2.1 WARM-UPS

1. An equation is a sentence that expresses the equality of two algebraic expressions.
2. The solution set is the set of all solutions to an equation.
3. A number satisfies an equation if the equation is true when the variable is replaced by the number.
4. Equations that have the same solution set are equivalent.
5. A linear equation in one variable has the form $ax = b$, with $a \neq 0$.
6. According the to the addition property of equality, adding the same number to both sides of an equation does not change the solution set.
7. True, because $10 - 5 = 5$ is correct.
8. True, because 8 satisfies both equations.
9. False, you should multiply by $\frac{4}{3}$.
10. True, because dividing by 7 and multiplying by $\frac{1}{7}$ are the same.
11. True, because the solution set to both equations is $\{0\}$.
12. True, because subtracting t from each side yields $t = 7$.
13. False, because $2(4) - 3 = 4 - 1$ is not correct.

2.1 EXERCISES

1.
$$x - 6 = -5$$
$$x - 6 + 6 = -5 + 6$$
$$x = 1$$
The solution set is $\{1\}$.

2.
$$x - 7 = -2$$
$$x - 7 + 7 = -2 + 7$$
$$x = 5$$
The solution set is $\{5\}$.

3.
$$-13 + x = -4$$
$$-13 + x + 13 = -4 + 13$$
$$x = 9$$
The solution set is $\{9\}$.

4.
$$-8 + x = -12$$
$$-8 + x + 8 = -12 + 8$$
$$x = -4$$
The solution set is $\{-4\}$.

5.
$$y - \frac{1}{2} = \frac{1}{2}$$
$$y - \frac{1}{2} + \frac{1}{2} = \frac{1}{2} + \frac{1}{2}$$
$$y = 1$$
The solution set is $\{1\}$.

6.
$$y - \frac{1}{4} = \frac{1}{2}$$
$$y - \frac{1}{4} + \frac{1}{4} = \frac{1}{2} + \frac{1}{4}$$
$$y = \frac{3}{4}$$
The solution set is $\left\{\frac{3}{4}\right\}$.

7.
$$w - \frac{1}{3} = \frac{1}{3}$$
$$w - \frac{1}{3} + \frac{1}{3} = \frac{1}{3} + \frac{1}{3}$$
$$w = \frac{2}{3}$$
The solution set is $\left\{\frac{2}{3}\right\}$.

8.
$$w - \frac{1}{3} = \frac{1}{2}$$
$$w - \frac{1}{3} + \frac{1}{3} = \frac{1}{2} + \frac{1}{3}$$
$$w = \frac{5}{6}$$
The solution set is $\left\{\frac{5}{6}\right\}$.

9.
$$x + 3 = -6$$
$$x + 3 - 3 = -6 - 3$$
$$x = -9$$
The solution set is $\{-9\}$.

10.
$$x + 4 = -3$$
$$x + 4 - 4 = -3 - 4$$
$$x = -7$$
The solution set is $\{-7\}$.

11.
$$12 + x = -7$$
$$12 + x - 12 = -7 - 12$$
$$x = -19$$
The solution set is $\{-19\}$.

12.
$$19 + x = -11$$
$$19 + x - 19 = -11 - 19$$
$$x = -30$$
The solution set is $\{-30\}$.

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

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

$t=\frac{1}{4}$

The solution set is $\left\{\frac{1}{4}\right\}$.

14. $t+\frac{1}{3}=1$

$t+\frac{1}{3}-\frac{1}{3}=1-\frac{1}{3}$

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

The solution set is $\left\{\frac{2}{3}\right\}$.

15. $\frac{1}{19}+m=\frac{1}{19}$

$\frac{1}{19}+m-\frac{1}{19}=\frac{1}{19}-\frac{1}{19}$

$m=0$

The solution set is $\{0\}$.

16. $\frac{1}{3}+n=\frac{1}{2}$

$\frac{1}{3}+n-\frac{1}{3}=\frac{1}{2}-\frac{1}{3}$

$n=\frac{1}{6}$

The solution set is $\left\{\frac{1}{6}\right\}$.

17. $a+0.05=6$

$a+0.05-0.05=6-0.05$

$a=5.95$

The solution set is $\{5.95\}$.

18. $b+4=-0.7$

$b+4-4=-0.7-4$

$b=-4.7$

The solution set is $\{-4.7\}$.

19. $2=x+7$

$2-7=x+7-7$

$-5=x$

The solution set is $\{-5\}$.

20. $3=x+5$

$3-5=x+5-5$

$-2=x$

The solution set is $\{-2\}$.

21. $-13=y-9$

$-13+9=y-9+9$

$-4=y$

The solution set is $\{-4\}$.

22. $-14=z-12$

$-14+12=z-12+12$

$-2=z$

The solution set is $\{-2\}$.

23. $0.5=-2.5+x$

$0.5+2.5=-2.5+x+2.5$

$3=x$

The solution set is $\{3\}$.

24. $0.6=-1.2+x$

$0.6+1.2=-1.2+x+1.2$

$1.8=x$

The solution set is $\{1.8\}$.

25. $\frac{1}{8}=-\frac{1}{8}+r$

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

$\frac{1}{4}=r$

The solution set is $\left\{\frac{1}{4}\right\}$.

26. $\frac{1}{6}=-\frac{1}{6}+h$

$\frac{1}{6}+\frac{1}{6}=-\frac{1}{6}+h+\frac{1}{6}$

$\frac{1}{3}=h$

The solution set is $\left\{\frac{1}{3}\right\}$.

27. $\frac{x}{2}=-4$

$2\cdot\frac{x}{2}=2\cdot(-4)$

$x=-8$

The solution set is $\{-8\}$.

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

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

$x=-18$

The solution set is $\{-18\}$.

29. $0.03=\frac{y}{60}$

$60\cdot 0.03=60\cdot\frac{y}{60}$

$1.8=y$

The solution set is $\{1.8\}$.

30. $0.05 = \dfrac{y}{80}$

$80 \cdot 0.05 = 80 \cdot \dfrac{y}{80}$

$4 = y$

The solution set is $\{4\}$.

31. $\dfrac{a}{2} = \dfrac{1}{3}$

$2 \cdot \dfrac{a}{2} = 2 \cdot \dfrac{1}{3}$

$a = \dfrac{2}{3}$

The solution set is $\left\{\frac{2}{3}\right\}$.

32. $\dfrac{b}{2} = \dfrac{1}{5}$

$2 \cdot \dfrac{b}{2} = 2 \cdot \dfrac{1}{5}$

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

The solution set is $\left\{\frac{2}{5}\right\}$.

33. $\dfrac{1}{6} = \dfrac{c}{3}$

$3 \cdot \dfrac{1}{6} = 3 \cdot \dfrac{c}{3}$

$\dfrac{1}{2} = c$

The solution set is $\left\{\frac{1}{2}\right\}$.

34. $\dfrac{1}{12} = \dfrac{d}{3}$

$3 \cdot \dfrac{1}{12} = 3 \cdot \dfrac{d}{3}$

$\dfrac{1}{4} = d$

The solution set is $\left\{\frac{1}{4}\right\}$.

35. $-3x = 15$

$\dfrac{-3x}{-3} = \dfrac{15}{-3}$

$x = -5$

The solution set is $\{-5\}$.

36. $-5x = -20$

$\dfrac{-5x}{-5} = \dfrac{-20}{-5}$

$x = 4$

The solution set is $\{4\}$.

37. $20 = 4y$

$\dfrac{20}{4} = \dfrac{4y}{4}$

$5 = y$

The solution set is $\{5\}$.

38. $18 = -3a$

$\dfrac{18}{-3} = \dfrac{-3a}{-3}$

$-6 = a$

The solution set is $\{-6\}$.

39. $2w = 2.5$

$\dfrac{2w}{2} = \dfrac{2.5}{2}$

$w = 1.25$

The solution set is $\{1.25\}$.

40. $-2x = -5.6$

$\dfrac{-2x}{-2} = \dfrac{-5.6}{-2}$

$x = 2.8$

The solution set is $\{2.8\}$.

41. $5 = 20x$

$\dfrac{5}{20} = \dfrac{20x}{20}$

$\dfrac{1}{4} = x$

The solution set is $\left\{\frac{1}{4}\right\}$.

42. $-3 = 27d$

$\dfrac{-3}{27} = \dfrac{27d}{27}$

$-\dfrac{1}{9} = d$

The solution set is $\left\{-\frac{1}{9}\right\}$.

43. $5x = \dfrac{3}{4}$

$\dfrac{1}{5} \cdot 5x = \dfrac{1}{5} \cdot \dfrac{3}{4}$

$x = \dfrac{3}{20}$

The solution set is $\left\{\frac{3}{20}\right\}$.

44. $3x = -\dfrac{2}{3}$

$\dfrac{1}{3} \cdot 3x = \dfrac{1}{3} \cdot \left(-\dfrac{2}{3}\right)$

$x = -\dfrac{2}{9}$

The solution set is $\left\{-\frac{2}{9}\right\}$.

45.
$$\frac{3}{2}x = -3$$
$$\frac{2}{3}\cdot\frac{3}{2}x = \frac{2}{3}\cdot(-3)$$
$$x = -2$$
The solution set is $\{-2\}$.

46.
$$\frac{2}{3}x = -8$$
$$\frac{3}{2}\cdot\frac{2}{3}x = \frac{3}{2}(-8)$$
$$x = -12$$
The solution set is $\{-12\}$.

47.
$$90 = \frac{3y}{4}$$
$$\frac{4}{3}\cdot 90 = \frac{4}{3}\cdot\frac{3y}{4}$$
$$120 = y$$
The solution set is $\{120\}$.

48.
$$14 = \frac{7y}{8}$$
$$\frac{8}{7}\cdot 14 = \frac{8}{7}\cdot\frac{7y}{8}$$
$$16 = y$$
The solution set is $\{16\}$.

49.
$$-\frac{3}{5}w = -\frac{1}{3}$$
$$-\frac{5}{3}\left(-\frac{3}{5}w\right) = -\frac{5}{3}\left(-\frac{1}{3}\right)$$
$$w = \frac{5}{9}$$
The solution set is $\left\{\frac{5}{9}\right\}$.

50.
$$-\frac{5}{2}t = -\frac{3}{5}$$
$$-\frac{2}{5}\left(-\frac{5}{2}t\right) = -\frac{2}{5}\left(-\frac{3}{5}\right)$$
$$t = \frac{6}{25}$$
The solution set is $\left\{\frac{6}{25}\right\}$.

51.
$$\frac{2}{3} = -\frac{4x}{3}$$
$$-\frac{3}{4}\left(\frac{2}{3}\right) = -\frac{3}{4}\left(-\frac{4x}{3}\right)$$
$$-\frac{1}{2} = x$$
The solution set is $\left\{-\frac{1}{2}\right\}$.

52.
$$\frac{1}{14} = -\frac{6p}{7}$$
$$-\frac{7}{6}\left(\frac{1}{14}\right) = -\frac{7}{6}\left(-\frac{6p}{7}\right)$$
$$-\frac{1}{12} = p$$
The solution set is $\left\{-\frac{1}{12}\right\}$.

53.
$$-x = 8$$
$$-1(-x) = -1(8)$$
$$x = -8$$
The solution set is $\{-8\}$.

54.
$$-x = 4$$
$$-1(-x) = -1(4)$$
$$x = -4$$
The solution set is $\{-4\}$.

55.
$$-y = -\frac{1}{3}$$
$$-1(-y) = -1\left(-\frac{1}{3}\right)$$
$$y = \frac{1}{3}$$
The solution set is $\left\{\frac{1}{3}\right\}$.

56.
$$-y = -\frac{7}{8}$$
$$-1(-y) = -1\left(-\frac{7}{8}\right)$$
$$y = \frac{7}{8}$$
The solution set is $\left\{\frac{7}{8}\right\}$.

57.
$$3.4 = -z$$
$$-1(3.4) = -1(-z)$$
$$-3.4 = z$$
The solution set is $\{-3.4\}$.

58.
$$4.9 = -t$$
$$-1(4.9) = -1(-t)$$
$$-4.9 = t$$
The solution set is $\{-4.9\}$.

59.
$$-k = -99$$
$$-1(-k) = -1(-99)$$
$$k = 99$$
The solution set is $\{99\}$.

60.
$$-m = -17$$
$$-1(-m) = -1(-17)$$
$$m = 17$$
The solution set is $\{17\}$.

61. $4x = 3x - 7$
$4x - 3x = 3x - 7 - 3x$
$x = -7$
The solution set is $\{-7\}$.

62. $3x = 2x + 9$
$3x - 2x = 2x + 9 - 2x$
$x = 9$
The solution set is $\{9\}$.

63. $9 - 6y = -5y$
$9 - 6y + 6y = -5y + 6y$
$9 = y$
The solution set is $\{9\}$.

64. $12 - 18w = -17w$
$12 - 18w + 18w = -17w + 18w$
$12 = w$
The solution set is $\{12\}$.

65. $-6x = 8 - 7x$
$-6x + 7x = 8 - 7x + 7x$
$x = 8$
The solution set is $\{8\}$.

66. $-3x = -6 - 4x$
$-3x + 4x = -6 - 4x + 4x$
$x = -6$
The solution set is $\{-6\}$.

67. $\frac{1}{2}c = 5 - \frac{1}{2}c$
$\frac{1}{2}c + \frac{1}{2}c = 5 - \frac{1}{2}c + \frac{1}{2}c$
$c = 5$
The solution set is $\{5\}$.

68. $-\frac{1}{2}h = 13 - \frac{3}{2}h$
$-\frac{1}{2}h + \frac{3}{2}h = 13 - \frac{3}{2}h + \frac{3}{2}h$
$h = 13$
The solution set is $\{13\}$.

69. $12 = x + 17$
$12 - 17 = x + 17 - 17$
$-5 = x$
The solution set is $\{-5\}$.

70. $-3 = x + 6$
$-3 - 6 = x + 6 - 6$
$-9 = x$
The solution set is $\{-9\}$.

71. $\frac{3}{4}y = -6$
$\frac{4}{3} \cdot \frac{3}{4}y = \frac{4}{3}(-6)$
$y = -8$
The solution set is $\{-8\}$.

72. $\frac{5}{9}z = -10$
$\frac{9}{5} \cdot \frac{5}{9}z = \frac{9}{5}(-10)$
$z = -18$
The solution set is $\{-18\}$.

73. $-3.2 + x = -1.2$
$-3.2 + x + 3.2 = -1.2 + 3.2$
$x = 2$
The solution set is $\{2\}$.

74. $t - 3.8 = -2.9$
$t - 3.8 + 3.8 = -2.9 + 3.8$
$t = 0.9$
The solution set is $\{0.9\}$.

75. $2a = \frac{1}{3}$
$\frac{1}{2} \cdot 2a = \frac{1}{2} \cdot \frac{1}{3}$
$a = \frac{1}{6}$
The solution set is $\left\{\frac{1}{6}\right\}$.

76. $-3w = \frac{1}{2}$
$-\frac{1}{3}(-3w) = -\frac{1}{3} \cdot \frac{1}{2}$
$w = -\frac{1}{6}$
The solution set is $\left\{-\frac{1}{6}\right\}$.

77. $-9m = 3$
$\frac{-9m}{-9} = \frac{3}{-9}$
$m = -\frac{1}{3}$
The solution set is $\left\{-\frac{1}{3}\right\}$.

78. $-4h = -2$
$\frac{-4h}{-4} = \frac{-2}{-4}$
$h = \frac{1}{2}$
The solution set is $\left\{\frac{1}{2}\right\}$.

79.
$$-b = -44$$
$$-1(-b) = -1(-44)$$
$$b = 44$$
The solution set is $\{44\}$.

80.
$$-r = 55$$
$$-1(-r) = -1(55)$$
$$r = -55$$
The solution set is $\{-55\}$.

81.
$$\frac{2}{3}x = \frac{1}{2}$$
$$\frac{3}{2} \cdot \frac{2}{3}x = \frac{3}{2} \cdot \frac{1}{2}$$
$$x = \frac{3}{4}$$
The solution set is $\left\{\frac{3}{4}\right\}$.

82.
$$\frac{3}{4}x = \frac{1}{3}$$
$$\frac{4}{3} \cdot \frac{3}{4}x = \frac{4}{3} \cdot \frac{1}{3}$$
$$x = \frac{4}{9}$$
The solution set is $\left\{\frac{4}{9}\right\}$.

83.
$$-5x = 7 - 6x$$
$$-5x + 6x = 7 - 6x + 6x$$
$$x = 7$$
The solution set is $\{7\}$.

84.
$$-\frac{1}{2} + 3y = 4y$$
$$-\frac{1}{2} + 3y - 3y = 4y - 3y$$
$$-\frac{1}{2} = y$$
The solution set is $\left\{-\frac{1}{2}\right\}$.

85.
$$\frac{5a}{7} = -10$$
$$\frac{7}{5} \cdot \frac{5a}{7} = \frac{7}{5}(-10)$$
$$a = -14$$
The solution set is $\{-14\}$.

86.
$$\frac{7r}{12} = -14$$
$$\frac{12}{7} \cdot \frac{7r}{12} = \frac{12}{7}(-14)$$
$$r = -24$$
The solution set is $\{-24\}$.

87.
$$\frac{1}{2}v = -\frac{1}{2}v + \frac{3}{8}$$
$$\frac{1}{2}v + \frac{1}{2}v = -\frac{1}{2}v + \frac{3}{8} + \frac{1}{2}v$$
$$v = \frac{3}{8}$$
The solution set is $\left\{\frac{3}{8}\right\}$.

88.
$$\frac{1}{3}s + \frac{7}{9} = \frac{4}{3}s$$
$$\frac{1}{3}s + \frac{7}{9} - \frac{1}{3}s = \frac{4}{3}s - \frac{1}{3}s$$
$$\frac{7}{9} = s$$
The solution set is $\left\{\frac{7}{9}\right\}$.

89. a) The 41.8 births per 1000 females in 2006 is $\frac{2}{3}$ of the birth rate in 1991. If x is the rate in 1991, we can write the following equation.
$$41.8 = \frac{2}{3}x$$
$$\frac{3}{2}(41.8) = \frac{3}{2} \cdot \frac{2}{3}x$$
$$62.7 = x$$
In 1991 the birth rate was about 62.7 births per 1000 females.

b) From the graph it appears that in 2000 the rate was about 50 births per 1000 females.

90. The 2015 world grain supply, 2.1 trillion metric tons, will be $\frac{3}{4}$ of the world grain demand d :
$$2.1 = \frac{3}{4}d$$
$$\frac{4}{3}(2.1) = \frac{4}{3} \cdot \frac{3}{4}d$$
$$2.8 = d$$
The 2015 world grain demand will be 2.8 trillion metric tons.

91. The number of advancers, 1918, was $\frac{2}{3}$of the number traded, t :
$$1918 = \frac{2}{3}t$$
$$\frac{3}{2}(1918) = \frac{3}{2} \cdot \frac{2}{3}t$$
$$2877 = t$$
So 2877 stocks were traded on that day.

92. The number of births to unmarried women, $1{,}707{,}600,$ was $\frac{2}{5}$ of all births, a:

$$1{,}707{,}600 = \frac{2}{5}a$$
$$\frac{5}{2}(1{,}707{,}600) = \frac{5}{2} \cdot \frac{2}{5}a$$
$$4{,}269{,}000 = a$$

There were $4{,}269{,}000$ births in 2009.

93. If x is the number of students at the college and 40% of them are male, then $0.40x$ is the number of males. But we also know that the number of males is 1200.

$$0.40x = 1200$$
$$\frac{0.40x}{0.40} = \frac{1200}{0.40}$$
$$x = 3000$$

There are 3000 students at the college.

94. If x is the annual revenue for the credit card company and 70% of the revenue comes from interest and penalties, then $0.70x$ is the amount from interest and penalties. But we also know that the amount from interest and penalties was \$210 million.

$$0.70x = 210$$
$$\frac{0.70x}{0.70} = \frac{210}{0.70}$$
$$x = 300$$

The annual revenue for the credit card company was \$300 million.

2.2 WARM-UPS

1. To solve $-x = 8$ we use the multiplication property of equality.

2. To solve $x + 5 = 9$ we use the addition property of equality.

3. To solve $3x - 7 = 11$ we apply the addition property of equality and then the multiplication property of equality.

4. True, because $4(3) - 3 = 3(3)$ is correct.

5. True, because subtracting 7 from each side of $2x + 7 = 8$ yields $2x = 1$.

6. True, because adding 5 to each side of $3x - 5 = 8x + 7$ yields $3x = 8x + 12$, and subtracting $8x$ from each side yields $-5x = 12$.

7. False, because that puts the variables and the numbers on the same side.

8. True, because multiplying each side of $-n = 9$ by -1 yields $n = -9$.

9. True, because multiplying each side of $-y = -7$ by -1 yields $y = 7$.

10. True, because $7(0) = 5(0)$.

11. False, you should add 7 to each side, and then divide each side by 3.

2.2 EXERCISES

1.
$$5a - 10 = 0$$
$$5a - 10 + 10 = 0 + 10$$
$$5a = 10$$
$$\frac{5a}{5} = \frac{10}{5}$$
$$a = 2$$

The solution set is $\{2\}$.

2.
$$8y + 24 = 0$$
$$8y + 24 - 24 = 0 - 24$$
$$8y = -24$$
$$\frac{8y}{8} = \frac{-24}{8}$$
$$y = -3$$

The solution set is $\{-3\}$.

3.
$$-3y - 6 = 0$$
$$-3y - 6 + 6 = 0 + 6$$
$$-3y = 6$$
$$\frac{-3y}{-3} = \frac{6}{-3}$$
$$y = -2$$

The solution set is $\{-2\}$.

4.
$$-9w - 54 = 0$$
$$-9w - 54 + 54 = 0 + 54$$
$$-9w = 54$$
$$\frac{-9w}{-9} = \frac{54}{-9}$$
$$w = -6$$

The solution set is $\{-6\}$.

5.
$$\begin{aligned} 3x-2&=0\\ 3x-2+2&=0+2\\ 3x&=2\\ \frac{3x}{3}&=\frac{2}{3}\\ x&=\frac{2}{3}\end{aligned}$$
The solution set is $\left\{\frac{2}{3}\right\}$.

6.
$$\begin{aligned} 5y+1&=0\\ 5y+1-1&=0-1\\ 5y&=-1\\ \frac{5y}{5}&=\frac{-1}{5}\\ y&=-\frac{1}{5}\end{aligned}$$
The solution set is $\left\{-\frac{1}{5}\right\}$.

7.
$$\begin{aligned} \frac{1}{2}w-3&=0\\ \frac{1}{2}w-3+3&=0+3\\ \frac{1}{2}w&=3\\ 2\cdot\frac{1}{2}w&=2\cdot 3\\ w&=6\end{aligned}$$
The solution set is $\{6\}$.

8.
$$\begin{aligned} \frac{3}{8}t+6&=0\\ \frac{3}{8}t+6-6&=0-6\\ \frac{3}{8}t&=-6\\ \frac{8}{3}\cdot\frac{3}{8}t&=\frac{8}{3}(-6)\\ t&=-16\end{aligned}$$
The solution set is $\{-16\}$.

9.
$$\begin{aligned} -\frac{2}{3}x+8&=0\\ -\frac{2}{3}x+8-8&=0-8\\ -\frac{2}{3}x&=-8\\ -\frac{3}{2}\left(-\frac{2}{3}x\right)&=-\frac{3}{2}(-8)\\ x&=12\end{aligned}$$
The solution set is $\{12\}$.

10.
$$\begin{aligned} -\frac{1}{7}z-5&=0\\ -\frac{1}{7}z-5+5&=0+5\\ -\frac{1}{7}z&=5\\ -7\left(-\frac{1}{7}z\right)&=-7(5)\\ z&=-35\end{aligned}$$
The solution set is $\{-35\}$.

11.
$$\begin{aligned} -m+\frac{1}{2}&=0\\ -m+\frac{1}{2}-\frac{1}{2}&=0-\frac{1}{2}\\ -m&=-\frac{1}{2}\\ -1(-m)&=-1\left(-\frac{1}{2}\right)\\ m&=\frac{1}{2}\end{aligned}$$
The solution set is $\left\{\frac{1}{2}\right\}$.

12.
$$\begin{aligned} -y-\frac{3}{4}&=0\\ -y-\frac{3}{4}+\frac{3}{4}&=0+\frac{3}{4}\\ -y&=\frac{3}{4}\\ -1(-y)&=-1\left(\frac{3}{4}\right)\\ y&=-\frac{3}{4}\end{aligned}$$
The solution set is $\left\{-\frac{3}{4}\right\}$.

13.
$$\begin{aligned} 3p+\frac{1}{2}&=0\\ 3p+\frac{1}{2}-\frac{1}{2}&=0-\frac{1}{2}\\ 3p&=-\frac{1}{2}\\ \frac{1}{3}\cdot 3p&=\frac{1}{3}\left(-\frac{1}{2}\right)\\ p&=-\frac{1}{6}\end{aligned}$$
The solution set is $\left\{-\frac{1}{6}\right\}$.

14.
$$\begin{aligned} 9z - \frac{1}{4} &= 0 \\ 9z - \frac{1}{4} + \frac{1}{4} &= 0 + \frac{1}{4} \\ 9z &= \frac{1}{4} \\ \frac{1}{9}(9z) &= \frac{1}{9} \cdot \frac{1}{4} \\ z &= \frac{1}{36} \end{aligned}$$
The solution set is $\left\{\frac{1}{36}\right\}$.

15.
$$\begin{aligned} 6x - 8 &= 4x \\ 6x - 8 + 8 &= 4x + 8 \\ 6x &= 4x + 8 \\ 6x - 4x &= 4x + 8 - 4x \\ 2x &= 8 \\ \frac{2x}{2} &= \frac{8}{2} \\ x &= 4 \end{aligned}$$
The solution set is $\{4\}$.

16.
$$\begin{aligned} 9y + 14 &= 2y \\ 9y &= 2y - 14 \\ 7y &= -14 \\ \frac{7y}{7} &= \frac{-14}{7} \\ y &= -2 \end{aligned}$$
The solution set is $\{-2\}$.

17.
$$\begin{aligned} 4z &= 5 - 2z \\ 4z + 2z &= 5 - 2z + 2z \\ 6z &= 5 \\ \frac{6z}{6} &= \frac{5}{6} \\ z &= \frac{5}{6} \end{aligned}$$
The solution set is $\left\{\frac{5}{6}\right\}$.

18.
$$\begin{aligned} 3t &= t - 3 \\ 3t - t &= t - 3 - t \\ 2t &= -3 \\ \frac{2t}{2} &= \frac{-3}{2} \\ t &= -\frac{3}{2} \end{aligned}$$
The solution set is $\left\{-\frac{3}{2}\right\}$.

19.
$$\begin{aligned} 4a - 9 &= 7 \\ 4a - 9 + 9 &= 7 + 9 \\ 4a &= 16 \\ \frac{4a}{4} &= \frac{16}{4} \\ a &= 4 \end{aligned}$$
The solution set is $\{4\}$.

