Chapter 2

Solving Equations and Inequalities

Exercise Set 2.1

RC2. The correct answer is (c).

RC4. The correct answer is (a).

2.
$$\begin{array}{r|l} t+17=53 & \\ \hline 35+17 \stackrel{?}{=} 53 & \\ 52 & \text{FALSE} \end{array}$$
35 is not a solution.

4.
$$\begin{array}{r|l} a-19=17 & \\ \hline 36-19 \stackrel{?}{=} 17 & \\ 17 & \text{TRUE} \end{array}$$
36 is a solution.

6.
$$\begin{array}{r|l} 8y=-72 & \\ \hline 8(-9) \stackrel{?}{=} -72 & \\ -72 & \text{TRUE} \end{array}$$
-9 is a solution.

8.
$$\begin{array}{r|l} \frac{y}{8}=6 & \\ \hline \frac{49}{8} \stackrel{?}{=} 6 & \\ 6\frac{1}{8} & \text{FALSE} \end{array}$$
49 is not a solution.

10.
$$\begin{array}{r|l} 9x+5=86 & \\ \hline 9\cdot 9+5 \stackrel{?}{=} 86 & \\ 86 & \text{TRUE} \end{array}$$
9 is a solution.

12.
$$\begin{array}{r|l} 6(y-2)=18 & \\ \hline 6(-5-2) \stackrel{?}{=} 18 & \\ 6(-7) & \\ -42 & \text{FALSE} \end{array}$$
-5 is not a solution.

14. 7

16. 34

18. -23

20. -31

22. 23

24. -11

26. 4

28. 25

30. -16

32. $24\frac{7}{10}$

34. 8.2

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

38.
$$\begin{aligned} x+\frac{2}{3} &= -\frac{5}{6} \\ x &= -\frac{5}{6}-\frac{4}{6}=-\frac{9}{6} \\ x &= -\frac{3}{2} \end{aligned}$$

40.
$$\begin{aligned} y-\frac{3}{4} &= \frac{5}{6} \\ y &= \frac{10}{12}+\frac{9}{12} \\ y &= \frac{19}{12} \end{aligned}$$

42.
$$\begin{aligned} -\frac{1}{8}+y &= -\frac{3}{4} \\ y &= -\frac{6}{8}+\frac{1}{8} \\ y &= -\frac{5}{8} \end{aligned}$$

44. 2.7

46. 16

48. -10.6

50.
$$\begin{aligned} 5\frac{1}{4} &= 4\frac{2}{3}+x \\ 5\frac{3}{12}-4\frac{8}{12} &= x \\ 4\frac{15}{12}-4\frac{8}{12} &= x \\ \frac{7}{12} &= x \end{aligned}$$

52. $136\frac{3}{8}$

54. -5.2

56. 172.72

58. $65t$ miles

60.
$$\begin{aligned} x+x &= x \\ 2x &= x \\ x &= 0 \end{aligned}$$

62. $x + 4 = 5 + x$
$4 = 5$

No solution

64. $|x| + 6 = 19$
$|x| + 6 - 6 = 19 - 6$
$|x| = 13$

x represents a number whose distance from 0 is 13. Thus $x = -13$ or $x = 13$.

The solutions are -13 and 13.

Exercise Set 2.2

RC2. The correct answer is (d).

RC4. The correct answer is (b).

2. 17

4. 9

6. 7

8. -53

10. 47

12. -7

14. -7

16. 8

18. -30

20. -88

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

24. $-\frac{3}{8}x = 12$
$-\frac{8}{3}\left(-\frac{3}{8}x\right) = -\frac{8}{3} \cdot 12$
$x = -32$

26. $\frac{-x}{6} = 9$
$-x = 54$
$x = -54$

28. $\frac{1}{8} = -\frac{y}{5}$
$\frac{5}{8} = -y$
$-\frac{5}{8} = y$

30. $\frac{2}{5}y = -\frac{4}{15}$
$\frac{5}{2} \cdot \frac{2}{5}y = \frac{5}{2} \cdot \left(-\frac{4}{15}\right)$
$y = -\frac{20}{30}$
$y = -\frac{2}{3}$

32. $-\frac{3}{8}x = -\frac{15}{16}$
$-\frac{8}{3} \cdot \left(-\frac{3}{8}x\right) = -\frac{8}{3} \cdot \left(-\frac{15}{16}\right)$
$x = \frac{120}{48}$
$x = \frac{5}{2}$

34. 20

36. -2

38. 8

40. $-\frac{9}{7}y = 12.06$
$-\frac{7}{9} \cdot \left(-\frac{9}{7}y\right) = -\frac{7}{9} \cdot (12.06)$
$y = -\frac{84.42}{9}$
$y = -9.38$

42. $\frac{-x}{8} = -16$
$8\left(\frac{-x}{8}\right) = 8 \cdot (-16)$
$-x = -128$
$-1 \cdot (-x) = -1 \cdot (-128)$
$x = 128$

44. $\frac{m}{-3} = 10$
$-3 \cdot \left(\frac{m}{-3}\right) = -3 \cdot 10$
$m = -30$

46. $-x + 5$

48. $-32y$

50. $2 - 5(x + 5) = 2 - 5x - 25 = -5x - 23$

52. $-2a - 4(5a - 1) = -2a - 20a + 4 = -22a + 4$

54. $\frac{1}{2} \cdot b \cdot 10\ \text{m}^2$, or $5b\ \text{m}^2$

56. All real numbers

58. $4|x| = 48$
$|x| = 12$

The distance of x from 0 is 12. Thus, $x = 12$ or $x = -12$.

60. 5

62. $\dfrac{a^2+1}{c}$

64. To "undo" the last step, divide 22.5 by 0.3.

$$22.5 \div 0.3 = 75$$

Now divide 75 by 0.3.

$$75 \div 0.3 = 250$$

The answer should be 250 not 22.5.

Exercise Set 2.3

RC2. The correct answer is (a).

RC4. The correct answers are (a) and (e). We would usually multiply by 100.

2. $7x + 6 = 13$
$7x = 7$
$x = 1$

4. $4y + 10 = 46$
$4y = 36$
$y = 9$

6. $5y - 2 = 53$
$5y = 55$
$y = 11$

8. $4x - 19 = 5$
$4x = 24$
$x = 6$

10. $5x + 4 = -41$
$5x = -45$
$x = -9$

12. $-91 = 9t + 8$
$-99 = 9t$
$-11 = t$

14. $-5x - 7 = 108$
$-5x = 115$
$x = -23$

16. $\dfrac{3}{2}x - 24 = -36$
$\dfrac{3}{2}x = -12$
$\dfrac{2}{3} \cdot \dfrac{3}{2}x = \dfrac{2}{3}(-12)$
$x = -8$

18. $8x + 3x = 55$
$11x = 55$
$x = 5$

20. $8x + 5x = 104$
$13x = 104$
$x = 8$

22. $7x + 18x = 125$
$25x = 125$
$x = 5$

24. $-5y - 7y = 144$
$-12y = 144$
$y = -12$

26. $-10y - 3y = -39$
$-13y = -39$
$y = 3$

28. $x + \dfrac{1}{4}x = 10$
$\dfrac{5}{4}x = 10$
$x = \dfrac{4}{5} \cdot 10$
$x = 8$

30. $6.8y - 2.4y = -88$
$4.4y = -88$
$y = -20$

32. $4x - 6 = 6x$
$-6 = 2x$
$-3 = x$

34. $5y - 2 = 28 - y$
$6y = 30$
$y = 5$

36. $4 - 3x = 6 - 7x$
$4x = 2$
$x = \dfrac{1}{2}$

38. $14 - 6a = -2a + 3$
$11 = 4a$
$\dfrac{11}{4} = a$

40. $-7z + 2z - 3z - 7 = 17$
$-8z - 7 = 17$
$-8z = 24$
$z = -3$

42. $5 + 4x - 7 = 4x - 2 - x$
$4x - 2 = 3x - 2$
$x = 0$

44. $5y - 7 + y = 7y + 21 - 5y$
$6y - 7 = 2y + 21$
$4y = 28$
$y = 7$

46. $\dfrac{7}{8}x - \dfrac{1}{4} + \dfrac{3}{4}x = \dfrac{1}{16} + x$, LCM is 16
$14x - 4 + 12x = 1 + 16x$
$26x - 4 = 1 + 16x$
$10x = 5$
$x = \dfrac{1}{2}$

48. $-\dfrac{3}{2} + x = -\dfrac{5}{6} - \dfrac{4}{3}$, LCM is 6
$-9 + 6x = -5 - 8$
$-9 + 6x = -13$
$6x = -4$
$x = -\dfrac{2}{3}$

50. $\frac{1}{2}+4m=3m-\frac{5}{2}$, LCM is 2

$1+8m=6m-5$

$2m=-6$

$m=-3$

52. $1-\frac{2}{3}y=\frac{9}{5}-\frac{y}{5}+\frac{3}{5}$, LCM is 15

$15-10y=27-3y+9$

$15-10y=36-3y$

$-7y=21$

$y=-3$

54. $0.96y-0.79=0.21y+0.46$

$96y-79=21y+46$

$75y=125$

$y=\frac{125}{75}=\frac{5}{3}$

56. $1.7t+8-1.62t=0.4t-0.32+8$

$170t+800-162t=40t-32+800$

$8t+800=40t+768$

$-32t=-32$

$t=1$

58. $\frac{5}{16}y+\frac{3}{8}y=2+\frac{1}{4}y$, LCM is 16

$5y+6y=32+4y$

$11y=32+4y$

$7y=32$

$y=\frac{32}{7}$

60. $8(3x+2)=30$

$24x+16=30$

$24x=14$

$x=\frac{7}{12}$

62. $9=3(5x-2)$

$9=15x-6$

$15=15x$

$1=x$

64. $17-t=-t+68$

$17=68$ FALSE

The equation has no solution.

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

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

All real numbers are solutions.

68. $5x+5(4x-1)=20$

$5x+20x-5=20$

$25x-5=20$

$25x=25$

$x=1$

70. $6b-(3b+8)=16$

$6b-3b-8=16$

$3b-8=16$

$3b=24$

$b=8$

72. $10-3(2x-1)=1$

$10-6x+3=1$

$13-6x=1$

$-6x=-12$

$x=2$

74. $3(t-2)=9(t+2)$

$3t-6=9t+18$

$-24=6t$

$-4=t$

76. $7(5x-2)=6(6x-1)$

$35x-14=36x-6$

$-8=x$

78. $3-7x+10x-14=9-6x+9x-20$

$3x-11=3x-11$

$-11=-11$ TRUE

All real numbers are solutions.

80. $11x-6-4x+1=9x-8-2x+12$

$7x-5=7x+4$

$-5=4$ FALSE

The equation has no solution.

82. $5(t+3)+9=3(t-2)+6$

$5t+15+9=3t-6+6$

$5t+24=3t$

$24=-2t$

$-12=t$

84. $13-(2c+2)=2(c+2)+3c$

$13-2c-2=2c+4+3c$

$11-2c=5c+4$

$7=7c$

$1=c$

86. $5[3(7-t)-4(8+2t)]-20=-6[2(6+3t)-4]$

$5[21-3t-32-8t]-20=-6[12+6t-4]$

$5[-11-11t]-20=-6[8+6t]$

$-55-55t-20=-48-36t$

$-75-55t=-48-36t$

$-27=19t$

$-\frac{27}{19}=t$

88. $6(2x-1)-12=7+12(x-1)$

$12x-6-12=7+12x-12$

$12x-18=12x-5$

$-18=-5$ FALSE

The equation has no solution.

90. $2+14x-9=7(2x+1)-14$

$2+14x-9=14x+7-14$

$14x-7=14x-7$

$-7=-7$ TRUE

All real numbers are solutions.

92. $0.9(2x+8) = 20-(x+5)$
$1.8x+7.2 = 20-x-5$
$18x+72 = 200-10x-50$
$18x+72 = 150-10x$
$28x = 78$
$x = \frac{78}{28}$
$x = \frac{39}{14}$

94. -75.14

96. $8y-88x+8 = 8(y-11x+1)$

98. $3x+2[4-5(2x-1)] = 3x+2[4-10x+5]$
$= 3x+2[9-10x]$
$= 3x+18-20x$
$= -17x+18$

100. $256 \div 64 \div 4^2 = 256 \div 64 \div 16$
$= 4 \div 16$
$= \frac{1}{4}$, or 0.25

102. $\frac{1}{4}(8y+4)-17 = -\frac{1}{2}(4y-8)$
$2y+1-17 = -2y+4$
$2y-16 = -2y+4$
$4y = 20$
$y = 5$

104. $5(3x+2) = 75$
$15x+10 = 75$
$15x = 65$
$x = \frac{65}{15} = \frac{13}{3}$, or $4\frac{1}{3}$

Exercise Set 2.4

RC2. $y = \frac{1}{4}x - w$
$w = \frac{1}{4}x - y$
The correct answer is (c).

RC4. $z = w+4$
$z-4 = w$
The correct answer is (a).

