Chapter 1

Section 1.2

1.2 Quick Checks

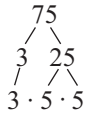
1. In the statement $6 \cdot 8 = 48$, 6 and 8 are called factors and 48 is called the product.

2.

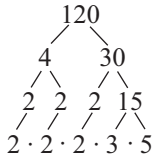
The prime factorization of 12 is $2 \cdot 2 \cdot 3$.

3.

The prime factorization of 18 is $2 \cdot 3 \cdot 3$.

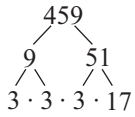
4.


The prime factorization of 75 is $3 \cdot 5 \cdot 5$.

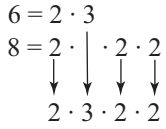
5.


The prime factorization of 120 is $2 \cdot 2 \cdot 2 \cdot 3 \cdot 5$.

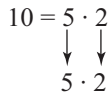
6. 131 is a prime number.

7.


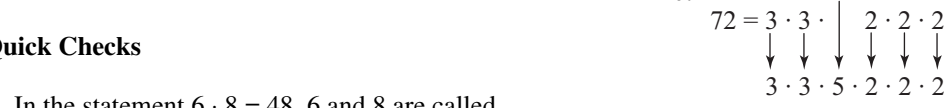
The prime factorization of 459 is $3 \cdot 3 \cdot 3 \cdot 17$.

8.


The LCM is $2 \cdot 3 \cdot 2 \cdot 2 = 24$.

9.


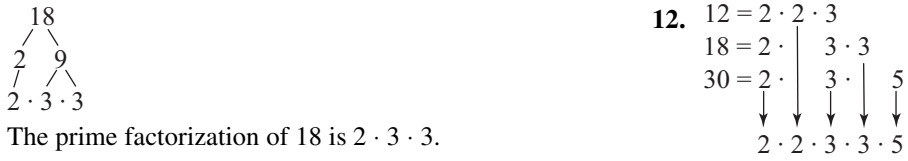
The LCM is $2 \cdot 5 = 10$.

10.


The LCM is $2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 = 360$.

11.


The LCM is $3 \cdot 7 = 21$.

12.


The LCM is $2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 = 180$.

13. Fractions which represent the same portion of a whole are called equivalent fractions.

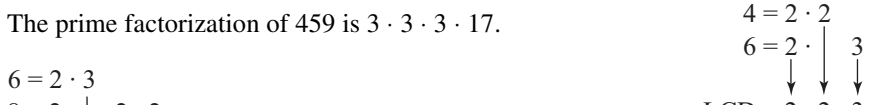
14. Multiply the numerator and denominator of $\frac{1}{2}$ by 5.

$$\frac{1}{2} = \frac{1 \cdot 5}{2 \cdot 5} = \frac{5}{10}$$

15. Multiply the numerator and denominator of $\frac{5}{8}$ by 6.

$$\frac{5}{8} = \frac{5 \cdot 6}{8 \cdot 6} = \frac{30}{48}$$

16. The denominators are 4 and 6.



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

$$\frac{5}{6} = \frac{5 \cdot 2}{6 \cdot 2} = \frac{10}{12}$$

17. The denominators are 12 and 15.

$$\frac{5}{12}=\frac{5\cdot 5}{12\cdot 5}=\frac{25}{60}$$
$$\frac{4}{15}=\frac{4\cdot 4}{15\cdot 4}=\frac{16}{60}$$

18. The denominators are 20 and 16.

$20 = 2 \cdot 2 \cdot 5$
$16 = 2 \cdot 2 \cdot 2 \cdot 2$

$\text{LCD} = 2 \cdot 2 \cdot 5 \cdot 2 \cdot 2 = 80$

$$\frac{9}{20}=\frac{9\cdot 4}{20\cdot 4}=\frac{36}{80}$$
$$\frac{11}{16}=\frac{11\cdot 5}{16\cdot 5}=\frac{55}{80}$$

19. $\frac{45}{80}=\frac{3\cdot 3\cdot 5}{2\cdot 2\cdot 2\cdot 2\cdot 5}=\frac{3\cdot 3\cdot \cancel{5}}{2\cdot 2\cdot 2\cdot 2\cdot \cancel{5}}=\frac{9}{16}$

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

21. $\frac{20}{50}=\frac{2\cdot 2\cdot 5}{2\cdot 5\cdot 5}=\frac{\cancel{2}\cdot 2\cdot \cancel{5}}{\cancel{2}\cdot 5\cdot \cancel{5}}=\frac{2}{5}$

22. $\frac{30}{105}=\frac{2\cdot 3\cdot 5}{3\cdot 5\cdot 7}=\frac{2\cdot \cancel{3}\cdot \cancel{5}}{\cancel{3}\cdot \cancel{5}\cdot 7}=\frac{2}{7}$

23. The 1 is two places to the right of the decimal; this is the hundredths place.

24. The 2 is one place to the right of the decimal; this the tenths place.

25. The 8 is four places to the left of the decimal; this is the thousands place.

26. The 9 is three places to the right of the decimal; this is the thousandths place.

27. The 3 is one place to the left of the decimal; this is the ones place.

28. The 2 is five places to the left of the decimal; this is the ten thousands place.

29. The number 1 is in the tenths place. The number to its right is 7. Since 7 is greater than 5, we round to 0.2.

30. The number 3 is in the hundredths place. The number to its right is 2. Since 2 is less than 5, we round to 0.93.

31. The number 9 is in the hundredths place. The number to its right is 6. Since 6 is greater than 5, we round to 1.40.

32. The number 8 is in the thousandths place. The number to its right is 3. Since 3 is less than 5, we round to 14.398.

33. The number 0 is in the hundredths place. The number to its right is 4. Since 4 is less than 5, we round to 690.00.

34. The number 9 is in the tenths place. The number to its right is 8. Since 8 is greater than 5, we round to 60.0.

35.
$$\begin{array}{r} 0.4 \\ 5\overline{)2.0} \\ \underline{2\,0} \\ 0 \end{array}$$

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

36.
$$\begin{array}{r} 0.428571 \\ 7\overline{)3.000000} \\ \underline{2\,8} \\ 20 \\ \underline{14} \\ 60 \\ \underline{56} \\ 40 \\ \underline{35} \\ 50 \\ \underline{49} \\ 10 \\ \underline{7} \\ 3 \end{array}$$

$\frac{3}{7}=0.\overline{428571}$

37.
$$\begin{array}{r} 1.375 \\ 8\overline{)11.000} \\ \underline{8} \\ 30 \\ \underline{24} \\ 60 \\ \underline{56} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

$\frac{11}{8}=1.375$

38.
$$\begin{array}{r} 0.833 \\ 6\overline{)5.000} \\ \underline{4\,8} \\ 20 \\ \underline{18} \\ 20 \\ \underline{18} \\ 2 \end{array}$$

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

39.
$$\begin{array}{r} 0.55 \\ 9\overline{)5.00} \\ \underline{4\,5} \\ 50 \\ \underline{45} \\ 5 \end{array}$$

$\frac{5}{9} = 0.\overline{5}$

40. $0.65 = \frac{65}{100} = \frac{\cancel{5}\cdot 13}{\cancel{5}\cdot 20} = \frac{13}{20}$

41. $0.2 = \frac{2}{10} = \frac{\cancel{2}}{\cancel{2}\cdot 5} = \frac{1}{5}$

42. $0.625 = \frac{625}{1000} = \frac{5\cdot \cancel{125}}{8\cdot \cancel{125}} = \frac{5}{8}$

43. The word percent means parts per hundred, so 35% means 35 parts out of 100 parts or $\frac{35}{100}$.

44. $23\% = 23\% \cdot \frac{1}{100\%} = \frac{23}{100} = 0.23$

45. $1\% = 1\% \cdot \frac{1}{100\%} = \frac{1}{100} = 0.01$

46. $72.4\% = 72.4\% \cdot \frac{1}{100\%} = \frac{72.4}{100} = 0.724$

47. $127\% = 127\% \cdot \frac{1}{100\%} = \frac{127}{100} = 1.27$

48. $89.26\% = 89.26\% \cdot \frac{1}{100\%} = \frac{89.26}{100} = 0.8926$

49. To convert a decimal to a percent, multiply the decimal by 100%.

50. $0.15 = 0.15 \cdot \frac{100\%}{1} = 15\%$

51. $0.8 = 0.8 \cdot \frac{100\%}{1} = 80\%$

52. $1.3 = 1.3 \cdot \frac{100\%}{1} = 130\%$

53. $0.398 = 0.398 \cdot \frac{100\%}{1} = 39.8\%$

54. $0.004 = 0.004 \cdot \frac{100\%}{1} = 0.4\%$

1.2 Exercises

56.
$$\begin{array}{c} 9 \\ 3 \cdot 3 \end{array}$$
The prime factorization of 9 is $3 \cdot 3$.

58.
$$\begin{array}{ccc} & 100 & \\ 4 & & 25 \\ 2\cdot 2 & & 5\cdot 5 \end{array}$$
The prime factorization of 100 is $2 \cdot 2 \cdot 5 \cdot 5$.

60.
$$\begin{array}{c} 35 \\ 5 \cdot 7 \end{array}$$
The prime factorization of 35 is $5 \cdot 7$.

62.
$$\begin{array}{ccc} & 54 & \\ 6 & & 9 \\ 2\cdot 3 & & 3\cdot 3 \end{array}$$
The prime factorization of 54 is $2 \cdot 3 \cdot 3 \cdot 3$.

64.
$$\begin{array}{ccc} & 63 & \\ 9 & & 7 \\ 3\cdot 3 & & 7 \end{array}$$
The prime factorization of 63 is $3 \cdot 3 \cdot 7$.

66.
$$\begin{array}{ccc} & 45 & \\ 9 & & 5 \\ 3\cdot 3 & & 5 \end{array}$$
The prime factorization of 45 is $3 \cdot 3 \cdot 5$.

68.
$$\begin{array}{c} 70 \\ 2 \quad 35 \\ 2 \cdot 5 \cdot 7 \end{array}$$
The prime factorization of 70 is $2 \cdot 5 \cdot 7$.

70. 79 is a prime number.

72.
$$\begin{array}{c} 315 \\ 9 \quad 35 \\ 3 \cdot 3 \cdot 5 \cdot 7 \end{array}$$
The prime factorization of 315 is $3 \cdot 3 \cdot 5 \cdot 7$.

74.
$$\begin{aligned} 10 &= 2 \cdot 5 \\ 14 &= 2 \cdot \quad 7 \\ &\quad\downarrow\ \downarrow\ \downarrow \\ &\quad 2 \cdot 5 \cdot 7 \end{aligned}$$
The LCM is $2 \cdot 5 \cdot 7 = 70$.

76.
$$\begin{aligned} 21 &= \qquad 3 \cdot 7 \\ 18 &= 2 \cdot 3 \cdot 3 \quad | \\ &\quad\downarrow\ \downarrow\ \downarrow\ \downarrow \\ &\quad 2 \cdot 3 \cdot 3 \cdot 7 \end{aligned}$$
The LCM of 21 and 18 is $2 \cdot 3 \cdot 3 \cdot 7 = 126$.

78.
$$\begin{aligned} 55 &= \qquad 5 \cdot 11 \\ 6 &= 2 \cdot 3 \quad | \quad | \\ &\quad\downarrow\ \downarrow\ \downarrow\ \downarrow \\ &\quad 2 \cdot 3 \cdot 5 \cdot 11 \end{aligned}$$
The LCM of 55 and 6 is $2 \cdot 3 \cdot 5 \cdot 11 = 330$.

80.
$$\begin{aligned} 8 &= 2 \cdot 2 \cdot 2 \\ 70 &= | \quad | \quad 2 \cdot 5 \cdot 7 \\ &\quad\downarrow\ \downarrow\ \downarrow\ \downarrow\ \downarrow \\ &\quad 2 \cdot 2 \cdot 2 \cdot 5 \cdot 7 \end{aligned}$$
The LCM of 8 and 70 is $2 \cdot 2 \cdot 2 \cdot 5 \cdot 7 = 280$.

82.
$$\begin{aligned} 9 &= \qquad 3 \cdot 3 \\ 15 &= \qquad | \quad 3 \cdot 5 \\ 20 &= 2 \cdot 2 \cdot | \quad | \quad 5 \\ &\quad\downarrow\ \downarrow\ \downarrow\ \downarrow\ \downarrow \\ &\quad 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 \end{aligned}$$
The LCM of 9, 15, and 20 is $2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 = 180$.

84.
$$\begin{aligned} 4 &= 2 \cdot 2 \\ 18 &= \quad 2 \cdot 3 \cdot 3 \\ 20 &= 2 \cdot 2 \cdot | \quad | \quad 5 \\ &\quad\downarrow\ \downarrow\ \downarrow\ \downarrow\ \downarrow \\ &\quad 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 \end{aligned}$$
The LCM of 4, 18, and 20 is $2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 = 180$.

86. $\dfrac{4}{5} = \dfrac{4 \cdot 3}{5 \cdot 3} = \dfrac{12}{15}$

88. $\dfrac{5}{14} = \dfrac{5 \cdot 2}{14 \cdot 2} = \dfrac{10}{28}$

90. $4 = \dfrac{4 \cdot 10}{1 \cdot 10} = \dfrac{40}{10}$

92.
$$\begin{aligned} 4 &= 2 \cdot 2 \\ 12 &= 2 \cdot 2 \cdot 3 \\ &\quad\downarrow\ \downarrow\ \downarrow \\ &\text{LCD} = 2 \cdot 2 \cdot 3 = 12 \end{aligned}$$
$$\frac{3}{4} = \frac{3 \cdot 3}{4 \cdot 3} = \frac{9}{12}$$
The equivalent fractions are $\dfrac{9}{12}$ and $\dfrac{5}{12}$.

94.
$$\begin{aligned} 4 &= 2 \cdot 2 \\ 9 &= | \quad | \quad 3 \cdot 3 \\ &\quad\downarrow\ \downarrow\ \downarrow\ \downarrow \\ &\text{LCD} = 2 \cdot 2 \cdot 3 \cdot 3 = 36 \end{aligned}$$
$$\frac{1}{4} = \frac{1 \cdot 9}{4 \cdot 9} = \frac{9}{36}$$
$$\frac{2}{9} = \frac{2 \cdot 4}{9 \cdot 4} = \frac{8}{36}$$
The equivalent fractions are $\dfrac{9}{36}$ and $\dfrac{8}{36}$.

96.
$$\begin{aligned} 12 &= 2 \cdot 2 \cdot 3 \\ 18 &= 2 \cdot | \quad 3 \cdot 3 \\ &\quad\downarrow\ \downarrow\ \downarrow\ \downarrow \\ &\text{LCD} = 2 \cdot 2 \cdot 3 \cdot 3 = 36 \end{aligned}$$
$$\frac{1}{12} = \frac{1 \cdot 3}{12 \cdot 3} = \frac{3}{36}$$
$$\frac{5}{18} = \frac{5 \cdot 2}{18 \cdot 2} = \frac{10}{36}$$
The equivalent fractions are $\dfrac{3}{36}$ and $\dfrac{10}{36}$.

98.
$$\begin{aligned} 12 &= 2 \cdot 2 \cdot 3 \\ 15 &= | \quad | \quad 3 \cdot 5 \\ &\quad\downarrow\ \downarrow\ \downarrow\ \downarrow \\ &\text{LCD} = 2 \cdot 2 \cdot 3 \cdot 5 = 60 \end{aligned}$$
$$\frac{5}{12} = \frac{5 \cdot 5}{12 \cdot 5} = \frac{25}{60}$$
$$\frac{7}{15} = \frac{7 \cdot 4}{15 \cdot 4} = \frac{28}{60}$$
The equivalent fractions are $\dfrac{25}{60}$ and $\dfrac{28}{60}$.

100.
$$\begin{aligned} 10 &= 2 \cdot 5 \\ 4 &= 2 \cdot 2 \\ 6 &= 2 \cdot 3 \\ \text{LCD} &= 2 \cdot 2 \cdot 3 \cdot 5 = 60 \end{aligned}$$
$$\frac{7}{10} = \frac{7 \cdot 6}{10 \cdot 6} = \frac{42}{60}$$
$$\frac{1}{4} = \frac{1 \cdot 15}{4 \cdot 15} = \frac{15}{60}$$
$$\frac{5}{6} = \frac{5 \cdot 10}{6 \cdot 10} = \frac{50}{60}$$
The equivalent fractions are $\frac{42}{60}, \frac{15}{60}$, and $\frac{50}{60}$.

102. $\frac{9}{15} = \frac{3 \cdot 3}{3 \cdot 5} = \frac{\cancel{3} \cdot 3}{\cancel{3} \cdot 5} = \frac{3}{5}$

104. $\frac{81}{36} = \frac{3 \cdot 3 \cdot 3 \cdot 3}{2 \cdot 2 \cdot 3 \cdot 3} = \frac{3 \cdot 3 \cdot \cancel{3} \cdot \cancel{3}}{2 \cdot 2 \cdot \cancel{3} \cdot \cancel{3}} = \frac{9}{4}$

106. $\frac{24}{27} = \frac{2 \cdot 2 \cdot 2 \cdot 3}{3 \cdot 3 \cdot 3} = \frac{2 \cdot 2 \cdot 2 \cdot \cancel{3}}{3 \cdot 3 \cdot \cancel{3}} = \frac{8}{9}$

108. $\frac{49}{63} = \frac{7 \cdot 7}{3 \cdot 3 \cdot 7} = \frac{7 \cdot \cancel{7}}{3 \cdot 3 \cdot \cancel{7}} = \frac{7}{9}$

110. The 8 is three places to the left of the decimal; this is the hundreds place.

112. The 7 is one place to the right of the decimal; this is the tenths place.

114. The 9 is one place to the left of the decimal; this is the ones place.

116. The number 2 is in the hundreds place. The number to the right of 2 is 9. Since 9 is greater than 5, we round to 7300.

118. The number 3 is in the ones place. The number to the right of 3 is 0. Since 0 is less than 5, we round to 543.

120. The number 9 is in the hundredths place. The number to the right of 9 is 8. Since 8 is greater than 5, we round to 683.10.

122. The number 4 is in the tenths place. The number to the right of 4 is 3. Since 3 is less than 5, we round to 37.4.

124.
$$\begin{array}{r} 0.75 \\ 4\overline{)3.00} \\ \underline{28} \\ 20 \\ \underline{20} \\ 0 \end{array}$$
$$\frac{3}{4} = 0.75$$

126.
$$\begin{array}{r} 0.222 \\ 9\overline{)2.000} \\ \underline{18} \\ 20 \\ \underline{18} \\ 20 \\ \underline{18} \\ 2 \end{array}$$
$$\frac{2}{9} = 0.222... \text{ or } 0.\overline{2}$$

128.
$$\begin{array}{r} 0.34375 \\ 32\overline{)11.00000} \\ \underline{96} \\ 140 \\ \underline{128} \\ 120 \\ \underline{96} \\ 240 \\ \underline{224} \\ 160 \\ \underline{160} \\ 0 \end{array}$$
$$\frac{11}{32} = 0.34375$$

130.
$$\begin{array}{r} 0.461538 \\ 13\overline{)6.000000} \\ \underline{52} \\ 80 \\ \underline{78} \\ 20 \\ \underline{13} \\ 70 \\ \underline{65} \\ 50 \\ \underline{39} \\ 110 \\ \underline{104} \\ 6 \end{array}$$
$$\frac{6}{13} = 0.\overline{461538}$$

132.
$$\begin{array}{r} 1.14 \\ 50\overline{)57.00} \\ \underline{50} \\ 70 \\ \underline{50} \\ 200 \\ \underline{200} \\ 0 \end{array}$$

$\frac{57}{50} = 1.14$

134.
$$\begin{array}{r} 1.87 \\ 8\overline{)15.00} \\ \underline{8} \\ 70 \\ \underline{64} \\ 60 \\ \underline{56} \\ 4 \end{array}$$

$\frac{15}{8}$ rounded to the nearest tenth is 1.9.

136.
$$\begin{array}{r} 1.285 \\ 7\overline{)9.000} \\ \underline{7} \\ 20 \\ \underline{14} \\ 60 \\ \underline{56} \\ 40 \\ \underline{35} \\ 5 \end{array}$$

$\frac{9}{7}$ rounded to the nearest hundredth is 1.29.

138.
$$\begin{array}{r} 0.5806 \\ 31\overline{)18.0000} \\ \underline{155} \\ 250 \\ \underline{248} \\ 200 \\ \underline{186} \\ 14 \end{array}$$

$\frac{18}{31}$ rounded to the nearest thousandth is 0.581.

140. $0.25 = \frac{25}{100} = \frac{1 \cdot \cancel{25}}{4 \cdot \cancel{25}} = \frac{1}{4}$

142. $0.4 = \frac{4}{10} = \frac{\cancel{2} \cdot 2}{\cancel{2} \cdot 5} = \frac{2}{5}$

144. $0.358 = \frac{358}{1000} = \frac{\cancel{2} \cdot 179}{\cancel{2} \cdot 500} = \frac{179}{500}$

146. $0.3334 = \frac{3334}{10,000} = \frac{\cancel{2} \cdot 1667}{\cancel{2} \cdot 5000} = \frac{1667}{5000}$

148. $59\% = 59\% \cdot \frac{1}{100\%} = \frac{59}{100} = 0.59$

150. $8.25\% = 8.25\% \cdot \frac{1}{100\%} = \frac{8.25}{100} = 0.0825$

152. $0.5\% = 0.5\% \cdot \frac{1}{100\%} = \frac{0.5}{100} = 0.005$

154. $0.5 = 0.5 \cdot \frac{100\%}{1} = 50\%$

156. $0.349 = 0.349 \cdot \frac{100\%}{1} = 34.9\%$

158. $1 = 1 \cdot \frac{100\%}{1} = 100\%$

160. The number of laps is the LCM of 21, 18, and 15.

$21 = 3 \cdot 7$
$18 = 2 \cdot 3 \cdot 3$
$15 = 3 \cdot 5$

LCM $= 2 \cdot 3 \cdot 3 \cdot 5 \cdot 7 = 630$
The race should have 630 laps.

