

## Solutions to Selected Exercises

### Chapter 1

#### Section 1.1

1. a.  $f(40) = 13$

b. 2 Tons of garbage per week is produced by a city with a population of 5,000.

3. a. In 1995 there are 30 ducks in the lake

b. In 2000 there are 40 ducks in the lake

5. a, b, d, e

7. a, b

9. a, b, d

11. b

13. b, c, e, f

15.  $f(1) = 1$ ,  $f(3) = 1$ 

17.  $g(2) = 4$ ,  $g(-3) = 2$

19.  $f(3) = 53$ ,  $f(2) = 1$

	$f(-2)$	$f(-1)$	$f(0)$	$f(1)$	$f(2)$
21.	8	6	4	2	0
23.	49	18	3	4	21
25.	4	-1	0	1	-4
27.	4	4.414	4.732	5	5.236
29.	-4	-6	-6	-4	0
31.	5	DNE	-3	-1	-1/3
33.	1/4	1/2	1	2	4

35. a. -6

b. -16

37. a. 5

b.  $-\frac{5}{3}$ 

39. a. iii

b. viii

c. I

d. ii

e. vi

f. iv

g. v

h. vii

41. a. iv

b. ii

c. v

d. I

e. vi

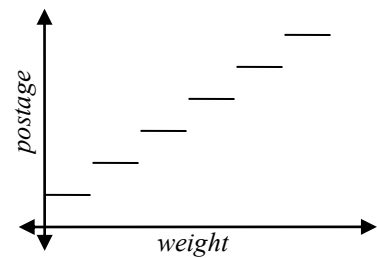
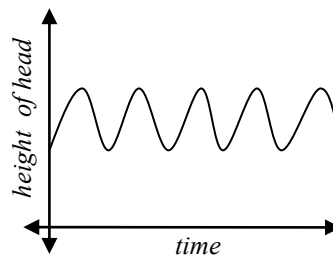
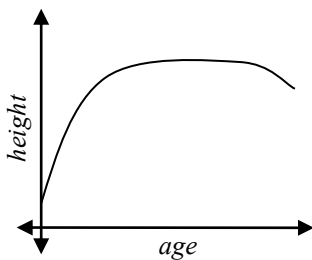
f. iii

43.  $(x-3)^2 + (y+9)^2 = 36$

45. (a)

(b)

(c)

47a.  $t$ b.  $a$ c.  $r$ 

d. L: (c, t) and K: (a, p)

## Section 1.2

1. D:  $[-5, 3)$

R:  $[0, 2]$

3. D:  $2 < t \leq 8$

R:  $6 \leq g(t) < 8$

5. D:  $[0, 4]$

R:  $[-3, 0]$

7.  $[2, \infty)$

9.  $(-\infty, 3]$

11.  $(-\infty, 6) \cup (6, \infty)$

13.  $(-\infty, -\frac{1}{2}) \cup (-\frac{1}{2}, \infty)$

15.  $[-4, 4) \cup (4, \infty)$

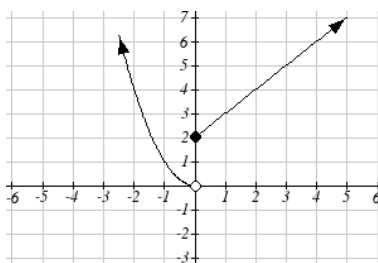
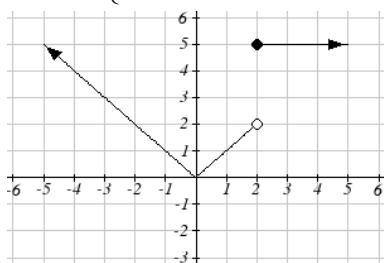
17.  $(-\infty, -11) \cup (-11, 2) \cup (2, \infty)$

	$f(-1)$	$f(0)$	$f(2)$	$f(4)$
19.	-4	6	20	34
21.	-1	-2	7	5
23.	-5	3	3	16

$$25. f(x) = \begin{cases} 2 & \text{if } -6 \leq x \leq -1 \\ -2 & \text{if } -1 < x \leq 2 \\ -4 & \text{if } 2 < x \leq 4 \end{cases}$$

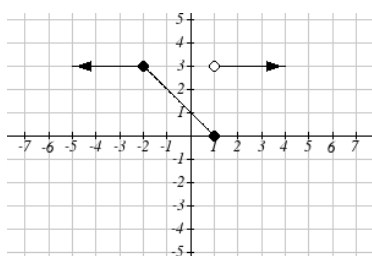
$$27. f(x) = \begin{cases} 3 & \text{if } x \leq 0 \\ x^2 & \text{if } x > 0 \end{cases}$$

$$29. f(x) = \begin{cases} 2x+3 & \text{if } -3 \leq x < -1 \\ x-1 & \text{if } -1 \leq x \leq 2 \\ -2 & \text{if } 2 < x \leq 5 \end{cases}$$



31.

33.



35.

### Section 1.3

1. a) 6 million dollars per year b) 2 million dollars per year

$$3. \frac{4-5}{4-1} = -\frac{1}{3}$$

5. 6

7. 27

$$9. \frac{352}{27}$$

11.  $4b+4$

13. 3

$$15. -\frac{1}{13h+169}$$

$$17. 9+9h+3h^2$$

19.  $4x+2h$

21. Increasing:  $(-1.5, 2)$ . Decreasing:  $(-\infty, -1.5) \cup (2, \infty)$

23. Increasing:  $(-\infty, 1) \cup (3, 4)$ . Decreasing:  $(1, 3) \cup (4, \infty)$

25. Increasing, concave up

27. Decreasing, concave down

29. Decreasing, concave up

31. Increasing, concave down

33. Concave up  $(-\infty, 1)$ . Concave down  $(1, \infty)$ . Inflection point at  $(1, 2)$

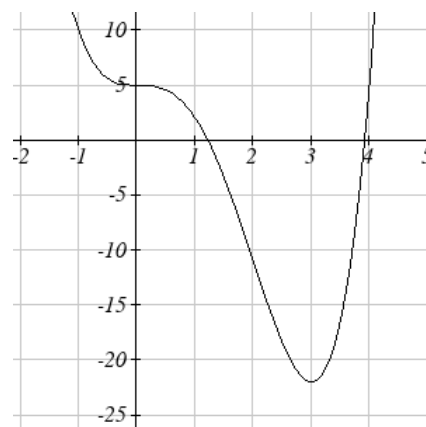
35. Concave down  $(-\infty, 3) \cup (3, \infty)$

37. Local minimum at  $(3, -22)$ .

Inflection points at  $(0, 5)$  and  $(2, -11)$ .

