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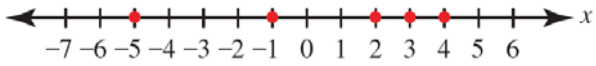
CHAPTER 1 FUNDAMENTALS OF ALGEBRA

Section 1.1 Sets and Numerical Expressions

1.



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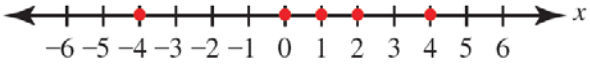

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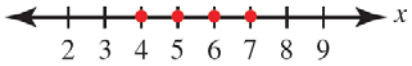


5. {−4, −1, 2, 3}

6. {−5, −4, −3, 1, 3}

7. {−250, −200, −150, −100, −50, 0, 50, 100, 150, 200}

8. {−25, −20, −15, −10, −5, 0, 5, 10, 15, 20}

9. {…, −3, −2, −1, 0, 1, 2, 3, …}

10. {0, 1, 2, 3, …}

11. prime

12. prime

13. composite, since $147 = 3 \cdot 7 \cdot 7$

14. composite, since $177 = 3 \cdot 59$

15. No. Whole numbers larger than 5 are elements in set *F*, but are not elements of set *G*.

16. Yes. Every element in set *G* is a whole number.

17. No. The elements blue and red are part of set *E*, but are not part of set *D*.

18. Yes. Both elements in set *D* are also part of set *E*.

19. Yes. Every integer can be written as a ratio of two integers. (For example, 17 can be written as $\frac{17}{1}$).

20. Yes. Every irrational number is a real number.

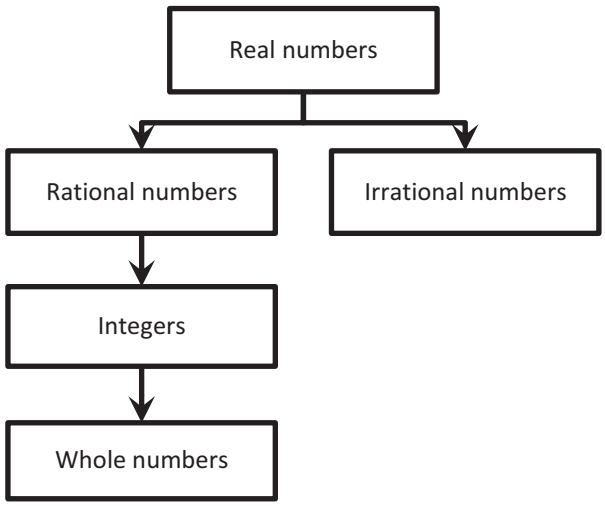
21. Yes. No irrational number is also a rational number.

22. No. The set of integers has every one of its elements in common with the set of rational numbers.

23. $0.399 = \dfrac{399}{1000}$

24. $0.2341 = \dfrac{2341}{10,000}$

25.



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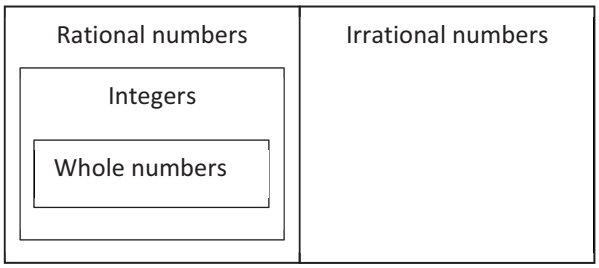


27. A, B, D

28. A, B

29. A, B

30. A, C

31. A, C

32. A, B, D, E, G

33. A, B, D, E, F

34. H

35. A, B

36. A, B, D

37. H

38. A, B

39. A, C

40. A, B, D

41.

	Real numbers	Rational numbers	Irrational numbers	Integers	Whole numbers
$\frac{1}{3}$	×	×			
π	×		×		
−8	×	×		×	
$\sqrt{13}$	×		×		
$\sqrt{100}$	×	×		×	×
$-0.\overline{43}$	×	×			

42.

	Real numbers	Rational numbers	Irrational numbers	Integers	Whole numbers
$\sqrt{36}$	×	×		×	×
$-0.6\overline{7}$	×	×			
π	×		×		
-2	×	×		×	
$\frac{1}{7}$	×	×			
$\sqrt{3}$	×		×		

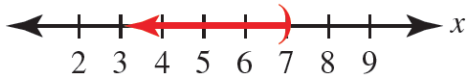
43. $(4, \infty)$ **44.** $(5, \infty)$

45. $(-\infty, 4)$ **46.** $(-\infty, 5)$

47. $[4, \infty)$ **48.** $[5, \infty)$

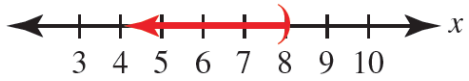
49. $(-\infty, 4]$ **50.** $(-\infty, 5]$

51.a.



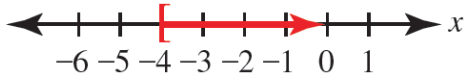
51.b. $(-\infty, 7)$

52.a.



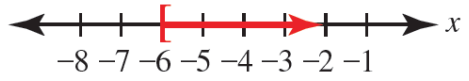
52.b. $(-\infty, 8)$

53.a.



53.b. $[-4, \infty)$

54.a.



54.b. $[-6, \infty)$

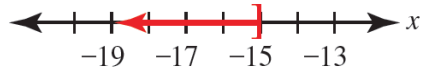
55.a.

55.b. (2, 10)

56.a.

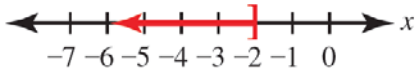
56.b. (1, 8)

57.a.



57.b. $(-\infty, -15]$

58.a.

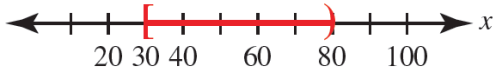


58.b. $(-\infty, -2]$

59.a.

59.b. [25, 100)

60.a.



60.b. [30, 80)

61. $9^2 = 9 \cdot 9 = 81$

62. $8^2 = 8 \cdot 8 = 64$

63. $(-9)^2 = (-9)(-9) = 81$

64. $(-8)^2 = (-8)(-8) = 64$

65. $2^3 = 2 \cdot 2 \cdot 2 = 8$

66. $5^3 = 5 \cdot 5 \cdot 5 = 125$

67. $(-2)^3 = (-2)(-2)(-2) = -8$

68. $(-5)^3 = (-5)(-5)(-5) = -125$

69. 9

70. 8

71. 7

72. 10

73. 1

74. 0

75. 6

76. 11

77. not a real number

78. not a real number

79. 1

80. 5

81. −5

82. −1

83. 36 has two square roots, 6 and −6, but $\sqrt{36}$ is the principal square root of 36 and is equal to the positive square root of 36.

84. Since any real number multiplied by itself always results in either 0 or a positive number, there is no number that can be multiplied by itself to give −100. So $\sqrt{-100}$ cannot be a real number.

85. 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47

86. 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24, 25

87.
$$\begin{aligned} &12 + 6 \div (-3) - 8 \cdot 3 \\ &= 12 + (-2) - 8 \cdot 3 \\ &= 12 + (-2) - 24 \\ &= 10 - 24 \\ &= -14 \end{aligned}$$

88.
$$\begin{aligned} &-18 + 12 \div (-4) - 6 \cdot 2 \\ &= -18 + (-3) - 12 \\ &= -33 \end{aligned}$$

89.
$$\begin{aligned} &\left(\frac{12 - 24}{-5 - 1}\right)^3 \\ &= \left(\frac{-12}{-6}\right)^3 \\ &= 2^3 \\ &= 8 \end{aligned}$$

90.
$$\begin{aligned} &\left(\frac{-35 - 20}{-4 - 7}\right)^3 \\ &= \left(\frac{-55}{-11}\right)^3 \\ &= 5^3 \\ &= 125 \end{aligned}$$

91. $8 \div 2 \cdot 4 - (-3) - 9^2$
$= 4 \cdot 4 + 3 - 81$
$= 16 + 3 - 81$
$= -62$

92. $6 \div 2 \cdot 10 - (-8) - 4^2$
$= 3 \cdot 10 + 8 - 16$
$= 30 + 8 - 16$
$= 22$

93. $-2(18 \div 9) + 4(8 - 15)$
$= -2(2) + 4(-7)$
$= -4 + 4(-7)$
$= -4 + (-28)$
$= -32$

94. $3(28 \div 7) + 6(9 - 17)$
$= 3(4) + 6(-8)$
$= 12 + (-48)$
$= -36$

95. $14 + 72 \div 3^2 - (11 - 15)$
$= 14 + 72 \div 3^2 - (-4)$
$= 14 + 72 \div 9 - (-4)$
$= 14 + 8 - (-4)$
$= 22 - (-4)$
$= 26$

96. $11 + 36 \div 3^2 - (2 - 21)$
$= 11 + 36 \div 9 - (-19)$
$= 11 + 4 + 19$
$= 34$

97. $\sqrt{257} = 16.031219... \approx 16.03$

98. $\sqrt{327} = 18.083141... \approx 18.08$

99. $-21^2 = -21 \cdot 21 = -441$

100. $(-21)^2 = (-21)(-21) = 441$

101.a. They used a (on the left endpoint.

101.b. $[-5, \infty)$

102.a. They have the numbers reversed.

102.b. $(-\infty, 6)$

103.a. They took the square root of 16 and made it negative.

103.b. Not a real number

104.a. They listed 1 as a prime number.

104.b. 2, 3, 5, 7, 11

Section 1.2 Algebraic Expressions

1. $3w - 11y + 18w - 20y$
$= 21w - 31y$

2. $5h - 14m + 47h - 11m$
$= 52h - 25m$

3. $2(3x + y) - 14x + y$
$= 2(3x) + 2(y) - 14x + y$
$= 6x + 2y - 14x + y$
$= -8x + 3y$

4. $7(8y - x) - 21y + x$
$= 7(8y) + 7(-x) - 21y + x$
$= 56y - 7x - 21y + x$
$= -6x + 35y$

5. $\frac{3}{4}(12x - 6) - \frac{2}{3}(15x + 2)$
$= \frac{3}{4}(12x) + \frac{3}{4}(-6) - \frac{2}{3}(15x) - \frac{2}{3}(2)$
$= 9x - \frac{18}{4} - 10x - \frac{4}{3}$
$= -x - \frac{9}{2} \cdot \frac{3}{3} - \frac{4}{3} \cdot \frac{2}{2}$
$= -x - \frac{27}{6} - \frac{8}{6}$
$= -x - \frac{35}{6}$

6. $\frac{2}{5}(20x - 3) - \frac{4}{7}(14x + 5)$
$= \frac{2}{5}(20x) + \frac{2}{5}(-3) - \frac{4}{7}(14x) - \frac{4}{7}(5)$
$= 8x - \frac{6}{5} - 8x - \frac{20}{7}$
$= -\frac{6}{5} \cdot \frac{7}{7} - \frac{20}{7} \cdot \frac{5}{5}$
$= -\frac{42}{35} - \frac{100}{35}$
$= -\frac{142}{35}$

7. $24\left(\frac{2}{3}x^2 + \frac{5}{8}x - \frac{1}{6}\right)$
$= 24\left(\frac{2}{3}x^2\right) + 24\left(\frac{5}{8}x\right) + 24\left(-\frac{1}{6}\right)$
$= 16x^2 + 15x - 4$

8. $30\left(\frac{5}{6}y^2 - \frac{7}{15}y + \frac{1}{2}\right)$
$= 30\left(\frac{5}{6}y^2\right) + 30\left(-\frac{7}{15}y\right) + 30\left(\frac{1}{2}\right)$
$= 25y^2 - 14y + 15$

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

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

$=-a+\frac{2}{3}+\frac{5}{6}$

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

$=-a+\frac{4}{6}+\frac{5}{6}$

$=-a+\frac{9}{6}$

$=-a+\frac{3}{2}$

10. $-\frac{4}{5}\left(\frac{5}{4}a-1\right)+\frac{3}{10}$

$=-\frac{4}{5}\left(\frac{5}{4}a\right)-\frac{4}{5}(-1)+\frac{3}{10}$

$=-a+\frac{4}{5}+\frac{3}{10}$

$=-a+\frac{4}{5}\cdot\frac{2}{2}+\frac{3}{10}$

$=-a+\frac{8}{10}+\frac{3}{10}$

$=-a+\frac{11}{10}$

11. $7(3x-4)$

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

$=21x-28$

12. $6(4x-9)$

$=6(4x)+6(-9)$

$=24x-54$

13. $7x(3x-4)$

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

$=21x^2+(-28x)$

$=21x^2-28x$

14. $6x(4x-9)$

$=6x(4x)+6x(-9)$

$=24x^2-54x$

15. $7x^2(3x-4)$

$=7x^2(3x)+7x^2(-4)$

$=21x^3-28x^2$

16. $6x^2(4x-9)$

$=6x^2(4x)+6x^2(-9)$

$=24x^3-54x^2$

17. $3(p-1)-(p-1)$

$=3p-3-p+1$

$=2p-2$

18. $5(a-1)-(a-1)$

$=5a-5-a+1$

$=4a-4$

19. $15(2f)-3(-8f)$

$=30f+24f$

$=54f$

20. $21(3d)-4(-9d)$

$=63d+36d$

$=99d$

21. $16-(2n-4)-8$

$=16-1(2n)-1(-4)-8$

$=16-2n+4-8$

$=-2n+12$

22. $28-(7m-11)-3$

$=28-1(7m)-1(-11)-3$

$=28-7m+11-3$

$=-7m+36$

23. $-16-3(2n-4)-8$

$=-16-3(2n)-3(-4)-8$

$=-16-6n+12-8$

$=-6n-12$

24. $-28-5(7m-11)-3$

$=-28-5(7m)-5(-11)-3$

$=-28-35m+55-3$

$=-35m+24$

25. $-\frac{5}{9}-\left(\frac{2}{15}+4g\right)$

$=-\frac{5}{9}-1\left(\frac{2}{15}\right)-1(4g)$

$=-\frac{5}{9}\cdot\frac{5}{5}-\frac{2}{15}\cdot\frac{3}{3}-4g$

$=-\frac{25}{45}-\frac{6}{45}-4g$

$=-4g-\frac{31}{45}$

26. $-\frac{7}{10}-\left(\frac{3}{8}+2k\right)$

$=-\frac{7}{10}-1\left(\frac{3}{8}\right)-1(2k)$

$=-\frac{7}{10}\cdot\frac{4}{4}-\frac{3}{8}\cdot\frac{5}{5}-2k$

$=-\frac{28}{40}-\frac{15}{40}-2k$

$=-2k-\frac{43}{40}$

27. $0.25(4b-8)-0.3(b-10)$

$=0.25(4b)+0.25(-8)-0.3(b)-0.3(-10)$

$=b-2-0.3b+3$

$=0.7b+1$

28. $0.75(12z-24)-0.5(z-10)$

$=0.75(12z)+0.75(-24)-0.5(z)-0.5(-10)$

$=9z-18-0.5z+5$

$=8.5z-13$

29. $-3.5(2n-3p+20z)$
$=-3.5(2n)-3.5(-3p)-3.5(20z)$
$=-7n+10.5p-70z$

30. $-4.5(3a-2b+30c)$
$=-4.5(3a)-4.5(-2b)-4.5(30c)$
$=-13.5a+9b-135c$

31. $2-5\neq 5-2$

32. $2\div 5\neq 5\div 2$

33. F

34. G

35. A

36. H

37. D

38. E

39. J

40. E

41. I

42. B

43. Yes, since the sum of a real number and its additive inverse always equals 0, and 0 is the additive identity of the real numbers.

44. Yes, since the product of a real number and its multiplicative inverse always equals 1, and 1 is the multiplicative identity of the real numbers.

45. $5=5-2+2$
$5=5$

46. $7=7+3-3$
$7=7$

47. If we consider $12\div 6$, it is equal to 2 since $2\cdot 6=12$. Similarly $3\div 0$ is equal to some number only if that number multiplied by 0 is equal to 3. But we know that multiplying zero by any number gives an answer of zero. This means there is no number that can equal $3\div 0$, so $3\div 0$ cannot equal 0.

48. Following the text's analogy, a model of the fraction $\frac{4}{0}$ is a pie cut into zero pieces. It is impossible to conclude how many pieces are gone, and impossible that 4 pieces could remain.

