Elementary and Intermediate Algebra Concepts and Applications 7th edition Bittinger Solutions Manual

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Chapter 2

Equations, Inequalities, and Problem Solving

Exercise Set 2.1

1. The equations $x+3=7$ and $6x=24$ are *equivalent equations*. Choice (c) is correct.

2. The expressions $3(x-2)$ and $3x-6$ are *equivalent expressions*. Choice (b) is correct.

3. A *solution* is a replacement that makes an equation true. Choice (f) is correct.

4. The 9 in $9ab$ is a *coefficient*. Choice (a) is correct.

5. *The multiplication principle* is used to solve $\frac{2}{3}\cdot x=-4$. Choice (d) is correct.

6. *The addition principle* is used to solve $\frac{2}{3}+x=-4$. Choice (e) is correct.

7. Substitute 4 for x.

$$\begin{array}{r|l} 6-x=-2 & \\ \hline 6-4 & -2 \end{array}$$

$$2 \stackrel{?}{=} -2 \quad \text{FALSE}$$

Since the left-hand and right-hand sides differ, 4 is not a solution.

8.

$$\begin{array}{r|l} 6-x=-2 & \\ \hline 6-8 & -2 \end{array}$$

$$-2 \stackrel{?}{=} -2 \quad \text{TRUE}$$

9. Substitute 18 for t.

$$\begin{array}{r|l} \frac{2}{3}t=12 & \\ \hline \frac{2}{3}(18) & 12 \end{array}$$

$$12 \stackrel{?}{=} 12 \quad \text{TRUE}$$

Since the left-hand and right-hand sides are the same, 18 is a solution.

10.

$$\begin{array}{r|l} \frac{2}{3}t=12 & \\ \hline \frac{2}{3}(8) & 12 \end{array}$$

$$\frac{16}{3} \stackrel{?}{=} 12 \quad \text{FALSE}$$

11. Substitute –2 for x.

$$\begin{array}{r|l} x+7=3-x & \\ \hline -2+7 & 3-(-2) \\ & 3+2 \end{array}$$

$$5 \stackrel{?}{=} 5 \quad \text{TRUE}$$

Since the left-hand and right-hand sides are the same, –2 is a solution.

12.

$$\begin{array}{r|l} -4+x=5x & \\ \hline -4+(-1) & 5(-1) \end{array}$$

$$-5 \stackrel{?}{=} -5 \quad \text{TRUE}$$

13. Substitute –20 for n.

$$\begin{array}{r|l} 4-\frac{1}{5}n=8 & \\ \hline 4-\frac{1}{5}(-20) & 8 \\ 4+4 & \end{array}$$

$$8 \stackrel{?}{=} 8 \quad \text{TRUE}$$

Since the left-hand and right-hand sides are the same, –20 is a solution.

14.

$$\begin{array}{r|l} -3=5-\frac{n}{2} & \\ \hline -3 & 5-\frac{4}{2} \\ & 5-2 \end{array}$$

$$-3 \stackrel{?}{=} 3 \quad \text{FALSE}$$

15.

$$x+10=21$$
$$x+10-10=21-10$$
$$x=11$$

Check:

$$\begin{array}{r|l} x+10=21 & \\ \hline 11+10 & 21 \end{array}$$

$$21 \stackrel{?}{=} 21 \quad \text{TRUE}$$

The solution is 11.

16. 38

17.

$$y+7=-18$$
$$y+7-7=-18-7$$
$$y=-25$$

Check:

$$\begin{array}{r|l} y+7=-18 & \\ \hline -25+7 & -18 \end{array}$$

$$-18 \stackrel{?}{=} -18 \quad \text{TRUE}$$

The solution is –25.

18. –19

19.

$$-6=y+25$$
$$-6-25=y+25-25$$
$$-31=y$$

Check:

$$\begin{array}{r|l} -6=y+25 & \\ \hline -6 & -31+25 \end{array}$$

$$-6 \stackrel{?}{=} -6 \quad \text{TRUE}$$

The solution is –31.

20. –13

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21. $x-18=23$

$x-18+18=23+18$

$x=41$

Check: $x-18=23$

$41-18 \mid 23$

$23 \stackrel{?}{=} 23$ TRUE

The solution is 41.

22. 35

23. $12=-7+y$

$7+12=7+(-7)+y$

$19=y$

Check: $12=-7+y$

$12 \mid -7+19$

$12 \stackrel{?}{=} 12$ TRUE

The solution is 19.

24. 23

25. $-5+t=-11$

$5+(-5)+t=5+(-11)$

$t=-6$

Check: $-5+t=-11$

$-5+(-6) \mid -11$

$-11 \stackrel{?}{=} -11$ TRUE

The solution is –6.

26. –15

27. $r+\frac{1}{3}=\frac{8}{3}$

$r+\frac{1}{3}-\frac{1}{3}=\frac{8}{3}-\frac{1}{3}$

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

Check: $r+\frac{1}{3}=\frac{8}{3}$

$\frac{7}{3}+\frac{1}{3} \mid \frac{8}{3}$

$\frac{8}{3} \stackrel{?}{=} \frac{8}{3}$ TRUE

The solution is $\frac{7}{3}$.

28. $\frac{1}{4}$

29. $x-\frac{3}{5}=-\frac{7}{10}$

$x-\frac{3}{5}+\frac{3}{5}=-\frac{7}{10}+\frac{3}{5}$

$x=-\frac{7}{10}+\frac{3}{5}\cdot\frac{2}{2}$

$x=-\frac{7}{10}+\frac{6}{10}$

$x=-\frac{1}{10}$

Check: $x-\frac{3}{5}=-\frac{7}{10}$

$-\frac{1}{10}-\frac{3}{5} \mid -\frac{7}{10}$

$-\frac{1}{10}-\frac{6}{10}$

$-\frac{7}{10} \stackrel{?}{=} -\frac{7}{10}$ TRUE

The solution is $-\frac{1}{10}$.

30. $x-\frac{2}{3}=-\frac{5}{6}$

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

$x=-\frac{1}{6}$

31. $x-\frac{5}{6}=\frac{7}{8}$

$x-\frac{5}{6}+\frac{5}{6}=\frac{7}{8}+\frac{5}{6}$

$x=\frac{7}{8}\cdot\frac{3}{3}+\frac{5}{6}\cdot\frac{4}{4}$

$x=\frac{21}{24}+\frac{20}{24}$

$x=\frac{41}{24}$

Check: $x-\frac{5}{6}=\frac{7}{8}$

$\frac{41}{24}-\frac{5}{6} \mid \frac{7}{8}$

$\frac{41}{24}-\frac{20}{24} \mid \frac{21}{24}$

$\frac{21}{24} \stackrel{?}{=} \frac{21}{24}$ TRUE

The solution is $\frac{41}{24}$.

32. $y-\frac{3}{4}=\frac{5}{6}$

$y=\frac{10}{12}+\frac{9}{12}$

$y=\frac{19}{12}$

33. $-\frac{1}{5}+z=-\frac{1}{4}$

$\frac{1}{5}-\frac{1}{5}+z=\frac{1}{5}-\frac{1}{4}$

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

$z=\frac{4}{20}-\frac{5}{20}$

$z=-\frac{1}{20}$

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Check:
$$-\frac{1}{5}+z=-\frac{1}{4}$$

$-\frac{1}{5}+\left(-\frac{1}{20}\right)$	$-\frac{1}{4}$
$-\frac{4}{20}+\left(-\frac{1}{20}\right)$	$-\frac{5}{20}$

$-\frac{5}{20}\stackrel{?}{=}-\frac{5}{20}$ TRUE

The solution is $-\frac{1}{20}$.

34. $-\frac{2}{3}+y=-\frac{3}{4}$

$y=-\frac{9}{12}+\frac{8}{12}$

$y=-\frac{1}{12}$

35. $m-2.8=6.3$

$m-2.8+2.8=6.3+2.8$

$m=9.1$

Check:
$$m-2.8=6.3$$

$9.1-2.8 \mid 6.3$

$6.3\stackrel{?}{=}6.3$ TRUE

The solution is 9.1.

36. 14

37. $-9.7=-4.7+y$

$4.7+(-9.7)=4.7+(-4.7)+y$

$-5=y$

Check:
$$-9.7=-4.7+y$$

$-9.7 \mid -4.7+(-5)$

$-9.7\stackrel{?}{=}-9.7$ TRUE

The solution is –5.

38. –10.6

39. $8a=56$

$\frac{8a}{8}=\frac{56}{8}$ Dividing both sides by 8

$1\cdot a=7$ Simplifying

$a=7$ Identity property of 1

Check:
$$8a=56$$

$8\cdot 7 \mid 56$

$56\stackrel{?}{=}56$ TRUE

The solution is 7.

40. 12

41. $84=7x$

$\frac{84}{7}=\frac{7x}{7}$ Dividing both sides by 7

$12=1\cdot x$

$12=x$

Check:
$$84=7x$$

$84 \mid 7\cdot 12$

$84\stackrel{?}{=}84$ TRUE

The solution is 12.

42. 5

43. $-x=38$

$-1\cdot x=38$

$-1\cdot(-1\cdot x)=-1\cdot 38$

$1\cdot x=-38$

$x=-38$

Check:
$$-x=38$$

$-(-38) \mid 38$

$38\stackrel{?}{=}38$ TRUE

The solution is –38.

44. –100

45. $-t=-8$

The equation states that the opposite of t is the opposite of 8. Thus, $t=8$. We could also do this exercise as follows.

$-t=-8$

$-1(-t)=-1(-8)$ Multiplying both sides by –1

$t=8$

Check:
$$-t=-8$$

$-(8) \mid -8$

$-8\stackrel{?}{=}-8$ TRUE

The solution is 8.

46. $-68=-r$

Using the reasoning in Exercise 47, we see that $r=68$. We can also multiply both sides of the equation by –1 to get this result. The solution is 68.

47. $-7x=49$

$\frac{-7x}{-7}=\frac{49}{-7}$

$1\cdot x=-7$

$x=-7$

Check:
$$-7x=49$$

$-7(-7) \mid 49$

$49\stackrel{?}{=}49$ TRUE

The solution is –7.

48. –9

49. $0.2m=10$

$\frac{0.2m}{0.2}=\frac{10}{0.2}$

$m=50$

Check:
$$0.2m=10$$

$0.2(50) \mid 10$

$10\stackrel{?}{=}10$ TRUE

The solution is 50.

50. 150

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51. $-1.2x = 0.24$

$$\frac{-1.2x}{-1.2} = \frac{0.24}{-1.2}$$

$$x = -0.2$$

Check:

$$\begin{array}{r|l} -1.2x = 0.24 & \\ \hline -1.2(-0.2) & 0.24 \end{array}$$

$$0.24 \stackrel{?}{=} 0.24 \quad \text{TRUE}$$

The solution is –0.2.

52. –0.5

53. $-1.3a = -10.4$

$$\frac{-1.3a}{-1.3} = \frac{-10.4}{-1.3}$$

$$a = 8$$

Check:

$$\begin{array}{r|l} -1.3a = -10.4 & \\ \hline -1.3(8) & -10.4 \end{array}$$

$$-10.4 \stackrel{?}{=} -10.4 \quad \text{TRUE}$$

The solution is 8.

54. 6

55. $\frac{y}{8} = 11$

$$\frac{1}{8} \cdot y = 11$$

$$8\left(\frac{1}{8}\right) \cdot y = 8 \cdot 11$$

$$y = 88$$

Check:

$$\begin{array}{r|l} \frac{y}{8} = 11 & \\ \hline \frac{88}{8} & 11 \end{array}$$

$$11 \stackrel{?}{=} 11 \quad \text{TRUE}$$

The solution is 88.

56. 52

57. $\frac{4}{5}x = 16$

$$\frac{5}{4} \cdot \frac{4}{5}x = \frac{5}{4} \cdot 16$$

$$x = \frac{5 \cdot \cancel{4} \cdot 4}{\cancel{4} \cdot 1}$$

$$x = 20$$

Check:

$$\begin{array}{r|l} \frac{4}{5}x = 16 & \\ \hline \frac{4}{5} \cdot 20 & 16 \end{array}$$

$$16 \stackrel{?}{=} 16 \quad \text{TRUE}$$

The solution is 20.

58. $\frac{3}{4}x = 27$

$$\frac{4}{3} \cdot \frac{3}{4}x = \frac{4}{3} \cdot 27$$

$$1 \cdot x = \frac{4 \cdot \cancel{3} \cdot 3 \cdot 3}{\cancel{3} \cdot 1}$$

$$x = 36$$

59. $\frac{-x}{6} = 9$

$$-\frac{1}{6} \cdot x = 9$$

$$-6\left(-\frac{1}{6}\right) \cdot x = -6 \cdot 9$$

$$x = -54$$

Check:

$$\begin{array}{r|l} \frac{-x}{6} = 9 & \\ \hline \frac{-(-54)}{6} & 9 \\ \frac{54}{6} & \end{array}$$

$$9 \stackrel{?}{=} 9 \quad \text{TRUE}$$

The solution is –54.

60. $\frac{-t}{4} = 8$

$$-\frac{1}{4} \cdot t = 8$$

$$-4\left(-\frac{1}{4}\right) \cdot t = -4 \cdot 8$$

$$t = -32$$

61. $\frac{1}{9} = \frac{z}{-5}$

$$\frac{1}{9} = -\frac{1}{5} \cdot z$$

$$-5 \cdot \frac{1}{9} = -5 \cdot \left(-\frac{1}{5} \cdot z\right)$$

$$-\frac{5}{9} = z$$

Check:

$$\begin{array}{r|l} \frac{1}{9} = \frac{z}{-5} & \\ \hline \frac{1}{9} & \frac{-5/9}{-5} \\ & -\frac{5}{9} \cdot \frac{1}{-5} \end{array}$$

$$\frac{1}{9} \stackrel{?}{=} \frac{1}{9} \quad \text{TRUE}$$

The solution is $-\frac{5}{9}$.

62. $-\frac{6}{7}$

63. $-\frac{3}{5}r = -\frac{3}{5}$

The solution of the equation is the number that is multiplied by $-\frac{3}{5}$ to get $-\frac{3}{5}$. That number is 1. We could also do this exercise as follows:

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

$$-\frac{5}{3} \cdot \left(-\frac{3}{5}r\right) = -\frac{5}{3}\left(-\frac{3}{5}\right)$$

$$r = 1$$

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Check: $-\frac{3}{5}r = -\frac{3}{5}$

$-\frac{3}{5}\cdot 1$	$-\frac{3}{5}$

$-\frac{3}{5} \stackrel{?}{=} -\frac{3}{5}$ TRUE

The solution is 1.

64. $-\frac{2}{5}y = -\frac{4}{15}$

$-\frac{5}{2}\left(-\frac{2}{5}y\right) = -\frac{5}{2}\cdot\left(-\frac{4}{15}\right)$

$y = -\frac{5\cdot 2\cdot 2}{2\cdot 3\cdot 5}$

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

65. $\frac{-3r}{2} = -\frac{27}{4}$

$-\frac{3}{2}r = -\frac{27}{4}$

$-\frac{2}{3}\cdot\left(-\frac{3}{2}r\right) = -\frac{2}{3}\cdot\left(-\frac{27}{4}\right)$

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

$r = \frac{9}{2}$

Check: $\frac{-3r}{2} = -\frac{27}{4}$

$-\frac{3}{2}\cdot\frac{9}{2}$	$-\frac{27}{4}$

$-\frac{27}{4} \stackrel{?}{=} -\frac{27}{4}$ TRUE

The solution is $\frac{9}{2}$.

66. $\frac{5x}{7} = -\frac{10}{14}$

$\frac{5}{7}x = -\frac{10}{14}$

$\frac{7}{5}\cdot\frac{5}{7}x = \frac{7}{5}\cdot\left(-\frac{10}{14}\right)$

$x = -\frac{7\cdot 5\cdot 2}{5\cdot 2\cdot 7}$

$x = -1$

67. $4.5 + t = -3.1$

$4.5 + t - 4.5 = -3.1 - 4.5$

$t = -7.6$

The solution is –7.6.

68. $\frac{3}{4}x = 18$

$x = \frac{4}{3}\cdot 18$

$x = 24$

69. $-8.2x = 20.5$

$\frac{-8.2x}{-8.2} = \frac{20.5}{-8.2}$

$x = -2.5$

The solution is –2.5.

70. –5.5

71. $x - 4 = -19$

$x - 4 + 4 = -19 + 4$

$x = -15$

The solution is –15.

72. $y - 6 = -14$

$y - 6 + 6 = -14 + 6$

$y = -8$

73. $t - 3 = 8$

$t - 3 + 3 = -8 + 3$

$t = -5$

The solution is –5.

74. $t - 9 = -8$

$t = -8 + 9$

$t = 1$

75. $-12x = 14$

$\frac{-12x}{-12} = \frac{14}{-12}$

$1\cdot x = -\frac{7}{6}$

$x = -\frac{7}{6}$

The solution is $-\frac{7}{6}$.

76. $-15x = 20$

$\frac{-15x}{-15} = \frac{20}{-15}$

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

77. $48 = -\frac{3}{8}y$

$-\frac{8}{3}\cdot 48 = -\frac{8}{3}\left(-\frac{3}{8}y\right)$

$-\frac{8\cdot 3\cdot 16}{3} = y$

$-128 = y$

The solution is –128.

78. $14 = t + 27$

$14 - 27 = t + 27 - 27$

$-13 = t$

79. $a - \frac{1}{6} = -\frac{2}{3}$

$a - \frac{1}{6} + \frac{1}{6} = -\frac{2}{3} + \frac{1}{6}$

$a = -\frac{4}{6} + \frac{1}{6}$

$a = -\frac{3}{6}$

$a = -\frac{1}{2}$

The solution is $-\frac{1}{2}$.

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80.
$$-\frac{x}{6}=\frac{2}{9}$$
$$-6\left(-\frac{x}{6}\right)=-6\cdot\frac{2}{9}$$
$$x=-\frac{4}{3}$$

81.
$$-24=\frac{8x}{5}$$
$$-24=\frac{8}{5}x$$
$$\frac{5}{8}(-24)=\frac{5}{8}\cdot\frac{8}{5}x$$
$$-\frac{5\cdot\cancel{8}\cdot 3}{\cancel{8}\cdot 1}=x$$
$$-15=x$$
The solution is –15.

82.
$$\frac{1}{5}+y=-\frac{3}{10}$$
$$y=-\frac{3}{10}-\frac{2}{10}=-\frac{5}{10}$$
$$y=-\frac{1}{2}$$

83.
$$-\frac{4}{3}t=-12$$
$$-\frac{3}{4}\left(-\frac{4}{3}t\right)=-\frac{3}{4}(-12)$$
$$t=\frac{3\cdot\cancel{4}\cdot 3}{\cancel{4}}$$
$$t=9$$
The solution is 9.

84. $\frac{17}{35}=-x$

The opposite of x is $\frac{17}{35}$, so $x=-\frac{17}{35}$. We could also multiply both sides of the equation by –1 to get this result. The solution is $-\frac{17}{35}$.

85.
$$-483.297=-794.053+t$$
$$-483.297+794.053=-794.053+t+794.053$$
$$310.756=t \quad \text{Using a calculator}$$
The solution is 310.756.

86. Using a calculator we find that the solution is –8655.

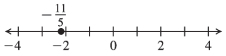
87. *Writing Exercise.* For an equation $x+a=b$, add the opposite of a (or subtract a) on both sides of the equation. For an equation $ax=b$, multiply by $1/a$ (or divide by a) on both sides of the equation.

88. *Writing Exercise.* Equivalent expressions have the same value for all possible replacements for the variables. Equivalent equations have the same solution(s).

89. $\frac{1}{3}y-7$

90. $6(2x+11)=12x+66$

91. $35a+55c+5=5(7a+11c+1)$

92.


93. *Writing Exercise.* Yes, it will form an equivalent equation by the addition principle. It will not help to solve the equation, however. The multiplication principle should be used to solve the equation.

94. *Writing Exercise.* Since $a-c=b-c$ can be rewritten as $a+(-c)=b+(-c)$, it is not necessary to state a subtraction principle.

95.
$$mx=11.6m$$
$$\frac{mx}{m}=\frac{11.6m}{m}$$
$$x=11.6$$
The solution is 11.6.

96.
$$x-4+a=a$$
$$x-4=0$$
$$x=4$$

97.
$$cx+5c=7c$$
$$cx+5c-5c=7c-5c$$
$$cx=2c$$
$$\frac{cx}{c}=\frac{2c}{c}$$
$$x=2$$
The solution is 2.

98.
$$c\cdot\frac{21}{a}=\frac{7cx}{2a}$$
$$\frac{2a}{7c}\cdot c\cdot\frac{21}{a}=\frac{2a}{7c}\cdot\frac{7cx}{2a}$$
$$\frac{2\cdot\cancel{a}\cdot\cancel{c}\cdot 3\cdot\cancel{7}}{\cancel{7}\cdot\cancel{c}\cdot\cancel{a}}=x$$
$$6=x$$

99.
$$7+|x|=30$$
$$-7+7+|x|=-7+30$$
$$|x|=23$$
x represents a number whose distance from 0 is 23. Thus $x=-23$ or $x=23$.

100.
$$ax-3a=5a$$
$$ax=8a$$
$$x=8$$

101.
$$t-3590=1820$$
$$t-3590+3590=1820+3590$$
$$t=5410$$
$$t+3590=5410+3590$$
$$t+3590=9000$$

102.
$$n+268=124$$
$$n+268-268=124-268$$
$$n=-144$$
$$n-268=-144-268$$
$$n-268=-412$$

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103. To "undo" the last step, divide 225 by 0.3.
$225 \div 0.3 = 750$
Now divide 750 by 0.3.
$750 \div 0.3 = 2500$
The answer should be 2500 not 225.

104. *Writing Exercise.* No; –5 is a solution of $x^2 = 25$ but not of $x = 5$.

Exercise Set 2.2

1. To isolate x in $x - 4 = 7$, we would use the *Addition principle*. Add 4 to both sides of the equation.

2. To isolate x in $5x = 8$, we would use the *Multiplication principle*. Multiplying both sides of the equation by $\frac{1}{5}$, or divide both sides by 5.

3. To clear fractions or decimals, we use the *Multiplication principle*.

4. To remove parentheses, we use the *Distributive law*.

5. To solve $3x - 1 = 8$, we use the *Addition principle* first. Add 1 to both sides of the equation.

6. To solve $5(x-1) + 3(x+7) = 2$, we use the *Distributive law* first. Distribute 5 in the first set of parentheses and 3 in the second set.

7. $3x - 1 = 7$
$3x - 1 + 1 = 7 + 1$ Adding 1 to both sides
$3x = 7 + 1$
Choice (c) is correct.

8. $4x + 5x = 12$
$9x = 12$ Combining like terms
Choice (e) is correct.

9. $6(x-1) = 2$
$6x - 6 = 2$ Using the distributive law
Choice (a) is correct.

10. $7x = 9$
$\frac{7x}{7} = \frac{9}{7}$ Dividing both sides by 7
$x = \frac{9}{7}$
Choice (f) is correct.

11. $4x = 3 - 2x$
$4x + 2x = 3 - 2x + 2x$ Adding $2x$ to both sides
$4x + 2x = 3$
Choice (b) is correct.

12. $8x - 5 = 6 - 2x$
$8x - 5 + 5 = 6 - 2x + 5$ Adding 5 to both sides
$8x = 6 - 2x + 5$
$8x + 2x = 6 - 2x + 5 + 2x$ Adding $2x$ to both sides
$8x + 2x = 6 + 5$
Choice (d) is correct.

13. $2x + 9 = 25$
$2x + 9 - 9 = 25 - 9$ Subtracting 9 from both sides
$2x = 16$ Simplifying
$\frac{2x}{2} = \frac{16}{2}$ Dividing both sides by 2
$x = 8$ Simplifying

Check: $2x + 9 = 25$

$2 \cdot 8 + 9$	25
$16 + 9$	

$\overset{?}{25 = 25}$ TRUE

The solution is 8.

14. $5z + 2 = 57$
$5z = 55$
$z = 11$

15. $7t - 8 = 27$
$7t - 8 + 8 = 27 + 8$ Adding 8 to both sides
$7t = 35$
$\frac{7t}{7} = \frac{35}{7}$ Dividing both sides by 7
$t = 5$

Check: $7t - 8 = 27$

$7 \cdot 5 - 8$	27
$35 - 8$	

$\overset{?}{27 = 27}$ TRUE

The solution is 5.

16. $6x - 5 = 2$
$6x = 7$
$x = \frac{7}{6}$

17. $3x - 9 = 1$
$3x - 9 + 9 = 1 + 9$
$3x = 10$
$\frac{3x}{3} = \frac{10}{3}$
$x = \frac{10}{3}$

Check: $3x - 9 = 1$

$3 \cdot \frac{10}{3} - 9$	1
$10 - 9$	

$\overset{?}{1 = 1}$ TRUE

The solution is $\frac{10}{3}$.

18. $5x - 9 = 41$
$5x = 50$
$x = 10$

19. $8z + 2 = -54$
$8z + 2 - 2 = -54 - 2$
$8z = -56$
$\frac{8z}{8} = \frac{-56}{8}$
$z = -7$

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Check:
$$\begin{array}{r|l} 8z+2=-54 & \\ \hline 8(-7)+2 & -54 \\ -56+2 & \end{array}$$
$$\overset{?}{-54=-54} \quad \text{TRUE}$$

The solution is –7.

20. $4x+3=-21$
$4x=-24$
$x=-6$

21. $-37=9t+8$
$-37-8=9t+8-8$
$-45=9t$
$\frac{-45}{9}=\frac{9t}{9}$
$-5=t$

Check:
$$\begin{array}{r|l} -37=9t+8 & \\ \hline -37 & 9\cdot(-5)+8 \\ & -45+8 \end{array}$$
$$\overset{?}{-37=-37} \quad \text{TRUE}$$

The solution is –5.

22. $-39=1+5t$
$-40=5t$
$-8=t$

23. $12-t=16$
$-12+12-t=-12+16$
$-t=4$
$\frac{-t}{-1}=\frac{4}{-1}$
$t=-4$

Check:
$$\begin{array}{r|l} 12-t=16 & \\ \hline 12-(-4) & 16 \\ 12+4 & \end{array}$$
$$\overset{?}{16=16} \quad \text{TRUE}$$

The solution is –4.

24. $9-t=21$
$-t=12$
$t=-12$

25. $-6z-18=-132$
$-6z-18+18=-132+18$
$-6z=-114$
$\frac{-6z}{-6}=\frac{-114}{-6}$
$z=19$

Check:
$$\begin{array}{r|l} -6z-18=-132 & \\ \hline -6\cdot 19-18 & -132 \\ -114-18 & \end{array}$$
$$\overset{?}{-132=-132} \quad \text{TRUE}$$

The solution is 19.

26. $-7x-24=-129$
$-7x=-105$
$x=15$

27. $5.3+1.2n=1.94$
$1.2n=-3.36$
$\frac{1.2n}{1.2}=\frac{-3.36}{1.2}$
$n=-2.8$

Check:
$$\begin{array}{r|l} 5.31+1.2n=1.94 & \\ \hline 5.3+1.2(-2.8) & 1.94 \\ 5.3+(-3.36) & \end{array}$$
$$\overset{?}{1.94=1.94} \quad \text{TRUE}$$

The solution is –2.8.

28. $6.4-2.5n=2.2$
$-2.5n=-4.2$
$n=1.68$

29. $32-7x=11$
$-32+32-7x=-32+11$
$-7x=-21$
$\frac{-7x}{-7}=\frac{-21}{-7}$
$x=3$

Check:
$$\begin{array}{r|l} 32-7x=11 & \\ \hline 32-7\cdot 3 & 11 \\ 32-21 & \end{array}$$
$$\overset{?}{11=11} \quad \text{TRUE}$$

The solution is 3.

30. $27-6x=99$
$-6x=72$
$x=-12$

31. $\frac{3}{5}t-1=8$
$\frac{3}{5}t-1+1=8+1$
$\frac{3}{5}t=9$
$\frac{5}{3}\cdot\frac{3}{5}t=\frac{5}{3}\cdot 9$
$t=\frac{5\cdot\cancel{3}\cdot 3}{\cancel{3}\cdot 1}$
$t=15$

Check:
$$\begin{array}{r|l} \frac{3}{5}t-1=8 & \\ \hline \frac{3}{5}\cdot 15-1 & 8 \\ 9-1 & \end{array}$$
$$\overset{?}{8=8} \quad \text{TRUE}$$

The solution is 15.

