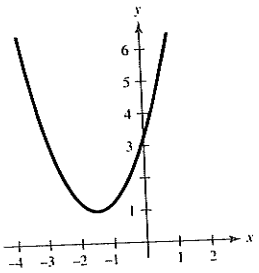
(b) Vertical stretch and reflection in the x-axis

(c) Vertical shift

(d) Horizontal shift

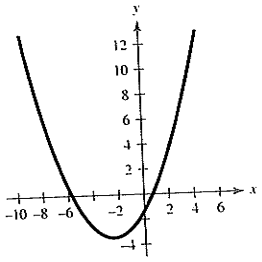
3.



Vertex: $\left(-\frac{3}{2}, 1\right)$

Intercept: $\left(0, \frac{13}{4}\right)$

5.



Vertex: $\left(-\frac{5}{2}, -\frac{41}{12}\right)$

Intercepts:

$\left(0, -\frac{4}{3}\right), \left(\frac{-5 \pm \sqrt{41}}{2}, 0\right)$

7. $f(x) = (x - 1)^2 - 4$

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

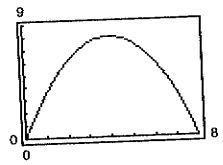
11. (a) $A = x\left(\frac{8 - x}{2}\right), 0 < x < 8$

(b)

x	Area
1	$(1)\left[4 - \frac{1}{2}(1)\right] = \frac{7}{2}$
2	$(2)\left[4 - \frac{1}{2}(2)\right] = 6$
3	$(3)\left[4 - \frac{1}{2}(3)\right] = \frac{15}{2}$
4	$(4)\left[4 - \frac{1}{2}(4)\right] = 8$
5	$(5)\left[4 - \frac{1}{2}(5)\right] = \frac{15}{2}$
6	$(6)\left[4 - \frac{1}{2}(6)\right] = 6$

$x = 4, y = 2$

(c)

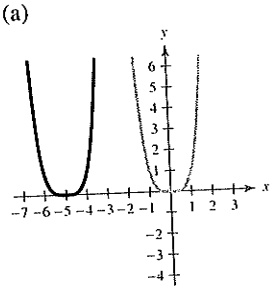


$x = 4, y = 2$

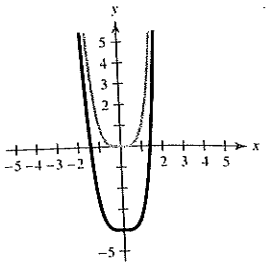
(d) $A = -\frac{1}{2}(x - 4)^2 + 8$

(e) Answers will vary.

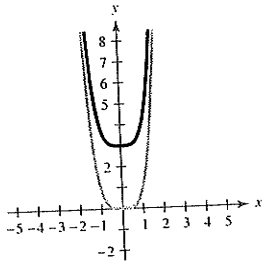
13. (a)



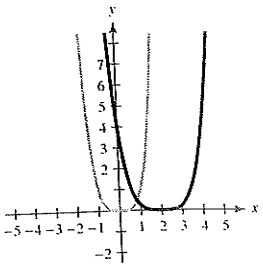
(b)



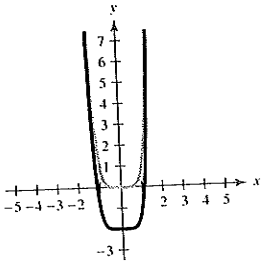
(c)



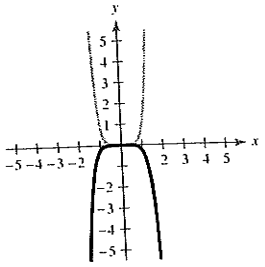
(d)



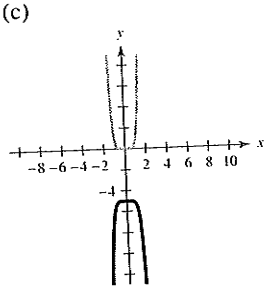
15. (a)



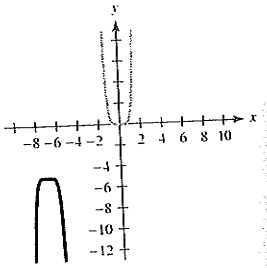
(b)



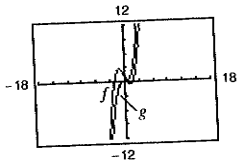
(c)



(d)

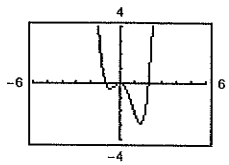


17.

