-11 - (-3)(6) = -11 - (-18)$

$= -11 + 18$

$= 7$

57. $-2(5) - (-4)(2) = -10 - (-8)$

$= -10 + 8$

$= -2$

58. $-4(3)-(-3)(6)=-12-(-18)$
$=-12+18$
$=6$

59. $-7(3-8)=-7(-5)$
$=35$

60. $-5(4-7)=-5(-3)$
$=15$

61. $7+2(4-1)=7+2(3)$
$=7+6$
$=13$

62. $5+3(6-4)=5+3(2)$
$=5+6$
$=11$

63. $-4+3(2-8)=-4+3(-6)$
$=-4-18$
$=-22$

64. $-8+4(5-7)=8+4(-2)$
$=-8-8$
$=-16$

65. $(12-14)(1-4)=(-2)(-3)$
$=6$

66. $(8-9)(4-12)=(-1)(-8)$
$=8$

67. $(7-10)(10-4)=(-3)(6)$
$=-18$

68. $(5-12)(19-4)=-7(15)$
$=-105$

69. $(-2-8)(-6)+7=(-10)(-6)+7$
$=60+7$
$=67$

70. $(-9-4)(-2)+10=(-13)(-2)+10$
$=26+10$
$=36$

71. $3(-5)+|3-10|=-15+|-7|$
$=-15+7$
$=-8$

72. $4(-8)+|4-15|=-32+|-11|$
$=-32+11$
$=-21$

73. $|8-7(2)|-6(-2)=|8-14|-6(-2)$
$=|-6|-6(-2)$
$=6-6(-2)$
$=6-(-12)$
$=18$

74. $|5-3(9)|-7(-4)=|5-27|-7(-4)$
$=|-22|-7(-4)$
$=22-7(-4)$
$=22-(-28)$
$=50$

75. $\frac{-5(-6)}{9-(-1)}=\frac{30}{9+1}=\frac{30}{10}=3$

76. $\frac{-12(-5)}{7-(-5)}=\frac{60}{7+5}=\frac{60}{12}=5$

77. $\frac{-21(3)}{-3-6}=\frac{-63}{-9}=7$

78. $\frac{-40(3)}{-2-3}=\frac{-120}{-5}=24$

79. $\frac{-10(2)+6(2)}{-3-(-1)}=\frac{-20+12}{-3+1}$
$=\frac{-8}{-2}$
$=4$

80. $\frac{-12(4)+5(3)}{-14-(-3)}=\frac{-48+15}{-14+3}$
$=\frac{-33}{-11}$
$=3$

81. $\frac{-6-|-9+5|}{2-(-3)}=\frac{-6-|-4|}{2+3}$
$=\frac{-6-4}{5}$
$=\frac{-10}{5}$
$=-2$

82. $\dfrac{-8-|-3+2|}{-3-(-6)}=\dfrac{-8-|-1|}{-3+6}$
$=\dfrac{-8-1}{3}$
$=\dfrac{-9}{3}$
$=-3$

83. $\dfrac{3^2-4^2}{7(-8+9)}=\dfrac{9-16}{7(1)}=\dfrac{-7}{7}=-1$

84. $\dfrac{5^2-7^2}{2(3+3)}=\dfrac{25-49}{2(6)}$
$=\dfrac{-24}{12}$
$=-2$

85. $\dfrac{8(-1)-|(-4)(-3)|}{-6-(-1)}=\dfrac{-8-|12|}{-6+1}$
$=\dfrac{-8-12}{-5}$
$=\dfrac{-20}{-5}$
$=4$

86. $\dfrac{-27(-2)-|6\cdot 4|}{-2(3)-2(2)}=\dfrac{54-|24|}{-6-4}$
$=\dfrac{54-24}{-10}$
$=\dfrac{30}{-10}$
$=-3$

87. $\dfrac{-13(-4)-(-8)(-2)}{(-10)(2)-4(-2)}=\dfrac{52-16}{-20-(-8)}$
$=\dfrac{36}{-20+8}$
$=\dfrac{36}{-12}$
$=-3$

88. $\dfrac{-5(2)+[3(-2)-4]}{-3-(-1)}=\dfrac{-10+[-6-4]}{-3+1}$
$=\dfrac{-10+[-10]}{-2}$
$=\dfrac{-20}{-2}$
$=10$

89. $3+2\times 4\div 2-3\times 7-4+47$
$=3+\left(\dfrac{2\times 4}{2}\right)-(3\times 7)-4+47$
$=3+\left(\dfrac{8}{2}\right)-(21)-4+47$
$=3+4-21-4+47$
$=29$

90. The incorrect answer, 92, was obtained by performing all of the operations from left to right rather than following the rules for order of operations. The multiplications and divisions need to be done in order, before the additions and subtractions.

91. $5x-2y+3a=5(6)-2(-4)+3(3)$
$=30-(-8)+9$
$=30+8+9$
$=38+9$
$=47$

92. $6x-5y+4a=6(6)-5(-4)+4(3)$
$=36+20+12$
$=56+12$
$=68$

93. $(2x+y)(3a)=[2(6)+(-4)][3(3)]$
$=[12+(-4)](9)$
$=(8)(9)$
$=72$

94. $(5x-2y)(-2a)=[5(6)-2(-4)][-2(3)]$
$=(30+8)(-6)$
$=(38)(-6)$
$=-228$

95. $\left(\frac{1}{3}x-\frac{4}{5}y\right)\left(-\frac{1}{5}a\right)$
$=\left[\frac{1}{3}(6)-\frac{4}{5}(-4)\right]\left[-\frac{1}{5}(3)\right]$
$=\left[2-\left(-\frac{16}{5}\right)\right]\left(-\frac{3}{5}\right)$
$=\left(2+\frac{16}{5}\right)\left(-\frac{3}{5}\right)$
$=\left(\frac{10}{5}+\frac{16}{5}\right)\left(-\frac{3}{5}\right)$
$=\left(\frac{26}{5}\right)\left(-\frac{3}{5}\right)$
$=-\frac{78}{25}$

96. $\left(\frac{5}{6}x+\frac{3}{2}y\right)\left(-\frac{1}{3}a\right)$
$=\left[\frac{5}{6}(6)+\frac{3}{2}(-4)\right]\left[-\frac{1}{3}(3)\right]$
$=[5+(-6)](-1)$
$=(-1)(-1)$
$=1$

97. $(6-x)(5+y)(3+a)$
$=(6-6)[5+(-4)](3+3)$
$=0(1)(6)$
$=0$

98. $(-5+x)(-3+y)(3-a)$
$=(-5+6)[-3+(-4)][3-3]$
$=(1)(-7)(0)$
$=0$

99. $-2y^2+3a^2=-2(-4)^2+3(3)^2$
$=-2(16)+3(9)$
$=-32+27$
$=-5$

100. $5x^2-4y^2=5(6)^2-4(-4)^2$
$=5(36)-4(16)$
$=180-64$
$=116$

101. $\frac{5y^2+4}{x}=\frac{5(-4)^2+4}{6}$
$=\frac{5(16)+4}{6}$
$=\frac{80+4}{6}$
$=\frac{84}{6}$
$=14$

102. $\frac{11-3a^2}{y}=\frac{11-3(3)^2}{-4}$
$=\frac{11-3(9)}{-4}$
$=\frac{11-27}{-4}$
$=\frac{-16}{-4}$
$=4$

103. $\frac{2y-x}{a-3}=\frac{2(-4)-(6)}{3-3}$
$=\frac{(-8)-6}{0}$
$=\frac{-14}{0}$
The expression is undefined.

104. $\frac{xy+8a}{x-6}=\frac{6(-4)+8(3)}{6-6}$
$=\frac{-24+24}{0}$
$=\frac{0}{0}$
The expression is undefined.

105. "The product of -9 and 2, added to 9" is written $9+(-9)(2)$.
$9+(-9)(2)=9+(-18)$
$=-9$

106. "The product of 4 and -7, added to -12" is written $-12+4(-7)$.
$-12+4(-7)=-12+(-28)$
$=-40$

107. "Twice the product of -1 and 6, subtracted from -4" is written $-4-2[(-1)(6)]$.

$$\begin{aligned}-4-2[(-1)(6)] &= -4-2(-6)\\ &= -4-(-12)\\ &= -4+12\\ &= 8\end{aligned}$$

108. "Twice the product of -8 and 2, subtracted from -1" is written $-1-2(-8)(2)$.

$$\begin{aligned}-1-2[(-8)(2)] &= -1-2(-16)\\ &= -1-(-32)\\ &= -1+32\\ &= 31\end{aligned}$$

109. "Nine subtracted from the product of 1.5 and -3.2" is written $(1.5)(-3.2)-9$.

$$\begin{aligned}(1.5)(-3.2)-9 &= -4.8-9\\ &= -4.8+(-9)\\ &= -13.8\end{aligned}$$

110. "Three subtracted from the product of 4.2 and -8.5" is written $(4.2)(-8.5)-3$.

$$\begin{aligned}(4.2)(-8.5)-3 &= -35.7-3\\ &= -35.7+(-3)\\ &= -38.7\end{aligned}$$

111. "The product of 12 and the difference of 9 and -8" is written $12[9-(-8)]$.

$$\begin{aligned}12[9-(-8)] &= 12[9+8]\\ &= 12(17)\\ &= 204\end{aligned}$$

112. "The product of -3 and the difference of 3 and -7" is written $-3[3-(-7)]$.

$$\begin{aligned}-3[3-(-7)] &= -3[3+7]\\ &= -3(10)\\ &= -30\end{aligned}$$

113. "The quotient of -12 and the sum of -5 and -1" is written $\frac{-12}{-5+(-1)}$, and

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

114. "The quotient of -20 and the sum of -8 and -2" is written $\frac{-20}{-8+(-2)}$, and

$$\frac{-20}{-8+(-2)} = \frac{-20}{-10} = 2.$$

115. "The sum of 15 and -3, divided by the product of 4 and -3" is written $\frac{15+(-3)}{4(-3)}$, and

$$\frac{15+(-3)}{4(-3)} = \frac{12}{-12} = -1.$$

116. "The sum of -18 and -6, divided by the product of 2 and -4" is written $\frac{-18+(-6)}{2(-4)}$, and $\frac{-18+(-6)}{2(-4)} = \frac{-24}{-8} = 3.$

117. "Two-thirds of the difference of 8 and -1" is written $\frac{2}{3}[8-(-1)]$, and

$$\begin{aligned}\frac{2}{3}[8-(-1)] &= \frac{2}{3}[8+(1)]\\ &= \frac{2}{3}[9]\\ &= 6\end{aligned}$$

118. "Three-fourths of the sum of -8 and 12" is written $\frac{3}{4}(-8+12)$, and

$$\frac{3}{4}(-8+12) = \frac{3}{4}(4) = 3.$$

119. "20% of the product of -5 and 6" is written $0.20(-5\cdot 6)$, and

$$0.20(-5\cdot 6) = 0.20(-30) = -6.$$

120. "30% of the product of -8 and 5" is written $0.30(-8\cdot 5)$, and

$$0.30(-8\cdot 5) = 0.30(-40) = -12.$$

121. "The sum of $\frac{1}{2}$ and $\frac{5}{8}$, times the difference of $\frac{3}{5}$ and $\frac{1}{3}$" is written $\left(\frac{1}{2}+\frac{5}{8}\right)\left(\frac{3}{5}-\frac{1}{3}\right)$, and

$$\begin{aligned}\left(\frac{1}{2}+\frac{5}{8}\right)\left(\frac{3}{5}-\frac{1}{3}\right) &= \left(\frac{4}{8}+\frac{5}{8}\right)\left(\frac{9}{15}-\frac{5}{15}\right)\\ &= \frac{9}{8}\left(\frac{4}{15}\right)\\ &= \frac{3}{10}\end{aligned}$$

122. "The sum of $\frac{3}{4}$ and $\frac{1}{2}$, times the difference of $\frac{2}{3}$ and $\frac{1}{6}$" is written $\left(\frac{3}{4}+\frac{1}{2}\right)\left(\frac{2}{3}-\frac{1}{6}\right)$, and

$$\begin{aligned}\left(\frac{3}{4}+\frac{1}{2}\right)\left(\frac{2}{3}-\frac{1}{6}\right) &= \left(\frac{3}{4}+\frac{2}{4}\right)\left(\frac{4}{6}-\frac{1}{6}\right)\\ &= \frac{5}{4}\left(\frac{3}{6}\right)\\ &= \frac{5}{8}\end{aligned}$$

123. "The product of $-\frac{1}{2}$ and $\frac{3}{4}$, divided by $-\frac{2}{3}$" is written $\dfrac{-\frac{1}{2}\left(\frac{3}{4}\right)}{-\frac{2}{3}}$. Simplifying gives us

$$\begin{aligned}\frac{-\frac{1}{2}\left(\frac{3}{4}\right)}{-\frac{2}{3}} &= \frac{-\frac{3}{8}}{-\frac{2}{3}}\\ &= -\frac{3}{8}\cdot\left(-\frac{3}{2}\right)\\ &= \frac{9}{16}\end{aligned}$$

124. "The product of $-\frac{2}{3}$ and $-\frac{1}{5}$, divided by $\frac{1}{7}$" is written $\dfrac{-\frac{2}{3}\left(-\frac{1}{5}\right)}{\frac{1}{7}}$. Simplifying gives us

$$\begin{aligned}\frac{-\frac{2}{3}\left(-\frac{1}{5}\right)}{\frac{1}{7}} &= \frac{\frac{2}{15}}{\frac{1}{7}}\\ &= \frac{2}{15}\cdot\frac{7}{1}\\ &= \frac{14}{15}\end{aligned}$$

125. "The quotient of a number and 3 is -3" is written $\frac{x}{3}=-3$. The solution is -9, because $\frac{-9}{3}=-3$.

