Technology Connection Exercises

For *College Algebra*, 4th Edition,
Beecher/Penna/Bittinger,
Pearson: Addison Wesley

Prepared for
University of Southern Indiana
Evansville, IN

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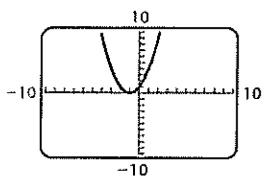
The following Technology Connection exercises supplement the exercise sets in *College Algebra,* 4th edition, Beecher/Penna/Bittinger. All answers are located at the back of this handout.

CHAPTER 1

Technology Connection Section 1.1

In Exercises 110-113 use a graphing calculator to match the equation with one of the graphs (a)–(d), which follow.

a)



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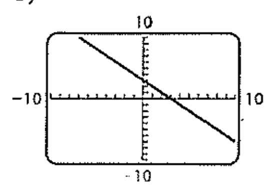

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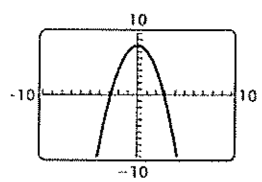

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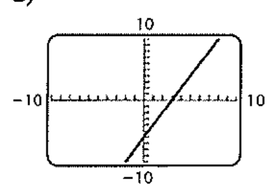


110. $y = 3 - x$ 111. $2x - y = 6$

112. $y = x^2 + 2x + 1$ 113. $y = 8 - x^2$

Use a graphing calculator to graph the equation in the standard window.

114. $4x + y = 7$ 115. $5x + y = -8$

116. $y = \frac{1}{3}x + 2$ 117. $y = \frac{3}{2}x - 4$

118. $y = x^2 + 6$ 119. $y = 5 - x^2$

120. $y = 2 - x^2$ 121. $y = x^2 - 5x + 3$

Graph the equation in the standard window and in the given window. Determine which window better shows the shape of the graph and the x- and y-intercepts.

122. $y = 3x^2 - 6$
$[-4, 4, -4, 4]$

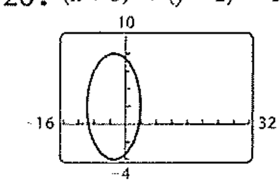
123. $y = -2x + 24$
$[-15, 15, -10, 30]$, with Xscl = 3 and Yscl = 5

124. $y = -\frac{1}{6}x^2 + \frac{1}{12}$
$[-1, 1, -0.3, 0.3]$, with Xscl = 0.1 and Yscl = 0.1

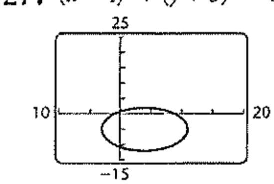
125. $y = 6 - x^2$
$[-3, 3, -3, 3]$

In Exercises 126 and 127, how would you change the window so that the circle is not distorted? Answers may vary.

126. $(x + 3)^2 + (y - 2)^2 = 36$



127. $(x - 4)^2 + (y + 5)^2 = 49$



128.-131. Using a graphing calculator, graph each of the circles given in Exercises 86, 83, 90, 87, respectively.

Technology Connection Section 1.2

In Exercise 103-105, use a graphing calculator and the TABLE *feature set in* ASK *mode.*

103. Given that
$$h(x) = 3x^4 - 10x^3 + 5x^2 - x + 6,$$
find $h(-11)$, $h(7)$, and $h(15)$.

104. Given that
$$g(x) = 0.06x^3 - 5.2x^2 - 0.8x,$$
find $g(-2.1)$, $g(5.08)$, and $g(10.003)$. Round answers to the nearest tenth.

105. Find the indicated function values if they exist.

a) $f(-4)$ and $f(-6)$, for $f(x) = \dfrac{4}{(x-4)(x+6)}$

b) $g(-5)$ and $g(1)$, for $g(x) = \sqrt{x-1} + 3$

Technology Connection Section 1.3

99. Use the VALUE feature in the CALC menu to find the function values in Exercises 71, 74(a), 75(b) and 76(a).

74. a) Use a graphing calculator to fit a regression line to the data in Exercise 62.
b) Estimate the percentage of deaths followed by cremation in 2016 and compare the result with the estimate found with the model in Exercise 62.
c) Find the correlation coefficient for the regression line and determine whether the line fits the data closely.

75. a) Use a graphing calculator to fit a regression line to the data in Exercise 61.
b) Estimate the number of Internet users worldwide in 2015 and compare the value with the result found in Exercise 61.
c) Find the correlation coefficient for the regression line and determine whether the line fits the data closely.

76. *Expenditures on Pets.* Data on total U.S. expenditures on pets, pet products, and related services, are given in the table below.

Year, x	Total U.S. Expenditures on Pets (in billions)
1991, 0	$19.6
1994, 3	24.9
1997, 6	32.5
2000, 9	39.7
2003, 12	46.8
2006, 15	56.9
2009, 18	67.1

Sources: Bureau of Economic Analysis; U.S. Department of Commerce

a) Use a graphing calculator to fit a regression line to the data.
b) Estimate total U.S. expenditures on pets in 2015.
c) Find the correlation coefficient for the regression line and determine whether the line fits the data closely.

77. a) Use a graphing calculator to fit a regression line to the data in Exercise 65.
b) Estimate average credit-card debt per U.S. household in 2014 and compare the result with the estimate found with the model in Exercise 65.
c) Find the correlation coefficient for the regression line and determine whether the line fits the data closely.

78. *Study Time versus Grades.* A math instructor asked her students to keep track of how much time each spent studying a chapter on functions in her algebra–trigonometry course. She collected the information together with test scores from that chapter's test. The data are listed in the table below.

Study Time, x (in hours)	Test Grade, y (in percent)
23	81%
15	85
17	80
9	75
21	86
13	80
16	85
11	93

a) Use a graphing calculator to model the data with a linear function.
b) Predict a student's score if he or she studies 24 hr, 6 hr, and 18 hr.
c) What is the correlation coefficient? How confident are you about using the regression line to predict function values?

79. *Maximum Heart Rate.* A person who is exercising should not exceed his or her maximum heart rate, which is determined on the basis of that person's sex, age, and resting heart rate. The table below relates resting heart rate and maximum heart rate for a 20-year-old man.

Resting Heart Rate, H (in beats per minute)	Maximum Heart Rate, M (in beats per minute)
50	166
60	168
70	170
80	172

Source: American Heart Association

a) Use a graphing calculator to model the data with a linear function.
b) Estimate the maximum heart rate if the resting heart rate is 40, 65, 76, and 84.
c) What is the correlation coefficient? How confident are you about using the regression line to estimate function values?

Technology Connection Section 1.5

109. Use a graphing calculator to solve the equations in Exercises 1–14.

110. Use a graphing calculator to find the zeros of the functions in Exercises 71–78.

Technology Connection Section 1.6

55. Use a graphing calculator to check your answers to Exercises 15 and 27.

56. Use a graphing calculator to check your answers to Exercises 16 and 28.

CHAPTER 2

Technology Connection Section 2.1

Graph the function using the given viewing window. Find the intervals on which the function is increasing or decreasing and find any relative maxima or minima. Change the viewing window if it seems appropriate for further analysis.