2. $B = 30 \cdot 1800 = 54,000$ Btu's

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

6. a) $A = 6s^2 = 6 \cdot 3^2 = 6 \cdot 9 = 54$ in^2
b) $\frac{A}{6} = s^2$, or $\frac{1}{6}A = s^2$

8. a) $P = I \cdot V = 12 \cdot 115 = 1380$ watts
b) $I = \frac{P}{V}$; $V = \frac{P}{I}$

10. $\frac{d}{55} = t$

12. $\frac{y}{m} = x$

14. $z-21 = t$

16. $y+\frac{2}{3} = x$

18. $t-6 = s$

20. $y-A = x$

22. $y = 10-x$
$y-10 = -x$
$-y+10 = x$, or
$10-y = x$

24. $y = q-x$
$y-q = -x$
$-y+q = x$, or
$q-y = x$

26. $y = -\frac{x}{2}$, or $-\frac{1}{2}x$

28. $y = \frac{Ax}{B}$

30. $W = mt-b$
$W+b = mt$
$\frac{W+b}{m} = t$

32. $y = bx-c$
$y+c = bx$
$\frac{y+c}{b} = x$

34. $d = rt$
$\frac{d}{t} = r$

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

38. $A = \frac{1}{2}bh$
$2A = bh$
$\frac{2A}{h} = b$

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

42. $S = rx+s$
$S-s = rx$
$\frac{S-s}{r} = x$

44.
$$\begin{aligned} Q &= \frac{p-q}{2} \\ 2Q &= p-q \\ 2Q+q &= p \end{aligned}$$

46.
$$\begin{aligned} I &= Prt \\ \frac{I}{rt} &= P \end{aligned}$$

48.
$$\begin{aligned} Ax+By &= c \\ By &= c-Ax \\ y &= \frac{c-Ax}{B} \end{aligned}$$

50.
$$\begin{aligned} P &= \frac{ab}{c} \\ Pc &= ab \\ c &= \frac{ab}{P} \end{aligned}$$

52. $4a-8b-5(5a-4b) = 4a-8b-25a+20b = -21a+12b$

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

56. $-\frac{5}{12}+\frac{1}{4} = -\frac{5}{12}+\frac{3}{12} = -\frac{2}{12} = -\frac{1}{6}$

58. $-2\frac{1}{2}+6\frac{1}{4} = -\frac{5}{2}+\frac{25}{4} = -\frac{10}{4}+\frac{25}{4} = \frac{15}{4} = 3\frac{3}{4}$

60.
$$\begin{aligned} 10x+4 &= 3x-2+x \\ 10x+4 &= 4x-2 \\ 6x &= -6 \\ x &= -1 \end{aligned}$$

62.
$$\begin{aligned} 5a &= 3(6-3a) \\ 5a &= 18-9a \\ 14a &= 18 \\ a &= \frac{9}{7} \end{aligned}$$

64.
$$\begin{aligned} P &= 4m+7mn \\ P &= m(4+7n) \\ \frac{P}{4+7n} &= m \end{aligned}$$

66. Not necessarily; $6 = 2\cdot 2+2\cdot 1$, but $2\cdot 6$, or 12, can be expressed as $2\cdot 5+2\cdot 1$.

68.
$$\begin{aligned} D &= \frac{1}{E+F} \\ D(E+F) &= 1 \\ E+F &= \frac{1}{D} \\ F &= \frac{1}{D}-E, \text{ or } \frac{1-DE}{D} \end{aligned}$$

Chapter 2 Mid-Chapter Review

1. The solution of $3-x = 4x$ is $\frac{3}{5}$; the solution of $5x = -3$ is $-\frac{3}{5}$. The equations have different solutions, so they are not equivalent. The given statement is false.

2. True; see page 85 in the text.

3. True; see page 90 in the text.

4. False; see page 102 in the text.

5.
$$\begin{aligned} x+5 &= -3 \\ x+5-5 &= -3-5 \\ x+0 &= -8 \\ x &= -8 \end{aligned}$$

6.
$$\begin{aligned} -6x &= 42 \\ \frac{-6x}{-6} &= \frac{42}{-6} \\ 1\cdot x &= -7 \\ x &= -7 \end{aligned}$$

7.
$$\begin{aligned} 5y+z &= t \\ 5y+z-z &= t-z \\ 5y &= t-z \\ \frac{5y}{5} &= \frac{t-z}{5} \\ y &= \frac{t-z}{5} \end{aligned}$$

8.
$$\begin{aligned} x+5 &= 11 \\ x+5-5 &= 11-5 \\ x &= 6 \end{aligned}$$
The solution is 6.

9.
$$\begin{aligned} x+9 &= -3 \\ x+9-9 &= -3-9 \\ x &= -12 \end{aligned}$$
The solution is -12.

10.
$$\begin{aligned} 8 &= t+1 \\ 8-1 &= t+1-1 \\ 7 &= t \end{aligned}$$
The solution is 7.

11.
$$\begin{aligned} -7 &= y+3 \\ -7-3 &= y+3-3 \\ -10 &= y \end{aligned}$$
The solution is -10.

12.
$$\begin{aligned} x-6 &= 14 \\ x-6+6 &= 14+6 \\ x &= 20 \end{aligned}$$
The solution is 20.

13.
$$\begin{aligned} y-7 &= -2 \\ y-7+7 &= -2+7 \\ y &= 5 \end{aligned}$$
The solution is 5.

14.
$$-\frac{3}{2}+z=-\frac{3}{4}$$
$$-\frac{3}{2}+z+\frac{3}{2}=-\frac{3}{4}+\frac{3}{2}$$
$$z=-\frac{3}{4}+\frac{6}{4}$$
$$z=\frac{3}{4}$$
The solution is $\frac{3}{4}$.

15.
$$-3.3=-1.9+t$$
$$-3.3+1.9=-1.9+t+1.9$$
$$-1.4=t$$
The solution is -1.4.

16.
$$7x=42$$
$$\frac{7x}{7}=\frac{42}{7}$$
$$x=6$$
The solution is 6.

17.
$$17=-t$$
$$17=-1\cdot t$$
$$\frac{17}{-1}=\frac{-1\cdot t}{-1}$$
$$-17=t$$
The solution is -17.

18.
$$6x=-54$$
$$\frac{6x}{6}=\frac{-54}{6}$$
$$x=-9$$
The solution is -9.

19.
$$-5y=-85$$
$$\frac{-5y}{-5}=\frac{-85}{-5}$$
$$y=17$$
The solution is 17.

20.
$$\frac{x}{7}=3$$
$$\frac{1}{7}\cdot x=3$$
$$7\cdot\frac{1}{7}x=7\cdot 3$$
$$x=21$$
The solution is 21.

21.
$$\frac{2}{3}x=12$$
$$\frac{3}{2}\cdot\frac{2}{3}x=\frac{3}{2}\cdot 12$$
$$x=\frac{3\cdot\cancel{2}\cdot 6}{\cancel{2}\cdot 1}$$
$$x=18$$
The solution is 18.

22.
$$-\frac{t}{5}=3$$
$$-\frac{1}{5}\cdot t=3$$
$$-5\left(-\frac{1}{5}\cdot t\right)=-5\cdot 3$$
$$t=-15$$
The solution is -15.

23.
$$\frac{3}{4}x=-\frac{9}{8}$$
$$\frac{4}{3}\cdot\frac{3}{4}x=\frac{4}{3}\left(-\frac{9}{8}\right)$$
$$x=-\frac{\cancel{4}\cdot\cancel{3}\cdot 3}{\cancel{3}\cdot 2\cdot\cancel{4}}$$
$$x=-\frac{3}{2}$$
The solution is $-\frac{3}{2}$.

24.
$$3x+2=5$$
$$3x+2-2=5-2$$
$$3x=3$$
$$\frac{3x}{3}=\frac{3}{3}$$
$$x=1$$
The solution is 1.

25.
$$5x+4=-11$$
$$5x+4-4=-11-4$$
$$5x=-15$$
$$\frac{5x}{5}=\frac{-15}{5}$$
$$x=-3$$
The solution is -3.

26.
$$6x-7=2$$
$$6x-7+7=2+7$$
$$6x=9$$
$$\frac{6x}{6}=\frac{9}{6}$$
$$x=\frac{9}{6}=\frac{3\cdot\cancel{3}}{2\cdot\cancel{3}}$$
$$x=\frac{3}{2}$$
The solution is $\frac{3}{2}$.

27.
$$-4x-9=-5$$
$$-4x-9+9=-5+9$$
$$-4x=4$$
$$\frac{-4x}{-4}=\frac{4}{-4}$$
$$x=-1$$
The solution is -1.

28. $6x + 5x = 33$

$11x = 33$

$\frac{11x}{11} = \frac{33}{11}$

$x = 3$

The solution is 3.

29. $-3y - 4y = 49$

$-7y = 49$

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

$y = -7$

The solution is -7.

30. $3x - 4 = 12 - x$

$3x - 4 + x = 12 - x + x$

$4x - 4 = 12$

$4x - 4 + 4 = 12 + 4$

$4x = 16$

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

$x = 4$

The solution is 4.

31. $5 - 6x = 9 - 8x$

$5 - 6x + 8x = 9 - 8x + 8x$

$5 + 2x = 9$

$5 + 2x - 5 = 9 - 5$

$2x = 4$

$\frac{2x}{2} = \frac{4}{2}$

$x = 2$

The solution is 2.

32. $4y - \frac{3}{2} = \frac{3}{4} + 2y$

$4\left(4y - \frac{3}{2}\right) = 4\left(\frac{3}{4} + 2y\right)$ Clearing fractions

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

$16y - 6 = 3 + 8y$

$16y - 6 - 8y = 3 + 8y - 8y$

$8y - 6 = 3$

$8y - 6 + 6 = 3 + 6$

$8y = 9$

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

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

33. $\frac{4}{5} + \frac{1}{6}t = \frac{1}{10}$

$30\left(\frac{4}{5} + \frac{1}{6}t\right) = 30 \cdot \frac{1}{10}$ Clearing fractions

$30 \cdot \frac{4}{5} + 30 \cdot \frac{1}{6}t = \frac{30}{10}$

$24 + 5t = 3$

$24 + 5t - 24 = 3 - 24$

$5t = -21$

$\frac{5t}{5} = \frac{-21}{5}$

$t = -\frac{21}{5}$

The solution is $-\frac{21}{5}$.

34. $0.21n - 1.05 = 2.1 - 0.14n$

$100(0.21n - 1.05) = 100(2.1 - 0.14n)$

Clearing decimals

$100(0.21n) - 100(1.05) = 100(2.1) - 100(0.14n)$

$21n - 105 = 210 - 14n$

$21n - 105 + 14n = 210 - 14n + 14n$

$35n - 105 = 210$

$35n - 105 + 105 = 210 + 105$

$35n = 315$

$\frac{35n}{35} = \frac{315}{35}$

$n = 9$

The solution is 9.

35. $5(3y - 1) = -35$

$15y - 5 = -35$

$15y - 5 + 5 = -35 + 5$

$15y = -30$

$\frac{15y}{15} = \frac{-30}{15}$

$y = -2$

The solution is -2.

36. $7 - 2(5x + 3) = 1$

$7 - 10x - 6 = 1$

$1 - 10x = 1$

$1 - 10x - 1 = 1 - 1$

$-10x = 0$

$\frac{-10x}{-10} = \frac{0}{-10}$

$x = 0$

The solution is 0.

37. $-8 + t = t - 8$

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

$-8 = -8$

We have an equation that is true for all real numbers. Thus, all real numbers are solutions.

38.
$$z + 12 = -12 + z$$
$$z + 12 - z = -12 + z - z$$
$$12 = -12$$
We have a false equation. There are no solutions.

39.
$$4(3x + 2) = 5(2x - 1)$$
$$12x + 8 = 10x - 5$$
$$12x + 8 - 10x = 10x - 5 - 10x$$
$$2x + 8 = -5$$
$$2x + 8 - 8 = -5 - 8$$
$$2x = -13$$
$$\frac{2x}{2} = \frac{-13}{2}$$
$$x = -\frac{13}{2}$$
The solution is $-\frac{13}{2}$.

40.
$$8x - 6 - 2x = 3(2x - 4) + 6$$
$$6x - 6 = 6x - 12 + 6$$
$$6x - 6 = 6x - 6$$
$$6x - 6 - 6x = 6x - 6 - 6x$$
$$-6 = -6$$
We have an equation that is true for all real numbers. Thus, all real numbers are solutions.

41.
$$A = 4b$$
$$\frac{A}{4} = \frac{4b}{4}$$
$$\frac{A}{4} = b$$

42.
$$y = x - 1.5$$
$$y + 1.5 = x - 1.5 + 1.5$$
$$y + 1.5 = x$$

43.
$$n = s - m$$
$$n - s = s - m - s$$
$$n - s = -m$$
$$-1(n - s) = -1(-m)$$
$$-n + s = m, \text{ or}$$
$$s - n = m$$

44.
$$4t = 9w$$
$$\frac{4t}{4} = \frac{9w}{4}$$
$$t = \frac{9w}{4}$$

45.
$$B = at - c$$
$$B + c = at - c + c$$
$$B + c = at$$
$$\frac{B + c}{a} = \frac{at}{a}$$
$$\frac{B + c}{a} = t$$

46.
$$M = \frac{x + y + z}{2}$$
$$2 \cdot M = 2\left(\frac{x + y + z}{2}\right)$$
$$2M = x + y + z$$
$$2M - x - z = x + y + z - x - z$$
$$2M - x - z = y$$

47. Equivalent expressions have the same value for all possible replacements for the variable(s). Equivalent equations have the same solution(s).

48. The equations are not equivalent because they do not have the same solutions. Although 5 is a solution of both equations, -5 is a solution of $x^2 = 25$ but not of $x = 5$.

49. For an equation $x + a = b$, add the opposite of a (or subtract a) on both sides of the equation.

50. It appears that the student added $\frac{1}{3}$ on the right side of the equation rather than subtracting $\frac{1}{3}$.

51. For an equation $ax = b$, multiply by $1/a$ (or divide by a) on both sides of the equation.

52. Answers may vary. A walker who knows how far and how long she walks each day wants to know her average speed each day.

Exercise Set 2.5

RC2. The correct answer is (b).

RC4. The correct answer is (a).

RC6. The correct answer is (c).

2. Solve: $p \cdot 76 = 19$
$p = 0.25 = 25\%$

4. Solve: $20.4 = 24\% \cdot a$
$85 = a$

6. Solve: $a = 50\% \cdot 50$
$a = 25$

8. Solve: $57 = p \cdot 300$
$0.19 = p$
$19\% = p$

10. Solve: $7 = 175\% \cdot b$
$4 = b$

12. Solve: $16 = p \cdot 40$
$p = 0.4 = 40\%$

14. Solve: $p \cdot 150 = 39$
$p = 0.26 = 26\%$

16. Solve: $a = 1\% \cdot 1,000,000$
$a = 10,000$

18. Solve: $p \cdot 60 = 75$
$p = 1.25 = 125\%$

20. Any number is 100% of itself, so 70 is 100% of 70. We could also do this exercise as follows:

Solve: $p \cdot 70 = 70$
$p = 1 = 100\%$

22. Solve: $54 = 24\% \cdot b$
$225 = b$

24. Solve: $a = 40\% \cdot 2$
$a = 0.8$

26. Solve: $40 = 2\% \cdot b$
$2000 = b$

28. Solve: $8 = 2\% \cdot b$
$400 = b$

30. Solve: $a = 7.0\% \cdot 8909$
$a \approx 624$ million

32. Solve: $a = 4.4\% \cdot 8909$
$a \approx 392$ million

34. Solve: $a = 0.5\% \cdot 8909$
$a \approx 45$ million

36. Solve: $a = 54.8\% \cdot \$2360$
$a \approx \$1293$ million

38. Solve: $a = 7.9\% \cdot \$5000$
$a = \$395$

40. Solve: $43 = p \cdot 116$
$0.37 \approx p$
$37\% \approx p$

42. a) Solve: $a = 20\% \cdot \$75$
$a = \$15$

b) $\$75 + \$15 = \$90$

44. a) Solve: $\$6.75 = 18\% \cdot b$
$\$37.50 = b$

b) $\$37.50 + \$6.75 = \$44.25$

46. Solve: $46.2 = 44\% \cdot b$
$b = 105$ billion pieces of junk mail

48. Increase, in millions of dollars: $1070 - 950 = 120$

To find the percent of increase, solve:

$120 = p \cdot 950$
$0.126 \approx p$
$12.6\% \approx p$

50. Decrease: $301 - 273 = 28$

To find the percent decrease, solve:

$28 = p \cdot 301$
$0.093 \approx p$
$9.3\% \approx p$

52. Increase: $764,495 - 582,996 = 181,499$

To find the percent increase, solve:

$181,499 = p \cdot 582,996$
$0.311 \approx p$
$31.1\% \approx p$

54. Decrease: $4381 - 962 = 3419$

To find the percent decrease, solve:

$3419 = p \cdot 4381$
$0.780 \approx p$
$78.0\% \approx p$

56. $5x - 21$

58. $-\dfrac{18b}{12b} = -\dfrac{3 \cdot \cancel{6} \cdot \cancel{b}}{2 \cdot \cancel{6} \cdot \cancel{b}} - \dfrac{3}{2}$

60.
$$\begin{aligned}&[3(x+4)-6]-[8+2(x-5)]\\&=[3x+12-6]-[8+2x-10]\\&=3x+6-[2x-2]\\&=3x+6-2x+2\\&=x+8\end{aligned}$$

62. Note: 4 ft 8 in. = 56 in.

Solve: $56 = 84.4\% \cdot b$
$66 \approx b$

Dana's final adult height will be about 66 in., or 5 ft 6 in.