32. $\frac{2}{3}t-1=5$
$\frac{2}{3}t=6$
$\frac{3}{2}\cdot\frac{2}{3}t=\frac{3}{2}\cdot 6$
$t=9$

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33. $6+\frac{7}{2}x=-15$

$-6+6+\frac{7}{2}x=-6-15$

$\frac{7}{2}x=-21$

$\frac{2}{7}\cdot\frac{7}{2}x=\frac{2}{7}(-21)$

$x=-\frac{2\cdot 3\cdot \cancel{7}}{\cancel{7}\cdot 1}$

$x=-6$

Check:

$6+\frac{7}{2}x=-15$	
$6+\frac{7}{2}(-6)$	-15
$6+(-21)$	
$-15\overset{?}{=}-15$ TRUE	

The solution is –6.

34. $6+\frac{5}{4}x=-4$

$\frac{5}{4}x=-10$

$x=\frac{4}{5}(-10)$

$x=-8$

35. $-\frac{4a}{5}-8=2$

$-\frac{4a}{5}-8+8=2+8$

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

$-\frac{5}{4}\left(-\frac{4a}{5}\right)=-\frac{5}{4}\cdot 10$

$a=-\frac{5\cdot 5\cdot \cancel{2}}{2\cdot \cancel{2}}$

$a=-\frac{25}{2}$

Check:

$-\frac{4a}{5}-8=2$	
$-\frac{4}{5}\left(-\frac{25}{2}\right)-8$	2
$10-8$	
$2\overset{?}{=}2$ TRUE	

The solution is $-\frac{25}{2}$.

36. $-\frac{8a}{7}-2=4$

$-\frac{8a}{7}=6$

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

$a=-\frac{21}{4}$

37. $6x+10x=18$

$16x=18$ Combining like terms

$\frac{16x}{16}=\frac{18}{16}$

$x=\frac{9}{8}$

Check:

$6x+10x=18$	
$6\left(\frac{9}{8}\right)+10\left(\frac{9}{8}\right)$	18
$\frac{27}{4}+\frac{45}{4}$	
$18\overset{?}{=}18$ TRUE	

The solution is $\frac{9}{8}$.

38. $-3z+8z=45$

$5z=45$

$z=9$

39. $4x-6=6x$

$-6=6x-4x$ Subtracting $4x$ from both sides

$-6=2x$ Simplifying

$\frac{-6}{2}=\frac{2x}{2}$ Dividing both sides by 2

$-3=x$

Check:

$4x-6=6x$	
$4(-3)-6$	$6(-3)$
$-12-6$	-18
$-18\overset{?}{=}-18$ TRUE	

The solution is –3.

40. $7n=2n+4$

$5n=4$

$n=\frac{4}{5}$

41. $2-5y=26-y$

$2-5y+y=26-y+y$ Adding y to both sides

$2-4y=26$ Simplifying

$-2+2-4y=-2+26$ Adding -2 to both sides

$-4y=24$ Simplifying

$\frac{-4y}{-4}=\frac{24}{-4}$ Dividing both sides by -4

$y=-6$

Check:

$2-5y=26-y$	
$2-5(-6)$	$26-(-6)$
$2+30$	$26+6$
$32\overset{?}{=}32$ TRUE	

The solution is –6.

42. $6x-5=7+2x$

$4x=12$ Simplifying

$x=3$

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43. $6x+3=2x+3$

$6x-2x=3-3$

$4x=0$

$\frac{4x}{4}=\frac{0}{4}$

$x=0$

Check:

$6x+3=2x+3$	
$6\cdot 0+3$	$2\cdot 0+3$
$0+3$	$0+3$

$\overset{?}{3=3}$ TRUE

The solution is 0.

44. $5y+3=2y+15$

$3y=12$

$y=4$

45. $5-2x=3x-7x+25$

$5-2x=-4x+25$

$4x-2x=25-5$

$2x=20$

$\frac{2x}{2}=\frac{20}{2}$

$x=10$

Check:

$5-2x=3x-7x+25$	
$5-2\cdot 10$	$3\cdot 10-7\cdot 10+25$
$5-20$	$30-70+25$
-15	$-40+25$

$\overset{?}{-15=-15}$ TRUE

The solution is 10.

46. $10-3x=x-2x+40$

$10-3x=-x+40$

$-2x=30$

$x=-15$

47. $7+3x-6=3x+5-x$

$3x+1=2x+5$ Combining like terms on each side

$3x-2x=5-1$

$x=4$

Check:

$7+3x-6=3x+5-x$	
$7+3\cdot 4-6$	$3\cdot 4+5-4$
$7+12-6$	$12+5-4$
$19-6$	$17-4$

$\overset{?}{13=13}$ TRUE

The solution is 4.

48. $5+4x-7=4x-2-x$

$4x-2=3x-2$

$x=0$

49. $\frac{2}{3}+\frac{1}{4}t=2$

The number 12 is the least common denominator, so we multiply by 12 on both sides.

$12\left(\frac{2}{3}+\frac{1}{4}t\right)=12\cdot 2$

$12\cdot\frac{2}{3}+12\cdot\frac{1}{4}t=24$

$8+3t=24$

$3t=24-8$

$3t=16$

$t=\frac{16}{3}$

Check:

$\frac{2}{3}+\frac{1}{4}t=2$	
$\frac{2}{3}+\frac{1}{4}\left(\frac{16}{3}\right)$	2
$\frac{2}{3}+\frac{4}{3}$	

$\overset{?}{2=2}$ TRUE

The solution is $\frac{16}{3}$.

50. $-\frac{5}{6}+x=-\frac{1}{2}-\frac{2}{3}$

The least common denominator is 6.

$-5+6x=-3-4$

$-5+6x=-7$

$6x=-7+5$

$6x=-2$

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

51. $\frac{2}{3}+4t=6t-\frac{2}{15}$

The number 15 is the least common denominator, so we multiply by 15 on both sides.

$15\left(\frac{2}{3}+4t\right)=15\left(6t-\frac{2}{15}\right)$

$15\cdot\frac{2}{3}+15\cdot 4t=15\cdot 6t-15\cdot\frac{2}{15}$

$10+60t=90t-2$

$10+2=90t-60t$

$12=30t$

$\frac{12}{30}=t$

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

Check:

$\frac{2}{3}+4t=6t-\frac{2}{15}$	
$\frac{2}{3}+4\cdot\frac{2}{5}$	$6\cdot\frac{2}{5}-\frac{2}{15}$
$\frac{2}{3}+\frac{8}{5}$	$\frac{12}{5}-\frac{2}{15}$
$\frac{10}{15}+\frac{24}{15}$	$\frac{36}{15}-\frac{2}{15}$

$\frac{34}{15}\overset{?}{=}\frac{34}{15}$ TRUE

The solution is $\frac{2}{5}$.

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52. $\frac{1}{2}+4m=3m-\frac{5}{2}$

The least common denominator is 2.

$$1+8m=6m-5$$
$$2m=-6$$
$$m=-3$$

53. $\frac{1}{3}x+\frac{2}{5}=\frac{4}{5}+\frac{3}{5}x-\frac{2}{3}$

The number 15 is the least common denominator, so we multiply by 15 on both sides.

$$15\left(\frac{1}{3}x+\frac{2}{5}\right)=15\left(\frac{4}{5}+\frac{3}{5}x-\frac{2}{3}\right)$$
$$15\cdot\frac{1}{3}x+15\cdot\frac{2}{5}=15\cdot\frac{4}{5}+15\cdot\frac{3}{5}x-15\cdot\frac{2}{3}$$
$$5x+6=12+9x-10$$
$$5x+6=2+9x$$
$$5x-9x=2-6$$
$$-4x=-4$$
$$\frac{-4x}{-4}=\frac{-4}{-4}$$
$$x=1$$

Check:

$$\frac{1}{3}x+\frac{2}{5}=\frac{4}{5}+\frac{3}{5}x-\frac{2}{3}$$

$\frac{1}{3}\cdot 1+\frac{2}{5}$	$\frac{4}{5}+\frac{3}{5}\cdot 1-\frac{2}{3}$
$\frac{1}{3}+\frac{2}{5}$	$\frac{4}{5}+\frac{3}{5}-\frac{2}{3}$
$\frac{5}{15}+\frac{6}{15}$	$\frac{12}{15}+\frac{9}{15}-\frac{10}{15}$
$\frac{11}{15}$	$\frac{11}{15}$

$$\frac{11}{15}\stackrel{?}{=}\frac{11}{15}\quad \text{TRUE}$$

The solution is 1.

54. $1-\frac{2}{3}y=\frac{9}{5}-\frac{1}{5}y+\frac{3}{5}$

The least common denominator is 15.

$$15-10y=27-3y+9$$
$$15-10y=36-3y$$
$$-7y=21$$
$$y=-3$$

55. $2.1x+45.2=3.2-8.4x$

Greatest number of decimal places is 1

$$10(2.1x+45.2)=10(3.2-8.4x)$$

Multiplying by 10 to clear decimals

$$10(2.1x)+10(45.2)=10(3.2)-10(8.4x)$$
$$21x+452=32-84x$$
$$21x+84x=32-452$$
$$105x=-420$$
$$x=\frac{-420}{105}$$
$$x=-4$$

Check:

$$2.1x+45.2=3.2-8.4x$$

$2.1(-4)+45.2$	$3.2-8.4(-4)$
$-8.4+45.2$	$3.2+33.6$

$$36.8\stackrel{?}{=}36.8\quad \text{TRUE}$$

The solution is –4.

56. $0.91-0.2z=1.23-0.6z$

$$91-20z=123-60z$$
$$40z=32$$
$$z=\frac{4}{5},\text{ or } 0.8$$

57. $0.76+0.21t=0.96t-0.49$

Greatest number of decimal places is 2

$$100(0.76+0.21t)=100(0.96t-0.49)$$

Multiplying by 100 to clear decimals

$$100(0.76)+100(0.21t)=100(0.96t)-100(0.49)$$
$$76+21t=96t-49$$
$$76+49=96t-21t$$
$$125=75t$$
$$\frac{125}{75}=t$$
$$\frac{5}{3}=t,\text{ or}$$
$$1.\overline{6}=t$$

The answer checks. The solution is $\frac{5}{3}$, or $1.\overline{6}$.

58. $1.7t+8-1.62t=0.4t-0.32+8$

$$170t+800-162t=40t-32+800$$
$$8t+800=40t+768$$
$$-32t=-32$$
$$t=1$$

59. $\frac{2}{5}x-\frac{3}{2}x=\frac{3}{4}x+3$

The least common denominator is 20.

$$20\left(\frac{2}{5}x-\frac{3}{2}x\right)=20\left(\frac{3}{4}x+3\right)$$
$$20\cdot\frac{2}{5}x-20\cdot\frac{3}{2}x=20\cdot\frac{3}{4}x+20\cdot 3$$
$$8x-30x=15x+60$$
$$-22x=15x+60$$
$$-22x-15x=60$$
$$-37x=60$$
$$x=-\frac{60}{37}$$

Check:

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

$\frac{2}{5}\left(-\frac{60}{37}\right)-\frac{3}{2}\left(-\frac{60}{37}\right)$	$\frac{3}{4}\left(-\frac{60}{37}\right)+3$
$-\frac{24}{37}+\frac{90}{37}$	$-\frac{45}{37}+\frac{111}{37}$

$$\frac{66}{37}\stackrel{?}{=}\frac{66}{37}\quad \text{TRUE}$$

The solution is $-\frac{60}{37}$.

60. $\frac{5}{16}y+\frac{3}{8}y=2+\frac{1}{4}y$

The least common denominator is 16.

$$5y+6y=32+4y$$
$$11y=32+4y$$
$$7y=32$$
$$y=\frac{32}{7}$$

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61. $\frac{1}{3}(2x-1)=7$

$3\cdot\frac{1}{3}(2x-1)=3\cdot 7$

$2x-1=21$

$2x=22$

$x=11$

Check:

$\frac{1}{3}(2x-1)=7$	
$\frac{1}{3}(2\cdot 11-1)$	7
$\frac{1}{3}\cdot 21$	

$\overset{?}{7=7}$ TRUE

The solution is 11.

62. $\frac{1}{5}(4x-1)=7$

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

$4x-1=35$

$4x=36$

$x=9$

63. $7(2a-1)=21$

$14a-7=21$ Using the distributive law

$14a=21+7$ Adding 7

$14a=28$

$a=2$ Dividing by 14

Check:

$7(2a-1)=21$	
$7(2\cdot 2-1)$	21
$7(4-1)$	
$7\cdot 3$	

$\overset{?}{21=21}$ TRUE

The solution is 2.

64. $5(3-3t)=30$

$15-15t=30$

$-15t=15$

$t=-1$

65. We can write $11=11(x+1)$ as $11\cdot 1=11(x+1)$. Then $1=x+1$, or $x=0$. The solution is 0.

66. $9=3(5x-2)$

$9=15x-6$

$15=15x$

$1=x$

67. $2(3+4m)-6=48$

$6+8m-6=48$

$8m=48$ Combining like terms

$m=6$

Check:

$2(3+4m)-6=48$	
$2(3+4\cdot 6)-6$	48
$2(3+24)-6$	
$2\cdot 27-6$	
$54-6$	

$\overset{?}{48=48}$ TRUE

The solution is 6.

68. $3(5+3m)-8=7$

$15+9m-8=7$

$9m+7=7$

$9m=0$

$m=0$

69. $2x=x+x$

$2x=2x$ TRUE

Identity; the solution set is all real numbers.

70. $5x-x=x+3x$

$4x=4x$ TRUE

Identity; the solution set is all real numbers.

71. $2r+8=6r+10$

$2r+8-10=6r+10-10$

$2r-2=6r$ Combining like terms

$-2r+2r-2=-2r+6r$

$-2=4r$

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

$-\frac{1}{2}=r$

Check:

$2r+8=6r+10$	
$2\left(-\frac{1}{2}\right)+8$	$6\left(-\frac{1}{2}\right)+10$
$-1+8$	$-3+10$

$\overset{?}{7=7}$ TRUE

The solution is $-\frac{1}{2}$.

72. $3b-2=7b+4$

$3b-6=7b$

$-6=4b$

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

73. $4y-4+y+24=6y+20-4y$

$5y+20=2y+20$

$5y-2y=20-20$

$3y=0$

$y=0$

Check:

$4y-4+y+24=6y+20-4y$	
$4\cdot 0-4+0+24$	$6\cdot 0+20-4\cdot 0$
$0-4+0+24$	$0+20-0$

$\overset{?}{20=20}$ TRUE

The solution is 0.

74. $5y-10+y=7y+18-5y$

$6y-10=2y+18$

$4y=28$

$y=7$

75. $3(x+4)=3(x-1)$

$3x+12=3x-3$

$3x-3x+12=3x-3x-3$

$12=-3$ FALSE

Contradiction; there is no solution.

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76. $5(x-7)=3(x-2)+2x$
$5x-35=3x-6+2x$
$5x-35=5x-6$
$5x-5x-35=5x-5x-6$
$-35=-6$ FALSE
Contradiction; there is no solution.

77. $19-3(2x-1)=7$
$19-6x+3=7$
$22-6x=7$
$-6x=7-22$
$-6x=-15$
$x=\frac{15}{6}$
$x=\frac{5}{2}$
Check:

$19-3(2x-1)=7$	
$19-3\left(2\cdot\frac{5}{2}-1\right)$	7
$19-3(5-1)$	
$19-3(4)$	
$19-12$	

$\overset{?}{7=7}$ TRUE

The solution is $\frac{5}{2}$.

78. $5(d+4)=7(d-2)$
$5d+20=7d-14$
$34=2d$
$17=d$

79. $2(3t+1)-5=t-(t+2)$
$6t+2-5=t-t-2$
$6t-3=-2$
$6t=-2+3$
$6t=1$
$t=\frac{1}{6}$
Check:

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

$\overset{?}{-2=-2}$ TRUE

The solution is $\frac{1}{6}$.

80. $4x-(x+6)=5(3x-1)+8$
$4x-x-6=15x-5+8$
$3x-6=15x+3$
$3x-9=15x$
$-9=12x$
$-\frac{3}{4}=x$

81. $19-(2x+3)=2(x+3)+x$
$19-2x-3=2x+6+x$
$16-2x=3x+6$
$16-6=3x+2x$
$10=5x$
$2=x$
Check:

$19-(2x+3)=2(x+3)+x$	
$19-(2\cdot 2+3)$	$2(2+3)+2$
$19-(4+3)$	$2\cdot 5+2$
$19-7$	$10+2$

$\overset{?}{12=12}$ TRUE

The solution is 2.

82. $13-(2c+2)=2(c+2)+3c$
$13-2c-2=2c+4+3c$
$11-2c=5c+4$
$7=7c$
$1=c$

83. $4+7x=7(x+1)$
$4+7x=7x+7$
$4+7x-7x=7x-7x+7$
$4=7$ FALSE
Contradiction; there is no solution.

84. $3(t+2)+t=2(3+2t)$
$3t+6+t=6+4t$
$4t+6=4t+6$ TRUE
Identity; the solution set is all real numbers.

85. $\frac{3}{4}(3t-4)=15$
$\frac{4}{3}\cdot\frac{3}{4}(3t-4)=\frac{4}{3}\cdot 15$
$3t-4=20$
$3t=24$
$t=8$
Check:

$\frac{3}{4}(3t-4)=15$	
$\frac{3}{4}(3\cdot 8-4)$	15
$\frac{3}{4}\cdot(24-4)$	
$\frac{3}{4}\cdot 20$	

$\overset{?}{15=15}$ TRUE

The solution is 8.

86. $\frac{3}{2}(2x+5)=-\frac{15}{2}$
$\frac{2}{3}\cdot\frac{3}{2}(2x+5)=\frac{2}{3}\left(-\frac{15}{2}\right)$
$2x+5=-5$
$2x=-10$
$x=-5$

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87. $\frac{1}{6}\left(\frac{3}{4}x-2\right)=-\frac{1}{5}$

$30\cdot\frac{1}{6}\left(\frac{3}{4}x-2\right)=30\left(-\frac{1}{5}\right)$

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

$\frac{15}{4}x-10=-6$

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

$4\cdot\frac{15}{4}x=4\cdot4$

$15x=16$

$x=\frac{16}{15}$

Check:

$\frac{1}{6}\left(\frac{3}{4}x-2\right)=-\frac{1}{5}$

$\frac{1}{6}\left(\frac{3}{4}\cdot\frac{16}{15}-2\right)\Big|\ -\frac{1}{5}$

$\frac{1}{6}\left(\frac{4}{5}-2\right)$

$\frac{1}{6}\left(-\frac{6}{5}\right)$

$-\frac{1}{5}\stackrel{?}{=}-\frac{1}{5}$ TRUE

The solution is $\frac{16}{15}$.

88. $\frac{2}{3}\left(\frac{7}{8}-4x\right)-\frac{5}{8}=\frac{3}{8}$

$\frac{7}{12}-\frac{8}{3}x-\frac{5}{8}=\frac{3}{8}$

$14-64x-15=9$ Multiplying by 24

$-64x-1=9$

$-64x=10$

$x=-\frac{10}{64}$

$x=-\frac{5}{32}$

89. $0.7(3x+6)=1.1-(x-3)$

$2.1x+4.2=1.1-x+3$

$2.1x+4.2=-x+4.1$

$10(2.1x+4.2)=10(-x+4.1)$ Clearing decimals

$21x+42=-10x+41$

$21x=-10x+41-42$

$21x=-10x-1$

$31x=-1$

$x=-\frac{1}{31}$

The check is left to the student. The solution is $-\frac{1}{31}$.

90. $0.9(2x-8)=4-(x+5)$

$1.8x-7.2=4-x-5$

$1.8x-7.2=-1-x$

$18x-72=-10-10x$

$28x=62$

$x=\frac{31}{14}$

91. $2(7-x)-20=7x-3(2+3x)$

$14-2x-20=7x-6-9x$

$-2x-6=-2x-6$ TRUE

Identity; the solution set is all real numbers.

92. $5(x-7)=3(x-2)+2x$

$5x-35=3x-6+2x$

$5x-35=5x-6$

$-35=-6$ FALSE

Contradiction; there is no solution.

93. $a+(a-3)=(a+2)-(a+1)$

$a+a-3=a+2-a-1$

$2a-3=1$

$2a=1+3$

$2a=4$

$a=2$

Check:

$a+(a-3)=(a+2)-(a+1)$

$2+(2-3)\ \Big|\ (2+2)-(2+1)$

$2-1\ \Big|\ 4-3$

$1\stackrel{?}{=}1$ TRUE

The solution is 2.

94. $0.8-4(b-1)=0.2+3(4-b)$

$0.8-4b+4=0.2+12-3b$

$8-40b+40=2+120-30b$

$48-40b=122-30b$

$-74=10b$

$-7.4=b$

95. *Writing Exercise.* By adding $t-13$ to both sides of $45-t=13$ we have $32=t$. This approach is preferable since we found the solution in just one step.

96. *Writing Exercise.* Since the rules for order of operations tell us to multiply (and divide) before we add (and subtract), we "undo" multiplications and additions in the opposite order when we solve equations. That is, we add or subtract first and then multiply or divide to isolate the variable.

97. $\frac{2}{9}+\frac{1}{6}=\frac{4}{18}+\frac{3}{18}=\frac{7}{18}$

98. 1

99.

$$\begin{array}{r} 0.111\ldots \\ 9\overline{)1.000} \\ \underline{9} \\ 10 \\ \underline{9} \\ 10 \\ \underline{9} \\ 1 \end{array}$$

$\frac{1}{9}=0.\overline{1}$, so $-\frac{1}{9}=-0.\overline{1}$.

100. 16

101. *Writing Exercise.* Multiply by 100 to clear decimals. Next multiply by 12 to clear fractions. (These steps could be reversed.) Then proceed as usual. The procedure could be streamlined by multiplying by 1200 to clear decimals and fractions in one step.

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102. *Writing Exercise*. First multiply both sides of the equation by $\frac{1}{3}$ to "eliminate" the 3. Then proceed as shown:

$$3x+4=-11$$
$$\frac{1}{3}(3x+4)=\frac{1}{3}(-11)$$
$$x+\frac{4}{3}=-\frac{11}{3}$$
$$x=-\frac{15}{3}$$
$$x=-5$$

103. $8.43x-2.5(3.2-0.7x)=-3.455x+9.04$
$$8.43x-8+1.75x=-3.455x+9.04$$
$$10.18x-8=-3.455x+9.04$$
$$10.18x+3.455x=9.04+8$$
$$13.635x=17.04$$
$$x=1.\overline{2497},\text{ or }\frac{1136}{909}$$

The solution is $1.\overline{2497}$, or $\frac{1136}{909}$.

104. Since we are using a calculator we will not clear the decimals.
$$0.008+9.62x-42.8=0.944x+0.0083-x$$
$$9.62x-42.792=-0.056x+0.0083$$
$$9.676x=42.8003$$
$$x\approx 4.423346424$$

105. $-2[3(x-2)+4]=4(5-x)-2x$
$$-2[3x-6+4]=20-4x-2x$$
$$-2[3x-2]=20-6x$$
$$-6x+4=20-6x$$
$$4=20 \quad \text{Adding } 6x \text{ to both sides}$$

This is a contradiction. No solution.

106. $0=t-(-6)-(-7t)$
$$0=t+6+7t$$
$$0=6+8t$$
$$-6=8t$$
$$-\frac{3}{4}=t$$

107. $3(x+5)=3(5+x)$
$$3x+15=15+3x$$
$$3x+15-15=15-15+3x$$
$$3x=3x$$

Identity; the solution set is all real numbers.

108. $5(x-7)=3(x-2)+2x$
$$5x-35=3x-6+2x$$
$$5x-35=5x-6$$
$$-35=-6$$

This is a contradiction. No solution.

109. $2x(x+5)-3(x^2+2x-1)=9-5x-x^2$
$$2x^2+10x-3x^2-6x+3=9-5x-x^2$$
$$-x^2+4x+3=9-5x-x^2$$
$$4x+3=9-5x \quad \text{Adding } x^2$$
$$4x+5x=9-3$$
$$9x=6$$
$$x=\frac{2}{3}$$

The solution is $\frac{2}{3}$.

110. $9-3x=2(5-2x)-(1-5x)$
$$9-3x=10-4x-1+5x$$
$$9-3x=9+x$$
$$9-9=x+3x$$
$$0=4x$$
$$0=x$$

The solution is 0.

111. $[7-2(8\div(-2))]x=0$

Since $7-2(8\div(-2))\neq 0$ and the product on the left side of the equation is 0, then x must be 0.

112. $\frac{5x+3}{4}+\frac{25}{12}=\frac{5+2x}{3}$
$$12\left(\frac{5x+3}{4}+\frac{25}{12}\right)=12\left(\frac{5+2x}{3}\right)$$
$$12\left(\frac{5x+3}{4}\right)+12\cdot\frac{25}{12}=4(5+2x)$$
$$3(5x+3)+25=4(5+2x)$$
$$15x+9+25=20+8x$$
$$15x+34=20+8x$$
$$7x=-14$$
$$x=-2$$

The solution is –2.

113. Let x represent the number of miles.
Translating we have:

$$\frac{3}{200}x+\frac{1}{4}(2)=8$$

Solve the equation for x.

$$\frac{3}{200}x+\frac{1}{4}(2)=8$$
$$\frac{3}{200}x+\frac{1}{2}=8$$
$$200\left(\frac{3}{200}x+\frac{1}{2}\right)=200(8)$$
$$3x+100=1600$$
$$3x=1500$$
$$\frac{3x}{3}=\frac{1500}{3}$$
$$x=500$$

He will drive 500 miles.

Exercise Set 2.3

1. False. For example, π represents a constant.

2. True

3. The distance around a circle is its *circumference*.

4. An equation that uses two or more letters to represent a relationship among quantities is a *formula*.

5. We substitute 0.9 for t and calculate d.
$$d=344t=344\cdot 0.9=309.6$$
The fans were 309.6 m from the stage.

6. $B=30\cdot 1800=54{,}000$ Btu's.

7. We substitute 21,345 for n and calculate f.
$$f=\frac{n}{15}=\frac{21{,}345}{15}=1423$$
There are 1423 full-time equivalent students.

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8. $M = \frac{1}{5} \cdot 10 = 2$ mi.

9. We substitute 0.025 for I and 0.044 for U and calculate f.

$$\begin{aligned} f &= 8.5 + 1.4(I - U) \\ &= 8.5 + 1.4(0.025 - 0.044) \\ &= 8.5 + 1.4(-0.019) \\ &= 8.5 - 0.0266 \\ &= 8.4734 \end{aligned}$$

The federal funds rate should be 8.4734.

10. $D = \frac{c}{w} = \frac{84}{8} = 10.5$ calories/oz

11. Substitute 1 for t and calculate n.

$$\begin{aligned} n &= 0.5t^4 + 3.45t^3 - 96.65t^2 + 347.7t \\ &= 0.5(1)^4 + 3.45(1)^3 - 96.65(1)^2 + 347.7(1) \\ &= 0.5 + 3.45 - 96.65 + 347.7 \\ &= 255 \end{aligned}$$

255 mg of ibuprofen remain in the bloodstream.