162. Find the LCM of 14 and 20.

$14 = 2 \cdot 7$
$20 = 2 \cdot 2 \cdot 5$

LCM $= 2 \cdot 2 \cdot 5 \cdot 7 = 140$
Pamela and Geoff are in Columbus every 140 days.

164. 450 of 750

$\frac{450}{750} = \frac{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5}{2 \cdot 3 \cdot 5 \cdot 5 \cdot 5} = \frac{\cancel{2} \cdot \cancel{3} \cdot 3 \cdot \cancel{5} \cdot \cancel{5}}{\cancel{2} \cdot \cancel{3} \cdot 5 \cdot \cancel{5} \cdot \cancel{5}} = \frac{3}{5}$

The fraction of students that are enrolled in 15 or more semester hours is $\frac{3}{5}$.

166.
$$1100\overline{)640.000}\quad \begin{array}{r} 0.581 \\ 550\,0 \\ \hline 90\,00 \\ 88\,00 \\ \hline 2000 \\ 1100 \\ \hline 900 \end{array}$$

$$\frac{640}{1100} = 0.58\overline{1} \approx 0.5818 \cdot \frac{100\%}{1} = 58.18\%$$

58.18% of adult women believe in ghosts.

168.
$$115\overline{)80.00000}\quad \begin{array}{r} 0.69565 \\ 690 \\ \hline 1100 \\ 1035 \\ \hline 650 \\ 575 \\ \hline 750 \\ 690 \\ \hline 600 \\ 575 \\ \hline 25 \end{array}$$

$$\frac{80}{115} \approx 0.6957 = 0.6957 \cdot \frac{100\%}{1} = 69.57\%$$

170. a.
$$\frac{48}{101} = 0.4752$$

$$0.4701 \cdot \frac{100\%}{1} = 47.52\%$$

47.52% were white ash.

b.
$$\frac{51}{101} = 0.5050$$

$$0.5050 \cdot \frac{100\%}{1} = 50.50\%$$

50.50% were green ash.

c.
$$\frac{2}{101} = 0.0198$$

$$0.0198 \cdot \frac{100\%}{1} = 1.98\%$$

1.98% were blue ash.

172.
$$11\overline{)5.00}\quad \begin{array}{r} 0.45 \\ 44 \\ \hline 60 \\ 55 \\ \hline 5 \end{array}$$

$$\frac{5}{11} = 0.\overline{45}$$

$$0.4545 \cdot \frac{100\%}{1} = 45.45\%$$

45.45% is saturated fat.

Section 1.3

Preparing for the Number Systems and the Real Number Line

P1.
$$8\overline{)5.000}\quad \begin{array}{r} 0.625 \\ 48 \\ \hline 20 \\ 16 \\ \hline 40 \\ 40 \\ \hline 0 \end{array}$$

$$\frac{5}{8} = 0.625$$

P2.
$$11\overline{)9.0000}\quad \begin{array}{r} 0.8181 \\ 88 \\ \hline 20 \\ 11 \\ \hline 90 \\ 88 \\ \hline 20 \\ 11 \\ \hline 9 \end{array}$$

$$\frac{9}{11} = 0.8181\ldots \text{ or } 0.\overline{81}$$

1.3 Quick Checks

1. The first 4 positive odd numbers are 1, 3, 5, and 7. If we let O represent this set, then $O = \{1, 3, 5, 7\}$.

2. The states whose names begin with the letter A are Alabama, Alaska, Arizona, and Arkansas. If we let A represent this set, then $A = \{\text{Alabama, Alaska, Arizona, Arkansas}\}$.

3. There are no states whose names begin with the letter *Z*. If we let *Z* represent this set, then $Z = \{\ \}$ or $\varnothing$.

4. Every integer is a rational number. True

5. Real numbers that can be represented with a terminating decimal are called rational.

6. 12 is the only natural number.

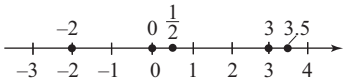
7. 0 and 12 are the whole numbers.

8. −5, 12, and 0 are the integers.

9. $\frac{11}{5}, -5, 12, 2.\overline{76}, 0,$ and $\frac{18}{4}$ are the rational numbers.

10. π is the only irrational number.

11. All the numbers listed are real numbers.

12. 

13. The symbols $<, >, \leq, \geq$ are called inequality symbols.

14. $2 < 9$ because 2 lies to the left of 9 on the real number line.

15. $-5 < -3$ because −5 lies to the left of −3 on the real number line.

16. $\frac{4}{5} > \frac{1}{2}$ because $\frac{4}{5} = \frac{8}{10}$ and $\frac{1}{2} = \frac{5}{10}$. Having 8 parts out of 10 is more than having 5 parts out of 10. Also, $\frac{4}{5} = 0.8$ and $\frac{1}{2} = 0.5$ and 0.8 lies to the right of 0.5 on the real number line.

17. $\frac{4}{7} > 0.5$ because $\frac{4}{7} = 0.\overline{571428}$ and $0.\overline{571428}$ lies to the right of 0.5 on the real number line.

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

19. $-\frac{4}{3} < -\frac{5}{4}$

20. The distance from zero to a point on a real number line whose coordinate is *a* is called the absolute value of *a*.

21. $|-15| = 15$ because the distance from 0 to −15 on the real number line is 15.

22. $\left|-\frac{3}{4}\right| = \frac{3}{4}$ because the distance from 0 to $-\frac{3}{4}$ on the real number line is $\frac{3}{4}$.

1.3 Exercises

24. The set of natural numbers less than 25 is $B = \{1, 2, 3, 4, ..., 24\}$.

26. The set of integers between −6 and 4 is $C = \{-5, -4, -3, -2, -1, 0, 1, 2, 3\}$.

28. There are no odd natural numbers that are less than 1; $F = \{\ \}$ or $\varnothing$.

30. 3 and 0 are the whole numbers.

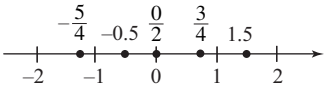
32. −4, 3, $-\frac{13}{2}$, and 0 are the rational numbers.

34. All the numbers listed are real numbers.

36. −4.2, $3.\overline{5}$, and $\frac{5}{5} = 1$ are the rational numbers.

38. $\frac{5}{5} = 1,$ so $\frac{5}{5}$ is the only integer.

40. $\frac{5}{5} = 1,$ so $\frac{5}{5}$ is the only natural number.

42. 

44. 0 lies to the right of −5 on the number line. The statement is false.

46. −3 lies to the right of −5 on the number line. The statement is true.

48. Since $4.\overline{7} = 4.777...,$ $4.7 < 4.\overline{7}$. The statement is false.

50. Since $\frac{1}{3} = 0.333...$, $\frac{1}{3} > 0.33$. The statement is false.

52. Since -8 lies to the right of -8.5 on the number line, $-8 > -8.5$.

54. Since $\frac{5}{12} = 0.41\overline{6}$ and $\frac{2}{3} = 0.66\overline{6}$, $\frac{5}{12} < \frac{2}{3}$.

56. Since $\frac{5}{11} = 0.4545...$, $\frac{5}{11} = 0.\overline{45}$.

58. Since $\frac{3}{4} = 0.75$ and $\frac{3}{5} = 0.6$, $\frac{3}{4} > \frac{3}{5}$.

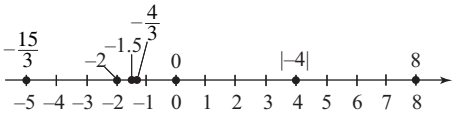
60. $|-8| = 8$ because the distance from 0 to -8 on the real number line is 8.

62. $|7| = 7$ because the distance from 0 to 7 on the real number line is 7.

64. $\left|-\frac{13}{9}\right| = \frac{13}{9}$ because the distance from 0 to $-\frac{13}{9}$ on the real number line is $\frac{13}{9}$.

66. $|-3.2| = 3.2$ because the distance from 0 to -3.2 on the number line is 3.2.

68. (a)



(b) From left to right on the number line, the order of the numbers is $-\frac{15}{3}, -2, -1.5, -\frac{4}{3}, 0, |-4|, 8$.

(c) i. $-\frac{15}{3} = -5$, -2, 0, $|-4| = 4$, 8 are integers.

ii. All numbers listed are rational numbers.

		Natural	Whole	Integers	Rational	Irrational	Real
70.	0		√	√	√		√
72.	π					√	√
74.	4	√	√	√	√		√
76.	$6.\overline{45}$				√		√

78. Only decimal numbers that are terminating or repeating are rational. The decimal number 4.010010001... is irrational. The statement is false.

80. 0 is neither positive nor negative. The statement is false.

82. The set of integers is a subset of the real numbers. The statement is true.

84. Consider the number in the form $\frac{8}{2} = 4,$ which is an integer. The statement is true.

86. -1 is a negative or non-positive integer. The statement is true.

88. Nonnegative integers are 0, 1, 2, ..., or the whole numbers.

90. Terminating or repeating decimals are rational numbers.

92. There is no number which is both negative and positive. This is the empty set or $\varnothing$.

94. The element f in Z is not an element of Y. The statement is false.

96. The element f in Z is not an element of X. The statement is false.

98. $A \cap B$ is the set of all elements common to both A and B, so $A \cap B = \{10, 11, 12\}$.

100. $B \cap C$ is the set of all elements common to both B and C, so $B \cap C = \{11, 12, 13, 14, 15\}$.

102. $A \cup C$ is the set of elements in either A or C, so $A \cup C = \{7, 8, 9, 10, 11, 12, 13, 14, 15\}$.

104. Since Y is a subset of X, then $X \cap Y = Y$, so $X \cap Y = \{60, 62, 64, ..., 80\}$.

106. **(a)** Answers may vary. One possibility: There are subsets with no elements, subsets with one element, subsets with two elements, and subsets with three elements.
0: { }
1: {a}, {b}, {c}
2: {a, b}, {a, c}, {b, c}
3: {a, b, c}

(b) There are a total of 8 subsets.

(c) A set with n elements has 2^n subsets.

108. An irrational number is any number that cannot be written as the quotient of two integers. Non-repeating, non-terminating decimals are irrational numbers. Numbers such as π and $\sqrt{2}$ and 8.98987987698765... are irrational numbers.

Section 1.4

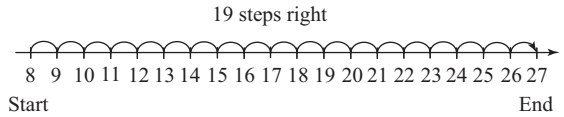
Preparing for Adding, Subtracting, Multiplying, and Dividing Integers

P1. $\frac{16}{36} = \frac{2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 3 \cdot 3} = \frac{\cancel{2} \cdot \cancel{2} \cdot 2 \cdot 2}{\cancel{2} \cdot \cancel{2} \cdot 3 \cdot 3} = \frac{2 \cdot 2}{3 \cdot 3} = \frac{4}{9}$

1.4 Quick Checks

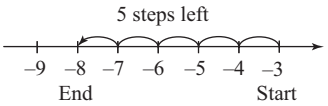
1. The answer to an addition problem is called the sum.

2.



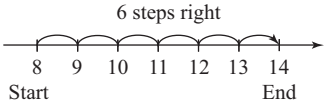
$8 + 19 = 27$

3.



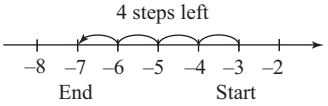
$-3 + (-5) = -8$

4.



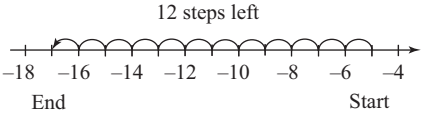
$8 + 6 = 14$

5.



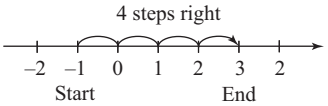
$-3 + (-4) = -7$

6.



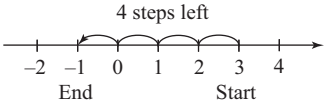
$-5 + (-12) = -17$

7.

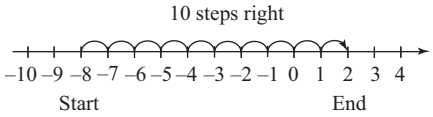


$-1 + 4 = 3$

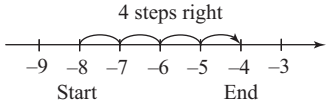
8.



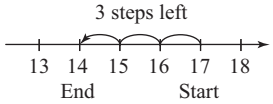
$3 + (-4) = -1$

9. 

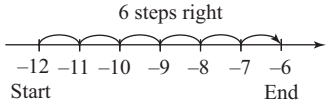
$-8 + 10 = 2$

10. 

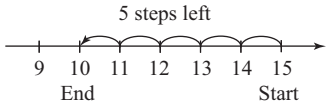
$-8 + 4 = -4$

11. 

$17 + (-3) = 14$

12. 

$-12 + 6 = -6$

13. 

$15 + (-5) = 10$

14. The sum of two negative integers will be negative.

15. $|-11| = 11$
$|7| = 7$
The signs of −11 and 7 are different, so we subtract the absolute values: $11 - 7 = 4$.
The larger absolute value, 11, corresponds to a negative number in the original problem, so the sum is negative.
$-11 + 7 = -4$

16. $|5| = 5$
$|-8| = 8$
The signs of 5 and −8 are different, so we subtract the absolute values: $8 - 5 = 3$.
The larger absolute value, 8, corresponds to a negative number in the original problem, so the sum is negative.
$5 + (-8) = -3$

17. $|-8| = 8$
$|-16| = 16$
The signs of −8 and −16 are the same, so we add the absolute values: $8 + 16 = 24$.
Both numbers in the original problem are negative, so the sum is negative.
$-8 + (-16) = -24$

18. $|-94| = 94$
$|38| = 38$
The signs of −94 and 38 are different, so we subtract the absolute values: $94 - 38 = 56$.
The larger absolute value, 94, corresponds to a negative number in the original problem, so the sum is negative.
$-94 + 38 = -56$

19. The additive inverse of 7 is −7 because $7 + (-7) = 0$.

20. The additive inverse of $\frac{3}{7}$ is $-\frac{3}{7}$ because $\frac{3}{7} + \left(-\frac{3}{7}\right) = 0$.

21. The additive inverse of −21 is $-(-21) = 21$ because $-21 + 21 = 0$.

22. The additive inverse of $-\frac{8}{5}$ is $-\left(-\frac{8}{5}\right) = \frac{8}{5}$ because $-\frac{8}{5} + \frac{8}{5} = 0$.

23. The additive inverse of −5.75 is $-(-5.75) = 5.75$ because $-5.75 + 5.75 = 0$.

24. The answer to a subtraction problem is called the difference.

25. The subtraction problem $-3 - 10$ is equivalent to $-3 + (-10)$.

26. $59 - (-21) = 59 + 21 = 80$

27. $-32 - 146 = -32 + (-146) = -178$

28. 17 minus 35 is $17 - 35$.
$17 - 35 = 17 + (-35) = -18$

29. −382 subtracted from −2954 is $-2954 - (-382)$.
$-2954 - (-382) = -2954 + 382 = -2572$

30.
$$\begin{aligned} 8 - 13 + 5 - 21 &= 8 + (-13) + 5 + (-21) \\ &= -5 + 5 + (-21) \\ &= 0 + (-21) \\ &= -21 \end{aligned}$$

31.
$$\begin{aligned} -27 - 49 + 18 &= -27 + (-49) + 18 \\ &= -76 + 18 \\ &= -58 \end{aligned}$$

32. $3-(-14)-8+3=3+14+(-8)+3$
$=17+(-8)+3$
$=9+3$
$=12$

33. $-825 + 375 - (-735) + 265$
$= -825 + 375 + 735 + 265$
$= -450 + 735 + 265$
$= 285 + 265$
$= 550$

34. The product of two integers with the same sign is positive.

35. $-3(7) = -21$

36. $13(-4) = -52$

37. $5 \cdot 16 = 80$

38. $-9(-12) = 108$

39. $(-13)(-25) = 325$

40. The product of thirteen negative factors is negative. True

41. $-3 \cdot 9 \cdot (-4) = -27 \cdot (-4) = 108$

42. $(-3)\cdot(-4)\cdot(-5)\cdot(-6)=12\cdot(-5)\cdot(-6)$
$=-60\cdot(-6)$
$=360$

43. The reciprocal of 6 is $\frac{1}{6}$.

44. The reciprocal of -2 is $-\frac{1}{2}$.

45. The quotient of two negative numbers is positive. True

46. $\frac{20}{-4}=\frac{5\cdot 4}{-1\cdot 4}=\frac{5\cdot \cancel{4}}{-1\cdot \cancel{4}}=\frac{5}{-1}=-5$

47. $\frac{707}{-101}=\frac{7\cdot 101}{-1\cdot 101}=\frac{7\cdot \cancel{101}}{-1\cdot \cancel{101}}=\frac{7}{-1}=-7$

48. $-63\div(-7)=\frac{-63}{-7}=\frac{9\cdot(-7)}{1\cdot(-7)}=\frac{9\cdot \cancel{(-7)}}{1\cdot \cancel{(-7)}}=9$

1.4 Exercises

50. $6 + 4 = 10$

52. $-4 + 12 = 8$

54. $13 + (-7) = 6$

56. $-13 + (-5) = -18$

58. $-32 + 49 = 17$

60. $-145 + (-68) = -213$

62. $(-13) + 37 + (-22) = 24 + (-22) = 2$

64. $-34+46+(-12)+72=12+(-12)+72$
$=0+72$
$=72$

66. The additive inverse of -34 is $-(-34) = 34$ because $-34 + 34 = 0$.

68. The additive inverse of 7 is -7 because $7 + (-7) = 0$.

70. $35 - 23 = 35 + (-23) = 12$

72. $12 - 19 + 12 + (-19) = -7$

74. $-15 - 9 = -15 + (-9) = -24$

76. $14 - (-18) = 14 + 18 = 32$

78. $-15 - (-15) = -15 + 15 = 0$

80. $0 - 18 = 0 + (-18) = -18$

82. $46 - (-25) = 46 + 25 = 71$

84. $49 - (-49) = 49 + 49 = 98$

86. $7 \cdot 9 = 63$

88. $9(-7) = -63$

90. $-21 \cdot 0 = 0$

92. $(-22)(-5) = 110$

94. $(-128)7 = -896$

96. $-6 \cdot 4 \cdot 8 = -24 \cdot 8 = -192$

98. $-8(2)(-9) = -16(-9) = 144$

100. $(-3)(-4)(6)(-1) = 12(6)(-1) = 72(-1) = -72$

102. The reciprocal of 10 is $\frac{1}{10}$.

104. The reciprocal of -3 is $-\frac{1}{3}$.

106. The reciprocal of 2 is $\frac{1}{2}$.

108. $36 \div 9 = \frac{36}{9} = \frac{4 \cdot 9}{1 \cdot 9} = \frac{4 \cdot \cancel{9}}{1 \cdot \cancel{9}} = 4$

110. $\frac{-63}{-7} = \frac{9 \cdot (-7)}{1 \cdot (-7)} = \frac{9 \cdot \cancel{(-7)}}{1 \cdot \cancel{(-7)}} = 9$

112. $\frac{-144}{6} = \frac{-24 \cdot 6}{1 \cdot 6} = \frac{-24 \cdot \cancel{6}}{1 \cdot \cancel{6}} = -24$

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

116. $\frac{120}{-66} = \frac{20 \cdot 6}{-11 \cdot 6} = \frac{20 \cdot \cancel{6}}{-11 \cdot \cancel{6}} = \frac{20}{-11} = -\frac{20}{11}$

118. $\frac{-80}{-12} = \frac{20 \cdot (-4)}{3 \cdot (-4)} = \frac{20 \cdot \cancel{(-4)}}{3 \cdot \cancel{(-4)}} = \frac{20}{3}$

120. $7 \cdot (-15) = -105$

122. $87 - 19 = 87 + (-19) = 68$

124. $7 \cdot 209 = 1463$

126. $\frac{-156}{-26} = \frac{6 \cdot (-26)}{1 \cdot (-26)} = \frac{6 \cdot \cancel{(-26)}}{1 \cdot \cancel{(-26)}} = 6$

128. $103 + (-66) = 37$

130. $\frac{|-42|}{12} = \frac{42}{12} = \frac{7 \cdot 6}{2 \cdot 6} = \frac{7 \cdot \cancel{6}}{2 \cdot \cancel{6}} = \frac{7}{2}$

132. $|-10| + (-62) = 10 + (-62) = -52$

134. $|-193| - (-20) = 193 - (-20) = 193 + 20 = 213$

136. The sum of 32 and -64 is written as $32 + (-64) = -32$.

138. -16 minus -85 is written as $-16 - (-85) = -16 + 85 = 69$.

140. 32 multiplied by -8 is written as $32 \cdot (-8) = -256$.

142. -40 divided by 100 is written as

$$-40 \div 100 = \frac{-40}{100} = \frac{-2 \cdot 20}{5 \cdot 20} = \frac{-2 \cdot \cancel{20}}{5 \cdot \cancel{20}} = -\frac{2}{5}.$$

144. $-14°$; the number is negative because the temperature is below zero.