Increasing on  $(3, \infty)$ . Decreasing  $(-\infty, 3)$

Concave up  $(-\infty, 0) \cup (2, \infty)$ . Concave down  $(0, 2)$

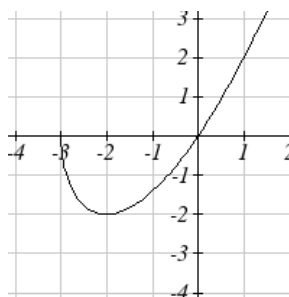


39. Local minimum at  $(-2, -2)$

Decreasing  $(-3, -2)$

Increasing  $(-2, \infty)$

Concave up  $(-3, \infty)$



41. Local minimums at  $(-3.152, -47.626)$

and  $(2.041, -32.041)$

Local maximum at  $(-0.389, 5.979)$

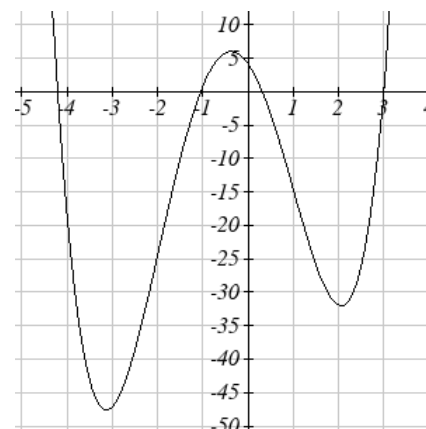
Inflection points at  $(-2, -24)$  and  $(1, -15)$

Increasing  $(-3.152, -0.389) \cup (2.041, \infty)$

Decreasing  $(-\infty, -3.152) \cup (-0.389, 2.041)$

Concave up  $(-\infty, -2) \cup (1, \infty)$

Concave down  $(-2, 1)$



**Section 1.4**

1.  $f(g(0)) = 36$ .  $g(f(0)) = -57$

3.  $f(g(0)) = 4$ .  $g(f(0)) = 4$

5. 4    7. 9    9. 4    11. 7    13. 0    15. 4    17. 3    19. 2

21.  $f(g(x)) = \frac{x}{7}$                        $g(f(x)) = 7x - 36$

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

25.  $f(g(x)) = |5x + 1|$                        $g(f(x)) = 5|x| + 1$

27.  $f(g(h(x))) = (\sqrt{x} - 6)^4 + 6$

29a.  $(0, 2) \cup (2, \infty)$

b.  $(-\infty, -2) \cup (2, \infty)$

c.  $(0, \infty)$

31. b

33a.  $r(V(t)) = \sqrt[3]{\frac{3(10+20t)}{4\pi}}$  b. 208.94

35.  $g(x) = x + 2, f(x) = x^2$

37.  $f(x) = \frac{3}{x}, g(x) = x - 5$

39.  $f(x) = 3 + \sqrt{x}, g(x) = x - 2$ , or  $f(x) = 3 + x, g(x) = \sqrt{x - 2}$

41a.  $f(f(x)) = a(ax + b) + b = (a^2)x + (ab + b)$

b.  $g(x) = \sqrt{6}x - \frac{8}{\sqrt{6} + 1}$  or  $g(x) = -\sqrt{6}x - \frac{8}{1 - \sqrt{6}}$

43a.  $C(f(s)) = \frac{70\left(\frac{s}{60}\right)^2}{10 + \left(\frac{s}{60}\right)^2}$

b.  $C(g(h)) = \frac{70(60h)^2}{10 + (60h)^2}$

c.  $v(C(m)) = \frac{5280}{3600} \left( \frac{70m^2}{10 + m^2} \right)$

**Section 1.5**

1. Horizontal shift right 49 units

3. Horizontal shift left 3 units

5. Vertical shift up 5 units

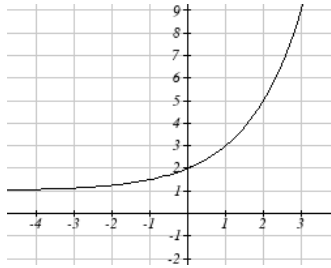
7. Vertical shift down 2 units

9. Horizontal shift right 2 units, Vertical shift up 3 units

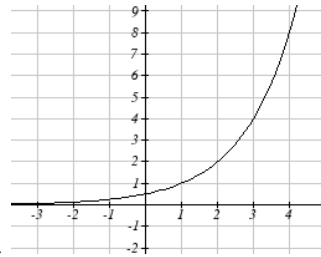
11.  $f(x+2)+1 = \sqrt{x+2} + 1$

13.  $f(x-3)-4 = \frac{1}{x-3} - 4$

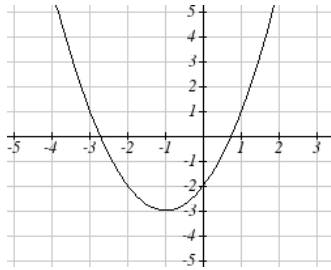
15.  $g(x) = f(x-1)$ ,  $h(x) = f(x)+1$



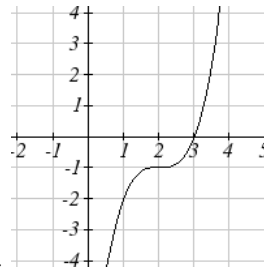
17.



19.



21.

