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Chapter 2 Equations, Inequalities, and Problem Solving

Exer	cise Set 2.1
1	<u></u>
1.	
2.	b
3.	f
4.	a
5.	d
6.	e
7.	d
8.	b
9.	c
10.	a
11.	$6-x = -2$ $\overline{6-4} -2$ $2 -2 \text{FALSE}$ No, 4 is not a solution.
12.	$6-x = -2$ $\overline{6-8} -2$ $-2 -2 \text{TRUE}$ Yes, 8 is a solution.
13.	$\begin{array}{c c} \frac{\frac{2}{3}t}{\frac{2}{3}(18)} &= 12\\ \hline \frac{\frac{2}{3}(18)}{12} & 12\\ 12 & 12 & \text{TRUE}\\ \text{Yes, 18 is a solution.} \end{array}$
14.	$\frac{\frac{2}{3}t}{\frac{2}{3}(8)} \frac{12}{12}$ $\frac{\frac{16}{3}}{12} 12 \text{ FALSE}$ No, 8 is not a solution.

- 15. x+7=3-x -2+7 | 3-(-2)5 | 5 TRUE Yes, -2 is a solution.
- 16. -4 + x = 5x $\overline{-4 + (-1)} | 5(-1)$ -5 | -5 TRUE Yes, -1 is a solution.
- 17. $\begin{array}{rrrr} 4 \frac{1}{5}n &= 8\\ \hline 4 \frac{1}{5}(-20) & 8\\ 4 (-4) & 8\\ 8 & 8 & \text{TRUE} \end{array}$
 - Yes, -20 is a solution.
- 18. $-3 = 5 \frac{n}{2}$ $-3 \quad 5 - \frac{4}{2}$ $-3 \quad 5 - 2$ $-3 \quad 3$ FALSE No, 4 is not a solution.
- 19. x + 6 = 23x+6-6=23-6 Subtracting 6 from both sides x = 17Simplifying Check: x + 6 = 2317+6 23 23 23 TRUE The solution is 17. 20. x + 5 = 8x + 5 - 5 = 8 - 5 Subtracting 5 from both sides Simplifying x = 3
 - Check: x+5=8 $\overline{3+5} | 8$ 8 | 8 TRUE The solution is 3.

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21. y+7 = -4 y+7-7 = -4-7 Subtracting 7 from both sides y = -11 Simplifying Check: y+7 = -4 -11+7 -4 -4 -4 TRUE The solution is -11.

22. t+6=43 t+6-6=43-6 Subtracting 6 from both sides t=37 Simplifying Check: t+6=43 $\overline{37+6}$ $\overline{43}$ 43 $\overline{43}$ TRUE The solution is 37.

23. -6 = y + 25-6 - 25 = y + 25 - 25Subtracting 25 from both sides-31 = ySimplifyingCheck: -6 = y + 25-6 = -6TRUEThe solution is -31.

24. -5 = x + 8 -5 - 8 = x + 8 - 8 Subtracting 8 from both sides -13 = x Simplifying Check: -5 = x + 8 $\overline{-5} = -13 + 8$ -5 = -5 TRUE The solution is -13.

25. x-8=5 x-8+8=5+8 Adding 8 to both sides x=13 Simplifying Check: x-8=5 $\overline{13-8}$ 5 5 5 TRUE The solution is 13. 26. x-9=6 x-9+9=6+9 Adding 9 to both sides x=15 Simplifying Check: x-9=6 15-9 6 6TRUE The solution is 15.

27. 12 = -7 + y

7+12 = 7 + (-7) + y Adding 7 to both sides 19 = y Simplifying Check: 12 = -7 + y $12 \quad | -7 + 19$ $12 \quad | 12$ TRUE The solution is 19.

28. 15 = -8 + z

8+15 = 8+(-8)+z Adding 8 to both sides 23 = z Simplifying Check: 15 = -8+z 15 | -8+23 15 | 15 TRUE The solution is 23.

29.
$$-5+t = -9$$

$$5+(-5)+t = 5+(-9)$$
 Adding 5 to both sides

$$t = -4$$
 Simplifying

Check: $\begin{array}{c|c} -5+t = -9 \\ \hline \hline -5+(-4) & -9 \\ -9 & -9 \end{array}$ TRUE

The solution is –4.

30.
$$-6 + y = -21$$

$$6 + (-6) + y = 6 + (-21)$$
Adding 6 to both sides
$$y = -15$$
Simplifying
Check:
$$-6 + y = -21$$

$$-6 + (-15) -21$$

$$-21 -21$$
TRUE
The solution is -15.

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52

31. $r + \frac{1}{3} = \frac{8}{3}$ $r + \frac{1}{3} + \left(-\frac{1}{3}\right) = \frac{8}{3} + \left(-\frac{1}{3}\right)$ Subtracting $\frac{1}{3}$ from both sides $r = \frac{7}{3}$ Simplifying Check: $r + \frac{1}{3} = \frac{8}{3}$ $\frac{7}{3} + \frac{1}{3} = \frac{8}{3}$ $\frac{8}{3} = \frac{8}{3}$ TRUE

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

32. $t + \frac{3}{8} = \frac{5}{8}$ $t + \frac{3}{8} + \left(-\frac{3}{8}\right) = \frac{5}{8} - \frac{3}{8}$ Subtracting $\frac{3}{8}$ from both sides $t = \frac{2}{8}$ Simplifying $t = \frac{1}{4}$ SimplifyingCheck: $t + \frac{3}{8} = \frac{5}{8}$ $\frac{1}{4} + \frac{3}{8} | \frac{5}{8}$ $\frac{2}{8} + \frac{3}{8} | \frac{5}{8}$ $\frac{5}{8} | \frac{5}{8}$ TRUE

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

33.
$$x - \frac{3}{5} = -\frac{7}{10}$$

 $x - \frac{3}{5} + (\frac{3}{5}) = -\frac{7}{10} + (\frac{3}{5})$ Adding $\frac{3}{5}$ to both sides
 $x = -\frac{7}{10} + (\frac{6}{10})$ Simplifying
 $x = -\frac{1}{10}$ Simplifying
Check: $x - \frac{3}{5} = -\frac{7}{10}$
 $-\frac{1}{10} - \frac{3}{5} - \frac{7}{10}$
 $-\frac{1}{10} - \frac{6}{10} - \frac{7}{10}$
 $-\frac{7}{10} - \frac{7}{10}$ TRUE

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

34.
$$x - \frac{2}{3} = -\frac{5}{6}$$

 $x - \frac{2}{3} + (\frac{2}{3}) = -\frac{5}{6} + (\frac{2}{3})$ Adding $\frac{2}{3}$ to both sides
 $x = -\frac{5}{6} + (\frac{4}{6})$ Simplifying
 $x = -\frac{1}{6}$ Simplifying
Check: $x - \frac{2}{3} = -\frac{5}{6}$
 $\overline{-\frac{1}{6} - \frac{2}{3}} - \frac{5}{6}$
 $-\frac{1}{6} - \frac{4}{6}} - \frac{5}{6}$
 $-\frac{5}{6} - \frac{5}{6}$ TRUE
The solution is $-\frac{1}{6}$.

35. $-\frac{1}{5} + z = -\frac{1}{4}$ $\frac{1}{5} + \left(-\frac{1}{5}\right) + z = \frac{1}{5} + \left(-\frac{1}{4}\right)$ Adding $\frac{1}{5}$ to both sides $z = \frac{4}{20} + \left(-\frac{5}{20}\right)$ Simplifying $z = -\frac{1}{20}$ Simplifying
Check: $-\frac{1}{5} + z = -\frac{1}{4}$ $\overline{-\frac{1}{5} + \left(-\frac{1}{20}\right)} = -\frac{1}{4}$ $-\frac{4}{20} + \left(-\frac{1}{20}\right) = -\frac{1}{4}$ $-\frac{5}{20} = -\frac{1}{4}$ The solution is $-\frac{1}{20}$.

36.
$$-\frac{1}{8} + y = -\frac{3}{4}$$

$$\frac{1}{8} + \left(-\frac{1}{8}\right) + y = \frac{1}{8} + \left(-\frac{3}{4}\right)$$
Adding $\frac{1}{8}$ to both sides
$$y = \frac{1}{8} + \left(-\frac{6}{8}\right)$$
Simplifying
$$y = -\frac{5}{8}$$
Simplifying
Check:
$$-\frac{1}{8} + y = -\frac{3}{4}$$

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

$$-\frac{6}{8} - \frac{3}{4}$$

$$-\frac{3}{4} - \frac{3}{4}$$
TRUE
The solution is $-\frac{5}{8}$.

37.
$$m+3.9 = 5.4$$

 $m+3.9-3.9 = 5.4-3.9$ Subtracting 3.9
from both sides
 $m = 1.5$ Simplifying
Check: $m+3.9 = 5.4$
 $\overline{1.5+3.9}$ 5.4
 5.4 5.4 TRUE

The solution is 1.5.

38. y+5.3 = 8.7 y+5.3-5.3 = 8.7-5.3 Subtracting 5.3 from both sides y = 3.4 Simplifying Check: y+5.3 = 8.7 $\overline{3.4+5.3} = 8.7$ 8.7 = 8.7 8.7 = 8.7TRUE The solution is 3.4.

39.
$$-9.7 = -4.7 + y$$

 $4.7 + -9.7 = 4.7 + (-4.7) + y$ Adding 4.7 to both sides
 $-5 = y$ Simplifying
Check: $-9.7 = -4.7 + y$
 $\overline{-9.7} = -4.7 + (-5)$
 $-9.7 = -9.7$ TRUE
The solution is -5.

-7.8 = 2.8 + x

40.

-2.8 + (-7.8) = -2.8 + 2.8 + xSubtracting 2.8 from both sides -10.6 = xSimplifying Check: -7.8 = 2.8 + x-7.8 = 2.8 + (-10.6)-7.8 = -7.8TRUE

The solution is -10.6.

41. 5x = 70 $\frac{5x}{5} = \frac{70}{5}$ Dividing both sides by 5 $1 \cdot x = 14$ Simplifying x = 14 Identity property of 1 Check: 5x = 70 $\overline{5 \cdot 14}$ 70 70 TRUE The solution is 14.

42. 3x = 39 $\frac{3x}{3} = \frac{39}{3}$ Dividing both sides by 3 $1 \cdot x = 13$ Simplifying x = 13 Identity property of 1 Check: 3x = 39 $\overline{3 \cdot 13}$ $\overline{39}$ 39 $\overline{39}$ TRUE

The solution is 13.

43. 84 = 7n $\frac{84}{7} = \frac{7n}{7}$ Dividing both sides by 7 $12 = 1 \cdot n$ Simplifying 12 = n Identity property of 1 Check: 84 = 7x $\overline{84} = 7x$ $\overline{84} = 7x$ $\overline{84} = 7 \cdot 12$ 84 = 84TRUE
The solution is 12. $44. \quad 56 = 7t$ $\frac{56}{7} = \frac{7t}{7}$ Dividing both sides by 7 $8 = 1 \cdot t$ Simplifying

8 = t Identity property of 1

Check: 56 = 7t

56 7.8 56 56 TRUE

The solution is 8.

45.
$$-x = 23$$

$$(-1)(-x) = (-1)23$$
Multiply both sides by -1
$$x = -23$$
Simplifying
Check:
$$-x = 23$$

$$\overline{-(-23)} \quad 23$$

$$23 \quad 23 \quad \text{TRUE}$$
The solution is -23.

46.
$$100 = -x$$

$$(-1)(100) = (-1)(-x)$$
Multiply both sides by -1
$$-100 = x$$
Simplifying
Check:
$$100 = -x$$

$$\overline{100} \quad -(-100)$$

$$100 \quad 100 \quad \text{TRUE}$$
The solution is -100.

47.
$$-t = -8$$
$$(-1)(-t) = (-1)(-8)$$
Multiply both sides by -1
$$t = 8$$
Simplifying
Check:
$$-t = -8$$
$$-(8) | -8$$
$$-8 | -8$$
TRUE
The solution is 8.

<u>54</u>

48. -68 = -r (-1)(-68) = (-1)(-r)Multiply both sides by -1 68 = rSimplifying
Check: -68 = -r $\overline{-68} - (68)$ -68 - 68TRUE
The solution is 68.

49. 2x = -5 $\frac{2x}{2} = \frac{-5}{2}$ Dividing both sides by 2 $1 \cdot x = -\frac{5}{2}$ Simplifying $x = -\frac{5}{2}$ Identity property of 1 Check: 2x = -5 $\overline{2(-\frac{5}{2})} = -5$ -5 = -5 TRUE The solution is $-\frac{5}{2}$.

50. -3x = 5 $\frac{-3x}{-3} = \frac{5}{-3}$ Dividing both sides by -3 $1 \cdot x = \frac{5}{-3}$ Simplifying $x = \frac{5}{-3}$ Identity property of 1 Check: -3x = 5 $-3(-\frac{5}{3}) = 5$ 5 = 5 TRUE

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

51.
$$-1.3a = -10.4$$

$$\frac{-1.3a}{-1.3} = \frac{-10.4}{-1.3}$$
Dividing both sides
$$\frac{1}{a} = 8$$
Simplifying
$$a = 8$$
Identity property of 1
Check:
$$-1.3a = -10.4$$

$$\frac{-1.3(8)}{-10.4} = -10.4$$
The solution is 8.

52. -3.4t = -20.4 $\frac{-3.4t}{-3.4} = \frac{-20.4}{-3.4}$ Dividing both sides $1 \cdot t = 6$ Simplifying t = 6 Identity property of 1 Check: -3.4t = -20.4 $\overline{-3.4(6)} = -20.4$ -20.4 = -20.4 TRUE

The solution is 6.

53. $\frac{y}{-8} = 11$ $\left(-\frac{1}{8}\right) \cdot y = 11$ Rewriting $\left(-8\right)\left(-\frac{1}{8}\right) \cdot y = (-8)11$ Multiplying both sides by 8 $1 \cdot y = -88$ Simplifying y = -88Identity property of 1

Check:
$$\frac{y}{-8} = 11$$

 $\frac{-88}{-8}$ 11
11 11 TRUE
The solution is -88.

54.
$$\frac{a}{4} = 13$$

$$\left(\frac{1}{4}\right) \cdot a = 13$$
 Rewriting
$$4 \cdot \left(\frac{1}{4}\right) \cdot a = 4 \cdot 13$$
 Multiplying both sides
$$1 \cdot a = 52$$
 Simplifying
$$a = 52$$
 Identity property of 1
Check:
$$\frac{a}{4} = 13$$

$$\frac{52}{13}$$

$$13$$

$$13$$
 TRUE
The solution is 52.

58.

55.
$$\frac{4}{5}x = 16$$

$$\frac{5}{4} \cdot \left(\frac{4}{5}\right) \cdot x = \frac{5}{4} \cdot 16$$
Multiplying both
sides by $\frac{5}{4}$

$$1 \cdot x = 20$$
Simplifying
 $x = 20$
Identity property of 1
Check:
$$\frac{4}{5}x = 16$$

$$\frac{4}{5} \cdot 20$$

$$\frac{16}{16}$$

$$16$$
TRUE
The solution is 20.

56. $\frac{3}{4}x = 27$ $\frac{4}{3} \cdot \left(\frac{3}{4}\right) \cdot x = \frac{4}{3} \cdot 27$ Multiplying both sides by $\frac{4}{3}$ $1 \cdot x = 36$ Simplifying x = 36Identity property of 1
Check: $\frac{3}{4}x = 27$ $\frac{3}{4} \cdot 36$ 27 27TRUE

The solution is 36.

The solution is –54.

57.
$$\frac{-x}{6} = 9$$

$$6 \cdot \left(\frac{1}{6}\right) \cdot (-x) = 6 \cdot 9$$
Rewriting and multiplying both sides by 6
$$-x = 54$$
Simplifying
$$x = -54$$
Multiplying both sides
$$by -1$$
Check:
$$\frac{-x}{6} = 9$$

$$\frac{-(-54)}{6} = 9$$

$$\frac{-(-54)}{6} = 9$$

$$\frac{54}{6} = 9$$

$$9 = 9$$
TRUE

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

$$5 \cdot \left(\frac{1}{5}\right) \cdot \left(-t\right) = 5 \cdot 9$$
Rewriting and
multiplying both
sides by 5
$$-t = 45$$
Simplifying
$$t = -45$$
Multiplying both sides
$$by -1$$
Check:
$$\frac{-t}{5} = 9$$

$$\frac{-(-45)}{5} = 9$$

$$\frac{-(-45)}{5} = 9$$

$$\frac{45}{5} = 9$$

$$\frac{-(-45)}{5} = 9$$
The solution is -45.

59.
$$\frac{1}{9} = \frac{z}{5}$$

$$5 \cdot \left(\frac{1}{9}\right) = 5 \cdot \left(\frac{1}{5}\right) \cdot z$$
Rewriting and multiplying both sides by 5
$$\frac{5}{9} = z$$
Simplifying
Check:
$$\frac{1}{9} = \frac{z}{5}$$

$$\frac{1}{9} \left| \frac{(5)}{9} \right| / 5$$

$$\frac{1}{9} \left| \frac{1}{9} \right|$$
TRUE

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

60.
$$\frac{2}{7} = \frac{x}{3}$$

$$3 \cdot \left(\frac{2}{7}\right) = 3 \cdot \left(\frac{1}{3}\right) \cdot x$$
Rewriting and multiplying both sides by 3
$$\frac{6}{7} = x$$
Simplifying
Check:
$$\frac{2}{7} = \frac{x}{3}$$

$$\frac{\frac{2}{7}}{\frac{2}{7}} = \frac{x}{7}$$
TRUE
The solution is $\frac{6}{7}$

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

56

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

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

$$\left(-\frac{5}{3}\right)\left(-\frac{3}{5}\right)r = \left(-\frac{5}{3}\right)\left(-\frac{3}{5}\right) \qquad \begin{array}{l} \text{Multiplying} \\ \text{both sides} \\ \text{by } -\frac{5}{3} \\ r = 1 \\ \text{Simplifying} \\ \text{Check:} \quad -\frac{3}{5}r = -\frac{3}{5} \\ \hline -\frac{3}{5} \cdot 1 \\ -\frac{3}{5} \\ \hline -\frac{3}{5} \\ -\frac{3}{5} \\ \hline -\frac{3}{5} \\ \hline -\frac{3}{5} \\ \hline \end{array} \qquad \begin{array}{l} \text{TRUE} \\ \end{array}$$

The solution is 1.

62. $-\frac{2}{5}y = -\frac{4}{15}$ $\left(-\frac{5}{2}\right)\left(-\frac{2}{5}\right)y = \left(-\frac{5}{2}\right)\left(-\frac{4}{15}\right)$ Multiplying both sides by $-\frac{5}{2}$ $y = \frac{2}{3}$ Simplifying
Check: $-\frac{2}{5}y = -\frac{4}{15}$ $-\frac{2}{5}\left(\frac{2}{3}\right) = -\frac{4}{15}$ $-\frac{4}{15} = -\frac{4}{15}$ TRUE

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

63.

 $\frac{-3r}{2} = -\frac{27}{4}$ $\left(-\frac{3}{2}\right)r = -\frac{27}{4}$ Rewriting $\left(-\frac{2}{3}\right)\left(-\frac{3}{2}\right)r = \left(-\frac{2}{3}\right)\left(-\frac{27}{4}\right)$ Multiplying
both sides
by $-\frac{2}{3}$ $r = \frac{9}{2}$ Simplifying
Check: $\frac{-3r}{2} = -\frac{27}{4}$

$$\frac{2}{\left[(-3)\left(\frac{9}{2}\right)\right]/2} - \frac{27}{4} - \frac{27}{4} - \frac{27}{2} - \frac{27}{4} - \frac$$

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

64.
$$\frac{5x}{7} = -\frac{10}{14}$$

 $\left(\frac{5}{7}\right)x = -\frac{10}{14}$ Rewriting
 $\left(\frac{7}{5}\right)\left(\frac{5}{7}\right)r = \left(\frac{7}{5}\right)\left(-\frac{10}{14}\right)$ Multiplying
both sides
by $\frac{7}{5}$
 $r = -1$ Simplifying
Check: $\frac{5x}{7} = -\frac{10}{14}$
 $\frac{5}{7}(-1) - \frac{10}{14}$
 $-\frac{5}{7} - \frac{10}{14}$
 $-\frac{5}{7} - \frac{10}{14}$
 $-\frac{5}{7} - \frac{10}{14}$
 $-\frac{5}{7} - \frac{10}{14}$
TRUE
The solution is -1.
65. $4.5 + t = -3.1$
 $4.5 + t - 4.5 = -3.1 - 4.5$
 $t = -7.6$
The solution is -7.6.
66. $\frac{3}{4}x = 18$
 $\left(\frac{4}{3}\right)\left(\frac{3}{4}\right)x = \left(\frac{4}{3}\right)18$
 $x = 24$
The solution is 24.
67. $-8.2x = 20.5$
 $-\frac{8.2}{-8.2}x = \frac{20.5}{-8.2}$
 $x = -2.5$
The solution is -2.5.
68. $t - 7.4 = -12.9$
 $t - 7.4 + 7.4 = -12.9 + 7.4$
 $t = -5.5$
The solution is -5.5.
69. $x - 4 = -19$
 $x - 4 + 4 = -19 + 4$
 $x = -15$
The solution is -15.

y - 6 + 6 = -14 + 6v = -8The solution is -8. 71. -12x = 72 $\frac{-12}{-12}x = \frac{72}{-12}$ x = -6The solution is –6. 72. -15x = 105 $\frac{-15}{-15}x = \frac{105}{-15}$ x = -7The solution is -7. $48 = -\frac{3}{8}y$ 73. $\left(-\frac{8}{3}\right) \cdot 48 = \left(-\frac{8}{3}\right) \left(-\frac{3}{8}\right) y$ -128 = yThe solution is -128. 14 = t + 2774. 14 - 27 = t + 27 - 27-13 = tThe solution is -13. 75. $a - \frac{1}{6} = -\frac{2}{3}$ $a - \frac{1}{6} + \frac{1}{6} = -\frac{2}{3} + \frac{1}{6}$ $a = -\frac{4}{6} + \frac{1}{6}$ $a = -\frac{3}{6}$ $a = -\frac{1}{2}$ The solution is $-\frac{1}{2}$.

76.
$$-\frac{x}{7} = \frac{2}{9}$$
$$(-7)\left(-\frac{1}{7}\right)x = (-7)\left(\frac{2}{9}\right)$$
$$x = -\frac{14}{9}$$
The solution is $-\frac{14}{9}$.
77.
$$-24 = \frac{8x}{5}$$
$$\left(\frac{5}{8}\right)(-24) = \left(\frac{5}{8}\right)\left(\frac{8}{5}\right)x$$
$$-15 = x$$
The solution is -15.
78.
$$\frac{1}{5} + y = -\frac{3}{10}$$
$$-\frac{1}{5} + \frac{1}{5} + y = -\frac{1}{5} - \frac{3}{10}$$
$$y = -\frac{2}{10} - \frac{3}{10}$$
$$y = -\frac{5}{10}$$
$$y = -\frac{1}{2}$$
The solution is $-\frac{1}{2}$.
79.
$$-\frac{4}{3}t = -16$$
$$\left(-\frac{3}{4}\right)\left(-\frac{4}{3}\right)t = \left(-\frac{3}{4}\right)(-16)$$
$$t = 12$$
The solution is 12.
80.
$$\frac{17}{35} = -x$$
$$(-1)\left(\frac{17}{35}\right) = (-1)(-x)$$

The solution is $-\frac{17}{35}$.

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

70.

y - 6 = -14

81. -483.297 = -794.053 + t794.053 - 483.297 = 794.053 - 794.053 + t 310.756 = tThe solution is 310.756.

82.
$$-0.2344x = 2028.732$$

 $\frac{-0.2344}{-0.2344}x = \frac{2028.732}{-0.2344}$
 $x = -8655$
The solution is -8655.

- 83. *Thinking and Writing Exercise*. For an equation x + a = b, add the opposite of *a* (or subtract *a*) on both sides of the equation to solve for *x*. For an equation ax = b, multiply by 1/a (or divide by *a*) on both sides of the equation to solve for *x*.
- 84. *Thinking and Writing Exercise*. Equivalent expressions have the same value for all possible replacements for the variables. Equivalent equations have the same solution(s).
- 85. $3 \cdot 4 18$ = 12 - 18 Multiplying = -6 Subtracting
- 86. 14 2(7 1)

Simplifying inside
the parentheses
Multiplying
Subtracting

87. $16 \div (2 - 3 \cdot 2) + 5$ = $16 \div (2 - 6) + 5$ Simplifying inside = $16 \div (-4) + 5$ the parentheses = -4 + 5 Dividing = 1 Adding

- 88. $12 5 \cdot 2^3 + 4 \cdot 3$
 - $= 12 5 \cdot 8 + 4 \cdot 3$ Simplifying the
exponential $= 12 40 + 4 \cdot 3$ Multiplying from left= 12 40 + 12to right= -28 + 12Adding from left= -16to right
- 89. *Thinking and Writing Exercise*. Yes, it will form an equivalent equation by the addition principle. It will not help to solve the equation, however. The multiplication principle should be used to solve the equation.
- 90. Thinking and Writing Exercise. Since a-c=b-c can be written as a+(-c)=b+(-c), it is not necessary to state a subtraction principle.
- 91. mx = 9.4m $\frac{mx}{m} = \frac{9.4m}{m}$ x = 9.4The solution is 9.4. 92. x - 4 + a = ax - 4 + a - a = a - ax - 4 = 0x - 4 + 4 = 0 + 4x = 4The solution is 4.
- 93. cx + 5c = 7c-5c + cx + 5c = -5c + 7ccx = 2c $\frac{cx}{c} = \frac{2c}{c}$ x = 2The solution is 2.

 $c \cdot \frac{21}{a} = \frac{7cx}{2a}$ Exercise Set 2.2 94. 1. c $(2a) \cdot c \cdot \frac{21}{a} = (2a) \left(\frac{7cx}{2a}\right)$ 2. e 42c = 7cx $\frac{42c}{7c} = \frac{7cx}{7c}$ 3. a 4. f 6 = xThe solution is 6. 5. b 95. 7 + |x| = 206. d -7 + 7 + |x| = -7 + 207. 2x + 9 = 25|x| = 132x+9-9=25-9 Subtracting 9 from x represents a number whose distance from 0 both sides is 13. Thus, x = -13 or x = 13. 2x = 16Simplifying $\frac{2x}{2} = \frac{16}{2}$ Dividing both sides 96. ax - 3a = 5aby 2 ax - 3a + 3a = 5a + 3ax = 8Simplifying ax = 8aCheck: 2x + 9 = 25ax - 8a $2 \cdot 8 + 9$ a [–] а 25 x = 816+9 25 The solution is 8. 25 25 TRUE The solution is 8. 97. t - 3590 = 1820t - 3590 + 7180 =Adding 7180 8. 3x + 6 = 181820 + 7180to both sides 3x+6-6=18-6 Subtracting 6 from t + 3590 = 9000 Simplifying both sides It follows that t + 3590 equals 9000. 3x = 12Simplifying 98. n + 268 = 124 $\frac{3x}{3} = \frac{12}{3}$ Dividing both sides Subtracting 536 by 3 n + 268 - 536 = 124 - 536to both sides x = 4Simplifying n - 268 = -412Simplifying Check: 3x + 6 = 18It follows that n - 268 equals -412. $3 \cdot 4 + 6$ | 18 99. To "undo" the last step, divide 225 by 0.3. 12+6 18 $225 \div 0.3 = 750$ 18 18 TRUE Now divide 750 by 0.3. The solution is 4. $750 \div 0.3 = 2500$ The answer should be \$2500, not \$225. 100. Thinking and Writing Exercise. No; -5 is a

solution of $x^2 = 25$ but not of x = 5.

- 9. 6z + 4 = -206z + 4 - 4 = -20 - 4Subtracting 4 from both sides 6z = -24Simplifying $\frac{6z}{6} = \frac{-24}{6}$ Dividing both sides by 6 z = -4Simplifying Check: 6z + 4 = -20 $6 \cdot (-4) + 4$ -20-24 + 4-20-20 -20 TRUE The solution is -4.
- 10. 6z + 3 = -456z + 3 - 3 = -45 - 3Subtracting 3 from both sides 6z = -48Simplifying $\frac{6z}{6} = \frac{-48}{6}$ Dividing both sides by 6 z = -8Simplifying Check: 6z + 3 = -45 $6 \cdot (-8) + 3$ -45 $-48+3 \mid -45$ -45 | -45 TRUE

The solution is -8.

11.
$$7t-8 = 27$$

$$7t-8+8 = 27+8$$
Adding 8 to both sides
$$7t = 35$$
Simplifying
$$\frac{7t}{7} = \frac{35}{7}$$
Dividing both sides
$$t = 5$$
Simplifying
Check:
$$7t-8 = 27$$

$$7\cdot5-8$$

$$27$$

$$35-8$$

$$27$$

$$27$$
TRUE
The solution is 5.

12. 6x - 3 = 156x - 3 + 3 = 15 + 3 Adding 3 to both sides 6x = 18Simplifying $\frac{6x}{6} = \frac{18}{6}$ Dividing both sides by 6 x = 3Simplifying Check: 6x - 3 = 15 $6 \cdot 3 - 3 = 15$ 18-3 15 15 15 TRUE The solution is 3. 13. 3x - 9 = 333x - 9 + 9 = 33 + 9 Adding 9 to both sides 3x = 42Simplifying $\frac{3x}{3} = \frac{42}{3}$ Dividing both sides by 3 x = 14Simplifying Check: 3x - 9 = 33

The solution is 14.

14. 5x - 9 = 415x - 9 + 9 = 41 + 9 Adding 9 to both sides 5x = 50Simplifying $\frac{5x}{5} = \frac{50}{5}$ Dividing both sides by 5 x = 10Simplifying Check: 5x - 9 = 41 $5 \cdot 10 - 9 \mid 41$ 50 - 941 41 41 TRUE

The solution is 10.

15.	-91 = 9t + 8	
	-91 - 8 = 9t + 8 - 8	Subtracting 8 from both sides
	-99 = 9t	Simplifying
	$\frac{-99}{9} = \frac{9t}{9}$	Dividing both sides by 9
	t = -11	Simplifying
	Check: $-91 = 9t + $	8
	-91 9.(-	(-11) + 8
	-91 -99	+8
	-91 -91	TRUE
	The solution is -11	•

16. -39 = 1 + 8x-1 - 39 = -1 + 1 + 8xSubtracting 1 from both sides -40 = 8xSimplifying $\frac{-40}{8} = \frac{8x}{8}$ Dividing both sides by 8 -5 = xSimplifying Check: -39 = 1 + 8x-39 1+8·(-5) -39 1 - 40-39 -39 TRUE The solution is -5

17.
$$12-t = 16$$

$$-12+12-t = -12+16$$
Subtracting 12 from both sides
$$-t = 4$$
Simplifying
$$\frac{-t}{-1} = \frac{4}{-1}$$
Dividing both sides by -1
$$t = -4$$
Simplifying
Check:
$$12-t = 16$$

$$12-(-4)$$

$$16$$

$$12+4$$

$$16$$

$$16$$

$$16$$
The solution is -4.

18. 9 - t = 21-9 + 9 - t = -9 + 21 Subtracting 9 from both sides -t = 12Simplifying $\frac{-t}{-1} = \frac{12}{-1}$ Dividing both sides by -1 t = -12Simplifying Check: 9 - t = 219 - (-12)21 9+12 21 21 21 TRUE The solution is -12. 19. -6z - 18 = -132-6z - 18 + 18 = -132 + 18Adding 18 to both sides -6z = -114Simplifying $\frac{-6z}{-6} = \frac{-114}{-6}$ Dividing both sides by -6*z* = 19 Simplifying -6z - 18 = -132Check: -6(19) - 18 | -132-114-18 -132 -132 | -132 TRUE The solution is 19. 20. -7x - 24 = -129-7x - 24 + 24 = -129 + 24Adding 24 to both sides -7x = -105Simplifying $\frac{-7x}{-7} = \frac{-105}{-7}$ Dividing both sides by -7Simplifying x = 15

Check:
$$-7x - 24 = -129$$

 $-7 \cdot 15 - 24$ -129
 $-105 - 24$ -129
 -129 -129 TRUE
The solution is 15.

<u>6</u>2

21.
$$5.3+1.2n = 1.94$$

 $-5.3+5.3+1.2n = -5.3+1.94$ Subtracting 5.3 from both sides
 $1.2n = -3.36$ Simplifying
 $\frac{1.2n}{1.2} = \frac{-3.36}{1.2}$ Dividing both sides by 1.2
 $x = -2.8$ Simplifying
Check: $5.3+1.2n = 1.94$
 $\overline{5.3+1.2(-2.8)}$ 1.94
 $5.3-3.36$ 1.94
 1.94 1.94 TRUE
The solution is -2.8.

22.

$$6.4 - 2.5n = 2.2$$

23. 4x + 5x = 10

$$9x = 10 \quad \text{Simplifying}$$

$$\frac{9x}{9} = \frac{10}{9} \quad \begin{array}{c} \text{Dividing both sides} \\ \frac{9y}{9} = \frac{10}{9} \quad \begin{array}{c} \text{Dividing both sides} \\ \frac{9y}{9} = \frac{10}{9} \quad \begin{array}{c} \text{Simplifying} \\ x = \frac{10}{9} \quad \begin{array}{c} \text{Simplifying} \\ \frac{4x + 5x = 10}{4 \cdot \frac{10}{9} + 5 \cdot \frac{10}{9}} \quad \begin{array}{c} 10 \\ \frac{40}{9} + \frac{50}{9} & 10 \\ \frac{90}{9} & 10 \\ 10 & 10 \end{array}$$
The solution is $\frac{10}{9}$.

24. 13 = 5x + 7x

25.

13 = 12xSimplifying $\frac{13}{12} = \frac{12x}{12}$ Dividing both sides by 12 $\frac{13}{12} = x$ Simplifying Check: 13 = 5x + 7x $\frac{13}{13} \quad 5\left(\frac{13}{12}\right) + 7\left(\frac{13}{12}\right) \\
13 \quad \frac{65}{12} + \frac{91}{12} \\
13 \quad \frac{156}{12} \\
13 \quad 13 \quad \text{TRUE}$ The solution is $\frac{13}{12}$. 32 - 7x = 11-32 + 32 - 7x = -32 + 11 Subtracting 32 from both sides -7x = -21Simplifying $\frac{-7x}{-7} = \frac{-21}{-7}$ Dividing both sides by -7 x = 3Simplifying Check: 32 - 7x = 11 $32 - 7 \cdot 3 \quad 11$ 32-21 11 11 11 TRUE

The solution is 3.

26.
$$27-6x = 99$$

 $-27+27-6x = -27+99$ Subtracting 27 from both sides
 $-6x = 72$ Simplifying
 $\frac{-6x}{-6} = \frac{72}{-6}$ Dividing both sides by -6
 $x = -12$ Simplifying
Check: $27-6x = 99$
 $27-6\cdot(-12)$ 99
 99 99 TRUE

The solution is -12.

27.
$$\frac{3}{5}t - 1 = 8$$

$$\frac{3}{5}t - 1 + 1 = 8 + 1$$
Adding 1 to both sides
$$\frac{3}{5}t = 9$$
Simplifying
$$\left(\frac{5}{3}\right)\left(\frac{3}{5}\right)t = \left(\frac{5}{3}\right) \cdot 9$$
Multiplying both sides
by $\frac{5}{3}$

$$t = 15$$
Simplifying
Check:
$$\frac{3}{5}t - 1 = 8$$

$$\frac{3}{5} \cdot (15) - 1$$
8
9 - 1
8
8
RTRUE
The solution is 15.

28.
$$\frac{2}{3}t-1=5$$

$$\frac{2}{3}t-1+1=5+1$$
Adding 1 to both sides
$$\frac{2}{3}t=6$$
Simplifying
$$\left(\frac{3}{2}\right)\left(\frac{2}{3}\right)t=\left(\frac{3}{2}\right)\cdot6$$
Multiplying both sides
by $\frac{3}{2}$

$$t=9$$
Simplifying
Check:
$$\frac{2}{3}t-1=5$$

$$\frac{2}{3}\cdot(9)-1$$
5
$$6-1$$
5
$$5$$
TRUE

The solution is 9.

29.
$$4 + \frac{7}{2}x = -10$$

$$-4 + 4 + \frac{7}{2}x = -4 - 10$$
 Subtracting 4
from both sides

$$\frac{7}{2}x = -14$$
 Simplifying

$$\binom{2}{7}\binom{7}{2}x = \binom{2}{7}(-14)$$
 Multiplying both
sides by $\frac{2}{7}$

$$x = -4$$
 Simplifying
Check:
$$4 + \frac{7}{2}x = -10$$

$$\frac{4 + \binom{7}{2}(-4)}{4 + \binom{7}{2}(-4)} = -10$$

$$4 + \binom{-14}{-10} = -10$$

TRUE

The solution is -4.

30.
$$6 + \frac{5}{4}x = -4$$

$$-6 + 6 + \frac{5}{4}x = -6 - 4$$
 Subtracting -6
from both sides

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

$$\left(\frac{4}{5}\right)\left(\frac{5}{4}\right)x = \left(\frac{4}{5}\right)(-10)$$
 Multiplying both
sides by $\frac{4}{5}$

$$x = -8$$
 Simplifying
Check:
$$6 + \frac{5}{4}x = -4$$

$$\frac{6 + \frac{5}{4}(-8) -4}{6 - 10 -4}$$

$$-4 -4$$
 TRUE
The solution is -8.
31.
$$-\frac{3a}{4} - 5 = 2$$

$$-\frac{3}{4}a - 5 = 2$$
 Rewriting

 $-\frac{3}{4}a - 5 = 2$ Rewriting $-\frac{3}{4}a - 5 + 5 = 2 + 5$ Adding 5 to both sides $-\frac{3}{4}a = 7$ Simplifying $\left(-\frac{4}{3}\right)\left(-\frac{3}{4}\right)a = \left(-\frac{4}{3}\right) \cdot 7$ Multiplying both sides by $-\frac{4}{3}$ $a = -\frac{28}{3}$ Simplifying Check: $-\frac{3a}{4} - 5 = 2$ $\overline{\left(-\frac{3}{4}\right)\left(-\frac{28}{3}\right) - 5} = 2$ 7 - 5 = 22 = 2 TRUE

The solution is $-\frac{28}{3}$.

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32.
$$-\frac{7a}{8} - 2 = 1$$
$$-\frac{7}{8}a - 2 = 1$$
Rewriting
$$-\frac{7}{8}a - 2 + 2 = 1 + 2$$
Adding 2 to both sides
$$-\frac{7}{8}a = 3$$
Simplifying
$$\left(-\frac{8}{7}\right)\left(-\frac{7}{8}\right)a = \left(-\frac{8}{7}\right) \cdot 3$$
Multiplying both sides by $-\frac{8}{7}$
$$a = -\frac{24}{7}$$
Simplifying
Check:
$$-\frac{7a}{8} - 2 = 1$$
$$\frac{-\frac{7a}{8} - 2 = 1}{\left(-\frac{7}{8}\right)\left(-\frac{24}{7}\right) - 2\right| 1}{3 - 2\left| 1 \right| 1}$$
TRUE
The solution is $-\frac{24}{7}$.

33. 2x = x + xThis equation is true regardless of the replacement for x, so all real numbers are solutions. The equation is an identity. 34. -3z + 8z = 45

$$5z = 45$$
 Combining like terms

$$\frac{5z}{5} = \frac{45}{5}$$
 Dividing both sides by 5

$$z = 9$$
 Simplifying
Check:
$$-3z + 8z = 45$$

$$-3\cdot9 + 8\cdot9 = 45$$

$$-27 + 72 = 45$$

$$45 = 45$$
 TRUE
The solution is 9.

$$4x = 6 = 6x$$

35.
$$4x-6 = 6x$$
$$4x-6-4x = 6x-4x$$
 Adding -4x to both sides
$$-6 = 2x$$
 Simplifying
$$\frac{-6}{2} = \frac{2x}{2}$$
 Dividing both sides
by 2
$$-3 = x$$
 Simplifying

Check:
$$4x-6 = 6x$$

$$\overline{4 \cdot (-3)-6} \quad 6 \cdot (-3)$$

$$-12-6 \quad -18$$

$$-18 \quad -18 \quad \text{TRUE}$$
The solution is -3.

