18. $-x^{1/2}$ 19. $6xy^7$ 20. $9x^2y^4$ 21. $-2\pi r^2(\pi r - 50)$

22. $2vw(v^2 + w^2 + u^2)$ 23. $(4 - x)(4 + x)$

24. $6t(2t - 3)(t + 1)$ 25. $-\frac{3}{4}$ and $\frac{1}{2}$ 26. -2 and $\frac{1}{3}$

27. $0, -3, 1$ 28. $\frac{\sqrt{2}}{2}$ and $-\frac{\sqrt{2}}{2}$ 29. $[-2, \frac{1}{2}]$ 30. $(-2, -\frac{3}{2})$

31. $(-1, 4)$ 32. $\frac{3}{2}; \frac{2}{3}$ 33. $1 + \sqrt{6}, 1 - \sqrt{6}$

34. $-2 + \frac{\sqrt{2}}{2}; -2 - \frac{\sqrt{2}}{2}$ 35. $\frac{180}{(t + 6)^2}$

36. $\frac{15x^2 + 24x + 2}{4(x + 2)(3x^2 + 2)}$ 37. $\frac{78x^2 - 8x - 27}{3(2x^2 - 1)(3x - 1)}$

38. $\frac{2(x + 2)}{\sqrt{x + 1}}$ 39. $\frac{1}{\sqrt{x} + 1}$ 40. $\frac{x - \sqrt{x}}{2x}$ 41. 5

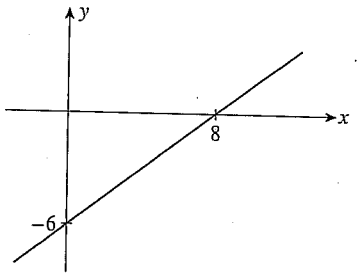
42. 2 43. $x = -2$ 44. $y = 4$ 45. $y = -\frac{1}{10}x + \frac{19}{5}$

46. $y = -\frac{4}{5}x + \frac{12}{5}$ 47. $y = \frac{5}{2}x + 9$ 48. $y = \frac{3}{4}x + \frac{11}{2}$

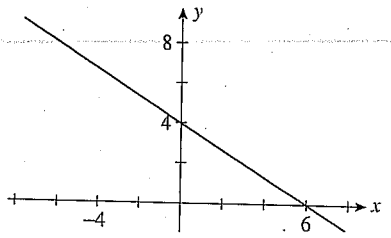
49. $y = -\frac{3}{4}x + \frac{9}{2}$ 50. $y = -\frac{3}{5}x + \frac{12}{5}$ 51. $y = 3x + 7$

52. $y = -\frac{3}{2}x - 7$

53.

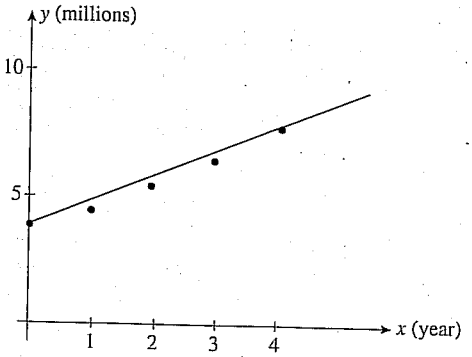


54.



55. \$100 56. \$400 57. Between 1 sec and 3 sec

58. a. and b.



c. $y = 0.975x + 3.9$ d. 6,825,000; differ by 25,000

Chapter 1 Before Moving On, page 48

1. a. $\sqrt{3} + \sqrt{2} - \pi$ b. -3 2. a. $12x^5y$ b. $\frac{b^5}{a^3}$

3. a. $\frac{2x\sqrt{y}}{3y}$ b. $\frac{x(\sqrt{x} + 4)}{x - 16}$

4. a. $\frac{1 - 3x^2}{2\sqrt{x}(x^2 + 1)^2}$ b. $\frac{6\sqrt{x + 2}}{x + 2}$ 5. $\frac{x - y}{(\sqrt{x} - \sqrt{y})^2}$