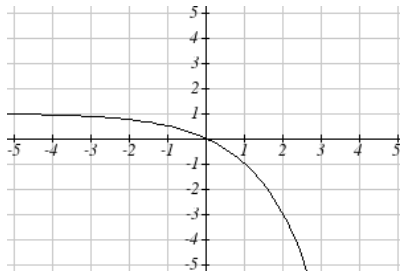


23.

25.  $y = |x-3| - 2$

27.  $y = \sqrt{x+3} - 1$

29.  $y = -\sqrt{x}$



31.

33a.  $-f(-x) = -6^{-x}$

b.  $-f(x+2)-3 = -6^{x+2} - 3$

35.  $y = -(x+1)^2 + 2$

37.  $y = \sqrt{-x} + 1$

39a. Even    b. Neither    c. Odd

41. Reflect  $f(x)$  about the  $x$ -axis43. Vertically stretch  $y$  values by 4

45. Horizontally compress  $x$  values by  $1/5$

47. Horizontally stretch  $x$  values by 3

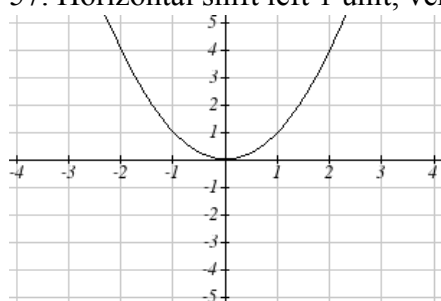
49. Reflect  $f(x)$  about the  $y$ -axis and vertically stretch  $y$  values by 3

51.  $f(-4x) = |-4x|$

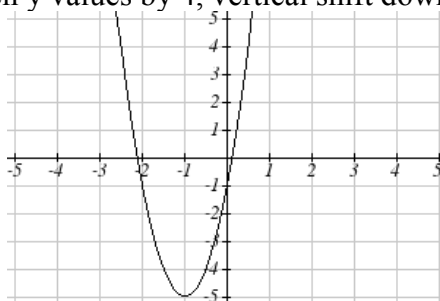
53.  $\frac{1}{3}f(x+2) - 3 = \frac{1}{3(x+2)^2} - 3$

55.  $f(2(x-5)) + 1 = (2(x-5))^2 + 1$

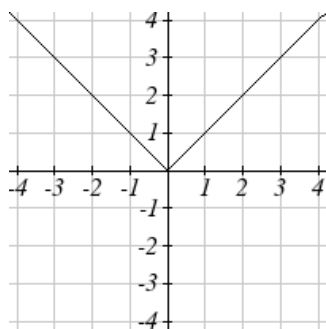
57. Horizontal shift left 1 unit, vertical stretch  $y$  values by 4, vertical shift down 5 units



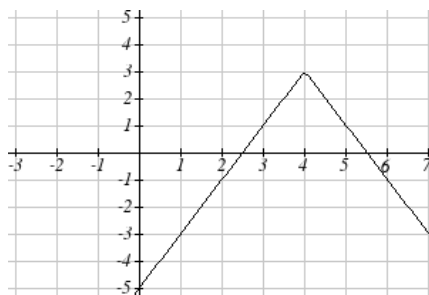
becomes



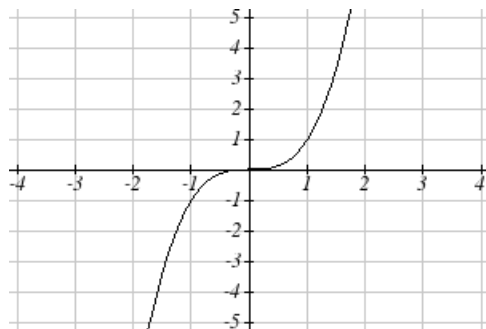
59. Horizontal shift right 4 units, vertical stretch  $y$  values by 2, reflect over  $x$  axis, vertically shift up 3 units.



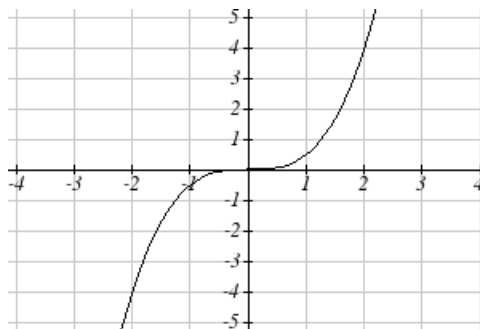
becomes



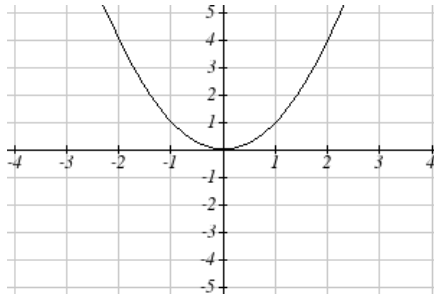
61. Vertically compress  $y$  values by  $1/2$



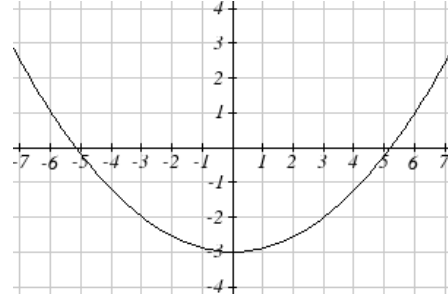
becomes



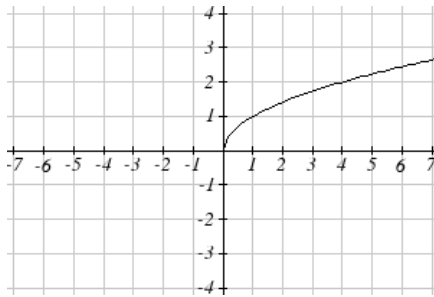
63. Horizontally stretch  $x$  values by 3, vertical shift down 3 units



