Instructor Answers

Finite Mathematics for Business, Economics, Life Sciences, and Social Sciences

Fourteenth Edition

Raymond Barnett

Merritt College

Michael Ziegler

Marquette University

Karl Byleen

Marquette University

Christopher J. Stocker

Marquette University

Pearson

ISBN-13: 978-0-13-467806-1
ISBN-10: 0-13-467806-0

ANSWERS

Diagnostic Prerequisite Test

Section references are provided in parentheses following each answer to guide students to the specific content in the book where they can find help or remediation.

1. (A) $(y + z)x$ (B) $(2 + x) + y$ (C) $2x + 3x$ *(A.1)*
2. $x^3 - 3x^2 + 4x + 8$ *(A.2)* **3.** $x^3 + 3x^2 - 2x + 12$ *(A.2)*
4. $-3x^5 + 2x^3 - 24x^2 + 16$ *(A.2)* **5.** (A) 1 (B) 1 (C) 2 (D) 3 *(A.2)* **6.** (A) 3 (B) 1 (C) -3 (D) 1 *(A.2)* **7.** $14x^2 - 30x$ *(A.2)*
8. $6x^2 - 5xy - 4y^2$ *(A.2)* **9.** $(x + 2)(x + 5)$ *(A.3)*
10. $x(x + 3)(x - 5)$ *(A.3)* **11.** $7/20$ *(A.1)* **12.** 0.875 *(A.1)*
13. (A) 4.065×10^{12} (B) 7.3×10^{-3} *(A.5)* **14.** (A) 255,000,000 (B) 0,000 406 *(A.5)* **15.** (A) T (B) F *(A.1)* **16.** 0 and -3 are two examples of infinitely many. *(A.1)* **17.** $6x^5y^{15}$ *(A.5)* **18.** $3u^4/v^2$ *(A.5)*
19. 6×10^2 *(A.5)* **20.** x^6/y^4 *(A.5)* **21.** $u^{7/3}$ *(A.6)* **22.** $3a^2/b$ *(A.6)*
23. $\frac{5}{9}$ *(A.5)* **24.** $x + 2x^{1/2}y^{1/2} + y$ *(A.6)* **25.** $\dfrac{a^2 + b^2}{ab}$ *(A.4)* **26.** $\dfrac{a^2 - c^2}{abc}$ *(A.4)* **27.** $\dfrac{y^5}{x}$ *(A.4)* **28.** $\dfrac{1}{xy^2}$ *(A.4)* **29.** $\dfrac{-1}{7(7 + h)}$ *(A.4)* **30.** $\dfrac{xy}{y - x}$ *(A.6)*
31. (A) Subtraction (B) Commutative (+) (C) Distributive (D) Associative ($\cdot$) (E) Negatives (F) Identity (+) *(A.1)* **32.** (A) 6 (B) 0 *(A.1)*
33. $4x = x - 4$; $x = -4/3$ *(1.1)* **34.** $-15/7$ *(1-2)* **35.** $(4/7, 0)$ *(1.2)*
36. $(0, -4)$ *(1-2)* **37.** $x = 0, 5$ *(A.7)* **38.** $x = \pm\sqrt{7}$ *(A.7)*
39. $x = -4, 5$ *(A.7)* **40.** $x = 1, \frac{1}{6}$ *(A.7)*

ANSWERS

Chapter 1

Exercises 1.1

1. $x = 5$ **2.** $x = -9$ **3.** $x = 2$ **4.** $x = -3$ **5.** $x = -19$
6. $x = -2$ **7.** $4 \le x < 13$ **8.** $-3 < x \le 5$ **9.** $-2 < x < 7$
10. $-6 \le x \le -1$ **11.** $x \le 4$ **12.** $x \ge 9$ **13.** $(-8, 2]$ **14.** $[-1, 5)$
15. $(-\infty, 9)$ **16.** $[4, \infty)$ **17.** $(-7, -5]$ **18.** $[-3, 2)$ **19.** $x = -\frac{3}{2}$
20. $m = 14$ **21.** $y < -\frac{15}{2}$ **22.** $x > -\frac{10}{3}$ **23.** $u = -\frac{3}{4}$ **24.** $y = \frac{2}{3}$
25. $x = 10$ **26.** $x = 4$ **27.** $y \ge 3$ **28.** $x \le 8$ **29.** $x = 36$
30. $y = -6$ **31.** $m < \frac{36}{7}$ **32.** $u < 16$
33. $3 \le x < 7$ or $[3, 7)$ 

34. $-2 \le x < 3$ or $[-2, 3)$ 

35. $-20 \le C \le 20$ or $[-20, 20]$ 

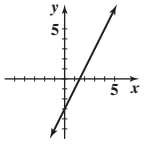
36. $-9 \le t \le 9$ or $[-9, 9]$ 

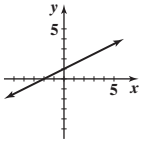
37. $y = \frac{3}{4}x - 3$ **38.** $x = -\frac{3}{2}y + 12$
39. $y = -(A/B)x + (C/B) = (-Ax + C)/B$ **40.** $m = \frac{y - b}{x}$
41. $C = \frac{5}{9}(F - 32)$ **42.** $F = \frac{9}{5}C + 32$ **43.** $-2 < x \le 1$ or $(-2, 1]$

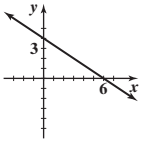

44. $\frac{14}{3} \le u \le 6$ or $\left[\frac{14}{3}, 6\right]$

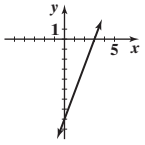

45. Negative **46.** Positive **47.** 4,500 $35 tickets and 5,000 $55 tickets **48.** 30 quarters; 70 dimes **49.** Fund A: $180,000; Fund B: $320,000 **50.** Fund A: $340,000; Fund B: $160,000 **51.** $15,405 **52.** $24,493 **53.** (A) $420 (B) $55 **54.** (A) $51 (B) $160 **55.** 34 rounds **56.** 12 times **57.** $32,000 **58.** (A) $20,000 (B) $24,493 (C) Choose the payment method with the larger base salary unless you can sell more than $52,000 per month. **59.** 5,851 books **60.** 7,132 books **61.** (B) 6,180 books (C) At least $11.50 **62.** (B) 7,480 books (C) At least $15.60 **63.** 5,000 **64.** $-45 \le C \le -10$ **65.** 12.6 yr **66.** 9.6 to 16.8

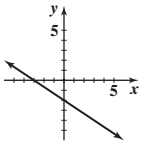
Exercises 1.2

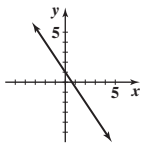
1. (D) **2.** (A) **3.** (C) **4.** (B) **5.** 

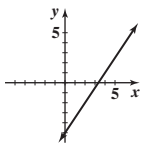
6. 

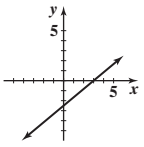
7. 

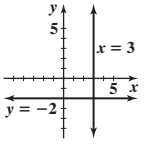
8. 

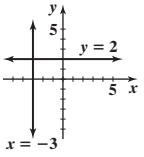
9. Slope $= 5$; y int. $= -7$
10. Slope $= 3$; y int. $= 2$
11. Slope $= -\frac{5}{2}$; y int. $= -9$
12. Slope $= -\frac{10}{3}$; y int. $= 4$
13. Slope $= \frac{1}{4}$; y int. $= \frac{2}{3}$ **14.** Slope $= \frac{1}{5}$; y int. $= -\frac{1}{2}$
15. Slope $= 2$; x int. $= -5$ **16.** Slope $= -4$; x int. $= 3$
17. Slope $= 8$; x int. $= 5$ **18.** Slope $= -3$; x int. $= 2$
19. Slope $= \frac{6}{7}$; x int. $= -7$ **20.** Slope $= -\frac{9}{2}$; x int. $= \frac{4}{9}$ **21.** $y = 2x + 1$
22. $y = x + 5$ **23.** $y = -\frac{1}{3}x + 6$ **24.** $y = \frac{6}{7}x - \frac{9}{2}$
25. x int.: $\frac{1}{2}$; y int.: 1; $y = -2x + 1$ **26.** x int.: 1; y int.: 3; $y = -3x + 3$
27. x int.: -3; y int.: 1; $y = \frac{x}{3} + 1$ **28.** x int.: 2; y int.: -1; $y = \frac{x}{2} - 1$
29. 

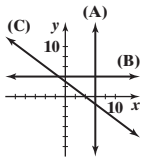
30. 

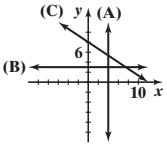
31. 

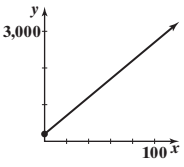
32. 

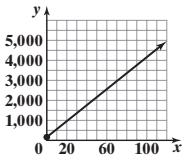
33. 

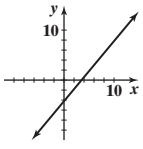
34. 

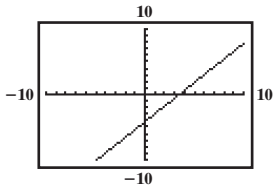
35. -4 **36.** 5 **37.** $-\frac{3}{5}$ **38.** $\frac{2}{3}$ **39.** 2 **40.** $\frac{1}{8}$
41. 

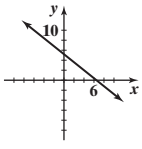
42. 

43. 

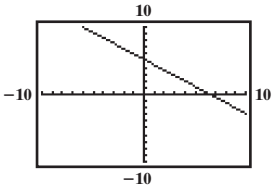
44. 

45. (A) 

(B) x int.: 3.5; y int.: -4.2
(C) 

46. (A) 

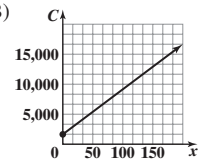
(D) x int.: 3.5; y int.: -4.2

(B) x int.: 6.5; y int.: 5.2 (C) 

(D) x int.: 6.5; y int.: 5.2

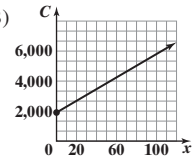
47. $x = 4, y = -3$ **48.** $x = -5; y = 6$ **49.** $x = -1.5, y = -3.5$
50. $x = 2.6; y = 3.8$ **51.** $y = 5x - 15$ **52.** $y = 4x + 6$
53. $y = -2x + 7$ **54.** $y = -10x + 15$ **55.** $y = \frac{1}{3}x - \frac{20}{3}$
56. $y = \frac{2}{7}x - 1$ **57.** $y = -3.2x + 30.86$ **58.** $y = 0.9x + 4.63$
59. (A) $m = \frac{2}{3}$ (B) $-2x + 3y = 11$ (C) $y = \frac{2}{3}x + \frac{11}{3}$
60. (A) $m = \frac{3}{2}$ (B) $3x - 2y = -1$ (C) $y = \frac{3}{2}x + \frac{1}{2}$
61. (A) $m = -\frac{5}{4}$ (B) $5x + 4y = -14$ (C) $y = -\frac{5}{4}x - \frac{7}{2}$
62. (A) $m = -\frac{4}{5}$ (B) $4x + 5y = 23$ (C) $y = -\frac{4}{5}x + \frac{23}{5}$

63. (A) Not defined (B) $x = 5$ (C) None **65.** (A) $m = 0$ (B) $y = 5$ (C) $y = 5$ **66.** (A) Not defined (B) $x = 2$ (C) None **67.** The graphs have the same y int., $(0, 2)$. **68.** The graphs have the same slope, -0.5.
69. $C = 124 + 0.12x$; 1,050 donuts **70.** $C = 1{,}200 + 45x$; 80 picnic tables
71. (A) $C = 75x + 1{,}647$ (B)



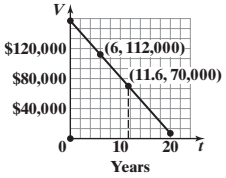
(C) The y int., \$1,647, is the fixed cost and the slope, \$75, is the cost per club.