12. $N = 7^2 - 7 = 49 - 7 = 42$ games

13. $A = bh$

$\frac{A}{h} = \frac{bh}{h}$ Dividing both sides by h

$\frac{A}{h} = b$

14. $\frac{A}{b} = h$

15. $I = Prt$

$\frac{I}{rt} = \frac{Prt}{rt}$ Dividing both sides by rt

$\frac{I}{rt} = P$

16. $\frac{I}{Pr} = t$

17. $H = 65 - m$

$H + m = 65$ Adding m to both sides

$m = 65 - H$ Subtracting H from both sides

18. $d + 64 = h$

19. $P = 2l + 2w$

$P - 2w = 2l + 2w - 2w$ Subtracting $2w$ from both sides

$P - 2w = 2l$

$\frac{P - 2w}{2} = \frac{2l}{2}$ Dividing both sides by 2

$\frac{P - 2w}{2} = l$, or $\frac{P}{2} - w = l$

20. $P = 2l + 2w$

$P - 2l = 2w$

$\frac{P - 2l}{2} = w$, or

$\frac{P}{2} - l = w$

21. $A = \pi r^2$

$\frac{A}{r^2} = \frac{\pi r^2}{r^2}$

$\frac{A}{r^2} = \pi$

22. $\frac{A}{\pi} = r^2$

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

$2A = 2 \cdot \frac{1}{2}bh$ Multiplying both sides by 2

$2A = bh$

$\frac{2A}{b} = \frac{bh}{b}$ Dividing both sides by h

$\frac{2A}{b} = h$

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

$2A = bh$

$\frac{2A}{h} = b$

25. $E = mc^2$

$\frac{E}{m} = \frac{mc^2}{m}$ Dividing both sides by m

$\frac{E}{m} = c^2$

26. $\frac{E}{c^2} = m$

27. $Q = \frac{c + d}{2}$

$2Q = 2 \cdot \frac{c + d}{2}$ Multiplying both sides by 2

$2Q = c + d$

$2Q - c = c + d - c$ Subtracting c from both sides

$2Q - c = d$

28. $A = \frac{a + b + c}{3}$

$3A = 3 \cdot \frac{a + b + c}{3}$

$3A = a + b + c$

$3A - a - c = a + b + c - a - c$ Subtracting a and c from both sides

$3A - a - c = b$

29. $p - q + r = 2$

$p + r = 2 + q$

$p + r - 2 = q$

30. $p = \frac{r - q}{2}$

$2 \cdot p = 2 \cdot \frac{r - q}{2}$ Multiplying both sides by 2

$2p = r - q$

$q + 2p = r$

$q = r - 2p$

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31. $w = \frac{r}{f}$

$f \cdot w = f \cdot \frac{r}{f}$ Multiplying both sides by f

$fw = r$

32. $M = \frac{A}{s}$

$s \cdot M = s \cdot \frac{A}{s}$ Multiplying both sides by s

$sM = A$

33. $H = \frac{TV}{550}$

$\frac{550}{V} \cdot H = \frac{550}{V} \cdot \frac{TV}{550}$ Multiplying both sides by $\frac{550}{V}$

$\frac{550H}{V} = T$

34. $P = \frac{ab}{c}$

$\frac{c}{a} \cdot P = \frac{c}{a} \cdot \frac{ab}{c}$

$\frac{Pc}{a} = b$

35. $F = \frac{9}{5}C + 32$

$F - 32 = \frac{9}{5}C$

$\frac{5}{9}(F - 32) = \frac{5}{9} \cdot \frac{9}{5}C$

$\frac{5}{9}(F - 32) = C$

36. $M = \frac{5}{9}n + 18$

$M - 18 = \frac{5}{9}n$

$\frac{9}{5}(M - 18) = n$

37. $2x - y = 1$

$2x - y + y - 1 = 1 + y - 1$ Adding $y - 1$ to both sides

$2x - 1 = y$

38. $3x - y = 7$

$3x - 7 = y$

39. $2x + 5y = 10$

$5y = -2x + 10$

$y = \frac{-2x + 10}{5}$

$y = -\frac{2}{5}x + 2$

40. $3x + 2y = 12$

$2y = -3x + 12$

$y = -\frac{3}{2}x + 6$

41. $4x - 3y = 6$

$-3y = -4x + 6$

$y = \frac{-4x + 6}{-3}$

$y = \frac{4}{3}x - 2$

42. $5x - 4y = 8$

$-4y = -5x + 8$

$y = \frac{5}{4}x - 2$

43. $9x + 8y = 4$

$8y = -9x + 4$

$y = \frac{-9x + 4}{8}$

$y = -\frac{9}{8}x + \frac{1}{2}$

44. $x + 10y = 2$

$10y = -x + 2$

$y = -\frac{1}{10}x + \frac{1}{5}$

45. $3x - 5y = 8$

$-5y = -3x + 8$

$y = \frac{-3x + 8}{-5}$

$y = \frac{3}{5}x - \frac{8}{5}$

46. $7x - 6y = 7$

$-6y = -7x + 7$

$y = \frac{7}{6}x - \frac{7}{6}$

47. $z = 13 + 2(x + y)$

$z - 13 = 2(x + y)$

$z - 13 = 2x + 2y$

$z - 13 - 2y = 2x$

$\frac{z - 13 - 2y}{2} = x$

$\frac{1}{2}z - \frac{13}{2} - y = x$

48. $A = 115 + \frac{1}{2}(p + s)$

$A - 115 = \frac{1}{2}(p + s)$

$2(A - 115) = p + s$

$2(A - 115) - p = s$

49. $t = 27 - \frac{1}{4}(w - l)$

$t - 27 = -\frac{1}{4}(w - l)$

$-4(t - 27) = w - l$ Multiplying by -4

$-4(t - 27) = w - l$

$-4(t - 27) - w = -l$

$4(t - 27) + w = l$ Multiplying by -1

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50.
$$m = 19 - 5(x - n)$$
$$m - 19 = -5(x - n)$$
$$-\frac{1}{5}(m - 19) = x - n$$
$$-\frac{1}{5}(m - 19) - x = -n$$
$$\frac{m - 19}{5} + x = n, \text{ or } n = \frac{m - 19 + 5x}{5}$$

51.
$$A = at + bt$$
$$A = t(a + b) \quad \text{Factoring}$$
$$\frac{A}{a + b} = t \quad \text{Dividing both sides by } a + b$$

52.
$$S = rx + sx$$
$$S = x(r + s)$$
$$\frac{S}{r + s} = x$$

53.
$$A = \frac{1}{2}ah + \frac{1}{2}bh$$
$$2A = 2\left(\frac{1}{2}ah + \frac{1}{2}bh\right)$$
$$2A = ah + bh$$
$$2A = h(a + b)$$
$$\frac{2A}{a + b} = h$$

54.
$$A = P + Prt$$
$$A = P(1 + rt)$$
$$\frac{A}{1 + rt} = P$$

55.
$$R = r + \frac{400(W - L)}{N}$$
$$N \cdot R = N\left(r + \frac{400(W - L)}{N}\right) \quad \text{Multiplying both sides by } N$$
$$NR = Nr + 400(W - L)$$
$$NR = Nr + 400W - 400L$$
$$NR + 400L = Nr + 400W \quad \text{Adding } 400L \text{ to both sides}$$
$$400L = Nr + 400W - NR \quad \text{Adding } -NR \text{ to both sides}$$
$$L = \frac{Nr + 400W - NR}{400}, \text{ or } L = W - \frac{N(R - r)}{400}$$

56.
$$S = \frac{360A}{\pi r^2}$$
$$Sr^2 = \frac{360A}{\pi}$$
$$r^2 = \frac{360A}{\pi S}$$

57. *Writing Exercise.* Given the formula for converting Celsius temperature C to Fahrenheit temperature F, solve for C. This yields a formula for converting Fahrenheit temperature to Celsius temperature.

58. *Writing Exercise.* Answers may vary. A person who knows the interest rate, the amount of interest to earn, and how long money is in the bank wants to know how much money to invest.

59.
$$-2 + 5 - (-4) - 17 = -2 + 5 + 4 - 17$$
$$= 3 + 4 - 17 = 7 - 17 = -10$$

60. $-98 \div \frac{1}{2} = -196$

61. $4.2(-11.75)(0) = 0$

62. $(-2)^5 = -32$

63.
$20 \div (-4) \cdot 2 - 3$
$= -5 \cdot 2 - 3$ Dividing and
$= -10 - 3$ multiplying from left to right
$= -13$ Subtracting

64. $5|8 - (2 - 7)| = 5|8 - (-5)| = 5|13| = 5 \cdot 13 = 65$

65. *Writing Exercise.* Answers may vary. A decorator wants to have a carpet cut for a bedroom. The perimeter of the room is 54 ft and its length is 15 ft. How wide should the carpet be?

66. *Writing Exercise.* Since h occurs on both sides of the formula, Eva has not solved the formula for h. The letter being solved for should be alone on one side of the equation with no occurrence of that letter on the other side.

67.
$$K = 21.235w + 7.75h - 10.54a + 102.3$$
$$2852 = 21.235(80) + 7.75(190) - 10.54a + 102.3$$
$$2852 = 1698.8 + 1472.5 - 10.54a + 102.3$$
$$2852 = 3273.6 - 10.54a$$
$$-421.6 = -10.54a$$
$$40 = a$$
The man is 40 years old.

68. To find the number of 100 meter rises in h meters we divide: $\frac{h}{100}$. Then
$$T = t - \frac{h}{100}$$
Note that $12 \text{ km} = 12 \text{ km} \cdot \frac{1000 \text{ m}}{1 \text{ km}} = 12{,}000 \text{ m}$.
Thus, we have
$$T = t - \frac{h}{100}, \ 0 \le h \le 12{,}000.$$

69. First we substitute 54 for A and solve for s to find the length of a side of the cube.
$$A = 6s^2$$
$$54 = 6s^2$$
$$9 = s^2$$
$$3 = s \quad \text{Taking the positive square root}$$
Now we substitute 3 for s in the formula for the volume of a cube and compute the volume.
$$V = s^3 = 3^3 = 27$$
The volume of the cube is 27 in^3.

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70. $8 \text{ ft} = 96 \text{ in.}$

$$700 = \frac{96g^2}{800}$$
$$560{,}000 = 96g^2$$
$$\frac{560{,}000}{96} = g^2$$
$$76.4 \approx g$$

The girth is about 76.4 in.

71. $c = \frac{w}{a} \cdot d$

$$ac = a \cdot \frac{w}{a} \cdot d$$
$$ac = wd$$
$$a = \frac{wd}{c}$$

72. $\frac{y}{z} \div \frac{z}{t} = 1$

$$\frac{y}{z} \cdot \frac{t}{z} = 1$$
$$\frac{yt}{z^2} = 1$$
$$\frac{z^2}{t} \cdot \frac{yt}{z^2} = \frac{z^2}{t} \cdot 1$$
$$y = \frac{z^2}{t}$$

73. $ac = bc + d$

$$ac - bc = d$$
$$c(a - b) = d$$
$$c = \frac{d}{a - b}$$

74. $qt = r(s + t)$

$$qt = rs + rt$$
$$qt - rt = rs$$
$$t(q - r) = rs$$
$$t = \frac{rs}{q - r}$$

75. $3a = c - a(b + d)$

$$3a = c - ab - ad$$
$$3a + ab + ad = c$$
$$a(3 + b + d) = c$$
$$a = \frac{c}{3 + b + d}$$

76. We subtract the minimum output for a well-insulated house with a square feet from the minimum output for a poorly-insulated house with a square feet. Let S represent the number of BTU's saved.

$$S = 50a - 30a$$
$$S = 20a$$

77. $K = 21.235w + 7.75h - 10.54a + 102.3$

$$K = 21.235\left(\frac{w}{2.2046}\right) + 7.75\left(\frac{h}{0.3937}\right) - 10.54a + 102.3$$
$$K = 9.632w + 19.685h - 10.54a + 102.3$$

Mid-Chapter Review

1. $2x + 3 - 3 = 10 - 3$

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

The solution is $\frac{7}{2}$.

2. $6 \cdot \frac{1}{2}(x - 3) = 6 \cdot \frac{1}{3}(x - 4)$

$$3(x - 3) = 2(x - 4)$$
$$3x - 9 + 9 = 2x - 8 + 9$$
$$3x - 9 = 2x - 8$$
$$3x = 2x + 1$$
$$3x - 2x = 2x + 1 - 2x$$
$$x = 1$$

3. $x - 2 = -1$

$$x - 2 + 2 = -1 + 2$$
$$x = 1$$

The solution is 1.

4. $2 - x = -1$

$$-x = -3$$
$$-1(-x) = -1(-3)$$
$$x = 3$$

5. $3t = 5$

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

The solution is $\frac{5}{3}$.

6. $-\frac{3}{2}x = 12$

$$-\frac{2}{3}\left(-\frac{3}{2}x\right) = -\frac{2}{3} \cdot 12$$
$$x = -8$$

7. $\frac{y}{8} = 6$

$$8 \cdot \frac{y}{8} = 8 \cdot 6$$
$$y = 48$$

The solution is 48.

8. $0.06x = 0.03$

$$\frac{0.06x}{0.06} = \frac{0.03}{0.06}$$
$$x = 0.5$$

9. $3x - 7x = 20$

$$-4x = 20$$
$$\frac{-4x}{-4} = \frac{20}{-4}$$
$$x = -5$$

The solution is -5.

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10. $9x-7=17$
$9x=24$
$x=\frac{8}{3}$

11. $4(t-3)-t=6$
$4t-12-t=6$
$3t-12=6$
$3t-12+12=6+12$
$3t=18$
$\frac{3t}{3}=\frac{18}{3}$
$t=6$
The solution is 6.

12. $8n-(3n-5)=5-n$
$8n-3n+5=5-n$
$5n+5=5-n$
$6n+5=5$
$6n=0$
$n=0$

13. $\frac{9}{10}y-\frac{7}{10}=\frac{21}{5}$
$10\left(\frac{9}{10}y-\frac{7}{10}\right)=10\left(\frac{21}{5}\right)$
$9y-7=42$
$9y-7+7=42+7$
$9y=49$
$\frac{9y}{9}=\frac{49}{9}$
$y=\frac{49}{9}$
The solution is $\frac{49}{9}$.

14. $2(t-5)-3(2t-7)=12-5(3t+1)$
$2t-10-6t+21=12-15t-5$
$-4t+11=7-15t$
$11t+11=7$
$11t=-4$
$t=-\frac{4}{11}$

15. $\frac{2}{3}(x-2)-1=-\frac{1}{2}(x-3)$
$6\cdot\left(\frac{2}{3}(x-2)-1\right)=6\cdot\left(-\frac{1}{2}(x-3)\right)$
$4(x-2)-6=-3(x-3)$
$4x-8-6=-3x+9$
$4x-14=-3x+9$
$4x-14+3x=-3x+9+3x$
$7x-14=9$
$7x=9+14$
$7x=23$
$\frac{7x}{7}=\frac{23}{7}$
$x=\frac{23}{7}$
The solution is $\frac{23}{7}$.

16. $E=wA$
$\frac{E}{w}=A$

17. $Ax+By=C$
$By=C-Ax$
$\frac{By}{B}=\frac{C-Ax}{B}$
$y=\frac{C-Ax}{B}$

18. $at+ap=m$
$a(t+p)=m$
$a=\frac{m}{t+p}$

19. $m=\frac{F}{a}$
$a\cdot m=a\cdot\frac{F}{a}$
$am=F$
$\frac{am}{m}=\frac{F}{m}$
$a=\frac{F}{m}$

20. $v=\frac{b-f}{t}$
$t\cdot v=t\cdot\frac{b-f}{t}$
$tv=b-f$
$tv+f=b$

Exercise Set 2.4

1. To convert from percent notation to decimal notation, move the decimal point two places to the *left* and drop the percent symbol.

2. The percent symbol, %, means "per *hundred*."

3. The expression 1.3% is written in *percent* notation.

4. The word "of" in a percent problem generally refers to the *base* amount.

5. The *sale* price is the original price minus the discount.

6. The symbol ≈ means "is *approximately* equal to."

7. "What percent of 57 is 23?" can be translated as $n\cdot 57=23$, so choice (d) is correct.

8. "What percent of 23 is 57?" can be translated as $n\cdot 23=57$, so choice (c) is correct.

9. "23 is 57% of what number?" can be translated as $23=0.57y$, so choice (e) is correct.

10. "57 is 23% of what number?" can be translated as $57=0.23y$, so choice (b) is correct.

11. "57 is what percent of 23?" can be translated as $n\cdot 23=57$, so choice (c) is correct.

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12. "23 is what percent of 57?" can be translated as $n \cdot 57 = 23$, so choice (d) is correct.

13. "What is 23% of 57?" can be translated as $a = (0.23)57$, so choice (f) is correct.

14. "What is 57% of 23?" can be translated as $a = (0.57)23$, so choice (a) is correct.

15. "23% of what number is 57?" can be translated as $57 = 0.23y$, so choice (b) is correct.

16. "57% of what number is 23?" can be translated as $23 = 0.57y$, so choice (e) is correct.

17. $47\% = 47.0\%$

$47\% \quad 0.47.0$

Move the decimal point 2 places to the left.

$47\% = 0.47$

18. $55\% = 0.55$

19. $5\% = 5.0\%$

$5\% \quad 0.05.0$

Move the decimal point 2 places to the left.

$5\% = 0.05$

20. $3\% = 0.03$

21. $3.2\% = 3.20\%$

$3.2\% \quad 0.03.20$

Move the decimal point 2 places to the left.

$3.2\% = 0.032$

22. $41.6\% = 0.416$

23. $10\% = 10.0\%$

$10\% \quad 0.10.0$

Move the decimal point 2 places to the left.

$10\% = 0.10$, or 0.1

24. $60\% = 0.60$, or 0.6

25. $6.25\% \quad 0.06.25$

Move the decimal point 2 places to the left.

$6.25\% = 0.0625$

26. $8.375\% = 0.08375$

27. $0.2\% \quad 0.00.2$

Move the decimal point 2 places to the left.

$0.2\% = 0.002$

28. $0.8\% = 0.008$

29. $175\% = 175.0\% \quad 1.75.0$

Move the decimal point 2 places to the left.

$175\% = 1.75$

30. $250\% = 2.50$, or 2.5

31. 0.21

First move the decimal point two places to the right; then write a % symbol: $0.21. \rightarrow 21\%$

32. $0.17 = 17\%$

33. 0.047

First move the decimal point two places to the right; then write a % symbol: $0.04.7 \rightarrow 4.7\%$

34. $0.019 = 1.9\%$

35. 0.7

First move the decimal point two places to the right; then write a % symbol: $0.70. \rightarrow 70\%$

36. $0.01 = 10\%$

37. 0.0009

First move the decimal point two places to the right; then write a % symbol: $0.00.09 \rightarrow 0.09\%$

38. $0.0056 = 0.56\%$

39. 1.06

First move the decimal point two places to the right; then write a % symbol: $1.06. \rightarrow 106\%$

40. $1.08 = 108\%$

41. $\frac{3}{5}$ $\left(\text{Note: } \frac{3}{5} = 0.6\right)$

Move the decimal point two places to the right; then write a % symbol: $0.60. \rightarrow 60\%$

42. $\frac{3}{2} = 1.50 = 150\%$

43. $\frac{8}{25}$ $\left(\text{Note: } \frac{8}{25} = 0.32\right)$

First move the decimal point two places to the right; then write a % symbol: $0.32. \rightarrow 32\%$

44. $\frac{5}{8} = 0.625 = 62.5\%$

45. ***Translate***.

$$\underbrace{\text{What percent}} \quad \text{of} \quad 76 \quad \text{is} \quad 19?$$

$$\downarrow \qquad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$

$$y \qquad \cdot \quad 76 \quad = \quad 19$$

We solve the equation and then convert to percent notation.

$$y \cdot 76 = 19$$

$$y = \frac{19}{76}$$

$$y = 0.25 = 25\%$$

The answer is 25%.

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46. Solve and convert to percent notation:

$$x \cdot 125 = 30$$
$$x = 0.24 = 24\%$$

47. ***Translate***.

$$\begin{array}{ccccc} 14 & \text{is} & 30\% & \text{of} & \underbrace{\text{what number}}? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 14 & = & 30\% & \cdot & y \end{array}$$

We solve the equation.

$$14 = 0.3y \quad (30\% = 0.3)$$
$$\frac{14}{0.3} = y$$
$$46.\overline{6} = y$$

The answer is $46.\overline{6}$, or $46\frac{2}{3}$, or $\frac{140}{3}$.

48. Solve: $54 = 24\% \cdot x$

$$225 = x$$

49. ***Translate***.

$$\begin{array}{ccccc} 0.3 & \text{is} & 12\% & \text{of} & \underbrace{\text{what number}}? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 0.3 & = & 12\% & \cdot & y \end{array}$$

We solve the equation.

$$0.3 = 0.12y \quad (12\% = 0.12)$$
$$\frac{0.3}{0.12} = y$$
$$2.5 = y$$

The answer is 2.5.

50. Solve: $7 = 175\% \cdot x$

$$4 = x$$

51. ***Translate***.

$$\begin{array}{ccccc} \underbrace{\text{What number}} & \text{is} & 1\% & \text{of} & \text{one million}? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ y & = & 1\% & \cdot & 1{,}000{,}000 \end{array}$$

We solve the equation.

$$y = 0.01 \cdot 1{,}000{,}000 \quad (1\% = 0.01)$$
$$y = 10{,}000 \quad \text{Multiplying}$$

The answer is 10,000.

52. Solve: $x = 35\% \cdot 240$

$$x = 84$$

53. ***Translate***.

$$\begin{array}{ccccc} \underbrace{\text{What percent}} & \text{of} & 60 & \text{is} & 75? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ y & \cdot & 60 & = & 75 \end{array}$$

We solve the equation and then convert to percent notation.

$$y \cdot 60 = 75$$
$$y = \frac{75}{60}$$
$$y = 1.25 = 125\%$$

The answer is 125%.

54. Any number is 100% of itself, so 70 is 100% of 70. We could also do this exercise as follows: Solve and convert to percent notation:

$$x \cdot 70 = 70$$
$$x = 1 = 100\%$$

55. ***Translate***.

$$\begin{array}{ccccc} \text{What} & \text{is} & 2\% & \text{of} & 40? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & = & 2\% & \cdot & 40 \end{array}$$

We solve the equation.

$$x = 0.02 \cdot 40 \quad (2\% = 0.02)$$
$$x = 0.8 \quad \text{Multiplying}$$

The answer is 0.8.

56. Solve: $z = 40\% \cdot 2$

$$z = 0.8$$

57. Observe that 25 is half of 50. Thus, the answer is 0.5, or 50%. We could also do this exercise by translating to an equation.

Translate.

$$\begin{array}{ccccc} 25 & \text{is} & \underbrace{\text{what percent}} & \text{of} & 50? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 25 & = & y & \cdot & 50 \end{array}$$

We solve the equation and convert to percent notation.

$$25 = y \cdot 50$$
$$\frac{25}{50} = y$$
$$0.5 = y, \text{ or } 50\% = y$$

The answer is 50%.

58. Solve: $0.8 = 2\% \cdot x$

$$40 = x$$

59. ***Translate***.

$$\begin{array}{ccccc} \text{What percent} & \text{of} & 69 & \text{is} & 23? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ y & \cdot & 69 & = & 23 \end{array}$$

We solve the equation and convert to percent notation.

$$y \cdot 69 = 23 \quad y = \frac{23}{69} \quad y = 0.33\overline{3} = 33.\overline{3}\% \text{ or } 33\frac{1}{3}\%$$

The answer is $33.\overline{3}\%$ or $33\,1/3\%$.

60. Solve: $x \cdot 40 = 9$

$$x = 0.225 = 22.5\%$$

61. First we reword and translate, letting c represent pet cats from animal shelters, in millions.

$$\begin{array}{ccccc} \text{What} & \text{is} & 15\% & \text{of} & 95.6? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ c & = & 0.15 & \cdot & 95.6 \end{array}$$

$c = 0.15 \cdot 95.6 = 14.34$

There are 14.34 million cats from animal shelters.

62. Solve: $c = 0.14 \cdot 95.6$

$c = 13.384$ million cats

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63. First we reword and translate, letting c represent pet cats from local animal rescue groups, in millions.

What	is	2%	of	95.6?
↓	↓	↓	↓	↓
c	=	0.02	·	95.6

$c = 0.02 \cdot 95.6 = 1.912$

There are 1.912 million cats from local animal rescue groups.

64. Solve: $c = 0.42 \cdot 95.6$

$c = 40.152$ million cats

65. First we reword and translate, letting c represent the number of credits Cody has completed.

What	is	60%	of	125?
↓	↓	↓	↓	↓
c	=	0.6	·	125

$c = 0.6 \cdot 125 = 75$

Cody has completed 75 credits.

66. Solve: $c = 0.2 \cdot 125$

$c = 25$ credits

67. First we reword and translate, letting b represent the number of at-bats.

172	is	31.4%	of	what number?
↓	↓	↓	↓	↓
172	=	0.314	·	b

$\frac{172}{0.314} = b$

$548 \approx b$

Andrew McCutchen had 548 at-bats.

68. Solve: $395 = 66.2\% \cdot p$

$p \approx 597$ attempts

69. a. First we reword and translate, letting p represent the unknown percent.

What percent	of	$25	is	$4?
↓	↓	↓	↓	↓
p	·	25	=	4

$\frac{p \cdot 25}{25} = \frac{4}{25}$

$p = 0.16 = 16\%$

The tip was 16% of the cost of the meal.

b. We add to find the total cost of the meal, including tip:

$\$25 + \$4 = \$29$

70. a. Solve: $12.76 = p \cdot 58$

$0.22 = p$

The tip was 22% of the meal's cost.

b. $\$58 + \$12.76 = \$70.76$

71. To find the percent of teachers who worked at public and private schools, we first reword and translate, letting p represent the unknown percent.

3.1 million	is	what percent	of	3.5 million?
↓	↓	↓	↓	↓
3.1	=	p	·	3.5

$\frac{3.1}{3.5} = p$

$0.886 \approx p$

$88.6\% \approx p$

About 88.6% of teachers worked in public schools.

To find the percent of teacher who worked in private schools, we subtract:

$100\% - 88.6\% = 11.4\%$

About 11.4% of of teachers worked in private schools.

72. Solve: $49.8 = p \cdot 54.8$

$0.909 = p$

About 90.9% of students were enrolled in public schools. We subtract to find what percent were enrolled in other schools.

$100\% - 90.9\% = 9.1\%$

About 91.1% of students were enrolled in other schools.

73. Let $I =$ the amount of interest Glenn will pay. Then we have:

I	is	6.8%	of	$2400.
↓	↓	↓	↓	↓
I	=	0.068	·	$2400
I	=	$163.20		

Glenn will pay $163.20 interest.

74. Let $I =$ the amount of interest LaTonya will pay.

Solve: $I = 4.50\% \cdot \$3500$

$I = \$157.50$

75. If $n =$ the number of women who had babies in good or excellent health, we have:

n	is	95%	of	300.
↓	↓	↓	↓	↓
n	=	0.95	·	300
n	=	285		

285 women had babies in good or excellent health.

76. Let $n =$ the number of women who had babies in good or excellent health.

Solve: $n = 8\% \cdot 300$

$n = 24$ women

77. A self-employed person must earn 120% as much as a non-self-employed person. Let $a =$ the amount Tia would need to earn, in dollars per hour, on her own for a comparable income.

a	is	120%	of	$16.
↓	↓	↓	↓	↓
a	=	1.2	·	16
a	=	19.20		

Tia would need to earn $19.20 per hour on her own.

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78. Let a = the amount Rik would need to earn, in dollars per hour, on his own for a comparable income.
Solve: $a = 1.2(\$18)$
$a = \$21.60$ per hour

79. We reword and translate.

What percent	of	2.6	is	12?
↓	↓	↓	↓	↓
p	·	2.6	=	12

$$p \cdot 2.6 = 12$$
$$p \approx 462 = 462\%$$

The actual cost exceeds the initial estimate by about 462%.

80. Solve: $p \cdot 20.91 = 0.61$
$p \approx 0.029$
The short course record is faster by 2.9%.

81. First we reword and translate.

What	is	16.5%	of	191?
↓	↓	↓	↓	↓
a	=	0.165	·	191

Solve. We convert 16.5% to decimal notation and multiply.
$a = 0.165 \cdot 191$
$a = 31.515 \approx 31.5$
About 31.5 lb of the author's body weight is fat.

82. Let a = the area of Arizona.
Solve: $a = 19\% \cdot 586,400$
$a = 111,416 \text{ mi}^2$

83. Let m = the number of e-mails that are spam and viruses. Then we have:

What percent	of	294	is	265?
↓	↓	↓	↓	↓
p	·	294	=	265

$$p = \frac{265}{294}$$
$$p \approx 0.90 = 90\%$$

About 90% of e-mail is spam and viruses.

84. Let p = the percent of people who will catch the cold.
Solve: $56 = p \cdot 800$
$p = 0.07$, or 7%

85. The number of calories in a serving of cranberry juice is 240% of the number of calories in a serving of cranberry juice drink. Let c = the number of calories in a serving of cranberry juice. Then we have:

120 calories	is	240%	of	c.
↓	↓	↓	↓	↓
120	=	2.40	·	c

$$\frac{120}{2.40} = c$$
$$50 = c$$

There are 50 calories in a serving cranberry juice.