6. a. $2x(3x + 2)(2x - 3)$ b. $(2b + 3c)(x - y)$

7. a. $x = -\frac{1}{4}$, or 1 b. $\frac{5 \pm \sqrt{13}}{6}$ 8. $4\sqrt{5}$

9. $y = \frac{7}{5}x - \frac{3}{5}$ 10. $y = -\frac{1}{3}x + \frac{4}{3}$

CHAPTER 2

Exercises 2.1, page 57

1. $21, -9, 5a + 6, -5a + 6, 5a + 21$

3. $-3, 6, 3a^2 - 6a - 3, 3a^2 + 6a - 3, 3x^2 - 6$

5. $2a + 2h + 5, -2a + 5, 2a^2 + 5, 2a - 4h + 5, 4a - 2h + 5$

7. $\frac{8}{15}, 0, \frac{2a}{a^2 - 1}, \frac{2(2 + a)}{a^2 + 4a + 3}, \frac{2(t + 1)}{t(t + 2)}$

9. $8, \frac{2a^2}{\sqrt{a - 1}}, \frac{2(x + 1)^2}{\sqrt{x}}, \frac{2(x - 1)^2}{\sqrt{x - 2}}$ 11. 5, 1, 1 13. $\frac{5}{2}$, 3, 3, 9

15. a. -2 b. (i) $x = 2$; (ii) $x = 1$ c. $[0, 6]$ d. $[-2, 6]$

17. Yes 19. Yes 21. 7 23. $(-\infty, \infty)$ 25. $(-\infty, 0) \cup (0, \infty)$

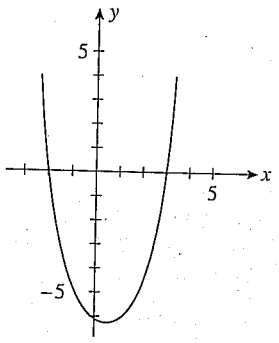
27. $(-\infty, \infty)$ 29. $(-\infty, 5]$ 31. $(-\infty, -1) \cup (-1, 1) \cup (1, \infty)$

33. $[-3, \infty)$ 35. $(-\infty, -2) \cup (-2, 1]$

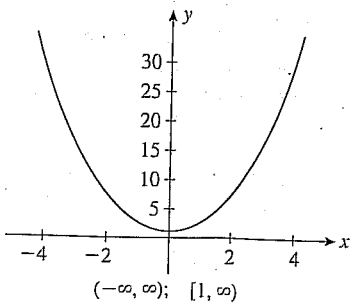
37. a. $(-\infty, \infty)$

b. $6, 0, -4, -6, -\frac{25}{4}, -6, -4, 0$

c.

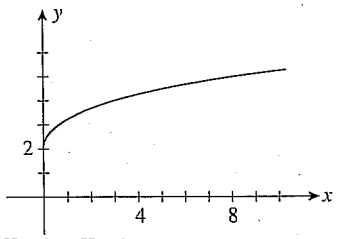


39.



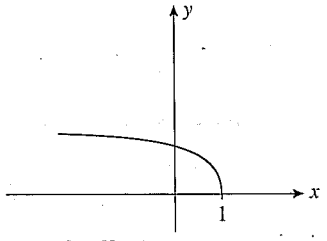
$(-\infty, \infty)$; $[1, \infty)$

41.



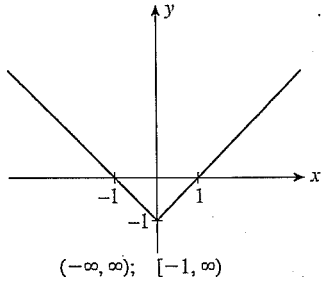
$[0, \infty)$; $[2, \infty)$

43.