74. $f(x) = -x^3 + 6x^2 - 9x - 4$,
$[-3, 7, -20, 15]$

75. $f(x) = 0.2x^3 - 0.2x^2 - 5x - 4$,
$[-10, 10, -30, 20]$

76. $f(x) = 1.1x^4 - 5.3x^2 + 4.07$,
$[-4, 4, -4, 8]$

77. $f(x) = 1.2(x + 3)^4 + 10.3(x + 3)^2 + 9.78$,
$[-9, 3, -40, 100]$

78. *Temperature During an Illness.* The temperature of a patient during an illness is given by the function

$$T(t) = -0.1t^2 + 1.2t + 98.6, \quad 0 \le t \le 12,$$

where T is the temperature, in degrees Fahrenheit, at time t, in days, after the onset of the illness.

a) Graph the function using a graphing calculator.
b) Use the MAXIMUM feature to determine at what time the patient's temperature was the highest. What was the highest temperature?

79. *Advertising Effect.* A software firm estimates that it will sell N units of a new DVD video game after spending a dollars on advertising, where

$$N(a) = -a^2 + 300a + 6, \quad 0 \le a \le 300,$$

and a is measured in thousands of dollars.

a) Graph the function using a graphing calculator.
b) Use the MAXIMUM feature to find the relative maximum.
c) For what advertising expenditure will the greatest number of games be sold? How many games will be sold for that amount?

Use a graphing calculator to find the intervals on which the function is increasing or decreasing. Consider the entire set of real numbers if no domain is given.

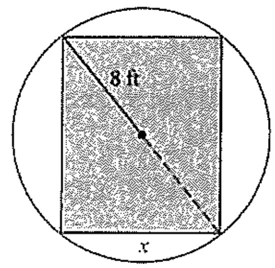
80. $f(x) = \dfrac{8x}{x^2 + 1}$

81. $f(x) = \dfrac{-4}{x^2 + 1}$

82. $f(x) = x\sqrt{4 - x^2}$, for $-2 \le x \le 2$

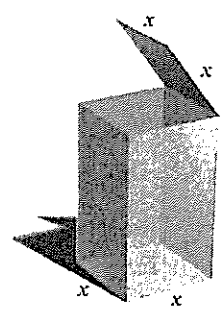
83. $f(x) = -0.8x\sqrt{9 - x^2}$, for $-3 \le x \le 3$

84. *Area of an Inscribed Rectangle.* A rectangle that is x feet wide is inscribed in a circle of radius 8 ft.



a) Express the area of the rectangle as a function of x.
b) Find the domain of the function.
c) Graph the function with a graphing calculator.
d) What dimensions maximize the area of the rectangle?

85. *Cost of Material.* A rectangular box with volume 320 ft^3 is built with a square base and top. The cost is \$1.50/ft^2 for the bottom, \$2.50/ft^2 for the sides, and \$1/ft^2 for the top. Let x = the length of the base, in feet.



a) Express the cost of the box as a function of x.
b) Find the domain of the function.
c) Graph the function with a graphing calculator.
d) What dimensions minimize the cost of the box?

Technology Connection Section 2.2

76. Using a graphing calculator, graph the three functions in Exercise 46 in the viewing window $[0, 200, 0, 10{,}000]$.

77. Using a graphing calculator, graph the three functions in Exercise 45 in the viewing window $[0, 160, 0, 3000]$.

CHAPTER 3

Technology Connection Section 3.1

102. Use a graphing calculator to perform the operations in Exercises 12, 20, 22, 24, 36, 40, and 70.

103. Use a graphing calculator to perform the operations in Exercises 11, 19, 21, 35, 39, 55, and 69.

Technology Connection Section 3.2

Solve graphically. Round solutions to three decimal places, where appropriate.

137. $x^2 - 8x + 12 = 0$

138. $5x^2 + 42x + 16 = 0$

139. $7x^2 - 43x + 6 = 0$

140. $10x^2 - 23x + 12 = 0$

141. $6x + 1 = 4x^2$

142. $3x^2 + 5x = 3$

Use a graphing calculator to find the zeros of the function. Round to three decimal places.

143. $f(x) = 2x^2 - 5x - 4$

144. $f(x) = 4x^2 - 3x - 2$

145. $f(x) = 3x^2 + 2x - 4$

146. $f(x) = 9x^2 - 8x - 7$

147. $f(x) = 5.02x^2 - 4.19x - 2.057$

148. $f(x) = 1.21x^2 - 2.34x - 5.63$

Technology Connection Section 3.3

Use a graphing calculator to check the answers for each of the following.

66. Exercises 4 and 16

67. Exercises 3 and 15

68. Exercises 26 and 30

69. Exercises 25 and 29

Technology Connection Section 3.4

98. Use a graphing calculator to do Exercises 4, 24, 58, and 70.

99. Use a graphing calculator to do Exercises 5, 23, 67, and 69.

Technology Connection Section 3.5

76. Use a graphing calculator to do Exercises 22 and 42.

77. Use a graphing calculator to do Exercises 21 and 41.

CHAPTER 4

Technology Connection Section 4.1

Using a graphing calculator, find the real zeros of the function.

67. $f(x) = x^3 - 3x - 1$

68. $f(x) = x^3 + 3x^2 - 9x - 13$

69. $f(x) = x^4 - 2x^2$

70. $f(x) = x^4 - 2x^3 - 5.6$

71. $f(x) = x^3 - x$

72. $f(x) = 2x^3 - x^2 - 14x - 10$

73. $f(x) = x^8 + 8x^7 - 28x^6 - 56x^5 + 70x^4 + 56x^3 - 28x^2 - 8x + 1$

74. $f(x) = x^6 - 10x^5 + 13x^3 - 4x^2 - 5$

Using a graphing calculator, estimate the real zeros, the relative maxima and minima, and the range of the polynomial function.

75. $g(x) = x^3 - 1.2x + 1$

76. $h(x) = -\frac{1}{2}x^4 + 3x^3 - 5x^2 + 3x + 6$

77. $f(x) = x^6 - 3.8$

78. $h(x) = 2x^3 - x^4 + 20$

79. $f(x) = x^2 + 10x - x^5$

80. $f(x) = 2x^4 - 5.6x^2 + 10$

For the scatterplots and graphs in Exercises determine which, if any, of the following functions might be used as a model for the data.

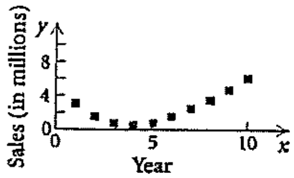
a) *Linear,* $f(x) = mx + b$

b) *Quadratic,* $f(x) = ax^2 + bx + c, a > 0$

c) *Quadratic,* $f(x) = ax^2 + bx + c, a < 0$

d) *Polynomial, not quadratic or linear*

81.



