

INSTRUCTOR ANSWERS

FINITE MATHEMATICS FOR BUSINESS, ECONOMICS, LIFE SCIENCES, AND SOCIAL SCIENCES

FOURTEENTH EDITION

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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. $\frac{a^2 + b^2}{ab}$ (A.4) 26. $\frac{a^2 - c^2}{abc}$
(A.4) 27. $\frac{y^5}{x}$ (A.4) 28. $\frac{1}{xy^2}$ (A.4) 29. $\frac{-1}{7(7 + h)}$ (A.4) 30. $\frac{xy}{y - x}$ (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. $4x = x - 4$; $x = -4/3$ (I.1) 34. $-15/7$ (I-2) 35. $(4/7, 0)$ (I.2)
36. $(0, -4)$ (I-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. $4 \leq x < 13$ 8. $-3 < x \leq 5$ 9. $-2 < x < 7$
 10. $-6 \leq x \leq -1$ 11. $x \leq 4$ 12. $x \geq 9$ 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. $y = \frac{2}{3}$

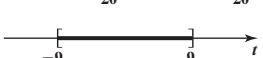
25. $x = 10$ 26. $x = 4$ 27. $y \geq 3$ 28. $x \leq 8$ 29. $x = 36$

30. $y = -6$ 31. $m < \frac{36}{7}$ 32. $u < 16$

33. $3 \leq x < 7$ or $[3, 7)$ 

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

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

36. $-9 \leq t \leq 9$ 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. $-2 < x \leq 1$ or $(-2, 1]$

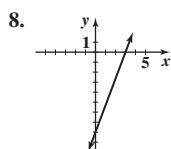
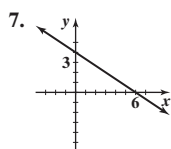
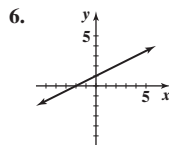
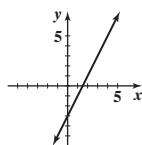
-  44. $\frac{14}{3} \leq u \leq 6$ or $[\frac{14}{3}, 6]$

-  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. $-45 \leq C \leq -10$ 65. 12.6 yr 66. 9.6 to 16.8

Exercises 1.2

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



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

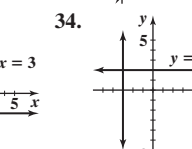
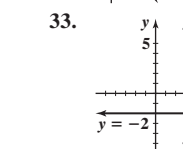
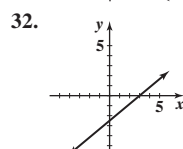
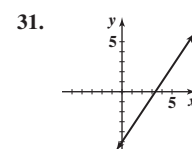
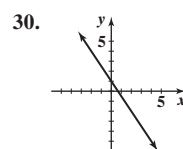
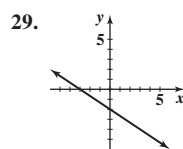
17. Slope = 8; x int. = 5 18. Slope = -3; x int. = 2

19. Slope = $\frac{6}{7}$; x int. = -7 20. Slope = $-\frac{9}{2}$; x int. = $\frac{4}{9}$ 21. $y = 2x + 1$

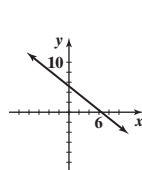
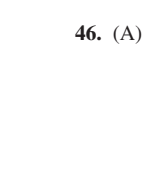
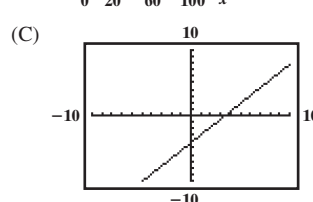
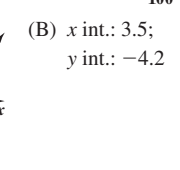
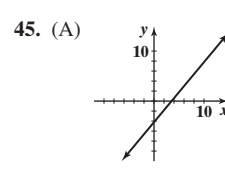
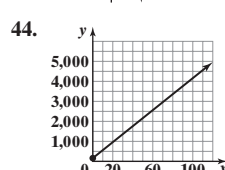
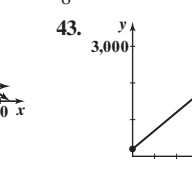
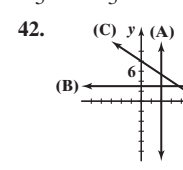
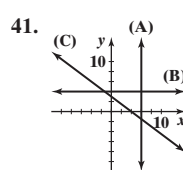
22. $y = x + 5$ 23. $y = -\frac{1}{3}x + 6$ 24. $y = \frac{6}{7}x - \frac{9}{2}$

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; $y = \frac{x}{2} - 1$

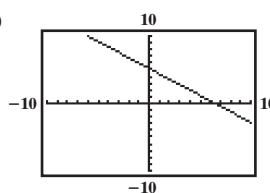


35. -4 36. 5 37. $-\frac{3}{5}$ 38. $\frac{2}{3}$ 39. 2 40. $\frac{1}{8}$



- (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) $y = \frac{3}{2}x + \frac{1}{2}$

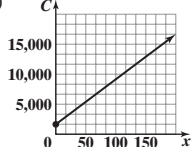
61. (A) $m = -\frac{5}{4}$ (B) $5x + 4y = -14$ (C) $y = -\frac{5}{4}x - \frac{7}{2}$

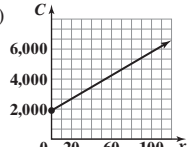
62. (A) $m = -\frac{4}{5}$ (B) $4x + 5y = 23$ (C) $y = -\frac{4}{5}x + \frac{23}{5}$

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 .

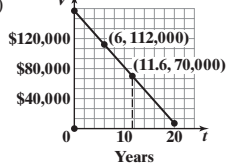
69. $C = 124 + 0.12x$; 1,050 donuts 70. $C = 1,200 + 45x$; 80 picnic tables

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.

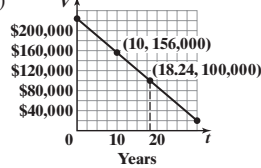
72. (A) $C = 39x + 1,905$ (B)  (C) The y int., \$1,905, is the fixed cost, and the slope, \$39, is the cost per racket.

73. (A) $R = 1.4C - 7$ (B) \$137 74. (A) $R = 1.5C + 3$ (B) \$158

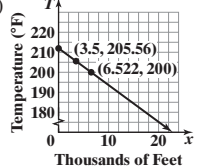
75. (A) $V = -7,500t + 157,000$ (B) \$112,000 (C) During the 12th year

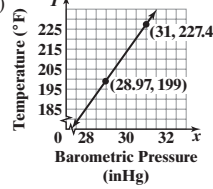
(D)  76. (A) $V = -6,800t + 224,000$

(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

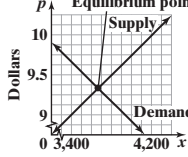
(C) 28.97 inHg (D) 

79. (A) $T = 70 - 3.6A$ (B) 10,000 ft 80. (A) $T = 3.2A + 200$

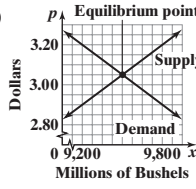
(B) 220.8 mph 81. (A) $N = -0.0063t + 2.76$ (B) 2.45 persons

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) $P = 0.445d + 14.7$ (B) The rate of change of pressure with respect to depth is 0.445 lb/in.² per ft. (C) 37 lb/in.²

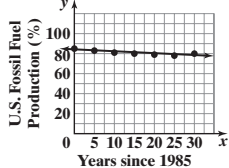
(D) 99 ft 4. (A) $P = 0.43d + 14.7$ (B) The rate of change of pressure with respect to depth is 0.43 lb/in.² per ft. (C) 36.3 lb/in.² (D) 102 ft

5. (A) $a = 2,880 - 24t$ (B) -24 ft/sec (C) 24 ft/sec

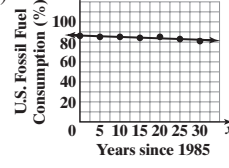
6. (A) $a = -16t + 2,880$ (B) -16 ft/sec (C) 16 ft/sec

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.