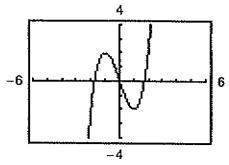


19. Falls to the left, falls to the right

21. Rises to the left, rises to the right

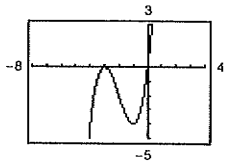
23. (a) 

(b) and (c) $x = -1, 0, 2$

25. (a) 

(b) $t = 0, \pm 1.7321$

(c) $t = 0, \pm\sqrt{3}$

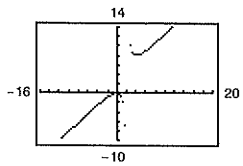
27. (a) 

(b) and (c) $x = -3, 0$

29. (a) $(-3, -2), (-1, 0), (0, 1)$

(b) $(-2.247, 0), (-0.555, 0), (0.802, 0)$

31. (a) $(-3, -2), (2, 3)$ (b) $(-2.570, 0), (2.570, 0)$

33. 

35. $8x + 5 + \dfrac{2}{3x - 2}$

37. $x^2 - 2,\ x \neq \pm 1$ **39.** $5x + 2,\ x \neq \dfrac{3 \pm \sqrt{5}}{2}$

41. $3x^2 + 5x + 8 + \dfrac{10}{2x^2 - 1}$

43. $\dfrac{1}{4}x^3 - \dfrac{9}{2}x^2 + 9x - 18 + \dfrac{36}{x + 2}$

45. $6x^3 - 27x,\ x \neq \frac{2}{3}$ **47.** $3x^2 + 2x + 20 + \dfrac{58}{x - 4}$

49. (a) -421 (b) -9

51. (a) Answers will vary.

(b) $(x + 1)(x + 7)$

(c) $f(x) = (x - 4)(x + 1)(x + 7)$

(d) $x = 4, -1, -7$

53. (a) Answers will vary.

(b) $(x + 1)(x - 4)$

(c) $f(x) = (x + 2)(x - 3)(x + 1)(x - 4)$

(d) $x = -2, 3, -1, 4$

55. $\pm 1, \pm 3, \pm\frac{3}{2}, \pm\frac{3}{4}, \pm\frac{1}{2}, \pm\frac{1}{4}$ **57.** $\frac{5}{6}, \pm 2i$ **59.** $-1, \frac{3}{2}, 3, \frac{2}{3}$

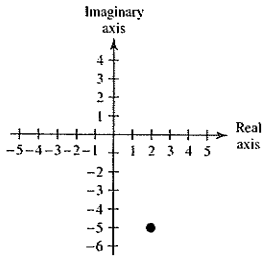
61. 2 or 0 positive real zeros

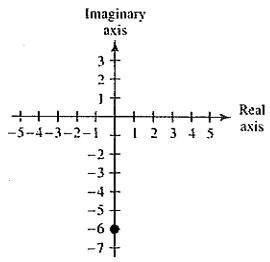
1 negative real zero

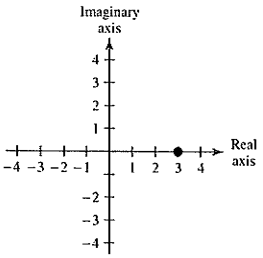
63. Answers will vary. **65.** $6 + 5i$ **67.** $2 + 7i$

69. $3 + 7i$ **71.** $40 + 65i$ **73.** $-4 - 46i$

75. -80 **77.** $1 - 6i$ **79.** $\frac{17}{26} + \frac{7}{26}i$

81. 

83. 

85. 