72. (A) $C = 39x + 1{,}905$ (B)

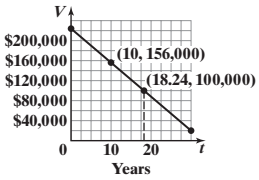


(C) The y int., \$1,905, is the fixed cost, and the slope, \$39, is the cost per racket.

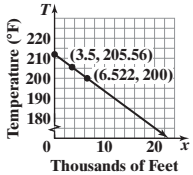
73. (A) $R = 1.4C - 7$ (B) \$137 **74.** (A) $R = 1.5C + 3$ (B) \$158
75. (A) $V = -7{,}500t + 157{,}000$ (B) \$112,000 (C) During the 12th year
(D)



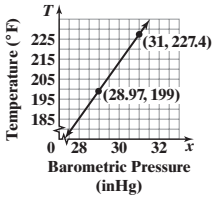
76. (A) $V = -6{,}800t + 224{,}000$
(B) \$156,000 (C) During the 19th year
(D)



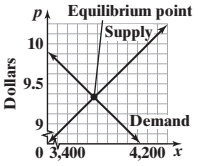
77. (A) $T = -1.84x + 212$ (B) 205.56°F (C) 6,522 ft
(D)



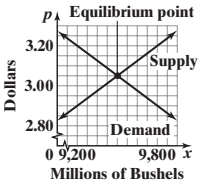
78. (A) $T = 14x - 206.6$ (B) 227.4°F
(C) 28.97 inHg (D)



79. (A) $T = 70 - 3.6A$ (B) 10,000 ft **80.** (A) $T = 3.2A + 200$
(B) 220.8 mph **81.** (A) $N = -0.0063t + 2.76$ (B) 2.45 persons
82. (A) $I = 1{,}031t + 30{,}000$ (B) \$71,240 **83.** (A) $f = -0.49t + 21$
(B) 2028 **84.** (A) $m = -0.6t + 25.7$ (B) 2031 **85.** (A) $p = 0.001x + 5.4$
(B) $p = -0.001x + 13$ (C) (3,800, 9.2) (D)



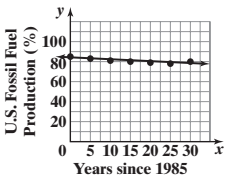
86. (A) $p = 0.0005x - 1.7$ (B) $p = -0.0005x + 7.8$ (C) (9,500, 3.05)
(D)



87. (A) $s = \frac{2}{5}w$ (B) 8 in. (C) 9 lb
88. (A) $d = -4w + 30$ (B) 30 in. (C) 7.5 lb

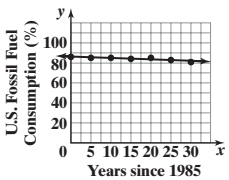
Exercises 1.3

1. (A) $w = 49 + 1.7h$ (B) The rate of change of weight with respect to height is 1.7 kg/in. (C) 55.8 kg (D) 5′6.5″ **2.** (A) $w = 52 + 1.9h$ (B) The rate of change of weight with respect to height is 1.9 in./kg. (C) 67.2 kg (D) 5′9.5″ **3.** (A) $P = 0.4\overline{45}d + 14.7$ (B) The rate of change of pressure with respect to depth is $0.4\overline{45}$ lb/in.^{2} per ft. (C) 37 lb/in.^{2} (D) 99 ft **4.** (A) $P = 0.43d + 14.7$ (B) The rate of change of pressure with respect to depth is 0.43 lb/in.2 per ft. (C) 36.3 lb/in.2 (D) 102 ft
5. (A) $a = 2{,}880 - 24t$ (B) -24 ft/sec (C) 24 ft/sec
6. (A) $a = -16t + 2{,}880$ (B) -16 ft/sec (C) 16 ft/sec
7. $s = 0.6t + 331$; the rate of change of the speed of sound with respect to temperature is 0.6 m/s per °C. **8.** $x = 3.9t + 1{,}403$; the rate of change of the speed of sound with respect to temperature is 3.9 m/s per °C.
9. (A)



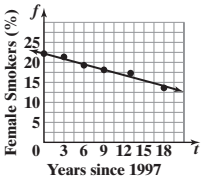
(B) The rate of change of fossil fuel production is -0.19% per year. (C) 76% of total production (D) 2058

10. (A)



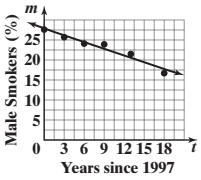
(B) The rate of change of fossil fuel consumption is -0.14% per year. (C) 81% (D) 2030

11. (A)



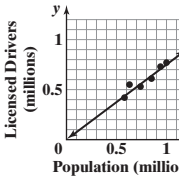
(B) 2025

12. (A)



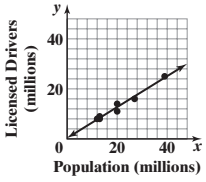
(B) 2029

13. (A)



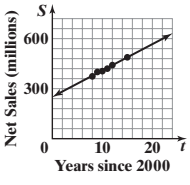
(B) 1,050,000 (C) 1,359,000

14. (A)

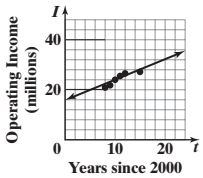


(B) 6,428,000 (C) 10,339,000

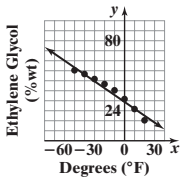
15. (A)



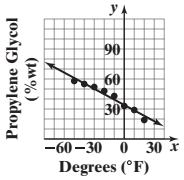
(B) \$662 billion

16. (A) 

(B) $37.2 billion

17. (A) 

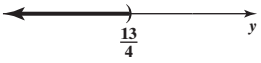
(B) 2°F (C) 22.75%

18. (A) 

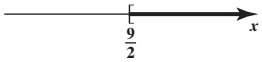
(B) 7°F (C) 25.9%

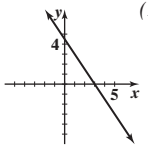
19. (A) The rate of change of height with respect to Dbh is 1.37 ft/in. (B) Height increases by approximately 1.37 ft. (C) 18 ft (D) 20 in.
20. (A) The rate of change of height with respect to Dbh is 1.66 ft/in. (B) Height increases by approximately 1.66 ft. (C) 15 ft (D) 18 in.
21. (A) Undergraduate male enrollment is increasing at a rate of 87,000 students per year; undergraduate female enrollment is increasing at a rate of 140,000 students per year. (B) Male: 8.6 million; female: 11.5 million (C) 2026 **22.** (A) Graduate male enrollment is increasing at a rate of 11,000 students per year; graduate female enrollment is increasing at a rate of 31,000 students per year. (B) Male: 1.3 million; female: 2.1 million (C) 2037 **23.** $y = 0.061x + 50.703$; 54.67°F
24. $y = 0.051x + 30.166$; 33.48 in. **25.** Men: $y = -0.070x + 49.058$; women: $y = -0.085x + 54.858$; yes **26.** Men: $y = -0.247x + 119.097$; Women: $y = -0.122x + 128.494$; no **27.** Supply: $y = 0.2x + 0.87$; demand: $y = -0.15x + 3.5$; equilibrium price = $2.37 **28.** Supply: $y = 1.53x + 2.85$; demand: $y = -2.21x + 10.66$; equilibrium price: $6.05

Chapter 1 Review Exercises

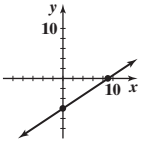
1. $x = 2.8$ *(1.1)* **2.** $x = 2$ *(1.1)* **3.** $y = 1.8 - 0.4x$ *(1.1)*
4. $x = \frac{4}{3}y + \frac{7}{3}$ *(1.1)* **5.** $y < \frac{13}{4}$ or $\left(-\infty, \frac{13}{4}\right)$ 

(1.1) **6.** $1 \le x < 3$ or $[1, 3)$ 

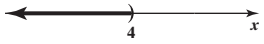
(1.1) **7.** $x \ge \frac{9}{2}$ or $\left[\frac{9}{2}, \infty\right)$ 

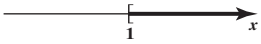
(1.1) **8.** 

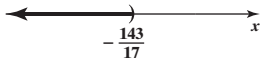
(1.2)

9. $2x + 3y = 12$ *(1.2)* **10.** x int. = 9; y int. = −6; slope = $\frac{2}{3}$ *(1.2)*


11. $y = -\frac{2}{3}x + 6$ *(1.2)*

12. Vert. line: $x = -6$; hor. line: $y = 5$ *(1.2)* **13.** (A) $y = -\frac{2}{3}x$ (B) $y = 3$ *(1.2)* **14.** (A) $3x + 2y = 1$ (B) $y = 5$ (C) $x = -2$ *(1.2)*
15. $x = \frac{25}{2}$ *(1.1)* **16.** $u = 36$ *(1.1)* **17.** $x = \frac{30}{11}$ *(1.1)* **18.** $x = 21$ *(1.1)*
19. $x = 4$ *(1.1)* **20.** $x < 4$ or $(-\infty, 4)$ *(1.1)* 

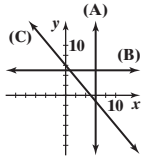
21. $x \ge 1$ or $[1, \infty)$ *(1.1)* 

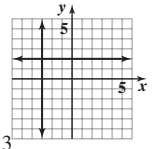
22. $x < -\frac{143}{17}$ or $\left(-\infty, -\frac{143}{17}\right)$ 

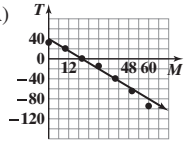
(1.1)
23. $1 < x \le 4$ or $(1, 4]$ 

(1.1)
24. $\frac{3}{8} \le x \le \frac{7}{8}$ or $\left[\frac{3}{8}, \frac{7}{8}\right]$ 

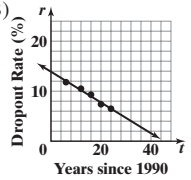
(1.1)

25. 

