

Chapter 2: First-Degree Equations and Inequalities

Section 2.1

Concept Review 2.1

1. Never true
An equation must have an equals sign.
3. Sometimes true
 $8 = 4 + 2$ is a false equation. $6 = 6$ is a true equation. Neither equation contains a variable.
5. Never true
This equation has no solution. Any replacement value for x will result in a false equation.
7. Always true

Objective 1 Exercises

5. $x - 2 = 7$
 $x - 2 + 2 = 7 + 2$
 $x = 9$
The solution is 9.
7. $a + 3 = -7$
 $a + 3 - 3 = -7 - 3$
 $a = -10$
The solution is -10 .
9. $3x = 12$
 $\frac{3x}{3} = \frac{12}{3}$
 $x = 4$
The solution is 4.
11. $\frac{2}{7} + x = \frac{17}{21}$
 $\frac{2}{7} - \frac{2}{7} + x = \frac{17}{21} - \frac{2}{7}$
 $x = \frac{17}{21} - \frac{6}{21}$
 $x = \frac{11}{21}$
The solution is $\frac{11}{21}$.
13. $\frac{5}{8} - y = \frac{3}{4}$
 $\frac{5}{8} - \frac{5}{8} - y = \frac{3}{4} - \frac{5}{8}$
 $-y = \frac{6}{8} - \frac{5}{8}$
 $-y = \frac{1}{8}$
 $(-1)(-y) = \frac{1}{8}(-1)$
 $y = -\frac{1}{8}$
The solution is $-\frac{1}{8}$.

$$15. \quad \frac{3}{5}y = 12$$

$$\frac{5}{3}\left(\frac{3}{5}y\right) = \frac{5}{3}(12)$$

$$y = 20$$

The solution is 20.

$$17. \quad \frac{3a}{7} = -21$$

$$\frac{7}{3}\left(\frac{3}{7}a\right) = \frac{7}{3}(-21)$$

$$a = -49$$

The solution is -49 .

$$19. \quad -\frac{5}{12}y = \frac{7}{16}$$

$$-\frac{12}{5}\left(-\frac{5}{12}y\right) = -\frac{12}{5}\left(\frac{7}{16}\right)$$

$$y = -\frac{21}{20}$$

The solution is $-\frac{21}{20}$.

$$21. \quad b - 14.72 = -18.45$$

$$b - 14.72 + 14.72 = -18.45 + 14.72$$

$$b = -3.73$$

The solution is -3.73 .

$$23. \quad 3x + 5x = 12$$

$$8x = 12$$

$$\frac{8x}{8} = \frac{12}{8}$$

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

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

$$25. \quad 2x - 4 = 12$$

$$2x - 4 + 4 = 12 + 4$$

$$2x = 16$$

$$\frac{2x}{2} = \frac{16}{2}$$

$$x = 8$$

$$27. \quad 4x + 2 = 4x$$

$$4x - 4x + 2 = 4x - 4x$$

$$2 = 0$$

The equation has no solution.

$$29. \quad 2x + 2 = 3x + 5$$

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

$$-x + 2 = 5$$

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

$$-x = 3$$

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

$$x = -3$$

The solution is -3 .

$$\begin{aligned}
 31. \quad & 2 - 3t = 3t - 4 \\
 & 2 - 3t - 3t = 3t - 3t - 4 \\
 & 2 - 6t = -4 \\
 & 2 - 2 - 6t = -4 - 2 \\
 & -6t = -6 \\
 & \frac{-6t}{-6} = \frac{-6}{-6} \\
 & t = 1
 \end{aligned}$$

The solution is 1.

$$\begin{aligned}
 33. \quad & 2a - 3a = 7 - 5a \\
 & -a = 7 - 5a \\
 & -a + 5a = 7 - 5a + 5a \\
 & 4a = 7 \\
 & \frac{4a}{4} = \frac{7}{4} \\
 & a = \frac{7}{4}
 \end{aligned}$$

The solution is $\frac{7}{4}$.

$$\begin{aligned}
 35. \quad & \frac{5}{8}b - 3 = 12 \\
 & \frac{5}{8}b - 3 + 3 = 12 + 3 \\
 & \frac{5}{8}b = 15 \\
 & \frac{8}{5}\left(\frac{5}{8}b\right) = \frac{8}{5}(15) \\
 & b = 24
 \end{aligned}$$

The solution is 24.

$$\begin{aligned}
 37. \quad & b + \frac{1}{5}b = 2 \\
 & \frac{6}{5}b = 2 \\
 & \frac{5}{6}\left(\frac{6}{5}b\right) = \frac{5}{6}(2) \\
 & b = \frac{5}{3}
 \end{aligned}$$

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

$$\begin{aligned}
 39. \quad & 2x - 9x + 3 = 6 - 5x \\
 & -7x + 3 = 6 - 5x \\
 & -7x + 5x + 3 = 6 - 5x + 5x \\
 & -2x + 3 = 6 \\
 & -2x + 3 - 3 = 6 - 3 \\
 & -2x = 3 \\
 & \frac{-2x}{-2} = \frac{3}{-2} \\
 & x = -\frac{3}{2}
 \end{aligned}$$

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

$$\begin{aligned}
 41. \quad & 2y - 4 + 8y = 7y - 8 + 3y \\
 & 10y - 4 = 10y - 8 \\
 & 10y - 10y - 4 = 10y - 10y - 8 \\
 & -4 = -8
 \end{aligned}$$

The equation has no solution.

$$\begin{aligned}
 43. \quad & 9 + 4x - 12 = -3x + 5x + 8 \\
 & 4x - 3 = 2x + 8 \\
 & 4x - 2x - 3 = 2x - 2x + 8 \\
 & 2x - 3 = 8 \\
 & 2x - 3 + 3 = 8 + 3 \\
 & 2x = 11 \\
 & \frac{2x}{2} = \frac{11}{2} \\
 & x = \frac{11}{2}
 \end{aligned}$$

The solution is $\frac{11}{2}$.

$$\begin{aligned}
 45. \quad & 5.3y + 0.35 = 5.02y \\
 & 5.3y - 5.3y + 0.35 = 5.02y - 5.3y \\
 & 0.35 = -0.28y \\
 & \frac{0.35}{-0.28} = \frac{-0.28y}{-0.28} \\
 & -1.25 = y
 \end{aligned}$$

The solution is -1.25 .

Objective 2 Exercises

$$\begin{aligned}
 47. \quad & 2x + 3(x - 5) = 15 \\
 & 2x + 3x - 15 = 15 \\
 & 5x - 15 = 15 \\
 & 5x = 30 \\
 & \frac{5x}{5} = \frac{30}{5} \\
 & x = 6
 \end{aligned}$$

The solution is 6.

$$\begin{aligned}
 49. \quad & 5(2 - b) = -3(b - 3) \\
 & 10 - 5b = -3b + 9 \\
 & 10 = 2b + 9 \\
 & 1 = 2b \\
 & \frac{1}{2} = \frac{2b}{2} \\
 & \frac{1}{2} = b
 \end{aligned}$$

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

$$\begin{aligned}
 51. \quad & 3(y - 5) - 5y = 2y + 9 \\
 & 3y - 15 - 5y = 2y + 9 \\
 & -2y - 15 = 2y + 9 \\
 & -4y - 15 = 9 \\
 & -4y = 24 \\
 & \frac{-4y}{-4} = \frac{24}{-4} \\
 & y = -6
 \end{aligned}$$

The solution is -6 .

$$53. \quad 2x - 3(x - 4) = 2(3 - 2x) + 2$$

$$2x - 3x + 12 = 6 - 4x + 2$$

$$-x + 12 = 8 - 4x$$

$$3x + 12 = 8$$

$$3x = -4$$

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

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

The solution is $-\frac{4}{3}$.

$$55. \quad -4(7y - 1) + 5y = -2(3y + 4) - 3y$$

$$-28y + 4 + 5y = -6y - 8 - 3y$$

$$-23y + 4 = -9y - 8$$

$$-14y + 4 = -8$$

$$-14y = -12$$

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

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

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

$$57. \quad 2[4 + 2(5 - x) - 2x] = 4x - 7$$

$$2[4 + 10 - 2x - 2x] = 4x - 7$$

$$2[14 - 4x] = 4x - 7$$

$$28 - 8x = 4x - 7$$

$$28 - 12x = -7$$

$$-12x = -35$$

$$\frac{-12x}{-12} = \frac{-35}{-12}$$

$$x = \frac{35}{12}$$

The solution is $\frac{35}{12}$.

$$59. \quad -3[x + 4(x + 1)] = x + 4$$

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

$$-3(5x + 4) = x + 4$$

$$-15x - 12 = x + 4$$

$$-16x - 12 = 4$$

$$-16x = 16$$

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

$$x = -1$$

The solution is -1 .

$$61. \quad 5 - 6[2t - 2(t + 3)] = 8 - t$$

$$5 - 6(2t - 2t - 6) = 8 - t$$

$$5 - 12t + 12t + 36 = 8 - t$$

$$41 = 8 - t$$

$$33 = -t$$

$$-33 = t$$

The solution is -33 .

$$63. \quad 3[x - (2 - x) - 2x] = 3(4 - x)$$

$$3[x - 2 + x - 2x] = 12 - 3x$$

$$3(-2) = 12 - 3x$$

$$-6 = 12 - 3x$$

$$-18 = -3x$$

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

$$6 = x$$

The solution is 6.

$$65. \quad \frac{3}{4}t - \frac{7}{12}t = 1$$

$$12\left(\frac{3}{4}t - \frac{7}{12}t\right) = 12 \cdot 1$$

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

$$9t - 7t = 12$$

$$2t = 12$$

$$\frac{2t}{2} = \frac{12}{2}$$

$$t = 6$$

The solution is 6.

$$67. \quad \frac{1}{2}x - \frac{3}{4}x + \frac{5}{8} = \frac{3}{2}x - \frac{5}{2}$$

$$8\left(\frac{1}{2}x - \frac{3}{4}x + \frac{5}{8}\right) = 8\left(\frac{3}{2}x - \frac{5}{2}\right)$$

$$\frac{8 \cdot x}{2} - \frac{8 \cdot 3x}{4} + \frac{8 \cdot 5}{8} = \frac{8 \cdot 3x}{2} - \frac{8 \cdot 5}{2}$$

$$4x - 6x + 5 = 12x - 20$$

$$-2x + 5 = 12x - 20$$

$$-14x + 5 = -20$$

$$-14x = -25$$

$$\frac{-14x}{-14} = \frac{-25}{-14}$$

$$x = \frac{25}{14}$$

The solution is $\frac{25}{14}$.

$$69. \quad \frac{2a - 9}{5} + 3 = 2a$$

$$5\left(\frac{2a - 9}{5} + 3\right) = 5 \cdot 2a$$

$$\frac{5(2a - 9)}{5} + 5 \cdot 3 = 10a$$

$$2a - 9 + 15 = 10a$$

$$2a + 6 = 10a$$

$$6 = 8a$$

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

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

The solution is $\frac{3}{4}$.

$$\begin{aligned}
 71. \quad & \frac{2x-1}{4} + \frac{3x+4}{8} = \frac{1-4x}{12} \\
 & 24\left(\frac{2x-1}{4} + \frac{3x+4}{8}\right) = 24\left(\frac{1-4x}{12}\right) \\
 & \frac{24(2x-1)}{4} + \frac{24(3x+4)}{8} = \frac{24(1-4x)}{12} \\
 & 6(2x-1) + 3(3x+4) = 2(1-4x) \\
 & 12x-6+9x+12 = 2-8x \\
 & 21x+6 = 2-8x \\
 & 29x+6 = 2 \\
 & 29x = -4 \\
 & \frac{29x}{29} = \frac{-4}{29} \\
 & x = -\frac{4}{29}
 \end{aligned}$$

The solution is $-\frac{4}{29}$.

$$\begin{aligned}
 73. \quad & \frac{1}{5}(20x+30) = \frac{1}{3}(6x+36) \\
 & 15\left[\frac{1}{5}(20x+30)\right] = 15\left[\frac{1}{3}(6x+36)\right] \\
 & 3(20x+30) = 5(6x+36) \\
 & 60x+90 = 30x+180 \\
 & 30x+90 = 180 \\
 & 30x = 90 \\
 & \frac{30x}{30} = \frac{90}{30} \\
 & x = 3
 \end{aligned}$$

The solution is 3.

$$\begin{aligned}
 75. \quad & 2(y-4)+8 = \frac{1}{2}(6y+20) \\
 & 2y-8+8 = \frac{6y}{2} + \frac{20}{2} \\
 & 2y = 3y+10 \\
 & -y = 10 \\
 & (-1)(-y) = (-1)(10) \\
 & y = -10
 \end{aligned}$$

The solution is -10 .

$$\begin{aligned}
 77. \quad & \frac{1}{4}(7-x) = \frac{2}{3}(x+2) \\
 & 12\left[\frac{1}{4}(7-x)\right] = 12\left[\frac{2}{3}(x+2)\right] \\
 & 3(7-x) = 8(x+2) \\
 & 21-3x = 8x+16 \\
 & 21-11x = 16 \\
 & -11x = -5 \\
 & \frac{-11x}{-11} = \frac{-5}{-11} \\
 & x = \frac{5}{11}
 \end{aligned}$$

The solution is $\frac{5}{11}$.

$$\begin{aligned}
 79. \quad & -1.6(b-2.35) = -11.28 \\
 & -1.6b+3.76 = -11.28 \\
 & -1.6b = -15.04 \\
 & \frac{-1.6b}{-1.6} = \frac{-15.04}{-1.6} \\
 & b = 9.4
 \end{aligned}$$

The solution is 9.4.

Objective 3 Exercises

81. Strategy

To find the number of bags purchased, write and solve an equation using b to represent the number of bags purchased.

Solution

The first bag purchased cost \$10.90. That means that $b-1$ bags cost $\$10.50(b-1)$.

$$84.40 = 10.90 + 10.50(b-1)$$

$$84.40 = 10.90 + 10.50b - 10.50$$

$$84.40 = 0.40 + 10.50b$$

$$84 = 10.50b$$

$$8 = b$$

The customer purchased 8 bags of feed.

83. Strategy

To find the charge per hour for labor, write and solve an equation using L to represent the charge per hour for labor.

Solution

The total charge for labor was $4L$ dollars.

$$316.55 = 4L + 148.55$$

$$168 = 4L$$

$$42 = L$$

Labor cost \$42 per hour.

85. Strategy

To find the employee's regular hourly rate, write and solve an equation using h to represent the hourly rate and $1.5h$ to represent the overtime rate.

Solution

The wages earned for the first forty hours plus the wages earned for overtime are \$374.50.

$$40h + 9(1.5h) = 374.50$$

$$40h + 13.5h = 374.50$$

$$53.5h = 374.50$$

$$h = 7$$

The regular hourly rate is \$7.

87. Strategy

To find the number of each type of ticket, write and solve an equation using g to represent the number of grandstand tickets and $12 - g$ to represent the number of upper field box tickets.

Solution

The total price of the tickets was \$275.

$$20g + 27(12 - g) = 275$$

$$20g + 324 - 27g = 275$$

$$-7g + 324 = 275$$

$$-7g = -49$$

$$g = 7$$

The fraternity purchased 7 grandstand tickets and 5 upper field box tickets.

89. Strategy

To find the number of mezzanine tickets purchased, write and solve an equation using m to represent the number of mezzanine tickets and $7 - m$ to represent the number of balcony tickets.