49. $20h^2-7h^2+5h^3$
$=5h^3+13h^2$

50. $13k^3-5k^2+9k^2$
$=13k^3+4k^2$

51. $x^8y^9x^3y$
$=x^{(8+3)}y^{(9+1)}$
$=x^{11}y^{10}$

52. $c^4d^9c^{17}d$
$=c^{(4+17)}d^{(9+1)}$
$=c^{21}d^{10}$

53. $\frac{u^9x^3}{u^5}$
$=u^{(9-5)}x^3$
$=u^4x^3$

54. $\frac{c^6d^3}{c^2}$
$=c^{(6-2)}d^3$
$=c^4d^3$

55. $\left(x^3\right)^4$
$=x^{(3)(4)}$
$=x^{12}$

56. $\left(a^5\right)^3$
$=a^{(5)(3)}$
$=a^{15}$

57. $\left(a^4b\right)^6$
$=\left(a^4\right)^6b^6$
$=a^{(4)(6)}b^6$
$=a^{24}b^6$

58. $\left(x^5y\right)^4$
$=\left(x^5\right)^4y^4$
$=x^{(5)(4)}y^4$
$=x^{20}y^4$

59. $\left(2x^5y^7\right)^3$
$=2^3\left(x^5\right)^3\left(y^7\right)^3$
$=8x^{(5)(3)}y^{(7)(3)}$
$=8x^{15}y^{21}$

60. $\left(2b^4c^9\right)^3$
$=2^3\left(b^4\right)^3\left(c^9\right)^3$
$=8b^{(4)(3)}c^{(9)(3)}$
$=8b^{12}c^{27}$

61. $\left(5j^2\right)(3jk)^2$
$=5j^2\cdot 3^2j^2k^2$
$=5\cdot 3^2\cdot j^2\cdot j^2k^2$
$=5\cdot 9\cdot j^{2+2}k^2$
$=45j^4k^2$

62. $\left(2p^3\right)(5vz)^2$
$=2p^3\cdot 5^2v^2z^2$
$=2\cdot 5^2\cdot p^3\cdot v^2z^2$
$=50p^3v^2z^2$

63. $\left(\frac{x}{2}\right)^3$
$=\frac{x^3}{2^3}$
$=\frac{x^3}{8}$

64. $\left(\frac{y}{4}\right)^3$
$=\frac{y^3}{4^3}$
$=\frac{y^3}{64}$

65. $\frac{h^4}{h^9}$
$=h^{(4-9)}$
$=h^{-5}$
$=\frac{1}{h^5}$

66. $\frac{p^6}{p^{10}}$
$=p^{(6-10)}$
$=p^{-4}$
$=\frac{1}{p^4}$

67. $3x^0$
$=3\cdot 1$
$=3$

68. $5y^0$
$=5\cdot 1$
$=5$

69. $\frac{z^2}{z^2}$
$=z^{(2-2)}$
$=z^0$
$=1$

70. $\frac{p^6}{p^6}$
$=p^{(6-6)}$
$=p^0$
$=1$

71. $\left(\frac{d^5v^3}{d^5v^{11}}\right)^0$
$=1$

72. $\left(\frac{x^7y^8}{x^7y^{20}}\right)^0$
$=1$

73. $6x\left(3x^2-4x\right)-9\left(2x^3+5x^2+1\right)$
$=6x\left(3x^2\right)+6x(-4x)-9\left(2x^3\right)-9\left(5x^2\right)-9(1)$
$=18x^3-24x^2-18x^3-45x^2-9$
$=-69x^2-9$

74. $10z\left(2z^2-9z\right)-3\left(5z^3+2z^2-1\right)$

$=10z\left(2z^2\right)+10z\left(-9z\right)-3\left(5z^3\right)-3\left(2z^2\right)-3\left(-1\right)$

$=20z^3-90z^2-15z^3-6z^2+3$

$=5z^3-96z^2+3$

75. $\dfrac{w^7z^{20}}{wz^{13}}$

$=w^{(7-1)}z^{(20-13)}$

$=w^6z^7$

76. $\dfrac{x^4y^{15}}{xy^8}$

$=x^{(4-1)}y^{(15-8)}$

$=x^3y^7$

77. $\dfrac{12a}{5}-\dfrac{16a}{3}$

$=\dfrac{12a}{5}\cdot\dfrac{3}{3}-\dfrac{16a}{3}\cdot\dfrac{5}{5}$

$=\dfrac{36a}{15}-\dfrac{80a}{15}$

$=-\dfrac{44a}{15}$

78. $\dfrac{14u}{3}-\dfrac{9u}{7}$

$=\dfrac{14u}{3}\cdot\dfrac{7}{7}-\dfrac{9u}{7}\cdot\dfrac{3}{3}$

$=\dfrac{98u}{21}-\dfrac{27u}{21}$

$=\dfrac{71u}{21}$

79. $\dfrac{12k^5}{15k^2}+\dfrac{9k^8}{10k^5}$

$=\dfrac{\cancel{3}\cdot 4}{\cancel{3}\cdot 5}k^{(5-2)}+\dfrac{9}{10}k^{(8-5)}$

$=\dfrac{4}{5}\cdot\dfrac{2}{2}k^3+\dfrac{9}{10}k^3$

$=\dfrac{8}{10}k^3+\dfrac{9}{10}k^3$

$=\dfrac{17}{10}k^3$

80. $\dfrac{20m^8}{30m^6}+\dfrac{35m^{12}}{50m^{10}}$

$=\dfrac{\cancel{10}\cdot 2}{\cancel{10}\cdot 3}m^{(8-6)}+\dfrac{\cancel{5}\cdot 7}{\cancel{5}\cdot 10}m^{(12-10)}$

$=\dfrac{2}{3}\cdot\dfrac{10}{10}m^2+\dfrac{7}{10}\cdot\dfrac{3}{3}m^2$

$=\dfrac{20}{30}m^2+\dfrac{21}{30}m^2$

$=\dfrac{41}{30}m^2$

81. $\dfrac{12a^3b^9}{4a^7b^3}$

$=\dfrac{12}{4}a^{3-7}b^{9-3}$

$=3a^{-4}b^6$

$=3\cdot\dfrac{1}{a^4}\cdot b^6$

$=\dfrac{3b^6}{a^4}$

82. $\dfrac{14x^9y^2}{30x^6y^{13}}$

$=\dfrac{\cancel{2}\cdot 7}{\cancel{2}\cdot 15}x^{(9-6)}y^{(2-13)}$

$=\dfrac{7}{15}x^3y^{-11}$

$=\dfrac{7}{15}\cdot x^3\cdot\dfrac{1}{y^{11}}$

$=\dfrac{7x^3}{15y^{11}}$

83. $\left(3x^6y^{11}\right)\left(4x^{-19}y^4\right)$

$=3\cdot 4\cdot x^{6+(-19)}y^{11+4}$

$=12x^{-13}y^{15}$

$=12\cdot\dfrac{1}{x^{13}}\cdot y^{15}$

$=\dfrac{12y^{15}}{x^{13}}$

84. $\left(2p^3k^{21}\right)\left(7p^{-18}k^2\right)$

$=2\cdot 7\cdot p^{3+(-18)}k^{21+2}$

$=14p^{-15}k^{23}$

$=14\cdot\dfrac{1}{p^{15}}\cdot k^{23}$

$=\dfrac{14k^{23}}{p^{15}}$

85. $\dfrac{d^5v^3}{d^5v^{11}}$

$=d^{(5-5)}v^{(3-11)}$

$=d^0v^{-8}$

$=1\cdot\dfrac{1}{v^8}$

$=\dfrac{1}{v^8}$

86. $\dfrac{x^7y^8}{x^7y^{20}}$

$=x^{(7-7)}y^{(8-20)}$

$=x^0y^{-12}$

$=1\cdot\dfrac{1}{y^{12}}$

$=\dfrac{1}{y^{12}}$

87. $\left(\dfrac{d^5v^3}{d^5v^{11}}\right)^4$

$=\left(d^{(5-5)}v^{(3-11)}\right)^4$

$=\left(d^0v^{-8}\right)^4$

$=\left(d^0\right)^4\left(v^{-8}\right)^4$

$=d^0v^{-32}$

$=1\cdot\dfrac{1}{v^{32}}$

$=\dfrac{1}{v^{32}}$

88. $\left(\dfrac{x^7y^8}{x^7y^{20}}\right)^5$

$=\left(x^{(7-7)}v^{(8-20)}\right)^5$

$=\left(x^0y^{-12}\right)^5$

$=\left(x^0\right)^5\left(y^{-12}\right)^5$

$=x^0y^{-60}$

$=1\cdot\dfrac{1}{y^{60}}$

$=\dfrac{1}{y^{60}}$

89. $\left(-\frac{3x^2y}{5}\right)^2\left(\frac{4x^3y^6}{7}\right)$

$=\frac{3^2\left(x^2\right)^2y^2}{5^2}\cdot\frac{4x^3y^6}{7}$

$=\frac{9x^4y^2}{25}\cdot\frac{4x^3y^6}{7}$

$=\frac{9\cdot4\cdot x^{(4+3)}y^{(2+6)}}{25\cdot7}$

$=\frac{36x^7y^8}{175}$

90. $\left(-\frac{2a^4b}{5}\right)^2\left(\frac{2a^3b^5}{7}\right)$

$=\frac{2^2\left(a^4\right)^2b^2}{5^2}\cdot\frac{2a^3b^5}{7}$

$=\frac{4a^8b^2}{25}\cdot\frac{2a^3b^5}{7}$

$=\frac{4\cdot2\cdot a^{(8+3)}b^{(2+5)}}{25\cdot7}$

$=\frac{8a^{11}b^7}{175}$

91.a. $\frac{z^8}{z^3}$

$=\frac{z\cdot z\cdot z\cdot z\cdot z\cdot \cancel{z}\cdot\cancel{z}\cdot\cancel{z}}{\cancel{z}\cdot\cancel{z}\cdot\cancel{z}}$

$=z^5$

91.b. $\frac{z^8}{z^3}$

$=z^{(8-3)}$

$=z^5$

92.a. $\left(z^4\right)\left(z^5\right)$

$=\left(z\cdot z\cdot z\cdot z\right)\left(z\cdot z\cdot z\cdot z\cdot z\right)$

$=z^9$

92.b. $\left(z^4\right)\left(z^5\right)$

$=z^{(4-5)}$

$=z^9$

93. -32 **94.** -45

95. -264 **96.** -290

97.a. They added exponents instead of multiplying them.

97.b. $\left(x^7\right)^3$

$=x^{(7)(3)}$

$=x^{21}$

98.a. They subtracted the exponent of the numerator from the exponent of the denominator.

98.b. $\frac{x^7}{x^{10}}$

$=x^{(7-10)}$

$=x^{-3}$

$=\frac{1}{x^3}$

99.a. They didn't distribute the negative sign correctly.

99.b. $3(h-5)-(h-11)$

$=3(h)+3(-5)-1(h)-1(-11)$

$=3h-15-h+11$

$=2h-4$

100.a. They did not write the answer with using positive exponents.

100.b. $x^{-7}y^2x^{-9}y^{-13}$

$=x^{(-7+(-9))}y^{(2+(-13))}$

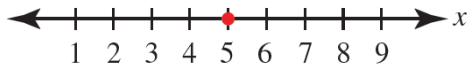
$=x^{-16}y^{-11}$

$=\frac{1}{x^{16}}\cdot\frac{1}{y^{11}}$

$=\frac{1}{x^{16}y^{11}}$

Section 1.3 Equations and Inequalities in One Variable

1.a.



1.b. [5, 5]

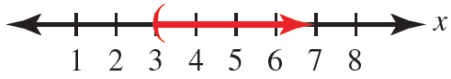
2.a.

2.b. [3, 3]

3.a.

3.b. (5, ∞)

4.a.



4.b. (3, ∞)

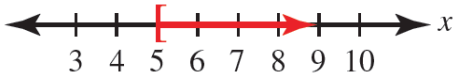
5.a.

5.b. (−∞, 5)

6.a.

6.b. (−∞, 3)

7.a.



7.b. $[5, \infty)$

8.a.

8.b. $[3, \infty)$

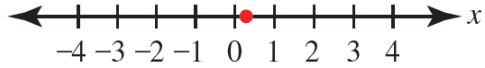
9.a.

9.b. $(-\infty, 5]$

10.a.

10.b. $(-\infty, 3]$

11.a.



11.b. $\left[\frac{3}{7}, \frac{3}{7}\right]$

12.a.

12.b. $\left[\frac{4}{9}, \frac{4}{9}\right]$

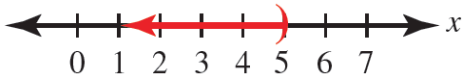
13.a.

13.b. $(100, \infty)$

14.a.

14.b. $(-150, \infty)$

15.a.



15.b. $(-\infty, 5)$

16.a.

16.b. $(-\infty, 2)$

17.a.
$$p - 8 = 21$$
$$+8 \quad +8$$
$$p = 29$$

17.b.
$$29 - 8 = 21$$
$$21 = 21$$

18.a.
$$w - 12 = 34$$
$$+12 \quad +12$$
$$w = 46$$

18.b.
$$46 - 12 = 34$$
$$34 = 34$$

19.a.
$$-31 = n + 40$$
$$-40 \quad -40$$
$$-71 = n$$

19.b.
$$-31 = -71 + 40$$
$$-31 = -31$$

20.a.
$$-24 = m + 13$$
$$-13 \quad -13$$
$$-37 = m$$

20.b.
$$-24 = -37 + 13$$
$$-24 = -24$$

21.a.
$$8b + 2 = -14$$
$$-2 \quad -2$$
$$8b = -16$$
$$\frac{8b}{8} = \frac{-16}{8}$$
$$b = -2$$

21.b.
$$8(-2) + 2 = -14$$
$$-16 + 2 = -14$$
$$-14 = -14$$

22.a.
$$6c + 8 = -34$$
$$-8 \quad -8$$
$$6c = -42$$
$$\frac{6c}{6} = \frac{-42}{6}$$
$$c = -7$$

22.b.
$$6(-7) + 8 = -34$$
$$-42 + 8 = -34$$
$$-34 = -34$$

23.a.
$$2(x - 1) = 15$$
$$2x - 2 = 15$$
$$+2 \quad +2$$
$$2x = 17$$
$$\frac{2x}{2} = \frac{17}{2}$$
$$x = \frac{17}{2}$$

23.b.
$$2\left(\frac{17}{2} - 1\right) = 15$$
$$2\left(\frac{17}{2}\right) + 2(-1) = 15$$
$$17 - 2 = 15$$
$$15 = 15$$

24.a.
$$3(x - 1) = 17$$
$$3x - 3 = 17$$
$$+3 \quad +3$$
$$3x = 20$$
$$\frac{3x}{3} = \frac{20}{3}$$
$$x = \frac{20}{3}$$

24.b.
$$3\left(\frac{20}{3} - 1\right) = 17$$
$$3\left(\frac{20}{3}\right) + 3(-1) = 17$$
$$20 - 3 = 17$$
$$17 = 17$$

25.a.
$$2(12 - z) = 4(3 - z)$$
$$24 - 2z = 12 - 4z$$
$$-24 + 4z \quad -24 + 4z$$
$$2z = -12$$
$$\frac{2z}{2} = \frac{-12}{2}$$
$$z = -6$$

25.b. $2(12-(-6)) = 4(3-(-6))$

$2(18) = 4(9)$

$36 = 36$

26.a. $8(10-y) = 6(14-y)$

$80-8y = 84-6y$

$-80+6y \quad -80+6y$

$-2y = 4$

$\frac{-2y}{-2} = \frac{4}{-2}$

$y = -2$

26.b. $8(10-(-2)) = 6(14-(-2))$

$8(12) = 6(16)$

$96 = 96$

27.a. $7(2x+4)-9 = 15x-3$

$14x+28-9 = 15x-3$

$14x+19 = 15x-3$

$-19 \quad -19$

$14x = 15x-22$

$-15x \quad -15x$

$-x = -22$

$-1(-x) = -1(-22)$

$x = 22$

27.b. $7(2(22)+4)-9 = 15(22)-3$

$7(44+4)-9 = 330-3$

$7(48)-9 = 327$

$336-9 = 327$

$327 = 327$

28.a. $3(2x-9)+8x = 15x-11$

$6x-27+8x = 15x-11$

$14x-27 = 15x-11$

$-15x+27 \quad -15x+27$

$-x = 16$

$-1(-x) = -1(16)$

$x = -16$

28.b. $3(2(-16)-9)+8(-16) = 15(-16)-11$

$3(-32-9)-128 = -240-11$

$3(-41)-128 = -251$

$-123-128 = -251$

$-251 = -251$

29.a. $c-\frac{3}{4} = \frac{17}{4}$

$+\frac{3}{4} \quad +\frac{3}{4}$

$c = \frac{20}{4}$

$c = 5$

29.b. $5-\frac{3}{4} = \frac{17}{4}$

$5\cdot\frac{4}{4}-\frac{3}{4} = \frac{17}{4}$

$\frac{20}{4}-\frac{3}{4} = \frac{17}{4}$

$\frac{17}{4} = \frac{17}{4}$

30.a. $d-\frac{5}{8} = \frac{27}{8}$

$+\frac{5}{8} \quad +\frac{5}{8}$

$d = \frac{32}{8}$

$d = 4$

30.b. $4-\frac{5}{8} = \frac{27}{8}$

$4\cdot\frac{8}{8}-\frac{5}{8} = \frac{27}{8}$

$\frac{32}{8}-\frac{5}{8} = \frac{27}{8}$

$\frac{27}{8} = \frac{27}{8}$

31.a. $\frac{3}{4}h = 15$

$\frac{4}{3}\left(\frac{3}{4}h\right) = \frac{4}{3}(15)$

$h = \frac{60}{3}$

$h = 20$

31.b. $\frac{3}{4}(20) = 15$

$\frac{60}{4} = 15$

$15 = 15$

32.a. $\frac{4}{5}k = 60$

$\frac{5}{4}\left(\frac{4}{5}k\right) = \frac{5}{4}(60)$

$k = \frac{300}{4}$

$k = 75$

32.b $\frac{4}{5}(75) = 60$

$\frac{300}{4} = 60$

$60 = 60$

33.a. $0.8 = w+1.9$

$-1.9 \quad -1.9$

$-1.1 = w$

33.b. $0.8 = -1.1+1.9$

$0.8 = 0.8$

34.a. $0.29 = y+0.81$

$-0.81 \quad -0.81$

$-0.52 = y$

34.b. $0.29 = -0.52+0.81$

$0.29 = 0.29$

35.a. $\frac{a}{0.3} = 15$

$0.3\left(\frac{a}{0.3}\right) = 0.3(15)$

$a = 4.5$

35.b. $\frac{4.5}{0.3} = 15$

$15 = 15$

36.a. $\frac{m}{0.7} = 12$

$0.7\left(\frac{m}{0.7}\right) = 0.7(12)$

$m = 8.4$

36.b. $\frac{8.4}{0.7} = 12$

$12 = 12$

37.a.
$$\frac{2}{3}x=\frac{8}{9}$$
$$\frac{3}{2}\left(\frac{2}{3}x\right)=\frac{3}{2}\left(\frac{8}{9}\right)$$
$$x=\frac{24}{18}$$
$$x=\frac{\cancel{6}\cdot 4}{\cancel{6}\cdot 3}$$
$$x=\frac{4}{3}$$

37.b.
$$\frac{2}{3}\left(\frac{4}{3}\right)=\frac{8}{9}$$
$$\frac{8}{9}=\frac{8}{9}$$

38.a.
$$\frac{3}{4}x=\frac{9}{16}$$
$$\frac{4}{3}\left(\frac{3}{4}x\right)=\frac{4}{3}\left(\frac{9}{16}\right)$$
$$x=\frac{36}{48}$$
$$x=\frac{\cancel{12}\cdot 3}{\cancel{12}\cdot 4}$$
$$x=\frac{3}{4}$$

38.b.
$$\frac{3}{4}\left(\frac{3}{4}\right)=\frac{9}{16}$$
$$\frac{9}{16}=\frac{9}{16}$$

39.a.
$$k-0.35k=78$$
$$0.65k=78$$
$$\frac{0.65k}{0.65}=\frac{78}{0.65}$$
$$k=120$$

39.b.
$$120-0.35(120)=78$$
$$120-42=78$$
$$78=78$$

40.a.
$$z-0.48z=208$$
$$0.52z=208$$
$$\frac{0.52z}{0.52}=\frac{208}{0.52}$$
$$z=400$$

40.b.
$$400-0.48(400)=208$$
$$400-192=208$$
$$208=208$$

41.a.
$$\frac{1}{8}a+\frac{3}{8}a=\frac{5}{6}$$
$$\frac{4}{8}a=\frac{5}{6}$$
$$\frac{1}{2}a=\frac{5}{6}$$
$$2\left(\frac{1}{2}a\right)=2\left(\frac{5}{6}\right)$$
$$a=\frac{10}{6}$$
$$a=\frac{\cancel{2}\cdot 5}{\cancel{2}\cdot 3}$$
$$a=\frac{5}{3}$$

