C H A P T E R 2
Linear Equations and Inequalities

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Section 2.1 Linear Equations

Solutions to Even-Numbered Exercises

2. (a) $x = -1$

$5(-1) + 9 \stackrel{?}{=} 4$

$-5 + 9 \stackrel{?}{=} 4$

$4 = 4$

Yes

(b) $x = 2$

$5(2) + 9 \stackrel{?}{=} 4$

$10 + 9 \stackrel{?}{=} 4$

$19 \neq 4$

No

4. (a) $x = 0$

$10(0) - 3 \stackrel{?}{=} 7(0)$

$0 - 3 \stackrel{?}{=} 0$

$-3 \neq 0$

No

(b) $x = -1$

$10(-1) - 3 \stackrel{?}{=} 7(-1)$

$-10 - 3 \stackrel{?}{=} -7$

$-13 \neq -7$

No

6. (a) $x = 2$

$7(2) - 1 \stackrel{?}{=} 5(2 + 5)$

$14 - 1 \stackrel{?}{=} 5(7)$

$13 \neq 35$

No

(b) $x = 13$

$7(13) - 1 \stackrel{?}{=} 5(13 + 5)$

$91 - 1 \stackrel{?}{=} 5(18)$

$90 = 90$

Yes

8. (a) $y = -\frac{3}{2}$

$3\left(-\frac{3}{2} + 2\right) \stackrel{?}{=} -\frac{3}{2} - 5$

$3\left(-\frac{3}{2} + \frac{4}{2}\right) \stackrel{?}{=} -\frac{3}{2} - \frac{10}{2}$

$3\left(\frac{1}{2}\right) \stackrel{?}{=} -\frac{13}{2}$

$\frac{3}{2} \neq -\frac{13}{2}$

No

(b) $y = -5.5$

$3(-5.5 + 2) \stackrel{?}{=} -5.5 - 5$

$3(-3.5) \stackrel{?}{=} -10.5$

$-10.5 = -10.5$

Yes

10.

$2x + 8 = 6x$	Original equation
$2x - 2x + 8 = 6x - 2x$	Addition Property of Equations
$8 = 4x$	Additive Inverse Property
$\left(\frac{1}{4}\right)8 = \left(\frac{1}{4}\right)4x$	Multiplication Property of Equations
$2 = x$	Multiplicative Inverse Property

Conditional equation whose solution is 2.

12.

$\frac{2}{3}x + 4 = \frac{1}{3}x + 12$	Original equation
$\frac{2}{3}x - \frac{1}{3}x + 4 = \frac{1}{3}x - \frac{1}{3}x + 12$	Addition Property of Equations
$\frac{1}{3}x + 4 = 12$	Additive Inverse Property
$\frac{1}{3}x + 4 - 4 = 12 - 4$	Addition Property of Equations
$\frac{1}{3}x = 8$	Additive Inverse Property
$3\left(\frac{1}{3}x\right) = 3(8)$	Multiplication Property of Equations
$x = 24$	Multiplicative Inverse Property

Conditional equation whose solution is 24.

14. $x^2 + 3 = 8$ is not linear since the variable has an exponent of 2.

16. $3(x + 2) = 4x$ is linear since the variable has an exponent of 1 in each term which contains it.

18.

$7x - 21 = 0$	Original equation
$7x - 21 + 21 = 0 + 21$	Add 21 to each side.
$7x = 21$	Combine like terms.
$\frac{7x}{7} = \frac{21}{7}$	Divide each side by 7.
$x = 3$	Simplify.

20.

$25 - 3x = 10$	Original equation
$25 - 3x + 3x = 10 + 3x$	Add $3x$ to each side.
$25 = 10 + 3x$	Combine like terms.
$25 - 10 = 10 + 3x - 10$	Subtract 10 from each side.
$15 = 3x$	Combine like terms.
$\frac{15}{3} = \frac{3x}{3}$	Divide each side by 3.
$5 = x$	Simplify.

22.

$x + 8 = 0$

$x + 8 - 8 = 0 - 8$

$x = -8$

Check:

$-8 + 8 \stackrel{?}{=} 0$

$0 = 0$

24.

$-14x - 28 = 0$

$-14x - 28 + 28 = 0 + 28$

$-14x = 28$

$\frac{-14x}{-14} = \frac{28}{-14}$

$x = -2$

Check:

$-14(-2) \stackrel{?}{=} 28$

$28 = 28$

26.

$0.5t - 7 = 0$

$0.5t - 7 + 7 = 0 + 7$

$0.5t = 7$

$\frac{0.5t}{0.5} = \frac{7}{0.5}$

$t = 14$

Check:

$0.5(14) \stackrel{?}{=} 7$

$7 = 7$

28.

$8z - 10 = 0$

$8z - 10 + 10 = 0 + 10$

$8z = 10$

$\frac{8z}{8} = \frac{10}{8}$

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

Check:

$8\left(\frac{5}{4}\right) - 10 \stackrel{?}{=} 0$

$\frac{40}{4} - 10 \stackrel{?}{=} 0$

$10 - 10 \stackrel{?}{=} 0$

$0 = 0$

30.

$-5x = 15$

$\frac{-5x}{-5} = \frac{15}{-5}$

$x = -3$

Check:

$-5(-3) \stackrel{?}{=} 15$

$15 = 15$

32.

$5y + 9 = -6$

$5y + 9 - 9 = -6 - 9$

$5y = -15$

$\frac{5y}{5} = \frac{-15}{3}$

$y = -3$

Check:

$5(-3) + 9 \stackrel{?}{=} -6$

$-15 + 9 \stackrel{?}{=} -6$

$-6 = -6$

34.

$15x - 18 = 27$

$15x - 18 + 18 = 27 + 18$

$15x = 45$

$\frac{15x}{15} = \frac{45}{15}$

$x = 3$

Check:

$15(3) - 18 \stackrel{?}{=} 27$

$45 - 18 \stackrel{?}{=} 27$

$27 = 27$

36.

$10 - 6x = -5$

$10 - 10 - 6x = -5 - 10$

$-6x = -15$

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

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

Check:

$10 - 6\left(\frac{5}{2}\right) \stackrel{?}{=} -5$

$10 - 15 \stackrel{?}{=} -5$

$-5 = -5$

38. $24 - 2x = x$

$24 - 2x + 2x = x + 2x$

$24 = 3x$

$\frac{24}{3} = \frac{3x}{3}$

$8 = x$

Check:

$24 - 2(8) \stackrel{?}{=} 8$

$24 - 16 \stackrel{?}{=} 8$

$8 = 8$

40. $6a + 2 = 6a$

$6a + 2 - 6a = 6a - 6a$

$2 = 0$

No solution, $2 \neq 0$.

42. $2s - 16 = 34s$

$2s - 2s - 16 = 34s - 2s$

$-16 = 32s$

$\frac{-16}{32} = \frac{32s}{32}$

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

Check:

$2\left(-\frac{1}{2}\right) - 16 \stackrel{?}{=} 34\left(-\frac{1}{2}\right)$

$-1 - 16 \stackrel{?}{=} -17$

$-17 = -17$

44. $3y + 14 = y + 20$

$3y + 14 - y = y + 20 - y$

$2y + 14 = 20$

$2y + 14 - 14 = 20 - 14$

$2y = 6$

$\frac{2y}{2} = \frac{6}{2}$

$y = 3$

Check:

$3(3) + 14 \stackrel{?}{=} 3 + 20$

$9 + 14 \stackrel{?}{=} 3 + 20$

$23 = 23$

46. $8 - 7y = 5y - 4$

$8 - 7y - 5y = 5y - 5y - 4$

$8 - 12y = -4$

$8 - 8 - 12y = -4 - 8$

$-12y = -12$

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

$y = 1$

Check:

$8 - 7(1) \stackrel{?}{=} 5(1) - 4$

$1 = 1$

48. $9y + 4 = 12y - 2$

$9y + 4 - 12y = 12y - 2 - 12y$

$-3y + 4 = -2$

$-3y + 4 - 4 = -2 - 4$

$-3y = -6$

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

$y = 2$

Check:

$9(2) + 4 \stackrel{?}{=} 12(2) - 2$

$18 + 4 \stackrel{?}{=} 24 - 2$

$22 = 22$

50. $6(x + 2) = 30$

$\frac{6(x + 2)}{6} = \frac{30}{6}$

$x + 2 = 5$

$x + 2 - 2 = 5 - 2$

$x = 3$

Check:

$6(3 + 2) \stackrel{?}{=} 30$

$6(5) \stackrel{?}{=} 30$

$30 = 30$

52. $8(z - 8) = 0$

$\frac{8(z - 8)}{8} = \frac{0}{8}$

$z - 8 = 0$

$z - 8 + 8 = 0 + 8$

$z = 8$

Check:

$8(8 - 8) \stackrel{?}{=} 0$

$8(0) \stackrel{?}{=} 0$

$0 = 0$

54. $-2(t + 3) = 9 - 5t$

$-2t - 6 = 9 - 5t$

$-2t + 5t - 6 = 9 - 5t + 5t$

$3t - 6 = 9$

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

$3t = 15$

$\frac{3t}{3} = \frac{15}{3}$

$t = 5$

Check:

$-2(5 + 3) \stackrel{?}{=} 9 - 5(5)$

$-2(8) \stackrel{?}{=} 9 - 25$

$-16 = -16$

56. $12 = 6(y + 1) - 8y$

$12 = 6y + 6 - 8y$

$12 = -2y + 6$

$12 - 6 = -2y + 6 - 6$

$6 = -2y$

$\frac{6}{-2} = \frac{-2y}{-2}$

$-3 = y$

Check:

$12 \stackrel{?}{=} 6(-3 + 1) - 8(-3)$

$12 \stackrel{?}{=} 6(-2) + 24$

$12 \stackrel{?}{=} -12 + 24$

$12 = 12$

58. $26 - (3x - 10) = 6$

$26 - 3x + 10 = 6$

$36 - 3x = 6$

$36 - 3x + 3x = 6 + 3x$

$36 = 6 + 3x$

$36 - 6 = 6 + 3x - 6$

$30 = 3x$

$\frac{30}{3} = \frac{3x}{3}$

$10 = x$

Check:

$26 - (3 \cdot 10 - 10) \stackrel{?}{=} 6$

$26 - (30 - 10) \stackrel{?}{=} 6$

$26 - 20 \stackrel{?}{=} 6$

$6 = 6$

60. $-5(x - 10) = 6(x - 10)$

$-5x + 50 = 6x - 60$

$-5x - 6x + 50 = 6x - 6x - 60$

$-11x + 50 = -60$

$-11x + 50 - 50 = -60 - 50$

$-11x = -110$

$x = 10$

Check:

$-5(10 - 10) \stackrel{?}{=} 6(10 - 10)$

$-5(0) \stackrel{?}{=} 6(0)$

$0 = 0$

62. $4(2 - x) = -2(x + 7) - 2x$

$8 - 4x = -2x - 14 - 2x$

$8 - 4x = -4x - 14$

$8 - 4x + 4x = -4x + 4x - 14$

$8 = -14$

No solution, $8 \neq -14$.

64. $-\frac{z}{2} = 7$

$(-2)\left(-\frac{z}{2}\right) = (-2)7$

$z = -14$

Check:

$-\frac{(-14)}{2} \stackrel{?}{=} 7$

$\frac{14}{2} \stackrel{?}{=} 7$

$7 = 7$

66. $z + \frac{1}{15} = -\frac{3}{10}$

$z + \frac{1}{15} - \frac{1}{15} = -\frac{3}{10} - \frac{1}{15}$

$z = -\frac{9}{30} - \frac{2}{30}$

$z = -\frac{11}{30}$

Check:

$\left(-\frac{11}{30}\right) + \frac{1}{15} \stackrel{?}{=} -\frac{3}{10}$

$-\frac{11}{30} + \frac{2}{30} \stackrel{?}{=} -\frac{3}{10}$

$-\frac{9}{30} \stackrel{?}{=} -\frac{3}{10}$

$-\frac{3}{10} = -\frac{3}{10}$

68. $\frac{t}{6} + \frac{t}{8} = 1$

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

$\frac{7t}{24} = 1$

$\left(\frac{24}{7}\right)\frac{7t}{24} = \left(\frac{24}{7}\right)1$

$t = \frac{24}{7}$

Check:

$\frac{\frac{24}{7}}{6} + \frac{\frac{24}{7}}{8} \stackrel{?}{=} 1$

$\frac{24}{7} \cdot \frac{1}{6} + \frac{24}{7} \cdot \frac{1}{8} \stackrel{?}{=} 1$

$\frac{4}{7} + \frac{3}{7} \stackrel{?}{=} 1$

$\frac{7}{7} \stackrel{?}{=} 1$

$1 = 1$

70.
$$\frac{11x}{6} + \frac{1}{3} = 2x$$
$$\frac{11x}{6} + \frac{1}{3} - \frac{1}{3} = 2x - \frac{1}{3}$$
$$\frac{11x}{6} = 2x - \frac{1}{3}$$
$$\frac{11}{6}x - 2x = 2x - 2x - \frac{1}{3}$$
$$\frac{11}{6}x - \frac{12}{6}x = -\frac{1}{3}$$
$$-\frac{1}{6}x = -\frac{1}{3}$$
$$-6\left(-\frac{1}{6}x\right) = \left(-\frac{1}{3}\right)(-6)$$
$$x = 2$$

Check:
$$\frac{11(2)}{6} + \frac{1}{3} \stackrel{?}{=} 2(2)$$
$$\frac{22}{6} + \frac{1}{3} \stackrel{?}{=} 4$$
$$\frac{11}{3} + \frac{1}{3} \stackrel{?}{=} 4$$
$$\frac{12}{3} \stackrel{?}{=} 4$$
$$4 = 4$$