Solution

The total cost of the tickets was \$275.00.

$$50m + 35(7 - m) = 275$$

$$50m + 245 - 35m = 275$$

$$15m + 245 = 275$$

$$15m = 30$$

$$m = 2$$

Two mezzanine tickets were purchased.

Applying Concepts 2.1

$$91. \frac{1}{\frac{1}{y}} = -9$$

$$y = -9$$

The solution is -9 .

$$93. \frac{\frac{10}{3}}{x} - 5 = 4x$$

$$10\left(\frac{x}{3}\right) - 5 = 4x$$

$$\frac{10}{3}x - 5 = 4x$$

$$\frac{10}{3}x - \frac{10}{3}x - 5 = 4x - \frac{10}{3}x$$

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

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

$$-\frac{15}{2} = x$$

The solution is $-\frac{15}{2}$.

$$95. 2[3(x+4) - 2(x+1)] = 5x + 3(1-x)$$

$$2[3x + 12 - 2x - 2] = 5x + 3 - 3x$$

$$2(x + 10) = 2x + 3$$

$$2x + 20 = 2x + 3$$

$$2x - 2x + 20 = 2x - 2x + 3$$

$$20 = 3$$

There is no solution.

$$97. \frac{4[(x-3) + 2(1-x)]}{5} = x + 1$$

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

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

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

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

$$-4x-4 = 5x+5$$

$$-4x+4x-4 = 5x+4x+5$$

$$-4 = 9x+5$$

$$-4-5 = 9x+5-5$$

$$-9 = 9x$$

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

$$-1 = x$$

The solution is -1 .

$$99. 3(2x+2) - 4(x-3) = 2(x+9)$$

$$6x+6-4x+12 = 2x+18$$

$$2x+18 = 2x+18$$

$$2x-2x+18 = 2x-2x+18$$

$$18 = 18$$

$$0 = 0$$

The solution is all real numbers.

Section 2.2

Concept Review 2.2

1. Always true

3. Always true

5. Sometimes true

If n is even, then $n + 1$, $n + 3$, and $n + 5$ represent consecutive odd integers.

If n is odd, then $n + 1$, $n + 3$, and $n + 5$ represent consecutive even integers.

Objective 1 Exercises

3. Strategy

Number of nickels: x Number of dimes: $56 - x$

Coin	Number	Value	Total Value
Nickel	x	5	$5x$
Dime	$56 - x$	10	$10(56 - x)$

The sum of the total values of each type of coin equals the total value of all the coins (400 cents).
 $5x + 10(56 - x) = 400$

Solution

$$5x + 10(56 - x) = 400$$

$$5x + 560 - 10x = 400$$

$$-5x + 560 = 400$$

$$-5x = -160$$

$$x = 32$$

$$56 - x = 56 - 32 = 24$$

There are 24 dimes in the bank.

5. Strategy

Number of twenty-dollar bills: x Number of five-dollar bills: $68 - x$

Bill	Number	Value	Total Value
20-dollar	x	20	$20x$
5-dollar	$68 - x$	5	$5(68 - x)$

The sum of the total values of each type of bill equals the total value of all the bills (730 dollars).
 $20x + 5(68 - x) = 730$

Solution

$$20x + 5(68 - x) = 730$$

$$20x + 340 - 5x = 730$$

$$15x + 340 = 730$$

$$15x = 390$$

$$x = 26$$

The cashier has 26 twenty-dollar bills.

7. Strategy

Number of 20¢ stamps: x Number of 15¢ stamps: $3x - 8$

Stamp	Number	Value	Total Value
20¢	x	20	$20x$
15¢	$3x - 8$	15	$15(3x - 8)$

The sum of the total values of each type of stamp equals the total value of all the stamps (400 cents). $20x + 15(3x - 8) = 400$

Solution

$$20x + 15(3x - 8) = 400$$

$$20x + 45x - 120 = 400$$

$$65x - 120 = 400$$

$$65x = 520$$

$$x = 8$$

$$3x - 8 = 3(8) - 8 = 24 - 8 = 16$$

There are eight 20¢ stamps and sixteen 15¢ stamps.

9. Strategy

Number of quarters: x Number of dimes: $4x$ Number of nickels: $25 - 5x$

Coin	Number	Value	Total Value
Quarter	x	25	$25x$
Dime	$4x$	10	$10(4x)$
Nickel	$25 - 5x$	5	$5(25 - 5x)$

The sum of the total values of each type of coin equals the total value of all the coins (205 cents).
 $25x + 10(4x) + 5(25 - 5x) = 205$

Solution

$$25x + 10(4x) + 5(25 - 5x) = 205$$

$$25x + 40x + 125 - 25x = 205$$

$$40x + 125 = 205$$

$$40x = 80$$

$$x = 2$$

$$4x = 4 \cdot 2 = 8$$

There are 8 dimes in the bank.

11. Strategy

Number of 3¢ stamps: x Number of 8¢ stamps: $2x - 3$ Number of 13¢ stamps: $2(2x - 3)$

Stamp	Number	Value	Total Value
3¢	x	3	$3x$
8¢	$2x - 3$	8	$8(2x - 3)$
13¢	$2(2x - 3)$	13	$13(2)(2x - 3)$

The sum of the total values of each type of stamp equals the total value of all the stamps (253 cents).
 $3x + 8(2x - 3) + 26(2x - 3) = 253$

$$3x + 8(2x - 3) + 26(2x - 3) = 253$$

Solution

$$3x + 8(2x - 3) + 26(2x - 3) = 253$$

$$3x + 16x - 24 + 52x - 78 = 253$$

$$71x - 102 = 253$$

$$71x = 355$$

$$x = 5$$

There are five 3¢ stamps in the collection.

13. Strategy

Number of 18¢ stamps: x
 Number of 8¢ stamps: $2x$
 Number of 11¢ stamps: $x + 3$

Stamp	Number	Value	Total Value
18¢	x	18	$18x$
8¢	$2x$	8	$8(2x)$
11¢	$x + 3$	11	$11(x + 3)$

The sum of the total values of each type of stamp equals the total value of all the stamps (348 cents).

$$18x + 8(2x) + 11(x + 3) = 348$$

Solution

$$18x + 8(2x) + 11(x + 3) = 348$$

$$18x + 16x + 11x + 33 = 348$$

$$45x + 33 = 348$$

$$45x = 315$$

$$x = 7$$

There are seven 18¢ stamps in the collection.

Objective 2 Exercises

17. Strategy

The smaller integer: n
 The larger integer: $10 - n$
 Three times the larger integer is three less than eight times the smaller integer.

$$3(10 - n) = 8n - 3$$

Solution

$$3(10 - n) = 8n - 3$$

$$30 - 3n = 8n - 3$$

$$-11n = -33$$

$$n = 3$$

$$10 - n = 10 - 3 = 7$$

The integers are 3 and 7.

19. Strategy

The larger integer: n
 The smaller integer: $n - 8$
 The sum of the two integers is fifty.

$$n + (n - 8) = 50$$

Solution

$$n + (n - 8) = 50$$

$$2n - 8 = 50$$

$$2n = 58$$

$$n = 29$$

$$n - 8 = 29 - 8 = 21$$

The two integers are 21 and 29.

21. Strategy

The first number: n
 The second number: $2n + 2$
 The third number: $3n - 5$
 The sum of the three numbers is 123.

Solution

$$n + (2n + 2) + (3n - 5) = 123$$

$$6n - 3 = 123$$

$$6n = 126$$

$$n = 21$$

$$2n + 2 = 2(21) + 2 = 42 + 2 = 44$$

$$3n - 5 = 3(21) - 5 = 63 - 5 = 58$$

The numbers are 21, 44, and 58.

23. Strategy

The first integer: n
 The second consecutive integer: $n + 1$
 The third consecutive integer: $n + 2$
 The sum of the integers is -57 .

$$n + (n + 1) + (n + 2) = -57$$

Solution

$$n + (n + 1) + (n + 2) = -57$$

$$3n + 3 = -57$$

$$3n = -60$$

$$n = -20$$

$$n + 1 = -20 + 1 = -19$$

$$n + 2 = -20 + 2 = -18$$

The integers are -20 , -19 , and -18 .

25. Strategy

The first odd integer: n
 The second consecutive odd integer: $n + 2$
 The third consecutive odd integer: $n + 4$
 Five times the smallest of the three integers is ten more than twice the largest.

$$5n = 2(n + 4) + 10$$

Solution

$$5n = 2(n + 4) + 10$$

$$5n = 2n + 8 + 10$$

$$5n = 2n + 18$$

$$3n = 18$$

$$n = 6$$

Since 6 is not an odd integer, there is no solution.

27. Strategy

The first odd integer: n
 The second consecutive odd integer: $n + 2$
 The third consecutive odd integer: $n + 4$
 Three times the middle integer is seven more than the sum of the first and third integers.

$$3(n + 2) = [n + (n + 4)] + 7$$

Solution

$$3(n + 2) = [n + (n + 4)] + 7$$

$$3n + 6 = 2n + 11$$

$$n = 5$$

$$n + 2 = 5 + 2 = 7$$

$$n + 4 = 5 + 4 = 9$$

The odd integers are 5, 7, and 9.

Applying Concepts 2.2

29. Strategy

Number of nickels: x Number of dimes: $2x - 2$

The number of nickels plus the number of dimes is the total number of coins in the bank (52).

Solution

$$x + (2x - 2) = 52$$

$$3x - 2 = 52$$

$$3x = 54$$

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

$$x = 18$$

$$2x - 2 = 2(18) - 2 = 36 - 2 = 34$$

There are 18 nickels in the bank and 34 dimes in the bank.

The value of the coins in the bank is equal to the value of the dimes (\$.10)(34) plus the value of the nickels (\$.05)(18).

$$$.10(34) + $.05(18) = \$3.40 + $.90 = \$4.30$$

The total value of the coins in the bank is \$4.30.

31. Strategy

Number of 5¢ stamps: x Number of 3¢ stamps: $x + 6$ Number of 7¢ stamps: $(x + 6) + 2 = x + 8$

Stamp	Number	Value	Total Value
5¢	x	5	$5x$
3¢	$x + 6$	3	$3(x + 6)$
7¢	$x + 8$	7	$7(x + 8)$

The sum of the total value of each type of stamp equals the total value of all the stamps (194 cents.)

$$5x + 3(x + 6) + 7(x + 8) = 194$$

Solution

$$5x + 3(x + 6) + 7(x + 8) = 194$$

$$5x + 3x + 18 + 7x + 56 = 194$$

$$15x + 74 = 194$$

$$15x = 120$$

$$x = 8$$

$$x + 6 = 8 + 6 = 14$$

There are fourteen 3¢ stamps on the collection.

33. Strategy

First odd integer: n Second consecutive odd integer: $n + 2$ Third consecutive odd integer: $n + 4$ Fourth consecutive odd integer: $n + 6$ The sum of the four integers is -64 .

$$n + (n + 2) + (n + 4) + (n + 6) = -64$$

Solution

$$n + (n + 2) + (n + 4) + (n + 6) = -64$$

$$4n + 12 = -64$$

$$4n = -76$$

$$n = -19$$

$$n + 6 = -19 + 6 = -13$$

The smallest of the four integers is -19 .The largest of the four integers is -13 .The sum of the smallest and largest integers is $-19 + (-13)$ or -32 .

35. Strategy

Units digit: x Tens digit: $x - 1$ Hundreds digit: $6 - (x + x - 1)$

The value of the number is 12 more than 100 times the hundreds digit.

Solution

$$x + 10(x - 1) + 100[6 - (x + x - 1)] = 100[6 - (x + x - 1)] + 12$$

$$x + 10x - 10 + 100[6 - 2x + 1] = 100[6 - 2x + 1] + 12$$

$$11x - 10 + 600 - 200x + 100 = 600 - 200x + 100 + 12$$

$$-189x + 690 = -200x + 712$$

$$11x = 22$$

$$x = 2$$

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

$$6 - (x + x - 1) = 6 - (2 + 2 - 1) = 6 - 3 = 3$$

The number is 312.

Section 2.3

Concept Review 2.3

- Sometimes true
This is true only when the same amounts of gold at each price are mixed.
- Never true
It takes a time of $t - \frac{1}{2}$ for the cyclist to overtake the runner.
- Never true
The car travels 3 h at a rate of 40 mph and 2 h at a rate of 60 mph for a total travel time of 5 h. The total distance traveled is 240 mi. The average speed is $240 \div 5 = 48$. The average speed is 48 mph.

Objective 1 Exercises

- Strategy
Cost of mixture: x

	Amount	Cost	Value
Snow peas	20	1.99	39.80
Petite onions	14	1.19	16.66
Mixture	34	x	$34x$

The sum of the values before mixing equals the value after mixing.
 $39.80 + 16.66 = 34x$

Solution
 $56.46 = 34x$
 $1.66 = x$
 The cost per pound of the mixture is \$1.66.

- Strategy
Number of adult tickets: x
Number of child tickets: $460 - x$

	Amount	Cost	Value
Adult tickets	x	5.00	$5x$
Child tickets	$460 - x$	2.00	$2(460 - x)$

The sum of the values of each type of ticket sold equals the total value of all the tickets sold (1880 dollars).
 $5x + 2(460 - x) = 1880$

Solution
 $5x + 2(460 - x) = 1880$
 $5x + 920 - 2x = 1880$
 $3x + 920 = 1880$
 $3x = 960$
 $x = 320$
 There were 320 adult tickets sold.

- Strategy
Liters of imitation maple syrup: x

	Amount	Cost	Value
Imitation Syrup	x	4.00	$4x$
Maple Syrup	50	9.50	$9.50(50)$
Mixture	$50 + x$	5.00	$5(50 + x)$

The sum of the values before mixing equals the value after mixing.
 $4x + 9.50(50) = 5(50 + x)$

Solution
 $4x + 9.50(50) = 5(50 + x)$
 $4x + 475 = 250 + 5x$
 $-x + 475 = 250$
 $-x = -225$
 $x = 225$

The mixture must contain 225 L of imitation maple syrup.

- Strategy
Number of pounds of nuts used x
Number of pounds of pretzels used $20 - x$

	Amount	Cost	Value
Nuts	x	3.99	$3.99x$
Pretzels	$20 - x$	1.29	$1.29(20 - x)$
Mixture	20	2.37	47.40

The sum of the values before mixing equals the value after mixing.

$3.99x + 1.29(20 - x) = 47.40$
 $3.99x + 25.80 - 1.29x = 47.40$
 $2.70x + 25.80 = 47.40$
 $2.70x = 21.60$
 $x = 8$

The mixture must contain 8 pounds of nuts.

- Strategy
Cost per pound of mixture: x

	Amount	Cost	Value
\$6.00 tea	30	6.00	$6.00(30)$
\$3.20 tea	70	3.20	$3.20(70)$
Mixture	100	x	$100x$

The sum of the values before mixing equals the value after mixing.
 $6.00(30) + 3.20(70) = 100x$

Solution
 $6.00(30) + 3.20(70) = 100x$
 $180 + 224 = 100x$
 $404 = 100x$
 $4.04 = x$

The cost of the mixture is \$4.04 per pound.

13. Strategy

Gallons of cranberry juice: x

	Amount	Cost	Value
Cranberry	x	4.20	$4.20x$
Apple	50	2.10	$50(2.10)$
Mixture	$50 + x$	3.00	$3(50 + x)$

The sum of the values before mixing equals the value after mixing.

$$4.20x + 50(2.10) = 3(50 + x)$$

Solution

$$4.20x + 50(2.10) = 3(50 + x)$$

$$4.20x + 105 = 150 + 3x$$

$$1.20x + 105 = 150$$

$$1.20x = 45$$

$$x = 37.5$$

The mixture must contain 37.5 gal of cranberry juice.