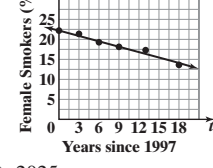
8. $x = 3.9t + 1,403$; the rate of change of the speed of sound with respect to temperature is 3.9 m/s per °C.

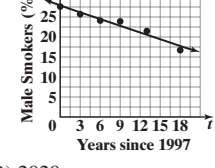
9. (A)  (B) The rate of change of fossil fuel production is -0.19% per year.

(C) 76% of total production (D) 2058

10. (A)  (B) The rate of change of fossil fuel consumption is -0.14% per year.

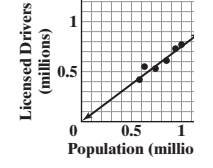
(C) 81% (D) 2030

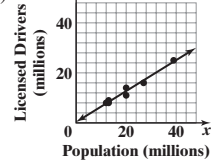
11. (A) 

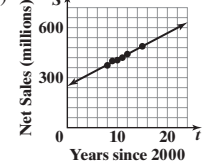
12. (A) 

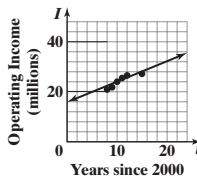
(B) 2025

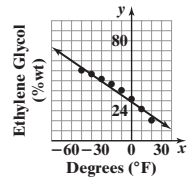
(B) 2029

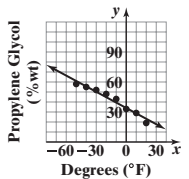
13. (A)  (B) 1,050,000 (C) 1,359,000

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%

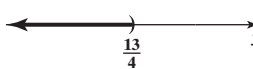
18. (A)
- 
- (B) 7°F (C) 25.9%

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

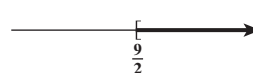
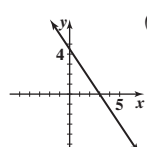
Chapter 1 Review Exercises

- 1.
- $x = 2.8$
- (I.1) 2.
- $x = 2$
- (I.1) 3.
- $y = 1.8 - 0.4x$
- (I.1)

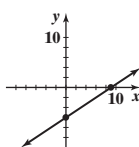
- 4.
- $x = \frac{4}{3}y + \frac{7}{3}$
- (I.1) 5.
- $y < \frac{13}{4}$
- or
- $(-\infty, \frac{13}{4})$

- 
- (I.1) 6.
- $1 \leq x < 3$
- or
- $[1, 3)$

- 
- (I.1) 7.
- $x \geq \frac{9}{2}$
- or
- $[\frac{9}{2}, \infty)$

- 
- (I.1) 8.
- 
- (I.2)

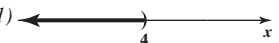
- 9.
- $2x + 3y = 12$
- (I.2) 10.
- x
- int. = 9;
- y
- int. = -6; slope =
- $\frac{2}{3}$
- (I.2)

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

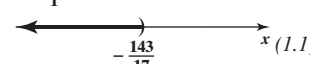
12. Vert. line:
- $x = -6$
- ; hor. line:
- $y = 5$
- (I.2) 13. (A)
- $y = -\frac{2}{3}x$

- (B)
- $y = 3$
- (I.2) 14. (A)
- $3x + 2y = 1$
- (B)
- $y = 5$
- (C)
- $x = -2$
- (I.2)

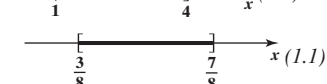
- 15.
- $x = \frac{25}{2}$
- (I.1) 16.
- $u = 36$
- (I.1) 17.
- $x = \frac{30}{11}$
- (I.1) 18.
- $x = 21$
- (I.1)

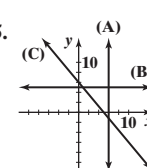
- 19.
- $x = 4$
- (I.1) 20.
- $x < 4$
- or
- $(-\infty, 4)$
- (I.1)
- 

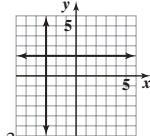
- 21.
- $x \geq 1$
- or
- $[1, \infty)$
- (I.1)
- 

- 22.
- $x < -\frac{143}{17}$
- or
- $(-\infty, -\frac{143}{17})$
- 
- (I.1)

- 23.
- $1 < x \leq 4$
- or
- $(1, 4]$
- 
- (I.1)

- 24.
- $\frac{3}{8} \leq x \leq \frac{7}{8}$
- or
- $[\frac{3}{8}, \frac{7}{8}]$
- 
- (I.1)

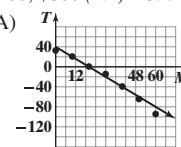
- 25.
- 
- (A) (I.2) 26. The graph of
- $x = -3$
- is a vert. line with
- x
- int. -3, and the graph of
- $y = 2$
- is a hor. line with
- y
- int. 2. (I.2)

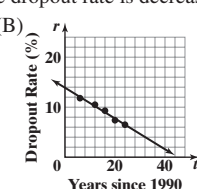


27. (A) An oblique line through the origin with slope
- $-\frac{3}{4}$
- (B) A vert. line

- with
- x
- int.
- $-\frac{4}{3}$
- (C) The
- x
- axis (D) An oblique line with
- x
- int. 12 and
- y
- int.