72.
$$\frac{1}{9}x + \frac{1}{3} = \frac{11}{18}$$
$$\frac{1}{9}x + \frac{1}{3} - \frac{1}{3} = \frac{11}{18} - \frac{1}{3}$$
$$\frac{1}{9}x = \frac{11}{18} - \frac{6}{18}$$
$$\frac{1}{9}x = \frac{5}{18}$$
$$9\left(\frac{1}{9}x\right) = 9\left(\frac{5}{18}\right)$$
$$x = \frac{5}{2}$$

Check:
$$\frac{1}{9}\left(\frac{5}{2}\right) + \frac{1}{3} \stackrel{?}{=} \frac{11}{18}$$
$$\frac{5}{18} + \frac{1}{3} \stackrel{?}{=} \frac{11}{18}$$
$$\frac{5}{18} + \frac{6}{18} \stackrel{?}{=} \frac{11}{18}$$
$$\frac{11}{18} = \frac{11}{18}$$

74.
$$\frac{8 - 3x}{4} - 4 = \frac{x}{6}$$
$$12\left(\frac{8 - 3x}{4} - 4\right) = \left(\frac{x}{6}\right)12$$
$$3(8 - 3x) - 48 = 2x$$
$$24 - 9x - 48 = 2x$$
$$-9x - 24 = 2x$$
$$-9x - 24 + 9x = 2x + 9x$$
$$-24 = 11x$$
$$\frac{-24}{11} = \frac{11x}{11}$$
$$-\frac{24}{11} = x$$

Check:
$$\frac{8 - 3\left(-\frac{24}{11}\right)}{4} - 4 \stackrel{?}{=} \frac{-\frac{24}{11}}{6}$$
$$\frac{8 + \frac{72}{11}}{4} - 4 \stackrel{?}{=} -\frac{24}{11} \cdot \frac{1}{6}$$
$$\frac{\frac{88}{11} + \frac{72}{11}}{4} - 4 \stackrel{?}{=} -\frac{4}{11}$$
$$\frac{\frac{160}{11}}{4} - 4 \stackrel{?}{=} -\frac{4}{11}$$
$$\frac{160}{11} \cdot \frac{1}{4} - 4 \stackrel{?}{=} -\frac{4}{11}$$
$$\frac{40}{11} - 4 \stackrel{?}{=} -\frac{4}{11}$$
$$\frac{40}{11} - \frac{44}{11} \stackrel{?}{=} -\frac{4}{11}$$
$$-\frac{4}{11} = -\frac{4}{11}$$

76.
$$16.3 - 0.2x = 7.1$$
$$10(16.3 - 0.2x) = 10(7.1)$$
$$163 - 2x = 71$$
$$163 - 2x - 163 = 71 - 163$$
$$-2x = -92$$
$$\frac{-2x}{-2} = \frac{-92}{-2}$$
$$x = 46$$

Check:
$$16.3 - 0.2(46) \stackrel{?}{=} 7.1$$
$$16.3 - 9.2 \stackrel{?}{=} 7.1$$
$$7.1 = 7.1$$

78.
$$6.5(1 - 2x) = 13$$
$$6.5 - 13.0x = 13$$
$$6.5 - 6.5 - 13x = 13 - 6.5$$
$$-13x = 6.5$$
$$\frac{-13x}{-13} = \frac{6.5}{-13}$$
$$x = -0.5$$

Check:
$$6.5[1 - 2(-0.5)] \stackrel{?}{=} 13$$
$$6.5(1 + 1) \stackrel{?}{=} 13$$
$$6.5(2) \stackrel{?}{=} 13$$
$$13 = 13$$

80.
$$\frac{3}{4}(6-x)=\frac{1}{3}(4x+5)+2$$
$$12\left[\frac{3}{4}(6-x)\right]=\left[\frac{1}{3}(4x+5)+2\right]12$$
$$9(6-x)=4(4x+5)+24$$
$$54-9x=16x+20+24$$
$$54-9x=16x+44$$
$$54-9x-16x=16x+44-16x$$
$$54-25x=44$$
$$54-54-25x=44-54$$
$$-25x=-10$$
$$\frac{-25x}{-25}=\frac{-10}{-25}$$
$$x=\frac{2}{5}$$

Check:
$$\frac{3}{4}\left(6-\frac{2}{5}\right)\stackrel{?}{=}\frac{1}{3}\left[4\left(\frac{2}{5}\right)+5\right]+2$$
$$\frac{3}{4}\left(\frac{30}{5}-\frac{2}{5}\right)\stackrel{?}{=}\frac{1}{3}\left(\frac{8}{5}+\frac{25}{5}\right)+2$$
$$\frac{3}{4}\left(\frac{28}{5}\right)\stackrel{?}{=}\frac{1}{3}\left(\frac{33}{5}\right)+2$$
$$\frac{21}{5}\stackrel{?}{=}\frac{11}{5}+\frac{10}{5}$$
$$\frac{21}{5}=\frac{21}{5}$$

82. *Verbal Model:* [First integer] + [Second integer] = 137

Labels: n = first integer
$n+1$ = second integer

Equation:
$$n+(n+1)=137$$
$$2n+1=137$$
$$2n+1-1=137-1$$
$$2n=136$$
$$\frac{2n}{2}=\frac{136}{2}$$
$$n=68$$
$$n+1=69$$

84. *Verbal Model:* [First even integer] + [Second even integer] = 626

Labels: n = first even integer
$n+2$ = second even integer

Equation:
$$n+(n+2)=626$$
$$2n+2=626$$
$$2n+2-2=626-2$$
$$2n=624$$
$$\frac{2n}{2}=\frac{624}{2}$$
$$n=312$$
$$n+2=314$$

86. *Verbal Model:* [Cost of parts] + [Service call] + 16 · [Number of half hours] = 172

Label: n = Number of half hours

Equation:
$$74+50+16n=172$$
$$124+16n=172$$
$$124-124+16n=172-124$$
$$16n=48$$
$$\frac{16n}{16}=\frac{48}{16}$$
$$n=3 \text{ half hours} + \text{first half hour}$$

The repair work took 2 hours.

88. The object reaches its maximum height when the velocity is zero. The object then returns to the ground.
$$v=64-32t$$
$$0=64-32t$$
$$0+32t=64-32t+32t$$
$$32t=64$$
$$\frac{32t}{32}=\frac{64}{32}$$
$$t=2 \text{ seconds}$$

90. $\frac{t}{12} + \frac{t}{20} = 1$

$60\left(\frac{t}{12} + \frac{t}{20}\right) = (1)60$

$5t + 3t = 60$

$8t = 60$

$\frac{8t}{8} = \frac{60}{8}$

$t = \frac{15}{2} = 7\frac{1}{2}$ hours

92. *Verbal Model:* $2 \cdot \boxed{\text{Length}} + 2 \cdot \boxed{\text{Width}} = \boxed{\text{Perimeter}}$

Labels: $n =$ width

$n + 10 =$ length

Equation: $2(n + 10) + 2n = 64$

$2n + 20 + 2n = 64$

$4n + 20 = 64$

$4n + 20 - 20 = 64 - 20$

$4n = 44$

$\frac{4n}{4} = \frac{44}{4}$

$n = 11$ meters

$n + 10 = 21$ meters

94. *Graphically:* You can use the bar graph to estimate the average monthly rate to be about \$29 in 1999.

Numerically: Use the model $y = 1.519t + 15.35$ to create a table showing values for $t = 3, 4, 5, 6, 7, 8, 9$, and 10. The table should indicate that the average monthly rate was approximately \$29 in 1999.

Algebraically: Substitute 29 for y and solve for t.

$29 = 1.519t + 15.35$

$29 - 15.35 = 1.519t$

$13.65 = 1.519t$

$\frac{13.65}{1.519} = \frac{1.519t}{1.519}$

$8.99 \approx t$

96. Evaluating an expression means finding its value when its variables are replaced by real numbers. Solving an equation means finding all values of the variable for which the equation is true.

98. Equivalent equations have the same solution set. For example, $3x + 4 = 10$ and $3x - 6 = 0$ are equivalent.

100. True, subtracting zero from both sides of an equation yields an equivalent equation, which follows the Addition Property of Equality.

Section 2.2 Linear Equations and Problem Solving

2. *Verbal Model:* $\boxed{\text{Number}} - 18 = 27$

Label: Number $= x$

Equation: $x - 18 = 27$

$x - 18 + 18 = 27 + 18$

$x = 45$

4. *Verbal Model:* $\boxed{\text{Daily earnings}} = \boxed{\text{Hourly rate}} \cdot \boxed{\text{Hours}} + \boxed{\text{Rate per unit}} \cdot \boxed{\text{Number of units}}$

Label: Number of units $= x$

Equation: $146 = (10) \cdot 8 + 0.75x$

$146 = 80 + 0.75x$

$146 - 80 = 80 + 0.75x - 80$

$66 = 0.75x$

$88 = x$

6. Percent: 75%

Parts out of 100: 75

Decimal: 0.75

Fraction: $\frac{75}{100} = \frac{3}{4}$

8. Percent: 8%

Parts out of 100: 8

Decimal: 0.08

Fraction: $\frac{2}{25}$

10. Percent: 12.5%

Parts out of 100: 12.5

Decimal: 0.125

Fraction: $\frac{1}{8}$

12. Percent: 42%

Parts out of 100: 42

Decimal: 0.42

Fraction: $\frac{21}{50}$

14. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$a = (0.68)(800)$

$a = 544$

16. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$a = (0.702)(980)$

$a = 687.96$

18. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$a = \left(\frac{1}{3}\right)(816)$

$a = 272$

20. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$a = (0.001)(8925)$

$a = 8.925$

22. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$a = (3.0)(16)$

$a = 48$

24. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$416 = (0.65)b$

$\frac{416}{0.65} = b$

$640 = b$

26. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$168 = (3.5)b$

$\frac{168}{3.5} = b$

$48 = b$

28. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$18 = (0.024)(b)$

$\frac{18}{0.024} = b$

$750 = b$

30. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$1650 = (p)(5000)$

$\frac{1650}{5000} = p$

$33\% = p$

32. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$3.8 = (p)(190)$

$\frac{3.8}{190} = p$

$2\% = p$

34. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$900 = (p)(500)$

$\frac{900}{500} = p$

$1.8 = p$

$p = 180\%$

36. $\frac{12 \text{ ounces}}{20 \text{ ounces}} = \frac{12}{20} = \frac{6}{10} = \frac{3}{5}$

38. $\frac{125 \text{ cm}}{200 \text{ cm}} = \frac{5}{8}$

40. $\frac{1 \text{ pint}}{1 \text{ gallon}} = \frac{1 \text{ pint}}{8 \text{ pints}} = \frac{1}{8}$

42. $\frac{45 \text{ minutes}}{2 \text{ hours}} = \frac{45 \text{ minutes}}{120 \text{ minutes}} = \frac{3}{8}$

44. $\frac{y}{36} = \frac{6}{7}$

$y = \frac{6}{7} \cdot 36$

$y = \frac{216}{7}$

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

$4\left(\frac{5}{16}\right) = x$

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

48. $\frac{7}{8} = \frac{x}{2}$

$2 \cdot \frac{7}{8} = x$

$\frac{7}{4} = x$

50. $\frac{a}{5} = \frac{a+4}{8}$

$8a = 5(a+4)$

$8a = 5a + 20$

$3a = 20$

$a = \frac{20}{3}$

52. $\frac{z-3}{3} = \frac{z+8}{12}$

$12(z-3) = 3(z+8)$

$\frac{12(z-3)}{3} = \frac{3(z+8)}{3}$

$4(z-3) = z+8$

$4z - 12 = z + 8$

$3z - 12 = 8$

$3z = 20$

$z = \frac{20}{3}$

54. *Verbal Model:* $\boxed{\text{Amount withheld}} = \boxed{\text{Percent}} \cdot \boxed{\text{Gross monthly income}}$

Labels: Amount withheld $= a$

Percent $= p$

Gross monthly income $= b$

Equation: $a = p \cdot b$

$a = (0.065)(3800)$

$a = \$247$

56. *Verbal Model:* $\boxed{\text{Votes cast}} = \boxed{\text{Percent}} \cdot \boxed{\text{Eligible voters}}$

Labels: Votes cast $= a$

Percent $= p$

Eligible voters $= b$

Equation: $a = p \cdot b$

$105{,}586{,}274 = (0.675)(b)$

$\frac{105{,}586{,}274}{0.675} = \frac{(0.675)(b)}{0.675}$

$\frac{105{,}586{,}274}{0.675} = b$

$156{,}424{,}110 \approx b$

58. *Verbal Model:* $\boxed{\text{Rent}} = \boxed{\text{Percent}} \cdot \boxed{\text{Monthly income}}$

Labels: Rent $= a$

Percent $= p$

Monthly income $= b$

Equation: $a = p \cdot b$

$748 = p \cdot 3400$

$\frac{748}{3400} = \frac{p \cdot 3400}{3400}$

$0.22 = p$

$22\% = p$

60. *Verbal Model:* $\boxed{\text{Tip}} = \boxed{\text{Percent}} \cdot \boxed{\text{Cost of meal}}$

Labels: Tip $= a$

Percent $= p$

Cost of meal $= b$

Equation: $a = p \cdot b$

$40 - 34.73 = p \cdot 34.73$

$5.27 = p \cdot 34.73$

$\frac{5.27}{34.73} = \frac{p \cdot 34.73}{34.73}$

$0.1517 \approx p$

$15.2\% \approx p$

62. *Verbal Model:* $\boxed{\text{Tip}} = \boxed{\text{Percent}} \cdot \boxed{\text{Cost of meal}}$

Labels: Tip $= a$
Percent $= p$
Cost of meal $= b$

Equation:
$$60 - 47.24 = p \cdot 47.24$$
$$12.76 = p \cdot 47.24$$
$$\frac{12.76}{47.24} = \frac{p \cdot 47.24}{47.24}$$
$$0.27 \approx p$$
$$27\% \approx p$$

64. *Verbal Model:* $\boxed{\text{Tip}} = \boxed{\text{Percent}} \cdot \boxed{\text{Cost of meal}}$