36. 4x - x = 2x + x

3x = 3xCombining like terms This equation is true regardless of the replacement for *x*, so all real numbers are solutions. The equation is an identity.

37. 2 - 5y = 26 - y2-5y+y=26-y+y Adding y to both sides 2 - 4y = 26Simplifying -2 + 2 - 4y = -2 + 26Subtracting 2 from both sides -4y = 24Simplifying $\frac{-4y}{-4} = \frac{24}{-4}$ Dividing both sides by -4 y = -6Simplifying Check: 2 - 5y = 26 - y $\overline{2-5}(-6) \mid 26-(-6)$ 2 + 3026 + 632 32 TRUE

The solution is -6.

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38.
$$6x-5=7+2x$$

$$6x-5-2x=7+2x-2x$$
Subtracting 2x
from both sides
$$4x-5=7$$
Simplifying
$$4x-5+5=7+5$$
Adding 5 to both
sides
$$4x = 12$$
Simplifying
$$\frac{4x}{4} = \frac{12}{4}$$
Dividing both
sides by 4
$$x = 3$$
Simplifying
Check:
$$6x-5=7+2x$$

$$\overline{6\cdot 3-5} \quad \overline{7+2\cdot 3}$$

$$18-5 \quad \overline{7+6}$$

$$13 \quad \text{TRUE}$$
The solution is 3.

20	7(2 - 1) - 21	
39.	7(2a-1) = 21	
	14a - 7 = 21	Distributive law
	14a - 7 + 7 = 21 + 7	Adding 7 to both sides
	14a = 28	Simplifying
	14 <i>a</i> 28	Dividing both sides
	$\frac{14}{14} = \frac{14}{14}$	by 14
	<i>a</i> = 2	Simplifying
	Check: $7(2a-1) =$	= 21
	$7(2 \cdot 2 - 1)$	21
	7(4-1)	21
	7(3)	21
	21	21 TRUE

The solution is 2.

40.
$$5(3-3t) = 30$$

 $15-15t = 30$ Distributive law
 $-15+15-15t = -15+30$ Subtracting 15
from both sides
 $-15t = 15$ Simplifying
 $\frac{-15t}{-15} = \frac{15}{-15}$ Dividing both
sides by -15
 $t = -1$ Simplifying
Check: $5(3-3t) = 30$
 $\overline{5(3-3\cdot(-1))}$ 30
 $5(3+3)$
 30
 30 TRUE
The solution is -1.

41. 8 = 8(x+1) 8 = 8x+8Distributive law 8-8 = 8x+8-8Subtracting 8 from both sides 0 = 8xSimplifying $\frac{0}{8} = \frac{8x}{8}$ Dividing both sides by 8 0 = xSimplifying Check: 8 = 8(x+1) $\frac{1}{8 + 8(x+1)}$

The solution is 0.

9 = 3(5x - 2)42. 9 = 15x - 6Distributive law 9 + 6 = 15x - 6 + 6Adding 6 to both sides 15 = 15xSimplifying $\frac{15}{15} = \frac{15x}{15}$ Dividing both sides by 15 1 = xSimplifying Check: 9 = 3(5x - 2) $9 | 3(5 \cdot 1 - 2)$ 9 3(5-2)9 3(3)9 9 TRUE

The solution is 1.

43.
$$2(3+4m)-6 = 48$$

 $6+8m-6 = 48$ Distributive law
 $8m = 48$ Simplifying
 $\frac{8m}{8} = \frac{48}{8}$ Dividing both sides
 $m = 6$ Simplifying
Check: $2(3+4m)-6 = 48$
 $\overline{2(3+4\cdot 6)-6}$ 48
 $2(3+24)-6$ 48
 $2(27)-6$ 48
 $54-6$ 48
48 48 TRUE
The solution is 6.

The solution is o

44. 3(5+3m)-8 = 7 15+9m-8 = 7 Distributive law 7+9m = 7 Simplifying -7+7+9m = -7+7 Adding -7 to both sides 9m = 0 Simplifying $\frac{9m}{9} = \frac{0}{9}$ Dividing both sides by 9m = 0

Check:
$$\frac{3(5+3m)-8=7}{3(5+3\cdot0)-8} = 7$$
$$3(5+0)-8 = 7$$
$$3(5)-8 = 7$$
$$3(5)-8 = 7$$
$$15-8 = 7$$
$$7 = 7$$
TRUE

The solution is 0.

45.	3(y+4) = 3(y-1)	
	3y + 12 = 3y - 3	Distributive law
	3y + 12 - 3y = 3y - 3 - 3y	Subtracting 3 <i>y</i> from both sides
	12 = -3	Simplifying

This is a false statement. The equation is a contradiction and has no solution.

46.	5(y-7) = 3(y-2) + 2y	
	5y - 35 = 3y - 6 + 2y	Distributive law
	5y - 35 = 5y - 6	Simplifying
5 J	y - 35 - 5y = 5y - 6 - 5y	Subtracting 5 <i>y</i> from both sides
	-35 = -6	Simplifying

This is a false statement. The equation is a contradiction and has no solution.

47.
$$2r + 8 = 6r + 10$$

 $-6r + 2r + 8 = -6r + 6r + 10$ Subtracting 6r
from both sides
 $-4r + 8 = 10$ Simplifying
 $-4r + 8 - 8 = 10 - 8$ Subtracting 8
from both sides
 $-4r = 2$ Simplifying
 $\frac{-4r}{-4} = \frac{2}{-4}$ Dividing both
sides by -4
 $r = -\frac{1}{2}$ Simplifing
Check: $2r + 8 = 6r + 10$
 $2 \cdot \left(-\frac{1}{2}\right) + 8$ $6 \cdot \left(-\frac{1}{2}\right) + 10$
 $-\frac{2}{2} + 8$ $-\frac{6}{2} + 10$
 $-1 + 8$ $-3 + 10$
7 TRUE

The solution is $-\frac{1}{2}$. 48. 3p-2 = 7p+4-3p + 3p - 2 =Subtracting 3p -3p + 7p + 4from both sides -2 = 4p + 4Simplifying -4 - 2 = 4p + 4 - 4Subtracting 4 from both sides -6 = 4pSimplifying $\frac{-6}{4} = \frac{4p}{4}$ Dividing both sides by 4 $p = -\frac{3}{2}$ Simplifying Check: 3p - 2 = 7p + 4 $\frac{3\left(-\frac{3}{2}\right)-2}{3\left(-\frac{3}{2}\right)+4}$ $\begin{array}{c|c} -\frac{9}{2} - 2 \\ -\frac{9}{2} - \frac{4}{2} \\ \end{array} \begin{array}{c} -\frac{21}{2} + 4 \\ -\frac{21}{2} + \frac{8}{2} \\ \end{array}$ $-\frac{13}{2}$ $-\frac{13}{2}$ TRUE The solution is $-\frac{3}{2}$. 49. 5-2x = 3x - 7x + 255 - 2x = -4x + 25Simplifying 5-2x+4x = -4x+25+4x Adding 4x to both sides

$$5+2x = 25$$

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

$$2x = 20$$

$$2x = 10$$

$$3x = 10$$

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

$$5-20$$

$$5-20$$

$$3x = 10$$

$$3x = 10 - 7x + 25$$

$$5-20$$

$$3x = 10 - 7x + 25$$

$$5-20$$

$$3x = 10 - 7x + 25$$

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10-3x = -6x + 40 Simplifying		
10-3x+6x = -6x+6x+40 Adding $6x$ to both sides		
10+3x = 40 Simplifying		
-10+10+3x = -10+40 Subtracting 1 from both sid	0 es	
3x = 30 Simplifying		
$\frac{3x}{3} = \frac{30}{3}$ Dividing both sides by 3	Dividing both sides by 3	
x = 10 Simplifying		
Check: $10 - 3x = 2x - 8x + 40$		
$10 - 3 \cdot 10$ 2 $\cdot 10 - 8 \cdot 10 + 40$		
10 - 30 $20 - 80 + 40$		
-20 -20 T	RUE	

The solution is 10.

51.
$$7+3x-6=3x+5-x$$

 $1+3x=2x+5$ Simplifying
 $1+3x-2x=2x+5-2x$ Subtracting 2x
from both sides
 $1+x=5$ Simplifying
 $-1+1+x=-1+5$ Subtracting 1
from both sides
 $x=4$ Simplifying
Check: $7+3x-6=3x+5-x$
 $7+3\cdot4-6$ $3\cdot4+5-4$
 $7+12-6$ $12+5-4$
 $19-6$ $17-4$
 13 13 TRUE

The solution is 4.

52.
$$5+4x-7 = 4x-2-x$$

$$4x-2 = 3x-2$$
Simplifying
$$4x-3x-2 =$$
Subtracting 3x
from both sides
$$x-2 = -2$$
Simplifying
$$x-2+2 = -2+2$$
Adding 2
to both sides
$$x = 0$$
Simplifying

Check:
$$5+4x-7 = 4x-2-x$$

$$5+4\cdot0-7 | 4\cdot0-2-0$$

$$5+0-7 | 0-2$$

$$-2 | -2 \text{ TRUE}$$

The solution is 0.

53.
$$4y-4+y+24 = 6y+20-4y$$

 $5y+20 = 2y+20$ Simplifying
 $5y+20-2y =$ Subtracting $2y$
 $7y+20-2y$ from both sides
 $3y+20 = 20$ Simplifying
 $3y+20-20 = 20-20$ Subtracting 20
from both sides
 $3y = 0$ Simplifying
 $\frac{3y}{3} = \frac{0}{3}$ Dividing both
sides by 3
 $y = 0$ Simplifying
Check:
 $\frac{4y-4+y+24}{4\cdot0-4+0+24} = 6y+20-4y$
 $\frac{6\cdot0+20-4\cdot0}{0+20-0}$
 $0-4+0+24$ $0+20-0$
 20 TRUE

The solution is 0.

54.
$$5y-10+y=7y+18-5y$$

 $6y-10=2y+18$ Simplifying
 $6y-10-2y=2y+18-2y$ Subtracting 2y
from both sides
 $4y-10=18$ Simplifying
 $4y-10+10=18+10$ Adding 10 to
both sides
 $4y=28$ Simplifying
 $\frac{4y}{4}=\frac{28}{4}$ Dividing both
sides by 4
 $y=7$ Simplifying
Check: $5y-10+y=7y+18-5y$
 $\overline{5\cdot7-10+7}$ $7\cdot7+18-5\cdot7$
 $35-10+7$ $49+18-35$
 $25+7$ $67-35$
 32 32 TRUE

The solution is 7.

<u>68</u>

55. 4 + 7a = 7(a - 1)4 + 7a = 7a - 7Distributive law 4 + 7a - 7a = 7a - 7a - 7Subtracting 7a from both sides 4 = -7Simplifying This is a false statement. The equation is a contradiction and has no solution. 56. 3(t+2)+t = 2(3+2t)3t + 6 + t = 6 + 4tDistributive law 4t + 6 = 6 + 4tSimplifying 4t + 6 - 4t = 6 + 4t - 4tSubtracting 4t from both sides 6 = 6Simplifying

Since this equation is true for all real numbers, this equation is an identity.

57. 13 - 3(2x - 1) = 413 - 6x + 3 = 4Distributive law 16 - 6x = 4Simplifying 16 - 6x - 16 = 4 - 16 Subtracting 16 from both sides -6x = -12Simplifying $\frac{-6x}{-6} = \frac{-12}{-6}$ Dividing both sides by -6 x = 2Simplifying Check: 13-3(2x-1)=4

$$\begin{array}{c|cccc} 13 - 3(2 \cdot 2 - 1) & 4 \\ 13 - 3(4 - 1) & 4 \\ 13 - 3(3) & 4 \\ 13 - 9 & 4 \\ 4 & 13 - 9 \\ 4 & 4 & TRUE \end{array}$$

The solution is 2.

58.
$$5(d+4) = 7(d-2)$$

 $5d+20 = 7d-14$ Distributive law
 $5d+20-7d =$ Subtracting 7d
 $7d-14-7d$ from both sides
 $-2d+20 = -14$ Simplifying
 $-2d+20-20 = -14-20$ Subtracting 20
from both sides
 $-2d = -34$ Simplifing
 $\frac{-2d}{-2} = \frac{-34}{-2}$ Dividing both
sides by -2
 $d = 17$
Check:
 $5(d+4) = 7(d-2)$
 $5(21)$ 7(15)
 105 TRUE
The solution is 17.
59. $7(5x-2) = 6(6x-1)$
 $35x-14 = 36x-6$ Distributive law
 $35x-14-35x =$ Subtracting $35x$
 $7(5x-2) = 6(5x-1)$
 $36x-6-35x$ from both sides
 $-14 = x-6$ Simplifying

-14 + 6 = x - 6 + 6

-8 = x

 $\frac{7(5x-2) = 6(6x-1)}{7\lceil 5(-8) - 2 \rceil \mid 6\lceil 6(-8) - 1 \rceil}$

6[-48-1]

6[-49]

-294 TRUE

Adding 6 to

both sides

Simplifing

The solution is –8.

7[-40-2]

7[-42]

-294

Check:

60. 5(t+1)+8 = 3(t-2)+6 5t+5+8 = 3t-6+6 Distributive law 5t+13 = 3t Simplifying -5t+5t+13 = -5t+3t Subtracting 5t from both sides 13 = -2t Simplifying $\frac{13}{-2} = \frac{-2t}{-2}$ Dividing both sides by -2 $t = -\frac{13}{2}$ Simplifying

Check:

$$5(t+1)+8 = 3(t-2)+6$$

$$5(t+1)+8 = 3(t-2)+6$$

$$-\frac{65}{2}+13 + 3(-\frac{13}{2}-2)+6$$

$$-\frac{65}{2}+5+8 -\frac{39}{2}-6+6$$

$$-\frac{65}{2}+13 -\frac{39}{2}$$

$$-\frac{65}{2}+\frac{26}{2}$$

$$-\frac{39}{2}$$
TRUE

The solution is
$$-\frac{12}{2}$$

61.
$$2(7-x) - 20 = 7x - 3(2+3x)$$

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

$$-2x-6 = -2x-6$$
 Simplifying

$$-2x-6+6 = -2x-6+6$$
 Adding 6
to both sides

$$-2x = -2x$$
 Simplifying
This equation is true regardless of the

This equation is true regardless of the replacement for x, so all real numbers are solutions. The equation is an identity.

62.
$$5(x-7) = 3(x-2) + 2x$$

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

$$5x-35 = 5x-6$$
 Distributive Law

$$-5x+5x-35 = -5x+5x-6$$
 Subtracting 5x
from both sides

$$-35 = -6$$
 Simplifying
This is a false statement. The equation is a

This is a false statement. The equation is a contradiction and has no solution.

$$19-2x-3 = 2x+6+x$$
 Distributive law

$$16-2x = 3x+6$$
 Simplifying

$$16-2x+2x =$$
 Adding 2x to

$$3x+6+2x$$

$$16 = 5x+6$$
 Simplifying

$$16-6 = 5x+6-6$$
 Subtracting 6
from both sides

63. 19 - (2x + 3) = 2(x + 3) + x

$$10 = 5x$$
Simplifying $\frac{10}{5} = \frac{5x}{5}$ Dividing both $2 = x$ Simplifying

Check:

$$\begin{array}{c|c}
19 - (2x + 3) = 2(x + 3) + x \\
\hline
19 - (2 \cdot 2 + 3) & 2(2 + 3) + 2 \\
19 - (4 + 3) & 2(5) + 2 \\
19 - (7) & 10 + 2 \\
12 & 12 & \text{TRUE}
\end{array}$$

The solution is 2.

64.
$$13 - (2c + 2) = 2(c + 2) + 3c$$

13 - 2c - 2 = 2c + 4 + 3c	Distributive law
11 - 2c = 5c + 4	Simplifying
11 - 2c + 2c = 5c + 4 + 2c	Adding 2 <i>c</i> to both sides
11 = 7c + 4	Simplifying
11 - 4 = 7c + 4 - 4	Subtracting 4 from both sides
7 = 7c	Simplifying
$\frac{7}{7} = \frac{7c}{7}$	Dividing both sides by 7
1 = c	Simplifying

Check:

$$\begin{array}{c|c} 13 - (2c+2) = 2(c+2) + 3c \\ \hline 13 - (2\cdot1+2) & 2(1+2) + 3\cdot1 \\ 13 - (2+2) & 2(3) + 3 \\ 13 - 4 & 6 + 3 \\ 9 & 9 & \text{TRUE} \end{array}$$

The solution is 1.

65. $\frac{2}{3} + \frac{1}{4}t = 2$ The number 12 is the least common denominator, so we multiply by 12 on both sides. $12\left(\frac{2}{3}+\frac{1}{4}t\right) = 12 \cdot 2$ 8 + 3t = 24-8 + 8 + 3t = -8 + 24Subtracting 8 from both sides 3t = 16Simplifying $\frac{3t}{3} = \frac{16}{3}$ Dividing both sides by 3 $t = \frac{16}{3}$ Simplifying Check: $\frac{2}{3} + \frac{1}{4}t = 2$ $\frac{2}{3} + \frac{1}{4} \left(\frac{16}{3} \right) = 2$ $\frac{2}{3} + \frac{16}{12}$ 2 $\frac{2}{3} + \frac{4}{3}$ 2 $\begin{array}{c|c} \frac{6}{3} & 2\\ 2 & 2 & TRUE \end{array}$ The solution is $\frac{16}{3}$. 66. $-\frac{5}{6} + x = -\frac{1}{2} - \frac{2}{3}$ The number 6 is the least common denominator, so we multiply by 6 on both sides.

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

-5+6x = -3-4
-5+6x = -7 Simplifying
5-5+6x = 5-7 Adding 5 to
both sides
 $6x = -2$ Simplifying
 $\frac{6x}{6} = \frac{-2}{6}$ Dividing both
sides by 6
 $x = -\frac{1}{3}$ Simplifying
Check:
 $-\frac{5}{6}+x = -\frac{1}{2}-\frac{2}{3}$
 $-\frac{5}{6}+\left(-\frac{1}{3}\right) = -\frac{1}{2}-\frac{2}{3}$
 $-\frac{5}{6}+\left(-\frac{2}{6}\right) = -\frac{3}{6}-\frac{4}{6}$
 $-\frac{7}{6}$ TRUE

The solution is
$$-\frac{1}{3}$$
.

67. $\frac{2}{3} + 4t = 6t - \frac{2}{15}$ The number 15 is the least common denominator, so we multiply by 15 on both sides. $15\left(\frac{2}{3}+4t\right) = 15\left(6t-\frac{2}{15}\right)$ 10 + 60t = 90t - 210 + 60t - 60t =Subtracting 60t from both sides 90t - 2 - 60t10 = 30t - 2Simplifying 10 + 2 = 30t - 2 + 2Adding 2 to both sides 12 = 30tSimplifying $\frac{12}{30} = \frac{30t}{30}$ Dividing both sides by 30 $\frac{2}{5} = t$ Simplifying Check: $\frac{2}{3} + 4t = 6t - \frac{2}{15}$ $\frac{\frac{2}{3}+4\left(\frac{2}{5}\right)}{6\left(\frac{2}{5}\right)-\frac{2}{15}}$ $\begin{array}{c|c} \frac{2}{3} + \frac{8}{5} & \frac{12}{5} - \frac{2}{15} \\ \frac{10}{15} + \frac{24}{15} & \frac{36}{15} - \frac{2}{15} \\ \frac{34}{15} & \frac{34}{15} & \frac{34}{15} \end{array}$ The solution is $\frac{2}{5}$. 68. $\frac{1}{2} + 4m = 3m - \frac{5}{2}$ The number 2 is the least common denominator, so we multiply by 2 on both sides. $2\left(\frac{1}{2}+4m\right)=2\left(3m-\frac{5}{2}\right)$ 1 + 8m = 6m - 5

1 + 8m - 6m = 6m - 5 - 6m	Subtracting 6 <i>m</i> from both sides
1 + 2m = -5	Simplifying
1 + 2m - 1 = -5 - 1	Subtracting 1 from both sides
2m = -6	Simplifying
$\frac{2m}{2} = \frac{-6}{2}$	Dividing both sides by 2

m = -3

Simplifying

Check:

$$\frac{\frac{1}{2} + 4m = 3m - \frac{5}{2}}{\frac{1}{2} + 4(-3)} | 3(-3) - \frac{5}{2} \\ \frac{\frac{1}{2} - 12}{\frac{1}{2} - \frac{24}{2}} | -9 - \frac{5}{2} \\ -\frac{18}{2} - \frac{5}{2} \\ -\frac{23}{2} | -\frac{23}{2} \\ \text{TRUE}$$

The solution is -3.

69. $\frac{1}{3}x + \frac{2}{5} = \frac{4}{15} + \frac{3}{5}x - \frac{2}{3}$

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

$$15\left(\frac{1}{3}x+\frac{2}{5}\right) = 15\left(\frac{4}{15}+\frac{3}{5}x-\frac{2}{3}\right)$$

$$5x+6=4+9x-10$$

$$5x+6=9x-6$$
Simplifying
$$5x+6-5x=9x-6-5x$$
Subtracting 5x
from both sides
$$6=4x-6$$
Simplifying
$$6+6=4x-6+6$$
Adding 6 to
both sides
$$12=4x$$
Simplifying
$$\frac{12}{4}=\frac{4x}{4}$$
Dividing both
sides by 4
$$3=x$$
Simplifying

Check:

$$\frac{\frac{1}{3}x + \frac{2}{5} = \frac{4}{15} + \frac{3}{5}x - \frac{2}{3}}{\frac{1}{3}(3) + \frac{2}{5}} + \frac{4}{15} + \frac{3}{5}(3) - \frac{2}{3}}$$

$$\frac{1 + \frac{2}{5}}{1 + \frac{2}{5}} + \frac{4}{15} + \frac{9}{5} - \frac{2}{3}}{\frac{5}{5} + \frac{2}{5}} + \frac{4}{15} + \frac{27}{15} - \frac{10}{15}}{\frac{7}{5}} + \frac{21}{15}$$

$$\frac{7}{5} + \frac{21}{15} + \frac{27}{15} - \frac{10}{15}}{\frac{7}{5}} + \frac{21}{15} + \frac{21}{15}$$

The solution is 3.

70. $1 - \frac{2}{3}y = \frac{9}{5} - \frac{1}{5}y + \frac{3}{5}$

The number 15 is the least common denominator, so we multiply by 15 on both sides. 15(1-2) = 15(9-1-3)

$$15(1-\frac{2}{3}y) = 15(\frac{9}{5}-\frac{1}{5}y+\frac{3}{5})$$

15 - 10y = 27 - 3y + 915 - 10y = 36 - 3ySimplifying 15 - 10y + 10y =Adding 10yto both sides 36 - 3y + 10y15 = 36 + 7ySimplifying 15 - 36 =Subtracting 36 from both 36 + 7v - 36sides -21 = 7ySimplifying $\frac{-21}{7} = \frac{7y}{7}$ Dividing both sides by 7 -3 = vSimplifying Check: $1 - \frac{2}{3}y = \frac{9}{5} - \frac{1}{5}y + \frac{3}{5}$ $1-\frac{2}{3}(-3)$ $\frac{9}{5}-\frac{1}{5}(-3)+\frac{3}{5}$ $\frac{9}{5} + \frac{3}{5} + \frac{3}{5}$ 1 + 2 $\frac{15}{5}$ 3 3 3 TRUE The solution is -3. 71. 2.1x + 45.2 = 3.2 - 8.4x

We can clear decimals by multiplying both sides by 10. 10(2.1x+45.2) = 10(3.2-8.4x)21x + 452 = 32 - 84x21x + 452 + 84x =Adding 84x to both sides 32 - 84x + 84x105x + 452 = 32Simplifying 105x + 452 - 452 =Subtracting 452 from both 32 - 452sides 105x = -420Simplifying $\frac{105x}{105} = \frac{-420}{105}$ Dividing both sides by 105 x = -4Simplifing Check: 2.1x + 45.2 = 3.2 - 8.4x $2.1(-4) + 45.2 \mid 3.2 - 8.4(-4)$ -8.4 + 45.2 3.2 + 33.6

The solution is –4.

0.91 - 0.2z = 1.23 - 0.6z					
We can clear decimals by multiplying					
sides by 100.					
100(0.91 - 0.2z) = 100(1.23 - 0.6z)					
91 - 20z = 123 - 60	0 <i>z</i>				
91 - 20z - 91 =	Subtracting 91				
123 – 60 <i>z</i> –	-91 from both sides				
-20z = -60z +	32 Simplifying				
-20z + 60z =	Adding 60z to				
-60z + 32 + 6	50z both sides				
40z = 32	Simplifying				
40 <i>z</i> _ 32	Dividing both				
$\frac{1}{40} = \frac{1}{40}$	sides by 40				
z = 0.8	Simplifing				
Check:					
0.91 - 0.2z = 1.23	-0.6z				
0.91-0.2(0.8) 1.23-	-0.6(0.8)				
0.91-0.16 1.	.23-0.48				
0.75	0.75 TRUE				
The solution is 0.8.					

73. 0.76 + 0.21t = 0.96t - 0.49We can clear decimals by multiplying both sides by 100. 100(0.76+0.21t) = 100(0.96t-0.49)76 + 21t = 96t - 4976 + 21t - 76 =Subtracting 76 from both sides 96t - 49 - 7621t = 96t - 125Simplifying 21t - 96t =Subtracting 96t from both sides 96t - 125 - 96t-75t = -125Simplifying $\frac{-75t}{-75} = \frac{-125}{-75}$ Dividing both sides by -75Simplifying t = 1.6Check: 0.76 + 0.21t = 0.96t - 0.490.76 + 0.21(1.6) | 0.96(1.6) - 0.490.76 + 0.351.6 - 0.491.11 TRUE 1.11 The solution is $1.\overline{6}$.

74. 1.7t + 8 - 1.62t = 0.4t - 0.32 + 8

We can clear decimals by multiplying both sides by 100. 100(1.7t + 8 - 1.62t) = 100(0.4t - 0.32 + 8)170t + 800 - 162t =40t - 32 + 8008t + 800 = 40t + 7688t + 800 - 800 =Subtracting 800 from 40t + 768 - 800both sides 8t = 40t - 32Simplifying 8t - 40t =Subtracting 40t from 40t - 32 - 40tboth sides -32t = -32Simplifying $\frac{-32t}{-32} = \frac{-32}{-32}$ Dividing both sides by -32-32 - 32Simplifing t = 1Check: 1.7t + 8 - 1.62t = 0.4t - 0.32 + 8 $\overline{1.7(1)} + 8 - 1.62(1)$ 0.4(1) - 0.32 + 81.7 + 8 - 1.620.4 - 0.32 + 88.08 8.08 TRUE

The solution is 1.

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

The number 20 is the least common denominator, so we multiply by 20 on both sides.

$$20\left(\frac{2}{5}x - \frac{3}{2}x\right) = 20\left(\frac{3}{4}x + 2\right)$$

$$8x - 30x = 15x + 40$$

$$-22x = 15x + 40$$
 Simplifying

$$-22x - 15x =$$
 Subtract 15x from

$$15x + 40 - 15x$$
 both sides

$$-37x = 40$$
 Simplifying

$$\frac{-37x}{-37} = \frac{40}{-37}$$
 Divide both
sides by - 37

$$x = -\frac{40}{37}$$
 Simplifying
Check:

$$\frac{\frac{2}{5}x - \frac{3}{2}x = \frac{3}{4}x + 2}{\frac{2}{5}\left(-\frac{40}{37}\right) - \frac{3}{2}\left(-\frac{40}{37}\right)} = \frac{3}{4}\left(-\frac{40}{37}\right) + 2}{-\frac{16}{37} + \frac{60}{37}} = \frac{-\frac{30}{37} + \frac{74}{37}}{-\frac{44}{37}}$$
 TRUE

The solution is $-\frac{40}{37}$.

76. $\frac{5}{16}y + \frac{3}{8}y = 2 + \frac{1}{4}y$ The number 16 is the least common denominator, so we multiply by 16 on both sides. $16\left(\frac{5}{16}y + \frac{3}{8}y\right) = 16\left(2 + \frac{1}{4}y\right)$ 5y + 6y = 32 + 4y11y = 32 + 4ySimplifying 11y - 4y = 32 + 4y - 4y Subtract 4y from both sides 7y = 32Simplifying $\frac{7y}{7} = \frac{32}{7}$ Divide both sides by 7 $y = \frac{32}{7}$ Simplifying Check: $\frac{5}{5}v + \frac{3}{5}v = 2 + \frac{1}{5}v$

$$\frac{\frac{16}{16}y + \frac{3}{8}y - 2 + \frac{4}{4}y}{\frac{5}{16}\left(\frac{32}{7}\right) + \frac{3}{8}\left(\frac{32}{7}\right)} \quad 2 + \frac{1}{4}\left(\frac{32}{7}\right)}{\frac{10}{7} + \frac{12}{7}} \quad \frac{14}{7} + \frac{8}{7}}{\frac{22}{7}} \quad \frac{22}{7} \quad \text{TRUE}$$

The solution is $\frac{32}{7}$.

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

The number 3 is the least common denominator, so we multiply by 3 on both sides.

 $3\left\lceil \frac{1}{3}(2x-1)\right\rceil = 3\cdot7$ 2x - 1 = 212x - 1 + 1 = 21 + 1 Add 1 to both sides 2x = 22Simplifying $\frac{2x}{2} = \frac{22}{2}$ Divide both sides by 2 x = 11Simplifying

Check:

$$\frac{\frac{1}{3}(2x-1) = 7}{\frac{1}{3}(2\cdot11-1) + 7}$$
$$\frac{\frac{1}{3}(22-1) + 7}{\frac{1}{3}(21) + 7}$$
$$\frac{1}{3}(21) + 7$$
$$\frac{1}{3}$$

The solution is 11.

78. $\frac{4}{3}(5x+1) = 8$ $\frac{3}{4}\left\lceil\frac{4}{3}\left(5x+1\right)\right\rceil = \frac{3}{4} \cdot 8$

5x + 1 = 6Simplifying 5x+1-1 = 6-1Subtract 1 from both sides 5*x* = 5 Simplifying $\frac{5x}{5} = \frac{5}{5}$ Divide both sides by 5 Simplifying x = 1Check: $\frac{4}{3}(5x+1) = 8$ $\frac{4}{3}(5\cdot 1+1)$ 8 $\frac{4}{3}(5+1)$ 8 $\frac{4}{3}(6)$ 8 8 8 TRUE

Multiply both

sides by $\frac{3}{4}$

The solution is 1.

79. $\frac{3}{4}(3t-6) = 9$

$\frac{4}{3}\left[\frac{3}{4}\left(3t-6\right)\right] = \frac{4}{3}\left(9\right)$	Multiply both sides by $\frac{4}{3}$
3t - 6 = 12	Simplifying
3t - 6 + 6 = 12 + 6	Add 6 to both sides
3t = 18	Simplifying
$\frac{3t}{3} = \frac{18}{3}$	Divide both sides by 3
<i>t</i> = 6	Simplifying
Check:	
$\frac{3}{4}(3t-6) = 9$	
$\frac{3}{4}(3 \cdot 6 - 6)$ 9	
$\frac{3}{4}(18-6)$ 9	
$\frac{3}{4}(12)$ 9	
9 9 TRUE	3
The solution is 6.	

80. $\frac{3}{2}(2x+5) = -\frac{15}{2}$ $\frac{2}{3}\left[\frac{3}{2}(2x+5)\right] = \frac{2}{3}\left(-\frac{15}{2}\right)$ Multiply both sides by $\frac{2}{3}$ 2x + 5 = -5Simplifying 2x + 5 - 5 = -5 - 5Subtract 5 from both sides 2x = -10Simplifying $\frac{2x}{2} = \frac{-10}{2}$ Divide both sides by 2 x = -5Simplifying Check: $\frac{3}{2}(2x+5) = -\frac{15}{2}$ $\frac{3}{2}\left[2\left(-5\right)+5\right] - \frac{15}{2}$

$$\begin{array}{c|c} \frac{3}{2}(-10+5) & -\frac{15}{2} \\ \frac{3}{2}(-5) & -\frac{15}{2} \\ -\frac{15}{2} & -\frac{15}{2} \end{array} \text{ TRUE}$$

The solution is -5.

81. $\frac{1}{6}(\frac{3}{4}x-2) = -\frac{1}{5}$ $30\left[\frac{1}{6}\left(\frac{3}{4}x-2\right)\right] = 30\left(-\frac{1}{5}\right)$ Multiply both sides by 30 $5(\frac{3}{4}x-2) = -6$ Simplifying $\frac{15}{4}x - 10 = -6$ Distributive Law $\frac{15}{4}x - 10 + 10 = -6 + 10$ Add 10 to both sides $\frac{15}{4}x = 4$ Simplifying $\left(\frac{4}{15}\right)\left(\frac{15}{4}\right)x = \left(\frac{4}{15}\right)(4)$ Multiply both sides by $\frac{4}{15}$ $x = \frac{16}{15}$ Simplifying Check:

$$\frac{\frac{1}{6}\left(\frac{3}{4}x-2\right) = -\frac{1}{5}}{\frac{1}{6}\left[\frac{3}{4}\left(\frac{16}{15}\right)-2\right] -\frac{1}{5}} \\ \frac{1}{6}\left(\frac{4}{5}-2\right) -\frac{1}{5} \\ \frac{1}{6}\left(\frac{4}{5}-\frac{10}{5}\right) -\frac{1}{5} \\ \frac{1}{6}\left(-\frac{6}{5}\right) -\frac{1}{5} \\ -\frac{1}{5} -\frac{1}{5} \\ \frac{1}{5} \\ TRUE$$

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

82. $\frac{2}{3}(\frac{7}{8}-4x)-\frac{5}{8}=\frac{3}{8}$ $24\left[\frac{2}{3}\left(\frac{7}{8}-4x\right)-\frac{5}{8}\right]=24\left(\frac{3}{8}\right)$ Multiply both sides by 24 $16\left(\frac{7}{8}-4x\right)-15=9$ Simplifying and 14 - 64x - 15 = 9Distributive Law -64x - 1 = 9Simplifying -64x - 1 + 1 = 9 + 1Add 1 to both sides -64x = 10Simplifying $\frac{-64x}{-64} = \frac{10}{-64}$ Divide both sides by - 64 $x = -\frac{5}{32}$ Simplifying Check: $\frac{2}{3}\left(\frac{7}{8}-4x\right)-\frac{5}{8}=\frac{3}{8}$ $\frac{2}{3}\left[\frac{7}{8}-4\left(-\frac{5}{32}\right)\right]-\frac{5}{8}\left[\frac{3}{8}\right]$ $\frac{2}{3}\left[\frac{7}{8} + \frac{5}{8}\right] - \frac{5}{8} \quad \frac{3}{8}$ $\frac{2}{3} \left[\frac{12}{8} \right] - \frac{5}{8} \quad \frac{3}{8}$ $\frac{\frac{8}{8} - \frac{5}{8}}{\frac{3}{8}} = \frac{3}{\frac{3}{8}}$ $\frac{3}{8} = \frac{3}{8}$ TRUE The solution is $-\frac{5}{32}$.

83. 0.7(3x+6) = 1.1 - (x+2)We can clear decimals by multiplying both sides by 10. 10[0.7(3x+6)] = 10[1.1-(x+2)]7(3x+6) = 11-10(x+2)21x + 42 = 11 - 10x - 20Distributive Law 21x + 42 = -10x - 9Simplifying 21x + 42 + 10x =Adding 10x to both sides -10x - 9 + 10x31x + 42 = -9Simplifying 31x + 42 - 42 = -9 - 42Subtracting 42 from both sides 31x = -51Simplifying $\frac{31x}{31} = \frac{-51}{31}$ Dividing both sides by 31 $x = -\frac{51}{31}$ Simplifying

Check: $\begin{array}{c|c}
0.7(3x+6) = 1.1 - (x+2) \\
\hline \frac{7}{10} \left[3\left(-\frac{51}{31}\right) + 6 \right] & \frac{11}{10} - \left(-\frac{51}{31} + 2\right) \\
\hline \frac{7}{10} \left(-\frac{153}{31} + \frac{186}{31}\right) & \frac{11}{10} - \left(-\frac{51}{31} + \frac{62}{31}\right) \\
\hline \frac{7}{10} \left(\frac{33}{31}\right) & \frac{11}{10} - \left(\frac{11}{31}\right) \\
\hline \frac{231}{310} & \frac{341}{310} - \frac{110}{310} \\
\hline \frac{231}{110} & \frac{231}{110} & \frac{231}{110} \\
\end{array}$ TRUE The solution is $-\frac{51}{31}$.

84. 0.9(2x+8) = 20 - (x+5)We can clear decimals by multiplying both sides by 10. 10[0.9(2x+8)] = 10[20-(x+5)]9(2x+8) = 200-10(x+5)18x + 72 = 200 - 10x - 50Distributive Law 18x + 72 = 150 - 10xSimplifying 18x + 72 + 10x = 150 - 10x + 10xAdding 10x to both sides 28x + 72 = 150Simplifying 28x + 72 - 72 = 150 - 72Subtracting 72 from both sides 28x = 78Simplifying $\frac{28x}{28} = \frac{78}{28}$ Dividing both sides by 28 $x = \frac{39}{14}$ Simplifying Check: 0.9(2x+8) = 20 - (x+5) $\frac{9}{10} \left[2\left(\frac{39}{14}\right) + 8 \right] \left[20 - \left(\frac{39}{14} + 5\right) \right]$ $\frac{9}{10}\left(\frac{39}{7}+\frac{56}{7}\right) \mid 20-\left(\frac{39}{14}+\frac{70}{14}\right)$ $\begin{array}{c|c} 9\\ 9\\ 10\\ \hline 7\\ \hline 11\\ 14\\ \hline 11\\ \hline$

The solution is $\frac{39}{14}$.

85. a + (a - 3) = (a + 2) - (a + 1)a+a-3 = a+2-a-1 Simplifying Distributive Law 2a - 3 = 1Simplifying 2a - 3 + 3 = 1 + 3Adding 3 to both sides 2a = 4Simplifying $\frac{2a}{2} = \frac{4}{2}$ Dividing both sides by 2 a = 2Simplifying Check: a + (a - 3) = (a + 2) - (a + 1) $\overline{2+(2-3)}$ (2+2)-(2+1) 2 + (-1)4 - 31 1 TRUE The solution is 2.

86. 0.8 - 4(b-1) = 0.2 + 3(4-b)We can clear decimals by multiplying both sides by 10. 10[0.8 - 4(b-1)] = 10[0.2 + 3(4-b)]8 - 40(b-1) = 2 + 30(4-b)

8 - 40b + 40 = 2 + 120 - 30bDistributive Law -40b + 48 = 122 - 30bSimplifying -40b + 48 + 30b = 122 - 30b + 30bAdd 30b to both sides -10b + 48 = 122Simplifying -10b + 48 - 48 = 122 - 48Subtract 48 from both sides -10b = 74Simplifing $\frac{-10b}{-10} = \frac{74}{-10}$ Dividing both sides by -10b = -7.4Check: 0.8 - 4(b-1) = 0.2 + 3(4-b) $\overline{0.8} - 4(-7.4 - 1) \mid 0.2 + 3(4 - (-7.4))$ 0.8 - 4(-8.4)0.2 + 3(4 + 7.4)0.8 + 33.60.2 + 3(11.4)34.4 0.2 + 34.234.4 TRUE 34.4 The solution is -7.4.

- 87. *Thinking and Writing Exercise*. No; although it might be easier to use the addition and multiplication principles when an equation does not contain decimals, it is possible to use these principles when an equation does contain decimals.
- 88. *Thinking and Writing Exercise.* Since the rules for order of operations tell us to multiply (and divide) before we add (and subtract), we "undo" multiplication and additions in opposite order when we solve equations. That is, we add or subtract first and then multiply or divide to isolate the variable.
- 89. 3-5aWe substitute 2 for *a* and evaluate. $3-5a = 3-5 \cdot 2$ = 3-10

- 90. $12 \div 4 \cdot t$ We substitute 5 for t and evaluate. $12 \div 4 \cdot t = 12 \div 4 \cdot 5$ $= 3 \cdot 5$
 - = 15

- 91. 7x-2xWe substitute -3 for x and evaluate. 7x-2x = 7(-3) - 2(-3)= -21+6= -15
- 92. t(8-3t)We substitute -2 for t and evaluate. t(8-3t) = -2[8-3(-2)]= -2(8+6)= -2(14)= -28
- 93. *Thinking and Writing Exercise*. Multiply by 100 to clear decimals. Next multiply by 12 to clear fractions. (These steps could be reversed.) Then proceed as usual. The procedure could be streamlined by multiplying by 1200 to clear decimals and fractions in one step.
- 94. *Thinking and Writing Exercise.* Joseph should first use the addition principle to eliminate the 4 on the left side of the equation. Then he could use the multiplication principle to eliminate the 3.