20.
$$\begin{aligned} 7r + 5 &= 47 \\ 7r + 5 - 5 &= 47 - 5 \\ 7r &= 42 \\ \frac{7r}{7} &= \frac{42}{7} \\ r &= 6 \end{aligned}$$
The solution set is $\{6\}$.

21.
$$\begin{aligned} 9 &= -6 - 3b \\ 9 + 6 &= -6 - 3b + 6 \\ 15 &= -3b \\ \frac{15}{-3} &= \frac{-3b}{-3} \\ -5 &= b \end{aligned}$$
The solution set is $\{-5\}$.

22.
$$\begin{aligned} 13 &= 3 - 10s \\ 13 - 3 &= 3 - 10s - 3 \\ 10 &= -10s \\ \frac{10}{-10} &= \frac{-10s}{-10} \\ -1 &= s \end{aligned}$$
The solution set is $\{-1\}$.

23.
$$\begin{aligned} \frac{1}{2}w - 4 &= 13 \\ \frac{1}{2}w - 4 + 4 &= 13 + 4 \\ \frac{1}{2}w &= 17 \\ 2 \cdot \frac{1}{2}w &= 2(17) \\ w &= 34 \end{aligned}$$
The solution set is $\{34\}$.

24.
$$\begin{aligned} \frac{1}{3}q + 13 &= -5 \\ \frac{1}{3}q + 13 - 13 &= -5 - 13 \\ \frac{1}{3}q &= -18 \\ 3 \cdot \frac{1}{3}q &= 3(-18) \\ q &= -54 \end{aligned}$$
The solution set is $\{-54\}$.

25.
$$\begin{aligned} 6-\frac{1}{3}d &= \frac{1}{3}d \\ 6-\frac{1}{3}d+\frac{1}{3}d &= \frac{1}{3}d+\frac{1}{3}d \\ 6 &= \frac{2}{3}d \\ \frac{3}{2}\cdot 6 &= \frac{3}{2}\cdot\frac{2}{3}d \\ 9 &= d \end{aligned}$$
The solution set is $\{9\}$.

26.
$$\begin{aligned} 9-\frac{1}{2}a &= \frac{1}{4}a \\ 9-\frac{1}{2}a+\frac{1}{2}a &= \frac{1}{4}a+\frac{1}{2}a \\ 9 &= \frac{3}{4}a \\ \frac{4}{3}\cdot 9 &= \frac{4}{3}\cdot\frac{3}{4}a \\ 12 &= a \end{aligned}$$
The solution set is $\{12\}$.

27.
$$\begin{aligned} 2w-0.4 &= 2 \\ 2w-0.4+0.4 &= 2+0.4 \\ 2w &= 2.4 \\ \frac{2w}{2} &= \frac{2.4}{2} \\ w &= 1.2 \end{aligned}$$
The solution set is $\{1.2\}$.

28.
$$\begin{aligned} 10h-1.3 &= 6 \\ 10h-1.3+1.3 &= 6+1.3 \\ 10h &= 7.3 \\ \frac{10h}{10} &= \frac{7.3}{10} \\ h &= 0.73 \end{aligned}$$
The solution set is $\{0.73\}$.

29.
$$\begin{aligned} x &= 3.3-0.1x \\ x+0.1x &= 3.3-0.1x+0.1x \\ 1.1x &= 3.3 \\ \frac{1.1x}{1.1} &= \frac{3.3}{1.1} \\ x &= 3 \end{aligned}$$
The solution set is $\{3\}$.

30.
$$\begin{aligned} y &= 2.4-0.2y \\ y+0.2y &= 2.4-0.2y+0.2y \\ 1.2y &= 2.4 \\ \frac{1.2y}{1.2} &= \frac{2.4}{1.2} \\ y &= 2 \end{aligned}$$
The solution set is $\{2\}$.

31.
$$\begin{aligned} 3x-3 &= x+5 \\ 3x &= x+8 \\ 2x &= 8 \\ \frac{2x}{2} &= \frac{8}{2} \\ x &= 4 \end{aligned}$$
The solution set is $\{4\}$.

32.
$$\begin{aligned} 9y-1 &= 6y+5 \\ 9y &= 6y+6 \\ 3y &= 6 \\ \frac{3y}{3} &= \frac{6}{3} \\ y &= 2 \end{aligned}$$
The solution set is $\{2\}$.

33.
$$\begin{aligned} 4-7d &= 13-4d \\ -7d &= 9-4d \\ -3d &= 9 \\ \frac{-3d}{-3} &= \frac{9}{-3} \\ d &= -3 \end{aligned}$$
The solution set is $\{-3\}$.

34.
$$\begin{aligned} y-9 &= 12-6y \\ y &= 21-6y \\ 7y &= 21 \\ \frac{7y}{7} &= \frac{21}{7} \\ y &= 3 \end{aligned}$$
The solution set is $\{3\}$.

35.
$$\begin{aligned} c+\frac{1}{2} &= 3c-\frac{1}{2} \\ c+1 &= 3c \\ 1 &= 2c \\ \frac{1}{2} &= \frac{2c}{2} \\ \frac{1}{2} &= c \end{aligned}$$
The solution set is $\left\{\frac{1}{2}\right\}$.

36.
$$\begin{aligned} x-\frac{1}{4} &= \frac{1}{2}-x \\ x &= \frac{3}{4}-x \\ 2x &= \frac{3}{4} \\ \frac{1}{2}\cdot 2x &= \frac{1}{2}\cdot\frac{3}{4} \\ x &= \frac{3}{8} \end{aligned}$$

The solution set is $\left\{\frac{3}{8}\right\}$.

37.
$$\frac{2}{3}a - 5 = \frac{1}{3}a + 5$$
$$\frac{2}{3}a = \frac{1}{3}a + 10$$
$$\frac{1}{3}a = 10$$
$$3 \cdot \frac{1}{3}a = 3 \cdot 10$$
$$a = 30$$

The solution set is $\{30\}$.

38.
$$\frac{1}{2}t - 3 = \frac{1}{4}t - 9$$
$$\frac{1}{2}t = \frac{1}{4}t - 6$$
$$\frac{1}{4}t = -6$$
$$4 \cdot \frac{1}{4}t = 4(-6)$$
$$t = -24$$

The solution set is $\{-24\}$.

39.
$$5(a-1) + 3 = 28$$
$$5a - 5 + 3 = 28$$
$$5a - 2 = 28$$
$$5a = 30$$
$$a = 6$$

The solution set is $\{6\}$.

40.
$$2(w+4) - 1 = 1$$
$$2w + 8 - 1 = 1$$
$$2w + 7 = 1$$
$$2w = -6$$
$$w = -3$$

The solution set is $\{-3\}$.

41.
$$2 - 3(q-1) = 10 - (q+1)$$
$$2 - 3q + 3 = 10 - q - 1$$
$$-3q + 5 = 9 - q$$
$$-2q = 4$$
$$q = -2$$

The solution set is $\{-2\}$.

42.
$$-2(y-6) = 3(7-y) - 5$$
$$-2y + 12 = 21 - 3y - 5$$
$$-2y + 12 = 16 - 3y$$
$$-2y = 4 - 3y$$
$$y = 4$$

The solution set is $\{4\}$.

43.
$$2(x-1) + 3x = 6x - 20$$
$$2x - 2 + 3x = 6x - 20$$
$$5x - 2 = 6x - 20$$
$$5x + 18 = 6x$$
$$18 = x$$

The solution set is $\{18\}$.

44.
$$3 - (r-1) = 2(r+1) - r$$
$$3 - r + 1 = 2r + 2 - r$$
$$4 - r = r + 2$$
$$2 = 2r$$
$$1 = r$$

The solution set is $\{1\}$.

45.
$$2\left(y - \frac{1}{2}\right) = 4\left(y - \frac{1}{4}\right) + y$$
$$2y - 1 = 4y - 1 + y$$
$$2y - 1 = 5y - 1$$
$$2y = 5y$$
$$-3y = 0$$
$$y = 0$$

The solution set is $\{0\}$.

46.
$$\frac{1}{2}(4m - 6) = \frac{2}{3}(6m - 9) + 3$$
$$2m - 3 = 4m - 6 + 3$$
$$2m - 3 = 4m - 3$$
$$2m = 4m$$
$$-2m = 0$$
$$m = 0$$

The solution set is $\{0\}$.

47. Multiply each side by $1/2$:
$$2x = \frac{1}{3}$$
$$x = \frac{1}{6}$$

The solution set is $\left\{\frac{1}{6}\right\}$.

48. Multiply each side by $1/3$:
$$3x = \frac{6}{11}$$
$$x = \frac{2}{11}$$

The solution set is $\left\{\frac{2}{11}\right\}$.

49.
$$5t = -2 + 4t$$
$$t = -2$$

The solution set is $\{-2\}$.

50.
$$8y = 6 + 7y$$
$$y = 6$$

The solution set is $\{6\}$.

51. $3x - 7 = 0$
$3x = 7$
$\frac{3x}{3} = \frac{7}{3}$
$x = \frac{7}{3}$
The solution set is $\left\{\frac{7}{3}\right\}$.

52. $5x + 4 = 0$
$5x = -4$
$\frac{5x}{5} = \frac{-4}{5}$
$x = -\frac{4}{5}$
The solution set is $\left\{-\frac{4}{5}\right\}$.

53. $-x + 6 = 5$
$-x = -1$
$-1(-x) = -1(-1)$
$x = 1$
The solution set is $\{1\}$.

54. $-x - 2 = 9$
$-x - 2 + 2 = 9 + 2$
$-x = 11$
$-1(-x) = -1(11)$
$x = -11$
The solution set is $\{-11\}$.

55. $-9 - a = -3$
$-9 - a + 9 = -3 + 9$
$-a = 6$
$-1(-a) = -1(6)$
$a = -6$
The solution set is $\{-6\}$.

56. $4 - r = 6$
$4 - r - 4 = 6 - 4$
$-r = 2$
$-1(-r) = -1(2)$
$r = -2$
The solution set is $\{-2\}$.

57. $2q + 5 = q - 7$
$2q = q - 12$
$q = -12$
The solution set is $\{-12\}$.

58. $3z - 6 = 2z - 7$
$3z = 2z - 1$
$z = -1$
The solution set is $\{-1\}$.

59. $-3x + 1 = 5 - 2x$
$-3x + 1 - 1 = 5 - 2x - 1$
$-3x = 4 - 2x$
$-x = 4$
$x = -4$
The solution set is $\{-4\}$.

60. $5 - 2x = 6 - x$
$-1 - 2x = -x$
$-1 - 2x + 2x = -x + 2x$
$-1 = x$
The solution set is $\{-1\}$.

61. $-12 - 5x = -4x + 1$
$-13 - 5x = -4x$
$-13 - 5x + 5x = -4x + 5x$
$-13 = x$
The solution set is $\{-13\}$.

62. $-3x - 4 = -2x + 8$
$-3x - 4 - 8 = -2x + 8 - 8$
$-3x - 12 = -2x$
$-3x - 12 + 3x = -2x + 3x$
$-12 = x$
The solution set is $\{-12\}$.

63. $3x + 0.3 = 2 + 2x$
$3x + 0.3 - 0.3 = 2 + 2x - 0.3$
$3x = 1.7 + 2x$
$3x - 2x = 1.7 + 2x - 2x$
$x = 1.7$
The solution set is $\{1.7\}$.

64. $2y - 0.05 = y + 1$
$2y - 0.05 + 0.05 = y + 1 + 0.05$
$2y = y + 1.05$
$2y - y = y + 1.05 - y$
$y = 1.05$
The solution set is $\{1.05\}$.

65. $k - 0.6 = 0.2k + 1$
$k = 0.2k + 1.6$
$0.8k = 1.6$
$\frac{0.8k}{0.8} = \frac{1.6}{0.8}$
$k = 2$
The solution set is $\{2\}$.

66. $2.3h + 6 = 1.8h - 1$
$2.3h = 1.8h - 7$
$0.5h = -7$
$2(0.5h) = 2(-7)$
$h = -14$
The solution set is $\{-14\}$.

67. $0.2x - 4 = 0.6 - 0.8x$
$0.2x = 4.6 - 0.8x$
$0.2x + 0.8x = 4.6 - 0.8x + 0.8x$
$x = 4.6$
The solution set is $\{4.6\}$.

68. $0.3x = 1 - 0.7x$
$0.3x + 0.7x = 1 - 0.7x + 0.7x$
$x = 1$
The solution set is $\{1\}$.

69. $-3(k - 6) = 2 - k$
$-3k + 18 = 2 - k$
$-3k + 16 = -k$
$16 = 2k$
$8 = k$
The solution set is $\{8\}$.

70. $-2(h - 5) = 3 - h$
$-2h + 10 = 3 - h$
$-2h + 7 = -h$
$-2h + 7 + 2h = -h + 2h$
$7 = h$
The solution set is $\{7\}$.

71. $2(p + 1) - p = 36$
$2p + 2 - p = 36$
$p + 2 = 36$
$p + 2 - 2 = 36 - 2$
$p = 34$
The solution set is $\{34\}$.

72. $3(q + 1) - q = 23$
$3q + 3 - q = 23$
$2q + 3 = 23$
$2q = 20$
$q = 10$
The solution set is $\{10\}$.

73. $7 - 3(5 - u) = 5(u - 4)$
$7 - 15 + 3u = 5u - 20$
$-8 + 3u = 5u - 20$
$12 = 2u$
$6 = u$
The solution set is $\{6\}$.

74. $v - 4(4 - v) = -2(2v - 1)$
$v - 16 + 4v = -4v + 2$
$5v - 16 = -4v + 2$
$9v = 18$
$v = 2$
The solution set is $\{2\}$.

75. $4(x + 3) = 12$
$4x + 12 = 12$
$4x = 0$
$\frac{4x}{4} = \frac{0}{4}$
$x = 0$
The solution set is $\{0\}$.

76. $5(x - 3) = -15$
$5x - 15 = -15$
$5x = 0$
$\frac{5x}{5} = \frac{0}{5}$
$x = 0$
The solution set is $\{0\}$.

77. $\frac{w}{5} - 4 = -6$
$\frac{w}{5} - 4 + 4 = -6 + 4$
$\frac{w}{5} = -2$
$5 \cdot \frac{w}{5} = 5(-2)$
$w = -10$
The solution set is $\{-10\}$.

78. $\frac{q}{2} + 13 = -22$
$\frac{q}{2} + 13 - 13 = -22 - 13$
$\frac{q}{2} = -35$
$2 \cdot \frac{q}{2} = 2(-35)$
$q = -70$
The solution set is $\{-70\}$.

79. $\frac{2}{3}y - 5 = 7$
$\frac{2}{3}y - 5 + 5 = 7 + 5$
$\frac{2}{3}y = 12$
$\frac{3}{2} \cdot \frac{2}{3}y = \frac{3}{2}(12)$
$y = 18$
The solution set is $\{18\}$.

80.
$$\frac{3}{4}u - 9 = -6$$
$$\frac{3}{4}u - 9 + 9 = -6 + 9$$
$$\frac{3}{4}u = 3$$
$$\frac{4}{3} \cdot \frac{3}{4}u = \frac{4}{3}(3)$$
$$u = 4$$
The solution set is $\{4\}$.

81.
$$4 - \frac{2n}{5} = 12$$
$$4 - \frac{2n}{5} - 4 = 12 - 4$$
$$-\frac{2n}{5} = 8$$
$$-\frac{5}{2}\left(-\frac{2n}{5}\right) = -\frac{5}{2}(8)$$
$$n = -20$$
The solution set is $\{-20\}$.

82.
$$9 - \frac{2m}{7} = 19$$
$$9 - \frac{2m}{7} - 9 = 19 - 9$$
$$-\frac{2m}{7} = 10$$
$$-\frac{7}{2}\left(-\frac{2m}{7}\right) = -\frac{7}{2}(10)$$
$$m = -35$$
The solution set is $\{-35\}$.

83.
$$-\frac{1}{3}p - \frac{1}{2} = \frac{1}{2}$$
$$-\frac{1}{3}p - \frac{1}{2} + \frac{1}{2} = \frac{1}{2} + \frac{1}{2}$$
$$-\frac{1}{3}p = 1$$
$$-3\left(-\frac{1}{3}p\right) = -3(1)$$
$$p = -3$$
The solution set is $\{-3\}$.

84.
$$-\frac{3}{4}z - \frac{2}{3} = \frac{1}{3}$$
$$-\frac{3}{4}z - \frac{2}{3} + \frac{2}{3} = \frac{1}{3} + \frac{2}{3}$$
$$-\frac{3}{4}z = 1$$
$$-\frac{4}{3}\left(-\frac{3}{4}z\right) = -\frac{4}{3}(1)$$
$$x = -\frac{4}{3}$$
The solution set is $\left\{-\frac{4}{3}\right\}$.

85.
$$3.5x - 23.7 = -38.75$$
$$3.5x - 23.7 + 23.7 = -38.75 + 23.7$$
$$3.5x = -15.05$$
$$\frac{3.5x}{3.5} = \frac{-15.05}{3.5}$$
$$x = -4.3$$
The solution set is $\{-4.3\}$.

86.
$$3(x - 0.87) - 2x = 4.98$$
$$3x - 2.61 - 2x = 4.98$$
$$x - 2.61 = 4.98$$
$$x - 2.61 + 2.61 = 4.98 + 2.61$$
$$x = 7.59$$
The solution set is $\{7.59\}$.

87. Let x represent the number of hours that the lawyer worked:
$$300 + 65x = 1405$$
$$65x = 1105$$
$$x = 17$$
The lawyer worked 17 hours on the case.

88. Let x represent the number of hours that the plumber worked:
$$45 + 40x = 165$$
$$40x = 120$$
$$x = 3$$
The plumber worked for 3 hours.

89.
$$\frac{9}{5}C + 32 = 68$$
$$\frac{9}{5}C = 36$$
$$\frac{5}{9} \cdot \frac{9}{5}C = \frac{5}{9}(36)$$
$$C = 20$$
The temperature is 20° C.

90. a) From the graph, water boils at 100°C.

b)
$$70 = \frac{5}{9}(F - 32)$$
$$\frac{9}{5}(70) = \frac{9}{5} \cdot \frac{5}{9}(F - 32)$$
$$126 = F - 32$$
$$158 = F$$

The temperature is 158° F.

91.
$$2x + 2(x + 3) = 42$$
$$2x + 2x + 6 = 42$$
$$4x = 36$$
$$x = 9$$

The width is 9 feet.

92.
$$x + (x + 1) + (x + 2) = 12$$
$$3x = 9$$
$$x = 3$$

So $x = 3$ m, $x + 1 = 4$ m, and $x + 2 = 5$ m.

93.
$$x + 0.09x + 150 = 16,009.50$$
$$1.09x = 15,859.50$$
$$x = 14,550$$

The price of the car was \$14,550.

94.
$$39.96n + 29.96 = 169.82$$
$$39.96n = 139.86$$
$$n = 3.5$$

The electrician worked of 3.5 hours.

2.3 WARM-UPS

1. If an equation involves fractions we multiply each side by the least common denominator of all of the fractions.

2. If an equation involves decimals we multiply each side by a power of 10 to eliminate all decimals.

3. An identity is satisfied by all numbers for which both sides are defined.

4. A conditional equation has at least one solution but is not an identity.

5. An inconsistent equation has no solution.

6. True, because multiplying by 6 eliminates all of the fractions.

7. False, because multiplying each side by 100 yields $20x + 3x = 800$.

8. False, because it has one solution.

9. True, because the solution set is $\{0\}$.

10. True, because it is satisfied by all real numbers.

11. True, because $\frac{x}{x} = 1$ is satisfied by all real numbers except 0.

2.3 EXERCISES

1.
$$\frac{x}{4} - \frac{3}{10} = 0$$
$$20\left(\frac{x}{4} - \frac{3}{10}\right) = 20(0)$$
$$5x - 6 = 0$$
$$5x - 6 + 6 = 0 + 6$$
$$5x = 6$$
$$x = \frac{6}{5}$$

The solution set is $\left\{\frac{6}{5}\right\}$.

2.
$$\frac{x}{15} + \frac{1}{6} = 0$$
$$30\left(\frac{x}{15} + \frac{1}{6}\right) = 30(0)$$
$$2x + 5 = 0$$
$$2x + 5 - 5 = 0 - 5$$
$$2x = -5$$
$$x = -\frac{5}{2}$$

The solution set is $\left\{-\frac{5}{2}\right\}$.

3.
$$3x - \frac{1}{6} = \frac{1}{2}$$
$$6\left(3x - \frac{1}{6}\right) = 6 \cdot \frac{1}{2}$$
$$18x - 1 = 3$$
$$18x - 1 + 1 = 3 + 1$$
$$18x = 4$$
$$x = \frac{2}{9}$$

The solution set is $\left\{\frac{2}{9}\right\}$.

4.
$$5x + \frac{1}{2} = \frac{3}{4}$$
$$4\left(5x + \frac{1}{2}\right) = 4 \cdot \frac{3}{4}$$
$$20x + 2 = 3$$
$$20x + 2 - 2 = 3 - 2$$
$$20x = 1$$
$$x = \frac{1}{20}$$

The solution set is $\left\{\frac{1}{20}\right\}$.

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

$$x+6+1=2x-1+1$$
$$x+7=2x$$
$$x+7-x=2x-x$$
$$7=x$$

The solution set is $\{7\}$.

6. $13-\frac{x}{2}=x-\frac{1}{2}$

$$2\left(13-\frac{x}{2}\right)=2\left(x-\frac{1}{2}\right)$$
$$26-x=2x-1$$
$$26-x-2x=2x-1-2x$$
$$26-3x=-1$$
$$-3x=-27$$
$$x=9$$

The solution set is $\{9\}$.

7. $\frac{x}{2}+\frac{x}{3}=20$

$$6\left(\frac{x}{2}+\frac{x}{3}\right)=6\cdot 20$$
$$3x+2x=120$$
$$5x=120$$
$$\frac{5x}{5}=\frac{120}{5}$$
$$x=24$$

The solution set is $\{24\}$.

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

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

The solution set is $\{30\}$.

9. $\frac{w}{2}+\frac{w}{4}=12$

$$4\left(\frac{w}{2}+\frac{w}{4}\right)=4\cdot 12$$
$$2w+w=48$$
$$3w=48$$
$$\frac{3w}{3}=\frac{48}{3}$$
$$w=16$$

The solution set is $\{16\}$.

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

$$4\left(\frac{a}{4}-\frac{a}{2}\right)=4(-5)$$
$$a-2a=-20$$
$$-a=-20$$
$$a=20$$

The solution set is $\{20\}$.

11. $\frac{3z}{2}-\frac{2z}{3}=-10$

$$6\left(\frac{3z}{2}-\frac{2z}{3}\right)=6(-10)$$
$$9z-4z=-60$$
$$5z=-60$$
$$\frac{5z}{5}=\frac{-60}{5}$$
$$z=-12$$

The solution set is $\{-12\}$.

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

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

The solution set is $\{-4\}$.

13. $\frac{1}{3}p-5=\frac{1}{4}p$

$$12\left(\frac{1}{3}p-5\right)=12\cdot\frac{1}{4}p$$
$$4p-60=3p$$
$$4p-60+60=3p+60$$
$$4p=3p+60$$
$$4p-3p=3p+60-3p$$
$$p=60$$

The solution set is $\{60\}$.

14. $\frac{1}{2}q-6=\frac{1}{5}q$

$$10\left(\frac{1}{2}q-6\right)=10\cdot\frac{1}{5}q$$
$$5q-60=2q$$
$$5q=2q+60$$
$$3q=60$$
$$q=20$$

The solution set is $\{20\}$.

15. $\frac{1}{6}v+1=\frac{1}{4}v-1$

$$12\left(\frac{1}{6}v+1\right)=12\left(\frac{1}{4}v-1\right)$$
$$2v+12=3v-12$$
$$2v+12+12=3v-12+12$$
$$2v+24=3v$$
$$2v+24-2v=3v-2v$$
$$24=v$$

The solution set is $\{24\}$.

16. $\frac{1}{15}k+5=\frac{1}{6}k-10$

$$30\left(\frac{1}{15}k+5\right)=30\left(\frac{1}{6}k-10\right)$$
$$2k+150=5k-300$$
$$2k=5k-450$$
$$-3k=-450$$
$$k=150$$

The solution set is $\{150\}$.

17. $\frac{1}{2}x+\frac{1}{3}=\frac{1}{4}x$

$$12\left(\frac{1}{2}x+\frac{1}{3}\right)=12\left(\frac{1}{4}x\right)$$
$$6x+4=3x$$

$$3x + 4 = 0$$
$$3x = -4$$
$$x = -\frac{4}{3}$$

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

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

$$30\left(\frac{1}{3}x - \frac{2}{5}x\right) = 30\left(\frac{5}{6}\right)$$
$$10x - 12x = 25$$
$$-2x = 25$$
$$x = -\frac{25}{2}$$

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

19. $x - 0.2x = 72$

$$10(x - 0.2x) = 10 \cdot 72$$
$$10x - 2x = 720$$
$$8x = 720$$
$$\frac{8x}{8} = \frac{720}{8}$$
$$x = 90$$

The solution set is $\{90\}$.

20. $x - 0.1x = 63$

$$10[x - 0.1x] = 10[63]$$
$$10x - x = 630$$
$$9x = 630$$
$$x = 70$$

The solution set is $\{70\}$.

21. $0.3x + 1.2 = 0.5x$

$$10(0.3x + 1.2) = 10(0.5x)$$
$$3x + 12 = 5x$$
$$3x + 12 - 3x = 5x - 3x$$
$$12 = 2x$$
$$\frac{12}{2} = \frac{2x}{2}$$
$$6 = x$$

The solution set is $\{6\}$.

22. $0.4x - 1.6 = 0.6x$

$$10(0.4x - 1.6) = 10(0.6x)$$
$$4x - 16 = 6x$$
$$-16 = 2x$$
$$-8 = x$$

The solution set is $\{-8\}$.

23. $0.02x - 1.56 = 0.8x$

$$100(0.02x - 1.56) = 100(0.8x)$$
$$2x - 156 = 80x$$
$$2x - 156 - 2x = 80x - 2x$$
$$-156 = 78x$$
$$\frac{-156}{78} = \frac{78x}{78}$$
$$-2 = x$$

The solution set is $\{-2\}$.

24. $0.6x + 10.4 = 0.08x$

$$100(0.6x + 10.4) = 100(0.08x)$$
$$60x + 1040 = 8x$$
$$52x + 1040 = 0$$
$$52x = -1040$$
$$x = -20$$

The solution set is $\{-20\}$.

25. $0.1a - 0.3 = 0.2a - 8.3$

$$10(0.1a - 0.3) = 10(0.2a - 8.3)$$
$$a - 3 = 2a - 83$$
$$a - 3 + 83 = 2a - 83 + 83$$
$$a + 80 = 2a$$
$$a + 80 - a = 2a - a$$
$$80 = a$$

The solution set is $\{80\}$.