Labels: Tip $= a$
Percent $= p$
Cost of meal $= b$

Equation:
$$21 - 18.80 = p \cdot 18.80$$
$$2.20 = p \cdot 18.80$$
$$\frac{2.20}{18.80} = \frac{p \cdot 18.80}{18.80}$$
$$0.12 \approx p$$
$$12\% \approx p$$

66. *Verbal Model:* $\boxed{\text{Commission}} = \boxed{\text{Percent}} \cdot \boxed{\text{Price of home}}$

Labels: Commission $= a$
Percent $= p$
Price of home $= b$

Equation:
$$a = p \cdot b$$
$$20{,}400 = (p)(240{,}000)$$
$$\frac{20{,}400}{240{,}000} = \frac{(p)(240{,}000)}{240{,}000}$$
$$\frac{20{,}400}{240{,}000} = p$$
$$0.085 = p$$
$$p = 8.5\%$$

68. *Verbal Model:* $\boxed{\text{Price of van}} = \boxed{\text{Percent}} \cdot \boxed{\text{Price 3 years ago}}$

Labels: Price of van $= a$
Percent $= p$
Price 3 years ago $= b$

Equation:
$$a = p \cdot b$$
$$29{,}750 = (1.15)(b)$$
$$\frac{29{,}750}{1.15} = \frac{(1.15)(b)}{1.15}$$
$$\frac{29{,}750}{1.15} = b$$
$$\$25{,}870 = b$$

70. *Verbal Model:* $\boxed{\text{Area covered by rug}} = \boxed{\text{Percent}} \cdot \boxed{\text{Area of floor}}$

Labels: Area covered by rug $= a$
Percent $= p$
Area of floor $= b$

Equation:
$$a = p \cdot b$$
$$\pi(4)^2 = p \cdot (10)(12)$$
$$16\pi = (120)(p)$$
$$\frac{16\pi}{120} = \frac{(120)(p)}{120}$$
$$\frac{16\pi}{120} = p$$
$$0.418879 \approx p$$
$$p \approx 41.9\%$$

72. *Verbal Model:* $\boxed{\text{Btu obtained from coal}} = \boxed{\text{Percent}} \cdot \boxed{\text{Total Btu}}$

Labels: Btu obtained from coal $= a$
Percent $= p$
Total Btu $= b$

Equation:
$$a = p \cdot b$$
$$a = (0.229)(96)$$
$$a = 21.984$$
$$a \approx 22.0 \text{ quadrillion Btu}$$

74. Approximate increase from graph is 12 pounds.

Verbal Model: $\boxed{\text{Amount of increase}} = \boxed{\text{Percent}} \cdot \boxed{\text{Chicken consumption in 1990}}$

Labels: Amount of increase $= a$

Percent $= p$

Chicken consumption in 1990 $= b$

Equation: $a = p \cdot b$

$12 = (p)(42)$

$\frac{12}{42} = \frac{(p)(42)}{42}$

$\frac{12}{42} = p$

$0.2857 \approx p$

$p \approx 28.6\%$

76. *Verbal Model:* $\boxed{\text{Amount of fish}} = \boxed{\text{Percent}} \cdot \boxed{\text{Amount of meat}}$

Labels: Amount of fish $= 15$

Percent $= p$

Amount of meat $= 64 + 49 + 49 + 15$

Equation: $a = p \cdot b$

$15 = p \cdot (64 + 49 + 49 + 15)$

$15 = (p)(177)$

$\frac{15}{177} = \frac{(p)(177)}{177}$

$\frac{15}{177} = p$

$0.085 \approx p$

$p \approx 8.5\%$

78. $\frac{\text{Stock price}}{\text{Stock earning}} = \frac{\$56.25}{\$6.25} = \frac{9}{1}$

80. Gear ratio $= \frac{60 \text{ teeth}}{40 \text{ teeth}} = \frac{3}{2}$

or

Gear ratio $= \frac{40 \text{ teeth}}{60 \text{ teeth}} = \frac{2}{3}$

82. $\frac{\text{Area of triangle 1}}{\text{Area of triangle 2}} = \frac{\frac{1}{2} \cdot 4 \cdot 3}{\frac{1}{2} \cdot 6 \cdot 4} = \frac{3}{6} = \frac{1}{2}$

84. $\frac{\text{Total price}}{\text{Total units}} = \frac{\$1.29}{64} \approx \$0.0202$ per ounce

86. $\frac{\text{Total price}}{\text{Total units}} = \frac{\$4.29}{18} \approx \$0.2383$ per ounce

88. (a) Unit price $= \frac{\$1.79}{10.5} \approx \$0.17$ per ounce

(b) Unit price $= \frac{\$2.39}{16} \approx \$0.15$ per ounce

The 16-ounce package is a better buy.

90. (a) Unit price $= \frac{\$3.49}{2} \approx \$1.75$ per pound

(b) Unit price $= \frac{\$5.29}{3} \approx \$1.76$ per pound

The 2-pound package is a better buy.

92. $\frac{2}{5} = \frac{3}{x}$

$2x = 15$

$x = \frac{15}{2} = 7\frac{1}{2}$

94. $\frac{x}{5} = \frac{2}{3}$

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

$x = \frac{10}{3} = 3\frac{1}{3}$

96. *Proportion:* $\frac{l}{6} = \frac{l + 15}{20}$

$20l = 6l + 90$

$14l = 90$

$l = \frac{90}{14}$

$l = \frac{45}{7} \approx 6.4$ feet

98. *Verbal Model:* $\boxed{\frac{\text{Pounds}}{\text{Inches}}} = \boxed{\frac{\text{Pounds}}{\text{Inches}}}$

Proportion: $\frac{x}{9} = \frac{32}{6}$

$x = 9 \cdot \frac{32}{6}$

$x = 48$ pounds

100. $\dfrac{3 \text{ cups}}{1 \text{ batch}} = \dfrac{x \text{ cups}}{3\frac{1}{2} \text{ batches}}$

$x = 3 \cdot 3\frac{1}{2}$

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

$x = \frac{21}{2} = 10\frac{1}{2}$ cups

102. *Verbal Model:* $\boxed{\dfrac{\text{Defective units}}{\text{Total units}}} = \boxed{\dfrac{\text{Defective units}}{\text{Total units}}}$

Proportion: $\dfrac{x}{5000} = \dfrac{3}{120}$

$x = 5000 \cdot \dfrac{3}{120}$

104. *Verbal Model:* $\boxed{\dfrac{\text{Defective units}}{\text{Total units}}} = \boxed{\dfrac{\text{Defective units}}{\text{Total units}}}$

Proportion: $\dfrac{x}{235} = \dfrac{1}{40}$

$x = \dfrac{235}{40}$

$x \approx 6$ units

106. *Verbal Model:* $\boxed{\dfrac{\text{Voters for Candidate A}}{\text{Total voters}}} = \boxed{\dfrac{\text{Voters for Candidate A}}{\text{Total voters}}}$

Proportion: $\dfrac{870}{1500} = \dfrac{x}{80{,}000}$

$80{,}000\left(\dfrac{870}{1500}\right) = x$

$46{,}400 \text{ votes} = x$

108. To change percents to decimals divide by 100. To change decimals to percents multiply by 100.

Examples: $42\% = \frac{42}{100} = 0.42$

$0.38 = (0.38)(100)\% = 38\%$

110. The ratio of a to b is a/b if a and b have the same units.

Examples: Price earnings ratio, gear ratio

112. Mathematical modeling is the use of mathematics to solve problems that occur in real-life situations. For examples review the real-life problems in the exercise set.

Section 2.3 Business and Scientific Problems

2. *Verbal Model:* $\boxed{\text{Selling price}} = \boxed{\text{Cost}} + \boxed{\text{Markup}}$

Labels: Selling price $= 113.67$

Cost $= 84.20$

Markup $= x$

Equation: $113.67 = 84.20 + x$

$113.67 - 84.20 = x$

$\$29.47 = x$

Verbal Model: $\boxed{\text{Markup}} = \boxed{\text{Markup rate}} \cdot \boxed{\text{Cost}}$

Labels: Markup $= 29.47$

Markup rate $= x$

Cost $= 84.20$

Equation: $29.47 = x \cdot 84.20$

$\dfrac{29.47}{84.20} = x$

$35\% = x$

4. *Verbal Model:* $\boxed{\text{Selling price}} = \boxed{\text{Cost}} + \boxed{\text{Markup}}$

Labels: Selling price $= 603.72$

Cost $= x$

Markup $= 184.47$

Equation: $603.72 = x + 184.47$

$603.72 - 184.47 = x$

$\$419.25 = x$

Verbal Model: $\boxed{\text{Markup}} = \boxed{\text{Markup rate}} \cdot \boxed{\text{Cost}}$

Labels: Markup $= 184.47$

Markup rate $= x$

Cost $= 419.25$

Equation: $184.47 = x \cdot 419.25$

$\dfrac{184.47}{419.25} = x$

$44\% = x$

6. *Verbal Model:* $\boxed{\text{Selling price}} = \boxed{\text{Cost}} + \boxed{\text{Markup}}$

Labels: Selling price $= 16{,}440.50$
Cost $= x$
Markup $= 3890.50$

Equation: $16{,}440.50 = x + 3890.50$
$16{,}440.50 - 3890.50 = x$
$\$12{,}550.00 = x$

Verbal Model: $\boxed{\text{Markup}} = \boxed{\text{Markup rate}} \cdot \boxed{\text{Cost}}$

Labels: Markup $= 3890.50$
Markup rate $= x$
Cost $= 12{,}550.00$

Equation: $3890.50 = x \cdot 12{,}550.00$
$\dfrac{3890.50}{12{,}550.00} = x$
$31\% = x$

8. *Verbal Model:* $\boxed{\text{Markup}} = \boxed{\text{Markup rate}} \cdot \boxed{\text{Cost}}$

Labels: Markup $= x$
Markup rate $= 33\frac{1}{3}\%$
Cost $= 732.00$

Equation: $x = 33\frac{1}{3}\% \cdot 732.00$
$x = \frac{1}{3} \cdot 732.00$
$x = \$244.00$

Verbal Model: $\boxed{\text{Selling price}} = \boxed{\text{Cost}} + \boxed{\text{Markup}}$

Labels: Selling price $= x$
Cost $= 732.00$
Markup $= 244.00$

Equation: $x = 732.00 + 244.00$
$x = \$976.00$

10. *Verbal Model:* $\boxed{\text{Sale price}} = \boxed{\text{List price}} - \boxed{\text{Discount}}$

Labels: Sale price $= 79.73$
List price $= 119.00$
Discount $= x$

Equation: $79.73 = 119.00 - x$
$x = 119.00 - 79.73$
$x = \$39.27$

Verbal Model: $\boxed{\text{Discount}} = \boxed{\text{Discount rate}} \cdot \boxed{\text{List price}}$

Labels: Discount $= 39.27$
Discount rate $= x$
List price $= 119.00$

Equation: $39.27 = x \cdot 119.00$
$\dfrac{39.27}{119.00} = x$
$33\% = x$

12. *Verbal Model:* $\boxed{\text{Sale price}} = \boxed{\text{List price}} - \boxed{\text{Discount}}$

Labels: Sale price $= x$
List price $= 345.00$
Discount $= 134.55$

Equation: $x = 345.00 - 134.55$
$x = \$210.45$

Verbal Model: $\boxed{\text{Discount}} = \boxed{\text{Discount rate}} \cdot \boxed{\text{List price}}$

Labels: Discount $= 134.55$
Discount rate $= x$
List price $= 345.00$

Equation: $134.55 = x \cdot 345.00$
$\dfrac{134.55}{345.00} = x$
$39\% = x$

14. *Verbal Model:* $\boxed{\text{Sale price}} = \boxed{\text{Percent}} \cdot \boxed{\text{List price}}$

Labels: Sale price $= 19.90$

Percent $= 0.80$

List price $= x$

Equation: $19.90 = 0.80 \cdot x$

$$\frac{19.90}{0.80} = x$$

$\$24.88 = x$

Verbal Model: $\boxed{\text{Sale price}} = \boxed{\text{List price}} - \boxed{\text{Discount}}$

Labels: Sale price $= 19.90$

List price $= 24.88$

Discount $= x$

Equation: $19.90 = 24.88 - x$

$x = 24.88 - 19.90$

$x = \$4.98$

16. *Verbal Model:* $\boxed{\text{Sale price}} = \boxed{\text{List price}} - \boxed{\text{Discount}}$

Labels: Sale price $= 257.32$

List price $= x$

Discount $= 202.18$

Equation: $257.32 = x - 202.18$

$257.32 + 202.18 = x$

$\$459.50 = x$

Verbal Model: $\boxed{\text{Discount}} = \boxed{\text{Discount rate}} \cdot \boxed{\text{List price}}$

Labels: Discount $= 202.18$

Discount rate $= x$

List price $= 459.50$

Equation: $202.18 = x \cdot 459.50$

$$\frac{202.18}{459.50} = x$$

$44\% = x$

18. *Verbal Model:* $\boxed{\text{Selling price}} = \boxed{\text{Cost}} + \boxed{\text{Markup}}$

Labels: Selling price $= 63.50$

Cost $= 43.50$

Markup $= x$

Equation: $63.50 = 43.50 + x$

$63.50 - 43.50 = x$

$\$20.00 = x$

20. *Verbal Model:* $\boxed{\text{Selling price}} = \boxed{\text{Cost}} + \boxed{\text{Markup}}$

Labels: Selling price $= 60$

Cost $= 35$

Markup $= x$

Equation: $60 = 35 + x$

$60 - 35 = x$

$25 = x$

Verbal Model: $\boxed{\text{Markup}} = \boxed{\text{Markup rate}} \cdot \boxed{\text{Cost}}$