87. $x = 0, 2, 2$

89. $x = -4, 6, \pm 2i$

91. Zeros: $2, -\frac{3}{2}, 1 \pm i$;

$(x - 2)(2x + 3)(x - 1 + i)(x - 1 - i)$

93. Zeros: $4, \dfrac{3 \pm \sqrt{15}i}{2}$;

$$(x - 4)\left(x - \frac{3 + \sqrt{15}i}{2}\right)\left(x - \frac{3 - \sqrt{15}i}{2}\right)$$

95. (a) $2, 1 \pm i$

(b) $(x - 2)(x - 1 - i)(x - 1 + i)$ (c) $(2, 0)$

97. (a) $-4, -1 \pm \sqrt{2}i$

(b) $(x + 4)\left(x + 1 + \sqrt{2}i\right)\left(x + 1 - \sqrt{2}i\right)$

(c) $(-4, 0)$

99. (a) $\pm 3i, \pm 5i$

(b) $(x - 3i)(x + 3i)(x - 5i)(x + 5i)$ (c) None

101. $f(x) = x^4 + 4x^3 + 29x^2 + 100x + 100$

103. $f(x) = x^4 + 9x^3 + 48x^2 + 78x - 136$

105. (a) $(x^2 + 4)(x^2 - 2)$

(b) $(x^2 + 4)\left(x - \sqrt{2}\right)\left(x + \sqrt{2}\right)$

(c) $(x + 2i)(x - 2i)\left(x - \sqrt{2}\right)\left(x + \sqrt{2}\right)$

107. (a) $(x^2 + 9)(x^2 - 2x - 1)$

(b) $(x^2 + 9)(x - 1 + \sqrt{2})(x - 1 - \sqrt{2})$

(c) $(x + 3i)(x - 3i)(x - 1 + \sqrt{2})(x - 1 - \sqrt{2})$

109. (a) Domain: all real numbers x except $x = 1$

(b) Vertical asymptote: $x = 1$

Horizontal asymptote: $y = -1$

111. (a) Domain: all real numbers x except $x = 6, -3$

(b) Vertical asymptotes: $x = 6, x = -3$

Horizontal asymptote: $y = 0$

113. (a) Domain: all real numbers x except $x = 7$

(b) Vertical asymptote: $x = 7$

Horizontal asymptote: $y = -1$

115. (a) Domain: all real numbers x except $x = \pm\frac{\sqrt{6}}{2}$

(b) Vertical asymptotes: $x = \pm\frac{\sqrt{6}}{2}$

Horizontal asymptote: $y = 2$

117. (a) Domain: all real numbers x except $x = 5, -3$

(b) Vertical asymptote: $x = -3$

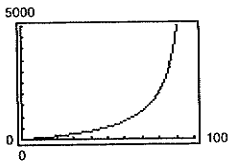
Horizontal asymptote: $y = 0$

119. (a) Domain: all real numbers

(b) Vertical asymptote: none

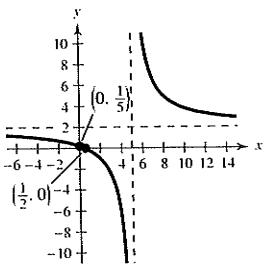
Horizontal asymptotes: $y = \pm 1$

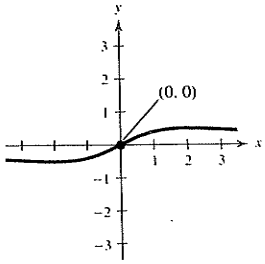
121. (a) \$176 million; \$528 million; \$1584 million

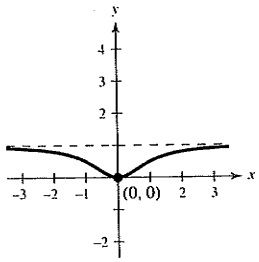
(b) 

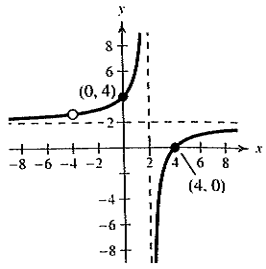
Answers will vary.

(c) No. As $p \to 100$, the cost approaches ∞.

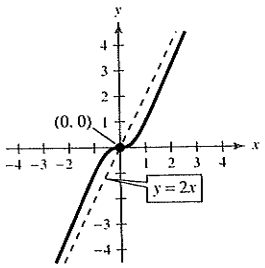
123. 

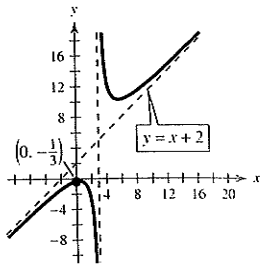
125. 