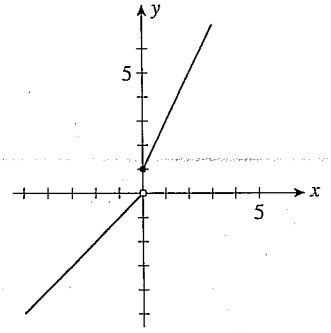
$(-\infty, 1]$; $[0, \infty)$

45.



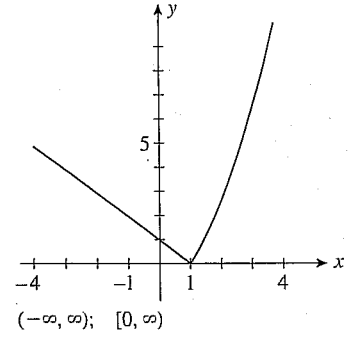
$(-\infty, \infty)$; $[-1, \infty)$

47.



$(-\infty, \infty)$; $(-\infty, 0) \cup [1, \infty)$

49.



$(-\infty, \infty)$; $[0, \infty)$

51. Yes 53. No 55. Yes 57. Yes

59. 10π in. 61. 8

63. a. From 1985 to 1990 b. From 1990 on
c. 1990; \$3.5 billion

65. a. $f(t) = \begin{cases} 0.0185t + 0.58 & \text{if } 0 \le t \le 20 \\ 0.015t + 0.65 & \text{if } 20 < t \le 30 \end{cases}$

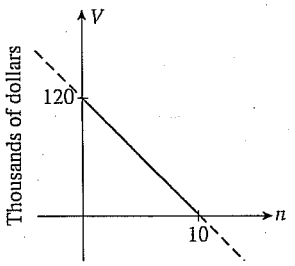
b. 0.0185/yr from 1960 through 1980; 0.015/yr from 1980 through 1990
c. 1983

67. a. $0.06x$ b. \$12.00; \$0.34 69. 160 mg

71. a. $f(t) = 7.5t + 20$ b. 65 million

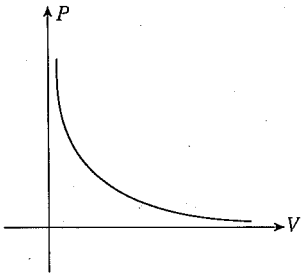
73. a. $V = -12{,}000n + 120{,}000$

b.



c. \$48,000 d. \$12,000/yr

75. $(0, \infty)$



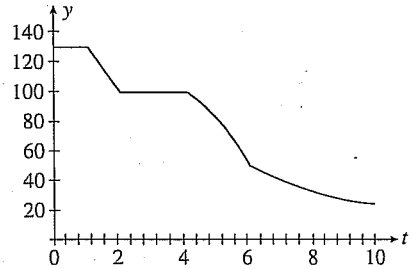
77. a. 3.6 million; 9.5 million b. 11.2 million 79. 20; 26

81. \$5.6 billion; \$7.8 billion

83. a. \$0.6 trillion; \$0.6 trillion b. \$0.96 trillion; \$1.2 trillion

85. a. 130 tons/day; 100 tons/day; 40 tons/day

b.



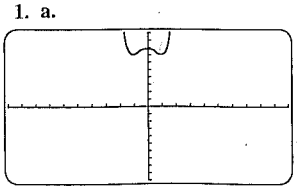
87. a. $D(t) = \begin{cases} 14t & \text{if } 0 \le t \le 2 \\ 2\sqrt{74t^2 - 100t + 100} & \text{if } 2 < t \end{cases}$

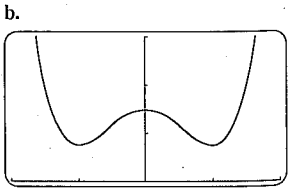
b. 76.16 miles

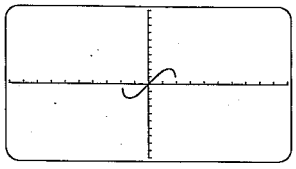
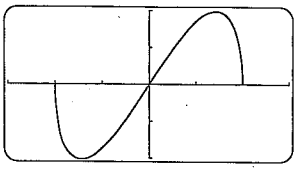
89. False 91. False 93. False

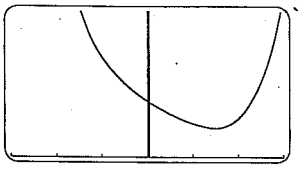
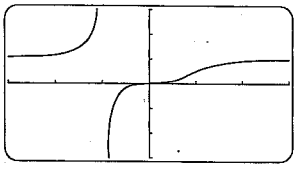
Using Technology Exercises 2.1, page 66

1. a. b.