Labels: Markup $= 25$

Markup rate $= x$

Cost $= 35$

Equation: $25 = x \cdot 35$

$\frac{25}{35} = x$

$0.714 \approx x$

$71.4\% \approx x$

22. *Verbal Model:* $\boxed{\text{Sale price}} = \boxed{\text{List price}} - \boxed{\text{Discount}}$

Labels: Sale price $= 0.75$
List price $= 1.75$
Discount $= x$

Equation: $0.75 = 1.75 - x$
$x = 1.75 - 0.75$
$x = \$1.00$

24. *Verbal Model:* $\boxed{\text{Sale price}} = \boxed{\text{List price}} - \boxed{\text{Discount}}$

Labels: Sale price $= 10$
List price $= 14$
Discount $= x$

Equation: $10 = 14 - x$
$x = 14 - 10$
$x = \$4$

Verbal Model: $\boxed{\text{Discount}} = \boxed{\text{Discount rate}} \cdot \boxed{\text{List price}}$

Labels: Discount $= 4$
Discount rate $= x$
List price $= 14$

Equation: $4 = x \cdot 14$
$\frac{4}{14} = x$
$0.286 \approx x$
$28.6\% \approx x$

26. *Verbal Model:* $\boxed{\text{Surcharge}} = \boxed{\text{Surcharge rate}} \cdot \boxed{\text{Premium}}$

Labels: Surcharge $= x$
Surcharge rate $= 20\%$
Premium $= 862$

Equation: $x = 20\% \cdot 862$
$x = \$172.40$

Verbal Model: $\boxed{\text{Current premium}} = \boxed{\text{Previous premium}} + \boxed{\text{Surcharge}}$

Labels: Current premium $= x$
Previous premium $= 862$
Surcharge $= 172.40$

Equation: $x = 862.00 + 172.40$
$x = \$1034.40$

28. *Verbal Model:* $\boxed{\text{Markup}} = \boxed{\text{Markup rate}} \cdot \boxed{\text{Cost}}$

Labels: Markup $= x$
Markup rate $= 30\%$
Cost $= 22.60$

Equation: $x = 30\% \cdot 22.60$
$x = \$6.78$

Verbal Model: $\boxed{\text{Selling price}} = \boxed{\text{Cost}} + \boxed{\text{Markup}}$

Labels: Selling price $= x$
Cost $= 22.60$
Markup $= 6.78$

Equation: $x = 22.60 + 6.78$
$x = \$29.38$

Verbal Model: $\boxed{\text{Number of spoiled bananas}} = \boxed{\text{Total bananas}} + \boxed{\text{Percent to spoil}}$

Labels: Spoiled bananas $= x$
Total bananas $= 100$
Percent $= 10\%$

Equation: $x = 100 \cdot 10\%$
$x = 10$

$$\text{Cost per pound} = \frac{\text{Total cost}}{\text{Number of pounds}}$$
$$= \frac{29.38}{90} = \$0.33/\text{lb}$$

30. *Verbal Model:* $\boxed{\text{Commission}} = \boxed{\text{Commission rate}} \cdot \boxed{\text{Sales}}$

Labels: Commission $= x$
Commission rate $= 6\%$
Sales $= 5500$

Equation: $x = 6\% \cdot 5500$
$x = \$330$

Verbal Model: $\boxed{\text{Weekly pay}} = \boxed{\text{Salary}} + \boxed{\text{Commission}}$

Labels: Weekly pay $= x$
Salary $= 375$
Commission $= 330$

Equation: $x = 375 + 330$
$x = \$705$

32. *Verbal Model:* $\boxed{\text{Total bill}} = \boxed{\text{First 1/2 hour charge}} + \boxed{\text{Additional 1/2 hour charges}}$

Labels: Total bill $= 104$
First $1/2$ hour charge $= 50$
Number of $1/2$ hours $= x$
Additional $1/2$ hour charges $= 18x$

Equation: $104 = 50 + 18x$
$54 = 18x$
$3 = x$

The length of a service call is 2 hours.

34. *Verbal Model:* $\boxed{\text{Total bill}} = \boxed{\text{Parts charge}} + \boxed{\text{Labor charge}}$

Labels: Total bill $= 648$
Parts charge $= 315$
Charge per hour $= x$
Labor charge $= 9x$

Equation: $648 = 315 + 9x$
$333 = 9x$
\$37 per hour $= x$

36. *Verbal Model:* $\boxed{\text{Amount of solution 1}} + \boxed{\text{Amount of solution 2}} = \boxed{\text{Amount of final solution}}$

Labels: Percent of solution 1 $= 50\%$
Liters of solution 1 $= x$
Percent of solution 2 $= 75\%$
Liters of solution 2 $= 10 - x$
Percent of final solution $= 60\%$
Liters of final solution $= 10$

Equation: $0.50x + 0.75(10 - x) = 0.60(10)$
$0.50x + 7.5 - 0.75x = 6$
$-0.25x = -1.5$
$x = 6$ liters at 50%
$10 - x = 4$ liters at 75%

38. *Verbal Model:* $\boxed{\text{Amount of solution 1}} + \boxed{\text{Amount of solution 2}} = \boxed{\text{Amount of final solution}}$

Labels: Percent of solution 1 $= 60\%$
Gallons of solution 1 $= x$
Percent of solution 2 $= 80\%$
Gallons of solution 2 $= 55 - x$
Percent of final solution $= 75\%$
Gallons of final solution $= 55$

Equation: $0.60x + 0.80(55 - x) = 0.75(55)$
$0.60x + 44 - 0.80x = 41.25$
$-0.20x = -2.75$
$x = 13.75$ gallons at 60%
$55 - x = 41.25$ gallons at 80%

40. *Verbal Model:* $\boxed{\text{Total cost}} = \boxed{\text{Cost of first nut}} + \boxed{\text{Cost of second nut}}$

Labels: Total number of pounds $= 100$
Cost per pound $= 4.13$
Number of pounds of first nut $= x$
Cost per pound of first nut $= 3.88$
Number of pounds of second nut $= 100 - x$
Cost per pound of second nut $= 4.88$

Equation: $100(4.13) = x(3.88) + (100 - x)(4.88)$
$413 = 3.88x + 488 - 4.88x$
$-75 = -1.00x$
$75 = x$ pounds at \$3.88
$25 = 100 - x$ pounds at \$4.88

42. *Verbal Model:* $\boxed{\text{Total sales}} = \boxed{\text{Adult sales}} + \boxed{\text{Children sales}}$

Labels:
Total sales $= 1350$
Number of adult tickets $= 4x$
Price of adult tickets $= 6$
Number of children's tickets $= x$
Price of children's tickets $= 3$

Equation:
$$1350 = 6(4x) + 3x$$
$$1350 = 24x + 3x$$
$$1350 = 27x$$
50 children's tickets $= x$

44. *Verbal Model:* $\boxed{\text{Original gas/oil mixture}} + \boxed{\text{Gasoline}} = \boxed{\text{Final gas/oil mixture}}$

Labels:
Percent of gasoline in original mixture $= \frac{40}{41}$
Number of gallons in original mixture $= 2.5$
Number of gallons of gasoline added $= x$
Percent of gasoline in final mixture $= \frac{50}{51}$
Number of gallons in final mixture $= 2.5 + x$

Equation:
$$\tfrac{40}{41}(2.5) + x = \tfrac{50}{51}(2.5 + x)$$
$$\tfrac{100}{41} + x = \tfrac{125}{51} + \tfrac{50}{51}x$$
$$\tfrac{1}{51}x = \tfrac{125}{51} - \tfrac{100}{41}$$
$$x = 51\left(\tfrac{125}{51} - \tfrac{100}{41}\right)$$
$$x \approx 0.61 \text{ gallon}$$

46. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance $= d$
Rate $= 45$
Time $= 10$

Equation:
$$d = 45 \cdot 10$$
$d = 450$ feet

48. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance $= 250$
Rate $= 32$
Time $= t$

Equation:
$$250 = 32 \cdot t$$
$$\tfrac{250}{32} = t$$
$\frac{125}{16}$ seconds $= t$

50. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance $= 1000$
Rate $= r$
Time $= \frac{3}{2}$

Equation:
$$1000 = r \cdot \tfrac{3}{2}$$
$$1000 \div \tfrac{3}{2} = r$$
$$1000 \cdot \tfrac{2}{3} = r$$
$\frac{2000}{3}$ ft/sec $= r$

52. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance $= 12$
Rate $= 8$
Time $= x$

Equation:
$$12 = 8x$$
$$\tfrac{12}{8} = x$$
$1\frac{1}{2}$ hours $= x$

54. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance $= 252$
Rate $= 28$
Time $= x$

Equation:
$$252 = 28 \cdot x$$
$$252 = 28x$$
$$\tfrac{252}{28} = x$$
9 seconds $= x$

56. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance $= 5000$
Rate $= 150$
Time $= x$

Equation:
$$5000 = 150 \cdot x$$
$$5000 = 150x$$
$$\tfrac{5000}{150} = x$$
$33\frac{1}{3}$ minutes $= x$

58. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance of truck 1 $= x$
Rate of truck 1 $= 52$
Time of truck 1 $= 4\frac{1}{2}$
Distance of truck 2 $= y$
Rate of truck 2 $= 56$
Time of truck 2 $= 4\frac{1}{2}$

Equations:
$x = 52 \cdot 4\frac{1}{2}$
$x = 234$ miles
$y = 56 \cdot 4\frac{1}{2}$
$y = 252$ miles

The two trucks are $252 - 234 = 18$ miles apart.

60. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance $= 93{,}000{,}000$
Rate $= 186{,}282.369$
Time $= x$

Equation:
$$93{,}000{,}000 = 186{,}282.369x$$
$$\frac{93{,}000{,}000}{186{,}282.369} = x$$
$$499.2420941 \text{ seconds} \approx x$$
$$8.32 \text{ minutes} \approx x$$

62. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance $= 5$
Rates $= 30$ and 45
Time $= x$

Equation:
$$5 = 45x - 30x$$
$$5 = 15x$$
$$\frac{5}{15} = x$$
$$20 \text{ minutes} = x$$

64. (a) Typist 1's rate $= \frac{1}{5}$ job per hour
Typist 2's rate $= \frac{1}{8}$ job per hour

(b) *Verbal Model:* $\boxed{\text{Work done}} = \boxed{\text{Work done by first person}} + \boxed{\text{Work done by second person}}$

Labels:
Work done $= 1$
Rate for first person $= \frac{1}{5}$
Time for first person $= t$
Rate for second person $= \frac{1}{8}$
Time for second person $= t$

Equation:
$$1 = \left(\frac{1}{5}\right)(t) + \left(\frac{1}{8}\right)(t)$$
$$1 = \left(\frac{1}{5} + \frac{1}{8}\right)t$$
$$1 = \left(\frac{13}{40}\right)t$$
$$\frac{1}{13/40} = t$$
$$3\frac{1}{13} \text{ hours} = \frac{40}{13} \text{ hours} = t$$

66. *Verbal Model:* $\boxed{\text{Work done}} = \boxed{\text{Work done by smaller pump}} + \boxed{\text{Work done by larger pump}}$

Labels:
Work done $= 1$
Rate of smaller pump $= \frac{1}{30}$
Rate of larger pump $= \frac{1}{15}$
Time for each pump $= t$

Equation:
$$1 = \left(\frac{1}{30}\right)(t) + \left(\frac{1}{15}\right)(t)$$
$$1 = \left(\frac{1}{30} + \frac{1}{15}\right)t$$
$$1 = \frac{3}{30}t$$
$$\frac{1}{3/30} = t$$
$$10 \text{ minutes} = t$$

68.
$$A = P + Prt$$
$$A - P = Prt$$
$$\frac{A - P}{Pt} = r$$

70.
$$S = C + rC$$
$$S = C(1 + r)$$
$$\frac{S}{1 + r} = C$$

72.
$$h = 18t + \frac{1}{2}at^2$$
$$h - 18t = \frac{1}{2}at^2$$
$$2(h - 18t) = at^2$$
$$2h - 36t = at^2$$
$$\frac{2h - 36t}{t^2} = a$$

74.
$$h = 36t + \frac{1}{2}at^2 + 50$$
$$h - 36t - 50 = \frac{1}{2}at^2$$
$$2(h - 36t - 50) = at^2$$
$$2h - 72t - 100 = at^2$$
$$\frac{2h - 72t - 100}{t^2} = a$$

76.
$$A = \frac{1}{2}(a + b)h$$
$$2A = (a + b)h$$
$$\frac{2A}{h} = a + b$$
$$\frac{2A}{h} - a = b$$
$$\frac{2A - ah}{h} = b$$

78. *Common formula:* $V = \frac{4}{3}\pi r^3$

Equation: $V = \frac{4}{3}\pi(2)^3$

$$V = \frac{32\pi}{3}$$
$$V \approx 33.5 \text{ cubic inches}$$

80. *Verbal Model:* $\text{Perimeter} = 2\boxed{\text{Width}} + 2\boxed{\text{Height}}$

Labels:
Perimeter $= 18$
Width $= x$
Height $= 1.25x$

Equation:
$$18 = 2x + 2(1.25x)$$
$$18 = 2x + 2.5x$$
$$18 = 4.5x$$
$$\frac{18}{4.5} = x$$
$$4 \text{ feet} = x$$

82. *Verbal Model:* $\text{Perimeter} = 2\boxed{\text{Width}} + 2\boxed{\text{Length}}$

Labels:
Perimeter $= 64$
Width $= x$
Length $= 3x$

Equation:
$$64 = 2x + 2(3x)$$
$$64 = 2x + 6x$$
$$64 = 8x$$
$$8 \text{ inches} = x$$
$$24 \text{ inches} = 3x$$

84. *Verbal Model:* $\boxed{\text{Degrees Fahrenheit}} = \frac{9}{5} \cdot \boxed{\text{Degrees Celsius}} + 32$

Labels:
Degrees Fahrenheit $= F$
Degrees Celsius $= C$

Equation:
$$F = \tfrac{9}{5}C + 32$$
$$68 = \tfrac{9}{5}C + 32$$
$$68 - 32 = \tfrac{9}{5}C + 32 - 32$$
$$\tfrac{5}{9} \cdot 36 = \tfrac{9}{5}C \cdot \tfrac{5}{9}$$
$$20^\circ = C$$

86. *Verbal Model:* $\boxed{\text{Interest}} = \boxed{\text{Principal}} \cdot \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels: Interest $= 400$
Principal $= 2500$
Rate $= r$
Time $= 2$

Equation:
$$400 = (2500)(r)(2)$$
$$400 = 5000r$$
$$\frac{400}{5000} = r$$
$$8\% = 0.08 = r$$

88. *Verbal Model:* $\boxed{\text{Interest}} = \boxed{\text{Principal}} \cdot \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels: Interest $= 400$
Principal at $7\% = x$
Principal at $5\% = 7000 - x$
Time $= 1$

Equation:
$$400 = 0.07x + 0.05(7000 - x)$$
$$400 = 0.07x + 350 - 0.05x$$
$$50 = 0.02x$$
$$\frac{50}{0.02} = x$$
$$\$2500 = x$$

90. (a) $y = 0.226t + 6.76,\ 5 \le t \le 10$

From the graph, 1998 was the year when the average hourly wage was \$8.56.

$$8.56 = 0.226t + 6.76$$
$$1.8 = 0.226t$$
$$\frac{1.8}{0.226} = t$$
$$7.96 \approx t$$
$$8 \approx t$$

Yes, the result is the same, 1998.

