Lesson 1.1.1

1-4.  a: \( \frac{1}{2} \)  \hspace{1cm} b: 3

1-5.  a: 16  \hspace{1cm} b: 9  \hspace{1cm} c: 478.38

1-6.  a: \( h(x) \) then \( g(x) \)

b: Yes, it is possible. Since the output of \( g(x) \) is positive, the only way to get a final negative output is if \( g(x) \) goes first. This gives \( g(6) = 1 \) and \( h(1) = -5 \).

1-7.  a.  \hspace{3cm} b.  \hspace{3cm} c.  \hspace{3cm} d.

1-8.  a: not linear  \hspace{1cm} b: \( x \) is squared

  c: a parabola  \hspace{1cm} d: D: All real numbers; R: \( y \geq 0 \)

1-9.  a: \( x = 13 \)  \hspace{1cm} b: \( x = 8 \)

1-10. a: \( 5m^2 + 9m - 2 \)  \hspace{1cm} b: \( -x^2 + 4x + 12 \)

  c: \( 25x^2 - 10xy + y^2 \)  \hspace{1cm} d: \( 6x^2 - 15xy + 12x \)
Lesson 1.1.2 Day 1

1-15.  a: More than one function is possible.  See sample graph at right.  
       b: More than one function is possible.  See sample graph at right.

1-16.  Let \( y \) represent the amount of money (cents) in the piggy bank, and \( x \) represent the time (days).  \( y = 2x + 10; \)  See graph and table shown below.  A discrete graph would also appropriate.

\[
\begin{array}{c|cccc}
 x & 0 & 1 & 2 & 3 & 4  \\
\hline
 y & 10 & 12 & 14 & 16 & 18 \\
\end{array}
\]

1-17.  a: 2  b: 10  c: 100  d: \( \approx 142.86 \)

1-18.  a: 14, –4, 3\( x \) – 1  
       b: \( f(x) = 3x – 1 \)

1-19.  a: \( x = 5, 3 \)  
       b: \( x = \frac{3x + \sqrt{73}}{4} \) or \( x \approx 3.39, –0.89 \)

1-20.  a: \( y \) depends on \( x \); \( x \) is independent.  Explanations vary.  
       b: Temperature is dependent; time is independent.

       c:

1-21.  a: \((x – 9)(x + 8)\)  
       b: \(6x(x + 8)\)  
       c: \((x – 4)^2\)  
       d: \((x + 7)(x – 7)\)
Lesson 1.1.2 Day 2

1-22. Graph shown at right. curved; increasing; intercepts: (0, –2) and (4, 0); domain: \( x \geq 0 \); range: \( y \geq –2 \); endpoint: (0, –2); continuous; function

1-23. 
   a: \( x = –13 \) or 7  
   b: \( x = –\frac{3}{2} \) or \( \frac{7}{3} \)  
   c: \( x = 0 \) or 3  
   d: \( x = 0 \) or 5  
   e: \( x = 7 \) or –5  
   f: \( x = –\frac{1}{3} \) or –5

1-24. 
   a: 2  
   b: –4  
   c: \( \frac{1}{0} \) is undefined  
   d: Justifications vary.

1-25. 
   a: 1  
   b: \( x = 12 \)  
   c: 13  
   d: no real solution  
   e: \( x = \pm \sqrt{12} = \pm 2.55 \)  
   f: \( x = \pm \sqrt{7} = \pm 2.65 \)

1-26. \( f(x) = x^3 \)

1-27. 
   a: The amount of money you spend is proportional to the amount of gas you buy.  
   b: People grow a lot in their early years and then their growing slows down.  
   c: As time goes by, the ozone concentration goes down, although the effect is slowing.  
   d: As the number of students grows, more classrooms are used and each classroom holds 30 students.  
   e: Possible inputs: any non-negative integer; Possible outputs: any non-negative integer

1-28. 
   a: \( x \approx –7.37 \)  
   b: \( x = 2.8 \)  
   c: \( x = 2 \)  
   d: \( x = –3.25 \)
Lesson 1.1.3 Day 1

1-35.  a: The numbers between –2 and 4 inclusive or \(-2 \leq x \leq 4\).

   b: The numbers between –1 and 3 inclusive or \(-1 \leq y \leq 3\).

   c: No. He is missing all the values between those numbers. The curve is continuous, so the description needs to include all real numbers, not just integers.

   d: Sample graph shown at right.

1-36.  They are both wrong. The equation needs to be set equal to zero before the Zero Product Property can be applied. \(2x^2 + 5x - 3 = 4\) is equivalent to \((2x + 7)(x - 1) = 0\). \(x = 1\) or \(x = -\frac{7}{2}\).

1-37.  a: \(y = \frac{x-6}{3}\)  
   b: \(y = \frac{x+10}{5}\)  
   c: \(y = \pm \sqrt{x}\)  
   d: \(y = \pm \sqrt{x+4}\)  
   e: \(y = \pm \sqrt{x} + 5\)

1-38.  a: \(-7\)  
   b: \(3.5\)  
   c: The y- and x-intercepts.

1-39.  \(y = 30 - x\); Graph and table shown at right. Answers vary. 

\[
\begin{array}{c|cccc}
   x & 0 & 1 & 6 & 20 \\
   \hline
   y & 30 & 29 & 24 & 10 \\
\end{array}
\]

1-40.  Sample graphs shown below.

1-41.  There is an error in line 2. Both sides need to be multiplied by \(x\): \(5 = x^2 - 4x, 0 = x^2 - 4x - 5 = (x - 5)(x + 1), x = -1, 5\).
Lesson 1.1.3 Day 2

1-42. See table and graph at right. Domain: \( x \neq 0 \), range: \( y \neq 0 \), asymptotes are the \( x \)- and \( y \)-axes, non-linear, two separate curves with reflection symmetry across \( y = x \) and \( y = -x \), or \( 180^\circ \) rotational symmetry.

\[
\begin{array}{c|c}
 x & y \\
 \hline
 -3 & -\frac{2}{3} \\
 -2 & -1 \\
 -1 & -2 \\
 -0.5 & -4 \\
 0 & \text{undefined} \\
 0.5 & 4 \\
 1 & 2 \\
 2 & 1 \\
 3 & \frac{4}{3}
\end{array}
\]

1-43. a: See graph at right.
   
   b: Yes, the pizza will never get below room temperature.

1-44. a: \( x = 3 \) or \( -2 \)  
   
   b: \( x = 3 \) or \( -3 \)

1-45. Solve \( x^2 + 2x + 1 = 1; \ x = 0 \) or \( -2 \)

1-46. a: \( (0, 6) \)  
   
   b: \( (0, 2) \)  
   
   c: \( (0, 0) \)  
   
   d: \( (0, -4) \)  
   
   e: \( (0, 25) \)  
   
   f: \( (0, 13) \)

1-47. Possible answers listed below.
   a: Factor and use the Zero Product Property (rewrite) \( x = -8 \) or \( 1 \)
   
   b: Take the square root (undo) \( x = -9 \) or \( 5 \)
   
   c: Quadratic Formula \( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \approx -1.09 \) or \( 1.29 \)
   
   d: Quadratic Formula \( x = -2 \pm \sqrt{3} \approx -3.73 \) or \( -0.27 \)

1-48. a: See answer graph at right.
   
   b: \( y = -\frac{1}{3} x + 1 \)
Lesson 1.1.4

1-56.  
   a: 70  
   b: 2  
   c: 43  
   d: undefined  
   e: \(-\infty < x < \infty\)  
   f: \(x \geq 5\)  
   g: The square root of a negative number is undefined, whereas any real number can be squared.

1-57. The functions in parts (a), (b), (d), (e), (h), (i), and (j) are polynomial functions. Part (c) has an exponential term. Part (f) is not a function. If part (g) is rewritten in standard form, it will have negative exponents.

1-58.  
   a: \(y = 3x + 24\); Table and graph shown at right.  
   \[
   \begin{array}{c|c}
   x & y \\
   \hline
   0 & 24 \\
   1 & 27 \\
   2 & 30 \\
   3 & 33 \\
   4 & 36 \\
   5 & 39 \\
   \end{array}
   \]
   b: At 16 weeks. You can see this in the table and graph where \(y = 72\). You can see this growth in the equation by substituting 72 for \(y\) and solving for \(x\).
   c: Possible inputs: all real numbers greater than and including 0  
      Possible outputs: all real numbers greater than and including 24

1-59. The error is in line 3. It should be: \(0 = 5.4x + 23.7, x \approx -4.39\)

1-60. See graph at right. Exponential function (increasing), horizontal asymptote \(y = 0\), y-intercept \((0, 1)\), D: all real numbers, R: \(y > 0\), continuous function.

1-61.  
   a: D: \(-1, 1, 2\); R: \(-2, 1, 2\)  
   b: D: \(-1 \leq x < 1\); R: \(-1 \leq y < 2\)  
   c: D: \(x \geq -1\); R: \(y \geq -1\)  
   d: D: \(-\infty < x < \infty\); R: \(y \geq -2\)

1-62. \(x = 70^\circ\); straight \(\angle\)s are supplementary and ext. \(\angle\).
Lesson 1.2.1

1-66. \((2, 1)\)

1-67. a: 3  
   b: \(\frac{x^2}{25x^2}\) 
   c: \(18x\)

1-68. \(x = 2.5\)

1-69. a: \(\sqrt{34} \approx 5.83\) units  
   b: \(\frac{3}{5}\)

1-70. a: Table and graph shown at right. \(y = 2x + 26\)  
   b: 37 weeks after Carlo’s birthday. In the table and the graph, the point \((37, 100)\). Using the equation, the value of \(x\) for which \(100 = 2x + 26\).

1-71. \(y = 0\)  
   a: \((-2, 0)\)  
   b: \((-10, 0)\)  
   c: \((0, 0)\)  
   d: \((\pm\sqrt{2} = \pm1.41, 0)\)  
   e: \((5, 0)\)  
   f: \((\sqrt{13} \approx 2.35, 0)\)

1-72. a: \(x = \frac{5(y-1)}{3}\)  
   b: \(x = -\frac{2y+6}{3}\)  
   c: \(x = \pm\sqrt{y}\)  
   d: \(x = \pm\sqrt{y+100}\)
Lesson 1.2.2 Day 1

1-80. a: $(-1, 9)$ and $(5, 21)$  
       b: $x^2 + 17$  
       c: $x^2 - 4x - 5$

1-81. a: $8.4 - 5.8 = 2.6$ cm  
       b: See boxplot at right.

1-82. a: 32  
       b: $x^2y^2\sqrt{x}$  
       c: $\frac{x^2}{y}$

1-83. See graph at right.  
       Domain: all real numbers  
       Range: all real numbers

1-84. a: D: $-2, -1, 2$; R: $-1, 0, 1$  
        b: D: $-1 < x \leq 1$; R: $-1 \leq y < 2$  
        c: D: $x > -1$; R: $y > -1$  
        d: D: $-\infty < x < \infty$; R: $-\infty < y < \infty$

1-85. $l = 4w$ and $l + w = 22$ or $w + 4w = 22$; The length is 17.6 cm, and the width is 4.4 cm.

1-86. $2x - \frac{7}{5} = 3 - 3x$; $x = \frac{5}{6}$, $y = \frac{1}{2}$; $(\frac{5}{6}, \frac{1}{2})$
Lesson 1.2.2 Day 2

1-87.  a: \( w = 0 \) or \( w = -4 \)  
       b: \( w = 0 \) or \( w = \frac{2}{3} \)  
       c: \( w = 0 \) or \( w = 6 \)

1-88.  Mean: 7.6 g;  Sample standard deviation: \( \sqrt{\frac{2.56 + 0.16 + 0.16 + 1.96 + 0.36}{5}} = \sqrt{1.3} \approx 1.14 \text{ g} \)

1-89.  \((\pm \sqrt{5}, 0)\);  See graph at right.

1-90.  \( y = 0; \ x = 0 \)

1-91.  a: \( x^2 - 1 \)  
       b: \( 2x^3 + 4x^2 + 2x \)  
       c: \( x^3 - 2x^2 - x + 2 \)  
       d: \( y: (0, 2); \ x: (1, 0), (-1, 0), (2, 0) \)

1-92.  a:  
       b:  

       c: \( y\)-intercept \( (0, 3) \) for both, \( x\)-intercept \( (-\frac{1}{2}, 0) \) for part (a) and none for part (b)  
       d: \( (0, 3) \) and \( (2, 7) \), solve \( 2x + 3 = x^2 + 3 \) to get \( x = 0 \) or \( x = 2 \)

1-93.  They are similar by AA \( \sim \).  
       a: \( \frac{n}{m} \)  
       b: \( \frac{m}{x} \)
Lesson 1.2.2 Day 3

1-94. Mean: 52 g; sample standard deviation is \(\sqrt{\frac{64+64+4+1+14+4}{5-1}} = \sqrt{70} \approx 8.4 \text{ g}\)

1-95. a: \(x = -6\)  
   b: \(x = \frac{38}{13} \approx 2.92\)

1-96. a: \(\frac{1}{12}\)  
   b: \(\sqrt{580} = 2\sqrt{145} \approx 24.08\)  
   c: \((-9, 1)\)  
   d: \(y = \frac{1}{x} x + \frac{7}{4}\)

1-97. See graph shown at right. Parabola with vertex/minimum \((-1, -8)\); increasing for \(x > -1\); decreasing for \(x < -1\); intercepts \((-3, 0), (1, 0),\) and \((0, -6)\). Line of symmetry at \(x = -1\), domain: \(-\infty < x < \infty\); range: \(y \geq -8\)

1-98. a: D: \(-3 \leq x < 3\); R: \(y = -2, 1, 3\)
   
   b: D: \(x = 2\); R: \(-\infty < y < \infty\)
   
   c: D: \(x \geq -2\); R: \(-\infty < y < \infty\)

1-99. a: \(\frac{1}{75}\)  
   b: \(\frac{1}{y^2}\)  
   c: \(\frac{1}{x^2y^2}\)  
   d: \(\frac{h^0}{a}\)

1-100. The independent variable is the volume of water; the dependent variable is the height of the liquid. The graph is three line segments starting at the origin. C is the steepest, and B is the least steep.
Lesson 1.2.3

1-103. **a:** The five-number summary is (1, 19.5, 29, 40.5, 76) cups of coffee per hour.

   **b:** The typical number of cups sold in an hour is 29 as determined by the median. Looking at the shape of the distribution, we see that the median is a satisfactory representation of the distribution. The distribution has a skew. There is a gap between 60 and 70 cups. The IQR is 21 cups. 76 cups of coffee in one hour is an apparent outlier.

1-104. **a:** \( x = \frac{-3 \pm \sqrt{11}}{2} \approx -3.79, 0.79 \)

   **b:** \( x = \frac{7 \pm \sqrt{103}}{6} \approx 3.48, -1.15 \)

1-105. Diagrams vary.

   See graph and table at right.

\[
\begin{array}{c|c}
 x & y \\
\hline
 1 & 3 \\
 2 & 6 \\
 3 & 9 \\
\end{array}
\]

1-106. See graph at right.

   **a:** See graph at right.

   **b:** \( y = 4x - 15 \)

   **c:** (4, 1)

1-107. **a:** D: all real numbers except \( x \neq 0 \); R: all real numbers except \( y \neq 0 \)

   **b:** D: \(-5 \leq x \leq 6\); R: \(-4 \leq y \leq 2\)

   **c:** D: all real numbers; R: \( y \leq 1 \)

1-108. The negative coefficient causes parabolas to open downward, without changing the vertex. See graph at right.

1-109. (1, 3) and (7, 81)
2-6.  
\(a: y = 0 \text{ or } 6\)  
\(b: n = 0 \text{ or } -5\)  
\(c: t = 0 \text{ or } 7\)  
\(d: x = 0 \text{ or } -9\)  
\(e: \) There is no constant term when each equation is set equal to zero, so the variable is a common factor after like terms are collected.

2-7.  
\(a: (7, -16); \quad y = (x - 7)^2 - 16\)  
\(b: (2, -16); \quad y = (x - 2)^2 - 16\)  
\(c: (7, 9); \quad y = (x - 7)^2 - 9\)  
\(d: (2, -1)\)

2-8.  
When \(x = 2\), \((x - 2)^2\) will equal zero and \(y = -1\), the smallest possible value for \(y\) in the equation. So the \(y\)-value of the vertex is the minimum value in the range of the function.

2-9.  
\(a: x \approx 5.18 \text{ units}\)  
\(b: x \approx 18.66 \text{ units}\)  
\(c: \theta \approx 24.62^\circ\)  
\(d: x = \sqrt{180} = 6\sqrt{5} \approx 13.42 \text{ units}\)

2-10.  
Ted will solve the system algebraically by setting \(18x - 30 = -22x + 50\). The lines intersect at the point \((2, 6)\).

2-11.  
\(x = -4\)

2-12.  
\(a: \) Hush Puppy: The distribution is left skewed so its center and spread are best described by the median of 58.3 dB and IQR of 25.6 dB; there are no apparent outliers. Quiet Down: Has some potential outliers over 100 dB or is perhaps dual-peaked. The main body of data has a left skew. The center and spread are best described by the median of 54.9 dB and IQR of 25.9 dB.

\(b: \) Answers may vary. Unless a student is familiar with the decibel scale a reasonable choice would be the Quiet Down because its mean and median sound levels are less and the IQRs between the two are nearly identical.

\(c: \) The Hush Puppy looks better now because those three high readings from the Quiet Down model are a lot more significant. Perhaps the Quiet Down could be redesigned to eliminate those high readings.
Lesson 2.1.2

2-18. Possible equations include $y = -\frac{1}{12} (x - 60)^2 + 50$, $y = -\frac{1}{2} x^2 + 50$, and $y = -\frac{1}{12} x^2$; The domain and range should include only those values that correspond to the water passing between the boat and the warehouse.

2-19. a: Years; 1.06; 120,000; $f(x) = 120000(1.06)^x$
   b: Hours; 1.22; 180; $f(x) = 180(1.22)^x$

2-20. $x \approx 2.7$ feet, $y \approx 1.3$ feet

2-21. a: $x = -\frac{1}{17} \approx -0.059$   b: $x = \frac{66}{13} \approx 5.08$   c: $x = -1, 3$

2-22. Table and graph shown at right. Sideways S-shaped; increasing; D: $-\infty < x < \infty$, R: $-\infty < y < \infty$, intercepts $(0, -4)$ and $(\sqrt{4}, 0)$ or $(1.59, 0)$; continuous; function

2-23. 56 inches

2-24. a: $\sqrt{146} = 12.1$   b: $\sqrt{145} = 12.0$   c: $\sqrt{50} = 5\sqrt{2} \approx 7.1$
Lesson 2.2.1 Day 1

2-30.  a: The vertex for the green hose is (5, 8) and for the red hose the vertex is (3, 7). The green hose will go higher.

   b: If Maura is standing at (0, 0), \( y = -\frac{4}{25} (x - 5)^2 + 8 \).

   c: Standing at (0, 0), domain: \( 0 \leq x \leq 10 \) and range: \( 4 \leq y \leq 8 \).

2-31.  See graph at right.

   a: \((-\frac{1}{2}, 0), (-1, 0), (0, 1)\)

   b: \( x = -\frac{4}{3} \)

   c: \((-\frac{3}{4}, -\frac{1}{8})\) or \((-0.75, -0.125)\)

2-32.  Move it up 0.125 units: \( y = 2x^2 + 3x + 1.125 \)

2-33.  a: \( 5\sqrt{2} \)       b: \( 6\sqrt{2} \)       c: \( 3\sqrt{5} \)

2-34.  a: Years; 0.89; 12,250; \( f(x) = 12250(0.89)^x \)

   b: Months; 1.005; 1000; \( f(x) = 1000(1.005)^x \)

2-35.  \( c + m = 18 \) and \( $4.89c + $5.43m = $92.07 \); 10.5 lbs. of Colombian and 7.5 lbs. of Mocha Java.

2-36.  a: 1; R: \( y \leq 3 \)       b: 3; R: \( y > 0 \)       c: 2; R; all real numbers
Lesson 2.2.1 Day 2

2-37. See graph at right. Line of symmetry $x = 4$.

2-38. a: About $5.41 \cdot 10^{12}$ dollars
   b: $y = 2.19(10^{12})(1.0317)^t$
   c: A possible assumption is that the rate of change stayed the same over time. This is not very likely given economic cycles.

2-39. a: $2\sqrt{6}$    b: $3\sqrt{2}$    c: $2\sqrt{3}$    d: $5\sqrt{3}$

2-40. a: $x = 8$    b: $\approx 30.8$ units

2-41. Perpendicular line is $y = 3x - 5$, and point of intersection is $(3, 4)$. The distance from $(3, 4)$ to $(5, 10)$ is $\sqrt{40} = 2\sqrt{10} \approx 6.32$.

2-42. a: $z = 3$    b: $z = 1.5$    c: $z = 8$    d: $z = -3, 2$

2-43. See graphs below.
   a: stretched parabola, vertex $(0, 5)$    b: inverted parabola, vertex $(3, -7)$
Lesson 2.2.1 Day 3

2-44.  a: \( y = \frac{1}{x^2} \)  
        b: \( y = x^2 - 5 \)  
        c: \( y = (x - 3)^3 \)  
        d: \( y = 2^x - 3 \)  
        e: \( y = 3x - 6 \)  
        f: \( y = (x + 2)^3 + 3 \)  
        g: \( y = (x + 3)^2 - 6 \)  
        h: \( y = -(x - 3)^2 + 6 \)  
        i: \( y = (x + 3)^3 - 2 \)  

2-45.  He should move it up 6 units or redraw the axes 6 units lower.