41.b.
$$\frac{1}{8}\left(\frac{5}{3}\right)+\frac{3}{8}\left(\frac{5}{3}\right)=\frac{5}{6}$$
$$\frac{5}{24}+\frac{15}{24}=\frac{5}{6}$$
$$\frac{20}{24}=\frac{5}{6}$$
$$\frac{\cancel{4}\cdot 5}{\cancel{4}\cdot 6}=\frac{5}{6}$$
$$\frac{5}{6}=\frac{5}{6}$$

42.a.
$$\frac{1}{10}d+\frac{7}{10}d=48$$
$$\frac{8}{10}d=48$$
$$\frac{10}{8}\left(\frac{8}{10}d\right)=\frac{10}{8}(48)$$
$$d=\frac{480}{8}$$
$$d=60$$

42.b.
$$\frac{1}{10}(60)+\frac{7}{10}(60)=48$$
$$\frac{60}{10}+\frac{420}{10}=48$$
$$\frac{480}{10}=48$$
$$48=48$$

43.a.
$$49=\frac{1}{4}k+\frac{1}{3}k$$
$$12(49)=12\left(\frac{1}{4}k+\frac{1}{3}k\right)$$
$$588=12\left(\frac{1}{4}k\right)+12\left(\frac{1}{3}k\right)$$
$$588=3k+4k$$
$$588=7k$$
$$\frac{588}{7}=\frac{7k}{7}$$
$$84=k$$

43.b.
$$49=\frac{1}{4}(84)+\frac{1}{3}(84)$$
$$49=21+28$$
$$49=49$$

44.a.
$$62=\frac{2}{5}n+\frac{3}{8}n$$
$$40(62)=40\left(\frac{2}{5}n+\frac{3}{8}n\right)$$
$$2480=40\left(\frac{2}{5}n\right)+40\left(\frac{3}{8}n\right)$$
$$2480=16n+15n$$
$$2480=31n$$
$$\frac{2480}{31}=\frac{31n}{31}$$
$$80=n$$

44.b. $62 = \frac{2}{5}(80) + \frac{3}{8}(80)$

$62 = 32 + 30$

$62 = 62$

45.a. $-c - c = 21$

$-2c = 21$

$\frac{-2c}{-2} = \frac{21}{-2}$

$c = -\frac{21}{2}$

45.b. $-\left(-\frac{21}{2}\right) - \left(-\frac{21}{2}\right) = 21$

$\frac{21}{2} + \frac{21}{2} = 21$

$\frac{42}{2} = 21$

$21 = 21$

46.a. $-p - p = 13$

$-2p = 13$

$\frac{-2p}{-2} = \frac{13}{-2}$

$p = -\frac{13}{2}$

46.b. $-\left(-\frac{13}{2}\right) - \left(-\frac{13}{2}\right) = 13$

$\frac{13}{2} + \frac{13}{2} = 13$

$\frac{26}{2} = 13$

$13 = 13$

47.a. $q - 0.9q = 45$

$10(q - 0.9q) = 10(45)$

$10q - 9q = 450$

$q = 450$

47.b. $450 - 0.9(450) = 45$

$450 - 405 = 45$

$45 = 45$

48.a. $a - 0.8a = 54$

$10(a - 0.8a) = 10(54)$

$10a - 8a = 540$

$2a = 540$

$\frac{2a}{2} = \frac{540}{2}$

$a = 270$

48.b. $270 - 0.8(270) = 54$

$270 - 216 = 54$

$54 = 54$

49.a. $2v - 9 = 2(v + 4)$

$2v - 9 = 2v + 8$

$-2v \quad -2v$

$-9 = 8$

NO SOLUTION

49.b. No check possible

50.a. $3u - 17 = 3(u + 9)$

$3u - 17 = 3u + 27$

$-3u \quad -3u$

$-17 = 27$

NO SOLUTION

50.b. No check possible

51.a. $7c - 18 = 2(4c - 9) - c$

$7c - 18 = 8c - 18 - c$

$7c - 18 = 7c - 18$

$-7c \quad -7c$

$-18 = -18$

Solution: The set of real numbers

51.b. Check with $c = 0$ and $c = 1$:

$7(0) - 18 = 2(4(0) - 9) - 0$

$-18 = 2(-9)$

$-18 = -18$

$7(1) - 18 = 2(4(1) - 9) - 1$

$7 - 18 = 2(-5) - 1$

$-11 = -10 - 1$

$-11 = -11$

52.a. $9w - 20 = 5(2w - 4) - w$

$9w - 20 = 10w - 20 - w$

$9w - 20 = 9w - 20$

$-9w \quad -9w$

$-20 = -20$

Solution: The set of real numbers

52.b. Check with $w = 0$ and $w = 1$:

$9(0) - 20 = 5(2(0) - 4) - 0$

$-20 = 5(-4)$

$-20 = -20$

$9(1) - 20 = 5(2(1) - 4) - 1$

$9 - 20 = 5(-2) - 1$

$-11 = -10 - 1$

$-11 = -11$

53.a. $7(2x + 4) - 9 = 15x - (x + 3)$

$14x + 28 - 9 = 15x - x - 3$

$14x + 19 = 14x - 3$

$-14x \quad -14x$

$19 = -3$

NO SOLUTION

53.b. No check possible

54.a. $3(2x - 9) + 8x = 15x - (x + 16)$

$6x - 27 + 8x = 15x - x - 16$

$14x - 27 = 14x - 16$

$-14x \quad -14x$

$-27 = -16$

NO SOLUTION

54.b. No check possible

55.a. $11n - (n + 5) = 3(2n + 1) + 4(n - 2)$

$11n - n - 5 = 6n + 3 + 4n - 8$

$10n - 5 = 10n - 5$

$-10n \quad -10n$

$-5 = -5$

Solution: The set of real numbers

55.b. Check with $n=0$ and $n=1$:

$$11(0)-(0+5)=3(2(0)+1)+4(0-2)$$
$$-5=3(1)+4(-2)$$
$$-5=3-8$$
$$-5=-5$$
$$11(1)-(1+5)=3(2(1)+1)+4(1-2)$$
$$11-6=3(3)+4(-1)$$
$$5=9-4$$
$$5=5$$

56.a.
$$9u-(u+11)=3(2u+1)+2(u-7)$$
$$9u-u-11=6u+3+2u-14$$
$$8u-11=8u-11$$
$$-8u \quad -8u$$
$$-11=-11$$

Solution: The set of real numbers

56.b. Check with $u=0$ and $u=1$:

$$9(0)-(0+11)=3(2(0)+1)+2(0-7)$$
$$-11=3-14$$
$$-11=-11$$
$$9(1)-(1+11)=3(2(1)+1)+2(1-7)$$
$$9-12=3(3)+2(-6)$$
$$-3=9-12$$
$$-3=-3$$

57.a.
$$2z=9z$$
$$-2z \quad -2z$$
$$0=7z$$
$$\frac{0}{7}=\frac{7z}{7}$$
$$0=z$$

57.b.
$$2(0)=9(0)$$
$$0=0$$

58.a.
$$12y=2y$$
$$-2y \quad -2y$$
$$10y=0$$
$$\frac{10y}{10}=\frac{0}{10}$$
$$y=0$$

58.b.
$$12(0)=2(0)$$
$$0=0$$

59.a.
$$\frac{3}{4}(12p-8)=16$$
$$4\left(\frac{3}{4}\right)(12p-8)=4(16)$$
$$3(12p-8)=64$$
$$36p-24=64$$
$$+24 \quad +24$$
$$36p=88$$
$$\frac{36p}{36}=\frac{88}{36}$$
$$p=\frac{88}{36}$$
$$p=\frac{\cancel{4}\cdot 22}{\cancel{4}\cdot 9}$$
$$p=\frac{22}{9}$$

59.b.
$$\frac{3}{4}\left(12\left(\frac{22}{9}\right)-8\right)=16$$
$$\frac{3}{4}\left(\frac{264}{9}-8\right)=16$$
$$\frac{3}{4}\left(\frac{\cancel{3}\cdot 88}{\cancel{3}\cdot 3}-8\cdot\frac{3}{3}\right)=16$$
$$\frac{3}{4}\left(\frac{88}{3}-\frac{24}{3}\right)=16$$
$$\frac{3}{4}\left(\frac{64}{3}\right)=16$$
$$\frac{64}{4}=16$$
$$16=16$$

60.a.
$$\frac{2}{3}(15k-4)=18$$
$$3\left(\frac{2}{3}\right)(15k-4)=3(18)$$
$$2(15k-4)=54$$
$$30k-8=54$$
$$+8 \quad +8$$
$$30k=62$$
$$\frac{30k}{30}=\frac{62}{30}$$
$$k=\frac{62}{30}$$
$$k=\frac{\cancel{2}\cdot 31}{\cancel{2}\cdot 15}$$
$$k=\frac{31}{15}$$

60.b. $\frac{2}{3}\left(15\left(\frac{31}{15}\right)-4\right)=18$

$\frac{2}{3}(31-4)=18$

$\frac{2}{3}(27)=18$

$\frac{54}{3}=18$

$\frac{\cancel{3}\cdot 18}{\cancel{3}\cdot 1}=18$

$18=18$

61.a. $\frac{h}{12}=9$

$12\left(\frac{h}{12}\right)=12(9)$

$h=108$

61.b. $\frac{108}{12}=9$

$9=9$

62.a. $\frac{k}{15}=6$

$15\left(\frac{k}{15}\right)=15(6)$

$k=90$

62.b. $\frac{90}{15}=6$

$6=6$

63.a. $\frac{M}{75}=\frac{8}{15}$

$75\left(\frac{M}{75}\right)=75\left(\frac{8}{15}\right)$

$M=\frac{600}{15}$

$M=40$

63.b. $\frac{40}{75}=\frac{8}{15}$

$\frac{\cancel{5}\cdot 8}{\cancel{5}\cdot 15}=\frac{8}{15}$

$\frac{8}{15}=\frac{8}{15}$

64.a. $\frac{P}{128}=\frac{11}{16}$

$128\left(\frac{P}{128}\right)=128\left(\frac{11}{16}\right)$

$P=\frac{1408}{16}$

$P=88$

64.b. $\frac{88}{128}=\frac{11}{16}$

$\frac{\cancel{8}\cdot 11}{\cancel{8}\cdot 16}=\frac{11}{16}$

$\frac{11}{16}=\frac{11}{16}$

65.a. $\frac{8}{15}=\frac{n}{20}$

$20\left(\frac{8}{15}\right)=20\left(\frac{n}{20}\right)$

$\frac{160}{15}=n$

$n=\frac{\cancel{5}\cdot 32}{\cancel{5}\cdot 3}$

$n=\frac{32}{3}$

65.b. $\frac{8}{15}=\frac{\frac{32}{3}}{20}$

$\frac{8}{15}=\frac{32}{3}\cdot\frac{1}{20}$

$\frac{8}{15}=\frac{32}{60}$

$\frac{8}{15}=\frac{\cancel{4}\cdot 8}{\cancel{4}\cdot 15}$

$\frac{8}{15}=\frac{8}{15}$

66.a. $30\left(\frac{9}{20}\right)=30\left(\frac{a}{30}\right)$

$\frac{270}{20}=a$

$a=\frac{\cancel{10}\cdot 27}{\cancel{10}\cdot 2}$

$a=\frac{27}{2}$

66.b. $\frac{9}{20}=\frac{\frac{27}{2}}{30}$

$\frac{9}{20}=\frac{27}{2}\cdot\frac{1}{30}$

$\frac{9}{20}=\frac{27}{60}$

$\frac{9}{20}=\frac{\cancel{3}\cdot 9}{\cancel{3}\cdot 20}$

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

67.a. $\frac{3}{4}x+\frac{5}{6}x-12=2x-12-\frac{5}{12}x$

$12\left(\frac{3}{4}x+\frac{5}{6}x-12\right)=12\left(2x-12-\frac{5}{12}x\right)$

$9x+10x-144=24x-144-5x$

$19x-144=19x-144$

$-19x \qquad -19x$

$-144=-144$

Solution: The set of real numbers

67.b. Check with $x=0$ and $x=1$:

$\frac{3}{4}(0)+\frac{5}{6}(0)-12=2(0)-12-\frac{5}{12}(0)$

$0+0-12=0-12-0$

$-12=-12$

$\frac{3}{4}(1)+\frac{5}{6}(1)-12=2(1)-12-\frac{5}{12}(1)$

$\frac{3}{4}+\frac{5}{6}-12=2-12-\frac{5}{12}$

$\frac{9}{12}+\frac{10}{12}-\frac{144}{12}=\frac{24}{12}-\frac{144}{12}-\frac{5}{12}$

$-\frac{125}{12}=-\frac{125}{12}$

68.a. $\frac{4}{5}x+\frac{2}{7}x-18=2x-18-\frac{32}{35}x$

$35\left(\frac{4}{5}x+\frac{2}{7}x-18\right)=35\left(2x-18-\frac{32}{35}x\right)$

$28x+10x-630=70x-630-32x$

$38x-630=38x-630$

$-38x \qquad -38x$

$-630=-630$

Solution: The set of real numbers

68.b. Check with $x = 0$ and $x = 1$:

$$\frac{4}{5}(0)+\frac{2}{7}(0)-18=2(0)-18-\frac{32}{35}(0)$$
$$-18=-18$$
$$\frac{4}{5}(1)+\frac{2}{7}(1)-18=2(1)-18-\frac{32}{35}(1)$$
$$\frac{4}{5}+\frac{2}{7}-18=2-18-\frac{32}{35}$$
$$\frac{4}{5}\cdot\frac{7}{7}+\frac{2}{7}\cdot\frac{5}{5}-18\cdot\frac{35}{35}=-16\cdot\frac{35}{35}-\frac{32}{35}$$
$$\frac{28}{35}+\frac{10}{35}-\frac{630}{35}=-\frac{560}{35}-\frac{32}{35}$$
$$-\frac{592}{35}=-\frac{592}{35}$$

69.a.
$$\frac{3}{4}a+\frac{5}{6}=\frac{5}{8}$$
$$24\left(\frac{3}{4}a+\frac{5}{6}\right)=24\left(\frac{5}{8}\right)$$
$$18a+20=15$$
$$-20\ \ -20$$
$$18a=-5$$
$$\frac{18a}{18}=\frac{-5}{18}$$
$$a=-\frac{5}{18}$$

69.b.
$$\frac{3}{4}\left(-\frac{5}{18}\right)+\frac{5}{6}=\frac{5}{8}$$
$$-\frac{15}{72}+\frac{5}{6}=\frac{5}{8}$$
$$-\frac{15}{72}+\frac{5}{6}\cdot\frac{12}{12}=\frac{5}{8}\cdot\frac{9}{9}$$
$$-\frac{15}{72}+\frac{60}{72}=\frac{45}{72}$$
$$\frac{45}{72}=\frac{45}{72}$$

70.a.
$$\frac{5}{6}c+\frac{7}{8}=\frac{3}{4}$$
$$24\left(\frac{5}{6}c+\frac{7}{8}\right)=24\left(\frac{3}{4}\right)$$
$$20c+21=18$$
$$-21\ \ -21$$
$$20c=-3$$
$$\frac{20c}{20}=\frac{-3}{20}$$
$$c=-\frac{3}{20}$$

70.b.
$$\frac{5}{6}\left(-\frac{3}{20}\right)+\frac{7}{8}=\frac{3}{4}$$
$$-\frac{15}{120}+\frac{7}{8}=\frac{3}{4}$$
$$-\frac{15}{120}+\frac{7}{8}\cdot\frac{15}{15}=\frac{3}{4}\cdot\frac{30}{30}$$
$$-\frac{15}{120}+\frac{105}{120}=\frac{90}{120}$$
$$\frac{90}{120}=\frac{90}{120}$$

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

71.b.
$$-\frac{1}{2}(-16)=8$$
$$8=8$$

72.a.
$$-\frac{1}{4}q=6$$
$$-4\left(-\frac{1}{4}q\right)=-4(6)$$
$$q=-24$$

72.b.
$$-\frac{1}{4}(-24)=6$$
$$6=6$$

73.a.
$$5x-(6-4x)=84$$
$$5x-6+4x=84$$
$$9x-6=84$$
$$+6\ \ +6$$
$$9x=90$$
$$\frac{9x}{9}=\frac{90}{9}$$
$$x=10$$

73.b.
$$5(10)-(6-4(10))=84$$
$$50-(6-40)=84$$
$$50-(-34)=84$$
$$84=84$$

74.a.
$$4x-(10-5x)=44$$
$$4x-10+5x=44$$
$$9x-10=44$$
$$+10\ \ +10$$
$$9x=54$$
$$\frac{9x}{9}=\frac{54}{9}$$
$$x=6$$

74.b.
$$4(6)-(10-5(6))=44$$
$$24-(10-30)=44$$
$$24-(-20)=44$$
$$44=44$$

75.a.
$$\begin{aligned} 2-(3z+1) &= 8z \\ 2-3z-1 &= 8z \\ 1-3z &= 8z \\ +3z &\ +3z \\ \hline 1 &= 11z \\ \frac{1}{11} &= \frac{11z}{11} \\ z &= \frac{1}{11} \end{aligned}$$

75.b.
$$\begin{aligned} 2-\left(3\left(\frac{1}{11}\right)+1\right) &= 8\left(\frac{1}{11}\right) \\ 2-\left(\frac{3}{11}+1\right) &= \frac{8}{11} \\ 2-\frac{3}{11}-1 &= \frac{8}{11} \\ 1-\frac{3}{11} &= \frac{8}{11} \\ 1\cdot\frac{11}{11}-\frac{3}{11} &= \frac{8}{11} \\ \frac{11}{11}-\frac{3}{11} &= \frac{8}{11} \\ \frac{8}{11} &= \frac{8}{11} \end{aligned}$$

76.a.
$$\begin{aligned} 4-(5p+2) &= 12p \\ 4-5p-2 &= 12p \\ 2-5p &= 12p \\ +5p &\ +5p \\ \hline 2 &= 17p \\ \frac{2}{17} &= \frac{17p}{17} \\ p &= \frac{2}{17} \end{aligned}$$

76.b.
$$\begin{aligned} 4-\left(5\left(\frac{2}{17}\right)+2\right) &= 12\left(\frac{2}{17}\right) \\ 4-\left(\frac{10}{17}+2\right) &= \frac{24}{17} \\ 4-\frac{10}{17}-2 &= \frac{24}{17} \\ 2-\frac{10}{17} &= \frac{24}{17} \\ 2\cdot\frac{17}{17}-\frac{10}{17} &= \frac{24}{17} \\ \frac{34}{17}-\frac{10}{17} &= \frac{24}{17} \\ \frac{24}{17} &= \frac{24}{17} \end{aligned}$$

77.a.
$$\begin{aligned} \frac{3}{7}x &= x \\ 7\left(\frac{3}{7}x\right) &= 7(x) \\ 3x &= 7x \\ -3x &\ -3x \\ \hline 0 &= 4x \\ \frac{0}{4} &= \frac{4x}{4} \\ x &= 0 \end{aligned}$$

77.b.
$$\begin{aligned} \frac{3}{7}(0) &= 0 \\ 0 &= 0 \end{aligned}$$

78.a.
$$\begin{aligned} \frac{4}{9}z &= z \\ 9\left(\frac{4}{9}z\right) &= 9(z) \\ 4z &= 9z \\ -4z &\ -4z \\ \hline 0 &= 5z \\ \frac{0}{5} &= \frac{5z}{5} \\ z &= 0 \end{aligned}$$

78.b.
$$\begin{aligned} \frac{4}{9}(0) &= 0 \\ 0 &= 0 \end{aligned}$$

79. The variable terms are the same and will cancel, leaving 2 constants that are not equal.

80. Both sides of the equation are identical, so any x value placed in the left hand side of the equation will produce the same result when placed in the right hand side of the equation.