(1.2)
26. The graph of $x = -3$ is a vert. line with x int. -3, and the graph of $y = 2$ is a hor. line with y int. 2. *(1.2)* 

27. (A) An oblique line through the origin with slope $-\frac{3}{4}$ (B) A vert. line with x int. $-\frac{4}{3}$ (C) The x axis (D) An oblique line with x int. 12 and y int. 9 *(1.2)* **28.** $\frac{2A - bh}{h}$ *(1.1)* **29.** $\frac{S - P}{St}$ *(1.1)* **30.** $a < 0$ and b any real number *(1.1)* **31.** Less than *(1.1)* **32.** The graphs appear to be perpendicular to each other. (It can be shown that if the slopes of two slant lines are the negative reciprocals of each other, then the two lines are perpendicular.) *(1.2)*
33. $75,000 *(1.1)* **34.** 9,375 DVDs *(1.1)* **35.** (A) $m = 132 - 0.6x$ (B) $M = 187 - 0.85x$ (C) Between 120 and 170 beats per minute (D) Between 102 and 144.5 beats per minute *(1.3)* **36.** (A) $V = 224{,}000 - 15{,}500t$ (B) $38,000 *(1.2)* **37.** (A) $R = 1.6C$ (B) $192 (C) $110 (D) The slope is 1.6. This is the rate of change of retail price with respect to cost. *(1.2)*
38. $400; $800 *(1.1)* **39.** Demand: $p = 5.24 - 0.00125x$; 1,560 bottles *(1.2)*
40. (A) 

(B) −30°F (C) 45% *(1.3)*

41. (A) The dropout rate is decreasing at a rate of 0.308 percentage points per year. (B) 

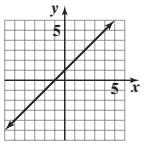
(C) 2026 *(1.3)*

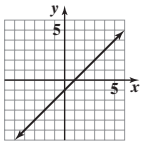
42. (A) The CPI is increasing at a rate of 4.295 units per year. (B) 276.62 *(1.3)*
43. (A) The rate of change of tree height with respect to Dbh is 0.74. (B) Tree height increases by about 0.74 ft. (C) 21 ft (D) 16 in. *(1.3)*

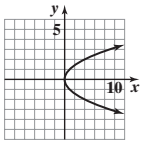
ANSWERS

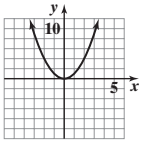
Chapter 2

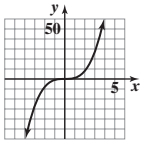
Exercises 2.1

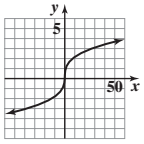
1. 

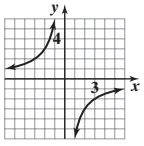
2. 

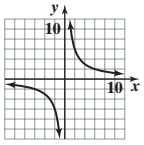
3. 

4. 

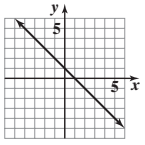
5. 

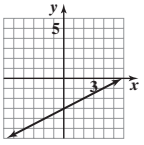
6. 

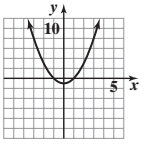
7. 

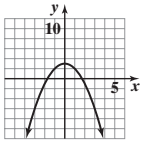
8. 

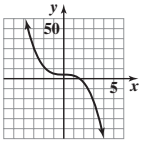
9. A function **10.** A function **11.** Not a function **12.** Not a function
13. A function **14.** A function **15.** A function **16.** A function
17. Not a function **18.** Not a function **19.** A function **20.** Not a function
21. Linear **22.** Neither **23.** Neither **24.** Linear **25.** Linear
26. Neither **27.** Constant **28.** Constant

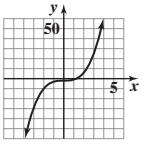
29. 

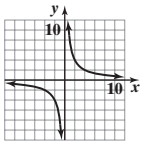
30. 

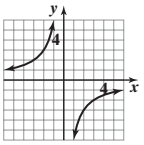
31. 

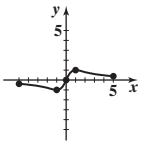
32. 

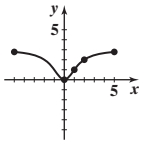
33. 

34. 

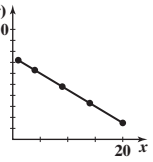
35. 

36. 

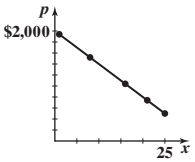
37. 

38. 

39. $y = 0$ **40.** $y = 0$ **41.** $y = 4$ **42.** $y = 3$
43. $x = -5$ **44.** $x = 5$ **45.** $x = -6$ **46.** $x = -5$, 0, 4 **47.** All real numbers **48.** All real numbers
49. All real numbers except -4 **50.** All real numbers except 2 **51.** $x \le 7$ **52.** $x > -5$ **53.** Yes; all real numbers **54.** Yes; all real numbers
55. No; for example, when $x = 0, y = \pm 2$ **56.** Yes; all real numbers except 0
57. Yes; all real numbers except 0 **58.** No; when $x = 0, y = \pm 3$ **59.** No; when $x = 1, y = \pm 1$ **60.** Yes; $x \ge 0$ **61.** $25x^2 - 4$ **62.** $9x^2 - 4$
63. $x^2 + 4x$ **64.** $x^2 - 2x - 3$ **65.** $x^4 - 4$ **66.** $x^6 - 4$ **67.** $x - 4$
68. $\sqrt{x} - 4$ **69.** $h^2 - 4$ **70.** $h^2 + 1$ **71.** $4h + h^2$ **72.** $5 - 6h + h^2$
73. $4h + h^2$ **74.** $-6h + h^2$ **75.** (A) $4x + 4h - 3$ (B) $4h$ (C) 4
76. (A) $-3x-3h+9$ (B) $-3h$ (C) -3 **77.** (A) $4x^2+8xh+4h^2-7x-7h+6$ (B) $8xh + 4h^2 - 7h$ (C) $8x + 4h - 7$
78. (A) $3x^2 + 6xh + 3h^2 + 5x + 5h - 8$ (B) $6xh + 3h^2 + 5h$ (C) $6x + 3h + 5$ **79.** (A) $20x + 20h - x^2 - 2xh - h^2$ (B) $20h - 2xh - h^2$ (C) $20 - 2x - h$
80. (A) $x^2 + 2xh + h^2 + 40x + 40h$ (B) $2xh + h^2 + 40h$ (C) $2x + h + 40$
81. $P(w) = 2w + \dfrac{50}{w}, w > 0$ **82.** $P(l) = 2l + \dfrac{162}{l}, l > 0$
83. $A(l) = l(50 - l), 0 < l < 50$ **84.** $A(w) = (80 - w)w, 0 < w < 80$

85. (A) 

(B) \$54; \$42

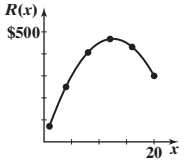
86. (A) 

(B) \$1,340; \$920

87. (A) $R(x) = (75 - 3x)x, 1 \le x \le 20$

(B)

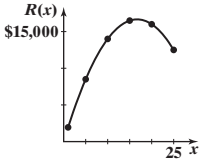
x	$R(x)$
1	72
4	252
8	408
12	468
16	432
20	300

(C) 

88. (A) $R(x) = x(2{,}000 - 60x), 1 \le x \le 25$

(B)

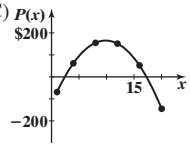
x	$R(x)$
1	1,940
5	8,500
10	14,000
15	16,500
20	16,000
25	12,500

(C) 

89. (A) $P(x) = 59x - 3x^2 - 125, 1 \le x \le 20$

(B)

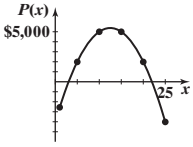
x	$P(x)$
1	-69
4	63
8	155
12	151
16	51
20	-145

(C) 

90. (A) $P(x) = 1{,}500x - 60x^2 - 4{,}000, 1 \le x \le 25$

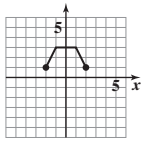
(B)

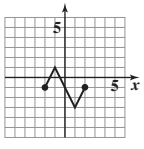
x	$P(x)$
1	$-2{,}560$
5	2,000
10	5,000
15	5,000
20	2,000
25	$-4{,}000$

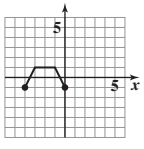
(C) 

91. $v = \dfrac{75 - w}{15 + w}$; 1.9032 cm/sec **92.** (A) $v = 0.4s + 0.28$; 48.4% (B) $s = 2.5v - 0.7$; 57.5%

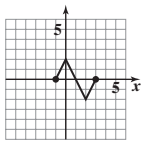
Exercises 2.2

1. Domain: all real numbers; range: $[-4, \infty]$ **2.** Domain: $[0, \infty)$; range: $[1, \infty)$
3. Domain: all real numbers; range: all real numbers **4.** Domain: all real numbers; range: $[10, \infty)$ **5.** Domain: $[0, \infty)$; range: $(-\infty, 8]$ **6.** Domain: all real numbers; range: all real numbers **7.** Domain: all real numbers; range: all real numbers **8.** Domain: all real numbers; range: $(-\infty, 15]$ **9.** Domain: all real numbers; range: $[9, \infty)$ **10.** Domain: all real numbers; range: all real numbers **11.** 

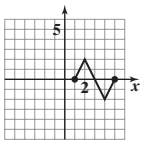
12. 

13. 

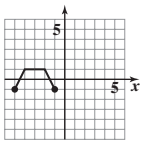
14.



15.



16.



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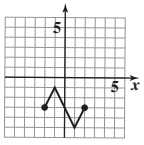
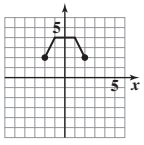
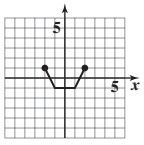


18.



19.



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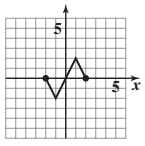

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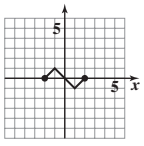

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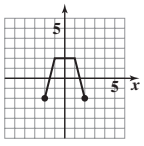
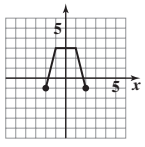


23.



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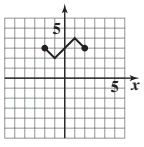

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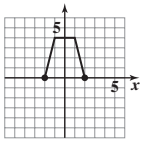
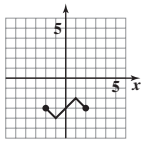
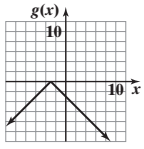


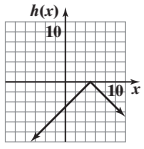
26.