Exercise Set 2.6

RC2. Translate the problem to an equation.

RC4. Check the answer in the original problem.

2. Solve: $c - 89 = 60$
$c = 149$ calories

4. Solve: $x + (x + 2) = 72$
$x = 35$

If $x = 35$, then $x + 2 = 37$.

The lengths of the pieces are 35 in. and 37 in.

6. Solve: $3a + 72,000 = 876,000$
$a = \$268,000$

8. Solve: $m + 59 = 385$
$m = 326$ ft

10. Solve: $x + (x + 1) = 547$
$x = 273$

If $x = 273$, then $x + 1 = 274$.

The numbers are 273 and 274.

12. Solve: $a + (a + 1) + (a + 2) = 108$
$a = 35$

Whitney, Wesley, and Wanda's ages are 35, 36, and 37, respectively.

14. Solve: $x + \dfrac{1}{2}(x + 1) + 2(x + 2) - 7 = 2101$
$x = 601$

If $x = 601$, then $x + 1 = 602$ and $x + 2 = 603$.

The integers are 601, 602, and 603.

16. Solve: $2(w+2)+2w=10$

$$w=\frac{3}{2},\text{ or }1\frac{1}{2}$$

If $w=1\frac{1}{2}$, then $w+2=1\frac{1}{2}+2=3\frac{1}{2}$.

The length is $3\frac{1}{2}$ in. and the width is $1\frac{1}{2}$ in.

18. Solve: $p-15\%p=33.15$

$$p=\$39$$

20. Solve: $p+6.5\%p=117.15$

$$p=\$110$$

22. Solve: $84.45+0.55m=250$

$$m=301\text{ mi}$$

24. Solve: $x+4x+(x+4x)-45=180$

$$x=22.5$$

If $x=22.5$, then $4x=90$ and $(x+4x)-45=67.5$.

The measures of the angles are 22.5°, 90°, and 67.5°.

26. Solve: $x+3x+(x-15)=180$

$$x=39$$

If $x=39$, then $3x=117$ and $x-15=24$.

The measures of the angles are 39°, 117°, and 24°.

28. Solve: $a+0.06a=6996$

$$a=\$6600$$

30. Solve: $b+0.1b=7194$

$$b=\$6540$$

32. Solve: $1.80+2.20m=26$

$$m=11\text{ mi}$$

34. Solve: $c+20\%c=\$24.90$

$$c=\$20.75$$

36. Solve: $\dfrac{t+2t+27}{3}=34$

$$t=25$$

If $t=\$25$, then $2t=\$50$. The prices of the other two shirts were \$25 and \$50.

38. Solve: $2x+85=\frac{3}{4}x$

$$x=-68$$

40. $-\frac{4}{5}+\frac{3}{8}=-\frac{32}{40}+\frac{15}{40}=-\frac{17}{40}$

42. $-\frac{4}{5}\div\frac{3}{8}=-\frac{4}{5}\cdot\frac{8}{3}=-\frac{32}{15}$

44. $-25.6\div(-16)=1.6$

46. $-25.6-(-16)=-25.6+16=-9.6$

48. $(-0.02)\div(-0.2)=0.1$

50. $c+(4+d)$

52. Solve: $3\cdot 7+3m=78$

$$m=19$$

The student answered 19 multiple-choice questions correctly.

54. Let $d=$ the number of dimes. Then $2d=$ the number of quarters, and $d+10=$ the number of nickels.

The value of d dimes is $0.10d$.

The value of $2d$ quarters is $0.25(2d)$.

The value of $d+10$ nickels is $0.05(d+10)$.

Solve: $0.10d+0.25(2d)+0.05(d+10)=20$

$$d=30$$

If $d=30$, then $2d=60$ and $d+10=40$.

Susanne got 60 quarters, 30 dimes, and 40 nickels.

Exercise Set 2.7

RC2. $3x-5\le -x+1$

$$4x\le 6$$

We see that $3x-5\le -x+1$ and $2x\le 6$ are not equivalent.

RC4. $2-t>-3t+4$

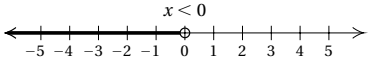
$$2t>2$$

We see that $2-t>-3t+4$ and $2t>2$ are equivalent.

2. a) Yes, b) yes, c) yes, d) yes, e) no

4. a) No, b) yes, c) yes, d) no, e) yes

6.



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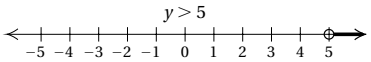

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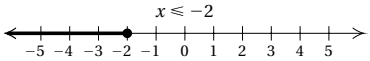

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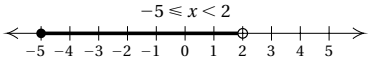

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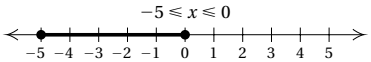
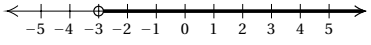


16. $x+5>2$

$$x>-3$$

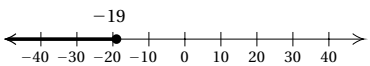
$\{x|x>-3\}$



18. $x+8\le -11$

$$x\le -19$$

$\{x|x\le -19\}$



20. $y-9>-15$

$$y>-6$$

$\{y|y>-6\}$

22. $2x + 4 > x + 7$
$x > 3$
$\{x|x > 3\}$

24. $3x + 18 \leq 2x + 16$
$x \leq -2$
$\{x|x \leq -2\}$

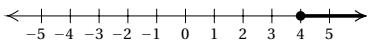
26. $9x - 8 < 8x - 9$
$x < -1$
$\{x|x < -1\}$

28. $-8 + p > 10$
$p > 18$
$\{p|p > 18\}$

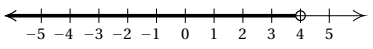
30. $x - \frac{1}{3} < \frac{5}{6}$
$x \leq \frac{7}{6}$
$\left\{x \middle| x \leq \frac{7}{6}\right\}$

32. $x + \frac{1}{8} > \frac{1}{2}$
$x > \frac{3}{8}$
$\left\{x \middle| x > \frac{3}{8}\right\}$

34. $8x \geq 32$
$x \geq 4$
$\{x|x \geq 4\}$



36. $-16x > -64$
$x < 4$
$\{x|x < 4\}$



38. $3x < -4$
$x < -\frac{4}{3}$
$\left\{x \middle| x < -\frac{4}{3}\right\}$

40. $-3x \leq 15$
$x \geq -5$
$\{x|x \geq -5\}$

42. $-7x < -21$
$x > 3$
$\{x|x > 3\}$

44. $-5y > -23$
$y < \frac{23}{5}$
$\left\{y \middle| y < \frac{23}{5}\right\}$

46. $-4x \leq \frac{1}{9}$
$x \geq -\frac{1}{36}$
$\left\{x|x \geq -\frac{1}{36}\right\}$

48. $-\frac{7}{9} > 63x$
$\frac{1}{63}\left(-\frac{7}{9}\right) > x$
$-\frac{1}{81} > x$
$\left\{x \middle| x < -\frac{1}{81}\right\}$

50. $3 + 4y < 35$
$4y < 32$
$y < 8$
$\{y|y < 8\}$

52. $5y - 9 \leq 21$
$5y \leq 30$
$y \leq 6$
$\{y|y \leq 6\}$

54. $8y - 6 < -54$
$8y < -48$
$y < -6$
$\{y|y < -6\}$

56. $48 > 13 - 7y$
$35 > -7y$
$-5 < y$
$\{y|y > -5\}$

58. $15x + 5 - 14x \leq 9$
$x + 5 \leq 9$
$x \leq 4$
$\{x|x \leq 4\}$

60. $-8 < 9x + 8 - 8x - 3$
$-8 < x + 5$
$-13 < x$
$\{x|x > -13\}$

62. $9 - 8y > 5 - 7y + 2$
$9 - 8y > 7 - 7y$
$2 > y$
$\{y|y < 2\}$

64. $6 - 18x \leq 4 - 12x - 5x$
$6 - 18x \leq 4 - 17x$
$2 \leq x$
$\{x|x \geq 2\}$

66. $18 - 6y - 4y < 63 + 5y$
$18 - 10y < 63 + 5y$
$-45 < 15y$
$-3 < y$
$\{y|y > -3\}$

68. $0.96y - 0.79 \le 0.21y + 0.46$
$96y - 79 \le 21y + 46$
$75y \le 125$
$y \le \frac{5}{3}$
$\left\{y \middle| y \le \frac{5}{3}\right\}$

70. $\frac{2}{3} + \frac{x}{5} < \frac{4}{15}$
$15\left(\frac{2}{3} + \frac{x}{5}\right) < 15 \cdot \frac{4}{15}$
$10 + 3x < 4$
$3x < -6$
$x < -2$
$\{x|x < -2\}$

72. $\frac{3x}{4} - \frac{7}{8} \ge -15$
$8\left(\frac{3x}{4} - \frac{7}{8}\right) \ge 8(-15)$
$6x - 7 \ge -120$
$6x \ge -113$
$x \ge -\frac{113}{6}$
$\left\{x \middle| x \ge -\frac{113}{6}\right\}$

74. $4(2y - 3) > 28$
$8y - 12 > 28$
$8y > 40$
$y > 5$
$\{y|y > 5\}$

76. $3(5 + 3m) - 8 \le 88$
$15 + 9m - 8 \le 88$
$9m + 7 \le 88$
$9m \le 81$
$m \le 9$
$\{m|m \le 9\}$

78. $7(5y - 2) > 6(6y - 1)$
$35y - 14 > 36y - 6$
$-8 > y$
$\{y|y < -8\}$

80. $5(x + 3) + 9 \le 3(x - 2) + 6$
$5x + 15 + 9 \le 3x - 6 + 6$
$5x + 24 \le 3x$
$2x \le -24$
$x \le -12$
$\{x|x \le -12\}$

82. $0.4(2x + 8) \ge 20 - (x + 5)$
$0.8x + 3.2 \ge 20 - x - 5$
$0.8x + 3.2 \ge 15 - x$
$8x + 32 \ge 150 - 10x$
$18x \ge 118$
$x \ge \frac{118}{18}$, or
$x \ge \frac{59}{9}$
$\left\{x \middle| x \ge \frac{59}{9}\right\}$

84. $1 - \frac{2}{3}y \ge \frac{9}{5} - \frac{y}{5} + \frac{3}{5}$
$15\left(1 - \frac{2}{3}y\right) \ge 15\left(\frac{9}{5} - \frac{y}{5} + \frac{3}{5}\right)$
$15 - 10y \ge 27 - 3y + 9$
$15 - 10y \ge 36 - 3y$
$-21 \ge 7y$
$-3 \ge y$
$\{y|y \le -3\}$

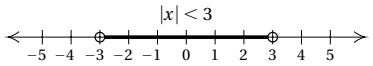
86. $8.12 - 9.23 = 8.12 + (-9.23) = -1.11$

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

90. $10 \div 2 \cdot 5 - 3^2 + (-5)^2 = 10 \div 2 \cdot 5 - 9 + 25$
$= 5 \cdot 5 - 9 + 25$
$= 25 - 9 + 25$
$= 16 + 25$
$= 41$

92. $9(3 + 5x) - 4(7 + 2x) = 27 + 45x - 28 - 8x = -1 + 37x$, or $37x - 1$

94. The solutions of $|x| < 3$ are all points whose distance from 0 is less than 3. This is equivalent to $-3 < x < 3$. The graph is as follows:



96. $x + 4 > 3 + x$
$4 > 3$
All real numbers are solutions.

Exercise Set 2.8

RC2. $q \le r$

RC4. $r \ge q$, so we choose $q \le r$.

RC6. $q \ge r$, so we choose $r \le q$.

2. $n \ge 5$

4. $75 < p < 100$

6. $a \le 180$

8. $A > 40$ L

10. $T \le -2°$

12. $x < 5$

14. $n \ge 18$

16. $c \le \$4857.95$

18. $c \ge \$3.19$

20. $\frac{1}{2}n - 5 > 17$

22. Solve: $\frac{73 + 75 + 89 + 91 + s}{5} \ge 85$

The solution set is $\{s|s \ge 97\}$.

24. Solve: $\frac{9}{5}C + 32 > 98.6$

The solution set is $\{C|C > 37°\}$.

26. Solve: $-0.028t + 20.8 < 19.0$

$t > 64\frac{2}{7}$

We have $1920 + 64\frac{2}{7} = 1984\frac{2}{7}$, so the solution set is $\{Y|Y \ge 1985\}$, where Y represents the year.

28. Solve: $80 + 16n \le 750$

$n \le 41.875$

At most, 41 people can attend the banquet.

30. Solve: $53 + L \le 165$

The solution set is $\{L|L \le 112 \text{ in.}\}$.

32. Solve: $0.45 + 0.25h \ge 2.20$

$h \ge 7$

Laura parks for at least 7 half hours, or for at least 3.5 hr.