2-46.  a: \((10, 48)\)  
        b: \(\left(\frac{20}{3}, \frac{9}{5}\right)\)

2-47.  \( m\angle B \approx 40^\circ; \ AB = \sqrt{244} = 2\sqrt{61} \approx 15.6 \) cm

2-48.  a: 3  
        b: \( \frac{1}{2\sqrt{y^4}} \)  
        c: \( \sqrt{\frac{y}{x}} \)

2-49.  a: \( n = -2 \)  
        b: \( x = -4 \) or \( 1 \)

2-50.  Smallest: a: 2; b: 0; c: -3; d: none  
        Largest: a: none; b: none; c: none; d: 0

Lesson 2.2.2 Day 1

2-56.  a: \( y = (x - 2)^2 + 3 \)  
        b: \( y = (x - 2)^3 + 3 \)  
        c: \( y = -2(x + 6)^2 \)

2-57.  a: D: all real numbers, R: \( y \geq 3 \)  
        b: D and R: all real numbers  
        c: D: all real numbers, R: \( y \leq 0 \)

2-58.  a: \$120  
        b: \$22,204

2-59.  a: \((a, b) = (2, \pm \frac{1}{2})\)  
        b: \((a, b) = (\frac{1}{2}, \pm 2)\)

2-60.  a: 3  
        b: 4  
        c: 1  
        d: 5  
        e: 2

2-61.  a: \(5i\)  
        b: \(4i\sqrt{2}\)  
        c: \(21 + i\)  
        d: \(8 - i\)

2-62.  Since \( A = \pi r^2, f(r) = \pi r^2 \). See graph and table at right.  
        domain: \( x \geq 0 \), range: \( y \geq 0 \),  
        \( x\)- and \( y\)-intercept: \((0, 0)\), no asymptotes,  
        half of parabola: \( y = \pi x^2 \)

\[ \begin{array}{c|cccccc} 
    x & 0 & 1 & 2 & 3 & 4 \\
    \hline 
    y & 0 & \pi & 4\pi & 9\pi & 16\pi 
\end{array} \]
Lesson 2.2.2 Day 2

2-63.  a: intercepts (2, 0), (6, 0), (0, 2); vertex (4, –2); 
D: all real numbers, R: y ≥ –2 
   b: intercepts (–4, 0), (2, 0), (0, 2); vertex (–1, 3); 
D: all real numbers, R: y ≤ 3

2-64.  a: vertex at (–3, –8), opens upward, vertically stretched. 
   b: x-intercepts (–5, 0) and (–1, 0); y-intercept (0, 10)

2-65.  a: \( x = \frac{3+i}{2} = 1.5 \pm 0.5i \)  \quad b: \( x = \frac{1}{3} \)

2-66.  a: \( y = 3 \cdot 4^x \)  \quad b: \( y = 2 \cdot 0.5^x \)

2-67.  a: \( 6x^3 + 8x^4y \)  \quad b: \( x^{14}y^9 \)

2-68.  a: No. Reasons vary, but may include: because there is only one height for each x or 
because it takes larger x-values to get larger y-values. 
   b: No. Reasons vary, but may include: because the domain is unlimited (any number can 
be squared).

2-69.  a: \( \sqrt{58} \approx 7.62 \) units  \quad b: \( -\frac{3}{7} \)
Lesson 2.2.3

2-75.  a: \( y + 2 = 5(x - 3) \)  
       b: \((0, -17)\) and \((\frac{17}{5}, 0)\)

2-76.  \( \approx 17.74 \) feet

2-77.  a: \( 8\sqrt{3} \)  
       b: \( 3\sqrt{x} \)  
       c: 12  
       d: 108

2-78.  \((-2, 5)\)

2-79.  a: 1722  
       b: 1368  
       c: \( y = 1500(1.047)^{x+3} \)

2-80.  Possible graph shown at right.

2-81.  a: See histogram at right.  
       b: There is a lot of variation in the calorie content of a batter fried chicken wings. Chickens are not all the same size and the amount of batter stuck to the wings can also vary.  
       c: The median and IQR are more appropriate because the distribution is skewed to the right and has an outlier (which increases the mean).

2-82.  a: neither  
       b: neither  
       c: even

2-83.  See graph at right.  intercepts: \((0, 0)\) and \((-6, 0)\); vertex \((-3, -9)\)

2-84.  a: \( \frac{2}{25} \)  
       b: \( \frac{3x^2y^3}{z^4} \)  
       c: \( 54m^5n \)  
       d: \( y\sqrt[3]{5x^2z} \)

2-85.  Answers vary. If the launch point is the origin, then \( y = -0.12(x - 50)^2 + 30 \).

2-86.  \( x = 62 \)

2-87.  There are no real solutions, but there are two imaginary solutions, \(4i\) and \(-4i\). Because \(i^2 = -1\), it follows that \((4i)^2 = 16i^2 = 16(-1) = -16\), and \((-4i)^2 = 16i^2 = -16\).

2-88.  \( \frac{1}{2} \) no matter where \( X \) is placed.
Lesson 2.2.4 Day 1

2-95.  a: odd  b: even  c: even

2-96.  Perpendicular line is $y = -\frac{1}{2}x + 7$. Intersection is at (1.6, 6.2). Distance from (4, 5) to (1.6, 6.2) to is $\sqrt{7.2} \approx 2.68$ units.

2-97.  See graph at right. Half of a sleeping parabola; locator point (3, –5); $x$-intercept: (28, 0); increasing; D: $x \geq 3$, R: $y \geq -5$

2-98.  $f(x) = x^2 + 1$

2-99.  a: $y = \frac{1}{4}x - 4$  b: $y = \frac{1}{2}x - \frac{1}{2}$
       c: $y = (x + 1)^2 + 4$  d: $y = x^2 + 4x$

2-100.  $(a + b)^2 = a + 2ab + b^2$, substitute numbers, etc.

2-101.  a: $-18 - 5i$  b: $1 \pm 2i$  c: $5 + 6i$
Lesson 2.2.4 Day 2

2-102. a: The graph is a circle. It is in the form \((x - h)^2 + (y - k)^2 = r^2\).

   b: The circle’s center is at \((4, -1)\) and the radius is 4.

   c: See graph at right.

2-103. a: \(y = -\frac{2}{5} (x - 3)^2 + 5\)  
b: \(x = -\frac{3}{25} (y - 5)^2 + 3\)

2-104. a: See graph at right. Note that this graph is not very intuitive—a distance verses loudness graph starts high and decreases. Many students will graph a bell shape. If so, this is a good time to do some whole-class graphical interpretation. The bell shape could be argued as appropriate if the student sees his or her position as the origin and the negative side of the \(x\)-axis as representing direction. Students should talk about what they are visualizing. Seeing themselves with the distance first decreasing then increasing is different from the way distance is usually graphed on the \(x\)-axis, small to large.

   b: Loudness depends on distance, so distance is the independent variable and loudness is the dependent variable.

2-105. a: \(x = \frac{2 \pm \sqrt{76}}{10} = -\frac{1}{5} \pm \frac{\sqrt{19}}{5}i\)  
b: \(x = \frac{1 \pm \sqrt{13}}{4} \approx 1.89 \text{ or } 2.39\)

2-106. a: \((5x - 1)(5x + 1)\)  
b: \(5x(x + 5)(x - 5)\)

   c: \((x + 9)(x - 8)\)  
d: \(x(x - 6)(x + 3)\)

2-107. a: \(x = 70^\circ, \parallel \text{ lines} \rightarrow \text{ alt. int. } \angle s = \); \(y = 50^\circ, \text{ corr. } \angle s = \)

   b: \(x = 105^\circ, \text{ ext. } \angle\)

2-108. a: \(x = 36\)  
b: \(x = \sqrt{800} = 20\sqrt{2} \approx 28.28\)
Lesson 2.2.5 Day 1

2-117. See graph at right.

2-118. a: 1.03  
   b: \( f(n) = 10.25(1.03)^n \)  
   c: $13.78$

2-119. a: The graph will be a circle with a center at (5, 8) and a radius of 7.  
   b: See graph at right.

2-120. See graph at right.  
   a: \( y = 2x^2 - 4x + 6 \)  
   b: There is no difference, but the explanations vary.  
   c: \( y = x^2 \)  
   d: \( y = x^2 \)

2-121. a: 30°  
   b: 22.6°

2-122. Answers will vary.

2-123. a: \( x = 14 \)  
   b: \( x = \frac{-5 \pm 4i\sqrt{6}}{11} \)
Lesson 2.2.5 Day 2

2-124. a: 254,000 people/year  b: 1,574,000 people/year  c: 1960 to 2010

2-125. a: Tables or graphs should be the same.
   b: See sample work at right.
   c: Students could point out that the \( a \) ends up being the coefficient of \( x^2 \) after the binomial is squared.

\[
y = 3(x - 1)^2 - 5 \\
y = 3(x^2 - 2x + 1) - 5 \\
y = 3x^2 - 6x + 3 - 5 \\
y = 3x^2 - 6x - 2
\]

2-126. a: \( 6\sqrt{x} + 3\sqrt{y} \)  b: 32  c: 5  d: \( \frac{\sqrt{5}}{2} \)

2-127. See graph at right. The domain is all positive numbers (or \( x > 0 \)). The range is all real numbers 3 or greater that are multiples of 0.25.

2-128. a: \( x = -2 \) or 3  b: \( x = \frac{12 \pm \sqrt{304}}{10} = \frac{6 \pm \sqrt{19}}{5} \approx -0.54 \) or 2.94  c: \( x = -4 \pm 2i \)  d: \( y = -\frac{1}{2} \) or 4

2-129. See graph at right.
   a: \( y = 2x: (0, 0); \ y = -\frac{1}{2} x + 6 : (0, 6), (12, 0) \)
   b: It should be a triangle with vertices \( (0, 0), (12, 0), \) and \( (2.4, 4.8) \).
   c: Domain \( 0 \leq x \leq 12 \); Range \( 0 \leq y \leq 4.8 \)
   d: \( A = \frac{1}{2}(12)(4.8) = 28.8 \) square units

2-130. a: 4  b: -30  c: 12  d: \( -2 \frac{1}{4} \)  e: \( x = -4, \frac{1}{3} \)
Lesson 2.3.1

2-136. Hannah is correct. \(4(x - 3)^2 - 29 = 4x^2 - 24x + 7\) and \(4(x - 3)^2 - 2 = 4x^2 - 24x + 34\)

2-137. a: \(y = 2(x - 2)^2 - 2\), vertex \((2, -1)\), line of symmetry \(x = 2\)
   b: \(y = 5(x - 1)^2 - 12\), vertex \((1, -12)\), line of symmetry \(x = 1\)

2-138. Answers vary. Show that \(f(x) = f(-x)\) in each of the representations.

2-139. Maximum profit is $25 dollars per day for either company. To expect a maximum profit, Math Starz will sell their apps for $5, which is less than the $8 sales price that Comet Math sets to expect a maximum profit.

2-140. This is a scalene triangle, because the sides have lengths \(\sqrt{29} \approx 5.39\), \(\sqrt{17} \approx 4.12\), and \(\sqrt{20} = 2\sqrt{5} \approx 4.47\).

2-141. See graph at right. Answers vary. The intercepts are \((0, -2)\) and \((8, 0)\).
   Domain: all real numbers; Range: all real numbers

2-142. a: No, incorrect vertex order.
   b: Yes, by SAS \(\cong\).
   c: No, incorrect vertex order.
   d: Yes, congruent parts of congruent triangles are congruent.
Lesson 3.1.1 Day 1

3-10. See graph at right.  $x = 0$ or $x = 4$

3-11.  a: $x = 5$ or $x = -3$  b: $m = 35$
        c: no solution  d: $x = 7$

3-12.  a: $-15$  b: $-4$  c: $3$  d: $-m^2$

3-13.  a: $f(x) = (x + 3)^2 + 6$, $(-3, 6)$, $x = -3$
        b: $y = (x - 2)^2 + 5$, $(2, 5)$, $x = 2$
        c: $f(x) = (x - 4)^2 - 16$, $(4, -16)$, $x = 4$
        d: $y = (x + 3.5)^2 - 14.25$, $(-3.5, -14.25)$, $x = -13.5$

3-14. The function is even. A reflection across the y-axis results in the same graph.

3-15.  a: $y = -2(x + 4)^2 + 2$  b: $y = \frac{1}{x+2}$  c: $y = -x^3 + 3$

3-16.  a: 

3-16.  b: 

3-16.  c:
Lesson 3.1.1 Day 2

3-17. **a** \( U = x^2 - \frac{4}{3}, \ x = \pm 2 \)

**b**: \( U = \frac{1}{n+1}; \ U^2 + 6U = 27; \ n = -\frac{10}{9} \) or \( -\frac{2}{3} \)

**c**: \( U = \frac{x+2}{6}, \ x = 0, \ x = -11 \)

3-18. **a**: C: (3, 7); \( r: 5 \)

**b**: C: (0, -5); \( r: 4 \)

**c**: C: (-9, 4); \( r: \sqrt{50} = 5\sqrt{2} \approx 7.07 \)

**d**: C: (3, 0); \( r: 1 \)

3-19. **a**: Solving leads to an impossible result, so there is no solution.

**b**: See graph at right.

**c**: The lines do not intersect because they are parallel. When solving for the point of intersection algebraically, students will find that their solution method results in a false statement.

3-20. Graph shown at right. A cubic graph that is increasing.
Locator point (-2, 4); x-intercept \( \approx -3.59, 0 \), y-intercept (12, 0);
Domain: all real numbers; Range: all real numbers

3-21. **a**: \( y = 3^x - 4 \)

**b**: \( y = 3^{(x-7)} \)

3-22. **a**: 0–2 times

**b**: 0–4 times

**c**: 0–4 times

**d**: 1–3 times if you consider parabolas that open up or down. 0–4 times if you consider rotated parabolas.

3-23. **a**: Students may create a boxplot or dot plot.
There is not enough data to make a viable histogram.

**b**: The median difference was 3 inches, with half of the pants mismarked between 2.5 and 3.5 inches from their actual size. One pair looks to be an outlier with a 6-inch difference. The lowest difference was a nearly-accurate 1 inch.

**c**: If the marked sizes were accurate, one would expect the differences to be zero. Out of the 11 pairs of pants sampled, there was not a single correctly marked pair of pants. Also, if the discrepancies were random, you would expect some of the differences to be negative, with the actual waistband smaller than the marked size. Fashion is a competitive business and if you can make your potential customers feel thinner by being generous with actual sizes versus marked sizes, it might give you an advantage.
Lesson 3.1.2 Day 1

3-31. Graph \( y = (x - 3)^2 - 2 \) and \( y = x + 1 \) and solve for the \( x \)-values of the points of intersection. Or, \( y = x^2 - 7x + 6 \) and solve for the \( x \)-intercepts. \( x = 1 \) or \( x = 6 \)

3-32. See graph at right. \( x = 3 \) or \( x = 6 \)

3-33. a: \( x = 15 \)  
   b: \( x = \frac{2}{3} \) or \( x = -5 \)

3-34. a: \( g\left(\frac{1}{2}\right) = -4.75 \)  
   b: \( g(h + 1) = h^2 + 2h - 4 \)

3-35. a: $4.00  
   b: $4.00  
   c: $4.00; $5.00  
   d: See graph at right.  
   e: no  
   f: The graph will shift upward $2.00.

3-36. a: 18  
   b: \( \frac{3}{2} \)  
   c: \( \frac{1}{\sqrt{3}} \) or \( \frac{\sqrt{3}}{3} \)  
   d: \( 11 + 6\sqrt{2} \)

3-37. 

\[
\begin{array}{c|c|c|c}
\text{Time (hours)} & \text{Cost ($)} \\
\hline
2 & 4 & 6 \\
\hline
\end{array}
\]
Lesson 3.1.2 Day 2

3-38. \(x = 1\) and \(x = 3\). Solve by making a graph, observing where \(y = 3x - 1\) intersects the graph of \(y = 2^x\), and algebraically checking the estimated solutions.

3-39. a: \(\frac{1}{2}(x - 2)^3 + 1 = 2x^2 - 6x - 3; \ x = 0\ or\ x = 4\)

b: Students may enter both equations into their graphing calculators and use the table to determine that \(x = 6\) is also a solution.

c: \(\frac{1}{2}(x - 2)^3 + 1 = 0, \ x = 2 - \frac{3\sqrt{2}}{2} \approx 0.74\)

3-40. a: \(x = 13; \ x = 5\) is extraneous

b: \(x = 1\)

3-41. \((x - 1)^2 + y^2 = 30; \) See graph at right. center: \((1, 0)\), intercepts: \((\pm \sqrt{30} + 1, 0)\) and \((0, \pm \sqrt{29})\)

3-42. a: \((0, -6)\)

b: \((-6, 0)\) and \((1, 0)\)

c: \(x\)-intercepts at \((0, 0)\) and \((-5, 0)\) and \(y\)-intercept at \((0, 0)\)

d: The graph of \(p(x)\) is 6 units lower than \(q(x)\).

e: \(-6\)

3-43. a: See graph at top right. b: See graph at bottom right.

c: The graph for part (b) is similar to the graph for part (a), but is rotated \(90^\circ\) clockwise.

d: (a) D: all real numbers; R: \(y \geq 0\); (b) D: \(x \geq 0\); R: all real numbers

3-44. a: \(x = \frac{1}{2}, y = \frac{1}{3}\)

b: \((\frac{1}{2}, \frac{1}{3})\)

c: The solution to the system is the point at which the lines intersect.
Lesson 3.1.3

3-49. a: \((-2, -11)\); The lines intersect at one point.
   b: infinitely many solutions; The lines coincide.
   c: \((2, 45)\) and \((-1, 3)\); The line and parabola intersect twice.
   d: \((3, 6)\); The line is tangent to the parabola (intersects it in exactly one point).

3-50. Look on the graph where \(x\) is equal to the given value and find the value of \(y\).
   a: 1   b: 4   c: 2   d: 5

3-51. a: \(x = 3\)   b: \(0 \leq x \leq 6\)   c: \(x = 1\) or \(5\)   d: \(x < 2\) or \(x > 4\)

3-52. Hyperbola with asymptotes \(x = -5\) and \(y = 7\) and locator point \((-5, 7)\).
   Stretched vertically by a factor of 4. Intercepts \((\approx -5.57, 0)\) and \((0, 7.8)\); decreasing for \(x < -5\), increasing for \(x > -5\); D: \(x \neq -5\); R: \(y \neq 7\)

3-53. \(y = -2|x + 3| + 4\)

3-54. a: odd   b: neither   c: odd

3-55. a: \(m^{1/9}\)   b: \(2g^{-7}\)   c: \(-3b^5\)
Lesson 3.1.4

3-60. \[4c + 5p = 32, \quad c + 8p = 35,\] cylinders weigh 3 oz. and prisms weigh 4 oz.

3-61. a: \(x = 4\)  
   b: \(x = 6\)  
   c: \(x = 6\)  
   d: \(x = \frac{3}{2}\)

3-62. Yes. No. Any value of \(x\) such that \(-3 \leq x \leq 2\) is a solution.

3-63. a: 
   ![Graph 1]
   b: 
   ![Graph 2]

3-64. a: neither  
   b: even

3-65. a: See graph at right. 
   b: Yes, for every possible amount of water usage, there is only one possible cost. 
   c: Domain: 0 to 1,000 cubic feet; range: discrete values including: $12.70, $16.60, $20.50, $24.40, $29.60, $34.80, $40, $45.20, $50.40, $55.60, $60.80 
   d: The graph would be shifted down by $2.50.

3-66. See graph at right. \(y = (x + 1)^2 - 81;\) \(x\)-intercepts: (-10, 0), (8, 0), 
   \(y\)-intercept: (0, -80); vertex: (-1, -81)
Lesson 3.2.1 Day 1

3-74.  a: boundary point \( x = -4 \)  \hspace{1cm} b: boundary points \( x = 4, -\frac{3}{2} \)

\[
\begin{array}{c}
-6 \mid -4 \mid -2 \mid 0 \mid 2 \\
\hline
\end{array}
\hspace{3cm}
\begin{array}{c}
-2 \mid -1 \mid 0 \mid 1 \mid 2 \mid 3 \mid 4 \\
\hline
\end{array}
\]

3-75.  a: \( -4 < x < 1 \)  \hspace{1cm} b: \( x \leq -4 \) or \( x \geq 1 \)

\[
\begin{array}{c}
-4 \mid -3 \mid -2 \mid -1 \mid 0 \mid 1 \\
\hline
\end{array}
\hspace{3cm}
\begin{array}{c}
-6 \mid -4 \mid -2 \mid 0 \mid 1 \mid 2 \\
\hline
\end{array}
\]

c: \( -1 < x < 4 \)  \hspace{1cm} d: \( x \leq -1 \) or \( x \geq 4 \)

\[
\begin{array}{c}
-1 \mid 0 \mid 1 \mid 2 \mid 3 \mid 4 \\
\hline
\end{array}
\hspace{3cm}
\begin{array}{c}
-4 \mid -2 \mid 0 \mid 2 \mid 4 \mid 6 \\
\hline
\end{array}
\]

e: \( -1 < x < 4 \)  \hspace{1cm} f: \( x \leq -1 \) or \( x \geq 4 \)

\[
\begin{array}{c}
-1 \mid 0 \mid 1 \mid 2 \mid 3 \mid 4 \\
\hline
\end{array}
\hspace{3cm}
\begin{array}{c}
-4 \mid -2 \mid 0 \mid 2 \mid 4 \mid 6 \\
\hline
\end{array}
\]

g: Some possibilities: The solutions for (c) and (e) are the same, as well as the solutions for (d) and (f), because \( 2x - 3 = -(3 - 2x) \) and \( |A| = |-A| \). The number line graphs for (a) and (b) and for (c) and (d) are complementary. For (a) and (c) and for (b) and (d) the difference between adding and subtracting 3 shows up as reversed opposites.

3-76.  a: \( \sqrt{61} \)  \hspace{1cm} b: 30°  \hspace{1cm} c: \tan^{-1}\left(\frac{4}{5}\right)  \hspace{1cm} d: 5\sqrt{3}

3-77.  a: See graph at right.  
\hspace{1cm} b: x = 2  \hspace{1cm}  \hspace{1cm} c: x = -1  \hspace{1cm}  \hspace{1cm} d: x = -2

\[
\begin{array}{c}
-4 \mid -2 \mid 0 \mid 2 \mid 4 \\
\hline
\end{array}
\]

\[
\begin{array}{c}
-4 \mid -2 \mid 0 \mid 2 \mid 4 \mid 6 \\
\hline
\end{array}
\]

e: \( x = -1 \pm 2\sqrt{3} = -4.46 \) or 2.46  \hspace{1cm} f: Three because the graphs intersect three times.

\[
\begin{array}{c}
-4 \mid -2 \mid 0 \mid 2 \mid 4 \\
\hline
\end{array}
\]

g: Both are neither.