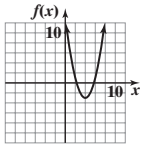
27. The graph of $g(x) = -|x + 3|$ is the graph of $y = |x|$ reflected in the x axis and shifted 3 units to the left.



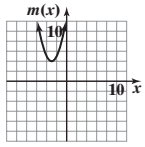
28. The graph of $h(x) = -|x - 5|$ is the graph of $y = |x|$ reflected in the x axis and shifted 5 units to the right.



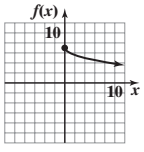
29. The graph of $f(x) = (x - 4)^2 - 3$ is the graph of $y = x^2$ shifted 4 units to the right and 3 units down.



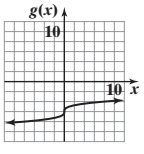
30. The graph of $m(x) = (x + 3)^2 + 4$ is the graph of $y = x^2$ shifted 3 units to the left and 4 units up.



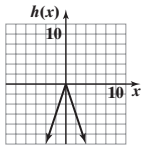
31. The graph of $f(x) = 7 - \sqrt{x}$ is the graph of $y = \sqrt{x}$ reflected in the x axis and shifted 7 units up.



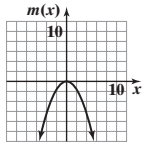
32. The graph of $g(x) = -6 + \sqrt[3]{x}$ is the graph of $y = \sqrt[3]{x}$ shifted 6 units down.



33. The graph of $h(x) = -3|x|$ is the graph of $y = |x|$ reflected in the x axis and vertically stretched by a factor of 3.

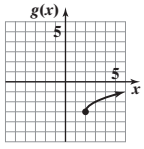


34. The graph of $m(x) = -0.4x^2$ is the graph of $y = x^2$ reflected in the x axis and vertically shrunk by a factor of 0.4.

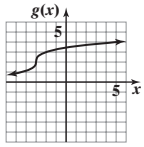


35. The graph of the basic function $y = x^2$ is shifted 2 units to the left and 3 units down. Equation: $y = (x + 2)^2 - 3$. **36.** The graph of the basic function $y = |x|$ is shifted 3 units to the right and 2 units up. Equation: $y = |x - 3| + 2$. **37.** The graph of the basic function $y = x^2$ is reflected in the x axis and shifted 3 units to the right and 2 units up. Equation: $y = 2 - (x - 3)^2$. **38.** The graph of the basic function $y = |x|$ is reflected in the x axis, shifted 2 units to the left and 3 units up. Equation: $y = 3 - |x + 2|$. **39.** The graph of the basic function $y = \sqrt{x}$ is reflected in the x axis and shifted 4 units up. Equation: $y = 4 - \sqrt{x}$. **40.** The graph of the basic function $\sqrt[3]{x}$ is reflected in the x axis and shifted 2 units up. Equation: $y = 2 - \sqrt[3]{x}$. **41.** The graph of the basic function $y = x^3$ is shifted 2 units to the left and 1 unit down. Equation: $y = (x + 2)^3 - 1$. **42.** The graph of the basic function $y = x^3$ is reflected in the x axis, shifted 3 units to the right and 1 unit up. Equation: $y = 1 - (x - 3)^3$.

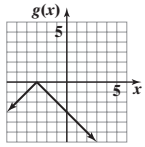
43. $g(x) = \sqrt{x - 2} - 3$



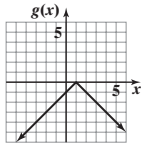
44. $g(x) = \sqrt[3]{x + 3} + 2$



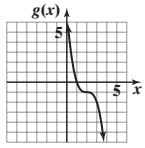
45. $g(x) = -|x + 3|$



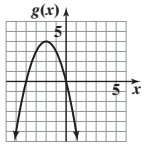
46. $g(x) = -|x - 1|$



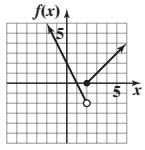
47. $g(x) = -(x - 2)^3 - 1$



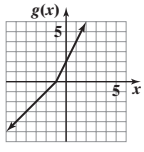
48. $g(x) = 4 - (x + 2)^2$



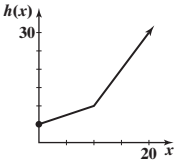
49.



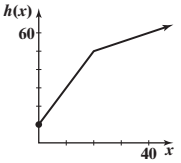
50.



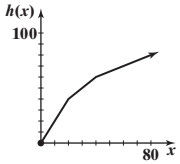
51.



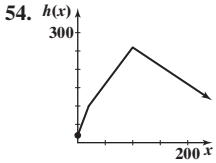
52.



53.

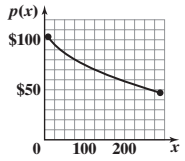


54.

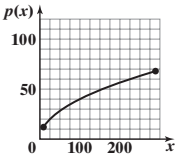


55. The graph of the basic function $y = |x|$ is reflected in the x axis and vertically shrunk by a factor of 0.5. Equation: $y = -0.5|x|$.

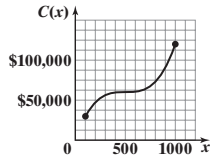
56. The graph of the basic function $y = x$ is reflected in the x axis and vertically stretched by a factor of 2. Equation: $y = -2x$. **57.** The graph of the basic function $y = x^2$ is reflected in the x axis and vertically stretched by a factor of 2. Equation: $y = -2x^2$. **58.** The graph of the basic function $y = |x|$ is vertically stretched by a factor of 4. Equation: $y = 4|x|$. **59.** The graph of the basic function $y = \sqrt[3]{x}$ is reflected in the x axis and vertically stretched by a factor of 3. Equation: $y = -3\sqrt[3]{x}$. **60.** The graph of the basic function $y = x^3$ is vertically shrunk by a factor of 0.25. Equation: $y = 0.25x^3$. **61.** Reversing the order does not change the result. **62.** Reversing the order does not change the result. **63.** Reversing the order can change the result. **64.** Reversing the order can change the result. **65.** Reversing the order can change the result. **66.** Reversing the order does not change the result. **67.** (A) The graph of the basic function $y = \sqrt{x}$ is reflected in the x axis, vertically expanded by a factor of 4, and shifted up 115 units.

(B) 

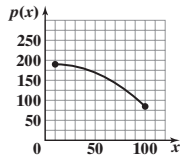
68. (A) The graph of the basic function $y = \sqrt{x}$ is vertically expanded by a factor of 4.

(B) 

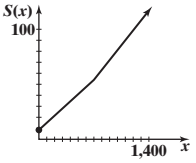
69. (A) The graph of the basic function $y = x^3$ is vertically contracted by a factor of 0.000 48 and shifted right 500 units and up 60,000 units.

(B) 

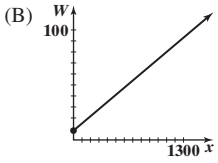
70. (A) The graph of the basic function $y = x^2$ is reflected in the x axis, vertically contracted by a factor of 0.013, and shifted 10 units to the right and 190 units up.

(B) 

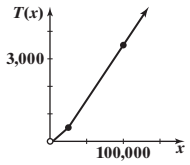
71. (A) $S(x) = \begin{cases} 8.5 + 0.065x & \text{if } 0 \le x \le 700 \\ -9 + 0.09x & \text{if } x > 700 \end{cases}$

(B) 

72. (A) $W(x) = \begin{cases} 8.5 + 0.065x & \text{if } 0 \le x \le 700 \\ 16.9 + 0.053x & \text{if } x > 700 \end{cases}$

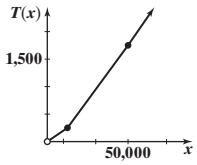
(B) 

73. (A) $T(x) = \begin{cases} 0.02x & \text{if } 0 < x \le 25{,}000 \\ 0.04x - 500 & \text{if } 25{,}000 < x \le 100{,}000 \\ 0.06x - 2{,}500 & \text{if } x > 100{,}000 \end{cases}$

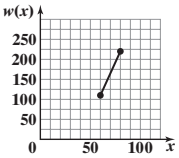
(B) 

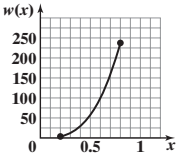
(C) $1,700; $4,100

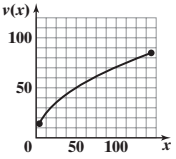
74. (A) $T(x) = \begin{cases} 0.02x & \text{if } 0 \le x < 12{,}500 \\ 0.04x - 250 & \text{if } 12{,}500 < x \le 50{,}000 \\ 0.06x - 1{,}250 & \text{if } x > 50{,}000 \end{cases}$

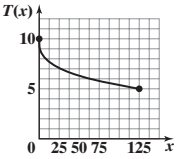
(B) 

(C) $1,030; $2,590 **75.** (A) The graph of the basic function $y = x$ is vertically stretched by a factor of 5.5 and shifted down 220 units.

(B) 

76. (A) The graph of the basic function $y = x^3$ is vertically stretched by a factor of 463. (B) 

77. (A) The graph of the basic function $y = \sqrt{x}$ is vertically stretched by a factor of 7.08. (B) 

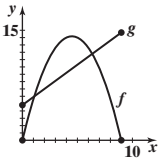
78. (A) The graph of the basic function $y = \sqrt[3]{x}$ is reflected in the x axis and shifted up 10 units. (B) 

Exercises 2.3

1. $f(x) = (x - 5)^2 - 25$ **2.** $f(x) = (x + 8)^2 - 64$
3. $f(x) = (x + 10)^2 - 50$ **4.** $f(x) = (x - 6)^2 - 44$
5. $f(x) = -2(x - 1)^2 - 3$ **6.** $f(x) = 3(x + 3)^2 - 6$
7. $f(x) = 2\left(x + \frac{1}{2}\right)^2 + \frac{1}{2}$ **8.** $f(x) = -5\left(x - \frac{3}{2}\right)^2 + \frac{1}{4}$