95. 8.43x - 2.5(3.2 - 0.7x) = -3.455x + 9.04We can clear decimals by multiplying both sides by 1000. 1000[8.43 - 2.5(3.2 - 0.7x)] = 1000[-3.455x + 9.04]8430x - 2500(3.2 - 0.7x) = -3455x + 90408430x - 8000 + 1750x = -3455x + 9040Distributive Law 10,180x - 8000 = -3455x + 9040Simplifying 10,180x - 8000 + 3455x = -3455x + 9040 + 3455xAdding 3455x to both sides 13,635x - 8000 = 9040Simplifying 13.635x - 8000 + 8000 = 9040 + 8000Adding 8000 to both sides 13,635x = 17,040Simplifying 13,635*x* 17,040 Dividing both sides by 13,635 13,635 13,635 $x = \frac{1136}{909}$ Simplifing The solution is $\frac{1136}{909}$, or $1.\overline{2497}$.

96. 0.008 + 9.62x - 42.8 = 0.944x + 0.0083 - xWe can clear decimals by multiplying both sides by 10,000. 10,000[0.008+9.62x-42.8] = 10,000[0.944x+0.0083-x]80 + 96,200x - 428,000 = 9440x + 83 - 10,000x96,200x - 427,920 = -560x + 83Simplifying 96,200x - 427,920 + 560x = -560x + 83 + 560xAdding 560x to both sides 96,760x - 427,920 = 83Simplifying 96,760x - 427,920 + 427,920 = 83 + 427,920Adding 427,920 to both sides 96,760x = 428,003Simplifying $\frac{96,760x}{428,003}$ Dividing both sides by 96,760 96,760 96,760 $x \approx 4.423346424$ Simplifing

The solution is $\frac{428,003}{96,760}$, or approximately 4.423346424.

97.
$$-2[3(x-2)+4] = 4(5-x)-2x$$

 $-2[3x-6+4] = 20-4x-2x$ Distributive Law
 $-6x+12-8 = 20-4x-2x$ Distributive Law
 $-6x+4 = 20-6x$ Simplifying
 $-6x+4+6x = 20-6x+6x$ Add 6x to both sides
 $4 = 20$ Simplifying

This is a false statement. The equation is a contradiction and has no solution.

98.
$$0 = y - (-14) - (-3y)$$
$$0 = y + 14 + 3y$$
$$0 = 4y + 14$$
$$-14 = 4y$$
$$-\frac{7}{2} = y$$
The solution is $-\frac{7}{2}$.

99.
$$2x(x+5) - 3(x^{2} + 2x - 1) = 9 - 5x - x^{2}$$
$$2x^{2} + 10x - 3x^{2} - 6x + 3 = 9 - 5x - x^{2}$$
$$-x^{2} + 4x + 3 = 9 - 5x - x^{2}$$
$$9x = 6$$
$$x = \frac{2}{3}$$

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

100.

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

$$x^{2} - 4x = 3x^{2} + 3x - 2x^{2} - 2x + 10$$

$$0 = -x^{2} + 4x + 3x^{2} + 3x - 2x^{2} - 2x + 10$$

$$0 = 5x + 10$$

$$-10 = 5x$$

$$-2 = x$$
The solution is -2.
101. $9 - 3x = 2(5 - 2x) - (1 - 5x)$

$$9 - 3x = 10 - 4x - 1 + 5x$$

$$0 = -9 + 3x + 10 - 4x - 1 + 5x$$

$$0 = 4x$$

102.
$$\left[7 - 2(8 \div (-2))\right]x = 0$$
$$\left[7 - 2(-4)\right]x = 0$$
$$(7 + 8)x = 0$$
$$15x = 0$$
The solution is 0.

0 = xThe solution is 0.

103.
$$\frac{x}{14} - \frac{5x+2}{49} = \frac{3x-4}{7}$$
$$98\left(\frac{x}{14} - \frac{5x+2}{49}\right) = 98\left(\frac{3x-4}{7}\right)$$
$$7x - 10x - 4 = 14(3x-4)$$
$$7x - 10x - 4 = 42x - 56$$
$$-3x - 4 = 42x - 56$$
$$-4 + 56 = 42x + 3x$$
$$52 = 45x$$
$$\frac{52}{45} = x$$
The solution is $\frac{52}{45}$

The solution is $\frac{52}{45}$.

104.
$$\frac{5x+3}{4} + \frac{25}{12} = \frac{5+2x}{3}$$
$$12\left(\frac{5x+3}{4} + \frac{25}{12}\right) = 12\left(\frac{5+2x}{3}\right)$$
$$15x+9+25 = 20+8x$$
$$15x+34 = 20+8x$$
$$15x-8x = 20-34$$
$$7x = -14$$
$$x = -2$$
The solution is -2.

105.
$$2\{9-3[-2x-4]\} = 12x+42$$

 $2\{9+6x+12\} = 12x+42$
 $2\{21+6x\} = 12x+42$
 $42+12x = 12x+42$
 $42 = 42$

Since this equation is true for all real numbers, this equation is an identity.

106.
$$-9t + 2 = 2 - 9t - 5(8 \div 4(1 + 3^{4}))$$
$$-9t + 2 = 2 - 9t - 5(8 \div 4(1 + 81))$$
$$-9t + 2 = 2 - 9t - 5(8 \div 4 \cdot (82))$$
$$-9t + 2 = 2 - 9t - 5(2(82))$$
$$-9t + 2 = 2 - 9t - 820$$
$$-9t + 2 = -9t - 818$$
$$2 = -818$$

This is a false statement. The equation is a contradiction and has no solution.

107. 3|x| - 2 = 10 3|x| = 12 |x| = 4 $x = \pm 4$ The solution is -4 and 4.

Exercise Set 2.3

- 1. We substitute 21,345 for *n* and calculate *f*. $f = \frac{n}{15} = \frac{21,345}{15} = 1423$ The number of students is 1423.
- 2. We substitute 10 for *t* and calculate *M*. $M = \frac{1}{5}t = \frac{1}{5} \cdot 10 = 2$ The storm is 2 miles away.
- 3. We substitute 30 for *I* and 115 for *V* and calculate *P*. $P = I \cdot V = 30 \cdot 115 = 3450$ The power consumed is 3450 watts.
- 4. We substitute 344 for *r* and 24 for *f*. $w = \frac{r}{f} = \frac{344}{24} = \frac{43}{3}$

The wavelength is $\frac{43}{3}$ m/cycle, or $14.\overline{3}$ m/cycle.

5. We substitute 0.025 for *I* and 0.044 for *U* and solve for *f*. f = 8.5 + 1.4(I - U)= 8.5 + 1.4(0.025 - 0.044)= 8.5 + 1.4(-0.019)= 8.5 - 0.0266= 8.4734

The federal funds rate should be 8.4734.

6. We substitute 84 for *c* and 8 for *w* and solve for *D*.

$$D = \frac{c}{w} = \frac{84}{8} = 10.5$$

The calorie density is 10.5 cal/oz.

7.	We substitute $n = 0.5t^4 + 2$	e 1 for <i>t</i> and solve for <i>n</i> . $45t^3 = 96.65t^2 + 347.7t$	15.	P = 2l + 2w	Subtraction ~ 2.
	n = 0.5t + 3	.43i - 90.03i + 54/./i		P - 2w = 2l + 2	2w-2w Subtracting $2w$ from both sides
	= 0.5(1) +	-3.45(1) - 96.65(1) + 347.7(1)		P-2w=2l	
	= 0.5 + 3.4	5-96.65+347.7		P-2w 2l	Dividing both
	= 255 After 1 hour	255 mg of ibuprofen remains in		$\frac{1}{2} = \frac{1}{2}$	sides by 2
	the bloodstre	am.		P-2w	5
				$\frac{1}{2} = l$, or	
8.	We substitute	e 7 for n and solve for N .		P $w = 1$	
	$N = n^2 - n$			$\frac{1}{2} - w = i$	
	$=7^{2}-7$		16	D 01 0	
	= 49 - 7		16.	P = 2l + 2w	Subtracting 21
	= 42	C 1 1:42		P - 2l = 2l + 2i	w-2l from both sides
	The number	of games played is 42.		P-2l=2w	
9.	A = bh			P-2l = 2w	
	A bh			$\frac{1}{2} = \frac{1}{2}$	Dividing both sides by 2
	$\frac{1}{h} = \frac{1}{h}$	Dividing both sides by h		P-2l	°, -
	$\frac{A}{-}$ - b			$\frac{1}{2} = w$, or	
	h^{b}			P_{1}	
10	4 11			$\frac{1}{2} - l = w$	
10.	A = bh			,)	
	$\frac{A}{l} = \frac{bh}{l}$	Dividing both sides by b	17.	$A = \pi r^2$	
	D D A			$\frac{A}{1} = \frac{\pi r^2}{1}$	Divide both sides by r^2
	$\frac{h}{h} = h$			r^2 r^2	5
	0			$\frac{A}{2} = \pi$	
11.	I = Prt			r	
	$I _ Prt$	Dividing both sides by rt	18.	$A = \pi r^2$	
	rt rt	Dividing both sides by <i>n</i>		$A \pi r^2$	
	$\frac{I}{-} = P$			$\frac{\pi}{\pi} = \frac{\pi}{\pi}$	Divide both sides by π
	rt				
12	I = Prt			$\frac{1}{\pi} = r^2$	
14.	I Prt				
	$\frac{1}{Pr} = \frac{1}{Pr}$	Dividing both sides by <i>Pr</i>	19.	$A = \frac{1}{2}bh$	
	Ι			2A = bh	Multiplying both sides by 2
	$\frac{1}{Pr} = t$			$\frac{2A}{2} = \frac{bh}{b}$	Dividing both sides by <i>b</i>
				b b	
13.	H = 65 - m			$\frac{2A}{d} = h$	
	H + m = 65	Adding <i>m</i> to both sides		Ь	
	m = 65 - H	Subtracting H from both sides			

14. d = h - 64d + 64 = h Adding 64 to both sides

- 20. $A = \frac{1}{2}bh$ 2A = bh Multiplying both sides by 2 $\frac{2A}{h} = \frac{bh}{h}$ Dividing both sides by h $\frac{2A}{h} = b$
- 21. $E = mc^2$ $\frac{E}{c^2} = \frac{mc^2}{c^2}$ Divide both sides by c^2 $\frac{E}{c^2} = m$

22.
$$E = mc^2$$

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

23.
$$Q = \frac{c+d}{2}$$

$$2Q = c+d$$
Multipling both sides
by 2

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

$$2Q - c = d$$

24.
$$A = \frac{a+b+c}{3}$$

$$3A = a+b+c$$
 Multiplying both
sides by 3

$$3A-a-c = Subtracting a and c$$

$$a+b+c-a-c$$
 from both sides

$$3A-a-c = b$$

25.
$$p-q+r=2$$

 $p-q+r+q=2+q$ Adding q to both
sides
 $p+r-2=2+q-2$ Subtracting 2 from
 $both$ sides
 $q=p+r-2$

26.
$$p = \frac{r-q}{2}$$

$$2p = r-q$$
Multiplying both
sides by 2
$$q = r-2p$$
Subtracting 2p
and adding q
27.
$$w = \frac{r}{f}$$
wf = r
Multiplying both sides by f
$$f = \frac{r}{w}$$
Dividing both sides by w
28.
$$M = \frac{A}{s}$$
Ms = A
Multiplying both sides by s
$$s = \frac{A}{M}$$
Dividing both sides by M
29.
$$H = \frac{TV}{550}$$
550H = TV
Multiplying both sides by 550
$$\frac{550H}{V} = T$$
Dividing both sides by V
30.
$$P = \frac{ab}{c}$$

$$P \cdot \frac{c}{a} = \frac{ab}{c} \cdot \frac{c}{a}$$
Multiplying both sides by $\frac{c}{a}$

$$\frac{Pc}{a} = b$$
31.
$$F = \frac{9}{5}C + 32$$

$$F - 32 = \frac{9}{5}C + 32 - 32$$
Subtracting 32
from both sides
$$F - 32 = \frac{9}{5}C$$

$$\frac{5}{9}(F - 32) = \frac{5}{9}(\frac{9}{5}C)$$
Multiplying both
sides by $\frac{5}{9}$

32.
$$M = \frac{3}{7}n + 29$$
$$M - 29 = \frac{3}{7}n + 29 - 29$$
Subtracting 29 from both sides
$$M - 29 = \frac{3}{7}n$$
$$\frac{7}{3} \cdot (M - 29) = \frac{7}{3} \cdot \left(\frac{3}{7}n\right)$$
Multiplying both sides by $\frac{7}{3}$
$$\frac{7}{3}(M - 29) = n$$

33.
$$2x - y = 1$$

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

2x - 1 = y

34.
$$3x - y = 7$$
$$3x - y + y = 7 + y$$
 Adding *y* to both sides
$$3x - 7 = 7 - 7 + y$$
 Subtracting 7
from both sides
$$3x - 7 = y$$

35.
$$2x + 5y = 10$$

$$-2x + 2x + 5y = -2x + 10$$
 Subtracting 2x
from both sides

$$\frac{5y}{5} = \frac{-2x + 10}{5}$$
 Dividing both
sides by 5

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

36. 3x + 2y = 12-3x + 3x + 2y = -3x + 12 Subtracting 3x from both sides

$$\frac{2y}{2} = \frac{-3x+12}{2}$$
 Dividing both sides by 2
$$y = -\frac{3}{2} + 6$$

37.
$$4x - 3y = 6$$
$$-4x + 4x - 3y = -4x + 6$$
Subtracting 4x
from both sides
$$\frac{-3y}{-3} = \frac{-4x + 6}{-3}$$
Dividing both sides by -3
$$y = \frac{4}{3}x - 2$$

38.
$$5x - 4y = 8$$
$$-5x + 5x - 4y = -5x + 8$$
Subtracting 5x
from both sides
$$\frac{-4y}{-4} = \frac{-5x + 8}{-4}$$
Dividing both sides by -4
$$y = \frac{5}{4}x - 2$$

39.
$$9x + 8y = 4$$
$$-9x + 9x + 8y = -9x + 4$$
Subtracting 9x
from both sides
$$\frac{8y}{8} = \frac{-9x + 4}{8}$$
Dividing both sides by 8
$$y = -\frac{9}{8}x + \frac{1}{2}$$

40.
$$x + 10y = 2$$
$$-x + x + 10y = -x + 2$$
Subtracting x
from both sides
$$\frac{10y}{10} = \frac{-x + 2}{10}$$
Dividing both sides by 10
$$y = -\frac{1}{10}x + \frac{1}{5}$$

41. 3x - 5y = 8 -3x + 3x - 5y = -3x + 8 Subtracting 3xfrom both sides $\frac{-5y}{-3x} = \frac{-3x + 8}{-3x}$ Dividing both sides by -

$$\frac{-5y}{-5} = \frac{-5x+8}{-5}$$
 Dividing both sides by -5
$$y = \frac{3}{5}x - \frac{8}{5}$$

42. 7x - 6y = 747. z = 13 + 2(x + y)-7x+7x-6y=-7x+7 Subtracting 7xz = 13 + 2x + 2y Distributive law z - 13 = 2x + 2yfrom both sides Subtracting both sides $\frac{-6y}{-6} = \frac{-7x+7}{-6}$ Dividing both sides by -6 by 13 z - 13 - 2y = 2xSubtracting both sides by 2v $y = \frac{7}{6}x - \frac{7}{6}$ $\frac{z-13-2y}{2} = \frac{2x}{2}$ Dividing both sides by 2 43. A = at + bt $\frac{z-13}{2} - y = x$ A = (a+b)tFactoring $\frac{A}{a+b} = \frac{(a+b)t}{a+b}$ Dividing both sides 48. $A = 115 + \frac{1}{2}(p+s)$ by a + b $\frac{A}{a+b} = t$ $A = 115 + \frac{1}{2}p + \frac{1}{2}s$ Distributive law $A-115 = \frac{1}{2}p + \frac{1}{2}s$ Subtracting both sides by 115 44. S = rx + sxS = (r+s)xFactoring $A-115-\frac{1}{2}p=\frac{1}{2}s$ Subtracting both sides $\frac{S}{r+s} = \frac{(r+s)x}{r+s}$ Dividing both sides by r+sby $\frac{1}{2}p$ 2(A-115) - p = s Multiplying both sides $\frac{S}{r+s} = x$ bv 2 45. $A = \frac{1}{2}ah + \frac{1}{2}bh$ 49. $t = 27 - \frac{1}{4}(w - l)$ $2A = 2(\frac{1}{2}ah + \frac{1}{2}bh)$ Multiplying both sides by 2 $t = 27 - \frac{1}{4}w + \frac{1}{4}l$ Distributive law 2A = ah + bh2A = (a+b)hFactoring $t-27 = -\frac{1}{4}w + \frac{1}{4}l$ Subtracting both sides $\frac{2A}{a+b} = \frac{\left(a+b\right)h}{a+b}$ Dividing both by 27 sides by a + b $t - 27 + \frac{1}{4}w = \frac{1}{4}l$ Adding $-\frac{1}{4}w$ $\frac{2A}{a+b} = h$ to both sides 4(t-27) + w = lMultiplying both sides 46. A = P + Prtby 4 A = P(1 + rt)Factoring $\frac{A}{1+rt} = \frac{P(1+rt)}{1+rt}$ Dividing both sides by 1+rt50. m = 19 - 5(x - n)m = 19 - 5x + 5nDistributive law $\frac{A}{1+rt} = P$ m-19 = -5x + 5n Subtracting both sides by 19 m - 19 + 5x = 5nAdding 5x to both sides $\frac{m-19}{5} + x = n$ Dividing both sides

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by 5

51.
$$R = r + \frac{400(W - L)}{N}$$

$$R - r = r + \frac{400(W - L)}{N} - r$$
Subtract *r* from both sides
$$R - r = \frac{400(W - L)}{N}$$

$$N(R - r) = N \left[\frac{400(W - L)}{N} \right]$$
Multiplying both sides by
$$NR - Nr = 400(W - L)$$

$$NR - Nr = 400W - 400L$$
Distributive
Law
$$NR - Nr - 400W = 400L - 400W$$
Subtracting
$$400W - 400L - 400U$$

$$\frac{NR - Nr - 400W}{-400} = -400L$$

$$\frac{NR - Nr - 400W}{-400} = \frac{-400L}{-400}$$
Dividing both
sides by - 400
$$\frac{N(R - r)}{-400} + W = L, \text{ or}$$

$$\frac{400W - NR + Nr}{400} = L$$
52.
$$S = \frac{360.4}{\pi r^2}$$

$$\pi r^{2}$$

$$(\pi r^{2})S = (\pi r^{2})\left(\frac{360A}{\pi r^{2}}\right)$$
Multiplying both
sides by πr^{2}

$$\pi r^{2}S = 360A$$

$$\frac{\pi r^{2}S}{\pi S} = \frac{360A}{\pi S}$$
Dividing both
sides by πS

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

- 53. *Thinking and Writing Exercise*. Given the formula for converting Celsius temperature *C* to Fahrenheit *F*, solve for *C*. This yields a formula for converting Fahrenheit temperature to Celsius temperature.
- 54. *Thinking and Writing Exercise*. Answers may vary. When you are given a time *t* and interest rate *r* and want to find how much principal *P* you need to invest (or deposit) to obtain a given dollar amount of interest *I*.

55.
$$-2+5-(-4)-17$$

 $= 3-(-4)-17$
 $= 7-17$
 $= -10$
56. $-98 \div \frac{1}{2} = -98 \cdot \frac{2}{1} = -196$
57. $4.2(-11.75)(0) = -49.35(0) = 0$
58. $(-2)^5 = (-2)(-2)(-2)(-2)(-2) = -32$
59. $20 \div (-4) \cdot 2 - 3 = -5 \cdot 2 - 3$
 $= -10 - 3$
 $= -13$
60. $5|8-(2-7)| = 5|8-(-5)|$
 $= 5|8+5|$
 $= 5|13|$
 $= 5\cdot13$
 $= 65$

- 61. *Thinking and Writing Exercise*. Answers may vary. A decorator wants to have a carpet cut for a bedroom. The perimeter of the room is 54 ft and its length is 15 ft. How wide should the carpet be?
- 62. Thinking and Writing Exercise. The expression on the left, $\frac{2A-ah}{b}$ still has a term containing *h*. Dee should have factored out the *h* to begin with. That is 2A = ah + bh

$$2A = (a+b)h.$$

Finally, Dee should divide both sides by a+b:

$$\frac{2A}{a+b} = \frac{(a+b)h}{a+b}$$
$$\frac{2A}{a+b} = h$$

63. We substitute 80 for w, 190 for h, and 2852 for K and solve for a. K = 21.235w + 7.75h - 10.54a + 102.3 2852 = 21.235(80) + 7.75(190) - 10.54a + 102.3 2852 = 1698.8 + 1472.5 - 10.54a + 102.3 2852 = 3273.6 - 10.54a 2852 - 3273.6 = 3273.6 - 10.54a - 3273.6 -421.6 = -10.54a 40 = aJanos is 40 years old.

64. To find the number of 100 meter rises in *h* meters we divide: $\frac{h}{100}$. Then $T = t - \frac{h}{100}$.

Note that 12 km = 12 km $\cdot \frac{1000 \text{ m}}{1 \text{ km}}$ = 12,000 m. Thus, we have $T = t - \frac{h}{100}$ °C, where

- $0 \leq h \leq 12,000$.
- 65. We substitute 54 for A and solve for s. $A = 6s^2$
 - $54 = 6s^2$ $54 = \frac{6s^2}{6}$ $9 = s^2$

So, s = -3 and s = 3. Since length cannot be negative, we disregard -3.

The volume of a cube is given by $V = s^3$, so we substitute 3 for s and solve for V.

$$V = s^{3}$$
$$= 3^{3}$$
$$= 27$$

The volume of the cube is 27 in^3 .

66.
$$c = \frac{w}{a} \cdot d$$

 $c = \frac{wd}{a}$ Rewriting
 $a \cdot c = a\left(\frac{wd}{a}\right)$ Multiplying both sides by a
 $ac = wd$
 $\frac{ac}{c} = \frac{wd}{c}$ Dividing both sides by c
 $a = \frac{w}{c} \cdot d$

67.
$$\frac{y}{z} \div \frac{z}{t} = 1$$

 $\frac{y}{z} \times \frac{t}{z} = 1$ Rewriting
 $\frac{yt}{z^2} = 1$
 $z^2 \left(\frac{yt}{z^2}\right) = z^2 \cdot 1$ Multiplying both sides
by z^2
 $yt = z^2$
 $\frac{yt}{t} = \frac{z^2}{t}$ Dividing both sides by t
 $y = \frac{z^2}{t}$

 $68. \quad ac = bc + d$

$$ac - bc = bc + d - bc$$

Subtract *bc* from
both sides
$$(a - b)c = d$$

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

Dividing both sides
by *a* - *b*

~ 1

69.
$$qt = r(s+t)$$
$$qt = rs + rt$$
$$qt - rt = rs + rt - rt$$
Subtracting *rt* from both sides
$$(q-r)t = rs$$
$$\frac{(q-r)t}{q-r} = \frac{rs}{q-r}$$
Dividing both sides
$$t = \frac{rs}{q-r}$$

- 70. 3a = c a(b + d) 3a = c - ab - ad 3a + ab + ad = c - ab - ad + ab + adDistributive law 3a + ab + ad = c - ab - ad + ab + adAdding *ab* and *ad* to both sides (3 + b + d)a = cFactoring $\frac{3 + b + d}{3 + b + d}a = \frac{c}{3 + b + d}$ Dividing both sides by 3 + b + d $a = \frac{c}{3 + b + d}$
- 71. We subtract the minimum output for a wellinsulated house with *a* square feet from the minimum output for a poorly-insulated house with *a* square feet. Let *S* represent the number of Btu's saved. S = 50a - 30a = 20a
- 72. To solve, divide the coefficients for weight and height by the conversion factors for pounds and inches: K = 21.235w + 7.75h - 10.54a + 102.3

$$K = \frac{21.235}{2.2046}w + \frac{7.75}{0.3937}h - 10.54a + 102.3$$

$$K = 9.6321w + 19.6850h - 10.54a + 102.3$$

Mid-Chapter Review

Guided Solutions

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

 $2x = 7$
 $\frac{1}{2} \cdot 2x = \frac{1}{2} \cdot 7$
 $x = \frac{7}{2}$
2. $6 \cdot \frac{1}{2}(x - 3) = 6 \cdot \frac{1}{3}(x - 4)$

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

$$3x-9 = 2x-8$$

$$3x-9+9 = 2x-8+9$$

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

$$x = 1$$

Mixed Review

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

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

2.
$$2 - x = -1$$
$$2 - 2 - x = -1 - 2$$
$$-x = -3$$
$$-1 \cdot (-x) = -1 \cdot (-3)$$
$$x = 3$$

3.
$$3t = 5$$
$$\frac{3}{3}t = \frac{5}{3}$$
$$t = \frac{5}{3}$$
$$\frac{3}{3}t = \frac{5}{3}$$
$$\frac{3}{4}t = \frac{5}{3}$$

4.
$$-\frac{3}{2}x = 12$$
$$(-\frac{2}{3}) \cdot -\frac{3}{2}x = (-\frac{2}{3})12$$
$$x = -8$$

5.
$$\frac{y}{8} = 6$$
$$\left(\frac{8}{1}\right) \cdot \frac{y}{8} = \left(\frac{8}{1}\right) \cdot 6$$
$$y = 48$$

6.
$$0.06x = 0.03$$
$$\frac{0.06x}{0.06} = \frac{0.03}{0.06}$$
$$t = \frac{1}{2} \text{ or } 0.5$$

7.
$$3x - 7x = 20$$
$$-4x = 20$$
$$-4x = 20$$
$$-4x = 20$$
$$\frac{-4x}{-4} = \frac{20}{-4}$$
$$x = -5$$

8.
$$9x - 7 = 17$$
$$9x - 7 + 7 = 17 + 7$$
$$9x = 24$$
$$\frac{9x}{9} = \frac{24}{9}$$
$$x = \frac{8}{3}$$
9.	4(t-3) - t = 6
	4t - 12 - t = 6
	3t - 12 = 6
	3t - 12 + 12 = 6 + 12
	3t - 18
	5t - 10
	$\frac{3t}{2} = \frac{18}{2}$
	3 3
	t = 0
10.	3(v+5) = 8v
101	3v + 15 - 8v
	3y + 15 = 8y
	5y + 15 - 5y = 8y - 5y
	15 = 5y
	$\frac{15}{5} = \frac{5y}{5}$
	5 5
	3 = y
11	
11.	8n - (3n - 5) = 5 - n
	8n-3n+5=5-n
	5n + 5 = 5 - n
	5n+5+n=5-n+n
	6n + 5 = 5
	6n + 5 - 5 = 5 - 5
	6n = 0
	n = 0
12.	$\frac{9}{10}y - \frac{7}{10} = \frac{21}{5}$
	$10\left(\frac{9}{10}v - \frac{7}{10}\right) = 10\cdot\left(\frac{21}{2}\right)$
	$(10^{-10})^{-10}$ (5)
	y = 7 = 42
	9y - 7 + 7 = 42 + 7
	9y = 49
	$y = \frac{49}{9}$
10	
13.	2(t-5) - 3(2t-7) = 12 - 5(3t+1)
	2t - 10 - 6t + 21 = 12 - 15t - 5
	-4t + 11 = -15t + 7
	-4t + 11 + 15t = -15t + 7 + 15t
	1 1t + 1 1 = 7
	11t + 11 - 11 = 7 - 11
	1 1t = -4
	$t = -\frac{4}{11}$

14.
$$\frac{2}{3}(x-2)-1 = -\frac{1}{2}(x-3)$$

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

$$4(x-2)-6 = -3(x-3)$$

$$4x-8-6 = -3x+9$$

$$4x-14 = -3x+9$$

$$4x-14 = -3x+9$$

$$4x-14+3x = -3x+9+3x$$

$$7x-14=9$$

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

$$7x = 23$$

$$x = \frac{23}{7}$$
15.
$$E = wA$$

$$\frac{E}{w} = \frac{wA}{w}$$

$$\frac{E}{w} = A$$
16.
$$V = lwh$$

$$\frac{V}{lh} = \frac{lwh}{lh}$$

$$\frac{V}{lh} = \frac{lwh}{lh}$$

$$\frac{V}{lh} = w$$
17.
$$Ax + By = C$$

$$Ax + By - Ax = C - Ax$$

$$By = C - Ax$$

$$By = C - Ax$$

$$\frac{By}{B} = \frac{C - Ax}{B}$$

$$y = \frac{C - Ax}{B}$$

$$y = \frac{C - Ax}{B}$$
18.
$$at + ap = m$$

$$a(t + p) = m$$

$$\frac{a(t + p)}{(t + p)} = \frac{m}{(t + p)}$$

$$a = \frac{m}{(t + p)}$$

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

20.

$$v = \frac{d_2 - d_1}{t}$$

$$v \cdot t = \frac{d_2 - d_1}{t} \cdot t$$

$$vt = d_2 - d_1$$

$$vt - d_2 = d_2 - d_1 - d_2$$

$$vt - d_2 = -d_1$$

$$-1(vt - d_2) = -1 \cdot (-d_1)$$

$$d_2 - vt = d_1$$

Exercise Set 2.4

_

1.	d		
2.	c		
3.	e		21.
4.	b		
5.	c		22.
6.	d		
7.	f		23.
8.	a		
9.	b		
10.	e		24.
11.	$47\% = 47 \times 0.01$ = 0.47	Replacing % by $\times 0.01$	25.
12.	$55\% = 55 \times 0.01$ = 0.55	Replacing % by $\times 0.01$	

13.	$5\% = 5 \times 0.01$ R = 0.05	eplacing % by ×0.01
14.	$7\% = 7 \times 0.01$ R = 0.07	eplacing % by $\times 0.01$
15.	$70\% = 70 \times 0.01$ R = 0.7	eplacing % by $\times 0.01$
16.	$20\% = 20 \times 0.01$ R = 0.2	eplacing % by ×0.01
17.	$3.5\% = 3.5 \times 0.01$ R = 0.035	eplacing % by $\times 0.01$
18.	$41.6\% = 41.6 \times 0.01 \mathrm{R}$ $= 0.416$	eplacing % by $\times 0.01$
19.	62.58% = 62.58 × 0.01 Repla = 0.6258	cing % by ×0.01
20.	39.81% = 39.81×0.01 Replace = 0.3981	cing % by $\times 0.01$
21.	0.7% = 0.7 × 0.01 Replacin = 0.007	ng % by $\times 0.01$
22.	0.3% = 0.3 × 0.01 Replacin = 0.003	ng % by $\times 0.01$
23.	125% = 125 × 0.01 Replacin = 1.25	ng % by ×0.01
24.	150% = 150 × 0.01 Replace = 1.5	ng % by ×0.01
25.	0.79 First move the decima places to the right; the	l point two 0.79. n write a %

79%

symbol:

26.	0.26 First move the decimal point two places to the right; then write a % symbol:	0.26. <u>1</u> 26%
27.	0.019 First move the decimal point two places to the right; then write a % symbol:	0.01.9 1.9%
28.	0.047 First move the decimal point two places to the right; then write a % symbol:	0.04.7 L_1 4.7%
29.	0.359 First move the decimal point two places to the right; then write a % symbol:	0.35.9 1 35.9%
30.	0.155 First move the decimal point two places to the right; then write a % symbol:	0.15.5 15.5%
31.	0.9 First move the decimal point two places to the right; then write a % symbol:	0.90. 1 90%
32.	0.1 First move the decimal point two places to the right; then write a % symbol:	0.1. ∐ 10%
33.	0.0049 First move the decimal point two places to the right; then write a % symbol:	0.00.49 0.49%
34.	0.0008 First move the decimal point two places to the right; then write a % symbol:	0.00.08 0.08%
35.	1.08 First move the decimal point two places to the right; then write a % symbol:	1.08. 108%
36.	1.05 First move the decimal point two places to the right; then write a % symbol:	1.05. 105%

37. 2.3 First m

First move the decimal point two	
places to the right; then write a %	
symbol:	

38. 2.9

39.

First move the decimal point two places to the right; then write a % symbol:

$$\frac{4}{5} \quad \left(\text{Note: } \frac{4}{5} = 0.8 \right)$$

First move the decimal point two places to the right; then write a % symbol:

0.80. 1 80%

40.
$$\frac{3}{4}$$
 (Note: $\frac{3}{4} = 0.75$)

First move the decimal point two places to the right; then write a % symbol:

0.75. 1 75%

41.
$$\frac{8}{25}$$
 (Note: $\frac{8}{25} = 0.32$)

First move the decimal point two places to the right; then write a % symbol:

$$0.32$$

42. $\frac{3}{8}$ (Note: $\frac{3}{8} = 0.375$)

First move the decimal point two places to the right; then write a % symbol:



43. Translate.

 $\downarrow \\ y$

What percent of 68 is 17?

$$\begin{array}{c} \downarrow \downarrow \downarrow \downarrow \downarrow \\ \cdot 68 = 17 \end{array}$$

We solve the equation and then convert to percent notation.

$$y \cdot 68 = 17$$
$$y = \frac{17}{68}$$
$$y = 0.25 = 25\%$$
The answer is 25%.

2.30. ______ 230%

2.90.

290%

44. Translate.

What percent of 150 is 39?

 $\begin{array}{c} \downarrow \\ y \end{array} \qquad \begin{array}{c} \downarrow \\ \cdot 150 \end{array} \begin{array}{c} \downarrow \\ = 39 \end{array}$

We solve the equation and then convert to percent notation. $y \cdot 150 = 39$

 $y = \frac{39}{150}$ y = 0.26 = 26%

The answer is 26%.

45. Translate.

What percent of 125 is 30?

$$y = \frac{30}{125}$$

 $y = 0.24 = 24\%$

The answer is 24%.

46. Translate.

What percent of 300 is 57?

$$\begin{array}{ccc} \downarrow & \downarrow \downarrow \downarrow \downarrow \downarrow \\ y & \cdot 300 = 57 \end{array}$$

We solve the equation and then convert to percent notation. $v \cdot 300 = 57$

 $y = \frac{57}{300}$ y = 0.19 = 19%

The answer is 19%.

47. Translate.

14 is 30% of what number?

 $\begin{array}{c} \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \\ 14 = 30\% \end{array} \begin{array}{c} \downarrow \\ \cdot \\ v \end{array}$

We convert to percent notation, then solve the equation.

(30% = 0.3)

$$14 = 0.3y$$
$$\frac{14}{0.3} = y$$
$$46.\overline{6} = y$$

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

48. Translate.

54 is 24% of what number?

We convert to percent notation, then solve the equation.

54 = 0.24y (24% = 0.24) $\frac{54}{0.24} = y$ 225 = yThe answer is 225.

49. Translate.

0.3 is 12% of what number?

$$\begin{array}{c} \downarrow \downarrow \downarrow \downarrow \\ 0.3 = 12\% \end{array} \begin{array}{c} \downarrow \\ \cdot \\ y \end{array}$$

We convert to percent notation, then solve the equation.

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

The answer is 2.5.

50. Translate.

7 is 175% of what number?

$$\begin{array}{c} \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow \\ 7 = 175\% \cdot \qquad y \end{array}$$

We convert to percent notation, then solve the equation.

$$7 = 1.75y$$
 (175% = 1.75)
 $\frac{7}{1.75} = y$
 $4 = y$
The answer is 4.

90

51. Translate. What number is 35% of 240? \downarrow $\downarrow \downarrow \downarrow \downarrow \downarrow$ $=35\% \cdot 240$ v We convert to percent notation, then solve the

equation. $y = 0.35 \cdot 240$ (35% = 0.35)

y = 84Multiplying

The answer is 84.

52. Translate.

What number is 1% of 1,000,000?

$$\begin{array}{ccc} \downarrow & \downarrow \downarrow \downarrow \downarrow \downarrow \\ y & =1\% \cdot 1,000,000 \end{array}$$

We convert to percent notation, then solve the equation.

 $y = 0.01 \cdot 1,000,000 \quad (1\% = 0.01)$ y = 10,000Multiplying The answer is 10,000.

53. Translate.

What percent of 60 is 75?

$$\begin{array}{ccc} \downarrow & \downarrow \downarrow \downarrow \downarrow \\ y & \cdot 60 = 75 \end{array}$$

We solve the equation and then convert to percent notation.

$$y \cdot 60 = 75$$

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

The answer is 125%.

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

y = 1 = 100%

55. Translate.

What is 2% of 40? $\downarrow \hspace{0.1cm} \downarrow \hspace{0.1cm} \downarrow \hspace{0.1cm} \downarrow \hspace{0.1cm} \downarrow \hspace{0.1cm} \downarrow \hspace{0.1cm} \downarrow$

 $y = 2\% \cdot 40$

We convert to percent notation, then solve the equation.

$$y = 0.02 \cdot 40$$
 (2% = 0.02)
 $y = 0.8$ Multiplying

The answer is 0.8.

What is 40% of 2? $\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$ $v = 40\% \cdot 2$

We convert to percent notation, then solve the equation.

 $v = 0.4 \cdot 2$ (40% = 0.4) y = 0.8Multiplying The answer is 0.8.

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

$$\begin{array}{cccc} \downarrow \downarrow & \downarrow & \downarrow & \downarrow \downarrow \\ 25 = & y & \cdot 50 \end{array}$$

y We solve the equation and then convert to percent notation. $25 = y \cdot 50$

 \downarrow

$$\frac{25}{50} = y$$

0.5 = y, or 50% = y
The answer is 50%.

58. Translate.

8 is 2% of what number?

We convert to percent notation, then solve the equation.

$$8 = 0.02y \quad (2\% = 0.02)$$
$$\frac{8}{0.02} = y$$
$$400 = y$$

The answer is 400.

59. Translate.

What percent of 69 is 23?

$$\begin{array}{ccc}
\downarrow & \downarrow \downarrow \downarrow \downarrow \\
p & \cdot & 69 = 23 \\
\hline
\frac{69}{69} = \frac{23}{69} \\
p = 0.3\overline{3}
\end{array}$$
The summarize $22\overline{29}(-22\overline{2})$

The answer is 33.3%, or $33\frac{1}{3}$ %.

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60. Translate. What percent of 40 is 9? \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow p \cdot 40 = 9 $40 \underline{p} \underline{-9}$

$$40 40 p = 0.225$$

The answer is 22.5%.

61. Let a = the number of cats obtained from animal shelters. Then we have: a is 15% of 95.6 million $\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$ $a = 0.15 \cdot 95.6 \text{ million}$ a = 14.34 million

14.34 million cats were obtained from animal shelters.

- 62. Let s = the number of cats found as strays. Then we have: s is 14% of 95.6 million $\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$ $s = 0.14 \cdot 95.6 \text{ million}$ s = 13.384 million13.384 million cats were found as strays.
- 63. Let *l* = the number of cats obtained from a local animal rescue group. Then we have: *l* is 2% of 95.6 million
 ↓ ↓ ↓ ↓ *l* = 0.02 · 95.6 million *l* = 1.912 million
 1.012 million

1.912 million cats were obtained from local animal rescue groups.

- 64. Let f = the number of cats obtained from family, friends, or neighbors. Then we have:
 f is 42% of 95.6 million
 ↓ ↓ ↓ ↓
 f = 0.42 · 95.6 million
 f = 40.152 million
 40.152 million cats were obtained from family, friends, or neighbors.
- 65. Let c = the number of credit hours Clayton completed. Then we have: c is 60% of 125?
 - $\begin{array}{c}
 \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \\
 c = 0.6 \\
 c = 75
 \end{array}$

Clayton has completed 75 credit hours.

needs to complete. Then we have: c is 20% of 125? $\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$ $c = 0.2 \cdot 125$ c = 25Lydia still needs to complete 25 credit hours. 67. Let x = the number of at-bats. Then we have: 31.4% of x is 172. $\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$ $0.314 \cdot x = 172$ $x = \frac{172}{0.314}$ $x \approx 548$ Andrew McCutchen had about 548 at-bats.