86. Let s = the sodium content, in mg, in a serving of the dry roasted peanuts.
Solve: $95 = 50\% \cdot s$
$s \approx 190$ mg

87. a. In the survey report, 40% of all sick days on Monday or Friday sounds excessive. However, for a traditional 5-day business week, 40% is the same as $\frac{2}{5}$. That is, just 2 days out of 5.

b. In the FBI statistics, 26% of home burglaries occurring between Memorial Day and Labor Day sounds excessive. However, 26% of a 365-day year is 73 days, For the months of June, July, and August there are at least 90 days. So 26% is less than the rate for other times during the year, or less than expected for a 90-day period.

88. *Writing Exercise*. \$12 is $13\frac{1}{3}\%$ of \$90. He would be considered to be stingy, since the standard tip rate is 15% to 20%.

89. The opposite of $-\frac{1}{3}$ is $\frac{1}{3}$.

90. –3

91. $-(-(-12)) = -12$

92. $(-3x)^2 = 9x^2$

93. *Writing Exercise*. The book is marked up \$30. Since Campus Bookbuyers paid \$30 for the book, this is a 100% markup.

94. *Writing Exercise*. No, the offset is not the same because of the bases for the percents are different. In the first case, the base is the men's salary. In the second case, the base is women's purchases.

If men are paid 100% and women are paid 30% less, then women are paid 70% of mens's salary. So if a man is paid \$100, then a woman would be paid 30% less, or \$70. However \$100 is *not* 30% more than \$70.
30% more than \$70 is 0.30(70) + 70 = \$91.

If men are charged 30% more than women, then an item a woman bought for \$100 would cost a man 30% more, or \$130. However \$100 is *not* 30% less than \$130.
30% less than \$130 is 130 – 0.3(130) = \$91.

95. Let p = the population of Bardville.
Then we have:

1332	is	15%	of	48%	of	the population.
↓	↓	↓	↓	↓	↓	↓
1332	=	0.15	·	0.48	·	p

$$\frac{1332}{0.15(0.48)} = p$$
$$18,500 = p$$

The population of Bardville is 18,500.

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96. Since $4 \text{ ft} = 4 \times 1 \text{ ft} = 4 \times 12 \text{ in.} = 48 \text{ in.}$, we can express 4 ft 8 in. as 48 in. + 8 in., or 56 in. We reword and translate. Let a = Dana's final adult height.

$$\underbrace{56 \text{ in.}}_{\downarrow} \quad \underbrace{\text{is}}_{\downarrow} \quad \underbrace{84.4\%}_{\downarrow} \quad \underbrace{\text{of}}_{\downarrow} \quad \underbrace{\text{adult height}}_{\downarrow}.$$

$$56 = 0.844 \cdot a$$

$$\frac{56}{0.844} = \frac{0.844 \cdot a}{0.844}$$

$$66 \approx a$$

Note that 66 in. = 60 in. + 6 in. = 5 ft 6 in. Dana's final adult height will be about 5 ft 6 in.

97. Since $6 \text{ ft} = 6 \times 1 \text{ ft} = 6 \times 12 \text{ in.} = 72 \text{ in.}$, we can express 6 ft 4 in. as 72 in. + 4 in., or 76 in. We reword and translate. Let a = Jaraan's final adult height.

$$\underbrace{76 \text{ in.}}_{\downarrow} \quad \underbrace{\text{is}}_{\downarrow} \quad \underbrace{96.1\%}_{\downarrow} \quad \underbrace{\text{of}}_{\downarrow} \quad \underbrace{\text{adult height}}_{\downarrow}$$

$$76 = 0.961 \cdot a$$

$$\frac{76}{0.961} = a$$

$$79 \approx a$$

Note that 79 in. = 72 in. + 7 in. = 6 ft 7 in. Jaraan's final adult height will be about 6 ft 7 in.

98. The dropout rate will decrease by 74 – 66, or 8 per thousand over 2 years (2010 to 2012).

$$\frac{74}{1000} - \frac{66}{1000} = \frac{8}{1000}$$

$$\frac{8}{1000} \div 2 \text{ years} = \frac{4}{1000} = 0.004 = 0.4\%$$

The dropout rate is about 0.4% per year. Assuming that the dropout rate will continue to decline by the same amount each year, $\frac{4}{1000}$, the estimates for 2011 and 2009 can be calculated as follows. If the drop out rate drops by about $\frac{4}{1000}$ per year, then the drop out rate in 2011 is $\frac{74}{1000} - \frac{4}{1000} = \frac{70}{1000}$.

So from 2010 to 2009, the drop out rate increases by about $\frac{4}{1000}$ per year: $\frac{74}{1000} + \frac{4}{1000} = \frac{78}{1000}$.

Thus, we estimate the drop out rate to be 0.4% per year. We estimate that the drop out rate in 2009 is 78 per thousand, and the drop out rate in 2011 is 70 per thousand.

99. Using the formula for the area A of a rectangle with length l and width w, $A = l \cdot w$, we first find the area of the photo.

$$A = 8 \text{ in.} \times 6 \text{ in.} = 48 \text{ in}^2$$

Next we find the area of the photo that will be visible using a mat intended for a 5-in. by 7-in. photo.

$$A = 7 \text{ in.} \times 5 \text{ in.} = 35 \text{ in}^2$$

Then the area of the photo that will be hidden by the mat is $48 \text{ in}^2 - 35 \text{ in}^2$, or 13 in^2.

We find what percentage of the area of the photo this represents.

$$\underbrace{\text{What percent}}_{\downarrow} \quad \underbrace{\text{of}}_{\downarrow} \quad \underbrace{48 \text{ in}^2}_{\downarrow} \quad \underbrace{\text{is}}_{\downarrow} \quad \underbrace{13 \text{ in}^2}_{\downarrow}?$$

$$p \cdot 48 = 13$$

$$\frac{p \cdot 48}{48} = \frac{13}{48}$$

$$p \approx 0.27$$

$$p \approx 27\%$$

The mat will hide about 27% of the photo.

100. *Writing Exercise.* The ending salary is the same either way. If s is the original salary, the new salary after a 5% raise followed by an 8% raise is $1.08(1.05s)$. If the raises occur in the opposite order, the new salary is $1.05(1.08s)$. It would be better to receive the 8% raise first, because this increase yields a higher new salary the first year than a 5% raise. By the commutative and associative laws of multiplication we see that these are equal.

101. *Writing Exercise.* Suppose Jorge has x dollars of taxable income. If he makes a \$50 tax-deductible contribution, then he pays tax of $0.3(x - \$50)$, or $0.3x - \$15$ and his assets are reduced by $0.3x - \$15 + \$50$, or $0.3x + \$35$. If he makes a \$40 non-tax-deductible contribution, he pays tax of $0.3x$ and his assets are reduced by $0.3x + \$40$. Thus, it costs him less to make a \$50 tax-deductible contribution.

Exercise Set 2.5

1. In order, the steps are:
1) Familiarize.
2) Translate.
3) Carry out.
4) Check.
5) State.

2. To solve an equation, use the step *Carry out*.

3. To write the answer clearly, use the step *State*.

4. To make and check a guess, use the step *Familiarize*.

5. To reword the problem, use the step *Translate*.

6. To make a table, use the step *Familiarize*.

7. To recall a formula, use the step *Familiarize*.

8. To compare the answer with a prediction from an earlier step, use the step *Check*.

9. ***Familiarize***. Let n = the number. Then three less than two times the number is $2n - 3$.

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Translate.

Three less than twice a number	is	19.
$\downarrow$	$\downarrow$	$\downarrow$
$2n-3$	$=$	19

Carry out. We solve the equation.

$$\begin{aligned} 2n-3&=19\\ 2n&=22 \quad \text{Adding 3}\\ n&=11 \quad \text{Dividing by 2}\end{aligned}$$

Check. Twice 11 is 22, and three fewer is 19. The answer checks.

State. The number is 11.

10. Let n = the number.

Solve: $10n-2=78$

$$n=8$$

11. ***Familiarize***. Let a = the number. Then "five times the sum of 3 and twice some number" translates to $5(2a+3)$.

Translate.

Five times the sum of 3 and twice some number	is	70.
$\downarrow$	$\downarrow$	$\downarrow$
$5(2a+3)$	$=$	70

Carry out. We solve the equation.

$$\begin{aligned} 5(2a+3)&=70\\ 10a+15&=70 \quad \text{Using the distributive law}\\ 10a&=55 \quad \text{Subtracting 15}\\ a&=\frac{11}{2} \quad \text{Dividing by 10}\end{aligned}$$

Check. The sum of $2\cdot\frac{11}{2}$ and 3 is 14, and $5\cdot 14=70$. The answer checks.

State. The number is $\frac{11}{2}$.

12. Let x = the number.

Solve: $2(3x+4)=34$

$$\begin{aligned} 6x+8&=34\\ 6x&=26\\ x&=\frac{13}{3}\end{aligned}$$

13. ***Familiarize***. Let d = the kayaker's distance, in miles, from the finish. Then the distance from the start line is $4d$.

Translate.

Distance from finish	plus	distance from start	is	20.5 mi.
$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$
d	$+$	$4d$	$=$	20.5

Carry out. We solve the equation.

$$\begin{aligned} d+4d&=20.5\\ 5d&=20.5\\ d&=4.1\end{aligned}$$

Check. If the kayakers are 4.1 mi from the finish, then they are $4\cdot(4.1)$, or 16.4 mi from the start. Since 4.1 + 16.4 is 20.5, the total distance, the answer checks.

State. The kayakers had traveled approximately 16.4 mi.

14. Let d = the distance from Nome, in miles. Then $2d$ = the distance from Anchorage.

Solve: $d+2d=1049$

$$d=\frac{1049}{3}$$

The musher has traveled $2\cdot\frac{1049}{3}$, or $699\frac{1}{3}$ mi.

15. ***Familiarize***. Let d = the distance, in miles, that Juan Pablo Montoya had traveled to the given point after the start. Then the distance from the finish line was $500-d$ miles.

Translate.

Distance to finish	plus	20 mi more	was	distance to start.
$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$
$500-d$	$+$	20	$=$	d

Carry out. We solve the equation.

$$\begin{aligned} 500-d+20&=d\\ 520-d&=d\\ 520&=2d\\ 260&=d\end{aligned}$$

Check. If Juan Pablo Montoyawas 260 mi from the start, he was 500 – 260, or 240 mi from the finish. Since 240 is 20 more than 260, the answer checks.

State. Juan Pablo Montoyahad traveled 260 mi at the given point.

16. Let d = the distance Jimmie Johnson had traveled, in miles, at the given point.

Solve: $400-d+80=d$

$$d=240 \text{ mi}$$

17. ***Familiarize***. Let n = the number of the smaller apartment number. Then $n+1=$ the number of the larger apartment number.

Translate.

Smaller number	plus	larger number	is	2409
$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$
n	$+$	$(n+1)$	$=$	2409

Carry out. We solve the equation.

$$\begin{aligned} n+(n+1)&=2409\\ 2n+1&=2409\\ 2n&=2408\\ n&=1204\end{aligned}$$

If the smaller apartment number is 1204, then the other number is $1204+1$, or 1205.

Check. 1204 and 1205 are consecutive numbers whose sum is 2409. The answer checks.

State. The apartment numbers are 1204 and 1205.

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18. Let n = the number of the smaller apartment number. Then $n+1=$ the number of the larger apartment number.

Solve: $n+(n+1)=1419$

$n=709$

The apartment numbers are 709 and $709+1$, or 709 and 710.

19. ***Familiarize***. Let n = the smaller house number. Then $n+2=$ the larger number.

Translate.

$$\underbrace{\text{Smaller number}} \quad \text{plus} \quad \underbrace{\text{larger number}} \quad \text{is} \quad 572.$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$n \quad + \quad (n+2) \quad = \quad 572$$

Carry out. We solve the equation.

$n+(n+2)=572$

$2n+2=572$

$2n=570$

$n=285$

If the smaller number is 285, then the larger number is $285+2$, or 287.

Check. 285 and 287 are consecutive odd numbers and $285+287=572$. The answer checks.

State. The house numbers are 285 and 287.

20. Let n = the smaller house number. Then $n+2=$ the larger number.

Solve: $n+(n+2)=794$

$n=396$

The house numbers are 396 and 398.

21. ***Familiarize***. Let x = the first page number. Then $x+1=$ the second page number, and $x+2=$ the third page number.

Translate.

$$\underbrace{\text{The sum of three consecutive page numbers}} \quad \text{is} \quad 99.$$

$$\downarrow \quad \downarrow \quad \downarrow$$
$$x+(x+1)+(x+2) \quad = \quad 99$$

Carry out. We solve the equation.

$x+(x+1)+(x+2)=99$

$3x+3=99$

$3x=96$

$x=32$

If x is 32, then $x+1$ is 33 and $x+2=34$.

Check. 32, 33, and 34 are consecutive integers, and $32+33+34=99$. The result checks.

State. The page numbers are 32, 33, and 34.

22. Let x, $x+1$, and $x+2$ represent the first, second, and third page numbers, respectively.

Solve: $x+(x+1)+(x+2)=60$

$x=19$

If x is 19, then $x+1$ is 20, and $x+2$ is 21. The page numbers are 19, 20, and 21.

23. ***Familiarize***. Let m = the man's age. Then $m-2=$ the woman's age.

Translate.

$$\underbrace{\text{Man's age}} \quad \text{plus} \quad \underbrace{\text{Woman's age}} \quad \text{is} \quad 206.$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$m \quad + \quad (m-2) \quad = \quad 206$$

Carry out. We solve the equation.

$m+(m-2)=206$

$2m-2=206$

$2m=208$

$m=104$

If m is 104, then $m-2$ is 102.

Check. 104 is 2 more than 102, and 104 + 102 = 206. The answer checks.

State. The man was 104 yr old, and the woman was 102 yr old.

24. Let g = the groom's age. Then $g+19=$ the bride's age.

Solve: $g+(g+19)=185$

$g=83$

If g is 83, then $g+19$ is 102. The bride was 102 years old, and the groom was 83 yr old.

25. ***Familiarize***. Familiarize. Let d = the number of dollars lost, in millions on *The 13th Warrior*. Then d + 12.7 is the number dollars lost, in millions on *Mars Needs Moms*.

Translate.

$$\underbrace{\text{The 13th Warrior}} \quad \text{plus} \quad \underbrace{\text{Mars Needs Moms}} \quad \text{is} \quad 209.3$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$d \quad + \quad d+12.7 \quad = \quad 209.3$$

Carry out. We solve the equation.

$d+d+12.7=209.3$

$2d=196.6$

$d=98.3$

If d is 98.3, then d + 12.7 is 98.3 + 12.7 = 111.

Check. Their total is 98.3 + 111 = 209.3. The answer checks.

State. *The 13th Warrior* lost \$98.3 million and *Mars Needs Moms* lost \$111 million.

26. Let m = the number of consumer e-mails, in billions. Then m + 21.1 is the number of business e-mails, in billions.

Solve: $m+(m+21.1)=196.3$

$m=87.6$ billion e-mails

If $m=87.6$, then $m+21.1=108.7$ billion e-mails. Then there were 87.6 billion consumer e-mails and 108.7 billion business e-mails sent each day.

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27. ***Familiarize***. The page numbers are consecutive integers. If we let x = the smaller number, then $x+1=$ the larger number.

Translate. We reword the problem.

$$\underbrace{\text{First integer}} + \underbrace{\text{Second integer}} = 281$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$x \quad + \quad (x+1) \quad = \quad 281$$

Carry out. We solve the equation.

$$x+(x+1)=281$$
$$2x+1=281 \quad \text{Combining like terms}$$
$$2x=280 \quad \text{Adding } -1 \text{ on both sides}$$
$$x=140 \quad \text{Dividing on both sides by 2}$$

Check. If $x=140$, then $x+1=141$. These are consecutive integers, and $140+141=281$. The answer checks.

State. The page numbers are 140 and 141.

28. Let s = the length of the shortest side, in mm. Then $s+2$ and $s+4$ represent the lengths of the other two sides.

Solve: $s+(s+2)+(s+4)=195$
$$s=63$$

If $s=63$, then $s+2=65$ and $s+4=67$. The lengths of the sides are 63 mm, 65 mm, and 67 mm.

29. ***Familiarize***. Let w = the width, in meters. Then $w+4$ is the length. The perimeter is twice the length plus twice the width.

Translate.

$$\underbrace{\text{Twice the width}} \quad \text{plus} \quad \underbrace{\text{twice the length}} \quad \text{is} \quad 92.$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$2w \quad + \quad 2(w+4) \quad = \quad 92$$

Carry out. We solve the equation.

$$2w+2(w+4)=92$$
$$2w+2w+8=92$$
$$4w=84$$
$$w=21$$

Then $w+4=21+4=25$.

Check. The length, 25 m is 4 more than the width, 21 m. The perimeter is $2\cdot 21\text{ m}+2\cdot 25\text{ m}=42\text{ m}+50\text{ m}=92\text{ m}$. The answer checks.

State. The length of the garden is 25 m and the width is 21 m.

30. Let $w=$ the width of the rectangle, in feet. Then $w+60=$ the length.

Solve: $2(w+60)+2w=520$
$$w=100$$

The length is 160 ft, the width is 100 ft, and the area is 16,000 ft^2.

31. ***Familiarize***. Let w = the width, in inches. Then $2w=$ the length. The perimeter is twice the length plus twice the width. We express $10\frac{1}{2}$ as 10.5.

Translate.

$$\underbrace{\text{Twice the length}} \quad \text{plus} \quad \underbrace{\text{twice the width}} \quad \text{is} \quad \underbrace{10.5 \text{ in.}}$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$2\cdot 2w \quad + \quad 2w \quad = \quad 10.5$$

Carry out. We solve the equation.

$$2\cdot 2w+2w=10.5$$
$$4w+2w=10.5$$
$$6w=10.5$$
$$w=1.75, \text{ or } 1\frac{3}{4}$$

Then $2w=2(1.75)=3.5$, or $3\frac{1}{2}$.

Check. The length, $3\frac{1}{2}$ in., is twice the width, $1\frac{3}{4}$ in. The perimeter is $2\left(3\frac{1}{2}\text{ in.}\right)+2\left(1\frac{3}{4}\text{ in.}\right)=7\text{ in.}+3\frac{1}{2}\text{ in.}=10\frac{1}{2}\text{ in.}$ The answer checks.

State. The actual dimensions are $3\frac{1}{2}$ in. by $1\frac{3}{4}$ in.

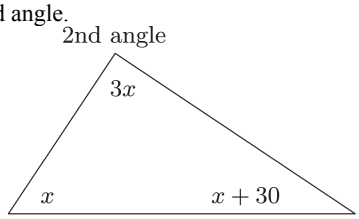
32. Let w = the width, in feet. Then $3w+6=$ the length.

Solve: $2(3w+6)+2w=124$
$$w=14$$

Then $3w+6=3\cdot 14+6=42+6=48$.

The billboard is 48 ft long and 14 ft wide.

33. ***Familiarize***. We draw a picture. We let $x=$ the measure of the first angle. Then $3x=$ the measure of the second angle, and $x+30=$ the measure of the third angle.



Recall that the measures of the angles of any triangle add up to 180°.

Translate.

$$\underbrace{\text{Measure of first angle}} + \underbrace{\text{measure of second angle}} + \underbrace{\text{measure of third angle}} \text{ is } \underbrace{180°}$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$x \quad + \quad 3x \quad + \quad x+30 \quad = \quad 180$$

Carry out. We solve the equation.

$$x+3x+(x+30)=180$$
$$5x+30=180$$
$$5x=150$$
$$x=30$$

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Possible answers for the angle measures are as follows:

First angle: $x = 30°$

Second angle: $3x = 3(30)° = 90°$

Third angle: $x + 30° = 30° + 30° = 60°$

Check. Consider 30º, 90º and 60º. The second angle is three times the first, and the third is 30º more than the first. The sum of the measures of the angles is 180º. These numbers check.

State. The measure of the first angle is 30º, the measure of the second angle is 90º, and the measure of the third angle is 60º.

34. Let x = the measure of the first angle. Then $4x$ = the measure of the second angle, and $x + 4x - 45$, or $5x - 45 =$ the measure of the third angle.

Solve: $x + 4x + (5x - 45) = 180$

$x = 22.5$

If x is 22.5, then $4x$ is 90, and $5x - 45$ is 67.5, so the measures of the first, second, and third angles are 22.5º, 90º, and 67.5º, respectively.

35. ***Familiarize***. Let x = the measure of the first angle. Then $4x =$ the measure of the second angle, and $x + 4x + 5 = 5x + 5$ is the measure of the third angle.

Translate.

Measure of first angle	+	measure of second angle	+	measure of third angle	is	$180°$
$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$
x	+	$4x$	+	$(5x + 5)$	=	180

Carry out. We solve the equation.

$x + 4x + (5x + 5) = 180$

$10x + 5 = 180$

$10x = 175$

$x = 17.5$

If $x = 17.5$, then $4x = 4(17.5) = 70$, and $5x + 5 = 5(17.5) + 5 = 87.5 + 5 = 92.5$.

Check. Consider 17.5º, 70º, and 92.5º. The second is four times the first, and the third is 5° more than the sum of the other two. The sum of the measures of the angles is 180º. These numbers check.

State. The measure of the second angle is 70º.

36. Let x = the measure of the first angle. Then $3x$ = the measure of the second angle, and $x + 3x + 10 = 4x + 10 =$ the measure of the third angle.

Solve: $x + 3x + (4x + 10) = 180$

$x = 21.25$

If $x = 21.25$, then $3x = 64.75$, and $4x + 10 = 95°$.

The measure of the third angle is 95º.

37. ***Familiarize***. Let b = the length of the bottom section of the rocket, in feet. Then $\frac{1}{6}b =$ the length of the top section, and $\frac{1}{2}b =$ the length of the middle section.

Translate.

Length of top section	+	length of middle section	+	length of bottom section	is	240 ft
$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$		
$\frac{1}{6}b$	+	$\frac{1}{2}b$	+	b	=	240

Carry out. We solve the equation. First we multiply by 6 on both sides to clear the fractions.

$$\frac{1}{6}b + \frac{1}{2}b + b = 240$$

$$6\left(\frac{1}{6}b + \frac{1}{2}b + b\right) = 6 \cdot 240$$

$$6 \cdot \frac{1}{6}b + 6 \cdot \frac{1}{2}b + 6 \cdot b = 1440$$

$$b + 3b + 6b = 1440$$

$$10b = 1440$$

$$b = 144$$

Then $\frac{1}{6}b = \frac{1}{6} \cdot 144 = 24$ and $\frac{1}{2}b = \frac{1}{2} \cdot 144 = 72$.

Check. 24 ft is $\frac{1}{6}$ of 144 ft, and 72 ft is $\frac{1}{2}$ of 144 ft. The sum of the lengths of the sections is 24 ft + 72 ft + 144 ft = 240 ft. The answer checks.

State. The length of the top section is 24 ft, the length of the middle section is 72 ft, and the length of the bottom section is 144 ft.

38. Let s = the part of the sandwich Jenny gets, in inches. Then the lengths of Demi's and Joel's portions are $\frac{1}{2}s$ and $\frac{3}{4}s$, respectively.

Solve: $s + \frac{1}{2}s + \frac{3}{4}s = 18$

$s = 8$

Then $\frac{1}{2}s = \frac{1}{2} \cdot 8 = 4$ and $\frac{3}{4}s = \frac{3}{4} \cdot 8 = 6$. Jenny gets 8 in., Demi gets 4 in., and Joel gets 6 in.

39. ***Familiarize***. Let r = the speed downstream. Then $r - 10$ = the speed upstream. Then, since $d = r \cdot t$, we multiply to find each distance.

Downstream distance $= r(2)$ mi;

Upstream distance $= (r - 10)(3)$ mi.

Translate.

Distance downstream	plus	distance upstream	is	total distance.
$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$
$r(2)$	+	$(r - 10)(3)$	=	30

Carry out. We solve the equation.

$2r + 3(r - 10) = 30$

$2r + 3r - 30 = 30$

$5r - 30 = 30$

$5r = 60$

$r = 12$

$r - 10 = 2$

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Check. Distance = speed × time.
Distance downstream $= 12(2) = 24$ mi
Distance upstream $= (12-10)(3) = 6$ mi
The total distance is 24 mi + 6 mi, or 30 mi.
The answer checks.

State. The speed downstream was 12 mph.

40. Let r = the speed of the bus. Then $r + 50$ = the speed of the train.

Solve: $r \cdot \frac{1}{3} + (r+50) \cdot \frac{1}{2} = 37.5$
$r = 15$ km/h

41. ***Familiarize***. Let d = the distance Phoebe ran. Then $17 - d$ = the distance Phoebe walked. Then, since $t = \frac{d}{r}$, we divide to find each time.

Time running $= \frac{d}{12}$ hr;

Time walking $= \frac{17-d}{5}$ hr;

Translate.

Time running	is	time walking.
↓	↓	↓
$\frac{d}{12}$	=	$\frac{17-d}{5}$

Carry out. We solve the equation.

$$60 \cdot \frac{d}{12} = 60 \cdot \frac{17-d}{5}$$
$$5d = 12(17-d)$$
$$5d = 204 - 12d$$
$$17d = 204$$
$$d = 12$$
$$17 - d = 5$$

Check. Time = distance ÷ speed.

Time running $= \frac{12}{12} = 1$ hr;

Time walking $= \frac{17-12}{5} = 1$ hr;

The time running is the same as the time walking
The answer checks.

State. Phoebe ran for 1 hour.

42. Let t = the time driving on the interstate. Then $3t$ = the time driving on the Blue Ridge Parkway.

Solve: $70 \cdot t + 40 \cdot (3t) = 285$
$t = 1\frac{1}{2}$ hr

43. Let p = the percent increase. The population increased by $660 - 570 = 90$.
Rewording and Translating:

Population increase	is	what percent	of	original population.
↓	↓	↓	↓	↓
90	=	p	·	570

$$\frac{90}{570} = p$$
$$0.158 \approx p$$

The percent increase was about 15.8%.

44. Let p = the percent. The premium decreased by $4.02 - 1.13 = 2.89$.
Solve: $2.89 = p \cdot 4.02$
$0.719 \approx p$ or about 71.9%

45. Let p = the percent increase. The budget increased by $\$1{,}800{,}000 - \$1{,}600{,}000 = \$200{,}000$.
Rewording and Translating:

Budget increase	is	what percent	of	original budget.
↓	↓	↓	↓	↓
200,000	=	p	·	1,600,000

$$\frac{200{,}000}{1{,}600{,}000} = p$$
$$0.125 = p$$

The percent increase is 12.5%.

46. Let p = the percent. The number of jobs increased by $1{,}816{,}200 - 1{,}800{,}000 = 16{,}200$.
Solve: $16{,}200 = p \cdot 1{,}800{,}000$
$0.009 = p$
$0.9\% = p$

47. Let b = the bill without tax.
Rewording and Translating:

The bill	plus	tax	is	$1310.75.
↓	↓	↓	↓	↓
b	+	$0.07b$	=	1310.75

$$1.07b = 1310.75$$
$$b = \frac{1310.75}{1.07}$$
$$b = 1225$$

The bill without tax is $1225.

48. Let c = the cost without tax
Solve: $c + 0.04c = 5824$
$\$5600 = c$

49. Let s = the sales tax.
Rewording and Translating:

amount spent	plus	sales tax	is	$4960.80.
↓	↓	↓	↓	↓
s	+	$0.06s$	=	4960.80

$$1.06s = 4960.80$$
$$s = \frac{4960.80}{1.06}$$
$$s = 4680$$

$4960.80 - 4680 = 280.80$
The sales tax is $280.80.

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50. Let $c =$ the cost without tax

Solve: $c + 0.04c = 7115.68$

$\$6842 = c$

Then $\$7115.68 - \$6842 = \$273.68$.

51. ***Familiarize***. Let p = the regular price of the camera. At 30% off, Raena paid $(100-30)\%$, or 70% of the regular price.

Translate.

$$\$224 \quad \text{is} \quad 70\% \quad \text{of} \quad \underbrace{\text{the regular price.}}$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$224 \quad = \quad 0.70 \quad \cdot \quad p$$

Carry out. We solve the equation.

$224 = 0.70p$

$320 = p$

Check. 70% of \$320, or 0.70(\$320), is \$224. The answer checks.