81. **Answers will vary. One possible answer is:**
$3(x-2)=3x+8$

82. **Answers will vary. One possible answer is:**
$4(x+2)=4x+8$

83. **Solving an equation in one variable:**
1. Apply the distributive property to clear all parentheses (and other grouping symbols) on both sides of the equation.
2. Combine like terms on each side of the equation.
3. Use the addition and/or subtraction properties of equality to get all variable terms on one side of the equals sign and all constant terms on the other side.
4. Use the multiplication and/or division properties of equality to make the coefficient of the variable equal to 1.

84. **Clearing fraction from an equation in one variable:**
1. Find the least common multiple of all denominators of all fractions in the problem.
2. Multiply both sides of the equation by the least common multiple.

85. Since x can be any number larger than 6, the interval begins at 6 and goes to positive infinity. Since 6 is not part of the solution, use a (on the left side of the interval. When infinity is a right endpoint of an interval, that side of the interval always uses a). So the interval is written $(6, \infty)$.

86. Since x can be any number smaller than 2 or equal to 2, the interval begins at negative infinity and continues to 2. Since 2 is part of the solution, use a] on the right side of the interval. When negative infinity is a left endpoint of an interval, that side of the interval always uses a (. So the interval is written $(-\infty, 2]$.

87. Since x can be any number smaller than 2 or equal to 2, the number line is shaded beginning at negative infinity and continuing to 2. Since 2 is part of the solution, use a] on the right side of the shaded line.

88. Since x can be any number larger than 6, the number line is shaded beginning at 6 and continuing to positive infinity. Since 6 is not part of the solution, use a (on the left side of the shaded line.

89.a.
$$\begin{aligned} 3x - 9 &\le 15 \\ +9 \quad &+9 \\ \hline 3x &\le 24 \\ \frac{3x}{3} &\le \frac{24}{3} \\ x &\le 8 \end{aligned}$$

89.b. Check with any number less than or equal to 8.
Letting $x = 7$:
$$\begin{aligned} 3(7) - 9 &\le 15 \\ 21 - 9 &\le 15 \\ 12 &\le 15 \end{aligned}$$

89.c. $(-\infty, 8]$

90.a.
$$\begin{aligned} 4x - 12 &\le 16 \\ +12 \quad &+12 \\ \hline 4x &\le 28 \\ \frac{4x}{4} &\le \frac{28}{4} \\ x &\le 7 \end{aligned}$$

90.b. Check with any number less than or equal to 7.
Letting $x = 0$:
$$\begin{aligned} 4(0) - 12 &\le 16 \\ -12 &\le 16 \end{aligned}$$

90.c. $(-\infty, 7]$

91.a.
$$\begin{aligned} -3x - 9 &< 15 \\ +9 \quad &+9 \\ \hline -3x &< 24 \\ \frac{-3x}{-3} &> \frac{24}{-3} \\ x &> -8 \end{aligned}$$

91.b. Check with any number greater than -8.
Letting $x = -5$:
$$\begin{aligned} -3(-5) - 9 &< 15 \\ 15 - 9 &< 15 \\ 6 &< 15 \end{aligned}$$

91.c. $(-8, \infty)$

92.a.
$$\begin{aligned} -4x - 12 &< 16 \\ +12 \quad &+12 \\ \hline -4x &< 28 \\ \frac{-4x}{-4} &> \frac{28}{-4} \\ x &> -7 \end{aligned}$$

92.b. Check with any number greater than -7.
Letting $x = -6$:
$$\begin{aligned} -4(-6) - 12 &< 16 \\ 24 - 12 &< 16 \\ 12 &< 16 \end{aligned}$$

92.c. $(-7, \infty)$

93.a.
$$\begin{aligned} -3x - 9 &> -15 \\ +9 \quad &+9 \\ \hline -3x &> -6 \\ \frac{-3x}{-3} &< \frac{-6}{-3} \\ x &< 2 \end{aligned}$$

93.b. Check with any number less than 2.
Letting $x = 1$:
$$\begin{aligned} -3(1) - 9 &> -15 \\ -3 - 9 &> -15 \\ -12 &> -15 \end{aligned}$$

93.c. $(-\infty, 2)$

94.a.
$$\begin{aligned} -4x - 12 &> -16 \\ +12 \quad &+12 \\ \hline -4x &> -4 \\ \frac{-4x}{-4} &< \frac{-4}{-4} \\ x &< 1 \end{aligned}$$

94.b. Check with any number less than 1.
Letting $x = 0$:
$$\begin{aligned} -4(0) - 12 &> -16 \\ -12 &> -16 \end{aligned}$$

94.c. $(-\infty, 1)$

95.a. $3x-9 \ge -15$

$$\begin{array}{r} +9 \quad +9 \\ \hline 3x \ge -6 \end{array}$$

$$\frac{3x}{3} \ge \frac{-6}{3}$$

$$x \ge -2$$

95.b. Check with any number greater than or equal to -2.

Letting $x = 0$:

$$3(0)-9 \ge -15$$

$$-9 \ge -15$$

95.c. $[-2, \infty)$

96.a. $4x-12 \ge -16$

$$\begin{array}{r} +12 \quad +12 \\ \hline 4x \ge -4 \end{array}$$

$$\frac{4x}{4} \ge \frac{-4}{4}$$

$$x \ge -1$$

96.b. Check with any number greater than or equal to -1.

Letting $x = 0$:

$$4(0)-12 \ge -16$$

$$-12 \ge -16$$

96.c. $[-1, \infty)$

97.a. $2(d+1)-(d+8) < -15$

$$2d+2-d-8 < -15$$

$$d-6 < -15$$

$$\begin{array}{r} +6 \quad +6 \\ \hline d < -9 \end{array}$$

97.b. Check with any number less than -9.

Letting $d = -10$:

$$2(-10+1)-(-10+8) < -15$$

$$2(-9)-(-2) < -15$$

$$-18+2 < -15$$

$$-16 < -15$$

97.c. $(-\infty, -9)$

98.a. $2(r+1)-(r+10) < -35$

$$2r+2-r-10 < -35$$

$$r-8 < -35$$

$$\begin{array}{r} +8 \quad +8 \\ \hline r < -27 \end{array}$$

98.b. Check with any number less than -27.

Letting $r = -30$:

$$2(-30+1)-(-30+10) < -35$$

$$2(-29)-(-20) < -35$$

$$-58+20 < -35$$

$$-38 < -35$$

98.c. $(-\infty, -27)$

99.a. $4(n-50) > 3(2n+6)$

$$4n-200 > 6n+18$$

$$\begin{array}{r} -6n+200 \quad -6n+200 \\ \hline -2n > 218 \end{array}$$

$$\frac{-2n}{-2} < \frac{218}{-2}$$

$$n < -109$$

99.b. Check with any number less than -109.

Letting $n = -110$:

$$4(-110-50) > 3(2(-110)+6)$$

$$4(-160) > 3(-214)$$

$$-640 > -642$$

99.c. $(-\infty, -109)$

100.a. $8(w-15) > 2(5w+14)$

$$8w-120 > 10w+28$$

$$\begin{array}{r} -10w+120 \quad -10w+120 \\ \hline -2w > 148 \end{array}$$

$$\frac{-2w}{-2} < \frac{148}{-2}$$

$$w < -74$$

100.b. Check with any number less than -74.

Letting $w = -75$:

$$8(-75-15) > 2(5(-75)+14)$$

$$8(-90) > 2(-361)$$

$$-720 > -722$$

100.c. $(-\infty, -74)$

101.a. $-\frac{3}{4}x+8 < 15-\frac{2}{3}x$

$$12\left(-\frac{3}{4}x+8\right) < 12\left(15-\frac{2}{3}x\right)$$

$$-9x+96 < 180-8x$$

$$\begin{array}{r} +8x \qquad +8x \\ \hline -x+96 < 180 \end{array}$$

$$\begin{array}{r} -96 \quad -96 \\ \hline -x < 84 \end{array}$$

$$-1(-x) > -1(84)$$

$$x > -84$$

101.b. Check with any number greater than −84.

Letting $x = -72$:

$$-\frac{3}{4}(-72) + 8 < 15 - \frac{2}{3}(-72)$$
$$54 + 8 < 15 + 48$$
$$62 < 63$$

101.c. $(-84, \infty)$

102.a.
$$-\frac{3}{8}x - 18 > 34 + \frac{5}{4}x$$
$$8\left(-\frac{3}{8}x - 18\right) > 8\left(34 + \frac{5}{4}x\right)$$
$$-3x - 144 > 272 + 10x$$
$$\underline{-10x + 144 \quad +144 - 10x}$$
$$-13x > 416$$
$$\frac{-13x}{-13} < \frac{416}{-13}$$
$$x < -32$$

102.b. Check with any number less than −32.

Letting $x = -40$:

$$-\frac{3}{8}(-40) - 18 > 34 + \frac{5}{4}(-40)$$
$$15 - 18 > 34 - 50$$
$$-3 > -16$$

102.c. $(-\infty, -32)$

103.a.
$$-\frac{1}{2}x > 36$$
$$-2\left(-\frac{1}{2}x\right) < -2(36)$$
$$x < -72$$

103.b. Check with any number less than −72.

Letting $x = -74$:

$$-\frac{1}{2}(-74) > 36$$
$$37 > 36$$

103.c. $(-\infty, -72)$

104.a.
$$-\frac{1}{3}x < 52$$
$$-3\left(-\frac{1}{3}x\right) > -3(52)$$
$$x > -156$$

104.b. Check with any number greater than −156.

Letting $x = -153$:

$$-\frac{1}{3}(-153) < 52$$
$$51 < 52$$

104.c. $(-156, \infty)$

105.a.
$$-12y \geq -2y$$
$$\underline{+2y \quad +2y}$$
$$-10y \geq 0$$
$$\frac{-10y}{-10} \leq \frac{0}{-10}$$
$$y \leq 0$$

105.b. Check with any number less than or equal to 0.

Letting $y = -1$:

$$-12(-1) \geq -2(-1)$$
$$12 \geq 2$$

105.c. $(-\infty, 0]$

106.a.
$$-24h \geq -2h$$
$$\underline{+2h \quad +2h}$$
$$-22h \geq 0$$
$$\frac{-22h}{-22} \leq \frac{0}{-22}$$
$$h \leq 0$$

106.b. Check with any number less than or equal to 0.

Letting $h = -1$:

$$-24(-1) \geq -2(-1)$$
$$24 \geq 2$$

106.c. $(-\infty, 0]$

107.a.
$$\frac{x}{2} + \frac{5}{9} \leq 0$$
$$18\left(\frac{x}{2} + \frac{5}{9}\right) \leq 18(0)$$
$$9x + 10 \leq 0$$
$$\underline{\quad -10 \quad -10}$$
$$9x \leq -10$$
$$\frac{9x}{9} \leq \frac{-10}{9}$$
$$x \leq -\frac{10}{9}$$

107.b. Check with any number less than or equal to $-\frac{10}{9}$.

Letting $x = -2$:

$$\frac{-2}{2} + \frac{5}{9} \leq 0$$
$$-1 + \frac{5}{9} \leq 0$$
$$-1 \cdot \frac{9}{9} + \frac{5}{9} \leq 0$$
$$-\frac{9}{9} + \frac{5}{9} \leq 0$$
$$-\frac{4}{9} \leq 0$$

107.c. $\left(-\infty, -\frac{10}{9}\right]$

108.a.
$$\frac{z}{3}+\frac{5}{8}\le 0$$
$$24\left(\frac{z}{3}+\frac{5}{8}\right)\le 24(0)$$
$$8z+15\le 0$$
$$\underline{\quad -15 \quad -15}$$
$$8z\le -15$$
$$\frac{8z}{8}\le\frac{-15}{8}$$
$$z\le -\frac{15}{8}$$

108.b. Check with any number less than or equal to $-\frac{15}{8}$.

Letting $z=-2$:
$$\frac{-2}{3}+\frac{5}{8}\le 0$$
$$-\frac{2}{3}\cdot\frac{8}{8}+\frac{5}{8}\cdot\frac{3}{3}\le 0$$
$$-\frac{16}{24}+\frac{15}{24}\le 0$$
$$-\frac{1}{24}\le 0$$

108.c. $\left(-\infty, -\frac{15}{8}\right]$

109.a.
$$-f>3$$
$$-1(-f)<-1(3)$$
$$f<-3$$

109.b. Check with any number less than −3.

Letting $f=-4$:
$$-(-4)>3$$
$$4>3$$

109.c. $(-\infty, -3)$

110.a.
$$-p>4$$
$$-1(-p)<-1(4)$$
$$p<-4$$

110.b. Check with any number less than −4.

Letting $p=-5$:
$$-(-5)>4$$
$$5>4$$

110.c. $(-\infty, -4)$

111.a.
$$0<-2k$$
$$\frac{0}{-2}>\frac{-2k}{-2}$$
$$0>k$$

111.b. Check with any number less than 0.

Letting $k=-1$:
$$0<-2(-1)$$
$$0<2$$

111.c. $(-\infty, 0)$

112.a.
$$0\le -8c$$
$$\frac{0}{-8}\ge\frac{-8c}{-8}$$
$$0\ge c$$

112.b. Check with any number less than or equal to 0.

Letting $c=-1$:
$$0\le -8(-1)$$
$$0\le 8$$

112.c. $(-\infty, 0]$

113.a.
$$8x-9\ge 6x-6$$
$$\underline{-6x+9 \quad -6x+9}$$
$$2x\ge 3$$
$$\frac{2x}{2}\ge\frac{3}{2}$$
$$x\ge\frac{3}{2}$$

113.b. Check with any number greater than or equal to $\frac{3}{2}$.

Letting $x=2$:
$$8(2)-9\ge 6(2)-6$$
$$16-9\ge 12-6$$
$$7\ge 6$$

113.c. $\left[\frac{3}{2}, \infty\right)$

114.a.
$$12x-3\ge 10x-4$$
$$\underline{-10x+3 \quad -10x+3}$$
$$2x\ge -1$$
$$2x\ge -1$$
$$x\ge -\frac{1}{2}$$

114.b. Check with any number greater than or equal to $-\frac{1}{2}$.

Letting $x=0$:
$$12(0)-3\ge 10(0)-4$$
$$-3\ge -4$$

114.c. $\left[-\frac{1}{2}, \infty\right)$

115.a.
$$7x-12>6x-12$$
$$\underline{-6x+12 \quad -6x+12}$$
$$x>0$$

115.b. Check with any number greater than 0.

Letting $x = 1$:

$$7(1) - 12 > 6(1) - 12$$
$$7 - 12 > 6 - 12$$
$$-5 > -6$$

115.c. $(0, \infty)$

116.a.
$$5x - 34 > 4x - 34$$
$$\underline{-4x + 34 \quad -4x + 34}$$
$$x > 0$$

116.b. Check with any number greater than 0.

Letting $x = 1$:

$$5(1) - 34 > 4(1) - 34$$
$$5 - 34 > 4 - 34$$
$$-29 > -30$$

116.c. $(0, \infty)$

117.a.
$$4(2x - 6) \le 5(x - 9)$$
$$8x - 24 \le 5x - 45$$
$$\underline{-5x + 24 \quad -5x + 24}$$
$$3x \le -21$$
$$\frac{3x}{3} \le \frac{-21}{3}$$
$$x \le -7$$

117.b. Check with any number less than or equal to -7.

Letting $x = -8$:

$$4(2(-8) - 6) \le 5((-8) - 9)$$
$$4(-22) \le 5(-17)$$
$$-88 \le -85$$

117.c. $(-\infty, -7]$

118.a.
$$3(4x - 1) \le 9(x - 15)$$
$$12x - 3 \le 9x - 135$$
$$\underline{-9x + 3 \quad -9x \quad +3}$$
$$3x \le -132$$
$$\frac{3x}{3} \le \frac{-132}{3}$$
$$x \le -44$$

118.b. Check with any number less than or equal to -44.

Letting $x = -45$:

$$3(4(-45) - 1) \le 9((-45) - 15)$$
$$3(-181) \le 9(-60)$$
$$-543 \le -540$$

118.c. $(-\infty, -44]$

119.a.
$$\frac{x}{340} \ge \frac{7}{20}$$
$$340\left(\frac{x}{340}\right) \ge 340\left(\frac{7}{20}\right)$$
$$x \ge 119$$

119.b. Check with any number greater than or equal to 119.

Letting $x = 120$:

$$\frac{120}{340} \ge \frac{7}{20} \qquad \text{OR} \qquad \frac{120}{340} \ge \frac{7}{20}$$
$$\frac{120}{340} \ge \frac{7}{20} \cdot \frac{17}{17} \qquad 0.3529... \ge 0.35$$
$$\frac{120}{340} \ge \frac{119}{340}$$

119.c. $[119, \infty)$

120.a.
$$\frac{x}{945} \ge \frac{7}{15}$$
$$945\left(\frac{x}{945}\right) \ge 945\left(\frac{7}{15}\right)$$
$$x \ge 441$$

120.b. Check with any number greater than or equal to 441.