26. $0.5b + 3.4 = 0.2b + 12.4$

$$10(0.5b + 3.4) = 10(0.2b + 12.4)$$
$$5b + 34 = 2b + 124$$
$$5b = 2b + 90$$
$$3b = 90$$
$$b = 30$$

The solution set is $\{30\}$.

27. $0.05r + 0.4r = 27$

$$100(0.05r + 0.4r) = 100 \cdot 27$$
$$5r + 40r = 2700$$
$$45r = 2700$$
$$\frac{45r}{45} = \frac{2700}{45}$$
$$r = 60$$

The solution set is $\{60\}$.

28. $0.08t + 28.3 = 0.5t - 9.5$

$$100(0.08t + 28.3) = 100(0.5t - 9.5)$$
$$8t + 2830 = 50t - 950$$
$$-42t + 2830 = -950$$
$$-42t = -3780$$
$$t = 90$$

The solution set is $\{90\}$.

29. $0.05y + 0.03(y + 50) = 17.5$

$$100[0.05y + 0.03(y + 50)] = 100(17.5)$$
$$5y + 3(y + 50) = 1750$$
$$5y + 3y + 150 = 1750$$
$$8y + 150 = 1750$$
$$8y + 150 - 150 = 1750 - 150$$
$$8y = 1600$$
$$\frac{8y}{8} = \frac{1600}{8}$$
$$y = 200$$

The solution set is $\{200\}$.

30. $0.07y + 0.08(y - 100) = 44.5$
$100[0.07y + 0.08(y - 100)] = 100[44.5]$
$7y + 8(y - 100) = 4450$
$7y + 8y - 800 = 4450$
$15y = 5250$
$y = 350$
The solution set is $\{350\}$.

31. $0.1x + 0.05(x - 300) = 105$
$100[0.1x + 0.05(x - 300)] = 100 \cdot 105$
$10x + 5(x - 300) = 10500$
$10x + 5x - 1500 = 10500$
$15x - 1500 = 10500$
$15x - 1500 + 1500 = 10500 + 1500$
$15x = 12000$
$\frac{15x}{15} = \frac{12000}{15}$
$x = 800$
The solution set is $\{800\}$.

32. $0.2x - 0.05(x - 100) = 35$
$100[0.2x - 0.05(x - 100)] = 100[35]$
$20x - 5(x - 100) = 3500$
$20x - 5x + 500 = 3500$
$15x = 3000$
$x = 200$
The solution set is $\{200\}$.

33. $2x - 9 = 0$
$2x = 9$
$x = \frac{9}{2}$
The solution set is $\left\{\frac{9}{2}\right\}$.

34. $3x + 7 = 0$
$3x = -7$
$x = -\frac{7}{3}$
The solution set is $\left\{-\frac{7}{3}\right\}$.

35. $-2x + 6 = 0$
$-2x = -6$
$x = 3$
The solution set is $\{3\}$.

36. $-3x - 12 = 0$
$-3x = 12$
$x = -4$
The solution set is $\{-4\}$.

37. $\frac{z}{5} + 1 = 6$
$\frac{z}{5} = 5$
$z = 25$
The solution set is $\{25\}$.

38. $\frac{s}{2} + 2 = 5$
$\frac{s}{2} = 3$
$s = 6$
The solution set is $\{6\}$.

39. $\frac{c}{2} - 3 = -4$
$\frac{c}{2} = -1$
$c = -2$
The solution set is $\{-2\}$.

40. $\frac{b}{3} - 4 = -7$
$\frac{b}{3} = -3$
$b = -9$
The solution set is $\{-9\}$.

41. $3 = t + 6$
$-3 = t$
The solution set is $\{-3\}$.

42. $-5 = y - 9$
$4 = y$
The solution set is $\{4\}$.

43. $5 + 2q = 3q$
$5 = q$
The solution set is $\{5\}$.

44. $-4 - 5p = -4p$
$-4 = p$
The solution set is $\{-4\}$.

45. $8x - 1 = 9 + 9x$
$-10 = x$
The solution set is $\{-10\}$.

46. $4x - 2 = -8 + 5x$
$6 = x$
The solution set is $\{6\}$.

47. $-3x + 1 = -1 - 2x$
$2 = x$
The solution set is $\{2\}$.

48. $-6x + 3 = -7 - 5x$
$10 = x$
The solution set is $\{10\}$.

49. $x + x = 2x$
$2x = 2x$
All real numbers satisfy the equation. The equation is an identity.

50. $2x - x = x$
$x = x$
All real numbers satisfy the equation. The equation is an identity.

51. $a - 1 = a + 1$
$a - 1 - a = a + 1 - a$
$-1 = 1$

The equation has no solution. It is an inconsistent equation.

52. $r + 7 = r$
$r + 7 - r = r - r$
$7 = 0$
The equation has no solution. It is an inconsistent equation.

53. $3y + 4y = 12y$
$7y = 12y$
$0 = 5y$
$0 = y$
The solution set is $\{0\}$. The equation is a conditional equation.

54. $9t - 8t = 7$
$t = 7$
The solution set is $\{7\}$. The equation is a conditional equation.

55. $-4 + 3(w - 1) = w + 2(w - 2) - 1$
$-4 + 3w - 3 = w + 2w - 4 - 1$
$3w - 7 = 3w - 5$
$-7 = -5$
The equation has no solution. The solution set is $\emptyset$. It is an inconsistent equation.

56. $4 - 5(w + 2) = 2(w - 1) - 7w - 4$
$4 - 5w - 10 = 2w - 2 - 7w - 4$
$-6 - 5w = -5w - 6$
All real numbers satisfy the equation. The equation is an identity.

57. $3(m + 1) = 3(m + 3)$
$3m + 3 = 3m + 9$
$3m + 3 - 3m = 3m + 9 - 3m$
$3 = 9$
The equation has no solution. The solution set is $\emptyset$. It is an inconsistent equation.

58. $5(m - 1) - 6(m + 3) = 4 - m$
$5m - 5 - 6m - 18 = 4 - m$
$-m - 23 = 4 - m$
$-23 = 4$
The equation has no solution. The solution set is $\emptyset$. It is an inconsistent equation.

59. $x + x = 2$
$2x = 2$
$\frac{2x}{2} = \frac{2}{2}$
$x = 1$
The solution set is $\{1\}$. It is a conditional equation.

60. $3x - 5 = 0$
$3x - 5 + 5 = 0 + 5$
$3x = 5$
$\frac{3x}{3} = \frac{5}{3}$
$x = \frac{5}{3}$
The solution set is $\left\{\frac{5}{3}\right\}$. It is a conditional equation.

61. $2 - 3(5 - x) = 3x$
$2 - 15 + 3x = 3x$
$-13 + 3x = 3x$
$-13 + 3x - 3x = 3x - 3x$
$-13 = 0$
The equation has no solution. The solution set is $\emptyset$. It is an inconsistent equation.

62. $3 - 3(5 - x) = 0$
$3 - 15 + 3x = 0$
$-12 + 3x = 0$
$12 + 3x + 12 = 0 + 12$
$3x = 12$
$\frac{3x}{3} = \frac{12}{3}$
$x = 4$
The solution set is $\{4\}$. It is a conditional equation.

63. $(3 - 3)(5 - z) = 0$
$0(5 - z) = 0$
$0 = 0$
All real numbers satisfy the equation. The equation is an identity.

64. $(2 \cdot 4 - 8)p = 0$
$0 \cdot p = 0$
$0 = 0$
All real numbers satisfy the equation. The equation is an identity.

65. $\frac{0}{x} = 0$
The equation is satisfied by every nonzero real number. The equation is an identity.

66. $\frac{2x}{2} = x$
$x = x$
All real numbers satisfy this identity.

67. $x \cdot x = x^2$
$x^2 = x^2$
All real numbers satisfy this identity.

68. $\frac{2x}{2x} = 1$
$\frac{x}{x} = 1$

The equation is satisfied by every nonzero real number. The equation is an identity.

69. $3x - 5 = 2x - 9$
$3x - 5 + 5 = 2x - 9 + 5$
$3x = 2x - 4$
$3x - 2x = 2x - 4 - 2x$
$x = -4$
The solution set is $\{-4\}$.

70. $5x - 9 = x - 4$
$5x = x + 5$
$4x = 5$
$x = \frac{5}{4}$
The solution set is $\left\{\frac{5}{4}\right\}$.

71. $x + 2(x + 4) = 3(x + 3) - 1$
$3x + 8 = 3x + 8$
All real numbers satisfy the equation. The solution set is R.

72. $u + 3(u - 4) = 4(u - 5)$
$4u - 12 = 4u - 20$
$-12 = -20$
There is no solution to this equation. The solution set is $\emptyset$.

73. $23 - 5(3 - n) = -4(n - 2) + 9n$
$23 - 15 + 5n = -4n + 8 + 9n$
$8 + 5n = 5n + 8$
All real numbers satisfy the equation. The solution set is R.

74. $-3 - 4(t - 5) = -2(t + 3) + 11$
$-3 - 4t + 20 = -2t - 6 + 11$
$-4t + 17 = -2t + 5$
$-2t + 17 = 5$
$-2t = -12$
$t = 6$
The solution set is $\{6\}$.

75. $0.05x + 30 = 0.4x - 5$
$100(0.05x + 30) = 100(0.4x - 5)$
$5x + 3000 = 40x - 500$
$5x + 3000 + 500 = 40x - 500 + 500$
$5x + 3500 = 40x$
$5x + 3500 - 5x = 40x - 5x$
$3500 = 35x$
$\frac{3500}{35} = \frac{35x}{35}$
$100 = x$
The solution set is $\{100\}$.

76. $x - 0.08x = 460$
$0.92x = 460$
$x = 500$
The solution set is $\{500\}$.

77. $-\frac{2}{3}a + 1 = 2$
$3\left(-\frac{2}{3}a + 1\right) = 3 \cdot 2$
$-2a + 3 = 6$
$-2a + 3 - 3 = 6 - 3$
$-2a = 3$
$\frac{-2a}{-2} = \frac{3}{-2}$
$x = -\frac{3}{2}$
The solution set is $\left\{-\frac{3}{2}\right\}$.

78. $-\frac{3}{4}t = \frac{1}{2}$
$-\frac{4}{3}\left(-\frac{3}{4}t\right) = -\frac{4}{3} \cdot \frac{1}{2}$
$t = -\frac{2}{3}$
The solution set is $\left\{-\frac{2}{3}\right\}$.

79. $\frac{y}{2} + \frac{y}{6} = 20$
$6\left(\frac{y}{2} + \frac{y}{6}\right) = 6 \cdot 20$
$3y + y = 120$
$4y = 120$
$\frac{4y}{4} = \frac{120}{4}$
$y = 30$
The solution set is $\{30\}$.

80. $\frac{3w}{5} - 1 = \frac{w}{2} + 1$
$10\left(\frac{3w}{5} - 1\right) = 10\left(\frac{w}{2} + 1\right)$
$6w - 10 = 5w + 10$
$w - 10 = 10$
$w = 20$
The solution set is $\{20\}$.

81. $0.09x - 0.2(x + 4) = -1.46$
$0.09x - 0.2x - 0.8 = -1.46$
$9x - 20x - 80 = -146$
$-11x - 80 = -146$
$-11x = -66$
$x = 6$
The solution set is $\{6\}$.

82. $0.08x + 0.5(x + 100) = 73.2$
$0.08x + 0.5x + 50 = 73.2$
$0.58x + 50 = 73.2$
$0.58x = 23.2$
$x = 40$
The solution set is $\{40\}$.

83. $436x - 789 = -571$
$436x - 789 + 789 = -571 + 789$
$436x = 218$

$$\frac{436x}{436} = \frac{218}{436}$$
$$x = 0.5$$

The solution set is $\{0.5\}$.

84. $0.08x + 4533 = 10x + 69$
$0.08x + 4464 = 10x$
$4464 = 9.92x$
$450 = x$

The solution set is $\{450\}$.

85. $\frac{x}{344} + 235 = 292$
$\frac{x}{344} + 235 - 235 = 292 - 235$
$\frac{x}{344} = 57$
$344\left(\frac{x}{344}\right) = 344 \cdot 57$
$x = 19608$

The solution set is $\{19{,}608\}$.

86. $34(x - 98) = \frac{x}{2} + 453.5$
$34x - 3332 = \frac{x}{2} + 453.5$
$33.5x = 3785.5$
$x = 113$

The solution set is $\{113\}$.

87. $x - 0.08x = 117{,}760$
$0.92x = 117{,}760$
$\frac{0.92x}{0.92} = \frac{117{,}760}{0.92}$
$x = 128{,}000$

The selling price was \$128,000.

88. $\frac{1}{2}x - 2 = \frac{1}{3}(x - 2)$
$\frac{1}{2}x - 2 = \frac{1}{3}x - \frac{2}{3}$
$6\left(\frac{1}{2}x - 2\right) = 6\left(\frac{1}{3}x - \frac{2}{3}\right)$
$3x - 12 = 2x - 4$
$x = 8$

He had 8 rabbits before the sale.

89. a) From the graph it appears that the taxable in come is approximately \$240,000.

b)
$46{,}742 + 0.33(x - 208{,}850) = 60{,}531$
$46{,}742 + 0.33x - 68{,}920.5 = 60{,}531$
$0.33x - 22{,}178.5 = 60{,}531$
$0.33x = 82{,}709.5$
$x \approx 250{,}635$

Taxable income was \$250,635.

90. $x = 0.25[200{,}000 - 0.10(200{,}000 - x)]$
$x = 0.25[200{,}000 - 20{,}000 + 0.10x]$
$x = 0.25[180{,}000 + 0.10x]$
$x = 45{,}000 + 0.025x$
$0.975x = 45{,}000$
$x \approx 46{,}153.85$

The federal tax is \$46,154.

2.4 WARM-UPS

1. An equation with two or more variables is a formula or literal equation.

2. To solve for a variable means to find an equivalent equation in which the variable is isolated.

3. If $D = RT$, then D is a function of R and T.

4. The formula $P = 2L + 2W$ is the formula for the perimeter of a rectangle.

5. The formula $A = LW$ is the formula for the area of a rectangle.

6. The formula $C = \pi d$ is the formula for the circumference of a circle.

7. False, because T is not isolated in $T \cdot R = D$.

8. False, because a appears on both sides.

9. True, because L is isolated on the left.

10. False, because $P = 2L + 2W$.

11. True, because if $x = -1$, then $y = -3(-1) + 6 = 9$.

2.4 EXERCISES

1. $D = R \cdot T$
$\frac{D}{T} = \frac{R \cdot T}{T}$
$\frac{D}{T} = R$
$R = \frac{D}{T}$

2. $A = L \cdot W$
$\frac{A}{L} = \frac{L \cdot W}{L}$
$\frac{A}{L} = W$
$W = \frac{A}{L}$

3. $C = \pi D$
$\frac{C}{\pi} = D$
$D = \frac{C}{\pi}$

4. $F = ma$
$a = \frac{F}{m}$

5. $I = Prt$
$\frac{I}{rt} = \frac{Prt}{rt}$
$P = \frac{I}{rt}$

6. $I = Prt$
$\frac{I}{Pr} = \frac{Prt}{Pr}$
$\frac{I}{Pr} = t$
$t = \frac{I}{Pr}$

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

8. $y = \frac{3}{4}x - 7$
$4y = 3x - 28$
$4y + 28 = 3x$
$x = \frac{4y + 28}{3}$

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

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

11. $P = 2L + 2W$
$P - 2W = 2L + 2W - 2W$
$P - 2W = 2L$
$\frac{P - 2W}{2} = \frac{2L}{2}$
$\frac{P - 2W}{2} = L$
$L = \frac{P - 2W}{2}$

12. $P = 2L + 2W$
$P - 2L = 2W$
$W = \frac{P - 2L}{2}$

13. $A = \frac{1}{2}(a + b)$
$2A = 2 \cdot \frac{1}{2}(a + b)$
$2A = a + b$
$2A - b = a + b - b$
$2A - b = a$
$a = 2A - b$

14. $A = \frac{1}{2}(a + b)$
$2A = 2 \cdot \frac{1}{2}(a + b)$
$2A = a + b$
$2A - a = b$
$b = 2A - a$

15. $S = P + Prt$
$S - P = P + Prt - P$
$S - P = Prt$
$\frac{S - P}{Pt} = \frac{Prt}{Pt}$
$\frac{S - P}{Pt} = r$
$r = \frac{S - P}{Pt}$

16. $S = P + Prt$
$S - P = Prt$
$t = \frac{S - P}{Pr}$

17. $A = \frac{1}{2}h(a + b)$
$2A = 2 \cdot \frac{1}{2}h(a + b)$
$2A = h(a + b)$
$2A = ah + bh$
$2A - bh = ah + bh - bh$
$2A - bh = ah$
$\frac{2A - bh}{h} = \frac{ah}{h}$
$a = \frac{2A - hb}{h}$

18. $A = \frac{1}{2}h(a + b)$
$2A = 2 \cdot \frac{1}{2}h(a + b)$
$2A = h(a + b)$
$2A = ah + bh$
$2A - ah = bh$
$b = \frac{2A - ah}{h}$

19. $x + y = -9$
$y = -x - 9$

20. $3x + y = -5$
$y = -3x - 5$

21. $x + y - 6 = 0$
$y = -x + 6$

22. $4x + y - 2 = 0$
$y = -4x + 2$

23. $2x - y = 2$
$2x = y + 2$
$2x - 2 = y$
$y = 2x - 2$

24. $x - y = -3$
$-y = -x - 3$
$y = x + 3$

25. $3x - y + 4 = 0$
$3x + 4 = y$
$y = 3x + 4$

26. $-2x - y + 5 = 0$
$-y = 2x - 5$
$y = -2x + 5$

27. $x + 2y = 4$
$2y = -x + 4$
$\frac{1}{2} \cdot 2y = \frac{1}{2} \cdot (-x + 4)$
$y = -\frac{1}{2}x + 2$

28. $3x + 2y = 6$
$2y = -3x + 6$
$\frac{1}{2} \cdot 2y = \frac{1}{2}(-3x + 6)$
$y = -\frac{3}{2}x + 3$

29. $2x - 2y = 1$
$-2y = -2x + 1$
$-\frac{1}{2}(-2y) = -\frac{1}{2}(-2x + 1)$
$y = x - \frac{1}{2}$

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

31. $y + 2 = 3(x - 4)$
$y + 2 = 3x - 12$
$y = 3x - 12 - 2$
$y = 3x - 14$

32. $y - 3 = -3(x - 1)$
$y - 3 = -3x + 3$
$y = -3x + 6$

33. $y - 1 = \frac{1}{2}(x - 2)$
$y - 1 = \frac{1}{2}x - 1$
$y = \frac{1}{2}x$

34. $y - 4 = -\frac{2}{3}(x - 9)$
$y - 4 = -\frac{2}{3}x + 6$
$y = -\frac{2}{3}x + 10$

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

36. $\frac{x}{2} + \frac{y}{4} = \frac{1}{2}$
$4\left(\frac{x}{2} + \frac{y}{4}\right) = 4\left(\frac{1}{2}\right)$
$2x + y = 2$
$y = -2x + 2$

37. $y - 2 = \frac{3}{2}(x + 3)$
$y - 2 = \frac{3}{2}x + \frac{9}{2}$
$y = \frac{3}{2}x + \frac{13}{2}$

38. $y + 4 = \frac{2}{3}(x - 2)$
$y + 4 = \frac{2}{3}x - \frac{4}{3}$
$y = \frac{2}{3}x - \frac{16}{3}$

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

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

41. $5x + a = 3x + b$
$5x = 3x + b - a$
$5x - 3x = b - a$
$2x = b - a$
$x = \frac{b - a}{2}$

42. $2c - x = 4x + c - 5b$
$c - x = 4x - 5b$
$c = 5x - 5b$
$c + 5b = 5x$
$x = \frac{c + 5b}{5}$

43. $4(a + x) - 3(x - a) = 0$
$4a + 4x - 3x + 3a = 0$
$x + 7a = 0$
$x = -7a$

44. $-2(x - b) - (5a - x) = a + b$
$-2x + 2b - 5a + x = a + b$
$-x = 6a - b$
$x = b - 6a$

45. $3x - 2(a - 3) = 4x - 6 - a$
$3x - 2a + 6 = 4x - 6 - a$
$3x - 2a + a + 6 + 6 = 4x$
$3x - a + 12 = 4x$
$-a + 12 = 4x - 3x$
$12 - a = x$
$x = 12 - a$

46. $2(x - 3w) = -3(x + w)$
$2x - 6w = -3x - 3w$
$5x = 3w$
$x = \frac{3w}{5}$

47. $3x + 2ab = 4x - 5ab$
$3x + 2ab + 5ab = 4x$
$3x + 7ab = 4x$
$7ab = 4x - 3x$
$7ab = x$
$x = 7ab$

48. $x - a = -x + a + 4b$
$2x - a = a + 4b$
$2x = 2a + 4b$
$\frac{2x}{2} = \frac{2a + 4b}{2}$
$x = a + 2b$

49. Let $x = 2$ in the equation $y = 3x - 4$.
$y = 3(2) - 4 = 6 - 4 = 2$

50. Let $x = 2$ in the equation $y = -2x + 5$.
$y = -2(2) + 5 = -4 + 5 = 1$

51. Let $x = 2$ in the equation $3x - 2y = -8$.
$3(2) - 2y = -8$
$6 - 2y = -8$
$-2y = -14$
$y = 7$

52. Let $x = 2$ in the equation $4x + 6y = 8$.
$4(2) + 6y = 8$
$8 + 6y = 8$
$6y = 0$
$y = 0$

53. Let $x = 2$ in the equation $\frac{3x}{2} - \frac{5y}{3} = 6$.
$\frac{3(2)}{2} - \frac{5y}{3} = 6$
$3 - \frac{5y}{3} = 6$
$9 - 5y = 18$
$-5y = 9$
$y = -\frac{9}{5}$

54. Let $x = 2$ in the equation $\frac{2y}{5} - \frac{3x}{4} = \frac{1}{2}$:
$\frac{2y}{5} - \frac{3(2)}{4} = \frac{1}{2}$
$\frac{2y}{5} - \frac{3}{2} = \frac{1}{2}$
$4y - 15 = 5$
$4y = 20$
$y = 5$

55. Let $x = 2$ in the equation $y - 3 = \frac{1}{2}(x - 6)$.
$y - 3 = \frac{1}{2}(2 - 6)$
$y - 3 = \frac{1}{2}(-4)$
$y - 3 = -2$
$y = 1$

56. Let $x = 2$ in the equation $y - 6 = -\frac{3}{4}(x - 2)$.
$y - 6 = -\frac{3}{4}(2 - 2)$
$y - 6 = 0$
$y = 6$

57. Let $x = 2$ in $y - 4.3 = 0.45(x - 8.6)$.
$y - 4.3 = 0.45(2 - 8.6)$
$y - 4.3 = 0.45(-6.6)$
$y - 4.3 = -2.97$
$y = -2.97 + 4.3$
$y = 1.33$

58. Let $x = 2$ in $y + 33.7 = 0.78(x - 45.6)$.
$y + 33.7 = 0.78(2 - 45.6)$
$y + 33.7 = -34.008$
$y = -67.708$

59. For each given value of x, find y using $y = -3x + 30$. For example, if $x = -10$, then $y = -3(-10) + 30 = 60$.

x	y
-10	60
0	30
10	0
20	-30
30	-60

60. For each given value of x, find y using $y = 4x - 20$. For example, if $x = -10$, then $y = 4(-10) - 20 = -60$.

x	y
-10	-60
-5	-40
0	-20
5	0
10	20

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

C	F
-10	14
-5	23
0	32
40	104
100	212

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

F	C
-40	-40
14	-10
32	0
59	15
86	30

63. $T = \frac{400}{R}$

R(mph)	T(hr)
10	40
20	20
40	10
80	5
100	4

64. $R = \frac{100}{T}$

T(hr)	R(mph)
1	100
5	20
20	5
50	2
100	1

65. $S = \frac{n(n+1)}{2}$

For $n = 1,\ S = \frac{1(1+1)}{2} = 1.$

For $n = 2,\ S = \frac{2(2+1)}{2} = 3.$

For $n = 3,\ S = \frac{3(3+1)}{2} = 6.$

For $n = 4,\ S = \frac{4(4+1)}{2} = 10.$

For $n = 5,\ S = \frac{5(5+1)}{2} = 15.$

n	S
1	1
2	3
3	6
4	10
5	15

66. $S = \frac{n(n+1)(2n+1)}{6}$

For $n = 1,\ S = \frac{1(1+1)(2\cdot 1+1)}{6} = 1.$

For $n = 2,\ S = \frac{2(2+1)(2\cdot 2+1)}{6} = 5.$

For $n = 3,\ S = \frac{3(3+1)(2\cdot 3+1)}{6} = 14.$

For $n = 4,\ S = \frac{4(4+1)(2\cdot 4+1)}{6} = 30.$

For $n = 5,\ S = \frac{5(5+1)(2\cdot 5+1)}{6} = 55.$

n	S
1	1
2	5
3	14
4	30
15	55

67. Solve $I = Prt$ for r to get $r = \frac{I}{Pt}$.
Now use the formula to find the rates for each interest amount:

$r = \frac{600}{5000 \cdot 3} = 0.04 = 4\%$

$r = \frac{700}{5000 \cdot 3} = 0.0466666666... = 4\frac{2}{3}\%$

$r = \frac{800}{5000 \cdot 3} = 0.05333333.... = 5\frac{1}{3}\%$

68. Solve $I = Prt$ for r to get $r = \frac{I}{Pt}$.
Now use the formula to find the rates for each interest amount:

$r = \frac{420}{1000 \cdot 7} = 0.06 = 6\%$

$r = \frac{455}{1000 \cdot 7} = 0.065 = 6.5\%$

$r = \frac{472.5}{1000 \cdot 7} = 0.0675 = 6.75\%$

69. Use $I = 500$, $P = 2500$, and $r = 5\%$ in the formula for simple interest $I = Prt$.

$500 = 2500(0.05)t$

$500 = 125t$

$$\frac{500}{125} = t$$
$$4 = t$$

The time was 4 years.

70. Use $I = 240$, $P = 1000$, and $r = 8\%$ in the formula for simple interest $I = Prt$.

$$240 = 1000(0.08)t$$
$$240 = 80t$$
$$\frac{240}{80} = t$$
$$3 = t$$

The time was 3 years.

71. First solve $A = LW$ for L to get $L = \frac{A}{W}$. Now find the lengths.

$L = \frac{28 \text{ yd}^2}{2 \text{ yd}} = 14$ yards

$L = \frac{28 \text{ yd}^2}{3 \text{ yd}} = 9\frac{1}{3}$ yards

$L = \frac{28 \text{ yd}^2}{4 \text{ yd}} = 7$ yards

72. First solve $A = LW$ for W to get $W = \frac{A}{L}$. Now find the widths.

$W = \frac{60 \text{ ft}^2}{10 \text{ ft}} = 6$ feet

$W = \frac{60 \text{ ft}^2}{16 \text{ ft}} = 3.75$ feet

$W = \frac{60 \text{ ft}^2}{18 \text{ ft}} = 3\frac{1}{3}$ feet

73. Use $P = 600$ and $W = 75$ in the formula for the perimeter of a rectangle, $P = 2L + 2W$.

$$600 = 2L + 2(75)$$
$$600 = 2L + 150$$
$$450 = 2L$$
$$225 = L$$

The length is 225 feet.