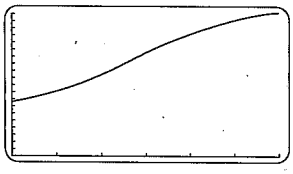




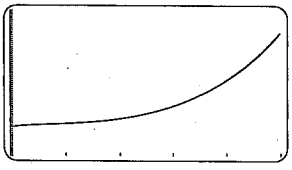
3. a.  b. 

5.  7. 

9. 18.5505 11. 4.1616

13. a. 

b. \$62.96 million; \$107.66 million

15. a. 

b. 44.7; 52.7; 129.2

Exercises 2.2, page 72

1. $f(x) + g(x) = x^3 + x^2 + 3$ 3. $f(x)g(x) = x^5 - 2x^3 + 5x^2 - 10$

5. $\dfrac{f(x)}{g(x)} = \dfrac{x^3 + 5}{x^2 - 2}$ 7. $\dfrac{f(x)g(x)}{h(x)} = \dfrac{x^5 - 2x^3 + 5x^2 - 10}{2x + 4}$

9. $f(x) + g(x) = x - 1 + \sqrt{x + 1}$

11. $f(x)g(x) = (x - 1)\sqrt{x + 1}$

13. $\dfrac{g(x)}{h(x)} = \dfrac{\sqrt{x + 1}}{2x^3 - 1}$ 15. $\dfrac{f(x)g(x)}{h(x)} = \dfrac{(x - 1)\sqrt{x + 1}}{2x^3 - 1}$

17. $\dfrac{f(x) - h(x)}{g(x)} = \dfrac{x - 2x^3}{\sqrt{x + 1}}$

19. $f(x) + g(x) = x^2 + \sqrt{x} + 3;$

$f(x) - g(x) = x^2 - \sqrt{x} + 7;$

$f(x)g(x) = (x^2 + 5)(\sqrt{x} - 2); \dfrac{f(x)}{g(x)} = \dfrac{x^2 + 5}{\sqrt{x} - 2}$

21. $f(x) + g(x) = \dfrac{(x - 1)\sqrt{x + 3} + 1}{x - 1};$

$f(x) - g(x) = \dfrac{(x - 1)\sqrt{x + 3} - 1}{x - 1};$

$f(x)g(x) = \dfrac{\sqrt{x + 3}}{x - 1}; \dfrac{f(x)}{g(x)} = (x - 1)\sqrt{x + 3}$

23. $f(x) + g(x) = \dfrac{2(x^2 - 2)}{(x - 1)(x - 2)};$

$f(x) - g(x) = \dfrac{-2x}{(x - 1)(x - 2)};$

$f(x)g(x) = \dfrac{(x + 1)(x + 2)}{(x - 1)(x - 2)}; \dfrac{f(x)}{g(x)} = \dfrac{(x + 1)(x - 2)}{(x - 1)(x + 2)}$