- 9 (I.2) 28. $\frac{2A - bh}{h}$ (I.1) 29. $\frac{S - P}{St}$ (I.1) 30. $a < 0$ and b any real number (I.1) 31. Less than (I.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.) (I.2)
 33. \$75,000 (I.1) 34. 9,375 DVDs (I.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 (I.3) 36. (A) $V = 224,000 - 15,500t$
 (B) \$38,000 (I.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. (I.2)
 38. \$400; \$800 (I.1) 39. Demand: $p = 5.24 - 0.00125x$; 1,560 bottles (I.2)

40. (A)
- 
- (B) -30°F (C) 45% (I.3)

41. (A) The dropout rate is decreasing at a rate of 0.308 percentage points per year. (B)
- 
- (C) 2026 (I.3)

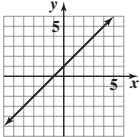
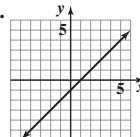
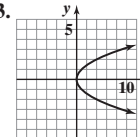
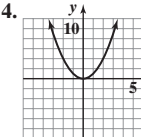
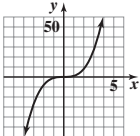
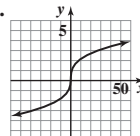
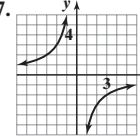
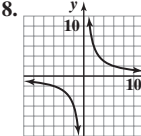
42. (A) The CPI is increasing at a rate of 4.295 units per year. (B) 276.62 (I.3)

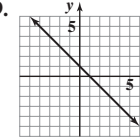
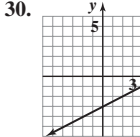
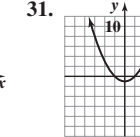
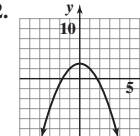
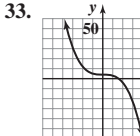
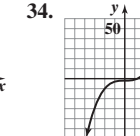
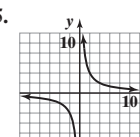
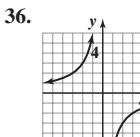
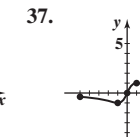
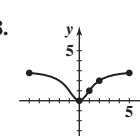
43. (A) The rate of change of tree height with respect to Dbh is 0.74.
-
- (B) Tree height increases by about 0.74 ft. (C) 21 ft (D) 16 in. (I.3)

ANSWERS

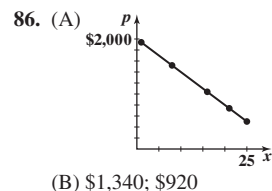
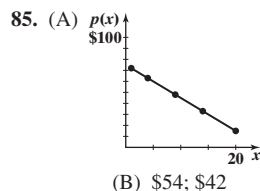
Chapter 2

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

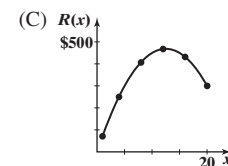
29.  30.  31. 
 32.  33.  34. 
 35.  36.  37. 
 38. 

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. $x \leq 7$ 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; $x \geq 0$ 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. $P(w) = 2w + \frac{50}{w}$, $w > 0$ 82. $P(l) = 2l + \frac{162}{l}$, $l > 0$
 83. $A(l) = l(50 - l)$, $0 < l < 50$ 84. $A(w) = (80 - w)w$, $0 < w < 80$



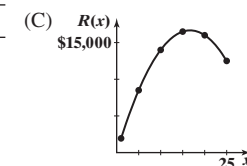
87. (A) $R(x) = (75 - 3x)x$, $1 \leq x \leq 20$

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



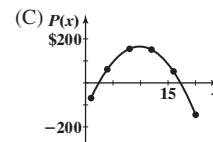
88. (A) $R(x) = x(2,000 - 60x)$, $1 \leq x \leq 25$

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



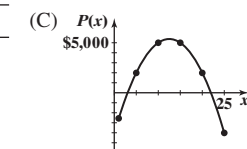
89. (A) $P(x) = 59x - 3x^2 - 125$, $1 \leq x \leq 20$

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



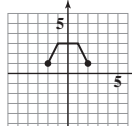
90. (A) $P(x) = 1,500x - 60x^2 - 4,000$, $1 \leq x \leq 25$

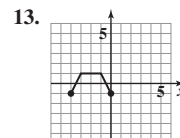
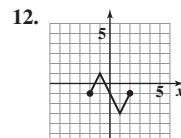
(B) x	$P(x)$
1	-2,560
5	2,000
10	5,000
15	5,000
20	2,000
25	-4,000

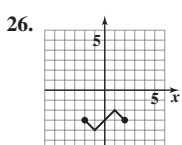
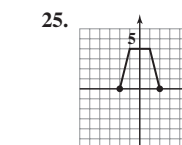
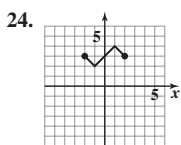
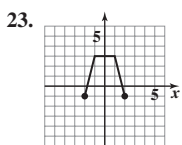
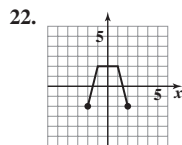
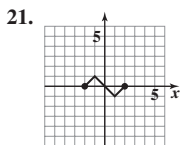
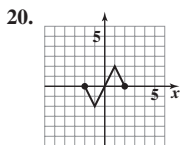
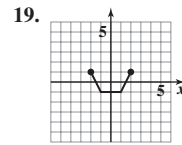
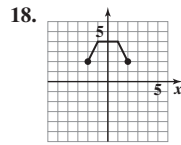
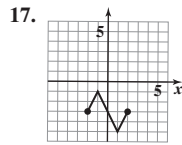
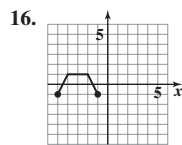
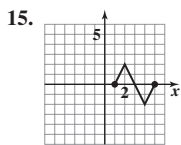
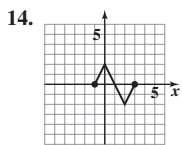


91. $v = \frac{75 - w}{15 + w}$; 1.9032 cm/sec 92. (A) $v = 0.4s + 0.28$; 48.4%
 (B) $s = 2.5v - 0.7$; 57.5%

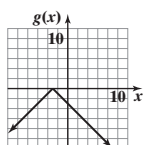
Exercises 2.2

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. 

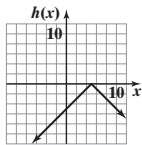




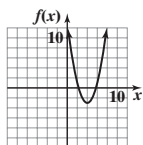
27. The graph of $g(x) = -|x + 3|$ is the graph of $y = |x|$ reflected in the x axis and shifted 3 units to the left.



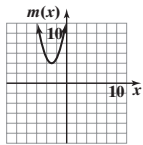
28. The graph of $h(x) = -|x - 5|$ is the graph of $y = |x|$ reflected in the x axis and shifted 5 units to the right.



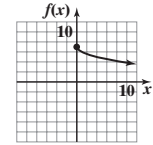
29. The graph of $f(x) = (x - 4)^2 - 3$ is the graph of $y = x^2$ shifted 4 units to the right and 3 units down.



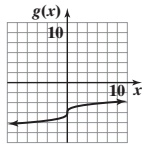
30. The graph of $m(x) = (x + 3)^2 + 4$ is the graph of $y = x^2$ shifted 3 units to the left and 4 units up.



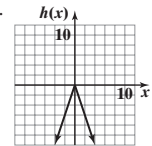
31. The graph of $f(x) = 7 - \sqrt{x}$ is the graph of $y = \sqrt{x}$ reflected in the x axis and shifted 7 units up.



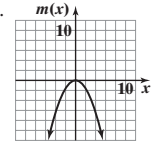
32. The graph of $g(x) = -6 + \sqrt[3]{x}$ is the graph of $y = \sqrt[3]{x}$ shifted 6 units down.



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.

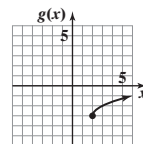


34. The graph of $m(x) = -0.4x^2$ is the graph of $y = x^2$ reflected in the x axis and vertically shrunk by a factor of 0.4.