State. The regular price was \$320.

52. Let p = the regular price of digital picture frame. The sale price is 80% of the regular price.

Solve: $\$68 = 0.80p$

$\$85 = p$

53. ***Familiarize***. Let s = the annual salary of Bradley's previous job. With a 15% pay cut, Bradley received $(100-15)\%$, or 85% of the salary of the previous job.

Translate.

$$\$30{,}600 \quad \text{is} \quad 85\% \quad \text{of} \quad \underbrace{\text{the previous salary.}}$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$30{,}600 \quad = \quad 0.85 \quad \cdot \quad s$$

Carry out. We solve the equation.

$30{,}600 = 0.85s$

$36{,}000 = s$

Check. 85% of \$36,000, or 0.85(\$36,000), is \$30,600. The answer checks.

State. Bradley's previous salary was \$36,000.

54. Let a = the original amount in the retirement account. With a 40% decrease, the account is worth $(100-40)\%$, or 60% of the original amount.

Solve: $\$87{,}000 = 0.60a$

$\$145{,}000 = a$

55. ***Familiarize***. Let g = the original amount of the grocery bill. Saving 85% pay cut, Marie paid $(100-85)\%$, or 15% of the original amount.

Translate.

$$\$15 \quad \text{is} \quad 15\% \quad \text{of} \quad \underbrace{\text{the original bill.}}$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$15 \quad = \quad 0.15 \quad \cdot \quad g$$

Carry out. We solve the equation.

$15 = 0.15g$

$100 = g$

Check. 15% of \$100, or 0.15(\$100), is \$15. The answer checks.

State. Marie's original grocery bill was \$100.

56. Let m = the original price of the meal. With a 12% discount, the price decreased $(100-12)\%$, or 88% of the original amount.

Solve: $\$11 = 0.88m$

$\$12.50 = m$

57. ***Familiarize***. Let c = the cost of a 30-sec slot in 2013, in millions of dollars. The increase was 20% of c, or $0.20c$.

Translate.

$$\underbrace{\text{Cost in 2013}} \quad \text{plus} \quad \underbrace{\text{increase}} \quad \text{is} \quad \$4.8.$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$c \quad + \quad 0.20c \quad = \quad 4.8$$

Carry out. We solve the equation.

$c + 0.20c = 4.8$

$1.2c = 4.8$

$c = 4$

Check. 20% of 4, or 0.20(4), is 0.8 and 4 + 0.8 is 4.8, the cost in 2016. The answer checks.

State. In 2013, a 30-sec slot cost \$4 million.

58. Let a = the number of individuals arrested in 2015.

Solve: $a + 0.23a = 350$

$a = 285$ individuals

59. ***Familiarize***. Let a the selling price of the house. Then the commission on the selling price is 6% times a, or $0.06a$.

Translate.

$$\underbrace{\text{Selling price}} \quad \text{minus} \quad \underbrace{\text{commission}} \quad \text{is} \quad \$117{,}500.$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$a \quad - \quad 0.06a \quad = \quad 117{,}500$$

Carry out. We solve the equation.

$a - 0.06a = 117{,}500$

$0.94a = 117{,}500$

$a = 125{,}000$

Check. A selling price of \$125,000 gives a commission of \$7500. Since $\$125{,}000 - \$7500 = \$117{,}500$, the answer checks.

State. They must sell the house for \$125,000.

60. Let c = the number of crashes before the cameras were installed. The number of crashes fell by 43.6%.

Solve: $c - 0.436c = 2591$

$c = 4594$ crashes

61. ***Familiarize***. Let m = the number of miles that can be traveled for \$19. Then the total cost of the taxi ride, in dollars, is $3.25 + 1.80m$.

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Translate.

$$\underbrace{\text{Cost of taxi ride}} \quad \text{is} \quad \$19.$$

$$\downarrow \qquad \downarrow \quad \downarrow$$
$$3.25 + 1.80m \quad = \quad 19$$

Carry out. We solve the equation.

$$3.25 + 1.80m = 19$$
$$1.80m = 15.75$$
$$m = \frac{15.75}{1.80} = 8.75 \text{ mi}$$

Check. The mileage charge is \$1.80(8.75), or \$15.75, and the total cost of the ride is \$3.25 + \$15.75 = \$19. The answer checks.

State. Debbie can travel 8.75 mi, or $8\frac{3}{4}$ mi.

62. Let m = the number of miles that can be traveled for \$24.95.

Solve: $5.45 + 2.86m = 24.95$

$$m = 6\frac{9}{11} \text{ mi}$$

Ashfaq can travel $6\frac{9}{11}$ mi for \$24.95.

63. ***Familiarize***. The total cost is the daily rate plus the mileage charge. Let d = the distance that can be traveled, in miles, in one day for \$100. The mileage charge is the cost per mile times the number of miles traveled, or $0.55d$.

Translate.

$$\underbrace{\text{Daily rate}} \quad \text{plus} \quad \underbrace{\text{mileage charge}} \quad \text{is} \quad \$100.$$

$$\downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow \quad \downarrow$$
$$39.95 \quad + \quad 0.55d \quad = \quad 100$$

Carry out. We solve the equation.

$$39.95 + 0.55d = 100$$
$$0.55d = 60.05$$
$$d \approx 109.2$$

Check. For a trip of 109.2 mi, the mileage charge is $\$0.55(109.2)$, or \$60.06, and $\$39.95 + \$60.06 \approx \$100$. The answer checks.

State. Concert Productions can travel 109.2 mi in one day and stay within their budget.

64. Let d = the distance, in miles, that Judy can travel in one day for \$70.

Solve: $42 + 0.35d = 70$

$$d = 80 \text{ mi}$$

65. ***Familiarize***. Let x = the measure of one angle. Then $90 - x =$ the measure of its complement.

Translate.

$$\underbrace{\text{Measure of one angle}} \quad \text{is} \quad 15° \quad \underbrace{\text{more than}} \quad \underbrace{\text{twice the measure of its complement.}}$$

$$\downarrow \qquad \downarrow \quad \downarrow \qquad \downarrow \qquad \downarrow$$
$$x \quad = \quad 15 \quad + \quad 2(90 - x)$$

Carry out. We solve the equation.

$$x = 15 + 2(90 - x)$$
$$x = 15 + 180 - 2x$$
$$x = 195 - 2x$$
$$3x = 195$$
$$x = 65$$

If x is 65, then $90 - x$ is 25.

Check. The sum of the angle measures is 90°. Also, 65° is 15° more than twice its complement, 25°. The answer checks.

State. The angle measures are 65° and 25°.

66. Let x = the measure of one angle. Then $90 - x =$ the measure of its complement.

Solve: $x = \frac{3}{2}(90 - x)$

$$x = 54°$$

If $x = 54$, then $90 - x$ is 36°.

67. ***Familiarize***. Let x = the measure of one angle. Then $180 - x =$ the measure of its supplement.

Translate.

$$\underbrace{\text{Measure of one angle}} \quad \text{is} \quad 3\tfrac{1}{2} \quad \text{times} \quad \underbrace{\text{measure of second angle.}}$$

$$\downarrow \qquad \downarrow \quad \downarrow \qquad \downarrow \qquad \downarrow$$
$$x \quad = \quad 3\tfrac{1}{2} \quad \cdot \quad (180 - x)$$

Carry out. We solve the equation.

$$x = 3\tfrac{1}{2}(180 - x)$$
$$x = 630 - 3.5x$$
$$4.5x = 630$$
$$x = 140$$

If $x = 140$, then $180 - 140 = 40°$.

Check. The sum of the angles is 180°. Also 140° is three and a half times 40°. The answer checks.

State. The angles are 40° and 140°.

68. Let x = the measure of one angle. Then $180 - x =$ the measure of its supplement.

Solve: $x = 2(180 - x) - 45$

$$x = 105$$

If x is 105, then $180 - x$ is 75. The angle measures are 105° and 75°.

69. ***Familiarize***. Let l = the length of the paper, in cm. Then $l - 6.3 =$ the width. The perimeter is twice the length plus twice the width.

Translate.

$$\underbrace{\text{Twice the length}} \quad \text{plus} \quad \underbrace{\text{twice the width}} \quad \text{is} \quad \underline{99 \text{ cm}}.$$

$$\downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow \quad \downarrow$$
$$2l \quad + \quad 2(l - 6.3) \quad = \quad 99$$

Carry out. We solve the equation.

$$2l + 2(l - 6.3) = 99$$
$$2l + 2l - 12.6 = 99$$
$$4l - 12.6 = 99$$
$$4l = 111.6$$
$$l = 27.9$$

Then $l - 6.3 = 27.9 - 6.3 = 21.6$.

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Check. The width, 21.6 cm, is 6.3 cm less than the length, 27.9 cm. The perimeter is 2(27.9 cm) +2(21.6 cm) = 55.8 cm +43.2 cm = 99 cm. The answer checks.

State. The length of the paper is 27.9 cm, and the width is 21.6 cm.

70. Let a = the amount Sarah invested.
Solve: $a + 0.28a = 448$
$a = \$350$

71. ***Familiarize***. Let a = the amount Janeka invested. Then the simple interest for one year is $1\% \cdot a$, or $0.01a$.

Translate.

Amount invested	plus	interest	is	$1555.40.
↓	↓	↓	↓	↓
a	+	$0.01a$	=	1555.40

Carry out. We solve the equation.
$a + 0.01a = 1555.40$
$1.01a = 1555.40$
$a = 1540$

Check. An investment of \$1540 at 1% simple interest earns $0.01(\$1540)$, or \$15.40, in one year. Since $\$1540 + \$15.40 = \$1555.40$, the answer checks.

State. Janeka invested \$1540.

72. Let b = the balance at the beginning of the month.
Solve: $b + 0.02b = 870$
$b = \$852.94$

73. ***Familiarize***. Let w = the winning score. Then $w - 340 =$ the losing score.

Translate.

Winning score	plus	losing score	was	1320 points.
↓	↓	↓	↓	↓
w	+	$w - 340$	=	1320

Carry out. We solve the equation.
$w + (w - 340) = 1320$
$2w - 340 = 1320$
$2w = 1660$
$w = 830$

Then $w - 340 = 830 - 340 = 490$.

Check. The winning score, 830, is 340 points more than the losing score, 490. The total of the two scores is $830 + 490 = 1320$ points. The answer checks.

State. The winning score was 830 points.

74. Let s = the distance of the West span. Then s + 556 = the distance of the East span.
Solve: $s + s + 556 = 19,796$
$s = 9620$
$s + 556 = 10,176$ ft

75. ***Familiarize***. We will use the equation
$c = 1.2x + 32.94.$

Translate. We substitute 50.94 for c.
$50.94 = 1.2x + 32.94.$

Carry out. We solve the equation.
$50.94 = 1.2x + 32.94.$
$18 = 1.2x$
$15 = x$

Check. When $x = 15$, we have $c = 1.2(15) + 32.94 = 18 + 32.94 = 50.94$. The answer checks.

State. The cost of a dinner for 10 people will be \$50.94 in 2015.

76. Solve: $63,537 = 1352x + 44,609$
$x = 14$
In the year 2014.

77. ***Familiarize***. We will use the equation
$T = \frac{1}{4}N + 40.$

Translate. We substitute 80 for T.
$80 = \frac{1}{4}N + 40$

Carry out. We solve the equation.
$80 = \frac{1}{4}N + 40$
$40 = \frac{1}{4}N$
$160 = N$ Multiplying by 4 on both sides

Check. When $N = 160$, we have $T = \frac{1}{4} \cdot 160 + 40 = 40 + 40 = 80$. The answer checks.

State. A cricket chirps 160 times per minute when the temperature is 80°F.

78. Solve: $18.0 = -0.028t + 20.8$
$100 = t$
The record will be 18.0 sec 100 yr after 1920, or in 2020.

79. *Writing Exercise*. Although many of the problems in this section might be solved by guessing, using the five-step problem-solving process to solve them would give the student practice is using a technique that can be used to solve other problems whose answers are not so readily guessed.

80. *Writing Exercise*. Either approach will work. Some might prefer to let a represent the bride's age because the groom's age is given in terms of the bride's age. When choosing a variable it is important to specify what it represents.

81. $4(2n + 8t + 1) = 8n + 32t + 4$

82. $12 + 18x + 21y = 3(4 + 6x + 7y)$

83. $x - 3[2x - 4(x - 1) + 2]$
$= x - 3[2x - 4x + 4 + 2]$
$= x - 3[-2x + 6]$
$= x + 6x - 18$
$= 7x - 18$

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84. 0

85. *Writing Exercise.* Answers may vary.
The sum of three consecutive odd integers is 375. What are the integers?

86. *Writing Exercise.* Answers may vary.
Acme Rentals rents a 12-foot truck at a rate of \$35 plus 20¢ per mile. Audrey has a truck-rental budget of \$45 for her move to a new apartment. How many miles can she drive the rental truck without exceeding her budget?

87. ***Familiarize.*** Let c = the amount the meal originally cost. The 15% tip is calculated on the original cost of the meal, so the tip is $0.15c$.

Translate.

Original cost	plus	tip	less	\$10	is	\$32.55.
↓	↓	↓	↓	↓	↓	↓
c	+	$0.15x$	−	10	=	32.55

Carry out. We solve the equation.

$$c + 0.15c - 10 = 32.55$$
$$1.15c - 10 = 32.55$$
$$1.15c = 42.55$$
$$c = 37$$

Check. If the meal originally cost \$37, the tip was 15% of \$37, or $0.15(\$37)$, or \$5.55. Since $\$37 + \$5.55 - \$10 = \$32.55$, the answer checks.

State. The meal originally cost \$37.

88. Let m = the number of multiple-choice questions Pam got right. Note that she got 4 – 1, or 3 fill-ins right.
Solve: $3 \cdot 7 + 3m = 78$
$m = 19$ questions

89. ***Familiarize.*** Let s = one score. Then four score = $4s$ and four score and seven = $4s + 7$.

Translate. We reword.

1776	plus	four score and seven	is	1863
↓	↓	↓	↓	↓
1776	+	$(4s + 7)$	=	1863

Carry out. We solve the equation.

$$1776 + (4s + 7) = 1863$$
$$4s + 1783 = 1863$$
$$4s = 80$$
$$s = 20$$

Check. If a score is 20 years, then four score and seven represents 87 years. Adding 87 to 1776 we get 1863. This checks.

State. A score is 20.

90. Let y = the larger number. Then 25% of y, or $0.25y$ = the smaller.
Solve: $y = 0.25y + 12$
$y = 16$
The numbers are 16 and 0.25(16), or 4.

91. ***Familiarize.*** Let n = the number of half dollars. Then the number of quarters is $2n$; the number of dimes is $2 \cdot 2n$, or $4n$; and the number of nickels is $3 \cdot 4n$, or $12n$. The total value of each type of coin, in dollars, is as follows.

Half dollars: $0.5n$
Quarters: $0.25(2n)$, or $0.5n$
Dimes: $0.1(4n)$, or $0.4n$
Nickels: $0.05(12n)$, or $0.6n$

Then the sum of these amounts is $0.5n + 0.5n + 0.4n + 0.6n$, or $2n$.

Translate.

Total amount of change	is	\$10.
↓	↓	↓
$2n$	=	10

Carry out. We solve the equation.

$$2n = 10$$
$$n = 5$$

Then $2n = 2 \cdot 5 = 10$, $4n = 4 \cdot 5 = 20$, and $12n = 12 \cdot 5 = 60$.

Check. If there are 5 half dollars, 10 quarters, 20 dimes, and 60 nickels, then there are twice as many quarters as half dollars, twice as many dimes as quarters, and 3 times as many nickels as dimes. The total value of the coins is

$$\$0.5(5) + \$0.25(10) + \$0.1(20) + \$0.05(60)$$
$$= \$2.50 + \$2.50 + \$2 + \$3 = \$10.$$

The answer checks.

State. The shopkeeper got 5 half dollars, 10 quarters, 20 dimes, and 60 nickels.

92. Let x = the length of the original rectangle.
Then $\frac{3}{4}x =$ the width. The length and width of the enlarged rectangle are $x + 2$ and $\frac{3}{4}x + 2$, respectively. Solve:

$$\left(\frac{3}{4}x + 2\right) + \left(\frac{3}{4}x + 2\right) + (x + 2) + (x + 2) = 50$$
$$x = 12$$

If x is 12, then $\frac{3}{4}x$ is 9. The length and width of the rectangle are 12 cm and 9 cm, respectively.

93. ***Familiarize.*** Let p = the price before the two discounts. With the first 10% discount, the price becomes 90% of p, or $0.9p$. With the second 10% discount, the final price is 90% of $0.9p$, or $0.9(0.9p)$.

Translate.

10% discount	and	10% discount of price	is	\$77.75.
↓	↓	↓	↓	↓
0.9	·	$0.9p$	=	77.75

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Carry out. We solve the equation.

$$0.9(0.9p) = 77.75$$
$$0.81p = 77.75$$
$$p = 95.99$$

Check. Since 90% of \$95.99 is \$86.39, and 90% of \$86.39 is \$77.75, the answer checks.

State. The original price before discounts was \$95.99.

94. Let a = the original number of apples in the basket. Solve:

$$\frac{1}{3}a + \frac{1}{4}a + \frac{1}{8}a + \frac{1}{5}a + 10 + 1 = a$$
$$40a + 30a + 15a + 24a + 1320 = 120a$$
$$1320 = 11a$$
$$a = 120 \text{ apples}$$

95. ***Familiarize***. Let n = the number of DVDs purchased. Assume that at least two more DVDs were purchased. Then the first DVD costs \$9.99 and the total cost of the remaining $(n-1)$ DVDs is $\$6.99(n-1)$. The shipping and handling costs are \$3 for the first DVD, \$1.50 for the second (half of \$3), and a total of $\$1(n-2)$ for the remaining $n-2$ DVDs.

Translate.

1st DVD	plus	remaining DVDs	plus	1st S&H charges
↓	↓	↓	↓	↓
9.99	+	$6.99(n-1)$	+	3

… plus	2nd S&H charges	plus	remaining S&H charges	is	\$45.45.
↓	↓	↓	↓	↓	↓
+	1.50	+	$1(n-2)$	=	45.45

Carry out. We solve the equation.

$$9.99 + 6.99(n-1) + 3 + 1.5 + (n-2) = 45.45$$
$$9.99 + 6.99n - 6.99 + 4.5 + n - 2 = 45.45$$
$$7.99n + 5.5 = 45.45$$
$$7.99n = 39.95$$
$$n = 5$$

Check. If there are 5 DVDs, the cost of the DVDs is \$9.99 + \$6.99(5 – 1), or \$9.99 + \$27.96, or \$37.95. The cost for shipping and handling is \$3 + \$1.50 + \$1(5 – 2) = \$7.50. The total cost is \$37.95 + \$7.50, or \$45.45. The answer checks.

State. There were 5 DVDs in the shipment.

96. ***Familiarize***. Let x = the number of additional games the Falcons will have to play. Then $\frac{x}{2}$ = the number of those games they will win, $15 + \frac{x}{2}$ = the total number of games won, and $20 + x$ = the total number of games played.

Translate.

Number of games won	is	60%	of	total number of games.
↓	↓	↓	↓	↓
$15 + \frac{x}{2}$	=	0.6	·	$20 + x$

Carry out. We solve the equation.

$$15 + \frac{x}{2} = 0.6(20 + x)$$
$$15 + 0.5x = 12 + 0.6x \qquad \left(\frac{x}{2} = \frac{1}{2}x = 0.5x\right)$$
$$15 = 12 + 0.1x$$
$$3 = 0.1x$$
$$30 = x$$

Check. If the Falcons play an additional 30 games, then they play a total of 20 + 30, or 50, games. If they win half of the 30 additional games, or 15 games, then their wins total 15 + 15, or 30. Since 60% of 50 is 30, the answer checks.

State. The Falcons will have to play 30 more games in order to win 60% of the total number of games.

97. ***Familiarize***. Let d = the distance, in miles, that Mya traveled. At \$0.50 per $\frac{1}{5}$ mile, the mileage charge can also be given as 5(\$0.50), or \$2.5 per mile. Since it took 20 min to complete what is usually a 10-min drive, the taxi was stopped in traffic for $20 - 10$, or 10 min.

Translate.

Initial charge	plus	\$2.50 per mile	plus	stopped in traffic charge	is	\$23.80.
↓	↓	↓	↓	↓	↓	↓
2.80	+	$2.50d$	+	0.60(10)	=	23.80

Carry out. We solve the equation.

$$2.80 + 2.5d + 0.6(10) = 23.80$$
$$2.8 + 2.5d + 6 = 23.80$$
$$2.5d + 8.8 = 23.80$$
$$2.5d = 15$$
$$d = 6$$

Check. Since \$2.5(6) = \$15, and \$0.60(10) = \$6, and \$15 + \$6 + \$2.80 = \$23.80, the answer checks.

State. Mya traveled 6 mi.

98. Let s = the score on the third test.

Solve: $\frac{2 \cdot 85 + s}{3} = 82$

$$170 + s = 246$$
$$s = 76$$

99. *Writing Exercise*. If the school can invest the \$2000 so that it earns at least 7.5% and thus grows to at least \$2150 by the end of the year, the second option should be selected. If not, the first option is preferable.

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100. *Writing Exercise*. Yes; the page numbers must be consecutive integers. The only consecutive integers whose sum is 191 are 95 and 96. These cannot be the numbers of facing pages, however, because the left-hand page of a book is even-numbered.

101. ***Familiarize***. Let w = the width of the rectangle, in cm. Then $w + 4.25 =$ the length.

Translate.

$$\underbrace{\text{The perimeter}}_{\downarrow} \quad \underbrace{\text{is}}_{\downarrow} \quad \underbrace{101.74 \text{ cm}}_{\downarrow}$$
$$2(w + 4.25) + 2w \quad = \quad 101.74$$

Carry out. We solve the equation.

$$\begin{aligned} 2(w + 4.25) + 2w &= 101.74 \\ 2w + 8.5 + 2w &= 101.74 \\ 4w + 8.5 &= 101.74 \\ 4w &= 93.24 \\ w &= 23.31 \end{aligned}$$

Then $w + 4.25 = 23.31 + 4.25 = 27.56$.

Check. The length, 27.56 cm, is 4.25 cm more than the width, 23.31 cm. The perimeter is 2(27.56) cm + 2(23.31 cm) = 55.12 cm + 46.62 cm = 101.74 cm. The answer checks.

State. The length of the rectangle is 27.56 cm, and the width is 23.31 cm.

102. Let $s =$ the length of the first side, in cm. Then $s + 3.25 =$ the length of the second side, and $(s + 3.25) + 4.35$, or $s + 7.6 =$ the length of the third side.

Solve: $s + (s + 3.25) + (s + 7.6) = 26.87$

$$s = 5.34$$

The lengths of the sides are 5.34 cm, $5.34 + 3.25$, or 8.59 cm, and $5.34 + 7.6$, or 12.94 cm.

Connecting the Concepts

1. $x - 6 = 15$

$x = 21$ Adding 6 to both sides

The solution is 21.

2. $x - 6 \le 15$

$x \le 21$ Adding 6 to both sides

The solution is $\{x | x \le 21\}$, or $(-\infty, 21]$.

3. $3x = -18$

$x = -6$ Dividing both sides by 3

The solution is –6.

4. $3x > -18$

$x > -6$ Dividing both sides by 3

The solution is $\{x | x > -6\}$, or $(-6, \infty)$.

5. $7 - 3x \ge 8$

$-3x \ge 1$ Subtracting 7 from both sides

$x \le -\frac{1}{3}$ Dividing both sides by –3 and reversing the direction of the inequality symbol

The solution is $\left\{x | x \le -\frac{1}{3}\right\}$, or $\left(-\infty, -\frac{1}{3}\right]$.

6. $7 - 3x = 8$

$-3x = 1$ Subtracting 7 from both sides

$x = -\frac{1}{3}$ Dividing both sides by –3

The solution is $-\frac{1}{3}$.

7. $\frac{n}{6} - 6 = 5$

$\frac{n}{6} = 11$ Adding 6 to both sides

$n = 66$ Multiplying both sides by 6

The solution is 66.

8. $\frac{n}{6} - 6 < 5$

$\frac{n}{6} < 11$ Adding 6 to both sides

$n < 66$ Multiplying both sides by 6

The solution is $\{n | n < 66\}$, or $(-\infty, 66)$.

9. $10 \ge -2(a - 5)$

$10 \ge -2a + 10$ Using the distributive law

$0 \ge -2a$ Subtracting 10 from both sides

$0 \le a$ Dividing both sides by –2 and reversing the direction of the inequality symbol

The solution is $\{a | a \ge 0\}$

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

$10 = -2a + 10$ Using the distributive law

$0 = -2a$ Subtracting 10 from both sides

$0 = a$ Dividing both sides by –2

The solution is 0.

Exercise Set 2.6

1. The number –2 is one *solution* of the inequality $x < 0$.

2. The solution set $\{x | x \ge 10\}$ is an example of *set-builder* notation.

3. The interval [6, 10] is an example of a *closed* interval.

4. When graphing the solution of the inequality $-3 \le x \le 2$, place a *bracket* at both ends of the interval.

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5. $y - 10 \geq 4$
$y \geq 14$ Add 10

6. $y + 6 \leq 4$
$y \leq -2$

7. $3n > 90$
$n > 30$ Dividing by 3

8. $-7t \geq 56$
$t \leq -8$

9. $-5x \leq 30$
$x \geq -6$ Dividing by -5 and reversing the inequality symbol

10. $4x < 12$
$x < 3$

11. $-2t > -14$
$t < 7$ Dividing by -2 and reversing the inequality symbol

12. $-3x < -15$
$x > 5$

13. $x > -4$

a. Since $4 > -4$ is true, 4 is a solution.

b. Since $-6 > -4$ is false, -6 is not a solution.

c. Since $-4 > -4$ is false, -4 is not a solution.

14. a. Yes, **b.** No, **c.** Yes

15. $y \leq 19$

a. Since $18.99 \leq 19$ is true, 18.99 is a solution.

b. Since $19.01 \leq 19$ is false, 19.01 is not a solution.

c. Since $19 \leq 19$ is true, 19 is a solution.

16. a. Yes, **b.** No, **c.** Yes

17. $c \geq -7$

a. Since $0 \geq -7$ is true, 0 is a solution.

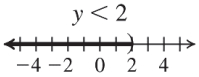
b. Since $-5\frac{4}{5} \geq -7$ is true, $-5\frac{4}{5}$ is a solution.

c. Since $1\frac{1}{3} \geq -7$ is true, $1\frac{1}{3}$ is a solution.

18. a. No, **b.** No, **c.** Yes

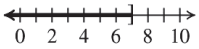
19. The solutions of $y < 2$ are those numbers less than 2. They are shown on the graph by shading all points to the left of 2. The parenthesis at 2 indicates that 2 is not part of the graph.

$y < 2$



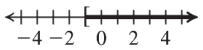
20. The solutions of $x \leq 7$ are those numbers less than or equal to 7. They are shown on the graph by shading all points to the left of 7. The bracket at 7 indicates that 7 is part of the graph.

$x \leq 7$



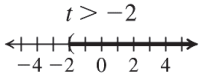
21. The solutions of $x \geq -1$ are those numbers greater than or equal to -1. They are shown on the graph by shading all points to the right of -1. The bracket at -1 indicates that the point -1 is part of the graph.

$x \geq -1$



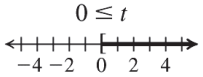
22. The solutions of $t > -2$ are those numbers greater than -2. They are shown on the graph by shading all points to the right of -2. The parenthesis at -2 indicates that -2 is not part of the graph.

$t > -2$



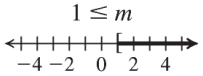
23. The solutions of $0 \leq t$, or $t \geq 0$, are those numbers greater than or equal to zero. They are shown on the graph by shading all points to the right of 0. The bracket at 0 indicates that 0 is part of the graph.

$0 \leq t$



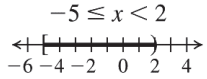
24. The solutions of $1 \leq m$, or $m \geq 1$, are those numbers greater than or equal to 1. They are shown on the graph by shading all points to the right of 1. The bracket at 1 indicates that 1 is part of the graph.