146. +\$125,000 or \$125,000; the number is positive because there was a profit.

148. +12,368 or 12,368; the number is positive because the population grew.

150. $15 + (-7) + 14 + 26 = 48$
The ball is on the 48 yard-marker.

152. $399 + 839 + (-69) + (-78) + (-739) = 352$
She has \$352 left for spending money.

154. $35{,}000 + 4290 + (-10{,}400) + (-2605) = 26{,}285$
The plane is flying at an elevation of 26,285 feet.

156. $14{,}495 - (-280) = 14{,}495 + 280 = 14{,}775$
The maximum difference is 14,775 feet.

158. $6 + (-4) = 2$
$6(-4) = -24$
The integers are 6 and -4.

160. $-15 + (-3) = -18$
$-15(-3) = 45$
The integers are -15 and -3.

162. Consider $5 \cdot (-3)$. The statement $5 \cdot (-3)$ means $(-3) + (-3) + (-3) + (-3) + (-3) = -15$. We conclude that the product of a positive number and a negative number is negative.

Section 1.5

Preparing for Adding, Subtracting, Multiplying, and Dividing Rational Numbers Expressed as Fractions and Decimals

P1. $12 = 2 \cdot 2 \cdot 3$
$16 = 2 \cdot 2 \cdot 2 \cdot 2$
$\text{LCD} = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 = 48$
The LCD of $\frac{5}{12}$ and $\frac{3}{16}$ is 48.

P2. $30 = 5 \cdot 6$

$$\frac{4}{5} = \frac{4}{5} \cdot \frac{6}{6} = \frac{4 \cdot 6}{5 \cdot 6} = \frac{24}{30}$$

1.5 Quick Checks

1. $\dfrac{-4}{14} = \dfrac{-2 \cdot 2}{7 \cdot 2} = \dfrac{-2 \cdot \cancel{2}}{7 \cdot \cancel{2}} = -\dfrac{2}{7}$

2. $-\dfrac{18}{30} = -\dfrac{3 \cdot 6}{5 \cdot 6} = -\dfrac{3 \cdot \cancel{6}}{5 \cdot \cancel{6}} = -\dfrac{3}{5}$

3. $\dfrac{24}{-4} = \dfrac{6 \cdot 4}{-1 \cdot 4} = \dfrac{6 \cdot \cancel{4}}{-1 \cdot \cancel{4}} = \dfrac{6}{-1} = -6$

4. $\dfrac{3}{4} \cdot \dfrac{9}{8} = \dfrac{3 \cdot 9}{4 \cdot 8} = \dfrac{27}{32}$

5. $\dfrac{-5}{7} \cdot \dfrac{56}{15} = \dfrac{-5 \cdot 56}{7 \cdot 15}$

$$= \frac{-1 \cdot 5 \cdot 7 \cdot 8}{7 \cdot 3 \cdot 5}$$

$$= \frac{-1 \cdot \cancel{5} \cdot \cancel{7} \cdot 8}{\cancel{7} \cdot 3 \cdot \cancel{5}}$$

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

6. $\dfrac{12}{45} \cdot \left(-\dfrac{18}{20}\right) = \dfrac{12}{45} \cdot \dfrac{-18}{20}$

$$= \frac{12 \cdot (-18)}{45 \cdot 20}$$

$$= \frac{2 \cdot 2 \cdot 3 \cdot 2 \cdot 3 \cdot (-3)}{3 \cdot 3 \cdot 5 \cdot 2 \cdot 2 \cdot 5}$$

$$= \frac{\cancel{2} \cdot \cancel{2} \cdot \cancel{3} \cdot 2 \cdot \cancel{3} \cdot (-3)}{\cancel{3} \cdot \cancel{3} \cdot 5 \cdot \cancel{2} \cdot \cancel{2} \cdot 5}$$

$$= \frac{2 \cdot (-3)}{5 \cdot 5}$$

$$= -\frac{6}{25}$$

7. $-\dfrac{25}{75} \cdot \left(-\dfrac{9}{4}\right) = \dfrac{-25}{75} \cdot \dfrac{-9}{4}$

$$= \frac{-25 \cdot (-9)}{75 \cdot 4}$$

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

$$= \frac{\cancel{5} \cdot \cancel{5} \cdot \cancel{3} \cdot 3}{\cancel{3} \cdot \cancel{5} \cdot \cancel{5} \cdot 2 \cdot 2}$$

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

$$= \frac{3}{4}$$

8. $\dfrac{7}{3} \cdot \dfrac{1}{14} \cdot \left(-\dfrac{9}{11}\right) = \dfrac{7}{3} \cdot \dfrac{1}{14} \cdot \dfrac{-9}{11}$

$$= \frac{7 \cdot 1 \cdot (-9)}{3 \cdot 14 \cdot 11}$$

$$= \frac{7 \cdot 3 \cdot (-3)}{3 \cdot 2 \cdot 7 \cdot 11}$$

$$= \frac{\cancel{7} \cdot \cancel{3} \cdot (-3)}{\cancel{3} \cdot 2 \cdot \cancel{7} \cdot 11}$$

$$= \frac{-3}{2 \cdot 11}$$

$$= -\frac{3}{22}$$

9. Two numbers are called multiplicative inverses, or reciprocals, if their product is equal to <u>one</u>.

10. The reciprocal of 12 is $\dfrac{1}{12}$ because $12 \cdot \dfrac{1}{12} = 1$.

11. The reciprocal of $\dfrac{7}{5}$ is $\dfrac{5}{7}$ because $\dfrac{7}{5} \cdot \dfrac{5}{7} = 1$.

12. The reciprocal of $-\dfrac{1}{4}$ is -4 because

$-\dfrac{1}{4} \cdot (-4) = 1$.

13. The reciprocal of $-\dfrac{31}{20}$ is $-\dfrac{20}{31}$ because

$-\dfrac{31}{20} \cdot \left(-\dfrac{20}{31}\right) = 1$.

14. $\dfrac{5}{7} \div \dfrac{7}{10} = \dfrac{5}{7} \cdot \dfrac{10}{7} = \dfrac{5 \cdot 10}{7 \cdot 7} = \dfrac{50}{49}$

15. $-\frac{9}{12}\div\frac{14}{7}=-\frac{9}{12}\cdot\frac{7}{14}$

$=-\frac{3\cdot3\cdot7}{2\cdot2\cdot3\cdot2\cdot7}$

$=-\frac{\cancel{3}\cdot3\cdot\cancel{7}}{2\cdot2\cdot\cancel{3}\cdot2\cdot\cancel{7}}$

$=-\frac{3}{2\cdot2\cdot2}$

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

16. $\frac{8}{35}\div\left(\frac{-1}{10}\right)=\frac{8}{35}\cdot\left(\frac{10}{-1}\right)$

$=\frac{2\cdot2\cdot2\cdot2\cdot5}{5\cdot7\cdot(-1)}$

$=\frac{2\cdot2\cdot2\cdot2\cdot\cancel{5}}{\cancel{5}\cdot7\cdot(-1)}$

$=\frac{2\cdot2\cdot2\cdot2}{7\cdot(-1)}$

$=-\frac{16}{7}$

17. $-\frac{18}{63}\div\left(-\frac{54}{35}\right)=\frac{-18}{63}\cdot\left(\frac{-35}{54}\right)$

$=\frac{-1\cdot2\cdot3\cdot3\cdot(-1)\cdot5\cdot7}{3\cdot3\cdot7\cdot2\cdot3\cdot3\cdot3}$

$=\frac{\cancel{2}\cdot\cancel{3}\cdot\cancel{3}\cdot5\cdot\cancel{7}}{\cancel{3}\cdot\cancel{3}\cdot\cancel{7}\cdot\cancel{2}\cdot3\cdot3\cdot3}$

$=\frac{5}{3\cdot3\cdot3}$

$=\frac{5}{27}$

18. $\frac{-5}{7}+\frac{3}{7}=\frac{-5+3}{7}$

19. $-\frac{9}{10}-\frac{3}{10}=\frac{-9}{10}-\frac{3}{10}$

$=\frac{-9-3}{10}$

$=\frac{-12}{10}$

$=\frac{2\cdot(-6)}{2\cdot5}$

$=\frac{\cancel{2}\cdot(-6)}{\cancel{2}\cdot5}$

$=-\frac{6}{5}$

20. $\frac{8}{11}+\frac{2}{11}=\frac{8+2}{11}=\frac{10}{11}$

21. $-\frac{18}{35}+\frac{3}{35}=\frac{-18}{35}+\frac{3}{35}$

$=\frac{-18+3}{35}$

$=\frac{-15}{35}$

$=\frac{-3\cdot5}{5\cdot7}$

$=\frac{-3\cdot\cancel{5}}{\cancel{5}\cdot7}$

$=-\frac{3}{7}$

22. $\frac{19}{63}-\frac{10}{63}=\frac{19-10}{63}=\frac{9}{63}=\frac{1\cdot9}{7\cdot9}=\frac{1\cdot\cancel{9}}{7\cdot\cancel{9}}=\frac{1}{7}$

23. $12=2\cdot2\cdot3$

$18=2\cdot3\cdot3$

$\text{LCD}=2\cdot2\cdot3\cdot3=36$

$\frac{5}{12}-\frac{5}{18}=\frac{5}{12}\cdot\frac{3}{3}-\frac{5}{18}\cdot\frac{2}{2}$

$=\frac{15}{36}-\frac{10}{36}$

$=\frac{15-10}{36}$

$=\frac{5}{36}$

24. $14=2\cdot7$

$21=3\cdot7$

$\text{LCD}=2\cdot3\cdot7=42$

$\frac{3}{14}+\frac{10}{21}=\frac{3}{14}\cdot\frac{3}{3}+\frac{10}{21}\cdot\frac{2}{2}$

$=\frac{9}{42}+\frac{20}{42}$

$=\frac{9+20}{42}$

$=\frac{29}{42}$

25. $6 = 2 \cdot 3$
$12 = 2 \cdot 2 \cdot 3$
$\text{LCD} = 2 \cdot 2 \cdot 3 = 12$

$$-\frac{23}{6}+\frac{7}{12}=\frac{-23}{6}\cdot\frac{2}{2}+\frac{7}{12}$$
$$=\frac{-46}{12}+\frac{7}{12}$$
$$=\frac{-46+7}{12}$$
$$=\frac{-39}{12}$$
$$=\frac{-1\cdot 3\cdot 13}{2\cdot 2\cdot 3}$$
$$=\frac{-1\cdot \cancel{3}\cdot 13}{2\cdot 2\cdot \cancel{3}}$$
$$=\frac{-13}{2\cdot 2}$$
$$=-\frac{13}{4}$$

26. $5 = 5$
$11 = 11$
$\text{LCD} = 5 \cdot 11 = 55$

$$\frac{3}{5}+\left(-\frac{4}{11}\right)=\frac{3}{5}\cdot\frac{11}{11}+\frac{-4}{11}\cdot\frac{5}{5}$$
$$=\frac{33}{55}+\frac{-20}{55}$$
$$=\frac{33+(-20)}{55}$$
$$=\frac{13}{55}$$

27.
$$-2+\frac{7}{16}=\frac{-2}{1}+\frac{7}{16}$$
$$=\frac{-2}{1}\cdot\frac{16}{16}+\frac{7}{16}$$
$$=\frac{-32}{16}+\frac{7}{16}$$
$$=\frac{-32+7}{16}$$
$$=\frac{-25}{16}$$
$$=-\frac{25}{16}$$

28.
$$6+\left(\frac{-9}{4}\right)=\frac{6}{1}+\left(\frac{-9}{4}\right)$$
$$=\frac{6}{1}\cdot\frac{4}{4}+\left(\frac{-9}{4}\right)$$
$$=\frac{24}{4}+\left(\frac{-9}{4}\right)$$
$$=\frac{24+(-9)}{4}$$
$$=\frac{15}{4}$$

29.
$$\begin{array}{r} 9.670 \\ +\ 11.344 \\ \hline 21.014 \end{array}$$
So $9.67 + 11.344 = 21.014$.

30.
$$\begin{array}{r} 81.96 \\ -\ 17.39 \\ \hline 64.57 \end{array}$$
So $81.96 - 17.39 = 64.57$.

31.
$$\begin{array}{r} 14.950 \\ 7.118 \\ +\ 0.300 \\ \hline 22.368 \end{array}$$
So $14.95 + 7.118 + 0.3 = 22.368$.

32.
$$\begin{array}{r} 345.6700 \\ -\ 8.0912 \\ \hline 337.5788 \end{array}$$
So $345.67 - 8.0912 = 337.5788$.

33.
$$\begin{array}{r} 180.782 \\ -\ 100.300 \\ \hline 80.482 \end{array}$$
$-180.782 + 100.3 + 9.07 = -80.482 + 9.07$
$$\begin{array}{r} 80.482 \\ -\ 9.070 \\ \hline 71.412 \end{array}$$
So $-180.782 + 100.3 + 9.07 = -71.412$.

34.
$$\begin{array}{r} 74.280 \\ +\ 14.832 \\ \hline 89.112 \end{array}$$
So $-74.28-14.832=-74.28+(-14.832)$
$= -89.112$.

35.
$$\begin{array}{rl} 23.9 & \text{one digit to the right of the decimal point} \\ \times\ 0.2 & \text{one digit to the right of the decimal point} \\ \hline 4.78 & \text{two digits to the right of the decimal point} \end{array}$$

36.
$$\begin{array}{rl} 9.1 & \text{one digit to the right of the decimal point} \\ \times\ 7.24 & \text{two digits to the right of the decimal point} \\ \hline 364 & \\ 182 & \\ 637 & \\ \hline 65.884 & \text{three digits to the right of the decimal point} \end{array}$$

37.
$$\begin{array}{rl} -3.45 & \text{two digits to the right of the decimal point} \\ \times\ 0.03 & \text{two digits to the right of the decimal point} \\ \hline -0.1035 & \text{four digits to the right of the decimal point} \end{array}$$

38.
$$\begin{array}{rl} 257 & \text{no digits to the right of the decimal point} \\ \times -3.5 & \text{one digit to the right of the decimal point} \\ \hline 1285 & \\ 771 & \\ \hline -899.5 & \text{one digit to the right of the decimal point} \end{array}$$

39.
$$\begin{array}{rl} -0.03 & \text{two digits to the right of the decimal point} \\ \times\ -0.45 & \text{two digits to the right of the decimal point} \\ \hline 0.0135 & \text{four digits to the right of the decimal point} \end{array}$$

40.
$$\begin{array}{rl} 9.9 & \text{one digit to the right of the decimal point} \\ \times\ 0.002 & \text{three digits to the right of the decimal point} \\ \hline 0.0198 & \text{four digits to the right of the decimal point} \end{array}$$

41.
$$\begin{array}{r} 0.25 \\ 73\overline{)18.25} \\ 146 \\ \hline 365 \\ 365 \\ \hline 0 \end{array}$$

So, $\dfrac{18.25}{73} = 0.25.$

42. $\dfrac{1.0032}{0.12} = \dfrac{1.0032}{0.12} \cdot \dfrac{100}{100} = \dfrac{100.32}{12}$

$$\begin{array}{r} 8.36 \\ 12\overline{)100.32} \\ 96 \\ \hline 43 \\ 36 \\ \hline 72 \\ 72 \\ \hline 0 \end{array}$$

So $\dfrac{1.0032}{0.12} = 8.36.$

43. $\dfrac{-4.2958}{45.7} = \dfrac{-4.2958}{45.7}\cdot\dfrac{10}{10} = \dfrac{-42.958}{457}$

$$457\overline{)42.958}\quad 0.094$$
$$\underline{41\,13}$$
$$1\,828$$
$$\underline{1\,828}$$
$$0$$

So $\dfrac{-4.2958}{45.7} = -0.094$.

44. $\dfrac{0.1515}{-5.05} = \dfrac{0.1515}{-5.05}\cdot\dfrac{100}{100} = \dfrac{15.15}{-505}$

$$505\overline{)15.15}\quad 0.03$$
$$\underline{15\,15}$$
$$0$$

So $\dfrac{0.1515}{-5.05} = -0.03$.

1.5 Exercises

46. $\dfrac{9}{15} = \dfrac{3\cdot 3}{3\cdot 5} = \dfrac{\cancel{3}\cdot 3}{\cancel{3}\cdot 5} = \dfrac{3}{5}$

48. $\dfrac{-81}{36} = \dfrac{-9\cdot 9}{4\cdot 9} = \dfrac{-9\cdot\cancel{9}}{4\cdot\cancel{9}} = \dfrac{-9}{4} = -\dfrac{9}{4}$

50. $-\dfrac{24}{27} = -\dfrac{3\cdot 8}{3\cdot 9} = -\dfrac{\cancel{3}\cdot 8}{\cancel{3}\cdot 9} = -\dfrac{8}{9}$

52. $\dfrac{49}{63} = \dfrac{7\cdot 7}{7\cdot 9} = \dfrac{\cancel{7}\cdot 7}{\cancel{7}\cdot 9} = \dfrac{7}{9}$

54. $\dfrac{7}{8}\cdot\dfrac{10}{21} = \dfrac{7\cdot 10}{8\cdot 21} = \dfrac{\cancel{7}\cdot\cancel{2}\cdot 5}{\cancel{2}\cdot 4\cdot\cancel{7}\cdot 3} = \dfrac{5}{4\cdot 3} = \dfrac{5}{12}$

56. $\dfrac{3}{-7}\cdot 63 = \dfrac{3}{-7}\cdot\dfrac{63}{1}$
$= \dfrac{3\cdot 63}{-7\cdot 1}$
$= \dfrac{3\cdot 7\cdot 9}{-1\cdot 7}$
$= \dfrac{3\cdot\cancel{7}\cdot 9}{-1\cdot\cancel{7}}$
$= \dfrac{3\cdot 9}{-1}$
$= -27$

58. $-\dfrac{5}{2}\cdot\dfrac{16}{25} = -\dfrac{5\cdot 16}{2\cdot 25} = -\dfrac{5\cdot 8\cdot 2}{2\cdot 5\cdot 5} = -\dfrac{\cancel{5}\cdot 8\cdot\cancel{2}}{\cancel{2}\cdot\cancel{5}\cdot 5} = -\dfrac{8}{5}$

60. $-\dfrac{60}{75}\cdot\left(-\dfrac{25}{36}\right) = \dfrac{-60\cdot(-25)}{75\cdot 36}$
$= \dfrac{-5\cdot 12\cdot(-1)\cdot(25)}{3\cdot 25\cdot 3\cdot 12}$
$= \dfrac{-5\cdot\cancel{12}\cdot(-1)\cdot\cancel{(25)}}{3\cdot\cancel{25}\cdot 3\cdot\cancel{12}}$
$= \dfrac{-5\cdot(-1)}{3\cdot 3}$
$= \dfrac{5}{9}$

62. $9\cdot\dfrac{5}{18} = \dfrac{9}{1}\cdot\dfrac{5}{18} = \dfrac{9\cdot 5}{1\cdot 18} = \dfrac{9\cdot 5}{1\cdot 9\cdot 2} = \dfrac{\cancel{9}\cdot 5}{1\cdot\cancel{9}\cdot 2} = \dfrac{5}{1\cdot 2} = \dfrac{5}{2}$

64. $\dfrac{4}{7}\cdot\dfrac{9}{16} = \dfrac{4\cdot 9}{7\cdot 16} = \dfrac{4\cdot 9}{7\cdot 4\cdot 4} = \dfrac{\cancel{4}\cdot 9}{7\cdot\cancel{4}\cdot 4} = \dfrac{9}{7\cdot 4} = \dfrac{9}{28}$

66. The reciprocal of $\dfrac{9}{4}$ is $\dfrac{4}{9}$.

68. The reciprocal of -8 or $-\dfrac{8}{1}$ is $-\dfrac{1}{8}$.

70. $\dfrac{1}{2}\div\dfrac{3}{6} = \dfrac{1}{2}\cdot\dfrac{6}{3} = \dfrac{1\cdot 6}{2\cdot 3} = \dfrac{1\cdot 2\cdot 3}{2\cdot 3} = \dfrac{1\cdot\cancel{2}\cdot\cancel{3}}{\cancel{2}\cdot\cancel{3}} = 1$

72. $-\dfrac{1}{4}\div 4 = -\dfrac{1}{4}\div\dfrac{4}{1} = -\dfrac{1}{4}\cdot\dfrac{1}{4} = -\dfrac{1\cdot 1}{4\cdot 4} = -\dfrac{1}{16}$

74. $\dfrac{4}{3}\div\left(-\dfrac{9}{10}\right) = \dfrac{4}{3}\cdot\left(-\dfrac{10}{9}\right) = \dfrac{4\cdot(-10)}{3\cdot 9} = -\dfrac{40}{27}$

76. $\dfrac{44}{63}\div\dfrac{11}{21} = \dfrac{44}{63}\cdot\dfrac{21}{11}$
$= \dfrac{44\cdot 21}{63\cdot 11}$
$= \dfrac{4\cdot 11\cdot 7\cdot 3}{3\cdot 3\cdot 7\cdot 11}$
$= \dfrac{4\cdot\cancel{11}\cdot\cancel{7}\cdot\cancel{3}}{3\cdot\cancel{3}\cdot\cancel{7}\cdot\cancel{11}}$
$= \dfrac{4}{3}$

78. $-3\div\dfrac{7}{9} = -\dfrac{3}{1}\cdot\dfrac{9}{7} = -\dfrac{3\cdot 9}{1\cdot 7} = -\dfrac{27}{7}$