34. Solve: $45 + 30t > 150$

$t > 3.5$ hr

36. Solve: $\frac{5 + 7 + 8 + c}{4} \ge 7$

$c \ge 8$ credits

38. Solve: $b + (b - 2) + (b + 3) > 19$

$b > 6$ cm

40. Solve: $16l \ge 264.$

$l \ge 16.5$ yd

42. Solve: $c > 0.8(21,000)$

$c > \$16,800$

44. Solve: $5 \le 0.75r$ (See Exercise 43.)

$r \ge 6\frac{2}{3}$ g

46. Solve: $\frac{1}{2} \cdot 8 \cdot h \le 12$

$h \le 3$ ft

48. Solve: $3 + \frac{3}{4}w > 22\frac{1}{2}$

$w > 26$

The puppy's weight will exceed $22\frac{1}{2}$ lb 26 weeks after its weight is 3 lb.

50. Solve: $h + (h + 3) > 27$

$h > 12$

George worked more than 12 hr, and Joan worked more than 15 hr.

52. -22

54. $8x + 3x = 66$

$11x = 66$

$x = 6$

56. $9x - 1 + 11x - 18 = 3x - 15 + 4 + 17x$

$20x - 19 = 20x - 11$

$-19 = -11$

The equation has no solution.

58. Solve: $a = 10\% \cdot 310$

$a = 31$

60. Solve: $80 = p \cdot 96$

$0.83\overline{3} = p$

$83.\overline{3}\% = p$, or

$83\frac{1}{3}\% = p$

62. Solve: $4 + 2.5(h - 1) > 16.5$

$h > 6$ hr

64. Solve: $14 < 4 + 2.50(h - 1) < 24$

$5 \text{ hr} < h < 9 \text{ hr}$

Chapter 2 Vocabulary Reinforcement

1. Any replacement for the variable that makes an equation true is called a solution of the equation.

2. The addition principle for equations states that for any real numbers a, b, and c, $a = b$ is equivalent to $a + c = b + c$.

3. The multiplication principle states that for any real numbers a, b, and c, $a = b$ is equivalent to $a \cdot c = b \cdot c$.

4. An inequality is a number sentence with $<$, $\le$, $>$, or $\ge$ as its verb.

5. Equations with the same solution are called equivalent equations.

Chapter 2 Concept Reinforcement

1. True; see page 102 in the text.

2. True; for any number n, $n \geq n$ is true because $n = n$ is true.

3. False; the solution set of $2x - 7 \leq 11$ is $\{x|x \leq 9\}$; the solution set of $x < 2$ is $\{x|x < 2\}$. The inequalities do not have the same solution set, so they are not equivalent.

4. True; if $x > y$, then $-1 \cdot x < -1 \cdot y$ (reversing the inequality symbol), or $-x < -y$.

Chapter 2 Study Guide

1.
$$\begin{aligned} 4(x-3) &= 6(x+2) \\ 4x - 12 &= 6x + 12 \\ 4x - 12 - 6x &= 6x + 12 - 6x \\ -2x - 12 &= 12 \\ -2x - 12 + 12 &= 12 + 12 \\ -2x &= 24 \\ \frac{-2x}{-2} &= \frac{24}{-2} \\ x &= -12 \end{aligned}$$

The solution is -12.

2.
$$\begin{aligned} 4 + 3y - 7 &= 3 + 3(y-2) \\ 4 + 3y - 7 &= 3 + 3y - 6 \\ 3y - 3 &= -3 + 3y \\ 3y - 3 - 3y &= -3 + 3y - 3y \\ -3 &= -3 \end{aligned}$$

Every real number is a solution of the equation $-3 = -3$, so all real numbers are solutions of the original equation.

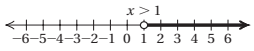
3.
$$\begin{aligned} 4(x-3) + 7 &= -5 + 4x + 10 \\ 4x - 12 + 7 &= -5 + 4x + 10 \\ 4x - 5 &= 5 + 4x \\ 4x - 5 - 4x &= 5 + 4x - 4x \\ -5 &= 5 \end{aligned}$$

We get a false equation, so the original equation has no solution.

4.
$$\begin{aligned} A &= \frac{1}{2}bh \\ 2 \cdot A &= 2 \cdot \frac{1}{2}bh \\ 2A &= bh \\ \frac{2A}{h} &= \frac{bh}{h} \\ \frac{2A}{h} &= b \end{aligned}$$

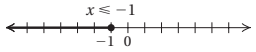
5. Graph: $x > 1$

The solutions of $x > 1$ are all numbers greater than 1. We shade all points to the right of 1 and use an open circle at 1 to indicate that 1 is not part of the graph.



6. Graph: $x \leq -1$

The solutions of $x \leq -1$ are all numbers less than or equal to -1. We shade all points to the left of -1 and use a closed circle at -1 to indicate that -1 is part of the graph.



7.
$$\begin{aligned} 6y + 5 &> 3y - 7 \\ 6y + 5 - 3y &> 3y - 7 - 3y \\ 3y + 5 &> -7 \\ 3y + 5 - 5 &> -7 - 5 \\ 3y &> -12 \\ \frac{3y}{3} &> \frac{-12}{3} \\ y &> -4 \end{aligned}$$

The solution set is $\{y|y > -4\}$.

Chapter 2 Review Exercises

1.
$$\begin{aligned} x + 5 &= -17 \\ x + 5 - 5 &= -17 - 5 \\ x &= -22 \end{aligned}$$

The solution is -22.

2.
$$\begin{aligned} n - 7 &= -6 \\ n - 7 + 7 &= -6 + 7 \\ n &= 1 \end{aligned}$$

The solution is 1.

3.
$$\begin{aligned} x - 11 &= 14 \\ x - 11 + 11 &= 14 + 11 \\ x &= 25 \end{aligned}$$

The solution is 25.

4.
$$\begin{aligned} y - 0.9 &= 9.09 \\ y - 0.9 + 0.9 &= 9.09 + 0.9 \\ y &= 9.99 \end{aligned}$$

The solution is 9.99.

5.
$$\begin{aligned} -\frac{2}{3}x &= -\frac{1}{6} \\ -\frac{3}{2} \cdot \left(-\frac{2}{3}x\right) &= -\frac{3}{2} \cdot \left(-\frac{1}{6}\right) \\ 1 \cdot x &= \frac{\cancel{3} \cdot 1}{2 \cdot 2 \cdot \cancel{3}} \\ x &= \frac{1}{4} \end{aligned}$$

The solution is $\frac{1}{4}$.

6.
$$\begin{aligned} -8x &= -56 \\ \frac{-8x}{-8} &= \frac{-56}{-8} \\ x &= 7 \end{aligned}$$

The solution is 7.

7.
$$-\frac{x}{4} = 48$$
$$4 \cdot \frac{1}{4} \cdot (-x) = 4 \cdot 48$$
$$-x = 192$$
$$-1 \cdot (-1 \cdot x) = -1 \cdot 192$$
$$x = -192$$
The solution is -192.

8.
$$15x = -35$$
$$\frac{15x}{15} = \frac{-35}{15}$$
$$x = -\frac{\cancel{5} \cdot 7}{3 \cdot \cancel{5}}$$
$$x = -\frac{7}{3}$$
The solution is $-\frac{7}{3}$.

9.
$$\frac{4}{5}y = -\frac{3}{16}$$
$$\frac{5}{4} \cdot \frac{4}{5}y = \frac{5}{4} \cdot \left(-\frac{3}{16}\right)$$
$$y = -\frac{15}{64}$$
The solution is $-\frac{15}{64}$.

10.
$$5 - x = 13$$
$$5 - x - 5 = 13 - 5$$
$$-x = 8$$
$$-1 \cdot (-1 \cdot x) = -1 \cdot 8$$
$$x = -8$$
The solution is -8.

11.
$$\frac{1}{4}x - \frac{5}{8} = \frac{3}{8}$$
$$\frac{1}{4}x - \frac{5}{8} + \frac{5}{8} = \frac{3}{8} + \frac{5}{8}$$
$$\frac{1}{4}x = 1$$
$$4 \cdot \frac{1}{4}x = 4 \cdot 1$$
$$x = 4$$
The solution is 4.

12.
$$5t + 9 = 3t - 1$$
$$5t + 9 - 3t = 3t - 1 - 3t$$
$$2t + 9 = -1$$
$$2t + 9 - 9 = -1 - 9$$
$$2t = -10$$
$$\frac{2t}{2} = \frac{-10}{2}$$
$$t = -5$$
The solution is -5.

13.
$$7x - 6 = 25x$$
$$7x - 6 - 7x = 25x - 7x$$
$$-6 = 18x$$
$$\frac{-6}{18} = \frac{18x}{18}$$
$$-\frac{\cancel{6} \cdot 1}{3 \cdot \cancel{6}} = x$$
$$-\frac{1}{3} = x$$
The solution is $-\frac{1}{3}$.

14.
$$14y = 23y - 17 - 10$$
$$14y = 23y - 27 \quad \text{Collecting like terms}$$
$$14y - 23y = 23y - 27 - 23y$$
$$-9y = -27$$
$$\frac{-9y}{-9} = \frac{-27}{-9}$$
$$y = 3$$
The solution is 3.

15.
$$0.22y - 0.6 = 0.12y + 3 - 0.8y$$
$$0.22y - 0.6 = -0.68y + 3 \quad \text{Collecting like terms}$$
$$0.22y - 0.6 + 0.68y = -0.68y + 3 + 0.68y$$
$$0.9y - 0.6 = 3$$
$$0.9y - 0.6 + 0.6 = 3 + 0.6$$
$$0.9y = 3.6$$
$$\frac{0.9y}{0.9} = \frac{3.6}{0.9}$$
$$y = 4$$
The solution is 4.

16.
$$\frac{1}{4}x - \frac{1}{8}x = 3 - \frac{1}{16}x$$
$$\frac{2}{8}x - \frac{1}{8}x = 3 - \frac{1}{16}x$$
$$\frac{1}{8}x = 3 - \frac{1}{16}x$$
$$\frac{1}{8}x + \frac{1}{16}x = 3 - \frac{1}{16}x + \frac{1}{16}x$$
$$\frac{2}{16}x + \frac{1}{16}x = 3$$
$$\frac{3}{16}x = 3$$
$$\frac{16}{3} \cdot \frac{3}{16}x = \frac{16}{3} \cdot 3$$
$$x = \frac{16 \cdot \cancel{3}}{\cancel{3} \cdot 1}$$
$$x = 16$$
The solution is 16.

17.
$$14y + 17 + 7y = 9 + 21y + 8$$
$$21y + 17 = 21y + 17$$
$$21y + 17 - 21y = 21y + 17 - 21y$$
$$17 = 17 \qquad \text{TRUE}$$
All real numbers are solutions.

18.
$$\begin{aligned} 4(x+3) &= 36 \\ 4x+12 &= 36 \\ 4x+12-12 &= 36-12 \\ 4x &= 24 \\ \frac{4x}{4} &= \frac{24}{4} \\ x &= 6 \end{aligned}$$
The solution is 6.

19.
$$\begin{aligned} 3(5x-7) &= -66 \\ 15x-21 &= -66 \\ 15x-21+21 &= -66+21 \\ 15x &= -45 \\ \frac{15x}{15} &= \frac{-45}{15} \\ x &= -3 \end{aligned}$$
The solution is -3.

20.
$$\begin{aligned} 8(x-2)-5(x+4) &= 20+x \\ 8x-16-5x-20 &= 20+x \\ 3x-36 &= 20+x \\ 3x-36-x &= 20+x-x \\ 2x-36 &= 20 \\ 2x-36+36 &= 20+36 \\ 2x &= 56 \\ \frac{2x}{2} &= \frac{56}{2} \\ x &= 28 \end{aligned}$$
The solution is 28.

21.
$$\begin{aligned} -5x+3(x+8) &= 16 \\ -5x+3x+24 &= 16 \\ -2x+24 &= 16 \\ -2x+24-24 &= 16-24 \\ -2x &= -8 \\ \frac{-2x}{-2} &= \frac{-8}{-2} \\ x &= 4 \end{aligned}$$
The solution is 4.

22.
$$\begin{aligned} 6(x-2)-16 &= 3(2x-5)+11 \\ 6x-12-16 &= 6x-15+11 \\ 6x-28 &= 6x-4 \\ 6x-28-6x &= 6x-4-6x \\ -28 &= -4 \qquad \text{False} \end{aligned}$$
There is no solution.

23. Since $-3 \le 4$ is true, -3 is a solution.

24. Since $7 \le 4$ is false, 7 is not a solution.

25. Since $4 \le 4$ is true, 4 is a solution.

26.
$$\begin{aligned} y+\frac{2}{3} &\ge \frac{1}{6} \\ y+\frac{2}{3}-\frac{2}{3} &\ge \frac{1}{6}-\frac{2}{3} \\ y &\ge \frac{1}{6}-\frac{4}{6} \\ y &\ge -\frac{3}{6} \\ y &\ge -\frac{1}{2} \end{aligned}$$
The solution set is $\left\{y \middle| y \ge -\frac{1}{2}\right\}$.

27.
$$\begin{aligned} 9x &\ge 63 \\ \frac{9x}{9} &\ge \frac{63}{9} \\ x &\ge 7 \end{aligned}$$
The solution set is $\{x|x \ge 7\}$.

28.
$$\begin{aligned} 2+6y &> 14 \\ 2+6y-2 &> 14-2 \\ 6y &> 12 \\ \frac{6y}{6} &> \frac{12}{6} \\ y &> 2 \end{aligned}$$
The solution set is $\{y|y > 2\}$.

29.
$$\begin{aligned} 7-3y &\ge 27+2y \\ 7-3y-2y &\ge 27+2y-2y \\ 7-5y &\ge 27 \\ 7-5y-7 &\ge 27-7 \\ -5y &\ge 20 \\ \frac{-5y}{-5} &\le \frac{20}{-5} \quad \text{Reversing the inequality symbol} \\ y &\le -4 \end{aligned}$$
The solution set is $\{y|y \le -4\}$.

30.
$$\begin{aligned} 3x+5 &< 2x-6 \\ 3x+5-2x &< 2x-6-2x \\ x+5 &< -6 \\ x+5-5 &< -6-5 \\ x &< -11 \end{aligned}$$
The solution set is $\{x|x < -11\}$.

31.
$$\begin{aligned} -4y &< 28 \\ \frac{-4y}{-4} &> \frac{28}{-4} \quad \text{Reversing the inequality symbol} \\ y &> -7 \end{aligned}$$
The solution set is $\{y|y > -7\}$.

32.
$$\begin{aligned} 4-8x &< 13+3x \\ 4-8x-3x &< 13+3x-3x \\ 4-11x &< 13 \\ 4-11x-4 &< 13-4 \\ -11x &< 9 \\ \frac{-11x}{-11} &> \frac{9}{-11} \quad \text{Reversing the inequality symbol} \\ x &> -\frac{9}{11} \end{aligned}$$

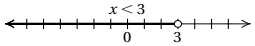
The solution set is $\left\{x \middle| x > -\frac{9}{11}\right\}$.