(b) The average annual hourly raise for cafeteria workers during this 6-year period is \$0.226. Determine the average hourly wage for each year using the model. The difference between each two consecutive years is \$0.226.

92. Markup is the difference between the cost a retailer pays for a product and the price at which the retailer sells the product. Markup rate is the percent increase of the markup.

94. If it takes you t hours to complete a task, you can complete $1/t$ of the task in 1 hour.

96. No, it quadruples. The area of a square of side s is s^2. If the length of the sides is $2s$, the area is $(2s)^2 = 4s^2$.

Section 2.4 Linear Inequalities

2. (a) $3(0) + 2 < \frac{7(0)}{5}$

$$0 + 2 < \frac{0}{5}$$
$$2 < 0$$

No

(b) $3(4) + 2 < \frac{7(4)}{5}$

$$12 + 2 < \frac{28}{5}$$
$$14 < \frac{28}{5}$$

No

(c) $3(-4) + 2 < \frac{7(-4)}{5}$

$$-12 + 2 < -\frac{28}{5}$$
$$-10 < -\frac{28}{5}$$

Yes

(d) $3(-1) + 2 < \frac{7(-1)}{5}$

$$-3 + 2 < -\frac{7}{5}$$
$$-1 < -\frac{7}{5}$$

No

4. (a) $-2 < \dfrac{3-0}{2} \le 2$

$-2 < \dfrac{3}{2} \le 2$

Yes

(b) $-2 < \dfrac{3-3}{2} \le 2$

$-2 < \dfrac{0}{2} \le 2$

$-2 < 0 \le 2$

Yes

(c) $-2 < \dfrac{3-9}{2} \le 2$

$-2 < -\dfrac{6}{2} \le 2$

$-2 < -3 \le 2$

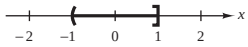
No

(d) $-2 < \dfrac{3-(-12)}{2} \le 2$

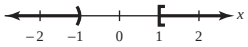
$-2 < \dfrac{15}{2} \le 2$

No

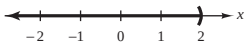
6. Matches graph (e).



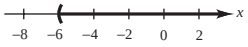
8. Matches graph (b).



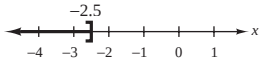
10. Matches graph (c).



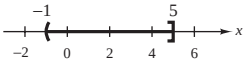
12. $x > -6$



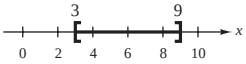
14. $x \le -2.5$



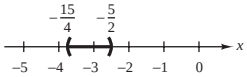
16. $-1 < x \le 5$



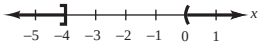
18. $9 \ge x \ge 3$



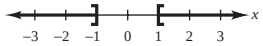
20. $-\frac{15}{4} < x < -\frac{5}{2}$



22. $x \le -4$ or $x > 0$

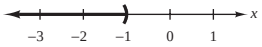


24. $x \le -1$ or $x \ge 1$

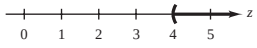


26.
$$5 - \tfrac{1}{3}x > 8$$
$$5 - \tfrac{1}{3}x + \tfrac{1}{3}x > 8 + \tfrac{1}{3}x$$
$$5 > 8 + \tfrac{1}{3}x$$

28.
$$x + 1 < 0$$
$$x + 1 - 1 < 0 - 1$$
$$x < -1$$

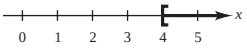


30.
$$z - 4 > 0$$
$$z - 4 + 4 > 0 + 4$$
$$z > 4$$



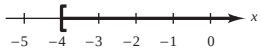
32. $3x \ge 12$

$$\frac{3x}{3} \ge \frac{12}{3}$$
$$x \ge 4$$

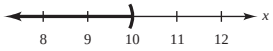


34. $-6x \le 24$

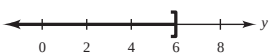
$$\frac{-6x}{-6} \ge \frac{24}{-6}$$
$$x \ge -4$$



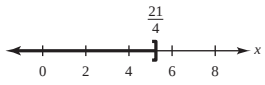
36.
$$-\frac{1}{5}x > -2$$
$$(-5)\left(-\frac{1}{5}x\right) < (-5)(-2)$$
$$x < 10$$



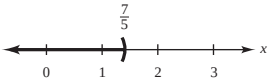
38.
$$1 - y \ge -5$$
$$1 - y - 1 \ge -5 - 1$$
$$-y \ge -6$$
$$(-1)(-y) \le (-1)(-6)$$
$$y \le 6$$



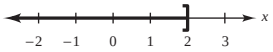
40.
$$1.6x + 4 \le 12.4$$
$$1.6x + 4 - 4 \le 12.4 - 4$$
$$1.6x \le 8.4$$
$$\frac{1.6x}{1.6} \le \frac{8.4}{1.6}$$
$$x \le 5.25 \text{ or } \frac{21}{4}$$



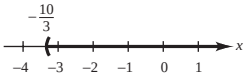
42.
$$12 - 5x > 5$$
$$12 - 5x - 12 > 5 - 12$$
$$-5x > -7$$
$$\frac{-5x}{-5} < \frac{-7}{-5}$$
$$x < \frac{7}{5}$$



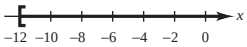
44.
$$21x - 11 \le 6x + 19$$
$$21x - 11 - 6x \le 6x + 19 - 6x$$
$$15x - 11 \le 19$$
$$15x - 11 + 11 \le 19 + 11$$
$$15x \le 30$$
$$\frac{15x}{15} \le \frac{30}{15}$$
$$x \le 2$$



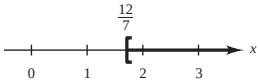
46.
$$6x - 1 > 3x - 11$$
$$6x - 3x - 1 > 3x - 3x - 11$$
$$3x - 1 > -11$$
$$3x - 1 + 1 > -11 + 1$$
$$3x > -10$$
$$\frac{3x}{3} > -\frac{10}{3}$$
$$x > -\frac{10}{3}$$



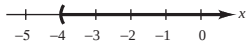
48.
$$\frac{x}{6} - \frac{x}{4} \le 1$$
$$12\left(\frac{x}{6} - \frac{x}{4}\right) \le 12(1)$$
$$2x - 3x \le 12$$
$$-x \le 12$$
$$(-1)(-x) \ge 12(-1)$$
$$x \ge -12$$



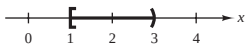
50.
$$\frac{x+3}{6} + \frac{x}{8} \ge 1$$
$$24\left(\frac{x+3}{6} + \frac{x}{8}\right) \ge 24(1)$$
$$4(x+3) + 3x \ge 24$$
$$4x + 12 + 3x \ge 24$$
$$7x + 12 \ge 24$$
$$7x + 12 - 12 \ge 24 - 12$$
$$7x \ge 12$$
$$\frac{7x}{7} \ge \frac{12}{7}$$
$$x \ge \frac{12}{7}$$



52.
$$\frac{4x}{7} + 1 > \frac{x}{2} + \frac{5}{7}$$
$$14\left(\frac{4x}{7} + 1\right) > 14\left(\frac{x}{2} + \frac{5}{7}\right)$$
$$8x + 14 > 7x + 10$$
$$8x - 7x + 14 > 7x - 7x + 10$$
$$x + 14 > 10$$
$$x + 14 - 14 > 10 - 14$$
$$x > -4$$



54.
$$-6 \le 3x - 9 < 0$$
$$-6 + 9 \le 3x - 9 + 9 < 0 + 9$$
$$3 \le 3x < 9$$
$$\frac{3}{3} \le \frac{3x}{3} < \frac{9}{3}$$
$$1 \le x < 3$$



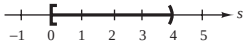
56.
$$-10 \le 4 - 7x < 10$$
$$-10 - 4 \le 4 - 4 - 7x < 10 - 4$$
$$-14 \le -7x < 6$$
$$\frac{-14}{-7} \ge \frac{-7x}{-7} > \frac{6}{-7}$$
$$2 \ge x > -\frac{6}{7}$$
$$-\frac{6}{7} < x \le 2$$

58. $-2 < -0.5s \le 0$

$$\frac{-2}{-0.5} > \frac{-0.05s}{-0.05} \ge \frac{0}{-0.5}$$

$$4 > s \ge 0$$

$$0 \le s < 4$$

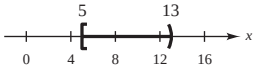


60. $0 \le \dfrac{x-5}{2} < 4$

$$0 \le x - 5 < 8$$

$$0 + 5 \le x - 5 + 5 < 8 + 5$$

$$5 \le x < 13$$



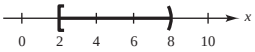
62. $-\dfrac{2}{3} < \dfrac{x-4}{-6} \le \dfrac{1}{3}$

$$4 > x - 4 \ge -2$$

$$4 + 4 > x - 4 + 4 \ge -2 + 4$$

$$8 > x \ge 2$$

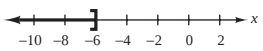
$$2 \le x < 8$$



64.

$7 + 4x < -5 + x$	and	$2x + 10 \le -2$
$7 + 4x - x < -5 + x - x$	and	$2x + 10 - 10 \le -2 - 10$
$7 + 3x < -5$	and	$2x \le -12$
$7 - 7 + 3x < -5 - 7$	and	$\dfrac{2x}{2} \le \dfrac{-12}{2}$
$3x < -12$	and	$x \le -6$
$\dfrac{3x}{3} < \dfrac{-12}{3}$		
$x < -4$	and	$x \le -6$

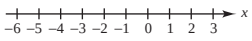
$$x \le -6$$



66.

$9 - x \le 3 + 2x$	and	$3x - 7 \le -22$
$9 - x - 2x \le 3 + 2x - 2x$	and	$3x - 7 + 7 \le -22 + 7$
$9 - 3x \le 3$	and	$3x \le -15$
$9 - 9 - 3x \le 3 - 9$	and	$\dfrac{3x}{3} \le \dfrac{-15}{3}$
$-3x \le -6$	and	$x \le -5$
$\dfrac{-3x}{-3} \ge \dfrac{-6}{-3}$		
$x \ge 2$		

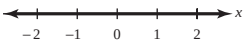
No solution



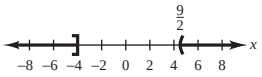
68.

$0.4x - 3 \le 8.1$	or	$4.2 - 1.6x \le 3$
$0.4x - 3 + 3 \le 8.1 + 3$	or	$4.2 - 1.6x - 4.2 \le 3 - 4.2$
$0.4x \le 11.1$	or	$-1.6x \le -1.2$
$\dfrac{0.4x}{0.4} \le \dfrac{11.1}{0.4}$	or	$\dfrac{-1.6x}{-1.6} \ge \dfrac{-1.2}{-1.6}$
$x \le \dfrac{111}{4}$	or	$x \ge \dfrac{12}{16}$

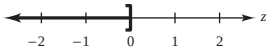
$$-\infty < x < \infty$$



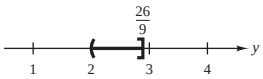
70.
$$3x + 10 \le -x - 6 \quad \text{or} \quad \frac{x}{2} + 5 < \frac{5}{2}x - 4$$
$$3x + x + 10 \le -x + x - 6 \quad \text{or} \quad 2\left(\frac{x}{2} + 5\right) < \left(\frac{5}{2}x - 4\right)2$$
$$4x + 10 \le -6 \quad \text{or} \quad x + 10 < 5x - 8$$
$$4x + 10 - 10 \le -6 - 10 \quad \text{or} \quad x - 5x + 10 < 5x - 5x - 8$$
$$4x \le -16 \quad \text{or} \quad -4x + 10 < -8$$
$$\frac{4x}{4} \le \frac{-16}{4} \quad \text{or} \quad -4x + 10 - 10 < -8 - 10$$
$$x \le -4 \quad \text{or} \quad -4x < -18$$
$$\frac{-4x}{-4} > \frac{-18}{-4}$$
$$x > \frac{9}{2}$$



72.
$$2(4 - z) \ge 8(1 + z)$$
$$8 - 2z \ge 8 + 8z$$
$$8 - 2z + 2z \ge 8 + 8z + 2z$$
$$8 \ge 8 + 10z$$
$$8 - 8 \ge 8 + 10z - 8$$
$$0 \ge 10z$$
$$\frac{0}{10} \ge \frac{10z}{10}$$
$$0 \ge z$$
$$z \le 0$$



74.
$$16 < 4(y + 2) - 5(2 - y) \le 24$$
$$16 < 4y + 8 - 10 + 5y \le 24$$
$$16 < 9y - 2 \le 24$$
$$16 + 2 < 9y - 2 + 2 \le 24 + 2$$
$$18 < 9y \le 26$$
$$\frac{18}{9} < \frac{9y}{9} \le \frac{26}{9}$$
$$2 < y \le \frac{26}{9}$$



76. $x < -2$ or $x > 5$

$\{x|x < -2\} \cup \{x|x > 5\}$

78. $-7 < x < -1$

$\{x|x > -7\} \cap \{x|x < -1\}$

80. $-4.5 \le x \le 2$

$\{x|x \ge -4.5\} \cap \{x|x \le 2\}$

82. $\{x|x > 2\} \cap \{x|x < 8\}$

84. $\{x|x \ge -1\} \cup \{x|x < -6\}$

86. $\{x|x < 0\} \cup \left\{x|x \ge \frac{2}{3}\right\}$

88. $y > -2$

90. $m \ge 4$

92. $450 \le x \le 500$

94. t is less than 4.