74. Use $P = 500$ and $W = 104$ in the formula for the perimeter of a rectangle, $P = 2L + 2W$.

$$500 = 2L + 2(104)$$
$$500 = 2L + 208$$
$$292 = 2L$$
$$146 = L$$

The length or depth is 146 feet.

75. Use $S = 54{,}450$, and $r = 10\%$ in the formula for the sale price, $S = L - rL$.

$$54{,}450 = L - 0.10L$$
$$54{,}450 = 0.90L$$
$$\frac{54{,}450}{0.90} = L$$
$$60{,}500 = L$$

The MSRP is \$60,500.

76. Use $S = 107{,}272$, and $r = 8\%$ in the formula for the sale price, $S = L - rL$.

$$107{,}272 = L - 0.08L$$
$$107{,}272 = 0.92L$$
$$\frac{107{,}272}{0.92} = L$$
$$116{,}600 = L$$

The MSRP is \$116,600.

77. Use $S = 255$, and $r = 15\%$ in the formula for the sale price, $S = L - rL$.

$$255 = L - 0.15L$$
$$255 = 0.85L$$
$$\frac{255}{0.85} = L$$
$$300 = L$$

The original price is \$300.

78. Use $S = 4400$, and $r = 12\%$ in the formula for the sale price, $S = L - rL$.

$$4400 = L - 0.12L$$
$$4400 = 0.88L$$
$$\frac{4400}{0.88} = L$$
$$5000 = L$$

The original price is \$5000.

79. Use $d = 40$ and $b = 200$ in the formula for discount, $d = br$.

$$40 = 200r$$
$$\frac{40}{200} = r$$
$$0.2 = r$$

The rate of discount was 20%.

80. Use $d = 20$ and $b = 250$ in the formula for discount, $d = br$.

$$20 = 250r$$
$$\frac{20}{250} = r$$
$$0.08 = r$$

The rate of discount was 8%.

81. The length of a football field is 100 yards or 300 feet. Use $P = 920$ and $L = 300$ in the formula $P = 2L + 2W$.

$$920 = 2(300) + 2W$$
$$920 = 600 + 2W$$
$$320 = 2W$$
$$160 = W$$

The width is 160 feet.

82. The perimeter of a rectangle is given by $P = 2L + 2W$. Use $W = 16$ and $L = 20$ in the formula.

$$P = 2(20) + 2(16) = 72$$

The perimeter is 72 inches.

83. Use $W = 2$, $L = 3$, and $H = 4$ in the formula for the volume of a rectangular solid, $V = LWH$.

$$V = 3 \cdot 2 \cdot 4 = 24$$

The volume is 24 cubic feet.

84. Use $W = 2$, $L = 2.5$, and $V = 20$ in the formula for the volume of a rectangular solid, $V = LWH$.

$$\begin{aligned} 20 &= 2(2.5)H \\ 20 &= 5H \\ 4 &= H \end{aligned}$$

The height is 4 feet.

85. Use $C = 8\pi$ in the formula for the circumference of a circle, $C = 2\pi r$.

$$\begin{aligned} 8\pi &= 2\pi r \\ \frac{8\pi}{2\pi} &= \frac{2\pi r}{2\pi} \\ 4 &= r \end{aligned}$$

The radius is 4 inches.

86. Use $C = 4\pi$ in the formula for the circumference of a circle, C = πD.

$$\begin{aligned} 4\pi &= \pi D \\ \frac{4\pi}{\pi} &= \frac{\pi D}{\pi} \\ 4 &= D \end{aligned}$$

The diameter is 4 meters.

87. Use $A = 16$ and $b = 4$ in the formula for the area of a triangle, $A = \frac{1}{2}bh$.

$$\begin{aligned} 16 &= \tfrac{1}{2} \cdot 4h \\ 16 &= 2h \\ 8 &= h \end{aligned}$$

The height is 8 feet.

88. Use $A = 14$ and $b = 4$ in the formula for the area of a triangle, $A = \frac{1}{2}bh$.

$$\begin{aligned} 14 &= \tfrac{1}{2} \cdot 4h \\ 14 &= 2h \\ 7 &= h \end{aligned}$$

The height is 7 meters.

89. Use $A = 200$, $h = 20$, and $b_1 = 8$ in the formula for the area of a trapezoid, $A = \frac{1}{2}h(b_1 + b_2)$.

$$\begin{aligned} 200 &= \tfrac{1}{2} \cdot 20(8 + b_2) \\ 200 &= 10(8 + b_2) \\ 200 &= 80 + 10b_2 \\ 120 &= 10b_2 \\ 12 &= b_2 \end{aligned}$$

The length of the upper base is 12 inches.

90. Use $A = 300$, $b_1 = 16$, and $b_2 = 24$ in the formula for the area of a trapezoid, $A = \frac{1}{2}h(b_1 + b_2)$.

$$\begin{aligned} 300 &= \tfrac{1}{2} \cdot h(16 + 24) \\ 300 &= 20h \\ 15 &= h \end{aligned}$$

The height is 15 centimeters.

91. a) Let $D = 1000$ and $a = 8$ in $d = 0.08aD$:

$$d = 0.08(8)(1000) = 640$$

Child's dosage is 640 milligrams.

b) Let $D = 600$ and $d = 200$:

$$\begin{aligned} 200 &= 0.08a(600) \\ 200 &= 48a \\ 4 &\approx a \end{aligned}$$

c) From the graph it appears that a child gets same dosage as an adult at about 13 years of age.

92. a) Use $D = 1000$ and $a = 8$ in $d = \dfrac{D(a+1)}{24}$.

$$d = \frac{1000(8+1)}{24} = 375$$

Prescribe 375 milligrams for an 8 year old.

b) Use $D = 600$ and $d = 200$ in $d = \dfrac{D(a+1)}{24}$.

$$\begin{aligned} 200 &= \frac{600(a+1)}{24} \\ 200 \cdot 24 &= 600(a+1) \\ 4800 &= 600a + 600 \\ 4200 &= 600a \\ 7 &= a \end{aligned}$$

The child is 7 years old.

93. $$\text{Amount} = \frac{750 \text{ mg}}{1000 \text{ mg}} \times 5 \text{ milliliters} = 3.75 \text{ ml}$$

94. a) For 2000 we have $t = 10$.

$$I = 7.5(10) + 115 = 190$$

The global investment in 2000 was \$190 billion.

b) From the graph it appears that global investment will reach \$300 billion around 2015.

c) $7.5t + 115 = 300$
$7.5t = 185$
$t \approx 25$
Global investment will reach \$300 billion 25 years after 1990 or in 2015.

95. $\dfrac{L + 2D - F\sqrt{S}}{2.37} = 2.4$
$L + 2D - F\sqrt{S} = 5.688$
$L = F\sqrt{S} - 2D + 5.688$

Mid Chapter Quiz 2.1 - 2.4

1. $x + 9 = -12$
$x = -12 - 9$
$x = -21$
The solution set is $\{-21\}$.

2. $\frac{3}{4}m = \frac{1}{2}$
$m = \frac{4}{3} \cdot \frac{1}{2} = \frac{2}{3}$
The solution set is $\left\{\frac{2}{3}\right\}$.

3. $-9x = 5 - 10x$
$x = 5$
The solution set is $\{5\}$.

4. $4a - 3 = 0$
$4a = 3$
$a = \frac{3}{4}$
The solution set is $\left\{\frac{3}{4}\right\}$.

5. $8w - 5 = 6w + 4$
$2w = 9$
$w = \frac{9}{2}$
The solution set is $\left\{\frac{9}{2}\right\}$.

6. $4(a + 3) + 8 = 48$
$4a + 12 + 8 = 48$
$4a = 28$
$a = 7$
The solution set is $\{7\}$.

7. $6 - 3(x + 2) = 4(x - 7)$
$6 - 3x - 6 = 4x - 28$
$-7x = -28$
$x = 4$
The solution set is $\{4\}$.

8. $\frac{3}{2}x + \frac{1}{6} = \frac{2}{3}$
$6\left(\frac{3}{2}x + \frac{1}{6}\right) = 6\left(\frac{2}{3}\right)$
$9x + 1 = 4$
$9x = 3$
$x = \frac{1}{3}$
The solution set is $\left\{\frac{1}{3}\right\}$.

9. $0.8x + 120 = x - 70$
$-0.2x = -190$
$x = 950$
The solution set is $\{950\}$.

10. $0.09x + 3.4 = 0.4x + 65.4$
$9x + 340 = 40x + 6540$
$-31x = 6200$
$x = -200$
The solution set is $\{-200\}$.

11. $7x - 12x = -5x$
$-5x = -5x$
The equation is an identity.

12. $7x - 12x = -5$
$-5x = -5$
$x = 1$
The equation is a conditional equation.

13. $7x - 12x = 6x$
$-5x = 6x$
$-11x = 0$
$x = 0$
The equation is a conditional equation.

14. $7x - 12x = -5x + 4$
$-5x = -5x + 4$
$0 = 4$
The equation is an inconsistent equation.

15. $ax + b = c$
$ax = c - b$
$x = \dfrac{c - b}{a}$

16. $5(x - a) = 2(x - b)$
$5x - 5a = 2x - 2b$
$3x = 5a - 2b$
$x = \dfrac{5a - 2b}{3}$

17. Let x be the original price.
$x - 0.12x = 13{,}904$
$0.88x = 13{,}904$
$x = 15{,}800$
The original price was \$15,800.

18. Let W be the width and use $P = 2L + 2W$.
$48 = 2(15) + 2W$
$18 = 2W$
$9 = W$

The width is 9 yd.

19. Let $x = 8$ in $3x - 4y = 12$.

$$3(8) - 4y = 12$$
$$-4y = -12$$
$$y = 3$$

20. Use $I = Prt$.

$$640 = 4000r(2)$$
$$r = \frac{640}{8000} = 0.08 = 8\%$$

2.5 WARM-UPS

1. Words such as sum, plus, increased by, and more than indicate addition.

2. Words such as product, twice, and percent of indicate multiplication.

3. Complementary angles have degree measures with a sum of 90°.

4. Supplementary angles have degree measures with a sum of 180°.

5. Distance is the product of rate and time.

6. We can use x and $x + 2$ to represent consecutive even or consecutive odd integers.

7. True, because $x + 6 - x = 6$.

8. True, because $a + 10 - a = 10$.

9. True, because distance is equal to rate times time.

10. False, because time is distance divide by rate. So the times is $10/x$ hours.

11. False, because three consecutive odd integers are represented by x, $x + 2$, and $x + 4$.

12. False, because the value in cents of n nickels and d dimes is $5n + 10d$ cents.

2.5 EXERCISES

1. The sum of a number and 3 indicates addition and so the algebraic expression for that phrase is $x + 3$.

2. Two more than a number indicates addition. So the expression is $x + 2$.

3. Three less than a number indicates subtraction. So the algebraic expression for the phrase is $x - 3$.

4. Four subtracted from a number is written as $x - 4$.

5. The product of a number and 5 indicates multiplication. So the algebraic expression is $5x$.

6. Five divided by some number is indicated as $5/x$.

7. Ten percent of a number is found by multiplying the number by 0.10 or 0.1. So the algebraic expression is $0.1x$.

8. Eight percent of a number is found by multiplying 0.08 and the number, $0.08x$.

9. A ratio is a fraction. So we have $x/3$.

10. Quotient indicates division. So we have $12/x$.

11. One-third of a number is a product. So we have $\frac{1}{3}x$.

12. Three-fourths of a number is a product. So we have $\frac{3}{4}x$.

13. If x is the smaller number, then x and $x + 15$ have a difference of 15. If x is the larger number, then x and $x - 15$ have a difference of 15 because $x-(x - 15) = 15$.

14. If x is the smaller number, then x and $x + 9$ differ by 9. If x is the larger number, then x and $x - 9$ differ by 9.

15. Two numbers with a sum of 6 are x and $6 - x$ because $x + (6 - x) = 6$.

16. Two numbers with a sum of 5 are x and $5 - x$ because $x + (5 - x) = 5$.

17. If x is the smaller number, then the numbers are x and $x + 3$. If x is the larger number, then the numbers are x and $x - 3$.

18. If x is the smaller number, then the numbers are x and $x + 8$. If x is the larger number, then the numbers are x and $x - 8$.

19. If x is one of the numbers, then 5% of x is $0.05x$. So the numbers are x and $0.05x$.

20. If x is one of the numbers, then 40% of x is $0.40x$. So the numbers are x and $0.40x$ or x and $0.4x$.

21. If one of the numbers is x, then 30% of x is $0.30x$ and a number that is 30% larger than x is $x + 0.30x$ or $1.30x$. So the numbers are x and $1.30x$.

22. If x is one of the numbers, the 20% of x is $0.20x$. A number that is 20% smaller than x is

$x - 0.20x$ or $0.80x$. So the numbers are x and $0.80x$.

23. Since the two angles are complementary we can use x and $90 - x$.

24. Since the two angles are supplementary we can use x and $180 - x$.

25. Since the sum of all angles of a triangle is $180°$, the two unknown angles have a sum of $120°$. So they are x and $120 - x$.

26. The two acute angles of a right triangle have a sum of $90°$. So they are x and $90 - x$.

27. Since consecutive even integers differ by 2, two consecutive even integers are expressed as n and $n + 2$, where n is an even integer.

28. Since consecutive odd integers differ by 2, two consecutive odd integers are expressed as x and $x + 2$, where x is an odd integer.

29. Consecutive integers differ by 1. So two consecutive integers are represented as x and $x + 1$, where x is an integer.

30. Consecutive even integers differ by 2, so three consecutive even integers are expressed as x, $x + 2$, and $x + 4$, where x is an even integer.

31. Three consecutive odd integers are expressed as x, $x + 2$, and $x + 4$, where x is an odd integer.

32. Three consecutive integers are expressed as x, $x + 1$, and $x + 2$, where x is an integer.

33. Four consecutive even integers are expressed as x, $x + 2$, $x + 4$, and $x + 6$, where x is an even integer.

34. Four consecutive odd integers are expressed as x, $x + 2$, $x + 4$, and $x + 6$, where x is an odd integer.

35. If we use $R = x$ and $T = 3$ in the formula $D = RT$, we get $D = 3x$. So an expression for the distance is $3x$ miles.

36. Since $D = RT$, we can express the distance as $(x + 10)5$ or $5x + 50$ miles.

37. Since the discount is 25% of the original price q, the discount is $0.25q$ dollars.

38. Since the discount is 10% of the original price t, the discount is $0.10t$ yen.

39. Use $D = x$ and $R = 20$ in the formula $T = D/R$, to get $T = x/20$. So an expression for the time is $x/20$ hr.

40. Since $T = D/R$, we can express the time as $300/(x + 30)$ hr.

41. Use $D = x - 100$ and $T = 12$ in the formula $R = D/T$, to get $R = (x - 100)/12$. So an expression for the rate is $(x - 100)/12$ m/sec.

42. Since $R = D/T$, we can express the rate as $200/(x + 3)$ ft/sec

43. Since the area of a rectangle is the length times the width, the area is $5x$ m^2.

44. Since the area of a rectangle is the length times the width, the area is $b(b - 6)$ yd^2 or $b^2 - 6b$ yd^2.

45. Since the perimeter of a rectangle is twice the length plus twice the width, the perimeter in this case is $2w + 2(w + 3)$ in.

46. Since the perimeter of a rectangle is twice the length plus twice the width, an expression for the perimeter in this case is $2r + 2(r - 1)$ cm.

47. If the perimeter of the rectangle is 300, then the total of the length and width is 150. If the length is x, then the width is expressed as $150 - x$ ft.

48. Since $A = LW$ or $L = A/W$, an expression for the length is $200/w$ ft.

49. If the width is x and the length is 1 foot longer than twice the width, then the length is expressed as $2x + 1$ ft.

50. If the width is w and the length is 3 feet shorter than twice the width, then the length is $2w - 3$ ft.

51. If the width is x and the length is 5 meters longer, then the length is $x + 5$. Since the area is length times width for a rectangle, we can express the area as $x(x + 5)$ m^2.

52. Since the perimeter is $2L + 2W$, we can express the perimeter as $2(x) + 2(x - 10)$ yd.

53. The simple interest is given by the formula $I = Prt$. So if P is $x + 1000$, r is 18%, and t is 1 year, then the simple interest is expressed as $0.18(x + 1000)$.

54. Since $I = Prt$, we can express the simple interest as $3x(0.06)(1)$ or $0.06(3x)$.

55. To find the price per pound we divide the total price by the number of pounds. So the price per pound for the peaches is expressed as $16.50/x$ dollars per pound.

56. If a mechanic gets \$480 for x hours of work, then the mechanic makes $480/x$ dollars per hour.

57. Since the sum of complementary angles is $90°$, the degree measure is $90 - x$ degrees.
58. Since supplementary angles have a sum of $180°$, the degree measure is $180 - x$ degrees.
59. If x represents the smaller number, then two numbers that differ by 5 are expressed as x and $x + 5$. If their product is 8, we can write the equation $x(x + 5) = 8$.
60. If x is the smaller number, then two numbers that differ by 6 are represented as x and $x + 6$. Since their product is -9, we can write $x(x + 6) = -9$.
61. If x is the selling price, the agent gets $0.07x$. Since Herman receives the selling price less the commission, $x - 0.07x = 84{,}532$.
62. If x is the selling price, then 10% of the selling price is expressed as $0.10x$. Since Gwen received the selling price minus the commission, we can write the equation $x - 0.10x = 6570$.
63. To find a percent of 500 we multiply the rate (or percent) x by 500: $500x = 100$.
64. To find a percent of 40 we multiply the rate (or percent) x by 40: $40x = 120$
65. The value in dollars of x nickels is $0.05x$. The value in dollars of $x + 2$ dimes is $0.10(x + 2)$. Since we know that the total value is $\$3.80$, we can write the equation $0.05x + 0.10(x + 2) = 3.80$. We could express the total value in cents as $5x + 10(x + 2) = 380$.
66. The value in dollars of d dimes is $0.10d$ and the value in dollars of $d - 3$ quarters is $0.25(d - 3)$. Since the total value is $\$6.75$, we can write $0.10d + 0.25(d - 3) = 6.75$.
67. Sum indicates addition. The sum of a number (x) and 5 is 13 is written as the equation $x + 5 = 13$.
68. If x represents the unknown number, then twelve subtracted from a number is -6 is written as $x - 12 = -6$.
69. Three consecutive integers are represented as x, $x + 1$, and $x + 2$, where x is the smallest of the three integers. Since their sum is 42, we can write $x + (x + 1) + (x + 2) = 42$.
70. If x represents the smallest of the three odd integers, then the three consecutive odd integers are represented as x, $x + 2$, and $x + 4$. Since their sum is 27, we can write $x + x + 2 + x + 4 = 27$.
71. Two consecutive integers are represented as x and $x + 1$, where x is an integer. Since their product is 182, we can write the equation $x(x + 1) = 182$.
72. Two consecutive even integers are represented by x and $x + 2$, where x is an even integer. Since their product is 168, we can write $x(x + 2) = 168$.
73. To find 12% of Harriet's income we multiply Harriet's income (x) by 0.12. Since we know that 12% of her income is $\$3000$, we can write the equation $0.12x = 3000$.
74. Nine percent of the members is represented by $0.09x$, where x is the number of members. Since 9% of the members is 252, we can write $0.09x = 252$.
75. To find 5% of a number we multiply the number (x) by 0.05. Since we know that 5% of the number is 13, we can write the equation $0.05x = 13$.
76. To find 8% of some number (x), we write $0.08x$. Since 300 is 8% of x, we can write $0.08x = 300$.
77. Since the length is 5 feet longer than the width, let x represent the length and $x + 5$ represent the width. Since the area is 126, we can write the equation $x(x + 5) = 126$.
78. If x is the width and the length is 1 yard shorter than twice the width, then the length is $2x - 1$. Since the perimeter is 298 yards, we can use the formula for perimeter to write the equation $2x + 2(2x - 1) = 298$.
79. The number of cents in n nickels is $5n$ and the number of cents in $n - 1$ dimes is $10(n - 1)$. Since the total value is 95 cents, we can write the equation $5n + 10(n - 1) = 95$.
80. The value in cents of q quarters is $25q$. The value in cents of $q + 1$ dimes is $10(q + 1)$. The value in cents of $2q$ nickels is $5(2q)$. Since the total value is 90 cents, we can write the equation $25q + 10(q + 1) + 5(2q) = 90$.
81. The measures of the two angles are x and $x - 38$. Since the angles are supplementary, we have $x + x - 38 = 180$.
82. The measures of the two angles are x and $x + 16$, where x is the smaller angle. Since the

angles are complementary we have $x + x + 16 = 90$.

83. a) If r is the resting hear rate then we subtract the sum of the age and the resting heart rate from 220 to get $220 - (30 + r)$. Now take 60% of that result and add it to the resting heart rate to get the target heart rate of 144:

$$r + 0.60(220 - (30 + r)) = 144$$

b) As the resting heart rate increases, the target heart rate also increases.

84. If L is the inside leg measurement, then the saddle height is 109% of the inside leg measurement. So $1.09L = 36$.

85. The sum of 6 and x is $6 + x$ or $x + 6$.

86. To express w less than 12, write $12 - w$.

87. To express m increased by 9, write $m + 9$.

88. To express q decreased by 5, write $q - 5$.

89. To express t multiplied by 11 write $t \cdot 11$ or $11t$.

90. To express 10 less than the square of y, write $y^2 - 10$.

91. To express 5 times the difference between x and 2, write $5(x - 2)$.

92. To express the sum of two-thirds of k and 1 write $\frac{2}{3}k + 1$.

93. To express m decreased by the product of 3 and m, write $m - 3m$.

94. To express 7 increased by the quotient of x and 2, write $7 + x/2$ or $7 + \frac{x}{2}$.

95. The ratio of 8 more than h and h is written as $(h + 8)/h$ or $\frac{h + 8}{h}$.

96. The product of 5 and the total of r and 3 is written as $5(r + 3)$.

97. To express 5 divided by the difference between y and 9, write $5/(y - 9)$ or $\frac{5}{y - 9}$.

98. The product of n and the sum of n and 6 is $n(n + 6)$.

99. The quotient of 8 less then w and twice w is written as $(w - 8)/(2w)$ or $\frac{w - 8}{2w}$.

100. To express 3 more than one-third of the square of b write $\frac{1}{3}b^2 + 3$ or $\frac{b^2}{3} + 3$.

101. To express 9 less than the product of v and -3, write $-3v - 9$.

102. The total of 4 times the cube of t and the square of b is written as $4t^3 + b^2$.

103. To express x decreased by the quotient of x and 7, write $x - x/7$ or $x - \frac{x}{7}$.

104. Five-eighths of the sum of y and 3 is written as $\frac{5}{8}(y + 3)$.

105. The difference between the square of m and the total of m and 7 is $m^2 - (m + 7)$.

106. The product of 13 and the total of t and 6 is $13(t + 6)$.

107. To express x increased by the difference between 9 times x and 8 write $x + (9x - 8)$ or $x + 9x - 8$.

108. The quotient of twice y and 8 is written as $2y/8$ or $\frac{2y}{8}$.

109. To express 9 less than the product of 13 and n write $13n - 9$.

110. The product of s and 5 more than s is written as $s(s + 5)$.

111. To express 6 increased by one-third of the sum of x and 2 write $6 + \frac{1}{3}(x + 2)$.

112. To express x decreased by the difference between $5x$ and 9 write $x - (5x - 9)$.

113. The sum of x divided by 2 and x is written $x/2 + x$ or $\frac{x}{2} + x$.

114. Twice the sum of 6 times n and 5 is written as $2(6n + 5)$.

115. Because the area of a rectangle is the length times the width, we have $x(x + 3) = 24$.

116. Because the area of a rectangle (or square) is the product of the length and the width, we have $(h + 2)(h + 2) = 24$.

117. Because the area of a parallelogram is the product of the base and height, we have $w(w - 4) = 24$.

118. Because the area of a triangle is one-half the product of the base and height, we have $\frac{1}{2}y(y - 2) = 24$.

2.6 WARM-UPS

1. Uniform motion is motion at a constant rate.
2. When solving a geometric problem you should draw a figure and label it.
3. If x and $x + 10$ are complementary angles, then $x + x + 10 = 90$.
4. If x and $x - 45$ are supplementary angles, then $x + x - 45 = 180$.
5. If x is an even integer, then $x + 2$ is an even integer.
6. If x is an odd integer, then $x + 2$ is an odd integer.
7. False, the first step is to read the problem.
8. True.
9. True, it is a good idea to draw a diagram.
10. False, if x is an odd integer, then $x + 2$ is also an odd integer.
11. True, because the sum of the degree measures of complementary angles is 90.
12. False, because x and $x + 180$ is not 180.

2.6 EXERCISES

1. Let $x =$ the first integer and $x + 1 =$ the second integer. Since their sum is 79, we can write the following equation.

$$\begin{aligned} x + x + 1 &= 79 \\ 2x + 1 &= 79 \\ 2x &= 78 \\ x &= 39 \\ x + 1 &= 40 \end{aligned}$$

The integers are 39 and 40.

2. Let $x =$ the first integer and $x + 2 =$ the second integer. Since their sum is 56, we can write the following equation.

$$\begin{aligned} x + x + 2 &= 56 \\ 2x + 2 &= 56 \\ 2x &= 54 \\ x &= 27 \\ x + 2 &= 29 \end{aligned}$$

The odd integers are 27 and 29.

3. Let $x =$ the first integer, $x + 1 =$ the second integer, and $x + 2 =$ the third integer. Since their sum is 141, we can write the following equation.

$$\begin{aligned} x + x + 1 + x + 2 &= 141 \\ 3x + 3 &= 141 \\ 3x &= 138 \\ x &= 46 \\ x + 1 &= 47 \\ x + 2 &= 48 \end{aligned}$$

The three integers are 46, 47, and 48.

4. Let $x =$ the first even integer, $x + 2 =$ the second even integer, and $x + 4 =$ the third even integer. Since their sum is 114, we can write the following equation.

$$\begin{aligned} x + x + 2 + x + 4 &= 114 \\ 3x + 6 &= 114 \\ 3x &= 108 \\ x &= 36 \\ x + 2 &= 38 \\ x + 4 &= 40 \end{aligned}$$

The three consecutive even integers are 36, 38, and 40.

5. Let $x =$ the first odd integer and $x + 2 =$ the second odd integer. Since their sum is 152, we can write the following equation.

$$\begin{aligned} x + x + 2 &= 152 \\ 2x + 2 &= 152 \\ 2x &= 150 \\ x &= 75 \\ x + 2 &= 77 \end{aligned}$$

The two consecutive odd integers are 75 and 77.