80. $-3 \div \left(-\frac{1}{6}\right) = -\frac{3}{1} \cdot \left(-\frac{6}{1}\right) = \frac{-3 \cdot (-6)}{1 \cdot 1} = 18$

82. $\frac{6}{11} + \frac{16}{11} = \frac{6+16}{11} = \frac{22}{11} = \frac{2 \cdot 11}{11} = 2$

84. $\frac{12}{5} - \frac{2}{5} = \frac{12-2}{5} = \frac{10}{5} = \frac{2 \cdot 5}{5} = 2$

86. $\frac{2}{3} - \left(-\frac{7}{3}\right) = \frac{2}{3} + \frac{7}{3} = \frac{2+7}{3} = \frac{9}{3} = \frac{3 \cdot 3}{3} = 3$

88. $-\frac{7}{8} + 4 = -\frac{7}{8} + \frac{4}{1} = -\frac{7}{8} + \frac{32}{8} = \frac{-7+32}{8} = \frac{25}{8}$

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

92.
$$\begin{aligned} -\frac{2}{5} + \left(-\frac{2}{3}\right) &= -\frac{2}{5} \cdot \frac{3}{3} + \left(-\frac{2}{3}\right) \cdot \frac{5}{5} \\ &= -\frac{6}{15} + \left(-\frac{10}{15}\right) \\ &= \frac{-6 + (-10)}{15} \\ &= -\frac{16}{15} \end{aligned}$$

94.
$$\begin{aligned} \frac{3}{4} + \left(-\frac{3}{8}\right) &= \frac{3}{4} \cdot \frac{2}{2} + \left(-\frac{3}{8}\right) \\ &= \frac{6}{8} + \left(-\frac{3}{8}\right) \\ &= \frac{6-3}{8} \\ &= \frac{3}{8} \end{aligned}$$

96.
$$\begin{aligned} \frac{8}{3} - \left(-\frac{29}{9}\right) &= \frac{8}{3} + \frac{29}{9} \\ &= \frac{8}{3} \cdot \frac{3}{3} + \frac{29}{9} \\ &= \frac{24}{9} + \frac{29}{9} \\ &= \frac{24+29}{9} \\ &= \frac{53}{9} \end{aligned}$$

98. $6 = 2 \cdot 3$
$9 = 3 \cdot 3$
$\text{LCD} = 2 \cdot 3 \cdot 3 = 18$
$$\begin{aligned} \frac{17}{6} - \frac{13}{9} &= \frac{17}{6} - \frac{13}{9} \\ &= \frac{17}{6} \cdot \frac{3}{3} - \frac{13}{9} \cdot \frac{2}{2} \\ &= \frac{51}{18} - \frac{26}{18} \\ &= \frac{51-26}{18} \\ &= \frac{25}{18} \end{aligned}$$

100. $6 = 2 \cdot 3$
$20 = 2 \cdot 2 \cdot 5$
$\text{LCD} = 2 \cdot 2 \cdot 3 \cdot 5 = 60$
$$\begin{aligned} -\frac{29}{6} - \left(-\frac{29}{20}\right) &= -\frac{29}{6} + \frac{29}{20} \\ &= -\frac{29}{6} \cdot \frac{10}{10} + \frac{29}{20} \cdot \frac{3}{3} \\ &= -\frac{290}{60} + \frac{87}{60} \\ &= \frac{-290+87}{60} \\ &= -\frac{203}{60} \end{aligned}$$

102. $12 = 2 \cdot 2 \cdot 3$
$16 = 2 \cdot 2 \cdot 2 \cdot 2$
$\text{LCD} = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 = 48$
$$\begin{aligned} \frac{13}{12} - \frac{35}{16} &= \frac{13}{12} \cdot \frac{4}{4} - \frac{35}{16} \cdot \frac{3}{3} \\ &= \frac{52}{48} - \frac{105}{48} \\ &= \frac{52-105}{48} \\ &= -\frac{53}{48} \end{aligned}$$

104. $2 = 2$
$8 = 2 \cdot 2 \cdot 2$
$4 = 2 \cdot 2$
LCD $= 2 \cdot 2 \cdot 2 = 8$

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

106.
$$\begin{array}{r} 13.2 \\ -\ 7.0 \\ \hline 6.2 \end{array}$$
So, $-13.2 + 7 = -6.2$.

108.
$$\begin{array}{r} 32.9 \\ +\ 10.3 \\ \hline 43.2 \end{array}$$
So, $-(-32.9) + 10.3 = 32.9 + 10.3 = 43.2$.

110.
$$\begin{array}{r} 29.23 \\ +\ 12.98 \\ \hline 42.21 \end{array}$$
So, $29.23 - (-12.98) = 29.23 + 12.98 = 42.21$.

112.
$$\begin{array}{r} 4.94 \\ -\ 3.87 \\ \hline 1.07 \end{array}$$
So, $-4.94 - (-3.87) = -4.94 + 3.87 = -1.07$.

114.
$$\begin{array}{r} 32.00 \\ -\ 5.68 \\ \hline 26.32 \end{array}$$
So, $32 - 5.68 = 26.32$.

116.
$$\begin{array}{r} 10.9 \\ \times\ 3.1 \\ \hline 109 \\ 327 \\ \hline 33.79 \end{array}$$
So, $3.1 \times 10.9 = 33.79$.

118.
$$\begin{array}{r} 340 \\ \times\ 0.065 \\ \hline 1\,700 \\ 2040 \\ \hline 22.100 \end{array}$$
So, $0.065 \times 340 = 22.1$.

120. $\dfrac{332.59}{7.9}=\dfrac{3325.9}{79}=42.1$

$$\begin{array}{r} 42.1 \\ 79\overline{)3325.9} \\ \underline{316} \\ 165 \\ \underline{158} \\ 79 \\ \underline{79} \\ 0 \end{array}$$

122. $\dfrac{48}{0.03}=\dfrac{4800}{3}=1600$

$$\begin{array}{r} 1600 \\ 3\overline{)4800} \\ \underline{3} \\ 18 \\ \underline{18} \\ 0 \end{array}$$

124.
$$-5.82-(-2.9)+(-2.74)=-5.82+2.9+(-2.74)$$
$$=-2.92+(-2.74)$$
$$=-5.66$$

126. $9 = 3 \cdot 3$
$21 = 3 \cdot 7$
LCD $= 3 \cdot 3 \cdot 7 = 63$

$$-\frac{8}{9}+\left(-\frac{16}{21}\right)=-\frac{8}{9}\cdot\frac{7}{7}+\left(-\frac{16}{21}\right)\cdot\frac{3}{3}$$
$$=-\frac{56}{63}+\left(-\frac{48}{63}\right)$$
$$=\frac{-56+(-48)}{63}$$
$$=-\frac{104}{63}$$

128.
$$\frac{24}{5}\cdot\left(-\frac{35}{4}\right)=\frac{24\cdot(-35)}{5\cdot 4}$$
$$=\frac{6\cdot 4\cdot(-7)\cdot 5}{5\cdot 4}$$
$$=\frac{6\cdot \cancel{4}\cdot(-7)\cdot \cancel{5}}{\cancel{5}\cdot \cancel{4}}$$
$$=\frac{6\cdot(-7)}{1}$$
$$=-42$$

130. $\dfrac{-12}{7} \div \dfrac{4}{-21} = \dfrac{-12}{7} \cdot \dfrac{-21}{4}$

$= \dfrac{-12 \cdot (-21)}{7 \cdot 4}$

$= \dfrac{-3 \cdot 4 \cdot (-3) \cdot 7}{7 \cdot 4}$

$= \dfrac{-3 \cdot \cancel{4} \cdot (-3) \cdot \cancel{7}}{\cancel{7} \cdot \cancel{4}}$

$= \dfrac{-3 \cdot (-3)}{1}$

$= 9$

132. $-\dfrac{4}{9} + \dfrac{1}{9} = \dfrac{-4+1}{9} = \dfrac{-3}{9} = \dfrac{-1 \cdot 3}{3 \cdot 3} = -\dfrac{1}{3}$

134. $-\dfrac{3}{4} - \dfrac{1}{5} = -\dfrac{3}{4} \cdot \dfrac{5}{5} - \dfrac{1}{5} \cdot \dfrac{4}{4}$

$= -\dfrac{15}{20} - \dfrac{4}{20}$

$= \dfrac{-15-4}{20}$

$= -\dfrac{19}{20}$

136.
$$\begin{array}{r} 12.90 \\ -\ 4.63 \\ \hline 8.27 \end{array}$$

So, $-4.63 - (-12.9) = -4.63 + 12.9 = 8.27$.

138. $16 = 2 \cdot 8$

$40 = 5 \cdot 8$

LCD $= 2 \cdot 5 \cdot 8 = 80$

$\dfrac{3}{16} + \left(-\dfrac{7}{40}\right) = \dfrac{3}{16} \cdot \dfrac{5}{5} + \left(-\dfrac{7}{40}\right) \cdot \dfrac{2}{2}$

$= \dfrac{15}{80} + \left(-\dfrac{14}{80}\right)$

$= \dfrac{15 + (-14)}{80}$

$= \dfrac{1}{80}$

140.
$$\begin{array}{r} 34.2 \\ \times\ -8.43 \\ \hline 1\,026 \\ 13\,68 \\ 273\,6 \\ \hline -288.306 \end{array}$$

So, $34.2 \times (-8.43) = -288.306$.

142. $-\dfrac{8}{3} \cdot 15 = -\dfrac{8}{3} \cdot \dfrac{15}{1}$

$= \dfrac{-8 \cdot 15}{3 \cdot 1}$

$= \dfrac{-8 \cdot 3 \cdot 5}{3 \cdot 1}$

$= \dfrac{-8 \cdot \cancel{3} \cdot 5}{\cancel{3} \cdot 1}$

$= \dfrac{-8 \cdot 5}{1}$

$= -40$

144. $-24 \div \dfrac{8}{7} = \dfrac{-24}{1} \div \dfrac{8}{7}$

$= \dfrac{-24}{1} \cdot \dfrac{7}{8}$

$= \dfrac{-24 \cdot 7}{1 \cdot 8}$

$= \dfrac{-3 \cdot 8 \cdot 7}{1 \cdot 8}$

$= \dfrac{-3 \cdot \cancel{8} \cdot 7}{1 \cdot \cancel{8}}$

$= \dfrac{-3 \cdot 7}{1}$

$= -21$

146.
$$\begin{array}{r} 6.20 \\ -\ 4.75 \\ \hline 1.45 \end{array}$$

So, $4.75 - 6.2 = -1.45$.

148. $\dfrac{-297.078}{22.17} = \dfrac{-29,707.8}{2217} = -13.4$

$$\begin{array}{r} 13.4 \\ 2217\overline{)29707.8} \\ \underline{2217} \\ 7537 \\ \underline{6651} \\ 8868 \\ \underline{8868} \\ 0 \end{array}$$

150. $4 = 2 \cdot 2$
$6 = 2 \cdot 3$
$8 = 2 \cdot 2 \cdot 2$
$\text{LCD} = 2 \cdot 2 \cdot 2 \cdot 3 = 24$

$$\begin{aligned}\frac{9}{4}-\frac{21}{6}-\frac{11}{8} &= \frac{9}{4}\cdot\frac{6}{6}-\frac{21}{6}\cdot\frac{4}{4}-\frac{11}{8}\cdot\frac{3}{3}\\ &= \frac{54}{24}-\frac{84}{24}-\frac{33}{24}\\ &= \frac{54-84-33}{24}\\ &= \frac{-63}{24}\\ &= \frac{-21\cdot 3}{8\cdot 3}\\ &= -\frac{21}{8}\end{aligned}$$

152. $90.3 - 100.9 - (-34.26) + 32.95 = 90.3 - 100.9 + 34.26 + 32.95 = 56.61$

154. $500 \times 12.4 \times 0.02 = 6200 \times 0.02 = 124$

156. $15 = 3 \cdot 5$
$9 = 3 \cdot 3$
$3 = 3$
$\text{LCD} = 3 \cdot 3 \cdot 5 = 45$

$$\begin{aligned}\frac{8}{15}-\left(-\frac{7}{9}\right)+\frac{2}{3} &= \frac{8}{15}+\frac{7}{9}+\frac{2}{3}\\ &= \frac{8}{15}\cdot\frac{3}{3}+\frac{7}{9}\cdot\frac{5}{5}+\frac{2}{3}\cdot\frac{15}{15}\\ &= \frac{24}{45}+\frac{35}{45}+\frac{30}{45}\\ &= \frac{24+35+30}{45}\\ &= \frac{89}{45}\end{aligned}$$

158.
$$\begin{aligned}16\div\frac{2}{3} &= \frac{16}{1}\div\frac{2}{3}\\ &= \frac{16}{1}\cdot\frac{3}{2}\\ &= \frac{16\cdot 3}{1\cdot 2}\\ &= \frac{2\cdot 8\cdot 3}{1\cdot 2}\\ &= \frac{\cancel{2}\cdot 8\cdot 3}{1\cdot\cancel{2}}\\ &= \frac{8\cdot 3}{1}\\ &= 24\end{aligned}$$

He will have 24 bags of candy.

160. $1-\frac{2}{5}=\frac{5}{5}-\frac{2}{5}=\frac{5-2}{5}=\frac{3}{5}$ remains for Ramie.

$\frac{1}{9}\cdot\frac{3}{5}=\frac{1\cdot 3}{9\cdot 5}=\frac{1\cdot 3}{3\cdot 3\cdot 5}=\frac{1\cdot \cancel{3}}{\cancel{3}\cdot 3\cdot 5}=\frac{1}{15}$ Ramie ate.

$1-\frac{2}{5}-\frac{1}{15}=\frac{15}{15}-\frac{6}{15}-\frac{1}{15}=\frac{15-6-1}{15}=\frac{8}{15}$

$\frac{8}{15}$ of the pizza remains.

162. $25.6-(-13.7)=25.6+13.7=39.3$
The temperature dropped 39.3°.

164. $43.68+929.30+(-650)+(-33.49)+(-229.50)+(-75.50)+(-159.30)=-174.81$
Henry's account has a balance of –$174.81.

166. $$\begin{aligned} d(P, Q) &= |2.6-(-12.5)| \\ &= |2.6+12.5| \\ &= |15.1| \\ &= 15.1 \end{aligned}$$

168. $$\begin{aligned} d(P, Q) &= \left|4-\left(-\frac{5}{6}\right)\right| \\ &= \left|4+\frac{5}{6}\right| \\ &= \left|\frac{4}{1}\cdot\frac{6}{6}+\frac{5}{6}\right| \\ &= \left|\frac{24}{6}+\frac{5}{6}\right| \\ &= \left|\frac{24+5}{6}\right| \\ &= \left|\frac{29}{6}\right| \\ &= \frac{29}{6} \end{aligned}$$

Putting the Concepts Together (Sections 1.2–1.5)

1. $8=2\cdot 2\cdot 2$

$20=2\cdot 2\cdot 5$

$\text{LCD}=2\cdot 2\cdot 2\cdot 5=40$

$\frac{7}{8}\cdot\frac{5}{5}=\frac{35}{40}$

$\frac{9}{20}\cdot\frac{2}{2}=\frac{18}{40}$

2. $\frac{21}{63}=\frac{7\cdot 3\cdot 1}{7\cdot 3\cdot 3}=\frac{1}{3}$

3. $\frac{2}{7} = 7\overline{)2.000000}$

$$\begin{array}{r} 0.285714 \\ 7\overline{)2.000000} \\ \underline{14} \\ 60 \\ \underline{56} \\ 40 \\ \underline{35} \\ 50 \\ \underline{49} \\ 10 \\ \underline{7} \\ 30 \\ \underline{28} \end{array}$$

$\frac{2}{7} = 0.\overline{285714}$

4. $0.375 = \frac{375}{1000} = \frac{3 \cdot 5 \cdot 5 \cdot 5}{2 \cdot 2 \cdot 2 \cdot 5 \cdot 5 \cdot 5} = \frac{3}{2 \cdot 2 \cdot 2} = \frac{3}{8}$

5. $12.3\% = 12.3\% \frac{1}{100\%} = \frac{12.3}{100} = 0.123$

6. $0.0625 = 0.0625 \cdot \frac{100\%}{1} = 6.25\%$

7. **(a)** -12, $-\frac{14}{7} = -2$, 0, and 3 are the integers.

(b) -12, $-\frac{14}{7}$, -1.25, 0, 3, and 11.2 are the rational numbers.

(c) $\sqrt{2}$ is the only irrational number.

(d) All the numbers listed are real numbers.

8. $\frac{1}{8} < 0.5$ because $0.5 = \frac{1}{2} = \frac{4}{8}$ and $\frac{1}{8} < \frac{4}{8}$.

9. $17 + (-28) = -11$

10. $-23 + (-42) = -65$

11. $18 - 45 = 18 + (-45) = -27$

12. $3 - (-24) = 3 + 24 = 27$

13. $-18 - (-12.5) = -18 + 12.5 = -5.5$

14. $(-5)(2) = -10$

15. $25(-4) = -100$

16. $(-8)(-9) = 72$

17. $\frac{-35}{7} = \frac{-5 \cdot 7}{7} = \frac{-5 \cdot \cancel{7}}{\cancel{7}} = -5$

18. $\frac{-32}{-2} = \frac{-2 \cdot 16}{-2} = \frac{\cancel{-2} \cdot 16}{\cancel{-2}} = 16$

19. $27 \div -3 = \frac{27}{-3} = \frac{9 \cdot 3}{-1 \cdot 3} = \frac{9 \cdot \cancel{3}}{-1 \cdot \cancel{3}} = -9$

20. $-\frac{4}{5} - \frac{11}{5} = \frac{-4-11}{5}$

$= \frac{-15}{5}$

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

$= \frac{-3 \cdot \cancel{5}}{\cancel{5}}$

$= -3$

21. $7 - \frac{4}{5} = \frac{7}{1} - \frac{4}{5}$

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

$= \frac{35}{5} - \frac{4}{5}$

$= \frac{35-4}{5}$

$= \frac{31}{5}$

22. $12 = 2 \cdot 2 \cdot 3$

$18 = 2 \cdot 3 \cdot 3$

$\text{LCD} = 2 \cdot 2 \cdot 3 \cdot 3 = 36$

$\frac{7}{12} + \frac{5}{18} = \frac{7}{12} \cdot \frac{3}{3} + \frac{5}{18} \cdot \frac{2}{2}$

$= \frac{21}{36} + \frac{10}{36}$

$= \frac{21+10}{36}$

$= \frac{31}{36}$

23. $12 = 2 \cdot 2 \cdot 3$
$18 = 2 \cdot 3 \cdot 3$
$\text{LCD} = 2 \cdot 2 \cdot 3 \cdot 3 = 36$

$$-\frac{5}{12} - \frac{1}{18} = -\frac{5}{12} \cdot \frac{3}{3} - \frac{1}{18} \cdot \frac{2}{2}$$
$$= -\frac{15}{36} - \frac{2}{36}$$
$$= \frac{-15-2}{36}$$
$$= \frac{-17}{36}$$
$$= -\frac{17}{36}$$

24.
$$\frac{6}{25} \cdot 15 \cdot \frac{1}{2} = \frac{6}{25} \cdot \frac{15}{1} \cdot \frac{1}{2}$$
$$= \frac{6 \cdot 15 \cdot 1}{25 \cdot 1 \cdot 2}$$
$$= \frac{2 \cdot 3 \cdot 3 \cdot 5 \cdot 1}{5 \cdot 5 \cdot 1 \cdot 2}$$
$$= \frac{\cancel{2} \cdot 3 \cdot 3 \cdot \cancel{5}}{\cancel{5} \cdot 5 \cdot \cancel{2}}$$
$$= \frac{3 \cdot 3}{5}$$
$$= \frac{9}{5}$$

25.
$$\frac{2}{7} \div (-8) = \frac{2}{7} \div \left(-\frac{8}{1}\right)$$
$$= \frac{2}{7} \cdot \left(-\frac{1}{8}\right)$$
$$= \frac{2 \cdot (-1)}{7 \cdot 8}$$
$$= \frac{2 \cdot (-1)}{7 \cdot 2 \cdot 4}$$
$$= \frac{\cancel{2} \cdot (-1)}{7 \cdot \cancel{2} \cdot 4}$$
$$= \frac{-1}{7 \cdot 4}$$
$$= -\frac{1}{28}$$

26. $\dfrac{0}{-8} = 0$

27.
$$\begin{array}{r} 3.56 \\ +\ 7.20 \\ \hline 10.76 \end{array}$$
So $3.56 - (-7.2) = 3.56 + 7.2 = 10.76$.

28.
$$\begin{array}{r} 18.946 \\ -\ 11.300 \\ \hline 7.646 \end{array}$$
So $18.946 - 11.3 = 7.646$.

29.
$$62.488 \div 42.8 = \frac{62.488}{42.8}$$
$$= \frac{62.488}{42.8} \cdot \frac{10}{10}$$
$$= \frac{624.88}{428}$$

$$\begin{array}{r} 1.46 \\ 428\overline{)624.88} \\ \underline{428} \\ 196\,8 \\ \underline{171\,2} \\ 25\,68 \\ \underline{25\,68} \\ 0 \end{array}$$

So $62.488 \div 42.8 = 1.46$.