3-78.  See graph top right.  
\hspace{1cm} a: See graph below right.  
\hspace{1cm} b: \[
y = \begin{cases} 
(x + 2)^3 & \text{if } x \leq -2 \\
|2x + 1| & \text{if } x > -2 
\end{cases}
\]

3-79.  a: \( 3p + 3d = 22.50 \) and \( p + 3d + 3(8) = 37.5 \), so popcorn costs $4.50 and a soft drink costs $3.00.

\[
\begin{array}{c}
-3 \mid -2 \mid -1 \mid 0 \mid 1 \mid 2 \mid 3 \\
\hline
\end{array}
\hspace{3cm}
\begin{array}{c}
-3 \mid -2 \mid -1 \mid 0 \mid 1 \mid 2 \\
\hline
\end{array}
\]

b: Answers vary.

3-80.  a: \( p^{36}w^{72} \)  \hspace{1cm} b: \( \frac{1}{19} \)  \hspace{1cm} c: \( 6^{12/7} \)
Lesson 3.2.1 Day 2

3-81. See graph at right.
  a: Rectangle; perpendicular lines or slopes
  b: (1, 4), (–3, –3), (5, 1), (3, 0)

3-82. a: \(-5 < x < 13\)  
   b: \(x \geq 250\) or \(x \leq 70\)  
   c: \(\frac{3}{2} \leq x \leq \frac{7}{2}\)

3-83. The solutions reveal the point(s) of intersection.
  a: (7, 5)  
  b: (–1, 3)  
  c: \((-\frac{1}{4}, 3)\)  
  d: (1, 1)

3-84. a: For each, \(x = 6\).  
   b: He divides by both \(10^3\) and 4.

3-85. a: \(\sqrt{233} = 15.26\) units  
   b: \(\sqrt{(x-5)^2 + (y-2)^2}\) units

3-86. See graph at right. Exponential graph, increasing, with asymptote \(y = -4\).  
Intercepts (3, 0) and (0, –3.5); D: All real numbers, R: \(y > -4\)

3-87. a: At 40°F the distribution is skewed to the right. Half of the seeds sprouted before 35 days with the shortest sprout time of 6 days. Two of the seeds are outliers and took more than 14 weeks (98 days) to sprout. For the 60°F batch, the distribution looks symmetric with a range of only 29 days. The median is around 50 days with no outliers.

b: On average, the seeds sprout faster at lower temperatures but the sprout times are inconsistent. It might be a good idea to use more seeds. At higher temperatures the seeds sprout more consistently but also more slowly, so a different plant might be a better choice if rain is expected soon.
Lesson 3.2.2

3-92.  \(a: x \leq 4\)  \(b: x < -6 \) or \(x > 6\)

\[\begin{align*}
-5 & \quad 0 & \quad 5 & \quad x \\
\hline
& & & \\
-5 & 0 & 5 & x
\end{align*}\]

3-93. The points on the line \(y = 2x - 2\) are excluded from the solution region of \(y < 2x - 2\).

3-94. red = 10 cm, blue = 14 cm

3-95. \(a: y = 3\) or \(y = -5\)  \(b: x = -\frac{99}{4}\)

\(c: y = 1\)  \(d: x = -13\)

3-96. \(a: y > 3x - 3\)  \(b: y < 3\)  \(c: y \geq \frac{3x}{2} - 3\)  \(d: y \geq x^2 - 9\)

3-97. \(y = (x - 2.5)^2 + 0.75; \) vertex (2.5, 0.75)

3-98. \(a: C = 800 + 60m\)  \(b: C = 1200 + 40m\)

\(c: 20\) months  \(d: 5\) years
Lesson 3.2.3

3-101. There is no solution, so the lines are parallel.

3-102. See graph at right.
   a: A square, justifications vary.
   b: (0, –3), (4, 1), (–4, 1), (0, 5)
   c: 32 square units

3-103. a: \( x < 13 \)
   b: \( \frac{5-\sqrt{57}}{4} \leq x \leq \frac{5+\sqrt{57}}{4} \) or \(-0.637 \leq x \leq 3.137\)

3-104. (25, –3)
   a: \( x^2 + 3y = 16 \) and \( x^2 - 2y = 31 \)
   b: The solutions to the new system are (5, –3) and (–5, –3).

3-105. a: See graph at right. \( y = -2x + 8 \)
   b: 63.43º

3-106. a: Answers may vary depending on you place your axes.
   \( y = -\frac{5}{121} (x - 11)^2 + 5 \)
   b: \( y = -\frac{62}{169} (x - 13)^2 + 6.2 \)

3-107. See graph at right. Parabola, opening upward, stretched vertically by a factor of 2, vertex (–3, 0), y-intercept at (0, 18). Domain: all real numbers, Range \( y \geq 0 \), decreasing for \( x < -3 \), increasing for \( x > -3 \).
   a: 8
   b: \( 2a^2 + 16a + 32 \)
   c: \( x = 1 \) or \( x = -7 \)
   d: \( x = -3 \)
Lesson 3.2.4

3-109. a: \( y = \frac{1}{2} (x + 3)^2 - 2 \)  
   b: \( y = x + 5 \)  
   c: \( x = 1 \) or \( x = -5 \)  
   d: \( (1, 6) \) and \( (-5, 0) \)  
   e: \( x < -5 \) and \( x > 1 \)  
   f: \( x = -1 \) or \( x = -5 \)  
   g: Answers vary. The parabola could be shifted up or reflected.

3-110. \( y \leq 3x + 3, \ y \geq 0.5x - 2, \ y \leq -0.75x + 3 \)

3-111. a: \(-3 < x < 5\)  
   b: \( x \leq -\frac{8}{3} \) or \( x \geq 4 \)

3-112. a:  
   b:  
   c:  

3-113. a: \( y = \frac{8 + i\sqrt{12}}{2} = 4 \pm i\sqrt{3} \)  
   b: \( y = 7 \) (\( y = \frac{13}{3} \) is extraneous)

3-114. \( y = -(x - 2)^2 \) for \( x < 2 \); \( y = x + 2 \) for \( x \geq 2 \)

3-115. \((x + 4)^2 + (y - 6)^2 = 64\); circle, center \((-4, 6)\), \( r = 8 \)  
   See graph at right.
Lesson 4.1.1

4-7.  
**a:** Population: U.S. employees. The population is too large to conveniently measure so sampling should be used.

**b:** Population: Students in the class. A census can be taken.

**c:** Population: All carrots. To measure the Vitamin A in a carrot, it must be destroyed, so even if it were possible to measure all carrots, it would not be wise. Sampling must be used.

**d:** Population: The public (the media does not generally make this population very clear). It could be all voting adults, all adults, or all people in the state. In any case, the population is too large, so sampling must be used.

**e:** Population: Elevator cables. To find this, elevator cables must hold greater and greater weight until they break. If all elevator cables were tested, there would be none left to use for elevators. Sampling must be used.

**f:** Population: Your friends. A census can be taken.

4-8.

4-9.  See graph at right. The region between an upward parabola with vertex \((0, -5)\) and a downward parabola with vertex \((1, 7)\).

4-10.  
**a:** \(y = \frac{x^8}{12} \)

**b:** \(-18x^3y + 6x^5y^2z\)

4-11.  
**a:** A portion of the trip at a specific speed.

**b:** About 400 miles. It is the total distance on the graph.

**c:** Graph shown at right. A speed of approximately 30 mph for 1 hour, approximately 80 mph for the next 3 hours, 0 mph for 2 hours, approximately 40 mph for 2 hours, and then approximately 20 mph for the last 2 hours. Note that the step graph assumes instantaneous change of speed, which is not technically possible.

4-12.  
**a:** \(x: (1, 0), (-\frac{5}{2}, 0); \ y: (0, -5)\)

**b:** \(x: (2, 0); \ y: \text{none}\)

4-13.  \(y = (x + 3.5)^2 - 20.25\)
Lesson 4.1.2

4-20.  a: The question implies that the questioner holds this opinion, thus biasing results.
        b: The question assumes that the respondent believes that the climate is changing and
        will think that one of the given factors is important and that it is important to slow
        global climate change, biasing results.
        c: The question implies that teacher salaries should be raised.

4-21.  Sample questions given.
        a: Are a majority of Americans in favor of replacing the Electoral College with a popular
           vote?
        b: How many calories are in a Mc Burger’s small order of fries?
        c: What was the class average on the semester final exam?
        d: What was the average score for high school students taking the state math proficiency
           examination last year?

4-22.  a: all real numbers             b: \(-5 < x < 4\)

4-23.  a: \(y = -x^2 + 4x\)                 b: \(y = 5 \pm \sqrt{x-3}\)

4-24.  a: D: \(-3 \leq x \leq 3\); R: \(-3 \leq y \leq 3\); no
        b: D: \(-3 \leq x \leq 4\); R: \(-2 \leq y \leq 4\); no
        c: D: \(x \leq 3\), R: \(y \leq 4\); yes
        d: D: \(-\infty < x < \infty\), R: \(y \geq -2\); yes

4-25.  \(x + (x + 18) = 84\) or \(x + y = 84\) and \(y = x + 18\); 33 and 51 meters long

4-26.  \(a = 113^\circ\) (suppl.); \(c = 54^\circ\) (vert. \(\angle s =\)); \(b = 67^\circ\) (alt. int. \(\angle s =\)); \(d = 126^\circ\) (same side
        interior \(\angle s\) between parallel lines are suppl.)
Lesson 4.1.3

4-32.  a: This information could be found on the web for all American League players. It would be a census, and the answer would be a parameter.

b: A random sample of eggs from different farms and different species of chickens in different parts of the country would need to be broken and the pressure measured. The findings would be a statistic.

c: Random high school students could be surveyed, possibly from different high schools in different parts of the country. Surveying every high school student would be almost impossible, so this survey would be a sample, and the answer would be a statistic.

4-33.  a: closed       b: open       c: open       d: closed

4-34. Sample answers: a: If someone exercises more than once a day, we would not know; b: “team sports”, “college women’s basketball”; c: “winter”, “sunny days”, “holiday season”; d: We do not learn the region of the country.

4-35.  B

4-36.  \( m = 15, b = -3 \)

4-37.  a: \( \frac{8}{27} \)          b: \( \frac{12}{27} \)          c: \( \frac{6}{27} \)          d: \( \frac{1}{27} \)

4-38.  a: \( y = \frac{1}{2}x - 2 \)          b: \( y = -2x + 6 \)
Lesson 4.2.1

4-44.  
\( d: \) Students should observe some clear preferences for some numbers, letters, and colors. This would provide evidence that people cannot behave or choose randomly.

\( e: \) Only certain types of people typically respond.

4-45.  
\( a: \) When asked to choose between an “m” and a “q,” most people prefer “m,” regardless of the Cola taste.

\( b: \) The “so that we can protect our families” is not part of the Bill of Rights; it will bias the results.

\( c: \) The statistics chosen for the lead-in sentence will bias the results.

4-46.  
See graph at right.

4-47.  
\( a: \frac{1}{5} \quad b: 3 \)

\( c: 27 \quad d: \frac{1}{8} \)

4-48.  
The second graph is a reflection of the first across the x-axis.

See graph at right.

4-49.  
\( a: x \approx 36.78 \quad b: x \approx 31.43 \)

4-50.  
He is incorrect. Justifications vary.
Lesson 4.2.2

4-54. In each of these, we could also notice that we only get responses from those who agree to participate in our polling activities—already a very unrepresentative sample.

a: Not likely; this samples the population of people with phone numbers listed online that are home midday.

b: Not likely; this samples the population of people who shop at that particular grocery store.

c: Not likely; this samples the population of people who attend movies.

d: Not likely; this samples the population of people who go downtown at the time you are there.

e: This sample is likely to be more representative, as it is closer to random.

4-55. Sample diagram:

4-56. a: \( x = 4 \)  

b: \( x = 9 \)

4-57. \( \sin 5^\circ = \frac{d}{1000} \); \( d \approx 87.2 \) yards

4-58. a:  

b:  

c: Each function is neither odd nor even.

4-59. a: not a function D: \(-3 \leq x \leq 3\); R: \(-3 \leq y \leq 3\)

b: function D: \(-2 \leq x \leq 3\); R: \(-2 \leq y \leq 2\)

4-60. a: See graph at top right.

b: See graph at bottom right.
Lesson 4.3.1

4-65. a: They will not show the people who named other stations or people saw the station logo and knew what station the interviewer was from.

b: Surveying outside the gym does not give you a random sample.

c: No; more people drive during the day. You should look at the probability of being in an accident.

d: About half of all power plants are below average. It does not mean that it is unsafe.

4-66. a: The simplest way to set up this study would be to get a large group of volunteers and randomly assign them to two groups who will take the same math test in different rooms. In one room classical music would be played and no music would be played in the other (control group). The scores from the groups could be averaged and compared. An expanded version of the experiment could have additional groups listening to other kinds of music while taking the test for comparison.

b: People would need to be randomly assigned to random cars that would crash. One group would wear seatbelts, the other would not, and the percentage of fatalities would be measured and compared. Clearly this is not ethical but reasonable results might be obtained in an experiment using crash dummies instead of human subjects.

c: A large group of volunteers would be randomly selected and exposed to a cold virus. The subjects would be randomly assigned to two treatment groups. One group would get a daily Vitamin C supplement and the other group would receive a daily placebo. The percentage of each group that contracts a cold would be calculated and compared.

4-67. a: \( y = \frac{1}{2}x - 2 \)  

b: \( y = -\frac{3}{2}x + 5 \)

4-68. a: \( x = \frac{-1+i\sqrt{47}}{6} \)  

b: \( y \approx 4.3 \) or 10.7

4-69. a: See graph at right.  

b: \( x \approx 0.7 \)

4-70. See graph at far right.

a: It is an absolute value graph where the vertex of the graph is at \((6, -4)\).

b: See graph at right. Reflect all parts of the graph that are below the \(x\)-axis above the \(x\)-axis.

4-71. Answers will vary.  
One possibility is shown at right.
Lesson 4.3.2

4-76. **a:** The typical number of tardy students (center) is the median, 3 students, because 50% of the students fall at 3 or below. The shape is single-peaked and symmetric, with no gaps or clusters. The IQR (spread) is 1 student, because Q1 is 2 and Q3 is 3. There are no apparent outliers.

**b:** Answers vary depending on estimates from histogram. 
\[(0.43 + 0.13 + 0.07)(30) \approx 18.9; \text{ about 19 days}\]

**c:** \( \approx 3\% \)

4-77. **a:** Start with a group of athlete volunteers and measure each athlete’s vertical leap. Using a random number generator or picking names from a hat, assign each athlete randomly to one of two treatment groups: Coach Pham’s program and a conventional agility program. Measure each athlete’s vertical leap again after six weeks. Compare the average change in vertical leap between the two groups.

**b:** Yes, assuming a sufficient sample size, a controlled randomized experiment can show cause and effect because of the random assignment of subjects to the groups.

4-78. **a:** See diagram at right.

**b:** 3000 ft³

**c:** 4.8 ft³

**d:** 0.2 butterflies per cubic foot because \( \frac{625 \text{ butterflies}}{3000 \text{ ft}^3} \approx 0.21 \text{ butterflies/ft}^3 \).

4-79. Possible answer: \( y = 2^x + 15 \)

4-80. **a:** \( 5^{1/2} \) 
**b:** \( 9^{1/3} \) or \( 3^{2/3} \) 
**c:** \( 17^{x/8} \) 
**d:** \( 7x^{3/4} \)

4-81. **a:** \( x = 4 \) (\( x = 1 \) is extraneous) 
**b:** \( x = \frac{1}{4} \)
Lesson 4.3.3

4-88.  a: $\approx 667.8649$ lunches; sample standard deviation is $\approx 56.1650$ lunches

   b: $(576, 624, 665, 700.5, 785)$

   c: See histogram at right.

   d: Since the shape is fairly symmetric, use the mean as the measure of center; the typical number of lunches served is 668. The shape is single-peaked and fairly symmetric with no gaps or clusters, the standard deviation is about 56 lunches, and there are no apparent outliers.

   e: 10.8%

   f: Use half of the 680 – 720 bin.

\[
0.216 + 0.351 + (0.5)(0.108) = 62.1\% 
\]

4-89. Children would need to be randomly assigned to treatment groups, one that gets spanked and another where there is no spanking. After a period of years the IQ of both groups would be tested and compared. Any variable that has the suggestion or potential to lower the IQ of a human does not belong in a clinical experiment. Who would decide who, when, and how the spankings would be administered? Is it ethical to spank children? Would you spank kids randomly?

4-90. Systems Incorporated: In both cases, $3000 per year. Functions Unlimited: $4177.80 per year for the first two years and $6621.92 for the first ten years.

4-91.  a:

4-92. An equation of a perpendicular line is \( y = \frac{3}{5}(x + 5) - 12 \). The lines intersect at the point \((7.5, -4.5)\). The distance between \((-5, -12)\) and \((7.5, -4.5)\) is \(\sqrt{212.5} \approx 14.58\) units.

4-93. Answers vary.

4-94. \(m \approx 2.19\)
**Lesson 4.4.1**

4-104. **a:** Yes, they are different. The horizontal slice will produce a circle (or part of a circle) as the cross-section, while the vertical slice will produce a rectangle.

**b:** No, rotating the cross-sections would create a cylinder with a flat top.

4-105. **a:** See graph at right.

**b:** 2.7333 tardy students, 1.1427

**c:** See graph at right.

**d:** See graph at right. Note that although the actual data is discrete, we used a continuous model for the data that extends infinitely, and we are using the model to make predictions.

normalcdf(4, 10^99, 2.7333, 1.1427) ≈ 13.4%

3.5 days in the model can also correctly be used as a lower bound.

**e:** 0.1338(180) ≈ 24 days

4-106. The equation that needs to be “solved” is $3x - 100 = 2^x$.

Solving graphically yields no solution.

4-107. **a:** $7i$

**b:** $\sqrt{2}i$ or $i\sqrt{2}$

**c:** $-16$

**d:** $-27i$

4-108. **a:** $a = 6, b = 2$

**b:** $a = 2, b = 4$

4-109. **a:** $x = -3$

**b:** $x = 3$

**c:** $x = -2$

**d:** $x = -3$

4-110. **a:** $m = \frac{y-b}{x}$

**b:** $r = \frac{C}{2\pi}$

**c:** $L = \frac{V}{HW}$

**d:** $y = \frac{1}{3x+7}$
Lesson 4.4.2

4-117. Cylinders for the legs and prisms for the table top.

4-118. a: \( y = 0.25 \cdot 6^x \)  
          b: \( y = 12 \cdot 0.3^x \)

4-119. a: See graph at right.

          b: 50% of the time.

          c: \( \text{normalcdf}(11.5, 12.5, 12, 0.33) \approx 87\% \)

          d: 99.9th percentile

          99.9% of the soda cans contain less than 13 ounces of soda.

4-120. \( \triangle ABC \cong \triangle KLM \) by SAS; \( \triangle DEF \cong \triangle OMN \) by ASA; \( \triangle ABC \cong \triangle HIG \) by SSS

4-121. a \( x = 10 \) or \( x = -8 \)
          b: \( x = 2 \) or \( x = -4 \)
          c: \( -2 < x < 4 \)
          d: \( x \geq 3 \) or \( x \leq -13 \)

4-122. a: \( (3m + 2)(3m - 2) \)
          b: \( (5p + 3)(p + 1) \)
          c: \( (2n - 3)(n - 1) \)
          d: \( 2(x + 7)(x + 2) \)

4-123. a: \( x^{\frac{1}{5}} \)
          b: \( x^{-3} \)
          c: \( \sqrt[5]{x^2} \)
          d: \( x^{\frac{1}{2}} \)
          e: \( \frac{1}{xy^8} \)
          f: \( \frac{1}{m^3} \)
          g: \( x^{\frac{1}{3}} \sqrt[3]{x} \)
          h: \( \frac{1}{81x^6y^{12}} \)
          i: \( \frac{2y^2 \sqrt{x}}{x^{10/3}} \)
          j: \( x = 3 \)
4-125. A right triangle can be rotated first about a leg, then the resulting cone would be rotated about an axis lying in the plane of the base, passing through the center.

4-126. a: \( \frac{24(0.5) + 25 + 16 + 5 + 2 + 3}{218} \approx 0.289; \) The singer is in about the 29th percentile.

b: \( \text{normalcdf}(70, 10^99, 60.2, 5.2) \approx 0.02974; \) 0.02974(1450) \approx 43.12; Mrs. Bell can expect about 43 girls to be taller than 5' 10".

4-127. Experiments can be very expensive, time consuming, and, in some cases that involve humans or animals, unethical.

4-128. a: Answers vary, but outputs should be the same as the inputs.

b: Replace \( x \) with \( c \) in first function machine resulting in \( c - 5 \), then substitute this expression for \( x \) in the second function machine, yielding \( \frac{6(c - 5) + 8}{2} = 3c - 11 \).

Substitute this a third time in the final machine, giving \( \frac{3(c - 11) + 11}{3} = c \).

4-129. a: \( x \approx 781.36 \)  
   b: \( x = 6 \)  
   c: \( x = 1, \frac{1}{2} \)  
   d: \( x = 0, 1, 2 \)

4-130. a: \( x = \pm 5 \)  
   b: \( x = \pm \sqrt{11} \)

4-131. a:  
   b:  
   c:
Lesson 5.1.1

5-8.  a: The inputs and outputs are switched.
   b: See graph at right.
   c: \( y = 2(x + 3) \)
   d: Yes, \( y = x \).

5-9.  a: 9  b: \( x = 4 \)  c: \( x \approx 1.89 \)

5-10. Answers will vary, but it should have an “L” shape to it. In the middle there would probably not be any armrests to cut through.

5-11. a: no solution  b: \( x = \frac{8}{3} \)
   c: \( x \approx 3.17 \)  d: \( x = 2 \)  e: \( x = \frac{13}{3} \)

5-12. a: \( T(x) = 3(2)^x \)
   b: \( C(x) = 3(2)^x + 10 \)
   c: The graph for Clifton is the same as the graph for Tasha shifted up 10 units.

5-13. See graph at right. 6 sq. units

5-14. The multiplier 1.083 represents a growth rate of 8.3%; for example, the average cost of a ticket will go up 8.3% a year, where \( t \) is the number of years.
Lesson 5.1.2 Day 1

5-25. See graph at right.

5-26. a: \( f^{-1}(x) = \frac{1}{3}(x + 8) \)
    b: \( f^{-1}(x) = 2(x - 6) \)
    c: \( f^{-1}(x) = 2x - 6 \)

5-27. Not necessarily if the rectangle’s sides are not parallel or perpendicular to the axis of rotation, or the rectangle is not touching the line.