66. Let c = the number of credit hours Lydia

68. Let x = the number of attempted passes. Then we have: 66.2% of x is 395. $\downarrow \quad \downarrow \downarrow \downarrow \downarrow \downarrow$ $0.662 \quad \cdot x = 395$ $x = \frac{395}{0.662}$ $x \approx 597$

Peyton Manning attempted about 597 passes.

- 69. a) Let x = the percent of the cost of the meal representing Shane's tip. Then we have: $x \cdot \$25$ is \$4. $\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$ $x \cdot \$25 = \4 $x = \frac{4}{25}$ x = 0.16, or 16% The tip was 16% of the cost of the meal.
 - b) The total cost of the meal, including the tip was \$25 + \$4, or \$29.
- 70. a) Let x = the percent of the cost of the meal representing Selena's tip. Then we have: $x \cdot \$58$ is \$12.76. $\downarrow \quad \downarrow \quad \downarrow \quad \downarrow$ $x \cdot \$58 = \12.76 $x = \frac{12.76}{58}$ x = 0.22, or 22%

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

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- b) The total cost of the meal, including the tip was \$58 + \$12.76, or \$70.76.
- 71. Let x = the percent of teachers who worked in public schools. Then we have:
 - $x \cdot 3.5$ is 3.1. $\downarrow \downarrow \downarrow \downarrow \downarrow$
 - $x \cdot 3.5 = 3.1$

$$r = \frac{3.1}{2}$$

$$3.5 \\ x \approx 0.88571$$

The percent of teachers who worked in public schools was about 88.6%. The percent that worked in other schools was about 100 - 88.6= 11.4%.

72. Let x = the percent of students that were enrolled in public schools. Then we have: $x \cdot 54.8$ million is 49.8 million.

> \downarrow \downarrow \downarrow \downarrow 54.8 49.8 $x \cdot$ = $x = \frac{49.8}{54.8}$ $x \approx 0.908759$ About 90.9% of students were enrolled in public schools. About 100 - 90.9 = 9.1% of students were enrolled in other schools.

73. Let I = the amount of interest Irena will pay. Then we have: I is 4.66% of \$3500 $\downarrow \downarrow \downarrow \downarrow$ \downarrow

 $I = 0.0466 \cdot 3500 I = \$163.10

Irena will pay \$163.10 in interest.

- 74. Let I = the amount of interest Glenn will pay. Then we have: I is 6.21% of \$2400 $\downarrow \downarrow \downarrow \downarrow \downarrow$ \downarrow $I = 0.0621 \cdot \$2400$ I = \$149.04Glenn will pay \$149.04 in interest.
- 75. Let x = the number of women who had babies in good or excellent health. Then we have: x is 95% of 300? $\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$ $x = 0.95 \cdot 300$ x = 285285 women had babies in good or excellent

health.

76. Let x = the number of women who had babies in good or excellent health. Then we have: x is 8% of 300?

 \downarrow

$$\begin{array}{c} \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\ x \ = \ 0.08 \ \cdot \quad 300 \end{array}$$

$$x = 0.00$$

 $x = 24$

24 women had babies in good or excellent health.

77. Let x = the amount of income Sara would need to earn on her own to be comparable to her hourly rate at Village Copy. Then we have:

$$\begin{array}{c} x \text{ is } 120\% \text{ of } \$16?\\ \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow\\ x = 1.2 \cdot \$16\\ x = 19.2 \end{array}$$

Sara would need to earn \$19.20/ hr if she worked on her own.

78. Let x = the amount of income Adam would need to earn on his own to be comparable to his hourly rate at Round Edge stairbuilders. Then we have:

$$x \text{ is } 120\% \text{ of } \$18?$$

$$\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$$

$$x = 1.2 \cdot \$18$$

$$x = 21.6$$

Adam would need to earn \$21.60/ hr if he worked on his own.

79. Let x = the percentage by which the number of dog households increased. Since the number of households grew from 43.0 million to 43.3 million, the increase was 0.3 million households. Then we have: $x \cdot 43$ is 0.3 $\downarrow \downarrow \downarrow \downarrow \downarrow$

$$x \cdot 43 = 0.3$$

$$x = \frac{0.3}{43}$$

$$x \approx 0.0069767, \text{ or } 0.7\%$$

The percentage by which the p

The percentage by which the number of dog households increased is about 0.7%.

- 80. Let x = by which the number of cat households decreased. Since the number of cat households fell from 37.5 million to 36.1 million, the decrease was 1.4 million households. Then we have:
 - $x \cdot 37.5 \text{ is } 1.4.$ $\downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow$ $x \cdot 37.5 = 1.4$ $x = \frac{1.4}{37.5}$
 - $x \approx 0.037333$, or 3.7%

The percentage by which the number of cat households decreased is about 3.7%.

81. Let c = the cost of the merchandise. Then we have:

Cost plus tax is \$37.80.

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

 $c \qquad + \ 0.05c = 37.80
 $1.05c = 37.80
 $c = \frac{$37.80}{1.05}$
 $c = 36
The cost of the merchandise is \$36.

- - *c* = \$940

The cost of the building materials was \$940.

83. Let c = the cost of only the software. Then we have:Cost plus tax is \$157.41

84. Let c = the cost of the sump pump. Then we have:Cost plus tax is \$145.90

$$\begin{array}{cccc} \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ c & + & 0.05c = \$145.90\\ 1.05c = \$145.90\\ c = \frac{\$145.90}{1.05}\\ c = \$138.952381 \end{array}$$

The cost of only the sump pump would have been \$138.95.

85. Let p = the number of pounds of body weight in fat. Then we have:16.5% of 191 pounds is weight of fat.

The part of Marv's body weight that is fat is about 31.5 pounds.

86. Let x = the area of Arizona. Then we have: Area of Arizona is 19% of area of Alaska.

87. Let x = the number of dogs that were reunited with their owners. Then we have:

Number is 15.8% of 3.9 million.

$$\begin{array}{cccc}
\downarrow & \downarrow \downarrow & \downarrow \downarrow \\
x &= 0.158 \cdot 3.9
\end{array}$$

x = 0.6162

The number of dogs that were reunited with their owners was about 0.62 million, or about 620,000.

94

88. Let p = the percentage of people who kiss a person with a cold who actually come down with a cold. Then we have:

$$p \cdot 800 \text{ is } 56$$

$$\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$$

$$p \cdot 800 = 56$$

$$800 p = 56$$

$$p = \frac{56}{800}$$

$$p = 0.07$$
, or 7%

7% of those who kiss a person with a cold will get a cold.

89. Let c = the number of calories in a 1-oz serving of Lay's® Classic potato chips. Then we have:

Baked Lay's
calories
is
$$25\%$$
 less calories
than Lay's Classic
 \downarrow \downarrow \downarrow
 $120 = c - 0.25c$
 $120 = c - 0.25c$
 $120 = 0.75c$
 $160 = c$

The number of calories in a serving of Lay's Classic Potato Chips is 160 calories.

90. Let c = the number of calories from fat in a serving of Lay's® Classic potato chips. Then we have:

The number of calories of fat in Lay's Classic Potato Chips is about 90 calories.

- 91. *Thinking and Writing Exercise*. The book is marked up \$30. Since Campus Bookbuyers paid \$30 for the book, this is a 100% markup.
- 92. Thinking and Writing Exercise. \$12 is

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

- 93. Let *l* represent the length and *w* represent the width; 2l + 2w.
- 94. 5% = 0.05, so 5% of \$180 is $0.05 \cdot 180$. (Note: replace "of" with multiplication).
- 95. Let *p* represent the number of points Tino scored. 5 fewer means subtract 5 from *p*, or p-5.
- 96. Product means multiplication, so $15+1.5 \cdot x$, or 15+1.5x.
- 97. The product of 10 and half of *a*, or $\frac{1}{2}a$, $10 \cdot (\frac{1}{2}a)$.
- 98. Let *n* represent the number. So 10 more than three times a number is 10+3n, or 3n+10.
- 99. Let *l* represent the length and *w* represent the width; w = l 2.
- 100. Let *x* represent the first number and *y* represent the second number; x = 4y.
- 101. a) Together Monday and Friday make up $\frac{2}{5}$ or 40% of the work week. So citing the survey indicates that Monday and Friday do not appear to involve excessive sick leave. b) Memorial Day is the last Monday of May and Labor Day is the first Monday in September. This means there are 3 months and a few days between these two dates, and $\frac{3}{12} = \frac{1}{4}$ which is about 25% of the entire year. So, if 26% of home burglaries occur between Memorial Day and Labor Day that is not more than would be expected.
- 102. *Thinking and Writing Exercise*. No. If women make 70% as much as men, that means that men make about 143% as much as women:

$$w = 0.7m$$
$$\frac{w}{0.7} = \frac{0.7m}{0.7}$$

1.429w = m

Men would have to be charged about 43% more to offset the inequality in pay.

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

1332 is 15% of 48% of the population.

$$\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$$

$$1332 = 0.15 \cdot 0.48 \cdot p$$

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

$$18,500 = p$$

The population of Bardville is 18,500.

104. Let h = Jaraan's final adult height. Jaaran's height of 6 ft 4 in is equivalent to 76 in (6 ft \times 12 in/ft + 4 in). Then we have: 76 in is 96.1% of adult height.

$$\begin{array}{cccc}
\downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\
76 &= & 0.961 & & h \\
76 &= & 0.961h \\
\hline
\frac{76}{0.961} &= h \\
79.0842872 &= h \\
\text{Jaraan's adult height would be about 6 ft 7in.}
\end{array}$$

105. Let h = Dana's final adult height. Dana's height of 4 ft 8 in is equivalent to 56 in (4 ft \times 12 in/ft + 8 in). Then we have: 56 in is 84.4% of adult height.

106. The area of the photo is 8 in. \times 6 in., or 48 in.². The mat is intended for a photo having an area of 5 in. \times 7 in., or 35 in.². Thus the mat window is 35 in.². The area of the photo covered by the mat would then be: Area of photo – Mat Window = 48 in.² – 35 in.², or 13 in.². The percentage of the photo covered by the mat is:

107. Between 2010 and 2012, the high school dropout rate in the US decreased from 74 to 66 per thousand, or by 74 - 66 = 8. Let p =the percent by which the dropout rate decreased. Then we have: 8 is what percent of 74?

$$\begin{array}{cccc}
\downarrow \downarrow & \downarrow & \downarrow \\
8 &= & p & \cdot & 74 \\
\frac{8}{74} &= p
\end{array}$$

 $0.108108 \approx p$

The dropout rate between 2010 and 2012 decreased by about 10.8%, which is about 10.8 ÷ 2 years, or 5.4% per year. Assuming the dropout rate remained the same, in 2009 it was $74 \div (1-0.054) \approx 78.2$, or about 78 per thousand, and in 2011 it was $66 \div (1-0.054) \approx 69.8$, or about 70 per thousand.

- 108. Thinking and Writing Exercise. 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). The new salary if raises occur the other way around is 1.05(1.08s). By the commutative and associative 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 new salary the first year than a 5% raise.
- 109. Thinking and Writing Exercise. Suppose Jose has x dollars of taxable income. If he makes a \$50 tax-deductible contribution, then he pays tax of 0.3(x \$50), or 0.3x \$15 and his assets are reduced by 0.3x + \$35 in all. If he makes a \$40 non-tax-deductible contribution, he pays tax of 0.3x and his assets are reduced by 0.3x + \$40. Thus, it costs him less to make a \$50 tax-deductible contribution.

Exercise Set 2.5

Familiarize. Let x = the number. Then "two fewer than ten times a number" translates to 10x - 2.
 Translate.

Two fewer than ten times a number is 78.

 $\downarrow \qquad \qquad \downarrow \downarrow \\ 10x - 2 \qquad = 78$

Carry out. We solve the equation. 10x - 2 = 78

10x = 80 Adding 2

x = 8 Dividing by 10

Check. Ten times 8 is 80. Two less than 80 is 78. The answer checks. *State.* The number is 8.

2. *Familiarize.* Let x = the number. Then "three less than twice a number" translates to 2x-3.

Translate.

Three less than twice a number is 19.

$$\begin{array}{c} \downarrow \\ 2x-3 \end{array} \qquad \begin{array}{c} \downarrow \\ = 19 \end{array}$$

Carry out. We solve the equation. 2x - 3 = 19

2x = 22 Adding 3

x = 11 Dividing by 2

Check. Twice, or 2 times, 11 is 22. Three less than 22 is 19. The answer checks. *State.* The number is 11.

3. *Familiarize.* Let x = the number. Then "five times the sum of 3 and some number" translates to 5(3+x).

Translate.

Five times the sum of three and some number is 70. $\downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow$

•		•	•
5(3+3)	r)	= 7	70

Carry out. We solve the equation. 5(3+x) = 70

$$15+5x=70$$
 Distributive Law

5x = 55 Subtracting 15

x = 11 Dividing by 5

Check. Three plus 11 is 14. Five times 14 is 70. The answer checks.

State. The number is 11.

4. *Familiarize.* Let x = the number. Then "twice the sum of 4 and some number" translates to 2(4+x).

Translate.

Twice the sum of 4 and some number is 34.

\downarrow	\downarrow	\downarrow
2(4+x)	=	34

Carry out. We solve the equation. 2(4+x) = 34 8+2x = 34 Distributive Law 2x = 26 Subtracting 8 x = 13 Dividing by 2

Check The sum of 4 and 13 is 17. Twice 17 is 34. The answer checks. *State.* The number is 13.

Familiarize. Let p = the price of the 32-GB iPod Touch. At 20% more, the price of the 64-GB iPod Touch is 120% of the price of the 32-GB iPod Touch.
 Translate.
 \$300 is 120% of the 32-GB iPod Touch.

$$\begin{array}{c} \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\ 300 = 1.20 \quad \cdot \quad p \end{array}$$

Carry out. We solve the equation. $300 = 1.20 \cdot p$

$$\frac{300}{1.20} = p$$
 Dividing by 1.20
250 = p

Check. 120% of \$250, or 1.20(\$250), is \$300. The answer checks. *State.* The price of the 32-GB iPod Nano was \$250.

 Familiarize. Let p = the price of the TI-89 Titanium graphing calculator. At 20% less, the TI-84 Plus graphing calculator is 80% of the cost of the TI-89 Titanium. Translate.

\$120 is 80% of the TI-89 Titanium.

$$\begin{array}{c} \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\ 120 \ = \ 0.80 \quad \cdot \quad \qquad p \end{array}$$

Carry out. We solve the equation. $120 = 0.80 \cdot p$

 $\frac{120}{0.80} = p$ Dividing by 0.80 150 = p

Check. 80% of \$150, or 0.80(\$150), is \$120. The answer checks. *State.* The price of the TI-89 Titanium graphing calculator was \$150.

Familiarize. Let p = the cost of the Nike running shoes. The sales tax is 7%. *Translate.*

Price of Nike shoes plus sales tax is \$90.95.

$$\begin{array}{cccc} \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ p & & + & 0.07 p & = & 90.95 \end{array}$$

Carry out. We solve the equation.

$$p + 0.07 p = 90.95$$

1.07
$$p = 90.95$$
 Combining like terms
 $p = \frac{90.95}{1.07}$ Dividing by 1.07
 $p = 85$

Check. The Nike running shoes cost \$85 and the sales tax is $0.07 \cdot $85 = 5.95 . Because \$85 + \$5.95 = \$90.95, the answer checks. *State.* The cost of the running shoes is \$85.

 Familiarize. Let p = the cost for a Cannon printer. The sales tax is 6%. Translate.

Price of printer plus sales tax is \$275.60.

Carry out. We solve the equation. p + 0.06 p = 275.60

$$1.06p = 275.60$$
 Combining like terms

$$p = \frac{275.60}{1.06}$$
 Dividing by 1.06
 $p = 260$

Check. The Cannon printer costs \$260 and the sales tax is $0.06 \cdot $260 = 15.60 . Because \$260 + \$15.60 = \$260.60, the answer checks. *State.* The cost of the printer is \$260.

9. *Familiarize.* Let d = Kouros' distance, in miles, from the start after 16 hr. Then the distance from the finish line is 2d.

Translate. Distance Distance plus distance from finish is 433 km. \downarrow \downarrow \downarrow \downarrow 2dd = 433 Carry out. We solve the equation. d + 2d = 4333d = 433Combining like terms $d = \frac{433}{3}$ Dividing by 3 $d = 144\frac{1}{3}$ **Check.** If Kouros is $\frac{433}{3}$ km from the start, then he is $2 \cdot \frac{433}{3}$, or $\frac{866}{3}$ km from the finish. $\frac{433}{3} + \frac{866}{3} = \frac{1299}{3} = 433$, the total distance run. The answer checks. State. Kouros had run approximately $144\frac{1}{3}$ km.

 Familiarize. Let d = the distance from Nome, in miles. Then 2d = the distance from Anchorage. Translate.

$$\underbrace{\begin{array}{c} \text{Distance from} \\ \text{Anchorage} \end{array}}_{2d} \text{ plus } \underbrace{\begin{array}{c} \text{distance} \\ \text{to Nome} \end{array}}_{2d} \text{ is 1049 mi.} \\ \downarrow \\ \downarrow \\ d \end{array} = 1049$$

Carry out. We solve the equation. 2d + d = 1049

$$3d = 1049$$
 Combining like terms
 $d = \frac{1049}{1000}$ Dividing by 3

$$d = 349\frac{2}{3}$$

Check. If the distance to Nome is $349\frac{2}{3}$ mi, then the distance to Anchorage is $2 \cdot 349\frac{2}{3}$, or $699\frac{1}{3}$ mi. So the total distance from Anchorage to Nome is $349\frac{2}{3} + 699\frac{1}{3}$, or

1049 mi. The result checks.

State. The distance the musher has traveled is $699\frac{1}{3}$ mi.

11. *Familiarize.* Let d = the distance the driver had traveled when he was 20 mi closer to the finish line than the start. At that point, his distance to the finish line is d - 20.

Translate.

d

Distance from start plus distance is 400 mi.

$$\begin{array}{cccc} \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ d & + & d-20 & = & 400 \end{array}$$

Carry out. We solve the equation.

$$+(d-20) = 400$$

$$2d-20 = 400$$
 Combining like terms

$$2d = 420$$
 Adding 20

$$d = 210$$
 Dividing by 2

Check. When the driver is 210 mi from the start, he has 400 - 210, or 190 mi left to go. 190 mi is 20 mi less than 210 mi. The answer checks.

State. The driver had traveled 210 mi.

12. *Familiarize*. Let d = the distance the driver had traveled when he was 80 mi closer to the finish line than the start. At that point, his distance to the finish line is d - 80.

Translate.

Distance from start	plus	distance from finish	is	400 mi.
\downarrow	\downarrow	\downarrow	\downarrow	\downarrow
d	+	d - 80	=	400

Carry out. We solve the equation. d + (d - 80) = 400

$$2d-80 = 400$$
 Combining like
terms
 $2d = 480$ Adding 80

d = 240Dividing by 2

Check. When the driver is 240 mi from the start, he has 400 - 240, or 160 mi left to go. 160 mi is 80 mi less than 240 mi. The answer checks.

State. The driver had traveled 240 mi.

13. *Familiarize*. Let n = Lara's apartmentnumber. Then her next-door neighbor's apartment number is n+1. Translate.

Lara's plus next-door's is 2409. \downarrow \downarrow \downarrow \downarrow

= 2409*n*+1 п +Carry out. We solve the equation.

$$n + (n + 1) = 2409$$

2n + 1 = 2409Combining like terms

2n = 2408Subtracting 1

n = 1204 Dividing by 2

Check. If = Lara's apartment number is 1204, then her next-door neighbor's apartment number is 1205. The sum of these two numbers is 2409. The answer checks. State. The apartment numbers are 1204 and 1205.

14. *Familiarize*. Let *n* = Jonathan's apartment number. Then his next-door neighbor's apartment number is n+1. Tuanalata

		I ran.	siate.	
Jonathan's number	plus	next-door number	's is	1419.
\downarrow	\downarrow	↓ `	\downarrow	\downarrow
п	+	n+1	=]	1419

Carry out. We solve the equation. n + (n+1) = 1419

2n + 1 = 1419Combining like terms

2n = 1418Subtracting 1

n = 709 Dividing by 2

Check. If Jonathan's apartment number is 709, then his next-door neighbor's apartment number is 710. The sum of these two numbers is 1419. The answer checks. State. The apartment numbers are 709 and 710.

15. *Familiarize*. Let *n* = Chrissy's house number. Then Bryan's house number is n + 2. Translate.

Chrissy's number	plus	Bryan's number	is	794.
\downarrow	\downarrow	\downarrow $n \pm 2$	↓	\downarrow

Carry out. We solve the equation. n + (n+2) = 794

2n+2 = 794	Combining like
2n+2 = 794	terms
2	Subtracting 2

2n = 792 Subtracting 2 n = 396 Dividing by 2

Check. If Chrissy's house number is 396, then Bryan's house number is 398. The sum of these number is 794. The answer checks. *State.* The house numbers are 396 and 398.

16. *Familiarize.* Let n = Art's housenumber. Then Colleen's house number is n+2.

Translate. Art's plus Colleen's is 572.

\downarrow	\downarrow	\downarrow	\downarrow	\downarrow
п	+	<i>n</i> +2	=	572

Carry out. We solve the equation.

$$n + (n+2) = 572$$

$$2n+2 = 572$$
 Combining like
terms

2n = 570 Subtracting 2 n = 285 Dividing by 2

n = 200 Dividing by 2

Check. If Art's house number is 285, then Colleen's house number is 287. The sum of these number is 572. The answer checks.

State. The house numbers are 285 and 287.

17. *Familiarize.* Let x = the first page number. Then x+1 = the second page number, and x+2 = the third page number.

Translate.

The sum of three consecutive page numbers is 60.



x+(x+1)+(x+2) = 60 3x+3 = 60Combining like terms 3x = 57Subtracting 3 x = 19Dividing by 3
If x = 19, then x+1 = 20, and x+2 = 21.
Check 19, 20, and 21 are consecutive integers, and 19+20+21 = 60. The result checks.
State. The page numbers are 19, 20, and 21.

18. *Familiarize.* Let x = the first page number. Then x+1 = the second page number, and x+2 = the third page number. *Translate.*

The second of the

The sum of three consecutive page numbers is 99.

Carry out. We solve the equation.

	x + (x+1) + (x+2) = 99
Combining like terms	3x + 3 = 99
Subtracting 3	3x = 96
Dividing by 3	x = 32

If x = 32, then x + 1 = 33, and x + 2 = 34. *Check* 32, 33, and 34 are consecutive integers, and 32 + 33 + 34 = 99. The result checks. *State.* The page numbers are 32, 33, and 34.

19. Familiarize. Let x = the amount The 13th Warrior lost. Then x+12.7 = the amount Mars Needs Moms lost. Translate.

The sum of the losses is \$209.3 million.

$$\downarrow \qquad \qquad \downarrow \downarrow \\ x + (x + 12.7) \qquad = 209.3$$

Carry out. We solve the equation.

x + (x + 12.7) = 209.3

2x+12.7 = 209.3 Combining like terms 2x = 196.6 Subtracting 12.7

x = 98.3 Dividing by 2

The 13th Warrior lost \$98.3 million, and *Mars Needs Women* lost (98.3 + 12.7) = \$111 million.

Check The sum of the amounts lost is 98.3 + 111, or \$209.3 million. The result checks.

State. The 13th Warrior lost \$98.3 million, and *Mars Needs Women* lost \$111 million.

20. *Familiarize.* Let x = the number of consumer e-mails sent. Then x + 21.1 = the number of business e-mails sent.

Translate.

The sum of consumer is 196.3 billion. and business e-mails

$$\downarrow \qquad \downarrow \downarrow \\ x + (x + 21.1) = 196.3$$

Carry out. We solve the equation. x+(x+21.1)=196.3

$$2x+21.1=196.3$$
 Combining like terms

2x = 175.2 Subtracting 21.1 x = 87.6 Dividing by 2

87.6 billion consumer e-mails were sent, and 87.6 + 21.1, or 108.7 billion, business e-mails were sent.

Check The sum of the e-mails is 87.6 + 108.7, or 196.3 billion. The result checks. *State.* 87.6 billion consumer e-mails were sent, and 108.7 billion business e-mails were sent.

21. *Familiarize.* Let x = the number of tablets. Then 9x = the number of mobile phones. *Translate.*

The sum of tablets and phones is 2 billion devices.

\downarrow	$\downarrow \downarrow$
x + 9x	= 2

Carry out. We solve the equation. x + 9x = 2

10x = 2	Combining like
	terms

x = 0.2 Dividing by 10

If the number of tablets was 0.2 billion, then number of phones was $9 \cdot 0.2$, or 1.8 billion. *Check* The sum of tablets and phones is 0.2 + 1.8 = 2 billion devices. The results check. *State.* The number of tablets was 0.2 billion or 200 million, and the number of mobile phones was 1.8 billion. 22. *Familiarize.* Let x = the amount of coal used by independent producers. Then 3x = the amount of coal used by utilities. *Translate.* The sum used by

independent producers is 848 million tons. and utilities

 $\begin{array}{c} \downarrow & \downarrow \downarrow \\ x+3x &= 848 \end{array}$

Carry out. We solve the equation. x + 3x = 848

4x = 848 Combining like terms

x

If 212 million tons of coal were used by independent producers, then $3 \cdot 212 = 636$ million tons were used by utilities. *Check* The sum of coal used by independent producers and utilities was 212 + 636, or 848 million. The result checks. *State.* 212 million tons of coal were used by independent producers, and 636 million tons were used by utilities.

23. *Familiarize.* Let x = the page number of the left page and x + 1 = the page number of the right page. *Translate.*

The sum of the pages is 281.

$$\downarrow \qquad \qquad \downarrow \downarrow \\ x + (x+1) \qquad = 281$$

Carry out. We solve the equation. x + (x + 1) = 281

> 2x+1 = 281 Combining like terms 2x = 280 Subtracting 1 x = 140 Dividing by 2

Check The pages are numbered 140 and 141, so they are consecutive. The sum of the pages is 140+141 = 281. The results check **State.** The facing pages are numbered 140 and 141.

24. *Familiarize.* Let x = the length of the first side, x + 2 = the length of the second side, and x + 4 = the length of the third side of the triangle.

Translate.

The sum of the lengths is 195 mm.

Carry out. We solve the equation.

x + (x + 2) + (x + 4) = 195 3x + 6 = 195 Combining like terms 3x = 189 Subtracting 6 x = 63 Dividing by 3

If 63 mm is the length of the first side, then the second side is x + 2 = 65 mm, and the third side is x + 4 = 67 mm.

Check The lengths, 63, 65, and 67, are consecutive odd integers. The sum of the lengths is 63+65+67=195 mm. The result checks.

State. The sides measure 63 mm, 65 mm, and 67 mm.

25. *Familiarize.* Let x = the width of the rectangular top, in feet. Then x + 60 = the length of the rectangular top, in feet. Recall that the perimeter is given by the formula: P = 2w + 2l

Translate.

The perimeter is 520 ft.

$$\begin{array}{c} \downarrow \qquad \downarrow \downarrow \\ 2x+2(x+60) = 520 \end{array}$$

Carry out. We solve the equation.

2x + 2(x + 60) = 520	
2x + 2x + 120 = 520	Distributive Law
4x + 120 = 520	Combining like terms
4x = 400	Subtracting 120
<i>x</i> = 100	Dividing by 4

If the width is 100 ft, then the length is 100 + 60, or 160 ft.

Check The length, 160 ft, is 60 ft more than the width, 100 ft. The perimeter is $2 \cdot 100 + 2 \cdot 160 = 520$. The perimeter is

 $2 \cdot 100 + 2 \cdot 160 = 520$. These results check *State.* The width of the rectangular top of the building is 100 ft, and the length of the top is 160 ft. The area of the top is length times width, or 100 ft \cdot 160 ft , or 16,000 ft².

26. *Familiarize.* Let x = the length of the state of Wyoming, in miles. Then x - 90 = the width of the state, in miles. Recall that the perimeter is given by the formula: P = 2w + 2l*Translate.*

The perimeter is 1280 mi.

$$\begin{array}{c} \downarrow \quad \downarrow \downarrow \\ 2(x-90)+2x = 1280 \end{array}$$

Carry out. We solve the equation.

2(x-90)+2x=1280

2x-180+2x = 1280 Distributive Law 4x-180 = 1280 Combining like terms

$$4x = 1460$$
 Adding 180

$$x = 365$$
 Dividing by 4

If the length of the state is 365 mi, then the width is 365 - 90, or 275 mi. *Check* The length of the state, 365 mi, is 90 mi more than the width, 275 mi. The perimeter is $2 \cdot 275$ mi + $2 \cdot 365$ mi = 1280 mi. These results check *State.* The length of the state is 365 mi, and the width is 275 mi.

27. *Familiarize.* Let x = the width of the basketball court, in feet. Then x + 34 is the length of the court, in feet. Recall that the perimeter is given by the formula: P = 2w + 2l*Translate.*

The perimeter is 268 ft.

Carry out. We solve the equation.

2x + 2(x + 34) = 268

2x + 2x + 68 = 268	Distributive Law
4x + 68 = 268	Combining like terms
4x = 200	Subtracting 68
x = 50	Dividing by 4

If the width of the court is 50 ft, then the length is 50 ft + 34 ft, or 84 ft.

Check The length, 84 ft, is 34 ft more than the width, 50 ft. The perimeter is $2 \cdot 50$ ft + $2 \cdot 84$ ft = 268 ft. These results check. **State.** The width of the basketball court is 50

ft, and the length is 84 ft.

28. *Familiarize.* Let x = the width of the garden, in feet. Then x + 4 is the length of the garden, in feet. Since 92 m of fencing will surround the garden, the perimeter is 92 m. Recall that the perimeter is given by the formula: P = 2w + 2l

Translate.

The perimeter is 92 m.

 $\begin{array}{c} \downarrow \qquad \downarrow \downarrow \\ 2x+2(x+4) \qquad = 92 \end{array}$

Carry out. We solve the equation.

2x + 2(x + 4) = 92 2x + 2x + 8 = 92 Distributive Law 4x + 8 = 92 Combining like terms 4x = 84 Subtracting 8 x = 21 Dividing by 4

If the width of the garden is 21 m, then the length is 21 m + 4 m, or 25 m. **Check** The length, 25 m, is 4 m longer than the width, 21 m. The perimeter is $2 \cdot 21 \text{ m} + 2 \cdot 25 \text{ m} = 92 \text{ m}$. These results check.

State. The garden is 21 m wide and 25 m long.

29. *Familiarize.* Let x = the width of the cross section and x + 2 = the length of the cross section. Recall that the perimeter is given by the formula: P = 2w + 2l*Translate.*

The perimeter is 10 in.

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 2x+2(x+2) &= & 10 \end{array}$$

Carry out. We solve the equation.

2x + 2(x + 2) = 10 2x + 2x + 4 = 10 4x + 4 = 10 Combining like terms 4x + 4 - 4 = 10 - 4 Subtracting 4 from both sides $\frac{4x}{4} = \frac{6}{4}$ Dividing by 4 $x = 1\frac{1}{2}$ If the width of the cross section is $1\frac{1}{2}$ in., then the length is $3\frac{1}{2}$ in. $(1\frac{1}{2} + 2 = 3\frac{1}{2})$.

Check The length of the cross section, $3\frac{1}{2}$ in. is two more than the width, $1\frac{1}{2}$ in. The perimeter is $2 \cdot (1\frac{1}{2}) + 2 \cdot (3\frac{1}{2}) = 10$ in. These results check.

State. The width of the cross section is $1\frac{1}{2}$

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

30. *Familiarize.* Let x = the width of the billboard sign, in feet. Then 3x + 6 is the length of the billboard, in feet. Recall that the perimeter is given by the formula: P = 2w + 2l

Translate.

The perimeter is 124 ft.

$$\begin{array}{c}
\downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow \\
2x+2(3x+6) = 124
\end{array}$$

Carry out. We solve the equation.

·····	1
2x+2(3x+6)=124	
2x + 6x + 12 = 124	Distributive Law
8x + 12 = 124	Combining like terms
8x = 112	Subtracting 12
x = 14	Dividing by 8
TC 41: 441 C 41 1. : 111.	and is 14 ft than th

If the width of the billboard is 14 ft, then the length is 3.14 ft + 6 ft, or 48 ft. **Check** The length, 48 ft, is 6 ft more than 3 times the width, 14 ft. The perimeter is 2.14 ft + 2.48 ft = 124 ft. These results check.

State. The width of the billboard is 14 ft, and the length is 48 ft.

31. *Familiarize.* Let x = the measure of the first angle, in degrees. Then the measure of the second angle is 3x degrees, and the third angle measures x + 30 degrees. Recall that the sum of the measures of the angles of any triangle is 180°.

Translate.

The sum of the measures of the three angles	is 180 degrees.
\downarrow	$\downarrow \downarrow$

x + 3x + (x + 30)= 180

Carry out. We solve the equation.

$$x + 3x + (x + 30) = 180$$

$$5x + 30 = 180$$
 Combining like
terms

$$5x = 150$$
 Subtracting 30

$$x = 30$$
 Dividing by 5

If the first angle measures 30°, then the second angle measures $3 \cdot 30^\circ$, or 90° , and the third angle measures $30^{\circ} + 30^{\circ}$, or 60° . *Check* The second angle has a measure of 90° , which is three times the measure of the first angle, 30°. The third angle measures 60° , which is 30° more than the first angle. The sum of the measures of the three angles is $30^{\circ} + 90^{\circ} + 60^{\circ}$, or 180°. These results check.

State. The angles measure 30° , 90° , and 60° , respectively.

32. *Familiarize.* Let x = the measure of the first angle, in degrees. Then the measure of the second angle is 4x degrees, and the third angle measures x + 4x - 45 degrees. Recall that the sum of the measures of the angles of any triangle is 180°.

Translate.

The sum of the measures is 180 degrees. of the three angles

Carry out. We solve the equation. x+4x+(x+4x-45)=180

> 10x - 45 = 180 Combining like terms 10x = 225 Adding 45 x = 22.5 Dividing by 10

If the first angle measures 22.5°, then the second angle measures $4 \cdot 22.5^\circ$, or 90° , and the third angle measures $22.5^{\circ} + 90^{\circ} - 45^{\circ}$, or 67.5°.

Check The second angle has a measure of 90°, which is four times the measure of the first angle, 22.5°. The third angle measures 67.5° , which is 45° less than the sum of the first and second angle. The sum of the measures of the three angles is $22.5^{\circ} + 90^{\circ} +$ 67.5°, or 180°. These results check. State. The angles measure 22.5°, 90°, and 67.5°, respectively.

33. *Familiarize.* Let x = the measure of the first angle, in degrees. Then the measure of the second angle is 3x degrees, and the third angle measures x + 3x + 10 degrees. Recall that the sum of the measures of the angles of any triangle is 180°.

Translate.

The sum of the measures of the three angles	is 180 degrees.	
↓ ,	$\downarrow \downarrow$	

$$x + 3x + (x + 3x + 10) = 180$$

Carry out. We solve the equation. 10)

$$x + 3x + (x + 3x + 10) = 180$$

100

$$8x + 10 = 180$$
 Combining
like terms
$$8x = 170$$
 Subtracting 10

x = 21.25 Dividing by 8

If the first angle measures 21.25°, then the second angle measures $3 \cdot 21.25$, or 63.75° , and the third angle measures $21.25^{\circ} + 63$. $75^{\circ} + 10^{\circ}$, or 95° .

Check The measure of the second angle, 63.75° , is three times the measure of the first angle, 21.25°. The third angle has a measure of 95°, which is 10° more than the sum of the first and second angles, $21.25^{\circ} + 63.75^{\circ}$. The sum of the measures of the three angles is $21.25^{\circ} + 63.75^{\circ} + 95^{\circ} = 180^{\circ}$. These results check.

State. The angles measure 21.25°, 63.75°, and 95°, respectively.

34. *Familiarize.* Let x = the measure of the first angle, in degrees. Then the measure of the second angle is 4x degrees, and the third angle measures x + 4x + 5 degrees. Recall

that the sum of the measures of the angles of any triangle is 180°.

Translate.

The sum of the measures of the three angles	is 180 degrees.
$\downarrow^{r+4r+(r+4r+5)}$	$\downarrow \downarrow \downarrow$ - 180

Carry out. We solve the equation.

x + 4x + (x + 4x + 5) = 180 10x + 5 = 180Combining like terms 10x = 175Subtracting 5 x = 17.5Dividing by 10

If the first angle measures 17.5° , then the second angle measures $4 \cdot 17.5^{\circ}$, or 70° , and the third angle measures $17.5^{\circ} + 70^{\circ} + 5^{\circ}$, or 92.5° .

Check The second angle has a measure of 70°, which is four times the measure of the first angle, 17.5°. The third angle measures 92.5°, which is 5° more than the sum of the measures of the first and second angles, 87.5°. The sum of the measures of the three angles is $17.5^{\circ} + 70^{\circ} + 92.5^{\circ}$, or 180° . These results check.

State. The angles measure 17.5°, 70°, and 92.5°, respectively.

35. *Familiarize.* Let x = the length of bottom

section, in ft. Then the top section is $\frac{x}{6}$ ft,

and the middle section is $\frac{x}{2}$ ft.

Translate.

The sum of the lengths is 240 ft.

$$\downarrow \qquad \qquad \downarrow \downarrow \\ x + \frac{x}{6} + \frac{x}{2} \qquad = 240$$

Carry out. We solve the equation.

$$x + \frac{x}{6} + \frac{x}{2} = 240$$

$$6x + x + 3x = 1440$$
 Multiply by LCD = 6

$$10x = 1440$$
 Combining like terms

$$x = 144$$
 Dividing by 10

If the bottom section is 144 ft, the top section is 144 ft / 6, or 24 ft, and the middle section is 144 ft / 2, or 72 ft.

Check The top section is 24 ft, which is one sixth of the bottom section, and the middle section is 72 ft, which is half the length of the bottom section. The sum of the lengths is 24 ft + 72 ft + 144 ft = 240 ft. The result checks. **State.** The top section of the rocket is 24 ft,

the middle section is 72 ft, and the bottom section is 144 ft.

36. *Familiarize*. Let x = the length of Jenny's

portion, in inches. Let $\frac{x}{2}$ = the length of Demi's portion, and $\frac{3}{4}x$ = Shaina's portion,

in inches. *Translate.*

The sum of the lengths is 18 in.

$$\downarrow \qquad \qquad \downarrow \downarrow \\
x + \frac{x}{2} + \frac{3x}{4} = 18$$

Carry out. We solve the equation.

$$x + \frac{x}{2} + \frac{3x}{4} = 18$$

$$4x + 2x + 3x = 72$$
 Multiply by LCD = 4

$$9x = 72$$
 Combining like terms

$$x = 8$$
 Dividing by 9

If Jenny gets 8 in., then Demi would get 4 in. and Sarah would get 6 in.

Check Demi's portion, 4 in., is half of Jenny's, and Shaina's portion, 6 in., is three fourths of Jenny's portion. The sum of the lengths is 8 in. + 4 in. + 6 in. = 18 in. These results check.

State. Jenny's portion is 8 in., Demi's portion is 4 in., and Shaina's portion is 6 in.

 37. *Familiarize.* Let x = the number of miles Debbie can travel. Therefore, the ride will cost \$3.25 + \$1.80x. *Translate.*

The total cost of the taxi ride is \$19.

$$\begin{array}{ccc} \downarrow & \downarrow \downarrow \\ 3.25+1.80x & = 19 \end{array}$$

Carry out. We solve the equation. 3.25 + 1.80x = 19

$$1.80x = 15.75$$
 Subtract 3.25

$$x = 8.75$$
 Dividing by 1.8

Check The total cost of the ride is 325 + 1.80/mi × 8.75 mi, or 19. This results checks.

State. On a \$19 budget, Debbie can travel $8\frac{3}{4}$, or 8.75 mi.

38. *Familiarize.* Let x = the number of miles Ashfaq can travel. Therefore, the ride will cost him \$5.45 + \$2.86x. *Translate.*

The total cost of the taxi ride is \$24.95.

$$\begin{array}{ccc} \downarrow & \downarrow \downarrow \\ 5.45 + 2.86x & = 24.95 \end{array}$$

Carry out. We solve the equation. 5.45 + 2.86x = 24.95

2.86x = 19.5 Subtract 5.45

 $x = 6.\overline{81}$ Dividing by 2.86

Check The total cost of the ride is $5.45 + 2.86/\text{mi} \times 6.81$ mi, or 24.95. This result checks.