33.
$$\begin{aligned} -4x &\le \frac{1}{3} \\ -\frac{1}{4}\cdot(-4x) &\ge -\frac{1}{4}\cdot\frac{1}{3} \quad \text{Reversing the inequality symbol} \\ x &\ge -\frac{1}{12} \end{aligned}$$

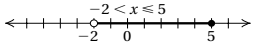
The solution set is $\left\{x \middle| x \ge -\frac{1}{12}\right\}$.

34.
$$\begin{aligned} 4x-6 &< x+3 \\ 4x-6-x &< x+3-x \\ 3x-6 &< 3 \\ 3x-6+6 &< 3+6 \\ 3x &< 9 \\ \frac{3x}{3} &< \frac{9}{3} \\ x &< 3 \end{aligned}$$

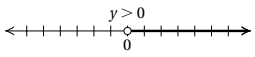
The solution set is $\{x|x<3\}$. The graph is as follows:



35. In order to be a solution of $-2 < x \le 5$, a number must be a solution of both $-2 < x$ and $x \le 5$. The solution set is graphed as follows:



36. The solutions of $y > 0$ are those numbers greater than 0. The graph is as follows:



37.
$$\begin{aligned} C &= \pi d \\ \frac{C}{\pi} &= \frac{\pi d}{\pi} \\ \frac{C}{\pi} &= d \end{aligned}$$

38.
$$\begin{aligned} V &= \frac{1}{3}Bh \\ 3\cdot V &= 3\cdot\frac{1}{3}Bh \\ 3V &= Bh \\ \frac{3V}{h} &= \frac{Bh}{h} \\ \frac{3V}{h} &= B \end{aligned}$$

39.
$$\begin{aligned} A &= \frac{a+b}{2} \\ 2\cdot A &= 2\cdot\left(\frac{a+b}{2}\right) \\ 2A &= a+b \\ 2A-b &= a+b-b \\ 2A-b &= a \end{aligned}$$

40.
$$\begin{aligned} y &= mx+b \\ y-b &= mx+b-b \\ y-b &= mx \\ \frac{y-b}{m} &= \frac{mx}{m} \\ \frac{y-b}{m} &= x \end{aligned}$$

41. ***Familiarize***. Let w = the width, in miles. Then $w+90$ = the length. Recall that the perimeter P of a rectangle with length l and width w is given by $P = 2l + 2w$.

Translate. Substitute 1280 for P and $w+90$ for l in the formula above.

$$\begin{aligned} P &= 2l+2w \\ 1280 &= 2(w+90)+2w \end{aligned}$$

Solve. We solve the equation.

$$\begin{aligned} 1280 &= 2(w+90)+2w \\ 1280 &= 2w+180+2w \\ 1280 &= 4w+180 \\ 1280-180 &= 4w+180-180 \\ 1100 &= 4w \\ \frac{1100}{4} &= \frac{4w}{4} \\ 275 &= w \end{aligned}$$

If $w = 275$, then $w + 90 = 275 + 90 = 365$.

Check. The length, 365 mi, is 90 mi more than the width, 275 mi. The perimeter is $2\cdot 365$ mi $+ 2\cdot 275$ mi $= 730$ mi $+$ 550 mi $= 1280$ mi. The answer checks.

State. The length is 365 mi, and the width is 275 mi.

42. ***Familiarize***. Let x = the number on the first marker. Then $x+1$ = the number on the second marker.

Translate.

$$\begin{array}{ccccccc} \underbrace{\text{First number}} & & \text{plus} & \underbrace{\text{second number}} & & \text{is} & 691. \\ \downarrow & & \downarrow & \downarrow & & \downarrow & \downarrow \\ x & & + & (x+1) & & = & 691 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} x + (x+1) &= 691 \\ 2x + 1 &= 691 \\ 2x + 1 - 1 &= 691 - 1 \\ 2x &= 690 \\ \frac{2x}{2} &= \frac{690}{2} \\ x &= 345 \end{aligned}$$

If $x = 345$, then $x + 1 = 345 + 1 = 346$.

Check. 345 and 346 are consecutive integers and $345 + 346 = 691$. The answer checks.

State. The numbers on the markers are 345 and 346.

43. ***Familiarize***. Let $c =$ the cost of the entertainment center in February.

Translate.

$$\begin{array}{ccccccc} \underbrace{\text{Cost in February}} & \text{plus} & \$332 & \text{is} & \underbrace{\text{Cost in June}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ c & + & 332 & = & 2449 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} c + 332 &= 2449 \\ c + 332 - 332 &= 2449 - 332 \\ c &= 2117 \end{aligned}$$

Check. $\$2117 + \$332 = \$2449$, so the answer checks.

State. The entertainment center cost \$2117 in February.

44. ***Familiarize***. Let $a =$ the number of subscriptions Ty sold.

Translate.

$$\begin{array}{ccccccc} \underbrace{\text{Commission per subscription}} & \text{times} & \underbrace{\text{number sold}} & \text{is} & \underbrace{\text{Total commission}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 4 & \times & a & = & 108 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} 4 \cdot a &= 108 \\ \frac{4 \cdot a}{4} &= \frac{108}{4} \\ a &= 27 \end{aligned}$$

Check. $\$4 \cdot 27 = \$108$, so the answer checks.

State. Ty sold 27 magazine subscriptions.

45. ***Familiarize.*** Let $x =$ the measure of the first angle. Then $x + 50 =$ the measure of the second angle, and $2x - 10 =$ the measure of the third angle. Recall that the sum of measures of the angles of a triangle is 180°.

Translate.

$$\begin{array}{ccccccccc} \underbrace{\text{Measure of first angle}} & + & \underbrace{\text{measure of second angle}} & + & \underbrace{\text{measure of third angle}} & \text{is } 180^\circ. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & (x+50) & + & (2x-10) & = & 180 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} x + (x+50) + (2x-10) &= 180 \\ 4x + 40 &= 180 \\ 4x + 40 - 40 &= 180 - 40 \\ 4x &= 140 \\ \frac{4x}{4} &= \frac{140}{4} \\ x &= 35 \end{aligned}$$

If $x = 35$, then $x + 50 = 35 + 50 = 85$ and $2x - 10 = 2 \cdot 35 - 10 = 70 - 10 = 60$.

Check. The measure of the second angle is 50° more than the measure of the first angle, and the measure of the third angle is 10° less than twice the measure of the first angle. The sum of the measure is $35° + 85° + 60° = 180°$. The answer checks.

State. The measures of the angles are 35°, 85°, and 60°.

46. *Translate.*

$$\begin{array}{ccccccc} \underbrace{\text{What number}} & \text{is} & 20\% & \text{of} & 75? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ a & = & 20\% & \cdot & 75 \end{array}$$

Solve. We convert 20% to decimal notation and multiply.

$$\begin{aligned} a &= 20\% \cdot 75 \\ a &= 0.2 \cdot 75 \\ a &= 15 \end{aligned}$$

Thus, 15 is 20% of 75.

47. *Translate.*

$$\begin{array}{ccccccc} 15 & \text{is} & \underbrace{\text{what percent}} & \text{of} & 80? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 15 & = & p & \cdot & 80 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} 15 &= p \cdot 80 \\ \frac{15}{80} &= \frac{p \cdot 80}{80} \\ 0.1875 &= p \\ 18.75\% &= p \end{aligned}$$

Thus, 15 is 18.75% of 80.

48. *Translate.*

$$\begin{array}{ccccccc} 18 & \text{is} & 3\% & \text{of} & \underbrace{\text{what number}}? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 18 & = & 3\% & \cdot & b \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} 18 &= 3\% \cdot b \\ 18 &= 0.03 \cdot b \\ \frac{18}{0.03} &= \frac{0.03 \cdot b}{0.03} \\ 600 &= b \end{aligned}$$

Thus, 18 is 3% of 600.

49. We subtract to find the increase.

$$164,440 - 87,872 = 76,568$$

The increase is 76,568.

Now we find the percent increase.

$$\begin{array}{l} 76,568 \text{ is } \underbrace{\text{what percent}} \text{ of } 87,872? \\ \quad\downarrow\quad\downarrow\qquad\quad\downarrow\qquad\downarrow\quad\downarrow \\ 76,568 = \qquad p \qquad \cdot \quad 87,872 \end{array}$$

We divide by 87,872 on both sides and then convert to percent notation.

$$\begin{aligned} 76,568 &= p \cdot 87,872 \\ \frac{76,568}{87,872} &= \frac{p \cdot 87,872}{87,872} \\ 0.871 &\approx p \\ 87.1\% &\approx p \end{aligned}$$

The percent increase is about 87.1%.

50. We subtract to find the decrease, in billions.

$$102.4 - 73.5 = 28.9$$

Now we find the percent decrease.

$$\begin{array}{l} 28.9 \text{ is } \underbrace{\text{what percent}} \text{ of } 102.4? \\ \quad\downarrow\quad\downarrow\qquad\quad\downarrow\qquad\downarrow\quad\downarrow \\ 28.9 = \qquad p \qquad \cdot \quad 102.4 \end{array}$$

We divide by 102.4 on both sides and then convert to percent notation.

$$\begin{aligned} 28.9 &= p \cdot 102.4 \\ \frac{28.9}{102.4} &= \frac{p \cdot 102.4}{102.4} \\ 0.282 &\approx p \\ 28.2\% &\approx p \end{aligned}$$

The percent decrease is about 28.2%.

51. ***Familiarize***. Let p = the price before the reduction.

Translate.

$$\begin{array}{l} \underbrace{\text{Price before reduction}} \text{ minus } 30\% \text{ of price is } \$154. \\ \quad\downarrow\qquad\qquad\downarrow\quad\downarrow\downarrow\quad\downarrow\quad\downarrow\quad\downarrow \\ \quad p \qquad\qquad - \quad 30\% \cdot \quad p \quad = \quad 154 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} p - 30\% \cdot p &= 154 \\ p - 0.3p &= 154 \\ 0.7p &= 154 \\ \frac{0.7p}{0.7} &= \frac{154}{0.7} \\ p &= 220 \end{aligned}$$

Check. 30% of \$220 is $0.3 \cdot \$220 = \$66$ and $\$220 - \$66 = \$154$, so the answer checks.

State. The price before the reduction was \$220.

52. ***Familiarize***. Let s = the previous salary.

Translate.

$$\begin{array}{l} \underbrace{\text{Previous salary}} \text{ plus } 8\% \text{ of } \underbrace{\text{previous salary}} \text{ is } \$78,300. \\ \quad\downarrow\qquad\downarrow\quad\downarrow\downarrow\qquad\quad\downarrow\qquad\downarrow\quad\downarrow \\ \quad s \qquad + \quad 8\% \cdot \qquad s \qquad = \quad 78,300 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} s + 8\% \cdot s &= 78,300 \\ s + 0.08s &= 78,300 \\ 1.08s &= 78,300 \\ \frac{1.08s}{1.08} &= \frac{78,300}{1.08} \\ s &= 72,500 \end{aligned}$$

Check. 8% of $\$72,500 = 0.08 \cdot \$72,500 = \$5800$ and $\$72,500 + \$5800 = \$78,300$, so the answer checks.

State. The previous salary was \$72,500.

53. ***Familiarize***. Let a = the amount the organization actually owes. This is the price of the supplies without sales tax added. Then the incorrect amount is $a + 5\%$ of a, or $a + 0.05a$, or $1.05a$.

Translate.

$$\begin{array}{l} \underbrace{\text{Incorrect amount}} \text{ is } \$145.90. \\ \quad\downarrow\qquad\quad\downarrow\quad\downarrow \\ 1.05a \qquad = \quad 145.90 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} 1.05a &= 145.90 \\ \frac{1.05a}{1.05} &= \frac{145.90}{1.05} \\ a &\approx 138.95 \end{aligned}$$

Check. 5% of \$138.95 is $0.05 \cdot \$138.95 \approx \$6.95$, and $\$138.95 + \$6.95 = \$145.90$, so the answer checks.

State. The organization actually owes \$138.95.

54. ***Familiarize***. Let s represent the score on the next test.

Translate.

$$\begin{array}{l} \underbrace{\text{The average score}} \quad \underbrace{\text{is at least}} \quad 80. \\ \quad\downarrow\qquad\qquad\quad\downarrow\quad\downarrow \\ \dfrac{71+75+82+86+s}{5} \quad \geq \quad 80 \end{array}$$

Solve.

$$\begin{aligned} \frac{71+75+82+86+s}{5} &\geq 80 \\ 5\left(\frac{71+75+82+86+s}{5}\right) &\geq 5 \cdot 80 \\ 71+75+82+86+s &\geq 400 \\ 314 + s &\geq 400 \\ s &\geq 86 \end{aligned}$$

Check. As a partial check we show that the average is at least 80 when the next test score is 86.

$$\frac{71+75+82+86+86}{5} = \frac{400}{5} = 80$$

State. The lowest grade Noah can get on the next test and have an average test score of 80 is 86.

55. ***Familiarize***. Let w represent the width of the rectangle, in cm. The perimeter is given by $P = 2l + 2w$, or $2 \cdot 43 + 2w$, or $86 + 2w$.

Translate.

$$\begin{array}{l} \underbrace{\text{The perimeter}} \quad \underbrace{\text{is greater than}} \quad \underbrace{120 \text{ cm}}. \\ \quad\downarrow\qquad\qquad\quad\downarrow\qquad\quad\downarrow \\ 86 + 2w \qquad > \qquad 120 \end{array}$$

Solve.

$$86 + 2w > 120$$
$$2w > 34$$
$$w > 17$$

Check. We check to see if the solution seems reasonable.

When $w = 16$ cm, $P = 2 \cdot 43 + 2 \cdot 16$, or 118 cm.

When $w = 17$ cm, $P = 2 \cdot 43 + 2 \cdot 17$, or 120 cm.

When $w = 18$ cm, $P = 2 \cdot 43 + 2 \cdot 18$, or 122 cm.

It appears that the solution is correct.

State. The solution set is $\{w|w > 17 \text{ cm}\}$.

56.
$$4(3x - 5) + 6 = 8 + x$$
$$12x - 20 + 6 = 8 + x$$
$$12x - 14 = 8 + x$$
$$12x - 14 - x = 8 + x - x$$
$$11x - 14 = 8$$
$$11x - 14 + 14 = 8 + 14$$
$$11x = 22$$
$$\frac{11x}{11} = \frac{22}{11}$$
$$x = 2$$

The solution is 2. This is between 1 and 5, so the correct answer is C.