25. $f(g(x)) = x^4 + x^2 + 1; g(f(x)) = (x^2 + x + 1)^2$

27. $f(g(x)) = \sqrt{x^2 - 1} + 1; g(f(x)) = x + 2\sqrt{x}$

29. $f(g(x)) = \dfrac{x}{x^2 + 1}; g(f(x)) = \dfrac{x^2 + 1}{x}$ 31. 49

33. $\dfrac{\sqrt{5}}{5}$ 35. $f(x) = 2x^3 + x^2 + 1$ and $g(x) = x^5$

37. $f(x) = x^2 - 1$ and $g(x) = \sqrt{x}$

39. $f(x) = x^2 - 1$ and $g(x) = \dfrac{1}{x}$

41. $f(x) = 3x^2 + 2$ and $g(x) = \dfrac{1}{x^{3/2}}$ 43. $3h$ 45. $-h(2a + h)$

47. $2a + h$ 49. $3a^2 + 3ah + h^2 - 1$ 51. $-\dfrac{1}{a(a + h)}$

53. The total revenue in dollars from both restaurants at time t

55. The value in dollars of Nancy's shares of IBM at time t

57. The carbon monoxide pollution in parts per million at time t

59. $C(x) = 0.6x + 12{,}100$

61. a. $f(t) = 267; g(t) = 2t^2 + 46t + 733$
b. $f(t) + g(t) = 2t^2 + 46t + 1000$ c. 1936 tons

63. a. 23; In 2002, 23% of reported serious crimes ended in the arrests or in the identification of the suspects.
b. 18; In 2007, 18% of reported serious crimes ended in the arrests or in the identification of the suspects.

65. a. $P(x) = -0.000003x^3 - 0.07x^2 + 300x - 100{,}000$
b. \$182,375

67. a. $3.5t^2 + 2.4t + 71.2$ b. 71,200; 109,900

69. a. 55%; 98.2% b. \$444,700; \$1,167,600

71. a. $s(x) = f(x) + g(x) + h(x)$

73. True 75. False

Exercises 2.3, page 85

1. Yes; $y = -\frac{2}{3}x + 2$ 3. Yes; $y = \frac{1}{2}x + 2$

5. Yes; $y = \frac{1}{2}x + \frac{9}{4}$ 7. No 9. Polynomial function; degree 6

11. Polynomial function; degree 6

13. Some other function 15. $m = -1; b = 2$

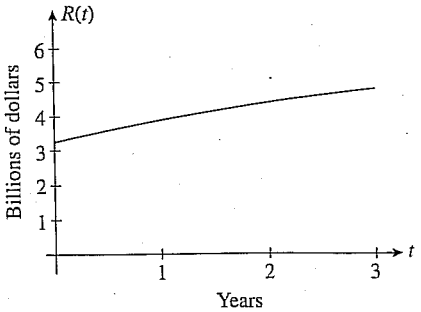
17. a. $C(x) = 8x + 40{,}000$ b. $R(x) = 12x$
c. $P(x) = 4x - 40{,}000$ d. A loss of \$8000; a profit of \$8000

19. \$43,200 21. 104 mg 23. \$128,000

25. 123,780,000 kWh; 175,820,000 kWh

27. **a.** \$3.25 billion **b.** \$3.88 billion; \$4.39 billion; \$4.78 billion

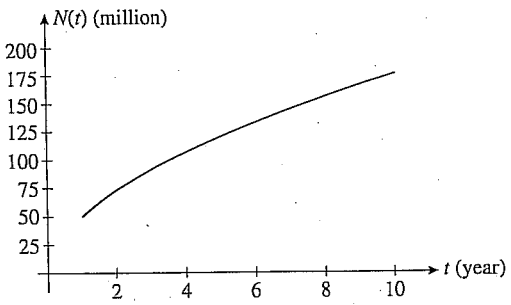
c.



29. \$751.50/yr; \$1772.38/yr

31. **a.** 320,000 **b.** 3,923,200

33. **a.**



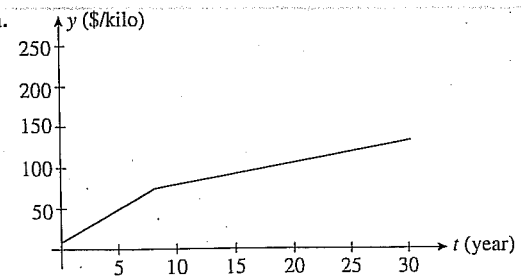
b. 176,000,000

35. 582,650; 1,605,590 37. \$699; \$130 39. **b.** 2003

41. $\dfrac{110}{\frac{1}{2}t+1} - 26\left(\dfrac{1}{4}t^2 - 1\right)^2 - 52$; \$32, \$6.71, \$3; the gap was closing.