5-28. a: \( a = 3, b = \pm 5 \)
    b: \( a = 2, b = 3 \)

5-29. a: \( L(x) = x^2 - 1; \ R(x) = 3(x + 2) \)
    b: 30
    c: Order does matter. \( R(3) = 15 \) and \( L(15) = 224 \), so an input of 3 in the changed order did not result in an output of 30.

5-30. \( (x + 2)^2 + (y - 3)^2 = 4r^2 \)

5-31. \( y \leq -\frac{3}{4}x + 3, \ y \geq -\frac{3}{4}x - 3, \ x \leq 3, \ x \geq -3 \)
Lesson 5.1.2 Day 2

5-32. \( y = \frac{x}{5} + 2 \)
See graph at right.

5-33. It does not matter which graph is labeled as the function or the inverse; \( h^{-1}(x) \) is the inverse of \( h(x) \), and \( h(x) \) is the inverse of \( h^{-1}(x) \).

5-34. See graph at right. For \( f(x) \), domain: \(-2 \leq x \leq 5\), range: \(-3 \leq y \leq 3\);
For \( f^{-1}(x) \), domain: \(-3 \leq x \leq 3\), range: \(-2 \leq y \leq 5\). The domain and range are switched.

5-35. One way would be to sweep a rectangle only about 45° rather than to revolve it completely. Then the piece will only be a wedge.

5-36. a: \( \text{normalcdf}(70, 79, 74, 5) \approx 0.629 \), About 63% would be considered average.

b: \( \text{normalcdf}(-10^99, 66, 74, 5) \approx 0.055 \), About 5 to 6% of them would be in excellent shape.

c: \( \text{normalcdf}(-10^99, 66, 70, 5) - 0.0548 \) from part (b) \( \approx 0.157 \); There would be a nearly 16% increase in women her age who are classified as being in excellent shape.

5-37. a: horizontal shift right if \( t > 0 \), horizontal shift left if \( t < 0 \)

b: vertical stretch for \(|t| > 1\), vertical compression for \(|t| < 1\), reflection if \( t < 0 \).

5-38. a: \( \sqrt{-3} \cdot \sqrt{-3} = i\sqrt{3} \cdot i\sqrt{3} = i^2 \sqrt{9} = -3 \)

b: She multiplied \( \sqrt{-3} \cdot \sqrt{-3} \) to get \( \sqrt{9} = 3 \).

c: \( \sqrt{-3} \) is undefined in relation to real numbers, and is only defined as the imaginary number \( i\sqrt{3} \), so it must be written in its imaginary form before operations such as addition or multiplication can be performed.

d: \( a \) and \( b \) must be non-negative real numbers.
Lesson 5.1.3

5-45.  Trejo is correct, as long as the domains are restricted appropriately.

5-46.  a: 121  b: 17

5-47.  a: 3  b: 5  c: 4  d: $\frac{1}{2}$  e: $\frac{1}{4}$
        f: $\frac{1}{6}$  g: $\frac{1}{2}$  h: 4  i: a

5-48.  a: Square 9 and subtract 5; Caleb dropped in 76.
        b: $k^{-1}(x) = x^2 - 5$

5-49.  Remembering that lower times are better, for David: normalcdf(122, 10^99, 149, 13.6) 
        $\approx 0.976$; for Regina: normalcdf(130, 10^99, 145, 8.2) $\approx 0.966$. David is relatively faster,
        but the difference is very small!

5-50.  One possible solution method is $5x + 8x + 56 = 160$. $x = 8$. Or, the two missing sides
        must have total length 104 cm. Since the ratio is 5:8 with no broken rods, there must be
        some multiple of 5 + 8 = 13 number of rods that makes up the two missing sides. Since
        $13 \cdot 8 = 104$, the rods could be 8 cm long. The three sides of the tail fin are 56, 40, and
        64 cm. If the rods were, say 4 inches or 2 inches long, the length of the sides would still
        be the same.

5-51.
5-56. Domain: $x > 0$; Range: $-\infty < y < \infty$; $x$-intercept: $(1, 0)$; no $y$-intercept; asymptote at $x = 0$, increasing, continuous function

5-57. 
- $a$: $b = 3, 3^5 = 243$
- $b$: $b = 10, 10^{-3} = 0.001$

5-58. Yes, it is possible. Make the slice at the apex so the cross-section is a point or slice at an angle.

5-59. See solid curve on graph at right.
- $a$: domain: all real numbers; range: $y > -3$
- $b$: no
- $c$: $(0, -2), \approx 1.585, 0$
- $d$: See dashed curve on graph at right. domain: $x > -3$; range: all real numbers; $(0, \approx 1.585), (-2, 0)$

5-60. The yield of the Amazing Apples tree was $\frac{940 - 840}{120} = 0.83$ standard deviations above the mean, while the Amazing Mango tree was only $\frac{400 - 350}{190} = 0.26$ standard deviations above the mean. Put another way, the Amazing Apple tree was at normalcdf(−10^{99}, 940, 840, 120) $\approx 79.8$ percentile, while the Amazing Mango tree was at normalcdf(−10^{99}, 400, 350, 190) $\approx 60.4$ percentile. The Amazing Apples fertilizer appears to be more amazing based on this one sample.

5-61. 
- $a$: $(x + 2)^2 + (y - 13)^2 = 144$
- $b$: $(x + 1)^2 + (y + 4)^2 = 1$
- $c$: $(x - 3)^2 + (y + 8)^2 = 16$

5-62. 
- $a$: $g(f(x)) = 3((x^2 - 1) + 2)$ or $3x^2 + 3$
- $b$: $f(g(x)) = (3(x + 2))^2 - 1$ or $9x^2 + 36x + 35$
Lesson 5.2.2

5-68. \( x = 2^y \); The two equations do not look the same, but they are equivalent. They have the same graph or give the same table, or one is just a rewritten equation of the other.

5-69. a: \( x = \log_5(y) \)  
    b: \( x = 7^y \)  
    c: \( x = \log_8(y) \)  
    d: \( K = \log_A(C) \)  
    e: \( C = A^K \)  
    f: \( K = \left(\frac{1}{2}\right)^N \)

5-70. a: See graph and tables at right. \( x \neq -2 \) for the original function, which means \( y \neq -2 \) for the inverse function. \( x \neq -1 \) for the inverse function (because \( y \neq 1 \) in the original function).
    
    b: \( f^{-1}(x) = \frac{-2x-2}{x-1} \) or \( f^{-1}(x) = \frac{-4}{x-1} - 2 \)

5-71. a: \( x \geq -5 \)
    b: \( e^{-1}(x) = (x - 1)^2 - 5; \ x \geq 1 \)
    c: \( e^{-1}(e(-4)) = -4 \) because one machine undoes the other.
    d: They would be reflections of each other across the line \( y = x \).
    e: See graph at right.

5-72. The parent graph is \( y = x^2 \). The graph of \( y = f(x) \) is reflected over the \( x \)-axis to open downward, stretched vertically by a factor of 2, and then translated 1 unit right and 3 units up to have a vertex at \((1, 3)\).

5-73. \( \frac{6}{7} \)

5-74. \( x = -7, y = 11 \)
Lesson 5.2.3

5-78. \( y = \log_7(x) \)

5-79. 11. The problem is asking for the exponent for base 6 that will give 6 to the 11\(^{th}\) power. That is similar to Jonique’s question because the answer is stated in the question.

5-80. The first would produce two separate circles as the cross-section. The second would produce a ring.

5-81. a: hyperbola with parent graph \( y = \frac{1}{x} \), translated right 3 units and up 4 units
   b: square root graph with parent graph \( y = \sqrt{x} \), stretched vertically by a factor of 3
   c: \( y = 2x^2 - 3 \)
   d: \( y = -(x - 1)^3 + 4 \)

5-82. a: \( \text{normalcdf}(-10^{99}, 59, 63.8, 2.7) \approx 0.0377; \ 3.77\% \)
   b: \((0.0377)(324)(\text{half girls}) = 6 \text{ girls}\)
   c: \( \text{normalcdf}(72, 10^{99}, 63.8, 2.7) \approx 0.00119. \ (0.00119)(324)(\text{half}) \approx 0.19 \text{ girls}; \ We \ would \ not \ expect \ to \ see \ any \ girls \ over \ 6 \ ft \ tall. \ This \ assumes \ that \ the \ senior \ girls \ at \ North \ City \ High \ are \ a \ representative \ sample \ of \ women \ in \ the \ United \ States. \)
   d: It is likely that there will be girls over 6 ft tall, and the senior girls are probably not a representative sample of women in the U.S.

5-83. a: \( x \approx 6.24 \)  b: \( x = 5 \)

5-84. a: \(-102\)  b: \(-7\)  c: \( x = \sqrt{\frac{c+1}{2}} \)
   d: \( x = \frac{c-3}{5} \)  e: \( g^{-1}(x) = \frac{x-3}{5} \)
Lesson 5.2.4

5-89.  a: \( x = 25 \)    b: \( x = 2 \)    c: \( x = 343 \)  
       d: \( x = \sqrt{3} \)    e: \( x = 3 \)    f: \( x = 4 \)

5-90.  See graph at right.

5-91.  No; \( \log_3 2 < 1 \) and \( \log_3 3 > 1 \)

5-92.  a: 12 because \( 12^{0.926628408} \) is very close to 10.  
       b: Answers vary, but 12 fingers make sense for base 12.

5-93.  A bit like a Bundt cake form.

5-94.  Sample answer: Yes, because if the numbers are the same, the exponent you have used to get them is the same, given the same base.

5-95.  a: Domain of \( f(x) \) is \( x \leq 7 \) and range is \( f(x) \geq -6 \).  
       For \( f^{-1}(x) \), switch them: domain of \( f^{-1}(x) \) is restricted to \( x \geq -6 \) and range is \( f(x) \leq 7 \).  
       b: \( f^{-1}(f(a)) = a \)
Lesson 6.1.1

6-5. If the nickel is tossed and the die rolled there are 12 equally likely outcomes. He can make a list of each of the possible outcomes, assign one player to each outcome (H1-Juan, H2-Rolf, … T6-Jordan), and then toss the coin and roll the die to select.

6-6. a: 5%. See the table at right.
   b: \( \frac{0.60}{0.80} = 75\% \)

6-7. a: preface  b: biased wording
   c: desire to please  d: fair question

6-8. Less than 0; Possible justifications: \( \log(1) = 0 \), so \( \log(0.3) \) is less than 0. On the graph of \( y = \log(x) \), the \( y \)-values are negative for all \( x < 1 \).

6-9. a: 62.83 cm\(^3\)  b: 0.04 g/cm\(^3\)

6-10. They intersect at \( \left( \frac{1}{2}, 0 \right) \) and \( (3, 10) \).

6-11. Possible answer would be a sphere for the head and cylinders or cones for the legs.

Lesson 6.1.2

6-16. Most students will find that Myriah does the dishes between 8 and 17 of the 30 days, or about 2 to 4 days per week.

6-17. Theoretical probability: \( P(\text{sum } \leq 6) = \frac{15}{36} = 0.42 \); \( 0.42(7) \approx 3 \) days a week

6-18. c: Possible answer: Research: What is the average commute distance to school for teenagers? Survey: What is the distance from where you live to school?

6-19. a: \( x = \frac{1}{2} \)  b: any number except 0  c: \( x = 10^{23} \)

6-20. Students will need to solve graphically to get \( x \approx -3.2 \).

6-21. a: \(-3 < x < 3\)  b: \(-2 < x < 1\)  c: \(x \leq -2 \) or \( x \geq 1\)

6-22. \( f^{-1}(x) = \sqrt[3]{2x} - 1 \); See graph at right.
Lesson 6.1.3

6-24. b: Theoretically, the series should last for 5.8125 games, so 6 games.

6-25. b: Theoretically, a streak of 4 or more has probability of about 48%, a streak of five or more about 25%, a streak of six or more 12%, and a streak of seven or more about 6%.

6-26. a: See diagram at right.

b: In the RR rectangle, \( \frac{18}{38} \cdot \frac{18}{38} = \frac{324}{1444} \approx 22.44\% \).

c: Add the RR, BR, and GR rectangles,

\[
\frac{324}{1444} + \frac{324}{1444} + \frac{36}{1444} \approx 47.37\% .
\]

d: Considering only the column in which the second spin is red (RR, BR, GR), the probability the first spin is red (RR) is

\[
\frac{\frac{324}{1444} + \frac{324}{1444} + \frac{36}{1444}}{\frac{324}{1444}} \approx 47.37\% .
\]

e: They are the same.

6-27. The survey is not random. The sample is mostly adults who may work in the same or similar fields. People may be influenced by the responses of others. An individual may have several favorites but only state one.

6-28. It is the \( \log_5(x) \) graph shifted 2 units to the right. See graph at right.

6-29. a: 

b:

6-30. \( \pm 6, \frac{1}{2} \)
6-35.  a: 7.83%
        b: 5% and 11%
        c: About 7.8% ± 3% def. flashlights

6-36.  b: Theoretically, there will be 7.39 streaks of three or more in 60 days.

6-37.  Each uses a convenience sample. Each sample comes from a distinct population with people who have many things in common, including attitudes and beliefs about the subject matter of murals.

6-38.  See table at right. 0.6 · 0.5 = 30%

6-39.  a: $x = 12^y$
        b: $y^x = 17$
        c: $2x = \log_{1.75}(y)$
        d: $7 = \log_x(3y)$

6-40.  yes

6-41.  a: $\frac{30}{x-2} + 8 = \frac{10x}{x-2}$
        b: She should multiply by $(x - 2)$.  $x = 7$
Lesson 6.2.2

6-44.  \( a: 0.56 \) and \( 0.74 \)  \( b: \approx 65\% \pm 9\% \)

6-45.  Answers will vary, but should be 3\% plus/minus a number smaller than 1.7\%.

6-46.  \( a: \approx 27.04 \text{ feet} \)  \( b: \approx 176.88 \text{ cm} \)  \( c: \approx 28.94 \text{ meters} \)

6-47.  Students should conclude that energy usage will change by \(-1.3\%\) to 1.7\%. Indiana could save up to $11.7 million, but could end up spending $15.3 million.

6-48.  \( a: \) Answers will vary. Like a tournament, the students could be paired and the coin tossed for each pair. The “winners” are paired and the coin tossed again, repeating until there is just one student.

\( b: \) Three tosses. Tossing a coin 3 times has 8 equally likely outcomes: HHH, HHT, HTH, HTT, THH, THT, TTH, TTT. Assign each student an outcome and toss the coin 3 times.

\( c: \) Yes. Use the method outlined in part (b) repeatedly until a baseball player is not selected.

6-49.  \( a: x \approx 1.204 \)  \( b: x \approx 1.613 \)  \( c: x = 6 \)  \( d: x \approx 2.004 \)

6-50.  \( a: -1 < x < 3 \)  \( b: x \leq 1 \text{ or } x \geq 2 \)
Lesson 6.2.3

6-53.  a: \(\frac{1}{16}\) or 6.25%; yes

b: Her study provides no reliable evidence of her conclusion. She uses a convenience sample of only four people. Her question introduces bias with the preface about violence and crime. There may also have been a desire to please the interviewer. She uses a closed question, forcing romantic comedies as the only alternative to action movies. Even if there is no real preference among moviegoers, it is plausible that four people will have the same opinion between any two types of movies.

6-54.  sample mean: 248111, upper bound: 25037, lower bound: 24587; 90% of the time we expect that the copy machine will need maintenance after 24811 ± 225 copies. The interval of confidence is from 24586 to 25036. 25000 copies is within the interval of confidence, so the research company may support the copy machine company’s claim. They may also state that the copy machine company is pushing the limits with a claim of “at least 25000 copies”.

6-55.  a: 0.12

b: A difference of zero is not within the margin of error, so it is not a plausible result. A difference of zero means that there is no difference in the percentage of food removed with detergent compared with the percentage of food cleaned off with plain water.

c: Yes. Because a difference of zero is not within the margin of error; a difference of zero is not a plausible result for the population of all food cleaned. We are convinced there is between 3.5% and 20.5% (12% ± 8.5%) more food removed with detergent than with plain water.

6-56.  a: Yes. Possible response: Both equations have the same solutions.

b: Yes. Possible response: Both equations have the same solutions.

6-57.  a: \(x = 6.5\)

b: \(x = -3.75\) or \(x = 5\)

6-58.  a: \(x = 7\)

b: \(x = 2\)

c: (2, –5) and (–1, 4)

d: \(\left(\frac{3}{2}, \frac{7}{2}\right)\) and \(\left(\frac{3}{2}, -\frac{1}{2}\right)\)

6-59.  [Diagram of a triangle with axes and points labeled]
Lesson 6.2.4

6-63. The first process is wildly out of control; systems wildly out of control are often caused by inexperienced operators. The second process is fully in control. The third process is technically out of control at only one point, but the cyclical nature of the process is disconcerting. Any hypothesis that explains why the process is cyclical over 20 hours is acceptable.

6-64. Yes, 20% is within the margin of error of 13% ± 10%.

6-65. Yes. As little as 11.75 ounces is still within specifications.

6-66. a: See diagram at right.
   b: \( \frac{1}{3} + \frac{1}{2} = \frac{5}{6} \approx 83.3\% \)
   c: \( \frac{1}{2} \cdot \frac{1}{6} + \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{3} \approx 33.3\% \)
   d: \( \frac{P(\text{dad and emoticon})}{P(\text{emoticon})} = \frac{1}{3} \cdot \frac{3}{4} = 75\% \)

6-67. See graph at right. \( y = \log(x - 6) + 3 \)

6-68. a: \[ W^{-1}(x) \]
   b: No; when the points are interchanged, the input \( x = 0 \) has two outputs.

6-69. Assuming a normal distribution, \( \text{normalcdf}(68, 75, 63.8, 3.8) \approx 13\% \) of U.S. women fall between 5' 8" and 6' 3" tall. Therefore, 87% of U.S. women are shorter or taller than the height range of the cockpit.
Lesson 6.3.1 Day 1

6-73. This is a “Gambler’s Ruin” problem. The player with more coins always has a better chance of winning in the long run. Theoretically, \( P(\text{Jill}) = \frac{4}{6} = 67\% \), \( P(\text{Jack}) = \frac{2}{6} = 33\% \).

6-74. a: Before asking the question, the person conducting the survey is connecting funding decisions to censorship.
   
   b: People at home during the day are more likely to have time to bake than the general population.
   
   c: Possibly healthy habits. Healthy habits might increase the number of apples you eat and also decrease the number of cavities you have. The apples are not preventing the cavities, the healthy habits are.

6-75. a: \( 24 = b^a \)  
   b: \( 7 = (2y)^3x \)
   
   c: \( 5x = \log_2(3y) \)  
   d: \( 6 = \log_{24}(4p) \)

6-76. a: undefined
   
   b: \( x \neq 7 \)
   
   c: \( f(x) \neq 0 \)

6-77. \( f^{-1}(x) = -x + 6 \). Students can justify using a table, a graph, or by substituting a value.

6-78. \( x = 5 \) (\( x \approx 19.69 \) is extraneous)

6-79. a: \((4, 8, 4\sqrt{3}), (5, 10, 5\sqrt{3})\)  
   
   b: For this sequence, if the short leg is \( n \) units long, then the long leg is \( n\sqrt{3} \) units long, and the hypotenuse is \( 2n \) units long.
Lesson 6.3.1 Day 2

6-80.  a: 0.10

b: i. 25% of 40 + 15% of 40 = 16 putts go into the hole
ii. 1 to 16 will represent a putt that goes into the hole; 17 to 80 will represent a putt that misses.

c: A difference of zero means that there is no difference between the proportion of putts that go in the hole with the new club and the proportion of putts that go in with the old club. A difference of zero is within the margin of error, so it is a plausible result.

d: No. A difference of zero is within the margin of error, and a difference of zero is a plausible result for the population of all putts. We are not convinced there is a true difference in the number of putts that go in with the new club compared to the old club.

6-81. a: See possible diagram and answers below.

Cell A is the proportion of times the system correctly activated the alarm.
Cell B is the proportion of times the alarm was correctly not activated.
Cell C is the proportion of times A happened and the alarm was incorrectly not activated.
Cell D is the proportion of times A did not happen and the alarm was activated.

Or as a tree diagram:

b: \( \frac{0.03966}{0.03966+0.00096} = 97.6\% \)

c: Yes, it is independent because the accuracy of the alarm is the same regardless of whether event A occurs or not.

6-82. Answers vary but students should recognize that \( 0 < b < 1 \).

6-83. \( x = 7 \)

6-84. \( f^{-1}(x) = (x - 1)^2 + 3 \) for \( x \geq 1 \); See graph at right.

6-85. a: \( \approx 140,809.30 \)  b: \( \approx 24.2 \) years  c: \( \approx 164,706.25 \)
6-86.  a: See graph at right.

b: Answers will vary. See graph at right. Using statistical computations, we find that the boundaries are $6.71$ and $13.29$.

c: Answers will vary. 
\[ \text{normalcdf}(6.71, 13.29, 10, 2) \approx 0.9000 \]
Lesson 7.1.1

7-8. The first requires logs to solve while the second does not but one must take the cube root of both sides. Although the answers may be close to one another, they are not equivalent. The methods are not interchangeable.

7-9. In $2 = 1.04^x$ the variable is the exponent, but in $56 = x^8$ the exponent is known so you can take the $8^{\text{th}}$ root.

7-10. $x > 100$, because $10^2 = 100$.

7-11. a: $y = 11(3)^x$  b: $y = 40(0.8)^x$

7-12. a: $x \approx 17.673$  b: $x \approx 1.68$  c: $x \approx 0.53$

7-13. a: $-3 < x < 2$  b: $x \leq -1$ or $x \geq \frac{7}{3}$

7-14. a: Consider only $x \geq -2$ or $x \leq -2$.
   
   b: Depending on the original domain restriction, $y = \sqrt[3]{\frac{x+7}{3}} - 2$ or $y = -\sqrt[3]{\frac{x+7}{3}} - 2$.
   
   c: $x \geq -7$ and $y \geq -2$ or $x \geq -7$ and $y \leq -2$

Lesson 7.1.2

7-24. a: $x = \frac{\log(3)}{\log(2)}$  b: $x = \frac{\log(8)}{\log(5)}$  c: $x = \frac{\log(12)}{\log(7)}$  d: $x = \frac{\log(b)}{\log(a)}$

7-25. a: $x \approx 5.717$  b: $x \approx 11.228$

7-26. a: $\frac{5}{2}$ or 2.5  b: 2.5
c: The answers are the same. $\frac{\log_2 32}{\log_2 4} = \frac{\log 32}{\log 2} \cdot \frac{1}{\log 4} \cdot \frac{\log 2}{\log 4} = \frac{\log 32}{\log 4}$
d: $\frac{\log_5 7}{\log_3 2}$

7-27. It is the $\log_5(x)$ graph shifted 4 units to the left. See graph at right.