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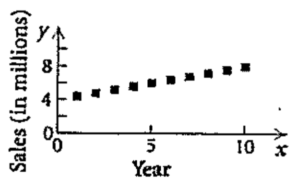

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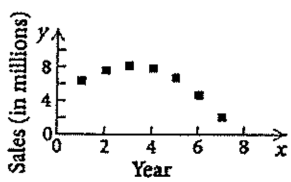

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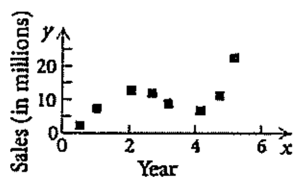

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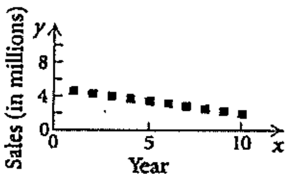

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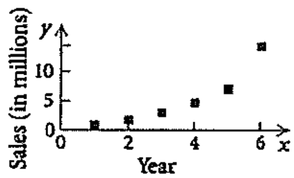


87. *Foreign Adoptions.* The number of foreign adoptions in the United States has declined in recent years, as shown in the table below.

Year, x	Number of U.S. Foreign Adoptions from Top 15 Countries, y
2000, 0	18,120
2001, 1	19,087
2002, 2	20,100
2003, 3	21,320
2004, 4	22,911
2005, 5	22,710
2006, 6	20,705
2007, 7	19,741
2008, 8	17,229
2009, 9	12,782

Sources: Office of Immigration Statistics; Department of Homeland Security

a) Use a graphing calculator to fit quadratic, cubic, and quartic functions to the data. Let x represent the number of years since 2000. Using R^2-values, determine which function is the best fit.

b) Using the function found in part (a), estimate the number of U.S. foreign adoptions in 2010.

88. *Classified Ad Revenue.* The table below lists the newspaper revenue from classified ads for selected years from 1975 to 2009.

Year, x	Newspaper Revenue from Classified Ads, y, (in billions of dollars)
1975, 0	$2.159
1980, 5	4.222
1985, 10	8.375
1990, 15	11.506
1995, 20	13.742
2000, 25	19.608
2005, 30	17.312
2006, 31	16.986
2007, 32	14.186
2008, 33	9.975
2009, 34	6.179

Source: Editor & Publisher International Yearbook, 2010

a) Use a graphing calculator to fit cubic and quartic functions to the data. Let x represent the number of years since 1975. Using R^2-values, determine which function is the best fit.

b) Using the function found in part (a), estimate the newspaper revenue from classified ads in 1988, in 2002, and in 2010.

Technology Connection Section 4.3

74. Use a graphing calculator to find the function values in Exercises 23–30.

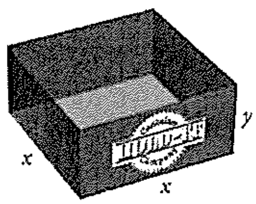
Technology Connection Section 4.4

115. Use a graphing calculator to narrow the list of possible rational zeros in Exercises 62–65. Then determine the rational zeros by evaluating the function using the TABLE feature.

Technology Connection Section 4.5

99. For Exercise 95, find the maximum population and the value of t that will yield it.

100. *Minimizing Surface Area.* The Hold-It Container Co. is designing an open-top rectangular box, with a square base, that will hold 108 cubic centimeters.



a) Express the surface area S as a function of the length x of a side of the base.
b) Graph the function on the interval $(0, \infty)$.
c) Estimate the minimum surface area and the value of x that will yield it.

101. Graph

$$y_1 = \frac{x^3 + 4}{x} \quad \text{and} \quad y_2 = x^2$$

using the same viewing window. Explain how the parabola $y_2 = x^2$ can be thought of as a nonlinear asymptote for y_1.

Technology Connection Section 4.6

97. Use a graphing calculator and the ZERO feature to check your answers to Exercises 25, 31, 39, 47, and 61.

CHAPTER 5

Technology Connection Section 5.1

Graph the function and its inverse using a graphing calculator. Use an inverse drawing feature, if available. Find the domain and the range of f. Find the domain and the range of the inverse f^{-1}.

103. $f(x) = 0.8x + 1.7$

104. $f(x) = 2.7 - 1.08x$

105. $f(x) = \frac{1}{2}x - 4$

106. $f(x) = x^3 - 1$

107. $f(x) = \sqrt{x - 3}$

108. $f(x) = -\dfrac{2}{x}$

109. $f(x) = x^2 - 4,\ x \geq 0$

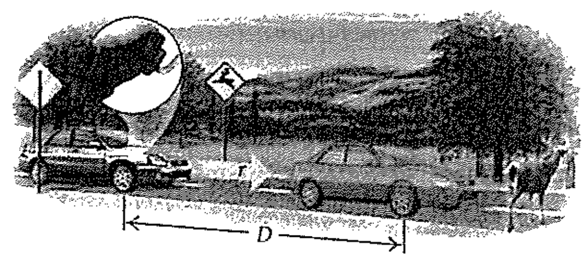
110. $f(x) = 3 - x^2,\ x \geq 0$

111. $f(x) = (3x - 9)^3$

112. $f(x) = \sqrt[3]{\dfrac{x - 3.2}{1.4}}$

113. *Reaction Distance.* You are driving a car when a deer suddenly darts across the road in front of you. Your brain registers the emergency and sends a signal to your foot to hit the brake. The car travels a distance D, in feet, during this time, where D is a function of the speed r, in miles per hour, that the car is traveling when you see the deer. That reaction distance D is a linear function given by

$$D(r) = \frac{11r + 5}{10}.$$

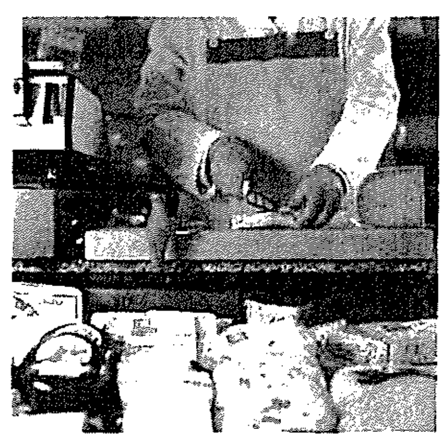


a) Find $D(0)$, $D(10)$, $D(20)$, $D(50)$, and $D(65)$.
b) Find $D^{-1}(r)$ and explain what it represents.
c) Graph the function and its inverse.

114. *Cheese Consumption.* The number of pounds of cheese consumed in the United States per person per year x years after 1990 is given by the function

$$N(x) = 0.4737x + 24.7702$$

(*Source*: U.S. Department of Agriculture).



114. (continued)

a) Determine the cheese consumption per person in 2007 and in 2010.
b) Graph the function and its inverse.
c) Explain what the inverse represents.