Letting $x = 442$:

$$\frac{442}{945} \ge \frac{7}{15} \qquad \text{OR} \qquad \frac{442}{945} \ge \frac{7}{15}$$
$$\frac{442}{945} \ge \frac{7}{15} \cdot \frac{63}{63} \qquad 0.4677... \ge 0.4666...$$
$$\frac{442}{945} \ge \frac{441}{945}$$

120.c. $[441, \infty)$

121.a.
$$\frac{15}{16} < \frac{x}{336}$$
$$336\left(\frac{15}{16}\right) < 336\left(\frac{x}{336}\right)$$
$$315 < x$$

121.b. Check with any number greater than 315.

Letting $x = 316$:

$$\frac{15}{16} < \frac{316}{336} \qquad \text{OR} \qquad \frac{15}{16} < \frac{316}{336}$$
$$\frac{15}{16} \cdot \frac{21}{21} < \frac{316}{336} \qquad 0.9375 < 0.94047...$$
$$\frac{315}{336} < \frac{316}{336}$$

121.c. $(315, \infty)$

122.a.
$$\frac{11}{12} < \frac{x}{276}$$
$$276\left(\frac{11}{12}\right) < 276\left(\frac{x}{276}\right)$$
$$253 < x$$

122.b. Check with any number greater than 253.

Letting $x = 254$:

$$\frac{11}{12} < \frac{254}{276} \qquad \text{OR} \qquad \frac{11}{12} < \frac{254}{276}$$
$$\frac{11}{12} \cdot \frac{23}{23} < \frac{254}{276} \qquad 0.91666... < 0.920289...$$
$$\frac{253}{276} < \frac{254}{276}$$

122.c. $(253, \infty)$

123.a.
$$3(x+6) - x < 5x + 1$$
$$3x + 18 - x < 5x + 1$$
$$2x + 18 < 5x + 1$$
$$-5x - 18 \quad -5x - 18$$
$$-3x < -17$$
$$\frac{-3x}{-3} > \frac{-17}{-3}$$
$$x > \frac{17}{3}$$

123.b. Check with any number greater than $\frac{17}{3}$.

Letting $x = 6$:
$$3(6+6) - 6 < 5(6) + 1$$
$$3(12) - 6 < 30 + 1$$
$$36 - 6 < 31$$
$$30 < 31$$

123.c. $\left(\frac{17}{3}, \infty\right)$

124.a.
$$2(x+4) - x < 7x + 1$$
$$2x + 8 - x < 7x + 1$$
$$x + 8 < 7x + 1$$
$$-7x - 8 \quad -7x - 8$$
$$-6x < -7$$
$$\frac{-6x}{-6} > \frac{-7}{-6}$$
$$x > \frac{7}{6}$$

124.b. Check with any number greater than $\frac{7}{6}$.

Letting $x = 2$:
$$2(2+4) - 2 < 7(2) + 1$$
$$2(6) - 2 < 14 + 1$$
$$12 - 2 < 14 + 1$$
$$10 < 13$$

124.c. $\left(\frac{7}{6}, \infty\right)$

125.a.
$$8p < 3p$$
$$-3p \quad -3p$$
$$5p < 0$$
$$\frac{5p}{5} < \frac{0}{5}$$
$$p < 0$$

125.b. Check with any number less than 0.

Letting $p = -1$:
$$8(-1) < 3(-1)$$
$$-8 < -3$$

125.c. $(-\infty, 0)$

126.a.
$$7k < 3k$$
$$-3k \quad -3k$$
$$4k < 0$$
$$\frac{4k}{4} < \frac{0}{4}$$
$$k < 0$$

126.b. Check with any number less than 0.

Letting $k = -1$:
$$7(-1) < 3(-1)$$
$$-7 < -3$$

126.c. $(-\infty, 0)$

127.a.
$$-8p < 3p$$
$$-3p \quad -3p$$
$$-11p < 0$$
$$\frac{-11p}{-11} > \frac{0}{-11}$$
$$p > 0$$

127.b. Check with any number greater than 0.

Letting $p = 1$:
$$-8(1) < 3(1)$$
$$-8 < 3$$

127.c. $(0, \infty)$

128.a.
$$-7k < 3k$$
$$-3k \quad -3k$$
$$-10k < 0$$
$$\frac{-10k}{-10} > \frac{0}{-10}$$
$$k > 0$$

128.b. Check with any number greater than 0.

Letting $k = 1$:
$$-7(1) < 3(1)$$
$$-7 < 3$$

128.c. $(0, \infty)$

129.a. $8p < -3p$

$+3p \quad +3p$

$11p < 0$

$\frac{11p}{11} < \frac{0}{11}$

$p < 0$

129.b. Check with any number less than 0.

Letting $p = -1$:

$8(-1) < -3(-1)$

$-8 < 3$

129.c. $(-\infty, 0)$

130.a. $7k < -3k$

$7k < -3k$

$+3k \quad +3k$

$10k < 0$

$\frac{10k}{10} < \frac{0}{10}$

$k < 0$

130.b. Check with any number less than 0.

Letting $k = -1$:

$7(-1) < -3(-1)$

$-7 < 3$

130.c. $(-\infty, 0)$

131.a. $-8p < -3p$

$+3p \quad +3p$

$-5p < 0$

$\frac{-5p}{-5} > \frac{0}{-5}$

$p > 0$

131.b. Check with any number greater than 0.

Letting $p = 1$:

$-8(1) < -3(1)$

$-8 < -3$

131.c. $(0, \infty)$

132.a. $-7k < -3k$

$+3k \quad +3k$

$-4k < 0$

$\frac{-4k}{-4} > \frac{0}{-4}$

$k > 0$

132.b. Check with any number greater than 0.

Letting $k = 1$:

$-7(1) < -3(1)$

$-7 < -3$

132.c. $(0, \infty)$

133.a. $\frac{3}{4}m + \frac{1}{6} > 1$

$12\left(\frac{3}{4}m + \frac{1}{6}\right) > 12(1)$

$9m + 2 > 12$

$-2 \quad -2$

$9m > 10$

$\frac{9m}{9} > \frac{10}{9}$

$m > \frac{10}{9}$

133.b. Check with any number greater than $\frac{10}{9}$.

Letting $m = 2$:

$\frac{3}{4}(2) + \frac{1}{6} > 1$

$\frac{6}{4} + \frac{1}{6} > 1$

$\frac{6}{4} \cdot \frac{3}{3} + \frac{1}{6} \cdot \frac{2}{2} > 1$

$\frac{18}{12} + \frac{2}{12} > 1$

$\frac{20}{12} > 1$

OR

$\frac{3}{4}(2) + \frac{1}{6} > 1$

$\frac{6}{4} + \frac{1}{6} > 1$

$1.666... > 1$

133.c. $\left(\frac{10}{9}, \infty\right)$

134.a. $\frac{5}{6}n + \frac{1}{4} > 1$

$12\left(\frac{5}{6}n + \frac{1}{4}\right) > 12(1)$

$10n + 3 > 12$

$-3 \quad -3$

$10n > 9$

$\frac{10n}{10} > \frac{9}{10}$

$n > \frac{9}{10}$

134.b. Check with any number greater than $\frac{9}{10}$.

Letting $n = 1$:

$$\frac{5}{6}(1)+\frac{1}{4}>1 \qquad \text{OR} \qquad \frac{5}{6}(1)+\frac{1}{4}>1$$
$$\frac{5}{6}+\frac{1}{4}>1 \qquad\qquad \frac{5}{6}+\frac{1}{4}>1$$
$$\frac{5}{6}\cdot\frac{2}{2}+\frac{1}{4}\cdot\frac{3}{3}>1 \qquad\qquad 1.08333...>1$$
$$\frac{10}{12}+\frac{3}{12}>1$$
$$\frac{13}{12}>1$$

134.c. $\left(\frac{9}{10},\infty\right)$

135.a.
$$\frac{1}{3}k-8\le\frac{3}{5}k+2$$
$$15\left(\frac{1}{3}k-8\right)\le 15\left(\frac{3}{5}k+2\right)$$
$$5k-120\le 9k+30$$
$$-9k+120 \quad -9k+120$$
$$-4k\le 150$$
$$\frac{-4k}{-4}\ge\frac{150}{-4}$$
$$k\ge-\frac{150}{4}$$
$$k\ge-\frac{\cancel{2}\cdot 75}{\cancel{2}\cdot 2}$$
$$k\ge-\frac{75}{2}$$

135.b. Check with any number greater than or equal to $-\frac{75}{2}$.

Letting $k = -30$:

$$\frac{1}{3}(-30)-8\le\frac{3}{5}(-30)+2$$
$$-10-8\le-18+2$$
$$-18\le-16$$

135.c. $\left[-\frac{75}{2},\infty\right)$

136.a.
$$\frac{1}{2}h-6\le\frac{5}{4}h+2$$
$$4\left(\frac{1}{2}h-6\right)\le 4\left(\frac{5}{4}h+2\right)$$
$$2h-24\le 5h+8$$
$$-5h+24 \quad -5h+24$$
$$-3h\le 32$$
$$\frac{-3h}{-3}\ge\frac{32}{-3}$$
$$h\ge-\frac{32}{3}$$

136.b. Check with any number greater than or equal to $-\frac{32}{3}$.

Letting $h = -10$:

$$\frac{1}{2}(-10)-6\le\frac{5}{4}(-10)+2 \qquad \text{OR} \qquad \frac{1}{2}(-10)-6\le\frac{5}{4}(-10)+2$$
$$-5-6\le-\frac{50}{4}+2 \qquad\qquad -5-6\le-12.5+2$$
$$-11\cdot\frac{4}{4}\le-\frac{50}{4}+2\cdot\frac{4}{4} \qquad\qquad -11\le-10.5$$
$$-\frac{44}{4}\le-\frac{50}{4}+\frac{8}{4}$$
$$-\frac{44}{4}\le-\frac{42}{4}$$

136.c. $\left[-\frac{32}{3},\infty\right)$

137.a.
$$\frac{2}{3}w-5<-\frac{4}{9}$$
$$9\left(\frac{2}{3}w-5\right)<9\left(-\frac{4}{9}\right)$$
$$6w-45<-4$$
$$+45 \quad +45$$
$$6w<41$$
$$\frac{6w}{6}<\frac{41}{6}$$
$$w<\frac{41}{6}$$

137.b. Check with any number less than $\frac{41}{6}$.

Letting $w = 6$:

$$\frac{2}{3}(6)-5<-\frac{4}{9}$$
$$4-5<-\frac{4}{9}$$
$$-1<-\frac{4}{9}$$

137.c. $\left(-\infty, \frac{41}{6}\right)$

138.a.
$$\frac{4}{5}m - 8 < -\frac{3}{10}$$
$$10\left(\frac{4}{5}m - 8\right) < 10\left(-\frac{3}{10}\right)$$
$$8m - 80 < -3$$
$$+80 \quad +80$$
$$8m < 77$$
$$\frac{8m}{8} < \frac{77}{8}$$
$$m < \frac{77}{8}$$

138.b. Check with any number less than $\frac{77}{8}$.

Letting $m = 5$:

$$\frac{4}{5}(5) - 8 < -\frac{3}{10}$$
$$4 - 8 < -\frac{3}{10}$$
$$-4 < -\frac{3}{10}$$

138.c. $\left(-\infty, \frac{77}{8}\right)$

139.a.
$$5h + \frac{1}{2} > -2h + \frac{3}{4}$$
$$4\left(5h + \frac{1}{2}\right) > 4\left(-2h + \frac{3}{4}\right)$$
$$20h + 2 > -8h + 3$$
$$+8h - 2 \quad +8h - 2$$
$$28h > 1$$
$$\frac{28h}{28} > \frac{1}{28}$$
$$h > \frac{1}{28}$$

139.b. Check with any number greater than $\frac{1}{28}$.

Letting $h = 1$:

$$5(1) + \frac{1}{2} > -2(1) + \frac{3}{4}$$
$$5 + \frac{1}{2} > -2 + \frac{3}{4}$$
$$5 \cdot \frac{4}{4} + \frac{1}{2} \cdot \frac{2}{2} > -2 \cdot \frac{4}{4} + \frac{3}{4}$$
$$\frac{20}{4} + \frac{2}{4} > -\frac{8}{4} + \frac{3}{4}$$
$$\frac{22}{4} > -\frac{5}{4}$$

OR

$$5(1) + \frac{1}{2} > -2(1) + \frac{3}{4}$$
$$5 + \frac{1}{2} > -2 + \frac{3}{4}$$
$$5.5 > -1.25$$

139.c. $\left(\frac{1}{28}, \infty\right)$

140.a.
$$9c + \frac{2}{3} > -5c + \frac{5}{6}$$
$$6\left(9c + \frac{2}{3}\right) > 6\left(-5c + \frac{5}{6}\right)$$
$$54c + 4 > -30c + 5$$
$$+30c - 4 \quad +30c - 4$$
$$84c > 1$$
$$\frac{84c}{84} > \frac{1}{84}$$
$$c > \frac{1}{84}$$

140.b. Check with any number greater than $\frac{1}{84}$.

Letting $c = 1$:

$$9(1) + \frac{2}{3} > -5(1) + \frac{5}{6}$$
$$9 + \frac{2}{3} > -5 + \frac{5}{6}$$
$$9 \cdot \frac{6}{6} + \frac{2}{3} \cdot \frac{2}{2} > -5 \cdot \frac{6}{6} + \frac{5}{6}$$
$$\frac{54}{6} + \frac{4}{6} > -\frac{30}{6} + \frac{5}{6}$$
$$\frac{58}{6} > -\frac{25}{6}$$

OR

$$9(1) + \frac{2}{3} > -5(1) + \frac{5}{6}$$
$$9 + \frac{2}{3} > -5 + \frac{5}{6}$$
$$9.666... > -4.1666...$$

140.c. $\left(\frac{1}{84}, \infty\right)$

141.a. $\frac{3}{4}(2u+8) < \frac{5}{6}(3u-12)$

$12\left(\frac{3}{4}\right)(2u+8) < 12\left(\frac{5}{6}\right)(3u-12)$

$9(2u+8) < 10(3u-12)$

$18u+72 < 30u-120$

$-18u+120 \quad -18u+120$

$192 < 12u$

$\frac{192}{12} < \frac{12u}{12}$

$16 < u$

141.b. Check with any number greater than 16.

Letting $u = 20$:

$\frac{3}{4}(2(20)+8) < \frac{5}{6}(3(20)-12)$

$\frac{3}{4}(48) < \frac{5}{6}(48)$

$36 < 40$

141.c. $(16, \infty)$

142.a. $\frac{1}{2}(3v-4) < \frac{4}{5}(2v-10)$

$10\left(\frac{1}{2}\right)(3v-4) < 10\left(\frac{4}{5}\right)(2v-10)$

$5(3v-4) < 8(2v-10)$

$15v-20 < 16v-80$

$-15v+80 \quad -15v+80$

$60 < v$

142.b. Check with any number greater than 60.

Letting $v = 70$:

$\frac{1}{2}(3(70)-4) < \frac{4}{5}(2(70)-10)$

$\frac{1}{2}(206) < \frac{4}{5}(130)$

$103 < 104$

142.c. $(60, \infty)$

143.a. $\frac{1}{2}(x+9) - \frac{6}{7}(x+2) \le 0$

$14\left(\frac{1}{2}(x+9) - \frac{6}{7}(x+2)\right) \le 14(0)$

$14\left(\frac{1}{2}\right)(x+9) - 14\left(\frac{6}{7}\right)(x+2) \le 0$

$7(x+9) - 12(x+2) \le 0$

$7x+63-12x-24 \le 0$

$-5x+39 \le 0$

$\quad -39 \quad -39$

$-5x \le -39$

$\frac{-5x}{-5} \ge \frac{-39}{-5}$

$x \ge \frac{39}{5}$

143.b. Check with any number greater than or equal to $\frac{39}{5}$.

Letting $x = 8$:

$\frac{1}{2}((8)+9) - \frac{6}{7}((8)+2) \le 0$

$\frac{1}{2}(17) - \frac{6}{7}(10) \le 0$

$\frac{17}{2} - \frac{60}{7} \le 0$

$\frac{17}{2} \cdot \frac{7}{7} - \frac{60}{7} \cdot \frac{2}{2} \le 0$

$\frac{119}{14} - \frac{120}{14} \le 0$

$-\frac{1}{14} \le 0$

143.c. $\left[\frac{39}{5}, \infty\right)$

144.a.
$$\frac{2}{5}(x+6)-\frac{7}{8}(x+5)\le 0$$
$$40\left(\frac{2}{5}(x+6)-\frac{7}{8}(x+5)\right)\le 40(0)$$
$$40\left(\frac{2}{5}\right)(x+6)-40\left(\frac{7}{8}\right)(x+5)\le 0$$
$$16(x+6)-35(x+5)\le 0$$
$$16x+96-35x-175\le 0$$
$$-19x-79\le 0$$
$$+79\quad +79$$
$$-19x\le 79$$
$$\frac{-19x}{-19}\ge\frac{79}{-19}$$
$$x\ge -\frac{79}{19}$$

144.b. Check with any number greater than or equal to $-\frac{79}{19}$.

Letting $x=-4$:
$$\frac{2}{5}((-4)+6)-\frac{7}{8}((-4)+5)\le 0$$
$$\frac{2}{5}(2)-\frac{7}{8}(1)\le 0$$
$$\frac{4}{5}\cdot\frac{8}{8}-\frac{7}{8}\cdot\frac{5}{5}\le 0$$
$$\frac{32}{40}-\frac{35}{40}\le 0$$
$$-\frac{3}{40}\le 0$$

144.c. $\left[-\frac{79}{19},\infty\right)$

145.a. They divided by a negative number, but did not reverse the direction of the inequality sign.

145.b. $-7x+2<30$
$$-2\quad -2$$
$$-7x<28$$
$$\frac{-7x}{-7}>\frac{28}{-7}$$
$$x>-4$$

146.a. They added 8 to both sides of the equation, instead of subtracting 8.

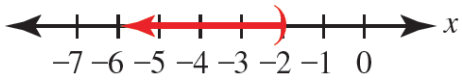
146.b. $3x+8=13$
$$-8\quad -8$$
$$3x=5$$
$$\frac{3x}{3}=\frac{5}{3}$$
$$x=\frac{5}{3}$$

147.a. They forgot the negative sign for $-\infty$.

147.b. $(-\infty, 5)$

148.a. They used a] instead of a).

148.b.