96. t is at least -4, but no more than 4.

98. x is no more than 5 and is more than -2.

100. *Verbal Model:* $\boxed{\text{Rent}} + \boxed{\text{Food}} + \boxed{\text{Other costs}} \leq \boxed{\text{Monthly budget}}$

Labels: Rent $= 600$

Food $= 350$

Other costs $= C$

Monthly budget $= 1800$

Inequality: $600 + 350 + C \leq 1800$

$950 + C \leq 1800$

$C \leq \$850$

102. *Verbal Model:* $\boxed{\text{Elevation of San Francisco}} < \boxed{\text{Elevation of Dallas}} < \boxed{\text{Elevation of Denver}}$

The elevation of San Francisco is less than (<) the elevation of Denver.

104. *Verbal Model:* $\boxed{\text{Cost}} < \boxed{25{,}000}$

Label: Cost $= 0.58m + 7800$

Inequality: $0.58m + 7800 < 25{,}000$

$0.58x + 7800 - 7800 < 25{,}000 - 7800$

$0.58m < 17{,}200$

$\frac{0.58m}{0.58} < \frac{17{,}200}{0.58}$

$m < 29{,}655.17$

$m \leq 29{,}655$

106. *Verbal Model:* $\boxed{R} > \boxed{C}$

Labels: $R = 105.45x$

$C = 78x + 25{,}850$

Inequality: $105.45x > 78x + 25{,}850$

$105.45x - 78x > 25{,}850$

$27.45x > 25{,}850$

$\frac{27.45x}{27.45} > \frac{25{,}850}{27.45}$

$x > 941.71$

$x \geq 942$ units

108. *Verbal Model:* $\boxed{\text{Cost of first minute}} + \boxed{\text{Cost of additional minutes}} \leq \boxed{15}$

Label: Number of additional minutes $= t$

Inequality: $1.45 + 0.95t \leq 15$

$1.45 + 0.95t - 1.45 \leq 15 - 1.45$

$0.95t \leq 13.55$

$\frac{0.95t}{0.95} \leq \frac{13.55}{0.95}$

$t \leq 14.26$

Since t represents the additional minutes after the first minute, the call must be less than or equal to 15.26 minutes. If a portion of a minute is billed as a full minute, then the call must be less than or equal to 15 minutes.

110. *Verbal Model:* $100 \leq \boxed{\text{Perimeter}} \leq 120$

Label: Perimeter $= 2x + 28$

Inequality: $100 \leq 2x + 28 \leq 120$

$100 - 28 \leq 2x + 28 - 28 \leq 120 - 28$

$72 \leq 2x \leq 92$

$\frac{72}{2} \leq \frac{2x}{2} \leq \frac{92}{2}$

$36 \leq x \leq 46$

112. $\frac{1}{3}n > 7$

$3\left(\frac{1}{3}n\right) > 3(7)$

$n > 21$

114. *Verbal Model:* $\boxed{\text{Second plan}} > \boxed{\text{First plan}}$

Label: Number of units produced $= x$

Inequality: $1000 + 0.04x > 3000$

$0.04x > 2000$

$\frac{0.04x}{0.04} > \frac{2000}{0.04}$

$x > \$50{,}000$

116. *Verbal Model:* $\boxed{\text{Air pollutant emission}} < 8.5$

Label: Air pollutant emission $= -0.434t + 12.23$

Inequality:

$$-0.434t + 12.23 < 8.5$$
$$-0.434t + 12.23 - 12.23 < 8.5 - 12.23$$
$$-0.434t < -3.73$$
$$\frac{-0.434t}{-0.434} > \frac{-3.73}{-0.434}$$
$$t > 8.59$$

$t = 9 \rightarrow$ year 1999

$t = 10 \rightarrow$ year 2000

118. Adding -5 and subtracting 5 from both sides of an inequality is the same.

120. The multiplication and division properties differ. The inequality symbol is reversed if both sides of the inequality are multiplied or divided by a negative real number.

122. $-3 \le x \le 10$

$3 \ge -x \ge -10$

Section 2.5 Absolute Value Equations and Inequalities

2. $|2(3) - 16| \stackrel{?}{=} 10$

$|6 - 16| \stackrel{?}{=} 10$

$|-10| \stackrel{?}{=} 10$

$10 = 10$

Yes

4. $\left|\frac{1}{2}(6) + 4\right| \stackrel{?}{=} 8$

$|3 + 4| \stackrel{?}{=} 8$

$|7| \stackrel{?}{=} 8$

$7 = 8$

No

6. $7 - 2t = 5$ or $7 - 2t = -5$

8. $22k + 6 = 9$ or $22k + 6 = -9$

10. $|x| = 3$

$x = 3$ or $x = -3$

12. $|s| = 16$

$s = 16$ or $s = -16$

14. $|x| = -82$

An absolute value cannot be negative. No solution

16. $\left|\frac{1}{3}x\right| = 2$

$\frac{1}{3}x = 2$ or $\frac{1}{3}x = -2$

$x = 6$ $\quad$ $x = -6$

18. $|x + 5| = 7$

$x + 5 = 7$ or $x + 5 = -7$

$x = 2$ $\quad$ $x = -12$

20. $\left|\frac{7a + 6}{4}\right| = 2$

$\frac{7a + 6}{4} = 2$ or $\frac{7a + 6}{4} = -2$

$7a + 6 = 8$ $\quad$ $7a + 6 = -8$

$7a = 2$ $\quad$ $7a = -14$

$a = \frac{2}{7}$ $\quad$ $a = -2$

22. $|3 - 5x| = 13$

$3 - 5x = 13$ or $3 - 5x = -13$

$-5x = 10$ $\quad -5x = -16$

$x = -2$ $\quad x = \frac{16}{5}$

24. $|20 - 5t| = 50$

$20 - 5t = 50$ or $20 - 5t = -50$

$-5t = 30$ $\quad -5t = -70$

$t = -6$ $\quad t = 14$

26. $|3x - 2| = -5$

An absolute value cannot be negative. No solution

28. $\left|3 - \frac{4}{5}x\right| = 1$

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

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

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

30. $|2 - 1.5x| = 2$

$2 - 1.5x = 2$ or $2 - 1.5x = -2$

$-1.5x = 0$ $\quad -1.5x = -4$

$x = 0$ $\quad x = \dfrac{-4}{-1.5}$

$x = \dfrac{8}{3}$

32. $|6x - 4| - 7 = 3$

$|6x - 4| = 10$

$6x - 4 = 10$ or $6x - 4 = -10$

$6x = 14$ $\quad 6x = -6$

$x = \dfrac{14}{6}$ $\quad x = -1$

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

34. $|5 - 2x| + 10 = 6$

$|5 - 2x| = -4$

An absolute value cannot be negative. No solution

36. $\left|\dfrac{x - 3}{4}\right| - 3 = 2$

$\left|\dfrac{x - 3}{4}\right| = 5$

$\dfrac{x - 3}{4} = 5$ or $\dfrac{x - 3}{4} = -5$

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

$x = 23$ $\quad x = -17$

38. $\left|\dfrac{3z + 5}{6}\right| - 3 = 6$

$\left|\dfrac{3z + 5}{6}\right| = 9$

$\dfrac{3z + 5}{6} = 9$ or $\dfrac{3z + 5}{6} = -9$

$3z + 5 = 54$ $\quad 3z + 5 = -54$

$3z = 49$ $\quad 3z = -59$

$z = \dfrac{49}{3}$ $\quad z = \dfrac{-59}{3}$

40. $4|5x + 1| = 24$

$|5x + 1| = 6$

$5x + 1 = 6$ or $5x + 1 = -6$

$5x = 5$ $\quad 5x = -7$

$x = 1$ $\quad x = -\dfrac{7}{5}$

42. $2|4 - 3x| - 6 = -2$

$2|4 - 3x| = 4$

$|4 - 3x| = 2$

$4 - 3x = 2$ or $4 - 3x = -2$

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

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

44. $|10 - 3x| = |x + 7|$

$10 - 3x = x + 7$ or $10 - 3x = -(x + 7)$

$10 = 4x + 7$ $\quad 10 - 3x = -x - 7$

$3 = 4x$ $\quad 17 = 2x$

$\frac{3}{4} = x$ $\quad \frac{17}{2} = x$

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

$x - 2 = 2x - 15$ or $x - 2 = -(2x - 15)$

$13 = x$ $\quad x - 2 = -2x + 15$

$3x = 17$

$x = \frac{17}{3}$

48. $|5x + 4| = |3x + 25|$

$5x + 4 = 3x + 25$ or $5x + 4 = -(3x + 25)$

$2x = 21$ $\quad 5x + 4 = -3x - 25$

$x = \frac{21}{2}$ $\quad 8x = -29$

$x = -\frac{29}{8}$

50. $\left|\frac{3}{2}r + 2\right| = \left|\frac{1}{2}r - 3\right|$

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

$2\left(\frac{3}{2}r + 2\right) = \left(\frac{1}{2}r - 3\right)2$ $\quad 2\left(\frac{3}{2}r + 2\right) = \left[-\left(\frac{1}{2}r - 3\right)2\right.$

$3r + 4 = r - 6$ $\quad 3r + 4 = -r + 6$

$2r + 4 = -6$ $\quad 4r + 4 = 6$

$2r = -10$ $\quad 4r = 2$

$r = -5$ $\quad r = \frac{2}{4} = \frac{1}{2}$

52. $3|2 - 3x| = |9x + 21|$

$3(2 - 3x) = 9x + 21$ or $3(2 - 3x) = -(9x + 21)$

$6 - 9x = 9x + 21$ $\quad 6 - 9x = -9x - 21$

$6 - 18x = 21$ $\quad 6 = -21$

$-18x = 15$ $\quad$ No solution

$x = \frac{15}{-18}$

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

54. $|t + 2| = 6$

56. (a) $|-7| \le 5$

$7 \le 5$

No

(b) $|-4| \le 5$

$4 \le 5$

Yes

(c) $|4| \le 5$

$4 \le 5$

Yes

(d) $|9| \le 5$

$9 \le 5$

No

58. (a) $|16 - 3| > 5$

$|13| > 5$

$13 > 5$

Yes

(b) $|3 - 3| > 5$

$|0| > 5$

$0 > 5$

No

(c) $|-2 - 3| > 5$

$|-5| > 5$

$5 > 5$

No

(d) $|-3 - 3| > 5$

$|-6| > 5$

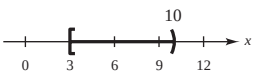
$6 > 5$

Yes

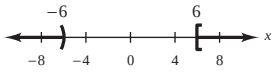
60. $-5 \le 6x + 7 \le 5$

62. $8 - x > 25$ or $8 - x < -25$

64.



66.



68. $|x| < 6$

$-6 < x < 6$

70. $|y| \ge 4$

$y \le -4$ or $y \ge 4$

72. $|4z| \le 9$

$-9 \le 4z \le 9$

$-\frac{9}{4} \le z \le \frac{9}{4}$

74. $\left|\frac{t}{2}\right| < 4$

$-4 < \frac{t}{2} < 4$

$-8 < t < 8$

76. $|x - 3| \le 6$

$-6 \le x - 3 \le 6$

$-3 \le x \le 9$

78. $|x - 4| \ge 3$

$x - 4 \ge 3$ or $x - 4 \le -3$

$x \ge 7$ $\qquad$ $x \le 1$

80. $|3x + 4| < 2$

$-2 < 3x + 4 < 2$

$-6 < 3x < -2$

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

82. $|3t + 1| > 5$

$3t + 1 > 5$ or $3t + 1 < -5$

$3t > 4$ $\qquad$ $3t < -6$

$t > \frac{4}{3}$ $\qquad$ $t < -2$

84. $|8 - 7x| < -6$

Absolute value is never negative.
No solution

86. $|4x - 5| > -3$

$-\infty < x < \infty$

Absolute value is always positive.