6. Let $x =$ the first odd integer, $x + 2 =$ the second odd integer, $x + 4 =$ third odd integer, and $x + 6 =$ the fourth odd integer. Since their sum is 120, we can write the following equation.

$$\begin{aligned} x + x + 2 + x + 4 + x + 6 &= 120 \\ 4x + 12 &= 120 \\ 4x &= 108 \\ x &= 27 \\ x + 2 &= 29 \\ x + 4 &= 31 \\ x + 6 &= 33 \end{aligned}$$

The 4 consecutive odd integers are 27, 29, 31, and 33.

7. Let $x =$ the first integer, $x + 1 =$ the second integer, $x + 2 =$ the third integer, and $x + 3 =$ the fourth integer. Since their sum is 194, we can write the following equation.

$$x + x + 1 + x + 2 + x + 3 = 194$$
$$4x + 6 = 194$$
$$4x = 188$$
$$x = 47$$
$$x + 1 = 48$$
$$x + 2 = 49$$
$$x + 3 = 50$$

The three integers are 47, 48, 49, and 50.

8. Let $x =$ the first even integer, $x + 2 =$ the second even integer, and $x + 4 =$ the third even integer, and $x + 6 =$ the fourth even integer. Since their sum is 340, we can write the following equation.

$$x + x + 2 + x + 4 + x + 6 = 340$$
$$4x + 12 = 340$$
$$4x = 328$$
$$x = 82$$
$$x + 2 = 84$$
$$x + 4 = 86$$
$$x + 6 = 88$$

The four consecutive even integers are 82, 84, 86, and 88.

9. Let $x =$ the width and $2x =$ the length. Since the perimeter is 150, we can write the following.

$$2(x) + 2(2x) = 150$$
$$6x = 150$$
$$x = 25$$
$$2x = 50$$

The length is 50 m and the width is 25 m.

10. Let $x =$ the width and $2x + 6 =$ the length. Since the perimeter is 228, we can write the following equation.

$$2(x) + 2(2x + 6) = 228$$
$$6x + 12 = 228$$
$$6x = 216$$
$$x = 36$$
$$2x + 6 = 78$$

The length is 78 feet and the width is 36 feet.

11. Let $x =$ the width and $x + 4 =$ the length. Since the perimeter is 176, we can write the following equation.

$$2x + 2(x + 4) = 176$$
$$2x + 2x + 8 = 176$$
$$4x + 8 = 176$$
$$4x = 168$$
$$x = 42$$
$$x + 4 = 46$$

The width is 42 inches and the length is 46 inches.

12. Let $x =$ the length of the first side, $2x - 81 =$ the length of the second side, and $x + 61 =$ the length of the third side. Since the total is 720, we can write the following equation.

$$x + 2x - 81 + x + 61 = 720$$
$$4x - 20 = 720$$
$$4x = 740$$
$$x = 185$$
$$2x - 81 = 289$$
$$x + 61 = 246$$

The sides are 185 mi, 289 mi, and 246 mi.

13. Let $x =$ the length of each of the equal sides and $x - 5 =$ the length of the base of the triangle. Since the perimeter is 34 inches, we can write the following equation.

$$x + x + x - 5 = 34$$
$$3x = 39$$
$$x = 13$$

The length of each of the equal sides is 13 inches.

14. Let $x =$ the width and $x + 8 =$ the length. Since the perimeter is 88 feet, we can write the following equation.

$$2x + 2(x + 8) = 88$$
$$2x + 2x + 16 = 88$$
$$4x = 72$$
$$x = 18$$
$$x + 8 = 26$$

The room is 18 feet by 26 feet.

15. $2w + 2w + 40 = 180$
$$4w + 40 = 180$$
$$4w = 140$$
$$w = 35$$

So the angle marked w is 35°.

16. $3z + z - 6 = 90$
$$4z = 96$$
$$z = 24$$

So the angle marked z is 24°.

17. Let $x =$ his speed on the freeway and $x - 20 =$ his speed on the country road. Since $D = RT$, his distance on the freeway was $4x$ and his distance on the country road was $5(x - 20)$. Since his total distance was 485 miles, we can write the following equation.

$$4x + 5(x - 20) = 485$$

$$4x + 5x - 100 = 485$$
$$9x = 585$$
$$x = 65$$

He traveled 65 mph on the freeway.

18. Let $x =$ her walking speed and $2x =$ her running speed. Her distance walking is $2x$ and her distance running is $0.5(2x)$. Since her total distance was 12 miles, we can write the following equation.

$$2x + 0.5(2x) = 12$$
$$3x = 12$$
$$x = 4$$

Her walking speed was 4 miles per hour.

19. Let $x =$ her speed after dawn and $x + 5 =$ her speed before dawn. Her distance after dawn was $6x$ and her distance before dawn was $5(x + 5)$. Since her total distance was 630 miles, we can write the following equation.

$$6x + 5(x + 5) = 630$$
$$6x + 5x + 25 = 630$$
$$11x + 25 = 630$$
$$11x = 605$$
$$x = 55$$

Her speed after dawn was 55 mph.

20. Let $x =$ his speed on Monday and $x + 12 =$ his speed on Tuesday. Since his time on Monday was 0.75 hour, his distance Monday was $0.75x$ miles. Since his time on Tuesday was $36/60 = 0.6$ hour, his distance on Tuesday was $0.6(x + 12)$. Since the distance is the same either day, we can write the following equation.

$$0.75x = 0.6(x + 12)$$
$$0.75x = 0.6x + 7.2$$
$$0.15x = 7.2$$
$$x = 48$$

Since his speed on Monday was 48 mph and his time on Monday was 0.75 hour, his distance on Monday was $0.75(48) = 36$ miles.

21. Let $x =$ the time in hours to L.A. and $x + 48/60 =$ the time in hours to Chicago. Since $D = RT$, we have

$$640x = 512(x + 0.8)$$
$$640x = 512x + 409.6$$
$$128x = 409.6$$
$$x = 3.2$$
$$640x = 2048$$

The trip from L.A. to Chicago was 3.2 hours and the trip from Chicago to L.A. was 4 hours. The distance from Chicago to L.A. is 2048 miles.

22. Let $x =$ the time in hours from Colorado Springs to Pikes Peak and $x - 1.5 =$ the time in hours for the return trip. Use $D = RT$ to get

$$6x = 15(x - 1.5)$$
$$6x = 15x - 22.5$$
$$-9x = -22.5$$
$$x = 2.5$$

The ride to Pikes Peak took 2.5 hours.

23. Let $x =$ the length and $x - 8 =$ the width of the frame. Use $P = 2L + 2W$.

$$2x + 2(x - 8) = 64$$
$$4x - 16 = 64$$
$$4x = 80$$
$$x = 20$$
$$x - 8 = 12$$

So the length is 20 in. and the width is 12 in.

24. Let $x =$ the length and $0.20x =$ the width of the box. Use $P = 2L + 2W$.

$$2x + 2(0.20x) = 192$$
$$2.4x = 192$$
$$x = 80$$
$$0.20x = 16$$

So the length is 80 cm and the width is 16 cm.

25. Let $x =$ the length of each of the equal sides and $x - 2 =$ the length of the third (shortest) side. The perimeter is 13 feet.

$$x + x + x - 2 = 13$$
$$3x = 15$$
$$x = 5$$
$$x - 2 = 3$$

So the sides are 5 ft, 5 ft, and 3 ft.

26. Let $x =$ the length of the second side, $2x =$ the length of the first side, and $x + 24 =$ the length of the third side. The perimeter is 144 m.

$$x + 2x + x + 24 = 144$$
$$4x = 120$$
$$x = 30$$
$$2x = 60$$
$$x + 24 = 54$$

So the lengths of the sides are 60 m, 30 m, and 54 m.

27. Let $x =$ degree measure of the smallest angle, $6x =$ the degree measure of the largest

angle, and $2x =$ the degree measure of the middle angle. The sum of the degree measures of all three angles in any triangle is $180°$.

$$\begin{aligned} x + 6x + 2x &= 180 \\ 9x &= 180 \\ x &= 20 \\ 6x &= 120 \\ 2x &= 40 \end{aligned}$$

So the angles are $20°$, $40°$, and $120°$.

28. Let $x =$ degree measure of the second acute angle of the right triangle. The sum of the degree measures of all three angles in any triangle is $180°$.

$$\begin{aligned} x + 38 + 90 &= 180 \\ x &= 52 \end{aligned}$$

So the angles are $38°$, $52°$, and $90°$.

29. Let $x =$ degree measure of the smallest angle and $4x =$ the degree measure of each of the equal angles. The sum of the degree measures of all three angles in any triangle is $180°$.

$$\begin{aligned} x + 4x + 4x &= 180 \\ 9x &= 180 \\ x &= 20 \\ 4x &= 80 \end{aligned}$$

So the angles are $20°$, $80°$, and $80°$.

30. Let $x =$ degree measure of the smallest angle and $2x + 10 =$ the degree measure of each of the equal angles. The sum of the degree measures of all three angles in any triangle is $180°$.

$$\begin{aligned} x + 2x + 10 + 2x + 10 &= 180 \\ 5x + 20 &= 180 \\ 5x &= 160 \\ x &= 32 \\ 2x + 10 &= 74 \end{aligned}$$

So the angles are $32°$, $74°$, and $74°$.

31. Let $x =$ the number of points scored by the Raiders and $x - 18 =$ the number scored by the Vikings.

$$\begin{aligned} x + x - 18 &= 46 \\ 2x &= 64 \\ x &= 32 \\ x - 18 &= 14 \end{aligned}$$

The scored was Raiders 32, Vikings 14.

32. Let $x =$ the payroll for the Mets in millions of dollars, $x + 52 =$ the payroll for the Yankees in millions of dollars, and $x - 14 =$ the payroll for the Cubs in millions of dollars.

$$\begin{aligned} x + x + 52 + x - 14 &= 485 \\ 3x + 38 &= 485 \\ 3x &= 447 \\ x &= 149 \\ x + 52 &= 201 \\ x - 14 &= 135 \end{aligned}$$

So the payroll were: Mets \$149 million, Yankees \$201 million, and Cubs \$135 million.

33. Let $x =$ the driving time before lunch and $x - 1 =$ the driving time after lunch. Since $D = RT$,

$$\begin{aligned} 50x + 53(x - 1) &= 256 \\ 103x - 53 &= 256 \\ 103x &= 309 \\ x &= 3 \\ x - 1 &= 2 \end{aligned}$$

She drove for 3 hours before lunch. The distance from Ardmore to Lawton is $2(53)$ or 106 miles.

34. Let $x =$ the Monday driving time and $x - 2 =$ the Tuesday driving time.

$$\begin{aligned} 47x + 69(x - 2) &= 326 \\ 116x - 138 &= 326 \\ 116x &= 464 \\ x &= 4 \\ x - 2 &= 2 \end{aligned}$$

He drove 4 hours on Monday. The distance from Valentine to Chadron is $2(69)$ or 138 miles.

35. Let $x =$ Crawford's age in 1950, $x - 1 =$ John Wayne's age in 1950, and $x - 2 =$ James Stewart's age in 1950.

$$\begin{aligned} x + x - 1 + x - 2 &= 129 \\ 3x &= 132 \\ x &= 44 \\ x - 1 &= 43 \\ x - 2 &= 42 \end{aligned}$$

So Crawford was born in 1906, Wayne in 1907, and Stewart in 1908.

36. Let $x =$ Hope's age in 1951, $x + 2 =$ Gable's age in 1951, and $x - 2 =$ Fonda's age in 1951.

$$\begin{aligned} x + x + 2 + x - 2 &= 144 \\ 3x &= 144 \\ x &= 48 \\ x + 2 &= 50 \\ x - 2 &= 46 \end{aligned}$$

Hope was born in 1903, Gable in 1901, and Fonda in 1905.

37. Let $x =$ the length of the shortest piece. The longest piece is $2x + 2$ feet. The total length for two short pieces and one long piece is 30 feet.

$$2x + 2x + 2 = 30$$
$$4x = 28$$
$$x = 7$$

The short pieces are 7 feet each and the long piece is $2(7) + 2$ or 16 feet.

38. Let $x =$ the width of each pen and $3x =$ the length of each pen. To fence the pens he needs 4 widths and 3 lengths.

$$4x + 3(3x) = 65$$
$$13x = 65$$
$$x = 5$$
$$3x = 15$$

So each pen is 5 feet by 15 feet.

2.7 WARM-UPS

1. The rate of discount is a percentage.

2. The discount is the amount by which a price is reduced.

3. The product of the original price and the rate of discount is the discount.

4. A table helps us to organize information given in a word problem.

5. An interest rate is a percentage.

6. True, because 12% of \$1000 is \$120.

7. False, because 5% of \$80,000 is \$4000.

8. True, because 20% of x is $0.2x$ and the amount she pays is $x - 0.2x$ or $0.8x$.

9. False, because 6% of x is $0.06x$.

2.7 EXERCISES

1. Let $x =$ the original price of the television and $0.25x =$ the amount of the discount. Since the amount of the discount is \$80, we can write the following equation.

$$0.25x = 80$$
$$x = \frac{80}{0.25} = 320$$

The original price was \$320.

2. Let $x =$ the original price.

$$0.12x = 75$$
$$x = 625$$

The original price was \$625.

3. Let $x =$ the original price and $0.20x =$ the amount of the discount. Since the price after the discount was \$320, we can write the following equation.

$$x - 0.20x = 320$$
$$0.80x = 320$$
$$x = \frac{320}{0.80} = 400$$

The original price was \$400.

4. Let $x =$ the original price and $0.15x$ is the amount of discount. The price she paid is the original price minus the discount.

$$x - 0.15x = 27{,}000$$
$$0.85x = 27{,}000$$
$$x = \frac{27000}{0.85} \approx 31{,}765$$

The original price was \$31,765.

5. Let $x =$ the selling price, and $0.10x =$ the real estate commission. The selling price minus the commission is what Kirk receives.

$$x - 0.08x = 115{,}000$$
$$0.92x = 115{,}000$$
$$x = 125{,}000$$

The house should sell for \$125,000.

6. Let $x =$ the selling price of the horse. The auctioneer gets $0.10x$ for selling the horse. Since the selling price minus the commission must equal \$810, we can write the following equation.

$$x - 0.10x = 810$$
$$0.9x = 810$$
$$x = 900$$

The horse must sell for \$900 for Gene to get \$810.

7. Let $x =$ the amount of her sales and $0.07x =$ the amount of sales tax. Since her total receipts were \$462.24, we can write the following equation.

$$x + 0.07x = 462.24$$
$$1.07x = 462.24$$
$$x = 432$$

The sales tax was $0.07(432)$ or \$30.24.

8. Let $x =$ the selling price and $0.08x =$ the amount of sales tax. The selling price plus the tax was \$15,714.

$$\begin{aligned} x + 0.08x &= 15{,}714 \\ 1.08x &= 15{,}714 \\ x &= 14{,}550 \end{aligned}$$

The selling price of the car was \$14,550.

9. Let $x =$ the amount invested in the 100 fund and $x + 3000 =$ the amount invested in the 101 fund.

$$\begin{aligned} 0.18x + 0.15(x + 3000) &= 3750 \\ 0.33x + 450 &= 3750 \\ 0.33x &= 3300 \\ x &= 10{,}000 \\ x + 3000 &= 13{,}000 \end{aligned}$$

He invested \$10,000 in the 100 fund and \$13,000 in the 101 fund.

10. Let $x =$ the amount lent to her brother at 8% and $2x =$ the amount lent to her sister at 16%. Since her total interest income was \$0.20, we can write the following equation.

$$\begin{aligned} 0.08(x) + 0.16(2x) &= 0.20 \\ 0.08x + 0.32x &= 0.20 \\ 0.40x &= 0.20 \\ x &= 0.50 \\ 2x &= 1.00 \end{aligned}$$

She lent her brother \$0.50 and her sister \$1.00.

11. Let $x =$ the amount invested at 5% and $25000 - x =$ the amount invested at 4%. His income on the first investment was $0.05x$ and his income from the second investment was $0.04(25000 - x)$. Since his total income was actually \$1140, we can write the following equation.

$$\begin{aligned} 0.05x + 0.04(25000 - x) &= 1140 \\ 0.05x + 1000 - 0.04x &= 1140 \\ 0.01x &= 140 \\ x &= 14{,}000 \\ 25{,}000 - x &= 11{,}000 \end{aligned}$$

He invested \$14,000 in Fidelity and \$11,000 in Price.

12. Let $x =$ the amount invested in the Dreyfus fund and $30000 - x =$ the amount invested in the Templeton fund.

$$\begin{aligned} 0.16x + 0.25(30{,}000 - x) &= 6060 \\ 0.16x + 7500 - 0.25x &= 6060 \\ -0.09x &= -1440 \\ x &= 16{,}000 \\ 30{,}000 - x &= 14{,}000 \end{aligned}$$

She invested \$16,000 in Dreyfus and \$14,000 in Templeton.

13. Let $x =$ the amount of 1% milk. The x gallons of 1% milk are mixed with 30 gallons of 3% milk to obtain $x + 30$ gallons of 2% milk. In the 1% milk there are $0.01x$ gallons of fat. In the 3% milk there are $0.03(30)$ gallons of fat. In the 2% milk there are $0.02(x + 30)$ gallons of fat. We can write an equation expressing the fact that the total of the fat in the two milks that are mixed is equal to the fat in the final mixture.

$$\begin{aligned} 0.01x + 0.03(30) &= 0.02(x + 30) \\ 0.01x + 0.9 &= 0.02x + 0.6 \\ 0.9 &= 0.01x + 0.6 \\ 0.3 &= 0.01x \\ 100(0.3) &= 100(0.01x) \\ 30 &= x \end{aligned}$$

Use 30 gallons of 1% milk.

14. Let $x =$ the number of gallons of 5% solution. This solution is mixed with 30 gallons to obtain $x + 30$ gallons of 8% solution. The equation accounts for all of the acid.

$$\begin{aligned} 0.05x + 0.10(30) &= 0.08(x + 30) \\ 0.05x + 3 &= 0.08x + 2.4 \\ 0.6 &= 0.03x \\ 20 &= x \end{aligned}$$

Twenty gallons of 5% solution should be used.

15. Let $x =$ the number of liters of 5% solution and $30 - x =$ the number of liters of 20% solution. The amount of alcohol in the 5% solution is $0.05x$. The amount of alcohol in the 20% solution is $0.20(30 - x)$. The amount of alcohol in the final 10% solution is $0.10(30)$. We can write an equation expressing the fact that the total of the alcohol in each of the two solutions mixed is equal to the alcohol in the final result.

$$\begin{aligned} 0.05x + 0.20(30 - x) &= 0.10(30) \\ 0.05x + 6 - 0.20x &= 3 \\ 6 - 0.15x &= 3 \\ -0.15x &= -3 \\ x &= \frac{-3}{-0.15} = 20 \\ 30 - x &= 10 \end{aligned}$$

He should use 20 liters of 5% alcohol and 10 liters of 20% alcohol.

16. Let $x =$ the amount of pure antifreeze and $20 - x =$ the amount of 40% solution.

$$x + 0.40(20 - x) = 0.50(20)$$
$$x + 8 - 0.4x = 10$$
$$0.6x + 8 = 10$$
$$0.6x = 2$$
$$x = \frac{2}{0.6} = \frac{10}{3}$$
$$20 - x = \frac{50}{3}$$

She should use $\frac{10}{3}$ quarts of pure antifreeze and $\frac{50}{3}$ quarts of 40% solution.

17. Let $x =$ the number of registered voters. We can write the following equation.

$$0.60x = 33420$$
$$x = \frac{33420}{0.6} = 55{,}700$$

There are 55,700 registered voters.

18. Let $x =$ the number of voters in the sample.

$$0.45x = 594$$
$$x = \frac{594}{0.45} = 1320$$

There were 1320 voters in the sample.

19. Let $x =$ the price of the car and $0.08x =$ the amount of sales tax. Since the amount of sales tax was \$1200, we can write the following equation.

$$0.08x = 1200$$
$$x = \frac{1200}{0.08} = 15000$$

The price of the car was \$15,000.

20. Let $x =$ her income and $0.24x =$ the amount of taxes she paid.

$$0.24x = 9600$$
$$x = \frac{9600}{0.24} = 40{,}000$$

Her income was \$40,000.

21. Let $x =$ the percent increase and $8x =$ the amount of increase. Since the actual amount of increase is \$6, we can write the following equation.

$$8x = 6$$
$$x = \frac{6}{8} = 0.75$$

The price of the shirts is increased 75%.

22. There were 7 fewer cases this year than last. Let $x =$ the percent of decrease.

$$x(35) = 7$$
$$x = \frac{7}{35} = 0.2 = 20\%$$

The percent decrease in AIDS cases was 20%.

23. Let $x =$ the number of students at Jefferson and $x + 400 =$ the number of students in the combined school. The number of African American students at Jefferson is $0.60x$. The number of African American students at Wilson is $0.20(400)$. The number of African American students in the combined school will be $0.44(x + 400)$.

$$0.60x + 0.20(400) = 0.44(x + 400)$$
$$0.60x + 80 = 0.44x + 176$$
$$0.16x + 80 = 176$$
$$0.16x = 96$$
$$x = 600$$

The number of students at Jefferson is 600.

24. Let $x =$ the number of students in the 58% school and $800 - x =$ the number of students in the 10% school. In the combined school 40% of the 800 students will be Caucasian. We can write the following equation.

$$0.58x + 0.10(800 - x) = 0.40(800)$$
$$0.58x + 80 - 0.10x = 320$$
$$0.48x = 240$$
$$x = 500$$

There are 500 students in the 58% school and 300 students in the 10% school.

25. Let $x =$ the number of people in private rooms and $x + 18 =$ the number of people in semiprivate rooms. The revenue from the private rooms is $200x$ dollars and the revenue from the semiprivate rooms is $150(x + 18)$ dollars. We can write an equation for the total receipts.

$$200x + 150(x + 18) = 17{,}400$$
$$200x + 150x + 2700 = 17{,}400$$
$$350x + 2700 = 17{,}400$$
$$350x = 14{,}700$$
$$x = 42$$
$$x + 18 = 60$$

They have 42 private rooms and 30 semi-private rooms (holding 60 people).

26. Let $x =$ the number of TV ads $x - 60 =$ the number of radio ads.

$$3{,}000x + 2{,}000(x - 60) = 580{,}000$$
$$5{,}000x - 120{,}000 = 580{,}000$$
$$5{,}000x = 700{,}000$$
$$x = 140$$
$$x - 60 = 80$$

There will be 140 TV ads and 80 radio ads.

27. Let $x =$ the number of pounds of pistachios. We can write an equation expressing the total cost of the mixture.

$$6.40x + 4.80(20) = 5.40(x + 20)$$

$$6.4x + 96 = 5.4x + 108$$
$$x = 12$$

We should mix 12 pounds of pistachios with 20 pounds of cashews to get a mix that sells for \$5.40 per pound.

28. Let $x =$ the number of pounds of premium coffee and $100 - x =$ the number of pounds of regular coffee.

$$6x + 4(100 - x) = 4.64(100)$$
$$2x + 400 = 464$$
$$2x = 64$$
$$x = 32$$
$$100 - x = 68$$

Blend 32 pounds of premium and 68 pounds of regular.

29. Let $x =$ the number of nickels and $10 - x =$ the number of dimes. The value in cents of the nickels is $5x$ and the value in cents of the dimes is $10(10 - x)$. Since she has 80 cents altogether, we can write the following equation.

$$5x + 10(10 - x) = 80$$
$$5x + 100 - 10x = 80$$
$$-5x = -20$$
$$x = 4$$
$$10 - x = 6$$

She used 4 nickels and 6 dimes.

30. Let $x =$ the number of dimes and $36 - x =$ the number of quarters. We can write an equation expressing the total value of the coins.

$$0.10x + 0.25(36 - x) = 4.50$$
$$0.10x + 9 - 0.25x = 4.50$$
$$-0.15x = -4.5$$
$$x = 30$$
$$36 - x = 6$$

He used 30 dimes and 6 quarters.

31. Let $x =$ the number of gallons of corn oil.

$$0.14x + 0.07(600) = 0.11(x + 600)$$
$$0.14x + 42 = 0.11x + 66$$
$$0.03x = 24$$
$$x = 800$$

Crisco should use 800 gallons of corn oil.

32. Let $x =$ the number of kilograms of dark chocolate.

$$0.35x + 0.48(50) = 0.40(x + 50)$$
$$0.35x + 24 = 0.40x + 20$$
$$-0.05x = -4$$
$$x = 80$$

Mix 80 kilograms of dark chocolate.

33. Let $x =$ the number of gallons of water. One gallon of Hawaiian Punch contains 0.10(1) or 0.10 gallon of fruit juice. The final mix will contain $0.06(x + 1)$ gallons of fruit juice.

$$0.10(1) = 0.06(x + 1)$$
$$0.10 = 0.06x + 0.06$$
$$0.04 = 0.06x$$
$$x = \frac{0.04}{0.06} = \frac{2}{3}$$

So, mix $2/3$ gal of water with one gallon of Hawaiian Punch.

34. Let $x =$ the number of liters of grape juice. The amount of alcohol in the wine is $0.12(2)$ and the amount in the mixture is $0.10(x + 2)$. These amounts are equal.

$$0.10(x + 2) = 0.12(2)$$
$$0.10x + 0.2 = 0.24$$
$$0.10x = 0.04$$
$$x = 0.4 = 2/5$$

So the amount of grape juice is $2/5$ liter.

35. Let $x =$ the price in dollars for a top and $2x =$ the price in dollars for a pair of shorts. The total price is \$108.

$$5(2x) + 8(x) = 108$$
$$18x = 108$$
$$x = 6$$
$$2x = 12$$

So shorts are \$12 and tops are \$6.

36. Let $x =$ the number of CD players and $3x =$ the number of VCRs.

$$150x + 120(3x) = 10{,}710$$
$$510x = 10{,}710$$
$$x = \frac{10{,}710}{510} = 21$$
$$3x = 63$$

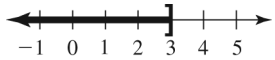
So she ordered 21 CD players and 63 VCRs.

2.8 WARM-UPS

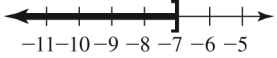
1. The symbols $<$, $\leq$, $>$, and $\geq$ are inequality symbols.
2. To graph $x \geq a$ on a number line we use a bracket at a.
3. To graph $x < a$ on a number line we use a parenthesis at a.
4. A compound inequality involves more the one inequality.
5. If $a < x < b$, then x is between a and b.
6. True, because $-2 = -2$.
7. False, because $-6 < -5$.
8. True, because $-2 > -3$ and $-2 < -1$.
9. True, because the inequalities $x < 7$ and $7 > x$ are equivalent.
10. False, because $-3 < -3$ is incorrect.
11. False, because $-2 < -3$ is not correct.