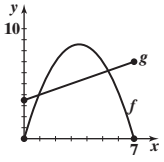
9. The graph of $f(x)$ is the graph of $y = x^2$ shifted right 2 units and down 1 unit. **10.** The graph of $g(x)$ is the graph of $y = x^2$ shifted right 1 unit and down 6 units. **11.** The graph of $m(x)$ is the graph of $y = x^2$ reflected in the x axis, then shifted right 3 units and up 5 units. **12.** The graph of $n(x)$ is the graph of $y = x^2$ reflected in the x axis, then shifted right 4 units and up 7 units. **13.** (A) m (B) g (C) f (D) n **14.** (A) g (B) m (C) n (D) f **15.** (A) x int.: 1, 3; y int.: -3 (B) Vertex: $(2, 1)$ (C) Max.: 1 (D) Range: $y \le 1$ or $(-\infty, 1]$ **16.** (A) x int.: -5, -1; y int.: -5 (B) Vertex: $(-3, 4)$ (C) max.: 4 (D) Range: $y \le 4$ or $(-\infty, 4]$ **17.** (A) x int.: -3, -1; y int.: 3 (B) Vertex: $(-2, -1)$ (C) Min.: -1 (D) Range: $y \ge -1$ or $[-1, \infty)$ **18.** (A) x int.: 1, 5; y int.: 5 (B) Vertex: $(3, -4)$ (C) min.: -4 (D) Range: $y \ge -4$ or $[-4, \infty)$ **19.** (A) x int.: $3 \pm \sqrt{2}$; y int.: -7 (B) Vertex: $(3, 2)$ (C) Max.: 2 (D) Range: $y \le 2$ or $(-\infty, 2]$ **20.** (A) x int.: $-2 \pm \sqrt{3}$; y int.: -1 (B) Vertex: $(-2, 3)$ (C) max.: 3 (D) Range: $y \le 3$ or $(-\infty, 3]$ **21.** (A) x int.: $-1 \pm \sqrt{2}$; y int.: -1 (B) Vertex: $(-1, -2)$ (C) Min.: -2 (D) Range: $y \ge -2$ or $[-2, \infty)$ **22.** (A) x int.: $4 \pm \sqrt{3}$; y int.: 13 (B) Vertex: $(4, -3)$ (C) min.: -3 (D) Range: $y \ge -3$ or $[-3, \infty)$ **23.** $y = -[x - (-2)]^2 + 5$ or $y = -(x + 2)^2 + 5$ **24.** $y = -(x - 4)^2 + 2$ **25.** $y = (x - 1)^2 - 3$ **26.** $y = [x - (-3)]^2 + 1$ or $y = (x + 3)^2 + 1$ **27.** Vertex form: $(x - 4)^2 - 4$ (A) x int.: 2, 6;

y int.: 12 (B) Vertex: $(4, -4)$ (C) Min.: -4 (D) Range: $y \geq -4$ or $[-4, \infty)$ **28.** Vertex form: $(x-3)^2 - 4$ (A) x int.: 1, 5; y int.: 5 (B) Vertex: $(3, -4)$ (C) min.: -4 (D) Range: $y \geq -4$ or $[-4, \infty)$ **29.** Vertex form: $-4(x-2)^2 + 1$ (A) x int.: 1.5, 2.5; y int.: -15 (B) Vertex: $(2, 1)$ (C) Max.: 1 (D) Range: $y \leq 1$ or $(-\infty, 1]$ **30.** Vertex form: $-4(x+1)^2 + 1$ (A) x int.: $-\frac{3}{2}, -\frac{1}{2}$; y int.: -3 (B) Vertex: $(-1, 1)$ (C) max.: 1 (D) Range: $y \leq 1$ or $(-\infty, 1]$ **31.** Vertex form: $0.5(x-2)^2 + 3$ (A) x int.: none; y int.: 5 (B) Vertex: $(2, 3)$ (C) Min.: 3 (D) Range: $y \geq 3$ or $[3, \infty)$ **32.** Vertex form: $0.5(x+4)^2 + 2$ (A) x int.: none; y int.: 10 (B) Vertex: $(-4, 2)$ (C) min.: 2 (D) Range: $y \geq 2$ or $[2, \infty)$ **33.** (A) $-4.87, 8.21$ (B) $-3.44, 6.78$ (C) No solution **34.** (A) $-1.53, 6.53$ (B) $0.36, 4.64$ (C) No solution **35.** 651.0417 **36.** 347.1429 **37.** $g(x) = 0.25(x-3)^2 - 9.25$ (A) x int.: -3.08, 9.08; y int.: -7 (B) Vertex: $(3, -9.25)$ (C) Min.: -9.25 (D) Range: $y \geq -9.25$ or $[-9.25, \infty)$ **38.** $m(x) = 0.20(x-4)^2 - 4.2$ (A) x int.: -0.58, 8.58; y int.: -1 (B) Vertex: $(4, -4.2)$ (C) min.: -4.2 (D) Range: $y \geq -4.2$ or $[-4.2, \infty)$ **39.** $f(x) = -0.12(x-4)^2 + 3.12$ (A) x int.: -1.1, 9.1; y int.: 1.2 (B) Vertex: $(4, 3.12)$ (C) Max.: 3.12 (D) Range: $y \leq 3.12$ or $(-\infty, 3.12]$ **40.** $n(x) = -0.15(x+3)^2 + 4.65$ (A) x int.: -8.57, 2.57; y int.: 3.30 (B) Vertex: $(-3, 4.65)$ (C) max.: 4.65 (D) Range: $y \leq 4.65$ or $(-\infty, 4.65]$ **41.** $(-\infty, -5) \cup (3, \infty)$ **42.** $(-6, 3)$ **43.** $[-3, 2]$ **44.** $(-\infty, -4] \cup [-3, \infty)$ **45.** $x = -5.37, 0.37$ **46.** $x = -1.27, 2.77$ **47.** $-1.37 < x < 2.16$ **48.** $-0.88 \leq x \leq 3.52$ **49.** $x \leq -0.74$ or $x \geq 4.19$ **50.** $x < -1$ or $x > 2.72$ **51.** Axis: $x = 2$; vertex: (2, 4); range: $y \geq 4$ or $[4, \infty)$; no x int. **52.** Axis: $x = -3$; vertex: $(-3, -5)$; range: $y \leq -5$ or $(-\infty, -5]$; no x intercept **53.** (A)



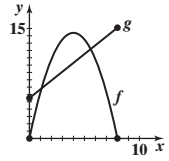
(B) 1.64, 7.61
(C) $1.64 < x < 7.61$
(D) $0 \leq x < 1.64$ or $7.61 < x \leq 10$

54. (A)



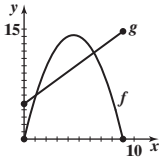
(B) 0.93, 5.35 (C) $0.93 < x < 5.35$
(D) $0 \leq x < 0.93$ or $5.35 < x \leq 7$

55. (A)



(B) 1.10, 5.57 (C) $1.10 < x < 5.57$
(D) $0 \leq x < 1.10$ or $5.57 < x \leq 8$

56. (A)

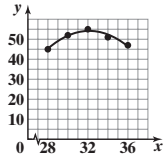


(B) 1.08, 6.35 (C) $1.08 < x < 6.35$
(D) $0 \leq x < 1.08$ or $6.35 < x \leq 9$

65. (A)

x	28	30	32	34	36
Mileage	45	52	55	51	47
$f(x)$	45.3	51.8	54.2	52.4	46.5

(B)

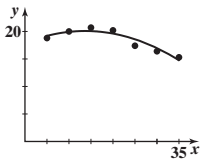


(C) $f(31) = 53.50$ thousand miles;
(D) $f(35) = 49.95$ thousand miles;

66. (A)

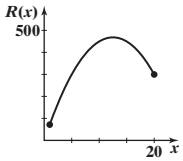
x	5	10	15	20	25	30	35
Market share	18.8	20.0	20.7	20.2	17.4	16.4	15.3
$f(x)$	19.2	19.9	20.1	19.6	18.6	17.0	14.8

(B)



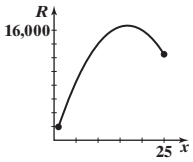
(C) $f(45) = 8.6\%$; $f(48) = 6.3\%$

69. (A)



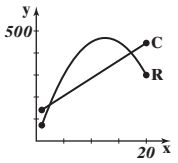
(B) 12.5 (12,500,000 chips); \$468,750,000 (C) \$37.50

70. (A)



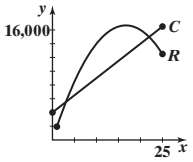
(B) 16.667 (16,667 computers); \$16,667,000 (C) \$1,000

71. (A)



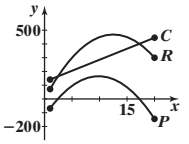
(B) 2,415,000 chips and 17,251,000 chips (C) Loss: $1 \leq x < 2.415$ or $17.251 < x \leq 20$; profit: $2.415 < x < 17.251$

72. (A)



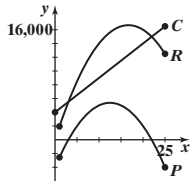
(B) 3,035 computers and 21,965 computers (C) Loss: $1 \leq x < 3.035$ or $21.965 < x \leq 25$; profit: $3.035 < x < 21.965$

73. (A) $P(x) = 59x - 3x^2 - 125$



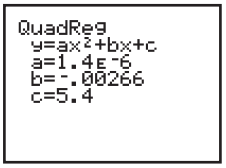
(C) Intercepts and break-even points: 2,415,000 chips and 17,251,000 chips
(D) Maximum profit is \$165,083,000 at a production level of 9,833,000 chips. This is much smaller than the maximum revenue of \$468,750,000.

74. (A) $P(x) = 1{,}500x - 60x^2 - 4{,}000$

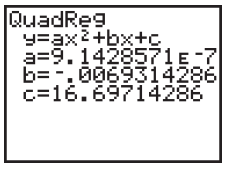


(C) Intercepts and break-even points: 3,035 computers and 21,965 computers
(D) Maximum profit is \$5,375,000 at a production level of 12,500 computers. This is much smaller than the maximum revenue of \$16,666,667.

75. $x = 0.14$ cm **76.** $x = 0.10$ cm **77.** 10.6 mph

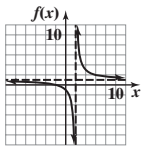


78. 5.6 mpg



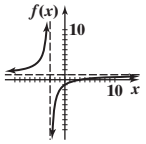
Exercises 2.4

1. (A) 1 (B) -3 (C) 21 **2.** (A) 2 (B) 2, 3 (C) 6 **3.** (A) 2 (B) $-5, -4$ (C) 20 **4.** (A) 1 (B) 10 (C) 30 **5.** (A) 6 (B) None (C) 15 **6.** (A) 8 (B) None (C) 10 **7.** (A) 5 (B) 0, -6 (C) 0 **8.** (A) 4 (B) $-7, 5$ (C) 1,225 **9.** (A) 11 (B) $-5, -2, 5$ (C) $-12{,}800$ **10.** (A) 10 (B) $-3, \frac{5}{2}, 3$ (C) 164,025 **11.** (A) 4 (B) Negative **12.** (A) 2 (B) Negative **13.** (A) 5 (B) Negative **14.** (A) 3 (B) Negative **15.** (A) 1 (B) Negative **16.** (A) 4 (B) Positive **17.** (A) 6 (B) Positive **18.** (A) 6 (B) Positive **19.** 10 **20.** 7 **21.** 1 **22.** 0 **23.** (A) x int.: -2; y int.: -1 (B) Domain: all real numbers except 2 (C) Vertical asymptote: $x = 2$; horizontal asymptote: $y = 1$ (D)

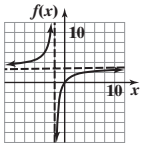


24. (A) x int.: 3; y int.: -1 (B) Domain: all real numbers except -3 (C) Vertical asymptote: $x = -3$; horizontal asymptote: $y = 1$

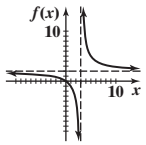
(D)



25. (A) x int.: 0; y int.: 0 (B) Domain: all real numbers except -2 (C) Vertical asymptote: $x = -2$; horizontal asymptote: $y = 3$ (D)