88. $\frac{|s - 3|}{5} > 4$

$|s - 3| > 20$

$s - 3 < -20$ or $s - 3 > 20$

$s < -17$ $\qquad$ $s > 23$

90. $\frac{|a + 6|}{2} \ge 16$

$|a + 6| \ge 32$

$a + 6 \ge 32$ or $a + 6 \le -32$

$a \ge 26$ $\qquad$ $a \le -38$

92. $\left|\frac{x}{8} + 1\right| < 0$

An absolute value cannot be less than zero. No solution

94. $\left|\frac{3 - 2x}{4}\right| \ge 5$

$\frac{3 - 2x}{4} \le -5$ or $\frac{3 - 2x}{4} \ge 5$

$3 - 2x \le -20$ $\qquad$ $3 - 2x \ge 20$

$-2x \le -23$ $\qquad$ $-2x \ge 17$

$x \ge \frac{-23}{-2}$ $\qquad$ $x \le \frac{17}{-2}$

$x \ge \frac{23}{2}$ or $x \le -\frac{17}{2}$

96. $|1.5t - 8| \le 16$

$-16 \le 1.5t - 8 \le 16$

$-8 \le 1.5t \le 24$

$\frac{-8}{1.5} \le \frac{1.5t}{1.5} \le \frac{2.4}{1.5}$

$-5.\overline{3} \le t \le 16$

98. $\left|3 - \frac{x}{4}\right| > 0.15$

$3 - \frac{x}{4} > 0.15$ or $3 - \frac{x}{4} < -0.15$

$12 - x > 0.6$ $\qquad$ $12 - x < -0.6$

$-x > -11.4$ $\qquad$ $-x < -12.6$

$x < 11.4$ $\qquad$ $x > 12.6$

$x < \frac{57}{5}$ $\qquad$ $x > \frac{63}{5}$

100. $-4|2x - 7| > -12$

$|2x - 7| < 3$

$-3 < 2x - 7 < 3$

$4 < 2x < 10$

$2 < x < 5$

102. $\left|8 - \frac{2}{3}x\right| + 6 \geq 10$

$\left|8 - \frac{2}{3}x\right| \geq 4$

$8 - \frac{2}{3}x \geq 4$ or $8 - \frac{2}{3}x \leq -4$

$-\frac{2}{3}x \geq -4$ $\quad$ $-\frac{2}{3}x \leq -12$

$x \leq 6$ $\quad$ $x \geq 18$

104. $\left|\frac{2x-4}{5}\right| - 9 \leq 3$

$\left|\frac{2x-4}{5}\right| \leq 12$

$-12 \leq \frac{2x-4}{5} \leq 12$

$-60 \leq 2x - 4 \leq 60$

$-56 \leq 2x \leq 64$

$-28 \leq x \leq 32$

106. $|2x - 1| \leq 3$

Keystrokes: Y= ABS (2 X,T,θ − 1) ≤ 3 GRAPH

$-1 \leq x \leq 2$

108. $|7r - 3| > 11$

Keystrokes: Y= ABS (7 X,T,θ − 3) > 11 GRAPH

$r < -\frac{8}{7}$ or $r > 2$

110. $|a + 1| - 4 < 0$

Keystrokes: Y= ABS (X,T,θ + 1) − 4 < 0 GRAPH

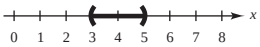
$-5 < a < 3$

112. Matches graph (c).

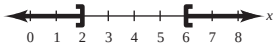
$|x - 4| < 1$

$-1 < x - 4 < 1$

$3 < x < 5$



114. Matches graph (a).



$|2(x - 4)| \geq 4$

$2(x - 4) \geq 4$ or $2(x - 4) \leq -4$

$x - 4 \geq 2$ $\quad$ $x - 4 \leq -2$

$x \geq 6$ $\quad$ $x \leq 2$

116. $(-4, 4)$

$|x| < 4$

118. $[-13, -9]$

$-13 \leq x \leq -9$

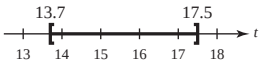
$-2 \leq x + 11 \leq 2$

$|x + 11| \leq 2$

120. $|x| > 2$

122. $|x - 16| < 5$

124. $\left|\frac{t - 15.6}{1.9}\right| \leq 1$



$-1 \leq \frac{t - 15.6}{1.9} \leq 1$

$-1.9 \leq t - 15.6 \leq 1.9$

$13.7 \leq t \leq 17.5$

126. (a) $|s - x| \leq \frac{3}{16}$

(b) $\left|5\frac{1}{8} - x\right| \leq \frac{3}{16}$

$-\frac{3}{16} \leq 5\frac{1}{8} - x \leq \frac{3}{16}$

$-\frac{3}{16} \leq \frac{41}{8} - x \leq \frac{3}{16}$

$-\frac{85}{16} \leq -x \leq -\frac{79}{16}$

$\frac{85}{16} \geq x \geq \frac{79}{16}$

128. An absolute value equation that has only one solution is $|x| = 0$.

130. The graph of $|x - 4| < 1$ can be described as all real numbers less than one unit from 4.

132. Maximum error for each bag is $\frac{1}{2}$ ounce. For four bags, the maximum error is $4\left(\frac{1}{2}\right) = 2$ ounces. The greatest amount you can expect to get is $4(16) + 2 = 66$ ounces. The least amount is $4(16) - 2 = 62$ ounces.

Review Exercises for Chapter 2

2. (a) $3\left(3 - \frac{9}{2}\right) = -\frac{9}{2}$

$3\left(\frac{6}{2} - \frac{9}{2}\right) = -\frac{9}{2}$

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

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

Solution

(b) $3\left[3 - \left(-\frac{2}{3}\right)\right] = -\left(-\frac{2}{3}\right)$

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

$3\left(\frac{11}{3}\right) = \frac{2}{3}$

$11 = \frac{2}{3}$

Not a solution

4. (a) $\frac{-12 + 2}{6} = \frac{7}{2}$

$\frac{-10}{6} = \frac{7}{2}$

$-\frac{5}{3} = \frac{7}{2}$

Not a solution

(b) $\frac{19 + 2}{6} = \frac{7}{2}$

$\frac{21}{6} = \frac{7}{2}$

$\frac{7}{2} = \frac{7}{2}$

Solution

6. $-4x + 64 = 0$

$-4x + 64 - 64 = 0 - 64$

$-4x = -64$

$\frac{-4x}{-4} = \frac{-64}{-4}$

$x = 16$

8. $7x - 49 = 0$

$7x - 49 + 49 = 0 + 49$

$7x = 49$

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

$x = 7$

10. $x - 7 = 3$

$x - 7 + 7 = 3 + 7$

$x = 10$

Check:

$10 - 7 \stackrel{?}{=} 3$

$3 = 3$

12. $11x = 44$

$\frac{11x}{11} = \frac{44}{11}$

$x = 4$

Check:

$11(4) \stackrel{?}{=} 44$

$44 = 44$

14. $\frac{1}{10}x = 5$

$10\left(\frac{1}{10}x\right) = (5)10$

$x = 50$

Check:

$\frac{1}{10}(50) \stackrel{?}{=} 5$

$5 = 5$

16. $3 - 2x = 9$

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

$-2x = 6$

$\frac{-2x}{-2} = \frac{6}{-2}$

$x = -3$

Check:

$3 - 2(-3) \stackrel{?}{=} 9$

$3 + 6 \stackrel{?}{=} 9$

$9 = 9$

18. $3 + 6x = 51$

$3 + 6x - 3 = 51 - 3$

$6x = 48$

$\frac{6x}{6} = \frac{48}{6}$

$x = 8$

Check:

$3 + 6(8) \stackrel{?}{=} 51$

$3 + 48 \stackrel{?}{=} 51$

$51 = 51$

20. $9 - 2x = 4x - 7$

$9 - 9 - 2x = 4x - 7 - 9$

$-2x = 4x - 16$

$-2x - 4x = 4x - 4x - 16$

$-6x = -16$

$\frac{-6x}{-6} = \frac{-16}{-6}$

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

Check:

$9 - 2\left(\frac{8}{3}\right) \stackrel{?}{=} 4\left(\frac{8}{3}\right) - 7$

$9 - \frac{16}{3} \stackrel{?}{=} \frac{32}{3} - 7$

$\frac{27}{3} - \frac{16}{3} \stackrel{?}{=} \frac{32}{3} - \frac{21}{3}$

$\frac{11}{3} = \frac{11}{3}$

22. $-2(x+4) = 2x - 7$

$-2x - 8 = 2x - 7$

$-2x - 2x - 8 = 2x - 2x - 7$

$-4x - 8 = -7$

$-4x - 8 + 8 = -7 + 8$

$-4x = 1$

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

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

Check:

$-2\left(-\frac{1}{4} + 4\right) \stackrel{?}{=} 2\left(-\frac{1}{4}\right) - 7$

$\frac{1}{2} - 8 \stackrel{?}{=} -\frac{1}{2} - 7$

$\frac{1}{2} - \frac{16}{2} \stackrel{?}{=} -\frac{1}{2} - \frac{14}{2}$

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

24. $7x + 2(7 - x) = 8$

$7x + 14 - 2x = 8$

$5x + 14 = 8$

$5x + 14 - 14 = 8 - 14$

$5x = -6$

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

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

Check:

$7\left(-\frac{6}{5}\right) + 2\left[7 - \left(\frac{6}{5}\right)\right] \stackrel{?}{=} 8$

$-\frac{42}{5} + 2\left(\frac{35}{5} + \frac{6}{5}\right) \stackrel{?}{=} 8$

$-\frac{42}{5} + 2\left(\frac{41}{5}\right) \stackrel{?}{=} 8$

$-\frac{42}{5} + \frac{82}{5} \stackrel{?}{=} 8$

$\frac{40}{5} \stackrel{?}{=} 8$

$8 = 8$

26. $8(x - 2) = 3(x - 2)$

$8x - 16 = 3x - 6$

$8x - 16 - 3x = 3x - 6 - 3x$

$5x - 16 = -6$

$5x - 16 + 16 = -6 + 16$

$5x = 10$

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

$x = 2$

Check:

$8(2 - 2) \stackrel{?}{=} 3(2 - 2)$

$8(0) \stackrel{?}{=} 3(0)$

$0 = 0$

28. $\frac{1}{4}s + \frac{3}{8} = \frac{5}{2}$

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

$2s + 3 = 20$

$2s + 3 - 3 = 20 - 3$

$2s = 17$

$\frac{2s}{2} = \frac{17}{2}$

$s = \frac{17}{2}$

Check:

$\frac{1}{4}\left(\frac{17}{2}\right) + \frac{3}{8} \stackrel{?}{=} \frac{5}{2}$

$\frac{17}{8} + \frac{3}{8} \stackrel{?}{=} \frac{5}{2}$

$\frac{20}{8} \stackrel{?}{=} \frac{5}{2}$

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

30. $2.5x - 6.2 = 3.7x - 5.8$

$2.5x - 3.7x - 6.2 = 3.7x - 3.7x - 5.8$

$-1.2x - 6.2 = -5.8$

$-1.2x - 6.2 + 6.2 = -5.8 + 6.2$

$-1.2x = 0.4$

$\frac{-1.2x}{-1.2} = \frac{0.4}{-1.2}$

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

Check:

$2.5\left(-\frac{1}{3}\right) - 6.2 \stackrel{?}{=} 3.7\left(-\frac{1}{3}\right) - 5.8$

$-\frac{2.5}{3} - \frac{18.6}{3} \stackrel{?}{=} -\frac{3.7}{3} - \frac{17.4}{3}$

$-\frac{21.1}{3} = -\frac{21.1}{3}$

32. *Verbal Model:* $\boxed{\text{First integer}} + \boxed{\text{Second integer}} = \boxed{\text{Sum}}$

Labels: First integer $= x$

Second integer $= x + 2$

Sum $= 74$

Equation: $x + (x + 2) = 74$

$2x + 2 = 74$

$2x = 72$

$x = 36, \quad x + 2 = 38$

34. *Verbal Model:* $\boxed{\text{Earnings}} = \boxed{\text{Hours worked}} \cdot \boxed{\text{Hourly wage}} + 1.25 \cdot \boxed{\text{Number of sales}}$

Labels: Earnings $= \$88$

Hours worked $= 8$

Hourly wage $= \$6$

Number of sales $= x$

Equation: $88 = (8)(6) + (1.25)(x)$

$88 = 48 + 1.25x$

$40 = 1.25x$

$32 = x$

36.

Percent	Parts out of 100	Decimal	Fraction
35%	35	0.35	$\frac{7}{20}$

38.

Percent	Parts out of 100	Decimal	Fraction
$16\frac{2}{3}\%$	$16\frac{2}{3}$	$0.1\overline{6}$	$\frac{1}{6}$

40. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$a = (0.004)(7350)$

$a = 29.4$

42. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$498 = (0.83)(b)$

$\frac{498}{0.83} = b$

$600 = b$

44. *Verbal Model:* $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number $= a$

Percent $= p$

Base number $= b$

Equation: $a = p \cdot b$

$162.5 = (p)(6500)$

$\frac{162.5}{6500} = p$

$0.025 = p$ or 2.5%

46. *Verbal Model:* $\boxed{\text{Defective parts}} = \boxed{\text{Percent rate}} \cdot \boxed{\text{Sample}}$

Labels: Defective parts $= 6$

Percent rate $= 1.6\%$

Sample $= x$

Equation: $6 = 0.016 \cdot x$

$\frac{6}{0.016} = x$

$375 = x$

48. *Verbal Model:* $\boxed{\text{Sales tax}} = \boxed{\text{Percent rate}} \cdot \boxed{\text{cost}}$

Labels: Sales tax $= x$

Percent rate $= 7\frac{1}{4}\%$

Cost $= 34$

Equation: $x = 0.0725 \cdot 34$

$x = \$2.47$

50. (a) Unit price $= \dfrac{3.08}{3.5} = 0.88$ per pound

(b) Unit price $= \dfrac{1.87}{2.2} = 0.85$ per pound

2.2 pound bag is the better buy.