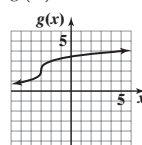


35. The graph of the basic function $y = x^2$ is shifted 2 units to the left and 3 units down. Equation: $y = (x + 2)^2 - 3$. 36. The graph of the basic function $y = |x|$ is shifted 3 units to the right and 2 units up. Equation: $y = |x - 3| + 2$. 37. The graph of the basic function $y = x^2$ is reflected 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 $y = \sqrt[3]{x}$ 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: $y = 1 - (x - 3)^3$.

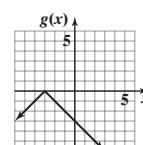
43. $g(x) = \sqrt{x - 2} - 3$



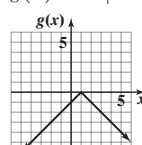
44. $g(x) = \sqrt[3]{x + 3} + 2$



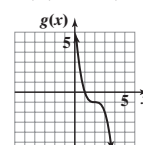
45. $g(x) = -|x + 3|$



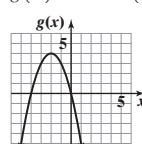
46. $g(x) = -|x - 1|$



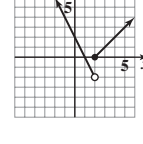
47. $g(x) = -(x - 2)^3 - 1$



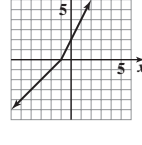
48. $g(x) = 4 - (x + 2)^2$



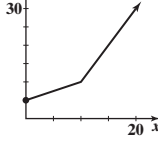
49. $f(x) = \sqrt{x}$



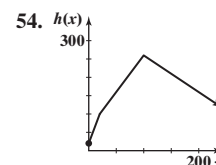
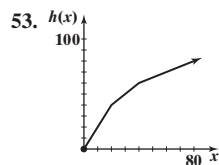
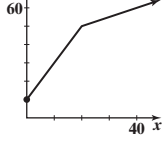
50. $g(x) = \sqrt{x}$



51. $h(x) = \sqrt{x}$



52. $h(x) = \sqrt{x}$



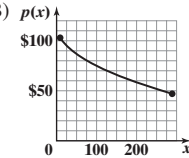
55. The graph of the basic function $y = |x|$ is reflected in the x axis and vertically shrunk by a factor of 0.5. Equation: $y = -0.5|x|$.

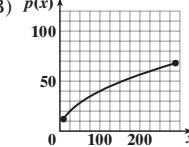
56. The graph of the basic function $y = x$ is reflected in the x axis and vertically stretched by a factor of 2. Equation: $y = -2x$. 57. The graph of the basic function $y = x^2$ is reflected in the x axis and vertically stretched by a factor of 2. Equation: $y = -2x^2$. 58. The graph of the basic function $y = |x|$ is vertically stretched by a factor of 4. Equation: $y = 4|x|$.

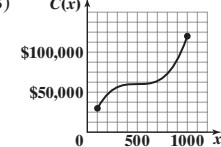
59. The graph of the basic function $y = \sqrt[3]{x}$ is reflected in the x axis and vertically stretched by a factor of 3. Equation: $y = -3\sqrt[3]{x}$. 60. The graph of the basic function $y = x^3$ is vertically shrunk by a factor of 0.25. Equation: $y = 0.25x^3$. 61. Reversing the order does not change the result.

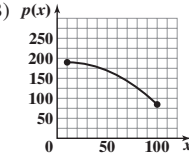
62. Reversing the order does not change the result. 63. Reversing the order can change the result. 64. Reversing the order can change the result.

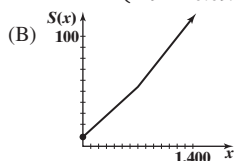
65. Reversing the order can change the result. 66. Reversing the order does not change the result. 67. (A) The graph of the basic function $y = \sqrt{x}$ is reflected in the x axis, vertically expanded by a factor of 4, and shifted up 115 units.

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

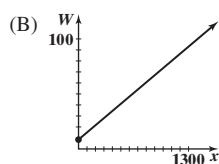
(B)  69. (A) The graph of the basic function $y = x^3$ is vertically contracted by a factor of 0.00048 and shifted right 500 units and up 60,000 units.

(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.

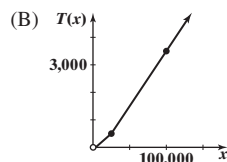
(B)  71. (A)
$$S(x) = \begin{cases} 8.5 + 0.065x & \text{if } 0 \leq x \leq 700 \\ -9 + 0.09x & \text{if } x > 700 \end{cases}$$



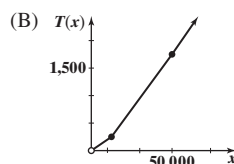
72. (A)
$$W(x) = \begin{cases} 8.5 + 0.065x & \text{if } 0 \leq x \leq 700 \\ 16.9 + 0.053x & \text{if } x > 700 \end{cases}$$



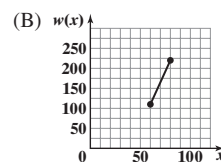
73. (A)
$$T(x) = \begin{cases} 0.02x & \text{if } 0 < x \leq 25,000 \\ 0.04x - 500 & \text{if } 25,000 < x \leq 100,000 \\ 0.06x - 2,500 & \text{if } x > 100,000 \end{cases}$$

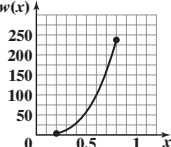


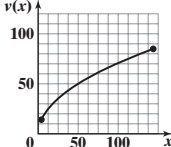
74. (A)
$$T(x) = \begin{cases} 0.02x & \text{if } 0 \leq x < 12,500 \\ 0.04x - 250 & \text{if } 12,500 < x \leq 50,000 \\ 0.06x - 1,250 & \text{if } x > 50,000 \end{cases}$$

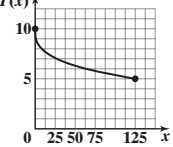


(C) \$1,030; \$2,590 75. (A) The graph of the basic function $y = x$ is vertically stretched by a factor of 5.5 and shifted down 220 units.



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: $y \leq 1$ or $(-\infty, 1]$ 16. (A) x int.: -5, -1; y int.: -5

(B) Vertex: (-3, 4) (C) max.: 4 (D) Range: $y \leq 4$ or $(-\infty, 4]$

17. (A) x int.: -3, -1; y int.: 3 (B) Vertex: (-2, -1) (C) Min.: -1

(D) Range: $y \geq -1$ or $[-1, \infty)$ 18. (A) x int.: 1, 5; y int.: 5

(B) Vertex: (3, -4) (C) min.: -4 (D) Range: $y \geq -4$ or $[-4, \infty)$

19. (A) x int.: $3 \pm \sqrt{2}$; y int.: -7 (B) Vertex: (3, 2) (C) Max.: 2

(D) Range: $y \leq 2$ or $(-\infty, 2]$ 20. (A) x int.: $-2 \pm \sqrt{3}$; y int.: -1

(B) Vertex: (-2, 3) (C) max.: 3 (D) Range: $y \leq 3$ or $(-\infty, 3]$

21. (A) x int.: $-1 \pm \sqrt{2}$; y int.: -1 (B) Vertex: (-1, -2) (C) Min.: -2

(D) Range: $y \geq -2$ or $[-2, \infty)$ 22. (A) x int.: $4 \pm \sqrt{3}$; y int.: 13

(B) Vertex: (4, -3) (C) min.: -3 (D) Range: $y \geq -3$ 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. $(-\infty, -5) \cup (3, \infty)$

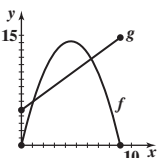
42. $(-6, 3)$ 43. $[-3, 2]$ 44. $(-\infty, -4] \cup [-3, \infty)$

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

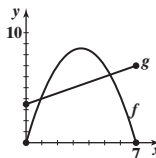
$x > 2.72$ 51. Axis: $x = 2$; vertex: $(2, 4)$; range: $y \geq 4$ or $[4, \infty)$; no x int.