7-28. See completed table at right. $y = 3^x$

7-29. a: Slice below where all branches come back together, close to the ground.

b: Slice above where the branches branch off.

c: Slice very near where the branches come together; they must have contiguous sides so that shapes are not separated.

7-30. $y = -\frac{3}{4}(x-2)^2 + 3$
Lesson 7.1.3

7-35.  a: \( y = 40(1.5)^x \)

b: When \( x = -9 \), or 9 days before the last day of October so Ryan got his first pockmark on October 22.

7-36.  \( y = 100(1.047)^x \); Lorretta will have about $251 in the account after 20 years.

7-37.  The graph should show a decreasing exponential function which will have an asymptote at room temperature. Students should realize that the temperature of the drink would not drop below the ambient temperature of the room.

7-38.  Possible answer: \( 4^{(x+1)} = 6 \)

7-39.  ![Triangle Diagram]

\[ \text{Area} = 25 \text{ sq. units} \]

7-40.  \( i^3 = i^2i = -1i = -i; 1 \)

7-41.  a: \( x = -4 \) or \( \frac{5}{2} \)  

b: \( x = -4, 2, \) or 3

c: \( x = 0, -1, \frac{7}{2}, -\frac{4}{3}, 13, \) or \(-7\)

d: Set each of the factors equal to zero and solve the corresponding equations.
Lesson 7.1.4

7-43.  a: Decreasing by 20% means you multiply by 0.8 each time, and the presence of a multiplier implies exponential.
        b: $y = 23500(0.8^t)$
        c: $9625.60$
        d: $\frac{23,500 - 9625}{0-4} = -\$3468.60 / year$; During the first four years, the value of the car will depreciate the equivalent of $3468.60 per year.
        e: $\approx 6.12$ years
        f: $42,926.44$

7-44.  a: $x = 2.236$  b: $x = 4.230$
        c: $x = 0.316$  d: $x = 2.021$
        e: $x = 3.673$

7-45.  $x \approx 1.585$

7-46.  a: $y = \log(x)$  b: $x = 2$
        c: $y = \log_2(x - 2)$ is one possibility.

7-47.  a: See graph at right.
        b: The process has a lot of variability for the first 14 hours. There are two out-of-control points (one upper and one lower). Apparently an adjustment was made at hour 14 because the process is much less variable, but now there are nine consecutive points above the centerline of 0.075. Apparently another adjustment was made at hour 22, but this apparently swung the process to the very low end.

7-48.  a: $p^{-1}(x) = 3\sqrt{\frac{x}{3} - 6}$  b: $k^{-1}(x) = 3\sqrt{\frac{x - 6}{3}}$
        c: $h^{-1}(x) = \frac{x + 1}{x - 1}$  d: $j^{-1}(x) = \frac{3x - 1}{x} = -\frac{2}{x} + 3$

7-49.  a: $x$-intercepts $\approx (2.71, 0)$ and $(5.29, 0), (2.5, 0)$; $y$-intercept $(0, 43)$
        b: $x$-intercepts $(-1, 0)$ and $y$-intercept $(0, -5)$
Lesson 7.2.1

7-56.  a: Impossible, because the sum of the angle measures is less than 180°.
       b: Impossible, because a leg cannot be congruent to the hypotenuse.

7-57.  B

7-58.  a: 3         b: 1.5         c: 2         d: 12

7-59.  See graph at right. A circle centered at the origin with radius 5, shaded inside.

7-60.  Yes. She is in the 92nd percentile for French and the 91st percentile for Spanish.

7-61.  a: x: (−1, 0), y: (0, 2), V: (−1, 0), y = 2(x + 1)^2
       b: x: (0, 0), (2, 0), y: (0, 0), V: (1, 1), y = −(x − 1)^2 + 1

7-62.  a: \( \approx 74.2 \text{ m}^2 \)         b: \( \approx 36.2 \text{ meters} \)         c: No, \( \frac{6 \text{ goats}}{74.2 \text{ m}^2} = 0.08 \frac{\text{ goats}}{\text{m}^2} \).
Lesson 7.2.2

7-69.  a: They must have equal length. Since the base angles have equal measure, it is an isosceles triangle, or sides opposite equal angles must be the same length.

    b: ≈ 6.67 mm

7-70.  72 square units

7-71.  a: \( y = 4(5)^x - 1 \)  b: \( y = 6(0.4)^x + 7 \)

7-72.  a: See graph at right.

    b: The number of defects seems to be staying at or within control limits, but there is a cycle apparent every eight hours. Perhaps, as the inspectors work through their shift, they get tired and catch fewer errors.

7-73.  a: \( a + b \)  b: \( 2c \)  c: \( a + 2b \)  d: \( 3a + c \)

7-74.  a: \( f \) is translated 2 units left and 5 units down to obtain \( g \).

    b: To get the second graph, the first graph is translated right 1 unit, reflected vertically, and translated up 20 units.

    c: To get the second graph, the first graph is vertically stretched by factor of 3, reflected across the \( x \)-axis, and translated left 71 units.

7-75.  \( x = \frac{11}{5} \)
Lesson 7.2.3

7-80.  a: $x \approx 6.4$ units  b: $\approx 10.3$ square units

7-81.  a: $29^\circ$; $y$ is adjacent  b: $\cos(29^\circ) = \frac{y}{42}; \ y \approx 36.7$

7-82.  $\approx 5626.5$ square miles

7-83.  See graph at right. It is shifted to the right 4 units and up 2 units.

7-84.  a: $y \approx 25.05(1.061)^x + 0.2$
        b: Answers vary depending on precision used, about $874.64$

7-85.  a: See graph at right. They do not intersect.
        b: Use the Equal Values Method to confirm that there is no solution.

7-86.  a: For $f(x)$, domain must be restricted to $x \geq 0$, then $f^{-1}(x) = \sqrt{x - 3}$.
        b: $f^{-1}(x) = 4 \left( \sqrt[3]{x - 6} \right)$
        c: The range of $f(x)$ is $y \geq 0$, so $f^{-1}(x) = \frac{x^2 + 6}{5}$ with a domain of $x \geq 0$. 
Lesson 7.2.4

7-92.  a: The diagram should be a triangle with sides marked 116 ft and 224 ft and the angle between them marked 58°. See diagram at right.

   b: \( \approx 190 \) feet, Law of Cosines
   c: \( \approx 11,018 \) square feet

7-93.  a: \( x \leq -4 \) or \( x \geq 2 \)

b: \( -3 < x < 3 \)

7-94.  a: To use a normal model, the data should be symmetric, single-peaked, and bell shaped. Using the normal model here is not a good idea because the data is neither symmetric nor bell-shaped; it is skewed. A different model would represent the data better.

b: \( \frac{9}{48} \approx 19^{th} \) percentile. In about 19% of the hours over the 48-hour time period the coffee shop was not profitable.

c: \( \frac{41}{48} \approx 85^{th} \) percentile. In about 85% of the hours over the 48-hour time period, the coffee shop would not have been profitable. If this data represents a typical 48-hour period, it is probably not a good time to expand.

7-95.  a: \( x = 2^{10} \)

b: \( x = 242 \)

c: \( x = 4 \)

d: \( x = 7 \)

7-96.  a: \( g(x) = f(x) + 3 = x^2 + 3; \) Translated up 3 units.

b: \( h(x) = 3f(x) = 3x^2; \) Vertically stretched by a factor of 3.

c: \( j(x) = f(x + 3) = (x + 3)^2; \) Translated left 3 units.

7-97.  There is no real solution, because a radical cannot be equal to a negative value. If students miss this, they are likely to come up with the incorrect solution \( x = -2, \) but they should recognize that it is incorrect when they substitute it back in to check.
Lesson 7.2.5 Day 1

7-107. a: The third side is 12.2 units long. The angle opposite the side of length 10 is approximately 35.5° while the angle opposite the side of length 17 is approximately 99.5°.

b: ≈ 60.1 square units

7-108. x ≈ 4.9 units; Methods include using the Pythagorean Theorem to set up the equation $x^2 + x^2 = 7^2$, using the 45°- 45°- 90° triangle relationships to divide 7 by $\sqrt{2}$, or using sine or cosine to solve.

7-109. Area = $\frac{5(5\sqrt{3})}{2} \approx 34.2$ sq. units, perimeter = $15 + 5\sqrt{2} + 5\sqrt{3} \approx 30.7$ units

7-110. a: Repeat 1, i, −1, −i, etc.  
b: 1, i, −i, 1  
c: 1  
d: i, −1, −i  
e: 1, i, −1, −i

7-111. a: ≈ $564,240$  
b: 2025  
c: ≈ $36,585$

7-112. a: $y = \frac{5}{3}x - 4$  
b: $m_2 = \frac{F_r^2}{GM}$  
c: $v = \pm \sqrt{\frac{2F}{m}}$  
d: $y = \pm \sqrt{10 - (x - 4)^2} + 1$

7-113. a: $x = \pm \sqrt{3} = \pm \sqrt{\frac{15}{5}} = \pm 0.77$  
b: $x = 4, -1$  
c: $x = 4$
Lesson 7.2.5  Day 2

7-114.  a: See diagram at right.
        b: \( \frac{10}{\sqrt{3}} = \frac{10\sqrt{3}}{3} = 5.8 \text{ ft}; \) 30°- 60°- 90° triangle

7-115.  a: Yes.
        b: See graph at right, (it is not a function).
        c: Not necessarily.
        d: Functions that have inverse functions have no repeated outputs; a horizontal line can intersect the graph in no more than one place.
        e: Yes; for example, a sleeping parabola is not a function, but its inverse is a function.

7-116.  a: \( x = \frac{125}{2} \)  b: \( x = -\frac{4}{5} \)
        c: \( x = 0.04 \)  d: \( y = \frac{9}{4} \)

7-117.  a: 70  b: \( 7x - 21 \)  c: 43  d: \( 3x - 3 \)
        e: \( 3(x + 4)^2 - 5 \) \text{ or } \( 3x^2 + 24x + 43 \)
        f: \( -3x^2 + x + 2 \)
        g: Domain: all real numbers  h: Domain: all real numbers

7-118.  a: \( y = 3(6)^x - 3 \)  b: \( y = -2(0.5)^x + 1 \)

7-119.  \( x = 3, \ y = 1, \ z = 3 \)

7-120.  Reject the upper 10% of the data. Flaws should be \( \leq 12 \).
Lesson 8.1.1 Day 1

8-8.  

<table>
<thead>
<tr>
<th>a:  ( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>-9</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

\( f(x) = 8 - x \)

b:  

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>9</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
</tr>
</tbody>
</table>

\( g(x) = x^2 \)

d:  

a: 3; b: 4; c: 3

8-9. Functions in parts (a), (b), and (e) are polynomial functions. Part (c) is exponential and has the variable in the exponent. Part (d) is a square root function. The exponent for square root is a not a whole number. Part (f) has a term with a negative exponent \((x^2 + 5)^{-1}\).

8-10. a: See answers in bold in the table below.

<table>
<thead>
<tr>
<th>What ( g ) does to ( x ):</th>
<th>1(^{st})</th>
<th>2(^{nd})</th>
<th>3(^{rd})</th>
<th>4(^{th})</th>
</tr>
</thead>
<tbody>
<tr>
<td>adds 1</td>
<td>( )(^2)</td>
<td>divides by 3</td>
<td>subtracts 2</td>
<td></td>
</tr>
<tr>
<td>adds 2</td>
<td>multiplies by 3</td>
<td>( \sqrt{\phantom{0}} )</td>
<td>subtracts 1</td>
<td></td>
</tr>
</tbody>
</table>

b: \( f^{-1}(x) = \left(\frac{x - 3}{2}\right)^2 + 1 \), \( g^{-1}(x) = \sqrt{3(x + 2)} - 1 \)

8-11. a: \((-3 \pm \sqrt{5}, 0)\)  
b: \((74, 0)\) and \((-29, 0)\)

8-12. a: 0  
b: 3  
c: 4  
d: 64

8-13. a: \(10 + 2i\)  
b: \(-16 + 30i\)  
c: 50  
d: \(-12i\)  
e: \(-i\)  
f: 1

8-14. \(60^\circ\)
Lesson 8.1.1 Day 2

8-15.  a: \( x = 2 \) or \( x = 4 \)  
        b: \( x = 3 \)  
        c: \( x = -2, x = 0, \) or \( x = 2 \)

8-16.  a: \( f^{-1}(x) = \frac{x+3}{2} \)  
        b: \( h^{-1}(x) = \sqrt{x-2} + 3 \)

8-17.  a: \( \log(6) = \log(3) + \log(2) \approx 0.7781 \)  
        b: \( \log(15) = \log(3) + \log(5) \approx 1.1761 \)  
        c: \( \log(9) = 2\log(3) \approx 0.9542 \)  
        d: \( \log(50) = 2\log(5) + \log(2) \approx 1.6990 \)

8-18.  a: 4  
        b: 5  
        c: 3  
        d: 1  
        e: 2

8-19.  a: See graph at right.  
        b: \( y = 3x + 2 \)  
        c: 2, 5, 8, 11  
        d: One is continuous and one is discrete. They have the same slope so the “lines” are parallel, but they have different intercepts and domains.

8-20.  Yes, \( \frac{580}{1024} = 0.566 \). Adding and subtracting the margin of error, we can be reasonably sure the population proportion is between 0.536 and 0.596, which is greater than 0.500 (a majority).

8-21.  a: \( x = \frac{216}{5} \)  
        b: \( x = 7^{-4} = \frac{1}{7^4} \)  
        c: \( x = 2 \)  
        d: \( x = 20 \)
Lesson 8.1.2

8-32. It does not. The roots are complex, so there are no x-intercepts.

8-33. Possible answers listed below.
   a: \( y = 2x^2 + 5x - 3 \)  \hspace{1cm} b: \( y = -2x^2 - 2x + 12 \)

8-34. a: 2 \hspace{1cm} b: 5 \hspace{1cm} c: 3 \hspace{1cm} d: 4

8-35. Lines, parabolas (vertically oriented), and cubics are polynomial functions because the terms in their equations can all be written in the form \( ax^n \). Exponentials are not polynomial functions because “\( x \)” is the exponent. Circles are not functions.

8-36. a: \( y = 20\left(\frac{1}{2}\right)^x + 5 \) \hspace{1cm} b: \( w = 5.078 \)

8-37. \( \frac{45\, \text{ft}}{60\, \text{ft}} = \frac{315\, \text{ft}}{(60+x)\, \text{ft}} ; \ 420 \text{ feet} \)

8-38. \( (\pm\sqrt{7}, 3), (0, -4) \)
Lesson 8.1.3

8-48. Possible equation: \( p(x) = 2.5(x + 4)(x - 1)(x - 3) \)

8-49. a: Yes, substitute it into the equation to check.
   
   b: \( x = 5 - 2i \)
   
   c: It does not; the roots are complex.

8-50. a: degree 4, \( a_4 = 6, a_3 = -3, a_2 = 5, a_1 = 1, a_0 = 8 \)
      
      b: degree 3, \( a_3 = -5, a_2 = 10, a_1 = 0, a_0 = 8 \)
      
      c: degree 2, \( a_2 = -1, a_1 = 1, a_0 = 0 \)
      
      d: degree 3, \( a_3 = 1, a_2 = -8, a_1 = 15, a_0 = 0 \)
      
      e: degree 1, \( a_1 = 1 \)
      
      f: degree 0, \( a_0 = 10 \)

8-51. a: \( x = 4 \) or \( x = -2 \)       b: \( x \approx 2.81 \)

8-52. a: 5,000,000 bytes
      
      b: \( \approx 12.3 \) minutes
      
      c: According to the equation, technically never, but for all practical purposes, after 23 minutes.

8-53. a: \( \sqrt{3} \)       b: 4       c: \( 6\sqrt{2} \)       d: 1

8-54. a: \( 4 \leq y \leq 10 \)    b: \( m > 1 \) or \( m < -2 \)

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Lesson 8.2.1

8-65.  a: \( y = (x - (3 + 4i))(x - (3 - 4i)) = x^2 - 6x + 25 \)

b: \( (x - 3)^2 = (4i)^2 \), so \( x^2 - 6x + 25 = 0 \), so the related function is \( y = x^2 - 6x + 25 \).

c: Answers vary.

8-66.  a: Yes; degree 3

b: Yes; degree 7

c: No; it contains an exponent of \( x \).

d: No; it contains a non-integer exponent \( \left( \frac{1}{2} \right) \).

e: Yes; degree 3

f: No; it contains a term that is a fraction with \( x \) in the denominator.

8-67.  a: \( y = 4x^2 + 5x - 6 \)

b: \( y = 3x^2 - 15 \)

8-68.  a: \( D: x \geq 2; \ R: f(x) \geq 2 \)

b: \( f^{-1}(x) = \frac{(x-2)^2}{2} + 2 \)

c: \( D: x \geq 2; \ R: f^{-1}(x) \geq 2 \)

8-69.  a: \( 10 + 11i \)  
b: \( 13 \)  
c: \( 29 \)  
d: \( a^2 + b^2 \)

8-70.  No. Using the Pythagorean Theorem and the Law of Cosines, the perimeter of the triangle is \( \approx 26.3 \) feet.

8-71.  See graph at right.

  a: Domain is all real numbers

  b: See graph far right.

c: \( f(x) \) is a continuous function with a domain of all real numbers while the graph of \( t(n) \) is discrete with a domain of positive integers.
Lesson 8.2.2

8-77. a: 

b: 

c: 

d: 

e: a: 5, b: 5, c: 4, d: 6

8-78. Possible functions listed below.

a: \( f(x) = x^2 + 6x + 10 \)  
b: \( g(x) = x^2 - 10x + 22 \)  
c: \( h(x) = x^3 + 2x^2 - 7x - 14 \)  
d: \( p(x) = x^3 + 2x^2 - 14x - 40 \)

8-79. a: \( x = 3, 0, -3 \)  
b: See graph at right.

8-80. a: \( x \approx 2.5121 \)  
b: \( x = \sqrt[3]{57y} \)

8-81. a: \( -21 \)  
b: \( -10 + 7i \)  
c: \( -22 + i \)

8-82. Her sink should be located \( 3 \frac{2}{3} \) feet from the right front edge of the counter. This will make the perimeter \( \approx 25.6 \) feet, which will meet industry standards.

8-83. a: The manager calculated the average rate of change between 2:04 p.m. and 2:15 p.m. and then used it to predict the amount of time it will take for the temperature to drop to 70ºF. For the temperature to drop from 85ºF to 70ºF by 3:00 p.m., the average rate of change must be \( \frac{15}{56} \approx 0.27º \text{ per min} \). Therefore at 2:15 p.m. it was about 82ºF.

b: \( \frac{2}{25} \approx 0.0776º \text{ per min} \); The average rate of cooling near 70ºF was only about a quarter of the rate when the cooling started.
Lesson 8.3.1 Day 1

8-92.  a: \( x = -7 \)

b: Substitute \( x = -7 \) into the original equation.

c: \( (x + 7) \)

d: Divide \( x^3 + 5x^2 - 16x - 14 \) by \( (x + 7) \) to get \( (x^2 - 2x - 2) \).

e: \( (x + 7)(x^2 - 2x - 2) = 0 \)

f: \( x = -7, 1 \pm \sqrt{3} \)

8-93. \( x = 1, \ x = \frac{1}{2} \), or \( x = -3 \)

8-94. Part (c), because \( (-2)(3)(-5) = 30 \) and \( (x)(x)(x) = x^3 \) not \( 2x^3 \).

8-95.  a: \( (x - 2)(5x + 3) \)

b: \( x = -\frac{3}{5}, 2 \)

c: Explanations vary.

8-96. See graph at right.
\[
g^{-1}(x) = \sqrt{x + 3} - 1; \quad D: x \geq -3, \ R: y \geq -1
\]

8-97. a: 20, 100, 500

b: \( n = 7 \)

c: No, because solving the equation \( 94500 = 4(5)^n \) does not result in a positive integer.

8-98. \( y = \frac{1}{5}x + \frac{27}{5} \)
Lesson 8.3.1 Day 2

8-99. Part (b), because 5 is a factor of the last term, but 2 and 3 are not.

8-100. \((x - 5)(x^2 - 4x - 1)\); roots: \(x = 5, 2 \pm \sqrt{5}\)

8-101. a: \(2x^4 - x^2 + 3x + 5 = (x - 1)(2x^3 + 2x^2 + x + 4) + 9\)
   b: \(x^5 - 2x^3 + 1 = (x - 3)(x^4 + 3x^3 + 7x^2 + 21x + 63) + 190\)
   c: 3 and 2 are factors of the constant term 6 and numerators of the solutions, while 5 and 1 are factors of the leading coefficient 5 and denominators of the solutions.

8-102. a: degree 3; two distinct real (one single, one double) roots
   b: degree 3; one real and two complex roots
   c: degree 4; four real roots
   d: degree 4; two real and two complex roots

8-103. a: \(x\)-intercepts \((-\frac{5}{2}, 0), (0, 0), \text{ and } \left(\frac{7}{2}, 0\right)\)
   \(y\)-intercept \((0, 0)\)
   b: \(x\)-intercepts \((-3, 0)\) and \(\left(\frac{15}{2}, 0\right)\) (double root),
   \(y\)-intercept \((0, 675)\)

8-104. a: 1  b: \(\frac{1}{2}\)  c: undefined  d: 9

8-105. \(m\angle C \approx 40.5^\circ\)
Lesson 8.3.2 Day 1

8-112. a: It shows that \((x - 3)\) is a repeated factor and \(x = 3\) is a double root.
   
   b: \(p(x) = (x - 3)^2(x^2 + 2x - 1); \ x = 3, \ -1 \pm \sqrt{2}\)

8-113. a: \(p(2) = 0; \ (x - 2)\)
   
   b: \(p(x) = (x - 2)(x - (-3 + 2i))(x - (-3 - 2i)); \ x = 2, -3 \pm 2i\)

8-114. a: \(f^{-1}(x) = \frac{1}{3}(\frac{x-5}{2})^2 + 1 = \frac{1}{12}(x-5)^2 + 1\) for \(x \geq 5\)
   
   b: See graph at right.