57.
$$3x + 4y = P$$
$$3x + 4y - 3x = P - 3x$$
$$4y = P - 3x$$
$$\frac{4y}{4} = \frac{P - 3x}{4}$$
$$y = \frac{P - 3x}{4}$$

Answer A is correct.

58.
$$2|x| + 4 = 50$$
$$2|x| = 46$$
$$|x| = 23$$

The solutions are the numbers whose distance from 0 is 23. Those numbers are -23 and 23.

59. $|3x| = 60$

The solutions are the values of x for which the distance of $3 \cdot x$ from 0 is 60. Then we have:

$$3x = -60 \quad or \quad 3x = 60$$
$$x = -20 \quad or \quad x = 20$$

The solutions are -20 and 20.

60.
$$y = 2a - ab + 3$$
$$y - 3 = 2a - ab$$
$$y - 3 = a(2 - b)$$
$$\frac{y - 3}{2 - b} = a$$

Chapter 2 Discussion and Writing Exercises

1. The end result 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 $1.05(1.08s)$. By the commutative and associate laws of multiplication, we see that these are equal. However, it would be better to receive the 8% raise first, because this increase yields a higher salary initially than a 5% raise.

2. No; Erin paid 75% of the original price and was offered credit for 125% of this amount, not to be used on sale items. Now 125% of 75% is 93.75%, so Erin would have a credit of 93.75% of the original price. Since this credit can be applied only to nonsale items, she has less purchasing power than if the amount she paid were refunded and she could spend it on sale items.

3. The inequalities are equivalent by the multiplication principle for inequalities. If we multiply both sides of one inequality by -1, the other inequality results.

4. For any pair of numbers, their relative position on the number line is reversed when both are multiplied by the same negative number. For example, -3 is to the left of 5 on the number line ($-3 < 5$), but 12 is to the right of -20. That is, $-3(-4) > 5(-4)$.

5. Answers may vary. Fran is more than 3 years older than Todd.

6. 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 $5 > n$.

Chapter 2 Test

1.
$$x + 7 = 15$$
$$x + 7 - 7 = 15 - 7$$
$$x = 8$$

The solution is 8.

2.
$$t - 9 = 17$$
$$t - 9 + 9 = 17 + 9$$
$$t = 26$$

The solution is 26.

3.
$$3x = -18$$
$$\frac{3x}{3} = \frac{-18}{3}$$
$$x = -6$$

The solution is -6.

4.
$$-\frac{4}{7}x = -28$$
$$-\frac{7}{4}\cdot\left(-\frac{4}{7}x\right) = -\frac{7}{4}\cdot(-28)$$
$$x = \frac{7\cdot\cancel{4}\cdot 7}{\cancel{4}\cdot 1}$$
$$x = 49$$

The solution is 49.

5.
$$3t + 7 = 2t - 5$$
$$3t + 7 - 2t = 2t - 5 - 2t$$
$$t + 7 = -5$$
$$t + 7 - 7 = -5 - 7$$
$$t = -12$$

The solution is -12.

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

The solution is 2.

7.
$$8 - y = 16$$
$$8 - y - 8 = 16 - 8$$
$$-y = 8$$
$$-1\cdot(-1\cdot y) = -1\cdot 8$$
$$y = -8$$

The solution is -8.

8.
$$-\frac{2}{5} + x = -\frac{3}{4}$$
$$-\frac{2}{5} + x + \frac{2}{5} = -\frac{3}{4} + \frac{2}{5}$$
$$x = -\frac{15}{20} + \frac{8}{20}$$
$$x = -\frac{7}{20}$$

The solution is $-\frac{7}{20}$.

9.
$$3(x + 2) = 27$$
$$3x + 6 = 27$$
$$3x + 6 - 6 = 27 - 6$$
$$3x = 21$$
$$\frac{3x}{3} = \frac{21}{3}$$
$$x = 7$$

The solution is 7.

10.
$$-3x - 6(x - 4) = 9$$
$$-3x - 6x + 24 = 9$$
$$-9x + 24 = 9$$
$$-9x + 24 - 24 = 9 - 24$$
$$-9x = -15$$
$$\frac{-9x}{-9} = \frac{-15}{-9}$$
$$x = \frac{\cancel{3}\cdot 5}{\cancel{3}\cdot 3}$$
$$x = \frac{5}{3}$$

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

11. We multiply by 10 to clear the decimals.
$$0.4p + 0.2 = 4.2p - 7.8 - 0.6p$$
$$10(0.4p + 0.2) = 10(4.2p - 7.8 - 0.6p)$$
$$4p + 2 = 42p - 78 - 6p$$
$$4p + 2 = 36p - 78$$
$$4p + 2 - 36p = 36p - 78 - 36p$$
$$-32p + 2 = -78$$
$$-32p + 2 - 2 = -78 - 2$$
$$-32p = -80$$
$$\frac{-32p}{-32} = \frac{-80}{-32}$$
$$p = \frac{5\cdot\cancel{16}}{2\cdot\cancel{16}}$$
$$p = \frac{5}{2}$$

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

12.
$$4(3x - 1) + 11 = 2(6x + 5) - 8$$
$$12x - 4 + 11 = 12x + 10 - 8$$
$$12x + 7 = 12x + 2$$
$$12x + 7 - 12x = 12x + 2 - 12x$$
$$7 = 2 \qquad \text{FALSE}$$

There are no solutions.

13.
$$-2 + 7x + 6 = 5x + 4 + 2x$$
$$7x + 4 = 7x + 4$$
$$7x + 4 - 7x = 7x + 4 - 7x$$
$$4 = 4 \qquad \text{TRUE}$$

All real numbers are solutions.

14.
$$x + 6 \le 2$$
$$x + 6 - 6 \le 2 - 6$$
$$x \le -4$$

The solution set is $\{x|x \le -4\}$.

15.
$$\begin{aligned} 14x+9 &> 13x-4 \\ 14x+9-13x &> 13x-4-13x \\ x+9 &> -4 \\ x+9-9 &> -4-9 \\ x &> -13 \end{aligned}$$
The solution set is $\{x|x > -13\}$.

16.
$$\begin{aligned} 12x &\le 60 \\ \frac{12x}{12} &\le \frac{60}{12} \\ x &\le 5 \end{aligned}$$
The solution set is $\{x|x \le 5\}$.

17.
$$\begin{aligned} -2y &\ge 26 \\ \frac{-2y}{-2} &\le \frac{26}{-2} \quad \text{Reversing the inequality symbol} \\ y &\le -13 \end{aligned}$$
The solution set is $\{y|y \le -13\}$.

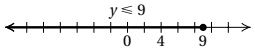
18.
$$\begin{aligned} -4y &\le -32 \\ \frac{-4y}{-4} &\ge \frac{-32}{-4} \quad \text{Reversing the inequality symbol} \\ y &\ge 8 \end{aligned}$$
The solution set is $\{y|y \ge 8\}$.

19.
$$\begin{aligned} -5x &\ge \frac{1}{4} \\ -\frac{1}{5}\cdot(-5x) &\le -\frac{1}{5}\cdot\frac{1}{4} \quad \text{Reversing the inequality symbol} \\ x &\le -\frac{1}{20} \end{aligned}$$
The solution set is $\left\{x\middle|x \le -\frac{1}{20}\right\}$.

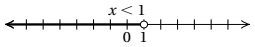
20.
$$\begin{aligned} 4-6x &> 40 \\ 4-6x-4 &> 40-4 \\ -6x &> 36 \\ \frac{-6x}{-6} &< \frac{36}{-6} \quad \text{Reversing the inequality symbol} \\ x &< -6 \end{aligned}$$
The solution set is $\{x|x < -6\}$.

21.
$$\begin{aligned} 5-9x &\ge 19+5x \\ 5-9x-5x &\ge 19+5x-5x \\ 5-14x &\ge 19 \\ 5-14x-5 &\ge 19-5 \\ -14x &\ge 14 \\ \frac{-14x}{-14} &\le \frac{14}{-14} \quad \text{Reversing the inequality symbol} \\ x &\le -1 \end{aligned}$$
The solution set is $\{x|x \le -1\}$.

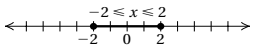
22. The solutions of $y \le 9$ are shown by shading the point for 9 and all points to the left of 9. The closed circle at 9 indicates that 9 is part of the graph.



23.
$$\begin{aligned} 6x-3 &< x+2 \\ 6x-3-x &< x+2-x \\ 5x-3 &< 2 \\ 5x-3+3 &< 2+3 \\ 5x &< 5 \\ \frac{5x}{5} &< \frac{5}{5} \\ x &< 1 \end{aligned}$$
The solution set is $\{x|x < 1\}$. The graph is as follows:



24. In order to be a solution of the inequality $-2 \le x \le 2$, a number must be a solution of both $-2 \le x$ and $x \le 2$. The solution set is graphed as follows:



25. *Translate.*

What number	is	24%	of	75?
↓	↓	↓	↓	↓
a	$=$	24%	$\cdot$	75

Solve. We convert 24% to decimal notation and multiply.
$$\begin{aligned} a &= 24\% \cdot 75 \\ a &= 0.24 \cdot 75 \\ a &= 18 \end{aligned}$$
Thus, 18 is 24% of 75.

26. *Translate.*

15.84	is	what percent	of	96?
↓	↓	↓	↓	↓
15.84	$=$	p	$\cdot$	96

Solve.
$$\begin{aligned} 15.84 &= p \cdot 96 \\ \frac{15.84}{96} &= \frac{p \cdot 96}{96} \\ 0.165 &= p \\ 16.5\% &= p \end{aligned}$$
Thus, 15.84 is 16.5% of 96.

27. *Translate.*

800	is	2%	of	what number?
↓	↓	↓	↓	↓
800	$=$	2%	$\cdot$	b

Solve.
$$\begin{aligned} 800 &= 2\% \cdot b \\ 800 &= 0.02 \cdot b \\ \frac{800}{0.02} &= \frac{0.02 \cdot b}{0.02} \\ 40,000 &= b \end{aligned}$$
Thus, 800 is 2% of 40,000.

28. We subtract to find the increase.

$$29.2 - 18.2 = 11$$

Now we find the percent of increase.

$$\begin{array}{ccccccc} 11 & \text{is} & \underbrace{\text{what percent}} & \text{of} & 18.2? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 11 & = & p & \cdot & 18.2 \end{array}$$

We divide by 18.2 on both sides and then convert to percent notation.

$$\begin{aligned} 11 &= p \cdot 18.2 \\ \frac{11}{18.2} &= \frac{p \cdot 18.2}{18.2} \\ 0.604 &\approx p \\ 60.4\% &\approx p \end{aligned}$$

The percent increase is about 60.4%.

29. ***Familiarize***. Let w = the width of the photograph, in cm. Then $w + 4$ = the length. Recall that the perimeter P of a rectangle with length l and width w is given by $P = 2l + 2w$.

Translate. We substitute 36 for P and $w + 4$ for l in the formula above.

$$\begin{aligned} P &= 2l + 2w \\ 36 &= 2(w + 4) + 2w \end{aligned}$$

Solve. We solve the equation.

$$\begin{aligned} 36 &= 2(w + 4) + 2w \\ 36 &= 2w + 8 + 2w \\ 36 &= 4w + 8 \\ 36 - 8 &= 4w + 8 - 8 \\ 28 &= 4w \\ \frac{28}{4} &= \frac{4w}{4} \\ 7 &= w \end{aligned}$$

If $w = 7$, then $w + 4 = 7 + 4 = 11$.

Check. The length, 11 cm, is 4 cm more than the width, 7 cm. The perimeter is $2 \cdot 11$ cm $+ 2 \cdot 7$ cm $= 22$ cm $+$ 14 cm $= 36$ cm. The answer checks.

State. The width is 7 cm, and the length is 11 cm.

30. ***Familiarize***. Let t = the total cost of raising a child to age 17.

Translate.

$$\begin{array}{ccccc} \underbrace{\text{Cost for child care and K-12 education}} & \text{is} & 18\% & \text{of} & \underbrace{\text{Total cost}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 41,500 & = & 18\% & \cdot & t \end{array}$$

Solve.

$$\begin{aligned} 41,500 &= 18\% \cdot t \\ 41,500 &= 0.18t \\ \frac{41,500}{0.18} &= \frac{0.18t}{0.18} \\ 230,556 &\approx t \end{aligned}$$

Check. 18% of \$230,556 is about \$41,500, so the answer checks.

State. The total cost of raising a child to age 17 is about \$230,556.

31. ***Familiarize***. Let x = the first integer. Then $x + 1$ = the second and $x + 2$ = the third.

Translate.

$$\begin{array}{ccccccccc} \underbrace{\text{First integer}} & \text{plus} & \underbrace{\text{second integer}} & \text{plus} & \underbrace{\text{third integer}} & \text{is} & 7530. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & (x+1) & + & (x+2) & = & 7530 \end{array}$$

Solve.

$$\begin{aligned} x + (x + 1) + (x + 2) &= 7530 \\ 3x + 3 &= 7530 \\ 3x + 3 - 3 &= 7530 - 3 \\ 3x &= 7527 \\ \frac{3x}{3} &= \frac{7527}{3} \\ x &= 2509 \end{aligned}$$

If $x = 2509$, then $x + 1 = 2510$ and $x + 2 = 2511$.

Check. The numbers 2509, 2510, and 2511 are consecutive integers and 2509+2510+2511 = 7530. The answer checks.

State. The integers are 2509, 2510, and 2511.

32. ***Familiarize***. Let x = the amount originally invested. Using the formula for simple interest, $I = Prt$, the interest earned in one year will be $x \cdot 5\% \cdot 1$, or $5\%x$.

Translate.

$$\begin{array}{ccccccc} \underbrace{\text{Amount invested}} & \text{plus} & \text{interest} & \text{is} & \underbrace{\text{amount after 1 year.}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & 5\%x & = & 924 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} x + 5\%x &= 924 \\ x + 0.05x &= 924 \\ 1.05x &= 924 \\ \frac{1.05x}{1.05} &= \frac{924}{1.05} \\ x &= 880 \end{aligned}$$

Check. 5% of \$880 is $0.05 \cdot \$880 = \$44$ and $\$880 + \$44 =$ \$924, so the answer checks.

State. \$880 was originally invested.

33. ***Familiarize***. Using the labels on the drawing in the text, we let x = the length of the shorter piece, in meters, and $x + 2$ = the length of the longer piece.