Section 1.4 Scientific Notation and Unit Analysis

1. 7×10^{-6} meter **2.** 1×10^{-7} meter

3. 2.7×10^{12} metric tons **4.** 7.5×10^{6} kilometers

5. 1.04×10^{4} light-years

6. 6.58×10^{4} square hectometers

7. 1×10^{-4} microgram **8.** 1×10^{-6} meter

9. 2.5×10^{1} kilonewtons **10.** $3\times10^{-6}\ \frac{\text{gram}}{\text{deciliter}}$

11.
$$\left(6.2\times10^{8}\right)\left(4.5\times10^{5}\right)$$
$$=(6.2\times4.5)\left(10^{8}\times10^{5}\right)$$
$$=27.9\times10^{8+5}$$
$$=27.9\times10^{13}$$
$$=2.79\times10^{14}$$

12.
$$\left(7.5\times10^{4}\right)\left(6.2\times10^{9}\right)$$
$$=(7.5\times6.2)\left(10^{4}\times10^{9}\right)$$
$$=46.5\times10^{4+9}$$
$$=46.5\times10^{13}$$
$$=4.65\times10^{14}$$

13.
$$\left(6.2\times10^{-8}\right)\left(4.5\times10^{5}\right)$$
$$=(6.2\times4.5)\left(10^{-8}\times10^{5}\right)$$
$$=27.9\times10^{-8+5}$$
$$=27.9\times10^{-3}$$
$$=2.79\times10^{-2}$$

14.
$$\left(7.5\times10^{4}\right)\left(6.2\times10^{-9}\right)$$
$$=(7.5\times6.2)\left(10^{4}\times10^{-9}\right)$$
$$=46.5\times10^{4+(-9)}$$
$$=46.5\times10^{-5}$$
$$=4.65\times10^{-4}$$

15.
$$\left(6.2\times10^{8}\right)\left(4.5\times10^{-5}\right)$$
$$=(6.2\times4.5)\left(10^{8}\times10^{-5}\right)$$
$$=27.9\times10^{8+(-5)}$$
$$=27.9\times10^{3}$$
$$=2.79\times10^{4}$$

16. $(7.5\times10^{-4})(6.2\times10^{9})$
$=(7.5\times6.2)(10^{-4}\times10^{9})$
$=46.5\times10^{-4+9}$
$=46.5\times10^{5}$
$=4.65\times10^{6}$

17. $(6\times10^{5})^{2}$
$=6^{2}\times(10^{5})^{2}$
$=36\times10^{10}$
$=3.6\times10^{11}$

18. $(8\times10^{9})^{2}$
$=8^{2}\times(10^{9})^{2}$
$=64\times10^{18}$
$=6.4\times10^{19}$

19. $(6\times10^{-5})^{2}$
$=6^{2}\times(10^{-5})^{2}$
$=36\times10^{-10}$
$=3.6\times10^{-9}$

20. $(8\times10^{-9})^{2}$
$=8^{2}\times(10^{-9})^{2}$
$=64\times10^{-18}$
$=6.4\times10^{-17}$

21. $(3\times10^{4})(5\times10^{3})^{2}$
$=(3\times5^{2})(10^{4}\times(10^{3})^{2})$
$=3\times25\times10^{4}\times10^{6}$
$=75\times10^{10}$
$=7.5\times10^{11}$

22. $(6\times10^{3})(5\times10^{4})^{2}$
$=(6\times5^{2})(10^{3}\times(10^{4})^{2})$
$=6\times25\times10^{3}\times10^{8}$
$=150\times10^{11}$
$=1.5\times10^{13}$

23. $(4\times10^{-4})^{3}$
$=4^{3}\times(10^{-4})^{3}$
$=64\times10^{-12}$
$=6.4\times10^{-11}$

24. $(5\times10^{-6})^{3}$
$=5^{3}\times(10^{-6})^{3}$
$=125\times10^{-18}$
$=1.25\times10^{-16}$

25. $(2\times10^{7})^{3}$
$=2^{3}\times(10^{7})^{3}$
$=8\times10^{21}$

26. $(3\times10^{5})^{2}$
$=3^{2}\times(10^{5})^{2}$
$=9\times10^{10}$

27. $\dfrac{3\times10^{5}}{6\times10^{2}}$
$=\dfrac{3}{6}\times\dfrac{10^{5}}{10^{2}}$
$=0.5\times10^{5-2}$
$=0.5\times10^{3}$
$=5\times10^{2}$

28. $\dfrac{4\times10^{7}}{8\times10^{3}}$
$=\dfrac{4}{8}\times\dfrac{10^{7}}{10^{3}}$
$=0.5\times10^{7-3}$
$=0.5\times10^{4}$
$=5\times10^{3}$

29. $\dfrac{3\times10^{5}}{6\times10^{-2}}$
$=\dfrac{3}{6}\times\dfrac{10^{5}}{10^{-2}}$
$=0.5\times10^{5-(-2)}$
$=0.5\times10^{7}$
$=5\times10^{6}$

30. $\dfrac{4\times10^{7}}{8\times10^{-3}}$
$=\dfrac{4}{8}\times\dfrac{10^{7}}{10^{-3}}$
$=0.5\times10^{7-(-3)}$
$=0.5\times10^{10}$
$=5\times10^{9}$

31. $\dfrac{3\times10^{-5}}{6\times10^{2}}$
$=\dfrac{3}{6}\times\dfrac{10^{-5}}{10^{2}}$
$=0.5\times10^{-5-2}$
$=0.5\times10^{-7}$
$=5\times10^{-8}$

32. $\dfrac{4\times10^{-7}}{8\times10^{3}}$
$=\dfrac{4}{8}\times\dfrac{10^{-7}}{10^{3}}$
$=0.5\times10^{-7-3}$
$=0.5\times10^{-10}$
$=5\times10^{-11}$

33. $3.2\times10^{4}+9.4\times10^{4}$
$=12.6\times10^{4}$
$=1.26\times10^{5}$

34. $5.9\times10^{6}+8.3\times10^{6}$
$=14.2\times10^{6}$
$=1.42\times10^{7}$

35. $3.2\times10^{-4}+9.4\times10^{-4}$
$=12.6\times10^{-4}$
$=1.26\times10^{-3}$

36. $5.9\times10^{-6}+8.3\times10^{-6}$
$=14.2\times10^{-6}$
$=1.42\times10^{-5}$

37. $3.2\times10^{4}+9.4\times10^{5}$
$=0.32\times10^{5}+9.4\times10^{5}$
$=9.72\times10^{5}$

38. $5.9\times10^{6}+8.3\times10^{7}$
$=0.59\times10^{7}+8.3\times10^{7}$
$=8.89\times10^{7}$

39. $3.2\times10^{6}+9.4\times10^{4}$
$=3.2\times10^{6}+0.094\times10^{6}$
$=3.294\times10^{6}$

40. $5.9\times10^{8}+8.3\times10^{6}$
$=5.9\times10^{8}+0.083\times10^{8}$
$=5.983\times10^{8}$

41. 3 centigrams
$=3\times10^{-2}$ grams
$=0.03$ gram

42. 5 centimeters
$=5\times10^{-2}$ meters
$=0.05$ meter

43. 6 kilometers
$=6\times10^{3}$ meters
$=6000$ meters

44. 9 kilograms
$=9\times10^{3}$ grams
$=9000$ grams

45. 8 decibels
$=8\times10^{-1}$ bels
$=0.8$ bel

46. 4 deciliters
$=4\times10^{-1}$ liters
$=0.4$ liter

47. 2 megatons
$=2\times10^{6}$ tons
$=2,000,000$ tons

48. 6 meganewtons
$=6\times10^{6}$ newtons
$=6,000,000$ newtons

49. 7 micrograms
$=7\times10^{-6}$ grams
$=0.000007$ gram

50. 3 microliters
$=3\times10^{-6}$ liters
$=0.000003$ liter

51. 1 km = 1000 m

52. 1 kg = 1000 g

53. 2 c = 1 pt

54. 16 T = 1 c

55. 1 min = 60 s

56. 1 hr = 60 min

57. 1.06 qt ≈ 1 L

58. 1 mi ≈ 1.6 km

59. 1 dollar ≈ 10.687 Mexican pesos

60. 1 dollar ≈ 0.69 euro

61.
$$35\frac{\text{mi}}{\text{hr}} = \frac{35\ \cancel{\text{mi}}}{\cancel{\text{hr}}} \cdot \frac{5280\ \text{ft}}{1\ \cancel{\text{mi}}} \cdot \frac{1\ \cancel{\text{hr}}}{60\ \text{min}} = 3080\frac{\text{ft}}{\text{min}}$$

62.
$$45\frac{\text{mi}}{\text{hr}} = \frac{45\ \cancel{\text{mi}}}{\cancel{\text{hr}}} \cdot \frac{5280\ \text{ft}}{1\ \cancel{\text{mi}}} \cdot \frac{1\ \cancel{\text{hr}}}{60\ \text{min}} = 3960\frac{\text{ft}}{\text{min}}$$

63.
$$25\frac{\text{mi}}{\text{hr}} = \frac{25\ \cancel{\text{mi}}}{\text{hr}} \cdot \frac{1.6\ \text{km}}{1\ \cancel{\text{mi}}} = 40\frac{\text{km}}{\text{hr}}$$

64.
$$35\frac{\text{mi}}{\text{hr}} = \frac{35\ \cancel{\text{mi}}}{\text{hr}} \cdot \frac{1.6\ \text{km}}{1\ \cancel{\text{mi}}} = 56\frac{\text{km}}{\text{hr}}$$

65.
$$60\frac{\text{km}}{\text{hr}} = \frac{60\ \cancel{\text{km}}}{\cancel{\text{hr}}} \cdot \frac{1\ \cancel{\text{mi}}}{1.6\ \cancel{\text{km}}} \cdot \frac{5280\ \text{ft}}{1\ \cancel{\text{mi}}} \cdot \frac{1\ \cancel{\text{hr}}}{60\ \cancel{\text{min}}} \cdot \frac{1\ \cancel{\text{min}}}{60\ \text{s}} = \frac{316{,}800}{5{,}760}\frac{\text{ft}}{\text{s}} = 55\frac{\text{ft}}{\text{s}}$$

66.
$$30\frac{\text{km}}{\text{hr}} = \frac{30\ \cancel{\text{km}}}{\cancel{\text{hr}}} \cdot \frac{1\ \cancel{\text{mi}}}{1.6\ \cancel{\text{km}}} \cdot \frac{5280\ \text{ft}}{1\ \cancel{\text{mi}}} \cdot \frac{1\ \cancel{\text{hr}}}{60\ \cancel{\text{min}}} \cdot \frac{1\ \cancel{\text{min}}}{60\ \text{s}} = \frac{158{,}400}{5{,}760}\frac{\text{ft}}{\text{s}} = 27.5\frac{\text{ft}}{\text{s}}$$

67.
$$2.5\frac{\text{g}}{\text{mL}} = \frac{2.5\ \cancel{\text{g}}}{\cancel{\text{mL}}} \cdot \frac{1\ \text{kg}}{1000\ \cancel{\text{g}}} \cdot \frac{1000\ \cancel{\text{mL}}}{1\ \text{L}} = 2.5\frac{\text{kg}}{\text{L}}$$

68.
$$1.9\frac{\text{g}}{\text{mL}} = \frac{1.9\ \cancel{\text{g}}}{\cancel{\text{mL}}} \cdot \frac{1\ \text{kg}}{1000\ \cancel{\text{g}}} \cdot \frac{1000\ \cancel{\text{mL}}}{1\ \text{L}} = 1.9\frac{\text{kg}}{\text{L}}$$

69.
$$2.5\frac{\text{g}}{\text{cm}^3} = \frac{2.5\ \cancel{\text{g}}}{\cancel{\text{cm}^3}} \cdot \frac{1\ \text{kg}}{1000\ \cancel{\text{g}}} \cdot \frac{1000\ \cancel{\text{mL}}}{1\ \text{L}} = 2.5\frac{\text{kg}}{\text{L}}$$

70.
$$1.9\frac{\text{g}}{\text{cm}^3} = \frac{1.9\ \cancel{\text{g}}}{\cancel{\text{cm}^3}} \cdot \frac{1\ \text{kg}}{1000\ \cancel{\text{g}}} \cdot \frac{1000\ \cancel{\text{mL}}}{1\ \text{L}} = 1.9\frac{\text{kg}}{\text{L}}$$

71.
$$3.0\times10^8\frac{\text{m}}{\text{s}} = \frac{3.0\times10^8\ \cancel{\text{m}}}{\text{s}} \cdot \frac{1\ \cancel{\text{km}}}{1000\ \cancel{\text{m}}} \cdot \frac{1\ \text{AU}}{1.496\times10^8\ \cancel{\text{km}}} = \frac{3.0}{1.496} \cdot \frac{10^8}{10^3\times10^8}\frac{\text{AU}}{\text{s}} = 2.005... \cdot \frac{10^8}{10^{11}}\frac{\text{AU}}{\text{s}} = 2.005...\times10^{-3}\frac{\text{AU}}{\text{s}} \approx 2.0\times10^{-3}\frac{\text{AU}}{\text{s}}$$

72.
$$3.0\times10^{10}\frac{\text{cm}}{\text{s}} = \frac{3.0\times10^{10}\ \cancel{\text{cm}}}{\text{s}} \cdot \frac{1\ \cancel{\text{m}}}{100\ \cancel{\text{cm}}} \cdot \frac{1\ \cancel{\text{km}}}{1000\ \cancel{\text{m}}} \cdot \frac{1\ \text{AU}}{1.496\times10^8\ \cancel{\text{km}}} = \frac{3.0}{1.496} \cdot \frac{10^{10}}{10^5\times10^8}\frac{\text{AU}}{\text{s}} = 2.005... \cdot \frac{10^{10}}{10^{13}}\frac{\text{AU}}{\text{s}} = 2.005...\times10^{-3}\frac{\text{AU}}{\text{s}} \approx 2.0\times10^{-3}\frac{\text{AU}}{\text{s}}$$

73. 0.75 g

$$= \frac{0.75 \text{ g}}{1} \cdot \frac{1000 \text{ mg}}{\text{g}} \cdot \frac{1 \text{ capsule}}{250 \text{ mg}}$$

$$= 3 \text{ capsules}$$

74. 0.25 g

$$= \frac{0.25 \text{ g}}{1} \cdot \frac{1000 \text{ mg}}{\text{g}} \cdot \frac{5 \text{ mL solution}}{100 \text{ mg}}$$

$$= 12.5 \text{ mL solution}$$

75. $\dfrac{0.849 \text{ Canadian dollars}}{1 \text{ liter}}$

$$= \frac{0.849 \text{ Canadian dollars}}{1 \text{ liter}} \cdot \frac{\$1.00}{1.23 \text{ Canadian dollars}} \times$$

$$\times \frac{1 \text{ liter}}{1.06 \text{ quarts}} \cdot \frac{4 \text{ quarts}}{1 \text{ gal}}$$

$$= 2.60469... \frac{\text{U.S. dollars}}{1 \text{ gal}}$$

$$\approx 2.60 \frac{\text{U.S. dollars}}{1 \text{ gal}}$$

76. $\dfrac{6.5 \text{ Mexican pesos}}{1 \text{ liter}}$

$$= \frac{6.5 \text{ Mexican pesos}}{1 \text{ liter}} \cdot \frac{\$1.00}{10.687 \text{ Mexican pesos}} \times$$

$$\times \frac{1 \text{ liter}}{1.06 \text{ quarts}} \cdot \frac{4 \text{ quarts}}{1 \text{ gal}}$$

$$= 2.29515... \frac{\text{U.S. dollars}}{1 \text{ gal}}$$

$$\approx 2.30 \frac{\text{U.S. dollars}}{1 \text{ gal}}$$

77. 125,000,000 acre-feet

$$= \frac{1.25 \times 10^8 \text{ acre-feet}}{1} \cdot \frac{43{,}560 \text{ ft}^2}{1 \text{ acre}} \cdot \frac{7.481 \text{ gal}}{1 \text{ cubic ft}}$$

$$= 407{,}340.45 \times 10^8 \text{ gal}$$

$$= 4.0734045 \times 10^{13} \text{ gal}$$

$$\approx 4.07 \times 10^{13} \text{ gal}$$

78. 30.04 in of mercury

$$= 30.04 \text{ in of mercury} \cdot \frac{2.54 \text{ cm of mercury}}{1 \text{ in of mercury}} \times$$

$$\times \frac{10 \text{ mm of mercury}}{1 \text{ cm of mercury}} \cdot \frac{101.325 \text{ kilopascals}}{760 \text{ mm of mercury}}$$

$$= \frac{77{,}312.5962}{760} \text{ kilopascals}$$

$$= 101.727100263 \text{ kilopascals}$$

$$\approx 102 \text{ kilopascals}$$

79. $\dfrac{1.5 \times 10^{11} \text{ m}}{3.0 \times 10^8 \ \frac{\text{m}}{\text{s}}}$

$$= \frac{1.5}{3.0} \times \frac{10^{11}}{10^8} \left(\text{m} \div \frac{\text{m}}{\text{s}} \right)$$

$$= 0.5 \times 10^{11-8} \ \text{m} \cdot \frac{\text{s}}{\text{m}}$$

$$= 0.5 \times 10^3 \text{ s}$$

$$= 5 \times 10^2 \text{ s}$$

80. $\dfrac{4.06 \times 10^8 \text{ m}}{3.0 \times 10^8 \ \frac{\text{m}}{\text{s}}}$

$$= \frac{4.06}{3.0} \times \frac{10^8}{10^8} \left(\text{m} \div \frac{\text{m}}{\text{s}} \right)$$

$$= 1.3533... \times 10^0 \ \text{m} \cdot \frac{\text{s}}{\text{m}}$$

$$= 1.35 \text{ s}$$

81. $\left(\dfrac{50 \text{ g } C_8H_{18}}{1} \right) \left(\dfrac{1 \text{ mole } C_8H_{18}}{114 \text{ g } C_8H_{18}} \right) \times$

$$\times \left(\frac{25 \text{ moles } O_2}{2 \text{ moles } C_8H_{18}} \right) \left(\frac{32 \text{ g } O_2}{1 \text{ moles } O_2} \right)$$

$$= \frac{40{,}000}{228} \text{ g oxygen}$$

$$= 175.43859... \text{ g oxygen}$$

$$\approx 175 \text{ g oxygen}$$

82. $\left(\dfrac{500 \text{ g } SiO_2}{1} \right) \left(\dfrac{1 \text{ mole } SiO_2}{60.1 \text{ g } SiO_2} \right) \times$

$$\times \left(\frac{1 \text{ mole } SiCO_2}{1 \text{ mole } SiO_2} \right) \left(\frac{40.1 \text{ g SiC}}{1 \text{ mole SiC}} \right)$$

$$= \frac{20{,}050}{60.1} \text{ g silicon carbide}$$

$$= 333.6106... \text{ g silicon carbide}$$

$$\approx 334 \text{ g silicon carbide}$$

83. $$\frac{\left(5\times10^{-5}\text{ m}\right)^2}{\left(\frac{1.1\times10^{-9}\text{ m}^2}{1\text{ s}}\right)}$$

$$= 5^2\times10^{-10}\text{m}^2\cdot\frac{1\text{ s}}{1.1\times10^{-9}\text{ m}^2}$$

$$=\frac{25}{1.1}\times10^{-10-(-9)}\text{s}$$

$$=22.\overline{72}\times10^{-1}\text{s}$$

$$=2.2\overline{72}\times10^{0}\text{s}$$

$$\approx 2\times10^{0}\text{s}$$

84. $$\frac{\left(5\times10^{-2}\text{ m}\right)^2}{\left(\frac{1.1\times10^{-9}\text{ m}^2}{1\text{ s}}\right)}$$

$$= 5^2\times10^{-4}\text{m}^2\cdot\frac{1\text{ s}}{1.1\times10^{-9}\text{ m}^2}$$

$$=\frac{25}{1.1}\times10^{-4-(-9)}\text{s}$$

$$=22.\overline{72}\times10^{5}\text{s}$$

$$=2.2\overline{72}\times10^{6}\text{s}$$

$$\approx 2\times10^{6}\text{s}$$

85. 10^{12} **86.** 10^{9}

87. **Answers will vary.** For most everyday bank transactions, scientific notation would be cumbersome. The amounts of money involved are not millions, billions or trillions. Using scientific notation for these transactions might lead to confusion and mistakes with exponents.