Objective 2 Exercises

15. Strategy

 t = time for bicyclist $t + 0.5$ = time for in-line skater

	Rate	Time	Distance
Bicyclist	18	t	$18t$
In-line skater	10	$t + 0.5$	$10(t + 0.5)$

The bicyclist and in-line skater travel the same distance.

$$18t = 10(t + 0.5)$$

$$18t = 10t + 5$$

$$8t = 5$$

$$t = 0.625$$

$$d = 18t = 11.25$$

The bicyclist will overtake the in-line skater after 11.25 miles.

17. Strategy

Rate of the first plane: r Rate of the second plane: $r + 80$

	Rate	Time	Distance
1st plane	r	1.5	$1.5r$
2nd plane	$r + 80$	1.5	$1.5(r + 80)$

The total distance traveled by the two planes is 1380 mi.

$$1.5r + 1.5(r + 80) = 1380$$

Solution

$$1.5r + 1.5(r + 80) = 1380$$

$$1.5r + 1.5r + 120 = 1380$$

$$3r + 120 = 1380$$

$$3r = 1260$$

$$r = 420$$

$$r + 80 = 420 + 80 = 500$$

The speed of the first plane is 420 mph.

The speed of the second plane is 500 mph.

19. Strategy

Time to the island: t Time returning from the island: $6 - t$

	Rate	Time	Distance
Going	18	t	$18t$
Returning	12	$6 - t$	$12(6 - t)$

The distance to the island is the same as the distance returning.

$$18t = 12(6 - t)$$

Solution

$$18t = 12(6 - t)$$

$$18t = 72 - 12t$$

$$30t = 72$$

$$t = 2.4$$

$$d = rt = 18(2.4) = 43.2$$

The distance to the island is 43.2 mi.

21. Strategy

Rate of the second plane: r
 Rate of the first plane: $r - 50$

	Rate	Time	Distance
2nd plane	r	2.5	$2.5r$
1st plane	$r - 50$	2.5	$2.5(r - 50)$

The total distance traveled by the two planes is 1400 mi.

$$2.5r + 2.5(r - 50) = 1400$$

Solution

$$2.5r + 2.5(r - 50) = 1400$$

$$2.5r + 2.5r - 125 = 1400$$

$$5r - 125 = 1400$$

$$5r = 1525$$

$$r = 305$$

$$r - 50 = 305 - 50 = 255$$

The rate of the first plane is 255 mph.

The rate of the second plane is 305 mph.

23. Strategy

Time to the repair shop: t
 Time walking home: $1 - t$

	Rate	Time	Distance
To repair shop	14	t	$14t$
Walking home	3.5	$1 - t$	$3.5(1 - t)$

The distance to the repair shop is the same as the distance walking home.

$$14t = 3.5(1 - t)$$

Solution

$$14t = 3.5(1 - t)$$

$$14t = 3.5 - 3.5t$$

$$17.5t = 3.5$$

$$t = 0.2$$

$$d = rt = 14(0.2) = 2.8$$

The distance between the student's home and the bicycle shop is 2.8 mi.

25. Strategy

Time Washington to Pittsburgh train travels: t
 Time Pittsburgh to Washington train travels: $t - 1$

	r	t	d
Washington to Pittsburgh	60	t	$60t$
Pittsburgh to Washington	40	$t - 1$	$40(t - 1)$

The trains together cover the distance from Washington to Pittsburgh, 260 miles.

$$60t + 40(t - 1) = 260$$

Solution

$$60t + 40t - 40 = 260$$

$$100t - 40 = 260$$

$$100t = 300$$

$$t = 3$$

$$t - 1 = 2$$

The two trains will pass each other after 2 hours.

Applying Concepts 2.3

27. The time it will take for the jogger to reach the end of the parade is the time it takes to run 2 mi at an apparent rate of 9 mph (the rate of the parade + the rate of the jogger.)

$$d = rt$$

$$2 = 9t$$

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

It will take the jogger $\frac{2}{9}$ h to reach the end of the parade.

29. The distance between them 2 min before impact is equal to the sum of the distances each one can travel during 2 min.

$$2 \text{ minutes} \cdot \frac{1 \text{ hour}}{60 \text{ minutes}} = 0.03\bar{3} \text{ hour}$$

$$\text{Distance between cars} = \text{rate of first car} \cdot 0.03\bar{3} + \text{rate of second car} \cdot 0.03\bar{3}$$

$$\text{Distance between cars} = 40 \cdot 0.03\bar{3} + 60 \cdot 0.03\bar{3} = 3.3\bar{3}$$

The cars are $3.3\bar{3}$ (or $3\frac{1}{3}$) miles apart 2 min before impact.

31. Rate during the second mile: x

	Rate	Distance	Time
1st mile	30	1	$\frac{1}{30}$
2nd mile	x	1	$\frac{1}{x}$
Both miles	60	2	$\frac{2}{60} = \frac{1}{30}$

The time traveled during the first mile plus the time traveled during the second mile is equal to the total time traveled during both miles.

$$\frac{1}{30} + \frac{1}{x} = \frac{1}{30}$$

Solution

$$\frac{1}{30} + \frac{1}{x} = \frac{1}{30}$$

$$\frac{1}{x} = 0$$

$$x \left(\frac{1}{x} \right) = 0 \cdot x$$

$$1 = 0$$

There is no solution to the equation. No, it is not possible to increase the speed enough.

Section 2.4

Concept Review 2.4

1. Never true

The amount invested in the other account is $10,000 - x$.

3. Never true

A mixture can never have a greater concentration of an ingredient than the concentrations of both substances going into the mixture.

Objective 1 Exercises**3. Strategy**Amount invested at 6.75%: x Amount invested at 7.25%: $40,000 - x$

	Principal	Rate	Interest
Amount at 6.75%	x	0.0675	$0.0675x$
Amount at 7.25%	$40,000 - x$	0.0725	$0.0725(40,000 - x)$

The sum of the interest earned by the two investments equals the total annual interest earned (\$2825)
 $0.0675x + 0.0725(40,000 - x) = 2825$

Solution

$$0.0675x + 0.0725(40,000 - x) = 2825$$

$$0.0675x + 2900 - 0.0725x = 2825$$

$$-0.005x = -75$$

$$x = 15,000$$

The amount invested in the certificate of deposit is \$15,000.

5. StrategyAmount invested at 10.5%: x

	Principal	Rate	Interest
Amount at 8.4%	5000	0.084	$0.084(5000)$
Amount at 10.5%	x	0.105	$0.105x$
Amount at 9%	$5000 + x$	0.09	$0.09(5000 + x)$

The sum of the interest earned by the two investments equals the interest earned by the total investment.
 $0.084(5000) + 0.105x = 0.09(5000 + x)$

Solution

$$0.084(5000) + 0.105x = 0.09(5000 + x)$$

$$420 + 0.105x = 450 + 0.09x$$

$$0.015x = 30$$

$$x = 2000$$

\$2000 more must be invested at 10.5%.

7. StrategyAmount invested at 8.5%: x Amount invested at 6.4%: $8000 - x$

	Principal	Rate	Interest
Amount at 8.5%	x	0.085	$0.085x$
Amount at 6.4%	$8000 - x$	0.064	$0.064(8000 - x)$

The sum of the interest earned by the two investments equals the total annual interest earned (\$575).
 $0.085x + 0.064(8000 - x) = 575$

Solution

$$0.085x + 0.064(8000 - x) = 575$$

$$0.085x + 512 - 0.064x = 575$$

$$0.021x = 63$$

$$x = 3000$$

$$8000 - x = 8000 - 3000 = 5000$$

The amount invested at 8.5% is \$3000.

The amount invested at 6.4% is \$5000.

9. Strategy

Amount of additional money at 10%: x

	Principal	Rate	Interest
Amount at 5.5%	6000	0.055	330
Amount at 10%	x	0.10	$0.10x$
Combined Investment	$6000 + x$	0.07	$0.07(6000 + x)$

The interest from the combined investment is the sum of the interests from each investment.

$$330 + 0.10x = 0.07(6000 + x)$$

$$330 + 0.10x = 420 + 0.07x$$

$$0.03x = 90$$

$$x = 3000$$

The additional amount that should be invested at 10% is \$3000.

11. Strategy

Amount invested at 4.2%: x Amount invested at 6%: $13,600 - x$

	Principal	Rate	Interest
Amount 4.2%	x	0.042	$0.042x$
Amount at 6%	$13,600 - x$	0.006	$0.006(13,600 - x)$

The interest earned on one investment is equal to the interest earned on the other investment.

$$0.042x = 0.06(13,600 - x)$$

Solution

$$0.042x = 0.06(13,600 - x)$$

$$0.042x = 816 - 0.06x$$

$$0.102x = 816$$

$$x = 8000$$

$$13,600 - x = 13,600 - 8000 = 5600$$

The amount that should be invested at 4.2% is \$8000.

the amount that should be invested at 6% is \$5600.

Objective 2 Exercises

15. Strategy

Percent concentration of resulting alloy: x

	Amount	Percent	Quantity
60% alloy	15	0.60	9
20% alloy	45	0.20	9
Mixture	60	x	$60x$

The sum of the quantities before mixing is equal to the quantity after mixing.

$$9 + 9 = 60x$$

Solution

$$9 + 9 = 60x$$

$$18 = 60x$$

$$0.30 = x$$

The resulting alloy is 30% silver.

17. Strategy

Percent concentration of the resulting alloy: x

	Amount	Percent	Quantity
70%	25	0.70	$0.70(25)$
15%	50	0.15	$0.15(50)$
Mixture	75	x	$75x$

The sum of the quantities before mixing is equal to the quantity after mixing.

$$0.70(25) + 0.15(50) = 75x$$

Solution

$$0.70(25) + 0.15(50) = 75x$$

$$17.5 + 7.5 = 75x$$

$$25 = 75x$$

$$0.\overline{33} = x$$

the resulting alloy is $33\frac{1}{3}\%$ silver.

19. Strategy

Pounds of 12% aluminum alloy: x

	Amount	Percent	Quantity
12%	x	0.12	$0.12x$
30%	400	0.30	$0.30(400)$
20%	$400 + x$	0.20	$0.20(400 + x)$

The sum of the quantities before mixing is equal to the quantity after mixing.
 $0.12x + 0.30(400) = 0.20(400 + x)$

Solution
 $0.12x + 0.30(400) = 0.20(400 + x)$
 $0.12x + 120 = 80 + 0.20x$
 $-0.08x + 120 = 80$
 $-0.08x = -40$
 $x = 500$
 500 lb of the 12% aluminum alloy must be used.

- 21. Strategy**
 Liters of 65% solution: x
 Liters of 15% solution: $50 - x$

	Amount	Percent	Quantity
65% solution	x	65%	$0.65x$
15% solution	$50 - x$	15%	$0.15(50 - x)$
Mixture	50	40%	$0.40(50)$

The sum of the quantities before mixing is equal to the quantity after mixing.
 $0.65x + 0.15(50 - x) = 0.40(50)$

Solution
 $0.65x + 0.15(50 - x) = 0.40(50)$
 $0.65x + 7.5 - 0.15x = 20$
 $0.5x = 12.5$
 $x = 25$
 25 L of 65% disinfectant solution and 25 L of 15% disinfectant solution were used.

- 23. Strategy**
 Number of quarts of water: x

	Amount	Percent	Quantity
Water	x	0	0
80% antifreeze	5	0.80	4
50% antifreeze	$5 + x$	0.50	$0.50(5 + x)$

The sum of the quantities before mixing is equal to the quantity after mixing.
 $0 + 4 = 0.50(5 + x)$

Solution
 $4 = 2.5 + 0.50x$
 $1.5 = 0.5x$
 $x = 3$
 3 quarts of water should be added.

- 25. Strategy**
 Ounces of water to be added: x
 Ounces of 5% solution: $60 + x$

	Amount	Percent	Quantity
Water	x	0	0
7.5% solution	60	0.075	4.5
5% solution	$60 + x$	0.05	$0.05(60 + x)$

The sum of the quantities before mixing is equal to the quantity after mixing.
 $0 + 4.5 = 0.05(60 + x)$

Solution
 $0 + 4.5 = 0.05(60 + x)$
 $4.5 = 3 + 0.05x$
 $1.5 = 0.05x$
 $x = 30$
 30 oz of water should be added.

- 27. Strategy**
 Percent concentration of result: x

	Amount	Percent	Quantity
5% fruit juice	12	0.05	$0.05(12)$
Water	2	0	0
Result	10	x	$10x$

The sum of the quantities before mixing is equal to the quantity after mixing.
 $0.05(12) + 0 = 10x$

Solution
 $0.05(12) + 0 = 10x$
 $0.60 = 10x$
 $x = 0.06$
 The result is 6% fruit juice.

- 29. Strategy**
 Percent concentration of the resulting alloy: x

	Amount	Percent	Quantity
54%	80	0.54	$0.54(80)$
22%	200	0.22	$0.22(200)$
Mixture	280	x	$280x$

The sum of the quantities before mixing is equal to the quantity after mixing.
 $0.54(80) + 0.22(200) = 280x$

Solution
 $0.54(80) + 0.22(200) = 280x$
 $43.2 + 44 = 280x$
 $87.2 = 280x$
 $0.3114 \approx x$
 The resulting alloy is about 31.1% copper.

Applying Concepts 2.4

31. Strategy

Total amount invested: x Amount invested at 9%: $0.25x$ Amount invested at 8%: $0.30x$ Amount invested at 9.5%: $0.45x$

	Amount	Percent	Quantity
Amount at 9%	$0.25x$	0.09	$0.09(0.25x)$
Amount at 8%	$0.30x$	0.08	$0.08(0.30x)$
Amount at 9.5%	$0.45x$	0.095	$0.095(0.45x)$

The total annual interest earned is \$1785.

Solution

$$0.09(0.25x) + 0.08(0.3x) + 0.095(0.45x) = 1785$$

$$0.0225x + 0.024x + 0.04275x = 1785$$

$$0.08925x = 1785$$

$$x = 20,000$$

$$0.25x = 0.25(20,000) = 5000$$

$$0.3x = 0.3(20,000) = 6000$$

$$0.45x = 0.45(20,000) = 9000$$

The amount invested at 9% was \$5000.

The amount invested at 8% was \$6000.

The amount invested at 9.5% was \$9000.

33. Strategy

Cost per pound of mixture: x

	Amount	Cost	Value
\$5.50 tea	50	550	$550(50)$
\$4.40 tea	75	440	$440(75)$
Mixture	125	x	$125x$

The sum of the quantities before mixing is equal to the quantity after mixing.

$$550(50) + 440(75) = 125x$$

Solution

$$550(50) + 440(75) = 125x$$

$$27,500 + 33,000 = 125x$$

$$60,500 = 125x$$

$$484 = x$$

The tea mixture would cost \$4.84 per pound.

35. Strategy
Grams of water: x

	Amount	Percent	Quantity
Pure water	x	0	0
Pure acid	20	1.00	$1.00(20)$
25% acid	$20 + x$	0.25	$0.25(20 + x)$

The sum of the quantities before mixing is equal to the quantity after mixing.
 $0 + 1.00(20) = 0.25(20 + x)$

Solution

$$\begin{aligned} 0 + 1.00(20) &= 0.25(20 + x) \\ 20 &= 5 + 0.25x \\ 15 &= 0.25x \\ 60 &= x \end{aligned}$$

60 g of pure water were in the beaker.