$1 \leq m$



25. In order to be solution of the inequality $-5 \leq x < 2$, a number must be a solution of both $-5 \leq x$ and $x < 2$. The solution set is graphed as follows:

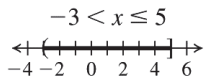
$-5 \leq x < 2$



The bracket at -5 means that -5 is part of the graph. The parenthesis at 2 means that 2 is not part of the graph.

26. In order to be a solution of the inequality $-3 < x \leq 5$, a number must be a solution of both $-3 < x$ and $x \leq 5$. The solution set is graphed as follows:

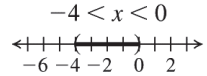
$-3 < x \leq 5$



The parenthesis at -3 means that -3 is not part of the graph. The bracket at 5 means that 5 is part of the graph.

27. In order to be a solution of the inequality $-4 < x < 0$, a number must be a solution of both $-4 < x$ and $x < 0$. The solution set is graphed as follows:

$-4 < x < 0$



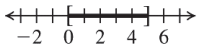
The parentheses at -4 and 0 mean that -4 and 0 are not part of the graph.

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28. In order to be a solution of the inequality $0 \le x \le 5$, a number must be a solution of both $0 \le x$ and $x \le 5$. The solution set is graphed as follows:

$0 \le x \le 5$

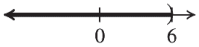


The brackets at 0 and at 5 mean that 0 and 5 are both part of the graph.

29. $y < 6$

Using set-builder notation, we write the solution set as $\{y|y < 6\}$. Using interval notation, we write $(-\infty, 6)$.

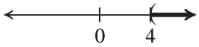
To graph the solution, we shade all numbers to the left of 6 and use a parenthesis to indicate that 6 is not a solution.



30. $x > 4$

Using set-builder notation, we write the solution set as $\{x|x > 4\}$. Using interval notation, we write $(4, \infty)$.

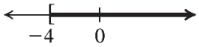
To graph the solution, we shade all numbers to the right of 4 and use a parenthesis to indicate that 4 is not a solution.



31. $x \ge -4$

Using set-builder notation, we write the solution set as $\{x|x \ge -4\}$. Using interval notation, we write $[-4, \infty)$.

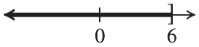
To graph the solution, we shade all numbers to the right of –4 and use a bracket to indicate that –4 is a solution.



32. $t \le 6$

Using set-builder notation, we write the solution set as $\{t|t \le 6\}$. Using interval notation, we write $[6, \infty)$.

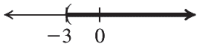
To graph the solution, we shade all numbers to the left of 6 and use a bracket to indicate that 6 is a solution.



33. $t > -3$

Using set-builder notation, we write the solution set as $\{t|t > -3\}$. Using interval notation, we write $(-3, \infty)$.

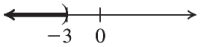
To graph the solution, we shade all numbers to the right of –3 and use a parenthesis to indicate that –3 is not a solution.



34. $y < -3$

Using set-builder notation, we write the solution set as $\{y|y < -3\}$. Using interval notation, we write $(-\infty, -3)$.

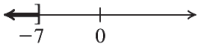
To graph the solution, we shade all numbers to the left of –3 and use a parenthesis to indicate that –3 is not a solution.



35. $x \le -7$

Using set-builder notation, we write the solution set as $\{x|x \le -7\}$. Using interval notation, we write $(-\infty, -7]$.

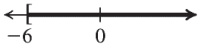
To graph the solution, we shade all numbers to the left of –7 and use a bracket to indicate that –7 is a solution.



36. $x \ge -6$

Using set-builder notation, we write the solution set as $\{x|x \ge -6\}$. Using interval notation, we write $[-6, \infty)$.

To graph the solution, we shade all numbers to the right of –6 and use a bracket to indicate that –6 is a solution.



37. All points to the right of –4 are shaded. The parenthesis at –4 indicates that –4 is not part of the graph. Set-builder notation: $\{x|x > -4\}$. Interval notation: $(-4, \infty)$.

38. $\{x|x < 3\}$, $(-\infty, 3)$

39. All points to the left of 2 are shaded. The bracket at 2 indicates that 2 is part of the graph. Set-builder notation: $\{x|x \le 2\}$. Interval notation: $(-\infty, 2]$.

40. $\{x|x \ge -2\}$, $[-2, \infty)$

41. All points to the left of –1 are shaded. The parenthesis at –1 indicates that –1 is not part of the graph. Set-builder notation: $\{x|x < -1\}$. Interval notation: $(-\infty, -1)$.

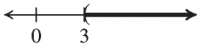
42. $\{x|x > 1\}$, $(1, \infty)$

43. All points to the right of 0 are shaded. The bracket at 0 indicates that 0 is part of the graph. Set-builder notation: $\{x|x \ge 0\}$. Interval notation: $[0, \infty)$

44. $\{x|x \le 0\}$, $(-\infty, 0]$

45.
$$\begin{aligned} y + 6 &> 9 \\ y + 6 - 6 &> 9 - 6 \quad \text{Adding } -6 \text{ to both sides} \\ y &> 3 \quad \text{Simplifying} \end{aligned}$$

The solution set is $\{y|y > 3\}$, or $(3, \infty)$.



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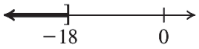
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46. $x+8\le -10$

$x+8-8\le -10-8$ Subtracting 8 from both sides

$x\le -18$ Simplifying

The solution set is $\{x|x\le -18\}$, or $(-\infty,-18]$.

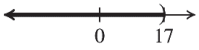


47. $n-6<11$

$n-6+6<11+6$ Adding 6 to both sides

$n<17$ Simplifying

The solution set is $\{n|n<17\}$, or $(17,\infty)$.

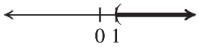


48. $n-4>-3$

$n-4+4>-3+4$

$n>1$

The solution set is $\{n|n>1\}$, or $(1,\infty)$.

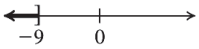


49. $2x\le x-9$

$2x-x\le x-9-x$

$x\le -9$

The solution set is $\{x|x\le -9\}$, or $(-\infty,-9]$.



50. $3x\le 2x+7$

$3x-2x\le 2x+7-2x$

$x\le 7$

The solution set is $\{x|x\le 7\}$, or $(-\infty,\ 7]$.

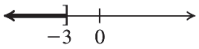


51. $5\ge t+8$

$5-8\ge t+8-8$

$-3\ge t$ or $t\le -3$

The solution set is $\{t|t\le -3\}$, or $(-\infty,-3]$.

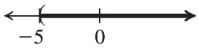


52. $4<t+9$

$4-9<t+9-9$

$-5<t$ or $t>-5$

The solution set is $\{t|t>-5\}$, or $(-5,\ \infty)$.



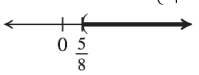
53. $t-\frac{1}{8}>\frac{1}{2}$

$t-\frac{1}{8}+\frac{1}{8}>\frac{1}{2}+\frac{1}{8}$

$t>\frac{4}{8}+\frac{1}{8}$

$t>\frac{5}{8}$

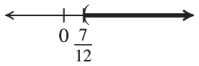
The solution set is $\left\{t\middle|t>\frac{5}{8}\right\}$, or $\left(\frac{5}{8},\ \infty\right)$.



54. $y-\frac{1}{3}>\frac{1}{4}$

$y>\frac{7}{12}$

$\left\{y\middle|y>\frac{7}{12}\right\}$, or $\left(\frac{7}{12},\ \infty\right)$



55. $-9x+17>17-8x$

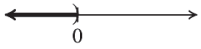
$-9x+17-17>17-8x-17$ Adding −17

$-9x>-8x$

$-9x+9x>-8x+9x$ Adding $9x$

$0>x$

The solution set is $\{x|x<0\}$, or $(-\infty,\ 0)$.

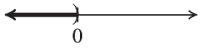


56. $-8n+12>12-7n$

$-8n>-7n$

$0>n$

$\{n|n<0\}$, or $(-\infty,\ 0)$



57. $-23<-t$

The inequality states that the opposite of 23 is less than the opposite of t. Thus, t must be less than 23, so the solution set is $\{t|t<23\}$. To solve this inequality using the addition principle, we would proceed as follows:

$-23<-t$

$t-23<0$ Adding t to both sides

$t<23$ Adding 23 to both sides

The solution set is $\{t|t<23\}$, or $(-\infty,\ 23)$



58. $19<-x$

$x+19<0$

$x<-19$

$\{x|x<-19\}$, or $(-\infty,-19)$

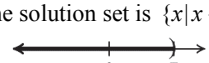


59. $4x<28$

$\frac{1}{4}\cdot 4x<\frac{1}{4}\cdot 28$ Multiplying by $\frac{1}{4}$

$x<7$

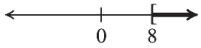
The solution set is $\{x|x<7\}$, or $(-\infty,\ 7)$.



60. $3x\ge 24$

$x\ge 8$

The solution set is $\{x|x\ge 8\}$, or $[8,\ \infty)$.



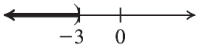
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61. $-24 > 8t$

$-3 > t$

The solution set is $\{t \mid t < -3\}$, or $(-\infty, -3)$.



62. $-16x < -64$

$x > 4$

$\{x \mid x > 4\}$, or $(4, \infty)$



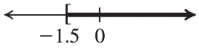
63. $1.8 \geq -1.2n$

$\frac{-1}{1.2} \cdot 1.8 \leq \frac{-1}{1.2}(-1.2n)$ Multiplying by $\frac{-1}{1.2}$

Reversing the inequality

$-1.5 \leq n$

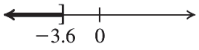
The solution set is $\{n \mid n \geq -1.5\}$, or $[-1.5, \infty)$.



64. $9 \leq -2.5a$

$-3.6 \geq a$

$\{a \mid a \leq -3.6\}$, or $(-\infty, -3.6]$

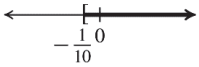


65. $-2y \leq \frac{1}{5}$

$-\frac{1}{2} \cdot (-2y) \geq -\frac{1}{2} \cdot \frac{1}{5}$ Reversing the inequality

$y \geq -\frac{1}{10}$

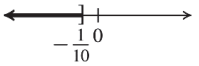
The solution set is $\left\{y \middle| y \geq -\frac{1}{10}\right\}$, or $\left[-\frac{1}{10}, \infty\right)$.



66. $-2x \geq \frac{1}{5}$

$x \leq -\frac{1}{10}$

$\left\{x \middle| x \leq -\frac{1}{10}\right\}$, or $\left(-\infty, -\frac{1}{10}\right]$



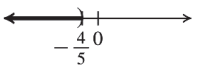
67. $-\frac{8}{5} > 2x$

$\frac{1}{2} \cdot \left(-\frac{8}{5}\right) > \frac{1}{2} \cdot (2x)$

$-\frac{8}{10} > x$

$-\frac{4}{5} > x$, or $x < -\frac{4}{5}$

The solution set is $\left\{x \middle| x < -\frac{4}{5}\right\}$, or $\left(-\infty, -\frac{4}{5}\right)$.

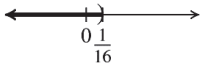


68. $-\frac{5}{8} < -10y$

$-\frac{1}{10}\left(-\frac{5}{8}\right) > y$

$\frac{1}{16} > y$

$\left\{y \middle| y < \frac{1}{16}\right\}$, or $\left(-\infty, \frac{1}{16}\right)$.



69. $2 + 3x < 20$

$2 + 3x - 2 < 20 - 2$ Adding -2 to both sides

$3x < 18$ Simplifying

$x < 6$ Multiplying both sides by $\frac{1}{3}$

The solution set is $\{x \mid x < 6\}$, or $(-\infty, 6)$.

70. $7 + 4y < 31$

$4y < 24$

$y < 6$

$\{y \mid y < 6\}$, or $(-\infty, 6)$

71. $4t - 5 \leq 23$

$4t - 5 + 5 \leq 23 + 5$ Adding 5 to both sides

$4t \leq 28$

$\frac{1}{4} \cdot 4t \leq \frac{1}{4} \cdot 28$ Multiplying both sides by $\frac{1}{4}$

$t \leq 7$

The solution set is $\{t \mid t \leq 7\}$, or $(-\infty, 7]$.

72. $15x - 7 \leq -7$

$15x \leq 0$

$x \leq 0$

The solution set is $\{x \mid x \leq 0\}$, or $(-\infty, 0]$.

73. $39 > 3 - 9x$

$39 - 3 > 3 - 9x - 3$ Adding -3

$36 > -9x$

$-\frac{1}{9} \cdot 36 < -\frac{1}{9} \cdot (-9x)$ Multiplying by $-\frac{1}{9}$

Reversing the inequality

$-4 < x$

The solution set is $\{x \mid x > -4\}$, or $(-4, \infty)$.

74. $5 > 5 - 7y$

$0 > -7y$

$0 < y$

$\{y \mid y > 0\}$, or $(0, \infty)$.

75. $5 - 6y > 25$

$-5 + 5 - 6y > -5 + 25$

$-6y > 20$

$-\frac{1}{6} \cdot (-6y) < -\frac{1}{6} \cdot 20$ Reversing the inequality.

$y < -\frac{20}{6}$

$y < -\frac{10}{3}$

The solution set is $\left\{y \middle| y < -\frac{10}{3}\right\}$, or $\left(-\infty, -\frac{10}{3}\right)$.

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76. $8-2y>9$
$-2y>1$
$y<-\frac{1}{2}$
$\left\{y\middle|y<-\frac{1}{2}\right\}$, or $\left(-\infty,-\frac{1}{2}\right)$.

77. $-3<8x+7-7x$
$-3<x+7$ Collecting like terms
$-3-7<x+7-7$
$-10<x$
The solution set is $\{x|x>-10\}$, or $(-10,\infty)$.

78. $-5<9x+8-8x$
$-5<x+8$
$-13<x$
$\{x|x>-13\}$, or $(-13,\infty)$.

79. $6-4y>6-3y$
$6-4y+4y>6-3y+4y$ Adding $4y$
$6>6+y$
$-6+6>-6+6+y$ Adding -4
$0>y$, or $y<0$
The solution set is $\{y|y<0\}$, or $(-\infty,0)$.

80. $7-8y>5-7y$
$2>y$
$\{y|y<2\}$, or $(-\infty,2)$

81. $2.1x+43.2>1.2-8.4x$
$10(2.1x+43.2)>10(1.2-8.4x)$ Multiplying by 10 to clear decimals
$21x+432>12-84x$
$21x+84x>12-432$ Adding $84x$ and -432
$105x>-420$
$x>-4$ Multiplying by $\frac{1}{105}$
The solution set is $\{x|x>-4\}$, or $(-4,\infty)$.

82. $0.96y-0.79\le 0.21y+0.46$
$96y-79\le 21y+46$
$75y\le 125$
$y\le\frac{5}{3}$
$\left\{y\middle|y\le\frac{5}{3}\right\}$, or $\left(-\infty,\frac{5}{3}\right]$

83. $1.7t+8-1.62t<0.4t-0.32+8$
$0.08t+8<0.4t+7.68$ Collecting like terms
$100(0.08t+8)<100(0.4t+7.68)$ Multiplying by 100
$8t+800<40t+768$
$-8t-768+8t+800<40t+768-8t-768$
$32<32t$
$1<t$
The solution set is $\{t|t>1\}$, or $(1,\infty)$.

84. $0.7n-15+n\ge 2n-8-0.4n$
$1.7n-15\ge 1.6n-8$
$17n-150\ge 16n-80$
$n\ge 70$
The solution set is $\{n|n\ge 70\}$, or $[70,\infty)$.

85. $\frac{x}{3}+4\le 1$
$3\left(\frac{x}{3}+4\right)\le 3\cdot 1$ Multiplying by 3 to clear the fraction
$x+12\le 3$
$x\le -9$
The solution set is $\{x|x\le -9\}$, or $(-\infty,-9]$.

86. $\frac{2}{3}-\frac{x}{5}<\frac{4}{15}$
$10-3x<4$
$-3<-6$
$x>2$
$\{x|x>2\}$, or $(2,\infty)$.

87. $3<5-\frac{t}{7}$
$-2<-\frac{t}{7}$
$-7(-2)>-7\left(-\frac{t}{7}\right)$
$14>t$
The solution set is $\{t|t<14\}$, or $(-\infty,14)$.

88. $2>9-\frac{x}{5}$
$-7>-\frac{x}{5}$
$35<x$
$\{x|x>35\}$, or $(35,\infty)$.

89. $4(2y-3)\le -44$
$8y-12\le -44$ Removing parentheses
$8y\le -32$ Adding 12
$y\le -4$ Multiplying by $\frac{1}{8}$
The solution set is $\{y|y\le -4\}$, or $(-\infty,-4]$.

90. $3(2y-3)>21$
$6y-9>21$
$6y>30$
$y>5$
$\{y|y>5\}$, or $(5,\infty)$

91. $8(2t+1)>4(7t+7)$
$16t+8>28t+28$
$-12t+8>28$
$-12t>20$
$t<-\frac{5}{3}$ Multiplying by $-\frac{1}{12}$ and reversing the symbol
The solution set is $\left\{t|t<-\frac{5}{3}\right\}$, or $\left(-\infty,-\frac{5}{3}\right)$.

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92. $3(t-2) \ge 9(t+2)$
$3t-6 \ge 9t+18$
$-6t \ge 24$
$t \le -4$
The solution set is $\{t \mid t \le -4\}$, or $(-\infty, -4]$.

93. $3(r-6)+2 < 4(r+2)-21$
$3r-18+2 < 4r+8-21$
$3r-16 < 4r-13$
$-16+13 < 4r-3r$
$-3 < r$, or $r > -3$
The solution set is $\{r \mid r > -3\}$, or $(-3, \infty)$.

94. $5(t+3)+9 \ge 3(t-2)-10$
$5t+15+9 \ge 3t-6-10$
$5t+24 \ge 3t-16$
$2t \ge -40$
$t \ge -20$
$\{t \mid t \ge -20\}$, or $[-20, \infty)$.

95. $\frac{4}{5}(3x-4) \le 20$
$\frac{5}{4} \cdot \frac{4}{5}(3x+4) \le \frac{5}{4} \cdot 20$
$3x+4 \le 25$
$3x \le 21$
$x \le 7$
The solution set is $\{x \mid x \le 7\}$, or $(-\infty, 7]$.

96. $\frac{2}{3}(2x-1) \ge 10$
$2x-1 \ge 15$
$2x \ge 16$
$x \ge 8$
$\{x \mid x \ge 8\}$, or $[8, \infty)$.

97. $\frac{2}{3}\left(\frac{7}{8}-4x\right)-\frac{5}{8} < \frac{3}{8}$
$\frac{2}{3}\left(\frac{7}{8}-4x\right) < 1$ Adding $\frac{5}{8}$
$\frac{7}{12}-\frac{8}{3}x < 1$ Removing parentheses
$12\left(\frac{7}{12}-\frac{8}{3}x\right) < 12 \cdot 1$ Clearing fractions
$7-32x < 12$
$-32x < 5$
$x > -\frac{5}{32}$
The solution is $\left\{x \middle| x > -\frac{5}{32}\right\}$, or $\left(-\frac{5}{32}, \infty\right)$.

98. $\frac{3}{4}\left(3x-\frac{1}{2}\right)-\frac{2}{3} < \frac{1}{3}$
$\frac{3}{4}\left(3x-\frac{1}{2}\right) < 1$
$\frac{9}{4}x-\frac{3}{8} < 1$
$18x-3 < 8$
$18x < 11$
$x < \frac{11}{18}$
$\left\{x \middle| x < \frac{11}{18}\right\}$, or $\left(-\infty, \frac{11}{18}\right)$.

99. *Writing Exercise.* The inequalities $x > -3$ and $x \ge -2$ are not equivalent because they do not have the same solution set. For example, –2.5 is a solution of $x > -3$, but it is not a solution of $x \ge -2$.

100. *Writing Exercise.* The inequalities $t < -7$ and $t \le -8$ are not equivalent because they do not have the same solution set. For example, –7.1 is a solution of $t < -7$, but it is not a solution of $t \le -8$.

101. $5x-2(3-6x) = 5x-6+12x = 17x-6$

102. $8m-n-3(2m+5n) = 8m-n-6m-15n$
$= 2m-16n$

103. $x-2[4y+3(8-x)-1]$
$= x-2[4y+24-3x-1]$
$= x-2[4y-3x+23]$
$= x-8y+6x-46$
$= 7x-8y-46$

104. $9x-2\{4-5[6-2(x+1)-x]\}$
$= 9x-2\{4-5[6-2x-2-x]\}$
$= 9x-2\{4-5[4-3x]\}$
$= 9x-2\{4-20+15x\}$
$= 9x-2\{-16+15x\}$
$= 9x+32-30x$
$= -21x+32$

105. *Writing Exercise.* The graph of an inequality of the form $a \le x \le a$ consists of just one number, a.

106. *Writing Exercise.* For the addition principle, when adding the same real number to both sides of an inequality, the sense of the inequality is maintained. For the multiplication principle, when multiplying both sides of an inequality by the same positive real number, the sense of the inequality stays the same. When multiplying both sides of an inequality by the same negative real number, the sense of the inequality is reversed.

107. $x < x+1$
When any real number is increased by 1, the result is greater than the original number. Thus the solution set is $\{x \mid x \text{ is a real number}\}$, or $(-\infty, \infty)$.

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108. $6[4-2(6+3t)] > 5[3(7-t)-4(8+2t)]-20$
$6[4-12-6t] > 5[21-3t-32-8t]-20$
$6[-8-6t] > 5[-11-11t]-20$
$-48-36t > -55-55t-20$
$-48-36t > -75-55t$
$-36t+55t > -75+48$
$19t > -27$
$t > -\frac{27}{19}$

The solution set is $\left\{t \middle| t > -\frac{27}{19}\right\}$, or $\left(-\frac{27}{19}, \infty\right)$.

109. $27-4[2(4x-3)+7] \geq 2[4-2(3-x)]-3$
$27-4[8x-6+7] \geq 2[4-6+2x]-3$
$27-4[8x+1] \geq 2[-2+2x]-3$
$27-32x-4 \geq -4+4x-3$
$23-32x \geq -7+4x$
$23+7 = 4x+32x$
$30 \geq 36x$
$\frac{5}{6} \geq x$

The solution set is $\left\{x \middle| x \leq \frac{5}{6}\right\}$, or $\left(-\infty, \frac{5}{6}\right]$.

110. $\frac{1}{2}(2x+2b) > \frac{1}{3}(21+3b)$
$x+b > 7+b$
$x+b-b > 7+b-b$
$x > 7$

The solution set is $\{x|x > 7\}$, or $(7, \infty)$.

111. $-(x+5) \geq 4a-5$
$-x-5 \geq 4a-5$
$-x \geq 4a-5+5$
$-x \geq 4a$
$-1(-x) \leq -1 \cdot 4a$
$x \leq -4a$

The solution set is $\{x|x \leq -4a\}$, or $(-\infty, -4a]$.

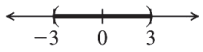
112. $y < ax+b$ Assume $a < 0$.
$y-b < ax$
$\frac{y-b}{a} > x$ Since $a < 0$, the inequality symbol must be reversed.

The solution set is $\left\{x \middle| x < \frac{y-b}{a}\right\}$, or $\left(-\infty, \frac{y-b}{a}\right)$.

113. $y < ax+b$ Assume $a > 0$.
$y-b < ax$
$\frac{y-b}{a} < x$ Since $a > 0$, the inequality symbol stays the same.

The solution set is $\left\{x \middle| x > \frac{y-b}{a}\right\}$, or $\left(\frac{y-b}{a}, \infty\right)$.

114. $\{x|-3 < x < 3\}$, or $(-3, 3)$.



115. $|x| > -3$

Since absolute value is always nonnegative, the absolute value of any real number will be greater than −3. Thus, the solution set is $\{x|x$ is a real number$\}$, or $(-\infty, \infty)$.

116. $|x| < 0$

For any real number x, $|x| \geq 0$. Thus, the solution set is $\emptyset$.

117. **a.** No. The percentage of calories from fat is $\frac{54}{150} = 0.36$, or 36%, which is greater than 30%.

b. There is more than 6 g of fat per serving.

Exercise Set 2.7

1. If Matt's income is always \$500 per week or more, then his income *is at least* \$500.

2. If Amy's entertainment budget for each month is \$250, then her entertainment expenses *cannot exceed* \$250.

3. If Lori works out 30 min or more every day, then her exercise time is *no less than* 30 min.

4. If Marco must pay \$20 or more toward his credit-card loan each month, then \$20 is his *minimum* monthly payment.

5. a is at least b can be translated as $b \leq a$.

6. a exceeds b can be translated as $b < a$.

7. a is at most b can be translated as $a \leq b$.

8. a is exceeded by b can be translated as $a < b$.

9. b is no more than a can be translated as $b \leq a$.

10. b is no less than a can be translated as $a \leq b$.

11. b is less than a can be translated as $b < a$.

12. b is more than a can be translated as $a < b$.

13. Let n represent the number. Then we have $n < 10$.

14. Let n represent the number. Then we have $n \geq 4$.

15. Let t represent the temperature. Then we have $t \leq -3$.

16. Let c represent the number of credits taken. Then we have $c \geq 12$.

17. Let d represent the number of years of driving experience. Then we have $d \geq 5$.

18. Let f represent the length of a focus-group session. Then we have $f \leq 2$.

19. Let a represent the age of the Mayan altar. Then we have $a > 1200$.

20. Let f represent the amount of exposure to formaldehyde. Then we have $f \leq 2$.

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21. Let h represent Bianca's hourly wage. Then we have $h \geq 12$.

22. Let c represent the cost of production. Then we have $c \leq 12,500$.

23. Let s represent the number of hours of sunshine. Then we have $1100 < s < 1600$.

24. Let c represent the cost of a gallon of gasoline in dollars. Then we have $2 < c < 4$.

25. ***Familiarize***. Let s = the length of the service call, in hours. The total charge is \$55 plus \$40 times the number of hours RJ's was there.

Translate.

\$55 charge	plus	hourly rate	times	number of hours	is greater than	\$150.
↓	↓	↓	↓	↓	↓	↓
55	+	40	·	s	>	150

Carry out. We solve the inequality.

$$55 + 40s > 150$$
$$40s > 95$$
$$s > 2.375$$

Check. As a partial check, we show that the cost of a 2.375 hour service call is \$150.

$$\$55 + \$30(2.375) = \$55 + \$95 = \$150$$

State. The length of the service call was more than 2.375 hr.

26. Let c = the number of courses for which Vanessa registers.

Solve: $95 + 675c \leq 2500$

$$c \leq 3.\overline{5629}$$

Rounding down, we find that Vanessa can register for 3 courses at most.

27. ***Familiarize***. Let q = Robbin's undergraduate grade point average. Unconditional acceptance is 500 plus 200 times the grade point average.

Translate.

GMAT score of 500	plus	200	times	grade point average	is at least	1020.
↓	↓	↓	↓	↓	↓	↓
500	+	200	·	q	≥	1020

Carry out. We solve the inequality.

$$500 + 200q \geq 1020$$
$$200q \geq 520$$
$$q \geq 2.6$$

Check. As a partial check we show that the acceptance score is 1020.

$$500 + 200(2.6) = 500 + 520 = 1020.$$

State. For unconditional acceptance, Robbin must have a GPA of at least 2.6.

28. Let p = Oliver's car payment

Solve: $p + 100 < 0.08 \cdot \frac{54000}{12}$

$$p < \$260$$

29. ***Familiarize***. The average of the five scores is their sum divided by the number of tests, 5. We let s represent Rod's score on the last test.

Translate. The average of the five scores is given by

$$\frac{73 + 75 + 89 + 91 + s}{5}.$$

Since this average must be at least 85, this means that it must be greater than or equal to 85. Thus, we can translate the problem to the inequality

$$\frac{73 + 75 + 89 + 91 + s}{5} \geq 85.$$

Carry out. We first multiply by 5 to clear the fraction.

$$5\left(\frac{73 + 75 + 89 + 91 + s}{5}\right) \geq 5 \cdot 85$$
$$73 + 75 + 89 + 91 + s \geq 425$$
$$328 + s \geq 425$$
$$s \geq 97$$

Check. As a partial check, we show that Rod can get a score of 97 on the fifth test and have an average of at least 85:

$$\frac{73 + 75 + 89 + 91 + 97}{5} = \frac{425}{5} = 85.$$

State. Scores of 97 and higher will earn Rod an average quiz grade of at least 85.