Technology Connection Section 5.2

In Exercises 87–100, use a graphing calculator to match the equation with one of the figures (a)–(n), which follow.

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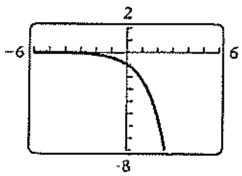

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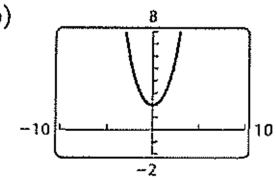

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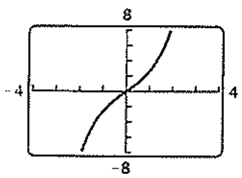

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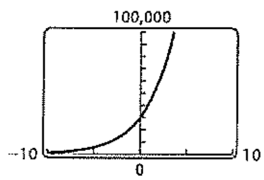

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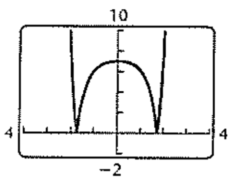

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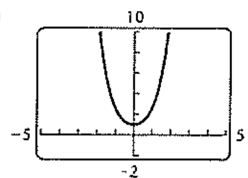

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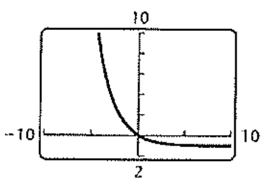

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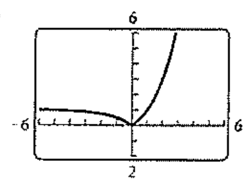

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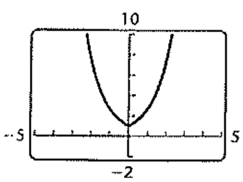

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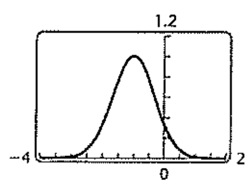

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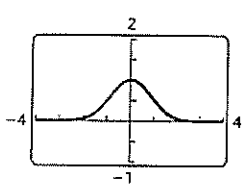

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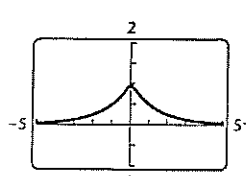
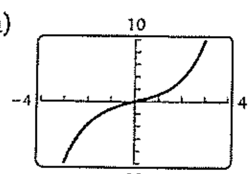
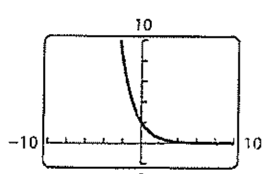


m)


n)


87. $y = 3^x - 3^{-x}$

88. $y = 3^{-(x+1)^2}$

89. $f(x) = -2.3^x$

90. $f(x) = 30{,}000(1.4)^x$

91. $y = 2^{-|x|}$

92. $y = 2^{-(x-1)}$

93. $f(x) = (0.58)^x - 1$

94. $y = 2^x + 2^{-x}$

95. $g(x) = e^{|x|}$

96. $f(x) = |2^x - 1|$

97. $y = 2^{-x^2}$

98. $y = |2^{x^2} - 8|$

99. $g(x) = \dfrac{e^x - e^{-x}}{2}$

100. $f(x) = \dfrac{e^x + e^{-x}}{2}$

Technology Connection Section 5.3

121. Use a graphing calculator that can graph inverses without the need to first find an equation of the inverse to graph the functions in Exercises 79–82.

Technology Connection Section 5.5

Find approximate solution(s) of the equation.

92. $e^{7.2x} = 14.009$

93. $0.082e^{0.05x} = 0.034$

94. $xe^{3x} - 1 = 3$

95. $5e^{5x} + 10 = 3x + 40$

96. $4 \ln(x + 3.4) = 2.5$

97. $\ln x^2 = -x^2$

98. $\log_8 x + \log_8 (x + 2) = 2$

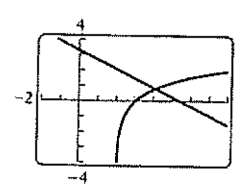
99. $\log_3 x + 7 = 4 - \log_5 x$

100. $\log_5 (x + 7) - \log_5 (2x - 3) = 1$

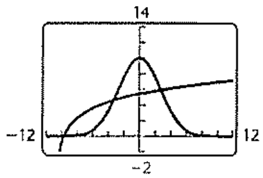
Approximate the point(s) of intersection of the pair of equations.

101. $y = \ln 3x,\ y = 3x - 8$

102. $2.3x + 3.8y = 12.4,\ y = 1.1 \ln(x - 2.05)$



103. $y = 2.3 \ln(x + 10.7),\ y = 10e^{-0.07x^2}$



104. $y = 2.3 \ln(x + 10.7),\ y = 10e^{-0.007x^2}$

Technology Connection Section 5.6

37. *Percent of Americans Ages 85 and Older.* In 1900, 0.2% of the U.S. population, or 122,000 people, were ages 85 and older. This number grew to 5,751,000 in 2010. The table below lists data regarding the percentage of the U.S. population ages 85 and older in selected years from 1900 to 2010.

Year, x	Percent of U.S. Population ages 85 and Older, y
1900, 0	0.2%
1910, 10	0.2
1920, 20	0.2
1930, 30	0.2
1940, 40	0.3
1950, 50	0.4
1960, 60	0.5
1970, 70	0.7
1980, 80	1.0
1990, 90	1.2
1995, 95	1.4
2000, 100	1.5
2005, 105	1.7
2010, 110	1.9

Sources: U.S. Census Bureau; U.S. Department of Commerce

a) Use a graphing calculator to fit an exponential function to the data, where x is the number of years after 1900. Determine whether the function is a good fit.
b) Graph the function found in part (a) with a scatterplot of the data.
c) Estimate the percentage of the U.S. population 85 and older in 2007, in 2015, and in 2020.

38. *Forgetting.* In an economics class, students were given a final exam at the end of the course. Then they were retested with an equivalent test at subsequent time intervals. Their scores after time x, in months, are listed in the table below.

Time, x (in months)	Score, y
1	84.9%
2	84.6
3	84.4
4	84.2
5	84.1
6	83.9

a) Use a graphing calculator to fit a logarithmic function $y = a + b \ln x$ to the data.
b) Use the function to predict test scores after 8, 10, 24, and 36 months.
c) After how long will the test scores fall below 82%?

39. *Unoccupied Homes in a Census.* After door-to-door canvassing, census workers determine the number of unoccupied homes. The table below lists the number of homes, in millions, that were unoccupied in four census years.

Year, x	Number of Unoccupied Homes in Census (in millions)
1980, 0	5.8
1990, 10	7.3
2000, 20	9.9
2010, 30	14.3

Source: U.S. Census Bureau

a) Use a graphing calculator to fit an exponential function to the data, where x is the number of years after 1980.
b) Graph the function found in part (a).
c) Use the function found in part (a) to project the number of unoccupied homes in the 2020 Census.