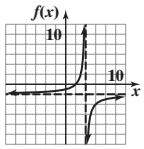


26. (A) x int.: 0; y int.: 0 (B) Domain: all real numbers except 3 (C) Vertical asymptote: $x = 3$; horizontal asymptote: $y = 2$ (D)

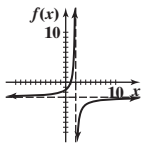


27. (A) x int.: 2; y int.: -1 (B) Domain: all real numbers except 4 (C) Vertical asymptote: $x = 4$; horizontal asymptote: $y = -2$

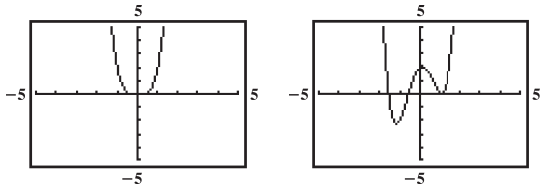
(D)



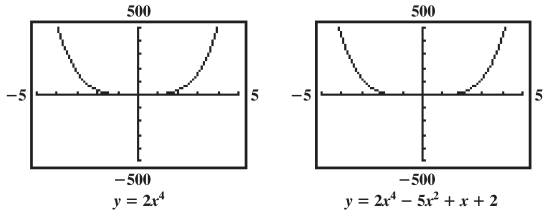
28. (A) x int.: 1; y int.: $-\frac{3}{2}$ (B) Domain: all real numbers except 2 (C) Vertical asymptote: $x = 2$; horizontal asymptote: $y = -3$ (D)



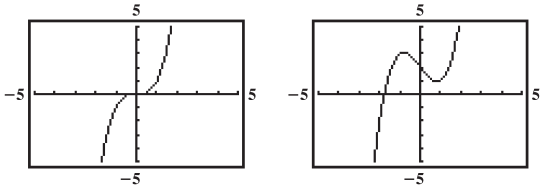
29. (A)



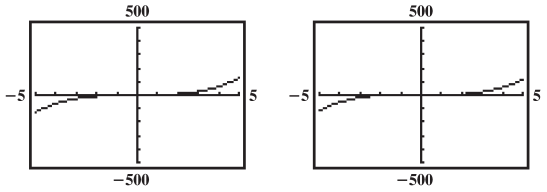
(B)



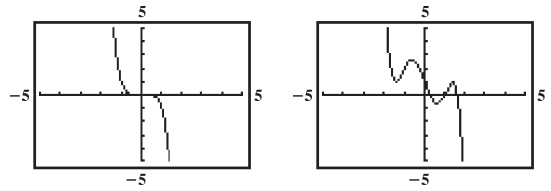
30. (A)



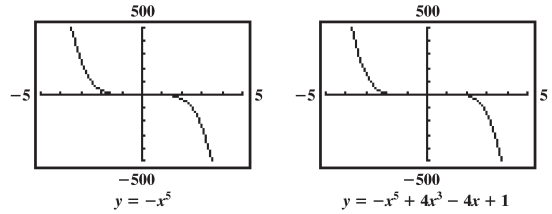
(B)



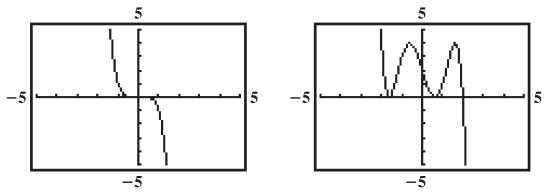
31. (A)



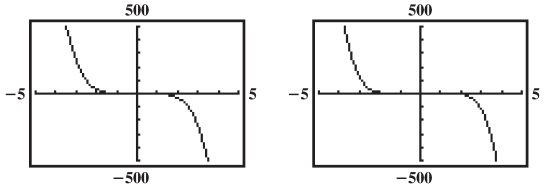
(B)



32. (A)

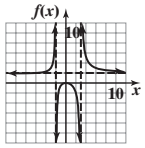


(B)

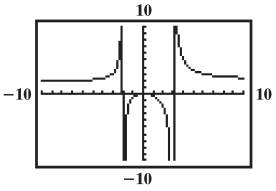


33. $y = \frac{5}{6}$ **34.** $y = \frac{3}{2}$ **35.** $y = \frac{1}{4}$ **36.** $y = -\frac{1}{2}$ **37.** $y = 0$ **38.** $y = 0$ **39.** None **40.** None **41.** $x = -1, x = 1, x = -3, x = 3$ **42.** $x = -2, x = 2, x = -4, x = 4$ **43.** $x = 5$ **44.** $x = -8$ **45.** $x = -6, x = 6$ **46.** $x = 0, x = 2$ **47.** (A) x int.: 0; y int.: 0 (B) Vertical asymptotes: $x = -2, x = 3$; horizontal asymptote: $y = 2$

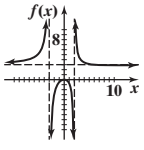
(C)



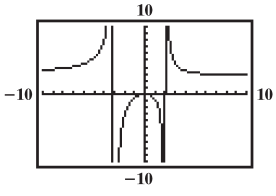
(D)



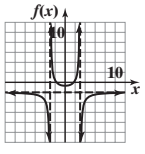
48. (A) x int.: 0; y int.: 0 (B) Vertical asymptotes: $x = -3, x = 2$; horizontal asymptote: $y = 3$ (C)



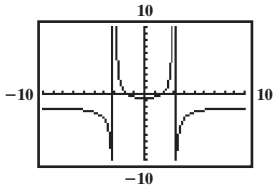
(D)



49. (A) x int.: $\pm\sqrt{3}$; y int.: $-\frac{2}{3}$ (B) Vertical asymptotes: $x = -3, x = 3$; horizontal asymptote: $y = -2$ (C)



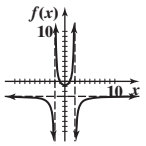
(D)



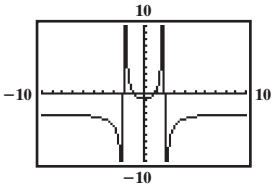
50. (A) x int.: ± 1; y int.: $-\frac{3}{4}$

(B) Vertical asymptote: $x = -2, x = 2$; horizontal asymptote: $y = -3$

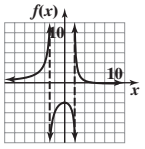
(C)



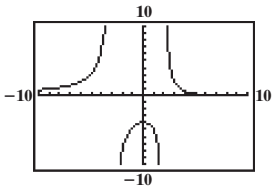
(D)



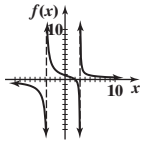
51. (A) x int.: 6; y int.: -4 (B) Vertical asymptotes: $x = -3, x = 2$; horizontal asymptote: $y = 0$ (C)



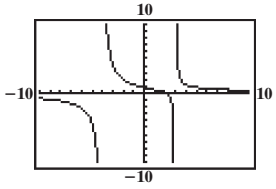
(D)



52. (A) x int.: 2; y int.: $\frac{5}{6}$ (B) Vertical asymptotes: $x = -4, x = 3$; horizontal asymptote: $y = 0$ (C)



(D)



53. $f(x) = x^2 - x - 2$

54. $f(x) = 2 - x - x^2$

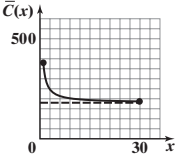
55. $f(x) = 4x - x^3$

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

57. (A) $C(x) = 180x + 200$

(B) $\overline{C}(x) = \dfrac{180x + 200}{x}$

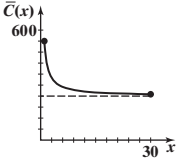
(C)



(D) \$180 per board

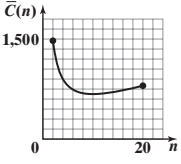
58. (A) $C(x) = 240x + 300$ (B) $\overline{C}(x) = \dfrac{240x + 300}{x}$

(C)

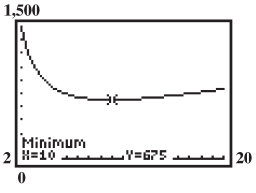


(D) \$240 per board

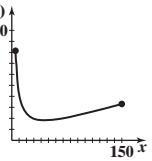
59. (A) $\overline{C}(n) = \dfrac{2{,}500 + 175n + 25n^2}{n}$ (B)



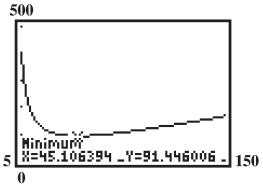
(C) 10 yr; \$675.00 per year (D) 10 yr; \$675.00 per year



60. (A) $\overline{C}(x) = \dfrac{x^2 + 2x + 2{,}000}{x}$ (B)

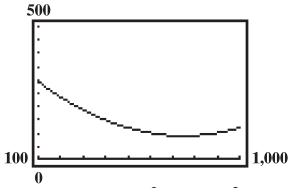


(C) 45 units; \$91.44 per player (D) 45 units; \$91.44 per player



61. (A) $\overline{C}(x) = \dfrac{0.00048(x - 500)^3 + 60{,}000}{x}$

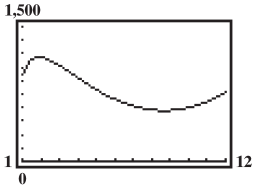
(B)



(C) 750 cases per month; \$90 per case

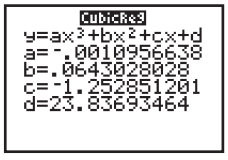
62. (A) $\overline{C}(x) = \dfrac{20x^3 - 360x^2 + 2{,}300x - 1{,}000}{x}$

(B)



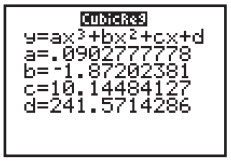
(C) 8.667 thousand cases per month; \$567 per case

63. (A)



(B) 1.7 lb

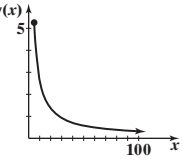
64. (A)



(B) 583 eggs

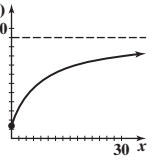
65. (A) 0.06 cm/sec

(B)

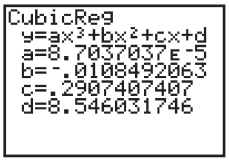


66. (A) 55 words per minute

(B)

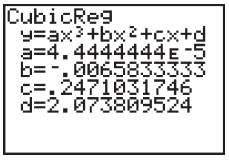


67. (A)



(B) 5.5

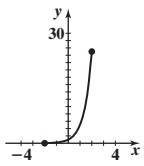
68. (A)



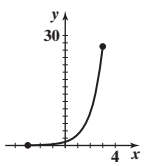
(B) 2.5

Exercises 2.5

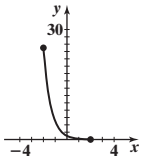
1. (A) k (B) g (C) h (D) f **2.** (A) g (B) f (C) h (D) k **3.**



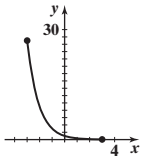
4.