37. a. The percent increases for '91 and '96 are very close but the percent increase for '96 is slightly higher.
 b. Since there was a positive percent increase every year, the costs were highest in 1997.

Section 2.5

Concept Review 2.5

- Always true
- Sometimes true
The rule states that when dividing an inequality by a negative integer, we must reverse the inequality.
- Sometimes true
This is not true for $a = 0$.

Objective 1 Exercises

- $x - 3 < 2$
 $x < 5$
 $\{x|x < 5\}$
- $4x \leq 8$
 $\frac{4x}{4} \leq \frac{8}{4}$
 $x \leq 2$
 $\{x|x \leq 2\}$
- $-2x > 8$
 $\frac{-2x}{-2} < \frac{8}{-2}$
 $x < -4$
 $\{x|x < -4\}$
- $3x - 1 > 2x + 2$
 $x - 1 > 2$
 $x > 3$
 $\{x|x > 3\}$
- $2x - 1 > 7$
 $2x > 8$
 $\frac{2x}{2} > \frac{8}{2}$
 $x > 4$
 $\{x|x > 4\}$
- $6x + 3 > 4x - 1$
 $2x + 3 > -1$
 $2x > -4$
 $\frac{2x}{2} > \frac{-4}{2}$
 $x > -2$
 $\{x|x > -2\}$
- $8x + 1 \geq 2x + 13$
 $6x + 1 \geq 13$
 $6x \geq 12$
 $\frac{6x}{6} \geq \frac{12}{6}$
 $x \geq 2$
 $\{x|x \geq 2\}$
- $7 - 2x \geq 1$
 $-2x \geq -6$
 $\frac{-2x}{-2} \leq \frac{-6}{-2}$
 $x \leq 3$
 $\{x|x \leq 3\}$

19. $4x - 2 < x - 11$

$3x - 2 < -11$

$3x < -9$

$\frac{3x}{3} < \frac{-9}{3}$

$x < -3$

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

21. $x + 7 \geq 4x - 8$

$-3x + 7 \geq -8$

$-3x \geq -15$

$\frac{-3x}{-3} \leq \frac{-15}{-3}$

$x \leq 5$

$(-\infty, 5]$

23. $6 - 2(x - 4) \leq 2x + 10$

$6 - 2x + 8 \leq 2x + 10$

$14 - 2x \leq 2x + 10$

$14 - 4x \leq 10$

$-4x \leq -4$

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

$x \geq 1$

$[1, \infty)$

25. $2(1 - 3x) - 4 > 10 + 3(1 - x)$

$2 - 6x - 4 > 10 + 3 - 3x$

$-6x - 2 > 13 - 3x$

$-3x - 2 > 13$

$-3x > 15$

$\frac{-3x}{-3} < \frac{15}{-3}$

$x < -5$

$(-\infty, -5)$

27. $\frac{3}{5}x - 2 < \frac{3}{10} - x$

$10\left(\frac{3}{5}x - 2\right) < 10\left(\frac{3}{10} - x\right)$

$6x - 20 < 3 - 10x$

$16x - 20 < 3$

$16x < 23$

$\frac{16x}{16} < \frac{23}{16}$

$x < \frac{23}{16}$

$\left(-\infty, \frac{23}{16}\right)$

29. $\frac{1}{3}x - \frac{3}{2} \geq \frac{7}{6} - \frac{2}{3}x$

$6\left(\frac{1}{3}x - \frac{3}{2}\right) \geq 6\left(\frac{7}{6} - \frac{2}{3}x\right)$

$2x - 9 \geq 7 - 4x$

$6x - 9 \geq 7$

$6x \geq 16$

$\frac{6x}{6} \geq \frac{16}{6}$

$x \geq \frac{8}{3}$

$\left[\frac{8}{3}, \infty\right)$

31. $\frac{1}{2}x - \frac{3}{4} > \frac{7}{4}x - 2$

$4\left(\frac{1}{2}x - \frac{3}{4}\right) > 4\left(\frac{7}{4}x - 2\right)$

$2x - 3 > 7x - 8$

$-5x - 3 > -8$

$-5x > -5$

$\frac{-5x}{-5} < \frac{-5}{-5}$

$x < 1$

$(-\infty, 1)$

33. $2 - 2(7 - 2x) < 3(3 - x)$

$2 - 14 + 4x < 9 - 3x$

$-12 + 4x < 9 - 3x$

$-12 + 7x < 9$

$7x < 21$

$\frac{7x}{7} < \frac{21}{7}$

$x < 3$

$(-\infty, 3)$

Objective 2 Exercises

35. $3x < 6$ and $x + 2 > 1$

$x < 2$ $x > -1$

$\{x | x < 2\}$ $\{x | x > -1\}$

$\{x | x < 2\} \cap \{x | x > -1\} = (-1, 2)$

37. $x + 2 \geq 5$ or $3x \leq 3$

$x \geq 3$ $x \leq 1$

$\{x | x \geq 3\}$ $\{x | x \leq 1\}$

$\{x | x \geq 3\} \cup \{x | x \leq 1\} = (-\infty, 1] \cup [3, \infty)$

39. $-2x > -8$ and $-3x < 6$

$x < 4$ $x > -2$

$\{x | x < 4\}$ $\{x | x > -2\}$

$\{x | x < 4\} \cap \{x | x > -2\} = (-2, 4)$

41. $\frac{1}{3}x < -1$ or $2x > 0$

$x < -3$ $x > 0$

$\{x | x < -3\}$ $\{x | x > 0\}$

$\{x | x < -3\} \cup \{x | x > 0\} = (-\infty, -3) \cup (0, \infty)$

43. $x+4 \geq 5$ and $2x \geq 6$
 $x \geq 1$ $x \geq 3$
 $\{x|x \geq 1\}$ $\{x|x \geq 3\}$
 $\{x|x \geq 1\} \cap \{x|x \geq 3\} = [3, \infty)$
45. $-5x > 10$ and $x+1 > 6$
 $x < -2$ $x > 5$
 $\{x|x < -2\}$ $\{x|x > 5\}$
 $\{x|x < -2\} \cap \{x|x > 5\} = \emptyset$
47. $2x-3 > 1$ and $3x-1 < 2$
 $2x > 4$ $3x < 3$
 $x > 2$ $x < 1$
 $\{x|x > 2\}$ $\{x|x < 1\}$
 $\{x|x > 2\} \cap \{x|x < 1\} = \emptyset$
49. $3x+7 < 10$ or $2x-1 > 5$
 $3x < 3$ $2x > 6$
 $x < 1$ $x > 3$
 $\{x|x < 1\}$ $\{x|x > 3\}$
 $\{x|x < 1\} \cup \{x|x > 3\} = (-\infty, 1) \cup (3, \infty)$
51. $-5 < 3x+4 < 16$
 $-5-4 < 3x+4-4 < 16-4$
 $-9 < 3x < 12$
 $-\frac{9}{3} < \frac{3x}{3} < \frac{12}{3}$
 $-3 < x < 4$
 $\{x|-3 < x < 4\}$
53. $0 < 2x-6 < 4$
 $0+6 < 2x-6+6 < 4+6$
 $6 < 2x < 10$
 $\frac{6}{2} < \frac{2x}{2} < \frac{10}{2}$
 $3 < x < 5$
 $\{x|3 < x < 5\}$
55. $4x-1 > 11$ or $4x-1 \leq -11$
 $4x > 12$ $4x \leq -10$
 $x > 3$ $x \leq -\frac{5}{2}$
 $\{x|x > 3\}$ $\left\{x|x \leq -\frac{5}{2}\right\}$
 $\{x|x > 3\} \cup \left\{x|x \leq -\frac{5}{2}\right\}$
 $= \left\{x|x > 3 \text{ or } x \leq -\frac{5}{2}\right\}$
57. $2x+3 \geq 5$ and $3x-1 > 11$
 $2x \geq 2$ $3x > 12$
 $x \geq 1$ $x > 4$
 $\{x|x \geq 1\}$ $\{x|x > 4\}$
 $\{x|x \geq 1\} \cap \{x|x > 4\} = \{x|x > 4\}$
59. $9x-2 < 7$ and $3x-5 > 10$
 $9x < 9$ $3x > 15$
 $x < 1$ $x > 5$
 $\{x|x < 1\}$ $\{x|x > 5\}$
 $\{x|x < 1\} \cap \{x|x > 5\} = \emptyset$
61. $3x-11 < 4$ or $4x+9 \geq 1$
 $3x < 15$ $4x \geq -8$
 $x < 5$ $x \geq -2$
 $\{x|x < 5\}$ $\{x|x \geq -2\}$
 $\{x|x < 5\} \cup \{x|x \geq -2\}$
 $= \{x|x \text{ is a real number}\}$
63. $3-2x > 7$ and $5x+2 > -18$
 $-2x > 4$ $5x > -20$
 $x < -2$ $x > -4$
 $\{x|x < -2\}$ $\{x|x > -4\}$
 $\{x|x < -2\} \cap \{x|x > -4\} = \{x|-4 < x < -2\}$
65. $5-4x > 21$ or $7x-2 > 19$
 $-4x > 16$ $7x > 21$
 $x < -4$ $x > 3$
 $\{x|x < -4\}$ $\{x|x > 3\}$
 $\{x|x < -4\} \cup \{x|x > 3\} = \{x|x < -4 \text{ or } x > 3\}$
67. $3-7x \leq 31$ and $5-4x > 1$
 $-7x \leq 28$ $-4x > -4$
 $x \geq -4$ $x < 1$
 $\{x|x \geq -4\}$ $\{x|x < 1\}$
 $\{x|x \geq -4\} \cap \{x|x < 1\} = \{x|-4 \leq x < 1\}$
69. $\frac{2}{3}x-4 > 5$ or $x+\frac{1}{2} < 3$
 $\frac{2}{3}x > 9$ $x < \frac{5}{2}$
 $x > \frac{27}{2}$
 $\left\{x|x > \frac{27}{2}\right\}$ $\left\{x|x < \frac{5}{2}\right\}$
 $\left\{x|x > \frac{27}{2}\right\} \cup \left\{x|x < \frac{5}{2}\right\}$
 $= \left\{x|x > \frac{27}{2} \text{ or } x < \frac{5}{2}\right\}$
71. $-\frac{3}{8} \leq 1 - \frac{1}{4}x \leq \frac{7}{2}$
 $-3 \leq 8 - 2x \leq 28$
 $-11 \leq -2x \leq 20$
 $\frac{11}{2} \geq x \geq -10$
 $\left\{x|-10 \leq x \leq \frac{11}{2}\right\}$

Objective 3 Exercises

73. Strategy

the unknown number: x
 five times the difference between the number and two: $5(x - 2)$
 the quotient of two times the number and three: $2x \div 3$

Solution

five times the difference between a number and two $>$ the quotient of two times the number and three

$$5(x - 2) > \frac{2x}{3}$$

$$5x - 10 > \frac{2x}{3}$$

$$3(5x - 10) > 2x$$

$$15x - 30 > 2x$$

$$13x - 30 > 0$$

$$13x > 30$$

$$x > \frac{30}{13}$$

$$x > 2\frac{4}{13}$$

The smallest integer is 3.

75. Strategy

the width of the rectangle: x
 the length of the rectangle: $4x + 2$
 To find the maximum width, substitute the given values in the inequality $2L + 2W < 34$ and solve.

Solution

$$2L + 2W < 34$$

$$2(4x + 2) + 2x < 34$$

$$8x + 4 + 2x < 34$$

$$10x + 4 < 34$$

$$10x < 30$$

$$x < 3$$

The maximum width of the rectangle is 2 ft.

77. Strategy

To find the four consecutive integers, write and solve a compound inequality using x to represent the first integer.

Solution

Lower limit of the sum $<$ sum $<$ Upper limit of the sum

$$62 < x + (x + 1) + (x + 2) + (x + 3) < 78$$

$$62 < 4x + 6 < 78$$

$$62 - 6 < 4x + 6 - 6 < 78 - 6$$

$$56 < 4x < 72$$

$$\frac{56}{4} < \frac{4x}{4} < \frac{72}{4}$$

$$14 < x < 18$$

The four integers are 15, 16, 17, and 18; or 16, 17, 18, and 19; or 17, 18, 19, and 20.

79. Strategy

First side of the triangle: $x + 1$
 Second side of the triangle: x
 Third side of the triangle: $x + 2$

Solution

The perimeter of the triangle is more than 15 in. and less than 25 in.

$$15 < P < 25$$

$$15 < (x + 1) + x + (x + 2) < 25$$

$$15 < 3x + 3 < 25$$

$$15 - 3 < 3x + 3 - 3 < 25 - 3$$

$$12 < 3x < 22$$

$$\frac{12}{3} < \frac{3x}{3} < \frac{22}{3}$$

$$4 < x < 7\frac{1}{3}$$

If $x = 5$: $5 + 1 = 6$; $5 + 2 = 7$;

$5 + 6 + 7 = 18 =$ perimeter

If $x = 6$: $6 + 1 = 7$; $6 + 2 = 8$;

$6 + 7 + 8 = 21 =$ perimeter

If $x = 7$: $7 + 1 = 8$; $7 + 2 = 9$;

$7 + 8 + 9 = 24 =$ perimeter

The lengths of the second side could be 5 in., 6 in., or 7 in.

81. Strategy

To find the number of minutes, write and solve an inequality using N to represent the number of minutes of cellular phone time.

Solution

cost of second option \leq cost of first option

$$0.4N + 35 \leq 99$$

$$0.4N \leq 64$$

$$N \leq 160$$

A customer can use a cellular phone 160 min before the charges exceed the first option.

83. Strategy

To find the number of pages for which the AirTouch plan is less expensive, solve an inequality using N to represent the number of pages.

Cost of AirTouch $<$ Cost of TopPage

$$6.95 + 0.10(x - 400) < 3.95 + 0.15(x - 400)$$

$$6.95 + 0.10x - 40 < 3.95 + 0.15x - 60$$

$$33.05 + 0.10x < -56.05 + 0.15x$$

$$23 < 0.05x$$

$$460 < x$$

AirTouch is less expensive for jobs more than 460 pages.

85. Strategy

To find the number of minutes for which a call will be cheaper to pay with coins, solve an inequality using N to represent the number of minutes.

Coins < Calling card

Solution

$$\begin{aligned}(0.70) + 0.15(N - 3) &< 0.35 + 0.196 + 0.126(N - 1) \\ 0.70 + 0.15N - 0.45 &< 0.35 + 0.196 + 0.126N - 0.126 \\ 0.25 + 0.15N &< 0.42 + 0.126N \\ 0.024N &< .17 \\ N &< 7.08\end{aligned}$$

Using coins will be cheaper for 7 minutes or less.

87. Strategy

To find the number of checks that have to be written for Glendale Federal to cost less than the competitor, solve an inequality using N to represent the number of checks.

Glendale account < Other account

$$\begin{aligned}8 + 0.12(N - 100) &< 5 + 0.15(N - 100) \\ 8 + 0.12N - 12 &< 5 + 0.15N - 15 \\ 0.12N - 4 &< 0.15N - 10 \\ -0.03N &< -6 \\ N &> 200\end{aligned}$$

The Glendale Federal account will cost less for more than 200 checks.

89. Strategy

To find the range of miles that a car can travel, write and solve an inequality using N to represent the range of miles.

Solution

$$\begin{aligned}22(19.5) &< N < 27.5(19.5) \\ 429 &< N < 536.25\end{aligned}$$

The range of miles is between 429 mi and 536.25 mi.