88. **Answers will vary.** A newborn baby's length is usually measured in inches. The number of inches is not a large number, never approaching even 100 inches. Using scientific notation would be cumbersome and might lead to confusion and mistakes due to decimal points and exponents.

89. $\left(3.2\times10^{8}\right)\left(4.1\times10^{6}\right)$

$$=13.12\times10^{14}$$

$$=1.312\times10^{15}$$

90. $$\frac{1.8\times10^{15}}{2\times10^{-9}}$$

$$=\frac{1.8}{2}\times\frac{10^{15}}{10^{-9}}$$

$$=0.9\times10^{15-(-9)}$$

$$=0.9\times10^{24}$$

$$=9\times10^{23}$$

91. $\left(3.2\times10^{-8}\right)\left(4.1\times10^{-6}\right)$

$$=13.12\times10^{-14}$$

$$=1.312\times10^{-13}$$

92. $$\frac{1.8\times10^{-15}}{2\times10^{-9}}$$

$$=\frac{1.8}{2}\times\frac{10^{-15}}{10^{-9}}$$

$$=0.9\times10^{-15-(-9)}$$

$$=0.9\times10^{-6}$$

$$=9\times10^{-7}$$

93.a. They used the conversion 1 hr = 60 s instead of 1 hr = 60 min and 1 min = 60 s.

93.b. $$35\frac{\text{mi}}{\text{hr}}$$

$$=\frac{35\ \cancel{\text{mi}}}{\cancel{\text{hr}}}\cdot\frac{5280\text{ ft}}{1\ \cancel{\text{mi}}}\cdot\frac{1\ \cancel{\text{hr}}}{60\ \cancel{\text{min}}}\cdot\frac{1\ \cancel{\text{min}}}{60\text{ s}}$$

$$=51.333...\frac{\text{ft}}{\text{s}}$$

$$\approx 51\frac{\text{ft}}{\text{s}}$$

94.a. They assumed that 10 minutes was 0.1 hr.

94.b. $$\text{distance}=\left(60\frac{\text{mi}}{\cancel{\text{hr}}}\right)\left(10\ \cancel{\text{min}}\right)\left(\frac{1\ \cancel{\text{hr}}}{60\ \cancel{\text{min}}}\right)$$

$$\text{distance}=10\text{ mi}$$

95.a. They added mantissas and added exponents.

95.b. $$2\times10^{3}+6\times10^{4}$$

$$=0.2\times10^{4}+6\times10^{4}$$

$$=6.2\times10^{4}$$

96.a. They evaluated 6^3 as 18.

96.b. $\left(6\times10^{-5}\right)^3$

$$=6^3\times\left(10^{-5}\right)^3$$

$$=216\times10^{-15}$$

$$=2.16\times10^{-13}$$

Section 1.5 Applications and Problem Solving

1. **Understand the Problem.** We know the amount of the student's grant and her tuition for two semesters. We don't know the amount remaining in her grant after paying tuition.

Let x = grant amount remaining

Make a Plan. The amount remaining is equal to the amount of the grant minus the amount of her tuition.

Carry Out the Plan.

amount remaining = grant amount – tuition amount

$$x=\$4600-\$4000$$

$$x=\$600$$

Continued on next page

Look Back. We can add what has been spent and what remains ($4000 + $600 = $4600). Since this equals the original amount of her grant, the answer seems reasonable.

Report the Solution. The amount remaining in the student's grant after paying tuition is $600.

2. **Understand the Problem.** We know the current monthly charge and the previous monthly charge. We don't know the increase in the monthly parking charge.
Let x = increase in monthly charge

Make a Plan. The monthly increase in parking equals the current charge minus the previous charge.

Carry Out the Plan.

monthly increase = new charge – previous charge

$$x = \$175 - \$158$$

$$x = \$17$$

Look Back. We can add the increase to the previous charge ($17 + $158 = $175). Since the equals the new amount, the answer seems reasonable.

Report the Solution. The increase in the monthly parking charge is $17.

3. **Understand the Problem.** We know the cost of a double cheeseburger. We don't know the cost of 14 double cheeseburgers. The cost of a vanilla shake is extraneous information.
Let x = cost of 14 double cheeseburgers

Make a Plan. The cost of 14 double cheeseburgers is 14 times the cost of one double cheeseburger.

Carry Out the Plan.

cost of 14 double cheeseburgers =
14(cost of 1 double cheeseburger)

$$x = \left(\frac{14 \ \cancel{\text{cheeseburgers}}}{1}\right)\left(\frac{\$5.25}{1 \ \cancel{\text{cheeseburger}}}\right)$$

$$x = \$73.50$$

Look Back. Estimating, if a cheeseburger costs about $5, then 10 would cost $50. Twenty would cost $100, and so 14 should cost about $75, so this answer is reasonable.

Report the Solution. The cost of 14 double cheeseburgers is $73.50.

4. **Understand the Problem.** We know the cost per gallon of premium gasoline. We need to find the cost of 12 gallons of premium gasoline. The price of regular grade gasoline is extraneous information.
Let x = cost of 12 gallons of premium gasoline

Make a Plan. The cost of 12 gallons of premium gasoline is 12 times the cost of one gallon of premium gasoline.

Continued in next column

Carry Out the Plan.

cost of 12 gallons of premium gasoline =
12(cost of 1 gallon of premium gasoline)

$$x = \frac{12 \ \cancel{\text{gal}}}{1}\left(\frac{\$3.93}{\cancel{\text{gal}}}\right)$$

$$x = \$47.16$$

Look Back. Estimating, if 1 gallon costs about $4, then 12 should be about $48, so the answer is reasonable.

Report the Solution. The cost of 12 gallons of premium grade gasoline is $47.16.

5. **Understand the Problem.** We know the cost to pave 1 square foot and the dimensions of the parking lot. We need to find the cost to pave the parking lot.
Let x = cost to pave a 900 ft by 1200 ft parking lot

Make a Plan. The cost to pave the whole area is equal to the cost per square foot multiplied by the number of square feet. Using the area formula, $A = LW$, we can find the area of the parking lot.

Carry Out the Plan.

cost to pave parking lot =
(cost per square foot)(width of lot)(length of lot)

$$x = \left(\frac{\$3}{\text{ft}^2}\right)(900 \text{ ft})(1200 \text{ ft})$$

$$x = \left(\frac{\$3}{\cancel{\text{ft}^2}}\right)1{,}080{,}000 \ \cancel{\text{ft}^2}$$

$$x = \$3{,}240{,}000$$

Look Back. Estimating, if the lot was 1000 ft by 1000 ft its area would be 1,000,000 ft^2. At $3 per square foot, this area would cost $3,000,000, so the answer is reasonable.

Report the Solution. The cost to pave a parking lot that is 900 feet by 1200 feet is $3,240,000.

6. **Understand the Problem.** We know the cost of 1 yd^2 of carpet and the dimensions of the room. We need to find the cost to carpet the area of the room.
Let x = cost to carpet a 13 ft by 20 ft room

Make a Plan. The cost to carpet the room is equal to the cost per square yard multiplied by the number of square yards. Using the area formula, $A = LW$, we can find the area of the room. We must also convert the room's dimensions from feet to yards.

Continued on next page

Carry Out the Plan.

cost to carpet the room =

(cost per sq. yd)(room's width)(room's length)

$$x = \left(\frac{\$32}{\text{yd}^2}\right)\left(\frac{13\ \cancel{\text{ft}}}{1}\right)\left(\frac{1\ \text{yd}}{3\ \cancel{\text{ft}}}\right)\left(\frac{20\ \cancel{\text{ft}}}{1}\right)\left(\frac{1\ \text{yd}}{3\ \cancel{\text{ft}}}\right)$$

$$x = \left(\frac{\$32}{\cancel{\text{yd}^2}}\right)\left(\frac{13\ \cancel{\text{yd}}}{3}\right)\left(\frac{20\ \cancel{\text{yd}}}{3}\right)$$

$x = \$924.4444...$

$x \approx \$924.44$

Look Back. Estimating, an area 12 ft (= 4 yd) by 21 ft (= 7 yd) would be 28 yd^2. At \$32 per yd^2 that area would cost \$896, so the answer is reasonable.

Report the Solution. It will cost \$924.44 to carpet a 13 ft by 20 ft room.

7. **Understand the Problem.** We know the monthly cost for daycare for preschoolers and for toddlers and that the family has two preschoolers and one toddler. We do not know the cost of daycare for 9 months for two preschoolers and one toddler. The monthly cost for infants is extraneous information.

Let x = cost for 9 months of daycare

Make a Plan. The cost for 1 month of daycare for two preschoolers and one toddler is equal to the number of preschoolers multiplied by the monthly cost for preschoolers plus the number of toddlers multiplied by the monthly cost for toddlers. The total cost for 9 months of daycare is 9 times this number.

Carry Out the Plan.

cost for 9 months of daycare =

(months of daycare)×

[no. of preschoolers(cost per preschooler) +

no. of toddlers(cost per toddler)]

$$x = 9\left[2(\$350) + 1(\$400)\right]$$

$$x = 9\left[\$1100\right]$$

$$x = \$9900$$

Look Back. Estimating, one preschooler would cost about \$3000 for 9 months, so two preschoolers should cost about \$6000. One toddler would cost \$3600 for 9 months. That makes a total of about \$9600 for all three children for 9 months, so the answer seems reasonable.

Report the Solution. The cost for 9 months of daycare for a family of two preschoolers and one toddler is \$9900.

8. **Understand the Problem.** We know the monthly cost for daycare for preschoolers and for infants and that the family has one preschooler and two infants. We do not know the cost of daycare for 9 months for a preschooler and two infants. The monthly cost for toddlers is extraneous information.

Let x = cost for 9 months of daycare

Make a Plan. The cost for 1 month of daycare for one preschooler and two infants is equal to the number of preschoolers multiplied by the monthly cost for preschoolers plus the number of infants multiplied by the monthly cost for infants. The total cost for 9 months of daycare is 9 times this number.

Carry Out the Plan.

cost for 9 months of daycare =

(months of daycare)×

[no. of preschoolers(cost per preschooler) +

no. of infants(cost per infant)]

$$x = 9\left[1(\$350) + 2(\$450)\right]$$

$$x = 9\left[\$1250\right]$$

$$x = \$11,250$$

Look Back. Estimating, one infant would cost about \$4000 for 9 months so two infants should cost about \$8000. One preschooler would cost \$3000 for 9 months. That makes a total of about \$11,000 for all three children for 9 months, so the answer seems reasonable.

Report the Solution. The cost for 9 months of daycare for a family of one preschooler and two infants is \$11,250.

9. **Understand the Problem.** We know the student's current weekly hours and pay and the pay he hopes to get and the amount of his bills. We do not know the number of additional hours he needs to work.

Let x = number of additional hours needed

Make a Plan. To find his earnings, multiply each job's pay by the numbers of hours worked each week. When these two figures are added together, they must equal the total amount of his weekly bills.

Continued on next page

Carry Out the Plan.

(new job's pay)(additional hours) +
(current pay)(current hrs) = amount of weekly bills

$$\left(\frac{\$8.50}{\text{hr}}\right)\left(\frac{x \text{ hrs}}{\text{week}}\right)+\left(\frac{\$7.25}{\text{hr}}\right)\left(\frac{12 \text{ hrs}}{\text{week}}\right)=\frac{\$225}{\text{week}}$$

Removing units and solving:

$$8.5x+(7.25)12=225$$
$$8.5x+87=225$$
$$-87 \quad -87$$
$$8.5x=138$$
$$\frac{8.5x}{8.5}=\frac{138}{8.5}$$
$$x=16.23529...$$
$$x\approx 17 \text{ hrs}$$

Look Back. If we estimate that the student is currently working about 10 hours a week at about \$7 per hour, he is making about \$70. Working an additional 15 hours at nearly \$10 per hour would provide an additional \$150. This would provide a total (weekly) income of about \$220 (nearly the amount of his bills), so the answer is reasonable.

Report the Solution. The student needs to work about 17 additional hours at \$8.50 per hour to pay his monthly bills.

10. **Understand the Problem.** We know the student's current weekly hours and pay and the pay he hopes to get and the amount of his bills. We do not know the number of additional hours he needs to work.

Let x = number of additional hours needed

Make a Plan. To find his earnings, multiply each job's pay by the numbers of hours worked each week. When these two figures are added together, they must equal the total amount of his weekly bills.

Carry Out the Plan.

(new job's pay)(additional hours) +
(current pay)(current hrs) = amount of weekly bills

$$\left(\frac{\$9.25}{\text{hr}}\right)\left(\frac{x \text{ hrs}}{\text{week}}\right)+\left(\frac{\$7.50}{\text{hr}}\right)\left(\frac{18 \text{ hrs}}{\text{week}}\right)=\frac{\$250}{\text{week}}$$

Removing units and solving:

$$9.25x+(7.50)18=250$$
$$9.25x+135=250$$
$$-135 \quad -135$$
$$9.25x=115$$
$$\frac{9.25x}{9.25}=\frac{115}{9.25}$$
$$x=12.432...$$
$$x\approx 13 \text{ hrs}$$

Continued in next column

Look Back. If we estimate that the student is currently working nearly 20 hours a week at about \$7 per hour, she is making about \$140. Working an additional 13 hours at nearly \$10 per hour would provide an additional \$130. This would provide a total (weekly) income of about \$270 (nearly the amount of her bills), so the answer is reasonable.

Report the Solution. The student needs to work about 13 additional hours at \$9.25 per hour to pay her monthly bills.

11. **Understand the Problem.** We know the monthly cost and the cost for each text message for each plan. We don't know the number of text messages at which the cost of the plans are equal.

Let x = number of texts at which plan costs are equal

Make a Plan. The cost of each plan is found by taking the cost per text message multiplied by the number of texts and adding it to the monthly cost. Setting the plan costs equal to each other, we can solve for the (unknown) number of text messages. [Notice that if texts are unlimited then there is no cost for them.]

Carry Out the Plan.

cost for Basic plan = (cost per text)(no. of texts) + monthly cost

cost for Select plan = (cost per text)(no. of texts) + monthly cost

To solve for the unknown, solve the equation:

cost for Basic plan = cost for Select plan

$$\left(\frac{\$0.20}{\text{text}}\right)(x \text{ texts})+\$39.99=\left(\frac{\$0}{\text{text}}\right)(x \text{ texts})+\$59.99$$
$$0.20x+39.99=59.99$$
$$-39.99 \quad -39.99$$
$$0.20x=20$$
$$\frac{0.20x}{0.20}=\frac{20}{0.20}$$
$$x=100$$

Look Back. If text messages for the Basic plan are \$0.20 each, then 100 texts would cost \$20. Add that to the nearly \$40 for the basic plan and you get \$60, which is nearly the cost of the Select plan, so the answer is reasonable.

Report the Solution. The Basic wireless plan and the Select plan cost the same amount if 100 text messages are sent.

12. **Understand the Problem.** We know the monthly cost and the cost per megabyte for each plan. We don't know the number of megabytes of data at which the cost of the plans are equal.

Let x = number of megabytes at which costs are equal

Continued on next page

Make a Plan. The cost of each plan is found by taking the cost per megabyte multiplied by the number of megabytes and adding it to the monthly cost. Setting the plan costs equal to each other, we can solve for the (unknown) number of megabytes.

Carry Out the Plan.

To save space, "megabytes" is abbreviated "MB".

cost for Basic plan = (cost per MB)(no. of MB's) + monthly cost

cost for Select plan = (cost per MB)(no. of MB's) + monthly cost

To solve for the unknown, solve the equation:

cost for Basic plan = cost for Select plan

$$\left(\frac{\$1.99}{\text{MB}}\right)(x\ \text{MB}) + \$59.99 = \left(\frac{\$0}{\text{MB}}\right)(x\ \text{MB}) + \$69.99$$

$$1.99x + 59.99 = 69.99$$

$$-59.99 \quad -59.99$$

$$1.99x = 10$$

$$\frac{1.99x}{1.99} = \frac{10}{1.99}$$

$$x = 5.025\ldots \text{ megabytes}$$

$$x \approx 5 \text{ megabytes}$$

Look Back. If data for the Select plan costs \$1.99 per megabyte, then 5 megabytes would cost about \$10. Add that to the nearly \$60 for the Select plan and you get \$70, which is nearly the cost of the Connect plan, so the answer is reasonable.

Report the Solution. The Select wireless plan and the Connect wireless plan cost the same amount if 5 megabytes of data is transferred.

13. Understand the Problem. We know the number of new citizenship applications for 2007 and 2008. We don't know the decrease in applications from 2007 to 2008. The percent increase and amount of the application fees is extraneous information.

Let x = decrease in new citizenship applications

Make a Plan. The decrease in applications is equal to the number of applications in 2007 minus the number of applications in 2008.

Carry Out the Plan.

decrease in applications = applications in 2007 – applications in 2008

$x = 253,666 \text{ applications} - 58,433 \text{ applications}$

$x = 195,233 \text{ applications}$

Look Back. If we add the number of applications in 2008 to the amount of the decrease, we get the number of applications in 2007, so the answer is reasonable.