52. Axis: $x = -3$; vertex: $(-3, -5)$; range: $y \leq -5$ or $(-\infty, -5]$; no x

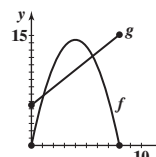
intercept 53. (A)  (B) 1.64, 7.61

(C) $1.64 < x < 7.61$

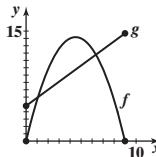
(D) $0 \leq x < 1.64$ or $7.61 < x \leq 10$

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) $1.10 < x < 5.57$

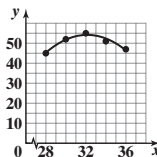
(D) $0 \leq x < 1.10$ or $5.57 < x \leq 8$

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)

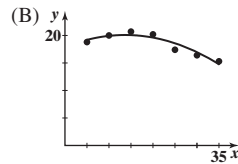
x	28	30	32	34	36
Mileage	45	52	55	51	47
f(x)	45.3	51.8	54.2	52.4	46.5

(B)  (C) $f(31) = 53.50$ thousand miles;

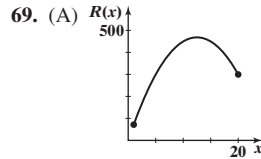
(D) $f(35) = 49.95$ thousand miles;

66. (A)

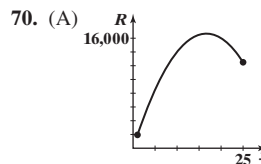
x	5	10	15	20	25	30	35
Market share	18.8	20.0	20.7	20.2	17.4	16.4	15.3
f(x)	19.2	19.9	20.1	19.6	18.6	17.0	14.8



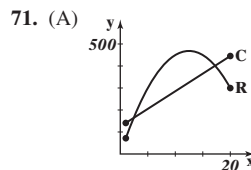
(C) $f(45) = 8.6\%$; $f(48) = 6.3\%$



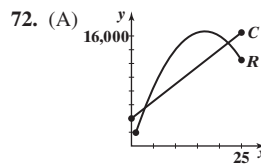
(B) 12.5 (12,500,000 chips);
\$468,750,000 (C) \$37.50



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

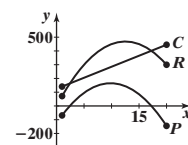


(B) 2,415,000 chips and 17,251,000
chips (C) Loss: $1 \leq x < 2.415$
or $17.251 < x \leq 20$; profit:
 $2.415 < x < 17.251$



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

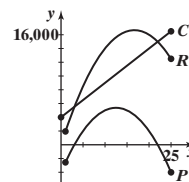


(C) Intercepts and break-even points: 2,415,000 chips and 17,251,000 chips
(D) Maximum profit is \$165,083,000 at a production level of 9,833,000 chips.
This is much smaller than the maximum revenue of \$468,750,000.

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

QuadReg
 $y = ax^2 + bx + c$
 $a = 1.4E-6$
 $b = -.00266$
 $c = 5.4$

78. 5.6 mpg

QuadReg
 $y = ax^2 + bx + c$
 $a = 9.1428571E-7$
 $b = -.0069314286$
 $c = 16.69714286$

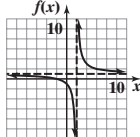
Exercises 2.4

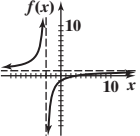
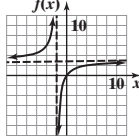
1. (A) 1 (B) -3 (C) 21 2. (A) 2 (B) 2, 3 (C) 6 3. (A) 2 (B) -5, -4 (C) 20 4. (A) 1 (B) 10 (C) 30 5. (A) 6 (B) None (C) 15 6. (A) 8 (B) None (C) 10 7. (A) 5 (B) 0, -6 (C) 0 8. (A) 4 (B) -7, 5

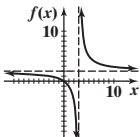
- (C) 1,225 9. (A) 11 (B) -5, -2, 5 (C) -12,800 10. (A) 10 (B) $-3, \frac{5}{2}, 3$

- (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

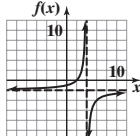
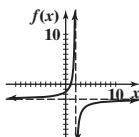
20. 7 21. 1 22. 0 23. (A) x int.: -2; y int.: -1 (B) Domain: all real numbers except 2 (C) Vertical asymptote: $x = 2$; horizontal asymptote: $y = 1$

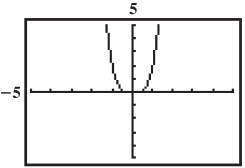
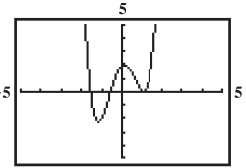
- (D)  24. (A) x int.: 3; y int.: -1 (B) Domain: all real numbers except -3 (C) Vertical asymptote: $x = -3$; horizontal asymptote: $y = 1$

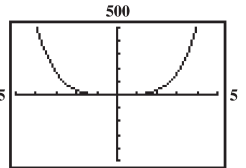
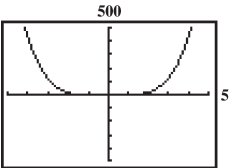
- (D)  25. (A) x int.: 0; y int.: 0 (B) Domain: all real numbers except -2 (C) Vertical asymptote: $x = -2$; horizontal asymptote: $y = 3$ (D) 

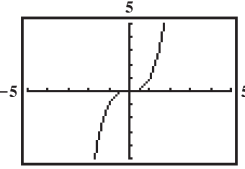
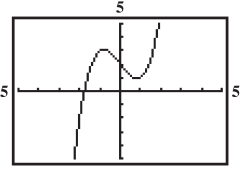
26. (A) x int.: 0; y int.: 0 (B) Domain: all real numbers except 3 (C) Vertical asymptote: $x = 3$; horizontal asymptote: $y = 2$ (D) 