40. *Older Americans in Debt.* The debt among older Americans has been exponentially increasing in recent years. The table below lists, for selected years, the average debt per household, where the primary head is age 55 or older.

Year, x	Average Debt per Household Where Primary Head Is Age 55 or Older
2000, 0	$34,000
2002, 2	38,000
2004, 4	42,000
2006, 6	59,000
2008, 8	66,000

Source: MacroMonitor, by Strategic Business Insights

a) Use a graphing calculator to fit the data with an exponential function, where x is the number of years since 2000.
b) Graph the function found in part (a).
c) Use the function in part (a) to estimate the debt in 2014.
d) In what year is average debt among older Americans expected to exceed $140,000?

41. *Effect of Advertising.* A company introduced a new software product on a trial run in a city. They advertised the product on television and found the following data regarding the percent P of people who bought the product after x ads were run.

Number of Ads, x	Percentage Who Bought, P
0	0.2%
10	0.7
20	2.7
30	9.2
40	27.0
50	57.6
60	83.3
70	94.8
80	98.5
90	99.6

a) Use a graphing calculator to fit a logistic function

$$P(x) = \frac{a}{1 + be^{-kx}}$$

to the data.

b) What percent of people bought the product when 55 ads were run?100 ads?
c) Find the horizontal asymptote for the graph. Interpret the asymptote in terms of the advertising situation.

CHAPTER 6

Technology Connection Section 6.1

89. Use a graphing calculator to solve the systems of equations in Exercises 7, 17, and 31.

90. Use a graphing calculator to solve the systems of equations in Exercises 8, 18, and 32.

91. *Video Rentals.* The table below lists the revenue, in billions of dollars, from video rentals in video stores and with subscriptions in recent years.

Year, x	Video rentals in video stores, $v(x)$ (in billions)	Video rentals with subscriptions, $s(x)$ (in billions)
2005	$6.1	$1.4
2006	5.8	1.7
2007	4.9	2.0
2008	4.3	2.1
2009	3.3	2.2

Source: Screen Digest

a) Find linear functions $v(x)$ and $s(x)$ that represent the revenues from video rentals in video stores and with subscriptions x years since 2005.
b) Use the functions found in part (a) to estimate when revenues from video rentals in video stores and with subscriptions services will be equal.

Technology Connection Section 6.2

54. *Unemployment Rate.* The table below lists the U.S. unemployment rate in October for selected years.

Year	U.S. Unemployment Rate in October
2002	5.7%
2004	5.5
2005	5.0
2008	5.6
2010	9.7

Source: U.S. Bureau of labor Statistics

a) Use a graphing calculator to fit a quadratic function $f(x)$ to the data, where x is the number of years since 2002.
b) Use the function found in part (a) to estimate the unemployment rate in 2003, in 2007, and in 2009.

55. *Box-Office Revenue.* The table below lists the box-office revenue for January through March, in millions of dollars, for years 2008–2011.

Year	Box-Office Revenue for January–March (in millions)
2008	$2219.40
2009	2430.30
2010	2646.50
2011	2095.50

Source: Box Office Mojo

a) Use a graphing calculator to fit a quadratic function $f(x)$ to the data, where x is the number of years since 2008.
b) Use the function found in part (a) to estimate the box-office revenue for January through March in 2012.

Technology Connection Section 6.4

60. Use a graphing calculator to perform the operations in Exercises 6, 8, 12, and 18.

61. Use a graphing calculator to perform the operations in Exercises 5, 9, 13, and 15.

Technology Connection Section 6.5

Use a graphing calculator to do the following.

55. Exercises 5, 13, and 21

56. Exercises 6, 14, and 24

57. Exercises 29, 35, and 37

58. Exercises 30, 34, and 38

Technology Connection Section 6.6

Use a graphing calculator to do the following.

65. Exercises 1 and 23

66. Exercises 2 and 24

For each matrix A, evaluate |A| on a graphing calculator.

67. $$A = \begin{bmatrix} 1 & 0 & 0 & -2 \\ 4 & 1 & 0 & 0 \\ 5 & 6 & 7 & 8 \\ -2 & -3 & -1 & 0 \end{bmatrix}$$

68. $$A = \begin{bmatrix} 5 & -4 & 2 & -2 \\ 3 & -3 & -4 & 7 \\ -2 & 3 & 2 & 4 \\ -8 & 9 & 5 & -5 \end{bmatrix}$$

Use a graphing calculator to do the following.

69. Exercises 29 and 37

70. Exercises 30 and 38

Technology Connection Section 6.7

Use a graphing calculator to do the following.

93. Exercises 9, 13, and 25

94. Exercises 10, 14, and 24

CHAPTER 7

Technology Connection Section 7.1

Use a graphing calculator to find the vertex, the focus, and the directrix of each of the following.

46. $4.5x^2 - 7.8x + 9.7y = 0$

47. $134.1y^2 + 43.4x - 316.6y - 122.4 = 0$

Technology Connection Section 7.2

Use a graphing calculator to find the center and the vertices of each of the following.

68. $4x^2 + 9y^2 - 16.025x + 18.0927y - 11.346 = 0$

69. $9x^2 + 4y^2 + 54.063x - 8.016y + 49.872 = 0$

Technology Connection Section 7.3

Use a graphing calculator to find the center, the vertices, and the asymptotes.

52. $5x^2 - 3.5y^2 + 14.6x - 6.7y + 3.4 = 0$

53. $x^2 - y^2 - 2.046x - 4.088y - 4.228 = 0$

Technology Connection Section 7.4

Solve using a graphing calculator.

107. $y - \ln x = 2,$
$y = x^2$

108. $y = \ln(x + 4),$
$x^2 + y^2 = 6$

109. $e^x - y = 1,$
$3x + y = 4$

110. $y - e^{-x} = 1,$
$y = 2x + 5$

111. $y = e^x,$
$x - y = -2$

112. $y = e^{-x},$
$x + y = 3$

113. $x^2 + y^2 = 19{,}380{,}510.36,$
$27{,}942.25x - 6.125y = 0$

114. $2x + 2y = 1660,$
$xy = 35{,}325$

115. $14.5x^2 - 13.5y^2 - 64.5 = 0,$
$5.5x - 6.3y - 12.3 = 0$

116. $13.5xy + 15.6 = 0,$
$5.6x - 6.7y - 42.3 = 0$

117. $0.319x^2 + 2688.7y^2 = 56{,}548,$
$0.306x^2 - 2688.7y^2 = 43{,}452$

118. $18.465x^2 + 788.723y^2 = 6408,$
$106.535x^2 - 788.723y^2 = 2692$

CHAPTER 8

Technology Connection Section 8.1

Use a graphing calculator to construct a table of values for the first 10 terms of the sequence.