8-115. \(y = 4(0.4)^x + 5\)

8-116. \(x = -8\)

8-117. a: \(x = \frac{\sqrt{3}}{4}\)  
   
   b: \(x = 1\)

8-118. a: The number of cards on the field is \(768 \times 1029 = 790,272\) cards. The probability is \(\frac{1}{790272}\) or 0.000001265.
   
   b: \(\frac{790,272 \text{ cards}}{\text{packs}} = 15,198\) packs of cards. The maximum loss is if the first player chooses a card and wins: \(-$1,000,000\) prize \(- ($0.99)(15,198)\) cost of packs \+ $5 from the player = \(-$1,015,041.02.\) (If nobody plays, then the million dollars is not paid out, and the boosters do not have the maximum possible loss.)
   
   c: If all of the chances are purchased, \(-$1,000,000\) prize \(- ($0.99)(15,198)\) cost of packs \+ ($5)(790,272) from players = $2,936,313.98.
   
   d: On average half the cards would be sold before there was a winner, \(-$1,000,000\) prize \(- ($0.99)(15,198)\) cost of packs \+ ($5)(395,136) from players = $960,633.98
   
   e: \(\frac{176,000,000}{790,272} \approx 223\) football fields would have to be covered to give the same odds as winning the state lottery!
Lesson 8.3.2 Day 2

8-119. a: \( x = -1, \frac{1±i\sqrt{3}}{2} \)

\[
\begin{array}{c}
\text{y-axis} \\
\text{y} \\
\text{x} \\
\end{array}
\]

b: \( x = 2, -1±\sqrt{3} i \)

\[
\begin{array}{c}
\text{y-axis} \\
\text{y} \\
\text{x} \\
\end{array}
\]

8-120. \( p(x) = x^3 + 5x^2 + 33x + 29 \)

8-121. a: \( p(2) = 0 \) b: \( (x - 2) \)

\[
\begin{array}{c}
\text{y-axis} \\
\text{y} \\
\text{x} \\
\end{array}
\]

c: \( (x^2 - 4x - 1) \) d: \( x = 2, 2±\sqrt{5} \)

8-122. \( b ≥ 20 \) or \( b ≤ -20 \)

8-123. Estimations should be between 310 and 320. Exact answer using advanced computation is 313.5.

8-124. 16.5 months; 99.2 months

8-125. a: \( \log_3(2xy^8) \) b: \( \log_4\left(\frac{5m}{n^r}\right) \)
Lesson 8.3.3

8-130. (0, 0), (3, 0), and (–0.5, 0)

8-131. 

8-132. a: \((x + \sqrt{10})(x - \sqrt{10})\)  
b: \(\left(x - \frac{3 + \sqrt{37}}{2}\right)\left(x - \frac{3 - \sqrt{37}}{2}\right)\)  
c: \((x + 2i)(x - 2i)\)  
d: \((x - (1 + i))(x - (1 - i))\)

8-133. a: \(x = \frac{\log_{17}}{\log_3}\)  
b: \(x = \sqrt[3]{17}\)

8-134. 64.16°; unsafe

8-135. a: \(a^3 + b^3\)  
b: \(x^3 - 8\)  
c: \(y^3 + 125\)  
d: \(x^3 - y^3\)  
e: They consist only of two terms; they are sums or differences of cubes.

8-136. a: \(\frac{1}{16}\)  
b: \(\frac{3}{16}\)
Lesson 8.3.4

8-144. a: Yes; it is the difference of the square \((3xy^2)^2\) and the square \((z^3)^2\).
   b: \((3xy^2 + z^3)(3xy^2 - z^3)\)

8-145. a: real        b: complex        c: complex
   d: real        e: real        f: complex

8-146. a: \(p(5) = 24\)
   b: \(p(1) = 0;\ x = 1\) is a root of the polynomial and \((x - 1)\) is a factor of the polynomial.

8-147. a: \(y = x^2 + 1\)
   b: \(y = x^2 - 2x - 1\)

8-148. A

8-149. a: \(t(n) = 40\left(\frac{1}{4}\right)^n\) or \(10\left(\frac{1}{4}\right)^{n-1}\)
   b: \(t(n) = -6n + 4\)

8-150. This might be tough for some students to visualize. The cross-sections of the first in this orientation will be equilateral triangles. In the second, the shapes are more complicated. The “first” cross-section is a line segment, and it expands to a rectangle; one side of the rectangle grows while the other shrinks until the cross-section is back to a line segment perpendicular in orientation to the first.
Lesson 9.1.1

9-3.  a: The shape would be stretched vertically. In other words, there would be a larger distance between the lowest and highest points of the curve.

   b: Each repeating section would be longer. Fewer repeating sections would fit on a page of the same length.

9-4.  $30^\circ-60^\circ-90^\circ$: $\frac{1}{2}, \frac{\sqrt{3}}{2}$; $45^\circ-45^\circ-90^\circ$: $\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}$

9-5.  a: $\log_3(5m)$  b: $\log_6\left(\frac{p}{m}\right)$

   c: not possible  d: $\log(10) = 1$

9-6.  Degree 4; Graph shown at right.

9-7.  90.21 feet or 4.71 feet

9-8.  a: 15, 21, 27, 33, $t(n) = 6n - 3$

   b: 27, 81, 243, 729, $t(n) = 3^n$

   c: Sequences and equations vary.

9-9.  a: $n = \sqrt[3]{49} \approx 3.66$

   b: $n = \frac{\log 49}{\log 3} \approx 3.54$

   c: $n = \frac{\log 49}{\log 3} - 1 \approx 2.54$
Lesson 9.1.2 Day 1

9-13. a: $30^\circ$-$60^\circ$-$90^\circ$: hypotenuse: $2$, leg: $\sqrt{3}$; $45^\circ$-$45^\circ$-$90^\circ$: hypotenuse: $\sqrt{2}$, leg: $1$
   
   b: See diagram at right.

9-14. $\approx 17.46^\circ$

9-15. a: Possible equation: $y = -\frac{3}{3125} (x - 125)^2 + 15$
   
   b: David’s ball traveled farther at 250 yards while Dwayne’s ball traveled 240 yards. Dwayne’s ball went higher at 18 yards compared to David’s ball which reached a height of 15 yards.

9-16. $x^2 + 25$

9-17. $x = 2$ or $\pm 5i$

9-18. a: Possible answer: about $-10$ new infections per week for $0 \leq x \leq 2$; about $-470$ new infections per week for $2 \leq x \leq 5$; about $-30$ new infections per week for $6 \leq x \leq 10$; about $+10$ new infections per week for $10 \leq x \leq 13$.

   b: From weeks 2 through 3 or 5 or 6 the average rate of change of new infections decreased the most.

   c: After 10 weeks the number of new infections seems to be increasing!

9-19. a: $18432\pi$ cubic in, or about 57,906 cubic in of candy.
   
   b: $c = \frac{4}{3} \pi (12r)^3 = 2304\pi r^3$
Lesson 9.1.2 Day 2

9-20. \(-\infty < \theta < \infty\)

9-21. \(\approx 40.5^\circ\) or \(\approx 139.5^\circ\)

9-22. See graph at right.

9-23. a: \(t(n)\) is arithmetic, \(h(n)\) is geometric, \(q(n)\) is neither.

   b: No, because all three graphs do not intersect at a single point.

   c: \(h(1) = q(1) = 12\) and \(t(2) = h(2) = 36\); Continuous graphs for \(t(n)\) and \(q(n)\) intersect but not for an integer \(n\).

9-24. a: \(x = 7\)            b: \(x = 1.5\)            c: \(x \approx 1.75\)            d: \(x \approx 1.87\)

9-25. a: \(x = 1\)            b: \(x = \frac{\sqrt{5}}{2}\)

9-26. No. The area of the classroom is 500 square feet. Given the dimensions of the room, the maximum coverage would come from organizing the rugs in a 4 by 5 arrangement. Thus, the area of coverage would be 20 times the area of one rug \((A = \pi r^2 \approx 19.63\) square feet) or approximately 392.7 square feet. The rugs only cover 78.5% of the classroom floor.

Lesson 9.1.3

9-30. See graph at right.

9-31. (A): above ground just past the highest point, slightly left of center; (B): just below ground and left to f center; (C): back to the starting point. See diagram at right.

9-32. \(x = 2\) or \(x \approx 1.1187\)

9-33. a: \(x^2(x + 2y)(x^2 - 2xy + 4y^2)\) b: \((2y^2 - 5x)(4y^4 + 10xy^2 + 25x^2)\)

9-34. The lake is about 1039 meters wide. This means Yee might have a problem.

9-35. a: \(3 + 2i\)            b: \(1 + 4i\)            c: \(5 + i\)

9-36. a: The box must be at least 4 ft by 4 ft by 4 ft for a volume of at least 64 cubic feet.

   b: Piñatas with radius less than 1.18 feet, or about 14 inches.

   c: \(r = \frac{3\sqrt{v}}{2}\)
9-45. \( P: (\cos(50^\circ), \sin(50^\circ)) \) or \((\approx 0.643, \approx 0.766)\); \( Q: (\cos(110^\circ), \sin(110^\circ)) \) or \((\approx -0.342, \approx 0.940)\)

9-46. \( a: 300^\circ \) \hspace{1cm} \( b: \frac{1}{2} \) and \( \frac{\sqrt{3}}{2} \) \hspace{1cm} \( c: \left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)\)

9-47. \( \left(\frac{\sqrt{15}}{4}, \frac{1}{4}\right) \) or \(\left(-\frac{\sqrt{15}}{4}, \frac{1}{4}\right)\)

9-48. \( \approx 278 \) months or \( \approx 23 \) years

9-49. \( a: (x \pm 1), (x \pm 7) \)
\( b: \) Neither is a factor. Use substitution to determine whether \(-1\) and \(1\) are zeros. Or, divide and see that \((x + 1)\) and \((x - 1)\) are not factors because there is a remainder (i.e., use the Remainder Theorem).

9-50. \( a: x = -3 \) or \( x = 2 \) \hspace{1cm} \( b: x < -3 \) or \( x > 2 \)

9-51. \( a: x \approx 1.356 \) \hspace{1cm} \( b: x \approx 2.112 \) \hspace{1cm} \( c: x \approx 1.792 \)

9-52. \( 58^\circ, 122^\circ, 238^\circ, \) or \( 302^\circ; \) \( \cos(\theta) = \pm 0.53 \)

9-53. \( a: \) Any angle in the \(4^{\text{th}}\) quadrant. \hspace{1cm} \( b: 270^\circ \)
\( c: \) Any angle in the \(3^{\text{rd}}\) quadrant. \hspace{1cm} \( d: \approx 160^\circ \)
\( e: \) No, an angle with a sine of \(0.9\) has cosine of \(\approx \pm 0.4359\). Or, the point \((0.8, 0.9)\) is not on the unit circle because \(0.8^2 + 0.9^2 \neq 1^2\).

9-54. \( a: \approx (0.3420, 0.9397) \) \hspace{1cm} \( b: (\cos(70^\circ), \sin(70^\circ)) \)
\( c: \cos^2(70^\circ) + \sin^2(70^\circ) \approx 0.1170 + 0.8830 = 1 \)

9-55. Graph \(A\) is sine, while graph \(B\) is cosine. Possible explanations include since \(\sin(0) = 0\), the sine function passes through the origin, \(\cos(0) = 1\), and the cosine graph passes through the point \((0, 1)\).

9-56. \( a: \) All yes. \hspace{1cm} \( b: \) Sample answers: \(x = \pm 180^\circ, \pm 540^\circ, \pm 900^\circ\) etc.
\( c: x = (-180^\circ + 360^\circ n)\) for all integers \(n\)

9-57. \( y = -\frac{1}{4} (x - 2)(x + 2)^2 \)

9-58. \( a: \) See graph at right.
\( b: f^{-1}(x) = (2(x + 1))^2 - 4 \) for \(x \geq -1\)
\( c: D: x \geq -1; \ y \geq -4 \)
Lesson 9.1.5

9-65.  a: Same; \( \frac{\pi}{3} \) and 60° are equivalent angle measures.

   b: 45°, 135°, 405°, etc.

9-66.  a: \( \frac{\sqrt{2}}{2} \approx 0.707 \)  b: \( \frac{\sqrt{3}}{2} \approx 0.866 \)

9-67. Colleen’s calculator is in radian mode, while Jolleen’s calculator is in degree mode. Colleen’s calculation is wrong.

9-68.  a: \( x = 4 \)  b: \( x = 200 \)

9-69.  a: \((2x - 3y)(2x + 3y)\)

   b: \(2x^3(2 + x^2)(2 - x^2)\)

   c: \( (x^2 + 9y^2)(x - 3y)(x + 3y) \) or \( (x + 3iy)(x - 3iy)(x - 3y)(x + 3y) \)

   d: \(2x^3(4 + x^4) \) or \( 2x^3(x^2 + 2i)(x^2 - 2i) \)

   e: Parts (a) – (c) are all a difference of squares.

9-70.  a: \( x = -\frac{21}{2} = -10.5 \)  b: \( x = -13 \)

9-71. A solid treetop would weigh about 102.78 grams, which would be too heavy. Making the treetop hollow will lighten the load on the trunk.
Lesson 9.1.6

9-76.  a: $30^\circ$  b: $60^\circ$  c: $67^\circ$  d: $23^\circ$

9-77.  a: $-0.76$  b: $-\frac{\sqrt{3}}{2}$

9-78.  $\theta = \frac{\pi}{6}, \frac{5\pi}{6}$

9-79.  $\frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}, \frac{3\pi}{4}, \frac{5\pi}{6}, \pi, \frac{7\pi}{6}, \frac{5\pi}{4}, \frac{4\pi}{3}, \frac{3\pi}{2}, \frac{5\pi}{3}, \frac{7\pi}{4}, \frac{11\pi}{6}, 2\pi$

9-80.  See diagram at right.
   a: A little less than 360º (almost 344º).
   b: $\sin(6) \approx -0.3$

9-81.  a: The more rabbits you have, the more new ones you get, but a linear model would grow by the same number each year. A sine function would be better if the population rises and falls, but more data would be needed to apply this model.
   b: $R = 80,000(5.477)^t$
   c: $\approx$ 394 million
   d: 1859; It seems okay that they grew to 80,000 in 7 years, if they are growing exponentially.
   e: No, since it would predict a huge number of rabbits now. The population probably leveled off at some point or dropped drastically and rebuilt periodically.

9-82.  $2x^4 - 2x + 1 + \frac{-1}{x-3}$
Lesson 9.1.7

9-88. 420°
   a: $\frac{\pi}{3} \pm 2\pi n$
   b: See diagram at right.
   c: $\frac{\sqrt{3}}{2}, \frac{1}{2}, \sqrt{3}$

9-89. a: 0     b: 0     c: $-1$
       d: 0.5    e: 0     f: undefined

9-90. Set up a proportion or use $\frac{\pi}{180}$.

9-91. a: 210°   b: 300°   c: $\frac{\pi}{4}$ radians
       d: $\frac{5\pi}{9}$ radians   e: $\frac{9\pi}{2}$ radians   f: 630°

9-92. a: $-\frac{5}{13}$   b: $\frac{5}{12}$

9-93. no solution

9-94. $P(x) = \frac{1}{4} (x - 3)(x - 2)(x + 1)$
Lesson 9.2.1

9-98.  a: See graph at right.
   b: Change “k”.  \( y = \sin(x) + 1 \)
   c: \( y : (0, 1), x : \left(-\frac{\pi}{2}, 0\right), \left(\frac{3\pi}{2}, 0\right), \left(\frac{3\pi}{2}, 0\right), \ldots \)
   d: Yes, there are infinitely many x-intercepts at intervals of \( 2\pi \) starting at \( x = \frac{3\pi}{2} \).

9-99.  a: \( \pi \) units  b: \( y = \sin(x + \pi) \)

9-100.  a: This may go up or down, but the cycles are probably of differing length.
   b: This may or may not be periodic.
   c: This is probably approximately periodic.

9-101. \( y = 100 \sin(x + \frac{\pi}{2}) - 50 \) or \( y = 100\cos(x) - 50 \)

9-102. Only one needs to be a parent, since \( y = \sin(x + 90^\circ) \) is the same as \( y = \cos(x) \).

9-103. \((-5, 0), (\frac{\pi}{3}, 0), (-\frac{1}{4}, 0)\)

9-104. \( \approx 75.52^\circ, 75.52^\circ, \) and \( 28.96^\circ \)

Lesson 9.2.2

9-109.  a: yes  b: \( y = \cos(x + \frac{\pi}{2}) \)  c: \( y = -\sin(x) \)

9-110. \( 360^\circ \) is the period of \( y = \cos(\theta) \), so shifting it \( 360^\circ \) left lines up the graphs exactly.

9-111.  a: \(-\sqrt{3}\)  b: \( \frac{\sqrt{3}}{3} \)

9-112. Students will need to realize (if they do not recognize this as the sides of a \( 30^\circ-60^\circ-90^\circ \) right triangle) that \( 1 \) is the longest side and they can show it is a right triangle by using the Pythagorean Theorem.

9-113. At 6 years, it will be worth $23,803.11. At 7 years it will be worth $25,707.36.

9-114. a, d

9-115.  a: \( (x - 3)(x^2 - 2x + 5) \)  b: \( x = 3, 1 \pm 2i \)
Lesson 9.2.3

9-122. a: Amplitude 3, period $4\pi$
   b: See graph at right.
   c: The differences are the period and amplitude, and therefore some of
   the $x$-intercepts. They have the same basic shape.

9-123. 1; $\frac{2\pi}{2\pi} = 1$ or $2\pi(1) = 2\pi$

9-124. $y = \sin 2(x - 1)$ is correct. To shift the graph one unit to the right, subtract 1 from $x$ before
   multiplying by anything.

9-125. a: $x = 4$  
   b: $x = 4\sqrt{2}$

9-126. a: $x = \frac{\log_{29}}{\log_3} = 3.065$  
   b: $x = -\frac{\log_{29}}{\log_3} = -3.065$  
   c: $x = \sqrt[3]{29} = 3.072$
   d: $x = \sqrt[3]{29} = -3.072$
   e: About 6 years from now.

9-127. $(-2, -1)$ and $(3, 4)$

9-128. $\frac{2}{3}$

Lesson 9.2.4

9-136. Answers may vary, but $y = 7 \sin \left(\frac{x}{4}\right)$ works.

9-137. a: $180^\circ$  
   b: $540^\circ$  
   c: $\frac{\pi}{6}$ radians  
   d: $45^\circ$
   e: $\frac{5\pi}{4}$ radians  
   f: $270^\circ$

9-138. a: $-\frac{\sqrt{2}}{2}$  
   b: $\sqrt{3}$  
   c: $-\frac{1}{2}$  
   d: $\frac{\sqrt{2}}{2}$
   e: 1  
   f: $-\frac{1}{\sqrt{3}}$ or $-\frac{\sqrt{3}}{3}$  
   g: $\frac{\pi}{4}$ or $\frac{5\pi}{4}$  
   h: $\frac{3\pi}{4}$ or $\frac{7\pi}{4}$

9-139. a: $\log_2(5x)$  
   b: $\log_3(5x^2)$  
   c: $x = 17$
   d: $x = -\frac{9}{20} = -0.45$
   e: $y = 15$  
   f: $x = 4$

9-140. $\pm 11, \pm 9, \pm 19$

9-141. a: $t(n) = 4n - 27$ or $t(n) = 4(n - 1) - 23$  
   b: The 2507th term has a value of 10001.

9-142. a: Let $y = $ total cost ($), $d =$ number of days, and $m =$ miles driven $y = 25d + 0.50m$
   and $y = 0.3(2)^{m-1}$
   b: Rip-off vs. Teacher: $55$ vs. $15.36$, $60$ vs. $15,728.64$, $100$ vs. $\sim 1.901 \times 10^{28}$
Lesson 10.1.1

10-7. a: 4050
   b: 300, 550, 800, ..., 4050; \( t(n) = 250(n - 1) + 300 \) or \( t(n) = 250n + 50 \)

10-8. a: $165
   b: \( t(n) = 5(n - 1) + 50 \) or \( t(n) = 5n + 45 \)
   c: $930

10-9. a: 15  b: \( \binom{n}{4} = 360 \)

10-10. a: \( t(n) = 3 + 7(n - 1) \) or \( t(n) = 7n - 4 \)  b: \( t(n) = 20 - 9(n - 1) \) or \( t(n) = 29 - 9n \)

10-11. -2

10-12. a: \( x \approx 46.71 \)  b: \( x \approx 8.19 \)

10-13. Multiple answers are possible.
   a: \( y = \sin(x - \frac{\pi}{4}) + 2 \)  b: \( y = 1.5\sin(x - \frac{\pi}{2}) + 0.5 \)
   c: \( y = -\sin(x - \frac{\pi}{6}) + 2 \) or \( y = \sin(x + \frac{2\pi}{3}) + 2 \)  d: \( y = 3\sin(x - \frac{2\pi}{3}) - 1 \) or \( y = -3\sin(x + \frac{\pi}{3}) - 1 \)

10-14. 34,800 people

10-15. Yes, because the sum of the diameters is 830 mm.

10-16. 235

10-17. \((-6) + (-3) + 0 + 3 + 6 + 9 + 12 + 15 + 18\)

10-18. Yes, it is the 55th term.

10-19. See answers in bold in the table below.