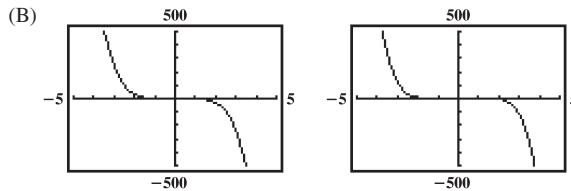
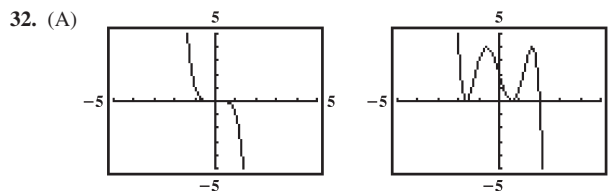
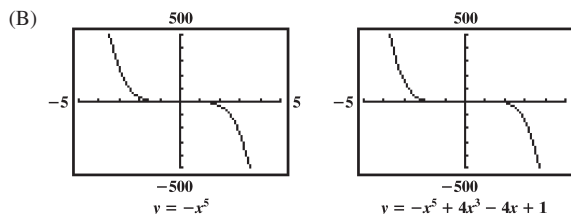
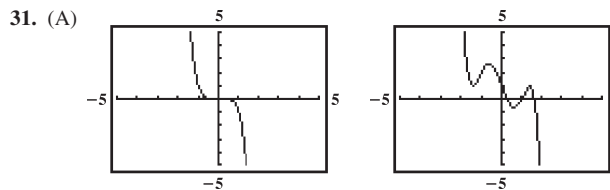
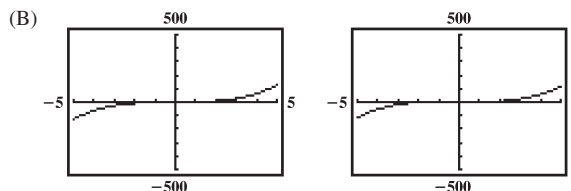
27. (A) x int.: 2; y int.: -1 (B) Domain: all real numbers except 4 (C) Vertical asymptote: $x = 4$; horizontal asymptote: $y = -2$

- (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)  

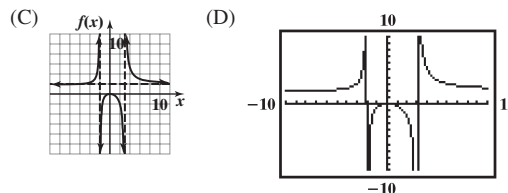
- (B)  
 $y = 2x^4$ $y = 2x^4 - 5x^2 + x + 2$

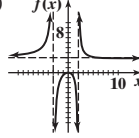
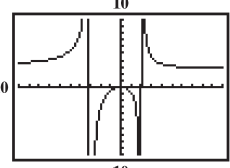
30. (A)  

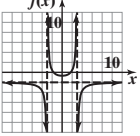


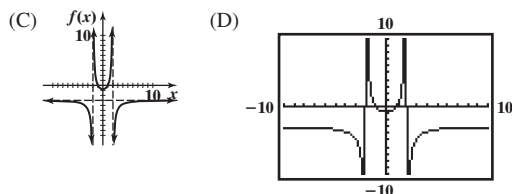
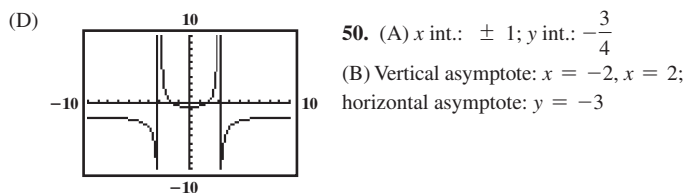
33. $y = \frac{5}{6}$ 34. $y = \frac{3}{2}$ 35. $y = \frac{1}{4}$ 36. $y = -\frac{1}{2}$ 37. $y = 0$

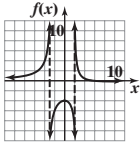
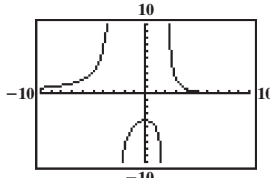
38. $y = 0$ 39. None 40. None 41. $x = -1, x = 1, x = -3, x = 3$ 42. $x = -2, x = 2, x = -4, x = 4$ 43. $x = 5$ 44. $x = -8$ 45. $x = -6, x = 6$ 46. $x = 0, x = 2$ 47. (A) x int.: 0; y int.: 0 (B) Vertical asymptotes: $x = -2, x = 3$; horizontal asymptote: $y = 2$

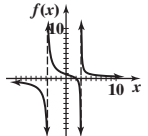


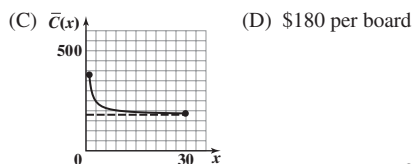
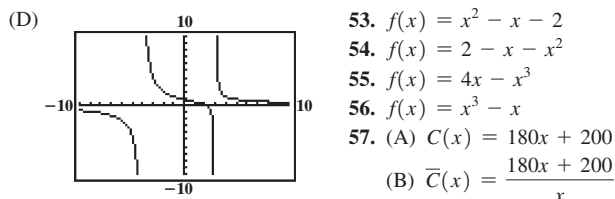
48. (A) x int.: 0; y int.: 0 (B) Vertical asymptotes: $x = -3, x = 2$; horizontal asymptote: $y = 3$ (C)  (D) 

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

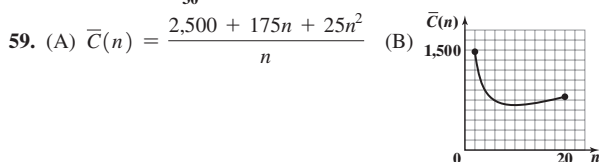
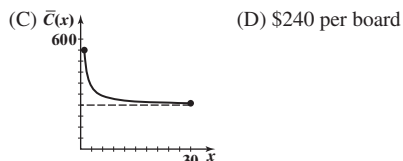


51. (A) x int.: 6; y int.: -4 (B) Vertical asymptotes: $x = -3, x = 2$; horizontal asymptote: $y = 0$ (C)  (D) 

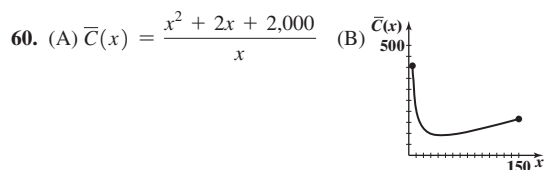
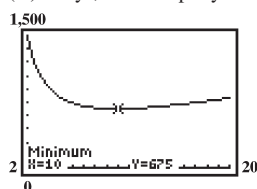
52. (A) x int.: 2; y int.: $\frac{5}{6}$ (B) Vertical asymptotes: $x = -4, x = 3$;
horizontal asymptote: $y = 0$ (C) 



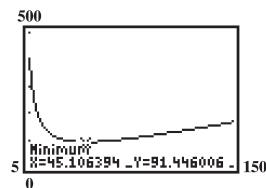
58. (A) $C(x) = 240x + 300$ (B) $\bar{C}(x) = \frac{240x + 300}{x}$



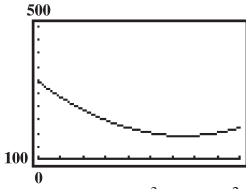
(C) 10 yr; \$675.00 per year (D) 10 yr; \$675.00 per year



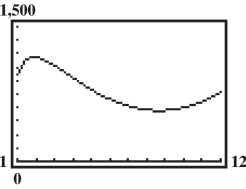
(C) 45 units; \$91.44 per player (D) 45 units; \$91.44 per player