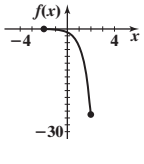
5.



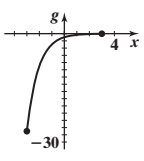
6.



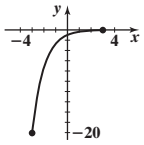
7.



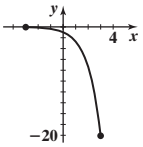
8.



9.

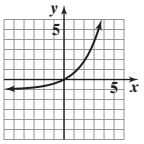


10.

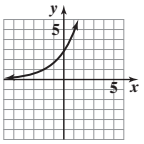


11. The graph of g is the graph of f reflected in the x axis. **12.** The graph of g is the graph of f shifted 2 units to the right. **13.** The graph of g is the graph of f shifted 1 unit to the left. **14.** The graph of g is the graph of f reflected in the x axis. **15.** The graph of g is the graph of f shifted 1 unit up. **16.** The graph of g is the graph of f shifted 2 units down. **17.** The graph of g is the graph of f vertically stretched by a factor of 2 and shifted to the left 2 units. **18.** The graph of g is the graph of f vertically shrunk by a factor of 0.5 and shifted 1 unit to the right.

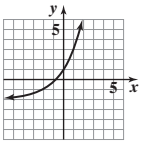
19. (A)



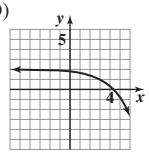
(B)



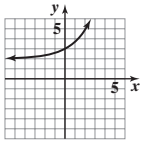
(C)



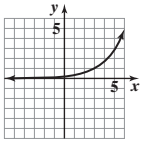
(D)



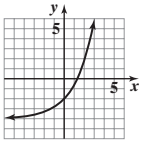
20. (A)



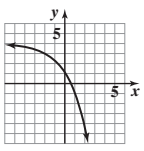
(B)



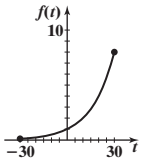
(C)



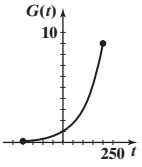
(D)



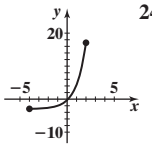
21.



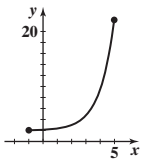
22.



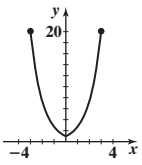
23.



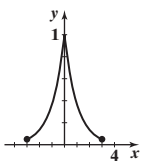
24.



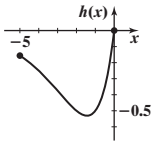
25.



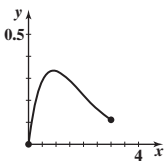
26.



27. $a = 1, -1$
28. $a = 2, b = -2$, for example
29. $x = 48$ **30.** $x = 9$
31. $x = -2, 5$ **32.** $x = -6, 7$
33. $x = -9$ **34.** $x = 16$
35. $x = 3, 19$ **36.** $x = 0, 2$
37. $x = -4, -3$ **38.** $x = 1, 11$ **39.** $x = -7$ **40.** $x = 1/2$
41. $x = -2, 2$ **42.** $x = -3, 3$ **43.** $x = 1/4$ **44.** No solution
45. No solution **46.** $x = 2/3$ **47.**



48.



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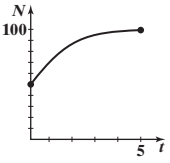
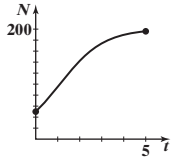
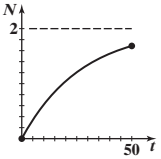


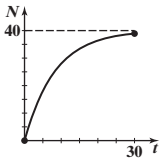
50.

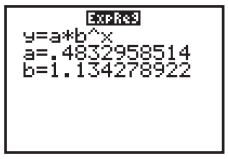


51. \$16,064.07 **52.** \$32,542.72 **53.** (A) \$2,633.56 (B) \$7,079.54
54. (A) \$4,121.75 (B) \$7,285.95 **55.** \$10,706 **56.** \$15,705
57. (A) \$10,095.41 (B) \$10,080.32 (C) \$10,085.27
58. (A) \$10,697.09 (B) \$10,671.21 (C) \$10,644.93
59. N approaches 2 as t increases without bound.



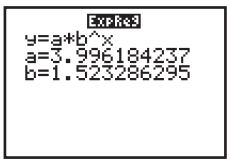
60. 40 boards per day **61.** (A)





(B) 9.94 billion

62. (A)

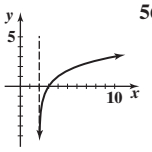


(B) 268.8 exabytes per month
63. (A) 10% (B) 1% **64.** (A) 62%
(B) 39% **65.** (A) $P = 12e^{0.0402x}$
(B) 17.9 million **66.** (A) $P = 204e^{0.0077x}$
(B) 229 million **67.** (A) $P = 127e^{-0.0016x}$
(B) 124 million
68. (A) $P = 7.4e^{0.0113x}$ (B) 2025: 8.2 billion; 2033: 9.0 billion

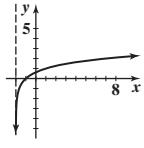
Exercises 2.6

1. $27 = 3^3$ **2.** $32 = 2^5$ **3.** $10^0 = 1$ **4.** $e^0 = 1$ **5.** $8 = 4^{3/2}$
6. $27 = 9^{3/2}$ **7.** $\log_7 49 = 2$ **8.** $\log_6 36 = 2$ **9.** $\log_4 8 = \frac{3}{2}$
10. $\log_{27} 9 = 2/3$ **11.** $\log_b A = u$ **12.** $\log_b M = x$ **13.** 6 **14.** -3
15. -5 **16.** 4 **17.** 7 **18.** -6 **19.** -3 **20.** Not defined **21.** Not defined
22. -1 **23.** $\log_b \mathrm{P} - \log_b \mathrm{Q}$ **24.** $\log_b F + \log_b G$ **25.** $5 \log_b \mathrm{L}$
26. $15 \log_b w$ **27.** q^p **28.** $\log_R P$ **29.** $x = 1/10$ **30.** $x = 10$
31. $b = 4$ **32.** $b = 1/5$ **33.** $y = -3$ **34.** $y = 1/2$ **35.** $b = 1/3$
36. $b = 100$ **37.** $x = 8$ **38.** $x = 32$ **39.** False **40.** False **41.** True
42. False **43.** True **44.** False **45.** False **46.** True **47.** $x = 2$
48. $x = 12$ **49.** $x = 8$ **50.** $x = 2$ **51.** $x = 7$ **52.** $x = 4$
53. No solution **54.** $x = 4$

55.

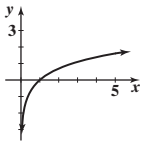


56.

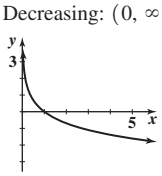


57. The graph of $y = \log_2 (x - 2)$ is the graph of $y = \log_2 x$ shifted to the right 2 units.

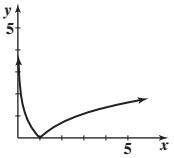
59. Domain: $(-1, \infty)$; range: all real numbers **60.** Domain: $(1, \infty)$; range: all real numbers **61.** (A) 3.547 43 (B) $-2.160\,32$ (C) 5.626 29
(D) $-3.197\,04$ **62.** (A) 1.860 96 (B) $-1.480\,95$ (C) 10.603 04
(D) $-5.128\,36$ **63.** (A) 13.4431 (B) 0.0089 (C) 16.0595 (D) 0.1514
64. (A) 121.1156 (B) 0.0089 (C) 22.9565 (D) 0.0132 **65.** 1.0792
66. 2.1847 **67.** 1.4595 **68.** -1.1845 **69.** 18.3559 **70.** 8.7507
71. Increasing: $(0, \infty)$



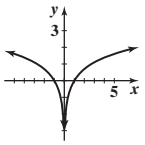
72. Decreasing: $(0, \infty)$



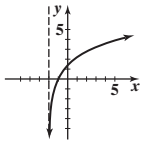
73. Decreasing: $(0, 1]$
Increasing: $[1, \infty)$



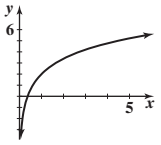
74. Decreasing: $(-\infty, 0)$
Increasing: $(0, \infty)$



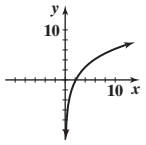
75. Increasing: $(-2, \infty)$



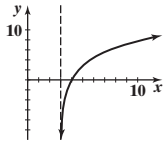
76. Increasing: $(0, \infty)$



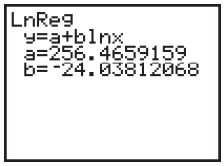
77. Increasing: $(0, \infty)$



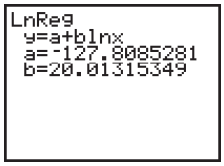
78. Increasing: $(3, \infty)$



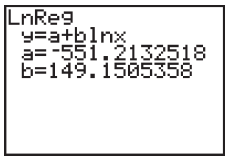
79. Because $b^0 = 1$ for any permissible base $b (b > 0, b \neq 1)$.
80. Because the function $y = 1^x$ is not one-to-one **81.** $x > \sqrt{x} > \ln x$ for $1 < x \leq 16$ **82.** $\log x < \sqrt[3]{x} < x$ **83.** 4 yr **84.** 8 yr **85.** 9.87 yr; 9.80 yr
86. 5.17 yr; 5.09 yr **87.** 7.51 yr **88.** 29.84 yr
89. (A) 5,373



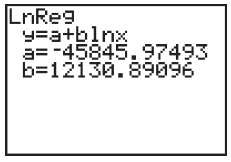
(B) 7,220



90. Equilibrium price: \$46.77; Equilibrium quantity: 6,145
92. (A) 30 (B) 65 (C) 80 (D) 150
93. 168 bushels/acre



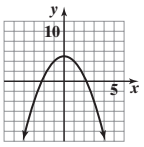
94. 12,628 million bushels



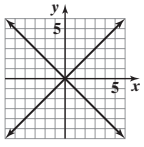
95. 912 yr **96.** 18,569 yr

Chapter 2 Review Exercises

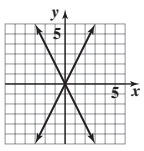
1. *(2.1)*



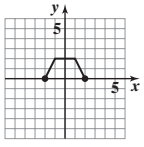
2. *(2.1)*



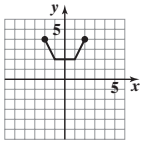
3. *(2.1)*



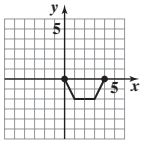
4. (A) Not a function (B) A function (C) A function (D) Not a function *(2.1)* **5.** (A) -2 (B) -8 (C) 0 (D) Not defined *(2.1)*
6. $v = \ln u$ *(2.6)* **7.** $y = \log x$ *(2.6)* **8.** $M = e^N$ *(2.6)* **9.** $u = 10^v$ *(2.6)*
10. $x = 9$ *(2.6)* **11.** $x = 6$ *(2.6)* **12.** $x = 4$ *(2.6)* **13.** $x = 2.157$ *(2.6)*
14. $x = 13.128$ *(2.6)* **15.** $x = 1{,}273.503$ *(2.6)* **16.** $x = 0.318$ *(2.6)*
17. (A) $y = 4$ (B) $x = 0$ (C) $y = 1$ (D) $x = -1$ or 1 (E) $y = -2$ (F) $x = -5$ or 5 *(2.1)*
18. (A)