81. $a_n = \sqrt{n+1} - \sqrt{n}$

82. $a_n = \left(1 + \frac{1}{n}\right)^n$

83. $a_1 = 2,\ a_{n+1} = \frac{1}{2}\left(a_n + \frac{2}{a_n}\right)$

84. $a_1 = 2,\ a_{n+1} = \sqrt{1 + \sqrt{a_n}}$

85. Vehicle Production. The table below lists world motor vehicle production in recent years.

Year, n	World Motor Vehicle Production (in thousands of units)
2001, 0	57,705
2002, 1	59,587
2003, 2	61,562
2004, 3	65,654
2005, 4	67,892
2006, 5	70,992
2007, 6	74,647
2008, 7	67,602
2009, 8	59,096

Sources: Automotive New Data Center; R. L. Polk

a) Use a graphing calculator to fit a quadratic sequence regression function

$$a_n = an^2 + bn + c$$

to the data, where n is the number of years since 2001.

b) Estimate the world motor vehicle production in 2010, in 2011, and in 2012.

86. Weekly Earnings. The table below lists the average weekly earnings of U.S. production workers in recent years.

Year, n	Average Weekly Earnings of U.S. Production Workers
2004, 0	$529.09
2005, 1	544.33
2006, 2	567.87
2007, 3	590.04
2008, 4	607.95
2009, 5	617.11

Sources: Bureau of Labor Statistics, U.S. Department of Labor

a) Use a graphing calculator to fit a linear sequence regression function

$$a_n = an + b$$

to the data, where n is the number of years since 2004.

b) Estimate the average weekly earnings in 2010, in 2012, and in 2015.

Technology Connection Section 8.3

80. Use a graphing calculator to find the sum in Exercise 40.

81. Use a graphing calculator to find the sum in Exercise 41.

Technology Connection Section 8.8

41. *Random-Number Generator.* Many graphing calculators have a **random-number generator.** This feature produces a random number in the interval [0, 1]. (Consult your user's manual.) W- can use such a feature to simulate coin flipping. number r such that $0 \leq r \leq 0.5$ would indicate heads, H. A number r such that $0.5 < r \leq 1.0$ would indicate tails, T. Use a random-number generator 100 times.

a) What is the experimental probability of getting heads?

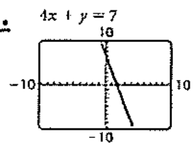
b) What is the experimental probability of getting tails?

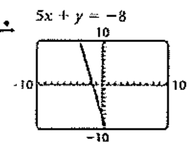
ANSWERS

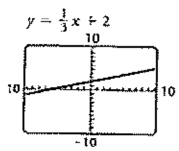
CHAPTER 1

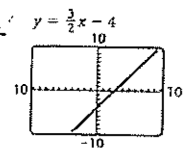
Section 1.1

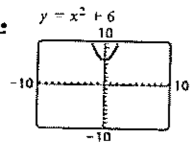
110. (b) 111. (d) 112. (a) 113. (c)

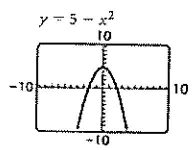
114. 

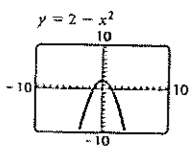
115. 

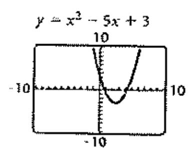
116. 

117. 

118. 

119. 

120. 

121. 

122. Standard window 123. [-15, 15, -10, 30]
124. [-1, 1, -0.3, 0.3] 125. Standard window
126. Square the window; for example, use [-12, 9, -4, 10]. 127. Square the window; for example, use [-10, 20, -15, 5].
128.-131. Left to the student

Section 1.2

103. $h(-11) = 57{,}855$; $h(7) = 4017$; $h(15) = 119{,}241$ 104. $g(-2.1) \approx -21.8$; $g(5.08) \approx -130.4$; $g(10.003) \approx -468.3$
105. (a) $f(-4) = -0.25$; $f(-6)$ does not exist. (b) $g(-5)$ does not exist; $g(1) = 3$

Section 1.3

99. Left to the student

Section 1.4

74. (a) $y = 1.08x + 32.24$, where x is the number of years after 2005 and y is the percentage of deaths followed by cremations; (b) about 44.1%; this percentage is more by 44.1% - 43.5%, or 0.6%, than the percentage found in Exercise 62; (c) $r \approx 0.9959$; the line fits the data well.
75. (a) $y = 146.9511905x + 499.2333333$, where x is the number of years after 2001 and y is in millions; (b) about 2556.6 million; this value is 7.4 million more than the value found in Exercise 61; (c) $r \approx 0.9980$; the line fits the data well.
76. (a) $y = 2.628571429x + 17.41428571$, where x is the number of years after 1991 and y is the total amount of U.S. expenditures on pets, in billions of dollars; (b) about \$80.5 billion; (c) $r \approx 0.9950$; the line fits the data well.
77. (a) $y = 411.025x + 4570$ where x is the number of years after 1992 and y is the average credit-card debt per household; (b) about \$13,613; this value is \$1033 more than the value found in Exercise 65; (c) $r \approx 0.9735$; the line fits the data fairly well.
78. (a) $y = 0.072050673x + 81.99920823$; (b) 84%, 82%, 83%; (c) $r \approx 0.0636$; not a good predictor 79. (a) $M = 0.2H + 156$; (b) 164, 169, 171, 173; (c) $r = 1$; the regression line fits the data perfectly and should be a good predictor.

Section 1.5

109.-110. Left to the student

Section 1.6

55.-56. Left to the student

CHAPTER 2

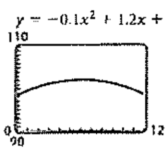
Section 2.1

74. Increasing: (1,3); decreasing: (-∞,1), (3,∞); relative maximum: -4 at x = 3; relative minimum: -8 at x = 1

75. Increasing: (-∞,-2.573), (3.239,∞); decreasing: (-2.573, 3.239); relative maximum: 4.134 at x = -2.573; relative minimum: -15.497 at x = 3.239

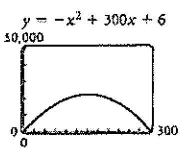
76. Increasing: (-1.552, 0), (1.552, ∞); decreasing: (- ∞ , -1.552), (0, 1.552); relative maximum: 4.07 at x = 0; relative minima: -2.314 at x = -1.552, -2.314 at x = 1.552 77. Increasing: (-3, ∞); decreasing: (-∞ ,-3); relative minimum: 9.78 at x = -3

78. (a)



; (b) 6 days after the illness began; 102.2°F

79. (a)

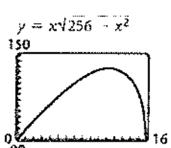


; (b) 22,506;

(c) When $150 thousand is spent on advertising, 22,506 games will be sold.