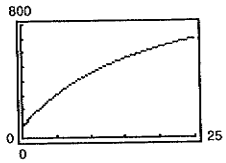
127. 

129. 

There is a hole at $x = -4$.

131. 

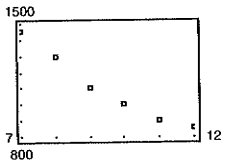
133. 

135. (a) 

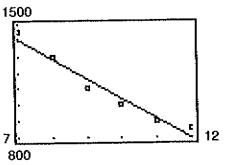
(b) 304,000; 453,333; 702,222

(c) 1,200,000, because N has a horizontal asymptote at $y = 1{,}200{,}000$.

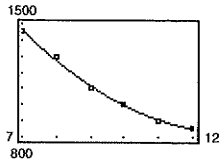
137. Quadratic **139.** Linear

141. (a) 

(b) $P = -122.1t + 2261$

(c) 

(d) $P = 16.52t^2 - 436.0t + 3704$

(e) 

(f) The quadratic model fits the data better than the linear model. \$1208. Answers will vary.

143. False. For the graph of a rational function to have a slant asymptote, the degree of its numerator must be exactly one more than the degree of its denominator.

145. The divisor is a factor of the dividend.

Chapter Test (page 174)

1. (a) Reflection in the x-axis followed by a vertical shift six units upward.

(b) Horizontal shift of $\frac{3}{2}$ units to the right

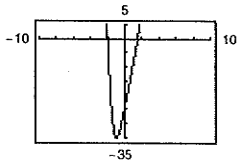
2. Vertex: $(-2, -1)$

Intercepts: $(0, 3), (-3, 0), (-1, 0)$

3. $y = (x - 3)^2 - 6$

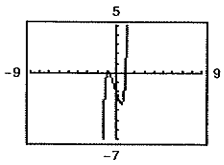
4. $3x + \dfrac{x - 1}{x^2 + 1}$ **5.** $2x^3 + 4x^2 + 3x + 6 + \dfrac{9}{x - 2}$

6. $\pm 1, \pm 2, \pm 3, \pm 4, \pm 6, \pm 8, \pm 12, \pm 24, \pm\frac{1}{2}, \pm\frac{3}{2}$



$-2, \frac{3}{2}$

7. $\pm 1, \pm 2, \pm\frac{1}{3}, \pm\frac{2}{3}$



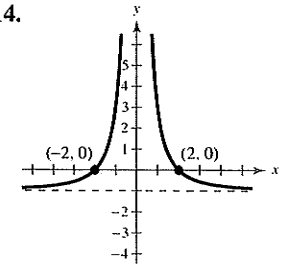
$\pm 1, -\frac{2}{3}$

8. $-9 - 18i$ **9.** $13 + 4i$ **10.** $-1 + 2i$

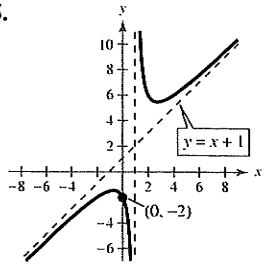
11. $\frac{3}{50} + \frac{21}{50}i$ **12.** $-0.819, 1.380$

13. $-1.414, -0.667, 1.414$

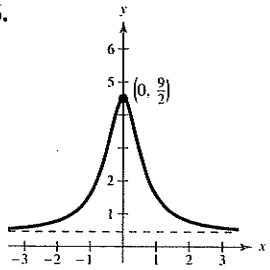
14.



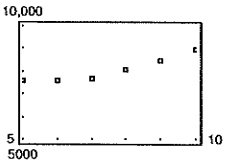
15.



16.

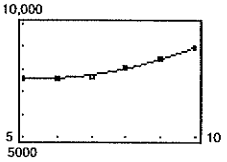


17. (a)



(b) $C = 62.55t^2 - 654.9t + 9269$

(c)



The model is a good fit.

(d) 2006

Chapter 3

Section 3.1 (page 185)

Vocabulary Check (page 185)

1. algebraic **2.** transcendental

3. natural exponential, natural

4. $A = P\left(1 + \dfrac{r}{n}\right)^{nt}$ **5.** $A = Pe^{rt}$

1. 4112.033 **3.** 0.006 **5.** 18,297.851