Continued in next column

Report the Solution. From 2007 to 2008 there was a decrease of 195,233 in new citizenship applications.

14. Understand the Problem. We know the total number of jobs lost and the number of jobs lost in construction. We don't know the number of non-construction jobs lost. The home price information and percent of workforce figures are extraneous information.

Let x = jobs lost that were not in construction

Make a Plan. To find the number of jobs lost that weren't in construction, subtract the construction jobs lost from the total number of jobs lost.

Carry Out the Plan.

non-construction jobs lost = total jobs lost – construction jobs lost

$x = 136,000 \text{ jobs} - 41,000 \text{ jobs}$

$x = 95,000 \text{ jobs}$

Look Back. If we add the number of construction jobs lost and the number of non-construction jobs lost, we get the total number of jobs lost, so the answer is reasonable.

Report the Solution. In Phoenix last year, there were 95,000 jobs lost that were not in construction.

15. Understand the Problem. We know the amount of water used by the "top single-family" residence and how many typical residential homes this is equivalent to. We do not know the amount of water used by a "typical" home.

Let x = gallons of water used by a "typical" home

Make a Plan. The amount of water used by a "typical" home is equal to the amount used by the "top single-family" residence divided by how many typical homes it is equivalent to.

Carry Out the Plan.

$$\text{"typical" water usage} = \frac{\text{"top single-family" usage}}{\text{equivalent "typical" homes}}$$

$$x = \frac{5.5 \text{ million gallons}}{44 \text{ typical homes}}$$

$$x = \frac{5,500,000}{44}\frac{\text{gallons}}{\text{home}}$$

$$x = 125,000\frac{\text{gallons}}{\text{home}}$$

Look Back. Estimating, if 40 homes use about 100,000 gallons each year, they would use a total of about 4,000,000 gallons of water. If 40 homes used about 150,000 gallons, that would make about 6,000,000 gallons a year. 40 homes using about 125,000 gallons each would make a total of around 5,000,000 gallons, so the answer is reasonable.

Continued on next page

Report the Solution. A "typical" home in in San Diego uses about 125,000 gallons of water each year.

16. Understand the Problem. We know the total cost and length of new toll roads. We don't know the average cost per mile.

Let x = average cost per mile

Make a Plan. The average cost per mile equals the total cost divided by the number of miles.

Carry Out the Plan.

average cost per mile = (total miles) ÷ (total cost)

$$x = \frac{\$2.9 \text{ billion}}{65 \text{ miles}}$$

$$x = \frac{\$2,900,000,000}{65 \text{ miles}}$$

$$x = \frac{\$44,615,384.615...}{\text{mile}}$$

$$x \approx \frac{\$45,000,000}{\text{mile}}$$

Look Back. If each mile costs $45,000,000, then 5 miles would cost nearly $250 million and 50 miles would cost nearly $2500 million, or $2.5 billion, so the answer is reasonable.

Report the Solution. New toll roads in central Texas cost an average of $45 million per mile.

17. Understand the Problem. We know the out-of-state tuition and fees, the number of credits, hours of class time and weeks in the semester. We do not know the cost per class hour. The number of semesters per year is extraneous information.

Make a Plan. The cost per hour is equal to the total cost multiplied by the conversions for semesters to weeks and weeks to hours.

Carry Out the Plan.

Using unit analysis and abbreviating to save space:

$$\frac{\text{cost}}{\text{class hr}} = \frac{\text{cost}}{1 \text{ sem.}} \cdot \frac{1 \text{ sem.}}{\text{no. of wks}} \cdot \frac{1 \text{ wk}}{\text{no. of class hrs}}$$

$$x = \frac{\$6393}{1 \cancel{\text{ semester}}} \cdot \frac{1 \cancel{\text{ semester}}}{16 \cancel{\text{ weeks}}} \cdot \frac{1 \cancel{\text{ week}}}{15 \text{ class hours}}$$

$$x = \frac{\$26.6375}{\text{class hour}}$$

$$x \approx \frac{\$27}{\text{class hour}}$$

Look back. Estimating, if each hour of class costs about $25 and you attended for 16 hours each week, this would cost $400. Doing this for 16 weeks would cost a total of $6400, so the answer seems reasonable.

Report the Solution. For an out-of-state student taking 15 credits at Lewis-Clark State College, the cost is about $27 per hour of class time.

18. Understand the Problem. We know the tuition and fees, the number of credits, hours of class time and weeks in the semester. We do not know the cost per class hour. The number of credits in the student's major is extraneous information.

Let x = cost per class hour

Make a Plan. The cost per hour is equal to the total cost multiplied by the conversions for semesters to weeks and weeks to hours.

Carry Out the Plan.

Using unit analysis and abbreviating to save space:

$$\frac{\text{cost}}{\text{class hr}} = \frac{\text{cost}}{1 \text{ sem.}} \cdot \frac{1 \text{ sem.}}{\text{no. of wks}} \cdot \frac{1 \text{ wk}}{\text{no. of class hrs}}$$

$$x = \frac{\$2298}{1 \cancel{\text{ semester}}} \cdot \frac{1 \cancel{\text{ semester}}}{16 \cancel{\text{ weeks}}} \cdot \frac{1 \cancel{\text{ week}}}{15 \text{ class hours}}$$

$$x = \frac{\$9.575}{\text{class hour}}$$

$$x \approx \frac{\$10}{\text{class hour}}$$

Look back. Estimating, if each hour of class costs about $10 and you attended for 15 hours each week, this would cost $150. Doing this for 10 weeks would cost $1500. For 20 weeks it would cost $3000, so 16 weeks should be about half way between $1500 and $3000, or about $2250, so the answer seems reasonable.

Report the Solution. For a state resident taking 15 credits at Lewis-Clark State College, the cost is about $10 per hour of class time.

19. Understand the Problem. We know the number of dentists per 100,000 people and the population of Kansas. We don't know the number of dentists in Kansas. Information about counties in Kansas and national targets is extraneous.

Let x = number of dentists in Kansas

Make a Plan. To find the number of dentists in Kansas, we make a proportion that sets the ratio of dentists to Kansas' total population to the number of dentists per 100,000 people.

Continued on next page

Carry Out the Plan.

$$\frac{\text{dentists in Kansas}}{\text{population of Kansas}} = \frac{\text{no. of dentists}}{\text{100,000 residents}}$$

$$\frac{x}{\text{2,802,134 residents}} = \frac{\text{36.8 dentists}}{\text{100,000 residents}}$$

To save space, abbreviate "dentists" as "dent." and "residents" as "res.":

$$\frac{x}{\text{2,802,134 res.}} = \frac{\text{36.8 dent.}}{\text{100,000 res.}}$$

$$\cancel{2{,}802{,}134}\left(\frac{x}{\cancel{2{,}802{,}134}}\right) = 2{,}802{,}134\left(\frac{36.8 \text{ dent.}}{100{,}000}\right)$$

$$x = 2{,}802{,}134\left(\frac{36.8 \text{ dentists}}{100{,}000}\right)$$

$$x = 1031.185... \text{ dentists}$$

$$x \approx 1031 \text{ dentists}$$

Look Back. Estimating, if there are 40 dentists for every 100,000 residents, there would be 400 dentists for 1,000,000 residents. Then for 3,000,000 Kansas residents there would be 1200 dentists, so the answer is reasonable.

Report the Solution. There are about 1031 dentists in Kansas.

20. **Understand the Problem.** We know the number of cases of valley fever per 100,000 people and the population of Arizona. We don't know the number of people who contracted valley fever in Arizona.

Let x = number of people who contracted valley fever.

Make a Plan. To find the number cases of valley fever in Arizona, we make a proportion that sets the ratio of cases to Arizona's total population equal to the number of cases per 100,000 people.

Carry Out the Plan.

$$\frac{\text{cases in Arizona}}{\text{population of Arizona}} = \frac{\text{no. of cases}}{\text{100,000 people}}$$

$$\frac{x}{\text{6,166,318 people}} = \frac{\text{91 cases}}{\text{100,000 people}}$$

$$\cancel{6{,}166{,}318}\left(\frac{x}{\cancel{6{,}166{,}318}}\right) = 6{,}166{,}318\left(\frac{91 \text{ cases}}{100{,}000}\right)$$

$$x = 6{,}166{,}318\left(\frac{91 \text{ cases}}{100{,}000}\right)$$

$$x = 5611.349... \text{ cases}$$

$$x \approx 5611 \text{ cases}$$

Look Back. Estimating, if there are 100 cases of valley fever for every 100,000 residents, there should be 600 cases for 600,000 residents. For 6,000,000 Arizona residents there would be 6000 cases, so the answer is reasonable.

Continued in next column

Report the Solution. CDC statistics predict that there were about 5611 cases of valley fever in Arizona in 2006.

21. **Understand the Problem.** We know the total number of students and the percentage in Prince William County relying on school for 2 meals a day. We don't know the number of students relying on schools for 2 meals a day. The percentage for Montgomery County is extraneous.

Let x = number of students relying on school for 2 meals a day

Make a Plan. The number of students relying on schools for 2 meals is equal to the percent of students relying on schools for 2 meals multiplied by the total number of students.

Carry Out the Plan.

$$\text{students relying on school} = \%\text{ relying}\left(\text{total students}\right)$$

$$x = 0.33\left(73{,}657 \text{ students}\right)$$

$$x = 24{,}306.81 \text{ students}$$

$$x \approx 24{,}300 \text{ students}$$

Look Back. Estimating, there are about 75,000 students in the county, and about one-third of those students rely on schools for 2 meals. One-third of 75,000 is 25,000, so the answer is reasonable.

Report the Solution. Of the 73,657 students in Prince William County, about 24,300 rely on schools for two meals a day.

22. **Understand the Problem.** We know the number of people in the study and the percentage who were nauseated. We don't know the number who became nauseated.

Let x = number of people who became nauseated after chemotherapy

Make a Plan. The number of people who became nauseated after chemo is equal to the percentage of those studied multiplied by the total number in the study.

Carry Out the Plan.

$$\text{no. of nauseated people} = \%\text{ nauseated}\left(\text{total people}\right)$$

$$x = 0.70\left(644 \text{ people}\right)$$

$$x = 450.8 \text{ people}$$

$$x \approx 450 \text{ people}$$

Look Back. Estimating, if we take 10% of the 644 people in the study, we get about 60 people. So 70% should be seven times that many, or about 420 people, so the answer is reasonable.

Report the Solution. In a study of 644 people, the maximum number who became nauseated after chemotherapy was 450 people.

23. **Understand the Problem.** We know the total number of full-time positions and how many of them were cut. We need to find the percentage of full-time positions that were cut. The percentage whose working hours were reduced is extraneous information.

Let x = percent of full-time positions cut

Make a Plan. To find the percent of full-time positions cut, we can find the ratio of positions cut to total positions and write it as a percent.

Carry Out the Plan.

$$\text{percent of positions cut} = \frac{\text{positions cut}}{\text{total positions}} \cdot 100\%$$

$$x = \left(\frac{3 \text{ positions}}{15 \text{ positions}}\right) \cdot 100\%$$

$$x = (0.20)100\%$$

$$x = 20\%$$

Look Back. If 10% of the 15 positions were cut, that would be 1.5 positions. So a 20% cut would be twice that, or 3 positions, showing the answer is reasonable.

Report the Solution. At the University of Utah museum, 20% of all full-time positions were cut.

24. **Understand the Problem.** We know the number of problem pay boxes and the total number. We don't know the percent of pay boxes with problems. The number of crews sent to fix them is extraneous information.

Let x = percent of pay boxes with problems

Make a Plan. To find the percent of pay boxes with problems, we can find the ratio of problem pay boxes to total number of pay boxes and write it as a percent.

Carry Out the Plan.

$$\%\text{ of boxes with problems} = \frac{\text{problem boxes}}{\text{total boxes}} \cdot 100\%$$

$$x = \left(\frac{125 \text{ boxes}}{556 \text{ boxes}}\right) \cdot 100\%$$

$$x = (0.22482...)100\%$$

$$x = 22.482...\%$$

$$x \approx 22\%$$

Look Back. Estimating, we know that 10% of 560 boxes is 56 boxes. Then 20% would be twice that, or 112 boxes, so the answer seems reasonable.

Report the Solution. Of the 556 pay boxes in downtown Chicago, about 22% had problems.

25. **Understand the Problem.** We know the monthly cost, the deductible, the percent paid by the employee and the doctor visit cost for the traditional and the PPO plans. We also know how often she expects to visit the doctor and her major medical expenses each year. We do not know the total cost of each plan or the difference in these costs.

Let x = difference between traditional & PPO costs

Make a Plan. The cost of each plan is the sum of the annual cost, the deductible, the percentage of any amount above the deductible, and her cost for doctor visits. The annual cost is 12 times the monthly cost. The cost for doctor visits is the number of visits multiplied by the cost for each visit. To find the difference in costs, subtract the cost of each plan.

Carry Out the Plan.

tradition plan cost = 12(cost per month) + deductible + percent(medical costs beyond deductible) + dost of doctor visits

PPO plan cost = 12(cost per month) + deductible + percent(medical costs beyond deductible) + cost of doctor visits

cost difference = *traditional plan cost – PPO plan cost*

$$x = \left[12(\$29.50) + \$350 + 0.20(\$600 - \$350)\right]$$
$$-\left[12(\$23) + \$250 + 0.15(\$600 - \$250) + 2(\$20)\right]$$

$$x = \left[\$354 + \$350 + \$50\right] - \left[\$276 + \$250 + \$52.50 + \$40\right]$$

$$x = \$754 - \$618.50$$

$$x = \$135.50$$

Look Back. Estimating, the Traditional plan monthly cost is about \$30 per month for 12 months, or \$360. The deductible is \$350. The employee pays 20% of any amount after the deductible. Since she expects \$600 in medical costs, she will pay 20% of about \$300, or \$60. She pays nothing for doctor visits. The approximate cost of the Traditional plan should be the sum of \$360 + \$350 + \$60, or about \$770. For the PPO plan, the monthly cost is about \$25 per month for 12 months, or \$300. The deductible is \$250. The employee pays 15% of any amount after the deductible. Since she expects \$600 in medical costs, she will pay 15% of about \$300, or \$45. In addition, she pays \$20 for each of 2 expected doctor visits, or \$40. The approximate cost of the PPO plan should be the sum of \$300 + \$250 + \$45 + \$40, or about \$635. Since the difference of these costs (\$770 – \$635 = \$135) is very close to our answer, the answer seems reasonable.

Report the Solution. The difference in annual cost between the Traditional plan and the PPO plan is \$135.50.

26. **Understand the Problem.** We know the monthly cost, the deductible amount, the percent paid by the employee and the doctor visit cost for the traditional and the PPO plans. We also know how often he expects to visit the doctor and his major medical expenses each year. We do not know the total cost of each plan or the difference in these costs.

Let $x =$ difference between traditional & PPO costs

Make a Plan. The cost of each plan is the sum of the annual cost, the deductible, the percentage of any amount above the deductible, and his cost for doctor visits. The annual cost is 12 times the monthly cost. The cost for doctor visits is the number of visits multiplied by the cost for each visit. To find the difference in costs, subtract the cost of each plan.

Carry Out the Plan.

tradition plan cost = 12(cost per month) + deductible + percent(medical costs beyond deductible) + cost of doctor visits

PPO plan cost = 12(cost per month) + deductible + percent(medical costs beyond deductible) + cost of doctor visits

cost difference = *traditional plan cost – PPO plan cost*

$$x = \left[12(\$29.50) + \$350 + 0.20(\$3000 - \$350)\right] - \left[12(\$23) + \$250 + 0.15(\$3000 - \$250) + 12(\$20)\right]$$

$$x = \left[\$354 + \$350 + \$530\right] - \left[\$276 + \$250 + \$412.50 + \$240\right]$$

$$x = \$1234 - \$1178.50$$

$$x = \$55.50$$

Look Back. Estimating, the Traditional plan monthly cost is about \$30 per month for 12 months, or \$360. The deductible is \$350. The employee pays 20% of any amount after the deductible. Since he expects \$3000 in medical costs, he will pay 20% of about \$2600, or \$520. In this plan, he pays nothing for doctor visits. The approximate cost of the Traditional plan should be the sum of these (\$360 + \$350 + \$520), or about \$1230. For the PPO plan, the monthly cost is about \$25 per month for 12 months, or \$300. The deductible is \$250. The employee pays 15% of any amount after the deductible. Since he expects \$3000 in medical costs, he will pay 15% of about \$2700, or about \$400. In addition, he pays \$20 for each of 12 expected doctor visits, or \$240. The approximate cost of the PPO plan should be the sum of these (\$300 + \$250 + \$400 + \$240), or about \$1190. Since the difference of these two costs (\$1230 – \$1190 = \$40) is close to the answer found above, the answer seems reasonable.

Continued in next column

Report the Solution. The difference in annual cost between the Traditional plan and the PPO plan is \$55.50.

27. **Understand the Problem.** We know the Hispanic population in Wisconsin in 2009, and the percent increase from 2000 to 2009. We need to find the Hispanic population in Wisconsin in 2000. The Hispanic population's percent of Wisconsin is extraneous.

Let $x =$ Wisconsin Hispanic population in 2000

Make a Plan. The amount of increase is equal to the percent increase multiplied by the Hispanic population in 2000. Adding this to the Hispanic population in 2000 will give the Hispanic population in 2009.

Carry Out the Plan.

$$2000 \text{ pop.} + \%\text{ increase}(2000 \text{ pop.}) = 2009 \text{ pop.}$$

$$x + 0.482x = 285{,}827$$

$$1.482x = 285{,}827$$

$$\frac{1.482x}{1.482} = \frac{285{,}827}{1.482}$$

$$x = 192{,}865.72...$$

$$x \approx 193{,}000 \text{ people}$$

Look Back. If the Hispanic population was 200,000 people in 2000 and there was about a 50% increase, this would be an increase of about 100,000 people. This would make the total Hispanic population in 2009 about 300,000, so the answer seems reasonable.

Report the Solution. The Hispanic population in Wisconsin in 2000 was about 193,000 people.

28. **Understand the Problem.** We know the number of student athletes competing in 2007-08 and the percent increase. We don't know the number of student athletes who competed in the 1981-82 school year. The number and percent increase in college teams is extraneous information.

Let $x =$ number of student athletes in 1981-1982

Make a Plan. The amount of increase is equal to the percent increase multiplied by the number of students who competed in 1981-82. Adding this value to the number of students in 1981-82 will give the number of students in 2007-08.

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