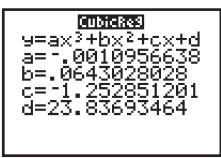


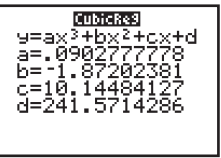
61. (A) $\bar{C}(x) = \frac{0.00048(x - 500)^3 + 60,000}{x}$

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

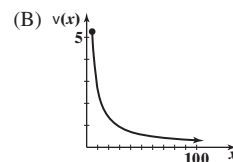
62. (A) $\bar{C}(x) = \frac{20x^3 - 360x^2 + 2,300x - 1,000}{x}$

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

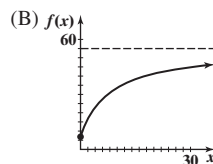
63. (A)  (B) 1.7 lb

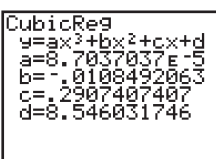
64. (A)  (B) 583 eggs

65. (A) 0.06 cm/sec

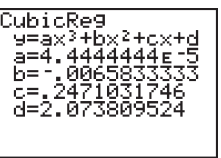


66. (A) 55 words per minute



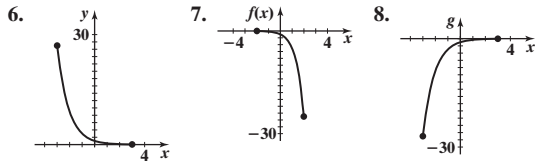
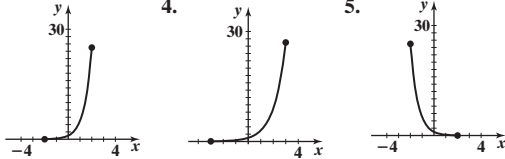
67. (A) 

(B) 5.5

68. (A)  (B) 2.5

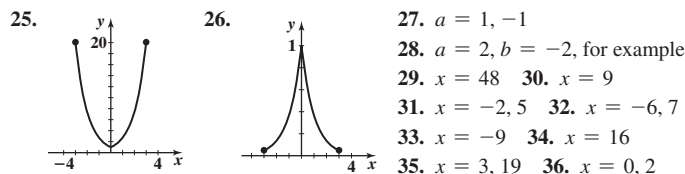
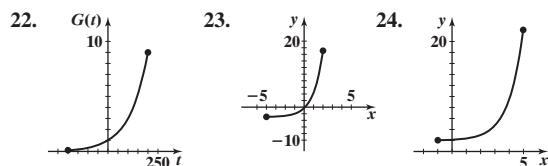
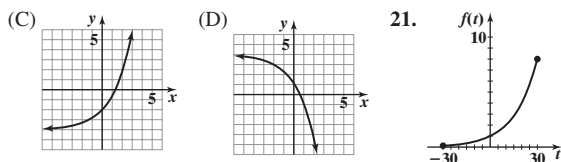
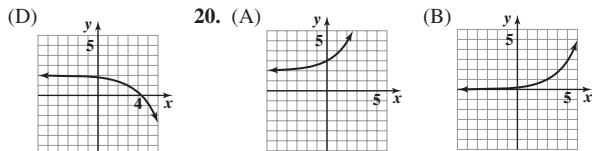
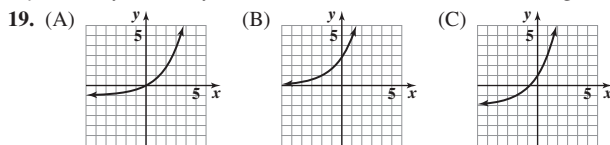
Exercises 2.5

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

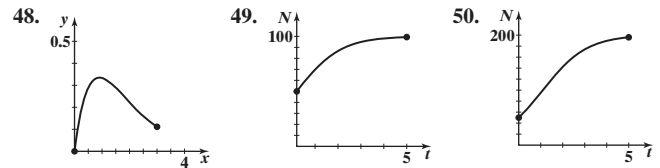
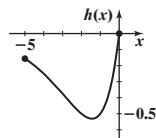


6. 7. 8. 9. 10. 11. The graph of g is the graph of f reflected in the x axis. 12. The graph of g is the graph of f shifted 2 units to the right. 13. The graph of g is the graph of f shifted 1 unit to the left.

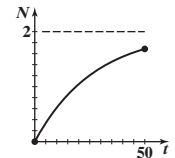
14. The graph of g is the graph of f reflected in the x axis. 15. The graph of g is the graph of f shifted 1 unit up. 16. The graph of g is the graph of f shifted 2 units down. 17. The graph of g is the graph of f vertically stretched by a factor of 2 and shifted to the left 2 units. 18. The graph of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



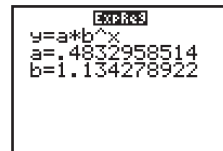
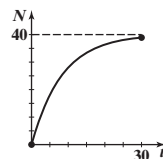
37. $x = -4, -3$ 38. $x = 1, 11$ 39. $x = -7$ 40. $x = 1/2$
41. $x = -2, 2$ 42. $x = -3, 3$ 43. $x = 1/4$ 44. No solution
45. No solution 46. $x = 2/3$ 47.



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

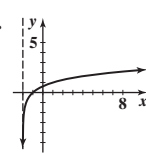
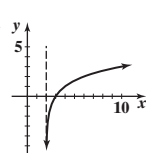


62. (A) (B) 268.8 exabytes per month
63. (A) 10% (B) 1% 64. (A) 62%
(B) 39% 65. (A) $P = 12e^{0.0402x}$
(B) 17.9 million 66. (A) $P = 204e^{0.0077x}$
(B) 229 million 67. (A) $P = 127e^{-0.0016x}$
(B) 124 million
68. (A) $P = 7.4e^{0.0113x}$ (B) 2025: 8.2 billion; 2033: 9.0 billion

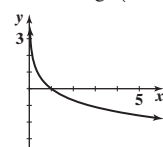
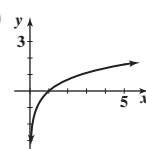
Exercises 2.6

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. $\log_b P - \log_b Q$ 24. $\log_b F + \log_b G$ 25. $5 \log_b L$
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. $x = 4$

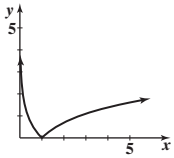
55. 56. 57. The graph of $y = \log_2(x - 2)$ is the graph of $y = \log_2 x$ shifted to the right 2 units.