Applying Concepts 2.5

91. $8x - 7 < 2x + 9$

$6x - 7 < 9$

$6x < 16$

$x < \frac{16}{6}$

$x < \frac{8}{3}$

{1, 2}

93. $5 + 3(2 + x) > 8 + 4(x - 1)$

$5 + 6 + 3x > 8 + 4x - 4$

$11 + 3x > 4 + 4x$

$3x > -7 + 4x$

$-x > -7$

$x < 7$

{1, 2, 3, 4, 5, 6}

95. $-3x < 15$ and $x + 2 < 7$

$x > -5$ $x < 5$

$\{x|x > -5\} \cap \{x|x < 5\} = \{x|-5 < x < 5\}$

{1, 2, 3, 4}

97. $-4 \leq 3x + 8 < 16$

$-4 + (-8) \leq 3x + 8 + (-8) < 16 + (-8)$

$-12 \leq 3x < 8$

$\frac{-12}{3} \leq \frac{3x}{3} < \frac{8}{3}$

$-4 \leq x < \frac{8}{3}$

{1, 2}

99. Strategy

To find the temperature range in degrees Celsius, write and solve a compound inequality.

Solution

$77 < \frac{9}{5}C + 32 < 86$

$77 - 32 < \frac{9}{5}C + 32 - 32 < 86 - 32$

$45 < \frac{9}{5}C < 54$

$\frac{5}{9}(45) < \frac{5}{9}\left(\frac{9}{5}C\right) < \frac{5}{9}(54)$

$25 < C < 30$

The temperature is between 25°C and 30°C.

101. Strategy

To find the largest whole number of minutes the call could last, set up an inequality with N representing the number of minutes and $N - 3$ representing the number of minutes after the first 3 minutes.

Solution

$$\begin{aligned} 156 + 52(N - 3) &< 540 \\ 156 + 52N - 156 &< 540 \\ 52N &< 540 \\ N &< 10.38 \end{aligned}$$

The largest whole number of minutes the call could last is 10 min.

Section 2.6

Concept Review 2.6

- Always true
- Never true
The absolute value of a number is always positive.
- Never true
 $|x + b| < c$ is equivalent to $-c < x + b < c$.

Objective 1 Exercises

3. $|x| = 7$

$$\begin{aligned} x = 7 & & x = -7 \\ \text{The solutions are } 7 \text{ and } -7. \end{aligned}$$

5. $|-t| = 3$

$$\begin{aligned} -t = 3 & & -t = -3 \\ t = -3 & & t = 3 \\ \text{The solutions are } -3 \text{ and } 3. \end{aligned}$$

7. $|-t| = -3$

There is no solution to this equation because the absolute value of a number must be non-negative.

9. $|x + 2| = 3$

$$\begin{aligned} x + 2 = 3 & & x + 2 = -3 \\ x = 1 & & x = -5 \\ \text{The solutions are } 1 \text{ and } -5. \end{aligned}$$

11. $|y - 5| = 3$

$$\begin{aligned} y - 5 = 3 & & y - 5 = -3 \\ y = 8 & & y = 2 \\ \text{The solutions are } 8 \text{ and } 2. \end{aligned}$$

13. $|a - 2| = 0$

$$\begin{aligned} a - 2 = 0 \\ a = 2 \\ \text{The solution is } 2. \end{aligned}$$

15. $|x - 2| = -4$

There is no solution to this equation because the absolute value of a number must be non-negative.

17. $|2x - 5| = 4$

$$\begin{aligned} 2x - 5 = 4 & & 2x - 5 = -4 \\ 2x = 9 & & 2x = 1 \\ x = \frac{9}{2} & & x = \frac{1}{2} \end{aligned}$$

The solutions are $\frac{9}{2}$ and $\frac{1}{2}$.

19. $|2 - 5x| = 2$

$$\begin{aligned} 2 - 5x = 2 & & 2 - 5x = -2 \\ -5x = 0 & & -5x = -4 \\ x = 0 & & x = \frac{4}{5} \end{aligned}$$

The solutions are 0 and $\frac{4}{5}$.

21. $|5x + 5| = 0$

$$\begin{aligned} 5x + 5 = 0 \\ 5x = -5 \\ x = -1 \end{aligned}$$

The solution is -1 .

23. $|2x + 5| = -2$

There is no solution to this equation because the absolute value of a number must be non-negative.

25. $|x - 9| - 3 = 2$

$$\begin{aligned} |x - 9| = 5 \\ x - 9 = 5 & & x - 9 = -5 \\ x = 14 & & x = 4 \end{aligned}$$

The solutions are 14 and 4.

27. $|8 - y| - 3 = 1$

$$\begin{aligned} |8 - y| = 4 \\ 8 - y = 4 & & 8 - y = -4 \\ -y = -4 & & -y = -12 \\ y = 4 & & y = 12 \end{aligned}$$

The solutions are 4 and 12.

29. $|4x - 7| - 5 = -5$

$$\begin{aligned} |4x - 7| = 0 \\ 4x - 7 = 0 \\ 4x = 7 \\ x = \frac{7}{4} \end{aligned}$$

The solution is $\frac{7}{4}$.

31. $|3x - 2| + 1 = -1$

$$|3x - 2| = -2$$

There is no solution to this equation because the absolute value of a number must be non-negative.

33. $|4b + 3| - 2 = 7$

$$\begin{aligned} |4b + 3| = 9 \\ 4b + 3 = 9 & & 4b + 3 = -9 \\ 4b = 6 & & 4b = -12 \\ b = \frac{3}{2} & & b = -3 \end{aligned}$$

The solutions are $\frac{3}{2}$ and -3 .

35. $|5x-2|+5=7$

$|5x-2|=2$

$5x-2=2$

$5x-2=-2$

$5x=4$

$5x=0$

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

$x=0$

The solutions are $\frac{4}{5}$ and 0.

37. $2-|x-5|=4$

$-|x-5|=2$

$|x-5|=-2$

There is no solution to this equation because the absolute value of a number must be non-negative.

39. $|3x-4|+8=3$

$|3x-4|=-5$

There is no solution to this equation because the absolute value of a number must be non-negative.

41. $5+|2x+1|=8$

$|2x+1|=3$

$2x+1=3$

$2x+1=-3$

$2x=2$

$2x=-4$

$x=1$

$x=-2$

The solutions are 1 and -2.

43. $3-|5x+3|=3$

$-|5x+3|=0$

$|5x+3|=0$

$5x+3=0$

$5x=-3$

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

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

Objective 2 Exercises

47. $|x|>3$

$x>3$ or $x<-3$

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

$\{x|x>3\} \cup \{x|x<-3\} = \{x|x>3 \text{ or } x<-3\}$

49. $|x+1|>2$

$x+1>2$ or $x+1<-2$

$x>1$ $x<-3$

$\{x|x>1\}$ $\{x|x<-3\}$

$\{x|x>1\} \cup \{x|x<-3\} = \{x|x>1 \text{ or } x<-3\}$

51. $|x-5|\leq 1$

$-1\leq x-5\leq 1$

$-1+5\leq x-5+5\leq 1+5$

$4\leq x\leq 6$

$\{x|4\leq x\leq 6\}$

53. $|2-x|\geq 3$

$2-x\leq -3$ or $2-x\geq 3$

$-x\leq -5$ $-x\geq 1$

$x\geq 5$ $x\leq -1$

$\{x|x\geq 5\}$ $\{x|x\leq -1\}$

$\{x|x\geq 5\} \cup \{x|x\leq -1\} = \{x|x\geq 5 \text{ or } x\leq -1\}$

55. $|2x+1|<5$

$-5<2x+1<5$

$-5-1<2x+1-1<5-1$

$-6<2x<4$

$\frac{-6}{2}<\frac{2x}{2}<\frac{4}{2}$

$-3<x<2$

$\{x|-3<x<2\}$

57. $|5x+2|>12$

$5x+2>12$ or $5x+2<-12$

$5x>10$ $5x<-14$

$x>2$ $x<-\frac{14}{5}$

$\{x|x>2\}$ $\{x|x<-\frac{14}{5}\}$

$\{x|x>2\} \cup \{x|x<-\frac{14}{5}\} = \{x|x>2 \text{ or } x<-\frac{14}{5}\}$

59. $|4x-3|\leq 2$

The absolute value of a number must be non-negative. The solution set is the empty set, \emptyset .

61. $|2x+7|>-5$

$2x+7>-5$ or $2x+7<5$

$2x>-12$ $2x<-2$

$x>-6$ $x<-1$

$\{x|x>-6\}$ $\{x|x<-1\}$

$\{x|x>-6\} \cup \{x|x<-1\} = \{x|x \text{ is a real number}\}$

63. $|4-3x|\geq 5$

$4-3x\geq 5$ or $4-3x\leq -5$

$-3x\geq 1$ $-3x\leq -9$

$x\leq -\frac{1}{3}$ $x\geq 3$

$\{x|x\leq -\frac{1}{3}\}$ $\{x|x\geq 3\}$

$\{x|x\leq -\frac{1}{3}\} \cup \{x|x\geq 3\} = \{x|x\leq -\frac{1}{3} \text{ or } x\geq 3\}$

65. $|5-4x|\leq 13$

$-13\leq 5-4x\leq 13$

$-13-5\leq 5-5-4x\leq 13-5$

$-18\leq -4x\leq 8$

$\frac{-18}{-4}\geq\frac{-4x}{-4}\geq\frac{8}{-4}$

$\frac{9}{2}\geq x\geq -2$

$\{x|-\frac{9}{2}\leq x\leq 2\}$

$\{x|-2\leq x\leq \frac{9}{2}\}$

$$\begin{aligned}
 67. \quad & |6 - 3x| \leq 0 \\
 & 6 - 3x = 0 \\
 & -3x = -6 \\
 & x = 2 \\
 & \{x | x = 2\}
 \end{aligned}$$

$$\begin{aligned}
 69. \quad & |2 - 9x| > 20 \\
 & 2 - 9x > 20 \quad \text{or} \quad 2 - 9x < -20 \\
 & -9x > 18 \qquad -9x < -22 \\
 & x < -2 \qquad \qquad x > \frac{22}{9} \\
 & \{x | x < -2\} \cup \left\{x \mid x > \frac{22}{9}\right\} = \left\{x \mid x < -2 \text{ or } x > \frac{22}{9}\right\}
 \end{aligned}$$

Objective 3 Exercises

71. Strategy

Let b represent the diameter of the bushing, T the tolerance, and d the lower and upper limits of the diameter. Solve the absolute value inequality $|d - b| \leq T$ for d .

Solution

$$\begin{aligned}
 & |d - b| \leq T \\
 & |d - 1.75| \leq 0.008 \\
 & -0.008 \leq d - 1.75 \leq 0.008 \\
 & -0.008 + 1.75 \leq d - 1.75 + 1.75 \leq 0.008 + 1.75 \\
 & 1.742 \leq d \leq 1.758
 \end{aligned}$$

The lower and upper limits of the diameter of the bushing are 1.742 in. and 1.758 in.

73. Strategy

Let p represent the prescribed amount of medication, T the tolerance, and m the lower and upper limits of the amount of medication. Solve the absolute value inequality $|m - p| \leq T$ for m .

Solution

$$\begin{aligned}
 & |m - p| \leq T \\
 & |m - 2.5| \leq 0.2 \\
 & -0.2 \leq m - 2.5 \leq 0.2 \\
 & -0.2 + 2.5 \leq m - 2.5 + 2.5 \leq 0.2 + 2.5 \\
 & 2.3 \leq m \leq 2.7
 \end{aligned}$$

The lower and upper limits of the amount of medicine to be given to the patient are 2.3 cc and 2.7 cc.

75. Strategy

Let v represent the prescribed number of volts, T the tolerance, and m the upper and lower limits of the amount of voltage. Solve the absolute value inequality $|m - v| \leq T$ for m .

Solution

$$\begin{aligned}
 & |m - v| \leq T \\
 & |m - 220| \leq 25 \\
 & -25 \leq m - 220 \leq 25 \\
 & -25 + 220 \leq m - 220 + 220 \leq 25 + 220 \\
 & 195 \leq m \leq 245
 \end{aligned}$$

The lower and upper limits of the amount of voltage on which the motor will run are 195 volts and 245 volts.

77. Strategy

Let r represent the diameter of the piston rod, T the tolerance, and L the lower and upper limits of the diameter. Solve the absolute value inequality $|L - r| \leq T$ for L .

Solution

$$\begin{aligned}
 & |L - r| \leq T \\
 & \left|L - 3\frac{5}{16}\right| \leq \frac{1}{64} \\
 & -\frac{1}{64} \leq L - 3\frac{5}{16} \leq \frac{1}{64} \\
 & -\frac{1}{64} + 3\frac{5}{16} \leq L - 3\frac{5}{16} + 3\frac{5}{16} \leq \frac{1}{64} + 3\frac{5}{16} \\
 & -\frac{1}{64} + 3\frac{5}{16} \leq L - 3\frac{5}{16} + 3\frac{5}{16} \leq \frac{1}{64} + 3\frac{5}{16} \\
 & 3\frac{19}{64} \leq L \leq 3\frac{21}{64}
 \end{aligned}$$

The lower and upper limits of the length of the piston rod are $3\frac{19}{64}$ in. and $3\frac{21}{64}$ in.

79. Strategy

Let M represent the amount of ohms, T the tolerance, and r the given amount of the resistor. Find the tolerance and solve $|M - r| \leq T$ for M .

Solution

$$T = (0.10)(15,000) = 1500 \text{ ohms}$$

$$|M - r| \leq T$$

$$|M - 15,000| \leq 1,500$$

$$-1,500 \leq M - 15,000 \leq 1,500$$

$$-1,500 + 15,000 \leq M - 15,000 + 15,000 \leq 1,500 + 15,000$$

$$13,500 \leq M \leq 16,500$$

The lower and upper limits of the resistor are 13,500 ohms and 16,500 ohms.

81. Strategy

Let M represent the amount of ohms, T the tolerance, and r the given amount of the resistor. Find the tolerance and solve $|M - r| \leq T$ for M .

Solution

$$T = (.05)(56) = 2.8$$

$$|M - r| \leq T$$

$$|M - 56| \leq 2.8$$

$$-2.8 \leq M - 56 \leq 2.8$$

$$-2.8 + 56 \leq M - 56 + 56 \leq 2.8 + 56$$

$$53.2 \leq M \leq 58.8$$

The lower and upper limits of the resistor are 53.2 ohms and 58.8 ohms.