State. For \$24.95, Ashfaq can travel $6\frac{9}{11}$, or $6\frac{9}{11}$ mi

6.81 mi.

39. *Familiarize*. Let x = the number of miles Concert Productions can travel. The total of their rental will be \$39.95 + \$0.69x. *Translate.*

The total cost of the rental is \$100.

$$\begin{array}{ccc} \downarrow & \downarrow \downarrow \\ 39.95 + 0.69x & = 100 \end{array}$$

Carry out. We solve the equation. 39.95 + 0.69x = 100

0.69x = 60.05 Subtract 39.95

 $x \approx 87$ Dividing by 0.69

Check The total amount for the rental will be about $39.95 + 0.69/\text{mi} \times 87$ mi, which is very close to 100. This result checks. **State.** Concert Productions can travel about 87 mi on their 100 budget.

40. *Familiarize.* Let x = the number of miles Judy can travel. The total of the rental will be \$42 + \$0.35x. *Translate.*

The total cost of the rental is \$70.

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 42+0.35x & = 70 \end{array}$$

Carry out. We solve the equation. 42 + 0.35x = 70

0.35x = 28 Subtract 42

x = 80 Dividing by 0.35

Check The total amount for the rental will be $42 + 0.35/mi \times 80$ mi, or 70. This results checks. **State.** Judy can travel a total of 80 mi on her 70 budget.

41. *Familiarize.* Let x = the measure of the first angle, in degrees. Then the complement of the first angle is $90^{\circ} - x$. *Translate.*

The measure of an angle	e is 15°	more than	twice the measure of its complement.
\downarrow	$\downarrow \downarrow$	\downarrow	\downarrow
x	= 15	+	2(90-x)
<i>Carry out.</i> We solve the equation.			
x = 15 + 2(9)	90-x		
x = 15 + 180	0-2x	Distribu	itive Law
x = 195 - 2x		Combining like terms	
3x = 195		Adding $2x$	
x = 65		Dividing by 3	

Check If the angle measures 65° , then its complement measures $90^{\circ} - 65^{\circ}$, or 25° . Twice the measure of the complement is $2 \cdot 25^{\circ}$, or 50° . The original angle's measure of 65° is 15° more than 50° . These results check.

State. The angle measures 65°, and its complement measures 25°.

42. *Familiarize.* Let x = the measure of the first angle, in degrees. Then the supplement of the first angle is $180^{\circ} - x$. *Translate.*

45° less than twice The measure is the measure of its supplement. \downarrow \downarrow \downarrow 2(180-x)-45х *Carry out.* We solve the equation. x = 2(180 - x) - 45x = 360 - 2x - 45 Distributive Law x = 315 - 2xCombining like terms 3x = 315Adding 2xx = 105Dividing by 3

Check If the angle measures 105° , then its supplement measures $180^\circ - 105^\circ$, or

75°. Twice the measure of the supplement is 2.75° , or 150°. The original angle's

measure of 105° is 45° less than 150° . These results check.

State. The angle measures 105° , and its supplement measures 75° .

43. *Familiarize.* Let l = the length of the paper, in cm. Then the width is l - 6.3 cm. Recall that the perimeter of a rectangle is calculated using the formula P = 2w + 2l.

Translate.

The perimeter of the paper is 99 cm.

\downarrow	$\downarrow \downarrow$
2(l-6.3)+2l	= 99

Carry out. We solve the equation.

2(l-6.3) + 2l = 99

1

2l - 12.6 + 2l = 99 Distributive Law 4l - 12.6 = 99 Combining like terms

2.0 = 77 Combining like te

4l = 111.6 Adding 12.6

$$= 27.9$$
 Dividing by 4

Check If the length of the paper is 27.9 cm, then the width is 27.9 cm – 6.3 cm, or 21.6 cm. Therefore the perimeter is $2 \cdot 21.6$ cm + $2 \cdot 27.9$ cm , or 99 cm. **State.** The width is the paper is 21.6 cm, and the length is 27.9 cm.

44. *Familiarize.* Let x = the amount Sarah invested in stock, in dollars. Her investment increased by 28%, or by 0.28x.

Translate.

Check If Sarah invested \$350, then her investment would have grown by 28%(\$350), or \$98. Thus her investment would have grown to \$350 + \$98, or \$448. These results check.

State. Sarah's original investment would have been \$350.

45. *Familiarize.* Let x = the amount Amber invested in her savings account, in dollars. Her investment increased by 1%, or by 0.01*x*.

Translate.

Investment plus $\underbrace{\frac{1\% \text{ of the}}{\text{investment}}}_{\text{investment}}$ is \$1555.40.

$$\begin{array}{cccc} \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & 0.01x & = 1555.40 \end{array}$$

Carry out. We solve the equation.

x + 0.01x = 1555.40

1.01x = 1555.40 Combining like terms x = 1540 Dividing by 1.01

Check If Amber invested \$1540, then her investment would have grown by 1%(\$1540), or \$15.40. Thus her investment would have grown to \$1540 + \$15.40, or \$1555.40. These results check. **State.** Amber's original investment was

\$1540.

46. *Familiarize.* Let x = the balance in Will's account at the beginning of the month. If he is charged 2% interest, his balance would have grown by 0.02x during the month. *Translate.*

Original balance	plus	balance	is \$870.
\downarrow	\downarrow	\downarrow	$\downarrow \downarrow$
x	+	0.02x	= 870

20/ 0/1

Carry out. We solve the equation. x + 0.02x = 870

1.02x = 870 Combining like terms x = 852.94 Dividing by 1.02 and rounding

Check If Will's beginning-of-the-month balance was \$852.94, then he would have been charged 2%(\$852.94), or \$17.06 (rounded), resulting in a balance of \$852.94 + \$17.06 = \$870. These results check. **State.** Will's beginning balance would have been \$852.94.

47. *Familiarize.* Let x = the losing score. If the margin of victory was 323 points, then the winning score would have been x + 323 points.

Translate.

Sum of the winning and losing scores is 1127 points.

Carry out. We solve the equation.

x + (x + 323) = 1127

2x + 323 = 1127 Combining like terms

2x = 804 Subtracting 323

x = 402 Dividing by 2

Check If the losing score was 402, then the winning score, assuming a margin of victory of 323 points, would have been 402 + 323, or 725 points. The sum of the winning and losing scores is 725 + 402, or 1127 points. These results check. *State.* The winning score was 725 points.

48. *Familiarize.* Let c = the number of brochures that can be printed for \$5000. If it costs \$200 per month to lease the printer and it is rented for 2 months, then the cost is 2(\$200), or \$400. The cost per brochure is 21.5¢ per copy, resulting in an additional cost of \$0.215*c*.

Translate.

Monthly cost	plus	ink and paper cost	is	\$5000.
\downarrow 2(200)	\downarrow +	\downarrow 0.215 <i>c</i>	$\stackrel{\downarrow}{=}$	↓ 5000

2(200) + 0.215c = 5000400 + 0.215c = 5000

$$0.215c = 4600$$
 Subtracting 400

c = 21,395 Dividing by 0.215 and rounding

Check If 21,395 brochures are printed, it will cost 21,365(\$0.215/brochure), or \$4600 (rounding), plus 2(\$200), or \$400, for a total of \$5000. These results check. *State.* On a budget of \$5000, 21,395 brochures can be printed.

49. *Familiarize.* Let x = the final bid. Let 0.08x = the seller's premium on the final bid. *Translate.*Final bid minus coller's

Final bid minus seller's is the amount left

$$\begin{array}{cccc} \downarrow & \downarrow & \downarrow \\ x - 0.08x & = & 1150 \end{array}$$

Carry out. We solve the equation.

x - 0.08x = 1150

0.92x = 1150 Combine like terms

x = 1250 Dividing by 0.92

Check If the final bid was \$1250, the 8% of \$1250 is 0.08(1250) = \$100. So, \$1250 - \$100 = \$1150. This result checks. *State.* The final bid is \$1250.

50. *Familiarize*. Let x = the original estimate of The Big Dig. Let 4.84x = the actual cost of The Big Dig. *Translate.* The cost of The Big Dig is \$14.6 billion.

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 4.84x & = 14.6 \end{array}$$

Carry out. We solve the equation. 4.84x = 14.6

 $x \approx 3.02$ Dividing by 4.84

Check If the original estimate was \$3.02 billion, then 484% of \$3.02 is $4.84(3.02) \approx 14.6$, or \$14.6 billion. This result checks. **State.** The original estimate of The Big Dig was about \$3.02 billion.

51. *Familiarize.* Let N = the number of times the cricket chirps per minute. Let T = the corresponding Fahrenheit temperature. Translate.

We are already given the equation relating Fahrenheit temperature T, in degrees, and the number of times a cricket chirps per minute *N*. We are to determine the number of chips corresponding to 80°F.

Temperature	is	40 more than one fourth the number of chirps.
\downarrow	\downarrow	\downarrow
Т	=	$\frac{1}{1}N + 40$

Carry out. We substitute 80 for *T* and solve the equation for N.

 $T = \frac{1}{4}N + 40$

 $80 = \frac{1}{4}N + 40$ Substituting 80 for T

 $40 = \frac{1}{4}N$ Subtracting 40

160 = NMultiplying by 4

Check If a cricket chirps 160 times per minute, then the Fahrenheit temperature would be $\frac{1}{4}(160) + 40$, or 40 + 40, or 80° F.

This result checks.

State. The number of chirps per minute corresponding to 80°F is 160.

52. *Familiarize*. Let *t* = the number of years since 1920. Let R = the number of seconds to complete the 200-m dash.

Translate.

We are already given the equation relating the number of seconds required R to complete the 200-m dash and time t, the number of years after 1920.

Time to run 1 100-m dash	the is	20.8 more than -0.28 times the number of years after 1920.
\downarrow	\downarrow	\downarrow
R	=	-0.028t + 20.8

Carry out. We substitute 18.0 for *R* and solve the equation for *t*.

R = -0.028t + 20.8	
18.0 = -0.028t + 20.8	Substituting 18.0 for <i>R</i>
-2.8 = -0.028t	Subtracting 20.8
t = 100	Dividing by -0.028

Check If the number of years after 1920 is 100, then the time required to complete the

200-m dash is -0.028(100) + 20.8, or 18 sec. This result checks.

State. The number of years after 1920 is 100, or 1920 + 100 = 2020.

53. *Familiarize*. We examine the table to determine the size of aquarium and the recommended stocking density. We notice that:

 $100 = 20 \times 5$ $120 = 24 \times 5$ $200 = 40 \times 5$

 $250 = 50 \times 5$

This leads us to conclude that size of aquarium is 5 times the stocking density. We let x = the stocking density and we let S = the size of the aquarium.

Translate.

Size of Aquarium is 5 times the stocking density.

 $\begin{array}{c} \downarrow \downarrow \downarrow \\ = 5 \end{array}$ \downarrow S x

Carry out. We substitute 30 in. for x and solve for S.

S = 5x

S = 5(30) Substituting 30 for x

S = 150Simplify

Check. If the aquarium is 150 gallons, then the recommended stocking density $150 \div 5$, or 30 inches. This result checks. State. The aquarium size for 30 in. of fish is 150 gallons.

54. Familiarize. We examine the table to determine the relationship between the cost of an order before shipping and the cost including shipping. Examining each row in the table, we see that the cost including shipping can be determined by adding \$5.95 to the cost before shipping:

15.50 + 5.95 = 21.45

21.65 + 5.95 = 27.60

We let T = the cost including shipping and let c = the cost before shipping. Translate.

Cost including shipping	is	cost of the order before shipping plus \$5.95.
\downarrow	\downarrow	\downarrow
Т	=	c + 5.95

Carry out. We substitute \$25.68 for *T* and solve for *c*. T = c + 5.95

25.68 = c + 5.95 Substituting 25.68 for *T*

19.73 = c Subtracting 5.95

Check. If the cost of an order before shipping is \$19.73, then the cost including shipping would be \$19.73 + \$5.95, or \$25.68. This result checks. *State.* The cost of the order before shipping was \$19.73.

55. *Familiarize.* We examine the table to determine the relationship between the level and the points required to complete the level. Observe that the points required increases by 70 points each level: From level 1 to level 2: 270 - 200 = 70 points From level 2 to level 3: 340 - 270 = 70 points From level 3 to level 5 (5 - 2, or 2 levels): $480 - 340 = 140 = 2 \cdot 70$ points From level 5 to level 10 (10 - 5, or 5 levels): $830 - 480 = 350 = 5 \cdot 70$ points From level 10 to level 20 (20 - 10, or 10 levels): $1530 - 830 = 7000 = 10 \cdot 70$ points Let *l* = the level that requires 1250 points *Translate.*

> number of Points for 1250 plus 70 times levels after is level 1 points. level 1 L T J L 200 70 · (l-1)1250 + = Carry out. We solve the equation. 200 + 70(l-1) = 1250200 + 70l - 70 = 125070l + 130 = 125070l = 1120l = 16Check. Level 10 requires 830 points to complete, so level 16 takes 830 + 70(16 - 10)= 1250 points. The answer checks.

State. Level 16 requires 1250 points to complete.

56. Familiarize. We examine the table and observe that, beginning with a rate of \$60 for 1000 square feet, each increase of 100 square feet corresponds to a \$5 increase in the cleaning rate: 1100 - 1000 = 100 and \$65 - \$60 = \$5; $1200 - 1000 = 200 = 2 \cdot 100$ and \$70 - \$60 = $10 = 2 \cdot 5$: $2000 - 1000 = 1000 = 10 \cdot 100$ and \$110 - $60 = \$50 = 10 \cdot \$5;$ $3000 - 1000 = 2000 = 20 \cdot 100$ and \$160 - $60 = 100 = 20 \cdot 5.$ Let h = the house size, in square feet, and let C = the total cost to clean the house. Translate. \$5 per every

hundred square

Cleaning cost is \$60 plus feet in excess

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of 1000 square
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feet.

Carry out. We substitute \$145 for *C* and solve for *h*.

$$C = 60 + 5\left(\frac{h - 1000}{100}\right)$$
$$145 = 60 + 5\left(\frac{h - 1000}{100}\right)$$

 $145 \cdot 100 = 6000 + 5(h - 1000)$ 14500 = 6000 + 5h - 500014500 = 1000 + 5h

$$13500 = 5h$$

$$2700 = h$$

Check. If the house has 2700 ft^2 , then the cost to clean would be

$$60 + 5\left(\frac{2700 - 1000}{100}\right)$$
, or \$145. This result checks.

State. The house has a total area of 2700 ft^2 .

57. *Familiarize.* Let w = the walking speed, in feet per minute. Then w + 250 = the running speed, in feet per minute. Since d = rt, the walking distance is $w \cdot 10$, or 10w, and the running distance is $(w+250) \cdot 20$, or

20(w+250).

Translate.

We are given that Samantha ran and walked a total of 15,500 feet.

 $\underbrace{\text{running distance}}_{\text{function}} \text{ plus } \underbrace{\underset{\text{distance}}^{\text{walking}}}_{\text{distance}} \text{ is 15,500.}$

Carry out. We solve the equation for w. 20(w + 250) + 10w = 15,500

20w + 5000 + 10w = 15,500 Distributive Law

$$30w + 5000 = 15,500$$
 Combine like terms

$$30w = 10,500$$
 Subtracting by 5000

w = 350 Dividing by 30

Check If the walking speed is 350 feet per minute, the running speed is 350 + 250 = 600 feet per minute. The total distance is: $20 \cdot 600 + 10 \cdot 350 = 12,000 + 3500 = 15,500$. This result checks.

State. Samantha ran at 600 feet per minute.

58. *Familiarize.* Let w = the walking speed, in feet per minute. Then 2w = the jogging speed, in feet per minute. Since d = rt, the walking distance is $w \cdot 5$, or 5w, and the jogging distance is $2w \cdot 40$, or 80w.

Translate.

We are given the Stephanie jogged and walked a total of 21,250 feet.

 $\underbrace{\underset{distance}{\text{jogging}}}_{\downarrow} \text{ plus } \underbrace{\underset{distance}{\text{walking}}}_{\downarrow} \text{ is 21,250}$

$$80w + 5w = 21,250$$

Carry out. We solve the equation for w. 80w + 5w = 21,250

85w = 21,250 Combine like terms

w = 250 Dividing by 85

Check If the walking speed is 250 feet per minute, the running speed is $2 \cdot 250 = 500$ feet per minute. The total distance is: $80 \cdot 250 + 5 \cdot 250 = 20,000 + 1250 = 21,250$. This result checks. *State.* Stephanie jogged at 500 feet per minute.

59. *Familiarize.* Let c = the driving speed in clear weather, in mph. Let $\frac{1}{2}c =$ the driving speed in the snowstorm, in mph. Since d = rt, the clear weather driving distance is $c \cdot 5$, or 5*c*, and the snowstorm driving distance is $\frac{1}{2}c \cdot 2$, or *c*.

Translate.

We are given the Anthony drove 240 more miles in clear weather than the snowstorm.

distance in clear weather is distance in snowstorm plus 240

\downarrow	\downarrow	\downarrow	\downarrow	\downarrow
5 <i>c</i>	=	С	+	240

Carry out. We solve the equation for *c*. 5c = c + 240

4c = 240 Subtracting by c

c = 60 Dividing by 4

Check If the driving speed in clear weather was 60 mph, the driving speed in the snowstorm was $\frac{1}{2} \cdot 60 = 30$ mph. The distance equation is: $5 \cdot 60 = 60 + 240$. This result checks.

State. Anthony drove 30 mph in the snow.

60. *Familiarize.* Let d = the driving speed on level highway, in mph. Let d - 20 = the driving speed in the mountains, in mph. Since d = rt, the driving distance on level highway is $d \cdot 6$, or 6d, and the driving distance in the mountains is 2(d - 20).

Translate.

We are given the Robert drove 300 more miles on level highway.

 $\underbrace{\underset{level highway}{\text{distance on}}}_{6d} \text{ is } \underbrace{\underset{mountains}{\text{distance in}}}_{4} \text{ plus } 300$

Carry out. We solve the equation for *d*. 6d = 2(d - 20) + 300

6d = 2d - 40 + 300 6d = 2d - 40 + 300 6d = 2d + 260 4d = 260 d = 65Subtracting by 2d Dividing by 4

Check If the driving speed on level highway was 65 mph, the driving speed in the mountians was 65-20 = 45 mph. The distance equation is: $6 \cdot 65 = 2(45) + 300$. This result checks. *State.* Robert drove 45 mph in the mountains.

61. *Familiarize.* Let t = the time spend bicycling at a slower rate of 10 mph *in hours*. Then t + 30 = the time *in minutes* spent bicycling at 15 mph. Converting this to time into hours gives $t + \frac{1}{2}$. Since d = rt, the distance at a slower rate is 10t, and the distance at a faster rate is $15(t + \frac{1}{2})$.

Translate.

We are given the total distance bicycled of 25 miles.

 $\underbrace{\frac{\text{distance at}}{\text{faster rate}}}_{15\left(t+\frac{1}{2}\right)} \text{ plus } \underbrace{\frac{\text{distance at}}{\text{slower rate}}}_{10t} \text{ is 25.}$

Carry out. We solve the equation for *w*. $15(t + \frac{1}{2}) + 10t = 25$ 15t + 7.5 + 10t = 25 Distributive Law 25t + 7.5 = 25 Combine like terms

25t = 17.5 Subtracting by 7.5

t = 0.7 Dividing by 25

Check The time spend bicycling at a slower rate is 0.7 hours, or $0.7 \cdot 60 = 42$ minutes. So the time spent bicycling at a faster rate is 42 + 30 = 72 minutes, or 0.7 + 0.5 = 1.2 hours. The total distance is: $15 \cdot 1.2 + 10 \cdot 0.7 = 18 + 7 = 25$. This result checks. **State.** Justin rode for 1.2 hours, or 72 minutes at a faster speed

minutes, at a faster speed.

62. *Familiarize.* Let t = the time spend going to school *in hours*. Then t + 4 = the time *in minutes* spent going to the library. Converting this to time into hours gives $t + \frac{1}{15}$ because

 $\frac{4}{60} = \frac{1}{15}$. Since d = rt, the distance to the library is $25(t+\frac{1}{15})$, and the distance to school is 15t. Translate. We are given the total distance of 15 miles. distance plus distance is 15. \downarrow $\downarrow \downarrow$ $25(t+\frac{1}{15}) +$ 1*5t* = 15*Carry out.* We solve the equation for *t*. $25(t+\frac{1}{15})+15t=15$ $25t + \frac{5}{3} + 15t = 15$ Distributive Law $40t + \frac{5}{3} = 15$ Combine like terms $40t = \frac{40}{3}$ Subtracting by $\frac{5}{3}$ $t = \frac{1}{2}$ Dividing by 40

Check The time spend going to school is $\frac{1}{3}$ hours, or $\frac{1}{3} \cdot 60 = 20$ minutes. So the time spent going to the library is 20 + 4 = 24 minutes, or $24 \div 60 = 0.4$ hours. The total distance is: $25 \cdot 0.4 + 15 \cdot \frac{1}{3} = 10 + 5 = 15$. This result checks.

State. Courtney rode her scooter to the library for 0.4 hours, or 24 minutes.

- 63. *Thinking and Writing Exercise*. Although many of the problems in this section might be solved by guessing, using the five-step problem-solving process to solve them would give Ethan practice in using a technique that can be used to solve other problems whose answers are not so readily guessed.
- 64. *Thinking and Writing Exercise*. Either approach will work. Some might prefer to let *m* represent the number of consumer e-mails because the number of business e-mails is given in terms of the number of consumer emails. When choosing a variable it is important to specify what it represents.
- 65. Since -9 is to the left of 5 on the number line, we have -9 < 5.
- 66. Since 1 is to the left of 3 on the number line, we have 1 < 3.
- 67. Since -4 is to the left of 7 on the number line, we have -4 < 7.

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- 68. Since -9 is to the right of -12 on the number line, we have -9 > -12.
- 69. Simply exchange the numbers and change the inequality symbol; $-4 \le x$.
- 70. Simply exchange the numbers and change the inequality symbol; 5 > x.
- 71. Simply exchange the numbers and change the inequality symbol; y < 5.
- 72. Simply exchange the numbers and change the inequality symbol; $t \ge -10$.
- 73. Thinking and Writing Exercise. Answers may vary. The sum of three consecutive odd integers is 375. What are the integers?
- 74. *Thinking and Writing Exercise*. Answers may vary.

Acme Rentals rents a 12-foot truck at a rate of \$35 plus 20¢ per mile. Audrey has a truck-rental budget of \$45 for her move to a new apartment. How many miles can she drive the rental truck without exceeding her budget?

75. *Familiarize.* Let c = the amount the meal originally cost. The 15% tip is calculated on the original cost of the meal, so the tip is 0.15*c*.

Translate.

Original cost plus tip less \$10 is \$32.55.

Carry out. We solve the equation. c + 0.15c - 10 = 32.55

1.15c - 10 = 32.551.15c = 42.55c = 37

Check. If the meal originally cost \$37, the tip was 15% of \$37, or 0.15(\$37), or \$5.55. Since \$37 + \$5.55 - \$10 = \$32.55, the answer checks.

State. The meal originally cost \$37.

76. *Familiarize.* Let m = the number of multiplechoice questions Pam got right. Note that she got 4 - 1, or 3 fill-ins right.

Translate.

Fill-in points	plus	multiple-choice points	total	78 points.
\downarrow	\downarrow	\downarrow	\downarrow	\downarrow
$7 \cdot 3$	+	3 <i>m</i>	=	78
Carry o	ut. V	Ve solve the equa	tion.	
$7 \cdot 3 + 3$	m = 7	8		
21 + 31	m = 7	8		

3m = 57m = 19

Check. Pam got 3 fill-ins right and received 7 points for each of them, for a total of $7 \cdot 3 = 21$ points. She also got 19 multiple-choice right and received 3 points for each of them, for a total of $3 \cdot 19 = 57$ points. So she had a grand total of 21 + 57, or 78 points. This result checks.

State. Pam got 19 multiple-choice questions right.

77. *Familiarize.* Let x = a score. Lincoln referred to "four score and seven,", which can be expressed as 4x + 7. The Gettysburg Address was given in 1863, and Lincoln refers to 1776, a total of 87 years prior. *Translate.*

Four score and seven years is 87 years.

\downarrow	\downarrow	\downarrow
4x + 7	=	87

Carry out. We solve the equation. 4x + 7 = 874x = 80

$$4x = 80$$

x = 20

Check. If a score is 20 years, then four score and seven is $4 \cdot 20 + 7$, or 87. If 87 is added to the year 1776, we have 1776 + 87, or 1863. This results checks. *State.* A score is 20 years.

78. *Familiarize.* Let x = the larger number. Then 25% of *x*, or 0.25*x* is the smaller number. *Translate.*

The larger number	is 12	more than	the smaller number.
\downarrow_{x}	$\downarrow \downarrow$ = 12	\downarrow +	\downarrow 0.25x

Carry out. We solve the equation.

x = 12 + 0.25x0.75x = 12

x = 16

Check. If 16 is the larger number, then 25% of 16, or 0.24(16) = 4 is the smaller number. The larger number, 16, is 12 more than the smaller number, 4. This results checks. State. The numbers are 4 and 16.

79. *Familiarize*. Let x = the number of halfdollars. Then 2x would represent the number of quarters, 2(2x), or 4x would represent the number of dimes, and 3(4x), or 12x would represent the number of nickels.

Furthermore, the value of the half-dollars, in cents, is represented by 50x, the value of the quarters, in cents, is represented by 25(2x), or 50x, the value of the dimes is represented by 10(4x), or 40x, and the value of the nickels, in cents is represented by 5(12x), or 60x. Translate.

Total value of the change, in cents, is 1000.

$$\downarrow \qquad \qquad \downarrow \downarrow \\
50x + 50x + 40x + 60x \qquad = 1000$$

Carry out. We solve the equation. 50x + 50x + 40x + 60x = 1000

$$200x = 1000$$

 $x = 5$

If x = 5, then there are 5 half-dollars; there are 10 quarters, there are 20 dimes, and there are 60 nickels.

Check. The total value of the change is: $5(50\phi) + 10(25\phi) + 20(10\phi) + 60(5\phi)$, or 250¢ $+250\phi + 200\phi + 300\phi = 1000\phi$, or \$10.00. These results check. State. There are 5 half-dollars, 10 quarters, 20 dimes, and 60 nickels.

80. *Familiarize*. Let x = the length of the rectangle, in cm. Then the width can be represented by $\frac{3}{4}x$, in cm. If the dimensions are increased by 2 cm, the length is x+2 and the width is $\frac{3}{4}x + 2$. Recall that the formula for the perimeter of a rectangle is P = 2w + 2l.

Translate.

Perimeter of the rectangle when length and width are is 50 cm. increased by 2 cm

$$\downarrow \qquad \qquad \downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow \qquad 2\left(\frac{3}{4}x+2\right)+2\left(x+2\right) \qquad = 50$$

Carry out. We solve the equation.

a) =0

$$2\left(\frac{3}{4}x+2\right)+2(x+2)=50$$

$$\frac{3}{2}x+4+2x+4=50$$

$$\frac{7}{2}x+8=50$$

$$\frac{7}{2}x=42$$

$$\frac{2}{7}\left(\frac{7}{2}x\right)=\frac{2}{7}(42)$$

$$x=12$$

a

If x = 12, then the length is 12 and the width is $\frac{3}{4}(12)$, or 9.

Check. If the length is increased by 2 cm, then the new length is 12 + 2, or 14 cm. If the width is increased by 2 cm, then the new width is 9 + 2, or 11 cm. The perimeter of the new rectangle would be 2(11 cm) + 2(14 cm), or 22 cm + 28 cm, or 50 cm. These results check.

State. The original rectangle had a length of 12 cm and a width of 9 cm.

81. *Familiarize.* Let x = the original price of the clothes before the two discounts. Julio's credit account agreement gives him a 10% discount; so, he would pay 90% of the original price, or 0.9x. His coupon give him an additional 10% discount off of the reduced price; so, he would pay 90% of 0.9x, or 0.9(0.9x), or 0.81x.

Translate.

Final discounted price is \$77.75. of the clothes .

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 0.81x & = 77.75 \end{array}$$

Carry out. We solve the equation. 0.81x = 77.75

x = 95.99 (Rounded)

Check. If the original price of the clothes was \$95.99, then after the credit account discount is applied, Julio will owe 90% of \$95.99, or \$86.39. After applying the coupon discount of 10%, he will owe 90% of the first

discounted price, or 90% of \$86.39, or \$77.75 (rounded). These results check. *State.* The original price of the clothes was \$95.99.

82. *Familiarize.* Let x = the original number of apples in the basket. Then $\frac{1}{3}x$, $\frac{1}{4}x$, $\frac{1}{8}x$, and

 $\frac{1}{5}x$ of the apples go to the first, second, third, and fourth person, respectively. The fifth person gets 10 apples, and the sixth person gets 1 apple.

Translate.

The number of apples distributed is the number in the basket. $\frac{1}{3}x + \frac{1}{4}x + \frac{1}{8}x + \frac{1}{5}x + 10 + 1 = x$ Carry out. We solve the equation. $\frac{1}{3}x + \frac{1}{4}x + \frac{1}{8}x + \frac{1}{5}x + 10 + 1 = x$ Multiply both sides by the LCD = 120. $120\left(\frac{1}{3}x + \frac{1}{4}x + \frac{1}{8}x + \frac{1}{5}x + 10 + 1\right) = 120x$ 40 - 220 - 150 - 220 - 120

40x + 30x + 15x + 24x + 1200 + 120 = 120x

109x + 1320 = 120x

$$1320 = 11x$$

120 = x

Check. If there were 120 apples in the basket to start with, then the first person received

- $\frac{1}{3}(120) = 40$ apples; the second received
- $\frac{1}{4}(120) = 30$ apples, the third received
- $\frac{1}{8}(120) = 15$ apples, the fourth received

 $\frac{1}{5}(120) = 24$ apples; the fifth received (we are

told) 10 apples, and the sixth received (we are told) 1 apple. This makes a total of 40 + 30 + 15 + 24 + 10 + 1, or 120 apples. These results check.

State. There were 120 apples in the basket.

83. *Familiarize.* Let x = the number of additional games they must play. Then the total number of games they will win is $\frac{1}{2}x+15$, and the total number of games they will play, including the additional games, is x + 20. *Translate.*

The total number of games they win is 60% of the number of games played.

Carry out. We solve the equation.

$$\frac{1}{2}x + 15 = 0.6(x + 20)$$
$$0.5x + 15 = 0.6x + 12$$
$$3 = 0.1x$$

30 = x

Check. If they play 30 additional games, then they will have played 20 + 30, or 50 games. If they win 60% of all the games they play, they will win 60% of 50, or 0.6(50), or 30 games. They have already won 15 games, and if they win half of the additional ones, or $\frac{1}{2}(30) = 15$, they will have won 15 + 15, or 30 games. These results check.

State. They must play a additional 30 games.

84. *Familiarize.* Let x = the number of DVDs purchased. . First DVD: 9.99 + 3 shipping = 12.99Second DVD: 6.99 + 1.50 shipping = 8.49Additional DVDs: 6.99 + 1 shipping = 7.99Therefore, the cost of each additional DVD after the first two is 7.99(x-2). *Translate.*

The total cost of the shipment was \$45.45. cost of 1st & additional 2nd DVDs \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow 12.99+8.49 + 7.99(x-2) = 45.45 Carry out. We solve the equation. 12.99+8.49+7.99(x-2) = 45.45 12.99+8.49+7.99x-15.98 = 45.45 7.99x-5.5 = 45.45 7.99x = 39.95 x = 5Check. The total cost for 5 DVDs is: 12.99+8.49+7.99(3) = 45.45 The results

12.99 + 8.49 + 7.99(3) = 45.45. The results check.

State. There were 5 DVDs in the shipment.

85. *Familiarize.* Let x = the score on the third test. If the average on the first two exams was 85, then it follows that the total of her exam percentages on the first two exams was 170 (170 ÷ 2 = 85).

Translate.

Average of the three exams is 82.

Carry out. We solve the equation.

$$\frac{170 + x}{3} = 82$$
$$3\left(\frac{170 + x}{3}\right) = 3 \cdot 82$$
$$170 + x = 246$$
$$x = 76$$

Check. If Elsa got an average of 85 on her first two exams, then she must have received a total of 170 points on the two exams since $170 \div 2 = 85$. If she received a score of 76 on her third exam, then her total exam points would be 170 + 76, or 246. The average on all three exams would be $246 \div 3 = 82$. This result checks.

State. The score on the third exam must have been 76.

86. *Familiarize.* Let x = the number of miles Mya rode in the taxi. If a 10-min drive took 20 min, then 10 min was spent stopped in traffic. Since there is a charge of 60¢ per min stopped in traffic, she would have been charged \$0.60(10), or \$6 for being stopped in traffic. Note there are 5 one-fifth miles per mile.

Translate.

$\underbrace{\begin{array}{c} \$2.80 \text{ plus} \\ 50 \notin \text{ per} \frac{1}{5} \text{ mile} \end{array}}_{50 \# 15}$	plus	charge for being stopped	is	\$23.80.
\downarrow	\downarrow	\downarrow	\downarrow	\downarrow
2.80 + 0.5(5x)	+	6.00	=	23.80

Carry out. We solve the equation.

$$2.80 + 0.5(5x) + 6 = 23.80$$
$$2.8 + 2.5x + 6 = 23.80$$
$$8.8 + 2.5x = 23.80$$
$$2.5x = 15.00$$
$$x = 6$$

Check. The cab charges \$2.80, plus \$0.50 per $\frac{1}{5}$ mile. If the trip was 6 miles, there

were 30 $\frac{1}{5}$ -miles covered, for a charge of

\$0.50(30), or \$15. In addition the cab sat in traffic 10 min for an additional charge of \$0.60(10), or \$6. So the total bill would have been \$2.80 + \$15 + \$6, or \$23.80. This result checks.

State. The trip consisted of 6 miles.

- 87. *Thinking and Writing Exercise*. If the school can invest the \$2000 so that it earns at least 7.5% and thus grows to at least \$2150 by the end of the year, the second option should be selected. If not, the first option is preferable.
- 88. Thinking and Writing Exercise. Yes; the page numbers must be consecutive integers. The only consecutive integers whose sum is 191 are 95 and 96. These cannot be the numbers of facing pages, however, because the left-hand page of a book is even-numbered.
- 89. *Familiarize.* Let x = the width of the rectangle, in cm. Then the length is x + 4.25 cm. Recall that the perimeter is P = 2w + 2l. *Translate.*

The perimeter of the rectangle is 101.74.

Carry out. We solve the equation. 2x + 2(x + 4.25) = 101.74 2x + 2x + 8.5 = 101.74 4x + 8.5 = 101.744x = 93.24

x = 23.31

Check. If the width is 23.32 cm, then the length is 23.31 + 4.25, or 27.56 cm. The perimeter is 2(23.31 cm) + 2(27.56 cm), or 101.74 cm. These results check. *State.* The width is 23.31 cm and the length is 27.56 cm.

90. *Familiarize.* Let x = the length of the first side of the triangle, in cm. Then the second side is x+3.25 cm, and the third side is (x+3.25)+4.35, or 7.6 cm. The perimeter

of a triangle is given by P = a + b + c, where a, b, and c represent the lengths of the sides of the triangle.

Translate.

Perimeter of the triangle is 26.87.

$$\downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow \\ x + (x + 3.25) + (x + 7.6) = 26.87$$

Carry out. We solve the equation.
$$x + (x + 3.25) + (x + 7.6) = 26.87$$
$$3x + 10.85 = 26.87$$
$$3x = 16.02$$
$$x = 5.34$$

If the first side is 5.34 cm, then the second side is 5.34 + 3.25, or 8.59 cm and the third side is 5.34 + 7.6 cm, or 12.94 cm. The perimeter is 5.34 cm + 8.59 cm + 12.94 cm, or 26.87 cm. These results check. *State.* The sides are 5.34 cm, 8.59 cm, and 12.94 cm.

- 1. ≥
- 2. ≤
- 3. <
- 4. >
- 5. Equivalent
- 6. Equivalent
- 7. Equivalent
- 8. Not equivalent
- 9. x > -2
 - a) Since 5 > -2 is true, 5 is a solution.
 - b) Since 0 > -2 is true, 0 is a solution.
 - c) Since -3 > -2 is false, -3 is not a solution.

- 10. y < 5
 - a) Since 0 < 5 is true, 0 is a solution.
 - b) Since 5 < 5 is false, 5 is not a solution.
 - c) Since -13 < 5, -13 is a solution.
- 11. $y \le 19$
 - a) Since $18.99 \le 19$ is true, 18.99 is a solution.
 - b) Since $19.01 \le 19$ is false, 19.01 is not a solution.
 - c) Since $19 \le 19$ is true, 19 is a solution.
- 12. $x \ge 11$
 - a) Since $11 \ge 11$ is true, 11 is a solution.
 - b) Since $11\frac{1}{2} \ge 11$ is true, $11\frac{1}{2}$ is a solution.
 - c) Since $10\frac{2}{3} \ge 11$ is false, $10\frac{2}{3}$ is not a solution.
- 13. $a \ge -6$
 - a) Since $-6 \ge -6$ is true, -6 is a solution.
 - b) Since $-6.1 \ge -6$ is false, -6.1 is not a solution.
 - c) Since $-5.9 \ge -6$ is true, -5.9 is a solution.
- 14. $c \leq -10$
 - a) Since $0 \le -10$ is false, 0 is not a solution.
 - b) Since $-10 \le -10$ is true, -10 is a solution.
 - c) Since $-10.1 \le -10$ is false, -10.1 is not a solution.
- 15. The solutions of $x \le 7$ are shown by using a bracket at the point 7 and shading all points to the left of 7. The bracket indicates that 7 is part of the graph.

16. The solutions of y < 2 are shown by using a parenthesis at the point 2 and shading all points to the left of 2. The parenthesis indicates that 2 is not part of the graph.

17. The solutions of t > -2 are shown by using a parenthesis at the point -2 and shading all points to the right of -2. The parenthesis indicates that -2 is not part of the graph.

18. The solutions of y > 4 are shown by using a parenthesis at the point 4 and shading all points to the right of 4. The parenthesis indicates that 4 is not part of the graph.

19. The solutions of $1 \le m$ are shown by using a bracket at the point 1 and shading all points to the right of 1. The bracket indicates that 1 is part of the graph.

20. The solutions of $0 \le t$ are shown by using a bracket at the point 0 and shading all points to the right of 0. The bracket indicates that 0 is part of the graph.

$$0 \le t \\ <-4 - 2 \ 0 \ 2 \ 4$$

21. In order to be the solution of the inequality $-3 < x \le 5$, a number must be a solution of both -3 < x and $x \le 5$. The solution set is graphed as follows:

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

$$-5 \le x < 2$$

23. In order to be the solution of the inequality 0 < x < 3, a number must be a solution of both 0 < x and x < 3. The solution set is graphed as follows:

24. In order to be the solution of the inequality $-5 \le x \le 0$, a number must be a solution of both $-5 \le x$ and $x \le 0$. The solution set is graphed as follows:

25. The solutions of y < 6 are shown by using a parenthesis at the point 6 and shading all points to the left of 6. The parenthesis indicates that 6 is not part of the graph. The solution set is $\{y \mid y < 6\}$, or $(-\infty, 6)$.

26. The solutions of
$$x > 4$$
 are shown by using parenthesis at the point 4 and shading all points to the right of 4. The parenthesis indicates that 4 is not part of the graph. The solution set is $\{x \mid x > 4\}$, or $(4, \infty)$.

- 27. The solutions of $x \ge -4$ are shown by using a bracket at the point -4 and shading all points to the right of -4. The bracket indicates that -4 is part of the graph. The solution set is $\{x \mid x \ge -4\}$, or $[-4, \infty)$.
- 28. The solutions of $t \le 6$ are shown by using a bracket at the point 6 and shading all points to the left of 6. The bracket indicates that 6 is part of the graph. The solution set is $\{x \mid t \le 6\}$, or $(-\infty, 6]$.

$$\begin{array}{c} & & & \\ & & & & \\ & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\$$

29. The solutions of t > -3 are shown by using parenthesis at the point -3 and shading all points to the right of -3. The parenthesis indicates that -3 is not part of the graph. The solution set is $\{t \mid t > -3\}$, or $(-3, \infty)$.

$$\leftarrow$$
 $(+$ \rightarrow -3 0

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30. The solutions of y < -3 are shown by using a parenthesis at the point -3 and shading all points to the left of -3. The parenthesis indicates that -3 is not part of the graph. The solution set is $\{y \mid y < -3\}$, or $(-\infty, -3)$.

$$-3 \quad 0$$

31. The solutions of $x \le -7$ are shown by using a bracket at the point -7 and shading all points to the left of -7. The bracket indicates that -7 is part of the graph. The solution set is $\{x \mid t \le -7\}$, or $(-\infty, -7]$.