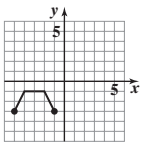
(B)



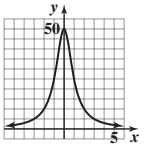
(C)



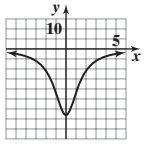
(D)



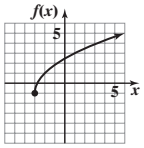
(2.2) **19.** $f(x) = -(x - 2)^2 + 4$. The graph of $f(x)$ is the graph of $y = x^2$ reflected in the x axis, then shifted right 2 units and up 4 units. *(2.2)* **20.** (A) g (B) m (C) n (D) f *(2.2, 2.3)*
21. (A) x intercepts: -4, 0; y intercept: 0 (B) Vertex: $(-2, -4)$ (C) Minimum: -4 (D) Range: $y \geq -4$ or $[-4, \infty)$ *(2.3)* **22.** Quadratic *(2.3)*
23. Linear *(2.1)* **24.** None *(2.1, 2.3)* **25.** Constant *(2.1)* **26.** $x = 8$ *(2.6)*
27. $x = 3$ *(2.6)* **28.** $x = 3$ *(2.5)* **29.** $x = -1, 3$ *(2.5)* **30.** $x = 0, \frac{3}{2}$ *(2.5)*
31. $x = -2$ *(2.6)* **32.** $x = \frac{1}{2}$ *(2.6)* **33.** $x = 27$ *(2.6)* **34.** $x = 13.3113$ *(2.6)*
35. $x = 158.7552$ *(2.6)* **36.** $x = 0.0097$ *(2.6)* **37.** $x = 1.4359$ *(2.6)*
38. $x = 1.4650$ *(2.6)* **39.** $x = 92.1034$ *(2.6)* **40.** $x = 9.0065$ *(2.6)*
41. $x = 2.1081$ *(2.6)* **42.** (A) All real numbers except $x = -2$ and 3 (B) $x < 5$ *(2.1)* **43.** Vertex form: $4\left(x + \frac{1}{2}\right)^2 - 4$; x intercepts: $-\frac{3}{2}$ and $\frac{1}{2}$; y intercept: -3; vertex: $(-\frac{1}{2}, -4)$; minimum: -4; range: $y \geq -4$ or $[-4, \infty)$ *(2.3)* **44.** $(-1.54, -0.79)$; $(0.69, 0.99)$ *(2.5, 2.6)*
45.



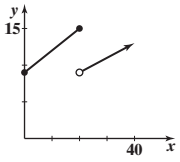
(2.1) **46.**



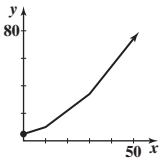
(2.1) **47.** 6 *(2.1)*
48. -19 *(2.1)* **49.** $10x - 4$ *(2.1)* **50.** $21 - 5x$ *(2.1)* **51.** (A) -1 (B) $-1 - 2h$ (C) $-2h$ (D) -2 *(2.1)* **52.** (A) $a^2 - 3a + 1$ (B) $a^2 + 2ah + h^2 - 3a - 3h + 1$ (C) $2ah + h^2 - 3h$ (D) $2a + h - 3$ *(2.1)* **53.** The graph of function m is the graph of $y = |x|$ reflected in the x axis and shifted to the right 4 units. *(2.2)* **54.** The graph of function g is the graph of $y = x^3$ vertically contracted by a factor of 0.3 and shifted up 3 units. *(2.2)* **55.** The graph of $y = x^2$ is vertically expanded by a factor of 2, reflected in the x axis, and shifted to the left 3 units. Equation: $y = -2(x + 3)^2$. *(2.2)* **56.** $f(x) = 2\sqrt{x + 3} - 1$ *(2.2)*



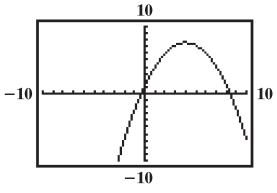
57. $y = 0$ *(2.4)* **58.** $y = \frac{3}{4}$ *(2.4)* **59.** None *(2.4)*
60. $x = -10, x = 10$ *(2.4)* **61.** $x = -2$ *(2.4)*
62. True *(2.3)* **63.** False *(2.3)* **64.** False *(2.3)*
65. True *(2.4)* **66.** True *(2.5)* **67.** True *(2.3)*
68.



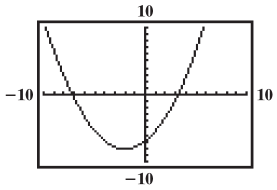
(2.2) **69.**



(2.2)
70. $y = -(x - 4)^2 + 3$ *(2.2, 2.3)* **71.** $f(x) = -0.4(x - 4)^2 + 7.6$ (A) x intercepts: -0.4, 8.4; y intercept: 1.2 (B) Vertex: $(4.0, 7.6)$ (C) Maximum: 7.6 (D) Range: $y \leq 7.6$ or $(-\infty, 7.6]$ *(2.3)*
72.

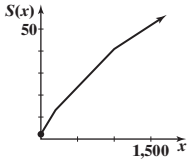


(A) x intercepts: $-.4$, 8.4; y intercept: 1.2 (B) Vertex: (4.0, 7.6) (C) Maximum: 7.6 (D) Range: $y \leq 7.6$ or $(-\infty, 7.6]$ *(2.3)*
73. $\log 10^\pi = \pi$ and $10^{\log \sqrt{2}} = \sqrt{2}$; $\ln e^\pi = \pi$ and $e^{\ln \sqrt{2}} = \sqrt{2}$ *(2.6)*
74. $x = 2$ *(2.6)* **75.** $x = 2$ *(2.6)* **76.** $x = 1$ *(2.6)* **77.** $x = 300$ *(2.6)*
78. $y = ce^{-5t}$ *(2.6)* **79.** If $\log_1 x = y$, then $1^y = x$; that is, $1 = x$ for all positive real numbers x, which is not possible. *(2.6)* **80.** The graph of $y = \sqrt[3]{x}$ is vertically expanded by a factor of 2, reflected in the x axis, and shifted 1 unit left and 1 unit down. Equation: $y = -2\sqrt[3]{x + 1} - 1$. *(2.2)*
81. $G(x) = 0.3(x + 2)^2 - 8.1$ (A) x intercepts: -7.2, 3.2; y intercept: -6.9 (B) Vertex: $(-2, -8.1)$ (C) Minimum: -8.1 (D) Range: $y \geq -8.1$ or $[-8.1, \infty)$ *(2.3)*

82. 

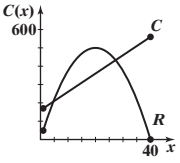
(A) x intercepts: -7.2. 3.2; y intercept: -6.9 (B) Vertex: $(-2, -8.1)$ (C) Minimum: -8.1 (D) Range: $y \geq -8.1$ or $[-8.1, \infty)$ *(2.3)*

83. (A) $S(x) = \begin{cases} 3 & \text{if } 0 \leq x \leq 20 \\ 0.057x + 1.86 & \text{if } 20 < x \leq 200 \\ 0.0346x + 6.34 & \text{if } 200 < x \leq 1{,}000 \\ 0.0217x + 19.24 & \text{if } x > 1{,}000 \end{cases}$

(B) 

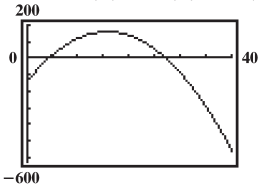
(2.2) **84.** $5,321.95 *(2.5)* **85.** $5,269.51 *(2.5)*

86. 201 months ($\approx$16.7 years) *(2.5)* **87.** 9.38 yr *(2.5)*

88. (A) 

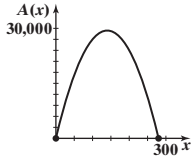
(B) $R = C$ for $x = 4.686$ thousand units (4,686 units) and for $x = 27.314$ thousand units (27,314 units); $R < C$ for $1 \leq x < 4.686$ or $27.314 < x \leq 40$; $R > C$ for $4.686 < x < 27.314$. (C) Maximum revenue is 500 thousand dollars ($500,000). This occurs at an output of 20 thousand units (20,000 units). At this output, the wholesale price is $p(20) = \$25$. *(2.3)*

89. (A) $P(x) = R(x) - C(x) = x(50 - 1.25x) - (160 + 10x)$



(B) $P = 0$ for $x = 4.686$ thousand units (4,686 units) and for $x = 27.314$ thousand units (27,314 units); $P < 0$ for $1 \leq x < 4.686$ or $27.314 < x \leq 40$; $p > 0$ for $4.686 < x < 27.314$. (C) Maximum profit is 160 thousand dollars ($160,000). This occurs at an output of 16 thousand units (16,000 units). At this output, the wholesale price is $p(16) = \$30$. *(2.3)*

90. (A) $A(x) = -\frac{3}{2}x^2 + 420x$ (B) Domain: $0 \leq x \leq 280$

(C) 

(D) There are two solutions to the equation $A(x) = 25{,}000$, one near 90 and another near 190. (E) 86 ft; 194 ft (F) Maximum combined area is 29,400 ft^2. This occurs for $x = 140$ ft and $y = 105$ ft. *(2.3)*

91. (A) 2,833 sets

```
QuadReg
y=ax²+bx+c
a=5.9477212E-6
b=-.1024018814
c=422.3467853
```

(B) 4,836

```
LinReg
y=ax+b
a=.0387421907
b=-7.364689544
```

(C) Equilibrium price: $131.59; equilibrium quantity: 3,587 cookware sets *(2.3)*

92. (A)

```
CubicReg
y=ax³+bx²+cx+d
a=.3039472614
b=-12.99286831
c=38.29231232
d=5604.782066
```

(B) 4976 *(2.4)*

93. (A) $N = 2^{2t}$ or $N = 4^t$ (B) 15 days *(2.5)* **94.** $k = 0.009\,42$; 489 ft *(2.6)* **95.** (A) 6,134,000 *(2.6)*

```
LnReg
y=a+blnx
a=42400.65695
b=-8207.259234
```

96. 23.1 yr *(2.5)* **97.** (A) $1,319 billion (B) 2031 *(2.5)*

```
ExpReg
y=a*b^x
a=47.19368975
b=1.076818175
```