Applying Concepts 2.6

$$83. \left| \frac{3x-2}{4} \right| + 5 = 6$$

$$\left| \frac{3x-2}{4} \right| = 1$$

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

$$3x-2 = 4 \qquad 3x-2 = -4$$

$$3x = 6 \qquad 3x = -2$$

$$x = 2 \qquad x = -\frac{2}{3}$$

The solutions are 2 and $-\frac{2}{3}$.

$$85. \left| \frac{2x-1}{5} \right| \leq 3$$

$$-3 \leq \frac{2x-1}{5} \leq 3$$

$$5(-3) \leq 5\left(\frac{2x-1}{5}\right) \leq 5(3)$$

$$-15 \leq 2x-1 \leq 15$$

$$-15+1 \leq 2x-1+1 \leq 15+1$$

$$-14 \leq 2x \leq 16$$

$$\frac{-14}{2} \leq \frac{2x}{2} \leq \frac{16}{2}$$

$$-7 \leq x \leq 8$$

$$\{x | -7 \leq x \leq 8\}$$

$$87. |y+6| = y+6$$

Any value of y that makes $y+6$ negative will result in a false equation because the left side of the equation will be positive and the right side of the equation will be negative. Therefore, the equation is true if $y+6$ is greater than or equal to zero.

$$y+6 \geq 0$$

$$y \geq -6$$

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

$$89. |b-7| = 7-b$$

Any value of b that makes $7-b$ negative will result in a false equation because the left side of the equation will be positive and the right side of the equation will be negative. Therefore, the equation is true if $7-b$ is greater than or equal to zero.

$$7-b \geq 0$$

$$b \leq 7$$

$$\{b | b \leq 7\}$$

$$91. |x-5| < 2$$

$$93. \text{ a. } |x+y| \leq |x|+|y|$$

$$\text{ b. } |x-y| \geq |x|-|y|$$

$$\text{ c. } ||x|-|y|| \geq |x|-|y|$$

$$\text{ d. } \left| \frac{x}{y} \right| = \frac{|x|}{|y|}, y \neq 0$$

$$\text{ e. } |xy| = |x||y|$$

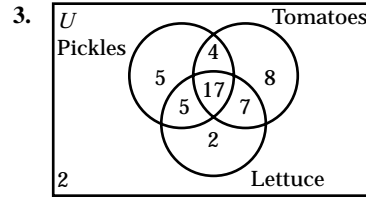
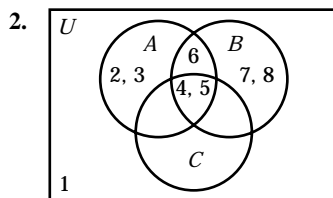
Focus on Problem Solving

- The goal is to find the cost of iced tea.
 - The information that Johanna spent one-third of her allowance on a book is unnecessary.
 - Johanna spent \$5 for a sandwich and tea, and one-fifth of this cost was for the iced tea. This is sufficient information for us to find the cost of iced tea.
- The goal is to find the speed of the plane.
 - To find the speed, we need to know the time of travel and the distance. We do not know the distance. There is not enough information to find the speed of the plane.
- The goal is to find the amount of cowhide that will cover 10 baseballs.
 - The formula for the surface area of a sphere is needed. It can be found in a reference book.
 - The radius of the baseball is all the dimensions that are needed to find the surface area of the cowhide.
- The number in a baker's dozen can be found in a reference book. Multiply this number by 7 and you will find the number of donuts.
- The goal is to find the size of the smallest prime number.
 - The first line indicates that the smallest prime number is 2. The rest of the information is unnecessary.

Projects and Group Activities

Venn Diagrams

- 9
 - 11
 - 2



- 5
- 7
- 2

Absolute Value Equations and Inequalities

- $|3x - 4| = |5x - 8|$
 $3x - 4 = 5x - 8$ or $3x - 4 = -(5x - 8)$
 $-2x = -4$ $3x - 4 = -5x + 8$
 $x = 2$ $8x = 12$
 $x = \frac{3}{2}$
 The solutions are 2 and $\frac{3}{2}$.
- $|5x - 3| = |3x - 3|$
 $5x - 3 = 3x - 3$ or $5x - 3 = -(3x - 3)$
 $2x = 0$ $5x - 3 = -3x + 3$
 $x = 0$ $8x = 6$
 $x = \frac{3}{4}$
 The solutions are 0 and $\frac{3}{4}$.
- $|2x - 1| = |x|$
 $2x - 1 = x$ or $2x - 1 = -x$
 $x = 1$ $3x = 1$
 $x = \frac{1}{3}$
 The solutions are 1 and $\frac{1}{3}$.
- $|x + 1| = |x|$
 $x + 1 = x$ or $x + 1 = -x$
 $1 = 0$ $2x = -1$
 no solution $x = -\frac{1}{2}$
 The solution is $-\frac{1}{2}$.

$$5. \quad \left| \frac{2x-3}{5} \right| = |2-x|$$

$$\frac{2x-3}{5} = 2-x \quad \text{or} \quad \frac{2x-3}{5} = -(2-x)$$

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

$$2x-3 = 10-5x \quad 5\left(\frac{2x-3}{5}\right) = 5(-2+x)$$

$$7x = 13 \quad 2x-3 = -10+5x$$

$$x = \frac{13}{7} \quad -3x = -7$$

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

The solutions are $\frac{13}{7}$ and $\frac{7}{3}$.

$$6. \quad \left| \frac{3-2x}{3} \right| = \left| \frac{x-4}{2} \right|$$

$$\frac{3-2x}{3} = \frac{x-4}{2} \quad \text{or} \quad \frac{3-2x}{3} = -\left(\frac{x-4}{2}\right)$$

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

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

$$6-4x = 3x-12 \quad 2(3-2x) = 3(-x+4)$$

$$-7x = -18 \quad 6-4x = -3x+12$$

$$x = \frac{18}{7} \quad -x = 6$$

$$x = -6$$

The solutions are $\frac{18}{7}$ and -6 .

$$7. \quad |2x-3| > |2x-5|$$

$$(2x-3)^2 > (2x-5)^2$$

$$4x^2 - 12x + 9 > 4x^2 - 20x + 25$$

$$4x^2 - 4x^2 - 12x + 9 > 4x^2 - 4x^2 - 20x + 25$$

$$-12x + 9 > -20x + 25$$

$$8x + 9 > 25$$

$$8x > 16$$

$$x > 2$$

The solution is $\{x|x > 2\}$.

$$8. \quad |x+4| < |3-x|$$

$$(x+4)^2 < (3-x)^2$$

$$x^2 + 8x + 16 < 9 - 6x + x^2$$

$$x^2 - x^2 + 8x + 16 < 9 - 6x + x^2 - x^2$$

$$8x + 16 < 9 - 6x$$

$$14x + 16 < 9$$

$$14x < -7$$

$$x < -\frac{1}{2}$$

The solution is $\left\{x \mid x < -\frac{1}{2}\right\}$.

$$9. \quad |3x-2| < |3x+2|$$

$$(3x-2)^2 < (3x+2)^2$$

$$9x^2 - 12x + 4 < 9x^2 + 12x + 4$$

$$9x^2 - 9x^2 - 12x + 4 < 9x^2 - 9x^2 + 12x + 4$$

$$-12x + 4 < 12x + 4$$

$$-24x + 4 < 4$$

$$-24x < 0$$

$$x > 0$$

The solution is $\{x|x > 0\}$.

Chapter Review Exercises

$$1. \quad x+4 = -5$$

$$x+4-4 = -5-4$$

$$x = -9$$

The solution is -9 .

$$2. \quad \frac{2}{3} = x + \frac{3}{4}$$

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

$$\frac{8}{12} - \frac{9}{12} = x$$

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

The solution is $-\frac{1}{12}$.

$$3. \quad -3x = -21$$

$$\frac{-3x}{-3} = \frac{-21}{-3}$$

$$x = 7$$

The solution is 7 .

$$4. \quad \frac{2}{3}x = \frac{4}{9}$$

$$\frac{3}{2}\left(\frac{2}{3}x\right) = \frac{3}{2}\left(\frac{4}{9}\right)$$

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

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

$$5. \quad 3y-5 = 3-2y$$

$$3y+2y-5 = 3-2y+2y$$

$$5y-5 = 3$$

$$5y-5+5 = 3+5$$

$$5y = 8$$

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

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

The solution is $\frac{8}{5}$.

6. $3x - 3 + 2x = 7x - 15$

$5x - 3 = 7x - 15$

$5x - 3 - 7x = 7x - 15 - 7x$

$-2x - 3 = -15$

$-2x - 3 + 3 = -15 + 3$

$-2x = -12$

$\frac{-2x}{-2} = \frac{-12}{-2}$

$x = 6$

The solution is 6.

7. $2(x - 3) = 5(4 - 3x)$

$2x - 6 = 20 - 15x$

$2x - 6 + 15x = 20 - 15x + 15x$

$17x - 6 = 20$

$17x - 6 + 6 = 20 + 6$

$17x = 26$

$\frac{17x}{17} = \frac{26}{17}$

$x = \frac{26}{17}$

The solution is $\frac{26}{17}$.

8. $2x - (3 - 2x) = 4 - 3(4 - 2x)$

$2x - 3 + 2x = 4 - 12 + 6x$

$4x - 3 = -8 + 6x$

$4x - 3 - 6x = -8 + 6x - 6x$

$-2x - 3 = -8$

$-2x - 3 + 3 = -8 + 3$

$-2x = -5$

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

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

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

9. $\frac{1}{2}x - \frac{5}{8} = \frac{3}{4}x + \frac{3}{2}$

$8\left(\frac{1}{2}x - \frac{5}{8}\right) = 8\left(\frac{3}{4}x + \frac{3}{2}\right)$

$8\left(\frac{1}{2}x\right) - 8\left(\frac{5}{8}\right) = 8\left(\frac{3}{4}x\right) + 8\left(\frac{3}{2}\right)$

$4x - 5 = 6x + 12$

$4x - 5 - 6x = 6x + 12 - 6x$

$-2x - 5 = 12$

$-2x - 5 + 5 = 12 + 5$

$-2x = 17$

$\frac{-2x}{-2} = \frac{17}{-2}$

$x = -\frac{17}{2}$

The solution is $-\frac{17}{2}$.

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

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

$\frac{15(2x - 3)}{3} + 15(2) = \frac{15(2 - 3x)}{5}$

$5(2x - 3) + 30 = 3(2 - 3x)$

$10x - 15 + 30 = 6 - 9x$

$10x + 15 = 6 - 9x$

$10x + 15 + 9x = 6 - 9x + 9x$

$19x + 15 = 6$

$19x + 15 - 15 = 6 - 15$

$19x = -9$

$\frac{19x}{19} = \frac{-9}{19}$

$x = -\frac{9}{19}$

The solution is $-\frac{9}{19}$.

11. $3x - 7 > -2$

$3x > 5$

$\frac{3x}{3} > \frac{5}{3}$

$x > \frac{5}{3}$

The solution is $\left(\frac{5}{3}, \infty\right)$.

12. $2x - 9 < 8x + 15$

$2x - 8x - 9 < 8x - 8x + 15$

$-6x - 9 < 15$

$-6x - 9 + 9 < 15 + 9$

$-6x < 24$

$\frac{-6x}{-6} > \frac{24}{-6}$

$x > -4$

The solution is $(-4, \infty)$.

13. $\frac{2}{3}x - \frac{5}{8} \geq \frac{5}{4}x + 3$

$24\left(\frac{2}{3}x - \frac{5}{8}\right) \geq 24\left(\frac{5}{4}x + 3\right)$

$16x - 15 \geq 30x + 72$

$16x - 30x - 15 \geq 30x - 30x + 72$

$-14x - 15 \geq 72$

$-14x - 15 + 15 \geq 72 + 15$

$-14x \geq 87$

$\frac{-14x}{-14} \leq \frac{87}{-14}$

$x \leq -\frac{87}{14}$

The solution is $\left\{x \mid x \leq -\frac{87}{14}\right\}$.

$$\begin{aligned}
 14. \quad & 2-3(x-4) \leq 4x-2(1-3x) \\
 & 2-3x+12 \leq 4x-2+6x \\
 & -3x+14 \leq 10x-2 \\
 & -3x-10x+14 \leq 10x-10x-2 \\
 & -13x+14 \leq -2 \\
 & -13x+14-14 \leq -2-14 \\
 & -13x \leq -16 \\
 & \frac{-13x}{-13} \geq \frac{-16}{-13} \\
 & x \geq \frac{16}{13}
 \end{aligned}$$

The solution is $\left\{x \mid x \geq \frac{16}{13}\right\}$.

$$\begin{aligned}
 15. \quad & -5 < 4x-1 < 7 \\
 & -5+1 < 4x-1+1 < 7+1 \\
 & -4 < 4x < 8 \\
 & \frac{-4}{4} < \frac{4x}{4} < \frac{8}{4} \\
 & -1 < x < 2
 \end{aligned}$$

The solution is $(-1, 2)$.

$$\begin{aligned}
 16. \quad & 5x-2 > 8 \quad \text{or} \quad 3x+2 < -4 \\
 & 5x > 10 \quad 3x < -6 \\
 & x > 2 \quad x < -2 \\
 & \{x \mid x > 2\} \quad \{x \mid x < -2\} \\
 & \{x \mid x > 2\} \cup \{x \mid x < -2\} = \{x \mid x > 2 \text{ or } x < -2\}
 \end{aligned}$$

The solution is $(-\infty, -2) \cup (2, \infty)$.

$$\begin{aligned}
 17. \quad & 3x < 4 \quad \text{and} \quad x+2 > -1 \\
 & x < \frac{4}{3} \quad x > -3 \\
 & \left\{x \mid x < \frac{4}{3}\right\} \quad \{x \mid x > -3\} \\
 & \left\{x \mid x < \frac{4}{3}\right\} \cap \{x \mid x > -3\} = \left\{x \mid -3 < x < \frac{4}{3}\right\}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & 3x-2 > -4 \quad \text{or} \quad 7x-5 < 3x+3 \\
 & 3x > -2 \quad 4x-5 < 3 \\
 & \frac{3x}{3} > \frac{-2}{3} \quad 4x < 8 \\
 & x > -\frac{2}{3} \quad \frac{4x}{4} < \frac{8}{4} \\
 & x > -\frac{2}{3} \quad x < 2 \\
 & \left\{x \mid x > -\frac{2}{3}\right\} \quad \{x \mid x < 2\} \\
 & \left\{x \mid x > -\frac{2}{3}\right\} \cup \{x \mid x < 2\} = \{x \mid x \text{ is any real number}\}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & |2x-3| = 8 \\
 & 2x-3 = 8 \quad \text{or} \quad 2x-3 = -8 \\
 & 2x = 11 \quad 2x = -5 \\
 & x = \frac{11}{2} \quad x = -\frac{5}{2} \\
 & \text{The solutions are } \frac{11}{2} \text{ and } -\frac{5}{2}.
 \end{aligned}$$

$$\begin{aligned}
 20. \quad & |5x+8| = 0 \\
 & 5x+8 = 0 \\
 & 5x = -8 \\
 & x = -\frac{8}{5} \\
 & \text{The solution is } -\frac{8}{5}.
 \end{aligned}$$

$$\begin{aligned}
 21. \quad & 6 + |3x-3| = 2 \\
 & |3x-3| = -4 \\
 & \text{There is no solution to this equation because the absolute value of a number must be non-negative.}
 \end{aligned}$$

$$\begin{aligned}
 22. \quad & |2x-5| \leq 3 \\
 & -3 \leq 2x-5 < 3 \\
 & -3+5 \leq 2x-5+5 \leq 3+5 \\
 & 2 \leq 2x \leq 8 \\
 & \frac{2}{2} \leq \frac{2x}{2} \leq \frac{8}{2} \\
 & 1 \leq x \leq 4
 \end{aligned}$$

The solution is $\{x \mid 1 \leq x \leq 4\}$.

$$\begin{aligned}
 23. \quad & |4x-5| \geq 3 \\
 & 4x-5 \geq 3 \quad \text{or} \quad 4x-5 \leq -3 \\
 & 4x \geq 8 \quad 4x \leq 2 \\
 & x \geq 2 \quad x \leq \frac{1}{2} \\
 & \{x \mid x \geq 2\} \quad \left\{x \mid x \leq \frac{1}{2}\right\} \\
 & \{x \mid x \geq 2\} \cup \left\{x \mid x \leq \frac{1}{2}\right\} = \left\{x \mid x \leq \frac{1}{2} \text{ or } x \geq 2\right\}
 \end{aligned}$$

$$\begin{aligned}
 24. \quad & |5x-4| < -2 \\
 & \text{There is no solution to this equation because the absolute value of a number must be non-negative.}
 \end{aligned}$$

25. Strategy
Let b represent the diameter of the bushing, T the tolerance, and d the lower and upper limits of the diameter. Solve the absolute value inequality $|d-b| \leq T$ for d .

$$\begin{aligned}
 \text{Solution} \\
 & |d-b| \leq T \\
 & |d-2.75| \leq 0.003 \\
 & -0.003 \leq d-2.75 \leq 0.003 \\
 & -0.003+2.75 \leq d-2.75+2.75 \leq 0.003+2.75 \\
 & 2.747 \leq d \leq 2.753
 \end{aligned}$$

The lower and upper limits of the diameter of the bushing are 2.747 in. and 2.753 in.