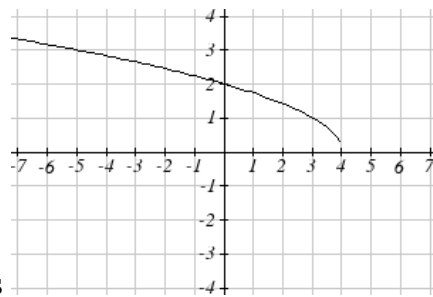
becomes



65. Reflected over the  $y$  axis, horizontally shift right 4 units  $a(x) = \sqrt{-(x-4)}$



becomes



67. This function is increasing on  $(-1, \infty)$  and decreasing on  $(-\infty, -1)$

69. This function is decreasing on  $(-\infty, 4)$

71. This function is concave down on  $(-3, \infty)$  and concave up on  $(-\infty, -3)$

73. This function is concave up everywhere

75.  $f(-x)$

77.  $3f(x)$

79.  $2f(-x)$

81.  $2f\left(\frac{1}{2}x\right)$

83.  $2f(x) - 2$

85.  $-f(x+1) + 3$

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

89.  $y = \left(\frac{1}{2}(x-1)\right)^3 + 2$

91.  $y = \sqrt{2(x+2)} + 1$

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

95.  $y = -2|x+1| + 3$

97.  $y = \sqrt[3]{-\frac{1}{2}(x-2)} + 1$

99a. Domain:  $3.5 \leq x \leq 6$

d. Range:  $-9 \leq y \leq 7$

**Section 1.6**

1. 6            3. -4            5.  $\frac{1}{2}$
- 7a. 3            b. 2            c. 2            d. 3
- 9a. 0            b. 7            c. 1            d. 3
- 11.

$x$	1	4	7	12	16
$f^{-1}(x)$	3	6	9	13	14

13.  $f^{-1}(x) = x - 3$             15.  $f^{-1}(x) = -x + 2$             17.  $f^{-1}(x) = \frac{x-7}{11}$
19. Restricted domain  $x \geq -7$ ,  $f^{-1}(x) = \sqrt{x} - 7$
21. Restricted domain  $x \geq 0$ ,  $f^{-1}(x) = \sqrt{x+5}$
- 23a.  $f(g(x)) = (\sqrt[3]{x+5})^3 - 5 = x$     b.  $g(f(x)) = \sqrt[3]{x^3 - 5 + 5} = x$
- c. This means that they are inverse functions (of each other)

**Chapter 2****Section 2.1**

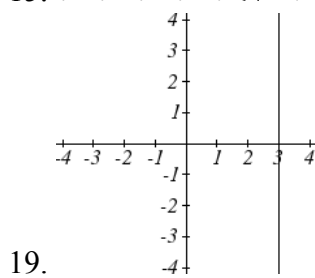
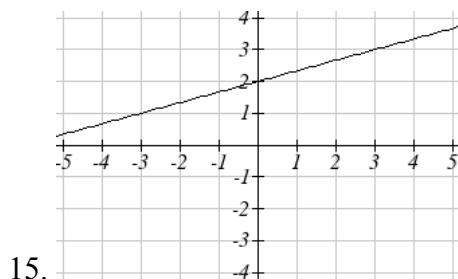
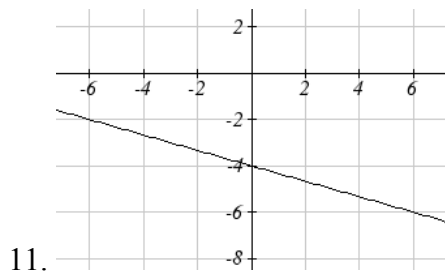
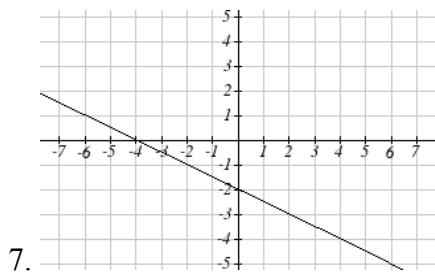
1.  $P(t) = 1700t + 45000$             3.  $D(t) = 10 + 2t$             5.  $M(n) = 40 - 2n$
7. Increasing            9. Decreasing            11. Decreasing
13. Increasing            15. Decreasing            17. 3
19.  $-\frac{1}{3}$             21.  $\frac{4}{5}$             23.  $\frac{2}{3}$
25. -0.05 mph (or 0.05 miles per hour toward her home)
27. Population is decreasing by 400 people per year
29. Monthly charge in dollars has an initial base charge of \$24, and increases by \$0.10 for each minute talked
31. Terry started at an elevation of 3,000 ft and is descending by 70ft per second.
33.  $y = \frac{3}{5}x - 1$             35.  $y = 3x - 2$             37.  $y = -\frac{1}{3}x + \frac{11}{3}$



39.  $y = -1.5x - 3$                       41.  $y = \frac{2}{3}x + 1$                       43.  $y = -2x + 3$
45.  $P(n) = -0.004n + 34$
47. The 1<sup>st</sup>, 3<sup>rd</sup> & 4<sup>th</sup> tables are linear: respectively
1.  $g(x) = -3x + 5$                       3.  $f(x) = 5x - 5$                       4.  $k(x) = 3x - 2$
- 49a.  $C = \frac{5}{9}F - \frac{160}{9}$                       b.  $F = \frac{9}{5}C + 32$                       c.  $-9.4^\circ F$