2.8 EXERCISES

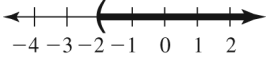
1. False, because -5 is to the right of -8 on the number line. So $-5 > -8$ is correct.
2. False, because -6 is to the left of -3 on the number line. So $-6 < -3$ is correct.
3. True, because -3 is to the left of 5 on the number line.
4. True, because -6 is to the left of 0 on the number line.
5. True, because $4 \leq 4$ is true if either $4 < 4$ or $4 = 4$ is correct.
6. True, because $-3 = -3$ is correct.
7. False, because -6 is to the left of -5 on the number line.
8. False, because -2 is to the right of -9 on the number line.
9. True, because $-4 < -3$ is correct.
10. True, because -5 is to the right of -10 on the number line.
11. True, $(-3)(4) - 1 < 0 - 3$ is equivalent to $-13 < -3$.
12. False, because $2(4) - 6 \leq -3(5) + 1$ is equivalent to $2 \leq -14$.
13. True, because $-4(5) - 6 \geq 5(-6)$ is equivalent to $-26 \geq -30$.
14. True, because $4(8) - 30 > 7(5) - 2(17)$ is equivalent to $2 > 1$.
15. True, because $7(4) - 12 \leq 3(9) - 2$ is equivalent to $16 \leq 25$.
16. True, because $-3(4) + 12 \leq 2(3) - 6$ is equivalent to $0 \leq 0$.
17. The graph of $x \leq 3$ consists of the numbers to the left of 3 including 3 on the number line. It is written in interval notation as $(-\infty, 3]$.



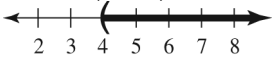
18. The graph of $x \leq -7$ consists of the numbers to the left of -7 including -7. It is written in interval notation as $(-\infty, -7]$.



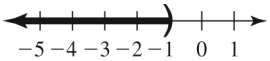
19. The graph of $x > -2$ consists of the numbers to the right of -2 on the number line. It is written in interval notation as $(-2, \infty)$.



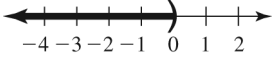
20. The graph of $x > 4$ consists of the numbers to the right of 4 on the number line. It is written in interval notation as $(4, \infty)$.



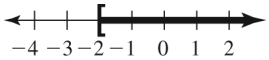
21. The inequality $-1 > x$ is the same as $x < -1$. It is written in interval notation as $(-\infty, -1)$.



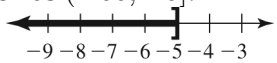
22. The inequality $0 > x$ is the same as $x < 0$. It is written in interval notation as $(-\infty, 0)$.



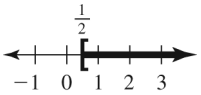
23. The graph of $-2 \leq x$ is the same as the graph of $x \geq -2$, the numbers to the right of and including -2. It is written in interval notation as $[-2, \infty)$.



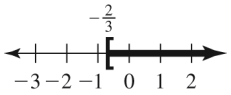
24. The graph of $-5 \geq x$ consists of the numbers to the left of and including -5. It is written in interval notation as $(-\infty, -5]$.



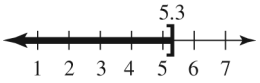
25. The graph of $x \geq \frac{1}{2}$ consists of the numbers to the right of and including $\frac{1}{2}$. It is written in interval notation as $[1/2, \infty)$.



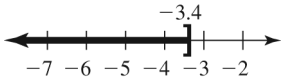
26. The graph of $x \geq -\frac{2}{3}$ consists of the numbers to the right of and including $-\frac{2}{3}$. It is written in interval notation as $[-2/3, \infty)$.



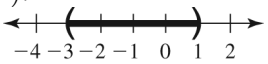
27. The graph of $x \leq 5.3$ consists of the numbers to the left of and including 5.3. It is written in interval notation as $(-\infty, 5.3]$.



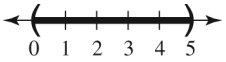
28. The graph of $x \leq -3.4$ consists of the number to the left of and including -3.4. It is written in interval notation as $(-\infty, -3.4]$.



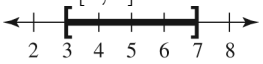
29. The graph of $-3 < x < 1$ consists of the numbers between -3 and 1. It is written in interval notation as $(-3, 1)$.



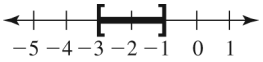
30. The graph of $0 < x < 5$ consists of the numbers between 0 and 5. It is written in interval notation as $(0, 5)$.



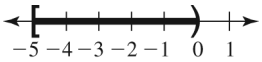
31. The graph of $3 \leq x \leq 7$ consists of the numbers between 3 and 7, including 3 and 7. It is written in interval notation as $[3, 7]$.



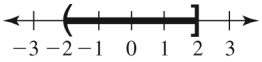
32. The graph of $-3 \leq x \leq -1$ consists of the numbers between -3 and -1, including -3 and -1. It is written in interval notation as $[-3, -1]$.



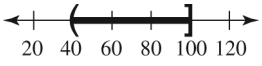
33. The graph of $-5 \leq x < 0$ consists of the numbers between -5 and 0, including -5 but not including 0. It is written in interval notation as $[-5, 0)$.



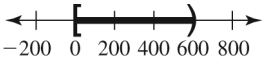
34. The graph of $-2 < x \leq 2$ consists of the numbers between -2 and 2, including 2 but not including -2. It is written in interval notation as $(-2, 2]$.



35. The graph of $40 < x \leq 100$ consists of the numbers between 40 and 100, including 100 but not including 40. It is written in interval notation as $(40, 100]$.



36. The graph of $0 \leq x < 600$ consists of the numbers between 0 and 600, including 0 but not including 600. It is written in interval notation as $[0, 600)$.



37. The graph shows the numbers to the right of 3. The inequality $x > 3$ describes this graph. The solution set in interval notation is $(3, \infty)$.

38. The graph shows the numbers to the left of and including 4. The inequality $x \leq 4$ describes the graph. The solution set in interval notation is $(-\infty, 4]$.

39. The graph shows the numbers to the left of and including 2. The inequality $x \leq 2$ describes this graph. The solution set in interval notation is $(-\infty, 2]$.

40. The graph shows the numbers between 0 and 3, including 3 but not including 0. The inequality $0 < x \leq 3$ describes this graph. The solution set in interval notation is $(0, 3]$.

41. The graph shows the numbers between 0 and 2. The inequality $0 < x < 2$ describes this graph. The solution set in interval notation is $(0, 2)$.

42. The graph shows the numbers between -1 and 3, including -1 but not including 3. The inequality $-1 \leq x < 3$ describes the graph. The solution set in interval notation is $[-1, 3)$.

43. The graph shows the numbers between -5 and 7, including 7 but not -5. The inequality $-5 < x \leq 7$ describes this graph. The solution set in interval notation is $(-5, 7]$.

44. The graph shows the number to the left of 4. The inequality $x < 4$ describes the graph.

The solution set in interval notation is $(-\infty, 4)$.

45. The graph shows the numbers to the right of -4. The inequality $x > -4$ describes this graph. The solution set in interval notation is $(-4, \infty)$.

46. The graph shows the numbers between 0 and 2, including 2. The inequality $0 < x \leq 2$ describes this graph. The solution set in interval notation is $(0, 2]$.

47. Replace x by -9 in $-x > 3$.

$$-(-9) > 3$$
$$9 > 3$$

Since the last inequality is correct, -9 satisfies $-x > 3$.

48. Replace x by 5 in $-3 < -x$.

$$-3 < -5$$

Since the last inequality is incorrect, 5 does not satisfy the inequality.

49. Replace x by -2 in $5 \leq x$.

$$5 \leq -2$$

Since the inequality is incorrect, -2 does not satisfy $5 \leq x$.

50. Replacing x by 4 in $4 \geq x$ gives us $4 \geq 4$, which is correct. So 4 satisfies the inequality $4 \geq x$.

51. Replace x by -6 in $2x - 3 > -11$.

$$2(-6) - 3 > -11$$
$$-15 > -11$$

Since the last inequality is incorrect, -6 does not satisfy $2x - 3 > -11$.

52. Replace x by 4 in $3x - 5 < 7$.

$$3(4) - 5 < 7$$
$$7 < 7$$

Since the last inequality is incorrect, 4 does not satisfy the inequality.

53. Replace x by 3 in $-3x + 4 > -7$.

$$-3(3) + 4 > -7$$
$$-5 > -7$$

Since $-5 > -7$ is correct, 3 satisfies $-3x + 4 > -7$.

54. Replace x by -4 in $-5x + 1 > -5$.

$$-5(-4) + 1 > -5$$
$$21 > -5$$

Since the last inequality is correct, -4 does satisfy the inequality.

55. Replace x by 0 in $3x - 7 \leq 5x - 7$.

$$3(0) - 7 \leq 5(0) - 7$$
$$-7 \leq -7$$

Since $-7 \leq -7$ is correct, 0 satisfies $3x - 7 \leq 5x - 7$.

56. Replace x by 0 in $2x + 6 \geq 4x - 9$.

$$2(0) + 6 \geq 4(0) - 9$$
$$6 \geq -9$$

Since $6 \geq -9$ is correct, 0 satisfies $2x + 6 \geq 4x - 9$.

57. Replace x by 2.5 in $-10x + 9 \leq 3(x + 3)$.

$$-10(0) + 9 \leq 3(0 + 3)$$
$$9 \leq 9$$

Since the last inequality is correct, 0 satisfies the inequality.

58. Replace x by 1.5 in $2x - 3 \leq 4(x - 1)$.

$$2(1.5) - 3 \leq 4(1.5 - 1)$$
$$0 \leq 2$$

Since the last inequality is correct, 1.5 satisfies the inequality.

59. Replace x by -7 in $-5 < x < 9$.

$$-5 < -7 < 9$$

Since -7 is not between -5 and 9, -7 does not satisfy $-5 < x < 9$.

60. Replace x by -9 in $-6 \leq x \leq 40$.

$$-6 \leq -9 \leq 40$$

Since -9 is smaller than -6, this inequality is incorrect and -9 does not satisfy $-6 \leq x \leq 40$.

61. Replace x by -2 in $-3 \leq 2x + 5 \leq 9$.

$$-3 \leq 2(-2) + 5 \leq 9$$
$$-3 \leq 1 \leq 9$$

Since 1 is between -3 and 9, -2 does satisfy $-3 \leq 2x + 5 \leq 9$.

62. Replace x by -5 in $-3 < -3x - 7 \leq 8$.

$$-3 < -3(-5) - 7 \leq 8$$
$$-3 < 8 \leq 8$$

Since the last inequality is correct, -5 satisfies the inequality.

63. Replace x by -3.4 in $-4.25x - 13.29 < 0.89$.

$$-4.25(-3.4) - 13.29 < 0.89$$
$$1.16 < 0.89$$

Since $1.16 < 0.89$ is incorrect, -3.4 does not satisfy $-4.25x - 13.29 < 0.89$.

64. Replace x by 4.8 in $3.25x - 14.78 \leq 1.3$.

$$3.25(4.8) - 14.78 \leq 1.3$$
$$0.82 \leq 1.3$$

Since the last inequality is correct, 4.8 satisfies the inequality.

65. Since $-5.1 > -5$ is false, $0 > -5$ is true, and $5.1 > -5$ is true, only 0 and 5.1 satisfy $x > -5$.
66. Since $-5.1 \leq 0$ is true, $0 \leq 0$ is true, and $5.1 \leq 0$ is false, only -5.1 and 0 satisfy $x \leq 0$.
67. Since $5 < -5.1$ is false, $5 < 0$ is false, and $5 < 5.1$ is true, only 5.1 satisfies $5 < x$.
68. Since $-5 > -5.1$ is true, $-5 > 0$ is false, and $-5 > 5.1$ is false, only -5.1 satisfies $-5 > x$.
69. Only 5.1 is between 5 and 7.
70. Only -5.1 satisfies $5 < -x < 7$.
71. All three given numbers satisfy $-6 < -x < 6$.
72. Only 5.1 and 0 satisfy $-5 \leq x - 0.1 \leq 5$.
73. Let $p =$ the sale price of the car and $0.08p =$ the amount of sales tax. The sales tax was more than \$1500 is expressed as $0.08p > 1500$.
74. Let $p =$ the price of the computer. The amount of sales tax is $0.09p$ and the total cost is less than \$1000. So $p + 0.09p + 40 < 1000$.
75. Let $p =$ the price of an order of fries, $2p =$ the price of a hamburger, and $p + 0.25 =$ the price of a Coke. If the price of all three is under \$2.00, then we can write $p + 2p + p + 0.25 < 2.00$.
76. If d is the number of dogs, then $\frac{1}{2}d$ is the number of cats. The total number of dogs and cats is greater than or equal to 30. So $d + \frac{1}{2}d \geq 30$.
77. Let $s =$ his score on the remaining test. The average is found by adding the scores and then dividing by 3. Since the average must be at least 60, we can write $\frac{44 + 72 + s}{3} \geq 60$.
78. Let $s =$ her score on the final. The average is found by adding the scores and then dividing by 2. Since the average must be at least 90, we can write $\frac{87 + s}{2} \geq 90$.
79. Let $R =$ his speed and $8R =$ his daily distance. His distance was between 396 and 453 is expressed as $396 < 8R < 453$.
80. Let $b =$ the amount that Betty will pay and $b + 100 =$ the amount that Bart will pay. Since the total is between \$399.99 and \$579.99 we can write the following inequality.
$399.99 < b + b + 100 < 579.99$
81. The angle at the base of the ladder is $90 - x$. So $60 < 90 - x < 70$.
82. The smallest angle is $180 - x - (x + 8)$ and the inequality is $180 - x - (x + 8) \leq 30$.
83. a) The girth is the sum of the length, twice the width and twice the height (h). So
$$45 + 2(30) + 2h \leq 130.$$
b) From the graph you can see that 130 inches of girth corresponds to about 12 in. in height. So the maximum height is 12 in.
84. a) The average is obtained by dividing the hits by the times at bat: $93/317 = 0.293$. If he gets x hits in the next 20 at bats, then he will have $93 + x$ hits in $317 + 20$ or 337 at bats. To get his average over 0.300 we have
$$\frac{93 + x}{317 + 20} > 0.300.$$
b) From the graph a batting average of 0.300 corresponds to about 100 hits. So he needs more than 100 hits.
85. In the formula $r = \frac{Nw}{n}$ let $w = 27$, $N = 50$, and $n = 17$:
$$r = \frac{50 \cdot 27}{17} \approx 79$$
The gear ratio is approximately 79 and according to the chart it is used for moderate effort on level ground.

2.9 WARM-UPS

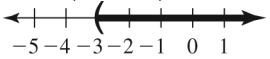
1. Equivalent inequalities have the same solution set.
2. According to the addition property of inequality, adding the same number to both sides of an inequality produces an equivalent inequality.
3. According to the multiplication property of inequality, the inequality symbol is reversed when multiplying by a negative number and not reversed when multiplying by a positive number.
4. True, because dividing each side of $2x > 18$ by 2 yields $x > 9$.
5. False, because adding 5 to each side of $x - 5 > 0$ yields $x > 5$.
6. True, because dividing each side by -2 reverses the inequality symbol.

7. False, because "x is at most 7" means x is less than or equal to 7.
8. True, because "x is not more than 85" means $x \leq 85$.
9. True, because $a > b$ and $b < a$ are equivalent.

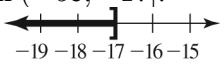
2.9 EXERCISES

1. Subtract 7 from each side to get $x > -7$.
2. Add 6 to each side to get $x < 6$.
3. Divide each side by 3 to get $3 \leq w$, or $w \geq 3$.
4. Divide each side by 5 to get $2 \geq z$, or $z \leq 2$.
5. Multiply each side by -1 and reverse the inequality to get $x > -8$.
6. Multiply each side by -1 and reverse the inequality to get $x \leq 3$.
7. Divide each side by -4 and reverse the inequality to get $k > 1$.
8. Divide each side by -9 and reverse the inequality to get $t < -3$.
9. Multiply each side by -2 and reverse the inequality to get $y \leq -8$.
10. Multiply each side by -3 and reverse the inequality to get $x \geq -12$.

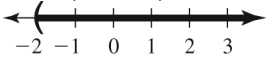
11.
$$x + 3 > 0$$
$$x + 3 - 3 > 0 - 3$$
$$x > -3$$
The solution set is the interval $(-3, \infty)$.



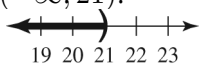
12.
$$x + 9 \leq -8$$
$$x \leq -17$$
The solution set is the interval $(-\infty, -17]$.



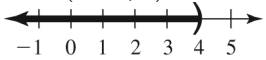
13.
$$-3 < w - 1$$
$$-2 < w$$
$$w > -2$$
The solution set is the interval $(-2, \infty)$.



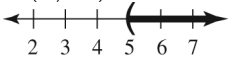
14.
$$9 > w - 12$$
$$21 > w$$
$$w < 21$$
The solution set is the interval $(-\infty, 21)$.



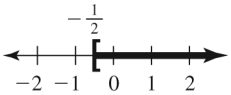
15.
$$8 > 2b$$
$$4 > b$$
$$b < 4$$
The solution set is the interval $(-\infty, 4)$.



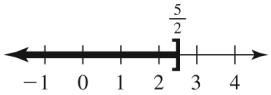
16.
$$35 < 7b$$
$$5 < b$$
$$b > 5$$
The solution set is the interval $(5, \infty)$.



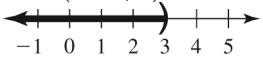
17.
$$-8z \leq 4$$
$$z \geq -\frac{1}{2}$$
The solution set is the interval $[-1/2, \infty)$.



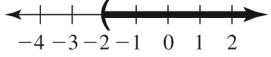
18.
$$-4y \geq -10$$
$$y \leq \frac{5}{2}$$
The solution set is the interval $(-\infty, 5/2)]$.



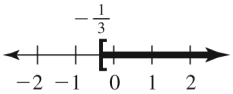
19.
$$3y - 2 < 7$$
$$3y < 9$$
$$y < 3$$
The solution set is the interval $(-\infty, 3)$.



20.
$$2y - 5 > -9$$
$$2y > -4$$
$$y > -2$$
The solution set is the interval $(-2, \infty)$.



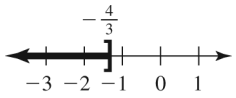
21.
$$3 - 9z \leq 6$$
$$-9z \leq 3$$
$$\frac{-9z}{-9} \geq \frac{3}{-9}$$
$$z \geq -\frac{1}{3}$$
The solution set is the interval $[-1/3, \infty)$.



22. $5 - 6z \geq 13$

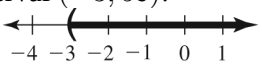
$$-6z \geq 8$$
$$z \leq -\frac{4}{3}$$

The solution set is the interval $(-\infty, -4/3]$.



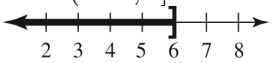
23. $6 > -r + 3$
$r > -3$

The solution set is the interval $(-3, \infty)$.



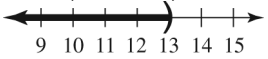
24. $6 \leq 12 - r$
$r \leq 6$

The solution set is the interval $(-\infty, 6]$.



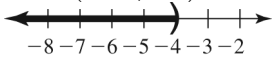
25. $5 - 4p > -8 - 3p$
$-p > -13$
$p < 13$

The solution set is the interval $(-\infty, 13)$.



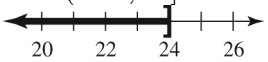
26. $7 - 9p > 11 - 8p$
$-p > 4$
$p < -4$

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



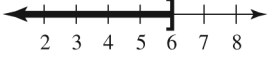
27. $-\frac{5}{6}q \geq -20$
$-\frac{6}{5}\left(-\frac{5}{6}\right)q \leq -\frac{6}{5}(-20)$
$q \leq 24$

The solution set is the interval $(-\infty, 24]$.



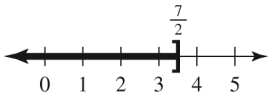
28. $-\frac{2}{3}q \geq -4$
$-\frac{3}{2}\left(-\frac{2}{3}q\right) \leq -\frac{3}{2}(-4)$
$q \leq 6$

The solution set is the interval $(-\infty, 6]$.



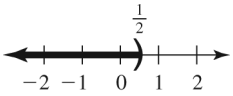
29. $1 - \frac{1}{4}t \geq \frac{1}{8}$
$-\frac{1}{4}t \geq -\frac{7}{8}$
$-4\left(-\frac{1}{4}t\right) \leq -4\left(-\frac{7}{8}\right)$
$t \leq \frac{7}{2}$

The solution set is the interval $(-\infty, 7/2]$.



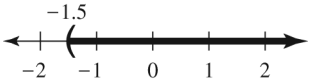
30. $\frac{1}{6} - \frac{1}{3}t > 0$
$-\frac{1}{3}t > -\frac{1}{6}$
$-3\left(-\frac{1}{3}t\right) < -3\left(-\frac{1}{6}\right)$
$t < \frac{1}{2}$

The solution set is the interval $(-\infty, 1/2)$.



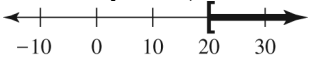
31. $0.1x + 0.35 > 0.2$
$10x + 35 > 20$
$10x > -15$
$x > -1.5$

The solution set is the interval $(-1.5, \infty)$.



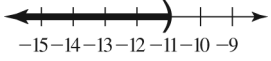
32. $1 - 0.02x \leq 0.6$
$100 - 2x \leq 60$
$-2x \leq -40$
$x \geq 20$

The solution set is the interval $[20, \infty)$.



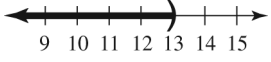
33. $2x + 5 < x - 6$
$x + 5 < -6$
$x < -11$

The solution set is the interval $(-\infty, -11)$.



34. $3x - 4 < 2x + 9$
$x - 4 < 9$
$x < 13$

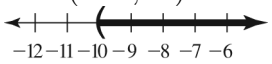
The solution set is the interval $(-\infty, 13)$.



35. $x - 4 < 2(x + 3)$
$x - 4 < 2x + 6$
$-4 < x + 6$
$-10 < x$

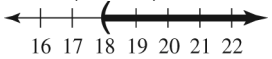
$x > -10$

The solution set is the interval $(-10, \infty)$.



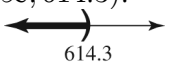
36. $2x + 3 < 3(x - 5)$
$2x + 3 < 3x - 15$
$3 < x - 15$
$18 < x$
$x > 18$

The solution set is the interval $(18, \infty)$.



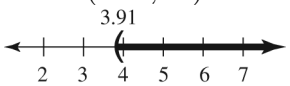
37. $0.52x - 35 < 0.45x + 8$
$0.52x < 0.45x + 43$
$0.07x < 43$
$x < \frac{43}{0.07}$
$x < 614.3$

The solution set is the interval $(-\infty, 614.3)$.



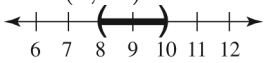
38. $8455(x - 3.4) > 4320$
$8455x - 28747 > 4320$
$8455x > 33067$
$x > 3.91$

The solution set is the interval $(3.91, \infty)$.



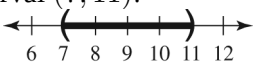
39. $5 < x - 3 < 7$
$5 + 3 < x - 3 + 3 < 7 + 3$
$8 < x < 10$

The solution set is the interval $(8, 10)$.



40. $2 < x - 5 < 6$
$7 < x < 11$

The solution set is the interval $(7, 11)$.

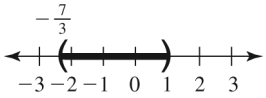


41. $3 < 2v + 1 < 10$
$2 < 2v < 9$
$1 < v < \frac{9}{2}$

The solution set is the interval $(1, 9/2)$.

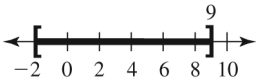
42. $-3 < 3v + 4 < 7$
$-7 < 3v < 3$
$-\frac{7}{3} < v < 1$

The solution set is the interval $(-7/3, 1)$.



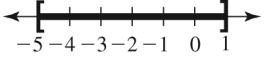
43. $-4 \le 5 - k \le 7$
$-9 \le -k \le 2$
$(-1)(-9) \ge (-1)(-k) \ge (-1)(2)$
$9 \ge k \ge -2$
$-2 \le k \le 9$

The solution set is the interval $[-2, 9]$.



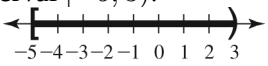
44. $2 \le 3 - k \le 8$
$-1 \le -k \le 5$
$1 \ge k \ge -5$
$-5 \le k \le 1$

The solution set is the interval $[-5, 1]$.



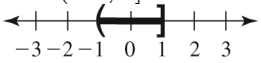
45. $-2 < 7 - 3y \le 22$
$-9 < -3y \le 15$
$3 > y \ge -5$
$-5 \le y < 3$

The solution set is the interval $[-5, 3)$.



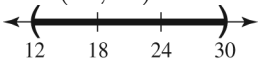
46. $-1 \le 1 - 2y < 3$
$-2 \le -2y < 2$
$1 \ge y > -1$
$-1 < y \le 1$

The solution set is the interval $(-1, 1]$.



47. $5 < \frac{2u}{3} - 3 < 17$
$8 < \frac{2u}{3} < 20$
$24 < 2u < 60$
$12 < u < 30$

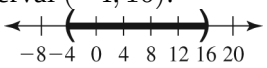
The solution set is the interval $(12, 30)$.



48. $-4 < \frac{3u}{4} - 1 < 11$
$-3 < \frac{3u}{4} < 12$

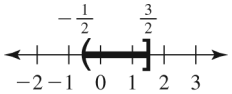
$$-12 < 3u < 48$$
$$-4 < u < 16$$

The solution set is the interval $(-4, 16)$.



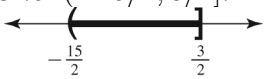
49. $$-2 < \frac{4m-4}{3} \le \frac{2}{3}$$
$$-6 < 4m - 4 \le 2$$
$$-2 < 4m \le 6$$
$$-\frac{1}{2} < m \le \frac{3}{2}$$

The solution set is the interval $(-1/2, 3/2]$.



50. $$0 \le \frac{3-2m}{2} < 9$$
$$0 \le 3 - 2m < 18$$
$$-3 \le -2m < 15$$
$$\frac{3}{2} \ge m > -\frac{15}{2}$$
$$-\frac{15}{2} < m \le \frac{3}{2}$$

The solution set is the interval $(-15/2, 3/2]$.

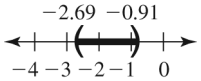


51. $$0.02 < 0.54 - 0.0048x < 0.05$$
$$-0.52 < -0.0048x < -0.49$$
$$\frac{-0.52}{-0.0048} > \frac{-0.0048x}{-0.0048} > \frac{-0.49}{-0.0048}$$
$$108.3 > x > 102.1$$
$$102.1 < x < 108.3$$

The solution set is the interval $(102.1, 108.3)$.

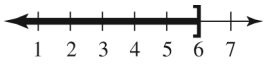
52. $$0.44 < \frac{34.55 - 22.3x}{124.5} < 0.76$$
$$54.78 < 34.55 - 22.3x < 94.62$$
$$20.23 < -22.3x < 60.07$$
$$-0.91 > x > -2.69$$
$$-2.69 < x < -0.91$$

The solution set is the interval $(-2.69, -0.91)$.