32. The solutions of $x \ge -6$ are shown by using a bracket at the point -6 and shading all points to the right of -6. The bracket indicates that -6 is part of the graph. The solution set

is
$$\{x \mid x \ge -6\}$$
, or $[-6, \infty)$.

- 33. All the points to the right of -4 are shaded. The parenthesis at -4 indicates that -4 is not part of the graph. We have $\{x \mid x > -4\}$, or $(-4, \infty)$.
- 34. All the points to the left of 3 are shaded. The parenthesis at 3 indicates that 3 is not part of the graph. We have $\{x \mid x < 3\}$, or $(-\infty, 3)$.
- 35. All the points to the left of 2 are shaded. The bracket at 2 indicates that 2 is part of the graph. We have $\{x \mid x \le 2\}$, or $(-\infty, 2]$.
- 36. All the points to the right of -2 are shaded. The bracket at -2 indicates that -2 is part of the graph. We have $\{x \mid x \ge -2\}$, or $[-2, \infty)$.
- 37. All the points to the left of -1 are shaded. The parenthesis at -1 indicates that -1 is not part of the graph. We have $\{x \mid x < -1\}$, or $(-\infty, -1)$.
- 38. All the points to the right of 1 are shaded. The parenthesis at 1 indicates that 1 is not part of the graph. We have $\{x \mid x > 1\}$, or $(1,\infty)$.

- 39. All the points to the right of 0 are shaded. The bracket at 0 indicates that 0 is part of the graph. We have $\{x \mid x \ge 0\}$, or $[0,\infty)$.
- 40. All the points to the left of 0 are shaded. The bracket at 0 indicates that 0 is part of the graph. We have $\{x \mid x \le 0\}$, or $(-\infty, 0]$.
- 41. y+2>9 y+2-2>9-2 Adding -2 to both sides y>7 Simplifying The solution set is $\{y \mid y>7\}$, or $(7,\infty)$. The graph is as follows:

$$\leftarrow + \qquad (\longrightarrow)$$

42. y + 6 > 9

$$y+6-6>9-6$$
 Adding -6 to both sides
 $y>3$ Simplifying
The solution set is $\{y \mid y>3\}$, or $(3,\infty)$.

The graph is as follows:

43. $x-8 \le -10$ $x-8+8 \le -10+8$ Adding 8 to both sides $x \le -2$ Simplifying The solution set is $\{x \mid x \le -2\}$, or $(-\infty, -2]$. The graph is as follows:

$$-2 \quad 0$$

44. $x-9 \le -12$ $x-9+9 \le -12+9$ Adding 9 to both sides $x \le -3$ Simplifying The solution set is $\{x \mid x \le -3\}$, or $(-\infty, -3]$. The graph is as follows:

45. $5 \le t+8$ $5-8 \le t+8-8$ Adding -8 to both sides $-3 \le t$ Simplifying The solution set is $\{t \mid -3 \le t\}$, or $\{t \mid t \ge -3\}$, or $[-3,\infty)$. The graph is as follows:

$$\leftarrow 1 \longrightarrow 0$$

46. $4 \le t+9$ $4-9 \le t+9-9$ Adding -9 to both sides $-5 \le t$ Simplifying

The solution set is $\{t \mid -5 \le t\}$, or

 $\{t \mid t \ge -5\}$, or $[-5,\infty)$. The graph is as follows:

$$\leftarrow \underbrace{\mathsf{I}}_{-5} + \longrightarrow 0$$

47. $2x + 4 \le x + 9$

 $2x+4-4 \le x+9-4 \quad \begin{array}{l} \text{Adding } -4 \text{ to both} \\ \text{sides} \end{array}$ $2x \le x+5 \quad \text{Simplifying} \\ 2x-x \le x+5-x \quad \text{Adding } -x \\ x \le 5 \quad \text{Simplifying} \end{array}$ The solution set is $\{x \mid x \le 5\}$, or $(-\infty, 5]$.

The graph is as follows:

$$\underbrace{\longleftrightarrow}_{5}$$

48. $2x+4 \le x+1$ $2x+4-4 \le x+1-4$ Adding -4 to both sides $2x \le x-3$ Simplifying $2x-x \le x-3-x$ Adding -x $x \le -3$ Simplifying The solution set is $\{x \mid x \le -3\}$, or $(-\infty, -3]$.

The graph is as follows:

$$\xrightarrow{-3}$$

49.
$$y + \frac{1}{3} \le \frac{5}{6}$$

 $y + \frac{1}{3} - \frac{1}{3} \le \frac{5}{6} - \frac{1}{3}$
 $y \le \frac{5}{6} - \frac{2}{6}$
 $y \le \frac{3}{6}$
 $y \le \frac{1}{2}$
The solution set is $\left\{ y \mid y \le \frac{1}{2} \right\}$, or $\left(-\infty, \frac{1}{2} \right]$.

50.
$$x + \frac{1}{4} \le \frac{1}{2}$$
$$x + \frac{1}{4} - \frac{1}{4} \le \frac{1}{2} - \frac{1}{4}$$
$$x \le \frac{1}{4}$$
The solution set is $\left\{ x \mid x \le \frac{1}{4} \right\}$, or $\left(-\infty, \frac{1}{4} \right]$.

51.
$$t - \frac{1}{8} > \frac{1}{2}$$

$$t - \frac{1}{8} + \frac{1}{8} > \frac{1}{2} + \frac{1}{8}$$

$$t > \frac{4}{8} + \frac{1}{8}$$

$$t > \frac{5}{8}$$

The solution set is $\left\{ t \left| t > \frac{5}{8} \right\}, \text{ or } \left(\frac{5}{8}, \infty \right).$

52.
$$y - \frac{1}{3} > \frac{1}{4}$$

 $y - \frac{1}{3} + \frac{1}{3} > \frac{1}{4} + \frac{1}{3}$
 $y > \frac{3}{12} + \frac{4}{12}$
 $y > \frac{7}{12}$
The solution set is $\left\{ y \mid y > \frac{7}{12} \right\}$, or $\left(\frac{7}{12}, \infty\right)$

- 53. -9x + 17 > 17 8x-9x + 17 17 > 17 8x 17-9x > -8x-9x + 9x > -8x + 9x0 > xThe solution set is $\{x \mid 0 > x\}$, or $\{x \mid x < 0\}$, or $(-\infty, 0)$.
- 54. -8n + 12 > 12 7n -8n > -7n 0 > nThe solution set is $\{n \mid n < 0\}$, or $(-\infty, 0)$.
- 55. -23 < -t

The inequality states that the opposite of 23 is less than the opposite of t. Thus, t must be less than 23, so the solution set is $\{t \mid t < 23\}$.

To solve this inequality using the addition principle, we would proceed as follows: -23 < -t

$$-23 < -t$$

$$-23 + t < -t + t$$

$$-23 + t < 0$$

$$-23 + t + 23 < 0 + 23$$

$$t < 23$$

The solution set is $\{t \mid t < 23\}$, or $(-\infty, 23)$.

56.

```
19 < -x

19 + x < -x + x

19 + x < 0

19 + x - 19 < 0 - 19

x < -19

The solution set is

\{x \mid x < -19\}, \text{ or } (-\infty, -19).
```

57.
$$5x < 35$$

 $\frac{1}{5} \cdot 5x < \frac{1}{5} \cdot 35$ Multiplying by $\frac{1}{5}$
 $x < 7$

The solution set is $\{x \mid x < 7\}$, or $(-\infty, 7)$. The graph is as follows:

$$\begin{array}{c} & & \\ & & \\ 0 & 7 \end{array}$$

 $\frac{1}{8} \cdot 8x \ge \frac{1}{8} \cdot 32 \qquad \text{Multiplying by } \frac{1}{8}$ $x \ge 4$ The solution set is $\{x \mid x \ge 4\}$, or $[4, \infty)$. The graph is as follows: $\underbrace{\longleftarrow}_{0} \quad \underbrace{4}$ 59. -24 > 8t $\frac{1}{8} \cdot (-24) > \frac{1}{8} \cdot 8t \quad \text{Multiplying by } \frac{1}{8}$ $-3 > t \quad \text{Simplifying}$ The solution set is $\{t \mid -3 > t\}$, or $\{t \mid t < -3\}$, or $(-\infty, -3)$. The graph is as follows: $\underbrace{\longleftarrow}_{-3} \quad \underbrace{\longleftarrow}_{-3} \quad \underbrace{-3}_{0} \quad \underbrace{\longleftarrow}_{-3} \quad \underbrace{-3}_{0} \quad \underbrace{\longleftarrow}_{-3} \quad \underbrace{-3}_{0} \quad \underbrace{-3$

 $8x \ge 32$

58.

60.
$$-16x < -64$$

 $-\frac{1}{16} \cdot (-16x) < -\frac{1}{16} (-64)$ Multiplying by $-\frac{1}{16}$ \uparrow The symbol has to be reversed. x > 4Simplifying

The solution set is $\{x \mid x > 4\}$, or $(4, \infty)$. The graph is as follows:

$$\begin{array}{c|c} \leftarrow & \bullet \\ \hline & 0 & 4 \end{array}$$

61.
$$1.8 \ge -1.2n$$

 $\frac{1.8}{-1.2} \le \frac{-1.2n}{-1.2}$ Dividing by -1.2
The symbol has to be reversed

 $-1.5 \le n$ The solution set is $\{n \mid n \ge -1.5\}$, or $\begin{bmatrix} 1.5 \\ \infty \end{bmatrix}$

$$(-1.5,\infty)$$
.
 \leftarrow $(-1.5,\infty)$.

62.
$$9 \le -2.5a$$

 $\frac{9}{-2.5} \ge \frac{-2.5a}{-2.5}$ Dividing by -2.5
The symbol has to be
reversed
 $-3.6 \ge a$
The solution set is $\{a | a \le -3.6\}$, or
 $(-\infty, -3.6]$.
 $\overleftarrow{-3.6 \ 0}$
63. $-2y \le \frac{1}{5}$
 $-\frac{1}{2} \cdot (-2y) \ge -\frac{1}{2} \cdot \frac{1}{5}$ Multiplying by $-\frac{1}{2}$
The symbol has to be
reversed
 $y \ge -\frac{1}{10}$
The solution set is $\{y | y \ge -\frac{1}{10}\}$, or
 $\left[-\frac{1}{10}, \infty\right]$.
64. $-2x \ge \frac{1}{5}$
 $-\frac{1}{2} \cdot (-2x) \le -\frac{1}{2} \cdot \frac{1}{5}$ Multiplying by $-\frac{1}{2}$
The symbol has to be
 $x \le -\frac{1}{10}$
The solution set is $\{x | x \le -\frac{1}{10}\}$, or
 $\left(-\infty, -\frac{1}{10}\right]$.

65.
$$-\frac{8}{5} > -2x$$

$$-\frac{1}{2} \cdot \left(-\frac{8}{5}\right) < -\frac{1}{2} \cdot (-2x) \quad \text{Multiplying by } -\frac{1}{2}$$

$$\uparrow \qquad \text{The symbol has to} \qquad \text{be reversed.}$$

$$\frac{8}{10} < x$$

$$\frac{4}{5} < x, \text{ or } x > \frac{4}{5}$$

$$\text{The solution set is } \left\{x \left|\frac{4}{5} < x\right.\right\}, \text{ or } \left\{x \left|x > \frac{4}{5}\right.\right\}, \text{ or } \left(\frac{4}{5}, \infty\right).$$
66.
$$-\frac{5}{8} < -10y$$

$$-\frac{1}{10} \left(-\frac{5}{8}\right) > -\frac{1}{10} \cdot (-10y) \quad \text{Multiplying by}$$

$$\uparrow \qquad -\frac{1}{10} \text{ and reversing the symbol}$$

$$\frac{5}{80} > y$$

$$\frac{1}{16} > y$$

$$\text{The solution set is } \left\{y \left|y < \frac{1}{16}\right.\right], \text{ or } \left(-\infty, \frac{1}{16}\right).$$
67.
$$7 + 3x < 34$$

$$7 + 3x - 7 < 34 - 7 \quad \text{Adding } -7$$

$$3x < 27 \quad \text{Simplifying}$$

$$x < 9 \quad \text{by } \frac{1}{3}$$

$$\text{The solution set is } \left\{x \mid x < 9\right\}, \text{ or } (-\infty, 9).$$
68.
$$5 + 4y < 37$$

$$5 + 4y - 5 < 37 - 5 \quad \text{Adding } -5$$

$$4y < 32 \quad \text{Simplifying}$$

$$Multiplying both sides$$

$$y < 8 \quad \text{by } \frac{1}{4}$$

$$\text{The solution set is } \left\{y \mid y < 8\right\}, \text{ or } (-\infty, 8).$$

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69.	$4t - 5 \le 23$	
	$4t - 5 + 5 \le 23 + 5$	Adding 5
	$4t \le 28$	Simplifying
	<i>t</i> ≤ 7	Multiplying both sides by $\frac{1}{4}$
	The solution set is	$\{t \mid t \le 7\}$, or $(-\infty, 7]$.

70. 13x - 7 < -46 13x - 7 + 7 < -46 + 7Adding 7 13x < -39Simplifying x < -3Multiplying both
sides by $\frac{1}{13}$

The solution set is $\{x \mid x < -3\}$, or $(-\infty, -3)$.

71. 16 < 4 - a 16 - 4 < 4 - a - 4 Adding -4 12 < -a Simplifying -12 > a Multiplying both sides by -1 and reversing the inequality symbol

The solution set is $\{a \mid -12 > a\}$, or $\{a \mid a < -12\}$, or $(-\infty, -12)$.

72. 22 < 6 - n 22 - 6 < 6 - n - 6 Adding - 6 16 < -n Simplifying -16 > n Multiplying both sides by -1 and reversing the inequality symbol

The solution set is $\{n \mid -16 > n\}$, or

$$\{n \mid n < -16\}$$
, or $(-\infty, -16)$.

73.
$$5-7y \ge 5$$

 $5-7y-5 \ge 5-5$ Subtracting 5
 $-7y \ge 0$ Simplifying
Multiplying both sides
 $y \le 0$ by $-\frac{1}{7}$ and reversing
the inequality symbol

The solution set is $\{y \mid y \le 0\}$, or $(-\infty, 0]$.

74. $8 - 2y \ge 14$ $8 - 2y - 8 \ge 14 - 8$ Adding -8 $-2y \ge 6$ Simplifying Multiplying both sides by $-\frac{1}{2}$ and reversing $y \leq -3$ the inequality symbol The solution set is $\{y \mid y \le -3\}$, or $(-\infty, -3]$. 75. -3 < 8x + 7 - 7x-3 < x + 7Simplifying -3 - 7 < x + 7 - 7Adding -7-10 < xSimplifying The solution set is $\{x \mid -10 < x\}$, or $\{x \mid x > -10\}$, or $(-10, \infty)$. -5 < 9x + 8 - 8x76. -5 < x + 8Simplifying -5 - 8 < x + 8 - 8Adding -8 -13 < xSimplifying The solution set is $\{x \mid -13 < x\}$, or $\{x \mid x > -13\}$, or $(-13, \infty)$. 6 - 4y > 4 - 3y77. 6 - 4y - 4 > 4 - 3y - 4 Adding -4 -4y + 2 > -3ySimplifying -4y + 2 + 4y > -3y + 4y Adding 4y 2 > vSimplifying The solution set is $\{y \mid 2 > y\}$, or $\{y \mid y < 2\}$, or $(-\infty, 2)$. 78. 7 - 8v > 5 - 7v7 - 8y - 5 > 5 - 7y - 5 Adding -52 - 8y > -7ySimplifying 2 - 8y + 8y > -7y + 8yAdding 8y 2 > vSimplifying The solution set is $\{y \mid 2 > y\}$, or

 $\{y \mid y < 2\}$, or $(-\infty, 2)$.

79. $7 - 9y \le 4 - 8y$ $7 - 9y - 4 \le 4 - 8y - 4 \quad \text{Adding } -4$ $3 - 9y \le -8y \quad \text{Simplifying}$ $3 - 9y + 9y \le -8y + 9y \quad \text{Adding } 9y$ $3 \le y \quad \text{Simplifying}$ The solution set is $\{y \mid 3 \le y\}$, or $\{y \mid y \ge 3\}$, or $[3,\infty)$.

80.
$$6-13y \le 4-12y$$

$$6-13y+12y \le 4-12y+12y$$
 Adding 12y

$$6-y \le 4$$
 Simplifying

$$6-y-6 \le 4-6$$
 Subtracting 6

$$-y \le -2$$
 Simplifying
Multiplying both
sides by -1 and
reversing the
inequality symbol

The solution set is $\{y | y \ge 2\}$, or $[2, \infty)$.

81.
$$2.1x + 43.2 > 1.2 - 8.4x$$

 $2.1x + 43.2 - 43.2 > 1.2 - 8.4x - 43.2$ Adding - 43.2
 $2.1x > -8.4x - 42$ Simplifying
 $2.1x + 8.4x > -8.4x - 42 + 8.4x$ Adding 8.4x
 $10.5x > -42$ Simplifying
 $x > -4$ by $\frac{1}{10.5}$
The solution set is $\{x | x > -4\}$, or $(-4, \infty)$.

$$\begin{array}{ll} 82. & 0.96 \ y - 0.79 \le 0.21 \ y + 0.46 \\ 0.96 \ y - 0.79 + 0.79 \le 0.21 \ y + 0.46 + 0.79 & \text{Adding } 0.79 \\ & 0.96 \ y \le 0.21 \ y + 1.25 & \text{Simplifying} \\ 0.96 \ y - 0.21 \ y \le 0.21 \ y + 1.25 - 0.21 \ y & \text{Adding } - 0.21 \ y \\ & 0.75 \ y \le 1.25 & \text{Simplifying} \\ & y \le \frac{1.25}{0.75} & \text{by } \frac{1}{0.75} \\ & y \le \frac{5}{3} & \text{Simplifying} \\ & \text{The solution set is } \left\{ y \ y \le \frac{5}{3} \right\}, \text{ or } \left(-\infty, \frac{5}{3} \right]. \end{array}$$

 83. $0.7n - 15 + n \ge 2n - 8 - 0.4n$
 $1.7n - 15 \ge 1.6n - 8$ Simplifying

 $1.7n - 15 - 1.6n \ge 1.6n - 8 - 1.6n$ Adding -1.6n

 $0.1n - 15 \ge -8$ Simplifying

 $0.1n - 15 \ge -8 + 15$ Adding 15

 $0.1n \ge 7$ Simplifying

 $n \ge 70$ Multiplying

 $by \frac{1}{0.1}$

The solution set is $\{n \mid n \ge 70\}$, or $[70, \infty)$.

84. 1.7t + 8 - 1.62t < 0.4t - 0.32 + 80.08t + 8 < 0.4t + 7.68Simplifying 0.08t + 8 - 7.68 < 0.4t + 7.68 - 7.68Adding-7.68 0.08t + 0.32 < 0.4tSimplifying 0.08t + 0.32 - 0.08t < 0.4t - 0.08tAdding -0.08t 0.32 < 0.32tSimplifying Multiplying $by + \frac{1}{0.32}$ 1 < tThe solution set is $\{t \mid 1 < t\}$, or $\{t \mid t > 1\}$, or $(1,\infty)$.

85.
$$\frac{x}{3} - 4 \le 1$$

$$\frac{x}{3} - 4 + 4 \le 1 + 4 \quad \text{Adding 4}$$

$$\frac{x}{3} \le 5 \quad \text{Simplifying}$$

$$3\left(\frac{x}{3}\right) \le 3 \cdot 5 \quad \text{Multiplying by 3}$$

$$x \le 15 \quad \text{Simplifying}$$

The solution set is $\{x \mid x \le 15\}$, or $(-\infty, 15]$.

86.
$$\frac{2}{3} - \frac{x}{5} < \frac{4}{15}$$

$$15\left(\frac{2}{3} - \frac{x}{5}\right) < 15\left(\frac{4}{15}\right)$$
Multiplying by 15
$$10 - 3x < 4$$
Simplifying
$$10 - 3x - 10 < 4 - 10$$
Adding - 10
$$-3x < -6$$
Simplifying
$$\left(-\frac{1}{3}\right)(-3x) < \left(-\frac{1}{3}\right)(-6)$$
Multiplying by
$$-\frac{1}{3}$$
and reversing
the inequality symbol

x > 2

The solution set is $\{x \mid x > 2\}$, or $(2, \infty)$.

87.
$$3 < 5 - \frac{t}{7}$$

$$7 \cdot 3 < 7\left(5 - \frac{t}{7}\right)$$

Multiplying by 7

$$21 < 35 - t$$

Simplifying

$$21 - 21 < 35 - t - 21$$

Adding - 21

$$0 < 14 - t$$

Simplifying

$$0 + t < 14 - t + t$$

Adding t

$$t < 14$$

Simplifying
The solution set is $\{t \mid t < 14\}$ or $(-\infty, 14)$.

88. $2 > 9 - \frac{x}{5}$ $5 \cdot 2 > 5\left(9 - \frac{x}{5}\right)$ Multiplying by 5 10 > 45 - xSimplifying 10 - 10 > 45 - x - 10Adding -10 0 > 35 - xSimplifying 0 + x > 35 - x + xAdding x x > 35Simplifying The solution set is $\{x \mid x > 35\}$, or $(35, \infty)$.

89.
$$4(2y-3) \le -44$$

$$8y-12 \le -44$$
 Distributive Law

$$8y-12+12 \le -44+12$$
 Adding 12

$$8y \le -32$$
 Simplifying

$$y \le -4$$
 Multiplying by $\frac{1}{8}$
The solution set is $\{y \mid y \le -4\}$, or $(-\infty, -4]$.

90. $3(2y-3) \ge 21$ $6y - 9 \ge 21$ Distributive Law $6y - 9 + 9 \ge 21 + 9 \quad \text{Adding } 9$ $6y \ge 30$ Simplifying Multiplying by $\frac{1}{6}$ $y \ge 5$ The solution set is $\{y \mid y \ge 5\}$, or $[5,\infty)$. 91. $3(t-2) \ge 9(t+2)$ $3t - 6 \ge 9t + 18$ Distributive Law $3t - 6 + 6 \ge 9t + 18 + 6$ Adding 6 $3t \ge 9t + 24$ Simplifying $3t - 9t \ge 9t + 24 - 9t$ Adding -9t $-6t \ge 24$ Simplifying Multiplying by $-\frac{1}{6}$ and reversing the inequality symbol $t \leq -4$

The solution set is $\{t \mid t \le -4\}$, or $(-\infty, -4]$.

92.
$$8(2t+1) > 4(7t+7)$$

 $16t+8 > 28t+28$ Distributive Law
 $16t+8-28 > 28t+28-28$ Adding -28
 $16t-20 > 28t$ Simplifying
 $16t-20-16t > 28t-16t$ Adding -16t
 $-20 > 12t$ Simplifying
 $-\frac{20}{12} > t$ Multiplying by $\frac{1}{12}$
 $-\frac{5}{3} > t$ Simplifying
The solution set is $\left\{t \left| -\frac{5}{3} > t\right\}$, or
 $\left\{t \left| t < -\frac{5}{3} \right\}$, or $\left(-\infty, -\frac{5}{3}\right)$.

93.
$$3(r-6)+2 < 4(r+2)-21$$

 $3r-18+2 < 4r+8-21$ Distributive Law
 $3r-16 < 4r-13$ Simplifying
 $3r-16+13 < 4r-13+13$ Adding 13
 $3r-3 < 4r$ Simplifying
 $3r-3-3r < 4r-3r$ Adding $-3r$
 $-3 < r$ Simplifying

The solution set is $\{r \mid -3 < r\}$, or $\{r \mid r > -3\}$, or $(-3, \infty)$.

94.
$$5(t+3)+9 > 3(t-2)+6$$

$$5t+15+9 > 3t-6+6$$
 Distributive Law

$$5t+24 > 3t$$
 Simplifying

$$5t+24-24 > 3t-24$$
 Adding -24

$$5t > 3t-24$$
 Simplifying

$$5t-3t > 3t-24-3t$$
 Adding -3t

$$2t > -24$$
 Simplifying

$$t > -12$$
 Multiplying by $\frac{1}{2}$

The solution set is $\{t \mid t > -12\}$, or $(-12, \infty)$.

95.
$$\frac{2}{3}(2x-1) \ge 10$$
$$\frac{3}{2}\left[\frac{2}{3}(2x-1)\right] \ge \frac{3}{2} \cdot 10$$
 Multiplying by $\frac{3}{2}$
$$2x-1 \ge 15$$
 Simplifying
$$2x-1+1 \ge 15+1$$
 Adding 1
$$2x \ge 16$$
 Simplifying
$$x \ge 8$$
 Multiplying by $\frac{1}{2}$ The solution set is $\{x \mid x \ge 8\}$, or $[8, \infty)$.

96.
$$\frac{4}{5}(3x+4) \le 20$$

$$\frac{5}{4}\left[\frac{4}{5}(3x+4)\right] \le \frac{5}{4} \cdot 20$$
Multiplying by $\frac{5}{4}$

$$3x+4 \le 25$$
Simplifying
$$3x+4-4 \le 25-4$$
Adding -4
$$3x \le 21$$
Simplifying
$$x \le 7$$
Multiplying by $\frac{1}{3}$
The solution set is $\{x \mid x \le 7\}$, or $(-\infty, 7]$.

97.
$$\frac{3}{4}(3x-\frac{1}{2})-\frac{2}{3}<\frac{1}{3}$$

 $12\left[\frac{3}{4}(3x-\frac{1}{2})-\frac{2}{3}\right]<12\cdot\frac{1}{3}$ Multiplying by 12
 $9(3x-\frac{1}{2})-8<4$ Simplifying
 $27x-4.5-8<4$ Distributive Law
 $27x-12.5<4$ Simplifying
 $27x-12.5+12.5<4+12.5$ Adding 12.5

$$27x < 16.5 \quad \text{Simplifying}$$

$$270x < 165 \quad \text{Multiplying by 10}$$

$$x < \frac{165}{270} \quad \text{Multiplying by } \frac{1}{270}$$

$$x < \frac{11}{18} \quad \text{Simplifying}$$
The solution set is $\left\{ x \middle| x < \frac{11}{18} \right\}$, or $\left(-\infty, \frac{11}{18} \right)$.

98.
$$\frac{2}{3}\left(\frac{7}{8}-4x\right)-\frac{5}{8}<\frac{3}{8}$$

$$24\left[\frac{2}{3}\left(\frac{7}{8}-4x\right)-\frac{5}{8}\right]<24\cdot\frac{3}{8}$$
 Multiplying by 24
$$16\left(\frac{7}{8}-4x\right)-15<9$$
 Distributive Law
$$14-64x-15<9$$
 Distributive Law
$$-64x-1<9$$
 Simplifying
$$-64x-1+1<9+1$$
 Adding 1
$$-64x<10$$
 Simplifying
$$x>-\frac{10}{64}$$
 Multiplying by $-\frac{1}{64}$
and reversing the inequality
symbol
$$x>-\frac{5}{32}$$
 Simplifying
The solution set is $\left\{x\left|x>-\frac{5}{32}\right\}$, or
$$\left(-\frac{5}{32},\infty\right)$$
.

- 99. Thinking and Writing Exercise. No, because the inequality x > -3 also includes all x-values greater than -3 that are less than -2.
- 100. *Thinking and Writing Exercise.* The solution set of the first inequality is $\{t \mid t > -7\}$ and the solution set of the second inequality is $\{t \mid t < -7\}$. Since the inequalities have different solution sets, they are not equivalent.

101. 4-x = 8-5x4-x-4 = 8-5x-4Subtracting 4-x = 4-5xSimplifying-x+5x = 4-5x+5xAdding 5x4x = 4Simplifyingx = 1Multiplying by $\frac{1}{4}$

The solution is x = 1.

102. 4-x > 8-5x 4-x-4 > 8-5x-4Adding -4 -x > 4-5xSimplifying -x+5x > 4-5x+5xAdding 5x 4x > 4Simplifying x > 1Multiplying by $\frac{1}{4}$

The solution set is $\{x \mid x > 1\}$, or $(1, \infty)$.

103.
$$2(5-x) = \frac{1}{2}(x+1)$$

$$2[2(5-x)] = 2[\frac{1}{2}(x+1)]$$
 Multiplying by 2

$$4(5-x) = x+1$$
 Simplifying

$$20-4x = x+1$$
 Distributive Law

$$20-4x-1 = x+1-1$$
 Adding -1

$$19-4x = x$$
 Simplifying

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

$$19 = 5x$$
 Simplifying

$$\frac{19}{5} = x$$
 Multiplying by $\frac{1}{5}$
The solution is $x = \frac{19}{5}$.

104. $2(5-x) \leq \frac{1}{2}(x+1)$ $2\left\lceil 2(5-x) \right\rceil \le 2\left\lceil \frac{1}{2}(x+1) \right\rceil$ Multiplying by 2 $4(5-x) \le x+1$ Simplifying $20 - 4x \le x + 1$ Distributive Law $20 - 4x - 1 \le x + 1 - 1$ Adding -1 $19 - 4x \le x$ Simplifying $19 - 4x + 4x \le x + 4x$ Adding 4x $19 \le 5x$ Simplifying $\frac{19}{5} \le x$ Multiplying by $\frac{1}{5}$ The solution set is $\left\{ x \mid x \ge \frac{19}{5} \right\}$, or $\left[\frac{19}{5}, \infty \right]$.

- 105. *Thinking and Writing Exercise.* The graph of an inequality of the form $a \le x \le a$ consists of just one number, *a*.
- 106. Thinking and Writing Exercise. 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, but 12 is to the right of -20. That is, -3 < 5, but -3(-4) > 5(-4).
- 107. One more than some number x, or x + 1 is always going to be larger than x for any x, so the solution set is $\{x \mid x \text{ is a real number}\}$, or

 $(-\infty,\infty)$. We could have also solved this inequality as follows: x < x+1

x - x < x + 1 - x Adding -x0 < 1 Simplifying

Since 0 < 1 is a true statement, *x* can be any real number.

108. $6 \lceil 4 - 2(6+3t) \rceil > 5 \lceil 3(7-t) - 4(8+2t) \rceil - 20$ 6[4-12-6t] > 5[21-3t-32-8t] - 20 Distributive Law 6[-8-6t] > 5[-11-11t] - 20Simplifying -48 - 36t > -55 - 55t - 20Distributive Law -48 - 36t + 48 > -75 - 55t + 48Adding 48 -36t > -27 - 55tSimplifying -36t + 55t > -27 - 55t + 55tAdding 55t 19t > -27Simplifying $t > -\frac{27}{10}$ Multiplying by $\frac{1}{10}$ The solution set is $\left\{ t \mid t > -\frac{27}{19} \right\}$, or $\left(-\frac{27}{9}, \infty \right)$. 109. $27 - 4 \left\lceil 2(4x - 3) + 7 \right\rceil \ge 2 \left\lceil 4 - 2(3 - x) \right\rceil - 3$ $27 - 4[8x - 6 + 7] \ge 2[4 - 6 + 2x] - 3$ Distributive Law $27 - 4(8x + 1) \ge 2(-2 + 2x) - 3$ Simplifying $27 - 32x - 4 \ge -4 + 4x - 3$ Distributive Law $23 - 32x \ge -7 + 4x$ Simplifying $23 - 32x - 23 \ge -7 + 4x - 23$ Adding - 23 $-32x \ge -30 + 4x$ Simplifying $-32x - 4x \ge -30 + 4x - 4x$ Adding -4x $-36x \ge -30$ Simplifying $x \leq \frac{30}{36}$ Multiplying by $-\frac{1}{36}$ and reversing the inequality symbol $x \leq \frac{5}{\epsilon}$ Simplifying The solution set is $\left\{ x \mid x \leq \frac{5}{6} \right\}$, or $\left(-\infty, \frac{5}{6} \right)$. 110. $-(x+5) \ge 4a-5$ 112. y < ax + bv-b < ax+b-b Adding -b $-x-5 \ge 4a-5$ Distributive Law y - b < ax Simplifying $-x-5+5 \ge 4a-5+5 \quad \text{Adding 5}$ $\frac{y-b}{a} < x$ Multiplying by $\frac{1}{a}$ $-x \ge 4a$ Simplifying $x \leq -4a$ Multiplying by -1The solution set is $\left\{ x \left| \frac{y-b}{a} < x \right\} \right\}$, or The solution set is $\{x \mid x \leq -4a\}$, or $(-\infty, -4a)$. $\left\{x \mid x > \frac{y-b}{a}\right\}$, or $\left(\frac{y-b}{a}, \infty\right)$. 111. $\frac{1}{2}(2x+2b) > \frac{1}{3}(21+3b)$ x + b > 7 + bDistributive Law x+b-b > 7+b-b Subtracting b x > 7Simplifying The solution set is $\{x \mid x > 7\}$, or $(7, \infty)$.

113. y < ax + b y - b < ax + b - b Adding -b y - b < ax Simplifying $\frac{y - b}{a} > x$ Multiplying by $\frac{1}{a}$ The solution set is $\left\{ x \left| \frac{y - b}{a} > x \right\} \right\}$, or $\left\{ x \left| x < \frac{y - b}{a} \right\} \right\}$, or $\left(-\infty, \frac{y - b}{a} \right)$.

114. |x| < 3

This inequality says that the distance from x to the origin is less than 3 units. So the solution set is $\{x \mid -3 < x < 3\}$, or (-3,3).

$$\leftarrow (-3) \rightarrow 3$$

115. |x| > -3

The absolute value of any real number is greater than or equal to 0, so the solution set is $\{x \mid x \text{ is a real number}\}$, or $(-\infty, \infty)$.

116. |x| < 0

The absolute value of any real number is greater than or equal to 0, so the solution set is \emptyset .

- Exercise Set 2.7
- 1. $b \leq a$
- 2. b < a
- 3. $a \leq b$
- 4. a < b
- 5. $b \leq a$
- 6. $a \leq b$
- 7. b < a
- 8. a < b
- 9. Let *n* represent the number. Then we have n < 10.

- 10. Let *n* represent the number. Then we have $n \ge 4$.
- 11. Let *t* represent the temperature. Then we have $t \le -3$.
- 12. Let *d* represent the average credit-card debt. Then we have $d \ge 2000$.
- 13. Let *a* represent the age of the Mayan altar. Then we have a > 1200.
- 14. Let *t* represent the time of the test. Then we have 45 < t < 55.
- 15. Let *f* represent the duration of a focus group session. Then we have $f \le 2$.
- 16. Let *h* represent Angenita's hourly wage. Then $h \ge 12$.
- 17. Let *s* represent the number of hours of direct sunlight. Then we have $s \ge 6$.
- 18. Let *f* represent the amount of exposure to formaldehyde. Then we have $f \le 2$.
- 19. Let *c* represent the cost of production. Then we have $c \le 12,500$.
- 20. Let *c* represent the cost of gasoline. Then we have $c \le 4$.
- Familiarize. Let h = the number of hours RJ worked. The cost of an emergency call is \$55 plus \$40 times the number of hours, or \$40h. Translate.

Emergency fee	plus	hourly fee	is more than	\$100.
\downarrow	\downarrow	\downarrow	\downarrow	\downarrow
55	+	40 <i>h</i>	>	100

Carry out. We solve the inequality.

$$55 + 40h > 100$$

$$h > \frac{9}{8}$$
 or 1.125

Check. As a partial check, we can determine how much the bill would have been if the plumber had worked 1 hour. The bill would have been \$55 + \$40(1) = \$95. From this

calculation, it would appear that h > 1.125 is correct.

State. The plumber worked more than 1.125 hours.

22. Familiarize. Let c = the number of courses Ayesha can take. Her total tuition is the \$95 registration fee plus \$675 times the number of courses for which she registers, or \$675c.

Translate.

Registration fee	plus	fee for courses	cannot exceed	\$2500.
		$\underbrace{}_{}$	\frown	
Ţ		Ļ		

 $95 + 675c \leq 2500$

Carry out. We solve the inequality. $95+675c \le 2500$

 $675c \le 2405$

$c \le 3.5630$

Check. Although the solution set of the inequality is all numbers less than or equal to 3.5630, since *c* represents the number of courses for which Ayesha registers, we round down to 3. If she registers for 3 courses, her tuition is $95 + 675 \cdot 3$, or 2120, which does not exceed 2500. If she registers for 4 courses, her tuition is $95 + 675 \cdot 4$, or 2795, which exceeds 2500. *State.* Ayesha can register for at most 3 courses.

 Familiarize. Let n = Chloe's grade point average. An unconditional acceptance is given to students whose GMAT score plus 200 times the undergraduate grade point average is at least 1020. Translate.

> GMAT plus 200 times the at least 1020 score undergrad GPA \downarrow \downarrow \downarrow \downarrow 500 + 200n \geq 1020 Carry out. We solve the inequality. $500 + 200n \ge 1020$ $200n \ge 520$ $n \ge 2.6$

Check. As a partial check, we can determine the score for a grade point average of 2.5. 500 + 200(2.5) = 500 + 500 = 1000. 1000 is less than the 1020 score required, so it appears that $n \ge 2.6$ is correct. *State.* Chloe must earn at least a 2.6 grade point average to gain an unconditional acceptance into the Master of Business Administration (MBA) program at Arkansas State University.

24. *Familiarize.* Let c =Oliver's monthly car payment. Debt payment should be less than 8% of a consumer's monthly gross income. Oliver makes \$54,000 per year or 54,000 \div 12 = 4500 per month.

Translate.

student- loan pay	plus	car payment	less than	8% of monthly gross income
↓ 100	\downarrow_+	\downarrow	\downarrow	\downarrow 0.08(4500)
Carr	y out.	We solv	e the ineq	uality.
		100 + c < 0	0.08(4500)
		100 + c < 100	360	

c < 260

Check. As a partial check, we can find the monthly debt payment and divide it by 8% to find the monthly income. 100 + 260 = \$360, and $360 \div 0.08 = 4500$. Because 4500 times 12 is 54,000, the monthly car payment of c < 260 is correct.

State. Oliver's monthly car payment must be less than \$260.

25. *Familiarize.* The average of the five scores is their sum divided by the number of quizzes,5. We let *s* represent Rod's score on the last quiz.

Translate.

The average of the four scores is given by 73 + 75 + 89 + 91 + s

$$\frac{3+75+89+91+s}{5}$$

Since this average must be at least 85, this means that it must be greater than or equal to 85. Thus, we can translate the problem to the inequality

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

Carry out. We first multiply by 5 to clear the fraction.

$$5\left(\frac{73+75+89+91+s}{5}\right) \ge 5 \cdot 85$$

73+75+89+91+s \ge 425
328+s \ge 425
s \ge 97

Check. As a partial check, we show that Rod can get a score of 97 on the fourth test and have an average of at least 85:

$$\frac{73+75+89+91+97}{5} = \frac{425}{5} = 85$$

State. Scores of 97 and higher will earn Rod at least an 85.

26. *Familiarize*. The average of the seven days is their sum of their servings divided by the number of days, 7. We let *s* represent the number of servings on Saturday.

Translate.

The average of the 7 servings is given by

$$\frac{4+6+7+4+6+4+s}{7} \, .$$

Since this average must be at least 5, this means that it must be greater than or equal to 5. Thus, we can translate the problem to the inequality

$$\frac{4+6+7+4+6+4+s}{7} \ge 5 \ .$$

Carry out. We first multiply by 5 to clear the fraction.

$$7\left(\frac{4+6+7+4+6+4+s}{7}\right) \ge 7.5$$

$$4+6+7+4+6+4+s \ge 35$$

$$31+s \ge 35$$

$$s \ge 4$$

Check. As a partial check, we show that Dale can eat 4 servings of fruits or vegetables on Saturday and have an average of at least 5:

$$\frac{4+6+7+4+6+4+4}{7} = \frac{35}{7} = 5$$

State. Servings of 4 or more will result in an average of at least 5.