Translate.

$$\begin{array}{ccccccc} \underbrace{\text{Length of shorter piece}} & \text{plus} & \underbrace{\text{length of longer piece}} & \text{is} & \underbrace{8 \text{ m}}. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & (x+2) & = & 8 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} x + (x+2) &= 8 \\ 2x + 2 &= 8 \\ 2x + 2 - 2 &= 8 - 2 \\ 2x &= 6 \\ \frac{2x}{2} &= \frac{6}{2} \\ x &= 3 \end{aligned}$$

If $x = 3$, then $x + 2 = 3 + 2 = 5$.

Check. One piece is 2 m longer than the other and the sum of the lengths is 3 m+5 m, or 8 m. The answer checks.

State. The lengths of the pieces are 3 m and 5 m.

34. ***Familiarize***. Let l = the length of the rectangle, in yd. The perimeter is given by $P = 2l + 2w$, or $2l + 2 \cdot 96$, or $2l + 192$.

Translate.

$$\underbrace{\text{The perimeter}}_{\downarrow} \ \underbrace{\text{is at least}}_{\downarrow} \ \underbrace{\text{540 yd}}_{\downarrow}.$$
$$2l + 192 \quad \geq \quad 540$$

Solve.

$$\begin{aligned} 2l + 192 &\geq 540 \\ 2l &\geq 348 \\ l &\geq 174 \end{aligned}$$

Check. We check to see if the solution seems reasonable.

When $l = 174$ yd, $P = 2 \cdot 174 + 2 \cdot 96$, or 540 yd.

When $l = 175$ yd, $P = 2 \cdot 175 + 2 \cdot 96$, or 542 yd.

It appears that the solution is correct.

State. For lengths that are at least 174 yd, the perimeter will be at least 540 yd. The solution set can be expressed as $\{l | l \geq 174 \text{ yd}\}$.

35. ***Familiarize***. Let s = the amount Jason spends in the sixth month.

Translate.

$$\underbrace{\text{Average spending}}_{\downarrow} \qquad \underbrace{\text{is no more than}}_{\downarrow} \ \underset{\downarrow}{\text{\$95.}}$$
$$\frac{98 + 89 + 110 + 85 + 83 + s}{6} \qquad \leq \qquad 95$$

Solve.

$$\begin{aligned} \frac{98 + 89 + 110 + 85 + 83 + s}{6} &\leq 95 \\ 6\left(\frac{98 + 89 + 110 + 85 + 83 + s}{6}\right) &\leq 6 \cdot 95 \\ 98 + 89 + 110 + 85 + 83 + s &\leq 570 \\ 465 + s &\leq 570 \\ s &\leq 105 \end{aligned}$$

Check. As a partial check we show that the average spending is \$95 when Jason spends \$105 in the sixth month.

$$\frac{98 + 89 + 110 + 85 + 83 + 105}{6} = \frac{570}{6} = 95$$

State. Jason can spend no more than \$105 in the sixth month. The solution set can be expressed as $\{s | s \leq \$105\}$.

36. ***Familiarize***. Let c = the number of copies made. For 3 months, the rental charge is $3 \cdot \$225$, or \$675. Expressing $3.2¢$ as \$0.032, the charge for the copies is given by $\$0.032 \cdot c$.

Translate.

$$\underbrace{\text{Rental charge}}_{\downarrow} \ \underset{\downarrow}{\text{plus}} \ \underbrace{\text{copy charge}}_{\downarrow} \ \underbrace{\text{is no more than}}_{\downarrow} \ \underset{\downarrow}{\text{\$4500.}}$$
$$675 \quad + \quad 0.032c \quad \leq \quad 4500$$

Solve.

$$\begin{aligned} 675 + 0.032c &\leq 4500 \\ 0.032c &\leq 3825 \\ c &\leq 119,531 \end{aligned}$$

Check. We check to see if the solution seems reasonable.

When $c = 119,530$, the total cost is $\$675 + \$0.032(119,530)$, or about \$4499.96.

When $c = 119,532$, the total cost is $\$675 + \$0.032(119,532)$, or about \$4500.02.

It appears that the solution is correct.

State. No more than 119,531 copies can be made. The solution set can be expressed as $\{c | c \leq 119,531\}$.

37.

$$\begin{aligned} A &= 2\pi rh \\ \frac{A}{2\pi h} &= \frac{2\pi rh}{2\pi h} \\ \frac{A}{2\pi h} &= r \end{aligned}$$

38.

$$\begin{aligned} y &= 8x + b \\ y - b &= 8x + b - b \\ y - b &= 8x \\ \frac{y-b}{8} &= \frac{8x}{8} \\ \frac{y-b}{8} &= x \end{aligned}$$

39. We subtract to find the increase, in millions.

$$70.3 - 40.4 = 29.9$$

Now we find the percent increase.

$$\begin{array}{ccccccc} 29.9 & \text{is} & \underbrace{\text{what percent}} & \text{of} & 40.4? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 29.9 & = & p & \cdot & 40.4 \end{array}$$

We divide by 40.4 on both sides and then convert to percent notation.

$$\begin{aligned} 29.9 &= p \cdot 40.4 \\ \frac{29.9}{40.4} &= \frac{p \cdot 40.4}{40.4} \\ 0.74 &\approx p \\ 74\% &\approx p \end{aligned}$$

The percent increase is about 74%. Answer D is correct.

40.
$$\begin{aligned} c &= \frac{1}{a-d} \\ (a-d)\cdot c &= a-d\cdot\left(\frac{1}{a-d}\right) \\ ac-dc &= 1 \\ ac-dc-ac &= 1-ac \\ -dc &= 1-ac \\ \frac{-dc}{-c} &= \frac{1-ac}{-c} \\ d &= \frac{1-ac}{-c} \end{aligned}$$

Since $\frac{1-ac}{-c} = \frac{-1}{-1}\cdot\frac{1-ac}{-c} = \frac{-1(1-ac)}{-1(-c)} = \frac{-1+ac}{c}$, or $\frac{ac-1}{c}$, we can also express the result as $d = \frac{ac-1}{c}$.

41.
$$\begin{aligned} 3|w|-8 &= 37 \\ 3|w| &= 45 \\ |w| &= 15 \end{aligned}$$

The solutions are the numbers whose distance from 0 is 15. They are -15 and 15.

42. ***Familiarize***. Let t = the number of tickets given away.

Translate. We add the number of tickets given to the five people.

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

Solve.

$$\begin{aligned} \frac{1}{3}t+\frac{1}{4}t+\frac{1}{5}t+8+5 &= t \\ \frac{20}{60}t+\frac{15}{60}t+\frac{12}{60}t+8+5 &= t \\ \frac{47}{60}t+13 &= t \\ 13 &= t-\frac{47}{60}t \\ 13 &= \frac{60}{60}t-\frac{47}{60}t \\ 13 &= \frac{13}{60}t \\ \frac{60}{13}\cdot 13 &= \frac{60}{13}\cdot\frac{13}{60}t \\ 60 &= t \end{aligned}$$

Check. $\frac{1}{3}\cdot 60 = 20$, $\frac{1}{4}\cdot 60 = 15$, $\frac{1}{5}\cdot 60 = 12$; then $20+15+12+8+5 = 60$. The answer checks.

State. 60 tickets were given away.

Cumulative Review Chapters 1 - 2

1. $\frac{y-x}{4} = \frac{12-6}{4} = \frac{6}{4} = \frac{\cancel{2}\cdot 3}{\cancel{2}\cdot 2} = \frac{3}{2}$

2. $\frac{3x}{y} = \frac{3\cdot 5}{4} = \frac{15}{4}$

3. $x-3 = 3-3 = 0$

4. $2w-4$

5. Since -4 is to the right of -6, we have $-4 > -6$.

6. Since 0 is to the right of -5, we have $0 > -5$.

7. Since -8 is to the left of 7, we have $-8 < 7$.

8. The opposite of $\frac{2}{5}$ is $-\frac{2}{5}$ because $\frac{2}{5}+\left(-\frac{2}{5}\right) = 0$.

The reciprocal of $\frac{2}{5}$ is $\frac{5}{2}$ because $\frac{2}{5}\cdot\frac{5}{2} = 1$.

9. The distance of 3 from 0 is 3, so $|3| = 3$.

10. The distance of $-\frac{3}{4}$ from 0 is $\frac{3}{4}$, so $\left|-\frac{3}{4}\right| = \frac{3}{4}$.

11. The distance of 0 from 0 is 0, so $|0| = 0$.

12. $-6.7+2.3$

One negative number and one positive number. The absolute values are 6.7 and 2.3. The difference of the absolute values is $6.7-2.3 = 4.4$. The negative number has the larger absolute value, so the sum is negative.

$-6.7+2.3 = -4.4$

13. $-\frac{1}{6}-\frac{7}{3} = -\frac{1}{6}+\left(-\frac{7}{3}\right) = -\frac{1}{6}+\left(-\frac{14}{6}\right) = -\frac{15}{6} = -\frac{\cancel{3}\cdot 5}{2\cdot\cancel{3}} = -\frac{5}{2}$

14. $-\frac{5}{8}\left(-\frac{4}{3}\right) = \frac{5\cdot 4}{8\cdot 3} = \frac{5\cdot\cancel{4}}{2\cdot\cancel{4}\cdot 3} = \frac{5}{6}$

15. $(-7)(5)(-6)(-0.5) = -35(3) = -105$

16. $81\div(-9) = -9$

17. $-10.8\div 3.6 = -3$

18. $-\frac{4}{5}\div-\frac{25}{8} = -\frac{4}{5}\cdot-\frac{8}{25} = \frac{4\cdot 8}{5\cdot 25} = \frac{32}{125}$

19. $5(3x+5y+2z) = 5\cdot 3x+5\cdot 5y+5\cdot 2z = 15x+25y+10z$

20. $4(-3x-2) = 4(-3x)-4\cdot 2 = -12x-8$

21. $-6(2y-4x) = -6\cdot 2y-(-6)(4x) = -12y-(-24x) = -12y+24x$

22. $64+18x+24y = 2\cdot 32+2\cdot 9x+2\cdot 12y = 2(32+9x+12y)$

23. $16y-56 = 8\cdot 2y-8\cdot 7 = 8(2y-7)$

24. $5a-15b+25 = 5\cdot a-5\cdot 3b+5\cdot 5 = 5(a-3b+5)$

25.
$$\begin{aligned} 9b+18y+6b+4y &= 9b+6b+18y+4y \\ &= (9+6)b+(18+4)y \\ &= 15b+22y \end{aligned}$$

26.
$$\begin{aligned} 3y+4+6z+6y &= 3y+6y+4+6z \\ &= (3+6)y+4+6z \\ &= 9y+4+6z \end{aligned}$$

27. $-4d-6a+3a-5d+1 = -4d-5d-6a+3a+1$
$= (-4-5)d+(-6+3)a+1$
$= -9d-3a+1$

28. $3.2x+2.9y-5.8x-8.1y = 3.2x-5.8x+2.9y-8.1y$
$= (3.2-5.8)x+(2.9-8.1)y$
$= -2.6x-5.2y$

29. $7-2x-(-5x)-8 = 7-2x+5x-8 = -1+3x$

30. $-3x-(-x+y) = -3x+x-y = -2x-y$

31. $-3(x-2)-4x = -3x+6-4x = -7x+6$

32. $10-2(5-4x) = 10-10+8x = 8x$

33. $[3(x+6)-10]-[5-2(x-8)]$
$= [3x+18-10]-[5-2x+16]$
$= [3x+8]-[21-2x]$
$= 3x+8-21+2x$
$= 5x-13$

34. $x+1.75 = 6.25$
$x+1.75-1.75 = 6.25-1.75$
$x = 4.5$

The solution is 4.5.

35. $\frac{5}{2}y = \frac{2}{5}$
$\frac{2}{5}\cdot\frac{5}{2}y = \frac{2}{5}\cdot\frac{2}{5}$
$y = \frac{4}{25}$

The solution is $\frac{4}{25}$.

36. $-2.6+x = 8.3$
$-2.6+x+2.6 = 8.3+2.6$
$x = 10.9$

The solution is 10.9.

37. $4\frac{1}{2}+y = 8\frac{1}{3}$
$4\frac{1}{2}+y-4\frac{1}{2} = 8\frac{1}{3}-4\frac{1}{2}$
$y = 8\frac{2}{6}-4\frac{3}{6}$
$y = 7\frac{8}{6}-4\frac{3}{6}$ $\left(8\frac{2}{6}=7+1\frac{2}{6}=7+\frac{8}{6}=7\frac{8}{6}\right)$
$y = 3\frac{5}{6}$

The solution is $3\frac{5}{6}$.

38. $-\frac{3}{4}x = 36$
$-\frac{4}{3}\left(-\frac{3}{4}x\right) = -\frac{4}{3}\cdot 36$
$x = -\frac{4\cdot 36}{3} = -\frac{4\cdot \cancel{3}\cdot 12}{\cancel{3}\cdot 1}$
$x = -48$

The solution is -48.

39. $\frac{2}{5}x = -\frac{3}{20}$
$\frac{5}{2}\cdot\frac{2}{5}x = \frac{5}{2}\left(-\frac{3}{20}\right)$
$x = -\frac{3\cdot\cancel{5}}{2\cdot 4\cdot\cancel{5}}$
$x = -\frac{3}{8}$

The solution is $-\frac{3}{8}$.

40. $5.8x = -35.96$
$\frac{5.8x}{5.8} = \frac{-35.96}{5.8}$
$x = -6.2$

The solution is -6.2.

41. $-4x+3 = 15$
$-4x+3-3 = 15-3$
$-4x = 12$
$\frac{-4x}{-4} = \frac{12}{-4}$
$x = -3$

The solution is -3.

42. $-3x+5 = -8x-7$
$-3x+5+8x = -8x-7+8x$
$5x+5 = -7$
$5x+5-5 = -7-5$
$5x = -12$
$\frac{5x}{5} = \frac{-12}{5}$
$x = -\frac{12}{5}$

The solution is $-\frac{12}{5}$.

43. $4y-4+y = 6y+20-4y$
$5y-4 = 2y+20$
$5y-4-2y = 2y+20-2y$
$3y-4 = 20$
$3y-4+4 = 20+4$
$3y = 24$
$\frac{3y}{3} = \frac{24}{3}$
$y = 8$

The solution is 8.

44.
$$\begin{aligned} -3(x-2) &= -15 \\ -3x+6 &= -15 \\ -3x+6-6 &= -15-6 \\ -3x &= -21 \\ \frac{-3x}{-3} &= \frac{-21}{-3} \\ x &= 7 \end{aligned}$$
The solution is 7.