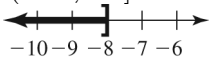
53. $$\frac{1}{2}x - 1 \le 4 - \frac{1}{3}x$$
$$6\left(\frac{1}{2}x - 1\right) \le 6\left(4 - \frac{1}{3}x\right)$$
$$3x - 6 \le 24 - 2x$$
$$5x \le 30$$
$$x \le 6$$

The solution set is the interval $(-\infty, 6]$.



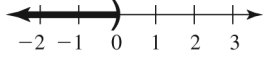
54. $$\frac{y}{4} - \frac{5}{12} \ge \frac{y}{3} + \frac{1}{4}$$
$$12\left(\frac{y}{4} - \frac{5}{12}\right) \ge 12\left(\frac{y}{3} + \frac{1}{4}\right)$$
$$3y - 5 \ge 4y + 3$$
$$-y \ge 8$$
$$y \le -8$$

The solution set is the interval $(-\infty, -8]$.



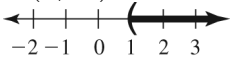
55. $$\frac{1}{2}\left(x - \frac{1}{4}\right) > \frac{1}{4}\left(6x - \frac{1}{2}\right)$$
$$\frac{1}{2}x - \frac{1}{8} > \frac{3}{2}x - \frac{1}{8}$$
$$4x - 1 > 12x - 1$$
$$-8x > 0$$
$$x < 0$$

The solution set is the interval $(-\infty, 0)$.



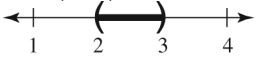
56. $$-\frac{1}{2}\left(z - \frac{2}{5}\right) < \frac{2}{3}\left(\frac{3}{4}z - \frac{6}{5}\right)$$
$$-\frac{1}{2}z + \frac{1}{5} < \frac{1}{2}z - \frac{4}{5}$$
$$-z < -1$$
$$z > 1$$

The solution set is the interval $(1, \infty)$.



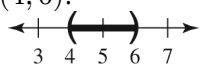
57. $$\frac{1}{3} < \frac{1}{4}x - \frac{1}{6} < \frac{7}{12}$$
$$4 < 3x - 2 < 7$$
$$6 < 3x < 9$$
$$2 < x < 3$$

The solution set is the interval $(2, 3)$.



58. $$-\frac{3}{5} < \frac{1}{5} - \frac{2}{15}w < -\frac{1}{3}$$
$$-9 < 3 - 2w < -5$$
$$-12 < -2w < -8$$
$$6 > w > 4$$
$$4 < w < 6$$

The solution set is the interval $(4, 6)$.



59. Let w = the width and $w + 4$ = the length. The perimeter is $2w + 2(w + 4)$. Since the

perimeter is at least 120, we can write the following inequality.

$$\begin{aligned} 2w + 2(w + 4) &\geq 120 \\ 4w + 8 &\geq 120 \\ 4w &\geq 112 \\ w &\geq 28 \end{aligned}$$

The width must be at least 28meters.

60. Let $w =$ the width and $2w =$ the length.

$$\begin{aligned} 2w + 2(2w) &\leq 180 \\ 6w &\leq 180 \\ w &\leq 30 \end{aligned}$$

The width must be at most 30 feet.

61. Let $x =$ the price of the car. Since the tax is $0.05x$, we can write the following inequality.

$$\begin{aligned} x + 0.05x + 144 &< 9970 \\ 1.05x &< 9826 \\ x &< 9358 \end{aligned}$$

The price of the car must be less than \$9358.

62. Let $x =$ the selling price of the car. The amount Ronald gets is $x - 0.10x$. Since he must at least pay off the loan, we can write the following inequality.

$$\begin{aligned} x - 0.10x &\geq 11{,}025 \\ 0.90x &\geq 11{,}025 \\ x &\geq 12{,}250 \end{aligned}$$

The car must sell for at least \$12,250.

63. Let $x =$ the price of the microwave. The cost of the microwave plus the tax is $1.08x$. Since she has at most \$594, we can write the following inequality.

$$\begin{aligned} 1.08x &\leq 594 \\ x &\leq \frac{594}{1.08} \\ x &\leq 550 \end{aligned}$$

The price of the microwave is at most \$550.

64. Let $x =$ the price of an order of fries, $2x =$ the price of a hamburger, and $x + 0.40 =$ the price of a Coke. Since the total is under \$4.00, we can write the following inequality.

$$\begin{aligned} x + 2x + x + 0.40 &< 4.00 \\ 4x + 0.40 &< 4.00 \\ 4x &< 3.60 \\ x &< 0.90 \end{aligned}$$

An order of fries costs less than 90 cents.

65. Let $x =$ Tilak's score on the last test. His average for the three tests is $\frac{44 + 72 + x}{3}$. Since his test average must be at least 60, we can write the following inequality.

$$\begin{aligned} \frac{44 + 72 + x}{3} &\geq 60 \\ 44 + 72 + x &\geq 180 \\ 116 + x &\geq 180 \\ x &\geq 64 \end{aligned}$$

He must score at least 64 on the last test to pass the course.

66. Let $x =$ her April income.

$$\begin{aligned} \frac{400 + 450 + 380 + x}{4} &\geq 430 \\ \frac{1230 + x}{4} &\geq 430 \\ 1230 + x &\geq 1720 \\ x &\geq 490 \end{aligned}$$

In April she must earn at least \$490.

67. Let $x =$ the final exam score. Stacy's semester average is $\frac{1}{3}(48) + \frac{2}{3}x$. Since the semester average must be between 70 and 79 inclusive, we can write the following inequality.

$$\begin{aligned} 70 &\leq \tfrac{1}{3}(48) + \tfrac{2}{3}x \leq 79 \\ 70 &\leq 16 + \tfrac{2}{3}x \leq 79 \\ 54 &\leq \tfrac{2}{3}x \leq 63 \\ \tfrac{3}{2} \cdot 54 &\leq \tfrac{3}{2} \cdot \tfrac{2}{3}x \leq \tfrac{3}{2} \cdot 63 \\ 81 &\leq x \leq 94.5 \end{aligned}$$

To get a C, Stacy must score between 81 and 94.5 inclusive on the final exam.

68. Let $x =$ her final exam score. Since $2/3$ of the midterm plus $1/3$ of the final must be between 70 and 79 inclusive, we can write the following inequality.

$$\begin{aligned} 70 &\leq \tfrac{2}{3}(48) + \tfrac{1}{3}x \leq 79 \\ 210 &\leq 96 + x \leq 237 \\ 114 &\leq x \leq 141 \end{aligned}$$

Wendy would have to score between 114 and 141 inclusive to get an average between 70 and 79.

69. Let $x =$ her average speed for a day. Her distance each day was $8x$. Since her distance was between 396 and 453 we can write the following inequality.

$$\begin{aligned} 396 &< 8x < 453 \\ 49.5 &< x < 56.625 \end{aligned}$$

Her average speed each day was between 49.5 and 56.625 miles per hour.

70. Let $x =$ her daily driving time. Her daily distance was $55x$.

$$330 < 55x < 495$$

$$6 < x < 9$$

She drove between 6 and 9 hours each day.

71. The supplement to the 85° angle is 95°. The angle at the lighthouse is $180 - 95 - x$ degrees. Since the angle at the lighthouse is less then 30° we have the following inequality.

$$\begin{aligned} 180 - 95 - x &< 30 \\ 85 - x &< 30 \\ -x &< -55 \\ x &> 55 \end{aligned}$$

So x must be greater than 55°. From the diagram, x must be less than 85°. So x is between 55° and 85°.

72. The supplement to 110° is 70° and the complement to x is $90 - x$ degrees. The measure of angle C is $180 - (90 - x) - 70$.

$$\begin{aligned} 180 - (90 - x) - 70 &< 85 \\ 180 - 90 + x - 70 &< 85 \\ 20 + x &< 85 \\ x &< 65 \end{aligned}$$

So x must be greater than 0° and less than 65°.

73. a) Since $60 < r < 80$, we have the following inequality.

$$\begin{aligned} 60 < \frac{N \cdot 27}{12} &< 80 \\ 720 < 27N &< 960 \\ 26.7 < N &< 35.6 \end{aligned}$$

The gear ratio is between 60 and 80 if the number of teeth on the chain ring is between 27 and 35 inclusive.

b)

$$\begin{aligned} 65 < \frac{48 \cdot w}{17} &< 70 \\ 1105 < 48w &< 1190 \\ 23.02 < w &< 24.79 \end{aligned}$$

The wheel diameter is between 23.02 in. and 24.79 in.

c)

$$\begin{aligned} \frac{40 \cdot 26}{n} &< 75 \\ 1040 &< 75n \\ 13.87 &< n \end{aligned}$$

Because n is a positive integer, we did not reverse the inequality when we multiplied each side by n. The number of teeth on the cog is greater than or equal to 14.

74. a) $d = 9000 - 60(30) = 7200$

When the price is \$30 the weekly demand is 7200 units.

b)

$$\begin{aligned} 9000 - 60p &> 6000 \\ -60p &> -3000 \\ p &< 50 \end{aligned}$$

The demand will be above 6000 units as long as the price is less than \$50.

Chapter 2 Wrap-Up

Enriching Your Mathematical Word Power

1. equation **2.** linear
3. identity **4.** conditional
5. inconsistent **6.** equivalent
7. literal, formula **8.** function
9. complementary **10.** supplementary
11. uniform **12.** inequality
13. equivalent

CHAPTER 2 REVIEW

1.

$$\begin{aligned} x - 23 &= 12 \\ x - 23 + 23 &= 12 + 23 \\ x &= 35 \end{aligned}$$

The solution set is $\{35\}$.

2.

$$\begin{aligned} 14 &= 18 + y \\ -4 &= y \end{aligned}$$

The solution set is $\{-4\}$.

3.

$$\begin{aligned} \frac{2}{3}u &= -4 \\ \frac{3}{2} \cdot \frac{2}{3}u &= \frac{3}{2}(-4) \\ u &= -6 \end{aligned}$$

The solution set is $\{-6\}$.

4.

$$\begin{aligned} -\frac{3}{8}r &= 15 \\ -\frac{8}{3}\left(-\frac{3}{8}r\right) &= -\frac{8}{3}(15) \\ r &= -40 \end{aligned}$$

The solution set is $\{-40\}$.

5.

$$\begin{aligned} -5y &= 35 \\ \frac{-5y}{-5} &= \frac{35}{-5} \\ y &= -7 \end{aligned}$$

The solution set is $\{-7\}$.

6.

$$\begin{aligned} -12 &= 6h \\ \frac{-12}{6} &= \frac{6h}{6} \\ -2 &= h \end{aligned}$$

The solution set is $\{-2\}$.

7.

$$6m = 13 + 5m$$

$$m = 13$$

The solution set is $\{13\}$.

8. $19 - 3n = -2n$

$$19 = n$$

The solution set is $\{19\}$.

9. $2x - 5 = 9$

$$2x = 14$$
$$x = 7$$

The solution set is $\{7\}$.

10. $5x - 8 = 38$

$$5x = 46$$
$$x = \frac{46}{5}$$

The solution set is $\left\{\frac{46}{5}\right\}$.

11. $3p - 14 = -4p$

$$3p = -4p + 14$$
$$7p = 14$$
$$p = 2$$

The solution set is $\{2\}$.

12. $36 - 9y = 3y$

$$36 = 12y$$
$$3 = y$$

The solution set is $\{3\}$.

13. $2z + 12 = 5z - 9$

$$2z = 5z - 21$$
$$-3z = -21$$
$$z = 7$$

The solution set is $\{7\}$.

14. $15 - 4w = 7 - 2w$

$$-4w = -8 - 2w$$
$$-2w = -8$$
$$w = 4$$

The solution set is $\{4\}$.

15. $2(h - 7) = -14$

$$2h - 14 = -14$$
$$2h = 0$$
$$h = 0$$

The solution set is $\{0\}$.

16. $2(t - 7) = 0$

$$2t - 14 = 0$$
$$2t = 14$$
$$t = 7$$

The solution set is $\{7\}$.

17. $3(w - 5) = 6(w + 2) - 3$

$$3w - 15 = 6w + 12 - 3$$
$$-3w = 24$$
$$w = -8$$

The solution set is $\{-8\}$.

18. $2(a - 4) + 4 = 5(9 - a)$

$$2a - 8 + 4 = 45 - 5a$$
$$2a - 4 = 45 - 5a$$
$$7a - 4 = 45$$
$$7a = 49$$
$$a = 7$$

The solution set is $\{7\}$.

19. $2(x - 7) - 5 = 5 - (3 - 2x)$

$$2x - 14 - 5 = 5 - 3 + 2x$$
$$2x - 19 = 2 + 2x$$
$$-19 = 2$$

There is no solution to this equation. It is an inconsistent equation. The solution set is $\emptyset$.

20. $2(x - 7) + 5 = -(9 - 2x)$

$$2x - 14 + 5 = -9 + 2x$$
$$2x - 9 = 2x - 9$$

All real numbers satisfy this equation. It is an identity.

21. $2(w - w) = 0$

$$2(0) = 0$$
$$0 = 0$$

All real numbers satisfy this equation. It is an identity.

22. $2y - y = 0$

$$y = 0$$

The solution set is $\{0\}$. It is a conditional equation.

23. $\frac{3r}{3r} = 1$

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

A number divided by itself is 1 except for $0/0$, which is undefined. The solution set is all real numbers except 0. It is an identity.

24. $\frac{3t}{3} = 1$

$$t = 1$$

The solution set is $\{1\}$. It is a conditional equation.

25. $\frac{1}{2}a - 5 = \frac{1}{3}a - 1$

$$6\left(\frac{1}{2}a - 5\right) = 6\left(\frac{1}{3}a - 1\right)$$
$$3a - 30 = 2a - 6$$
$$a - 30 = -6$$
$$a = 24$$

The solution set is $\{24\}$. It is a conditional equation.

26. $\frac{1}{2}b - \frac{1}{2} = \frac{1}{4}b$

$$4\left(\frac{1}{2}b - \frac{1}{2}\right) = 4\left(\frac{1}{4}b\right)$$
$$2b - 2 = b$$

$$b = 2$$

The solution set is $\{2\}$. It is a conditional equation.

27. $0.06q + 14 = 0.3q - 5.2$
$$0.06q = 0.3q - 19.2$$
$$-0.24q = -19.2$$
$$q = 80$$

The solution set is $\{80\}$. It is a conditional equation.

28. $0.05(z + 20) = 0.1z - 0.5$
$$0.05z + 1 = 0.1z - 0.5$$
$$1 = 0.05z - 0.5$$
$$1.5 = 0.05z$$
$$30 = z$$

The solution set is $\{30\}$. It is a conditional equation.

29. $0.05(x + 100) + 0.06x = 115$
$$0.05x + 5 + 0.06x = 115$$
$$0.11x = 110$$
$$x = 1000$$

The solution set is $\{1000\}$. It is a conditional equation.

30. $0.06x + 0.08(x + 1) = 0.41$
$$0.06x + 0.08x + 0.08 = 0.41$$
$$0.14x = 0.33$$
$$x = \frac{33}{14}$$

The solution set is $\left\{\frac{33}{14}\right\}$. It is a conditional equation.

31. $2x + \frac{1}{2} = 3x + \frac{1}{4}$
$$8x + 2 = 12x + 1$$
$$-4x = -1$$
$$x = \frac{1}{4}$$

The solution set is $\left\{\frac{1}{4}\right\}$.

32. $5x - \frac{1}{3} = 6x - \frac{1}{2}$
$$30x - 2 = 36x - 3$$
$$-6x = -1$$
$$x = \frac{1}{6}$$

The solution set is $\left\{\frac{1}{6}\right\}$.

33. $\frac{x}{2} - \frac{3}{4} = \frac{x}{6} + \frac{1}{8}$
$$12x - 18 = 4x + 3$$
$$8x = 21$$
$$x = \frac{21}{8}$$

The solution set is $\left\{\frac{21}{8}\right\}$.

34. $\frac{1}{3} - \frac{x}{5} = \frac{1}{2} - \frac{x}{10}$
$$10 - 6x = 15 - 3x$$
$$-3x = 5$$
$$x = -\frac{5}{3}$$

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

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

The solution set is $\left\{-\frac{4}{5}\right\}$.

36. $-\frac{2}{3}x = \frac{3}{4}$
$$x = -\frac{3}{2} \cdot \frac{3}{4} = -\frac{9}{8}$$

The solution set is $\left\{-\frac{9}{8}\right\}$.

37. $-\frac{1}{2}(x - 10) = \frac{3}{4}x$
$$-\frac{1}{2}x + 5 = \frac{3}{4}x$$
$$-2x + 20 = 3x$$
$$-5x = -20$$
$$x = 4$$

The solution set is $\{4\}$.

38. $-\frac{1}{3}(6x - 9) = 23$
$$-2x + 3 = 23$$
$$-2x = 20$$
$$x = -10$$

The solution set is $\{-10\}$.

39. $3 - 4(x - 1) + 6 = -3(x + 2) - 5$
$$3 - 4x + 4 + 6 = -3x - 6 - 5$$
$$-4x + 13 = -3x - 11$$
$$-x = -24$$
$$x = 24$$

The solution set is $\{24\}$.

40. $6 - 5(1 - 2x) + 3 = -3(1 - 2x) - 1$
$$6 - 5 + 10x + 3 = -3 + 6x - 1$$
$$10x + 4 = 6x - 4$$
$$4x = -8$$
$$x = -2$$

The solution set is $\{-2\}$.

41. $5 - 0.1(x - 30) = 18 + 0.05(x + 100)$
$$5 - 0.1x + 3 = 18 + 0.05x + 5$$
$$-0.1x + 8 = 23 + 0.05x$$
$$-0.15x = 15$$
$$x = -100$$

The solution set is $\{-100\}$.

42. $0.6(x - 50) = 18 - 0.3(40 - 10x)$
$$0.6x - 30 = 18 - 12 + 3x$$

$$0.6x - 30 = 6 + 3x$$
$$6x - 300 = 60 + 30x$$
$$-24x = 360$$
$$x = -15$$

The solution set is $\{-15\}$.

43. $ax + b = 0$
$$ax = -b$$
$$x = -\frac{b}{a}$$

44. $mx + e = t$
$$mx = t - e$$
$$x = \frac{t - e}{m}$$

45. $ax - 2 = b$
$$ax = b + 2$$
$$x = \frac{b + 2}{a}$$

46. $b = 5 - x$
$$x + b = 5$$
$$x = 5 - b$$

47. $LWx = V$
$$x = \frac{V}{LW}$$

48. $3xy = 6$
$$xy = 2$$
$$x = \frac{2}{y}$$

49. $2x - b = 5x$
$$-b = 3x$$
$$-\frac{b}{3} = x$$
$$x = -\frac{b}{3}$$

50. $t - 5x = 4x$
$$t = 9x$$
$$\frac{t}{9} = x$$
$$x = \frac{t}{9}$$

51. $5x + 2y = 6$
$$2y = -5x + 6$$
$$y = -\frac{5}{2}x + 3$$

52. $5x - 3y + 9 = 0$
$$-3y = -5x - 9$$
$$y = \frac{5}{3}x + 3$$

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

54. $y + 6 = \frac{1}{2}(x + 8)$
$$y + 6 = \frac{1}{2}x + 4$$
$$y = \frac{1}{2}x - 2$$

55. $\frac{1}{2}x + \frac{1}{4}y = 4$
$$\frac{1}{4}y = -\frac{1}{2}x + 4$$
$$4 \cdot \frac{1}{4}y = 4\left(-\frac{1}{2}x + 4\right)$$
$$y = -2x + 16$$

56. $-\frac{x}{3} + \frac{y}{2} = 1$
$$\frac{y}{2} = \frac{x}{3} + 1$$
$$y = \frac{2}{3}x + 2$$

57. Use -3 for x in $y = 3x - 4$.
$$y = 3(-3) - 4 = -13$$

58. Use -3 for x in $2x - 3y = -7$.
$$2(-3) - 3y = -7$$
$$-6 - 3y = -7$$
$$-3y = -1$$
$$y = \frac{1}{3}$$

59. Use -3 for x in $5xy = 6$.
$$5(-3)y = 6$$
$$-15y = 6$$
$$y = -\frac{6}{15} = -\frac{2}{5}$$

60. Use -3 for x in $3xy - 2x = -12$.
$$3(-3)y - 2(-3) = -12$$
$$-9y + 6 = -12$$
$$-9y = -18$$
$$y = 2$$

61. Use -3 for x in $y - 3 = -2(x - 4)$.
$$y - 3 = -2(-3 - 4)$$
$$y - 3 = 14$$
$$y = 17$$

62. Use -3 for x in $y + 1 = 2(x - 5)$.
$$y + 1 = 2(-3 - 5)$$
$$y + 1 = -16$$
$$y = -17$$

63. $y = -5x + 10$
If $x = -1$, then $y = -5(-1) + 10 = 15$.
If $x = 0$, then $y = -5(0) + 10 = 10$.
If $x = 1$, then $y = -5(1) + 10 = 5$.
If $x = 2$, then $y = -5(2) + 10 = 0$.
If $x = 3$, then $y = -5(3) + 10 = -5$.

x	y
-1	15
0	10
1	5
2	0
3	-5

64. $y = 2x - 4$
If $x = 0$, then $y = 2(0) - 4 = -4$.
If $x = 1$, then $y = 2(1) - 4 = -2$.
If $x = 2$, then $y = 2(2) - 4 = 0$.
If $x = 3$, then $y = 2(3) - 4 = 2$.
If $x = 4$, then $y = 2(4) - 4 = 4$.

x	y
0	-4
1	-2
2	0
3	2
4	4

65. For each value of x find the y-value by using the formula $y = \frac{2}{3}x - 1$ as in the previous exercise.

x	y
-3	-3
0	-1
3	1
6	3

66. For each value of x find the y-value by using the formula $y = 10x + 100$.

x	y
-20	-100
-10	0
0	100
10	200

67. Sum indicates addition. So the sum of a number (x) and 9 is $x + 9$.
68. The product of a number (x) and 7 is $7x$.
69. If two numbers differ by 8, then one number is 8 larger than the other. So if x is the smaller, then x and $x + 8$ are used to represent the numbers. We could also use x and $x - 8$ with x being the larger number.
70. If x is one of the numbers, then two numbers with a sum of 12 are x and $12 - x$, because $x + 12 - x = 12$ no matter what number is used for x.
71. Sixty-five percent of a number is 0.65 times the number (x) or $0.65x$.
72. One-half of a number (x) is $\frac{1}{2}x$.
73. If x represents the width, then $x + 5$ is the length. Since the area of the rectangle is 98, we can write $x(x + 5) = 98$.
74. If x represents one side, then the other side is $2x + 1$. Since the perimeter is 56, we can write the equation $2x + 2(2x + 1) = 56$.
75. Let $x - 10 =$ Barbara's speed and $x =$ Jim's speed. In 3 hours Barbara travels $3(x - 10)$ miles. In 2 hours Jim travels $2x$ miles. Since the distances are the same, we can write the equation $2x = 3(x - 10)$.
76. Let $x + 5 =$ Gladys' speed and $x =$ Ned's speed. $6(x + 5) + 5x = 840$
77. If x is the first even integer, then $x + 2$ and $x + 4$ represent the second and the third. Since their sum is 90, we can write the equation $x + x + 2 + x + 4 = 90$.
78. Let x and $x + 2$ represent two consecutive odd integers. Since their sum is 40, we have $x + x + 2 = 40$.
79. Since the sum of the measures of a triangle is 180°, we have $t + 2t + t - 10 = 180$.
80. Since complementary angles have a sum of 90°, we have $p + 3p - 6 = 90$.
81. Let $x =$ the first odd integer, $x + 2 =$ the second odd integer, and $x + 4 =$ the third odd integer. Since their sum is 237, we can write the following equation.

$$\begin{aligned} x + x + 2 + x + 4 &= 237 \\ 3x + 6 &= 237 \\ 3x &= 231 \\ x &= 77 \\ x + 2 &= 79 \\ x + 4 &= 81 \end{aligned}$$

The three consecutive odd integers are 77, 79, and 81.
82. Let x and $x + 2$ represent the two consecutive even integers. Their sum is 450.

$$\begin{aligned} x + x + 2 &= 450 \\ 2x &= 448 \\ x &= 224 \\ x + 2 &= 226 \end{aligned}$$

The consecutive even integers are 224 and 226.

83. Let $x =$ Betty's rate of speed and $x + 15 =$ Lawanda's rate of speed. Since $D = RT$, Betty's distance is $4x$ and Lawanda's distance is $3(x + 15)$. Since their distances are equal, we can write the following equation.

$$\begin{aligned} 4x &= 3(x + 15) \\ 4x &= 3x + 45 \\ x &= 45 \\ x + 15 &= 60 \end{aligned}$$

Betty drives 45 mph and Lawanda drives 60 mph.

84. Let $x =$ the width and $x + 50 =$ the length. Since the perimeter is 500 feet, we can write the following equation.

$$\begin{aligned} 2x + 2(x + 50) &= 500 \\ 4x + 100 &= 500 \\ 4x &= 400 \\ x &= 100 \\ x + 50 &= 150 \end{aligned}$$

The length is 150 feet and the width is 100 feet.

85. Let $x =$ the husband's income and $x + 6000 =$ Wanda's income. Wanda saves $0.10(x + 6000)$ and her husband saves $0.06x$. Since they save \$5400 together, we can write the following equation.

$$\begin{aligned} 0.10(x + 6000) + 0.06x &= 5400 \\ 0.10x + 600 + 0.06x &= 5400 \\ 0.16x &= 4800 \\ x &= 30{,}000 \\ x + 6000 &= 36{,}000 \end{aligned}$$

Wanda makes \$36,000 and her husband makes \$30,000 per year.

86. Let $x =$ the number of employees in aerospace and $3000 - x =$ the number in agriculture.

$$\begin{aligned} 0.10x + 0.15(3000 - x) &= 0.12(3000) \\ 0.10x + 450 - 0.15x &= 360 \\ -0.05x &= -90 \\ x &= 1800 \\ 3000 - x &= 1200 \end{aligned}$$

There are 1800 employees in aerospace and 1200 in agriculture.

87. Use 3 for x in $-2x + 5 \leq x - 6$.

$$\begin{aligned} -2(3) + 5 &\leq 3 - 6 \\ -1 &\leq -3 \end{aligned}$$

Since this inequality is incorrect, 3 is not a solution to $-2x + 5 \leq x - 6$.

88. Replace x by -2 in $5 - x > 4x + 3$.

$$\begin{aligned} 5 - (-2) &> 4(-2) + 3 \\ 7 &> -5 \end{aligned}$$

Since the last inequality is correct, -2 is a solution to the inequality.

89. Use -1 for x in $-2 \leq 6 + 4x < 0$.

$$\begin{aligned} -2 &\leq 6 + 4(-1) < 0 \\ -2 &\leq 2 < 0 \end{aligned}$$

Since this last inequality is incorrect, -1 is not a solution to $-2 \leq 6 + 4x < 0$.