30.
$$\begin{array}{r} 7.94 \\ \times\ \ 2.8 \\ \hline 6\ 352 \\ 15\ 88 \\ \hline 22.232 \end{array}$$

Section 1.6

Preparing for Properties of Real Numbers

P1. $12 + 3 + (-12) = 15 + (-12) = 3$

P2.
$$\frac{3}{4} \cdot 11 \cdot \frac{4}{3} = \frac{3}{4} \cdot \frac{11}{1} \cdot \frac{4}{3}$$
$$= \frac{3 \cdot 11}{4 \cdot 1} \cdot \frac{4}{3}$$
$$= \frac{3 \cdot 11 \cdot 4}{4 \cdot 1 \cdot 3}$$
$$= \frac{\cancel{3} \cdot 11 \cdot \cancel{4}}{\cancel{4} \cdot 1 \cdot \cancel{3}}$$
$$= \frac{11}{1}$$
$$= 11$$

1.6 Quick Checks

1. The product of any real number and the number 1 is that number.

2. $96 \text{ inches} = 96 \text{ inches} \cdot \dfrac{1 \text{ foot}}{12 \text{ inches}}$

$= \dfrac{96}{12} \text{ feet}$

$= \dfrac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3}{2 \cdot 2 \cdot 3} \text{ feet}$

$= \dfrac{\cancel{2} \cdot \cancel{2} \cdot 2 \cdot 2 \cdot 2 \cdot \cancel{3}}{\cancel{2} \cdot \cancel{2} \cdot \cancel{3}} \text{ feet}$

$= 8 \text{ feet}$

3. $500 \text{ minutes} = 500 \text{ minutes} \cdot \dfrac{1 \text{ hour}}{60 \text{ minutes}}$

$= \dfrac{500}{60} \text{ hours}$

$= \dfrac{2 \cdot 2 \cdot 5 \cdot 5 \cdot 5}{2 \cdot 2 \cdot 3 \cdot 5} \text{ hours}$

$= \dfrac{\cancel{2} \cdot \cancel{2} \cdot \cancel{5} \cdot 5 \cdot 5}{\cancel{2} \cdot \cancel{2} \cdot 3 \cdot \cancel{5}} \text{ hours}$

$= \dfrac{25}{3} \text{ hours}$

$= 8\dfrac{1}{3} \text{ hours or 8 hours, 20 minutes}$

4. $88 \text{ ounces} = 88 \text{ ounces} \cdot \dfrac{1 \text{ pound}}{16 \text{ ounces}}$

$= \dfrac{88}{16} \text{ pounds}$

$= \dfrac{2 \cdot 2 \cdot 2 \cdot 11}{2 \cdot 2 \cdot 2 \cdot 2} \text{ pounds}$

$= \dfrac{\cancel{2} \cdot \cancel{2} \cdot \cancel{2} \cdot 11}{\cancel{2} \cdot \cancel{2} \cdot \cancel{2} \cdot 2} \text{ pounds}$

$= \dfrac{11}{2} \text{ pounds}$

$= 5\dfrac{1}{2} \text{ pounds or 5 pounds, 8 ounces}$

5. The Commutative Property of Addition states that for any real numbers a and b, $a + b = \underline{b + a}$.

6. The sum of any real number and its opposite is equal to $\underline{0}$.

7. $(-8) + 22 + 8 = (-8) + 8 + 22 = 0 + 22 = 22$

8. $\dfrac{8}{15} + \dfrac{3}{20} + \left(-\dfrac{8}{15}\right) = \dfrac{8}{15} + \left(-\dfrac{8}{15}\right) + \dfrac{3}{20}$

$= 0 + \dfrac{3}{20}$

$= \dfrac{3}{20}$

9. $2.1 + 11.98 + (-2.1) = 2.1 + (-2.1) + 11.98$

$= 0 + 11.98$

$= 11.98$

10. $-8 \cdot (-13) \cdot \left(-\dfrac{3}{4}\right) = -8 \cdot \left(-\dfrac{3}{4}\right) \cdot (-13)$

$= -\overset{2}{\cancel{8}} \cdot \left(-\dfrac{3}{\cancel{4}_{1}}\right) \cdot (-13)$

$= -2 \cdot (-3) \cdot (-13)$

$= 6 \cdot (-13)$

$= -78$

11. $\dfrac{5}{22} \cdot \dfrac{18}{331} \cdot \left(-\dfrac{44}{5}\right) = \dfrac{5}{22} \cdot \left(-\dfrac{44}{5}\right) \cdot \dfrac{18}{331}$

$= \dfrac{\overset{1}{\cancel{5}}}{\underset{1}{\cancel{22}}} \cdot \left(-\dfrac{\overset{2}{\cancel{44}}}{\underset{1}{\cancel{5}}}\right) \cdot \dfrac{18}{331}$

$= \dfrac{1}{1} \cdot \left(-\dfrac{2}{1}\right) \cdot \dfrac{18}{331}$

$= -\dfrac{2}{1} \cdot \dfrac{18}{331}$

$= -\dfrac{36}{331}$

12. $100{,}000 \cdot 349 \cdot 0.00001$

$= 100{,}000 \cdot 0.00001 \cdot 349$

$= 1 \cdot 349$

$= 349$

13. $14 + 101 + (-101) = 14 + (101 + (-101))$

$= 14 + 0$

$= 14$

14. $14 \cdot \dfrac{1}{5} \cdot 5 = 14 \cdot \left(\dfrac{1}{5} \cdot 5\right) = 14 \cdot 1 = 14$

15. $-34.2 + 12.6 + (-2.6)$

$= -34.2 + (12.6 + (-2.6))$

$= -34.2 + 10$

$= -24.2$

16. $\frac{19}{2}\cdot\frac{4}{38}\cdot\frac{50}{13}=\left(\frac{19}{2}\cdot\frac{4}{38}\right)\cdot\frac{50}{13}$

$=\left(\frac{\cancel{19}^{1}}{\cancel{2}_{1}}\cdot\frac{\cancel{4}^{2}}{\cancel{38}_{2}}\right)\cdot\frac{50}{13}$

$=\frac{2}{2}\cdot\frac{50}{13}$

$=1\cdot\frac{50}{13}$

$=\frac{50}{13}$

17. $\frac{0}{22}=0$ because 0 is the dividend.

18. $\frac{-11}{0}$ is undefined because 0 is the divisor.

19. $-\frac{0}{5}=0$ because 0 is the dividend.

20. $\frac{5678}{0}$ is undefined because 0 is the divisor.

1.6 Exercises

22. $130 \text{ feet} = 130 \text{ feet}\cdot\frac{1 \text{ yard}}{3 \text{ feet}}$

$=\frac{130}{3} \text{ yards}$

$=43\frac{1}{3} \text{ yards}$

$=43 \text{ yards, } 1 \text{ foot}$

24. 5900 centimeters

$=5900 \text{ centimeters}\cdot\frac{1 \text{ meter}}{100 \text{ centimeters}}$

$=\frac{5900}{100} \text{ meters}$

$=59 \text{ meters}$

26. $58 \text{ quarts} = 58 \text{ quarts}\cdot\frac{1 \text{ gallon}}{4 \text{ quarts}}$

$=\frac{58}{4} \text{ gallons}$

$=14\frac{1}{2} \text{ gallons}$

$=14 \text{ gallons, } 2 \text{ quarts}$

28. $120 \text{ ounces} = 120 \text{ ounces}\cdot\frac{1 \text{ pound}}{16 \text{ ounces}}$

$=\frac{120}{16} \text{ pounds}$

$=7\frac{1}{2} \text{ pounds}$

$=7 \text{ pounds, } 8 \text{ ounces}$

30. 22,500 seconds

$=22{,}500 \text{ seconds}\cdot\frac{1 \text{ hour}}{3600 \text{ seconds}}$

$=\frac{22{,}500}{3600} \text{ hours}$

$=6\frac{1}{4} \text{ hours}$

$=6 \text{ hours, } 15 \text{ minutes}$

32. $4\cdot 63\cdot\frac{1}{4}=4\cdot\frac{1}{4}\cdot 63$ illustrates the Commutative Property of Multiplication since the order in which the numbers are multiplied changes.

34. $4 + 5 + (-4) = 4 + (-4) + 5$ illustrates the Commutative Property of Addition since the order in which the numbers are added changes.

36. $-236 + 236 = 0$ illustrates the Additive Inverse Property.

38. $(4 \cdot 5) \cdot 7 = 4 \cdot (5 \cdot 7)$ illustrates the Associative Property of Multiplication since the grouping of multiplication changes.

40. $\frac{a}{0}$ is undefined.

42. $\frac{5}{12}\cdot\frac{12}{5}=1$ illustrates the Multiplicative Inverse Property.

44. $16.4 \cdot 0 = 0$ illustrates the Multiplicative Property of Zero.

46. $\frac{0}{a}=0$

48. $46+59+(-46)=46+(-46)+59$

$=0+59$

$=59$

50. $\frac{4}{9}\cdot\frac{9}{4}\cdot 28=1\cdot 28=28$

52. $36\cdot(-12)\cdot\frac{1}{6}=36\cdot\frac{1}{6}\cdot(-12)=6\cdot(-12)=-72$

54. $593+306+(-306)=593+(306+(-306))$
$=593+0$
$=593$

56. $\frac{13}{2}\cdot\frac{8}{39}\cdot\frac{39}{4}=\frac{13}{2}\cdot\left(\frac{8}{39}\cdot\frac{39}{4}\right)$
$=\frac{13}{2}\cdot\left(\frac{\overset{2}{\cancel{8}}}{\underset{1}{\cancel{39}}}\cdot\frac{\overset{1}{\cancel{39}}}{\underset{1}{\cancel{4}}}\right)$
$=\frac{13}{2}\cdot 2$
$=13$

58. $\frac{0}{100}=0$ because 0 is the dividend.

60. $4000(0.5)(0.001)=4000(0.001)(0.5)$
$=4(0.5)$
$=2$

62. $104\cdot\frac{1}{104}=1$

64. $30\cdot\frac{4}{4}=30\cdot 1=30$

66. $\frac{7}{48}\cdot\left(-\frac{21}{4}\right)\cdot\frac{12}{7}=\frac{7}{48}\cdot\frac{12}{7}\cdot\left(-\frac{21}{4}\right)$
$=\frac{\overset{1}{\cancel{7}}}{\underset{4}{\cancel{48}}}\cdot\frac{\overset{1}{\cancel{12}}}{\underset{1}{\cancel{7}}}\cdot\left(-\frac{21}{4}\right)$
$=\frac{1}{4}\cdot\left(-\frac{21}{4}\right)$
$=-\frac{21}{16}$

68. $32.04 + 0.54 + (-0.32) + (-0.54)$
$= (-0.54) + 0.54 + 32.04 + (-0.32)$
$= 0 + 32.04 + (-0.32)$
$= 31.72$
The closing price on Wednesday was \$31.72.

70. $-6 - (4 + 10) = -6 - 14 = -6 + (-14) = -20$

72. $25-(6-10)-1=25-[6+(-10)]-1$
$=25-(-4)-1$
$=25+4-1$
$=29-1$
$=28$

74. $\frac{40\text{ miles}}{1\text{ hour}}=\frac{40\text{ miles}}{1\text{ hour}}\cdot\frac{1\text{ hour}}{3600\text{ seconds}}\cdot\frac{5280\text{ feet}}{1\text{ mile}}$
$=\frac{40\cdot 5280\text{ feet}}{3600\text{ seconds}}$
$=\frac{176}{3}\text{ feet per second}$
$=58\frac{2}{3}\text{ feet per second}$

76. The product $2(4 \cdot 5)$ is not equal to the product $(2 \cdot 4) \cdot (2 \cdot 5)$ because the Distributive Property is really the Distributive Property of Multiplication over addition. The Distributive Property applies to $2(4 \div 5) = 2 \cdot 4 \div 2 \cdot 5$.

78. The sum of a real number and its additive inverse (opposite) equals zero, the additive identity.

Section 1.7

Preparing for Exponents and the Order of Operations

P1. $9 + (-19) = -10$

P2. $28 - (-7) = 28 + 7 = 35$

P3. $-7\cdot\frac{8}{3}\cdot 36=-7\cdot\left(\frac{8}{3}\cdot\frac{36}{1}\right)$
$=-7\cdot\left(\frac{8\cdot 36}{3\cdot 1}\right)$
$=-7\cdot\left(\frac{8\cdot 3\cdot 12}{3\cdot 1}\right)$
$=-7\cdot\left(\frac{8\cdot\cancel{3}\cdot 12}{\cancel{3}\cdot 1}\right)$
$=-7\cdot\left(\frac{96}{1}\right)$
$=-672$

P4. $\frac{100}{-15}=\frac{5\cdot 20}{-3\cdot 5}=\frac{\cancel{5}\cdot 20}{-3\cdot\cancel{5}}=\frac{20}{-3}=-\frac{20}{3}$

1.7 Quick Checks

1. The expression $11 \cdot 11 \cdot 11 \cdot 11 \cdot 11$ contains five factors of 11, so $11\cdot 11\cdot 11\cdot 11\cdot 11 = 11^5$.

2. The expression $(-7)(-7)(-7)(-7)$ contains four factors of -7, so $(-7)^4$.

3. The expression $(-2)\cdot(-2)\cdot(-2)$ contains three factors of -2, so $(-2)\cdot(-2)\cdot(-2)=(-2)^3$.

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

5. $(-7)^2 = (-7)\cdot(-7) = 49$

6. $\left(-\frac{1}{6}\right)^3 = \left(-\frac{1}{6}\right)\cdot\left(-\frac{1}{6}\right)\cdot\left(-\frac{1}{6}\right) = -\frac{1}{216}$

7. $(0.9)^2 = (0.9)\cdot(0.9) = 0.81$

8. $-2^4 = -(2\cdot 2\cdot 2\cdot 2) = -16$

9. $(-2)^4 = (-2)\cdot(-2)\cdot(-2)\cdot(-2) = 16$

10. $1 + 7\cdot 2 = 1 + 14 = 15$

11. $-11\cdot 3 + 2 = -33 + 2 = -31$

12. $18+3\div\left(-\frac{1}{2}\right) = 18+3\cdot\left(-\frac{2}{1}\right)$
$= 18+(-6)$
$= 12$

13. $9\cdot 4 - 5 = 36 - 5 = 31$

14. $\frac{15}{2}\div(-5)-\frac{3}{2} = \frac{15}{2}\cdot\left(-\frac{1}{5}\right)-\frac{3}{2}$
$= -\frac{3}{2}-\frac{3}{2}$
$= -\frac{6}{2}$
$= -3$

15. $8(2+3) = 8(5) = 40$

16. $(2-9)\cdot(5+4) = (-7)\cdot(9) = -63$

17. $\left(\frac{6}{7}+\frac{8}{7}\right)\cdot\left(\frac{11}{8}+\frac{5}{8}\right) = \left(\frac{14}{7}\right)\cdot\left(\frac{16}{8}\right) = 2\cdot 2 = 4$

18. $\frac{2+5\cdot 6}{-3\cdot 8-4} = \frac{2+30}{-24-4} = \frac{32}{-28} = \frac{8\cdot\cancel{4}}{-7\cdot\cancel{4}} = -\frac{8}{7}$

19. $\frac{(12+14)\cdot 2}{13\cdot 2+13\cdot 5} = \frac{26\cdot 2}{13\cdot 2+13\cdot 5}$
$= \frac{52}{26+65}$
$= \frac{52}{91}$
$= \frac{4\cdot\cancel{13}}{7\cdot\cancel{13}}$
$= \frac{4}{7}$

20. $\frac{4+3\div\frac{1}{7}}{2\cdot 9-3} = \frac{4+3\cdot 7}{2\cdot 9-3}$
$= \frac{4+21}{18-3}$
$= \frac{25}{15}$
$= \frac{5\cdot\cancel{5}}{3\cdot\cancel{5}}$
$= \frac{5}{3}$

21. $4\cdot[2\cdot(3+7)-15] = 4\cdot[2\cdot 10-15]$
$= 4\cdot[20-15]$
$= 4\cdot[5]$
$= 20$

22. $2\cdot\{4\cdot[26-(9+7)]-15\}-10$
$= 2\cdot\{4[26-16]-15\}-10$
$= 2\cdot\{4[10]-15\}-10$
$= 2\cdot\{40-15\}-10$
$= 2\cdot\{25\}-10$
$= 50-10$
$= 40$

23. $\frac{7-5^2}{2} = \frac{7-25}{2} = \frac{-18}{2} = \frac{-9\cdot\cancel{2}}{\cancel{2}} = -9$

24. $3(7-3)^2 = 3(4)^2 = 3\cdot 16 = 48$

25. $\dfrac{(-3)^2+7(1-3)}{3\cdot 2+5}=\dfrac{9+7(1-3)}{6+5}$
$=\dfrac{9+7(-2)}{11}$
$=\dfrac{9+(-14)}{11}$
$=\dfrac{-5}{11}$
$=-\dfrac{5}{11}$

26. $2+5\cdot 3^2-\dfrac{3}{2}\cdot 2^2=2+5\cdot 9-\dfrac{3}{2}\cdot 4$
$=2+45-6$
$=47-6$
$=41$

27. $\dfrac{(4-10)^2}{2^3-5}=\dfrac{(-6)^2}{2^3-5}=\dfrac{36}{8-5}=\dfrac{36}{3}=\dfrac{12\cdot \cancel{3}}{\cancel{3}}=12$

28. $-3[(-4)^2-5(8-6)]^2=-3[(-4)^2-5(2)]^2$
$=-3[16-5(2)]^2$
$=-3[16-10]^2$
$=-3[6]^2$
$=-3[36]$
$=-108$

29. $\dfrac{(2.9+7.1)^2}{5^2-15}=\dfrac{(10)^2}{25-15}=\dfrac{100}{10}=\dfrac{10\cdot \cancel{10}}{\cancel{10}}=10$

30. $\left(\dfrac{4^2-4(-3)(1)}{7\cdot 2}\right)^2=\left(\dfrac{16-4(-3)}{14}\right)^2$
$=\left(\dfrac{16+12}{14}\right)^2$
$=\left(\dfrac{28}{14}\right)^2$
$=(2)^2$
$=2^2$
$=4$

1.7 Exercises

32. The expression $4\cdot 4\cdot 4\cdot 4\cdot 4$ contains five factors of 4, so $4\cdot 4\cdot 4\cdot 4\cdot 4=4^5$.

34. The expression $(-8)(-8)(-8)$ contains three factors of (-8), so $(-8)(-8)(-8)=(-8)^3$.

36. $4^3=4\cdot 4\cdot 4=64$

38. $(-4)^3=(-4)(-4)(-4)=-64$

40. $2^5=2\cdot 2\cdot 2\cdot 2\cdot 2=32$

42. $\left(\dfrac{5}{2}\right)^4=\left(\dfrac{5}{2}\right)\left(\dfrac{5}{2}\right)\left(\dfrac{5}{2}\right)\left(\dfrac{5}{2}\right)=\dfrac{625}{16}$

44. $(0.04)^2=(0.04)(0.04)=0.0016$

46. $-5^4=-(5\cdot 5\cdot 5\cdot 5)=-625$

48. $(-1)^{19}=\underbrace{(-1)(-1)(-1)\cdots(-1)}_{19\text{ factors}}=-1$

50. $1^6=1\cdot 1\cdot 1\cdot 1\cdot 1\cdot 1=1$

52. $\left(-\dfrac{3}{2}\right)^5=\left(-\dfrac{3}{2}\right)\left(-\dfrac{3}{2}\right)\left(-\dfrac{3}{2}\right)\left(-\dfrac{3}{2}\right)\left(-\dfrac{3}{2}\right)=-\dfrac{243}{32}$

54. $\left(-\dfrac{3}{4}\right)^2=\left(-\dfrac{3}{4}\right)\left(-\dfrac{3}{4}\right)=\dfrac{9}{16}$

56. $12+8\cdot 3=12+24=36$

58. $-3\cdot 12+9=-36+9=-27$

60. $50\div 5\cdot 4=10\cdot 4=40$

62. $86-4\cdot 3+6=86-12+6=74+6=80$

64. $(7-5)\cdot\dfrac{5}{2}=2\cdot\dfrac{5}{2}=5$

66. $4\div 7\cdot 21=\dfrac{4}{7}\cdot 21=\dfrac{4}{7}\cdot 7\cdot 3=4\cdot 3=12$

68. $\dfrac{5+3}{3+15}=\dfrac{8}{18}=\dfrac{4\cdot 2}{9\cdot 2}=\dfrac{4}{9}$

70. $\dfrac{15-7}{7-15}=\dfrac{8}{-8}=\dfrac{1\cdot 8}{-1\cdot 8}=-1$

72. $12-[7+(-6)3]=12-[7+(-18)]$
$=12-[-11]$
$=12+11$
$=23$

74. $(-11.8-15.2)\div(-2)=-27\div(-2)=13.5$

76. $10-4^2=10-16=-6$

78. $10+3\cdot 2^4=10+3\cdot 16=10+48=58$

80. $-5^2+3^2\div(3^2+9)=-25+9\div(9+9)$
$=-25+9\div 18$
$=-25+\frac{1}{2}$
$=-\frac{50}{2}+\frac{1}{2}$
$=-\frac{49}{2}$

82. $\left(\frac{7-5^2}{8+4\cdot 2}\right)^2=\left(\frac{7-25}{8+8}\right)^2$
$=\left(\frac{-18}{16}\right)^2$
$=\left(\frac{-9}{8}\right)^2$
$=\left(-\frac{9}{8}\right)^2$
$=\frac{81}{64}$

84. $3\cdot[6\cdot(5-2)-2\cdot 5]=3\cdot[6\cdot 3-2\cdot 5]$
$=3\cdot[18-10]$
$=3\cdot 8$
$=24$