30. Let s = the number of servings of fruits or vegetables Dale eats on Saturday.

Solve: $\frac{4 + 6 + 7 + 4 + 6 + 4 + s}{7} \geq 5$

$$s \geq 4 \text{ servings}$$

31. ***Familiarize***. Let c = the number of credits Millie must complete in the fourth quarter.

Translate.

Average number of credits	is at least	7.
↓	↓	↓
$\frac{5 + 7 + 8 + c}{4}$	≥	7

Carry out. We solve the inequality.

$$\frac{5 + 7 + 8 + c}{4} \geq 7$$
$$4\left(\frac{5 + 7 + 8 + c}{4}\right) \geq 4 \cdot 7$$
$$5 + 7 + 8 + c \geq 28$$
$$20 + c \geq 28$$
$$c \geq 8$$

Check. As a partial check, we show that Millie can complete 8 credits in the fourth quarter and average 7 credits per quarter.

$$\frac{5 + 7 + 8 + 8}{4} = \frac{28}{4} = 7$$

State. Millie must complete 8 credits or more in the fourth quarter.

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32. Let m = the number of minutes Monroe must practice on the seventh day.

Solve: $\dfrac{15+28+30+0+15+25+m}{7} \geq 20$

$$m \geq 27 \text{ min}$$

33. ***Familiarize***. The average number of plate appearances for 10 days is the sum of the number of appearance per day divided by the number of days, 10. We let p represent the number of plate appearances on the tenth day.

Translate. The average for 10 days is given by $\dfrac{5+1+4+2+3+4+4+3+2+p}{10}$.

Since the average must be at least 3.1, this means that it must be greater than or equal to 3.1. Thus, we can translate the problem to the inequality

$$\frac{5+1+4+2+3+4+4+3+2+p}{10} \geq 3.1.$$

Carry out. We first multiply by 10 to clear the fraction.

$$10\left(\frac{5+1+4+2+3+4+4+3+2+p}{10}\right) \geq 10 \cdot 3.1$$
$$5+1+4+2+3+4+4+3+2+p \geq 31$$
$$28+p \geq 31$$
$$p \geq 3$$

Check. As a partial check, we show that 3 plate appearances in the 10th game will average 3.1.

$$\frac{5+1+4+2+3+4+4+3+2+3}{10} = \frac{31}{10} = 3.1$$

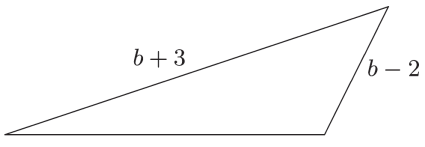
State. On the tenth day, 3 or more plate appearances will give an average of at least 3.1.

34. Let h = the number of hours of school on Friday.

Solve: $\dfrac{4+6\frac{1}{2}+3\frac{1}{2}+6\frac{1}{2}+h}{5} \geq 5\frac{1}{2}$

$$h \geq 7 \text{ hours}$$

35. ***Familiarize***. We first make a drawing. We let b represent the length of the base. Then the lengths of the other sides are $b-2$ and $b+3$.



The perimeter is the sum of the lengths of the sides or $b+b-2+b+3$, or $3b+1$.

Translate.

The perimeter	is greater than	19 cm.
↓	↓	↓
$3b+1$	$>$	19

Carry out.

$$3b+1 > 19$$
$$3b > 18$$
$$b > 6$$

Check. We check to see if the solution seems reasonable.

When $b=5$, the perimeter is $3 \cdot 5+1$, or 16 cm.

When $b=6$, the perimeter is $3 \cdot 6+1$, or 19 cm.

When $b=7$, the perimeter is $3 \cdot 7+1$, or 22 cm.

From these calculations, it would appear that the solution is correct.

State. For lengths of the base greater than 6 cm the perimeter will be greater than 19 cm.

36. Let w = the width of the rectangle.

Solve: $2(2w)+2w \leq 50$

$$w \leq \frac{25}{3} \text{ ft, or } 8\frac{1}{3} \text{ ft}$$

37. ***Familiarize***. Let d = the depth of the well, in feet. Then the cost on the pay-as-you-go plan is $\$500+\$8d$. The cost of the guaranteed-water plan is \$4000. We want to find the values of d for which the pay-as-you-go plan costs less than the guaranteed-water plan.

Translate.

Cost of pay-as-you-go plan	is less than	cost of guaranteed-water plan
↓	↓	↓
$500+8d$	$<$	4000

Carry out.

$$500+8d < 4000$$
$$8d < 3500$$
$$d < 437.5$$

Check. We check to see that the solution is reasonable.

When $d=437$, $\$500+\$8 \cdot 437 = \$3996 < \$4000$

When $d=437.5$, $\$500+\$8(437.5) = \$4000$

When $d=438$, $\$500+\$8(438) = \$4004 > \$4000$

From these calculations, it appears that the solution is correct.

State. It would save a customer money to use the pay-as-you-go plan for a well of less than 437.5 ft.

38. Let t = the number of 15-min units of time for a road call.

Solve: $50+15t < 70+10t$

$$t < 4$$

It would be more economical to call Rick's for a service call of less than 4 15-min time units, or of less than 1 hr.

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39. ***Familiarize***. Let v = the blue book value of the car. Since the car was repaired, we know that \$8500 does not exceed $0.8v$ or, in other words, $0.8v$ is at least \$8500.

Translate.

$$\underbrace{\text{80\% of the blue book value}} \quad \underbrace{\text{is at least}} \quad \$8500.$$

$$\downarrow \qquad \downarrow \qquad \downarrow$$
$$0.8v \qquad \geq \qquad 8500$$

Carry out.

$$0.8v \geq 8500$$
$$v \geq \frac{8500}{0.8}$$
$$v \geq 10{,}625$$

Check. As a partial check, we show that 80% of \$10,625 is at least \$8500:

$$0.8(\$10{,}625) = \$8500$$

State. The blue book value of the car was at least \$10,625.

40. Let c = the cost of the repair.

Solve: $c > 0.8(21{,}000)$

$c > \$16{,}800$

41. ***Familiarize***. Let L = the length of the package.

Translate.

$$\underbrace{\text{Length}} \quad \text{and} \quad \underbrace{\text{girth}} \quad \underbrace{\text{is less than}} \quad \underbrace{\text{84 in}}$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$L \quad + \quad 29 \quad < \quad 84$$

Carry out.

$$L + 29 < 84$$
$$L < 55$$

Check. We check to see if the solution seems reasonable.

When $L = 60$, $60 + 29 = 89$ in.

When $L = 55$, $55 + 29 = 84$ in.

When $L = 50$, $50 + 29 = 79$ in.

From these calculations, it would appear that the solution is correct.

State. For lengths less than 55 in, the box is considered a "package."

42. Let L = the length of the envelope.

Solve: $\left(3\frac{1}{2}\right)L \geq 17\frac{1}{2}$

$$\frac{7}{2}L \geq \frac{35}{2}$$
$$L \geq 5 \text{ in.}$$

43. ***Familiarize***. We will use the formula $F = \frac{9}{5}C + 32$.

Translate.

$$\underbrace{\text{Fahrenheit temperature}} \quad \underbrace{\text{is above}} \quad 98.6°.$$

$$\downarrow \qquad \downarrow \qquad \downarrow$$
$$F \qquad > \qquad 98.6$$

Substituting $\frac{9}{5}C + 32$ for F, we have

$$\frac{9}{5}C + 32 > 98.6.$$

Carry out. We solve the inequality.

$$\frac{9}{5}C + 32 > 98.6$$
$$\frac{9}{5}C > 66.6$$
$$C > \frac{333}{9}$$
$$C > 37$$

Check. We check to see if the solution seems reasonable.

When $C = 36$, $\frac{9}{5} \cdot 36 + 32 = 96.8$.

When $C = 37$, $\frac{9}{5} \cdot 37 + 32 = 98.6$.

When $C = 38$, $\frac{9}{5} \cdot 38 + 32 = 100.4$.

It would appear that the solution is correct, considering that rounding occurred.

State. The human body is feverish for Celsius temperatures greater than 37°.

44. Solve: $\frac{9}{5}C + 32 < 1945.4$

$$C < 1063°\text{C}$$

45. ***Familiarize***. Let h = the height of the triangle, in ft. Recall that the formula for the area of a triangle with base b and height h is $A = \frac{1}{2}bh$.

Translate.

$$\text{Area} \quad \underbrace{\text{less than or equal to}} \quad \underbrace{12 \text{ ft}^2}.$$

$$\downarrow \qquad \downarrow \qquad \downarrow$$
$$\frac{1}{2}(8)h \qquad \leq \qquad 12$$

Carry out. We solve the inequality.

$$\frac{1}{2}(8)h \leq 12$$
$$4h \leq 12$$
$$h \leq 3$$

Check. As a partial check, we show that a length of 3 ft will result in an area of 12 ft^2.

$$\frac{1}{2}(8)(3) = 12$$

State. The height should be no more than 3 ft.

46. Let h = the length of the triangle

Solve: $\frac{1}{2} \cdot \left(1\frac{1}{2}\right)h \geq 3$

$$\frac{3}{4}h \geq 3$$
$$h \geq 4$$

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47. ***Familiarize***. Let r = the amount of fat in a serving of the peanut butter, in grams. If reduced fat peanut butter has at least 25% less fat than regular peanut butter, then it has at most 75% as much fat as the regular peanut butter.

Translate.

12 g of fat	is at most	75%	of	the amount of fat in regular peanut butter.
↓	↓	↓	↓	↓
12	$\le$	0.75	·	r

Carry out.

$12 \le 0.75r$

$16 \le r$

Check. As a partial check, we show that 12 g of fat does not exceed 75% of 16 g of fat:

$0.75(16) = 12$

State. A serving of regular peanut butter contains at least 16 g of fat.

48. Let r = the amount of fat in a serving of the regular cheese, in grams.

Solve: $5 \le 0.75r$ (See Exercise 47.)

$r \ge 6\frac{2}{3}$ g

49. ***Familiarize***. Let t = the number of years after 2004. To simplify, the number of dogs is in millions.

Translate.

Number of dogs in 2004	plus	1.1 dogs per year	times
↓	↓	↓	↓
73.9	+	1.1	·

number of years	exceeds	90 dogs.
↓	↓	↓
t	>	90

Carry out. We solve the inequality.

$73.9 + 1.1t > 90$

$1.1t > 16.1$

$t > 14.6$

$2004 + 15 = 2019$

Check. As a partial check, we can show that the number of dogs is 90 million 15 years after 2004.

$73.9 + 1.1 \cdot 15 = 73.9 + 16.5 = 90.4$

State. The there will be more than 90 million dogs living as household pets in 2019 and after.

50. Let w = the number of weeks after July 1.

Solve: $25 - \frac{2}{3}w \le 21.$

$w \ge 6$

The water level will not exceed 21 ft for dates at least 6 weeks after July 1, or on August 12 and later.

51. ***Familiarize***. Let n = the number of text messages. The total cost is the monthly fee of \$1.99 each day for 22 days, or 1.99(22) = \$43.78, plus 0.02 times the number of text messages, or $0.02n$.

Translate.

Day fee	plus	text messages	cannot exceed	\$60
↓	↓	↓	↓	↓
\$43.78	+	$0.02n$	$\le$	60

Carry out. We solve the inequality.

$43.78 + 0.02n \le 60$

$0.02n \le 16.22$

$n \le 811$

Check. As a partial check, if the number of text messages is 811, the budget of \$60 will not be exceeded.

State. Liam can send or receive 811 text messages and stay within his budget.

52. Let p = the number of persons attending the banquet.

Solve: $100 + 24p \le 700$

$p \le 25$

At most, 25 people can attend the banquet.

53. ***Familiarize***. We will use the formula

$R = -0.0065t + 4.3259.$

Translate.

The world record	is less than	3.6 minutes.
↓	↓	↓
$-0.0065t + 4.3259$	<	3.6

Carry out. We solve the inequality.

$-0.0065t + 4.3259 < 3.6$

$-0.0065t < -0.7259$

$t > 111.68$

Check. As a partial check, we can show that the record is more than 3.6 min 111 yr after 1900 and is less than 3.6 min 112 yr after 1900.

For $t = 111$, $R = -0.0065(111) + 4.3259 = 3.7709$.

For $t = 112$, $R = -0.0065(112) + 4.3259 = 3.5979$.

State. The world record in the mile run is less than 3.6 min more than 112 yr after 1900, or in years after 2012.

54. Solve: $-0.0026t + 4.0807 < 3.7$

$t > 146.42$

The world record in the 1500-m run will be less than 3.7 min more than 146 yr after 1900, or in years after 2046.

55. ***Familiarize***. We will use the equation

$y = 0.122x + 0.912.$

Translate.

The cost	is at most	\$14.
↓	↓	↓
$0.122x + 0.912$	$\le$	14

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Carry out. We solve the inequality.

$$0.122x + 0.912 \le 14$$
$$0.122x \le 13.088$$
$$x \le 107$$

Check. As a partial check, we show that the cost for driving 107 mi is \$14.

$$0.122(107) + 0.912 \approx 14$$

State. The cost will be at most \$14 for mileages less than or equal to 107 mi.

56. Solve: $0.237Y - 468.87 \ge 9$

$$Y \ge 2016.33$$

The average price of a movie ticket will be at least \$9 in 2017 and beyond.

57. *Writing Exercise*. Answers may vary. Fran is more than 3 years older than Todd.

58. *Writing Exercise*. Let n represent "a number." Then "five more than a number" translates to $n + 5$, or $5 + n$, and "five is more than a number" translates to $5 > n$.

59. $7 + xy$

60. $225 = 3 \cdot 3 \cdot 5 \cdot 5$

61. Changing the sign of 18 gives -18.

62. $-(-(-5)) = -5$

63. *Writing Exercise*. Answers may vary.

A boat has a capacity of 2800 lb. How many passengers can go on the boat if each passenger is considered to weigh 150 lb.

64. *Writing Exercise*. Answers may vary.

Acme rents a truck at a daily rate of \$46 plus \$0.43 per mile. The Rothmans want a one-day truck rental, but they must stay within an \$85 budget. What mileage will allow them to stay within their budget?

65. ***Familiarize***. We use the formula $F = \frac{9}{5}C + 32$.

Translate. We are interested in temperatures such that $5° < F < 15°$. Substituting for F, we have:

$$5 < \frac{9}{5}C + 32 < 15$$

Carry out:

$$5 < \frac{9}{5}C + 32 < 15$$
$$5 \cdot 5 < 5\left(\frac{9}{5}C + 32\right) < 5 \cdot 15$$
$$25 < 9C + 160 < 75$$
$$-135 < 9C < -85$$
$$-15 < C < -9\frac{4}{9}$$

Check. The check is left to the student.

State. Green ski wax works best for temperatures between $-15°\text{C}$ and $-9\frac{4}{9}°\text{C}$.

66. Let h = the number of hours the car has been parked.

Solve: $4 + 2.5(h - 1) > 16.5$

$$h > 6 \text{ hr}$$

67. Since $8^2 = 64$, the length of a side must be less than or equal to 8 cm (and greater than 0 cm, of course). We can also use the five-step problem-solving procedure.

Familiarize. Let s represent the length of a side of the square. The area s is the square of the length of a side, or s^2.

Translate.

$$\underbrace{\text{The area}} \quad \underbrace{\text{is no more than}} \quad 64 \text{ cm}^2.$$
$$\downarrow \qquad \downarrow \qquad \downarrow$$
$$s^2 \qquad \le \qquad 64$$

Carry out.

$$s^2 \le 64$$
$$|s| \le 8$$

Then $-8 \le s \le 8$.

Check. Since the length of a side cannot be negative we only consider positive values of s, or $0 < s \le 8$. We check to see if this solution seems reasonable.

When $s = 7$, the area is 7^2, or 49 cm^2.

When $s = 8$, the area is 8^2, or 64 cm^2.

When $s = 9$, the area is 9^2, or 81 cm^2.

From these calculations, it appears that the solution is correct.

State. Sides of length 8 cm or less will allow an area of no more than 64 cm^2. (Of course, the length of a side must be greater than 0 also.)

68. Because we are considering odd integers we know that the larger integer cannot be greater than 49. $(51 + 49$ is not less than 100.) Then the smaller integer is $49 - 2$, or 47. We can also do this exercise as follows:

Let x = the smaller integer. Then $x + 2 =$ the larger integer.

Solve: $x + (x + 2) < 100$

$$x < 49$$

The largest odd integer less than 49 is 47, so the integers are 47 and 49.

69. ***Familiarize***. Let p = the price of Neoma's tenth book. If the average price of each of the first 9 books is \$12, then the total price of the 9 books is $9 \cdot \$12$, or \$108. The average price of the first 10 books will be $\frac{\$108 + p}{10}$.

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Translate.

$$\underbrace{\text{The average price of 10 books}} \quad \underbrace{\text{is at least}} \quad \$15.$$

$$\downarrow \qquad \downarrow \qquad \downarrow$$

$$\frac{108+p}{10} \qquad \geq \qquad 15$$

Carry out. We solve the inequality.

$$\frac{108+p}{10} \geq 15$$
$$108+p \geq 150$$
$$p \geq 42$$

Check. As a partial check, we show that the average price of the 10 books is \$15 when the price of the tenth book is \$42.

$$\frac{\$108+\$42}{10} = \frac{\$150}{10} = \$15$$

State. Neoma's tenth book should cost at least \$42 if she wants to select a \$15 book for her free book.

70. Let h = the number of hours the car has been parked. Then $h-1=$ the number of hours after the first hour.
Solve: $14 < 4 + 2.50(h-1) < 24$
$5 \text{ hr} < h < 9 \text{ hr}$

71. *Writing Exercise*. Let $s=$ Blythe's score on the tenth quiz. We determine the score required to improve her average at least 2 points. Solving $\frac{9\cdot 84+s}{10} \geq 86$, we get $s \geq 104$. Since the maximum possible score is 100, Blythe cannot improve her average two points with the next quiz.

72. *Writing Exercise*. Let b = the total purchases of hardcover bestsellers, n = the purchase other eligible purchases at Barnes & Noble.
(1) Solving $0.40b > 25$, we get \$62.50
(2) Solving $0.10n > 25$, we get \$250
Thus when a customer's hardcover bestseller purchases are more than \$62.50, or other eligable purchases are more than \$250, the customer saves money by purchasing the card.

Chapter 2 Review

1. True

2. False

3. True

4. True

5. True

6. False

7. True

8. True

9. $x+9=-16$
$x+9-9=-16-9$ Adding -9
$x=-25$ Simplifying
The solution is -25.

10. $-8x=-56$
$\left(-\frac{1}{8}\right)(-8x)=\left(-\frac{1}{8}\right)(-56)$ Multiplying by $-\frac{1}{8}$
$x=7$ Simplifying
The solution is 7.

11. $-\frac{x}{5}=13$
$-5\left(-\frac{x}{5}\right)=-5(13)$ Multiplying by -5
$x=-65$ Simplifying
The solution is -65.

12. $x-0.1=1.01$
$x-0.1+0.1=1.01+0.1$ Adding 0.1
$x=1.11$ Simplifying
The solution is 1.11.

13. $-\frac{2}{3}+x=-\frac{1}{6}$
$6\left(-\frac{2}{3}+x\right)=6\left(-\frac{1}{6}\right)$ Multiplying by 6
$-4+6x=-1$ Simplifying
$-4+6x+4=-1+4$ Adding 4
$6x=3$ Simplifying
$x=\frac{1}{2}$ Multiplying by $\frac{1}{6}$
The solution is $\frac{1}{2}$.

14. $4y+11=5$
$4y+11-11=5-11$ Adding -11
$4y=-6$ Simplifying
$y=\frac{-6}{4}=-\frac{3}{2}$ Multiplying by $\frac{1}{4}$ and reducing
The solution is $-\frac{3}{2}$.

15. $5-x=13$
$5-x-5=13-5$ Adding -5
$-x=8$ Simplifying
$x=-8$ Multiplying by -1
The solution is -8.

16. $3t+7=t-1$
$3t+7-7=t-1-7$ Adding -7
$3t=t-8$ Simplifying
$3t-t=t-8-t$ Adding $-t$
$2t=-8$ Simplifying
$t=-4$ Multiplying by $\frac{1}{2}$
The solution is -4.

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17. $7x-6=25x$

$7x-6-7x=25x-7x$ Adding $-7x$

$-6=18x$ Simplifying

$-\frac{1}{3}=x$ Multiplying by $\frac{1}{18}$

The solution is $-\frac{1}{3}$.

18. $\frac{1}{4}x-\frac{5}{8}=\frac{3}{8}$

$8\left(\frac{1}{4}x-\frac{5}{8}\right)=8\left(\frac{3}{8}\right)$ Multiplying by 8

$2x-5=3$ Simplifying

$2x-5+5=3+5$ Adding 5

$2x=8$ Simplifying

$x=4$ Multiplying by $\frac{1}{2}$

The solution is 4.

19. $14y=23y-17-9y$

$14y=14y-17$

$14y-14y=14y-14y-17$

$0=-17$ FALSE

Contradiction; there is no solution.

20. $0.22y-0.6=0.12y+3-0.8y$

$0.22y-0.6=-0.68y+3$ Simplifying

$0.22y-0.6+0.68y=-0.68y+3+0.68y$ Adding $0.68y$

$0.9y-0.6=3$ Simplifying

$0.9y-0.6+0.6=3+0.6$ Adding 0.6

$0.9y=3.6$ Simplifying

$y=4$ Multiplying by $\frac{1}{0.9}$

The solution is 4.

21. $\frac{1}{4}x-\frac{1}{8}x=3-\frac{1}{16}x$

$16\left(\frac{1}{4}x-\frac{1}{8}x\right)=16\left(3-\frac{1}{16}x\right)$ Multiplying by 16

$4x-2x=48-x$ Distributive Law

$2x=48-x$ Simplifying

$2x+x=48-x+x$ Adding x

$3x=48$ Simplifying

$x=16$ Multiplying by $\frac{1}{3}$

The solution is 16.

22. $6(4-n)=18$

$24-6n=18$ Distributive Law

$24-6n-24=18-24$ Adding -24

$-6n=-6$ Simplifying

$n=1$ Multiplying by $-\frac{1}{6}$

The solution is 1.

23. $4(5x-7)=-56$

$20x-28=-56$ Distributive Law

$20x-28+28=-56+28$ Adding 28

$20x=-28$ Simplifying

$x=-\frac{28}{20}$ Multiplying by $\frac{1}{20}$

$x=-\frac{7}{5}$ Simplifying

The solution is $-\frac{7}{5}$.

24. $8(x-2)=4(x-4)$

$8x-16=4x-16$ Distributive Law

$8x-16+16=4x-16+16$ Adding 16

$8x=4x$ Simplifying

$8x-4x=4x-4x$ Adding $-4x$

$4x=0$ Simplifying

$x=0$ Multiplying by $\frac{1}{4}$

The solution is 0.

25. $3(x-4)+2=x+2(x-5)$

$3x-12+2=x+2x-10$

$3x-10=3x-10$ TRUE

Identity; the solution is all real numbers.

26. $C=\pi d$

$C\left(\frac{1}{\pi}\right)=\pi d\left(\frac{1}{\pi}\right)$ Multiplying by $\frac{1}{\pi}$

$\frac{C}{\pi}=d$ Simplifying

27. $V=\frac{1}{3}Bh$

$3\cdot V=3\left(\frac{1}{3}Bh\right)$ Multiplying by 3

$3V=Bh$ Simplifying

$\frac{1}{h}(3V)=\frac{1}{h}(Bh)$ Multiplying by $\frac{1}{h}$

$\frac{3V}{h}=B$ Simplifying

28. $5x-2y=10$

$-5x+5x-2y=-5x+10$ Adding $-5x$

$-2y=-5x+10$ Simplifying

$-\frac{1}{2}(-2y)=-\frac{1}{2}(-5x+10)$ Multiplying by $-\frac{1}{2}$

$y=\frac{5}{2}x-5$ Simplifying

29. $tx=ax+b$

$tx-ax=ax+b-ax$ Adding $-ax$

$tx-ax=b$ Simplifying

$x(t-a)=b$ Factoring x

$x=\frac{b}{t-a}$ Multiplying by $\frac{1}{t-a}$

30. 1.2% 0.01.2

Move the decimal 2 places to the left. $1.2\%=0.012$

31. $\frac{11}{25}=\frac{4}{4}\cdot\frac{11}{25}=\frac{44}{100}=0.44$

First, move the decimal point two places to the right; then write a % symbol: The answer is 44%.

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32. ***Translate***.

What percent of 60 is 42?

$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$

$y \quad \cdot \quad 60 \quad = \quad 42$

We solve the equation and then convert to percent notation.

$$y \cdot 60 = 42$$
$$y = \frac{42}{60}$$
$$y = 0.70 = 70\%$$

The answer is 70%.

33. ***Translate***.

49 is 35% of What number?

$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$

$49 \quad = \quad 0.35 \quad \cdot \quad y$

We solve the equation and then convert to percent notation.

$$49 = 0.35y$$
$$\frac{49}{0.35} = y$$
$$140 = y$$

The answer is 140.

34. $x \le -5$

We substitute -3 for x giving $-3 \le -5$, which is a false statement since -3 is not to the left of -5 on the number line, so -3 is not a solution of the inequality $x \le -5$.

35. $x \le -5$

We substitute -7 for x giving $-7 \le -5$, which is a true statement since -7 is to the left of -5 on the number line, so -7 is a solution of the inequality $x \le -5$.

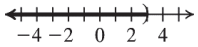
36. $x \le -5$

We substitute 0 for x giving $0 \le -5$, which is a false statement since 0 is not to the left of -5 on the number line, so 0 is not a solution of the inequality $x \le -5$.

37.
$$5x - 6 < 2x + 3$$
$$5x - 6 + 6 < 2x + 3 + 6 \quad \text{Adding 6}$$
$$5x < 2x + 9 \quad \text{Simplifying}$$
$$5x - 2x < 2x + 9 - 2x \quad \text{Adding } -2x$$
$$3x < 9 \quad \text{Simplifying}$$
$$x < 3 \quad \text{Multiplying by } \frac{1}{3}$$

The solution set is $\{x \mid x < 3\}$. The graph is as follows:

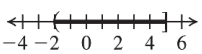
$5x - 6 < 2x + 3$



38. $-2 < x \le 5$

The solution set is $\{x \mid -2 < x \le 5\}$. The graph is as follows:

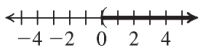
$-2 < x \le 5$



39. $t > 0$

The solution set is $\{t \mid t > 0\}$. The graph is as follows:

$t > 0$



40.
$$t + \frac{2}{3} \ge \frac{1}{6}$$
$$6\left(t + \frac{2}{3}\right) \ge 6\left(\frac{1}{6}\right) \quad \text{Multiplying by 6}$$
$$6t + 4 \ge 1 \quad \text{Simplifying}$$
$$6t + 4 - 4 \ge 1 - 4 \quad \text{Adding } -4$$
$$6t \ge -3 \quad \text{Simplifying}$$
$$\frac{1}{6}(6t) \ge \frac{1}{6}(-3) \quad \text{Multiplying by } \frac{1}{6}$$
$$t \ge -\frac{1}{2} \quad \text{Simplifying}$$

The solution set is $\left\{t \mid t \ge -\frac{1}{2}\right\}$, or $\left[-\frac{1}{2}, \infty\right)$.

41.
$$2 + 6y > 20$$
$$2 + 6y - 2 > 20 - 2 \quad \text{Adding } -2$$
$$6y > 18 \quad \text{Simplifying}$$
$$\frac{1}{6}(6y) > \frac{1}{6} \cdot 18 \quad \text{Multiplying by } \frac{1}{6}$$
$$y > 3 \quad \text{Simplifying}$$

The solution set is $\{y \mid y > 3\}$, or $(3, \infty)$.

42.
$$7 - 3y \ge 27 + 2y$$
$$7 - 3y - 7 \ge 27 + 2y - 7 \quad \text{Adding } -7$$
$$-3y \ge 20 + 2y \quad \text{Simplifying}$$
$$-3y - 2y \ge 20 + 2y - 2y \quad \text{Adding } -2y$$
$$-5y \ge 20 \quad \text{Simplifying}$$
$$y \le -4 \quad \text{Multiplying by } -\frac{1}{5} \text{ and reversing the inequality symbol}$$

The solution set is $\{y \mid y \le -4\}$, or $(-\infty, -4]$.