52. $\dfrac{\text{Price of stock}}{\text{Earnings}} = \dfrac{46.75}{5.50} = \dfrac{1.87}{0.22} = \dfrac{0.17}{0.02} = \dfrac{17}{2}$

54. $\dfrac{x}{16} = \dfrac{5}{12}$

$16\left(\dfrac{x}{16}\right) = 16\left(\dfrac{5}{12}\right)$

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

56. $\dfrac{x+1}{3} = \dfrac{x-1}{2}$

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

$2x + 2 = 3x - 3$

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

$-x + 2 = -3$

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

$-x = -5$

$x = 5$

58. *Verbal Model:* $\boxed{\dfrac{\text{Base}}{\text{Side}}} = \boxed{\dfrac{\text{Base}}{\text{Side}}}$

Proportion: $\dfrac{3}{3.5} = \dfrac{4}{x}$

$3x = 14$

$x = \dfrac{14}{3}$

60. *Verbal Model:* $\boxed{\dfrac{\text{Silo's height}}{\text{Silo's shadow}}} = \boxed{\dfrac{\text{Your height}}{\text{Your shadow}}}$

Proportion: $\dfrac{x}{20} = \dfrac{6}{1\frac{1}{2}}$

$x = \dfrac{120}{1\frac{1}{2}}$

$x = 80$ feet

62. *Verbal Model:* $\boxed{\dfrac{\text{Cups}}{\text{Batches}}} = \boxed{\dfrac{\text{Cups}}{\text{Batches}}}$

Proportion: $\dfrac{1\frac{1}{2}}{1} = \dfrac{x}{2\frac{1}{2}}$

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

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

64. *Verbal Model:* $\boxed{\text{Selling price}} = \boxed{\text{Cost}} + \boxed{\text{Markup}}$

Labels: Selling price $= 31.33$

Cost $= 23.50$

Markup $= x$

Equation: $31.33 = 23.50 + x$

$31.33 - 23.50 = x$

$\$7.83 = x$

Verbal Model: $\boxed{\text{Markup}} = \boxed{\text{Markup rate}} \cdot \boxed{\text{Cost}}$

Labels: Markup $= 7.83$

Markup rate $= x$

Cost $= 23.50$

Equation: $7.83 = x \cdot 23.50$

$\dfrac{7.83}{23.50} = x$

$33.3\% \approx x$

66. *Verbal Model:* $\boxed{\text{Selling price}} = \boxed{\text{Cost}} + \boxed{\text{Markup}}$

Labels: Selling price $= 895.00$
Cost $= x$
Markup $= 223.75$

Equation: $895.00 = x + 223.75$
$895.00 - 223.75 = x$
$\$671.25 = x$

Verbal Model: $\boxed{\text{Markup}} = \boxed{\text{Markup rate}} \cdot \boxed{\text{Cost}}$

Labels: Markup $= 223.75$
Markup rate $= x$
Cost $= 671.25$

Equation: $223.75 = x \cdot 671.25$
$\frac{223.75}{671.25} = x$
$33.3\% \approx x$

68. *Verbal Model:* $\boxed{\text{Sale price}} = \boxed{\text{List price}} - \boxed{\text{Discount}}$

Labels: Sale price $= 279.98$
List price $= 559.95$
Discount $= x$

Equation: $279.98 = 559.95 - x$
$x = 559.95 - 279.98$
$x = \$279.97$

Verbal Model: $\boxed{\text{Discount}} = \boxed{\text{Discount rate}} \cdot \boxed{\text{List price}}$

Labels: Discount $= 279.97$
Discount rate $= x$
List price $= 559.95$

Equation: $279.97 = x \cdot 559.95$
$\frac{279.97}{559.95} = x$
$50\% \approx x$

70. *Verbal Model:* $\boxed{\text{Sale price}} = \boxed{\text{List price}} - \boxed{\text{Discount}}$

Labels: Sale price $= x$
List price $= 39.00$
Discount $= 15.60$

Equation: $x = 39.00 - 15.60$
$x = \$23.40$

Verbal Model: $\boxed{\text{Discount}} = \boxed{\text{Discount rate}} \cdot \boxed{\text{List price}}$

Labels: Discount $= 15.60$
Discount rate $= x$
List price $= 39.00$

Equation: $15.60 = x \cdot 39.00$
$\frac{15.60}{39.00} = x$
$40\% = x$

72. *Verbal Model:* $\boxed{\text{Repair bill}} = \boxed{\text{Parts}} + \boxed{\text{Labor rate}} \cdot \boxed{\text{Number of hours labor}}$

Labels: Repair bill $= \$325.30$
Parts $= \$200.30$
Labor rate $= \$25$
Number of hours labor $= x$

Equation: $325.30 = 200.30 + 25x$
$125.00 = 25x$
$5 \text{ hours} = x$

74. *Verbal Model:* $\boxed{\text{Amount of solution 1}} + \boxed{\text{Amount of solution 2}} = \boxed{\text{Amount of final solution}}$

Labels:
Percent of solution 1 = 25%
Gallons of solution 1 = x
Percent of solution 2 = 50%
Gallons of solution 2 = $8 - x$
Percent of final solution = 40%
Gallons of final solution = 8

Equation:
$$0.25x + 0.50(8 - x) = 0.40(8)$$
$$0.25x + 4 - 0.50x = 3.2$$
$$-0.25x = -0.8$$
$$x = 3.2 \text{ gallons of solution 1}$$
$$8 - x = 4.8 \text{ gallons of solution 2}$$

76. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance = 330 miles
Rate = 52 mph
Time = t

Equation:
$$330 = 52 \cdot t$$
$$\frac{330}{52} = t$$
$$6.35 \text{ hours} \approx t$$

78. *Verbal Model:* $\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Distance = 80 miles at 40 mph
320 miles at r mph
400 miles at 50 mph
Rates = 40, r, 50
Time = 8 hours

Equation:
$$\frac{80}{40} + \frac{320}{r} = \frac{400}{50}$$
$$2 + \frac{320}{r} = 8$$
$$\frac{320}{r} = 6$$
$$320 = 6r$$
$$53\tfrac{1}{3} \text{ mph} = r$$

80. *Verbal Model:* $\boxed{\text{Work done}} = \boxed{\text{Work done by person 1}} + \boxed{\text{Work done by person 2}}$

Labels:
Work done = $\frac{1}{2}$
Rate of person 1 = $\frac{1}{8}$
Rate of person 2 = $\frac{1}{10}$
Time = t

Equation:
$$\frac{1}{2} = \frac{1}{8}(t) + \frac{1}{10}(t)$$
$$\frac{1}{2} = \frac{5}{40}t + \frac{4}{20}t$$
$$\frac{1}{2} = \frac{9}{40}t$$
$$\left(\frac{40}{9}\right)\left(\frac{1}{2}\right) = \left(\frac{40}{9}\right)\left(\frac{9}{40}t\right)$$
$$\frac{20}{9} = t$$
$$t \approx 2.22 \text{ hours}$$

82. *Verbal Model:* $\boxed{\text{Interest}} = \boxed{\text{Principal}} \cdot \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels:
Interest = 37.50
Principal = 500.00
Rate = r
Time = 1

Equation:
$$37.50 = 500.00 \cdot r \cdot 1$$
$$\frac{37.50}{500.00} = r$$
$$7.5\% = r$$

84. *Verbal Model:* $\boxed{\text{Interest}} = \boxed{\text{Principal}} \cdot \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels: Interest $= i$
Principal $= 3{,}250{,}000$
Rate $= 12\%$
Time $= 2$

Equation: $i = (3{,}250{,}000)(0.12)(2)$
$i = \$780{,}000$

Verbal Model: $\boxed{\text{Total repaid}} = \boxed{\text{Principal}} + \boxed{\text{Interest}}$

Labels: Total repaid $= x$
Principal $= 3{,}250{,}000$
Interest $= 780{,}000$

Equation: $x = 3{,}250{,}000 + 780{,}000$
$x = \$4{,}030{,}000$

86. *Verbal Model:* $\boxed{\text{Interest}} = \boxed{\text{Principal}} \cdot \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels: Interest $= i$
Principal $= \$1000$
Rate $= 7\%$
Time $= \frac{1}{2}$

Equation: $i = 1000 \cdot 0.07 \cdot \frac{1}{2}$
$i = \$35$

Verbal Model: $\boxed{\text{New principal}} = \boxed{\text{Principal}} + \boxed{\text{Interest}}$

Labels: New principal $= x$
Principal $= 1000$
Interest $= 35$

Equation: $x = 1000 + 35$
$x = \$1035$

Verbal Model: $\boxed{\text{Interest}} = \boxed{\text{New principal}} \cdot \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$

Labels: Interest $= i$
New principal $= 1035$
Rate $= 7\%$
Time $= \frac{1}{2}$

Equation: $i = 1035 \cdot 0.07 \cdot \frac{1}{2}$
$i = \$36.23$

Verbal Model: $\boxed{\text{Total interest}} = \boxed{\text{Interest in first 6 months}} + \boxed{\text{Interest in second 6 months}}$

Labels: Total interest $= i$
Interest in first 6 months $= 35$
Interest in second 6 months $= 36.23$

Equation: $i = 35 + 36.23$
$i = \$71.23$

88. *Verbal Model:* $\boxed{\text{Area}} = \frac{1}{2} \cdot \boxed{\text{Base}} \cdot \boxed{\text{Height}}$

Labels: Area $= 90$ square meters
Base $= x + 8$
Height $= 10$

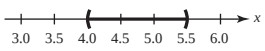
Equation: $90 = \frac{1}{2}(x + 8)10$
$90 = 5(x + 8)$
$90 = 5x + 40$
$50 = 5x$
$10 = x$
$18 = x + 8$

90. *Verbal Model:* $\boxed{\text{Fahrenheit temperature}} = \frac{9}{5} \cdot \boxed{\text{Celsius temperature}} + 32$

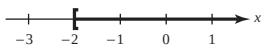
Labels: Fahrenheit temperature $= 41°$
Celsius temperature $= x$

Equation: $41 = \frac{9}{5}x + 32$
$9 = \frac{9}{5}x$
$5°$ Celsius $= x$

92.



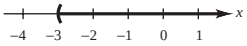
94.



96. $x + 8 > 5$

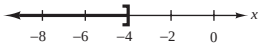
$x + 8 - 8 > 5 - 8$

$x > -3$



98. $-11x \geq 44$

$x \leq -4$



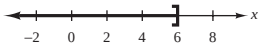
100. $3x - 11 \leq 7$

$3x - 11 + 11 \leq 7 + 11$

$3x \leq 18$

$\frac{3x}{3} \leq \frac{18}{3}$

$x \leq 6$



102. $12 - 3x < 4x - 2$

$12 - 3x - 4x < 4x - 4x - 2$

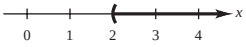
$12 - 7x < -2$

$12 - 12 - 7x < -2 - 12$

$-7x < -14$

$\frac{-7x}{-7} > \frac{-14}{-7}$

$x > 2$



104. $\frac{x}{4} - 2 < \frac{3x}{8} + 5$

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

$2x - 16 < 3x + 40$

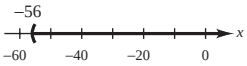
$2x - 3x - 16 < 3x - 3x + 40$

$-x - 16 < 40$

$-x - 16 + 16 < 40 + 16$

$-x < 56$

$x > -56$

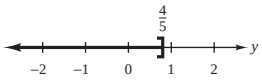


106. $3(2 - y) \geq 2(1 + y)$

$6 - 3y \geq 2 + 2y$

$4 \geq 5y$

$\frac{4}{5} \geq y$



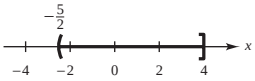
108. $-13 \leq 3 - 4x < 13$

$-16 \leq -4x < 10$

$4 \geq x > -\frac{10}{4}$

$4 \geq x > -\frac{5}{2}$

$-\frac{5}{2} < x \leq 4$

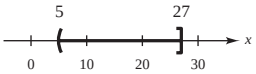


110. $12 \geq \frac{x - 3}{2} > 1$

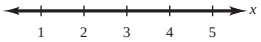
$24 \geq x - 3 > 2$

$27 \geq x > 5$

$5 < x \leq 27$



112.
$$\begin{array}{rcl} 6-2x\le 1 & \text{or} & 10-4x>-6 \\ 6-6-2x\le 1-6 & \text{or} & 10-10-4x>-6-10 \\ -2x\le -5 & \text{or} & -4x>-16 \\ \frac{-2x}{-2}\ge\frac{-5}{-2} & \text{or} & \frac{-4x}{-4}<\frac{-16}{-4} \\ x\ge\frac{5}{2} & \text{or} & x<4 \\ -\infty<x<\infty & & \end{array}$$



114. *Verbal Model:* Total cost $\ge$ Cost of first minute $+ 0.49 \cdot$ Cost of additional minutes

Labels: Total cost $= 7.50$
Cost of first minute $= 0.99$
Number of additional minutes $= x$

Inequality: $7.50 \ge 0.99 + 0.49x > 0.99$
$6.51 \ge 0.49x > 0$
$13.3 \ge x > 0$
$0 <$ length of call ≤ 14

116. $|x| = -4$

No solution. Absolute value cannot be negative.

118. $|2x + 3| = 7$

$2x + 3 = 7$ or $2x + 3 = -7$
$2x = 4$ $\quad$ $2x = -10$
$x = 2$ $\quad$ $x = -5$

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

$|x - 2| = 6$
$x - 2 = 6$ or $x - 2 = -6$
$x = 8$ $\quad$ $x = -4$

122. $|5x + 6| = |2x - 1|$

$5x + 6 = 2x - 1$ or $5x + 6 = -(2x - 1)$
$3x = -7$ $\quad$ $5x + 6 = -2x + 1$
$x = -\frac{7}{3}$ $\quad$ $7x = -5$
$x = -\frac{5}{7}$

124. $|t + 3| > 2$

$t + 3 > 2$ or $t + 3 < -2$
$t > -1$ or $t < -5$

126. $\left|\frac{t}{3}\right| < 1$

$-1 < \frac{t}{3} < 1$

$-3 < t < 3$

128. $|5x - 1| < 9$

$-9 < 5x - 1 < 9$

$-8 < 5x < 10$

$-\frac{8}{5} < x < 2$

130. $|2y - 1| + 4 < -1$

$|2y - 1| < -5$

No solution. Absolute value cannot be negative.

132. $|5(1 - x)| \le 25$

Keystrokes: Y= ABS (5 − 5 X,T,θ) ≤ 25 GRAPH

$-4 \le x \le 6$ or $[-4, 6]$

134. $[-18, -12]$

$-18 \le x \le -12$

$-3 \le x + 15 \le 3$

$|x + 15| \le 3$

136. $|t - 77| \le 27$

$-27 \le t - 77 \le 27$

$50 \le t \le 104$