**Section 2.2**

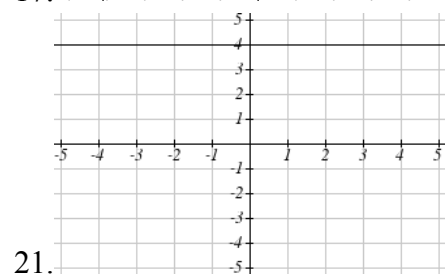
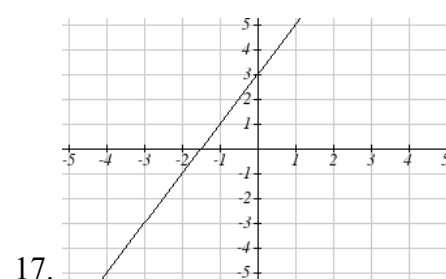
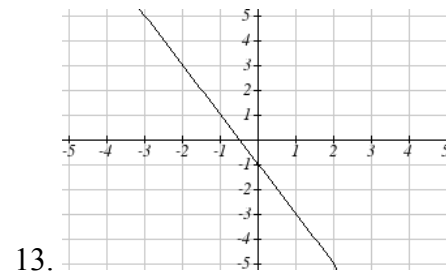
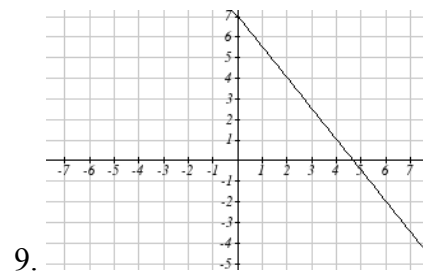
1. E



23. a.  $g(x) = \frac{3}{4}(x+2) - 4$     b.  $\frac{3}{4}$     c.  $-5/2$

25.  $y = 3$

3. D



5. B

27.  $x = -3$

	Vertical Intercept	Horizontal Intercept
29.	(0,2)	(2,0)
31.	(0,-5)	(5/3, 0)
33.	(0,4)	(-10,0)

35. Line 1:  $m = -10$

Line 2:  $m = -10$

Parallel

37. Line 1:  $m = -2$

Line 2:  $m = 1$

Neither

39. Line 1:  $m = -\frac{2}{3}$

Line 2:  $m = \frac{3}{2}$

Perpendicular

41.  $y = -5x - 2$

43.  $y = \frac{1}{2}t + 1$

45. (-1,1)

47. (1.2, 10)

49. Plan B saves money if the miles are  $> 111\frac{1}{9}$

**Section 2.3**

1a. 696 people

b. 4 years

c. 174 people per year

d. 305 people

e.  $P(t) = 305 + 174t$

f. 2219 people.

3a.  $C(x) = 0.15x + 10$

b. The flat monthly fee is \$10 and there is an additional \$0.15 fee for each additional minute used

c. \$113.05

5a.  $P(t) = 190t + 4170$

b. 6640 moose

7a.  $R(t) = 16 - 2.1t$

b. 5.5 billion cubic feet

c. During the year 2017

9. More than 133 minutes

11. More than \$42,857.14 worth of jewelry

13. 20.012 square units

15. 6 square units

17.  $A = -\frac{b^2}{2m}$

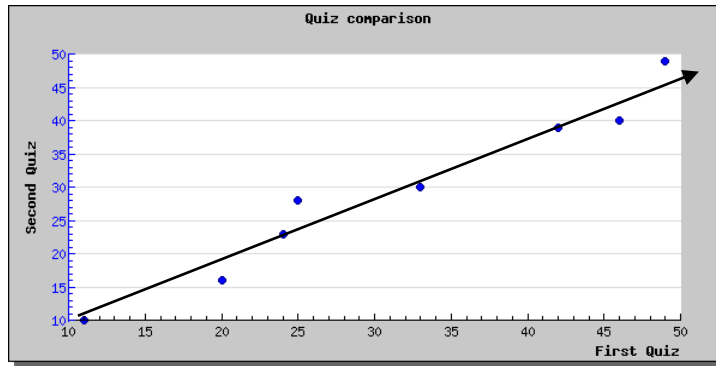
19a. Hawaii

b. \$80,640

c. During the year 1933

21. 26.225 miles

## Section 2.4



1.

[http://www.mathcracker.com/scatter\\_plot.php](http://www.mathcracker.com/scatter_plot.php)

3.  $y = 1.971x - 3.519$ ,  $r = 0.967$

5.  $y = -0.901x + 26.04$ ,  $r = -0.968$

7.  $17.483 \approx 17$  situps

9. D

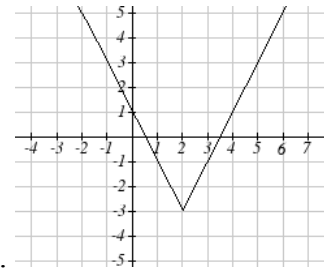
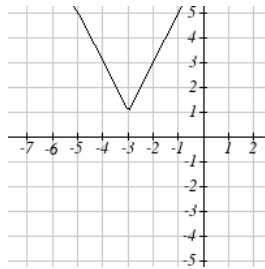
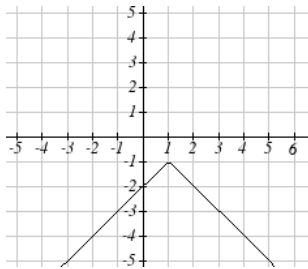
11. A

13. Yes, trend appears linear because  $r = 0.994$  and will exceed 35% near the end of the year 2019.

## Section 2.5

1.  $y = \frac{1}{2}|x+2|+1$

3.  $y = -3|x-3|+3$



5.

7.

9.

11.  $x = -\frac{9}{5}$  or  $x = \frac{13}{5}$

13.  $x = \frac{1}{2}$  or  $x = \frac{15}{2}$

15.  $x = -\frac{5}{3}$  or  $x = -\frac{1}{3}$

	Horizontal Intercepts	Vertical Intercept
17.	$(-6, 0)$ and $(4, 0)$	$(0, -8)$
19.	none	$(0, -7)$