<table>
<thead>
<tr>
<th>Angle</th>
<th>$-90^\circ$</th>
<th>$-45^\circ$</th>
<th>$0^\circ$</th>
<th>$45^\circ$</th>
<th>$90^\circ$</th>
<th>$135^\circ$</th>
<th>$180^\circ$</th>
<th>...</th>
<th>$270^\circ$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>-30'</td>
<td>-21.2'</td>
<td>0'</td>
<td>21.2'</td>
<td>30'</td>
<td>21.2'</td>
<td>0'</td>
<td>-30'</td>
<td></td>
</tr>
</tbody>
</table>

a: Repeat the pattern for several cycles.

b: 30'

c: \( y = 30\sin(x) \)

10-20. \( x \leq -5 \)
Lesson 10.1.2

10-30. **a:** odds: \( t(n) = 1 + 2(n - 1) \); evens: \( t(n) = 2 + 2(n - 1) \)
       **b:** odds: 5625; evens: 5700

10-31. **a:** 
       \( t(n) = -4n + 25 \) or 
       \( t(n) = -4(n - 1) + 21 \)
       **b:** 31; you can solve the equation \(-4n + 25 = -99\).
       **c:** -1209

10-32. **a:** \( \approx 41.41^\circ \)  
       **b:** \( \approx 28.30^\circ \)

10-33. \( \binom{4}{3}P_{4} = 24 \)

10-34. **a:**  
       ![Graph](image1)

10-35. **a:** 
       \( (x + 2 - \sqrt{3})(x + 2 + \sqrt{3}) = x^2 + 4x + 1 \)
       **b:** 
       \( (x + 2 - i)(x + 2 + i) = x^2 + 4x + 5 \)

10-36. **a:** \( \frac{\pi}{3} \)  
       **b:** \( \frac{5\pi}{12} \)  
       **c:** \( \frac{7\pi}{6} \)  
       **d:** \( \frac{5\pi}{4} \)
Lesson 10.1.3

10-43. a: 16,200  b: 16,040  c: 564

10-44. 11 + 22 + 33 + … + 99 = 495

10-45. a: Sample response: The terms continually decrease by two, then add seven, then decrease by two, then add seven.
   b: It is not arithmetic because the difference from one term to the next is not constant. Some students may not see a way to calculate the sum of this different series, while others might.
   c: Calculate the sum of each “unzipped” series and then add these sums together. The sum is 32,240.

10-46. a: \( \binom{12}{10} = 66 \)  b: \( \binom{9}{7} = 36 \)

10-47. a: \( x \approx 33.7 \)  b: \( x \approx 9.7 \)

10-48. In the unit circle, if you draw the complement of an angle, the base and height of the corresponding triangle are reversed and therefore the values of sine and cosine are switched.

10-49. a: 17.67 years
   b: \( \frac{14.06 - 9.50}{10 - 0} \approx 0.46 \)  Movie tickets will, over the course of 10 years, increase the equivalent of 46 cents per year.
Lesson 10.1.4

10-54. a: \( \sum_{k=1}^{11} (60 - 13k) = -198 \)  

b: \( \sum_{k=1}^{n} (7k - 4) = \frac{n(7n-1)}{2} \)

10-55. 495,550

10-56. a: \( \binom{12}{5} = 95,040 \)  

b: \( \binom{12}{5} = 792 \)

10-57. trigonometric ratios, Law of Sines, Law of Cosines, Pythagorean Theorem

a: \( \approx 80.86^\circ \)  
b: \( \approx 24.05 \) units  
c: \( \approx 15.50^\circ \)

10-58. \( y = 4\sin(x) + 2 \)

10-59. a: double roots at \(-1, 2, 5\)

b: Same as the previous except reflected over the \(x\)-axis.

10-60. a: \( x = \frac{a+b}{c} \)

b: \( x = ab^2 + ac \)

c: \( x = a, b \)

d: \( x = 0, c \)

e: \( x = \frac{a+b}{c} \)

f: \( x = \sqrt[3]{\frac{1}{b-a}} \)
Lesson 10.1.5 Day 1

10-67. \[
\frac{3k^2 + 7k}{2} + 3k + 5 = \frac{3k^2 + 7k}{2} + \frac{6k}{2} + \frac{10}{2} = \frac{3k^2 + 13k + 10}{2}
\]

10-68. 506

10-69. \[
\sum_{n=1}^{10} (2n) = 110
\]

10-70. \[7 + 14 + 21 + \ldots + 497 = 35,784\]

10-71. a: 2   b: 4   c: 5   d: 3   e: 1

10-72. Sample solutions shown below.
   a: \(\frac{2}{3} \log(8), \frac{1}{3} \log(8^2), \log(4), 2 \log(\sqrt[3]{8})\)
   b: \(\log(5^2), -\log(25), 2 \log(\frac{1}{2})\)
   c: \(\log(n^2a^b), b \log(na)^c, b \log(na)\)

10-73. a: \(\approx 11.27\) meters off the ground
   b: \(h = -4.9(t - 5)^2 + 133.77; \) Therefore, the maximum height is \(\approx 133.77\) meters.
   c: \(\approx 10.22\) seconds
Lesson 10.1.5 Day 2

10-74. If \( n = 1 \), \( 4(1) + 5 = 9 \). Assume \( 9 + 14 + 19 + \ldots + (4k + 5) = k(2k + 7) \).

Then \( 9 + 14 + 19 + \ldots + (4k + 5) + (4(k + 1) + 5) = k(2k + 7) + (4(k + 1) + 5) \)

\( = 2k^2 + 11k + 9 \)

\( = (k + 1)(2(k + 1) + 7) \)

10-75. a: She proved that \( 3 + 6 + 9 + \ldots + 3n = \frac{3}{2}n(n + 1) \) is true for all integers \( n \geq 2 \).

b: She could have verified that the relationship was true for \( n = 1 \) instead of \( n = 2 \).

10-76. a: \(-338\) \hspace{1cm} b: \(-8325\)

10-77. \( \sum_{v=1}^{6} (3v - 2) \) or \( \sum_{h=0}^{5} (1 + 3h) \)

10-78. \( \sin(\theta) = -\frac{1}{\sqrt{5}} \)

10-79. a: \( 10 \log 2 \approx 3 \)

b: \( 20 \cdot 10^6 \)

c: Two sounds have equivalent pressures, or one sound has a pressure of 20 micropascals.

d: 100

10-80. a: A rectangular prism or cylinder for a handle, a cylinder for the body, and a cube for the portion that touches the ground. Cylindrical hoses can also be part of the design.

b: \( \approx 350.94 \) cubic inches
Lesson 10.2.1 Day 1

10-97. a: \[ 3 + 30 + 300 + 3,000 + 30,000 + 300,000 = 333,333 \]
   b: Write the series \( 3 + 30 + \ldots + 300,000 = S(6) \) twice. Multiply one of them by 10. Subtract \( 10S(6) - S(6) = 2,999,997 = 9S(6) \). Divide by 9 to get 333,333.
   c: \[ \sum_{i=1}^{n} 3 \cdot 10^{i-1} = \frac{310^n - 3}{9} \]

10-98. a: The sequence represents the list of the sizes of the graduating classes as the number of years since the school opened increases. The corresponding series represents the total number of alumni after \( n \) years.
   b: \( t(10) = 150; \) total = 960
   c: \( n(36 + 6n) = 36n + 6n^2 \)

10-99. a: 15  b: -615

10-100. 210; arithmetic

10-101. a: \( 18P_3 = 4896 \)  b: \( 18C_3 = 816 \)

10-102. a: \( \sin(34^\circ) = \frac{x}{124}; \ x \approx 69.34 \text{ units} \)  b: \( x \approx 5.35 \text{ units} \)

10-103. a: period = \( 2\pi \), amplitude: 3, horizontal shift of \(-\frac{\pi}{2}\)

   \[ y \]
   \[ \begin{array}{c}
   \hline
   -\frac{\pi}{2} & -2 \\
   \frac{\pi}{2} & 2 \\
   \frac{\pi}{2} & \pi \\
   \end{array} \]

   b: period: \( \frac{\pi}{2} \), amplitude: 2, vertically reflected

   \[ y \]
   \[ \begin{array}{c}
   \hline
   -2 & \frac{\pi}{2} \\
   \end{array} \]
Lesson 10.2.1 Day 2

10-104. Calculate the sums of two geometric series, the first with 25 terms, the second with 15. Retirement at age 55: $1,093,777; at age 65: $1,115,934

10-105. $20,000 at 8% and $30,000 at 6.5%

10-106. a: $\approx 8.6 \text{ cm}$  
   b: $PS = SR \approx 5.3 \text{ cm}$, so the perimeter is $\approx 25.6 \text{ cm}$

10-107. $\cos\left(\frac{2\pi}{3}\right) = -\frac{1}{2}$, $\cos\left(\frac{4\pi}{3}\right) = -\frac{1}{2}$, $\cos\left(\frac{5\pi}{3}\right) = \frac{1}{2}$

10-108. a: $x(b + a)$  
   b: $x(1 + a)$  
   c: $\frac{a}{x+1}$  
   d: $\frac{x-b}{a}$

10-109. a: He should add the next consecutive odd number, 11. $25 + 11 = 36$, the next perfect square.
   b: Start with an integer $n$. The difference between $n^2$ and $(n + 1)^2$ is:
   $(n + 1)^2 - n^2 = n^2 + 2n + 1 - n^2 = 2n + 1$. Since $2n$ is even for any integer $n > 0$, then $2n + 1$ must be odd. The next consecutive odd number is $2n + 3$.
   $(n + 1)^2 + 2n + 3 = n^2 + 2n + 1 + 2n + 3 = n^2 + 4n + 4 = (n + 2)^2$, which is the next prime number. Since $n$ can represent any positive integer, this proof works for all perfect squares $\geq 1$.

10-110. a: 2  
   b: $a - 2$
Lesson 10.2.2 Day 1

10-123. \( \binom{6}{39} \times C = 13,983,816 \)

10-124. a: 

b: 

c: 

d: 

10-125. a: yes

b: \( x^4 + x^3 + x^2 + x + 1 \); yes

c: \( x^n + x^{n-1} + x^{n-2} + \ldots + x + 1 \)

10-126. 

10-127. If the load is driven down the center of the road, the height of the tunnel at the edge of the house is only approximately 23.56 feet. The load will not fit.

10-128. \$1157

10-129. (1, 12) and (–5, 42)
Lesson 10.2.2  Day 2

10-130. 500 miles

10-131. \( \frac{3}{11} \)

10-132. When \( |r| \geq 1 \), \( r^n \) increases in size as \( n \) increases, so the expression \( 1 - r^n \) does not get close to 1, and being able to replace that expression with 1 is a key part of the derivation of the formula.

10-133. 4.5

10-134. a: \( x \approx 9.10 \) units  

                       b: \( \approx 9.19 \) square units

10-135. \( \cos \beta = -\frac{3}{5}, \tan \beta = \frac{4}{3}, \cos \beta = -\frac{5}{4}, \sec \beta = -\frac{5}{3}, \cot \beta = \frac{3}{4} \)

10-136. a: 3.6 people infected per day for Region A, and 3.3 people per day for Region B. Region A appears higher.

                       b: Outbreaks of disease usually grow exponentially at first.

                       c: Region B. In 20 more days, the number of people infected in Region B will have surpassed the number in Region A, and within 30 more days Region B will have far surpassed Region A.

                       d: If you use June 7 as day 0, Region A can be modeled by \( y = 117 \cdot 1.026^x \) and Region B can be modeled by \( y = 22.8 \cdot 1.086^x \). On day 34, the number of people infected in Region A is only 280, while 377 are infected in Region B.

                       e: Not very confident at all. This prediction is a large extrapolation from the data collected.
Lesson 10.3.1

10-144. a: \(21C_2 = 210\) unique pairings
   b: \(\left(\frac{1}{365}\right) \approx 0.002740\)
   c: \(\left(\frac{364}{365}\right)\) or \(1 - \left(\frac{1}{365}\right) \approx 0.997260\)
   d: \# of pairs \(\cdot P(1\) match) \(\cdot P(20\) non match) \(= 210\left(\frac{1}{365}\right)^1\left(\frac{364}{365}\right)^{20} \approx 0.5446\)

10-145. a: 16
   b: Not possible. \(r > 1\), so the terms keep increasing.

10-146. 1365

10-147. a: [Graph]
   b: [Graph]

10-148. \(x^3 + 3x^2 - 2x + 5\)

10-149. a: 306.3 feet
   b: Possible answer: \(\tan^{-1}\left(\frac{25}{34}\right) \approx 36^\circ\)
   c: \(4\sqrt{x^2 + 34^2} + 2\sqrt{x^2 + 16^2} + 2\sqrt{x^2 + 30^2}\)

10-150. a: \(B = 0.07(0.3x)\) or \(B = 0.021x\)
   b: \(S = 0.09(0.7x)\) or \(S = 0.063x\)
   c: 0.084\(x = 5000\); $59,523.81
Lesson 10.3.2  Day 1

10-162. \( x^7 + 7x^6y + 21x^5y^2 + 35x^4y^3 + 35x^3y^4 + 21x^2y^5 + 7xy^6 + y^7 \)

10-163. \( -640w^2z^3 \)

10-164. \( _4C_0 = 1, _4C_1 = 4, _4C_2 = 6, _4C_3 = 4, _4C_4 = 1 \)

a: The number of possibilities are the elements of the 4th row of the triangle.
b: 1, 6, 15, 20, 15, 6, 1; Use the 6th row of the triangle.

d: The tenth row entry of Pascal’s Triangle is the sum of the two ninth row entries above it and these numbers correspond to the total number of combinations when one more choice is added (those that don’t include the new choice and those that do, or more generally two entries in the \( n \)th row of the triangle give the entry below in the \(( n + 1)\)th row, and \( _{n+1}C_r = _nC_r + _nC_{r-1} \).

10-165. a: \( _9C_3 = 84 \)
b: \( _9C_2 = 36 \)
c: \( _{10}C_3 = _9C_3 + _9C_2 \)
d: The tenth row entry of Pascal’s Triangle is the sum of the two ninth row entries above it and these numbers correspond to the total number of combinations when one more choice is added (those that don’t include the new choice and those that do, or more generally two entries in the \( n \)th row of the triangle give the entry below in the \(( n + 1)\)th row, and \( _{n+1}C_r = _nC_r + _nC_{r-1} \).

10-166. a: \( x \approx 3.50 \)
b: \( \theta \approx 33.56^\circ \)
c: Area \( \approx 75.8 \) square units
d: About 7.9 feet.

10-167. Divide by \( x - 3 \), then solve the resulting quadratic; \( x = 1 \pm i \).

10-168. a: 60º, 300º   b: 135º, 315º   c: 60º, 120º   d: 150º, 210º
Lesson 10.3.2  Day 2

10-169. $42x^3$

10-170. 728

10-171. $81x^4 + 108x^3 + 54x^2 + 12x + 1$

10-172. a: 26 inches
          b: 2 revolutions per second
          c: $y = -13\cos(4\pi x) + 13$

10-173. Possible answer: $f(x) = x^4 - 5x^3 - 17x^2 + 131x - 170$

10-174. a: (2, 8) and (4, 4)
          b: no real solutions
          c: In system (a), the solutions are the points of intersection. In system (b), the solutions show that they do not intersect.

10-175. a: Between June 15 and June 29, students may know it is usually between June 20 and June 22.
          b: Answers will vary but should show the curve continuing to decrease, with a slight increase at the very end of December.
          c: Answers vary; a sine or cosine function would work, but more information is needed to model the data.
Lesson 10.3.3  Day 1

10-183. Robin: $11,887.58;  Teryll: $11,815.60;  difference: $71.98

10-184. a: 9.00646832 for both
   b: 3.10628372 for both
   c: It will take about 9 years to double.
   d: After about three years and one month, the car will be worth less than half of the original price.

10-185. a: The base of the natural logs is $e$; $e$ is between 2 and 3, and $\ln(e) = 1$; $x = e$
   b: i. $\ln(2 \cdot 3) = \ln(2) + \ln(3) = 1.79175$
      ii. $\ln(2^2 \cdot 3) = 2\ln(2) + \ln(3) = 2.4849$
      iii. $\ln(2^3) = 4\ln(2) = 2.7726$
      iv. $\ln(3^{-1}) = -\ln(3) = -1.0986$

10-186. $27x^3 - 54x^2 + 36x - 8$

10-187. a: 765  b: 684

10-188. a: $\theta = 30^\circ$ or $150^\circ$
   b: $\theta = 120^\circ$ or $240^\circ$
   c: $\theta = 45^\circ$ or $225^\circ$
   d: $\theta = 35.26^\circ, 144.74^\circ, 215.26^\circ, \text{ or } 324.76^\circ$

10-189. a: $x^2 + y^2 = 169$
   b: $247.403^\circ \text{ or } 112.597^\circ; \ 4.318 \text{ rad or } 1.966 \text{ rad}$
   d: $\frac{25}{169} \approx 0.15$
Lesson 10.3.3 Day 2

10-190. $849.47$

10-191. a: \(1 + \frac{3}{n^2} + \frac{1}{n^3}\) \hspace{1cm} b: \(1 + \frac{5}{n^2} + \frac{10}{n^3} + \frac{5}{n^4} + \frac{1}{n^5}\)

10-192. a: 14.7 lb/sq. in \hspace{1cm} b: About 12.55 lb/sq. in \hspace{1cm} c: About 14.83 lb/sq. in

10-193. 388.8

10-194. \(x = \pm \frac{3}{5}\)

10-195. \((x - 2)^2 + y^2 = 20; \) circle, \(x^2 + y^2 = r^2, \) center (2, 0) and radius \(\approx 4.5\)

See graph at right.

10-196. a: \(x = \frac{5}{2}\) \hspace{1cm} b: \(y = 10\)
Lesson 11.1.1

11-7. a: \( \frac{x-4}{3x+2} \) \hspace{1cm} b: \( \frac{5}{x-3} \) \hspace{1cm} c: 2

11-8. a: \( \frac{3}{7} \) \hspace{1cm} b: \( \frac{5}{4} \)

11-9. a: $10,304.56$; It rounds off to the same amount.
   b: $10,832,870,680$ and $10,832,775,720$, a difference of $94,960$.
   c: Maybe billionaires, or other investors of large amounts.

11-10. a: \( a^3 + 3a^2b + 3ab^2 + b^3 \) \hspace{1cm} b: \( 8m^3 + 60m^2 + 150m + 125 \)

11-11. a: 
   ![Graph of a function]

   c: \( g(x) = -f(x) \)

11-12. The plane needs to change its course 11.72\(^\circ\).

11-13. \( \pm \frac{15}{17} \)
Lesson 11.1.2

11-19. a: \( \frac{2x}{3(x-1)} = \frac{2x}{6x-3} \)  
   b: \( \frac{x-4}{x+4} \)

11-20. a: \( x \neq -4 \text{ or } 2; \  \frac{x+4}{x-2} \)  
   b: \( x \neq -2 \text{ or } 3; \ \frac{2(x+2)}{(x-3)^2} \)

11-21. Answers will vary but should include the idea that she needs to create fractions with equal denominators before she can combine them.
   a: \( \frac{5}{11} \)  
   b: \( \frac{x+2}{6} \)  
   c: \( \frac{11}{15} \)

11-22. a: Yes, it is true. In general, \( \frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd} \) for \( b \neq 0 \) and \( d \neq 0 \).
   b: Yes; In general, \( \frac{a}{b} \div \frac{c}{d} = \frac{ad}{bc} \) for \( b \neq 0, c \neq 0 \) and \( d \neq 0 \).

11-23. a: \( 2 = (1.015)^t; \ 2 = e^{0.06t} \)
   b: quarterly: 11.64 years; continuously: 11.55 years
   c: The difference is about one month, so probably not.

11-24. \( x^3 - 2x^2 - 3x + 9 \)

11-25. a: 

11-26. b: 

Lesson 11.1.3

11-31. \( \frac{2x^2+13x+1}{(x-1)(x+5)} \)

11-32. a: \( \frac{9m+27}{m+3} = 9 \)  
   b: \( \frac{a+3}{a-1} \)

11-33. a: \( x - 4 \)  
   b: \( \frac{7m-1}{3m+2} \)  
   c: \( \frac{(4x-1)^2}{x+2} \)  
   d: \( \frac{3x-3}{x-2} \)

11-34. a: \( \frac{5(3x-1)}{2(4x+1)} \)  
   b: 1  
   c: \( \frac{p+9}{3p-2} \)  
   d: \( \frac{4}{x-2} \)

11-35. See graph at right. x-intercept: (–2, 0),  
y-intercept: (0, –2); there is no value for \( g(1) \),  
which creates a vertical asymptote.

11-36. a: Yes, each sum was a fraction and therefore a rational number.
   b: Yes, it is true. In general, \( \frac{a}{b} + \frac{c}{d} = \frac{ad+bc}{bd} \)  
   for \( b \neq 0 \) and \( d \neq 0 \). Since \( a, d, b, \) 
   and \( c \) are all integers by the definition of rational numbers, \( ad + bc \) will be an integer.

11-37. a: Answers vary. Possible equation: \( f(x) = 4 \cos \left( \frac{2\pi}{52} (x - 4) \right) + 7.7 \)
   b: \( \approx 6:45 \) p.m.
Lesson 11.1.4

11-42. a: \(\frac{2}{3x+1}\)  
   b: \(\frac{x-7}{x-3}\)  
   c: \(\frac{x-2}{2x+12}\)  
   d: \(\frac{13x+31}{(x+5)^2}\)

11-43. a: Some may predict the amount due will be far too much for a state to pay.
   b: \(\approx 1.126 \cdot 10^{15}\) dollars
   c: In the U.S. system, a quadrillion. In many other countries, one thousand billion.
   d: \(A = 2.791 \cdot 10^{16}\), or about \(2.68 \cdot 10^{16}\) dollars more.

11-44. Possible answer: \(f(x) = x^3 - 5x^2 + 8x - 6\)

11-45. \(\approx 5.7\) miles

11-46. a: \(30^\circ, 150^\circ\)  
   b: \(60^\circ, 240^\circ\)  
   c: \(30^\circ, 330^\circ\)  
   d: \(225^\circ, 315^\circ\)

11-47. a:  
   b:  

11-48. 610
Lesson 11.2.1

11-56. a: Their $y$- and $z$-coordinates are zero.
   b: Answers vary, but should include the idea that the other coordinate axes values will be zero.

11-57. a: \(\frac{8x+8}{(x-4)(x+2)}\) \hspace{1cm} b: \(\frac{1}{x+2}\)

11-58. a: \(\frac{x-3}{3x-14}\) \hspace{1cm} b: \(\frac{2x-1}{x+1}\)

11-59. a: \(a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4\) \hspace{1cm} b: \(81m^4 - 216m^3 + 216m^2 - 96m + 16\)

11-60.