43.
$$-4y < 28$$
$$-\frac{1}{4}(-4y) > -\frac{1}{4} \cdot 28 \quad \text{Multiplying by } -\frac{1}{4} \text{ and reversing the inequality symbol}$$
$$y > -7 \quad \text{Simplifying}$$

The solution set is $\{y \mid y > -7\}$, or $(-7, \infty)$.

44.
$$3 - 4x < 27$$
$$3 - 4x - 3 < 27 - 3 \quad \text{Adding } -3$$
$$-4x < 24 \quad \text{Simplifying}$$
$$-\frac{1}{4}(-4x) > -\frac{1}{4} \cdot 24 \quad \text{Multiplying by } -\frac{1}{4} \text{ and reversing the inequality symbol}$$
$$x > -6 \quad \text{Simplifying}$$

The solution set is $\{x \mid x > -6\}$, or $(-6, \infty)$.

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45.
$$\begin{aligned} 4-8x &< 13+3x \\ 4-8x-4 &< 13+3x-4 && \text{Adding } -4 \\ -8x &< 9+3x && \text{Simplifying} \\ -8x-3x &< 9+3x-3x && \text{Adding } -3x \\ -11x &< 9 && \text{Simplifying} \\ -\frac{1}{11}(-11x) &> -\frac{1}{11}\cdot 9 && \text{Multiplying by } -\frac{1}{11} \\ x &> -\frac{9}{11} && \text{Simplifying} \end{aligned}$$

The solution set is $\left\{x \mid x > -\frac{9}{11}\right\}$, or $\left(-\frac{9}{11}, \infty\right)$.

46.
$$\begin{aligned} 13 &\le -\frac{2}{3}t+5 \\ 13-5 &\le -\frac{2}{3}t+5-5 && \text{Adding } -5 \\ 8 &\le -\frac{2}{3}t && \text{Simplifying} \\ -\frac{3}{2}(8) &\ge \left(-\frac{3}{2}\right)\left(-\frac{2}{3}t\right) && \text{Multiplying by } -\frac{3}{2} \\ -12t &\ge t && \text{Simplifying} \end{aligned}$$

The solution set is $\{t \mid t \le -12\}$, or $(-\infty, -12]$.

47.
$$\begin{aligned} 7 &\le 1-\frac{3}{4}x \\ 7-1 &\le 1-\frac{3}{4}x-1 && \text{Adding } -1 \\ 6 &\le -\frac{3}{4}x && \text{Simplifying} \\ -\frac{4}{3}\cdot 6 &\ge -\frac{4}{3}\left(-\frac{3}{4}x\right) && \text{Multiplying by } -\frac{4}{3} \\ -8 &\ge x && \text{Simplifying} \end{aligned}$$

The solution set is $\{x \mid x \le -8\}$, or $(-\infty, -8]$.

48. ***Familiarize***. Let $x =$ the total number of cats placed.

Translate.

30% of total cats was 280?

$$\begin{array}{ccccc} \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 0.30 & \cdot & x & = & 280 \end{array}$$

Carry out. We solve the equation.
$$\begin{aligned} 0.30x &= 280 \\ x &= \frac{280}{0.3} \\ x &\approx 933 \end{aligned}$$

Check. If 933 was the total number of cats placed, then 30% of 933 is 0.30(933), about 280. This checks.

State. There were about 933 cats adopted through FACE in 2014.

49. ***Familiarize***. Let x = the length of the first piece, in ft. Since the second piece is 2 ft longer than the first piece, it must be $x+2$ ft.

Translate.

The sum of the lengths of the two pieces is 32 ft.

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ x+(x+2) & = & 32 \end{array}$$

Carry out. We solve the equation.
$$\begin{aligned} x+(x+2) &= 32 \\ 2x+2 &= 32 \\ 2x &= 30 \\ x &= 15 \end{aligned}$$

Check. If the first piece is 15 ft long, then the second piece must be 15 + 2, or 17 ft long. The sum of the lengths of the two pieces is 15 ft + 17 ft, or 32 ft. The answer checks.

State. The lengths of the two pieces are 15 ft and 17 ft.

50. ***Familiarize***. Let x = the number of Indian students. Then $2x-6000$ is the number of Chinese students.

Translate.

The number of Indian students plus the number of Chinese students is 294,000

$$\begin{array}{ccccccc} \downarrow & & \downarrow & & \downarrow & & \\ x & + & 2x-6000 & = & 294{,}000 & & \end{array}$$

Carry out. We solve the equation.
$$\begin{aligned} x+2x-6000 &= 294{,}000 \\ 3x-6000 &= 294{,}000 \\ 3x &= 300{,}000 \\ x &= 100{,}000 \end{aligned}$$
$$2x-000 = 2\cdot 100{,}000 - 6000 = 194{,}000$$

Check. If the number of Indian students is 100,000 and the number of Chinese students is 194,000, then the total is 100,000 + 194,000, or 294,000. The answer checks.

State. There were 100,000 Indian students and 194,000 Chinese students.

51. ***Familiarize***. Let x = the original number of new international students in 2014.

Translate.

Students in 2014 plus 14.18% increase is 1,130,000.

$$\begin{array}{ccccccc} \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & 0.1418x & = & 1{,}130{,}000 \end{array}$$

Carry out. We solve the equation.
$$\begin{aligned} x+0.1418x &= 1{,}130{,}000 \\ 1.1418x &= 1{,}130{,}000 \\ x &= \frac{1{,}130{,}000}{1.1418} \\ x &\approx 990{,}000 \end{aligned}$$

Check. If the number of new international students in 2014 was about 990,000, then that number plus an increase of 14.18% is $990{,}000 + 0.1418\cdot 990{,}000$, is about 1,130,000. The answer checks.

State. There were about 990,000 new international students in 2014.

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52. ***Familiarize***. Let x = the first odd integer and let $x+2=$ the next consecutive odd integer.

Translate.

$$\underbrace{\text{The sum of the two consecutive odd integers}} \quad \text{is} \quad 116$$

$$\downarrow \qquad\qquad \downarrow \quad \downarrow$$

$$x+(x+2) \quad = \quad 116$$

Carry out. We solve the equation.

$$\begin{aligned} x+(x+2)&=116\\ 2x+2&=116\\ 2x&=114\\ x&=57 \end{aligned}$$

Check. If the first odd integer is 57, then the next consecutive odd integer would be 57 + 2 or 59. The sum of these two integers is 57 + 59, or 116. This result checks.

State. The integers are 57 and 59.

53. ***Familiarize***. Let x = the length of the rectangle, in cm. The width of the rectangle is $x-6$ cm. The perimeter of a rectangle is given by $P=2l+2w$, where l is the length and w is the width.

Translate.

$$\underbrace{\text{The perimeter of the rectangle}} \quad \text{is} \quad 56 \text{ cm}$$

$$\downarrow \qquad\qquad \downarrow \quad \downarrow$$

$$2x+2(x-6) \quad = \quad 56$$

Carry out. We solve the equation.

$$\begin{aligned} 2x+2(x-6)&=56\\ 2x+2x-12&=56\\ 4x-12&=56\\ 4x&=68\\ x&=17 \end{aligned}$$

Check. If the length is 17 cm, then the width is 17 cm – 6 cm, or 11 cm. The perimeter is $2\cdot 17$ cm $+ 2\cdot 11$ cm, or 34 cm + 22 cm, or 56 cm. These results check.

State. The length is 17 cm and the width is 11 cm.

54. ***Familiarize***. Let x = the regular price of the picnic table. Since the picnic table was reduced by 25%, it actually sold for 75% of its original price.

Translate.

$$75\% \quad \text{of} \quad \underbrace{\text{the original price}} \quad \text{is} \quad \$120?$$

$$\downarrow \quad \downarrow \qquad \downarrow \qquad \downarrow \quad \downarrow$$

$$0.75 \quad \cdot \quad x \quad = \quad 120$$

Carry out. We solve the equation.

$$\begin{aligned} 0.75x&=120\\ x&=\frac{120}{0.75}\\ x&=160 \end{aligned}$$

Check. If the original price was \$160 with a 25% discount, then the purchaser would have paid 75% of \$160, or $0.75\cdot\$160$, or \$120. This result checks.

State. The original price was \$160.

55. ***Familiarize***. Let x = the measure of the first angle. The measure of the second angle is $x+50°$, and the measure of the third angle is $2x-10°$. The sum of the measures of the angles of a triangle is 180°.

Translate.

$$\underbrace{\text{The sum of the measures of the angles}} \quad \text{is} \quad 180°$$

$$\downarrow \qquad\qquad\qquad\qquad\qquad\qquad \downarrow \quad \downarrow$$

$$x+(x+50)+(2x-10) \quad = \quad 180$$

Carry out. We solve the equation.

$$\begin{aligned} x+(x+50)+(2x-10)&=180\\ 4x+40&=180\\ 4x&=140\\ x&=35 \end{aligned}$$

Check. If the measure of the first angle is 35°, then the measure of the second angle is $35°+50°$, or 85°, and the measure of the third angle is $2\cdot 35°-10°$, or 60°. The sum of the measures of the first, second, and third angles is $35°+85°+60°$, or 180°. These results check.

State. The measures of the angles are 35°, 85°, and 60°.

56. ***Familiarize***. Let x = the amount spent in the sixth month.

Translate.

$$\underbrace{\text{Entertainment average}} \quad \underbrace{\text{does not exceed}} \quad \$95$$

$$\downarrow \qquad\qquad \downarrow \quad \downarrow$$

$$\frac{98+89+110+85+83+x}{6} \quad \leq \quad 95$$

Carry out. We solve the inequality.

$$\begin{aligned} \frac{98+89+110+85+83+x}{6}&\leq 95\\ 6\left(\frac{98+89+110+85+83+x}{6}\right)&\leq 6\cdot 95\\ 98+89+110+85+83+x&\leq 570\\ 465+x&\leq 570\\ x&\leq 105 \end{aligned}$$

Check. As a partial check we calculate the average spent if \$105 was spent on the sixth month. The average is $\frac{98+89+110+85+83+105}{6}=\frac{570}{6}=95$. The results check.

State. Kathleen can spend \$105 or less in the sixth month without exceeding her budget.

57. ***Familiarize***. Let n = the number of copies. The total cost is the setuup fee of \$6 plus \$4 per copy, or $4n$.

Translate.

$$\underbrace{\text{Set up fee}} \quad \text{plus} \quad \underbrace{\text{cost per copy}} \quad \underbrace{\text{cannot exceed}} \quad \$65$$

$$\downarrow \quad \downarrow \quad \downarrow$$

$$6 \quad + \quad 4n \quad \leq \quad 65$$

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Carry out. We solve the inequality.

$$\begin{aligned} 6+4n &\le 65 \\ 4n &\le 59 \\ n &\le \frac{59}{4} \\ n &\le 14.75 \end{aligned}$$

Check. As a partial check, if the number of copies is 14, the total cost $\$6+\$4\cdot 14$, or \$62 does not exceed the budget of \$65.

State. Myra can make 14 or fewer copies.

58. *Writing Exercise*. Multiplying both sides of an equation by *any* nonzero number results in an equivalent equation. When multiplying on both sides of an inequality, the sign of the number being multiplied by must be considered. If the number is positive, the direction of the inequality symbol remains unchanged; if the number is negative, the direction of the inequality symbol must be reversed to produce an equivalent inequality.

59. *Writing Exercise*. The solutions of an equation can usually each be checked. The solutions of an inequality are normally too numerous to check. Checking a few numbers from the solution set found cannot guarantee that the answer is correct, although if any number does not check, the answer found is incorrect.

60. ***Familiarize***. Let x = the amount of time the average child spends reading or doing homework.

Translate.

Time spent reading or doing homework		108% more		3 hr 20 min.
$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$
x	+	$1.08x$	=	$3\frac{1}{3}$

Carry out. We solve the equation.

$$\begin{aligned} x+1.08x &= 3\tfrac{1}{3} \\ 2.08x &= 3\tfrac{1}{3} \\ x &\approx 1.6 \text{ hr} \approx 1 \text{ hr } 36 \text{ min} \end{aligned}$$

Check. If the amount of time spent reading or doing homework is 1 hr 36 min, then that time plus an increase of 108% more is 1 hr 36 min + $1.08\cdot 1$ hr 36 min, is about 3 hrs 20 min.

The answer checks.

State. About 1hr 36 min is spent reading or doing homework.

61. ***Familiarize***. Let x = the length of the Nile River, in mi. Let $x+65$ represent the length of the Amazon River, in mi.

Translate.

The combined length of both rivers			is	8385 mi
$\downarrow$		$\downarrow$	$\downarrow$	$\downarrow$
$x+(x+65)$			=	8385

Carry out. We solve the equation.

$$\begin{aligned} x+(x+65) &= 8385 \\ 2x+65 &= 8385 \\ 2x &= 8320 \\ x &= 4160 \end{aligned}$$

Check. If the Nile River is 4160 mi long, then the Amazon River is 4160 mi + 65 mi, or 4225 mi. The combined length of both rivers is then 4160 mi + 4225 mi, or 8385 mi. These results check.

State. The Amazon River is 4225 mi long, and the Nile River is 4160 mi long.

62. $2|n|+4=50$

$$\begin{aligned} 2|n| &= 46 \\ |n| &= 23 \end{aligned}$$

The distance from some number n and the origin is 23 units. Thus, $n = -23$ or $n = 23$.

63. $|3n| = 60$

The distance from some number, $3n$, to the origin is 60 units. So we have:

$$\begin{aligned} 3n &= -60 \quad \textit{or} \quad 3n = 60 \\ n &= -20 \quad \textit{or} \quad n = 20 \end{aligned}$$

The solutions are –20 and 20.

64.

$$\begin{aligned} y &= 2a-ab+3 \\ y &= a(2-b)+3 \\ y-3 &= a(2-b) \\ \frac{y-3}{2-b} &= a \end{aligned}$$

The solution is $a = \dfrac{y-3}{2-b}$.

65. **1.** w; $12w$

2. $12w$; $0.3(12w)$

3. $0.3(12w)$; $\dfrac{0.3(12w)}{9}$

So $F = \dfrac{0.3(12w)}{9}$ or $F = 0.4w$.

Chapter 2 Test

1.

$$\begin{aligned} t+7 &= 16 \\ t+7-7 &= 16-7 \quad \text{Adding } -7 \\ t &= 9 \quad \text{Simplifying} \end{aligned}$$

The solution is 9.

2.

$$\begin{aligned} 6x &= -18 \\ \tfrac{1}{6}(6x) &= \tfrac{1}{6}(-18) \quad \text{Multiplying by } \tfrac{1}{6} \\ x &= -3 \quad \text{Simplifying} \end{aligned}$$

The solution is –3.

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3. $-\frac{4}{7}x = -28$

$-\frac{7}{4}\left(-\frac{4}{7}\right) = -\frac{7}{4}(-28)$ Multiplying by $-\frac{7}{4}$

$x = 49$ Simplifying

The solution is 49.

4. $3t + 7 = 2t - 5$

$3t + 7 - 7 = 2t - 5 - 7$ Adding -7

$3t = 2t - 12$ Simplifying

$3t - 2t = 2t - 12 - 2t$ Adding $-2t$

$t = -12$ Simplifying

The solution is -12.

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

$\frac{1}{2}x - \frac{3}{5} + \frac{3}{5} = \frac{2}{5} + \frac{3}{5}$ Adding $\frac{3}{5}$

$\frac{1}{2}x = 1$ Simplifying

$x = 2$ Multiplying by 2

The solution is 2.

6. $8 - y = 16$

$8 - y - 8 = 16 - 8$ Adding -8

$-y = 8$ Simplifying

$y = -8$ Multiplying by -1

The solution is -8.

7. $4.2x + 3.5 = 1.2 - 2.5x$

$-3.5 + 4.2 + 3.5 = 1.2 - 2.5x - 3.5$ Adding -3.5

$4.2x = -2.5x - 2.3$ Simplifying

$4.2x + 2.5x = -2.5x - 2.3 + 2.5x$ Adding $2.5x$

$6.7x = -2.3$ Simplifying

$\frac{1}{6.7}(6.7x) = \frac{1}{6.7}(-2.3)$ Multiplying by $\frac{1}{6.7}$

$x = -\frac{23}{67}$ Simplifying

The solution is $-\frac{23}{67}$.

8. $4(x + 2) = 36$

$4x + 8 = 36$ Distributive Law

$4x + 8 - 8 = 36 - 8$ Adding -8

$4x = 28$ Simplifying

$\frac{1}{4}(4x) = \frac{1}{4}(28)$ Multiplying by $\frac{1}{4}$

$x = 7$ Simplifying

The solution is 7.

9. $\frac{5}{6}(3x + 1) = 20$

$\frac{6}{5}\left[\frac{5}{6}(3x + 1)\right] = \frac{6}{5} \cdot 20$ Multiplying by $\frac{6}{5}$

$3x + 1 = 24$ Simplifying

$3x + 1 - 1 = 24 - 1$ Adding -1

$3x = 23$ Simplifying

$\frac{1}{3}(3x) = \frac{1}{3}(23)$ Multiplying by $\frac{1}{3}$

$x = \frac{23}{3}$ Simplifying

The solution is $\frac{23}{3}$.

10. $13t - (5 - 2t) = 5(3t - 1)$

$13t - 5 + 2t = 15t - 5$

$15t - 5 = 15t - 5$ TRUE

Identity; the solution is all real numbers.

11. $x + 6 > 1$

$x + 6 - 6 > 1 - 6$ Adding -6

$x > -5$ Simplifying

The solution set is $\{x \mid x > -5\}$, or $(-5, \infty)$.

12. $14x + 9 > 13x - 4$

$14x + 9 - 9 > 13x - 4 - 9$ Adding -9

$14x > 13x - 13$ Simplifying

$14x - 13x > 13x - 13 - 13x$ Adding $-13x$

$x > -13$ Simplifying

The solution set is $\{x \mid x > -13\}$, or $(-13, \infty)$.

13. $-5y \geq 65$

$y \leq -13$

The solution set is $\{y \mid y \leq -13\}$, or $(-\infty, -13]$.

14. $4n + 3 < -17$

$4n + 3 - 3 < -17 - 3$ Adding -3

$4n < -20$ Simplifying

$\frac{1}{4}(4n) < \frac{1}{4}(-20)$ Multiplying by $\frac{1}{4}$

$n < -5$ Simplifying

The solution set is $\{n \mid n < -5\}$, or $(-\infty, -5)$.

15. $3 - 5x > 38$

$3 - 5x - 3 > 38 - 3$ Adding -3

$-5x > 35$ Simplifying

$-\frac{1}{5}(-5x) < -\frac{1}{5}(35)$ Multiplying by $-\frac{1}{5}$ and reversing the inequality symbol

$x < -7$ Simplifying

The solution set is $\{x \mid x < -7\}$, or $(-\infty, -7)$.

16. $\frac{1}{2}t - \frac{1}{4} \leq \frac{3}{4}t$

$\frac{1}{2}t - \frac{1}{4} - \frac{1}{2}t \leq \frac{3}{4}t - \frac{1}{2}t$ Adding $-\frac{1}{2}t$

$-\frac{1}{4} \leq \frac{1}{4}t$ Simplifying

$4\left(-\frac{1}{4}\right) \leq 4\left(\frac{1}{4}t\right)$ Multiplying by 4

$-1 \leq t$ Simplifying

The solution set is $\{t \mid t \geq -1\}$, or $[-1, \infty)$.

17. $5 - 9x \geq 19 + 5x$

$5 - 9x - 5 \geq 19 + 5x - 5$ Adding -5

$-9x \geq 14 + 5x$ Simplifying

$-9x - 5x \geq 14 + 5x - 5x$ Adding $-5x$

$-14x \geq 14$ Simplifying

$-\frac{1}{14}(-14x) \leq -\frac{1}{14}(14)$ Multiplying by $-\frac{1}{14}$ and reversing the inequality symbol

$x \leq -1$ Simplifying

The solution set is $\{x \mid x \leq -1\}$, or $(-\infty, -1]$.

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18. $A = 2\pi rh$

$\frac{1}{2\pi h} \cdot A = \frac{1}{2\pi h}(2\pi rh)$ Multiplying by $\frac{1}{2\pi h}$

$\frac{A}{2\pi h} = r$ Simplifying

The solution is $r = \frac{A}{2\pi h}$.

19. $w = \frac{P+l}{2}$

$2 \cdot w = 2\left(\frac{P+l}{2}\right)$ Multiplying by 2

$2w = P + l$ Simplifying

$2w - P = P + l - P$ Adding $-P$

$2w - P = l$ Simplifying

The solution is $l = 2w - P$.

20. $230\% = 230 \times 0.01$ Replacing % by $\times 0.01$

$= 2.3$

21. 0.003 First move the decimal point two places to the right; then write a % symbol. The answer is 0.3%.

22. ***Translate***.

What number	is	18.5%	of	80?
↓	↓	↓	↓	↓
x	=	0.185	·	80

We solve the equation.

$x = 0.185 \cdot 80$

$x = 14.8$

The solution is 14.8.

23. ***Translate***.

What percent	of	75	is	33?
↓	↓	↓	↓	↓
y	·	75	=	33

We solve the equation and then convert to percent notation.

$y \cdot 75 = 33$

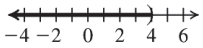
$y = \frac{33}{75}$

$y = 0.44 = 44\%$

The solution is 44%.

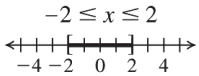
24.

$y < 4$



25.

$-2 \le x \le 2$



26. ***Familiarize***. Let w = the width of the calculator, in cm. Then the length is $w + 4$, in cm. The perimeter of a rectangle is given by $P = 2l + 2w$.

Translate.

The perimeter of the rectangle	is	36.
↓	↓	↓
$2(w+4) + 2w$	=	36

Carry out. We solve the equation.

$2(w+4) + 2w = 36$

$2w + 8 + 2w = 36$

$4w + 8 = 36$

$4w = 28$

$w = 7$

Check. If the width is 7 cm, then the length is $7 + 4$, or 11 cm. The perimeter is then $2 \cdot 11 + 2 \cdot 7$, or $22 + 14$, or 36 cm. These results check.

State. The width is 7 cm and the length is 11 cm.

27. ***Familiarize***. Let x = the distance from start. Then $3x$ mi is the distance to the end.

Translate.

Distance from start	and	distance to end	is	whole trip.
↓	↓	↓	↓	↓
x	+	$3x$	=	240

Carry out. We solve the equation.

$x + 3x = 240$

$4x = 240$

$x = 60$

$3x = 180$

Check.

$60 + 180 = 240$.

State. Kari has biked a distance of 60 miles so far.

28. ***Familiarize***. Let x = the length of the first side, in mm. Then the length of the second side is $x + 2$ mm, and the length of the third side is $x + 4$ mm. The perimeter of a triangle is the sum of the lengths of the three sides.

Translate.

The perimeter of the triangle	is	249 mm.
↓	↓	↓
$x + (x+2) + (x+4)$	=	249

Carry out. We solve the equation.

$x + (x+2) + (x+4) = 249$

$3x + 6 = 249$

$3x = 243$

$x = 81$

Check. If the length of the first side is 81 mm, then the length of the second side is $81 + 2$, or 83 mm, and the length of the third side is $81 + 4$, or 85 mm. The perimeter of the triangle is $81 + 83 + 85$, or 249 mm. These results check.

State. The lengths of the sides are 81 mm, 83 mm, and 85 mm.

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29. ***Familiarize***. Let $x =$ the electric bill before the temperature of the water heater was lowered. If the bill dropped by 7%, then the Kellys paid 93% of their original bill.

Translate.

$$\underset{\downarrow}{93\%} \quad \underset{\downarrow}{\text{of}} \quad \underbrace{\underset{\downarrow}{\text{the original bill}}}_{\downarrow} \quad \underset{\downarrow}{\text{is}} \quad \underset{\downarrow}{\$60.45.}$$

$$\underset{\downarrow}{0.93} \quad \underset{\downarrow}{\cdot} \quad \underbrace{\underset{\downarrow}{x}}_{\downarrow} \quad \underset{\downarrow}{=} \quad \underset{\downarrow}{60.45}$$

Carry out. We solve the equation.

$$0.93x = 60.45$$
$$x = \frac{60.45}{0.93}$$
$$x = 65$$

Check. If the original bill was \$65, and the bill was reduced by 7%, or $0.07 \cdot \$65$, or \$4.55, the new bill would be \$65 – \$4.55, or \$60.45. This result checks.

State. The original bill was \$65.

30. ***Familarize***. Let $x =$ the number of trips.

Translate.

$$\underbrace{\text{Monthly pass}}_{\downarrow} \quad \underset{\downarrow}{\text{must not exceed}} \quad \underbrace{\underbrace{\text{cost of individual trips}}_{\downarrow}}_{\downarrow}$$

$$\underset{\downarrow}{79} \quad \underset{\downarrow}{<} \quad \underbrace{\underset{\downarrow}{2.25x}}_{\downarrow}$$

Carry out. We solve the inequality.

$$79 < 2.25x$$
$$\frac{79}{2.25} < x$$
$$35.1 < x$$

Check. As a partial check, we let $x = 36$ trips and determine the cost. The cost would be $36(2.25) = \$81$. If the number of trips were less, the cost would be under \$81, so the result checks.

State. Gail should make more than 35 one-way trips per month.

31.
$$c = \frac{2cd}{a-d}$$
$$(a-d)c = (a-d)\left(\frac{2cd}{a-d}\right) \quad \text{Multiplying by } a-d$$
$$ac - dc = 2cd \quad \text{Simplifying}$$
$$ac - dc + dc = 2cd + dc \quad \text{Adding } dc$$
$$ac = 3cd \quad \text{Simplifying}$$
$$\frac{1}{3c}(ac) = \frac{1}{3c}(3cd) \quad \text{Multiplying by } \frac{1}{3c}$$
$$\frac{a}{3} = d \quad \text{Simplifying}$$

The solution is $d = \frac{a}{3}$.

32.
$$3|w| - 8 = 37$$
$$3|w| - 8 + 8 = 37 + 8 \quad \text{Adding 8}$$
$$3|w| = 45 \quad \text{Simplifying}$$
$$\frac{1}{3}(3|w|) = \frac{1}{3} \cdot 45 \quad \text{Multiplying by } \frac{1}{3}$$
$$|w| = 15 \quad \text{Simplifying}$$

This tells us that the number w is 15 units from the origin. The solutions are $w = -15$ and $w = 15$.

33. Let h = the number of hours of sun each day. Then we have $4 \le h \le 6$.

34. ***Familiarize***. Let x = the number of tickets given away. The following shows the distribution of the tickets:

First person received $\frac{1}{3}x$ tickets.

Second person received $\frac{1}{4}x$ tickets.

Third person received $\frac{1}{5}x$ tickets.

Fourth person received 8 tickets.
Fifth person received 5 tickets.

Translate.

$$\underbrace{\text{The number of tickets the five people received}}_{\downarrow} \quad \underset{\downarrow}{\text{is}} \quad \underbrace{\underbrace{\text{the total number of tickets.}}}_{\downarrow}$$

$$\underbrace{\frac{1}{3}x + \frac{1}{4}x + \frac{1}{5}x + 8 + 5}_{\downarrow} \quad \underset{\downarrow}{=} \quad \underbrace{\underbrace{x}}_{\downarrow}$$

Carry out. We solve the equation.

$$\frac{1}{3}x + \frac{1}{4}x + \frac{1}{5}x + 8 + 5 = x$$
$$60\left(\frac{1}{3}x + \frac{1}{4}x + \frac{1}{5}x + 8 + 5\right) = 60x$$
$$60\left(\frac{1}{3}x + \frac{1}{4}x + \frac{1}{5}x + 13\right) = 60x$$
$$20x + 15x + 12x + 780 = 60x$$
$$47x + 780 = 60x$$
$$780 = 13x$$
$$60 = x$$

Check. If the total number of tickets given away was 60, then the first person received $\frac{1}{3}(60)$, or 20 tickets; the second person received $\frac{1}{4}(60)$, or 15 tickets; the third person received $\frac{1}{5}(60)$, or 12 tickets. We are told that the fourth person received 8 tickets, and the fifth person received 5 tickets. The sum of the tickets distributed is $20 + 15 + 12 + 8 + 5$, or 60 tickets. These results check.

State. There were 60 tickets given away.

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