126. "The quotient of a number and 4 is -1" is written $\frac{x}{4}=-1$. The solution is -4, because $\frac{-4}{4}=-1$.

127. "6 less than a number is 4" is written $x-6=4$. The solution is 10, because $10-6=4$.

128. "7 less than a number is 2" is written $x-7=2$. The solution is 9, because $9-7=2$.

129. "When 5 is added to a number, the result is -5" is written $x+5=-5$. The solution is -10, because $-10+5=-5$.

130. "When 6 is added to a number, the result is -3" is written $x+6=-3$. The solution is -9, because $-9+6=-3$.

131. **(a)** 3,473,986 is divisible by 2 because its last digit, 6, is divisible by 2.

(b) 4,336,879 is not divisible by 2 because its last digit, 9, is not divisible by 2.

132. **(a)** 4,799,232 is divisible by 3 because the sum of its digits, $4+7+9+9+2+3+2=36$, is divisible by 3.

(b) 2,443,871 is not divisible by 3 because the sum of its digits, $2+4+4+3+8+7+1=29$, is not divisible by 3.

133. **(a)** 2,876,335 is not divisible by 4 because the number formed by its last two digits, 35, is not divisible by 4.

(b) 6,221,464 is divisible by 4 because the number formed by its last two digits, 64, is divisible by 4.

134. **(a)** 9,332,123 is not divisible by 5 because its last digit, 3, is not divisible by 5.

(b) 3,774,595 is divisible by 5 because its last digit, 5, is divisible by 5.

135. **(a)** 1,524,822 is divisible by 2 because its last digit, 2, is divisible by 2. It is also divisible by 3 because the sum of its digits, $1+5+2+4+8+2+2=24,$ is divisible by 3. Because 1,524,822 is divisible by both 2 and 3, it is divisible by 6.

(b) 2,873,590 is divisible by 2 because its last digit, 0, is divisible by 2. However, it is not divisible by 3 because the sum of its digits, $2+8+7+3+5+9+0=34,$ is not divisible by 3. Because 2,873,590 is not divisible by both 2 and 3, it is not divisible by 6.

136. **(a)** 2,923,296 is divisible by 8 because the number formed by its last three digits, 296, is divisible by 8.

(b) 7,291,623 is not divisible by 8 because the number formed by its last three digits, 623, is not divisible by 8.

137. **(a)** 2,287,321 is not divisible by 9 because the sum of its digits, $2+2+8+7+3+2+1=25,$ is not divisible by 9.

(b) 4,114,107 is divisible by 9 because the sum of its digits, $4+1+1+4+1+0+7=18,$ is divisible by 9.

138. **(a)** 4,249,474 is not divisible by 3 because the sum of its digits, $4+2+4+9+4+7+4=34,$ is not divisible by 3. Because a number is not divisible by 12 unless it is divisible by both 3 and 4, this is sufficient to show that the number is not divisible by 12.

(b) 4,253,520 is divisible by 3 because the sum of its digits, $4+2+5+3+5+2+0=21,$ is divisible by 3. It is also divisible by 4 because the number formed by its last two digits, 20, is divisible by 4. Because 4,253,520 is divisible by both 3 and 4, it is divisible by 12.

139. Add the numbers.

$$\begin{aligned}&23+18+13+(-4)+(-8)\\&=41+13+(-4)+(-8)\\&=54+(-4)+(-8)\\&=50+(-8)\\&=42\end{aligned}$$

140. There are 5 numbers in the group.

141. Divide 42 (the answer for Exercise 139) by 5 (the answer for Exercise 140).

$$\frac{42}{5}=8\frac{2}{5}$$

142. To find the average of a group of numbers, we add the numbers and then divide the sum by the number of terms added. The average of the given group of numbers is $\frac{42}{5}=8\frac{2}{5}$.

143. Add the numbers and divide by 4.

$$\begin{aligned}\frac{-15+29+8+(-6)}{4}&=\frac{14+8+(-6)}{4}\\&=\frac{22+(-6)}{4}\\&=\frac{16}{4}\\&=4\end{aligned}$$

144. Add the numbers and divide by 4.

$$\begin{aligned}\frac{-17+34+9+(-2)}{4}&=\frac{17+9+(-2)}{4}\\&=\frac{26+(-2)}{4}\\&=\frac{24}{4}\\&=6\end{aligned}$$

145. Add the integers from -10 to 14.

$(-10)+(-9)+\cdots+14=50$

[The 3 dots indicate that the pattern continues.] There are 25 integers from -10 to 14 (10 negative, zero, and 14 positive). Thus, the average is $\frac{50}{25}=2$.

146. Add the integers from -15 to -10.
$(-15)+(-14)+\cdots+(-11)+(-10)=-75$
There are 6 integers from from -15 to -10.
Thus, the average is $\frac{-75}{6}=-12\frac{1}{2}$.

Summary Exercises: Performing Operations with Real Numbers

1. $$\begin{aligned}14-3\cdot 10&=14-30\\&=14+(-30)\\&=-16\end{aligned}$$

2. $$\begin{aligned}-3(8)-4(-7)&=-24-(-28)\\&=-24+28\\&=4\end{aligned}$$

3. $$\begin{aligned}(3-8)(-2)-10&=(-5)(-2)-10\\&=10-10\\&=0\end{aligned}$$

4. $$\begin{aligned}-6(7-3)&=-6(4)\\&=-24\end{aligned}$$

5. $$\begin{aligned}7+3(2-10)&=7+3(-8)\\&=7-24\\&=-17\end{aligned}$$

6. $$\begin{aligned}-4[(-2)(6)-7]&=-4[-12-7]\\&=-4[-19]\\&=76\end{aligned}$$

7. $$\begin{aligned}(-4)(7)-(-5)(2)&=(-28)-(-10)\\&=-28+(10)\\&=-18\end{aligned}$$

8. $$\begin{aligned}-5[-4-(-2)(-7)]&=-5[-4-(14)]\\&=-5[-18]\\&=90\end{aligned}$$

9. $$\begin{aligned}40-(-2)[8-9]&=40-(-2)[-1]\\&=40-(2)\\&=38\end{aligned}$$

10. $$\begin{aligned}-5.1(-0.2)&=5.1(0.2)\\&=1.02\end{aligned}$$

11. $$\begin{aligned}-0.9(-3.7)&=0.9(3.7)\\&=3.33\end{aligned}$$

12. $$\begin{aligned}|-4(9)|-|-11|&=|-36|-11\\&=36-11\\&=25\end{aligned}$$

13. $$\begin{aligned}|-2(3)+4|-|-2|&=|-6+4|-2\\&=|-2|-2\\&=2-2\\&=0\end{aligned}$$

14. $$\begin{aligned}|11-3(-4)|-5(3)&=|11-(-12)|-15\\&=|11+12|-15\\&=|23|-15\\&=23-15\\&=8\end{aligned}$$

15. $$\begin{aligned}\frac{1}{2}\div\left(-\frac{1}{2}\right)&=\frac{1}{2}\cdot\left(-\frac{2}{1}\right)\\&=-\frac{2}{2}\\&=-1\end{aligned}$$

16. $$\begin{aligned}-\frac{3}{4}\div\left(-\frac{5}{8}\right)&=-\frac{3}{4}\cdot\left(-\frac{8}{5}\right)\\&=\frac{24}{20}\\&=\frac{6}{5},\quad\text{or}\quad 1\frac{1}{5}\end{aligned}$$

17. $$\begin{aligned}\left[\frac{5}{8}-\left(-\frac{1}{16}\right)\right]+\frac{3}{8}&=\left[\frac{10}{16}+\frac{1}{16}\right]+\frac{6}{16}\\&=\left[\frac{11}{16}\right]+\frac{6}{16}\\&=\frac{17}{16},\text{ or }1\frac{1}{16}\end{aligned}$$

18. $$\begin{aligned}\left(\frac{1}{2}-\frac{1}{3}\right)-\frac{5}{6}&=\left(\frac{3}{6}-\frac{2}{6}\right)-\frac{5}{6}\\&=\left(\frac{1}{6}\right)-\frac{5}{6}\\&=-\frac{4}{6}\\&=-\frac{2}{3}\end{aligned}$$

19. $\frac{5(-4)}{-7-(-2)}=\frac{-20}{-7+2}$
$=\frac{-20}{-5}$
$=4$

20. $\frac{5(-8+3)}{13(-2)+(-7)(-3)}=\frac{5(-5)}{-26+21}$
$=\frac{-25}{-5}$
$=5$

21. $\frac{-3-(-9+1)}{-7-(-6)}=\frac{-3-(-8)}{-7+6}$
$=\frac{-3+8}{-1}$
$=\frac{5}{-1}$
$=-5$

22. $\frac{2^2+4^2}{5^2-3^2}=\frac{4+16}{25-9}$
$=\frac{20}{16}$
$=\frac{5}{4}$, or $1\frac{1}{4}$

23. $\frac{(2+4)^2}{(5-3)^2}=\frac{(6)^2}{(2)^2}$
$=\frac{36}{4}$
$=9$

24. $\frac{4^2-3^2}{-5(-4+2)}=\frac{16-9}{-5(-2)}$
$=\frac{7}{10}$

25. $\frac{6^2-8}{-2(2)+4(-1)}=\frac{36-8}{-4+(-4)}$
$=\frac{28}{-8}$
$=-\frac{7}{2}$, or $-3\frac{1}{2}$

26. $\frac{6(-10+3)}{15(-2)-3(-9)}=\frac{6(-7)}{(-30)-(-27)}$
$=\frac{-42}{-30+27}$
$=\frac{-42}{-3}$
$=14$

27. $\frac{9(-6)-3(8)}{4(-7)+(-2)(-11)}=\frac{-54-24}{-28+22}$
$=\frac{-78}{-6}$
$=13$

28. $\frac{3^2-5^2}{(-9)^2-9^2}=\frac{9-25}{81-81}$
$=\frac{-16}{0}$, which is undefined.

29. $\frac{(-10)^2+10^2}{-10(5)}=\frac{100+100}{-50}$
$=\frac{200}{-50}$
$=-4$

30. $\frac{8^2-12}{(-5)^2+2(6)}=\frac{64-12}{25+12}$
$=\frac{52}{37}$, or $1\frac{15}{37}$

31. $\frac{-9(-6)+(-2)(27)}{3(8-9)}=\frac{54+(-54)}{3(-1)}$
$=\frac{0}{-3}$
$=0$

32. $\frac{16(-8+5)}{15(-3)+(-7-4)(-3)}=\frac{16(-3)}{-45+(-11)(-3)}$
$=\frac{-48}{-45+33}$
$=\frac{-48}{-12}$
$=4$

33. $-x+y-3a=-(-2)+3-3(4)$
$=2+3-12$
$=5-12$
$=-7$

34. $(x-y)-(a-2y)=(-2-3)-(4-2\cdot 3)$
$=(-5)-(4-6)$
$=-5-(-2)$
$=-5+2$
$=-3$

35. $(-8x-3y)(-2a)=[-8(-2)-3(3)][-2(4)]$
$=[16-9][-8]$
$=7[-8]$
$=-56$

36. $\frac{2x+3y}{a-xy}=\frac{2(-2)+3(3)}{4-(-2)(3)}$
$=\frac{-4+9}{4-(-6)}$
$=\frac{5}{4+6}$
$=\frac{5}{10}$
$=\frac{1}{2}$

37. $\frac{x^2-y^2}{x^2+y^2}=\frac{(-2)^2-3^2}{(-2)^2+3^2}$
$=\frac{4-9}{4+9}$
$=\frac{-5}{13}$
$=-\frac{5}{13}$

38. $-x^2+3y=-(-2)^2+3(3)$
$=-(4)+9$
$=5$

39. $\left(\frac{1}{2}x+\frac{2}{3}y\right)\left(-\frac{1}{4}a\right)$
$=\left(\frac{1}{2}(-2)+\frac{2}{3}(3)\right)\left(-\frac{1}{4}(4)\right)$
$=(-1+2)(-1)$
$=(1)(-1)$
$=-1$

40. $\frac{3a+6x}{-2y}=\frac{3(4)+6(-2)}{-2(3)}$
$=\frac{12+(-12)}{-6}$
$=\frac{0}{-6}$
$=0$

1.6 Properties of Real Numbers

Classroom Examples, Now Try Exercises

1. **(a)** $x+2=2+\underline{x}$

(b) $5x=x\cdot\underline{5}$

N1. **(a)** $7+(-3)=-3+\underline{7}$

(b) $(-5)4=4\cdot\underline{(-5)}$

2. **(a)** $-5+(2+8)=\underline{(-5+2)}+8$

(b) $10[(-8)\cdot(-3)]=\underline{[10\cdot(-8)]\cdot(-3)}$

N2. **(a)** $-9+(3+7)=\underline{(-9+3)}+7$

(b) $5[(-4)\cdot 9]=\underline{[5\cdot(-4)]\cdot 9}$

3. $(2\cdot 4)6=(4\cdot 2)6$

While the same numbers are grouped inside the two pairs of parentheses, the order of the numbers has been changed. This illustrates a commutative property.