11-61. \(\approx 82.4\) feet

11-62. a: From its equation, object A has $x$-intercept at (5, 0). From the graph, object B was in the air about 5.5 seconds, which was longer than object A.
   b: At 3 seconds, object A reached a peak of 96 feet, which is higher than object B.
   c: \(1 < t < 4\)
   d: \(0 \leq t \leq 5\)
Lesson 11.2.2

11-68. a: (0, 10, 0), (0, 0, 4)  
                               b: (8, 0, 0), (0, 6, 0), (0, 0, 12)  
                               c: (0, 0, 4), (0, 0, −4), (2, 0, 0), (−8, 0, 0)  
                               d: (0, 0, 6)  

11-69. Sketches shown below.  
                               a: A line.  
                               b: They do not intersect.  
                               c: They do not intersect.  

\[ \frac{x+1}{x^2-4} \] \[ \frac{x+6}{2(x+2)^2} \] \[ \frac{1}{x} \] \[ -\frac{1}{2} \]  

11-70. a: \[ \frac{x+1}{x^2-4} \]  
                               b: \[ \frac{x+6}{2(x+2)^2} \]  
                               c: \[ \frac{1}{x} \]  
                               d: \[ -\frac{1}{2} \]  

11-71. Most students will assume it is a cubic with \( y = x^3 \) as the parent, though other options are also reasonable. An equation of the graph is \( y = \frac{1}{8} (x - 3)^3 + 3 \); its inverse is \( y = \frac{3}{8}(x - 3) + 3 \).  

11-72. \( \tan(A) = -\frac{3}{\sqrt{91}} = -0.3145 \)  

11-73. a: Height of the tank = \( 6\sqrt{3} \approx 10.4 \) in, so  
                               \[ V = 7 \cdot 13 \cdot 6\sqrt{3} = 546\sqrt{3} \approx 945.7 \text{ cubic inches} \]  
                               b: \( \frac{25 \text{ fish}}{945.7 \text{ in}^3} \approx 0.026 \text{ fish per in}^3 \) or about 0.026 fish per cubic inch.  
                               c: \( \frac{25 \text{ fish}}{945.7 \text{ in}^3} \cdot \frac{12 \text{ inch}}{1 \text{ foot}} \cdot \frac{12 \text{ inch}}{1 \text{ foot}} \approx \frac{45.68 \text{ fish}}{1 \text{ ft}^3} \)  

11-74. a: \( y = 2 \left(x + \frac{7}{4}\right)^2 - \frac{105}{8} \)  
                               vertex: \( \left(-\frac{7}{4}, -\frac{105}{8}\right) \)  
                               axis of symmetry: \( x = -\frac{7}{4} \)  
                               b: \( y = 3 \left(x - \frac{1}{6}\right)^2 - \frac{97}{12} \)  
                               vertex: \( \left(\frac{1}{6}, -\frac{97}{12}\right) \)  
                               axis of symmetry: \( x = \frac{1}{6} \)  

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Lesson 11.2.3

11-82. See graph at right. The intersection is a line.

11-83. a: \( \frac{x+3}{2x-1} \)  
 b: \( \frac{1}{x-3} \)

11-84. a: \( 126a^2b^4 \)  
 b: \( 1120x^4y^4 \)

11-85. a: roots: \( x = -2, 1, 3 \); \( P(x) = (x - 3)(x + 2)(x - 1) \)  
 b: \( y = 0.1(x + 5)(x + 2)(x - 2)^2 \)  
 c: \( y = -(x - 1)(x + 4)(x + 2) \)

11-86. a: 

![Graph a](image)

b: 

![Graph b](image)

c: 

![Graph c](image)

d: 

![Graph d](image)

11-87. Surface area of triangles = \( 2 \left( \frac{1}{2} \cdot 12 \cdot 8 \right) \) = 96 square feet. If \( x \) represents the length (feet), \( 96 + 12x + 10x + 10x \leq 500 \). The maximum length is 12 feet (\( x \approx 12.5 \) ft) when you consider the precision of the measurements and not exceeding the constraint.

11-88. a: 7.38 m/s

b: The current Olympic record is 43.5 seconds, which corresponds to a speed of 9.2 m/s.

c: \( f(x) = \frac{400}{x} \)
Lesson 11.2.4 Day 1

11-100. \((-1, 3, 5)\)

11-101. \(y = 2x^2 - 3x + 5\)

11-102. a: \(\frac{3x^2 + x - 3}{2x^3 + 9x^2 - 5x}\)  
           b: \(\frac{3x-5}{2x+3}\)  
           c: \(\frac{x+4}{4x-3}\)  
           d: \(\frac{m+5}{m+4}\)

11-103. a: any polynomial with 5 \(x\)-intercepts
           
           b: a polynomial graph with 3 \(x\)-intercepts and another ‘bend’
           
           c: no \(x\)-intercepts, could have two ‘humps’
           
           d: 2 \(x\)-intercepts and up to two ‘humps.’

11-104. a:  \(x = \frac{2\pi}{3}, \frac{4\pi}{3}\)  
           b:  \(x = \frac{\pi}{6}, \frac{7\pi}{6}\)
           
           c:  \(x = 0, \pi\)  
           d:  \(x = \frac{\pi}{4}, \frac{7\pi}{4}\)

11-105. a: See table and graph at right.
           
           b: He had 28,900 miles in May.
           
           c: 5600 miles
           
           d: No, he will not be able to go in December, he will only have 24,200 mile.

11-106. a:  \(e^{1.95} = 7\)
           
           b: \(\ln(148.41) = 5\)
           
           c: 3
Lesson 11.2.4 Day 2

11-107. \((-1, 3, 6)\)

11-108. \(y = 3x^2 - 5x + 7\)

11-109. a: \(2\)  
        b: \(\frac{1}{x+2}\)  
        c: \(\frac{x-4}{(x-2)(x-1)}\)  
        d: \(\frac{4x+16}{x(x+2)}\)

11-110. a: \(\frac{\pi}{6}\)  
        b: \(\frac{\pi}{12}\)  
        c: \(-\frac{5\pi}{12}\)  
        d: \(\frac{7\pi}{2}\)

11-111. a: Stretched (amplitude = 3), shifted left \(\frac{\pi}{2}\), and shifted down 4 units.  
        b: See graph at right.

11-112. a: \(x = \sqrt{5} - \frac{\sqrt{5}}{4} \approx -1.046\)  
        b: \(x = \log(2) \approx 0.301\)  
        c: \(x = 7^{7/8} - 1 \approx 4.489\)  
        d: \(x = \frac{3+\sqrt{51}}{2} \approx 5.071\) or \(-2.071\)

11-113. a: \(S(12) = \frac{82(1-0.3^{12})}{1-0.3} \approx 117.143\)  
        b: \(S = \frac{82}{1-0.3} \approx 117.143\)
Lesson 12.1.1 Day 1

12-5.  a: always          b: never          c: always
       d: True for $x = \frac{\pi}{4} + 2\pi n$ and $x = \frac{5\pi}{4} + 2\pi n$

12-6.  a: $(x - 2)(x + 2)$  b: $(y - 9)(y + 9)$
       c: $(1 - x)(1 + x)$          d: $(1 - \sin x)(1 + \sin x)$

12-7.  The graphs of $y = \sin(2x)$ and $y = 2\sin(x)$ intersect at integer multiples of $\pi$.

12-8.  a: It looks like an endless wave repeating the original cycle over and over again.
       b: Yes, it could be a graph of $f(x) = \cos(x - 90^\circ)$.
       c: A polynomial of degree $n$ has at most $n$ roots, but $f(x) = \sin(x)$ has infinitely many roots. Also, every polynomial eventually heads away from the $x$-axis.

12-9.  a: $\frac{6x-21}{(x-4)(x+1)}$  b: $\frac{5-6x}{2(x-5)}$
       c: $\frac{1}{x+1}$          d: $\frac{5}{x^2-9}$

12-10. $(1, -2, 4)$

12-11. $(7, 2)$
Lesson 12.1.1 Day 2

12-12. Sample answers: \( h = \frac{\pi}{2}, \frac{5\pi}{2}, -\frac{3\pi}{2} \)

12-13. a: negative  
b: negative  
c: positive  
d: negative

12-14. See graph at right. Both graphs are the same.  
a: period = \( \pi \)  
b: period = \( \pi \)

12-15. a:  
b:

12-16. a: \( y + \frac{x}{2} \)  
b: \( 2b + 4a^2 \)  
c: \( 6x - 1 \)  
d: \( xy \)

12-17. a: \( \frac{x^2}{x-1} \)  
b: \( \frac{b+a}{a(1-ab)} \)

12-18. a: (0, -5), (4, 3), (8, 3)  
b: See graph at right.  
c: \( y = -\frac{1}{4} x^2 + 3x - 5 \)  
d: after 10 seconds  
e: \( 0 \leq x \leq 10 \)  
f: \( 0 \leq x < 2 \)
Lesson 12.1.2

12-24. \( \theta = 37^\circ + 360^\circ n; \ \theta = 143^\circ + 360^\circ n \)

12-25. a: \( x = \frac{\pi}{6}, \frac{5\pi}{6} \)  \hspace{1cm} b: \( x = \frac{5\pi}{6}, \frac{7\pi}{6} \)
   c: \( x = \frac{\pi}{4}, \frac{3\pi}{4} \)  \hspace{1cm} d: \( x = 0 \)

12-26. Answers vary; \( \cos (52^\circ) = \cos (308^\circ) \), but 128\(^\circ\) has the opposite cosine value. However, we need to know more about the problem they are solving. See diagram at right.

12-27. See graph at right below.

12-28. \( x = -2, y = 3, z = -5 \); Solve the system to two equations with \( x \) and \( y \), then substitute these values into the third equation to solve for \( z \).

12-29. a: \( \ln \left( \frac{16x^3}{y^2} \right) \)  \hspace{1cm} b: \( 3\ln(x - 3) + 3\ln(3x + 2) \)

12-30. a: 12  \hspace{1cm} b: \( \frac{1}{2} \)
Lesson 12.1.3

12-37. a: $\theta = 30^\circ, 150^\circ$ or $\theta = \frac{\pi}{6}, \frac{5\pi}{6}$  
   b: $\theta = 120^\circ, 240^\circ$ or $\theta = \frac{2\pi}{3}, \frac{4\pi}{3}$  
   c: $\theta = 45^\circ, 225^\circ$ or $\theta = \frac{\pi}{4}, \frac{5\pi}{4}$

12-38. a: $\theta = 30^\circ, 150^\circ$ or $\theta = \frac{\pi}{6}, \frac{5\pi}{6}$  
   b: $\theta = 120^\circ, 240^\circ$ or $\theta = \frac{2\pi}{3}, \frac{4\pi}{3}$  
   c: $\theta = 45^\circ, 225^\circ$ or $\theta = \frac{\pi}{4}, \frac{5\pi}{4}$

12-39. a: $\frac{x}{x+1}$  
   b: $\frac{x-4}{x^2-3x+2}$

12-40. See answers in bold in the table below.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>undefined</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
</table>

a: See graph at right. It is linear. The data does not all connect because $f(1)$ is undefined.

b: $y = x + 5, f(0.9) = 5.9, f(1.1) = 6.1$; There is no asymptote.

c: The complete graph is the line $y = x + 5$ with a hole at $(1, 6)$.

12-41. $y = x^2 - 6x + 8$

12-42. a: $\frac{1}{2(x-1)}$  
   b: $\frac{4x}{3x^2+10x+3}$

12-43. a: 9840  
   b: 48

12-44. The restrictions are needed so that the inverses will be functions. The domain of the sine function is restricted to $-\frac{\pi}{2} \leq x \leq \frac{\pi}{2}$, the domain of the cosine function is restricted to $0 \leq x \leq \pi$, and the domain of the tangent function is restricted to $-\frac{\pi}{2} \leq x \leq \frac{\pi}{2}$.

12-45. a: $x = \frac{7\pi}{6} + 2\pi n, \frac{11\pi}{6} + 2\pi n$  
   b: $x = \frac{\pi}{6} + 2\pi n, \frac{11\pi}{6} + 2\pi n$  
   c: $x = \frac{3\pi}{4} + \pi n$  
   d: $x = 2\pi n$

12-46. a: shifted up 1 unit  
   b: shifted left $\frac{\pi}{4}$ units  
   c: reflected across the $x$-axis  
   d: vertically stretched by a factor of 4

12-47. a: $\frac{3+2}{6} = \frac{5}{6}$  
   b: $\frac{3x+8}{2x^2}$  
   c: $\frac{x^2+2x+3}{(x+1)(x-1)}$ or $\frac{x^2+2x+3}{x^2-1}$  
   d: $\frac{\sin^2(\theta)+\cos(\theta)}{\sin(\theta)\cos(\theta)}$

12-48. a: $(x-2)^2 + (y-6)^2 = 4$  
   b: $(x-3)^2 + (y-9)^2 = 9$

12-49. $x = -3, y = 0, z = 5$

12-50. $\approx 261$ feet

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Core Connections Integrated III
Lesson 12.1.4 Day 1

12-58. a: $\frac{a}{c}$  
   b: $\frac{c}{a}$  
   c: $\frac{a}{c}$  
   d: $\frac{c}{a}$

12-59. a: $x = \pm \frac{\pi}{6}, \pm \frac{5\pi}{6}, \pm \frac{7\pi}{6}, \pm \frac{11\pi}{6}$  
   b: Same solutions as part (a).

12-60. The solution is equivalent to the solutions of $\sin(x) = -\frac{1}{2}$ and $\cos(x) = 0$. $90^\circ + 180^\circ n$, $210^\circ + 360^\circ n, 330^\circ + 360^\circ n$; or $\frac{\pi}{2} + \pi n, \frac{7\pi}{6} + 2\pi n, \frac{11\pi}{6} + 2\pi n$

12-61. a: $\frac{6x-21}{x^2-3x-4}$  
   b: $\frac{5}{x^2-9}$

12-62. $x = 18, y = 13, z = 9$

12-63. a:  
   b:  
   c:  
   d: 

12-64. The fourth term. $-56a^5b^3$
Lesson 12.1.4 Day 2

12-65. a: \( \frac{a}{b} \)  

b: \( \frac{b}{a} \)  

c: \( \frac{a}{b} \)

12-66. The solution is equivalent to the solutions of \( \cos(x) = \frac{1}{2} \) and \( \sin(x) = 0 \). \( x = 0, \pi, \frac{5\pi}{3} \)

12-67. a: Possible answer: \( y = -2(\sin \frac{1}{2} (x - \frac{\pi}{2})) + 1 \) The graph has an amplitude of 2, is reflected over the x-axis, a period of \( 4\pi \), is shifted \( \frac{\pi}{2} \) units to the right and 1 unit up.

b: Possible answer: \( y = 5 \cos(x - \frac{\pi}{2}) - 2 \) The graph has an amplitude of 5, a period of \( 2\pi \), shifted \( \frac{\pi}{2} \) units to the right and 2 units down.

12-68. \( R + B + G = 40, R = B + 5, R = 2G; \) 18 red, 13 blue and 9 green

12-69. a: This manner in a non-right triangle.

Use the Law of Sines instead: \( \frac{x}{\sin(16^\circ)} = \frac{10}{\sin(101^\circ)} \); \( x \approx 2.8 \)

b: \( x \approx 64 \) units

12-70. a: \( \frac{195 \text{ peaches}}{768 \pi \text{ in}^3} \approx \frac{0.808 \text{ peaches}}{\text{in}^3} \)

b: \( \frac{0.808 \text{ peaches}}{\text{in}^3} \approx \frac{140 \text{ peaches}}{\text{ft}^3} \)

c: \( \frac{140 \text{ peaches}}{\text{ft}^3} \approx 2520 \text{ ft}^3 \approx 353,000 \) peaches

12-71. a: \( x = 1 \)

b: \( x = \frac{-2\pm\sqrt{10}}{3} \)

c: \( x = -\frac{\log 11}{\log 4} = -1.73 \)

d: \( x = 13^6 \)

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Lesson 12.2.1

12-76. a: \( \frac{\sin(\theta)}{\cos(\theta)} \)  
  b: \( \frac{1}{\sin(\theta)} \)  
  c: \( \frac{\sin(\theta)}{\sin(\theta)} \)  
  d: \( \frac{1}{\cos(\theta)} \)

12-77. a: \( x = \frac{\pi}{6} + 2\pi n \) or \( x = \frac{5\pi}{6} + 2\pi n \)  
  b: no solution

12-78. a: \( P = 44, A = 20 \)  
  b: \( y = 20(\frac{5}{22} (x-15)) + 3 \) is one possibility.

12-79. a: \( x + 5 \)  
  b: \( a + 5 \)  
  c: \( x - y \)  
  d: \( \frac{x^2 + 1}{x^2 - 1} \)

12-80. \( C + W + P = 40, W = C - 5, C = 2P \); 18 from California, 13 from Washington, and 9 from Pennsylvania

12-81. All of these problems can be solved using the same system of equations.

12-82. a: \( \frac{32}{7} \)  
  b: No sum, \( r > 1 \).

12-83. Possibilities include: \( \sin^2(x) = 1 - \cos^2(x) \), \( \sin(x) = \pm \sqrt{1 - \cos^2(x)} \), \( \sin^2(x) = (1 - \cos(x))(1 + \cos(x)) \) or similar variations for the cosine in terms of the sine.

12-84. \( AC = 10 \) inches

12-85. a: 1  
  b: \( \cos(4w) \)  
  c: \( \tan(\theta) \)

12-86. a: \( \frac{x-2}{x+2} \)  
  b: \( \frac{x-3}{2x+1} \)

12-87. \( y = -x^2 + 6x \)

12-88. a: \( x = -26 \)  
  b: \( x = \pm 2 \)  
  c: \( x = 7, 2i, -2i \)  
  d: \( x = \frac{16}{10} \approx 8.47 \)

12-89. See graph at right.
   a: D: \( x > -9 \); R: all real numbers
   b: intercepts: \( 5^x - 9, 0 \) and \( (0, \log_5(9) - 5) \) or \( (0, \approx -3.63) \); locator point: \((-8, -5)\)
   c: \( y = 5^{(x + 5)} - 9 \)
   d: D: all real numbers; R: \( y > 9 \)
Lesson 12.2.2 Day 1

12-91. a: \( x = \frac{3 \pi}{2} \)  b: \( x = \frac{\pi}{3}, \frac{5 \pi}{3} \)  c: \( x = \frac{\pi}{4}, \frac{5 \pi}{4} \)  d: \( x = \frac{7 \pi}{6}, \frac{11 \pi}{6} \)

12-92. \( \left( \pm \frac{\sqrt{55}}{8}, -\frac{3}{8} \right) \)

12-93. \( m \angle B \approx 86.17^\circ \)

12-94. a: Amplitude = 2, period = 2\( \pi \). The parent function is \( y = \sin(x) \). This graph is stretched vertically to have amplitude 2 and is translated \( \frac{\pi}{2} \) units to the left.

b: Amplitude = 1, period = \( \pi \). The parent function is \( y = \cos(x) \). This graph is compressed horizontally to have a period of \( \pi \) and is translated 1 unit down.

c: No amplitude, period = \( \pi \). The parent function is \( y = \tan(x) \). This graph is translated \( \frac{\pi}{4} \) units to the left.

d: \( y = \sin(x) + 1 \)

e: \( y = \cos(2x) \)

12-95. a: \( y = x^2 - 4x + 5 \)  b: (2, 1)

12-96. See graph at right. The locator point is (4, 2).

12-97. a: 51  b: 64.77
Lesson 12.2.2 Day 2

12-98. Sample proofs:
   a: \((\sin(\theta) + \cos(\theta))^2 = \sin^2(\theta) + 2\sin(\theta)\cos(\theta) + \cos^2(\theta) = 1 + 2\sin(\theta)\cos(\theta)\)
   b: \(\tan(\theta) + \cot(\theta) = \frac{\sin(\theta)}{\cos(\theta)} + \frac{\cos(\theta)}{\sin(\theta)} = \frac{\sin^2(\theta) + \cos^2(\theta)}{\sin(\theta)\cos(\theta)} = \frac{1}{\sin(\theta)\cos(\theta)} = \csc(\theta)\sec(\theta)\)
   c: \((\tan(\theta)\cos(\theta))(\sin^2(\theta) + \frac{1}{\sec^2(\theta)}) = (\frac{\sin(\theta)}{\cos(\theta)}\cos(\theta))(\sin^2(\theta) + \cos^2(\theta)) = \sin(\theta)\)

12-99. See unit circle at right. \(\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}\)

12-100. a: \(\frac{x^2}{x(x-4)}\)  b: \(\frac{4}{x-2}\)
        c: \(\frac{1}{3x}\)  d: 3

12-101. a: See graph at right.
        b: Yes, it is a solution to the equation.

12-102. The first process is fully in control. The second process is wildly out of control. The third process is out of control; beginning at the 9th hour, there are 12 consecutive points above the centerline.

12-103. a: \(x = -1, 4\)  b: \(x \leq -1 \text{ or } x \geq 4\)  c: \(-1 \leq x \leq 4\)

12-104. a: \(x + 3\)  b: \(\sqrt{(x+3)^2 + (y-2)^2}\)
Lesson 12.2.3

12-108. \( \sin \left( \frac{\pi}{12} \right) = \sin \left( \frac{\pi}{3} - \frac{\pi}{4} \right) = \frac{\sqrt{6} - \sqrt{2}}{4} \); \( \cos \left( \frac{\pi}{12} \right) = \cos \left( \frac{\pi}{3} - \frac{\pi}{4} \right) = \frac{\sqrt{6} + \sqrt{2}}{4} \).

12-109. a: \( \sin \left( \frac{\pi}{3} + \frac{\pi}{4} \right) = \frac{\sqrt{6} + \sqrt{2}}{4} \) b: \( \cos \left( \frac{3\pi}{4} + \frac{\pi}{6} \right) = \cos \left( \frac{7\pi}{6} - \frac{\pi}{4} \right) = -\frac{\sqrt{6} + \sqrt{2}}{4} \)

12-110. \( \sin(x + x) = \sin(x)\cos(x) + \cos(x)\sin(x) = 2\sin(x)\cos(x) \); 
\( \cos(x + x) = \cos(x)\cos(x) - \sin(x)\sin(x) = \cos^2(x) - \sin^2(x) \)

12-111. a: See graph at right.
   b: Possible answer: \( f(x) = -\sin(x) \).
   c: \( \cos(x + \frac{\pi}{2}) = \cos(x)\cos\left( \frac{\pi}{2} \right) - \sin(x)\sin\left( \frac{\pi}{2} \right) = -\sin(x) \)
   d: If you wrote \( f(x) = -\sin(x) \) in part (b), the agreement is obvious. If not, you should recognize that they could have.

12-112. \( \sin(x) + \cos(x) \)

12-113. a: \((-3, 5, 10)\)
   b: infinitely many solutions
   c: The planes intersect in a line.

12-114. a: \( \frac{1}{5} \) b: \( \frac{1}{3} \) c: 100 d: \( \frac{x + 60}{x + 300} = \frac{2}{5} \)