90. Replace x by 0 in $4x + 9 \geq 5(x - 3)$.

$$\begin{aligned} 4(0) + 9 &\geq 5(0 - 3) \\ 9 &\geq -15 \end{aligned}$$

Since the last inequality is correct, 0 is a solution to the inequality.

91. The graph shows the numbers to the right of 1 on the number line. This graph indicates the solution to $x > 1$. The solution set is the interval $(1, \infty)$.

92. The graph shows the numbers to the left of 2 on the number line. The graph indicates the solution to $x < 2$. The solution set is the interval $(-\infty, 2)$.

93. The graph shows the number to the right of and including 2. This graph indicates the solution to $x \geq 2$. The solution set is the interval $[2, \infty)$.

94. The graph shows the numbers between 3 and 5, the numbers that satisfy the inequality $3 < x < 5$. The solution set is the interval $(3, 5)$.

95. The graph shows the numbers between -3 and 3, including -3 but not 3. This graph indicates the solution to $-3 \leq x < 3$. The solution set is the interval $[-3, 3)$.

96. The graph shows the numbers to the left of and including 1, the numbers that satisfy the inequality $x \leq 1$. The solution set is the interval $(-\infty, 1]$.

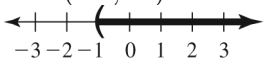
97. The graph shows the numbers to the left of -1 on the number line. This graph indicates the solution to $x < -1$. The solution set is the interval $(-\infty, -1)$.

98. The graph shows the numbers between -2 and 2, including -2 but not including 2. These are the numbers that satisfy the inequality $-2 \leq x < 2$. The solution set is the interval $[-2, 2)$.

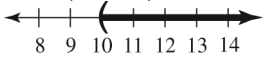
99.

$$\begin{aligned} x + 2 &> 1 \\ x &> -1 \end{aligned}$$

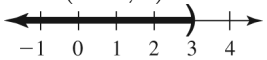
The solution set is the interval $(-1, \infty)$.



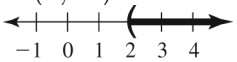
100. $x - 3 > 7$
$x > 10$
The solution set is the interval $(10, \infty)$.



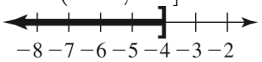
101. $3x - 5 < x + 1$
$2x < 6$
$x < 3$
The solution set is the interval $(-\infty, 3)$.



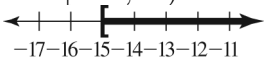
102. $5x - 5 > 9 - 2x$
$7x > 14$
$x > 2$
The solution set is the interval $(2, \infty)$.



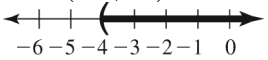
103. $-\frac{3}{4}x \geq 3$
$-\frac{4}{3}\left(-\frac{3}{4}x\right) \leq -\frac{4}{3} \cdot 3$
$x \leq -4$
The solution set is the interval $(-\infty, -4]$.



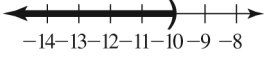
104. $-\frac{2}{3}x \leq 10$
$-\frac{3}{2}\left(-\frac{2}{3}x\right) \geq -\frac{3}{2}(10)$
$x \geq -15$
The solution set is the interval $[-15, \infty)$.



105. $3 - 2x < 11$
$-2x < 8$
$x > -4$
The solution set is the interval $(-4, \infty)$.

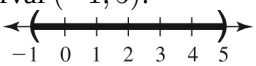


106. $5 - 3x > 35$
$-3x > 30$
$x < -10$
The solution set is the interval $(-\infty, -10)$.



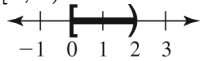
107. $-3 < 2x - 1 < 9$
$-2 < 2x < 10$
$-1 < x < 5$

The solution set is the interval $(-1, 5)$.



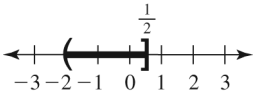
108. $2 \leq 3x + 2 < 8$
$0 \leq 3x < 6$
$0 \leq x < 2$

The solution set is the interval $[0, 2)$.



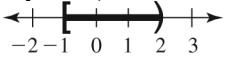
109. $0 \leq 1 - 2x < 5$
$-1 \leq -2x < 4$
$\frac{1}{2} \geq x > -2$
$-2 < x \leq \frac{1}{2}$

The solution set is the interval $(-2, 1/2]$.



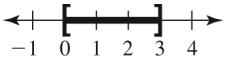
110. $-5 < 3 - 4x \leq 7$
$-8 < -4x \leq 4$
$2 > x \geq -1$
$-1 \leq x < 2$

The solution set is the interval $[-1, 2)$.



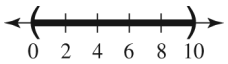
111. $-1 \leq \frac{2x - 3}{3} \leq 1$
$-3 \leq 2x - 3 \leq 3$
$0 \leq 2x \leq 6$
$0 \leq x \leq 3$

The solution set is the interval $[0, 3]$.

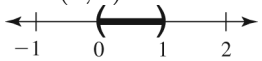


112. $-3 < \frac{4 - x}{2} < 2$
$-6 < 4 - x < 4$
$-10 < -x < 0$
$10 > x > 0$
$0 < x < 10$

The solution set is the interval $(0, 10)$.

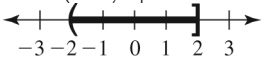


113. $\frac{1}{3} < \frac{1}{3} + \frac{x}{2} < \frac{5}{6}$
$2 < 2 + 3x < 5$
$0 < 3x < 3$
$0 < x < 1$
The solution set is the interval $(0, 1)$.



114. $-\frac{3}{8} \le -\frac{1}{4}x + \frac{1}{8} < \frac{5}{8}$
$-3 \le -2x + 1 < 5$
$-4 \le -2x < 4$
$2 \ge x > -2$
$-2 < x \le 2$

The solution set is the interval $(-2, 2]$.



115. Let $x =$ the original price of the TV.
The discount is $0.14x$.
$0.14x = 392$
$x = 2800$
So the price of the TV was \$2800.

116. Let $x =$ the original price of the laptop.
The discount is $0.12x$.
$x - 0.12x = 1166$
$0.88x = 1166$
$x = 1325$
So the original price was \$1325.

117. Let $x =$ the selling price of the rug.
The commission was $0.08x$.
$x - 0.08x = 7820$
$0.92x = 7820$
$x = 8500$
So the selling price was \$8500.

118. Let $x =$ the bid price. The buyer's premium is $0.09x$.
$x + 0.09x = 95{,}920$
$1.09x = 95{,}920$
$x = 88000$
So the bid price was \$88,000.

119. Use $I = Prt$.
$I = 10{,}000 \cdot 0.05375 \cdot 1$
$= 537.5$
So the amount of interest was \$537.50.

120. Solve $I = Prt$ for r to get $r = \frac{I}{Pt}$.
The amount of interest is \$20 and the amount of principal is \$260. The time is 2 weeks, which is $\frac{2}{52}$ of a year.
$$r = \frac{20}{260 \cdot \frac{2}{52}} = 2 = 200\%$$

121. Let $x =$ the number of movies at ABC. Since XYZ had 200 movies, the combined store has $x + 200$ movies. The number of children's movies at ABC was $0.60x$ and the number of children's movies after the merger is $0.40(x + 200)$. Since XYZ had no children's movies, these two amounts of children's movies are equal.
$0.60x = 0.40(x + 200)$
$0.60x = 0.40x + 80$
$0.20x = 80$
$x = 400$
So ABC had 400 movies before the merger.

122. Let $x =$ his income. Since the government gets 24% of his income ($0.24x$), we can write the following equation.
$x - 0.24x = 30400$
$0.76x = 30400$
$x = 40{,}000$
He must earn \$40,000.

123. Complementary angles have a sum of 90°.
$x + 2x - 3 = 90$
$3x = 93$
$x = 31$
The degree measure is 31°.

124. The supplementary angle to the angle marked x has measure $180 - x$ degrees. The total measure of the three angles of the triangle is 180°.
$20 + 50 + 180 - x = 180$
$250 - x = 180$
$-x = -70$
$x = 70$
The angle marked x has measure 70°.

125. Let $x =$ the length of the shortest side, $x + 1 =$ the length of the second side, and $2x =$ the length of the third side. Since the perimeter is less than 25 feet we can write the following inequality.
$x + x + 1 + 2x < 25$

$$4x + 1 < 25$$
$$4x < 24$$
$$x < 6$$

The shortest side is less than 6 feet in length.

126. Let $x =$ the number of hours per week that she works. She makes $5.80x$ and this quantity must be kept between \$116 and \$145 inclusive.

$$116 \le 5.80x \le 145$$
$$20 \le x \le 25$$

She can work between 20 and 25 hours per week inclusive.

CHAPTER 2 TEST

1. $-10x - 6 + 4x = -4x + 8$
$$-6x - 6 = -4x + 8$$
$$-2x - 6 = 8$$
$$-2x = 14$$
$$x = -7$$

The solution set is $\{-7\}$.

2. $5(2x - 3) = x + 3$
$$10x - 15 = x + 3$$
$$10x = x + 18$$
$$9x = 18$$
$$x = 2$$

The solution set is $\{2\}$.

3. $-\frac{2}{3}x + 1 = 7$
$$-\frac{2}{3}x = 6$$
$$-\frac{3}{2}\left(-\frac{2}{3}x\right) = -\frac{3}{2} \cdot 6$$
$$x = -9$$

The solution set is $\{-9\}$.

4. $x + 0.06x = 742$
$$1.06x = 742$$
$$x = 700$$

The solution set is $\{700\}$.

5. $x - 0.03x = 0.97$
$$0.97x = 0.97$$
$$x = 1$$

The solution set is $\{1\}$.

6. $6x - 7 = 0$
$$6x = 7$$
$$x = \frac{7}{6}$$

The solution set is $\left\{\frac{7}{6}\right\}$.

7. $\frac{1}{2}x - \frac{1}{3} = \frac{1}{4}x + \frac{1}{6}$
$$6x - 4 = 3x + 2$$
$$3x = 6$$
$$x = 2$$

The solution set is $\{2\}$.

8. $2(x + 6) = 2x - 5$
$$2x + 12 = 2x - 5$$
$$12 = -5$$

The solution set is $\emptyset$.

9. $x + 7x = 8x$
$$8x = 8x$$

All real numbers satisfy the equation.

10. $2x - 3y = 9$
$$-3y = -2x + 9$$
$$-\frac{1}{3}(-3y) = -\frac{1}{3}(-2x + 9)$$
$$y = \frac{2}{3}x - 3$$

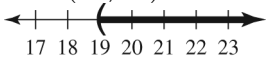
11. $m = aP - w$
$$m + w = aP$$
$$\frac{m + w}{P} = a$$
$$a = \frac{m + w}{P}$$

12. The graph shows the numbers between -3 and 2, including 2 but not including -3. This graph is the solution set to $-3 < x \le 2$. The solution set is the interval $(-3, 2]$.

13. The graph shows the numbers to the right of 1 on the number line. This graph is the solution to the inequality $x > 1$. The solution set is the interval $(1, \infty)$.

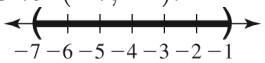
14. $4 - 3(w - 5) < -2w$
$$4 - 3w + 15 < -2w$$
$$19 - 3w < -2w$$
$$19 < w$$
$$w > 19$$

The solution set is the interval $(19, \infty)$.



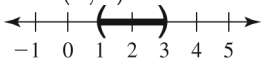
15. $1 < \frac{1 - 2x}{3} < 5$
$$3 < 1 - 2x < 15$$
$$2 < -2x < 14$$
$$-1 > x > -7$$
$$-7 < x < -1$$

The solution set is the interval $(-7, -1)$.



16. $1 < 3x - 2 < 7$
$$3 < 3x < 9$$
$$1 < x < 3$$

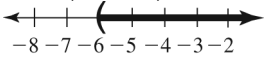
The solution set is the interval $(1, 3)$.



17. $-\frac{2}{3}y < 4$

$$-\frac{3}{2}\left(-\frac{2}{3}y\right) > -\frac{3}{2} \cdot 4$$
$$y > -6$$

The solution set is the interval $(-6, \infty)$.



18. Let $x =$ the width and $x + 8 =$ the length. Since perimeter is 72, we can write the following equation.

$$2x + 2(x + 8) = 72$$
$$4x + 16 = 72$$
$$4x = 56$$
$$x = 14$$
$$x + 8 = 22$$

The width of the rectangle is 14 meters.

19. a) The formula for the area of a triangle is $A = \frac{1}{2}bh$.

b) Solve for h to get $h = \frac{2A}{b}$.

c) Use $A = 54$ and $b = 12$ in the formula for the area of a triangle, $A = \frac{1}{2}bh$.

$$54 = \frac{1}{2} \cdot 12h$$
$$54 = 6h$$
$$9 = h$$

The height is 9 inches.

20. Let $x =$ the number of liters of 20% solution. If she mixes the 20% solution with 50 liters of 60% solution she will obtain $x + 50$ liters of 30% solution. The amount of alcohol in the 20% solution is $0.20x$. The amount of alcohol in the 60% solution is $0.60(50)$. The amount of alcohol in the final 30% solution is $0.30(x + 50)$. The alcohol in the final solution is the total of the alcohol in the two solutions.

$$0.20x + 0.60(50) = 0.30(x + 50)$$
$$0.20x + 30 = 0.30x + 15$$
$$0.20x + 15 = 0.30x$$
$$15 = 0.10x$$
$$150 = x$$

She should use 150 liters of 20% solution.

21. Let $x =$ the original price of the diamonds. His discount is $0.40x$. The price he pays is $x - 0.40x + 250$.

$$x - 0.40x + 250 \le 1450$$
$$0.60x \le 1200$$
$$x \le 2000$$

The original price of the diamonds can be at most \$2000.

22. If $x =$ the degree measure of the smallest angle, then the degree measures of the other two are $2x$ and $3x$.

$$x + 2x + 3x = 180$$
$$6x = 180$$
$$x = 30$$

The angles are 30°, 60°, and 90°.

Making Connections

Chapters 1-2

1. $3x + 5x = (3 + 5)x = 8x$

2. $3x \cdot 5x = 3 \cdot 5 \cdot x \cdot x = 15x^2$

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

4. $5 - 4(3 - x) = 5 - 12 + 4x = 4x - 7$

5. $3x + 8 - 5(x - 1) = 3x + 8 - 5x + 5$
$= -2x + 13$

6. $(-6)^2 - 4(-3)2 = 36 - (-24) = 36 + 24$
$= 60$

7. $3^2 \cdot 2^3 = 9 \cdot 8 = 72$

8. $4(-7) - (-6)(3) = -28 + 18 = -10$

9. $-2x \cdot x \cdot x = -2x^3$

10. $(-1)(-1)(-1)(-1)(-1) = -1$

11. If $x = -2$, then
$5x + 4x = 5(-2) + 4(-2) = -18.$

12. If $x = -2$, then $9x = 9(-2) = -18$.

13. If $x = -2$ and $y = 3$, then
$(y - x)(y + x)$
$= (3 - (-2))(3 + (-2))$
$= (5)(1) = 5$

14. If $x = -2$ and $y = 3$, then
$y^2 - x^2 = (3)^2 - (-2)^2 = 9 - 4 = 5.$

15. If $x = -2$ and $y = 3$, then
$(x - y)^2 = (-2 - 3)^2 = (-5)^2 = 25.$

16. If $x = -2$ and $y = 3$, then
$x^2 - 2xy + y^2 = (-2)^2 - 2(-2)(3) + 3^2$
$= 4 + 12 + 9 = 25$

17. If $x = -2$ and $y = 3$, then
$(2x + y)^2 = (2(-2) + 3)^2 = (-1)^2 = 1$

18. If $x = -2$ and $y = 3$, then
$4x^2 + 4xy + y^2 = 4(-2)^2 + 4(-2)(3) + 3^2$
$= 16 - 24 + 9 = 1$

19. The interval of real numbers less than 2 is $(-\infty, 2)$.

20. The interval of real numbers greater than -6 is $(-6, \infty)$.
21. The interval of real numbers greater than or equal to 5 is $[5, \infty)$.
22. The interval of real numbers less than or equal to -1 is $(-\infty, -1]$.
23. The real numbers between 2 and 6 inclusive is $[2, 6]$.
24. The real numbers greater than 4 and less than 8 is $(4, 8)$.
25. $\frac{1}{2} + \frac{1}{3} = \frac{1}{2} \cdot \frac{3}{3} + \frac{1}{3} \cdot \frac{2}{2} = \frac{5}{6}$
26. $\frac{1}{2} - \frac{1}{3} = \frac{1}{2} \cdot \frac{3}{3} - \frac{1}{3} \cdot \frac{2}{2} = \frac{1}{6}$
27. $\frac{5}{3} \cdot \frac{1}{15} = \frac{5}{45} = \frac{1}{9}$
28. $\frac{2}{3} \cdot \frac{5}{6} = \frac{10}{18} = \frac{5}{9}$
29. $6 \cdot \left(\frac{5}{3} + \frac{1}{2}\right) = 10 + 3 = 13$
30. $15\left(\frac{2}{3} - \frac{2}{15}\right) = 10 - 2 = 8$
31. $4 \cdot \left(\frac{x}{2} + \frac{1}{4}\right) = 2x + 1$
32. $12\left(\frac{5}{6}x - \frac{3}{4}\right) = 10x - 9$
33.
$$\begin{aligned} x - \tfrac{1}{2} &= \tfrac{1}{6} \\ 6x - 3 &= 1 \\ 6x &= 4 \\ x &= \tfrac{2}{3} \end{aligned}$$
The solution set is $\left\{\frac{2}{3}\right\}$.
34.
$$\begin{aligned} x + \tfrac{1}{3} &= \tfrac{1}{2} \\ x &= \tfrac{1}{2} - \tfrac{1}{3} \\ x &= \tfrac{1}{6} \end{aligned}$$
The solution set is $\left\{\frac{1}{6}\right\}$.
35.
$$\begin{aligned} x - \tfrac{1}{2} &> \tfrac{1}{6} \\ x &> \tfrac{1}{6} + \tfrac{1}{2} \\ x &> \tfrac{2}{3} \end{aligned}$$
The solution set is the interval $(2/3, \infty)$.

36.
$$\begin{aligned} x + \tfrac{1}{3} &\le \tfrac{1}{2} \\ x &\le \tfrac{1}{2} - \tfrac{1}{3} \\ x &\le \tfrac{1}{6} \end{aligned}$$
The solution set is the interval $(-\infty, 1/6]$.

37.
$$\begin{aligned} \tfrac{3}{5}x &= \tfrac{1}{15} \\ 9x &= 1 \\ x &= \tfrac{1}{9} \end{aligned}$$
The solution set is $\left\{\frac{1}{9}\right\}$.

38.
$$\begin{aligned} \tfrac{3}{2}x &= \tfrac{5}{6} \\ 9x &= 5 \\ x &= \tfrac{5}{9} \end{aligned}$$
The solution set is $\left\{\frac{5}{9}\right\}$.
39.
$$\begin{aligned} -\tfrac{3}{5}x &\le \tfrac{1}{15} \\ x &\ge -\tfrac{5}{3} \cdot \tfrac{1}{15} \\ x &\ge -\tfrac{1}{9} \end{aligned}$$
The solution set is the interval $[-1/9, \infty)$.
40.
$$\begin{aligned} -\tfrac{3}{2}x &> \tfrac{5}{6} \\ x &< -\tfrac{2}{3} \cdot \tfrac{5}{6} \\ x &< -\tfrac{5}{9} \end{aligned}$$
The solution set is the interval $(-\infty, -5/9)$.

41.
$$\begin{aligned} \tfrac{5}{3}x + \tfrac{1}{2} &= 1 \\ 10x + 3 &= 6 \\ 10x &= 3 \\ x &= \tfrac{3}{10} \end{aligned}$$
The solution set is $\left\{\frac{3}{10}\right\}$.

42.
$$\begin{aligned} \tfrac{2}{3}x - \tfrac{2}{15} &= 2 \\ 10x - 2 &= 30 \\ x &= \tfrac{32}{10} = \tfrac{16}{5} \end{aligned}$$
The solution set is $\left\{\frac{16}{5}\right\}$.

43.
$$\begin{aligned} \tfrac{x}{2} + \tfrac{1}{4} &= \tfrac{1}{2} \\ 2x + 1 &= 2 \\ x &= \tfrac{1}{2} \end{aligned}$$
The solution set is $\left\{\frac{1}{2}\right\}$.

44.
$$\begin{aligned} \tfrac{5}{6}x - \tfrac{3}{4} &= \tfrac{5}{12} \\ 10x - 9 &= 5 \\ x &= \tfrac{14}{10} = \tfrac{7}{5} \end{aligned}$$
The solution set is $\left\{\frac{7}{5}\right\}$.

45.
$$\begin{aligned} 3x + 5x &= 8 \\ 8x &= 8 \end{aligned}$$

$$x = 1$$

The solution set is $\{1\}$.

46. $3x + 5x = 8x$
$8x = 8x$

All real numbers satisfy this equation.

47. $3x + 5x = 7x$
$8x = 7x$
$8x - 7x = 7x - 7x$
$x = 0$

The solution set is $\{0\}$.

48. $3x + 5 = 8$
$3x = 3$
$x = 1$

The solution set is $\{1\}$.

49. $3x + 5x > 7x$
$8x > 7x$
$x > 0$

The solution set is the interval $(0, \infty)$.

50. $3x + 5x > 8x$
$8x > 8x$
$0 > 0$

Since $0 > 0$ is false, there is no solution to the inequality. The solution set is the empty set $\emptyset$.

51. $3x + 1 = 7$
$3x = 6$
$x = 2$

The solution set is $\{2\}$.

52. $5 - 4(3 - x) = 1$
$5 - 12 + 4x = 1$
$-7 + 4x = 1$
$4x = 8$
$x = 2$

The solution set is $\{2\}$.

53. $3x + 8 = 5(x - 1)$
$3x + 8 = 5x - 5$
$3x + 13 = 5x$
$13 = 2x$
$\frac{13}{2} = x$

The solution set is $\left\{\frac{13}{2}\right\}$.

54. $x - 0.05x = 190$
$0.95x = 190$
$x = \frac{190}{0.95} = 200$

The solution set is $\{200\}$.

55. $5 - 3x < 11$
$-3x < 6$
$x > -2$

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

56. $19 \le 3 + 8x$
$16 \le 8x$
$2 \le x$

The solution set is $[2, \infty)$.

57. $0 \le \frac{x+3}{5} \le 3$
$0 \le x + 3 \le 15$
$-3 \le x \le 12$

The solution set is $[-3, 12]$.

58. $1 < \frac{7-x}{12} < 4$
$12 < 7 - x < 48$
$5 < -x < 41$
$-5 > x > -41$
$-41 < x < -5$

The solution set is $(-41, -5)$.

59. a) $V = C - \frac{C-S}{5}t$
$V = 20{,}000 - \frac{20{,}000 - 4{,}000}{5} \cdot 2$
$= 13{,}600$

The value after 2 years is \$13,600.

b) $14{,}000 = 20{,}000 - \frac{20{,}000 - S}{5} \cdot 3$
$14{,}000 = 20{,}000 - \frac{60{,}000 - 3S}{5}$
$-6{,}000 = -\frac{60{,}000 - 3S}{5}$
$-30{,}000 = -60{,}000 + 3S$
$30{,}000 = 3S$
$S = 10{,}000$

The scrap value is \$10,000.

c) The scrap value is the value at time $t = 5$. From the graph it appears that the value at $t = 5$, the scrap value, is \$12,000.

Critical Thinking Chapter 2

1. a) There is only one square in this diagram.
b) There are four 1 by 1 squares and one 2 by 2 square for a total of 5 squares
c) There are nine 1 by 1 squares, four 2 by 2 squares, and one 3 by 3 square for a total of 14 squares.
d) There are sixteen 1 by 1 squares, nine 2 by 2 squares, four 3 by 3 squares, and one 4 by 4 square for a total of 30 squares.

2. Let a be the amount of flour in the 6 cup scoop and b be the amount of flour in the 11 cup scoop. Use the ordered pair (a, b) to represent the amounts in the scoops at any time. Originally we start with $(0, 0)$. The apprentice can fill a scoop, pour from one scoop to the other, or empty a scoop into the bin. Use the following sequence of amounts in the scoops: $(0, 11), (6, 5), (0, 5),$ $(5, 0), (5, 11), (6, 10), (0, 10), (6, 4), (0, 4),$ $(4, 0), (4, 11), (6, 9), (0, 9), (6, 3), (0, 3),$ $(3, 0), (3, 11), (6, 8), (0, 8).$

3. Using trial and error, you can find that $9 + 8 + 76 + 5 - 4 + 3 + 2 + 1 = 100$ $98 - 76 + 54 + 3 + 21 = 100$. There might be others.
Since you can place $+$, $-$, or no sign in each of the 8 spaces in 987654321 there are 3^8 or 6561 possibilities. A good and reasonable exercise would be to write a computer program to find them all.

4. By trial and error, $3 + 3^{3-3} = 4$, $3 + 3 - 3/3 = 5$, $3 + 3 + 3 - 3 = 6$, and so on.

5. With hours from 1 - 12 (no leading zeros) and minutes from 00 - 59 (no seconds) 1:01, 1:11, 1:21, 1:31, 1:41, and 1:51 are the palindromic displays in the 1 o'clock hour. During the 2 o'clock hour they are 2:02, 2:12, 2:22, 2:32, 2:42, and 2:52. For hours 1 through 9 there are six each hour. Then 10:01, 11:11, and 12:21 are the only 3 others. So there is a total of 57 palindromic displays.

6. Let $10a + b$ and $10c + d$ represent the original two digit numbers and $10b + a$ and $10d + c$ be the numbers with the reversed digits. If the products are equal, $(10a + b)(10c + d) = (10b + a)(10d + c)$. Simplify this equation to get $ac = bd$ or $a/b = d/c$. So another pair is 39 and 62 because Since $3/9 = 2/6$, another pair is 39 and 62. Since $6/4 = 9/6$ another pair is 64 and 69.

7. When Alice gets to class at what she thinks is 8 o'clock her watch says 7:56. But her watch is actually 8 minutes fast and the true time is 7:48 and she is 12 minutes early. When Bea gets to class at what she thinks is 8 o'clock, her watch says 8:08. But her watch is actually 8 minutes slow and the true time is 8:16 and she is 16 minutes late. When Carl gets to class at what he thinks is 8 o'clock his watch says 8:08. But his watch is actually 4 minutes slow so the true time is 8:12 and he is 12 minutes late. When Don gets to class at what he thinks is 8 o'clock, his watch says 7:52. But his watch is 4 actually minutes fast and the actual time is 7:48 and he is early.

8. By trial and error you can find that $25^2 = 625$, $76^2 = 5776$, $376^2 = 141{,}376$, and $625^2 = 390{,}625$.
Of course, you do not actually have to try all integers, because an automorphic number larger than 1 must end in 5or 6. So 25, 76, 376, and 625 are the next four automorphic numbers.