45. First we will multiply by the least common multiple of all the denominators to clear the fractions.
$$\begin{aligned} \frac{1}{3}x - \frac{5}{6} &= \frac{1}{2} + 2x \\ 6\left(\frac{1}{3}x - \frac{5}{6}\right) &= 6\left(\frac{1}{2} + 2x\right) \\ 6\cdot\frac{1}{3}x - 6\cdot\frac{5}{6} &= 6\cdot\frac{1}{2} + 6\cdot 2x \\ 2x - 5 &= 3 + 12x \\ 2x - 5 - 12x &= 3 + 12x - 12x \\ -10x - 5 &= 3 \\ -10x - 5 + 5 &= 3 + 5 \\ -10x &= 8 \\ \frac{-10x}{-10} &= \frac{8}{-10} \\ x &= -\frac{8}{10} = -\frac{\cancel{2}\cdot 4}{\cancel{2}\cdot 5} \\ x &= -\frac{4}{5} \end{aligned}$$
The solution is $-\frac{4}{5}$.

46. First we will multiply by 10 to clear the decimals.
$$\begin{aligned} -3.7x + 6.2 &= -7.3x - 5.8 \\ 10(-3.7x + 6.2) &= 10(-7.3x - 5.8) \\ -37x + 62 &= -73x - 58 \\ -37x + 62 + 73x &= -73x - 58 + 73x \\ 36x + 62 &= -58 \\ 36x + 62 - 62 &= -58 - 62 \\ 36x &= -120 \\ \frac{36x}{36} &= \frac{-120}{36} \\ x &= -\frac{10\cdot\cancel{12}}{3\cdot\cancel{12}} \\ x &= -\frac{10}{3} \end{aligned}$$
The solution is $-\frac{10}{3}$.

47.
$$\begin{aligned} 4(x+2) &= 4(x-2) + 16 \\ 4x + 8 &= 4x - 8 + 16 \\ 4x + 8 &= 4x + 8 \\ 4x + 8 - 4x &= 4x + 8 - 4x \\ 8 &= 8 \qquad \text{TRUE} \end{aligned}$$
All real numbers are solutions.

48.
$$\begin{aligned} 0(x+3) + 4 &= 0 \\ 0 + 4 &= 0 \\ 4 &= 0 \qquad \text{FALSE} \end{aligned}$$
There is no solution.

49.
$$\begin{aligned} 3x - 1 &< 2x + 1 \\ 3x - 1 - 2x &< 2x + 1 - 2x \\ x - 1 &< 1 \\ x - 1 + 1 &< 1 + 1 \\ x &< 2 \end{aligned}$$
The solution set is $\{x|x < 2\}$.

50.
$$\begin{aligned} 3y + 7 &> 5y + 13 \\ 3y + 7 - 5y &> 5y + 13 - 5y \\ -2y + 7 &> 13 \\ -2y + 7 - 7 &> 13 - 7 \\ -2y &> 6 \\ \frac{-2y}{-2} &< \frac{6}{-2} \qquad \text{Reversing the inequality symbol} \\ y &< -3 \end{aligned}$$
The solution set is $\{y|y < -3\}$.

51.
$$\begin{aligned} 5 - y &\le 2y - 7 \\ 5 - y - 2y &\le 2y - 7 - 2y \\ 5 - 3y &\le -7 \\ 5 - 3y - 5 &\le -7 - 5 \\ -3y &\le -12 \\ \frac{-3y}{-3} &\ge \frac{-12}{-3} \qquad \text{Reversing the inequality symbol} \\ y &\ge 4 \end{aligned}$$
The solution set is $\{y|y \ge 4\}$.

52.
$$\begin{aligned} H &= 65 - m \\ H - 65 &= 65 - m - 65 \\ H - 65 &= -m \\ -1(H - 65) &= -1\cdot(-1\cdot m) \\ -H + 65 &= m, \text{ or} \\ 65 - H &= m \end{aligned}$$

53.
$$\begin{aligned} I &= Prt \\ \frac{I}{Pr} &= \frac{Prt}{Pr} \\ \frac{I}{Pr} &= t \end{aligned}$$

54. *Translate.*
$$\begin{array}{ccccccc} \underbrace{\text{What number}} & \text{is} & 24\% & \text{of} & 105? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ a & = & 24\% & \cdot & 105 \end{array}$$
Solve. We convert 24% to decimal notation and multiply.
$$\begin{aligned} a &= 24\%\cdot 105 \\ a &= 0.24\cdot 105 \\ a &= 25.2 \end{aligned}$$
Thus, 25.2 is 24% of 105.

55. *Translate.*

$$\begin{array}{l} 39.6 \text{ is } \underbrace{\text{what percent}} \text{ of } 88? \\ \downarrow\ \downarrow\quad\ \downarrow\quad\ \downarrow\ \downarrow \\ 39.6 =\quad p\quad\ \cdot\ 88 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} 39.6 &= p \cdot 88 \\ \frac{39.6}{88} &= \frac{p \cdot 88}{88} \\ 0.45 &= p \\ 45\% &= p \end{aligned}$$

Thus, 39.6 is 45% of 88.

56. ***Translate.***

$$\begin{array}{l} \$163.35 \text{ is } 45\% \text{ of } \underbrace{\text{what number}}? \\ \downarrow\quad\ \downarrow\ \downarrow\ \downarrow\quad\ \downarrow \\ 163.35\ =\ 45\%\ \cdot\quad b \end{array}$$

Solve.

$$\begin{aligned} 163.35 &= 45\% \cdot b \\ 163.35 &= 0.45 \cdot b \\ \frac{163.35}{0.45} &= \frac{0.45 \cdot b}{0.45} \\ 363 &= b \end{aligned}$$

Thus, \$163.35 is 45% of \$363.

57. ***Familiarize.*** Let p = the price before the reduction.

Translate.

$$\begin{array}{l} \underbrace{\text{Price before reduction}} \text{ minus } 25\% \text{ of price is } \$18.45. \\ \downarrow\quad\ \downarrow\ \downarrow\ \downarrow\ \downarrow\ \downarrow\ \downarrow \\ p\quad -\ 25\%\ \cdot\ p\ =\ 18.45 \end{array}$$

Solve. We solve the equation.

$$\begin{aligned} p - 25\% \cdot p &= 18.45 \\ p - 0.25p &= 18.45 \\ 0.75p &= 18.45 \\ \frac{0.75p}{0.75p} &= \frac{18.45}{0.75} \\ p &= 24.6 \end{aligned}$$

Check. 25% of \$24.60 is $0.25 \cdot \$24.60 = \$6.15$ and $\$24.60 - \$6.15 = \$18.45$, so the answer checks.

State. The price before the reduction was \$24.60.

58. ***Familiarize.*** Let m = the amount Melinda paid for her rollerblades. Then $m + 17$ = the amount Susan paid for hers.

Translate.

$$\begin{array}{l} \underbrace{\text{Amount Melinda paid}}\ \text{plus}\ \underbrace{\text{amount Susan paid}}\ \text{is}\ \$107. \\ \downarrow\quad\ \downarrow\quad\ \downarrow\quad\ \downarrow\ \downarrow \\ m\quad +\quad (m+17)\ =\ 107 \end{array}$$

Solve.

$$\begin{aligned} m + (m + 17) &= 107 \\ 2m + 17 &= 107 \\ 2m + 17 - 17 &= 107 - 17 \\ 2m &= 90 \\ \frac{2m}{2} &= \frac{90}{2} \\ m &= 45 \end{aligned}$$

The exercise asks only for the amount Melinda paid, but we also find the amount Susan paid so that we can check the answer.

If $m = 45$, then $m + 17 = 45 + 17 = 62$.

Check. \$62 is \$17 more than \$45, and $\$45 + \$62 = \$107$. The answer checks.

State. Melinda paid \$45 for her rollerblades.

59. ***Familiarize.*** Let x = the amount originally invested. Using the formula for simple interest, $I = Prt$, the interest earned in one year will be $x \cdot 8\% \cdot 1$, or $8\%x$.

Translate.

$$\begin{array}{l} \underbrace{\text{Amount invested}}\ \text{plus interest is}\ \underbrace{\text{amount after 1 year.}} \\ \downarrow\quad\ \downarrow\quad\ \downarrow\ \downarrow\quad\ \downarrow \\ x\quad +\quad 8\%x\ =\quad 1134 \end{array}$$

Solve.

$$\begin{aligned} x + 8\%x &= 1134 \\ x + 0.08x &= 1134 \\ 1.08x &= 1134 \\ \frac{1.08x}{1.08} &= \frac{1134}{1.08} \\ x &= 1050 \end{aligned}$$

Check. 8% of \$1050 is $0.08 \cdot \$1050 = \$84$ and $\$1050 + \$84 = \$1134$, so the answer checks.

State. \$1050 was originally invested.

60. ***Familiarize.*** Let l = the length of the first piece of wire, in meters. Then $l + 3$ = the length of the second piece and $\frac{4}{5}l$ = the length of the third piece.

Translate.

$$\begin{array}{l} \underbrace{\text{Length of first piece}}\ \text{plus}\ \underbrace{\text{length of second piece}}\ \text{plus}\ \underbrace{\text{length of third piece}}\ \text{is}\ \underbrace{143 \text{ m}}. \\ \downarrow\quad\ \downarrow\quad\ \downarrow\quad\ \downarrow\quad\ \downarrow\ \downarrow\ \downarrow \\ l\quad +\quad (l+3)\quad +\quad \frac{4}{5}l\ =\ 143 \end{array}$$

Solve.

$$\begin{aligned} l + (l+3) + \frac{4}{5}l &= 143 \\ \frac{5}{5}l + \frac{5}{5}l + 3 + \frac{4}{5}l &= 143 \\ \frac{14}{5}l + 3 &= 143 \\ \frac{14}{5}l + 3 - 3 &= 143 - 3 \\ \frac{14}{5}l &= 140 \\ \frac{5}{14} \cdot \frac{14}{5}l &= \frac{5}{14} \cdot 140 \\ l &= \frac{5 \cdot 10 \cdot \cancel{14}}{\cancel{14} \cdot 1} \\ l &= 50 \end{aligned}$$

If $l = 50$, then $l + 3 = 50 + 3 = 53$ and $\frac{4}{5}l = \frac{4}{5} \cdot 50 = 40$.

Check. The second piece is 3 m longer than the first piece and the third piece is $\frac{4}{5}$ as long as the first. Also, 50 m + 53 m + 40 m = 143 m. The answer checks.

State. The lengths of the pieces are 50 m, 53 m, and 40 m.

61. ***Familiarize***. Let s = Nadia's score on the fourth test.

Translate.

$$\underbrace{\text{The average score}}_{\downarrow} \quad \underbrace{\text{is at least}}_{\downarrow} \quad 80.$$
$$\begin{array}{ccc} \frac{82+76+78+s}{4} & \geq & 80 \end{array}$$

Solve.

$$\begin{aligned} \frac{82+76+78+s}{4} &\geq 80 \\ 4\left(\frac{82+76+78+s}{4}\right) &\geq 4 \cdot 80 \\ 82+76+78+s &\geq 320 \\ 236 + s &\geq 320 \\ s &\geq 84 \end{aligned}$$

Check. As a partial check we show that the average is at least 80 when the fourth test score is 84.

$$\frac{82+76+78+84}{4} = \frac{320}{4} = 80$$

State. Scores greater than or equal to 84 will earn Nadia at least a B. The solution set is $\{s | s \geq 84\}$.

62.

$$\begin{aligned} -125 \div 25 \cdot 625 \div 5 &= -5 \cdot 625 \div 5 \\ &= -3125 \div 5 \\ &= -625 \end{aligned}$$

Answer C is correct.

63. ***Familiarize***. Let s = the salary at the beginning of the year. After a 4% increase the new salary is $s + 4\%s$, or $s + 0.04s$, or $1.04s$. Then after a 3% cost-of-living adjustment the final salary is $1.04s + 3\% \cdot 1.04s$, or $1.04s + 0.03 \cdot 1.04s$, or $1.04s + 0.0312s$, or $1.0712s$.

Translate.

$$\underbrace{\text{Final salary}}_{\downarrow} \quad \text{is} \quad \$48,418.24.$$
$$\begin{array}{ccc} 1.0712s & = & 48,418.24 \end{array}$$

Solve.

$$\begin{aligned} 1.0712s &= 48,418.24 \\ \frac{1.0712s}{1.0712} &= \frac{48,418.24}{1.0712} \\ s &= 45,200 \end{aligned}$$

Check. 4% of \$45,200 is $0.04 \cdot \$45,200 = \$1808$ and $\$45,200 + \$1808 = \$47,008$. Then 3% of \$47,008 is $0.03 \cdot \$47,008 = \$1410.24$ and $\$47,008 + \$1410.24 = \$48,418.24$. The answer checks.

State. At the beginning of the year the salary was \$45,200.

64. First we subtract to find the amount of the reduction.

9 in. − 6.3 in. = 2.7 in.

Translate.

$$\underbrace{\text{2.7 in.}}_{\downarrow} \quad \text{is} \quad \underbrace{\text{what percent}}_{\downarrow} \quad \text{of} \quad \underbrace{\text{9 in.}}_{\downarrow} ?$$
$$\begin{array}{ccccc} 2.7 & = & p & \cdot & 9 \end{array}$$

Solve.

$$\begin{aligned} 2.7 &= p \cdot 9 \\ \frac{2.7}{9} &= \frac{p \cdot 9}{9} \\ 0.3 &= p \\ 30\% &= p \end{aligned}$$

The drawing should be reduced 30%.

65.

$$\begin{aligned} 4|x| - 13 &= 3 \\ 4|x| &= 16 \\ |x| &= 4 \end{aligned}$$

The solutions are the numbers whose distance from 0 is 4. They are −4 and 4.

66. First we multiply by 28 to clear the fractions.

$$\begin{aligned} \frac{2+5x}{4} &= \frac{11}{28} + \frac{8x+3}{7} \\ 28\left(\frac{2+5x}{4}\right) &= 28\left(\frac{11}{28} + \frac{8x+3}{7}\right) \\ \frac{28(2+5x)}{4} &= 28 \cdot \frac{11}{28} + \frac{28(8x+3)}{7} \\ 7(2+5x) &= 11 + 4(8x+3) \\ 14 + 35x &= 11 + 32x + 12 \\ 14 + 35x &= 32x + 23 \\ 14 + 3x &= 23 \\ 3x &= 9 \\ x &= 3 \end{aligned}$$

The solution is 3.

67.
$$\begin{aligned} p &= \frac{2}{m+Q} \\ (m+Q)\cdot p &= (m+Q)\cdot\frac{2}{m+Q} \\ mp+Qp &= 2 \\ Qp &= 2-mp \\ Q &= \frac{2-mp}{p} \end{aligned}$$