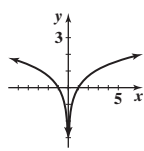
59. Domain: $(-1, \infty)$; range: all real numbers 60. Domain: $(1, \infty)$; range: all real numbers
61. (A) 3.547 43 (B) -2.160 32 (C) 5.626 29
(D) -3.197 04 62. (A) 1.860 96 (B) -1.480 95 (C) 10.603 04
(D) -5.128 36 63. (A) 13.443 1 (B) 0.008 9 (C) 16.059 5 (D) 0.151 4
64. (A) 121.115 6 (B) 0.008 9 (C) 22.956 5 (D) 0.013 2 65. 1.079 2
66. 2.184 7 67. 1.459 5 68. -1.184 5 69. 18.355 9 70. 8.750 7
71. Increasing: $(0, \infty)$ 72. Decreasing: $(0, \infty)$



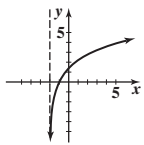
73. Decreasing: $(0, 1]$
Increasing: $[1, \infty)$



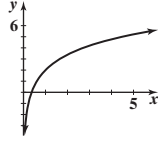
74. Decreasing: $(-\infty, 0)$
Increasing: $(0, \infty)$



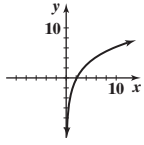
75. Increasing: $(-2, \infty)$



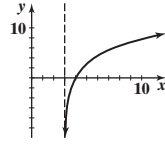
76. Increasing: $(0, \infty)$



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



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

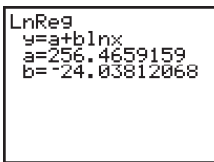


79. Because $b^0 = 1$ for any permissible base b ($b > 0, b \neq 1$).

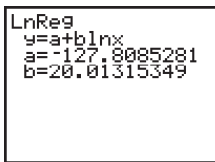
80. Because the function $y = 1^x$ is not one-to-one 81. $x > \sqrt{x} > \ln x$ for $1 < x \leq 16$ 82. $\log x < \sqrt[3]{x} < x$ 83. 4 yr 84. 8 yr 85. 9.87 yr; 9.80 yr

86. 5.17 yr; 5.09 yr 87. 7.51 yr 88. 29.84 yr

89. (A) 5,373



- (B) 7,220

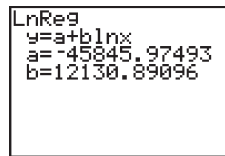
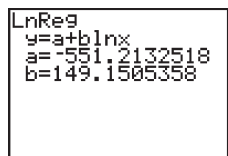


90. Equilibrium price: \$46.77; Equilibrium quantity: 6,145

92. (A) 30 (B) 65 (C) 80 (D) 150

93. 168 bushels/acre

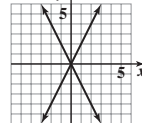
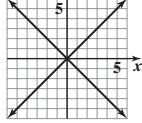
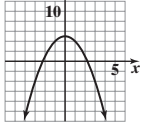
94. 12,628 million bushels



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)

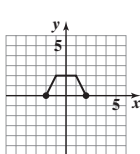
10. $x = 9$ (2.6) 11. $x = 6$ (2.6) 12. $x = 4$ (2.6) 13. $x = 2.157$ (2.6)

14. $x = 13.128$ (2.6) 15. $x = 1,273.503$ (2.6) 16. $x = 0.318$ (2.6)

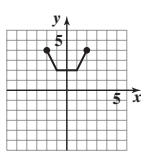
17. (A) $y = 4$ (B) $x = 0$ (C) $y = 1$ (D) $x = -1$ or 1 (E) $y = -2$

- (F) $x = -5$ or 5 (2.1)

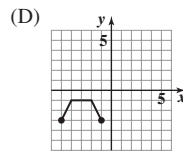
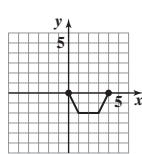
18. (A)



- (B)



- (C)



- (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)

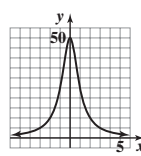
38. $x = 1.4650$ (2.6) 39. $x = 92.1034$ (2.6) 40. $x = 9.0065$ (2.6)

41. $x = 2.1081$ (2.6) 42. (A) All real numbers except $x = -2$ and 3

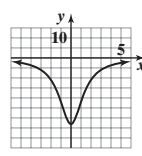
- (B) $x < 5$ (2.1) 43. Vertex form: $4\left(x + \frac{1}{2}\right)^2 - 4$; x intercepts: $-\frac{3}{2}$ and $\frac{1}{2}$;

- 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 $y = |x|$

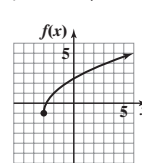
- reflected in the x axis and shifted to the right 4 units. (2.2) 54. The graph of

- 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)



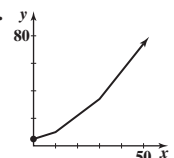
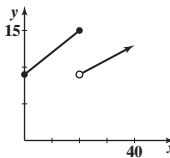
57. $y = 0$ (2.4) 58. $y = \frac{3}{4}$ (2.4) 59. None (2.4)

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)

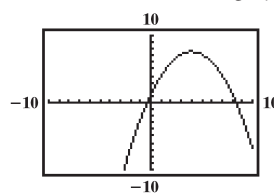


70. $y = -(x-4)^2 + 3$ (2.2, 2.3) 71. $f(x) = -0.4(x-4)^2 + 7.6$

- (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

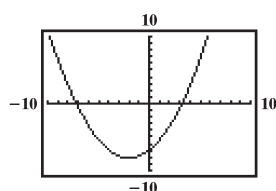
- shifted 1 unit left and 1 unit down. Equation: $y = -2\sqrt[3]{x+1} - 1$. (2.2)

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: $y \geq -8.1$

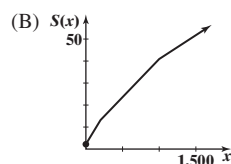
- or $[-8.1, \infty)$ (2.3)

82.



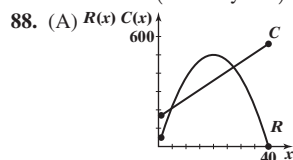
- (A) x intercepts: $-7.2, 3.2$;
 y intercept: -6.9 (B) Vertex:
 $(-2, -8.1)$ (C) Minimum:
 -8.1 (D) Range:
 $y \geq -8.1$ or $[-8.1, \infty)$ (2.3)

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



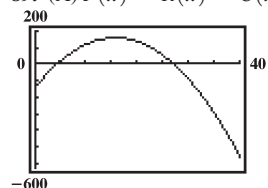
- (2.2) 84. \$5,321.95 (2.5)
 85. \$5,269.51 (2.5)

86. 201 months (≈ 16.7 years) (2.5) 87. 9.38 yr (2.5)



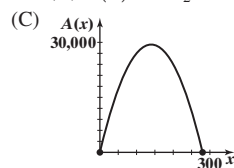
- (B) $R = C$ for $x = 4.686$ thousand units (4,686 units) and for $x = 27.314$ thousand units (27,314 units); $R < C$ for $1 \leq x < 4.686$ or $27.314 < x \leq 40$; $R > C$ for $4.686 < x < 27.314$. (C) Maximum revenue is 500 thousand dollars (\$500,000). This occurs at an output of 20 thousand units (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) 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=a*x^2+b*x+c
a=5.9477212E-6
b=-.1024018814
c=422.3467853
```

(B) 4,836

```
LinReg
y=a*x+b
a=.0387421907
b=-7.364689544
```

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

92. (A)

```
CubicReg
y=a*x^3+b*x^2+c*x+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. $k = 0.00942$; 489 ft (2.6) 95. (A) 6,134,000 (2.6)

```
LnReg
y=a+b*lnx
a=42400.65695
b=-8207.259234
```

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

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