27. *Familiarize.* The average of the credits for the four quarters is their sum divided by the number of quarters, 4. We let *c* represent the number of credits for the fourth quarter. *Translate.*

The average of the credits for the four quarters is given by

$$\frac{5+7+8+c}{4}$$

Since this average must be at least 7, this means that it must be greater than or equal to 7. Thus, we can translate the problem to the inequality

$$\frac{5+7+8+c}{4} \ge 7$$

Carry out. We first multiply by 4 to clear the fraction.

$$4\left(\frac{5+7+8+c}{4}\right) \ge 4 \cdot 7$$
$$5+7+8+c \ge 28$$
$$20+c \ge 28$$
$$c \ge 8$$

Check. As a partial check, we show that Millie can complete 8 credits during the fourth quarter and have an average of at least 7 credits:

$$\frac{5+7+8+8}{4} = \frac{28}{4} = 7$$

State. Millie can average 7 credits per quarter per year if she takes 8 credits or more in the fourth quarter.

28. *Familiarize*. Let *m* represent the number of minutes Monroe practices on the seventh day.

Translate.

Average practice time

$$\downarrow$$
 is at least 20 min
 \downarrow \downarrow \downarrow \downarrow
 $\frac{15+28+30+0+15+25+m}{7} \ge 20$

Carry out. We solve the inequality. 15+28+30+0+15+25+m

$$\frac{15+28+30+0+15+25+m}{7} \ge 20$$

$$7\left(\frac{15+28+30+0+15+25+m}{7}\right) \ge 7 \cdot 20$$

$$15+28+30+0+15+25+m \ge 140$$

$$113+m \ge 140$$

$$m \ge 27$$

Check. As a partial check, we show that if Monroe practices 27 min on the seventh day he meets expectations.

$$\frac{15+28+30+0+15+25+27}{7} = \frac{140}{7} = 20$$

State. Monroe must practice 27 min or more on the seventh day in order to meet expectations.

29. *Familiarize.* Let *b* represent the plate appearances in the tenth game. The average plate appearances per game must be at least 3.1 to qualify for a batting title. *Translate.*

$$\underbrace{\text{Average plate appearances}}_{5+1+4+2+3+4+4+3+2+b} \underbrace{\stackrel{\text{is at }}{\underset{10}{\downarrow}} 3.1.}_{3.1}$$

Carry out. We solve the inequality.

$$\frac{5+1+4+2+3+4+4+3+2+b}{10} \ge 3.1$$

$$10\left(\frac{5+1+4+2+3+4+4+3+2+b}{10}\right) \ge 3.1$$

$$5+1+4+2+3+4+4+3+2+b \ge 31$$

$$28+b \ge 31$$

$$b \ge 3$$

Check. As a partial check, we show that if 3 plate appearances occur in the tenth game, $\frac{5+1+4+2+3+4+4+3+2+3}{10} = \frac{31}{10} = 3.1$

and the answer checks.

State. The player must have at least 3 plate appearances in the tenth game in order to qualify for a batting title.

30. *Familiarize.* Let *d* represent the Friday school day in hours. The standard school day is at least $5\frac{1}{2}$ hours.

Translate.

$$\underbrace{\frac{\text{Average school day}}{\underbrace{\frac{4+6\frac{1}{2}+3\frac{1}{2}+6\frac{1}{2}+d}{5}}}_{\text{5}} \underbrace{\frac{\text{is at}}{\downarrow}}_{\text{2}} \underbrace{5\frac{1}{2}}_{\frac{1}{2}} \text{hr}}_{\text{2}}$$

Carry out. We solve the inequality.

$$\frac{4+6\frac{1}{2}+3\frac{1}{2}+6\frac{1}{2}+d}{5} \ge 5\frac{1}{2}$$

$$5\left(\frac{4+6\frac{1}{2}+3\frac{1}{2}+6\frac{1}{2}+d}{5}\right) \ge 5\frac{1}{2}$$

$$4+6\frac{1}{2}+3\frac{1}{2}+6\frac{1}{2}+d \ge 25+\frac{5}{2}$$

$$20\frac{1}{2}+d \ge 27\frac{1}{2}$$

$$d \ge 7$$

Check. As a partial check, we show that if Friday is 7 hours (excluding meal breaks), $4+6\frac{1}{2}+3\frac{1}{2}+6\frac{1}{2}+7=27\frac{1}{2}$

then
$$\frac{4+6\frac{1}{2}+3\frac{1}{2}+6\frac{1}{2}+7}{5} = \frac{27\frac{1}{2}}{5} = 5\frac{1}{2}$$
, and

the answer checks.

State. The school day on Friday must be at least 7 hours.

31. We first make a drawing. Let b = the length of the base, in cm. The one side is b-2 and the other side is b+3.



Translate.

h

The perimeter is greater than 19 cm.

 \downarrow

19

b + (b-2) + (b+3)Carry out.

$$(b-2) + (b+3) > 19$$

 $(b+1) > 19$
 $(b+1) > 19$

Check. We check to see if the solution seems reasonable. If b = 5 cm, the perimeter is 5+(5-2)+(5+3), or 16 cm. If b = 6

cm, the perimeter is 6+(6-2)+(6+3), or

19 cm. If b = 7 cm, the perimeter is 7 + (7-2) + (7+3), or 22 cm.

State. If the base is greater than 6 cm, then the perimeter of the triangle will be greater than 19 cm.

32. *Familiarize.* We first make a drawing. Let w = the width, in feet. Then 2w = the length.



The perimeter is P = 2l + 2w= $2 \cdot 2w + 2w = 4w + 2w = 6w$.

Translate.

The perimeter cannot exceed 70 ft.

Ŷ		
\downarrow	\downarrow	\downarrow
6w	\leq	70

Carry out. We solve the inequality. $6w \le 70$

$$w \le \frac{35}{3}$$
, or $11\frac{2}{3}$

Check. As a partial check, we show that the perimeter is 70 ft when the width is $\frac{35}{3}$ ft and the length is $2 \cdot \frac{35}{3}$, or $\frac{70}{3}$ ft. $P = 2 \cdot \frac{70}{3} + 2 \cdot \frac{35}{3} = \frac{140}{3} + \frac{70}{3} = \frac{210}{3} = 70$ **State.** Widths less than or equal to $11\frac{2}{3}$ ft

will meet the given conditions.

33. *Familiarize.* Let d = the depth of the well. Under the "pay-as-you-go" plan, the charge is \$500 + \$8d. Under the "guaranteed-water" plan, the charge is \$4000.

Translate.

Pay-as-you -go plan	is less than	the guaranteed -water plan.
\downarrow 500+8d	\downarrow <	↓ 4000

Carry out. We solve the inequality. 500 + 8d < 4000

8*d* < 3500

Check. We compute the cost of the well under the "pay-as-you-go" plan for various depths. If d = 437 ft, the cost is $$500 + $8 \cdot 437 = 3996 . If d = 438 ft, the cost is $$500 + $8 \cdot 438 = 4004 . *State.* The "pay-as-you-go" plan is cheaper if the depth is less than 437.5 ft.

34. *Familiarize.* Let t = the number of 15-min units of time for a road call. Rick's Automotive charges $50 + 15 \cdot t$ for a road call, and Twin City Repair charges $70 + 10 \cdot t$.

Translate

Rick's charge	is less than	Twin City's charge.
\downarrow	\downarrow	\downarrow
50 + 15t	<	70 + 10t
Carry out. We	e solve t	he inequality.
50 + 15t < 70 + 15t	-10 <i>t</i>	
15t < 20 +	-10 <i>t</i>	
5t < 20		
<i>t</i> < 4		
Check. We ch	eck to s	ee if the solution seems
reasonable. W	Then $t =$	3, Rick's charges
$$50 + $15 \cdot 3, c$	or \$95, a	and Twin City charges
$$70 + $10 \cdot 3$,	or \$100.	When $t = 4$, Rick's
charges $$50+$	\$1534,	or \$110, and Twin City
charges \$70+	\$10.4,	or \$110. When $t = 5$,
Rick's charges	\$\$50+\$	15.5, or 125 , and
Twin City char	rges \$70	0 + \$10.5, or $$120$.
From these cal	culation	ns, it appears that the
solution is corr	rect.	
State. It would	d be mo	re economical to call
Rick's for a se	rvice ca	ll of less than 4 15-min

- time units, or of less than 1 hr.
 35. *Familiarize.* Let b = the blue-book value of
- 35. Familiarize. Let b = the blue-book value of Michelle's car. The car was repaired rather than being replaced.

Translate.

Cost of	did not	80% of the
the repair	exceed	blue-book value.
<u> </u>	$\underline{\hspace{1.5cm}}$	
\downarrow	\downarrow	\downarrow
8500	\leq	0.8b

Carry out. We solve the inequality. $8500 \le 0.8b$

 $10,625 \le b$

Check. If the blue-book value of the vehicle is \$10,625, then 80% of that amount would be $$10,625 \cdot 0.8 = 8500 . Since the repairs, \$8500, did not exceed this amount, the car would have been repaired rather than being replaced.

State. The blue-book value of the vehicle was at least \$10,625.

36. *Familiarize.* Let c = the cost of the repairs. Translate.

$$\underbrace{ \text{The cost of}}_{\text{the repairs}} \text{ exceeded } \underbrace{ 80\% \text{ of the}}_{\text{blue-book value.}} .$$

 \downarrow

 \downarrow \downarrow $0.8 \cdot (21,000)$ > С

Carry out. We solve the inequality.

c > 16,800

Check. The blue-book value was \$21,000. The pickup was replaced rather than being repaired, so the cost had to exceed 80% of \$21,000, or \$16,800.

State. The cost of the repairs had to exceed \$16,800.

37. *Familiarize*. Let L = the length of the envelope.

Translate.

The area of the envelop is $A = L \cdot W$. Area of the must be $17\frac{1}{2}$ in².

envelope	at least	1/ ₂ II
	$\underline{\qquad}$	
\downarrow	\downarrow	\downarrow
$L \cdot \left(3\frac{1}{2}\right)$	\geq	$17\frac{1}{2}$

Carry out. We solve the inequality. $L \cdot (3\frac{1}{2}) \ge 17\frac{1}{2}$

$$\frac{7}{2}L \ge \frac{35}{2}$$
$$7L \ge 35$$

5

$$L \ge$$

Check. We can do a partial check by calculating the area when the length is 5 in. The area would be

$$3\frac{1}{2} \cdot 5 = \frac{7}{2} \cdot 5 = \frac{35}{2} = 17\frac{1}{2}$$
 in².

State. The envelopes used must have lengths greater than or equal to 5 in.

38. *Familiarize*. Let l = the length of the package, in inches. The girth of the package is 53 in. and the sum of the length and girth, l+53 in., is less than 108 inches. Translate.

Length and girth less than 108 in.

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ l+53 & < & 108 \end{array}$$

Carry out. We solve the inequality. l + 53 < 108

l < 55

Check. As a partial check, we can test a package with a length of 55 in. We are told that the package has a girth of 53 in., so the combined length and girth would be 55 in. + 53 in., or 108 in. This is not less than 108 inches, so it is barely too long to be mailed.

State. The length of the package must be less than 55 in.

39. *Familiarize*. We let C = the body temperature of the person, in degrees Celsius and let F = the body temperature of the person, in degrees Fahrenheit. We will use

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

Translate.

Fahrenheit temperature is above 98.6°.

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ F & & > & 98.6 \end{array}$$

Substituting $\frac{9}{5}C + 32$ for *F*, we have

$$\frac{9}{5}C + 32 > 98.6$$

Carry out. We solve the inequality.

$$\frac{9}{5}C + 32 > 98.6$$
$$\frac{9}{5}C > 66.6$$
$$C > \frac{333}{9}$$
$$C > 37$$

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

When
$$C = 36$$
, $\frac{9}{5} \cdot 36 + 32 = 96.8$.
When $C = 37$, $\frac{9}{5} \cdot 37 + 32 = 98.6$.
When $C = 38$, $\frac{9}{5} \cdot 38 + 32 = 100.4$.

It would appear that the solution is correct, considering that rounding occurred.

State. The human body is feverish for Celsius temperatures greater than 37°C.

40. *Familiarize.* Let C = the Celsius temperatures for which gold stays solid. Let F = those Fahrenheit temperatures for which gold stays solid. We will use the formula

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

Translate.

Fahrenheit temperature is below 1945.4°.

$$\begin{array}{cccc}
\downarrow & \downarrow & \downarrow \\
F & < 1945.4
\end{array}$$

Substituting
$$\frac{9}{5}C + 32$$
 for *F*, we have

$$\frac{9}{5}C + 32 < 1945.4$$

Carry out. We solve the inequality.

$$\frac{9}{5}C + 32 < 1945.4$$
$$\frac{9}{5}C < 1913.4$$
$$C < \frac{9567}{9}$$
$$C < 1063$$

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

When
$$C = 1062$$
, $\frac{9}{5} \cdot 1062 + 32 = 1943.6$.
When $C = 1063$, $\frac{9}{5} \cdot 1063 + 32 = 1945.4$.
When $C = 1064$, $\frac{9}{5} \cdot 1064 + 32 = 1947.2$.
It would appear that the solution is correct, considering that rounding accurred

considering that rounding occurred. *State.* Gold stays solid for temperatures less than 1063°C.

41. *Familiarize.* Let h = the height of the triangular flag, in ft. The base of the flag is $1\frac{1}{2}$ ft. We will use the formula for the area of

a triangle, $A = \frac{1}{2}bh$, where b = the base and h = the height. *Translate.*

Area of the flag is at least 3 ft^2 .

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ \frac{1}{2} \cdot \left(1 \frac{1}{2}\right) \cdot h & \geq & 3 \end{array}$$

Carry out. We solve the inequality.

$$\frac{1}{2} \cdot \left(1\frac{1}{2}\right) \cdot h \ge 3$$
$$\frac{1}{2} \left(\frac{3}{2}\right) h \ge 3$$
$$\frac{3}{4} h \ge 3$$
$$h \ge 4$$

Check. As a partial check we compute the area of the flag with a height of 4 ft to be $\frac{1}{2}(1\frac{1}{2})(4) = \frac{1}{2}(\frac{3}{2})(4) = 3$ ft². Any increase in the height would result in an area greater than 3 ft².

State. The height of the flag must be greater than or equal to 4 ft.

42. *Familiarize.* Let h = the height of the triangular sign, in ft. The base of the sign is 8 ft. We will use the formula for the area of a triangle, $A = \frac{1}{2}bh$, where b = the base and h = the height.

Translate.

Area of the flag cannot exceed 12 ft^2 .

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ \frac{1}{2} \cdot 8 \cdot h & \leq & 12 \end{array}$$

Carry out. We solve the inequality.

$$\frac{1}{2} \cdot 8 \cdot h \le 12$$
$$4h \le 12$$

$$h \leq 3$$

Check. As a partial check we compute the area of the sign 3 ft tall to be $\frac{1}{2}(8)(3) = 12$

 ft^2 . Any increase in the height would result in an area greater than 12 ft^2 .

State. The sign can be no more than 3 ft tall.

43. *Familiarize.* Let r = the number of grams of fat in a serving of regular Jif peanut butter. Jif Creamy Reduced Fat peanut butter has 12 g of fat per serving. If reduced fat Jif peanut butter contains at least 25% less fat than regular Jif, then reduced fat Jim contains at most 75% as much fat as the regular Jif peanut butter. *Translate.*

12 g of fat is at most 75% of fat in regular Jif® peanut butter

 \downarrow

Carry out. We solve the inequality. $12 \le 0.75r$

 $16 \le r$

Check. As a partial check, we show that 12 g of fat does not exceed 75% of 16 g of fat: 0.75(16) = 12

State. Regular Jif peanut butter contains at least 16 g of fat per serving.

44. *Familiarize.* Let r = the number of grams of fat in a serving of regular Sargento® colby cheese. Reduced Fat Sargento® colby cheese contains 5 g of fat per serving. If Reduced Fat Sargento® colby cheese contains at least 25% less fat than Sargento® colby cheese, then Reduced Fat Sargento® colby cheese contains at most 75% as much fat as the regular Sargento® colby cheese . *Translate.*

5 g of fat	is at most	75% of	the amount of fat in regular Sargento® colby cheese
\downarrow	\downarrow	$\downarrow \downarrow$	Ŷ
5	\leq	0.75.	r

Carry out. We solve the inequality. $5 \le 0.75r$

 $6\frac{2}{3} \leq r$

Check. As a partial check, we show that 5 g of fat does not exceed 75% of $6\frac{2}{3}$ g of fat:

 $0.75(6\frac{2}{3}) = 5$

State. Regular Sargento® colby cheese contains at least $6\frac{2}{3}$ g of fat per serving.

45. *Familiarize.* Let y = the number of years after 2004. Then *y* years after 2004, the number of dogs kept as pets is 73.9 + 1.1*y*. *Translate.*

 $\frac{\text{The number}}{\text{of dogs}} \quad \underbrace{\text{will be more than}}_{\text{OB}} 90 \text{ million.}$

\downarrow	\downarrow	\downarrow
73.9 + 1.1y	>	90

Carry out. We solve the inequality. 73.9+1.1y > 90

1.1y > 16.1

d >14.6363

Check. As a partial check, we calculate the number of dogs in different years. If y = 14, there are

73.9 + 1.1(14) = 89.3 million dogs.

If y = 15, there are

73.9 + 1.1(15) = 90.4 million dogs.

State. There will be more than 90 million dogs kept as pets in 2004 + 15 = 2019 and later.

46. *Familiarize.* Let w = the number of weeks after July 1. Then w weeks after July 1, the water level will be $25 - \frac{2}{3}d$ ft.

Translate.

The water level will not exceed 21 ft.

\downarrow	\downarrow	\downarrow
$25 - \frac{2}{3}w$	\leq	21

Carry out. We solve the inequality.

$$25 - \frac{2}{3}w \le 21$$
$$-\frac{2}{3}w \le -4$$
$$w \ge 6$$

Check. As a partial check, we determine the water level for different dates.

If w = 5, the water level is $25 - \frac{2}{3}(5) = 21\frac{2}{3}$.

If w = 6, the water level is $25 - \frac{2}{3}(6) = 21$.

If w = 7, the water level is $25 - \frac{2}{3}(7) = 20\frac{1}{3}$.

It is apparent that for 6 or more weeks after July1, the water level is below 21 ft. **State.** Six weeks after July 1, or later, the water level will not exceed 21 ft. Six weeks is $6 \cdot 7 = 42$ days. After July 1, there are 30 days left with 12 remaining, so on August 12 or later the water level will be below 21 ft.

47. *Familiarize.* Let m = the number of movies on demand. The monthly package cost of \$45 plus receiver service and cable box cost of \$28 is \$73 per month. The cost of movies is 6m, and Braden's budget is \$100 per month.

Translate.

Cost of monthly	is at	\$100
fees and movies	most	\$100.
	$\overline{}$	

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 73+6n & \leq & 100 \end{array}$$

Carry out. We solve the inequality. $73 + 6n \le 100$

6*n* ≤ 27

 $n \le 4.5$

Check. As a partial check, if 4 movies are watched, the total cost will be

 $73 + 6 \cdot 4 = \$97$. If 5 movies are watched, the total cost will be $73 + 6 \cdot 5 = \$103$.

State. Carl can watch no more than 4 movies.

48. *Familiarize.* Let n = the number of people who can attend the banquet. Then the total cost of the banquet will be \$40 + \$16n.

Translate.

Total cost of the banquet cannot exceed \$450.

\downarrow	\downarrow	\downarrow
40 + 16n	\leq	450

Carry out. We solve the inequality. $40 + 16n \le 450$

 $16n \le 410$

 $n \le 25.625$

Since it is impossible for a fractional person to attend, we round down and obtain $n \le 25$. *Check.* As a partial check, if 25 people attend, the cost will be $$40 + $16 \cdot 25 = 440 . If 26 people attend, the cost will be $$40 + $16 \cdot 26 = 456 . *State.* No more than 25 people can attend the

State. No more than 25 people can attend the banquet.

49. *Familiarize.* Let t = the number of years after 1900 for which the world record will be less than 3.6 min. We use the equation R = -0.0065t + 4.3259 where R = the world record, in minutes. *Translate.*

The world record is less than 3.6 min.

 $\begin{array}{cccc}
\downarrow & \downarrow & \downarrow \\
R & < 3.6
\end{array}$

We substitute -0.0065t + 4.3259 for *R* to get the inequality -0.0065t + 4.3259 < 3.6.

Carry out. We solve the inequality. -0.0065*t* + 4.3259 < 3.6

-0.0065t < -0.7259

t > 111.67692308

Check. As a partial check, we calculate the record time for different values of *t*. If t = 112, the time would be

-0.0065(112) + 4.3259, or 3.5979 min. If

t = 111, the time would be

-0.0065(111) + 4.3259, or 3.6044.

State. The record time will be less than 3.6 min for years greater than 112 years after 1900, or years after 2012.

50. *Familiarize.* Let t = the number of years after 1900 for which the world record will be less than 3.8 min. We use the equation R = -0.0026t + 4.0807 where R = the world record, in minutes. *Translate.*

The world record is less than 3.8 min.

\downarrow	\downarrow	\downarrow
R	<	3.8
	0.000	0007 0

We substitute -0.0026t + 4.0807 for *R* to get the inequality -0.0026t + 4.0807 < 3.8.

Carry out. We solve the inequality. -0.0026*t* + 4.0807 < 3.8

-0.0026t < -0.2807

t > 107.961538

Check. As a partial check, we calculate the record time for *t* after 108 years, or 1900 + 108 = 2008. When t = 108, the time would be -0.0026(108) + 4.0807 = 3.7999, or 3.8 min.

State. The record time will be under 3.8 min for years after 2008.

51. *Familiarize.* Let x = the number of miles driven and let y = the cost of driving on the toll road, in dollars. We will use the equation y = 0.078x + 3.13.

Translate.

The cost of driving on the toll road	is at most	\$14.

\downarrow	\downarrow	\downarrow
У	\leq	14

Carry out. We substitute y = 0.078x + 3.13

for *y* to obtain the inequality

 $0.078x + 3.13 \le 14$. We then solve this inequality.

 $0.078x + 3.13 \le 14$

$$0.078x \le 10.87$$

x ≤139.36

Check. As a partial check we determine the toll cost if 139 miles are driven to be 0.079(120) + 2.12 - 12.07

$$0.078(139) + 3.13 = 13.97$$

State. If the toll is at most \$14, the number of miles driven must be less than or equal to 139 miles.

52. *Familiarize*. Let Y = the year and let P = the average price per movie ticket, in dollars. We will use the equation P = 0.237Y - 468.87.

Translate.

The average price of a movie ticket	is at least	\$9.
\downarrow	\downarrow	\downarrow
P	\geq	9

We substitute 0.237Y - 468.87 for *P* and solve the inequality. *Carry out.* We solve the inequality.

 $0.237Y - 468.87 \ge 9$

$$0.237Y \ge 477.87$$

$$Y \ge 2016.329$$

Check. As a partial check we can calculate the average price of a ticket for different years. If Y = 2016, the average price is 0.237(2016) - 468.87, or about \$8.92. If

Y = 2017, the average price is

0.237(2017)-468.87, or about \$9.16.

State. The average price of a ticket will be at least \$9 for years 2017 and beyond.

53. *Familiarize.* Let *s* = the number of same-day shipments per year. Without an Amazon Prime membership, the total cost of shipping is 8.99s. With an Amazon Prime membership, the total cost of shipping is 49 + 5.99s.

Translate.

Cost of shipping with Prime membership	is less than	the cost of shipping without Prime membership
\downarrow	↓	↓
49+5.99s	<	8.99s

Carry out. We solve the inequality. 49 + 5.99s < 8.99s

 $16.\overline{3} < n$

Check. As a partial check, we can calculate the costs of each plan for different numbers of shipments.

No. With Pri	With Drimo	Without
	with fille	Prime
16	49 + 5.99(16) =	8.99(16) =
10	\$144.84	\$143.84
17	49 + 5.99(17) =	8.99(17) =
17	\$150.83	\$152.83

State. The Amazon Prime membership saves Katya money if she orders more than 16 same-day shipments.

54. *Familiarize.* Let h = the number of hours required to move items across town. Musclebound Movers charges \$85+\$40h, and Champion charges \$60h. *Translate.*

Champion Moving charge	is greater than	Musclebound Moving charge.
	$\underline{\qquad}$	
\downarrow	\downarrow	\downarrow
60h	>	85 + 40h

Carry out. We solve the inequality. 60h > 85 + 40h 20h > 85h > 4.25

Check. As a partial check, we can calculate the cost of moving for each mover for different times.

Hrs.	Champion	Muscle
4	\$60(4) = \$240	\$85 + \$40(4) = \$245
4.25	\$60(4.25) = \$255	\$85 + \$40(4.25) = \$255
5	\$60(5) = \$300	\$85 + \$40(5) = \$285

State. If the move requires more than 4.25 hours, Champion Moving is more expensive than Musclebound Moving.

55. Familiarize. We list the given information in a table. Let s = gross sales.

Plan A:	Plan B:
Monthly Income	Monthly Income
\$400 salary	\$610
8% of sales	5% of sales
Total:	Total:
400 + 8% of sales	610 + 5% of sales

Translate.

Income from	is greater	income from
plan A	than	plan B.
\downarrow	\downarrow	\downarrow
400 + 0.08s	>	610 + 0.05s

Carry out. We solve the inequality. 400 + 0.08s > 610 + 0.05s

400 + 0.03s > 610

0.03s > 210

s > 7000

Check. For s = \$7000, the income from plan A is \$400 + 0.08(\$7000), or \$960, and the income from plan B is 610 + 0.05(7000), or \$960. This shows that for sales of \$7000 Toni's income is the same from each plan. For s =\$6990, the income from plan A is \$400 + 0.08(\$6990), or \$959.20, and the income from plan B is 610 + 0.05(6990), or \$959.50. For s = \$7010, the income from plan A is \$400 + 0.08(\$7010), or \$960.80, and the income from plan B is 610 +0.05(\$7010), or \$960.50.

State. For gross sales greater than \$7000, plan A provides Toni with the greater income. 56. Familiarize. We list the given information in a table. Let n = the number of hours required to do the job.

Plan A:	Plan B:
\$300 + \$9 <i>n</i>	\$12.50 <i>n</i>

Translate

Pay for plan B	is greater than	pay for plan A.
↓ 12.50 <i>h</i>	\downarrow >	\downarrow 300+9.00 <i>h</i>

Carry out. We solve the inequality.

$$12.50h > 300 + 9.00h$$

3.50h > 300

 $h > 85\frac{5}{7}$

<i>Check.</i> As a partial check, we compute the
pay under both plans for different numbers of
hours.

Hrs.	Plan A	Plan B
05	300 + 9(85) =	\$12.50(85) =
83	\$1065	\$1062.50
85 <u>5</u>	$300 + 9(85\frac{5}{7})$	$12.50(85\frac{5}{7})$
05 7	≈ \$1071.43	≈ \$1071.43
96	300 + 9(86) =	\$12.50(86) =
80	\$1074	\$1075

State. Plan B is better when the job requires more than $85\frac{5}{7}$ hr.

57. *Familiarize.* Let g = the number of gallons of gasoline used. If Abriana chooses the first option, paying for an entire tank of gasoline, she would pay \$3.099(14), or \$43.386. If she chooses the second option, paying for only the gasoline required to fill the tank, she would pay \$6.34g.

Translate.

Paying for only the gallons used	is less than	paying for an entire tank.
↓ 6.34g	$\stackrel{\downarrow}{<}$	↓ 43.386

Carry out. We solve the inequality. 6.34g < 43.386

g < 6.843217666

Check. As a partial check, we can calculate the cost under both options if 6.8 gallons of gas was used. Paying for only the gas used,

139

Abriana would owe \$6.34(6.8), or about \$43.11.

State. Abriana should use the second plan, paying for only the gas used, if she uses about 6.8 gallons of gasoline or less.

- 58. For the first option to be more economical, Abriana would have to use more than 6.8 gallons of gas. If the car gets 30 mph, this amounts to driving the car 6.8 gal (30 mph), or 204 miles. So Abriana would have to drive more than 204 miles.
- 59. *Thinking and Writing Exercise*. Answers may vary. Three more than Walt's age is less than Fran's age.
- 60. Thinking and Writing Exercise. Let *n* represent "a number." Then "five more than a number" translates to n+5, or 5+n, and "five is more than a number" translates to 5 > n.

$$61. \quad -2 + (-5) - 7 = -7 - 7 = -14$$

62.
$$\frac{1}{2} \div \left(-\frac{3}{4}\right) = \frac{1}{2} \cdot \left(-\frac{4}{3}\right) = -\frac{4}{6} = -\frac{2}{3}$$

- 63. $3 \cdot (-10) \cdot (-1) \cdot (-2) = -30 \cdot (-1) \cdot (-2)$ = $30 \cdot (-2) = -60$
- $64. \quad -6.3 + (-4.8) = -11.1$
- 65. (3-7) (4-8) = -4 (-4) = -4 + 4 = 0
- 66. $3-2+5\cdot10\div5^2\cdot2=3-2+5\cdot10\div25\cdot2$ = 1+(50÷25)·2 = 1+2·2=5

$$67. \quad \frac{-2 - (-6)}{8 - 10} = \frac{4}{-2} = -2$$

- $68. \quad \frac{1-(-7)}{-3-5} = \frac{8}{-8} = -1$
- 69. Thinking and Writing Exercise. Answers may vary.
 Acme rents a truck at a daily rate of \$40 plus \$0.50 per mile. The Rothmans want a

one-day truck rental, but they must stay within an \$85 budget. What mileage will allow them to stay within their budget? Round to the nearest mile.

70. *Thinking and Writing Exercise*. Answers may vary.

A boat has a capacity of 2700 lb. How many passengers can go on the boat if each passenger is considered to weigh 150 lb?

71. *Familiarize.* Let n = the number of wedding guests. For plan A, the cost for the guests would be \$30n. For plan B, the cost for the guests would be \$1300 + \$20(n - 25), assuming that more than 25 guests attend. *Translate.*

$\underbrace{ \begin{array}{c} \text{The cost} \\ \text{for plan B} \end{array} }_{\text{for plan B}} \underbrace{ \begin{array}{c} \text{is} \\ \text{is} \end{array} }$	less than	the cost for plan A.
$\downarrow \\ 1300 + 20(n-25)$	\downarrow <	\downarrow 30 <i>n</i>

Carry out. We solve the inequality. 1300 + 20(n - 25) < 30n 1300 + 20n - 500 < 30n 800 < 10n80 < n

Check. As a partial check, we calculate the cost for the guests under both plans for different numbers of guests.

No	Plan A	Plan B
70	\$30(79)	1300 + 20(79 - 25)
19	= \$2370	= \$2380
80	\$30(80)	1300 + 20(80 - 25)
80	= \$2400	= \$2400
01	\$30(81)	1300 + 20(81 - 25)
01	= \$2430	= \$2420

State. Plan B is cheaper if there are more than 80 guests attending the wedding.

72. *Familiarize.* Let b = the amount of Giselle's medical bills. Under plan A, Giselle would pay \$50 + 0.2(b - 50). Under plan B, Giselle would pay \$250 + 0.1(b - 250). We assume the bills exceed \$250.

Translate.

Medical cost under plan B	is less than	medical cost under plan A.
\downarrow 250+0.1(b-2	\downarrow 50) < 5	$\downarrow 50 + 0.2(b - 50)$

Carry out. We solve the inequality. 250 + 0.1(b - 250) < 50 + 0.2(b - 50) 250 + 0.1b - 25 < 50 + 0.2b - 10 225 + 0.1b < 40 + 0.2b 185 < 0.1b1850 < b

Check. As a partial check, we compute the cost to Giselle under plans A and B for different medical bills.

Bill	Plan A	Plan B
\$1840	\$50 + 0.2(\$1849 -	\$250 + 0.1(\$1849
\$1049	\$50) = \$409.80	-250) = \$409.90
\$1850	\$50 + 0.2(1850 -	\$250 + 0.1(\$1850
\$1650	50) = \$410	-250) = \$410
¢1951	\$50 + \$0.2(\$1851	\$250 + 0.1(\$1851
\$1031	(-50) = \$410.20	-250) = \$410.10

State. Plan B is the cheapest if Giselle's medical bills are more than \$1850.

73. *Familiarize.* Let h = the number of hours the car was parked. The cost to park the car can be expressed as 4 + 2.50(h - 1), assuming the car was parked at least one hour. *Translate.*

The charge to park the car exceeds \$16.50.

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 4+2.5(h-1) & > & 16.50 \end{array}$$

Carry out. We solve the inequality.

$$4+2.5(h-1) > 16.50$$

$$4+2.5h-2.5 > 16.50$$

$$2.5h+1.5 > 16.50$$

$$2.5h > 15$$

$$h > 6$$

Check. As a partial check, we can calculate the cost to park the car for 6 hours. The cost would be \$4 + \$2.5(6 - 1), or \$4 + \$2.5(5), or \$16.50.

State. The car must have been parked more than 6 hours.

74. Familiarize. Let C = the Celsius temperatures for which Green ski was works best. Let F = the Fahrenheit temperature for which Green ski works best. We will use the

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

Translate.

Fahrenheit temperature is between 5° and 15°. \downarrow 5 < F < 15

Carry out. We substitute $\frac{9}{5}C + 32$ for *F* and solve the inequality.

$$5 < \frac{9}{5}C + 32 < 15$$

$$5 - 32 < \frac{9}{5}C + 32 - 32 < 15 - 32$$

$$-27 < \frac{9}{5}C < -17$$

$$\frac{5}{9}(-27) < \frac{5}{9}\left(\frac{9}{5}C\right) < \frac{5}{9}(-17)$$

$$-15 < C - \frac{85}{9}$$

$$-15 < C < -9\frac{4}{9}$$

Check. The above steps indicate that the Celsius temperature is greater than -15° ,

which is $\frac{9}{5}(-15) + 32$, or 5° F, and the Celsius temperature is less than $-9\frac{4}{9}$ ° F, which is $\frac{9}{5}(-9\frac{4}{9}) + 32 = \frac{9}{5}(-\frac{85}{9}) + 32$, or -17 + 32, or 15° F. **State.** Green ski was works best between

State. Green ski was works best between -15° C and $-9\frac{4}{9}^{\circ}$ C.

75. *Familiarize.* Let s = the length of the side of the square, in cm. The area of the square would be $s^2 \text{ cm}^2$.

Translate.

The area of a square	can be no more than	64 cm^2
	$\underbrace{}_{}$	
\downarrow	\downarrow	\downarrow
s^2	\leq	64

Carry out. We solve the inequality. $s^2 \le 64$

$$s \leq 8$$

Check. As a partial check, we find the area of a square having length of side equal to 8. The area is $8^2 = 64$.

State. The length can be less than or equal to 8 cm.

76.	Familiarize. Let $x =$ the first odd integer and let $x + 2$ equal the second odd integer				
	Translata				
	The sum of the two				
	consecutive odd integers <u>is less than</u> 100.				
	$\downarrow \qquad \downarrow \qquad \downarrow$				
	x + (x + 2) < 100				
	<i>Carry out.</i> We solve the inequality.				
	x + (x+2) < 100				
	2x + 2 < 100				
	2 <i>x</i> < 98				
	<i>x</i> < 49				
	The first odd integer less than 49 is 47. The				
	next odd integer would be 49.				
	<i>Check.</i> Both 47 and 49 are odd integers, and				
	they are consecutive odd integers. As a				
	partial check, we calculate their sum, $47 + 49$,				
	or 96, which is less than 100.				
	State. The integers are 47 and 49.				
77.	<i>Familiarize.</i> Let $x =$ the amount of fat in				
	a serving of nacho cheese tortilla chips, in				
	grams. If reduced fat Tortilla Pops contain				
	60% less fat than regular nacho cheese tortilla				
	chips, then they must contain 40% of the fat				

in regular nacho cheese tortilla chips, or 0.4x g.

Translate.

Reduced fat Tortilla Pops	contain at least	$\underbrace{3 \text{ g of fat.}}_{}$
\downarrow 0.4x	\downarrow \geq	\downarrow_3

Carry out. We solve the inequality. $0.4x \ge 3$

$$x \ge 7.5$$

Check. As a partial check, if a serving of nacho cheese tortilla chips have 7.5 g of fat, then a serving of reduced fat Tortilla Pops must contain 60% less fat, or 40% of the fat in nacho cheese tortilla chips, or 0.4(7.5), or 3 g of fat. In order to be labeled "lowfat," the reduced fat Tortilla Pops would have to contain less than 3 of fat. *State.* A serving of nacho cheese tortilla chips contain at least 7.5 g of fat.

78. *Familiarize.* Let h = the number of hours the car was parked. The cost to park the care can be expressed as 4 + 2.50(h - 1), assuming the car was parked at least one hour.

Translate.

The cost to park was between \$14 and \$24.

$$14 < 4 + 2.5(h-1) < 24$$
Carry out. We solve the inequality.
 $14 < 4 + 2.5(h-1) < 24$
 $14 < 4 + 2.5(h-1) < 24$
 $14 < 2.5h + 1.5 < 24$
 $14 < 2.5h + 1.5 < 24$
 $14 - 1.5 < 2.5h + 1.5 - 1.5 < 24 - 1.5$
 $12.5 < 2.5h < 22.5$
 $5 < h < 9$

Check. As a partial check, if the car was parked 5 hours, then the cost would have been more than \$4 + \$2.5(5 - 1), or \$4 + \$2.5(4), or \$14. If the car was parked 9 hours, then the cost would have been less than \$4 + \$2.5(9 - 1), or \$4 + \$2.5(8), or \$24. *State.* The car was parked between 5 and 9

State. The car was parked between 5 and 9 hours.

79. *Familiarize.* Let p = the price of Neoma's tenth book. If the average price of each of the first 9 books is \$12, then the total price of the 9 books is $9 \cdot 12$, or \$108. The average

price of the first 10 books will be $\frac{\$108 + p}{10}$.

Translate.

The average price of 10 books	is at least	\$15.
\downarrow	\downarrow	\downarrow
$\frac{108 + p}{10}$	\geq	15
10		

Carry out. We solve the inequality.

$$\frac{108+p}{10} \ge 15$$
$$108+p \ge 150$$
$$p \ge 42$$

Check. As a partial check, we show that the average price of the 10 books is \$15 when the price of the tenth book is \$42.

$$\frac{\$108 + \$42}{10} = \frac{150}{10} = \$15$$

State. Neoma's tenth book should cost at least \$42 if she wants to select a \$15 book for her free book.

80. Thinking and Writing Exercise. Let s =Blythe's score on the tenth quiz. We determine the score required to improve her average at least 2 points. Solving

 $\frac{9 \cdot 84 + s}{10} \ge 86$, we get $s \ge 104$. Since the

maximum possible score is 100, Blythe cannot improve her average two points with the next quiz.

81. *Thinking and Writing Exercise*. Let p = the total other purchases for the year. Solving 10% p > 25, we get p > 250. Thus, when a customer's other purchases are more than \$250 for the year, the customer saves money by purchasing a card. Or, let p = the total hardcover bestseller purchases for the year. Solving 40% p > 25, we get p > 62.50.

> Thus, when a customer's hardcover bestseller purchases are more than \$62.50 for the year, the customer saves money by buying a card.

Chapter 2 Study Summary

1. x - 8 = -3x - 8 + 8 = -3 + 8 Adding 8 *x* = 5 Simpifying The solution is 5.

2.
$$\frac{1}{4}x = 1.2$$

 $4\left(\frac{1}{4}x\right) = 4(1.2)$ Multiplying by 4
 $x = 4.8$ Simplifying

The solution is 4.8.

3.
$$4-3x = 7$$

 $4-3x + (-4) = 7 + (-4)$ Adding -4
 $-3x = 3$ Simplifying
 $\frac{-3x}{-3} = \frac{3}{-3}$ Dividing by -3

x = -1

-4

The solution is -1.