21.  $-11 < x < 1$  or  $(-11, 1)$

23.  $x \geq 5$ ,  $x \leq -1$  or  $(-\infty, -1] \cup [5, \infty)$

25.  $-\frac{13}{3} < x < -\frac{5}{3}$  or  $(-\frac{13}{3}, -\frac{5}{3})$

## Chapter 3

### Section 3.1

1. As  $x \rightarrow \infty, f(x) \rightarrow \infty$       As  $x \rightarrow -\infty, f(x) \rightarrow \infty$
3. As  $x \rightarrow \infty, f(x) \rightarrow \infty$       As  $x \rightarrow -\infty, f(x) \rightarrow -\infty$
5. As  $x \rightarrow \infty, f(x) \rightarrow -\infty$       As  $x \rightarrow -\infty, f(x) \rightarrow -\infty$
7. As  $x \rightarrow \infty, f(x) \rightarrow -\infty$       As  $x \rightarrow -\infty, f(x) \rightarrow \infty$
9. 7<sup>th</sup> Degree, Leading coefficient 4
11. 2<sup>nd</sup> Degree, Leading coefficient -1
13. 4<sup>th</sup> Degree, Leading coefficient -2
15. 3<sup>rd</sup> Degree, Leading coefficient 6
17. As  $x \rightarrow \infty, f(x) \rightarrow -\infty$       As  $x \rightarrow -\infty, f(x) \rightarrow -\infty$
19. As  $x \rightarrow \infty, f(x) \rightarrow \infty$       As  $x \rightarrow -\infty, f(x) \rightarrow \infty$
21. intercepts: 5, turning points: 4      23. 3
25. 5      27. 3      29. 5
31. Horizontal Intercepts (1,0), (-2, 0), (3, 0)      Vertical Intercept (0, 12)
33. Horizontal Intercepts (1/3, 0) (-1/2, 0)      Vertical Intercept (0, 2)

### Section 3.2

1.  $f(x) = (x-2)^2 - 3$
3.  $f(x) = -2(x-2)^2 + 7$
5.  $f(x) = \frac{1}{2}(x-3)^2 - 1$

	Vertex	Vertical Intercept	Horizontal Intercepts
7.	(-2.5, -0.5)	(0,12)	(-2, 0)    (-3, 0)
9.	(2.5, -8.5)	(0,4)	(0.438, 0)    (4.562,0)
11.	(0.75,1.25)	(0,-1)	(0.191, 0)    (1.309, 0)

13.  $f(x) = (x-6)^2 - 4$
15.  $f(x) = 2(x+2)^2 - 18$
17.  $b = 32$  and  $c = -39$
19.  $f(x) = -\frac{2}{3}(x+3)(x-1)$
21.  $f(x) = \frac{3}{5}(x-2)(x-5)$
23.  $f(x) = -\frac{1}{4}(x-4)^2$
25.  $f(x) = -\frac{1}{9}(x+3)^2 + 2$
- 27a. 234m      b. 2909.561 ft      c. 47.735 seconds
- 29a. 3 ft      b. 111 ft      c. 72.497 ft
31. 24.91 in by 24.91 in
33. 125 ft by  $83\frac{1}{3}$  ft
35. 24.6344 cm
37. \$10.70

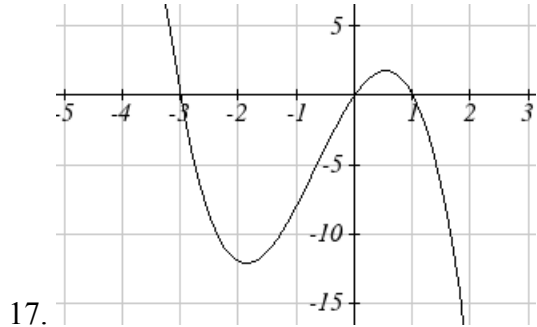
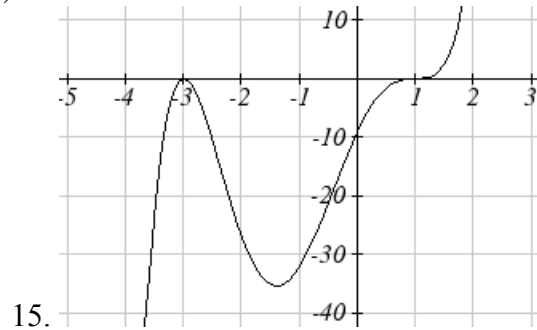
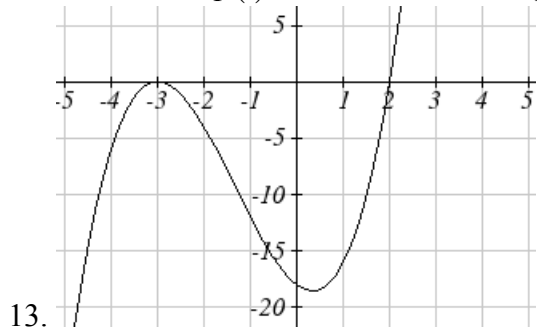
## Section 3.3

$C(t)$	$C$ , intercepts	$t$ , intercepts
1.	(0,48)	(4,0), (-1,0), (6,0)
3.	(0,0)	(0,0), (2,0), (-1,0)
5.	(0,0)	(0,0), (1,0), (3,0)

7. (-1.646, 0) (3.646, 0) (5,0)