N3. $5+(7+6)=5+(6+7)$

While the same numbers are grouped inside the two pairs of parentheses, the order of the numbers has been changed. This illustrates a commutative property.

4. **(a)** 43 + 26 + 17 + 24 + 6
$=(43+17)+(26+24)+6$
$=60+50+6$
$=110+6$
$=116$

(b) $\frac{1}{2}(67)(2)=\frac{1}{2}(2)(67)=1(67)=67$

N4. **(a)** $8+54+7+6+32$
$=(8+32)+(54+6)+7$
$=40+60+7$
$=100+7$
$=107$

(b) $5(37)(20)=5(20)(37)=100(37)=3700$

5. **(a)** $5+\underline{0}=5$ Additive identity

(b) $\underline{1}\cdot\frac{1}{3}=\frac{1}{3}$ Multiplicative identity

N5. **(a)** $\frac{2}{5}\cdot\underline{1}=\frac{2}{5}$ Multiplicative identity

(b) $8+\underline{0}=8$ Additive identity

6. **(a)** $\frac{36}{48}=\frac{3\cdot 12}{4\cdot 12}$ Factor.
$=\frac{3}{4}\cdot\frac{12}{12}$ Write as a product.
$=\frac{3}{4}\cdot 1$ Property of 1
$=\frac{3}{4}$ Identity property

(b) $\frac{3}{8}-\frac{5}{24}=\frac{3}{8}\cdot 1-\frac{5}{24}$ Identity property
$=\frac{3}{8}\cdot\frac{3}{3}-\frac{5}{24}$ Multiply by $\frac{3}{3}$.
$=\frac{9}{24}-\frac{5}{24}$ Multiply.
$=\frac{4}{24}$ Subtract.
$=\frac{1}{6}$ Reduce.

N6. **(a)** $\frac{16}{20}=\frac{4\cdot 4}{5\cdot 4}$ Factor.
$=\frac{4}{5}\cdot\frac{4}{4}$ Write as a product.
$=\frac{4}{5}\cdot 1$ Property of 1
$=\frac{4}{5}$ Identity property

(b) $\frac{2}{5}+\frac{3}{20}=\frac{2}{5}\cdot 1+\frac{3}{20}$ Identity property
$=\frac{2}{5}\cdot\frac{4}{4}+\frac{3}{20}$ Multiply by $\frac{4}{4}$.
$=\frac{8}{20}+\frac{3}{20}$ Multiply.
$=\frac{11}{20}$ Add.

7. **(a)** $\underline{-6}+6=0$ Inverse property of addition

(b) $-\frac{1}{9}\cdot\underline{(-9)}=1$ Inverse property of multiplication

N7. **(a)** $10+\underline{(-10)}=0$ Inverse property of addition

(b) $-9\cdot\underline{\left(-\frac{1}{9}\right)}=1$ Inverse property of multiplication

8. $\frac{1}{2}y+3-\frac{1}{2}y$
$=\left(\frac{1}{2}y+3\right)-\frac{1}{2}y$ Order of operations
$=\left(3+\frac{1}{2}y\right)-\frac{1}{2}y$ Commutative property
$=3+\left[\frac{1}{2}y+\left(-\frac{1}{2}y\right)\right]$ Associative property
$=3+0$ Inverse property
$=3$ Identity property

N8. $-\frac{1}{3}x+7+\frac{1}{3}x$
$=\left(-\frac{1}{3}x+7\right)+\frac{1}{3}x$ Order of operations
$=\left[7+\left(-\frac{1}{3}x\right)\right]+\frac{1}{3}x$ Commutative property
$=7+\left[\left(-\frac{1}{3}x\right)+\frac{1}{3}x\right]$ Associative property
$=7+0$ Inverse property
$=7$ Identity property

9. **(a)** $4(3+7)=4\cdot 3+4\cdot 7$ Distributive property
$=12+28$ Multiply.
$=40$ Add.

(b) $5(2m-3)=5(2m)-5(3)$
$=10m-15$

(c) $-6(x+2y-z)$
$=-6x+(-6)(2y)+(-6)(-z)$
$=-6x-12y+6z$

N9. **(a)** $2(p+5)=2p+2\cdot 5$ Distributive prop.
$=2p+10$ Multiply.

(b) $-5(4x+1)=-5(4x)+(-5)(1)$
$=-20x-5$

(c) $6(2r+t-5z)=6(2r)+6t+6(-5z)$
$=12r+6t-30z$

10. **(a)** $-(-5y+8)=-1(-5y+8)$
$=-1(-5y)+(-1)(8)$
$=5y-8$

(b) $-(x-y-z)=-1(x-y-z)$
$=-1(x)-1(-y)-1(-z)$
$=-x+y+z$

N10. **(a)** $-(2-r)=-1(2-1r)$
$=-1(2)-1(-1r)$
$=-2+r$

(b) $-(2x-5y-7)=-1(2x-5y-7)$
$=-1(2x)-1(-5y)-1(-7)$
$=-2x+5y+7$

Exercises

1. **(a)** B, since 0 is the identity element for addition.

(b) F, since l is the identity element for multiplication.

(c) C, since $-a$ is the additive inverse of a.

(d) I, since $\frac{1}{a}$ is the multiplicative inverse, or reciprocal, of any nonzero number a.

(e) B, since 0 is the only number that is equal to its negative—that is, $0=-0$.

(f) D and F, since -1 has reciprocal $\frac{1}{(-1)}=-1$ and 1 has a reciprocal $\frac{1}{(1)}=1$—that is, -1 and 1 are their own multiplicative inverses.

(g) B, since the multiplicative inverse of a number a is $\frac{1}{a}$ and the only number that we cannot divide by is 0.

(h) A, because the equation $(5\cdot 4)\cdot 3=(3\cdot 4)\cdot 5$ is true by the associative property.

(i) G, since we can consider $(5\cdot 4)$ to be one number, $(5\cdot 4)\cdot 3$ is the same as $3\cdot(5\cdot 4)$ by the commutative property.

(j) H, because $5(4+3)$ is the same as $5\cdot 4+5\cdot 3$ by the distributive property.

2. The commutative property allows us to change the *order* of the addends in a sum or the factors in a product.
The associative property allows us to change the *grouping* of the addends in a sum or the factors in a product.

3. "Washing your face" and "brushing your teeth" are commutative.

4. "Putting on your left sock" and "putting on your right sock" are commutative.

5. "Preparing a meal" and "eating a meal" are not commutative.

6. "Starting a car" and "driving away in a car" are not commutative.

7. "Putting on your socks" and "putting on your shoes" are not commutative.

8. "Getting undressed" and "taking a shower" are not commutative.

9. A "(large deposit) slip" is a slip for a large deposit of money, whereas a "large (deposit slip)" is a large piece of paper onto which a deposit is written.

10. "(Defective merchandise) counter" is a location at which we would return an item that does not work, whereas "defective (merchandise counter)" is a broken place where items are bought and sold.

11. $25-(6-2)=25-(4)$
$=21$
$(25-6)-2=19-2$
$=17$
Since $21\neq 17$, this example shows that subtraction does not appear to be associative.

12. $180\div(15\div 3)=180\div 5$
$=36$
$(180\div 15)\div 3=12\div 3$
$=4$
Since $36\neq 4$, this example shows that division does not appear to be associative.

13. In general, a number and its additive inverse have *opposite* signs. A number and its multiplicative inverse have *the same* signs.

Number	**Additive Inverse**	**Multiplicative Inverse**
5	−5	$\frac{1}{5}$
−10	10	$-\frac{1}{10}$
$-\frac{1}{2}$	$\frac{1}{2}$	−2
$\frac{3}{8}$	$-\frac{3}{8}$	$\frac{8}{3}$
$x(x\neq 0)$	$-x$	$\frac{1}{x}$
$-y(y\neq 0)$	y	$-\frac{1}{y}$

14. Jack recognized the identity property of addition.

15. $-15+9=9+\underline{(-15)}$ by the commutative property of addition.

16. $6+(-2)=-2+\underline{6}$ by the commutative property of addition.

17. $-8\cdot 3=\underline{3}\cdot(-8)$ by the commutative property of multiplication.

18. $-12\cdot 4=4\cdot\underline{(-12)}$ by the commutative property of multiplication.

19. $(3+6)+7=3+(\underline{6}+7)$ by the associative property of addition.

20. $(-2+3)+6=-2+(\underline{3}+6)$ by the associative property of addition.

21. $7\cdot(2\cdot 5)=(\underline{7}\cdot 2)\cdot 5$ by the associative property of multiplication.

22. $8\cdot(6\cdot 4)=(8\cdot\underline{6})\cdot 4$ by the associative property of multiplication.

23. $4+15=15+4$
The order of the two numbers has been changed, so this is an example of the commutative property of addition:
$a+b=b+a$.

24. $3+12=12+3$
The order of the two numbers has been changed, so this is an example of the commutative property of addition:
$a+b=b+a$.

25. $5\cdot(13\cdot 7)=(5\cdot 13)\cdot 7$
The numbers are in the same order but grouped differently, so this is an example of the associative property of multiplication:
$(ab)c=a(bc)$.

26. $-4(2\cdot 6)=(-4\cdot 2)\cdot 6$
The numbers are in the same order but grouped differently, so this is an example of the associative property of multiplication:
$(ab)c=a(bc)$.

27. $-6+(12+7)=(-6+12)+7$
The numbers are in the same order but grouped differently, so this is an example of the associative property of addition:
$(a+b)+c=a+(b+c)$.

28. $(-8+13)+2=-8+(13+2)$
The numbers are in the same order but grouped differently, so this is an example of the associative property of addition:
$(a+b)+c=a+(b+c)$.

29. $-9+9=0$
The sum of the two numbers is 0, so they are additive inverses (or opposites) of each other. This is an example of the additive inverse property: $a+(-a)=0$.

30. $1+(-1)=0$

The sum of the two numbers is 0, so they are additive inverses (or opposites) of each other. This is an example of the additive inverse property: $a+(-a)=0$.

31. $\frac{2}{3}\left(\frac{3}{2}\right)=1$

The product of the two numbers is l, so they are multiplicative inverses (or reciprocals) of each other. This is an example of the multiplicative inverse property: $a\cdot\frac{1}{a}=1(a\neq 0)$.

32. $\frac{5}{8}\left(\frac{8}{5}\right)=1$

The product of the two numbers is l, so they are multiplicative inverses (or reciprocals) of each other. This is an example of the multiplicative inverse property: $a\cdot\frac{1}{a}=1\,(a\neq 0)$.

33. $1.75+0=1.75$

The sum of a number and 0 is the original number. This is an example of the identity property of addition: $a+0=a$.

34. $-8.45+0=-8.45$

The sum of a number and 0 is the original number. This is an example of the identity property of addition: $a+0=a$.

35. $(4+17)+3=3+(4+17)$

The order of the numbers has been changed, but the grouping has not, so this is an example of the commutative property of addition: $a+b=b+a$.

36. $(-8+4)+12=12+(-8+4)$

The order of the numbers has been changed, but the grouping has not, so this is an example of the commutative property of addition: $a+b=b+a$.

37. $2(x+y)=2x+2y$

The number 2 outside the parentheses is "distributed" over the *x* and *y*. This is an example of the distributive property.

38. $9(t+s)=9t+9s$

The number 9 outside the parentheses is "distributed" over the *t* and *s*. This is an example of the distributive property.

39. $-\frac{5}{9}=-\frac{5}{9}\cdot\frac{3}{3}=-\frac{15}{27}$

$\frac{3}{3}$ is a form of the number 1. We use it to rewrite $-\frac{5}{9}$ as $-\frac{15}{27}$. This is an example of the identity property of multiplication.

40. $-\frac{7}{12}=-\frac{7}{12}\cdot\frac{7}{7}=-\frac{49}{84}$

$\frac{7}{7}$ is a form of the number 1. We use it to rewrite $-\frac{7}{12}$ as $-\frac{49}{84}$. This is an example of the identity property of multiplication.

41. $4(2x)+4(3y)=4(2x+3y)$

This is an example of the distributive property. The number 4 is "distributed" over $2x$ and $3y$.

42. $6(5t)-6(7r)=6(5t-7r)$

This is an example of the distributive property. The number 6 is "distributed" over $5t$ and $7r$.