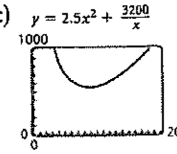
80. Increasing: (-1,1); decreasing: (-∞,-1) (1,∞) 81. Increasing: (0,∞); decreasing: (-∞,0) 82. Increasing: (-1.414, 1.414); decreasing: (-2, -1,414), (1.414,2) 83. Increasing: (-3,-2.121), (2.121, 3); decreasing: (-2.121, 2.121)

84. (a) $A(x) = x\sqrt{256 - x^2}$;
(b) {x| 0 < x < 16}; (c)



(d) 11.314 ft by 11.314 ft

85. (a) $C(x) = 2.5x^2 + \frac{3200}{x}$;
(b) {x | x > 0}; (c)



(d) about 8.618 ft by 8.618 ft by 4.309 ft

Section 2.2

76.-77. Left to the student

CHAPTER 3

Section 3.1

102.-103. Left to the student

Section 3.2

137. 2, 6 138. -8, -0.4 139. 0.143, 6
140. 0.8, 1.5 141. -0.151, 1.651
142. -2.135, 0.468 143. -0.637, 3.137
144. -0.425, 1.175 145. -1.535, 0.869
146. -0.543, 1.432 147. -0.347, 1.181
148. -1.397, 3.331

Section 3.3

66.-69. Left to the student

Section 3.4

98.-99. Left to the student

Section 3.5

76.-77. Left to the student

CHAPTER 4

Section 4.1

67. -1.532, -0.347, 1.879 68. -4.378, -1.167, 2.545 69. -1.414, 0, 1.414
70. -1.205, 2.403 71. -1, 0, 1
72. -1.831, -0.856, 3.188 73. -10,153, -1.871, -0.821, -0.303, 0.098, 0.535 1.219, 3.297 74. -1.281, 9.871

75. −1.386; relative maximum: 1.506 at $x = -0.632$, relative minimum: 0.494 at $x = 0.632$; $(-\infty, \infty)$ 76. −0.720, 4.089; relative maxima: 6.59375 at $x = 0.5$, 10.5 at $x = 3$, relative minimum: 6.5 at $x = 1$; $(-\infty, 10.5]$ 77. −1.249, 1.249; relative minimum: −3.8 at $x = 0$, no relative maxima; $[-3.8, \infty)$ 78. −1.748, 2.857; relative maximum: 21.688 at $x = 1.5$, no relative minima; $(-\infty, 21.688]$ 79. −1.697, 0, 1.856; relative maximum: 11.012 at $x = 1.258$, relative minimum: −8.183 at $x = -1.116$; $(-\infty, \infty)$ 80. No real zeros; relative maximum: 10 at $x = 0$, relative minima: 6.08 at $x = -1.183$ and $x = 1.183$; $[6.08, \infty)$

81. (b) 82. (a)

83. (c) 84. (d)

85. (a)

86. (b) Might fit. It is possible that there is no polynomial function that fits the data well.

87. **(a)** Quadratic: $y = -342.2575758x^2 + 2687.051515x + 17{,}133.10909$, $R^2 \approx 0.9388$; cubic: $y = -31.88461538x^3 + 88.18473193x^2 + 1217.170746x + 17{,}936.6014$, $R^2 \approx 0.9783$; quartic: $y = 3.968531469x^4 - 103.3181818x^3 + 489.0064103x^2 + 502.8350816x + 18{,}108.04196$, $R^2 \approx 0.9815$; the R^2-value, 0.9815, for the quartic function is the closest to 1; thus the quartic function is the best fit; (b) 8404 foreign adoptions

88. **(a)** Cubic: $y = -0.0029175919x^3 + 0.1195127076x^2 - 0.5287827297x + 3.087289783$, $R^2 \approx 0.9023$; quartic: $y = -0.0001884254x^4 + 0.0099636973x^3 - 0.1550252422x^2 + 1.300895521x + 1.77274528$, $R^2 \approx 0.9734$; the R^2-value, 0.9734, for the quartic function is the closest to 1; thus the quartic function is the better fit; **(b)** 1988: \$8.994 billion; 2002: \$19.862 billion; 2010: \$1.836 billion

Section 4.3

74. Left to the student

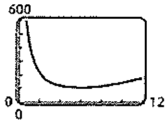
Section 4.4

115. Left to the student

Section 4.5

99. 58,926 at t ≈ 2.12 months

100. (a) $S(x) = x^2 + \frac{432}{x}$; (b) $y = x^2 + \frac{432}{x}$



(c) minimum: 108 cm² when $x = 6$ cm

101. $y_1 = \frac{x^3 + 4}{x} = x^2 + \frac{4}{x}$. As $|x| \to \infty$, $\frac{4}{x} \to 0$ and the value of $y_1 \to x^2$. Thus the parabola $y_2 = x^2$ can be thought of as a nonlinear asymptote for y_1. The graph confirms this.

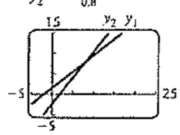
Section 4.6

97. Left to the student

CHAPTER 5

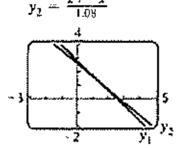
Section 5.1

103. $y_1 = 0.8x + 1.7$, $y_2 = \frac{x - 1.7}{0.8}$



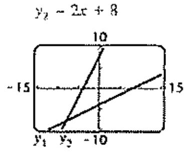
Domain and range of both f and f^{-1}: all real numbers

104. $y_1 = 2.7 - 1.08x$, $y_2 = \frac{2.7 - x}{1.08}$



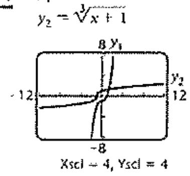
Domain and range of both f and f^{-1}: all real numbers

105. $y_1 = \frac{1}{2}x - 4$, $y_2 = 2x + 8$



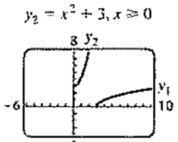
Domain and range of both f and f^{-1}: all real numbers

106. $y_1 = x^3 - 1$, $y_2 = \sqrt[3]{x + 1}$



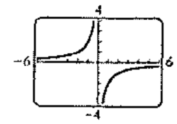
Domain and range of both f and f^{-1}: all real numbers

107. $y_1 = \sqrt{x - 3}$, $y_2 = x^2 + 3, x \geq 0$



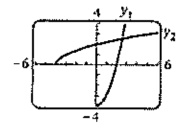
Domain of f: $[3, \infty)$, range of f: $[0, \infty)$; domain of f^{-1}: $[0, \infty)$, range of f^{-1}: $[3, \infty)$

108. $y_1 = -\frac{2}{x}$, $y_2 = -\frac{2}{x}$



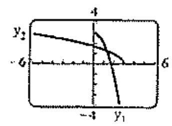
$f = f^{-1}$, domain and range of both f and f^{-1} are $(-\infty, 0) \cup (0, \infty)$

109. $y_1 = x^2 - 4, x \geq 0$, $y_2 = \sqrt{4 + x}$



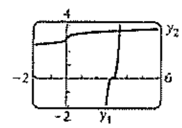
Domain of f: $[0, \infty)$, range of f: $[-4, \infty)$; domain of f^{-1}: $[-4, \infty)$, range of f^{-1}: $[0, \infty)$