9. As  $t \rightarrow \infty$ ,  $h(t) \rightarrow \infty$      $t \rightarrow -\infty$ ,  $h(t) \rightarrow -\infty$

11. As  $t \rightarrow \infty$ ,  $p(t) \rightarrow -\infty$      $t \rightarrow -\infty$ ,  $p(t) \rightarrow -\infty$



19.  $(3, \infty)$

23.  $[3.5, 6]$

27.  $[-2, -2] \cup [3, \infty)$

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

35.  $y = -15(x-1)^2(x-3)^3$

39.  $y = -(x+1)^2(x-2)$

43.  $y = \frac{1}{24}(x+4)(x+2)(x-3)^2$

47.  $y = \frac{1}{6}(x+3)(x+2)(x-1)^3$

51. Base 2.58, Height 3.336

21.  $(-\infty, -2) \cup (1, 3)$

25.  $(-\infty, 1] \cup [4, \infty)$

29.  $(-\infty, -4) \cup (-4, 2) \cup (2, \infty)$

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

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

41.  $y = -\frac{1}{24}(x+3)(x+2)(x-2)(x-4)$

45.  $y = \frac{1}{12}(x+2)^2(x-3)^2$

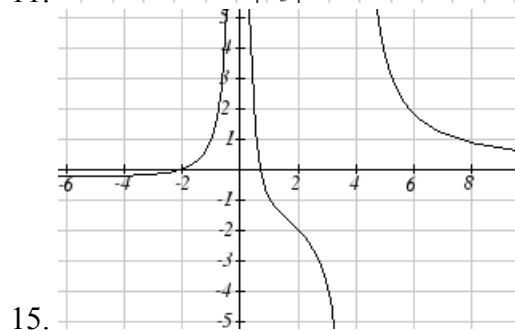
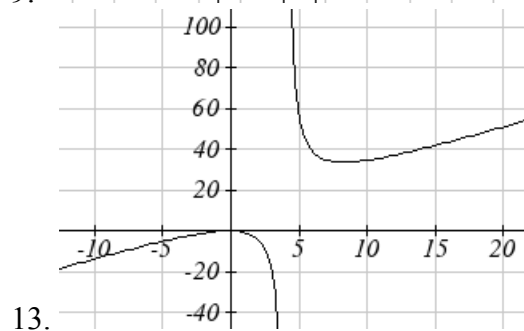
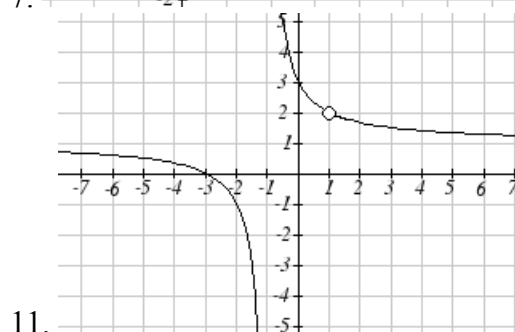
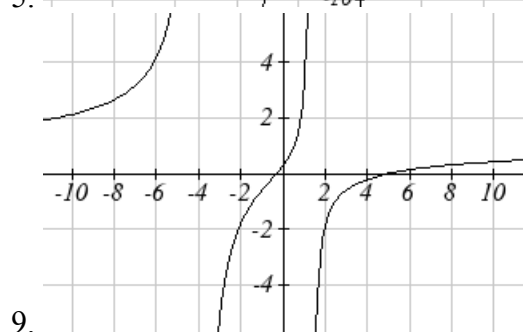
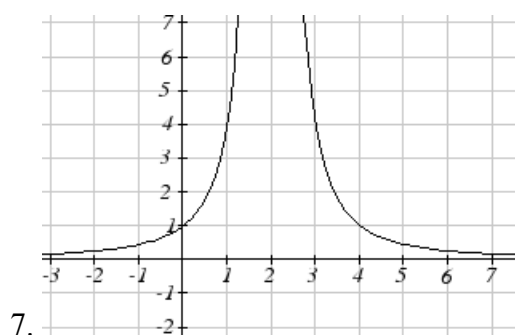
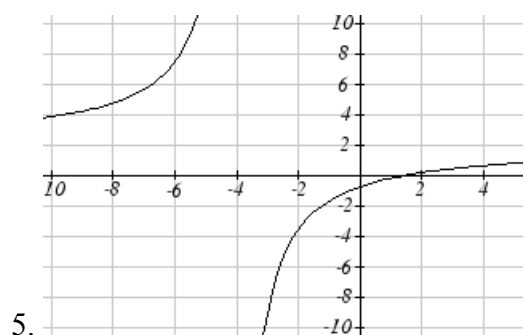
49.  $y = -\frac{1}{16}(x+3)(x+1)(x-2)^2(x-4)$

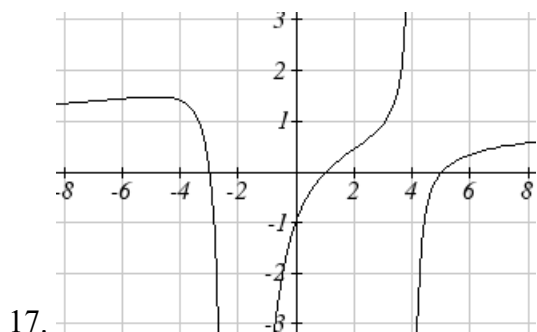
## Section 3.4

1. D

3. A

	Vertical Asymptotes	Horizontal Asymptote	Vertical y-Intercept	Horizontal x-intercept
5.	$x = -4$	$y = 2$	$(0, -3/4)$	$(3/2, 0)$
7.	$x = 2$	$y = 0$	$(0, 1)$	DNE
9.	$x = -4, 1\frac{1}{3}$	$y = 1$	$(0, 5/16)$	$(-1/3, 0), (5, 0)$
11.	$x = -1$ , hole at $x = 1$	$y = 1$	$(0, 3)$	$(-3, 0)$
13.	$x = 4$	none $y = 2x$ (oblique)	$(0, 1/4)$	$(-1, 0), (1/2, 0)$
15.	$x = 0, 4$	$y = 0$	DNE	$(-2, 0), (2/3, 0)$
17.	$x = -2, 4$	$y = 1$	$(0, -15/16)$	$(1, 0), (-3, 0), (5, 0)$





19.  $y = \frac{50(x-2)(x+1)}{(x+5)(x-5)}$

21.  $y = \frac{7(x-4)(x+6)}{(x+4)(x+5)}$

23.  $y = \frac{1(x-2)^2}{2(x+1)}$

25.  $y = \frac{4(x-3)}{(x+3)(x-4)}$

27.  $y = \frac{27(x-2)}{(x+3)(x-3)^2}$

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

31.  $y = \frac{-6(x-1)^2}{(x+3)(x-2)^2}$

33.  $y = -\frac{2(x)(x-3)}{(x+3)(x-4)}$

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

37.  $y = \frac{(x-4)(x-2)}{(x-4)(x+1)}$

39. a.  $C(n) = \frac{4}{20+n}$  b.  $C(10) \approx 13.33\%$  c. 80 mL d. as  $n \rightarrow \infty, C \rightarrow 0$