43.
$$\begin{aligned}97+13+3+37&=(97+3)+(13+37)\\&=100+50\\&=150\end{aligned}$$

44.
$$\begin{aligned}49+199+1+1&=(49+1)+(199+1)\\&=50+200\\&=250\end{aligned}$$

45.
$$\begin{aligned}1999+2+1+8&=(1999+1)+(2+8)\\&=2000+10\\&=2010\end{aligned}$$

46.
$$\begin{aligned}2998+3+2+17&=(2998+2)+(3+17)\\&=3000+20\\&=3020\end{aligned}$$

47.
$$\begin{aligned}159+12+141+88&=(159+141)+(12+88)\\&=300+100\\&=400\end{aligned}$$

48.
$$\begin{aligned}106+8+14+72&=(106+14)+(8+72)\\&=120+80\\&=200\end{aligned}$$

49. $843+627+(-43)+(-27)$
$=[843+(-43)]+[627+(-27)]$
$=800+600$
$=1400$

50. $1846+1293+(-46)+(-93)$
$=[1846+(-46)]+[1293+(-93)]$
$=1800+1200$
$=3000$

51. $5(47)(2)=5(2)(47)=10(47)=470$

52. $2(79)(5)=2(5)(79)=10(79)=790$

53. $-4\cdot5\cdot93\cdot5=-4\cdot5\cdot5\cdot93$
$=-20\cdot5\cdot93$
$=-100\cdot93$
$=-9300$

54. $2\cdot25\cdot67\cdot(-2)=-2\cdot2\cdot25\cdot67$
$=-4\cdot25\cdot67$
$=-100\cdot67$
$=-6700$

55. $6t+8-6t+3$
$=6t+8+(-6t)+3$ Def. of subtraction
$=(6t+8)+(-6t)+3$ Order of operations
$=(8+6t)+(-6t)+3$ Commutative property
$=8+[6t+(-6t)]+3$ Associative property
$=8+0+3$ Inverse property
$=(8+0)+3$ Order of operations
$=8+3$ Identity property
$=11$ Add.

56. $9r+12-9r+1$
$=9r+12+(-9r)+1$ Def. of subtraction
$=(9r+12)+(-9r)+1$ Order of operations
$=(12+9r)+(-9r)+1$ Commutative property
$=12+[9r+(-9r)]+1$ Associative property
$=12+0+1$ Inverse property
$=(12+0)+1$ Order of operations
$=12+1$ Identity property
$=13$ Add.

57. $\frac{2}{3}x-11+11-\frac{2}{3}x$
$=\frac{2}{3}x+(-11)+11+\left(-\frac{2}{3}x\right)$
$=\left[\frac{2}{3}x+(-11)\right]+11+\left(-\frac{2}{3}x\right)$
$=\frac{2}{3}x+(-11+11)+\left(-\frac{2}{3}x\right)$ Associative prop.
$=\frac{2}{3}x+0+\left(-\frac{2}{3}x\right)$ Inverse property
$=\left(\frac{2}{3}x+0\right)+\left(-\frac{2}{3}x\right)$
$=\frac{2}{3}x+\left(-\frac{2}{3}x\right)$ Identity property
$=0$ Inverse property

58. $\frac{1}{5}y+4-4-\frac{1}{5}y$
$=\frac{1}{5}y+4+(-4)+\left(-\frac{1}{5}y\right)$
$=\left(\frac{1}{5}y+4\right)+(-4)+\left(-\frac{1}{5}y\right)$
$=\frac{1}{5}y+[4+(-4)]+\left(-\frac{1}{5}y\right)$ Associative prop.
$=\frac{1}{5}y+0+\left(-\frac{1}{5}y\right)$ Inverse property
$=\left(\frac{1}{5}y+0\right)+\left(-\frac{1}{5}y\right)$
$=\frac{1}{5}y+\left(-\frac{1}{5}y\right)$ Identity property
$=0$ Inverse property

59. $\left(\frac{9}{7}\right)(-0.38)\left(\frac{7}{9}\right)$
$=\left[\left(\frac{9}{7}\right)(-0.38)\right]\left(\frac{7}{9}\right)$ Order of operations
$=\left[(-0.38)\left(\frac{9}{7}\right)\right]\left(\frac{7}{9}\right)$ Commutative property
$=(-0.38)\left[\left(\frac{9}{7}\right)\left(\frac{7}{9}\right)\right]$ Associative property
$=(-0.38)(1)$ Inverse property
$=-0.38$ Identity property

60. $\left(\frac{4}{5}\right)(-0.73)\left(\frac{5}{4}\right)$

$=\left[\left(\frac{4}{5}\right)(-0.73)\right]\left(\frac{5}{4}\right)$ Order of operations

$=\left[(-0.73)\left(\frac{4}{5}\right)\right]\left(\frac{5}{4}\right)$ Commutative property

$=(-0.73)\left[\left(\frac{4}{5}\right)\left(\frac{5}{4}\right)\right]$ Associative property

$=(-0.73)(1)$ Inverse property

$=-0.73$ Identity property

61. $t+(-t)+\frac{1}{2}(2)$

$=t+(-t)+1$ Inverse property

$=[t+(-t)]+1$ Order of operations

$=0+1$ Inverse property

$=1$ Identity property

62. $w+(-w)+\frac{1}{4}(4)$

$=w+(-w)+1$ Inverse property

$=[w+(-w)]+1$ Order of operations

$=0+1$ Inverse property

$=1$ Identity property

63. When distributing a negative number over a quantity, be careful not to "lose" a negative sign. The problem should be worked in the following way.

$$\begin{aligned}-3(4-6)&=-3(4)-3(-6)\\&=-12+18\\&=6\end{aligned}$$

64. In the third line, -1 must also be distributed to the number 4.

$$\begin{aligned}-(3x+4)&=-1(3x+4)\\&=-1(3x)+(-1)(4)\\&=-3x-4\end{aligned}$$

65. $\frac{3}{4}=\frac{3}{4}\cdot 1=\frac{3}{4}\cdot\frac{3}{3}=\frac{9}{12}$

To rewrite $\frac{3}{4}$ as $\frac{9}{12}$, use the fact that $\frac{3}{3}$ is another name for the multiplicative identity element, 1.

66. $\frac{9}{12}=\frac{3}{3}\cdot\frac{3}{4}=1\cdot\frac{3}{4}=\frac{3}{4}$

To rewrite $\frac{9}{12}$ as $\frac{3}{4}$, use the fact that $\frac{3}{3}$ is another name for the multiplicative identity element, 1.

67. $$\begin{aligned}5(9+8)&=5\cdot 9+5\cdot 8\\&=45+40\\&=85\end{aligned}$$

68. $$\begin{aligned}6(11+8)&=6\cdot 11+6\cdot 8\\&=66+48\\&=114\end{aligned}$$

69. $$\begin{aligned}4(t+3)&=4\cdot t+4\cdot 3\\&=4t+12\end{aligned}$$

70. $$\begin{aligned}5(w+4)&=5\cdot w+5\cdot 4\\&=5w+20\end{aligned}$$

71. $$\begin{aligned}7(z-8)&=7[z+(-8)]\\&=7z+7(-8)\\&=7z-56\end{aligned}$$

72. $$\begin{aligned}8(x-6)&=8[x+(-6)]\\&=8x+8(-6)\\&=8x-48\end{aligned}$$

73. $$\begin{aligned}-8(r+3)&=-8(r)+(-8)(3)\\&=-8r+(-24)\\&=-8r-24\end{aligned}$$

74. $$\begin{aligned}-11(x+4)&=-11(x)+(-11)(4)\\&=-11x-44\end{aligned}$$

75. $-\frac{1}{4}(8x+3)$

$$\begin{aligned}&=-\frac{1}{4}(8x)+\left(-\frac{1}{4}\right)(3)\\&=\left[\left(-\frac{1}{4}\right)\cdot 8\right]x-\frac{3}{4}\\&=-2x-\frac{3}{4}\end{aligned}$$

76. $-\frac{1}{3}(9x+5)=-\frac{1}{3}(9x)+\left(-\frac{1}{3}\right)(5)$
$=\left[\left(-\frac{1}{3}\right)\cdot 9\right]x-\frac{5}{3}$
$=-3x-\frac{5}{3}$

77. $-\frac{1}{3}(9x-4)=-\frac{1}{3}[9x+(-4)]$
$=-\frac{1}{3}(9x)+\left(-\frac{1}{3}\right)(-4)$
$=\left[\left(-\frac{1}{3}\right)\cdot 9\right]x+\frac{4}{3}$
$=-3x+\frac{4}{3}$

78. $-\frac{1}{5}(5x-7)=-\frac{1}{5}[5x+(-7)]$
$=-\frac{1}{5}(5x)+\left(-\frac{1}{5}\right)(-7)$
$=\left[\left(-\frac{1}{5}\right)\cdot 5\right]x+\left(-\frac{1}{5}\right)(-7)$
$=-x+\frac{7}{5}$

79. $2(6x+5)=2(6x)+2(5)$
$=12x+10$

80. $3(3x+4)=3(3x)+3(4)$
$=9x+12$

81. $-3(2x-5)=(-3)(2x)+(-3)(-5)$
$=-6x+15$

82. $-4(3x-2)=(-4)(3x)+(-4)(-2)$
$=-12x+8$

83. $-0.6(8x+1.2)=(-0.6)(8x)+(-0.6)(1.2)$
$=-4.8x-0.72$

84. $-5.2(4x+2.3)=(-5.2)(4x)+(-5.2)(2.3)$
$=-20.8x-11.96$

85. $-\frac{4}{3}(12y+15z)=-\frac{4}{3}(12y)+\left(-\frac{4}{3}\right)(15z)$
$=\left[\left(-\frac{4}{3}\right)\cdot 12\right]y+\left[\left(-\frac{4}{3}\right)\cdot 15\right]z$
$=-16y+(-20)z$
$=-16y-20z$

86. $-\frac{2}{5}(10b+20a)=-\frac{2}{5}(10b)+\left(-\frac{2}{5}\right)(20a)$
$=\left[\left(-\frac{2}{5}\right)\cdot 10\right]b+\left[\left(-\frac{2}{5}\right)\cdot 20\right]a$
$=-4b+(-8a)$
$=-4b-8a$

87. $8(3r+4s-5y)=8(3r)+8(4s)+8(-5y)$
$=(8\cdot 3)r+(8\cdot 4)s+[8(-5)]y$
$=24r+32s-40y$

88. $2(5u-3v+7w)=2(5u)+2(-3v)+2(7w)$
$=(2\cdot 5)u+[2(-3)]v+(2\cdot 7)w$
$=10u-6v+14w$

89. $-3(8x+3y+4z)$
$=-3(8x)+(-3)(3y)+(-3)(4z)$
$=(-3\cdot 8)x+(-3\cdot 3)y+(-3\cdot 4)z$
$=-24x-9y-12z$

90. $-5(2x-5y+6z)$
$=-5(2x)+(-5)(-5y)+(-5)(6z)$
$=(-5\cdot 2)x+[-5(-5)]y+(-5\cdot 6)z$
$=-10x+25y-30z$

91. $-(4t+3m)=-1(4t+3m)$
$=-1(4t)+(-1)(3m)$
$=(-1\cdot 4)t+(-1\cdot 3)m$
$=-4t-3m$

92. $-(9x+12y)=-1(9x+12y)$
$=-1(9x)+(-1)(12y)$
$=(-1\cdot 9)x+(-1\cdot 12)y$
$=-9x-12y$

93. $-(-5c-4d)=-1(-5c-4d)$
$=-1(-5c)-1(-4d)$
$=5c+4d$

94. $-(-13x-15y)=-1(-13x-15y)$
$=-1(-13x)-1(-15y)$
$=13x+15y$

95. $-(-3q+5r-8s)=-1(-3q+5r-8s)$
$=-1(-3q)-1(5r)-1(-8s)$
$=3q-5r+8s$

96. $-(-z+5w-9y)=-1(-z+5w-9y)$
$=-1(-z)-1(5w)-1(-9y)$
$=z-5w+9y$

1.7 Simplifying Expressions

Classroom Examples, Now Try Exercises

1. **(a)** $5(4x-3y)=5(4x)-5(3y)$
$=(5\cdot 4)x-(5\cdot 3)y$
$=20x-15y$

(b) $-(7-6k)+9=-1(7-6k)+9$
$=-1(7)-1(-6k)+9$
$=-7+6k+9$
$=-7+9+6k$
$=2+6k$

N1. **(a)** $3(2x-4y)=3(2x)-3(4y)$
$=(3\cdot 2)x-(3\cdot 4)y$
$=6x-12y$

(b) $-4-(-3y+5)=-4-1(-3y+5)$
$=-4-1(-3y)-1(5)$
$=-4+3y+(-5)$
$=-4+(-5)+3y$
$=-9+3y$, or $3y-9$

2. **(a)** $5z+9z-4z=(5+9-4)z=10z$

(b) $4r-r=4r-1r=(4-1)r=3r$

(c) $8p+8p^2$ cannot be simplified. $8p$ and $8p^2$ are unlike terms and cannot be combined.

N2. **(a)** $4x+6x-7x=(4+6-7)x=3x$

(b) $z^2+z^2=1z^2+1z^2=(1+1)z^2=2z^2$

(c) $4p^2-3p$ cannot be simplified because these unlike terms cannot be combined.