4. $\frac{1}{6}t - \frac{3}{4} = t - \frac{2}{3}$ $12\left(\frac{1}{6}t - \frac{3}{4}\right) = 12\left(t - \frac{2}{3}\right)$ Multiplying by 12 $12 \cdot \frac{1}{6}t - 12 \cdot \frac{3}{4} = 12 \cdot t - 12 \cdot \frac{2}{3}$ Distributive Law 2t - 9 = 12t - 8Simplifying 2t - 9 + 9 = 12t - 8 + 9Adding 9 2t = 12t + 1Simplifying 2t - 12t = 12t + 1 - 12tAdding -12t -10t = 1Simplifying $\frac{-10t}{-10} = \frac{1}{-10}$ Dividing by -10 $t = -\frac{1}{10}$ Simplifying

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

5.
$$ac-bc = d$$

 $c(a-b) = d$ Factoring out c
 $\frac{c(a-b)}{(a-b)} = \frac{d}{(a-b)}$ Dividing by $a-b$
 $c = \frac{d}{(a-b)}$ Simplifying

 $\begin{array}{c} \downarrow \downarrow \downarrow \downarrow \\ 12 = 0.15 \end{array}$ \downarrow v We solve the equation. $12 = 0.15 \cdot y$ $\frac{12}{0.15} = y$ 80 = vThe answer is 80.

7. *Familiarize.* Let x = the length of the shorter bicycle tour, in miles. Then x + 25 is the length of the longer tour, in miles. Translate. Length of two was a total of 120 miles. bicycle tours

$$\begin{array}{c} \downarrow \qquad \downarrow \qquad \downarrow \\ x + (x+25) = 120 \end{array}$$

Carry out. We solve the equation.

x + (x + 25) = 120 2x + 25 = 120 2x = 95 $x = 47\frac{1}{2}$

Check. If the short tour was $47\frac{1}{2}$, then the total length is: $47\frac{1}{2} + (47\frac{1}{2} + 25) = 47\frac{1}{2} + 72\frac{1}{2} = 120$ miles. This checks. *State.* The length of tours were $47\frac{1}{2}$ miles and $72\frac{1}{2}$ miles.

- 8. $\{x \mid x \le 0\}$ in interval notation is $(-\infty, 0]$
- 9. x-11 > -4 x-11+11 > -4+11 Adding 11 x > 7 Simplifying The solution set is $\{x | x > 7\}$, or $(7, \infty)$.
- 10. $-8x \le 2$ $\frac{-8x}{-8} \ge \frac{2}{-8}$ Dividing by -8 $x \ge -\frac{1}{4}$ Simplifying The solution set is $\left\{x \mid x \ge -\frac{1}{4}\right\}$, or $\left[-\frac{1}{4},\infty\right)$.
- 11. Let *d* represent the distance Luke runs, in miles. If Luke runs no less than 3 mi per day, then $d \ge 3$.

Chapter 2 Review Exercises

- 1. True
- 2. False
- 3. True
- 4. True
- 5. True
- 6. False
- 7. True
- 8. True

- 9. x+9 = -16 x+9-9 = -16-9 Adding -9 x = -25 Simplifying The solution is -25.
- 10. -8x = -56 $\left(-\frac{1}{8}\right)\left(-8x\right) = \left(-\frac{1}{8}\right)\left(-56\right)$ Multiplying by $-\frac{1}{8}$ x = 7 Simplifying The solution is 7

The solution is 7.

- 11. $-\frac{x}{5} = 13$ $-5\left(-\frac{x}{5}\right) = -5(13)$ Multiplying by -5x = -65 Simplifying The solution is -65.
- 12. -8 = n 11 -8 + 11 = n - 11 + 11 Adding 11 3 = n Simpifying The solution is 3.
- 13. $\frac{2}{5}t = -8$ $\frac{5}{2}\left(\frac{2}{5}t\right) = \frac{5}{2}\left(-8\right)$ Multiplying by $\frac{5}{2}$ t = -20 Simplifying The solution is -20.
- 14. x-0.1 = 1.01x-0.1+0.1 = 1.01+0.1 Adding 0.1 x = 1.11 Simplifying The solution is 1.11.
- 15. $-\frac{2}{3} + x = -\frac{1}{6}$ $6\left(-\frac{2}{3} + x\right) = 6\left(-\frac{1}{6}\right)$ Multiplying by 6 -4 + 6x = -1Simplifying -4 + 6x + 4 = -1 + 4Adding 4 6x = 3Simplifying $x = \frac{1}{2}$ Multiplying by $\frac{1}{6}$

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

16. 5z + 3 = 41 5z + 3 - 3 = 41 - 3 Adding -3 5z = 38 Simplifying $z = \frac{38}{5}$ Multiplying by $\frac{1}{5}$ The solution is $\frac{38}{5}$.

17. 5-x = 13 5-x-5 = 13-5 Adding -5 -x = 8 Simplifying x = -8 Multiplying by -1The solution is -8.

18.
$$5t+9 = 3t-1$$

$$5t+9-9 = 3t-1-9$$
 Adding -9

$$5t = 3t-10$$
 Simplifying

$$5t-3t = 3t-10-3t$$
 Adding -3t

$$2t = -10$$
 Simplifying

$$t = -5$$
 Multiplying by $\frac{1}{2}$
The solution is -5.

19.
$$7x-6 = 25x$$
$$7x-6-7x = 25x-7x$$
 Adding $-7x$
$$-6 = 18x$$
 Simplifying
$$-\frac{1}{3} = x$$
 Multiplying by $\frac{1}{18}$ The solution is $-\frac{1}{3}$.

20.
$$\frac{1}{4}a - \frac{5}{8} = \frac{3}{8}$$

$$8\left(\frac{1}{4}a - \frac{5}{8}\right) = 8\left(\frac{3}{8}\right)$$
Multiplying by 8
$$2a - 5 = 3$$
Simplifying
$$2a - 5 + 5 = 3 + 5$$
Adding 5
$$2a = 8$$
Simplifying
$$\frac{2a}{2} = \frac{8}{2}$$
Dividing by 2
$$a = 4$$
Simplifying

The solution is 4.

21.
$$14y = 23y - 17 - 9y$$
$$14y = 14y - 17$$
Simplifying
$$14y - 14y = 14y - 17 - 14y$$
Adding - 14y
$$0 = -17$$
Simplifying
This is a false statement. The equation is a

contradiction, and has no solution.

$$22. \qquad 0.22y - 0.6 = 0.12y + 3 - 0.8y$$

 $\begin{array}{ll} 0.22y - 0.6 = -0.68y + 3 & \text{Simplifying} \\ 0.22y - 0.6 + 0.68y = -0.68y + 3 + 0.68y & \text{Adding } 0.68y \\ 0.9y - 0.6 = 3 & \text{Simplifying} \\ 0.9y - 0.6 + 0.6 = 3 + 0.6 & \text{Adding } 0.6 \\ 0.9y = 3.6 & \text{Simplifying} \\ y = 4 & \text{Multiplying by } \frac{1}{0.9} \\ \end{array}$

23. $\frac{1}{4}x - \frac{1}{8}x = 3 - \frac{1}{16}x$ $16\left(\frac{1}{4}x - \frac{1}{8}x\right) = 16\left(3 - \frac{1}{16}x\right)$ Multiplying by 16 4x - 2x = 48 - xDistributive Law 2x = 48 - xSimplifying 2x + x = 48 - x + xAdding x 3x = 48Simplifying x = 16Multiplying by $\frac{1}{3}$

The solution is 16.

24 3(5-n) = 36 15-3n = 36 Distributive Law 15-3n-15 = 36-15 Adding -15 -3n = 21 Simplifying x = -7 Multiplying by $-\frac{1}{3}$ The solution is -7.

25.
$$4(5x-7) = -56$$

 $20x-28 = -56$ Distributive Law
 $20x-28+28 = -56+28$ Adding 28
 $20x = -28$ Simplifying
 $x = -\frac{28}{20}$ Multiplying by $\frac{1}{20}$
 $x = -\frac{7}{5}$ Simplifying
The solution is $-\frac{7}{5}$.

26.
$$8(x-2) = 5(x+4)$$

 $8x-16 = 5x + 20$ Distributive Law
 $8x-16+16 = 5x + 20 + 16$ Adding 16
 $8x = 5x + 36$ Simplifying
 $8x - 5x = 5x + 36 - 5x$ Adding $-5x$
 $3x = 36$ Simplifying
 $x = 12$ Multiplying by $\frac{1}{3}$

The solution is 12.

27. 3(x-4)+2 = x+2(x-5) 3x-12+2 = x+2x-10 Distributive Law 3x-10 = 3x-10 Simplifying 3x-10-3x = 3x-10-3x Subtracting 3x-10 = -10 Simplifying

Because -10 = -10 is a true statement, this equation is an identity and the solution is all real numbers.

28.
$$C = \pi d$$

 $C\left(\frac{1}{\pi}\right) = \pi d\left(\frac{1}{\pi}\right)$ Multipling by $\frac{1}{\pi}$
 $\frac{C}{\pi} = d$ Simplifying

29.
$$V = \frac{1}{3}Bh$$

$$3 \cdot V = 3\left(\frac{1}{3}Bh\right)$$
 Multiplying by 3

$$3V = Bh$$
 Simplifying

$$\frac{1}{h}(3V) = \frac{1}{h}(Bh)$$
 Multiplying by $\frac{1}{h}$

$$\frac{3V}{h} = B$$
 Simplifying

30.
$$5x - 2y = 10$$

$$5x - 2y - 5x = 10 - 5x$$
 Subtracting 5x

$$-2y = 10 - 5x$$
 Simplifying

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

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

$$tx = ax + b$$

$$tx - ax = ax + b - ax$$
Subtracting ax
$$tx - ax = b$$
Simplifying
$$x(t - a) = b$$
Factor out x
$$\frac{x(t - a)}{t - a} = \frac{b}{t - a}$$
Dividing by $t - a$

$$x = \frac{b}{t - a}$$
Simplifying

32. $0.9\% = 0.9 \times 0.01$ Replacing % by $\times 0.01$ = 0.009

- 33. $\frac{11}{25} = \frac{4}{4} \cdot \frac{11}{25} = \frac{44}{100} = 0.44$ First, move the decimal point two places to the right; then write a % 44% 44% 44%
- 34. What percent of 60 is 42?

 \downarrow

v

$$\downarrow \downarrow \downarrow \downarrow \downarrow$$

 $\cdot 60 = 42$

We solve the equation and then convert to percent notation. $y \cdot 60 = 42$

$$y = \frac{42}{60}$$

 $y = 0.70 = 70\%$
The answer is 70%.

35. 42 is 30% of what number?

 $\begin{array}{c}
\downarrow \downarrow \downarrow \downarrow \downarrow \\
42 = 0.30 \\
\cdot \\
y
\end{array}$ We solve the equation. $\begin{array}{c}
42 = 0.30 \\
\cdot \\
y
\end{array}$ We solve the equation. $\begin{array}{c}
42 \\
0.30 \\
- \\
y
\end{array}$ The answer is 140.

36. $x \leq -5$

We substitute -3 for x giving $-3 \le -5$, which is a false statement since -3 is to the right of -5 on the number line. So -3 is not a solution of the inequality $x \le -5$.

37. $x \le -5$

We substitute -7 for x giving $-7 \le -5$, which is a true statement since -7 is to the left of -5on the number line. So -7 is a solution of the inequality $x \le -5$.

38. $x \leq -5$

We substitute 0 for x giving $0 \le -5$, which is a false statement since 0 is to the right of -5 on the number line. So 0 is not a solution of the inequality $x \le -5$.

31.

39. 5x-6 < 2x+3 5x-6+6 < 2x+3+6Adding 6 5x < 2x+9Simplifying 5x-2x < 2x+9-2xAdding - 2x 3x < 9Simplifying x < 3Multiplying by $\frac{1}{3}$ The solution set is $\{x \mid x < 3\}$, or $(-\infty, 3)$.
The graph is as follows: 5x-6 < 2x+3

40. $-2 < x \le 5$ The solution set is $\{x \mid -2 < x \le 5\}$, or

(-2,5]. The graph is as follows:

41. t > 0

The solution set is $\{t \mid t > 0\}$, or $(0, \infty)$. The graph is as follows:

- 42. $t + \frac{2}{3} \ge \frac{1}{6}$ $6\left(t + \frac{2}{3}\right) \ge 6\left(\frac{1}{6}\right)$ Multiplying by 6 $6t + 4 \ge 1$ Simplifying $6t + 4 4 \ge 1 4$ Adding 4 $6t \ge -3$ Simplifying $\frac{1}{6}(6t) \ge \frac{1}{6}(-3)$ Multiplying by $\frac{1}{6}$ $t \ge -\frac{1}{2}$ Simplifying
 The solution set is $\left\{t \mid t \ge -\frac{1}{2}\right\}$, or $\left[-\frac{1}{2}, \infty\right)$.
- 43. $9x \ge 63$ $\frac{1}{9}(9x) \ge \frac{1}{9} \cdot 63 \quad \text{Multiplying by } \frac{1}{9}$ $x \ge 7 \quad \text{Simplifying}$ The solution set is $\{x \mid x \ge 7\}$, or $[7, \infty)$.

44. 2+6y > 20 $2+6y-2 > 20-2 \quad \text{Adding} - 2$ $6y > 18 \quad \text{Simplifying}$ $\frac{1}{6}(6y) > \frac{1}{6} \cdot 18 \quad \text{Multiplying by } \frac{1}{6}$ $y > 3 \quad \text{Simplifying}$ The solution set is $\{y \mid y > 3\}$, or $(3, \infty)$.

45. $7-3y \ge 27+2y$ $7-3y-7 \ge 27+2y-7$ $-3y \ge 20+2y$ $-3y-2y \ge 20+2y-2y$ $-5y \ge 20$ Simplifying $y \le -4$ y = -4 y = -

The solution set is $\{y \mid y \le -4\}$, or $(-\infty, -4]$.

46. 3x+5 < 2x-6 3x+5-2x < 2x-6-2x Adding -2x x+5 < -6 Simplifying x+5-5 < -6-5 Adding -5 x < -11 Simplifying
The solution set is $\{x \mid x < -11\}, \text{ or}$

$$(-\infty, -11)$$
.

47. -4y < 28

$$-\frac{1}{4}(-4y) > -\frac{1}{4} \cdot 28$$

Multiplying by $-\frac{1}{4}$
and reversing the
inequality symbol
 $y > -7$
Simplifying

The solution set is $\{y \mid y > -7\}$, or $(-7, \infty)$.

48. 3-4x < 27 3-4x-3 < 27-3Adding -3 -4x < 24Simplifying $-\frac{1}{4}(-4x) > -\frac{1}{4} \cdot 24$ Multiplying by $-\frac{1}{4}$ and reversing the inequality symbol x > -6Simplifying
The solution set is $\{x \mid x > -6\}$, or $(-6, \infty)$.

- 49. 4-8x < 13+3x 4-8x-4 < 13+3x-4 Adding -4 -8x < 9+3x Simplifying -8x-3x < 9+3x-3x Adding -3x -11x < 9 Simplifying $-\frac{1}{11}(-11x) > -\frac{1}{11} \cdot 9$ Multiplying by $-\frac{1}{11}$ $x > -\frac{9}{11}$ Simplifying The solution set is $\{x | x > -\frac{9}{11}\}$, or $(-\frac{9}{11}, \infty)$.
- 50.
- $$\begin{split} & 13 \leq -\frac{2}{3}t + 5 \\ & 13 + \frac{2}{3}t \leq -\frac{2}{3}t + 5 + \frac{2}{3}t & \text{Adding } \frac{2}{3}t \\ & 13 + \frac{2}{3}t \leq 5 & \text{Simplifying} \\ & 13 + \frac{2}{3}t 13 \leq 5 13 & \text{Adding } -13 \\ & \frac{2}{3}t \leq -8 & \text{Simplifying} \\ & \frac{3}{2}\left(\frac{2}{3}t\right) \leq \frac{3}{2}\left(-8\right) & \text{Multipying by } \frac{3}{2} \\ & t \leq -12 & \text{Simplifying} \\ \end{split}$$
 The solution set is $\{t \mid t \leq -12\}$, or

51. $7 \le 1 - \frac{3}{4}x$ $7 - 1 \le 1 - \frac{3}{4}x - 1$ Adding -1 $6 \le -\frac{3}{4}x$ Simplifying $-\frac{4}{3} \cdot 6 \ge -\frac{4}{3}\left(-\frac{3}{4}x\right)$ Multiplying by $-\frac{4}{3}$ $-8 \ge x$ Simplifying

The solution set is $\{x \mid -8 \ge x\}$, or

$$\{x \mid x \le -8\}$$
, or $(-\infty, -8]$.

52. *Familiarize*. Let x = the number of cats adopted through the FACE clinic in 2014. *Translate.*

30%	of t	he number of adopted cats	was	<u>280 cats</u>
\downarrow	\downarrow	↓ ↓	\downarrow	\downarrow
0.3	•	x	=	280
Cam		• We colve th	0.0011	ation

Carry out. We solve the equation. 0.3x = 280

$$x = \frac{280}{0.3}$$
$$x \approx 933$$

Check. If about 933 cats were adopted through the FACE clinic, then 30% of 933, or about 280, cats were adopted into barn homes. This amount checks.

State. About 933 cats were adopted through the FACE clinic in 2014.

53. *Familiarize.* Let x = the length of the first piece, in ft. Since the second piece is 2 ft longer than the first piece, it must be x + 2 ft. *Translate.*

The sum of the lengths of the two pieces is 32 ft.

$$\downarrow \qquad \qquad \downarrow \downarrow \\ x + (x+2) \qquad = 32$$

Carry out. We solve the equation.

$$x + (x + 2) = 32$$
$$2x + 2 = 32$$
$$2x = 30$$
$$x = 15$$

Check. If the first piece is 15 ft long, then the second piece must be 15 + 2, or 17 ft long. The sum of the lengths of the two pieces is 15 ft + 17 ft, or 32 ft. The answer checks. *State.* The lengths of the two pieces are 15 ft and 17 ft.

54. *Familiarize.* Let x = the first odd integer and let x + 2 = the next consecutive odd integer. *Translate.* The sum of the two

consecutive odd integers is 116.

$$\downarrow \qquad \qquad \downarrow \downarrow \\ x + (x + 2) \qquad = 116$$

Carry out. We solve the equation.

$$x + (x + 2) = 116$$
$$2x + 2 = 116$$
$$2x = 114$$
$$x = 57$$

Check. If the first odd integer is 57, then the next consecutive odd integer would be 57 + 2, or 59. The sum of these two integers is 57 + 59, or 116. This result checks. **State.** The integers are 57 and 59.

55. *Familiarize.* Let x = the length of the rectangle, in cm. The width of the rectangle is x-6 cm. The perimeter of a rectangle is given by P = 2l + 2w, where *l* is the length and *w* is the width. *Translate.*

The perimeter of the rectangle is 56 cm.

 $\downarrow \downarrow$ \downarrow 2x + 2(x - 6)= 56 Carry out. We solve the equation. 2x+2(x-6)=56

$$2x + 2(x - 6) = 56$$
$$2x + 2x - 12 = 56$$
$$4x - 12 = 56$$
$$4x = 68$$
$$x = 17$$

Check. If the length is 17 cm, then the width is 17 cm - 6 cm, or 11 cm. The perimeter is $2 \cdot 17 \text{ cm} + 2 \cdot 11 \text{ cm}$, or 34 cm + 22 cm, or 56 cm + 22 cmcm. These results check.

State. The length is 17 cm and the width is 11 cm.

56. *Familiarize.* Let x = the regular price of the picnic table. Since the picnic table was reduced by 25%, it actually sold for 75% of its original price.

Translate.

75% of the original price is \$120.

\downarrow	\downarrow	\downarrow	\downarrow	\downarrow
0.75	•	x	=	120

Carry out. We solve the equation. 0.75x = 120

$$x = \frac{120}{0.75}$$
$$x = 160$$

Check. If the original price was \$160 with a 25% discount, then the purchaser would have paid 75% of \$160, or 0.75 · \$160, or \$120. This result checks.

State. The original price was \$160.

57. *Familiarize.* Let x = the amount of sleep that infants need. 12 hours is 25% less than x, or 75% of *x*.

Translate.

the hours 75% of is 12 hours. infants sleep \downarrow \downarrow L \downarrow \downarrow

$$0.75 \cdot x = 12$$

Carry out. We solve the equation. 0.75x = 12

$$x = \frac{12}{0.75}$$
$$x = 16$$

Check. If infants sleep 16 hours, then 75% of 16 hours is 12 hours. This result checks. State. Infants need 16 hours of sleep per day.

58. *Familiarize.* Let x = the measure of the first 10°. The sum of the measures of the angles of a triangle is 180°.

Translate. C .1 **T**1

Check. If the measure of the first angle is 35° , then the measure of the second angle is $35^{\circ} + 50^{\circ}$, or 85° , and the measure of the third angle is $2 \cdot 35^{\circ} - 10^{\circ}$, or 60° . The sum of the measures of the first, second, and third angles is $35^{\circ} + 85^{\circ} + 60^{\circ}$, or 180° . These results check.

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

59. Familiarize. We examine the values in the table and determine the relationship between the number of parts and the total cost of the parts.

Number of Parts	Total Cost of Parts
1	$1 \cdot 50 + 2000 = 2050$
2	$2 \cdot 50 + 2000 = 2100$
3	$3 \cdot 50 + 2000 = 2150$
10	$10 \cdot 50 + 2000 = 2500$
50	$50 \cdot 50 + 2000 = 4500$
100	$100 \cdot 50 + 2000 = 7000$

We note that \$50 times the number of parts plus \$2000 gives the total cost of the parts. We let x represent the number of parts. Translate.

The total cost of parts is \$6000.

$$\begin{array}{c} \downarrow \\ 50x + 2000 \end{array} \qquad \qquad \downarrow \downarrow \\ = 6000 \end{array}$$

Carry out. We solve the equation. 50x + 2000 = 6000

50x = 4000

$$x = 80$$

Check. If the number of parts is 80, then the total cost of the parts is $$50 \cdot 80 + 2000 , or \$6000. This result checks. State. Kaitlin purchased 80 hinges.

60. *Familiarize*. Let *x* = the amounts Caroline can spend during the sixth month. Translate.

The average of the amounts spent for entertainment	does not exceed	\$95.
\downarrow	\downarrow	\downarrow
98 + 89 + 110 + 85 + 83 + x	-	05

95

$$\frac{3+89+110+85+83+x}{6} \leq$$

Carry out. We solve the inequality. 98 + 89 + 110 + 85 + 83 + x < 05

$$\frac{6}{6} \left(\frac{98+89+110+85+83+x}{6}\right) \le 6.95$$

$$\frac{98+89+110+85+83+x}{6} \le 6.95$$

$$\frac{98+89+110+85+83+x}{465+x} \le 570$$

$$\frac{465+x}{465+x} \le 570$$

$$\frac{465+x}{465} \le 570-465$$

$$x \le 105$$

Check. As a partial check we calculate the average amount spent on entertainment if Caroline spends \$105 during the sixth month. The average is

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

$$=\frac{\$570}{6}=\$95.$$

If Caroline spent any less than \$105 during the sixth month, her 6-month average would be less than \$95. These results check. *State.* Caroline should spend \$105 or less during the sixth month.

61. *Familiarize*. Let x = the widths of the rectangle. The perimeter of a rectangle is given by P = 2l + 2w.

Translate.

The perimeter of the rectangle	is greater than	120 cm.
\downarrow 2 · 43 + 2x	\downarrow >	\downarrow 120

Carry out. We solve the inequality.

$$2 \cdot 43 + 2x > 120$$

$$86 + 2x > 120$$

$$86 + 2x - 86 > 120 - 86$$

$$2x > 34$$

$$x > 17$$

Check. As a partial check, we calculate the perimeter when the width is 17 cm. The perimeter is $2 \cdot 43 \text{ cm} + 2 \cdot 17 \text{ cm}$, or $86 \text{ cm} + 2 \cdot 17 \text{ cm}$ 34 cm, or 120 cm. If the width exceeded 17 cm, the perimeter would exceed 120 cm. These results check. State. The width must be greater than 17 cm.

- 62. Thinking and Writing Exercise. Multiplying both sides of an equation by any nonzero number results in an equivalent equation. When multiplying on both sides of an inequality, the sign of the number being multiplied by must be considered. If the number is positive, the direction of the inequality symbol remains unchanged; if the number is negative, the direction of the inequality symbol must be reversed to produce an equivalent inequality.
- 63. Thinking and Writing Exercise. The solutions of an equation can usually each be checked. The solutions of an inequality are normally too numerous to check. Checking a few numbers from the solution set found cannot guarantee that the answer is correct, although if any number does not check, the answer found is incorrect.
- 64. *Familiarize.* Let x = the amount of time that sixth- and seventh-graders spend reading or doing homework each day. 108% more than this is 208%x. Note that 3 hr 20 min is equivalent to 200 min. Translate.

208%	of of	the time spent children on rea or homeworl	by ding is 200 min.
\downarrow	\downarrow	\downarrow	$\downarrow \downarrow$
2.08	•	x	= 200
<i>Carry</i> 2.08 <i>x</i>	<i>out.</i> = 20	We solve the	equation.
x	$=\frac{2}{2}$	$\frac{00}{08}$	
x	≈ 96	5.153846	

Check. If children spend 96.153846 minutes reading or doing homework, they spend (2.08)(96.153846) minutes watching TV or playing video games, or about 200 minutes. The result checks.

State. Children spend about 96 minutes, or 1 hour 36 minutes, reading or doing homework each day.

65. *Familiarize.* Let x = the length of the Nile River, in miles. Let x + 65 represent the length of the Amazon River, in miles. *Translate.*

The combined length of both rivers is 8385 miles.

$$\downarrow \qquad \qquad \downarrow \qquad \downarrow \\
x + (x + 65) \qquad = 8385$$

Carry out. We solve the equation.

$$x + (x + 65) = 8385$$

$$2x + 65 = 8385$$

$$2x = 8320$$

$$x = 4160$$

Check If the Nile 1

Check. If the Nile River is 4160 miles long, then the Amazon River is 4160 + 65, or 4225 miles. The combined length of both rivers is then 4160 + 4225, or 8385 miles. These results check.

State. The Nile River is 4160 miles long, and the Amazon River is 4225 miles long.

66. *Familiarize.* Let x = the sticker price of the car. The sticker price minus 20% of the sticker price would be x - 0.20x.

Translate.

The sticker price minus 20% of the plus \$200 is \$15,080. sticker price

$$x = 18,600$$

Check. If the sticker price is \$18,600, then 20% of the sticker price is $0.20 \cdot $18,600$, or \$3720. The sticker price minus 20% of the

sticker price is \$18,600 - \$3720, or \$14,880. Adding \$200, we get \$14,880 + \$200, or \$15,080, which is the purchase price. *State.* The sticker price of the car is \$18,600.

67.
$$2|n|+4=50$$

 $2|n|=46$

$$|n| = 23$$

The distance from some number *n* and the origin is 23 units. The solution is n = 23, or n = -23.

68. |3n| = 60

The distance from some number, 3n, to the origin is 60 units. So we have: 3n = -60 3n = 60n = -20 n = 20

The solution is -20 and 20.

69.
$$y = 2a - ab + 3$$
$$y = a(2-b) + 3$$
$$y - 3 = a(2-b)$$
$$\frac{y-3}{2-b} = a$$
The solution is $a = \frac{y-3}{2-b}$.

Chapter 2 Test

1. t+7=16 t+7-7=16-7 Adding -7 t=9 Simplifying The solution is 9.

2. t-3 = 12t-3+3 = 12+3 Adding 3 t = 15 Simplifying The solution is 15.

3.
$$6x = -18$$

$$\frac{1}{6}(6x) = \frac{1}{6}(-18)$$
 Multiplying by $\frac{1}{6}$
 $x = -3$ Simplifying
The solution is -3.

- 4. $-\frac{4}{7}x = -28$ $-\frac{7}{4}\left(-\frac{4}{7}x\right) = -\frac{7}{4}\left(-28\right)$ Multiplying by $-\frac{7}{4}$ x = 49 Simplifying The solution is 49.
- 5. 3t + 7 = 2t 53t + 7 7 = 2t 5 7Adding -73t = 2t 12Simplifying3t 2t = 2t 12 2tAdding -2tt = -12Simplifying
The solution is -12.
- 6. $\frac{1}{2}x \frac{3}{5} = \frac{2}{5}$ $\frac{1}{2}x \frac{3}{5} + \frac{3}{5} = \frac{2}{5} + \frac{3}{5}$ Adding $\frac{3}{5}$ $\frac{1}{2}x = \frac{5}{5}$ Simplifying $\frac{1}{2}x = 1$ Simplifying $2(\frac{1}{2}x) = 2 \cdot 1$ Multiplying by 2 x = 2Simplifying
 The solution is 2.
- 7. 8 y = 16 8 - y - 8 = 16 - 8 Adding - 8 -y = 8 Simplifying y = -8 Multiply by -1 The solution is -8.
- 4.2x + 3.5 = 1.2 2.5x8. 4.2x + 3.5 - 3.5 = 1.2 - 2.5x - 3.5Subtracting 3.5 4.2x = -2.3 - 2.5xSimplifying 4.2x + 2.5x = -2.3 - 2.5x + 2.5xAdding 2.5x 6.7x = -2.3Simplifying $\frac{6.7x}{-2.3}$ Dividing by 6.7 6.7 67 $x = \frac{-23}{67}$ Simplifying

The solution is $-\frac{23}{67}$.

9. 4(x+2) = 36 4x+8 = 36 Distributive Law 4x+8-8 = 36-8 Adding -8 4x = 28 Simplifying $\frac{1}{4}(4x) = \frac{1}{4}(28)$ Multiplying by $\frac{1}{4}$ x = 7 Simplifying The solution is 7. 10. 9-3x=6(x+4)Distributive 9 - 3x = 6x + 24Law 9 - 3x - 24 = 6x + 24 - 24Adding -24 -3x - 15 = 6xSimplifying -3x - 15 + 3x = 6x + 3xAdding 3x-15 = 9xSimplifying Multiplying $\frac{1}{9}(-15) = \frac{1}{9}(9x)$ by $\frac{1}{9}$ $-\frac{5}{3} = x$ Simplifying

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

- 11. $\frac{5}{6}(3x+1) = 20$ $\frac{6}{5}\left[\frac{5}{6}(3x+1)\right] = \frac{6}{5} \cdot 20$ Multiplying by $\frac{6}{5}$ 3x+1 = 24 Simplifying 3x+1-1 = 24-1 Adding -1 3x = 23 Simplifying $\frac{1}{3}(3x) = \frac{1}{3}(23)$ Multiplying by $\frac{1}{3}$ $x = \frac{23}{3}$ Simplifying The solution is $\frac{23}{3}$.
- 12. 3(2x-8) = 6(x-4)6x-24 = 6x-24 Distributive Law Since this is true for all *x*, the equation is an identity.
- 13. x+6>1x+6-6>1-6 Adding -6 x>-5 Simplifying

The solution set is $\{x \mid x > -5\}$, or $(-5, \infty)$.

14. 14x+9>13x-4 14x+9-9>13x-4-9 Adding -9 14x>13x-13 Simplifying 14x-13x>13x-13-13x Adding -13x x>-13 Simplifying The solution set is $\{x \mid x > -13\}$, or $(-13,\infty)$.

- 15. $-2y \le 26$ $-\frac{1}{2}(-2y) \ge -\frac{1}{2}(26)$ Multiplying by $-\frac{1}{2}$ and reversing the inequality symbol $y \ge -13$ Simplifying The solution set is $\{y \mid y \ge -13\}$, or $[-13,\infty)$.
- 16. $4y \le -32$ $\frac{1}{4}(4y) \le \frac{1}{4}(-32)$ Multiplying by $\frac{1}{4}$ $y \le -8$ Simplifying The solution set is $\{y \mid y \le -8\}$, or $(-\infty, -8]$.
- 17. 4n+3 < -17 4n+3-3 < -17Subtracting 3 4n < -20Simplifying $\frac{4n}{4} < \frac{-20}{4}$ Dividing by 4 n < -5

The solution set is $\{n \mid n < -5\}$, or $(-\infty, -5)$.

18. $\frac{1}{2}t - \frac{1}{4} \le \frac{3}{4}t$ $4\left(\frac{1}{2}t - \frac{1}{4}\right) \le 4 \cdot \left(\frac{3}{4}t\right)$ Multiplying by 4 $2t - 1 \le 3t$ Simplifying $2t - 1 + 1 \le 3t + 1$ Adding 1 $2t \le 3t + 1$ Simplifying $2t - 3t \le 3t + 1 - 3t$ Subtracting 3t $-t \leq 1$ Simplifying $t \ge -1$ Multiplying by -1 The solution set is $\{t | t \ge -1\}$, or $[-1, \infty)$.

19.
$$5-9x \ge 19+5x$$

$$5-9x-5 \ge 19+5x-5$$
Adding -5
$$-9x \ge 14+5x$$
Simplifying
$$-9x-5x \ge 14+5x-5x$$
Adding -5x
$$-14x \ge 14$$
Simplifying
$$-\frac{1}{14}(-14x) \le -\frac{1}{14}(14)$$

$$x \le -1$$
Multiplying by
$$-\frac{1}{14} \text{ and revers-ing the inequality symbol}$$

$$x \le -1$$
Simplifying
The solution set is $\{x \mid x \le -1\}$, or $(-\infty, -1]$.

20. $A = 2\pi rh$

$$\frac{1}{2\pi h} \cdot A = \frac{1}{2\pi h} (2\pi rh) \quad \begin{array}{l} \text{Multiplying} \\ \text{by } \frac{1}{2\pi h} \\ \frac{A}{2\pi h} = r \\ \end{array}$$
Simplifying
The solution is $r = \frac{A}{2\pi h}$.

21.
$$w = \frac{P+l}{2}$$

$$2 \cdot w = 2\left(\frac{P+l}{2}\right)$$
 Multiplying by 2

$$2w = P+l$$
 Simplifying

$$2w-P = P+l-P$$
 Adding $-P$

$$2w-P = l$$
 Simplifying
The solution is $l = 2w-P$.

- 22. $230\% = 230 \times 0.01$ Replacing % by $\times 0.01$ = 2.3
- 23. 0.054 First move the decimal point two 0.05.4 places to the right; then write a % ⊥ ± symbol. The answer is 5.4%. 5.4%

24. Translate.

What number is 32% of 50?

25. Translate.

What percent of 75 is 33?

$$\downarrow \qquad \downarrow \downarrow \downarrow \downarrow \\
y \qquad \cdot 75 = 33$$

We solve the equation and then convert to percent notation. $v \cdot 75 = 33$

y · 75 = 33

$$y = \frac{33}{75}$$

 $y = 0.44 = 44\%$
The solution is 44%.

26.
$$\begin{array}{c} y < 4 \\ \hline & & \\ -10 - 8 - 6 - 4 - 2 & 0 & 2 & 4 & 6 & 8 & 10 \end{array}$$

$$\begin{array}{c} -2 \le x \le 2\\ 27. \quad \underbrace{<+++ \underbrace{+++-3}_{-5-4-3-2-1} \quad 0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \end{array}$$

28. *Familiarize.* Let w = the width of the calculator, in cm. Then the length is w+4, in cm. The perimeter of a rectangle is given by P = 2l + 2w.

Translate.

The perimeter of the rectangle is 36.

$$\downarrow \qquad \qquad \downarrow \downarrow \\ 2(w+4)+2w \qquad = 36$$

Carry out. We solve the equation.

$$2(w+4)+2w = 36$$

 $2w+8+2w = 36$
 $4w+8 = 36$

$$w + 8 = 30$$
$$4w = 28$$
$$w = 7$$

Check. If the width is 7 cm, then the length is 7 + 4, or 11 cm. The perimeter is then $2 \cdot 11 + 2 \cdot 7$, or 22 + 14, or 36 cm. The results checks.

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

29. *Familiarize.* Let x = the number of miles Kari has already ridden. Then she has 3x miles to go.

Translate.

The total length of Kari's bicycle trip is 240 miles.

\downarrow	$\downarrow \downarrow$
x + 3x	= 240

Carry out. We solve the equation.

$$x + 3x = 240$$
$$4x = 240$$

x = 60

Check. If Kari has already ridden 60 mi, then she has yet to ride 3.60 mi, or 180 mi. The total length of her ride is 60 mi + 180 mi, or 240 mi. This result checks. **State.** Kari has already ridden 60 miles.

30. *Familiarize.* Let x = the length of the first side, in mm. Then the length of the second side is x + 2 mm, and the length of the third

side is x + 4 mm. The perimeter of a triangle is the sum of the lengths of the three sides. *Translate.*

The perimeter of the triangle is 249 mm.

$$3x + 6 = 249$$
$$3x = 243$$

x = 81

Check. If the length of the first side is 81 mm, then the length of the second side is 81 + 2, or 83 mm, and the length of the third side is 81 + 4, or 85 mm. The perimeter of the triangle is 81 + 83 + 85, or 249 mm. These results check. *State.* The lengths of the sides are 81 mm, 83 mm, and 85 mm.

31. *Familiarize.* Let x = the electric bill before the temperature of the water heater was lowered. If the bill dropped by 7%, then the Kelly's paid 93% of their original bill. *Translate.*

93% of the original bill is \$60.45.

32. *Familiarize.* Let x = the number of miles that will allow the business to stay within budget. The cost for the rental would be \$14.95 + \$0.59x.

Translate.

33.



$$x \le \frac{235.05}{0.59}$$
$$x \le 398.3898$$

Check. As a partial check, we let x = 398.39 mi and determine the cost of the rental. The rental would be \$14.95 + \$0.59(398.39), or \$250 (rounded to the nearest dollar). If the mileage were less, the rental would be under \$250, so the result checks. If 398.4 miles is used, the result will be slightly more than \$250, so we round down to 398.3 miles to the nearest tenth of a mile.

State. The mileage is less than or equal to 398.3 mi, rounded to the nearest tenth.

$$c = \frac{2cd}{a-d}$$

$$(a-d)c = (a-d)\left(\frac{2cd}{a-d}\right) \quad \begin{array}{l} \text{Multiplying} \\ \text{by } a-d \\ ac-dc = 2cd \\ ac-dc + dc = 2cd + dc \\ \end{array}$$
Simplifying
$$c = \frac{2cd}{a-d} \quad \begin{array}{l} \text{Simplifying} \\ \text{Simplifying} \\ \text{Adding dc} \\ \end{array}$$

$$ac = 3cd$$
 Simplifying
 $\frac{1}{3c}(ac) = \frac{1}{3c}(3cd)$ Multiplying
by $\frac{1}{3c}$

$$\frac{dc}{dc} = d$$
 Simplifying

The solution is $d = \frac{a}{3}$.

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

34. 3|w| - 8 = 37

3|w| - 8 + 8 = 37 + 8 Adding 8

 $3|w| = 45 \qquad \text{Simplifying} \\ \frac{1}{3}(3|w|) = \frac{1}{3} \cdot 45 \qquad \text{Multiplying by } \frac{1}{3} \\ |w| = 15 \qquad \text{Simplifying} \end{cases}$

This tells us that the number w is 15 units from the origin. The solutions are w = -15 and w = 15.

- 35. Let h = the number of hours of sun each day. Then at least 4 hr but no more than 6 hr of sun is $4 \le h \le 6$.
- 36. *Familiarize.* Let x = the number of tickets given away. The following shows the distribution of the tickets:

First person received $\frac{1}{3}x$ tickets.

Second person received $\frac{1}{4}x$ tickets.

Third person received $\frac{1}{5}x$ tickets. Fourth person received 8 tickets. Fifth person received 5 tickets.

Translate.

The number of tickets is the total number of tickets.

 $\begin{array}{c} & \downarrow & \downarrow & \downarrow \\ \frac{1}{3}x + \frac{1}{4}x + \frac{1}{5}x + 8 + 5 &= & x \\ \hline carry \ out. \ We \ solve \ the \ equation. \\ \frac{1}{3}x + \frac{1}{4}x + \frac{1}{5}x + 8 + 5 &= & x \\ 60(\frac{1}{3}x + \frac{1}{4}x + \frac{1}{5}x + 8 + 5) &= 60x \\ 60(\frac{1}{3}x + \frac{1}{4}x + \frac{1}{5}x + 13) &= 60x \\ 20x + 15x + 12x + 780 &= 60x \\ 20x + 15x + 12x + 780 &= 60x \\ 47x + 780 &= 60x \\ 780 &= 13x \\ 60 &= x \end{array}$

Check. If the total number of tickets given away was 60, then the first person received $\frac{1}{3}(60)$, or 20 tickets; the second person

received $\frac{1}{4}(60)$, or 15 tickets; the third person

received $\frac{1}{5}(60)$, or 12 tickets. We are told

that the fourth person received 8 tickets, and the fifth person received 5 tickets. The sum of the tickets distributed is 20 + 15 + 12 + 8 +5, or 60 tickets. These results check. **State.** A total of 60 tickets were given away.

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