26. Strategy

Let p represent the prescribed amount of medication, T the tolerance, and m the lower and upper limits of the amount of medication. Solve the absolute value inequality $|m - p| \leq T$ for m .

Solution

$$|m - p| \leq T$$

$$|m - 2| \leq 0.25$$

$$-0.25 \leq m - 2 \leq 0.25$$

$$-0.25 + 2 \leq m - 2 + 2 \leq 0.25 + 2$$

$$1.75 \leq m \leq 2.25$$

The lower and upper limits of the amount of medicine to be given to the patient are 1.75 cc and 2.25 cc.

27. Strategy

The smaller integer: n

The larger integer: $20 - n$

Five times the smaller integer is two more than twice the larger integer.

$$5n = 2 + 2(20 - n)$$

Solution

$$5n = 2 + 2(20 - n)$$

$$5n = 2 + 40 - 2n$$

$$5n = 42 - 2n$$

$$7n = 42$$

$$n = 6$$

$$20 - n = 20 - 6 = 14$$

The integers are 6 and 14.

28. Strategy

First consecutive integer: x

Second consecutive integer: $x + 1$

Third consecutive integer: $x + 2$

Five times the middle integer is twice the sum of the other two integers.

$$5(x + 1) = 2[x + (x + 2)]$$

Solution

$$5(x + 1) = 2[x + (x + 2)]$$

$$5x + 5 = 2(2x + 2)$$

$$5x + 5 = 4x + 4$$

$$x + 5 = 4$$

$$x = -1$$

$$x + 1 = -1 + 1 = 0$$

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

The integers are -1 , 0 , and 1 .

29. Strategy

Number of nickels: x

Number of dimes: $x + 3$

Number of quarters: $30 - (2x + 3) = 27 - 2x$

Coin	Number	Value	Total Value
Nickel	x	5	$5x$
Dime	$x + 3$	10	$10(x + 3)$
Quarter	$27 - 2x$	25	$25(27 - 2x)$

The sum of the total values of each type of coin equals the total value of all the coins (355 cents).
 $5x + 10(x + 3) + 25(27 - 2x) = 355$

Solution

$$5x + 10(x + 3) + 25(27 - 2x) = 355$$

$$5x + 10x + 30 + 675 - 50x = 355$$

$$-35x + 705 = 355$$

$$-35x = -350$$

$$x = 10$$

$$27 - 2x = 27 - 2(10) = 27 - 20 = 7$$

There are 7 quarters in the collection.

30. Strategy

Cost per ounce of the mixture: x

	Amount	Cost	Value
Pure silver	40	\$8.00	$8(40)$
Alloy	200	\$3.50	$3.50(200)$
Mixture	240	x	$240x$

The sum of the values before mixing equals the value after mixing.

$$8(40) + 3.50(200) = 240x$$

Solution

$$8(40) + 3.50(200) = 240x$$

$$320 + 700 = 240x$$

$$1020 = 240x$$

$$4.25 = x$$

The mixture costs \$4.25 per ounce.

31. Strategy
Gallons of apple juice: x

	Amount	Cost	Value
Apple juice	x	3.20	$3.20x$
Cranberry juice	40	5.50	$40(5.50)$
Mixture	$40 + x$	4.20	$4.20(40 + x)$

The sum of the values before mixing equals the value after mixing.

$$3.20x + 40(5.50) = 4.20(40 + x)$$

Solution

$$3.20x + 40(5.50) = 4.20(40 + x)$$

$$3.20x + 220 = 168 + 4.20x$$

$$-x = -52$$

$$x = 52$$

The mixture must contain 52 gal of apple juice.

32. Strategy
Rate of the first plane: r
Rate of the second plane: $r + 80$

	Rate	Time	Distance
1st plane	r	1.75	$1.75r$
2nd plane	$r + 80$	1.75	$1.75(r + 80)$

The total distance traveled by the two planes is 1680 mi.

$$1.75r + 1.75(r + 80) = 1680$$

Solution

$$1.75r + 1.75(r + 80) = 1680$$

$$1.75r + 1.75r + 140 = 1680$$

$$3.5r + 140 = 1680$$

$$3.5r = 1540$$

$$r = 440$$

$$r + 80 = 440 + 80 = 520$$

The speed of the first plane is 440 mph. The speed of the second plane is 520 mph.

33. Strategy
Amount invested at 10.5%: x
Amount invested at 6.4%: $8000 - x$

	Principal	Rate	Interest
Amount at 10.5%	x	0.105	$0.105x$
Amount at 6.4%	$8000 - x$	0.064	$0.064(8000 - x)$

The sum of the interest earned by the two investments equals the total annual interest earned (\$635).

$$0.105x + 0.064(8000 - x) = 635$$

Solution

$$0.105x + 0.064(8000 - x) = 635$$

$$0.105x + 512 - 0.064x = 635$$

$$0.041x + 512 = 635$$

$$0.041x = 123$$

$$x = 3000$$

$$8000 - x = 8000 - 3000 = 5000$$

The amount invested at 10.5% was \$3000.

The amount invested at 6.4% was \$5000.

34. Strategy
Pounds of 30% tin: x
Pounds of 70% tin: $500 - x$

	Amount	Percent	Quantity
30%	x	0.30	$0.30x$
70%	$500 - x$	0.70	$0.70(500 - x)$
40%	500	0.40	$0.40(500)$

The sum of the quantities before mixing is equal to the quantity after mixing.

$$0.30x + 0.70(500 - x) = 0.40(500)$$

Solution

$$0.30x + 0.70(500 - x) = 0.40(500)$$

$$0.30x + 350 - 0.70x = 200$$

$$-0.40x + 350 = 200$$

$$-0.40x = -150$$

$$x = 375$$

$$500 - x = 500 - 375 = 125$$

375 lb of 30% tin and 125 lb of 70% tin were used.

35. Strategy
To find the minimum amount of sales, write and solve an inequality using N to represent the amount of sales.

Solution

$$800 + 0.04N \geq 3000$$

$$0.04N \geq 2200$$

$$N \geq 55,000$$

The executive's amount of sales must be \$55,000 or more.

36. Strategy

To find the range of scores, write and solve an inequality using N to represent the score on the last test.

Solution

$$80 \leq \frac{92 + 66 + 72 + 88 + N}{5} \leq 90$$

$$80 \leq \frac{318 + N}{5} \leq 90$$

$$5 \cdot 80 \leq 5 \cdot \frac{318 + N}{5} \leq 5 \cdot 90$$

$$400 \leq 318 + N \leq 450$$

$$400 - 318 \leq 318 + N - 318 \leq 450 - 318$$

$$82 \leq N \leq 132$$

Since 100 is the maximum score, the range of scores to receive a B grade is $82 \leq x \leq 100$.

Chapter Test

1. $x - 2 = -4$

$$x - 2 + 2 = -4 + 2$$

$$x = -2$$

The solution is -2 .

2. $x + \frac{3}{4} = \frac{5}{8}$

$$x + \frac{3}{4} - \frac{3}{4} = \frac{5}{8} - \frac{3}{4}$$

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

$$x = -\frac{1}{8}$$

The solution is $-\frac{1}{8}$.

3. $-\frac{3}{4}y = -\frac{5}{8}$

$$-\frac{4}{3}\left(-\frac{3}{4}y\right) = -\frac{4}{3}\left(-\frac{5}{8}\right)$$

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

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

4. $3x - 5 = 7$

$$3x - 5 + 5 = 7 + 5$$

$$3x = 12$$

$$\frac{3x}{3} = \frac{12}{3}$$

$$x = 4$$

The solution is 4.

5. $\frac{3}{4}y - 2 = 6$

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

$$\frac{3}{4}y = 8$$

$$\frac{4}{3}\left(\frac{3}{4}y\right) = \frac{4}{3}(8)$$

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

The solution is $\frac{32}{3}$.

6. $2x - 3 - 5x = 8 + 2x - 10$

$$-3x - 3 = -2 + 2x$$

$$-3x - 3 + 3x = -2 + 2x + 3x$$

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

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

$$-1 = 5x$$

$$\frac{-1}{5} = \frac{5x}{5}$$

$$-\frac{1}{5} = x$$

$$x = -\frac{1}{5}$$

The solution is $-\frac{1}{5}$.

7. $2[x - (2 - 3x) - 4] = x - 5$

$$2[x - 2 + 3x - 4] = x - 5$$

$$2[4x - 6] = x - 5$$

$$8x - 12 = x - 5$$

$$8x - x - 12 = x - x - 5$$

$$7x - 12 = -5$$

$$7x - 12 + 12 = -5 + 12$$

$$7x = 7$$

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

$$x = 1$$

The solution is 1.

8. $\frac{2}{3}x - \frac{5}{6}x = 4$

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

$$-\frac{1}{6}x = 4$$

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

$$x = -24$$

The solution is -24 .

$$\begin{aligned}
 9. \quad & \frac{2x+1}{3} - \frac{3x+4}{6} = \frac{5x-9}{9} \\
 & 18\left(\frac{2x+1}{3} - \frac{3x+4}{6}\right) = 18\left(\frac{5x-9}{9}\right) \\
 & 18\left(\frac{2x+1}{3}\right) - 18\left(\frac{3x+4}{6}\right) = 18\left(\frac{5x-9}{9}\right) \\
 & 6(2x+1) - 3(3x+4) = 2(5x-9) \\
 & 12x+6-9x-12 = 10x-18 \\
 & \quad 3x-6 = 10x-18 \\
 & 3x-6-10x = 10x-18-10x \\
 & \quad -7x-6 = -18 \\
 & \quad -7x-6+6 = -18+6 \\
 & \quad -7x = -12 \\
 & \quad \frac{-7x}{-7} = \frac{-12}{-7} \\
 & \quad x = \frac{12}{7}
 \end{aligned}$$

The solution is $\frac{12}{7}$.

$$\begin{aligned}
 10. \quad & 2x-5 \geq 5x+4 \\
 & -3x-5 \geq 4 \\
 & \quad -3x \geq 9 \\
 & \quad \frac{-3x}{-3} \leq \frac{9}{-3} \\
 & \quad x \leq -3 \\
 & (-\infty, -3]
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & 4-3(x+2) < 2(2x+3)-1 \\
 & 4-3x-6 < 4x+6-1 \\
 & -2-3x < 4x+5 \\
 & \quad -7x < 7 \\
 & \quad \frac{-7x}{-7} > \frac{7}{-7} \\
 & \quad x > -1 \\
 & (-1, \infty)
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & 3x-2 > 4 \quad \text{or} \quad 4-5x < 14 \\
 & 3x > 6 \quad -5x < 10 \\
 & x > 2 \quad \frac{-5x}{-5} > \frac{10}{-5} \\
 & \quad \quad \quad x > -2 \\
 & \{x|x > 2\} \quad \{x|x > -2\} \\
 & \{x|x > 2\} \cup \{x|x > -2\} = \{x|x > -2\}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & 4-3x \geq 7 \quad \text{and} \quad 2x+3 \geq 7 \\
 & -3x \geq 3 \quad 2x \geq 4 \\
 & \frac{-3x}{-3} \leq \frac{3}{-3} \quad \frac{2x}{2} \geq \frac{4}{2} \\
 & \quad x \leq -1 \quad x \geq 2 \\
 & \{x|x \leq -1\} \cap \{x|x \geq 2\} = \emptyset
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & |3-5x|=12 \\
 & 3-5x=12 \quad 3-5x=-12 \\
 & -5x=9 \quad -5x=-15 \\
 & \quad x = -\frac{9}{5} \quad x = 3
 \end{aligned}$$

The solutions are $-\frac{9}{5}$ and 3.

$$\begin{aligned}
 15. \quad & 2-|2x-5| = -7 \\
 & -|2x-5| = -9 \\
 & |2x-5| = 9 \\
 & 2x-5=9 \quad 2x-5=-9 \\
 & 2x=14 \quad 2x=-4 \\
 & x=7 \quad x=-2
 \end{aligned}$$

The solutions are 7 and -2.

$$\begin{aligned}
 16. \quad & |3x-1| \leq 2 \\
 & -2 \leq 3x-1 \leq 2 \\
 & -2+1 \leq 3x-1+1 \leq 2+1 \\
 & \quad -1 \leq 3x \leq 3 \\
 & \quad \frac{-1}{3} \leq \frac{3x}{3} \leq \frac{3}{3} \\
 & \quad -\frac{1}{3} \leq x \leq 1 \\
 & \left\{x \mid -\frac{1}{3} \leq x \leq 1\right\}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & |2x-1| > 3 \\
 & 2x-1 > 3 \quad \text{or} \quad 2x-1 < -3 \\
 & 2x > 4 \quad 2x < -2 \\
 & x > 2 \quad x < -1 \\
 & \{x|x > 2\} \cup \{x|x < -1\} = \{x|x > 2 \text{ or } x < -1\}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & 4+|2x-3|=1 \\
 & |2x-3| = -3
 \end{aligned}$$

There is no solution because the absolute value of a number is always non-negative.

19. Strategy
To find the number of miles, write and solve an inequality using N to represent the number of miles.

Solution

$$\begin{aligned}
 & \text{cost of car A} < \text{cost of car B} \\
 & 12 + 0.10N < 24 \\
 & 0.10N < 12 \\
 & N < 120
 \end{aligned}$$

It costs less to rent from Agency A if the car is driven less than 120 mi.

20. Strategy
Let p represent the prescribed amount of medication, T the tolerance, and m the lower and upper limits of the given amount of medication. Solve the absolute value inequality $|m-p| \leq T$ for m .

Solution

$$\begin{aligned}
 & |m-p| \leq T \\
 & |m-3| \leq 0.1 \\
 & -0.1 \leq m-3 \leq 0.1 \\
 & -0.1+3 \leq m-3+3 \leq 0.1+3 \\
 & \quad 2.9 \leq m \leq 3.1
 \end{aligned}$$

The lower and upper limits of the amount of medication to be given to the patient are 2.9 cc and 3.1 cc.

21. Strategy

Number of 15¢ stamps: x Number of 11¢ stamps: $2x$ Number of 24¢ stamps: $30 - 3x$

Stamp	Number	Value	Total Value
15¢	x	15	$15x$
11¢	$2x$	11	$11(2x)$
24¢	$30 - 3x$	24	$24(30 - 3x)$

The sum of the total values of each type of stamp equals the total value of all the stamps (440 cents).

$$15x + 11(2x) + 24(30 - 3x) = 440$$

Solution

$$15x + 11(2x) + 24(30 - 3x) = 440$$

$$15x + 22x + 720 - 72x = 440$$

$$-35x + 720 = 440$$

$$-35x = -280$$

$$x = 8$$

$$30 - 3x = 30 - 3(8) = 30 - 24 = 6$$

There are six 24¢ stamps.