3. **(a)** $-(3+5k)+7k=-1(3+5k)+7k$
$=-1(3)-1(5k)+7k$
$=-3-5k+7k$
$=-3+2k$

(b) $-\frac{2}{5}(x-10)-\frac{1}{10}x=-\frac{2}{5}(x)-\frac{2}{5}(-10)-\frac{1}{10}x$
$=-\frac{2}{5}x+4-\frac{1}{10}x$
$=-\frac{4}{10}x+4-\frac{1}{10}x$
$=-\frac{5}{10}x+4$
$=-\frac{1}{2}x+4$

N3. **(a)** $5k-6-(3-4k)$
$=5k-6-1(3-4k)$
$=5k-6-1(3)-1(-4k)$
$=5k-6-3+4k$
$=9k-9$

(b) $\frac{1}{4}x-\frac{2}{3}(x-9)=\frac{1}{4}x-\frac{2}{3}(x)-\frac{2}{3}(-9)$
$=\frac{3}{12}x-\frac{8}{12}x+6$
$=-\frac{5}{12}x+6$

4. "Three times a number, subtracted from the sum of the number and 8" is written $(x+8)-3x$.
$(x+8)-3x=x+8-3x$
$=-2x+8$

N4. "Twice a number, subtracted from the sum of the number and 5" is written $(x+5)-2x$.
$(x+5)-2x=x+5-2x$
$=-x+5$, or $5-x$

Exercises

1. $-(6x-3)=-1(6x-3)$
$=-1(6x)-1(-3)$
$=-6x+3$
The correct response is B.

2. The numerical coefficient of $5x^3y^7$ is 5. The correct response is A.

3. Examples A, B, and D are pairs of *unlike* terms, since either the variables or their powers are different. Example C is a pair of *like* terms, since both terms have the same variables (r and y) and the same exponents (both variables are to the first power). Note that we can use the commutative property to rewrite $6yr$ as $6ry$.

4. "Six times a number" translates as $6x$, and "the product of eleven and the number" translates as $11x$. Thus, the correct translation of "six times a number, subtracted from the product of eleven and the number" is B, $11x-6x$.

5. The student made a sign error when applying the distributive property.
$$\begin{aligned}7x-2(3-2x)&=7x-2(3)-2(-2x)\\&=7x-6+4x\\&=11x-6\end{aligned}$$
The correct answer is $11x-6$.

6. The student incorrectly started by adding $3+2$. First, 2 must be multiplied by $4x-5$.
$$\begin{aligned}3+2(4x-5)&=3+2(4x)+2(-5)\\&=3+8x-10\\&=8x-7\end{aligned}$$

7. $4r+19-8=4r+11$

8. $7t+18-4=7t+14$

9. $$\begin{aligned}7(3x-4y)&=7(3x)-7(4y)\\&=21x-28y\end{aligned}$$

10. $$\begin{aligned}8(2p-9q)&=8(2p)-8(9q)\\&=16p-72q\end{aligned}$$

11. $$\begin{aligned}5+2(x-3y)&=5+2(x)-2(3y)\\&=5+2x-6y\end{aligned}$$

12. $$\begin{aligned}8+3(s-6t)&=8+3s-3(6t)\\&=8+3s-18t\end{aligned}$$

13. $$\begin{aligned}8+4(3x+6)&=8+4(3x)+4(6)\\&=8+12x+24\\&=8+24+12x\\&=32+12x\end{aligned}$$

14. $$\begin{aligned}10+5(2y+7)&=10+5(2y)+5(7)\\&=10+10y+35\\&=10+35+10y\\&=45+10y\end{aligned}$$

15. $$\begin{aligned}-2-(5-3p)&=-2-1(5-3p)\\&=-2-1(5)-1(-3p)\\&=-2-5+3p\\&=-7+3p\end{aligned}$$

16. $$\begin{aligned}-10-(7-14r)&=-10-1(7-14r)\\&=-10-1(7)-1(-14r)\\&=-10-7+14r\\&=-17+14r\end{aligned}$$

17. $$\begin{aligned}6+(4-3x)-8&=6+4-3x-8\\&=10-3x-8\\&=10-8-3x\\&=2-3x\end{aligned}$$

18. $$\begin{aligned}-12+(7-8x)+6&=-12+7-8x+6\\&=-5-8x+6\\&=-5+6-8x\\&=1-8x\end{aligned}$$

19. The numerical coefficient of the term $-12k$ is -12.

20. The numerical coefficient of the term $-11y$ is -11.

21. The numerical coefficient of the term $3m^2$ is 3.

22. The numerical coefficient of the term $9n^6$ is 9.

23. Because xw can be written as $1\cdot xw$, the numerical coefficient of the term xw is 1.

24. Because pq can be written as $1\cdot pq$, the numerical coefficient of the term pq is 1.

25. Since $-x=-1x$, the numerical coefficient of the term $-x$ is -1.

26. Since $-t=-1t$, the numerical coefficient of the term $-t$ is -1.

27. Since $\frac{x}{2}=\frac{1}{2}x$, the numerical coefficient of the term $\frac{x}{2}$ is $\frac{1}{2}$.

28. Since $\frac{x}{6}=\frac{1}{6}x$, the numerical coefficient of the term $\frac{x}{6}$ is $\frac{1}{6}$.

29. Since $\frac{2x}{5}=\frac{2}{5}x$, the numerical coefficient of the term $\frac{2x}{5}$ is $\frac{2}{5}$.

30. Since $\frac{8x}{9}=\frac{8}{9}x,$ the numerical coefficient of the term $\frac{8x}{9}$ is $\frac{8}{9}$.

31. Since $-0.5x^3=-0.5\cdot x^3,$ the numerical coefficient of the term $-0.5x^3$ is -0.5.

32. Since $-1.75x^2=-1.75\cdot x^2,$ the numerical coefficient of the term $-1.75x^2$ is -1.75.

33. The numerical coefficient of the term 10 is 10.

34. The numerical coefficient of the term 15 is 15.

35. $8r$ and $-13r$ are like terms since they have the same variable with the same exponent (which is understood to be 1).

36. $-7x$ and $12x$ are like terms since they have the same variable with the same exponent (which is understood to be 1).

37. $5z^4$ and $9z^3$ are unlike terms. Although both have the variable *z*, the exponents are not the same.

38. $8x^5$ and $-10x^3$ are unlike terms. Although both have the variable *x*, the exponents are not the same.

39. All numerical terms (constants) are considered like terms, so 4, 9, and -24 are like terms.

40. All numerical terms (constants) are considered like terms, so 7, 17, and -83 are like terms.

41. *x* and *y* are unlike terms because they do not have the same variable.

42. *t* and *s* are unlike terms because they do not have the same variable.

43. $$\begin{aligned}7y+6y&=(7+6)y\\&=13y\end{aligned}$$

44. $$\begin{aligned}5m+2m&=(5+2)m\\&=7m\end{aligned}$$

45. $$\begin{aligned}-6x-3x&=(-6-3)x\\&=-9x\end{aligned}$$

46. $$\begin{aligned}-4z-8z&=(-4-8)z\\&=-12z\end{aligned}$$

47. $$\begin{aligned}12b+b&=12b+1b\\&=(12+1)b\\&=13b\end{aligned}$$

48. $$\begin{aligned}19x+x&=19x+1x\\&=(19+1)x\\&=20x\end{aligned}$$

49. $$\begin{aligned}3k+8+4k+7&=3k+4k+8+7\\&=(3+4)k+15\\&=7k+15\end{aligned}$$

50. $$\begin{aligned}15z+1+4z+2&=15z+4z+1+2\\&=(15+4)z+3\\&=19z+3\end{aligned}$$

51. $$\begin{aligned}&-5y+3-1+5+y-7\\&=(-5y+1y)+(3+5)+(-1-7)\\&=(-5+1)y+(8)+(-8)\\&=-4y+8-8\\&=-4y\end{aligned}$$

52. $$\begin{aligned}&2k-7-5k+6-1+2\\&=(2k-5k)+(-7+6-1+2)\\&=(2-5)k+(0)\\&=-3k\end{aligned}$$

53. $$\begin{aligned}&-2x+3+4x-17+20\\&=(-2x+4x)+(3-17+20)\\&=(-2+4)x+6\\&=2x+6\end{aligned}$$

54. $$\begin{aligned}&r-6-12r-4+16\\&=(1r-12r)+(-6-4+16)\\&=(1-12)r+(6)\\&=-11r+6\end{aligned}$$

55. $$\begin{aligned}&16-5m-4m-2+2m\\&=(16-2)+(-5m-4m+2m)\\&=14+(-5-4+2)m\\&=14-7m\end{aligned}$$

56. $$\begin{aligned}&6-3z-2z-5-2z\\&=(6-5)+(-3z-2z-2z)\\&=1+(-3-2-2)z\\&=1-7z\end{aligned}$$

57. $2.3x-1.1+4.2x-0.7$
$=(2.3x+4.2x)-1.1-0.7$
$=(2.3+4.2)x-1.8$
$=6.5x-1.8$

58. $-3.4p-0.8+2.5+7.2p$
$=(-3.4p+7.2p)-0.8+2.5$
$=(-3.4+7.2)p+1.7$
$=3.8p+1.7$

59. $7.2x-5.1+2.3x+5.1$
$=(7.2x+2.3x)-5.1+5.1$
$=(7.2+2.3)x+0$
$=9.5x$

60. $-9.6r+2.7-8.5r-2.7$
$=(-9.6r-8.5r)+2.7-2.7$
$=(-9.6-8.5)r+0$
$=-18.1r$

61. $-\frac{4}{3}+2t+\frac{1}{3}t-8-\frac{8}{3}t$
$=\left(2t+\frac{1}{3}t-\frac{8}{3}t\right)+\left(-\frac{4}{3}-8\right)$
$=\left(2+\frac{1}{3}-\frac{8}{3}\right)t+\left(-\frac{4}{3}-8\right)$
$=\left(\frac{6}{3}+\frac{1}{3}-\frac{8}{3}\right)t+\left(-\frac{4}{3}-\frac{24}{3}\right)$
$=-\frac{1}{3}t-\frac{28}{3}$

62. $-\frac{5}{6}+8x+\frac{1}{6}x-7-\frac{7}{6}$
$=\left(8x+\frac{1}{6}x\right)+\left(-\frac{5}{6}-7-\frac{7}{6}\right)$
$=\left(\frac{48}{6}x+\frac{1}{6}x\right)+\left(-\frac{5}{6}-\frac{42}{6}-\frac{7}{6}\right)$
$=\frac{49}{6}x-\frac{54}{6}$
$=\frac{49}{6}x-9$

63. $6y^2+11y^2-8y^2=(6+11-8)y^2$
$=9y^2$

64. $-9m^3+3m^3-7m^3=(-9+3-7)m^3$
$=-13m^3$

65. $2p^2+3p^2-8p^3-6p^3$
$=\left(2p^2+3p^2\right)+\left(-8p^3-6p^3\right)$
$=(2+3)p^2+(-8-6)p^3$
$=5p^2-14p^3$

66. $5y^3+6y^3-3y^2-4y^2$
$=\left(5y^3+6y^3\right)+\left(-3y^2-4y^2\right)$
$=(5+6)y^3+(-3-4)y^2$
$=11y^3-7y^2$

67. $2(4x+6)+3=2(4x)+2(6)+3$
$=8x+12+3$
$=8x+15$

68. $4(6y+9)+7=4(6y)+4(9)+7$
$=24y+36+7$
$=24y+43$

69. $-6-4(y-7)=-6-4(y)-4(-7)$
$=-6-4y+28$
$=22-4y$

70. $-4-5(t-13)=-4-5(t)-5(-13)$
$=-4-5t+65$
$=61-5t$

71. $13p+4(4-8p)=13p+4(4)+4(-8p)$
$=13p+16-32p$
$=-19p+16$

72. $5x+3(7-2x)=5x+3(7)+3(-2x)$
$=5x+21-6x$
$=-x+21$

73. $3t-5-2(2t-4)=3t-5-2(2t)-2(-4)$
$=3t-5-4t+8$
$=-t+3$

74. $8p+6-3(3p-1)=8p+6-3(3p)-3(-1)$
$=8p+6-9p+3$
$=-p+9$

75. $100[0.05(x+3)]$
$=[100(0.05)](x+3)$ Associative property
$=5(x+3)$
$=5(x)+5(3)$ Distributive prop.
$=5x+15$

76. $100[0.06(x+5)]$
$=[100(0.06)](x+5)$ Associative prop.
$=6(x+5)$
$=6(x)+6(5)$ Distributive prop.
$=6x+30$

77. $10[0.3(5-3x)]$
$=[10(0.3)](5-3x)$ Associative prop.
$=3(5-3x)$
$=3(5)+3(-3x)$ Distributive prop.
$=15-9x$

78. $10[0.5(8-2z)]$
$=[10(0.5)](8-2z)$ Associative prop.
$=5(8-2z)$
$=5(8)+5(-2z)$ Distributive prop.
$=40-10z$