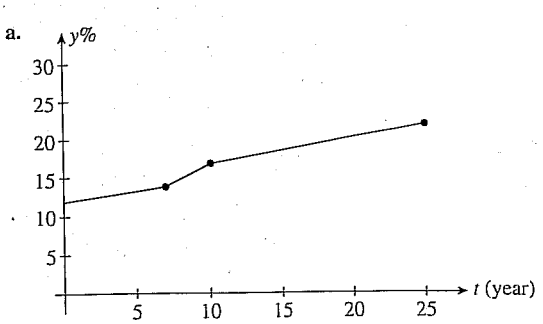
45. \$4770; \$6400; \$7560

47. **a.**



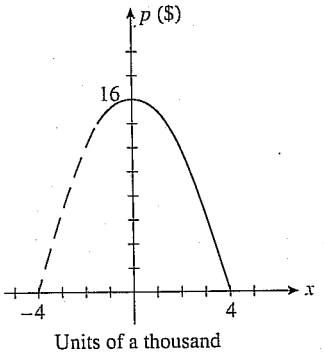
b. \$7.44/kilo; \$108.48/kilo

49. **a.**



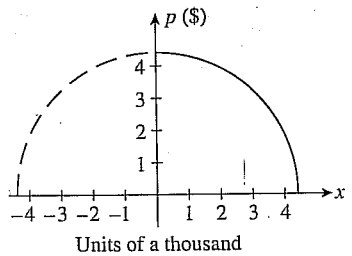
b. 13.43%; $18\frac{2}{3}$%

51. **a.**



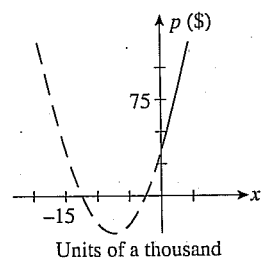
b. 3000 units

53. **a.**



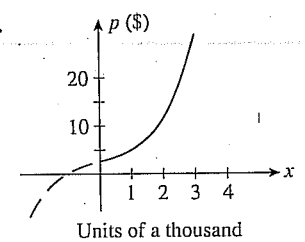
b. 3000

55. **a.**



b. \$76

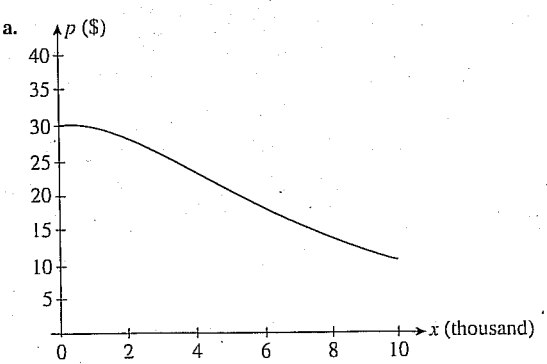
57. **a.**



b. \$15

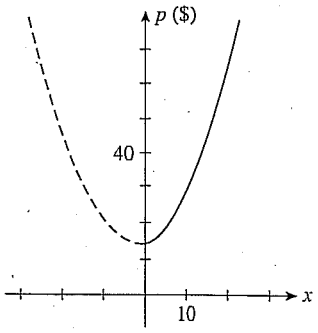
59. L_2; for each dollar decrease in the price of a clock radio, the additional quantity demanded of model B clock radios will be greater than that of model A clock radios.

61. **a.**



b. \$10

63. a.



Units of a thousand

b. $20

65. a. $\frac{b-d}{c-a}; \frac{bc-ad}{c-a}$

b. If the unit price is increased, then the equilibrium quantity decreases while the equilibrium price increases.

c. If the upper bound for the unit price of a commodity is lowered, then both the equilibrium quantity and the equilibrium price drop.