110. $y_1 = 3 - x^2, x \geq 0$, $y_2 = \sqrt{3 - x}$



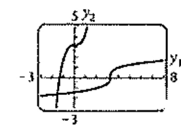
Domain of f: $[0, \infty)$, range of f: $(-\infty, 3]$; domain of f^{-1}: $(-\infty, 3]$, range of f^{-1}: $[0, \infty)$

111. $y_1 = (3x - 9)^3$, $y_2 = \frac{\sqrt[3]{x} + 9}{3}$



Domain and range of both f and f^{-1}: all real numbers

112. $y_1 = \sqrt[3]{\frac{x - 3.2}{1.4}}$, $y_2 = 1.4x^3 + 3.2$

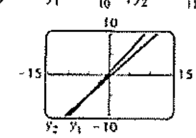


Domain and range of both f and f^{-1}: all real numbers

113. (a) 0.5, 11.5, 22.5, 55.5, 72;

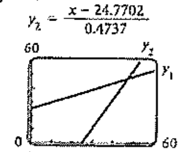
(b) $D^{-1}(r) = \frac{10r - 5}{11}$; the speed, in miles per hour, that the car is traveling when the reaction distance is r feet;

(c) $y_1 = \frac{11x + 5}{10}$, $y_2 = \frac{10x - 5}{11}$



114. (a) 32.8231 lb, 34.2442 lb;

(b) $y_1 = 0.4737x + 24.7702$, $y_2 = \frac{x - 24.7702}{0.4737}$



(c) $N^{-1}(x)$ represents the number of years after 1990 when x pounds of cheese are consumed per person per year.

Section 5.2

87. (c) 88. (j) 89. (a) 90. (d)
91. (l) 92. (n) 93. (g) 94. (b)
95. (i) 96. (h) 97. (k) 98. (e)
99. (m) 100. (f)

Section 5.3

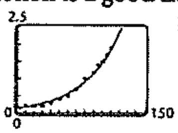
121. Left to the student

Section 5.5

92. 0.367 93. -17.607 94. 0.621
95. -10, 0.366 96. -1.532 97. -0.753, 0.753 98. 7.062 99. 0.141 100. 2.444
101. (-0.0001, -7.9997), (3.445, 2.336)
102. (4.093, 0.786) 103. (-9.694, 0.014), (-3.334, 4.593), (2.714, 5.971)
104. (7.586, 6.684)

Section 5.6

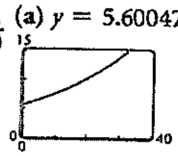
37. (a) $y = 0.1377082721(1.023820625)^x$; $r \approx 0.9824$, the function is a good fit;
(b)



; (c) 2007: 1.7% 2015: 2.1% 2020: 2.3%

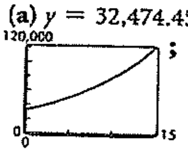
38. (a) $y = 84.94353992 - 0.5412834098 \ln x$; (b) 83.8%; 83.7%; 83.2%; 83.0%; (c) about 230 months

39. (a) $y = 5.600477432(1.030576807)^x$;
(b)



; (c) 18.7 million homes

40. (a) $y = 32{,}474.45414(1.092345245)^x$;
(b)



; (c) about $111,836; (d) about 17 years after 2000, or in 2017

41. (a) $P(x) = \dfrac{99.98884912}{1 + 489.2438401e^{-0.1299899024x}}$
(b) 72.2%; 99.9% (c) y = 99.98884912 is an asymptote; as more and more ads run, the percent of people who buy the product approaches 100%.

CHAPTER 6

Section 6.1

89.-90. Left to the student
91. (a) $v(x) = -0.71x + 6.3$, $s(x) = 0.2x + 1.48$; (b) about 5 years after 2005

Section 6.2

54. (a) $f(x) = 0.143707483x^2 - 0.6921768707x + 5.882482993$; (b) 2003: 5.3%, 2007: 6.0%, 2009: 8.1%
55. (a) $f(x) = -190.475x^2 + 555.875x + 2180.775$; (b) about $1356.68 million

Section 6.4

60.-61. Left to the student

Section 6.5

55.-58. Left to the student

Section 6.6

65.-66. Left to the student
67. 110 68. -195 69.-70. Left to the student

Section 6.7

93.-94. Left to the student

CHAPTER 7

Section 7.1

46. V:(0.867, 0.348); F:(0.867, -0.190); D: y = 0.887 47. V:(7.126, 1.180); F: (7.045, 1.180); D: x = 7.207

Section 7.2

68. C:(2.003, -1.005); V:(-1.017, -1.005), (5.023, -1.005) 69. C:(-3.004, 1.002); V:(-3.004, -1.970), (-3.004, 3.974)

Section 7.3

52. C:(-1.460, -0.957); V:(-2.360, -0.957), (-0.560, -0.957); A: y = -1.429x - 3.043, y = 1.429x + 1.129 53. C:(1.023, -2.044); V:(2.07, -2.044), (-0.024); A: y = x - 3.067, y = -x - 1.021

Section 7.4

107. (1.564, 2.448), (0.138, 0.019)

108. (1.720, 1.744), (-2.405, 0.467)

109. (0.871, 1.388) 110. (-0.841, 3.318)

111. (1.146, 3.146), (-1.841, 0.159)

112. (2.948, 0.052), (-1.505, 4.505)

113. (0.965, 4402.33), (-0.965, -4402.33)

114. (785, 45), (45, 785)

115. (2.112, -0.109), (-13.041 , -13.337)

116. (7.366, -0.157), (0.188, -6.157)

117. (400, 1.431), (-400, 1.431), (400, -1.431), (-400, -1.431)

118. (8.532, 2.534), (8.532, -2.534), (-8.532, 2.534), (-8.532, -2.534)

CHAPTER 8

Section 8.1

81.

n	U_n
1	0.41421
2	0.31784
3	0.26795
4	0.23607
5	0.21342
6	0.19626
7	0.18268
8	0.17157
9	0.16228
10	0.15435

82.

n	U_n
1	2
2	2.25
3	2.3704
4	2.4414
5	2.4883
6	2.5216
7	2.5465
8	2.5658
9	2.5812
10	2.5937

83.

n	U_n
1	2
2	1.5
3	1.4167
4	1.4142
5	1.4142
6	1.4142
7	1.4142
8	1.4142
9	1.4142
10	1.4142

84.

n	U_n
1	2
2	1.5538
3	1.4988
4	1.4914
5	1.4904
6	1.4902
7	1.4902
8	1.4902
9	1.4902
10	1.4902

85. (a) $a_n = -659.8950216n^2 + 6297.77684n + 54{,}737.29091$; (b) 2010: 57,966,000, 2011: 51,726,000, 2012: 44,166,000

86. (a) $a_n = 18.66085714n + 529.4128571$; (b) 2010: \$641.38, 2012: \$678.70, 2015: \$734.68

Section 8.3

80.-81. Left to the student

Section 8.8

41. Answers will vary.