79. $-5(5y-9)+3(3y+6)$
$=-5(5y)-5(-9)+3(3y)+3(6)$
$=-25y+45+9y+18$
$=-16y+63$

80. $-3(2t+4)+8(2t-4)$
$=-3(2t)-3(4)+8(2t)+8(-4)$
$=-6t-12+16t-32$
$=10t-44$

81. $2(5r+3)-3(2r-3)$
$=2(5r)+2(3)-3(2r)-3(-3)$
$=10r+6-6r+9$
$=4r+15$

82. $3(2y-5)-4(5y-7)$
$=3(2y)+3(-5)-4(5y)-4(-7)$
$=6y-15-20y+28$
$=-14y+13$

83. $8(2k-1)-(4k-3)$
$=8(2k-1)-1(4k-3)$
$=8(2k)+8(-1)-1(4k)-1(-3)$
$=16k-8-4k+3$
$=12k-5$

84. $6(3p-2)-(5p+1)$
$=6(3p-2)-1(5p+1)$
$=6(3p)+6(-2)-1(5p)-1(1)$
$=18p-12-5p-1$
$=13p-13$

85. $-\frac{4}{3}(y-12)-\frac{1}{6}y$
$=-\frac{4}{3}y-\frac{4}{3}(-12)-\frac{1}{6}y$
$=-\frac{4}{3}y+16-\frac{1}{6}y$
$=-\frac{4}{3}y-\frac{1}{6}y+16$
$=\left(-\frac{8}{6}-\frac{1}{6}\right)y+16$
$=-\frac{3}{2}y+16$

86. $-\frac{7}{5}(t-15)-\frac{1}{2}t=-\frac{7}{5}t-\frac{7}{5}(-15)-\frac{1}{2}t$
$=-\frac{14}{10}t+21-\frac{5}{10}t$
$=-\frac{19}{10}t+21$

87. $\frac{1}{2}(2x+4)-\frac{1}{3}(9x-6)$
$=\frac{1}{2}(2x)+\frac{1}{2}(4)-\frac{1}{3}(9x)-\frac{1}{3}(-6)$
$=x+2-3x+2$
$=-2x+4$

88. $\frac{1}{4}(8x+16)-\frac{1}{5}(20x-15)$
$=\frac{1}{4}(8x)+\frac{1}{4}(16)-\frac{1}{5}(20x)-\frac{1}{5}(-15)$
$=2x+4-4x+3$
$=-2x+7$

89. $-\frac{2}{3}(5x+7)-\frac{1}{3}(4x+8)$
$=-\frac{2}{3}(5x)-\frac{2}{3}(7)-\frac{1}{3}(4x)-\frac{1}{3}(8)$
$=-\frac{10}{3}x-\frac{14}{3}-\frac{4}{3}x-\frac{8}{3}$
$=-\frac{14}{3}x-\frac{22}{3}$

90. $-\frac{3}{4}(7x+9)-\frac{1}{4}(5x+7)$
$=-\frac{3}{4}(7x)-\frac{3}{4}(9)-\frac{1}{4}(5x)-\frac{1}{4}(7)$
$=-\frac{21}{4}x-\frac{27}{4}-\frac{5}{4}x-\frac{7}{4}$
$=-\frac{26}{4}x-\frac{34}{4}$
$=-\frac{13}{2}x-\frac{17}{2}$

91. $-7.5(2y+4)-2.9(3y-6)$
$=-7.5(2y)-7.5(4)-2.9(3y)-2.9(-6)$
$=-15y-30-8.7y+17.4$
$=-23.7y-12.6$

92. $8.4(6t-6)+2.4(9-3t)$
$=8.4(6t)+8.4(-6)+2.4(9)+2.4(-3t)$
$=50.4t-50.4+21.6-7.2t$
$=43.2t-28.8$

93. $-2(-3k+2)-(5k-6)-3k-5$
$=-2(-3k+2)-1(5k-6)-3k-5$
$=-2(-3k)-2(2)-1(5k)-1(-6)-3k-5$
$=6k-4-5k+6-3k-5$
$=-2k-3$

94. $-2(3r-4)-(6-r)+2r-5$
$=-2(3r-4)-1(6-r)+2r-5$
$=-2(3r)-2(-4)-1(6)-1(-r)+2r-5$
$=-6r+8-6+r+2r-5$
$=-3r-3$

95. $-4(-3x+3)-(6x-4)-2x+1$
$=-4(-3x+3)-1(6x-4)-2x+1$
$=-4(-3x)-4(3)-1(6x)-1(-4)-2x+1$
$=12x-12-6x+4-2x+1$
$=4x-7$

96. $-5(8x+2)-(5x-3)-3x+17$
$=-5(8x+2)-1(5x-3)-3x+17$
$=-5(8x)-5(2)-1(5x)-1(-3)-3x+17$
$=-40x-10-5x+3-3x+17$
$=-48x+10$

97. $(4x+8)+(3x-2)$
$=4x+8+3x-2$
$=7x+6$

98. $(10t-8)+(8t+5)$
$=10t-8+8t+5$
$=18t-3$

99. $(5x+1)-(x-7)=(5x+1)-1(x-7)$
$=5x+1-1(x)-1(-7)$
$=5x+1-x+7$
$=4x+8$

100. $(2x-3)-(3x-5)=(2x-3)-1(3x-5)$
$=2x-3-1(3x)-1(-5)$
$=2x-3-3x+5$
$=-x+2$

101. "Five times a number, added to the sum of the number and three" is written $(x+3)+5x$.
$(x+3)+5x=x+3+5x$
$=(x+5x)+3$
$=6x+3$

102. "Six times a number, added to the sum of the number and six" is written $(x+6)+6x$.
$(x+6)+6x=x+6+6x$
$=(x+6x)+6$
$=7x+6$

103. "A number multiplied by -7, subtracted from the sum of 13 and six times the number" is written $(13+6x)-(-7x)$.
$(13+6x)-(-7x)=13+6x+7x$
$=13+13x$

104. "A number multiplied by 5, subtracted from the sum of 14 and eight times the number" is written $(14+8x)-5x$.
$(14+8x)-5x=14+8x-5x$
$=14+3x$

105. "Six times a number added to -4, subtracted from twice the sum of three times the number and 4" is written $2(3x+4)-(-4+6x)$.

$$\begin{aligned}&2(3x+4)-(-4+6x)\\&=2(3x+4)-1(-4+6x)\\&=2(3x)+2(4)-1(-4)-1(6x)\\&=6x+8+4-6x\\&=6x+(-6x)+8+4\\&=0+12\\&=12\end{aligned}$$

106. "Nine times a number added to 6, subtracted from triple the sum of 12 and 8 times the number" is written $3(12+8x)-(6+9x)$.

$$\begin{aligned}&3(12+8x)-(6+9x)\\&=3(12+8x)-1(6+9x)\\&=3(12)+3(8x)-1(6)-1(9x)\\&=36+24x-6-9x\\&=30+15x\end{aligned}$$

107. For gizmos, the fixed cost is \$1000 and the variable cost is \$5 per gizmo, so the cost to produce x gizmos is $1000+5x$ (dollars).

108. For gadgets, the fixed cost is \$750 and the variable cost is \$3 per gadget, so the cost to produce y gadgets is $750+3y$ (dollars).

109. The total cost to make x gizmos and y gadgets is $1000+5x+750+3y$ (dollars).

110. $$\begin{aligned}&1000+5x+750+3y\\&=(1000+750)+5x+3y\\&=1750+5x+3y,\end{aligned}$$
so the total cost to make x gizmos and y gadgets is $1750+5x+3y$ (dollars).

Chapter 1 Review Exercises

1. $5^4=5\cdot5\cdot5\cdot5=625$

2. $\left(\frac{3}{5}\right)^3=\frac{3}{5}\cdot\frac{3}{5}\cdot\frac{3}{5}=\frac{27}{125}$

3. $\left(\frac{1}{8}\right)^2=\frac{1}{8}\cdot\frac{1}{8}=\frac{1}{64}$

4. $(0.1)^3=0.1\cdot0.1\cdot0.1=0.001$

5. $8\cdot5-13=40-13=27$

6. $$\begin{aligned}16+12\div4-2&=16+(12\div4)-2\\&=16+3-2\\&=19-2\\&=17\end{aligned}$$

7. $$\begin{aligned}20-2(5+3)&=20-2(8)\\&=20-16\\&=4\end{aligned}$$

8. $$\begin{aligned}7\left[3+6\left(3^2\right)\right]&=7[3+6(9)]\\&=7(3+54)\\&=7(57)\\&=399\end{aligned}$$

9. $$\begin{aligned}\frac{5\left(6^2-2^4\right)}{3\cdot5+10}&=\frac{5(36-16)}{3\cdot5+10}\\&=\frac{5(20)}{3\cdot5+10}\\&=\frac{100}{15+10}\\&=\frac{100}{25}\\&=4\end{aligned}$$

10. $$\begin{aligned}\frac{6(5-4)+2(4-2)}{3^2-(4+3)}&=\frac{6(1)+2(2)}{9-(4+3)}\\&=\frac{6+4}{9-7}\\&=\frac{10}{2}=5\end{aligned}$$

11. $12\cdot3-6\cdot6=36-36=0$
Since $0=0$ is true, so is $0\le0$, and therefore, the statement "$12\cdot3-6\cdot6\le0$" is true.

12. $3[5(2)-3]=3(10-3)=3(7)=21$
Therefore, the statement "$3[5(2)-3]>20$" is true.

13. $4^2-8=16-8=8$
Since $9\le8$ is false, the statement "$9\le4^2-8$" is false.

14. "Thirteen is less than seventeen" is written $13<17$.

15. "Five plus two is not equal to ten" is written $5+2\ne10$.

16. "Two-thirds is greater than or equal to four-sixths" is written $\frac{2}{3} \geq \frac{4}{6}$.

17. $$\begin{aligned} 2x+6y &= 2(6)+6(3) \\ &= 12+18 \\ &= 30 \end{aligned}$$

18. $$\begin{aligned} 4(3x-y) &= 4[3(6)-3] \\ &= 4(18-3) \\ &= 4(15) \\ &= 60 \end{aligned}$$

19. $$\begin{aligned} \frac{x}{3}+4y &= \frac{6}{3}+4(3) \\ &= 2+12 \\ &= 14 \end{aligned}$$

20. $$\begin{aligned} \frac{x^2+3}{3y-x} &= \frac{6^2+3}{3(3)-6} \\ &= \frac{36+3}{9-6} \\ &= \frac{39}{3} \\ &= 13 \end{aligned}$$

21. "Six added to a number" translates as $x+6$.

22. "A number subtracted from eight" translates as $8-x$.

23. "The difference of six times a number and nine" translates as $6x-9$.

24. "Three-fifths of a number added to 12" translates as $12+\frac{3}{5}x$.

25. $5x+3(x+2)=52;\ 2$

$$\begin{aligned} 5x+3(x+2) &= 5(2)+3(2+2) \quad \text{Let } x=2. \\ &= 5(2)+3(4) \\ &= 10+12 \\ &= 22 \end{aligned}$$

Because the left side, 22, is not equal to the right side, 52, the number 2 is not a solution of the given equation.

26. $\frac{2}{9}t+\frac{1}{3}=1;\ 3$

$$\begin{aligned} \frac{2}{9}t+\frac{1}{3} &= \frac{2}{9}(3)+\frac{1}{3} \quad \text{Let } t=3. \\ &= \frac{6}{9}+\frac{3}{9} \\ &= \frac{9}{9}, \quad \text{or } 1 \end{aligned}$$

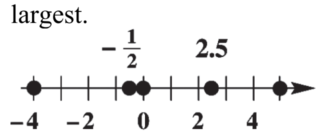
Because the left side and the right side are equal, 3 is a solution of the given equation.

27. "Six less than twice a number is 10" is written $2x-6=10$.
Letting x equal 0, 2, 4, 6, and 10 results in a false statement, so those values are not solutions. Since $2(8)-6=16-6=10$, the solution is 8.

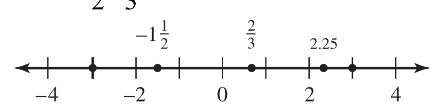
28. "The product of a number and 4 is 8" is written $4x=8$. Since $4(2)=8$, the solution is 2.

29. $-4, -\frac{1}{2}, 0, 2.5, 5$

Graph these numbers on a number line. They are already arranged in order from smallest to largest.



30. $-3, -1\frac{1}{2}, \frac{2}{3}, 2.25, 3$



31. Since $\frac{4}{3}$ is the quotient of two integers, it is a rational number. Since all rational numbers are also real numbers, $\frac{4}{3}$ is a real number.

32. Since the decimal representation of $0.\overline{63}$ repeats, it is a rational number. Since all rational numbers are also real numbers, $0.\overline{63}$ is a real number.

33. Since 19 is a natural number, it is also a whole number and an integer. We can write it as $\frac{19}{1}$, so it is a rational number and, hence, a real number.

34. Since the decimal representation of $\sqrt{6}$ does not terminate or repeat, it is an irrational number. Since all irrational numbers are also real numbers, $\sqrt{6}$ is a real number.