86. $\left(\frac{3}{4}+\frac{1}{2}\right)\left(\frac{2}{3}-\frac{1}{2}\right)=\left(\frac{3}{4}+\frac{2}{4}\right)\left(\frac{4}{6}-\frac{3}{6}\right)$
$=\left(\frac{5}{4}\right)\left(\frac{1}{6}\right)$
$=\frac{5\cdot 1}{4\cdot 6}$
$=\frac{5}{24}$

88. $7.2-10.4\div 5.2=7.2-2=5.2$

90. $3+6\cdot(9-5)=3+6\cdot 4=3+24=27$

92. $\frac{6+15\div 3+16}{6+10\cdot 0}=\frac{6+5+16}{6+0}$
$=\frac{11+16}{6}$
$=\frac{27}{6}$
$=\frac{3\cdot 9}{3\cdot 2}$
$=\frac{9}{2}$

94. $\left(\frac{9\cdot 2-(-2)^3}{4^2+3(-1)^5}\right)^2=\left(\frac{18-(-8)}{16+3(-1)}\right)^2$
$=\left(\frac{18+8}{16-3}\right)^2$
$=\left(\frac{26}{13}\right)^2$
$=(2)^2$
$=2^2$
$=4$

96. $\frac{12(2)^3}{4^2+4\cdot 5}=\frac{12(8)}{16+4\cdot 5}$
$=\frac{96}{16+20}$
$=\frac{96}{36}$
$=\frac{8\cdot 12}{3\cdot 12}$
$=\frac{8}{3}$

98. $-6\cdot\left(2+\left|2\cdot 3-4^2\right|\right)=-6\cdot\left(2+|2\cdot 3-16|\right)$
$=-6\cdot\left(2+|6-16|\right)$
$=-6\cdot\left(2+|-10|\right)$
$=-6\cdot(2+10)$
$=-6\cdot 12$
$=-72$

100. $\frac{5}{12}\div\frac{1}{3}-\frac{7}{2}=\frac{5}{12}\cdot\frac{3}{1}-\frac{7}{2}$
$=\frac{5}{4}-\frac{7}{2}$
$=\frac{5}{4}-\frac{14}{4}$
$=\frac{5-14}{4}$
$=-\frac{9}{4}$

102. $-\frac{4}{5}+\frac{3}{10}\div\frac{2}{9}=-\frac{4}{5}+\frac{3}{10}\cdot\frac{9}{2}$
$=-\frac{4}{5}+\frac{27}{20}$
$=-\frac{4\cdot4}{5\cdot4}+\frac{27}{20}$
$=-\frac{16}{20}+\frac{27}{20}$
$=\frac{11}{20}$

104. $\frac{5+3^2}{2+5}=\frac{5+9}{2+5}=\frac{14}{7}=\frac{2\cdot7}{1\cdot7}=2$

106. $\left[\frac{9}{10}\div\left(\frac{2}{5}+\frac{1}{5}\right)+\frac{7}{2}\right]\cdot\frac{1}{10}=\left[\frac{9}{10}\div\frac{3}{5}+\frac{7}{2}\right]\cdot\frac{1}{10}$
$=\left[\frac{9}{10}\cdot\frac{5}{3}+\frac{7}{2}\right]\cdot\frac{1}{10}$
$=\left[\frac{45}{35}+\frac{7}{2}\right]\cdot\frac{1}{10}$
$=\left[\frac{3}{2}+\frac{7}{2}\right]\cdot\frac{1}{10}$
$=\frac{10}{2}\cdot\frac{1}{10}$
$=\frac{10\cdot1}{2\cdot10}$
$=\frac{1}{2}$

108. $\frac{1}{18}\cdot\frac{46}{5}-\left(\frac{2}{3}\right)^2=\frac{1}{18}\cdot\frac{46}{5}-\frac{4}{9}$
$=\frac{46}{90}-\frac{4}{9}$
$=\frac{46}{90}-\frac{40}{90}$
$=\frac{6}{90}$
$=\frac{1\cdot6}{15\cdot6}$
$=\frac{1}{15}$

110. $\frac{3\cdot2^3-2^2\cdot12}{3+3^2}=\frac{3\cdot8-4\cdot12}{3+9}$
$=\frac{24-48}{3+9}$
$=\frac{-24}{12}$
$=\frac{-2\cdot12}{1\cdot12}$
$=-2$

112. $675=27\cdot25=(3\cdot3\cdot3)\cdot(5\cdot5)=3^3\cdot5^2$

114. $200=8\cdot25=(2\cdot2\cdot2)\cdot(5\cdot5)=2^3\cdot5^2$

116. $4\cdot(7-4^2)=4\cdot(7-16)=4\cdot(-9)=-36$

118. $6-(4+3-1)=6-(7-1)=6-6=0$

120. $[4+3\cdot(2-1)]\cdot6=[4+3\cdot1]\cdot6$
$=[4+3]\cdot6$
$=7\cdot6$
$=42$

122. $3000+6(100)-\frac{100^2}{1000}$
$=3000+6(100)-\frac{10{,}000}{1000}$
$=3000+600-\frac{10{,}000}{1000}$
$=3000+600-10$
$=3600-10$
$=3590$
The production cost is \$3590.

124. $\frac{1}{3}\cdot3.1416\cdot3^2\cdot12=\frac{1}{3}\cdot3.1416\cdot9\cdot12=113.0976$
The volume is about 113.10 cubic centimeters.

126. $5000(1+0.045)^5 = 5000(1.045)^5$
$\approx 5000(1.246182)$
≈ 6230.91
The amount of money is \$6230.91.

128. $\angle XYQ = \angle XYZ - \angle QYZ = 57° - 18° = 39°$

Section 1.8

Preparing for Simplifying Algebraic Expressions

P1. $-3 + 8 = 5$

P2. $-7 - 8 = -7 + (-8) = -15$

P3. $-\frac{4}{3}(27) = -\frac{4}{3}\left(\frac{27}{1}\right)$
$= -\frac{4 \cdot 27}{3 \cdot 1}$
$= -\frac{4 \cdot 3 \cdot 9}{3 \cdot 1}$
$= -\frac{4 \cdot \cancel{3} \cdot 9}{\cancel{3} \cdot 1}$
$= -\frac{4 \cdot 9}{1}$
$= -36$

1.8 Quick Checks

1. To evaluate an algebraic expression means to substitute the numerical value for each variable into the expression and simplify.

2. Substitute 4 for k.
$-3k + 5 = -3(4) + 5 = -12 + 5 = -7$

3. Substitute 12 for t.
$\frac{5}{4}t - 6 = \frac{5}{4}(12) - 6 = \frac{60}{4} - 6 = 15 - 6 = 9$

4. Substitute -2 for y.
$-2y^2 - y + 8 = -2(-2)^2 - (-2) + 8$
$= -2(4) - (-2) + 8$
$= -8 - (-2) + 8$
$= -8 + 2 + 8$
$= -8 + 8 + 2$
$= 0 + 2$
$= 2$

5. Substitute 8 for x and 16 for y.
$7.50x + 10y = 7.50(8) + 10(16)$
$= 60 + 160$
$= 220$
The value is \$220.

6. The algebraic expression $5x^2 + 3xy$ has two terms: $5x^2$ and $3xy$.

7. The algebraic expression $9ab - 3bc + 5ac - ac^2$ has four terms: $9ab$, $-3bc$, $5ac$, and $-ac^2$.

8. The algebraic expression $\frac{2mn}{5} - \frac{3n}{7}$ has two terms: $\frac{2mn}{5}$ and $-\frac{3n}{7}$.

9. The algebraic expression $\frac{m^2}{3} - 8$ has two terms: $\frac{m^2}{3}$ and -8.

10. The coefficient of $2z^2$ is 2.

11. The coefficient of $xy = 1 \cdot xy$ is 1.

12. The coefficient of $-b = -1 \cdot b$ is -1.

13. The coefficient of 5 is 5.

14. The coefficient of $-\frac{2}{3}z$ is $-\frac{2}{3}$.

15. The coefficient of $\frac{x}{6} = \frac{1}{6} \cdot x$ is $\frac{1}{6}$.

16. $-\frac{2}{3}p^2$ and $\frac{4}{5}p^2$ are like terms. They have the same variable raised to the same power.

17. $\frac{m}{6} = \frac{1}{6}m$ and $4m$ are like terms. They have the same variable raised to the same power.

18. $3a^2b$ and $-2ab^2$ are unlike terms. The variable a is raised to the second power in $3a^2b$ and to the first power in $-2ab^2$.

19. $8a$ and 11 are unlike terms. $8a$ has a variable and 11 does not.

20. $6(x+2) = 6 \cdot x + 6 \cdot 2 = 6x + 12$

21. $-5(x+2) = -5 \cdot x + (-5) \cdot 2$
$= -5x + (-10)$
$= -5x - 10$

22. $-2(k-7) = -2 \cdot k - (-2) \cdot 7$
$= -2k - (-14)$
$= -2k + 14$

23. $(8x+12)\frac{3}{4} = 8x \cdot \frac{3}{4} + 12 \cdot \frac{3}{4}$

$= \overset{2}{\cancel{8}}x \cdot \frac{3}{\cancel{4}_{1}} + \overset{3}{\cancel{12}} \cdot \frac{3}{\cancel{4}_{1}}$

$= 2x \cdot 3 + 3 \cdot 3$
$= 6x + 9$

24. $3x - 8x = (3-8)x = -5x$

25. $-5x^2 + x^2 = -5x^2 + 1x^2 = (-5+1)x^2 = -4x^2$

26. $-7x - x + 6 - 3 = -7x - 1x + 6 - 3$
$= (-7-1)x + (6-3)$
$= -8x + 3$

27. $4x - 12x - 3 + 17 = (4-12)x + (-3+17)$
$= -8x + 14$

28. $3a + 2b - 5a + 7b - 4 = 3a - 5a + 2b + 7b - 4$
$= (3-5)a + (2+7)b - 4$
$= -2a + 9b - 4$

29. $(5ac + 2b) + (7ac - 5a) + (-b)$
$= 5ac + 2b + 7ac - 5a + (-1)b$
$= 5ac + 7ac + 2b + (-1)b - 5a$
$= (5+7)ac + (2 + (-1))b - 5a$
$= 12ac + 1b - 5a$
$= 12ac + b - 5a$

30. $5ab^2 + 7a^2b + 3ab^2 - 8a^2b$
$= 5ab^2 + 3ab^2 + 7a^2b - 8a^2b$
$= (5+3)ab^2 + (7-8)a^2b$
$= 8ab^2 - 1a^2b$
$= 8ab^2 - a^2b$

31. $\frac{4}{3}rs - \frac{3}{2}r^2 + \frac{2}{3}rs - 5$
$= \frac{4}{3}rs + \frac{2}{3}rs - \frac{3}{2}r^2 - 5$
$= \left(\frac{4}{3} + \frac{2}{3}\right)rs - \frac{3}{2}r^2 - 5$
$= \frac{6}{3}rs - \frac{3}{2}r^2 - 5$
$= 2rs - \frac{3}{2}r^2 - 5$

32. To simplify an algebraic expression means to remove all parentheses and combine like terms.

33. $3x + 2(x-1) - 7x + 1 = 3x + 2x - 2 - 7x + 1$
$= 3x + 2x - 7x - 2 + 1$
$= -2x - 1$

34. $m + 2n - 3(m + 2n) - (7 - 3n)$
$= m + 2n - 3m - 6n - 7 + 3n$
$= m - 3m + 2n - 6n + 3n - 7$
$= -2m - 1n - 7$
$= -2m - n - 7$

35. $2(a - 4b) - (a + 4b) + b$
$= 2a - 8b - a - 4b + b$
$= 2a - a - 8b - 4b + b$
$= 2a - 1a - 8b - 4b + 1b$
$= (2-1)a + (-8-4+1)b$
$= 1a + (-11)b$
$= a - 11b$

36. $\frac{1}{2}(6x+4) - \frac{1}{3}(12 - 9x) = 3x + 2 - 4 + 3x$
$= 3x + 3x + 2 - 4$
$= 6x - 2$

1.8 Exercises

38. Substitute 2 for x.
$3x + 7 = 3(2) + 7 = 6 + 7 = 13$

40. Substitute 2 for n.
$n^2 - 4n + 3 = 2^2 - 4(2) + 3$
$= 4 - 4(2) + 3$
$= 4 - 8 + 3$
$= -4 + 3$
$= -1$

42. Substitute -3 for p.

$$\begin{aligned}-2p^2+5p+1 &= -2(-3)^2+5(-3)+1\\ &= -2(9)+5(-3)+1\\ &= -18-15+1\\ &= -33+1\\ &= -32\end{aligned}$$

44. Substitute 2 for m and 4 for n.

$$\begin{aligned}m^2-\frac{3n}{m} &= 2^2-\frac{3(4)}{2}\\ &= 4-\frac{3(4)}{2}\\ &= 4-\frac{12}{2}\\ &= 4-6\\ &= -2\end{aligned}$$

46. Substitute 4 for y and -3 for z.

$$\frac{3y+2z}{y-z}=\frac{3(4)+2(-3)}{4-(-3)}=\frac{12+(-6)}{4+3}=\frac{6}{7}$$

48. Substitute 1 for a and -2 for b.

$$(a-2b)^2=(1-2(-2))^2=(1+4)^2=5^2=25$$

50. Substitute 1 for a and -2 for b.

$$a^2-4b^2=1^2-4(-2)^2=1-4\cdot 4=1-16=-15$$

52. $3m^4-m^3n^2+\frac{5n}{7}-1$ can be written as $3m^4+(-1)\cdot m^3n^2+\frac{5}{7}n+(-1)$. The terms are $3m^4$, $-m^3n^2$, $\frac{5n}{7}$, and -1. The coefficient of $3m^4$ is 3. The coefficient of $-m^3n^2$ is -1. The coefficient of $\frac{5n}{7}$ is $\frac{5}{7}$. The coefficient of -1 is -1.

54. $t^3-\frac{t}{4}$ can be written as $1\cdot t^3+\left(-\frac{1}{4}\right)\cdot t$. The terms are t^3 and $-\frac{t}{4}$. The coefficient of t^3 is 1. The coefficient of $-\frac{t}{4}$ is $-\frac{1}{4}$.

56. $11p$ and 11 are unlike terms. $11p$ has a variable and 11 does not.

58. -13 and 38 are like terms. They are both constants.

60. $6a^2$ and $-3a^2$ are like terms. They have the same variable raised to the same power.

62. x^2y^3 and y^2x^3 are unlike terms. The variable x is raised to the second power in x^2y^3 and the third power in y^2x^3.

64. $3(4s+2)=3\cdot 4s+3\cdot 2=12s+6$

66. $$\begin{aligned}(6a^4-4a^2+2)3 &= 6a^4\cdot 3-4a^2\cdot 3+2\cdot 3\\ &= 18a^4-12a^2+6\end{aligned}$$

68. $-5(k-n)=-5\cdot k-(-5)\cdot n=-5k+5n$

70. $$\begin{aligned}(16a+12b)(-0.4) &= 16a\cdot(-0.4)+12b\cdot(-0.4)\\ &= -6.4a-4.8b\end{aligned}$$

72. $14k-11k=(14-11)k=3k$

74. $9m-8m+2m=(9-8+2)m=3m$

76. $$\begin{aligned}x+2y+5x+7y &= x+5x+2y+7y\\ &= (1+5)x+(2+7)y\\ &= 6x+9y\end{aligned}$$

78. $$\begin{aligned}1.7n^4-n^2+2.1n^4 &= 1.7n^4+2.1n^4-n^2\\ &= (1.7+2.1)n^4-n^2\\ &= 3.8n^4-n^2\end{aligned}$$

80. $-7p^5+2p^5=(-7+2)p^5=-5p^5$

82. $$\begin{aligned}&-(-6m+9n-8p)\\ &= -1\cdot(-6m)+(-1)\cdot 9n-(-1)\cdot 8p\\ &= 6m-9n-(-8p)\\ &= 6m-9n+8p\end{aligned}$$

84. $$\begin{aligned}3(7-z)-z &= 3\cdot 7-3\cdot z-z\\ &= 21-3z-z\\ &= 21-4z\end{aligned}$$

86. $$\begin{aligned}18m-(6+9m) &= 18m-6-9m\\ &= 18m-9m-6\\ &= 9m-6\end{aligned}$$

88. $$\begin{aligned}(3k+1)-(4-k) &= 3k+1-4+k\\ &= 4k+1-4\\ &= 4k-3\end{aligned}$$

90. $(5y-6)-(11y+8)=5y-6-11y-8=-6y-14$

92. $-9(7r-6)+9(10r+3)=-63r+54+90r+27$
$=-63r+90r+54+27$
$=27r+81$

94. $\frac{3}{5}y+\frac{7}{10}y=\frac{6}{10}y+\frac{7}{10}y=\frac{13}{10}y$

96. $\frac{1}{5}(60-15x)+\frac{3}{4}(12-24x)=12-3x+9-18x$
$=-3x-18x+12+9$
$=-21x+21$

98. $3(0.2x+6)-5(1.6x+1)=0.6x+18-8x-5$
$=0.6x-8x+18-5$
$=-7.4x+13$

100. $1.8(x+2.5)+1.1(3x-2.8)$
$=1.8x+4.5+3.3x-3.08$
$=1.8x+3.3x+4.5-3.08$
$=5.1x+1.42$

102. **(a)** $8y+2y=8(-3)+2(-3)=-24+(-6)=-30$

(b) $8y+2y=10y=10(-3)=-30$

104. **(a)** $4b^2-7b^2=4(5)^2-7(5)^2$
$=4(25)-7(25)$
$=100-175$
$=-75$

(b) $4b^2-7b^2=-3b^2=-3(5)^2=-3(25)=-75$

106. **(a)** $8p-3(p-4)=8(3)-3(3-4)$
$=8(3)-3(-1)$
$=24+3$
$=27$

(b) $8p-3(p-4)=8p-3p+12$
$=5p+12$
$=5(3)+12$
$=15+12$
$=27$

108. **(a)** $3x^2+8x-x^2-6x=3(5)^2+8(5)-5^2-6(5)$
$=3(25)+8(5)-25-6(5)$
$=75+40-25-30$
$=60$

(b) $3x^2+8x-x^2-6x=3x^2-x^2+8x-6x$
$=2x^2+2x$
$=2(5)^2+2(5)$
$=2(25)+2(5)$
$=50+10$
$=60$

110. **(a)** $\frac{1}{5}(5x-10)-\frac{1}{6}(6x+12)$
$=\frac{1}{5}(5(-2)-10)-\frac{1}{6}(6(-2)+12)$
$=\frac{1}{5}(-10-10)-\frac{1}{6}(-12+12)$
$=\frac{1}{5}(-20)-\frac{1}{6}(0)$
$=-4-0$
$=-4$

(b) $\frac{1}{5}(5x-10)-\frac{1}{6}(6x+12)=x-2-x-2$
$=x-x-2-2$
$=-4$

112. **(a)** $-4x-y+2(x-3y)$
$=-4(3)-(-2)+2(3-3(-2))$
$=-4(3)-(-2)+2(3+6)$
$=-4(3)-(-2)+2(9)$
$=-12+2+18$
$=8$

(b) $-4x-y+2(x-3y)=-4x-y+2x-6y$
$=-4x+2x-y-6y$
$=-2x-7y$
$=-2(3)-7(-2)$
$=-6+14$
$=8$

114. Let $h=9$, $b=3$, $B=12$.
$\frac{1}{2}h(b+B)=\frac{1}{2}(9)(3+12)$
$=\frac{1}{2}(9)(15)$
$=\frac{9}{2}\cdot 15$
$=\frac{135}{2}$

116. Let $a=-5$, $b=-2$, $c=7$, $d=1$.
$\frac{a-b}{c-d}=\frac{-5-(-2)}{7-1}=\frac{-5+2}{7-1}=\frac{-3}{6}=-\frac{1}{2}$

118. Let $a = 2$, $b = 5$, $c = 3$.
$b^2 - 4ac = 5^2 - 4(2)(3) = 25 - 24 = 1$

120. Let $m = 245$.
$29.95 + 0.17m = 29.95 + 0.17(245)$
$= 29.95 + 41.65$
$= 71.60$
The cost of renting the car is \$71.60.

122. Let $s = 76$ and $n = 63$.
$5s + 8n = 5(76) + 8(63) = 380 + 504 = 884$
The revenue for 76 student tickets and 63 non-student tickets is \$884.

124. **(a)** $2l + 2(l - 11) = 2l + 2l - 22 = 4l - 22$

(b) Let $l = 15$.
$4l - 22 = 4(15) - 22 = 60 - 22 = 38$
The perimeter is 38 meters.

126. Let $x = 2500$ and $y = 1000$.
$0.0295x + 0.128y = 0.0295(2500) + 0.128(1000)$
$= 73.75 + 128$
$= 201.75$
His investment will earn \$201.75.

128. $11.23(7.695x + 81.34) + 8.77(7.695x + 81.34)$
$= (11.23 + 8.77)(7.695x + 81.34)$
$= 20(7.695x + 81.34)$
$= 153.9x + 1626.8$

130. **(a)** $x^2 + y^2 = 4^2 + 5^2 = 16 + 25 = 41$

(b) $(x + y)^2 = (4 + 5)^2 = (9)^2 = 9^2 = 81$

(c) The expression $(x + y)^2$ requires that we find $x + y$ and square the result. The expression $x^2 + y^2$ requires that each value is squared first and then find the sum.