22. Strategy

Price of hamburger mixture: x

	Amount	Cost	Value
\$1.60 hamburger	100	1.60	$1.60(100)$
\$3.20 hamburger	60	3.20	$3.20(60)$
Mixture	160	x	$160x$

The sum of the values before mixing equals the value after mixing.

$$1.60(100) + 3.20(60) = 160x$$

Solution

$$1.60(100) + 3.20(60) = 160x$$

$$160 + 192 = 160x$$

$$352 = 160x$$

$$2.20 = x$$

The price of the hamburger mixture is \$2.20/lb.

23. StrategyTime jogger runs a distance: t Time jogger returns same distance: $1\frac{45}{60} - t$

	Rate	Time	Distance
Jogger runs a distance	8	t	$8t$
Jogger returns same distance	6	$\frac{7}{4} - t$	$6\left(\frac{7}{4} - t\right)$

The jogger runs a distance and returns the same distance.

$$8t = 6\left(\frac{7}{4} - t\right)$$

Solution

$$8t = 6\left(\frac{7}{4} - t\right)$$

$$8t = \frac{21}{2} - 6t$$

$$14t = \frac{21}{2}$$

$$\frac{1}{14}(14t) = \frac{1}{14}\left(\frac{21}{2}\right)$$

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

The jogger ran for $\frac{3}{4}$ hour.

$$8t = 8 \cdot \frac{3}{4} = 6$$

The jogger ran a distance of 6 mi one way. The jogger ran a total distance of 12 mi.

24. StrategyAmount invested at 7.8%: x Amount invested at 9%: $12,000 - x$

	Principal	Rate	Interest
Amount invested at 7.8%	x	0.078	$0.078x$
Amount invested at 9%	$12,000 - x$	0.09	$0.09(12,000 - x)$

The sum of the interest earned by the two investments equals the total annual interest earned (\$1020).

$$0.078x + 0.09(12,000 - x) = 1020$$

Solution

$$0.078x + 0.09(12,000 - x) = 1020$$

$$0.078x + 1080 - 0.09x = 1020$$

$$-0.012x = -60$$

$$x = 5000$$

$$12,000 - x = 12,000 - 5000 = 7000$$

The amount invested at 7.8% was \$5000.

The amount invested at 9% was \$7000.

25. Strategy

Ounces of pure water: x

	Amount	Percent	Quantity
Pure water	x	0	0
8% salt	60	0.08	$0.08(60)$
3% salt	$60 + x$	0.03	$0.03(60 + x)$

The sum of the quantities before mixing is equal to the quantity after mixing.

$$0 + 0.08(60) = 0.03(60 + x)$$

Solution

$$0 + 0.08(60) = 0.03(60 + x)$$

$$4.8 = 1.8 + 0.03x$$

$$3 = 0.03x$$

$$100 = x$$

There are 100 oz of pure water.

Cumulative Review Exercises

$$1. -2^2 \cdot 3^3 = -(2 \cdot 2)(3 \cdot 3 \cdot 3) = -(4)(27) = -108$$

$$\begin{aligned} 2. 4 - (-2 - 5)^2 \div 3 + 2 &= 4 - (-3)^2 \div 3 + 2 \\ &= 4 - 9 \div 3 + 2 \\ &= 4 - 3 + 2 \\ &= 1 + 2 \\ &= 3 \end{aligned}$$

$$\begin{aligned} 3. 4 \div \frac{\frac{3}{8} - 1}{5} \cdot 2 &= 4 \div \frac{-\frac{5}{8}}{5} \cdot 2 \\ &= 4 \div \left(-\frac{5}{8} \cdot \frac{1}{5}\right) \cdot 2 \\ &= 4 \div \left(-\frac{1}{8}\right) \cdot 2 \\ &= 4 \cdot (-8) \cdot 2 \\ &= -32 \cdot 2 \\ &= -64 \end{aligned}$$

$$\begin{aligned} 4. 2a^2 - (b - c)^2 &= 2(2)^2 - (3 - (-1))^2 \\ &= 2 \cdot 4 - (3 + 1)^2 \\ &= 2 \cdot 4 - 4^2 \\ &= 2 \cdot 4 - 16 \\ &= 8 - 16 \\ &= -8 \end{aligned}$$

5. The Commutative Property of Addition

$$6. A \cap B = \{3, 9\}$$

$$\begin{aligned} 7. 3x - 2[x - 3(2 - 3x) + 5] &= 3x - 2[x - 6 + 9x + 5] \\ &= 3x - 2[10x - 1] \\ &= 3x - 20x + 2 \\ &= -17x + 2 \end{aligned}$$

$$\begin{aligned} 8. 5[y - 2(3 - 2y) + 6] &= 5[y - 6 + 4y + 6] \\ &= 5[5y] \\ &= 25y \end{aligned}$$

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

The solution is 2.

$$\begin{aligned} 10. -\frac{5}{6}b &= -\frac{5}{12} \\ \left(-\frac{6}{5}\right)\left(-\frac{5}{6}\right)b &= \left(-\frac{6}{5}\right)\left(-\frac{5}{12}\right) \\ b &= \frac{1}{2} \end{aligned}$$

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

$$\begin{aligned} 11. 2x + 5 &= 5x + 2 \\ 2x + 5 - 5x &= 5x + 2 - 5x \\ -3x + 5 &= 2 \\ -3x + 5 - 5 &= 2 - 5 \\ -3x &= -3 \\ \frac{-3x}{-3} &= \frac{-3}{-3} \\ x &= 1 \end{aligned}$$

The solution is 1.

$$\begin{aligned} 12. \frac{5}{12}x - 3 &= 7 \\ \frac{5}{12}x - 3 + 3 &= 7 + 3 \\ \frac{5}{12}x &= 10 \\ \left(\frac{12}{5}\right)\left(\frac{5}{12}\right)x &= \left(\frac{12}{5}\right)10 \\ x &= 24 \end{aligned}$$

The solution is 24.

$$\begin{aligned} 13. 2[3 - 2(3 - 2x)] &= 2(3 + x) \\ 2[3 - 6 + 4x] &= 6 + 2x \\ 2[-3 + 4x] &= 6 + 2x \\ -6 + 8x &= 6 + 2x \\ -6 + 8x - 2x &= 6 + 2x - 2x \\ -6 + 6x &= 6 \\ -6 + 6x + 6 &= 6 + 6 \\ 6x &= 12 \\ \frac{6x}{6} &= \frac{12}{6} \\ x &= 2 \end{aligned}$$

The solution is 2.

$$\begin{aligned}
 14. \quad & 3[2x - 3(4 - x)] = 2(1 - 2x) \\
 & 3[2x - 12 + 3x] = 2 - 4x \\
 & 3[5x - 12] = 2 - 4x \\
 & 15x - 36 = 2 - 4x \\
 & 15x - 36 + 4x = 2 - 4x + 4x \\
 & 19x - 36 = 2 \\
 & 19x - 36 + 36 = 2 + 36 \\
 & 19x = 38 \\
 & \frac{19x}{19} = \frac{38}{19} \\
 & x = 2
 \end{aligned}$$

The solution is 2.

$$\begin{aligned}
 15. \quad & \frac{3x-1}{4} - \frac{4x-1}{12} = \frac{3+5x}{8} \\
 & 24\left(\frac{3x-1}{4} - \frac{4x-1}{12}\right) = 24\left(\frac{3+5x}{8}\right) \\
 & \frac{24(3x-1)}{4} - \frac{24(4x-1)}{12} = \frac{24(3+5x)}{8} \\
 & 6(3x-1) - 2(4x-1) = 3(3+5x) \\
 & 18x - 6 - 8x + 2 = 9 + 15x \\
 & 10x - 4 = 9 + 15x \\
 & 10x - 4 - 15x = 9 + 15x - 15x \\
 & -5x - 4 = 9 \\
 & -5x - 4 + 4 = 9 + 4 \\
 & -5x = 13 \\
 & \frac{-5x}{-5} = \frac{13}{-5} \\
 & x = -\frac{13}{5}
 \end{aligned}$$

The solution is $-\frac{13}{5}$.

$$\begin{aligned}
 16. \quad & 3x - 2 \geq 6x + 7 \\
 & 3x \geq 6x + 9 \\
 & -3x \geq 9 \\
 & x \leq -3 \\
 & \{x|x \leq -3\}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & 5 - 2x \geq 6 \quad \text{and} \quad 3x + 2 \geq 5 \\
 & -2x \geq 1 \qquad \qquad 3x \geq 3 \\
 & x \leq -\frac{1}{2} \qquad \qquad x \geq 1 \\
 & \left\{x|x \leq -\frac{1}{2}\right\} \cap \{x|x \geq 1\} \\
 & \left\{x|x \leq -\frac{1}{2}\right\} \cap \{x|x \geq 1\} = \emptyset
 \end{aligned}$$

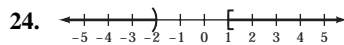
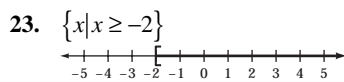
$$\begin{aligned}
 18. \quad & 4x - 1 > 5 \quad \text{or} \quad 2 - 3x < 8 \\
 & 4x > 6 \qquad \qquad -3x < 6 \\
 & x > \frac{3}{2} \qquad \qquad x > -2 \\
 & \left\{x|x > \frac{3}{2}\right\} \cup \{x|x > -2\} \\
 & \left\{x|x > \frac{3}{2}\right\} \cup \{x|x > -2\} = \{x|x > -2\}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & |3 - 2x| = 5 \\
 & 3 - 2x = 5 \qquad \qquad 3 - 2x = -5 \\
 & -2x = 2 \qquad \qquad -2x = -8 \\
 & x = -1 \qquad \qquad x = 4 \\
 & \text{The solutions are } -1 \text{ and } 4.
 \end{aligned}$$

$$\begin{aligned}
 20. \quad & 3 - |2x - 3| = -8 \\
 & -|2x - 3| = -11 \\
 & |2x - 3| = 11 \\
 & 2x - 3 = 11 \qquad \qquad 2x - 3 = -11 \\
 & 2x = 14 \qquad \qquad 2x = -8 \\
 & x = 7 \qquad \qquad x = -4 \\
 & \text{The solutions are } 7 \text{ and } -4.
 \end{aligned}$$

$$\begin{aligned}
 21. \quad & |3x - 5| \leq 4 \\
 & -4 \leq 3x - 5 \leq 4 \\
 & -4 + 5 \leq 3x - 5 + 5 \leq 4 + 5 \\
 & 1 \leq 3x \leq 9 \\
 & \frac{1}{3} \leq \frac{3x}{3} \leq \frac{9}{3} \\
 & \frac{1}{3} \leq x \leq 3 \\
 & \left\{x \mid \frac{1}{3} \leq x \leq 3\right\}
 \end{aligned}$$

$$\begin{aligned}
 22. \quad & |4x - 3| > 5 \\
 & 4x - 3 < -5 \quad \text{or} \quad 4x - 3 > 5 \\
 & 4x < -2 \qquad \qquad 4x > 8 \\
 & x < -\frac{1}{2} \qquad \qquad x > 2 \\
 & \left\{x|x < -\frac{1}{2}\right\} \cup \{x|x > 2\} \\
 & \left\{x|x < -\frac{1}{2}\right\} \cup \{x|x > 2\} = \left\{x|x < -\frac{1}{2} \text{ or } x > 2\right\}
 \end{aligned}$$



25. The unknown number: n
 three times the number: $3n$
 the sum of three times the number and six: $3n + 6$
 $(3n + 6) + 3n = 6n + 6$

26. Strategy
 The first integer: n
 Second consecutive odd integer: $n + 2$
 Third consecutive odd integer: $n + 4$
 Three times the sum of the first and third integers is fifteen more than the second integer.

Solution

$$\begin{aligned}
 3[n + (n + 4)] &= (n + 2) + 15 \\
 3(2n + 4) &= n + 17 \\
 6n + 12 &= n + 17 \\
 5n + 12 &= 17 \\
 5n &= 5 \\
 n &= 1 \\
 \text{The first integer is } 1.
 \end{aligned}$$

27. Strategy

Number of 11¢ stamps: n
 Number of 9¢ stamps: $2n - 5$

Stamp	Number	Value	Total Value
9¢	$2n - 5$	9	$9(2n - 5)$
11¢	n	11	$11n$

The sum of the total values of each denomination of stamp equals the total value of all the stamps (187 cents).

$$9(2n - 5) + 11n = 187$$

Solution

$$9(2n - 5) + 11n = 187$$

$$18n - 45 + 11n = 187$$

$$29n - 45 = 187$$

$$29n = 232$$

$$n = 8$$

$$2n - 5 = 2(8) - 5 = 16 - 5 = 11$$

There are eleven 9¢ stamps.

28. Strategy

Number of adult tickets: n
 Number of children's tickets: $75 - n$

	Number	Value	Total Value
Adult tickets	n	2.25	$2.25n$
Children's tickets	$75 - n$	0.75	$0.75(75 - n)$

The sum of the total values of each denomination of ticket equals the total value of all the tickets (\$128.25).

$$2.25n + 0.75(75 - n) = 128.25$$

Solution

$$2.25n + 0.75(75 - n) = 128.25$$

$$2.25n + 56.25 - 0.75n = 128.25$$

$$1.5n + 56.25 = 128.25$$

$$1.5n = 72$$

$$n = 48$$

48 adult tickets were sold.

29. Strategy

Slower plane: x
 Faster plane: $x + 120$

	Rate	Time	Distance
Slower plane	x	2.5	$2.5x$
Faster plane	$x + 120$	2.5	$2.5(x + 120)$

The two planes travel a total distance of 1400 mi.

$$2.5x + 2.5(x + 120) = 1400$$

Solution

$$2.5x + 2.5(x + 120) = 1400$$

$$2.5x + 2.5x + 300 = 1400$$

$$5x + 300 = 1400$$

$$5x = 1100$$

$$x = 220$$

$$x + 120 = 220 + 120 = 340$$

The speed of the faster plane is 340 mph.

30. Strategy

Liters of 12% acid solution: x

Solution	Amount	Percent	Quantity
12%	x	0.12	$0.12x$
5%	4	0.05	$0.05(4)$
8%	$x + 4$	0.08	$0.08(x + 4)$

The sum of the quantities before mixing equals the quantity after mixing.

$$0.12x + 0.05(4) = 0.08(x + 4)$$

Solution

$$0.12x + 0.05(4) = 0.08(x + 4)$$

$$0.12x + 0.2 = 0.08x + 0.32$$

$$0.04x + 0.2 = 0.32$$

$$0.04x = 0.12$$

$$x = 3$$

3 L of 12% acid solution must be in the mixture.

31. StrategyAmount invested at 9.8%: x Amount invested at 12.8%: $10,000 - x$

	Principal	Rate	Interest
Amount at 9.8%	x	0.098	$0.098x$
Amount at 12.8%	$10,000 - x$	0.128	$0.128(10,000 - x)$

The sum of the interest earned by the two investments is equal to the total annual interest earned (\$1085).

$$0.098x + 0.128(10,000 - x) = 1085$$

Solution

$$0.098x + 0.128(10,000 - x) = 1085$$

$$0.098x + 1280 - 0.128x = 1085$$

$$-0.03x + 1280 = 1085$$

$$-0.03x = -195$$

$$x = 6500$$

\$6500 was invested at 9.8%.