35. Since any negative number is less than any positive number, -10 is the lesser number.

36. Since -9 is to the left of -8 on the number line, -9 is the lesser number.

37. To compare these fractions, use a common denominator.
$-\frac{2}{3}=-\frac{8}{12}, -\frac{3}{4}=-\frac{9}{12}$
Since $-\frac{9}{12}$ is to the left of $-\frac{8}{12}$ on the number line, $-\frac{3}{4}$ is the lesser number.

38. Since $-|23|=-23$ and $-23<0, -|23|$ is the lesser number.

39. The statement $12>-13$ is true since 12 is to the right of -13 on the number line.

40. The statement $0>-5$ is true since 0 is to the right of -5 on the number line.

41. The statement $-9<-7$ is true since -9 is to the left of -7 on the number line.

42. The statement $-13\geq-13$ is true since $-13=-13$.

43. **(a)** The opposite of the number -9 is its negative—that is, $-9(-9)=9$.

(b) Since $-9<0$, the absolute value of the number -9 is $|-9|=-(-9)=9$.

44. **(a)** $-0=0$

(b) $|0|=0$

45. **(a)** $-(6)=-6$

(b) $|6|=6$

46. **(a)** $-\left(-\frac{5}{7}\right)=\frac{5}{7}$

(b) $\left|-\frac{5}{7}\right|=-\left(-\frac{5}{7}\right)=\frac{5}{7}$

47. $|-12|=-(-12)=12$

48. $-|3|=-3$

49. $-|-19|=-(19)=-19$

50. $-|9-2|=-|7|=-7$

51. $-10+4=-6$

52. $14+(-18)=-4$

53. $-8+(-9)=-17$

54. $\frac{4}{9}+\left(-\frac{5}{4}\right)=\frac{4\cdot4}{9\cdot4}+\left(-\frac{5\cdot9}{4\cdot9}\right)$ LCD = 36
$=\frac{16}{36}+\left(-\frac{45}{36}\right)$
$=-\frac{29}{36}$

55. $-13.5+(-8.3)=-21.8$

56. $|-10+7|+|-11|=|-3|+11$
$=3+11$
$=14$

57. $[-6+(-8)+8]+[9+(-13)]$
$=\{[-6+(-8)]+8\}+(-4)$
$=[(-14)+8]+(-4)$
$=(-6)+(-4)$
$=-10$

58. $(-4+7)+(-11+3)+(-15+1)$
$=(3)+(-8)+(-14)$
$=[3+(-8)]+(-14)$
$=(-5)+(-14)$
$=-19$

59. $-7-4=-7+(-4)=-11$

60. $-12-(-11)=-12+11=-1$

61. $5-(-2)=5+2=7$

62. $-\frac{3}{7}-\frac{4}{5}=-\frac{3\cdot 5}{7\cdot 5}-\frac{4\cdot 7}{5\cdot 7}$
$=-\frac{15}{35}-\frac{28}{35}$ LCD = 35
$=-\frac{15}{35}+\left(-\frac{28}{35}\right)$
$=-\frac{43}{35}$, or $-1\frac{8}{35}$

63. $2.56-(-7.75)=2.56+7.75$
$=10.31$

64. $(-10-4)-(-2)=[-10+(-4)]+2$
$=(-14)+2$
$=-12$

65. $-5-[(-7-4)+(8-12)]$
$=-5-[(-7+(-4))+(8+(-12))]$
$=-5-[(-11)+(-4)]$
$=-5-[-15]$
$=-5+15$
$=10$

66. $-5.6+[(-7.4+3.6)-4.82]$
$=-5.6+[-3.8-4.82]$
$=-5.6+[-3.8+(-4.82)]$
$=-5.6+[-8.62]$
$=-14.22$

67. "19 added to the sum of -31 and 12" is written
$(-31+12)+19=(-19)+19$
$=0.$

68. "13 more than the sum of -4 and -8" is written
$[-4+(-8)]+13=-12+13$
$=1.$

69. "The difference of -4 and -6" is written
$-4-(-6)=-4+6$
$=2.$

70. "Five less than the difference of 7 and -5" is written
$[7-(-5)]-5=[7+5]-5$
$=12-5$
$=7.$

71. $-23.75+50.00=26.25$
He now has a positive balance of \$26.25.

72. $-26+16=-10$
The high temperature was -10°F.

73. $-28+13-14=(-28+13)-14$
$=(-28+13)+(-14)$
$=-15+(-14)$
$=-29$
His present financial status is $-\$29$.

74. $-3-7=-3+(-7)$
$=-10$
The new temperature is $-10°$.

75. $8-12+42=[8+(-12)]+42$
$=-4+42$
$=38$
The total net yardage is 38.

76. To get the closing value for the previous day, we can subtract the change from the amount at which it closed on October 25.
$23{,}329.46-(-112.30)=23{,}329.46+112.30$
$=23{,}441.76$

77. $(-12)(-3)=36$

78. $15(-7)=-(15\cdot 7)$
$=-105$

79. $-\frac{4}{3}\left(-\frac{3}{8}\right)=\frac{4}{3}\cdot\frac{3}{8}$
$=\frac{12}{24}$
$=\frac{1}{2}$

80. $(-4.8)(-2.1)=10.08$

81. $5(8-12)=5(-4)=-20$

82. $(5-7)(8-3)=(-2)(5)=-10$

83. $2(-6)-(-4)(-3)=-12-(12)=-24$

84. $3(-10)-5=-30-5=-35$

85. $\frac{-36}{-9}=4$

86. $\frac{220}{-11}=-20$

87. $-\frac{1}{2} \div \frac{2}{3} = -\frac{1}{2} \cdot \frac{3}{2} = -\frac{3}{4}$

88. $\frac{-33.9}{-3} = 11.3$

89. $\frac{-5(3)-1}{8+4(-2)} = \frac{-15-1}{8+(-8)}$
$= \frac{-16}{0}$, which is undefined

90. $\frac{5(-2)-3(4)}{-2[3-(-2)]-1} = \frac{-10-12}{-2[3+2]-1}$
$= \frac{-22}{-2[5]-1}$
$= \frac{-22}{-10-1}$
$= \frac{-22}{-11}$
$= 2$

91. $\frac{10^2-5^2}{8^2+3^2-(-2)} = \frac{100-25}{64+9+2}$
$= \frac{75}{75}$
$= 1$

92. $\frac{4(0.4)^2-(0.8)^2}{(-1.2)^2-(-0.56)} = \frac{4(0.16)-0.64}{1.44+0.56}$
$= \frac{0.64-0.64}{2.00}$
$= \frac{0}{2}$
$= 0$

93. $6x-4z = 6(-5)-4(-3)$
$= -30-(-12)$
$= -30+12$
$= -18$

94. $5x^2 = 5(-5)^2$
$= 5(25)$
$= 125$

95. $z^2(3x-8y) = (-3)^2[3(-5)-8(4)]$
$= 9[-15-32]$
$= 9(-47)$
$= -423$

96. $\frac{3y-z}{x+5} = \frac{3(4)-(-3)}{(-5)+5}$
$= \frac{12+3}{0}$
$= \frac{15}{0}$, which is undefined

97. "Nine less than the product of -4 and 5" is written
$-4(5)-9 = -20+(-9)$
$= -29.$

98. "Five-sixths of the sum of 12 and -6" is written
$\frac{5}{6}[12+(-6)] = \frac{5}{6}(6)$
$= 5.$

99. "The quotient of 12 and the sum of 8 and -4" is written
$\frac{12}{8+(-4)} = \frac{12}{4} = 3.$

100. "The product of -20 and 12, divided by the difference of 15 and -15" is written
$\frac{-20(12)}{15-(-15)} = \frac{-240}{15+15}$
$= \frac{-240}{30} = -8.$

101. "8 times a number is -24" is written
$8x = -24.$
If $x = -3$, $8x = 8(-3) = -24$. The solution is -3.

102. "The quotient of a number and 3 is -2" is written $\frac{x}{3} = -2$. If $x = -6$, $\frac{x}{3} = \frac{-6}{3} = -2$. The solution is -6.

103. The statement $6+0=6$ is an example of an identity property.

104. The statement $5 \cdot 1 = 5$ is an example of an identity property.

105. The statement $-\frac{2}{3}\left(-\frac{3}{2}\right) = 1$ is an example of an inverse property.

106. The statement $17+(-17)=0$ is an example of an inverse property.

107. The statement $5+(-9+2)=[5+(-9)]+2$ is an example of an associative property.

108. The statement $w(xy)=(wx)y$ is an example of an associative property.

109. The statement $3(x+y)=3x+3y$ is an example of the distributive property.

110. The statement $(1+2)+3=3+(1+2)$ is an example of a commutative property.

111. $7(y+2)=7y+7\cdot 2$
$=7y+14$

112. $-12(4-t)=-12[4+(-t)]$
$=-12(4)+(-12)(-t)$
$=-48+12t$

113. $3(2s+5y)=3(2s)+3(5y)$
$=6s+15y$

114. $-(-4r+5s)=-1(-4r+5s)$
$=(-1)(-4r)+(-1)(5s)$
$=4r-5s$

115. $2m+9m=(2+9)m$
$=11m$

116. $15p^2-7p^2+8p^2$
$=(15-7+8)p^2$
$=16p^2$

117. $5p^2-4p+6p+11p^2$
$=(5+11)p^2+(-4+6)p$
$=16p^2+2p$

118. $-2(3k-5)+2(k+1)$
$=-2(3k)-2(-5)+2(k)+2(1)$
$=-6k+10+2k+2$
$=-4k+12$

119. $7(2m+3)-2(8m-4)$
$=7(2m)+7(3)-2(8m)-2(-4)$
$=14m+21-16m+8$
$=(14-16)m+29$
$=-2m+29$

120. $\frac{2}{5}(15x-4)-\frac{1}{5}(10x+7)$
$=\frac{2}{5}(15x)+\frac{2}{5}(-4)-\frac{1}{5}(10x)-\frac{1}{5}(7)$
$=6x-\frac{8}{5}-2x-\frac{7}{5}$
$=4x-\frac{15}{5}$
$=4x-3$

121. "Seven times a number, subtracted from the product of -2 and three times the number" is written $-2(3x)-7x=-6x-7x=-13x$.

122. "A number multiplied by 8, added to the sum of 5 and four times the number" is written $(5+4x)+8x=5+(4x+8x)=5+12x$.

Chapter 1 Mixed Review Exercises

1. Complete the first row of the table.

Number	Absolute Value	Additive Inverse	Multiplicative Inverse
-3	3	3	$-\frac{1}{3}$

2. Complete the second row of the table.

Number	Absolute Value	Additive Inverse	Multiplicative Inverse
12	12	-12	$\frac{1}{12}$

3. Complete the third row of the table.

Number	Absolute Value	Additive Inverse	Multiplicative Inverse
$-\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$	$-\frac{3}{2}$

4. Complete the fourth row of the table.

Number	Absolute Value	Additive Inverse	Multiplicative Inverse
0.2	0.2	-0.2	5

5. The repeating decimal $0.\overline{6}$ is a rational number. All rational numbers are real numbers, so it is also a real number.

6. $$\begin{aligned}&(x+6)^3-y^3\\&=(-2+6)^3-(3)^3\\&=(4)^3-(27)\\&=64-27\\&=37\end{aligned}$$

7. $$\begin{aligned}\frac{6(-4)+2(-12)}{5(-3)+(-3)}&=\frac{-24+(-24)}{-15+(-3)}\\&=\frac{-48}{-18}\\&=\frac{8}{3},\quad\text{or}\quad 2\frac{2}{3}\end{aligned}$$

8. $$\begin{aligned}\frac{3}{8}-\frac{5}{12}&=\frac{3\cdot3}{8\cdot3}-\frac{5\cdot2}{12\cdot2}\\&=\frac{9}{24}-\frac{10}{24}\\&=\frac{9}{24}+\left(-\frac{10}{24}\right)\\&=-\frac{1}{24}\end{aligned}$$

9. $$\begin{aligned}\frac{8^2+6^2}{7^2+1^2}&=\frac{64+36}{49+1}\\&=\frac{100}{50}\\&=2\end{aligned}$$

10. $$\begin{aligned}-\frac{12}{5}\div\frac{9}{7}&=-\frac{12}{5}\cdot\frac{7}{9}\\&=-\frac{12\cdot7}{5\cdot9}\\&=-\frac{3\cdot4\cdot7}{5\cdot3\cdot3}\\&=-\frac{28}{15},\quad\text{or}\quad -1\frac{13}{15}\end{aligned}$$

11. $$\begin{aligned}2\frac{5}{6}-4\frac{1}{3}&=\frac{17}{6}-\frac{13}{3}\\&=\frac{17}{6}-\frac{13\cdot2}{3\cdot2}\\&=\frac{17}{6}-\frac{26}{6}\\&=-\frac{9}{6}\\&=-\frac{3}{2},\quad\text{or}\quad -1\frac{1}{2}\end{aligned}$$

12. $$\begin{aligned}\left(\frac{5}{6}\right)^2&=\frac{5}{6}\cdot\frac{5}{6}\\&=\frac{25}{36}\end{aligned}$$

13. $$\begin{aligned}&\left[(-2)+7-(-5)\right]+\left[-4-(-10)\right]\\&=\left[(-2)+7+5\right]+\left[-4+10\right]\\&=\left[(-2+7)+5\right]+[6]\\&=[5+5]+[6]\\&=10+6\\&=16\end{aligned}$$

14. $$\begin{aligned}-16(-3.5)-7.2(-3)&=56-(-21.6)\\&=56+21.6\\&=77.6\end{aligned}$$

15. $$\begin{aligned}-8+\left[(-4+17)-(-3-3)\right]&=-8+\left[(13)-(-6)\right]\\&=-8+[13+6]\\&=-8+19\\&=11\end{aligned}$$

16. $$\begin{aligned}&-4(2t+1)-8(-3t+4)\\&=-4(2t)-4(1)-8(-3t)-8(4)\\&=-8t-4+24t-32\\&=16t-36\end{aligned}$$

17. $$\begin{aligned}&5x^2-12y^2+3x^2-9y^2\\&=\left(5x^2+3x^2\right)+\left(-12y^2-9y^2\right)\\&=(5+3)x^2+(-12-9)y^2\\&=8x^2-21y^2\end{aligned}$$

18. $(-8-3)-5(2-9)=(-11)-5(-7)$
$=-11-5(-7)$
$=-11-(-35)$
$=-11+35$
$=24$

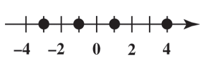
19. $118-165=118+(-165)$
$=-47$
The lowest temperature ever recorded in Iowa was $-47°F$.