Chapter 1 Review

1.
$$\begin{array}{c} 24 \\ / \quad \backslash \\ 4 \quad\quad 6 \\ / \backslash \quad / \backslash \\ 2 \cdot 2 \cdot 2 \cdot 3 \end{array}$$
$24 = 2 \cdot 2 \cdot 2 \cdot 3$

2.
$$\begin{array}{c} 87 \\ / \ \backslash \\ 3 \cdot 29 \end{array}$$
$87 = 3 \cdot 29$

3.
$$\begin{array}{c} 81 \\ / \quad \backslash \\ 9 \quad\quad 9 \\ / \backslash \quad / \backslash \\ 3 \cdot 3 \cdot 3 \cdot 3 \end{array}$$
$81 = 3 \cdot 3 \cdot 3 \cdot 3$

4.
$$\begin{array}{c} 124 \\ / \ \backslash \\ 4 \quad 31 \\ / \backslash \quad \backslash \\ 2 \cdot 2 \cdot 31 \end{array}$$
$124 = 2 \cdot 2 \cdot 31$

5. 17 is prime.

6. $18 = 3 \cdot 3 \cdot 2$
$24 = 3 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
$3 \cdot 3 \cdot 2 \cdot 2 \cdot 2 = 72$

7. $4 = 2 \cdot 2$
$8 = 2 \cdot 2 \cdot 2$
$18 = 2 \cdot 3 \cdot 3$
$2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 = 72$

8. $\dfrac{7}{15} = \dfrac{7}{15} \cdot \dfrac{2}{2} = \dfrac{14}{30}$

9. $3 = \dfrac{3}{1} = \dfrac{3}{1} \cdot \dfrac{4}{4} = \dfrac{12}{4}$

10. $6 = 2 \cdot 3$
$8 = 2 \cdot 2 \cdot 2$
$\text{LCD} = 2 \cdot 3 \cdot 2 \cdot 2 = 24$
$\dfrac{1}{6} = \dfrac{1}{6} \cdot \dfrac{4}{4} = \dfrac{4}{24}$
$\dfrac{3}{8} = \dfrac{3}{8} \cdot \dfrac{3}{3} = \dfrac{9}{24}$

11. $16 = 2 \cdot 2 \cdot 2 \cdot 2$
$24 = 2 \cdot 2 \cdot 2 \cdot 3$

$\text{LCD} = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 2 = 48$

$\frac{9}{16} = \frac{9}{16} \cdot \frac{3}{3} = \frac{27}{48}$

$\frac{7}{24} = \frac{7}{24} \cdot \frac{2}{2} = \frac{14}{48}$

12. $\frac{25}{60} = \frac{5 \cdot 5}{5 \cdot 3 \cdot 2 \cdot 2} = \frac{5}{3 \cdot 2 \cdot 2} = \frac{5}{12}$

13. $\frac{125}{250} = \frac{5 \cdot 5 \cdot 5}{5 \cdot 5 \cdot 5 \cdot 2} = \frac{1}{2}$

14. $\frac{96}{120} = \frac{3 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{3 \cdot 2 \cdot 2 \cdot 2 \cdot 5} = \frac{2 \cdot 2}{5} = \frac{4}{5}$

15. 21.76

16. 15

17. $\frac{8}{9} = 9\overline{)8.00}$ 0.88

72

80

$\frac{8}{9} = 0.88... = 0.\overline{8}$

18. $\frac{9}{32} = 32\overline{)9.00000}$ 0.28125

64

260

256

40

32

80

64

160

160

0

$\frac{9}{32} = 0.28125$

19. $6\overline{)11.000}$ 1.833

6

50

48

20

18

20

$\frac{11}{6}$ rounded to the nearest hundredth is 1.83.

20. $8\overline{)19.00}$ 2.37

16

30

24

60

56

40

$\frac{19}{8}$ rounded to the nearest tenth is 2.4.

21. $0.6 = \frac{6}{10} = \frac{3 \cdot 2}{5 \cdot 2} = \frac{3}{5}$

22. $0.375 = \frac{375}{1000} = \frac{5 \cdot 5 \cdot 5 \cdot 3}{5 \cdot 5 \cdot 5 \cdot 2 \cdot 2 \cdot 2} = \frac{3}{2 \cdot 2 \cdot 2} = \frac{3}{8}$

23. $0.864 = \frac{864}{1000}$
$= \frac{3 \cdot 3 \cdot 3 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{5 \cdot 5 \cdot 5 \cdot 2 \cdot 2 \cdot 2}$
$= \frac{3 \cdot 3 \cdot 3 \cdot 2 \cdot 2}{5 \cdot 5 \cdot 5}$
$= \frac{108}{125}$

24. $41\% = 41\% \cdot \frac{1}{100\%} = \frac{41}{100} = 0.41$

25. $760\% = 760\% \cdot \frac{1}{100\%} = \frac{760}{100} = 7.60$

26. $9.03\% = 9.03\% \cdot \frac{1}{100\%} = \frac{9.03}{100} = 0.0903$

27. $0.35\% = 0.35\% \cdot \frac{1}{100\%} = \frac{0.35}{100} = 0.0035$

28. $0.23 = 0.23 \cdot \dfrac{100\%}{1} = 23\%$

29. $1.17 = 1.17 \cdot \dfrac{100\%}{1} = 117\%$

30. $0.045 = 0.045 \cdot \dfrac{100\%}{1} = 4.5\%$

31. $3 = 3 \cdot \dfrac{100\%}{1} = 300\%$

32. **(a)** $\dfrac{12}{20} = \dfrac{3 \cdot 2 \cdot 2}{5 \cdot 2 \cdot 2} = \dfrac{3}{5}$

The student earned $\dfrac{3}{5}$ of the point.

(b) $\dfrac{3}{5} = 0.6$

$0.6 \cdot \dfrac{100\%}{1} = 60\%$

The student earned 60% of the points.

33. The set of whole numbers less than 7 is $A = \{0, 1, 2, 3, 4, 5, 6\}$.

34. The set of natural numbers less than or equal to 3 is $B = \{1, 2, 3\}$.

35. The set of integers greater than −3 and less than or equal to 5 is $C = \{-2, -1, 0, 1, 2, 3, 4, 5\}$.

36. The set of integers greater than or equal to −2 and less than 4 is $D = \{-2, -1, 0, 1, 2, 3\}$.

37. $\dfrac{9}{3} = 3$ and 11 are the natural numbers.

38. 0, $\dfrac{9}{3} = 3,$ and 11 are the whole numbers.

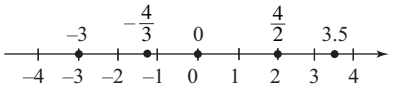
39. −6, 0, $\dfrac{9}{3} = 3,$ and 11 are the integers.

40. −6, −3.25, 0, $\dfrac{9}{3},$ 11, and $\dfrac{5}{7}$ are the rational numbers.

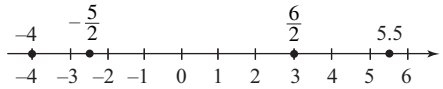
41. 5.030030003... is the only irrational number.

42. All the numbers listed are real numbers.

43.



44.



45. Since −3 lies to the left of −1 on the real number line, $-3 < -1$. The statement is false.

46. Since $5 = 5$, the statement $5 \le 5$ is true.

47. Since −5 lies to the left of −3 on the real number line, $-5 \le -3$ is a true statement.

48. Since $\dfrac{1}{2} = 0.5,$ the statement is true.

49. $-\left|\dfrac{1}{2}\right| = -\dfrac{1}{2}$

50. $|-7| = 7$

51. $-|-6| = -6$

52. $-|-8.2| = -8.2$

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

54. Since −6 lies to the left of 0 on the real number line, $-6 < 0$.

55. Since $\dfrac{3}{4} = 0.75$ and $0.83 > 0.75$, then $0.83 > \dfrac{3}{4}$.

56. Since −2 lies to the right of −10 on the real number line, $-2 > -10$.

57. $|-4| = 4$

$|-3| = 3$

Since 4 lies to the right of 3 on the real number line $4 > 3$ and $|-4| > |-3|$.

58. $\dfrac{4}{5} = \dfrac{4 \cdot 6}{5 \cdot 6} = \dfrac{24}{30}$

$\left|-\dfrac{5}{6}\right| = \dfrac{5}{6} = \dfrac{5 \cdot 5}{6 \cdot 5} = \dfrac{25}{30}$

Since $\dfrac{24}{30} < \dfrac{25}{30},$ then $\dfrac{4}{5} < \left|-\dfrac{5}{6}\right|$.

59. A rational number is any number that may be written as the quotient of two integers where the denominator does not equal zero. Both terminating decimals and repeating decimals are rational numbers. An irrational number is a non-repeating, non-terminating decimal.

60. The set of positive integers is called the natural numbers.

61. $-2 + 9 = 7$

62. $6 + (-10) = -4$

63. $-23 + (-11) = -34$

64. $-120 + 25 = -95$

65. $-|-2 + 6| = -|4| = -4$

66. $-|-15| + |-62| = -15 + 62 = 47$

67. $-110 + 50 + (-18) + 25 = -60 + (-18) + 25$
$= -78 + 25$
$= -53$

68. $-28 + (-35) + (-52) = -63 + (-52) = -115$

69. $-10 - 12 = -10 + (-12) = -22$

70. $18 - 25 = 18 + (-25) = -7$

71. $-11 - (-32) = -11 + 32 = 21$

72. $0 - (-67) = 0 + 67 = 67$

73. $34 - 18 + 10 = 34 + (-18) + 10 = 16 + 10 = 26$

74. $-49 - 8 + 21 = -49 + (-8) + 21$
$= -57 + 21$
$= -36$

75. $-6(-2) = 12$

76. $4(-10) = -40$

77. $13(-86) = -1118$

78. $-19 \times 423 = -8037$

79. $(11)(13)(-5) = 143(-5) = -715$

80. $(-53)(-21)(-10) = 1113(-10) = -11{,}130$

81. $\dfrac{-20}{-4} = \dfrac{-4 \cdot 5}{-4 \cdot 1} = \dfrac{\cancel{-4} \cdot 5}{\cancel{-4} \cdot 1} = \dfrac{5}{1} = 5$

82. $\dfrac{60}{-5} = \dfrac{5 \cdot 12}{5 \cdot (-1)} = \dfrac{\cancel{5} \cdot 12}{\cancel{5} \cdot (-1)} = \dfrac{12}{-1} = -12$

83. $\dfrac{|-55|}{11} = \dfrac{55}{11} = \dfrac{11 \cdot 5}{11 \cdot 1} = \dfrac{\cancel{11} \cdot 5}{\cancel{11} \cdot 1} = \dfrac{5}{1} = 5$

84. $-\left|\dfrac{-100}{4}\right| = -\left|\dfrac{4 \cdot (-25)}{4}\right|$
$= -\left|\dfrac{\cancel{4} \cdot (-25)}{\cancel{4}}\right|$
$= -|-25|$
$= -25$

85. $\dfrac{120}{-15} = \dfrac{15 \cdot 8}{15 \cdot (-1)} = \dfrac{\cancel{15} \cdot 8}{\cancel{15} \cdot (-1)} = \dfrac{8}{-1} = -8$

86. $\dfrac{64}{-20} = \dfrac{4 \cdot 16}{4 \cdot (-5)} = \dfrac{\cancel{4} \cdot 16}{\cancel{4} \cdot (-5)} = -\dfrac{16}{5}$

87. $\dfrac{-180}{54} = \dfrac{-10 \cdot 18}{3 \cdot 18} = \dfrac{-10 \cdot \cancel{18}}{3 \cdot \cancel{18}} = -\dfrac{10}{3}$

88. $\dfrac{-450}{105} = \dfrac{-30 \cdot 15}{7 \cdot 15} = \dfrac{-30 \cdot \cancel{15}}{7 \cdot \cancel{15}} = -\dfrac{30}{7}$

89. The additive inverse of 13 is −13 since $13 + (-13) = 0$.

90. The additive inverse of −45 is 45 since $-45 + 45 = 0$.

91. −43 plus 101 is written as $-43 + 101 = 58$.

92. 45 plus −28 is written as $45 + (-28) = 17$.

93. −10 minus −116 is written as $-10 - (-116) = -10 + 116 = 106$.

94. 74 minus 56 is written as $74 - 56 = 74 + (-56) = 18$.

95. The sum of 13 and −8 is written as $13 + (-8) = 5$.

96. The difference between −60 and −10 is written as $-60 - (-10) = -60 + 10 = -50$.

97. −21 multiplied by −3 is written as $-21 \cdot (-3) = 63$.

98. 54 multiplied by −18 is written as $54 \cdot (-18) = -972$.

99. -34 divided by -2 is written as

$$-34 \div (-2) = \frac{-34}{-2} = \frac{-2 \cdot 17}{-2 \cdot 1} = \frac{17}{1} = 17.$$

100. -49 divided by 14 is written as

$$-49 \div 14 = \frac{-49}{14} = \frac{-7 \cdot 7}{2 \cdot 7} = -\frac{7}{2}.$$

101. $20 + (-6) + 12 = 14 + 12 = 26$
His total yardage was a gain of 26 yards.

102. $10 + 12 + (-25) = 22 + (-25) = -3$
The temperature at midnight was -3°F.

103. $6 - (-18) = 6 + 18 = 24$
The difference in temperature was 24°F.

104. $11 \cdot 5 = 55$
$8 \cdot 4 = 32$
$55 + 32 = 87$
Sarah's test score was 87 points.

105. $\frac{32}{64} = \frac{1 \cdot 32}{2 \cdot 32} = \frac{1 \cdot \cancel{32}}{2 \cdot \cancel{32}} = \frac{1}{2}$

106. $-\frac{27}{81} = -\frac{1 \cdot 27}{3 \cdot 27} = -\frac{1 \cdot \cancel{27}}{3 \cdot \cancel{27}} = -\frac{1}{3}$

107. $\frac{-100}{150} = \frac{-2 \cdot 50}{3 \cdot 50} = \frac{-2 \cdot \cancel{50}}{3 \cdot \cancel{50}} = \frac{-2}{3} = -\frac{2}{3}$

108. $\frac{35}{-25} = \frac{5 \cdot 7}{5 \cdot (-5)} = \frac{\cancel{5} \cdot 7}{\cancel{5} \cdot (-5)} = \frac{7}{-5} = -\frac{7}{5}$

109. $\frac{2}{3} \cdot \frac{15}{8} = \frac{2 \cdot 15}{3 \cdot 8} = \frac{2 \cdot 3 \cdot 5}{3 \cdot 2 \cdot 4} = \frac{\cancel{2} \cdot \cancel{3} \cdot 5}{\cancel{3} \cdot \cancel{2} \cdot 4} = \frac{5}{4}$

110. $-\frac{3}{8} \cdot \frac{10}{21} = -\frac{3 \cdot 10}{8 \cdot 21}$

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

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

$$= -\frac{5}{4 \cdot 7}$$

$$= -\frac{5}{28}$$

111. $\frac{5}{8} \cdot \left(-\frac{2}{25}\right) = \frac{5 \cdot (-2)}{8 \cdot 25}$

$$= \frac{5 \cdot 2 \cdot (-1)}{2 \cdot 4 \cdot 5 \cdot 5}$$

$$= \frac{\cancel{5} \cdot \cancel{2} \cdot (-1)}{\cancel{2} \cdot 4 \cdot \cancel{5} \cdot 5}$$

$$= \frac{-1}{4 \cdot 5}$$

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

112. $5 \cdot \left(-\frac{3}{10}\right) = \frac{5}{1} \cdot \left(-\frac{3}{10}\right)$

$$= \frac{5 \cdot (-3)}{1 \cdot 10}$$

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

$$= \frac{\cancel{5} \cdot (-3)}{1 \cdot 2 \cdot \cancel{5}}$$

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

113. $\frac{24}{17} \div \frac{18}{3} = \frac{24}{17} \cdot \frac{3}{18}$

$$= \frac{24 \cdot 3}{17 \cdot 18}$$

$$= \frac{6 \cdot 4 \cdot 3}{17 \cdot 6 \cdot 3}$$

$$= \frac{\cancel{6} \cdot 4 \cdot \cancel{3}}{17 \cdot \cancel{6} \cdot \cancel{3}}$$

$$= \frac{4}{17}$$

114. $-\frac{5}{12} \div \frac{10}{16} = -\frac{5}{12} \cdot \frac{16}{10}$

$$= -\frac{5 \cdot 16}{12 \cdot 10}$$

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

$$= -\frac{\cancel{5} \cdot \cancel{4} \cdot 2 \cdot \cancel{2}}{\cancel{4} \cdot 3 \cdot \cancel{5} \cdot \cancel{2}}$$

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

115. $-\frac{27}{10}\div 9 = -\frac{27}{10}\div\frac{9}{1}$
$= -\frac{27}{10}\cdot\frac{1}{9}$
$= -\frac{27\cdot 1}{10\cdot 9}$
$= -\frac{3\cdot 9\cdot 1}{10\cdot 9}$
$= -\frac{3\cdot \cancel{9}\cdot 1}{10\cdot \cancel{9}}$
$= -\frac{3}{10}$

116. $20\div\left(-\frac{5}{8}\right) = \frac{20}{1}\div\left(-\frac{5}{8}\right)$
$= \frac{20}{1}\cdot\left(-\frac{8}{5}\right)$
$= \frac{20\cdot(-8)}{1\cdot 5}$
$= \frac{4\cdot 5\cdot(-8)}{1\cdot 5}$
$= \frac{4\cdot \cancel{5}\cdot(-8)}{1\cdot \cancel{5}}$
$= \frac{4\cdot(-8)}{1}$
$= -32$

117. $\frac{2}{9}+\frac{1}{9} = \frac{2+1}{9} = \frac{3}{9} = \frac{3\cdot 1}{3\cdot 3} = \frac{\cancel{3}\cdot 1}{\cancel{3}\cdot 3} = \frac{1}{3}$

118. $-\frac{6}{5}+\frac{4}{5} = \frac{-6+4}{5} = \frac{-2}{5} = -\frac{2}{5}$

119. $\frac{5}{7}-\frac{2}{7} = \frac{5-2}{7} = \frac{3}{7}$

120. $\frac{7}{5}-\left(-\frac{8}{5}\right) = \frac{7}{5}+\frac{8}{5}$
$= \frac{7+8}{5}$
$= \frac{15}{5}$
$= \frac{5\cdot 3}{5}$
$= \frac{\cancel{5}\cdot 3}{\cancel{5}}$
$= 3$

121. $\frac{3}{10}+\frac{1}{20} = \frac{3}{10}\cdot\frac{2}{2}+\frac{1}{20}$
$= \frac{6}{20}+\frac{1}{20}$
$= \frac{6+1}{20}$
$= \frac{7}{20}$

122. $12 = 4\cdot 3$
$9 = 3\cdot 3$
$\text{LCD} = 4\cdot 3\cdot 3 = 36$
$\frac{5}{12}+\frac{4}{9} = \frac{5}{12}\cdot\frac{3}{3}+\frac{4}{9}\cdot\frac{4}{4}$
$= \frac{15}{36}+\frac{16}{36}$
$= \frac{15+16}{36}$
$= \frac{31}{36}$

123. $35 = 5\cdot 7$
$49 = 7\cdot 7$
$\text{LCD} = 5\cdot 7\cdot 7 = 245$
$-\frac{7}{35}-\frac{2}{49} = -\frac{7}{35}\cdot\frac{7}{7}-\frac{2}{49}\cdot\frac{5}{5}$
$= -\frac{49}{245}-\frac{10}{245}$
$= \frac{-49-10}{245}$
$= -\frac{59}{245}$

124. $6 = 2\cdot 3$
$4 = 2\cdot 2$
$\text{LCD} = 2\cdot 2\cdot 3 = 12$
$\frac{5}{6}-\left(-\frac{1}{4}\right) = \frac{5}{6}+\frac{1}{4}$
$= \frac{5}{6}\cdot\frac{2}{2}+\frac{1}{4}\cdot\frac{3}{3}$
$= \frac{10}{12}+\frac{3}{12}$
$= \frac{10+3}{12}$
$= \frac{13}{12}$

125. $-2-\left(-\frac{5}{12}\right)=-2+\frac{5}{12}$

$=-\frac{2}{1}\cdot\frac{12}{12}+\frac{5}{12}$

$=-\frac{24}{12}+\frac{5}{12}$

$=\frac{-24+5}{12}$

$=-\frac{19}{12}$

126. $-5+\frac{9}{4}=-\frac{5}{1}\cdot\frac{4}{4}+\frac{9}{4}$

$=-\frac{20}{4}+\frac{9}{4}$

$=\frac{-20+9}{4}$

$=-\frac{11}{4}$

127. $10=2\cdot5$

$5=5$

$2=2$

LCD $=2\cdot5=10$

$-\frac{1}{10}+\left(-\frac{2}{5}\right)+\frac{1}{2}=-\frac{1}{10}+\left(-\frac{2}{5}\cdot\frac{2}{2}\right)+\frac{1}{2}\cdot\frac{5}{5}$

$=-\frac{1}{10}+\left(-\frac{4}{10}\right)+\frac{5}{10}$

$=\frac{-1+(-4)+5}{10}$

$=\frac{0}{10}$

$=0$

128. $6=2\cdot3$

$4=2\cdot2$

$24=2\cdot2\cdot2\cdot3$

LCD $=2\cdot2\cdot2\cdot3=24$

$-\frac{5}{6}-\frac{1}{4}+\frac{3}{24}=-\frac{5}{6}\cdot\frac{4}{4}-\frac{1}{4}\cdot\frac{6}{6}+\frac{3}{24}$

$=-\frac{20}{24}-\frac{6}{24}+\frac{3}{24}$

$=\frac{-20-6+3}{24}$

$=-\frac{23}{24}$

129.
$$\begin{array}{r} 30.3 \\ +\ 18.2 \\ \hline 48.5 \end{array}$$

So, 30.3 + 18.2 = 48.5.