67. 2500; $67.50 69. 11,000; $3 71. 8000; $80

73. $f(x) = 2x + \frac{500}{x}; x > 0$ 75. $f(x) = 0.5x^2 + \frac{8}{x}$

77. $f(x) = (22 + x)(36 - 2x)$ bushels/acre

79. a. $P(x) = (10{,}000 + x)(5 - 0.0002x)$ b. $60,800

81. False 83. False

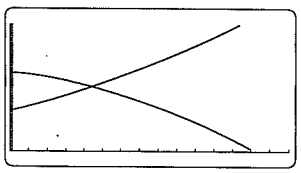
Using Technology Exercises 2.3, page 94

1. (−3.0414, 0.1503); (3.0414, 7.4497)

3. (−2.3371, 2.4117); (6.0514, −2.5015)

5. (−1.0219, −6.3461); (1.2414, −1.5931); (5.7805, 7.9391)

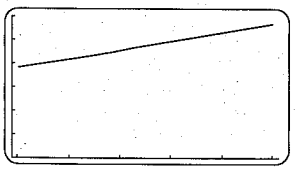
7. a.



b. 438 wall clocks; $40.92

9. a. $f(t) = 1.85t + 16.9$

b.



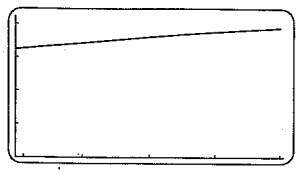
c.

t	1	2	3	4	5	6
y	18.8	20.6	22.5	24.3	26.2	28.0

d. 31.7 gallons

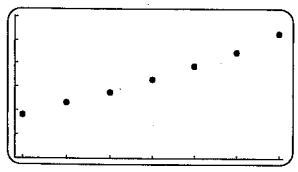
11. a. $f(t) = -0.221t^2 + 4.14t + 64.8$

b.



c. 77.8 million

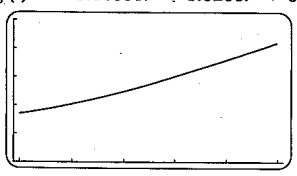
13. a.



b. $f(t) = 2.94t^2 + 38.75t + 188.5$ c. $604 billion

15. a. $f(t) = -0.00081t^3 + 0.0206t^2 + 0.125t + 1.69$

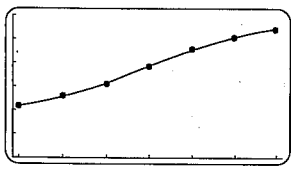
b.



c. $1.8 trillion; $2.7 trillion; $4.2 trillion

17. a. $f(t) = -0.425t^3 + 3.6571t^2 + 4.018t + 43.7$

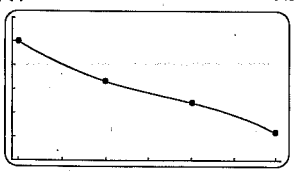
b.



c. $43.7 million; $77.2 million; $107.7 million

19. a. $f(t) = -2.4167t^3 + 24.5t^2 - 123.33t + 506$

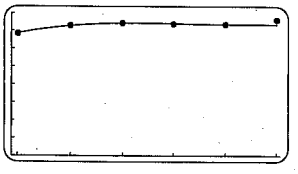
b.



c. 506,000; 338,000; 126,000 d. Approximately 200,000

21. a. $f(t) = 0.000133t^4 + 0.00353t^3 - 0.04487t^2 + 0.143t + 1.71$

b.



c. 1.71 mg; 1.81 mg; 1.85 mg; 1.84 mg; 1.82 mg; 1.83 mg

d. 1.9 mg/cigarette

Exercises 2.4, page 111

1. $\lim_{x \to -2} f(x) = 3$ 3. $\lim_{x \to 3} f(x) = 3$ 5. $\lim_{x \to -2} f(x) = 3$

7. The limit does not exist.