20. $14,494-(-282)=14,494+282$
$=14,776$
The difference in elevation is 14,776 ft.

Chapter 1 Test

1. $4[-20+7(-2)]=4[-20+(-14)]$
$=4(-34)=-136$
Since $-136 \le 135$, the statement "$4[-20+7(-2)] \le 135$" is true.

2. $\left(\frac{1}{2}\right)^2+\left(\frac{2}{3}\right)^2=\left(\frac{1}{2}+\frac{2}{3}\right)^2$
$\frac{1}{4}+\frac{4}{9}=\left(\frac{7}{6}\right)^2$
$\frac{25}{36} \ne \frac{49}{36}$
Since $\frac{25}{36} \ne \frac{49}{36}$ the statement $\left(\frac{1}{2}\right)^2+\left(\frac{2}{3}\right)^2=\left(\frac{1}{2}+\frac{2}{3}\right)^2$ is false.

3.


4. The number $-\frac{2}{3}$ can be written as a quotient of two integers with denominator not 0, so it is a rational number. Since all rational numbers are real numbers, it is also a real number.

5. Simplify $-|-8|$.
$-|-8|=-[-(-8)]$
$=-(8)$
$=-8$
The number -8 is less than 6, and thus $-|-8|$ is the lesser number.

6. Since -1.277 is located to the left of -0.742 on the number line, -1.277 is the lesser number.

7. "The quotient of -6 and the sum of 2 and -8" is written $\frac{-6}{2+(-8)}$, and $\frac{-6}{2+(-8)}=\frac{-6}{-6}=1$.

8. $-2-(5-17)+(-6)=-2-(-12)+(-6)$
$=-2+12+(-6)$
$=10+(-6)$
$=4$

9. $-5\frac{1}{2}+2\frac{2}{3}=-\frac{11}{2}+\frac{8}{3}$
$=-\frac{11\cdot 3}{2\cdot 3}+\frac{8\cdot 2}{3\cdot 2}$
$=-\frac{33}{6}+\frac{16}{6}$
$=-\frac{17}{6}$, or $-2\frac{5}{6}$

10. $-6.2-[-7.1+(2.0-3.1)]$
$=-6.2-[-7.1-1.1]$
$=-6.2-[-8.2]$
$=-6.2+8.2$
$=2$

11. $4^2+(-8)-(2^3-6)=16+(-8)-(8-6)$
$=16+(-8)-2$
$=8-2$
$=6$

12. $(-5)(-12)+4(-4)-8^2$
$=(-5)(-12)+4(-4)-64$
$=60-16-64$
$=44-64$
$=-20$

13. $25-15\div 3-12=25-5-12$
$=20-12$
$=8$

14. $\dfrac{30(-1-2)}{-9[3-(-2)]-12(-2)}$

$=\dfrac{30(-3)}{-9(5)-(-24)}$

$=\dfrac{-90}{-45+24}$

$=\dfrac{-90}{-21}$

$=\dfrac{30}{7}$, or $4\dfrac{2}{7}$

15. $\dfrac{-7-|-6+2|}{-5-(-4)}=\dfrac{-7-|-4|}{-5+4}$

$=\dfrac{-7-4}{-1}$

$=\dfrac{-11}{-1}$

$=11$

16. $3x-4y^2$

$=3(-2)-4(4)^2$ Let $x=-2, y=4.$

$=3(-2)-4(16)$

$=-6-64$

$=-70$

17. $\dfrac{5x+7y}{3(x+y)}$

$=\dfrac{5(-2)+7(4)}{3(-2+4)}$ Let $x=-2, y=4.$

$=\dfrac{-10+28}{3(2)}$

$=\dfrac{18}{6}$

$=3$

18. The difference between the highest and lowest elevations is
$6960-(-40)=6960+40=7000$ meters.

19. 4 saves (3 points per save)
+3 wins (3 points per win)
+2 losses (-2 points per loss)
+1 blown save (-2 points per blown save)
$=4(3)+3(3)+2(-2)+1(-2)$
$=12+9-4-2$
$=15$ points
He has a total of 15 points.

20. $3.34-3.95=3.34+(-3.95)=-0.61$
As a signed number, the federal budget deficit is $-\$0.61$ trillion.

21. $-\dfrac{2}{3}+\dfrac{2}{3}=0$ illustrates an inverse property. The correct response is C.

22. $3x+0=3x$ illustrates an identity property. The correct response is D.

23. $(5+2)+8=8+(5+2)$ illustrates a commutative property because the order of the numbers is changed, but the grouping is not. The correct response is A.

24. $-3(x+y)=-3x+(-3y)$ illustrates the distributive property. The correct response is E.

25. $-5+(3+2)=(-5+3)+2$ illustrates an associative property because the grouping of the numbers is changed, but the order is not. The correct response is B.

26. $-\dfrac{5}{3}\left(-\dfrac{3}{5}\right)=1$ illustrates an inverse property.
The correct response is C.

27. $8x+4x-6x+x+14x$
$=(8+4-6+1+14)x$
$=21x$

28. $-8.5t-0.9+7.6+5.7t$
$=-8.5t+5.7t-0.9+7.6$
$=-2.8t+6.7$

29. $-\dfrac{1}{6}(12x-3)+5x=-\dfrac{1}{6}(12x)-\dfrac{1}{6}(-3)+5x$

$=-2x+\dfrac{1}{2}+5x$

$=3x+\dfrac{1}{2}$

30. $5(2x-1)-(x-12)+2(3x-5)$
$=5(2x-1)-1(x-12)+2(3x-5)$
$=10x-5-x+12+6x-10$
$=(10-1+6)x+(-5+12-10)$
$=15x-3$

Chapters R–1 Cumulative Review Exercises

1. $\frac{5}{8}\cdot\frac{2}{7}=\frac{5\cdot 2}{8\cdot 7}=\frac{5\cdot 2}{2\cdot 4\cdot 7}=\frac{5}{28}$

2. To divide fractions, multiply by the reciprocal of the divisor.

$$9\div\frac{3}{2}=\frac{9}{1}\cdot\frac{2}{3}=\frac{9\cdot 2}{1\cdot 3}=\frac{3\cdot 3\cdot 2}{1\cdot 3}=\frac{6}{1}=6$$

3. $\frac{11}{16}-\frac{5}{12}=\frac{11}{16}\cdot\frac{3}{3}-\frac{5}{12}\cdot\frac{4}{4}$ The LCD of 12 and 16 is 48.

$$=\frac{33}{48}-\frac{20}{48}=\frac{13}{48}$$

4.
$$\begin{array}{r} 42.50 \\ -15.72 \\ \hline 26.78 \end{array}$$

5.
$$\begin{array}{rl} 0.3 & \text{1 decimal place} \\ \times 0.05 & \text{2 decimal places} \\ \hline 15 & 1+2=3 \\ \hline 0.015 & \text{3 decimal places} \end{array}$$

6. Move the decimal point two places to the left.
$9.26\div 100=0.0926$

7. Divide the total board length by 3.

$$12\frac{3}{4}\div 3=\frac{51}{4}\div\frac{3}{1}=\frac{51}{4}\cdot\frac{1}{3}=\frac{51\cdot 1}{4\cdot 3}=\frac{3\cdot 17\cdot 1}{4\cdot 3}=\frac{17}{4},\text{ or } 4\frac{1}{4}$$

The length of each of the three pieces must be $4\frac{1}{4}$ inches.

8. The discount is 15% of \$379. The word *of* here means multiply.

$$\begin{array}{ccccc} 15\% & \text{of} & \$379 & & \\ \downarrow & \downarrow & \downarrow & & \\ 0.15 & \cdot & \$379 & = & \$56.85 \end{array}$$

The amount of the discount is \$56.85. The sale price is found by subtracting.
$\$379-\$56.85=\$322.15$

9. Simplify both sides of the inequality.

$$105\le 5[4+3(7-4)]$$
$$105\le 5[4+3(3)]$$
$$105\le 5[4+9]$$
$$105\le 5[13]$$
$$105\le 65$$

The statement is false because 105 *is greater than* 65.

10. Simplify both sides of the inequality.

$$\frac{6(4^2-10)+12}{15-3^2}>2$$
$$\frac{6(16-10)+12}{15-9}>2$$
$$\frac{6(6)+12}{6}>2$$
$$\frac{36+12}{6}>2$$
$$\frac{48}{6}>2$$
$$8>2$$

The statement is true because $8>2$.

11. $5x+4(2x-7)=-19;\ 3$

$$5\cdot 3+4(2\cdot 3-7)\stackrel{?}{=}-19 \quad \text{Let } x=3.$$
$$5\cdot 3+4(6-7)\stackrel{?}{=}-19$$
$$5\cdot 3+4(-1)\stackrel{?}{=}-19$$
$$15+(-4)\stackrel{?}{=}-19$$
$$11=-19 \quad \text{False}$$

Because substituting 3 for x results in a false statement, 3 is not a solution of the equation.

12. $\frac{5}{8}x - \frac{3}{2} = 1;\ 4$

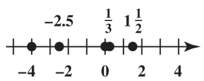
$\frac{5}{8}(4) - \frac{3}{2} \stackrel{?}{=} 1$ Let $x = 4$.

$\frac{20}{8} - \frac{12}{8} \stackrel{?}{=} 1$

$\frac{8}{8} = 1$ True

The true result shows that 4 is a solution of the equation.

13.



14.
$$\frac{5x+4y}{8x^2-y} = \frac{5(-4)+4(5)}{8(-4)^2-5} = \frac{-20+20}{8(16)-5} = \frac{0}{128-5} = \frac{0}{123} = 0$$

15. $-5.37 + 2.76 = -2.61$

16.
$$-\frac{3}{4} - \frac{5}{8} = -\frac{3}{4} + \left(-\frac{5}{8}\right) = -\frac{6}{8} + \left(-\frac{5}{8}\right) = -\frac{11}{8},\ \text{ or }\ -1\frac{3}{8}$$

17. $|-4-2| - |-9+1|$

$= |-4+(-2)| - |-8|$

$= |-6| - |-8|$

$= -(-6) - [-(-8)]$

$= 6 - [8]$

$= -2$

18. $\frac{-12(-14)}{8-(-6)} = \frac{168}{8+6} = \frac{168}{14} = 12$

19. $\frac{3^2-6^2}{-3(12-3)} = \frac{9-36}{-3(9)} = \frac{-27}{-27} = 1$

20.
$$\frac{-7(2)+[3(-5)-6]}{-9-(-3)(3)} = \frac{-14+[-15-6]}{-9-(-9)} = \frac{-14+[-21]}{-9+9} = \frac{-35}{0},\ \text{or undefined}$$

21. $-4\left(-\frac{1}{4}\right) = 1$

The product of the two numbers is 1, so they are multiplicative inverses (or reciprocals) of each other. This is an example of the multiplicative inverse property: $a \cdot \frac{1}{a} = 1\ (a \neq 0)$.

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

The numbers are in the same order but grouped differently, so this is an example of the associative property of addition:
$(a+b)+c = a+(b+c)$.

23. $8t + 4t - 12 + 7 - 9t = (8t + 4t - 9t) + (-12 + 7)$

$= (8 + 4 - 9)t + (-5)$

$= 3t - 5$

24. $5(3x-7) - (2x-8)$

$= 5(3x-7) - 1(2x-8)$

$= 5(3x) + 5(-7) - 1(2x) - 1(-8)$

$= 15x - 35 - 2x + 8$

$= 13x - 27$

25. $2753 - 55 = 2698$

The difference between the highest and lowest elevations is 2698 feet.