130.
$$\begin{array}{r} 43.02 \\ -\ 18.36 \\ \hline 24.66 \end{array}$$

So, −43.02 + 18.36 = −24.66.

131.
$$\begin{array}{r} 201.37 \\ -\ 118.39 \\ \hline 82.98 \end{array}$$

So, 201.37 − 118.39 = 82.98.

132.
$$\begin{array}{r} 35.10 \\ +\ 18.64 \\ \hline 53.74 \end{array}$$

So, $-35.1-18.64=-35.1+(-18.64)$

$=-53.74.$

133.
$$\begin{array}{r} 2.01 \\ \times\ 0.04 \\ \hline 0.0804 \end{array}$$

So, (−0.04)(−2.01) = 0.0804.

134.
$$\begin{array}{r} 87.3 \\ \times\ 2.98 \\ \hline 6984 \\ 7857 \\ 1746 \\ \hline 260.154 \end{array}$$

So, (87.3)(−2.98) = −260.154.

135. $\frac{69.92}{3.8}=\frac{699.2}{38}=18.4$

$$\begin{array}{r} 18.4 \\ 38\overline{)699.2} \\ \underline{38} \\ 319 \\ \underline{304} \\ 152 \\ \underline{152} \\ 0 \end{array}$$

136. $-\frac{1.08318}{0.042}=-\frac{1083.18}{42}=-25.79$

$$\begin{array}{r} 25.79 \\ 42\overline{)1083.18} \\ \underline{84} \\ 243 \\ \underline{210} \\ 33\ 1 \\ \underline{29\ 4} \\ 3\ 78 \\ \underline{3\ 78} \\ 0 \end{array}$$

137. $12.5-18.6+8.4=12.5+(-18.6)+8.4$
$=-6.1+8.4$
$=2.3$

138. $-13.5+10.8-20.2=-13.5+10.8+(-20.2)$
$=-2.7+(-20.2)$
$=-22.9$

139. $12.9\times1.4\times(-0.3)=18.06\times(-0.3)=-5.418$

140. $2.4\times6.1\times(-0.05)=14.64\times(-0.05)$
$=-0.732$

141. $256.75+(-175.68)+(-180.00)$
$=81.07+(-180.00)$
$=-98.93$
Lee's checking account balance is –$98.93. The account is overdrawn.

142. $36\cdot\frac{2}{3}=\frac{36}{1}\cdot\frac{2}{3}$
$=\frac{36\cdot2}{1\cdot3}$
$=\frac{3\cdot12\cdot2}{1\cdot3}$
$=\frac{\cancel{3}\cdot12\cdot2}{1\cdot\cancel{3}}$
$=\frac{12\cdot2}{1}$
$=24$
Jarred had 24 friends that wanted the Panthers to win.

143. $15-3\frac{1}{2}=15-\frac{7}{2}$
$=\frac{15}{1}-\frac{7}{2}$
$=\frac{15}{1}\cdot\frac{2}{2}-\frac{7}{2}$
$=\frac{30}{2}-\frac{7}{2}$
$=\frac{30-7}{2}$
$=\frac{23}{2}$ or $11\frac{1}{2}$
The length of the remaining piece is $11\frac{1}{2}$ inches.

144. net price = price × quantity
$=\$35\times5$
$=\$175$
sales tax $=\$175\times6.75\%$
$=\$175\times0.0675$
$=\$11.81$
Sierra spent $175 + $11.81 = $186.81 on the clothes.

145. $(5\cdot12)\cdot10=5\cdot(12\cdot10)$ illustrates the associative property of multiplication since the grouping of multiplication changes.

146. $20\cdot\frac{1}{20}=1$ illustrates the multiplicative inverse property.

147. $\frac{8}{3}\cdot\frac{3}{8}=1$ illustrates the multiplicative inverse property.

148. $\frac{5}{3}\cdot\left(-\frac{18}{61}\right)\cdot\frac{3}{5}=\frac{5}{3}\cdot\frac{3}{5}\cdot\left(-\frac{18}{61}\right)$ illustrates the commutative property of multiplication since the order in which the numbers are multiplied changes.

149. $9\cdot73\cdot\frac{1}{9}=9\cdot\frac{1}{9}\cdot73$ illustrates the commutative property of multiplication since the order in which the numbers are multiplied changes.

150. 23.9 + (–23.9) = 0 illustrates the additive inverse property.

151. 36 + 0 = 36 illustrates the identity property of addition.

152. –49 + 0 = –49 illustrates the identity property of addition.

153. 23 + 5 + (–23) = 23 + (–23) + 5 illustrates the commutative property of addition since the order of the addition changes.

154. $\frac{7}{8}=\frac{7}{8}\cdot\frac{3}{3}$ illustrates the multiplicative identity property since $\frac{3}{3}=1$.

155. 14 · 0 = 0 illustrates the multiplication property of zero.

156. $-5.3 + (5.3 + 2.8) = (-5.3 + 5.3) + 2.8$ illustrates the associative property of addition since the grouping of the addition changes.

157. $144 + 29 + (-144) = 144 + (-144) + 29$
$= 0 + 29$
$= 29$

158. $76 + 99 + (-76) = 76 + (-76) + 99$
$= 0 + 99$
$= 99$

159. $\frac{19}{3} \cdot 18 \cdot \frac{3}{19} = \frac{19}{3} \cdot \frac{3}{19} \cdot 18 = 1 \cdot 18 = 18$

160. $\frac{14}{9} \cdot 121 \cdot \frac{9}{14} = \frac{14}{9} \cdot \frac{9}{14} \cdot 121 = 1 \cdot 121 = 121$

161. $3.4 + 42.56 + (-42.56)$
$= 3.4 + [42.56 + (-42.56)]$
$= 3.4 + 0$
$= 3.4$

162. $5.3 + 3.6 + (-3.6) = 5.3 + [3.6 + (-3.6)]$
$= 5.3 + 0$
$= 5.3$

163. $\frac{9}{7} \cdot \left(-\frac{11}{3}\right) \cdot 7 = \frac{9}{7} \cdot 7 \cdot \left(-\frac{11}{3}\right)$
$= 9 \cdot \left(-\frac{11}{3}\right)$
$= \overset{3}{\cancel{9}} \cdot \left(-\frac{11}{\cancel{3}}\right)$
$= 3 \cdot (-11)$
$= -33$

164. $\frac{13}{5} \cdot \frac{18}{39} \cdot 5 = \frac{13}{5} \cdot 5 \cdot \frac{18}{39}$
$= 13 \cdot \frac{18}{39}$
$= \cancel{13} \cdot \frac{18}{\cancel{39}_{3}}$
$= \frac{18}{3}$
$= \frac{6 \cdot 3}{1 \cdot 3}$
$= 6$

165. $\frac{7}{0}$ is undefined because 0 is the divisor.

166. $\frac{0}{100} = 0$ because 0 is the dividend.

167. $1000(-334)(0.001) = 1000(0.001)(-334)$
$= 1(-334)$
$= -334$

168. $400(0.5)(0.01) = 400(0.01)(0.5) = 4(0.5) = 2$

169. $43{,}569{,}003 \cdot 0 = 0$

170. $154 \cdot \frac{1}{154} = 1$

171. $\frac{3445}{302} + \left(-\frac{3445}{302}\right) = 0$

172. $130 \cdot \frac{42}{42} = 130 \cdot 1 = 130$

173. $-\frac{7}{48} \cdot \frac{20}{3} \cdot \frac{12}{7} = -\frac{7}{48} \cdot \frac{12}{7} \cdot \frac{20}{3}$
$= -\frac{\overset{1}{\cancel{7}}}{\cancel{48}_{4}} \cdot \frac{\overset{1}{\cancel{12}}}{\cancel{7}_{1}} \cdot \frac{20}{3}$
$= -\frac{1}{4} \cdot \frac{20}{3}$
$= -\frac{1}{\cancel{4}_{1}} \cdot \frac{\overset{5}{\cancel{20}}}{3}$
$= -\frac{5}{3}$

174. $\frac{9}{8} \cdot \left(-\frac{25}{13}\right) \cdot \frac{48}{9} = \frac{9}{8} \cdot \frac{48}{9} \cdot \left(-\frac{25}{13}\right)$
$= \frac{\overset{1}{\cancel{9}}}{8} \cdot \frac{\overset{6}{\cancel{48}}}{\cancel{9}_{1}} \cdot \left(-\frac{25}{13}\right)$
$= 6 \cdot \left(-\frac{25}{13}\right)$
$= -\frac{150}{13}$

175. The expression $3 \cdot 3 \cdot 3 \cdot 3$ contains four factors of 3, so $3 \cdot 3 \cdot 3 \cdot 3 = 3^4$.

176. The expression $\frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3}$ contains three factors of $\frac{2}{3}$, so $\frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} = \left(\frac{2}{3}\right)^3$.

177. The expression $(-4)(-4)$ contains two factors of -4, so $(-4)(-4) = (-4)^2$.

178. The expression $(-3)(-3)(-3)$ contains three factors of -3, so $(-3)(-3)(-3) = (-3)^3$.

179. $5^3 = 5 \cdot 5 \cdot 5 = 125$

180. $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$

181. $(-3)^4 = (-3) \cdot (-3) \cdot (-3) \cdot (-3) = 81$

182. $(-4)^3 = (-4) \cdot (-4) \cdot (-4) = -64$

183. $-3^4 = -(3 \cdot 3 \cdot 3 \cdot 3) = -81$

184. $\left(\frac{1}{2}\right)^6 = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{64}$

185.
$$\begin{aligned} -2 + 16 \div 4 \cdot 2 - 10 &= -2 + 4 \cdot 2 - 10 \\ &= -2 + 8 - 10 \\ &= 6 - 10 \\ &= -4 \end{aligned}$$

186.
$$\begin{aligned} -4 + 3[2^3 + 4(2 - 10)] &= -4 + 3[2^3 + 4(-8)] \\ &= -4 + 3[8 + 4(-8)] \\ &= -4 + 3[8 - 32] \\ &= -4 + 3[-24] \\ &= -4 - 72 \\ &= -76 \end{aligned}$$

187.
$$\begin{aligned} (12 - 7)^3 + (19 - 10)^2 &= 5^3 + 9^2 \\ &= 125 + 81 \\ &= 206 \end{aligned}$$

188.
$$\begin{aligned} 5 - (-12 \div 2 \cdot 3) + (-3)^2 &= 5 - (-6 \cdot 3) + (-3)^2 \\ &= 5 - (-18) + (-3)^2 \\ &= 5 - (-18) + 9 \\ &= 5 + 18 + 9 \\ &= 32 \end{aligned}$$

189. $\frac{2 \cdot (4 + 8)}{3 + 3^2} = \frac{2 \cdot (12)}{3 + 9} = \frac{24}{12} = \frac{2 \cdot 12}{1 \cdot 12} = 2$

190.
$$\begin{aligned} \frac{3 \cdot (5 + 2^2)}{2 \cdot 3^3} &= \frac{3 \cdot (5 + 4)}{2 \cdot 27} \\ &= \frac{3 \cdot 9}{2 \cdot 27} \\ &= \frac{27}{2 \cdot 27} \\ &= \frac{1}{2} \end{aligned}$$

191.
$$\begin{aligned} \frac{6 \cdot [12 - 3 \cdot (5 - 2)]}{5 \cdot [21 - 2 \cdot (4 + 5)]} &= \frac{6 \cdot [12 - 3 \cdot 3]}{5 \cdot [21 - 2 \cdot 9]} \\ &= \frac{6 \cdot [12 - 9]}{5 \cdot [21 - 18]} \\ &= \frac{6 \cdot 3}{5 \cdot 3} \\ &= \frac{6}{5} \end{aligned}$$

192.
$$\begin{aligned} \frac{4 \cdot [3 + 2 \cdot (8 - 6)]}{5 \cdot [14 - 2 \cdot (2 + 3)]} &= \frac{4 \cdot [3 + 2 \cdot 2]}{5 \cdot [14 - 2 \cdot 5]} \\ &= \frac{4 \cdot [3 + 4]}{5 \cdot [14 - 10]} \\ &= \frac{4 \cdot 7}{5 \cdot 4} \\ &= \frac{7}{5} \end{aligned}$$

193. Let $x = 5$ and $y = -2$.
$x^2 - y^2 = 5^2 - (-2)^2 = 25 - 4 = 21$

194. Let $x = 3$ and $y = -3$.
$$\begin{aligned} x^2 - 3y^2 &= 3^2 - 3(-3)^2 \\ &= 9 - 3(9) \\ &= 9 - 27 \\ &= -18 \end{aligned}$$

195. Let $x = -1$ and $y = -4$.

$$\begin{aligned}(x+2y)^3 &= (-1+2(-4))^3\\ &= (-1-8)^3\\ &= (-9)^3\\ &= -729\end{aligned}$$

196. Let $a = 5,\ b = -10,\ x = -3,\ y = 2$.

$$\begin{aligned}\frac{a-b}{x-y} &= \frac{5-(-10)}{-3-2}\\ &= \frac{5+10}{-3-2}\\ &= \frac{15}{-5}\\ &= \frac{3\cdot 5}{-1\cdot 5}\\ &= -3\end{aligned}$$

197. $3x^2 - x + 6$ can be written as $3x^2 + (-1)\cdot x + 6$.

The terms are $3x^2$, $-x$, and 6. The coefficient of $3x^2$ is 3. The coefficient of $-x$ is -1. The coefficient of 6 is 6.

198. $2x^2y^3 - \frac{y}{5}$ can be written as $2x^2y^3 + \left(-\frac{1}{5}\right)\cdot y$.

The terms are $2x^2y^3$ and $-\frac{y}{5}$. The coefficient of $2x^2y^3$ is 2. The coefficient of $-\frac{y}{5}$ is $-\frac{1}{5}$.

199. $4xy^2$ and $-6xy^2$ are like terms. They have the same variables raised to the same power.

200. $-3x$ and $4x^2$ are unlike terms. They have the same variable, but it is raised to different powers.

201. $-6y$ and -6 are unlike terms. $-6y$ has a variable and -6 does not.

202. -10 and 4 are like terms. They are both constants.

203. $4x - 6x - x = (4 - 6 - 1)x = -3x$

204.

$$\begin{aligned}6x-10-10x-5 &= 6x-10x-10-5\\ &= (6-10)x+(-10-5)\\ &= -4x-15\end{aligned}$$

205.

$$\begin{aligned}&0.2x^4+0.3x^3-4.3x^4\\ &= 0.2x^4-4.3x^4+0.3x^3\\ &= (0.2-4.3)x^4+0.3x^3\\ &= -4.1x^4+0.3x^3\end{aligned}$$

206.

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

207. $20-(x+2) = 20-x-2 = 20-2-x = 18-x$

208.

$$\begin{aligned}&-6(2x+5)+4(4x+3)\\ &= -6\cdot 2x+(-6)\cdot 5+4\cdot 4x+4\cdot 3\\ &= -12x-30+16x+12\\ &= -12x+16x-30+12\\ &= 4x-18\end{aligned}$$

209.

$$\begin{aligned}&5-(3x-1)+2(6x-5)\\ &= 5-3x+1+2\cdot 6x-2\cdot 5\\ &= 5-3x+1+12x-10\\ &= -3x+12x+5+1-10\\ &= 9x-4\end{aligned}$$

210.

$$\begin{aligned}&\frac{1}{6}(12x+18)-\frac{2}{5}(5x+10)\\ &= \frac{1}{6}\cdot 12x+\frac{1}{6}\cdot 18+\left(-\frac{2}{5}\right)\cdot 5x+\left(-\frac{2}{5}\right)\cdot 10\\ &= 2x+3-2x-4\\ &= 2x-2x+3-4\\ &= -1\end{aligned}$$

211. Let $m = 315$.

$$\begin{aligned}19.95+0.25m &= 19.95+0.25(315)\\ &= 19.95+78.75\\ &= 98.7\end{aligned}$$

The total daily cost is \$98.70.

Chapter 1 Test

1.

$$\begin{aligned}2 &= 2\\ 6 &= 2\cdot 3\\ 14 &= 2\quad\cdot 7\\ &\downarrow\quad\downarrow\quad\downarrow\\ &2\cdot 3\cdot 7\end{aligned}$$

The LCM is $2\cdot 3\cdot 7 = 42$.

2. $\frac{21}{66} = \frac{3\cdot 7}{2\cdot 3\cdot 11} = \frac{\cancel{3}\cdot 7}{2\cdot\cancel{3}\cdot 11} = \frac{7}{22}$

3.
$$\begin{array}{r} 1.444 \\ 9\overline{)13.000} \\ \underline{9} \\ 40 \\ \underline{36} \\ 40 \end{array}$$

$\frac{13}{9}$ rounded to the nearest hundredth is 1.44.

4. $0.425 = \frac{425}{1000} = \frac{17 \cdot \cancel{25}}{40 \cdot \cancel{25}} = \frac{17}{40}$

5. $0.6\% = 0.6\% \cdot \frac{1}{100\%} = \frac{0.6}{100} = 0.006$

6. $0.183 = 0.183 \cdot \frac{100\%}{1} = 18.3\%$

7.
$$\begin{aligned} \frac{4}{15} - \left(-\frac{2}{30}\right) &= \frac{4}{15} \cdot \frac{2}{2} - \left(-\frac{2}{30}\right) \\ &= \frac{8}{30} - \left(-\frac{2}{30}\right) \\ &= \frac{8}{30} + \frac{2}{30} \\ &= \frac{8+2}{30} \\ &= \frac{10}{30} \\ &= \frac{1 \cdot 10}{3 \cdot 10} \\ &= \frac{1}{3} \end{aligned}$$

8.
$$\begin{aligned} \frac{21}{4} \cdot \frac{3}{7} &= \frac{21 \cdot 3}{4 \cdot 7} \\ &= \frac{3 \cdot 7 \cdot 3}{4 \cdot 7} \\ &= \frac{3 \cdot \cancel{7} \cdot 3}{4 \cdot \cancel{7}} \\ &= \frac{3 \cdot 3}{4} \\ &= \frac{9}{4} \end{aligned}$$

9.
$$\begin{aligned} -16 \div \frac{3}{20} &= -16 \cdot \frac{20}{3} \\ &= \frac{-16}{1} \cdot \frac{20}{3} \\ &= \frac{-16 \cdot 20}{1 \cdot 3} \\ &= -\frac{320}{3} \end{aligned}$$

10.
$$\begin{aligned} &14 - 110 - (-15) + (-21) \\ &= 14 + (-110) + 15 + (-21) \\ &= -96 + 15 + (-21) \\ &= -81 + (-21) \\ &= -102 \end{aligned}$$

11.
$$\begin{array}{r} 14.50 \\ -\ 2.34 \\ \hline 12.16 \end{array}$$
So, $-14.5 + 2.34 = -12.16$.

12. $(-4)(-1)(-5) = 4(-5) = -20$

13. $16 \div 0 = \frac{16}{0}$ is undefined because 0 is the divisor.

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

15. $-110 \div (-2) = \frac{-110}{-2} = \frac{-2 \cdot 55}{-2 \cdot 1} = 55$

16. **(a)** 6 is the only natural number.

(b) 0 and 6 are the whole numbers

(c) -2, 0, and 6 are the integers.

(d) All those listed, -2, $-\frac{1}{2}$, 0, 2.5, and 6, are the rational numbers.

(e) There are no irrational numbers.

(f) All those listed are real numbers.

17. $-|-14| = -14$
Since $-14 < -12$, $-|-14| < -12$.

18. $\left|-\frac{2}{5}\right| = |-0.4| = 0.4$

So, $\left|-\frac{2}{5}\right| = 0.4$.

19. $-16 \div 2^2 \cdot 4 + (-3)^2 = -16 \div 4 \cdot 4 + 9$
$= -4 \cdot 4 + 9$
$= -16 + 9$
$= -7$

20. $\dfrac{4(-9) - 3^2}{25 + 4(-6-1)} = \dfrac{4(-9) - 9}{25 + 4(-7)}$
$= \dfrac{-36 - 9}{25 - 28}$
$= \dfrac{-45}{-3}$
$= \dfrac{-3 \cdot 15}{-3 \cdot 1}$
$= 15$

21. $8 - 10[6^2 - 5(2+3)] = 8 - 10[6^2 - 5(5)]$
$= 8 - 10[36 - 25]$
$= 8 - 10[11]$
$= 8 - 110$
$= -102$

22. Let $x = -1$ and $y = 3$.
$(x - 2y)^3 = (-1 - 2 \cdot 3)^3$
$= (-1 - 6)^3$
$= (-7)^3$
$= (-7)(-7)(-7)$
$= -343$

23. $-6(2x+5) - (4x-2)$
$= -6 \cdot 2x - 6 \cdot 5 - 4x - (-2)$
$= -12x - 30 - 4x + 2$
$= -12x - 4x - 30 + 2$
$= -16x - 28$

24. $\dfrac{1}{2}(4x^2 + 8) - 6x^2 + 5x$
$= \dfrac{1}{2} \cdot 4x^2 + \dfrac{1}{2} \cdot 8 - 6x^2 + 5x$
$= 2x^2 + 4 - 6x^2 + 5x$
$= 2x^2 - 6x^2 + 5x + 4$
$= -4x^2 + 5x + 4$

25. $675.15 + (-175.50) + (-78) + 110.20$
$= 499.65 + (-78) + 110.20$
$= 421.65 + 110.20$
$= 531.85$
Latoya has \$531.85 in her bank account.

26. $2(x+5) + 2x = 2 \cdot x + 2 \cdot 5 + 2x$
$= 2x + 10 + 2x$
$= 2x + 2x + 10$
$= 4x + 10$