### Section 3.5

1. Domain  $(4, \infty)$  Inverse  $f^{-1}(x) = \sqrt{x} + 4$

3. Domain  $(-\infty, 0)$  Inverse  $f^{-1}(x) = -\sqrt{12-x}$

5. Domain  $(-\infty, \infty)$  Inverse  $f^{-1}(x) = \sqrt[3]{\frac{x-1}{3}}$

7.  $f^{-1}(x) = \frac{(x-9)^2}{4} + 1$

9.  $f^{-1}(x) = \left(\frac{x-9}{2}\right)^3$

11.  $f^{-1}(x) = \frac{2-8x}{x}$

13.  $f^{-1}(x) = \frac{3-7x}{x-1}$

15.  $f^{-1}(x) = \frac{5x-4}{3+4x}$

17. 65.574 mph

19. 34.073 mph

21. 14.142 feet

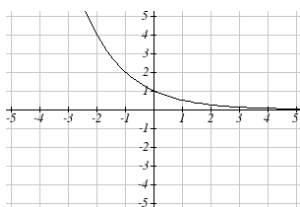
## Chapter 4

### Section 4.1

1. Linear  
 7.  $P(t) = 11,000(1.085)^t$   
 11. \$17561.70  
 17.  $y = 3(2)^x$   
 23. 34.32 mg  
 29. Annual  $\approx$  \$7353.84  
     Continuously  $\approx$  \$7,510.44  
 31. 3.03%  
 35a.  $w(t) = (1.113)(1.046)^t$
3. Exponential  
 9. 47622 Fox  
 13.  $y = 6(5)^x$   
 19.  $y = \left(\frac{1}{6}\right)^{-\frac{3}{5}} \left(\frac{1}{6}\right)^{\frac{x}{5}} = 2.93(0.699)^x$   
 25. 1.39%; \$155,368.09  
     Quarterly  $\approx$  \$7,469.63  
 33. 7.4 years  
 b. \$1.11      c. Below what the model predicts  $\approx$  \$5.70
5. Neither  
 15.  $y = 2000(0.1)^x$   
 21.  $y = \frac{1}{8}(2)^x$   
 27. \$4,813.55  
 Monthly  $\approx$  \$7,496.71

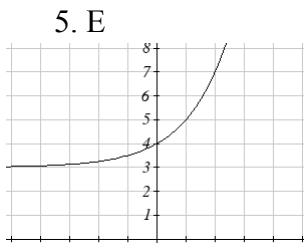
### Section 4.2

1. B



11.

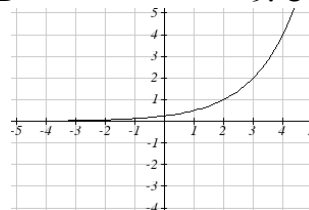
3. A



13.

5. E

7. D



15.

9. C

17.  $y = 4^x + 4$

19.  $y = 4^{x+2}$

21.  $y = -4^x$

23. As  $x \rightarrow \infty$   $f(x) \rightarrow -\infty$ . As  $x \rightarrow -\infty$   $f(x) \rightarrow -1$

25. As  $x \rightarrow \infty$   $f(x) \rightarrow -2$  As  $x \rightarrow -\infty$   $f(x) \rightarrow \infty$

27. As  $x \rightarrow \infty$   $f(x) \rightarrow 2$  As  $x \rightarrow -\infty$   $f(x) \rightarrow \infty$

29.  $y = -2^{x+2} + 1 = -4(2)^x + 1$       31.  $y = -2(2)^{-x} + 3$

33.  $y = -2(3)^x + 7$       35.  $y = 2\left(\frac{1}{2}\right)^x - 4$

### Section 4.3

1.  $4^m = q$

3.  $a^c = b$

5.  $10^t = v$

7.  $e^n = w$

9.  $\log_4(y) = x$

11.  $\log_c(k) = d$

13.  $\log(b) = a$

15.  $\ln(h) = k$

17. 9

19. 1/8

21. 1000

23.  $e^2$

25. 2

27. -3

29.  $\frac{1}{2}$



31. 4

37. -1.398

43.  $\frac{\log\left(\frac{1}{15}\right)}{\log(7)} \approx -1.392$

49.  $\frac{\log(5)}{\log(1.03)} \approx 54.449$

55.  $\frac{\log\left(\frac{5}{8}\right)}{\log\left(\frac{1}{2}\right)} \approx 0.678$

61.  $f(t) = 150(1.0618)^t$

67. During the year 2074

33. -3

39. 2.708

45.  $\frac{\ln(17)}{5} \approx 0.567$

51.  $\frac{\log\left(\frac{8}{3}\right)}{3\log(1.04)} \approx 8.335$

57.  $f(t) = 300e^{-0.0943t}$

63.  $f(t) = 50(0.98807)^t$

69.  $\approx 34$  hours

35. -2

41.  $\frac{\log(14)}{\log(5)} \approx 1.6397$

47.  $\frac{\frac{\log(38)}{\log(3)} + 5}{4} \approx 2.078$

53.  $\frac{\ln\left(\frac{1}{5}\right)}{-0.12} \approx 13.412$

59.  $f(t) = 10e^{0.03922t}$

65. During the year 2013

71. 13.532 years

**Section 4.4**

1.  $\log_3(4)$     3.  $\log_3(7)$     5.  $\log_3(5)$     7.  $\log_7(2)$     9.  $\log(6x^9)$

11.  $\ln(2x^7)$     13.  $\log(x^2(x+1)^3)$     15.  $\log\left(\frac{xz^3}{\sqrt{y}}\right)$

17.  $15\log(x) + 13\log(y) - 19\log(z)$     19.  $-2\ln(a) + 4\ln(b) - 5\ln(c)$

21.  $\frac{3}{2}\log(x) - 2\log(y)$     23.  $\ln(y) + \frac{1}{2}(\ln(y) - \ln(1-y))$

25.  $\frac{8}{3}\log(x) + \frac{14}{3}\log(y)$

27.  $x \approx -0.717$

29.  $x \approx -6.395$

31.  $t \approx 17.329$

33.  $x = \frac{2}{7}$

35.  $x \approx 0.123$

37.  $x \approx 4.642$

39.  $x \approx 30.158$

41.  $x \approx -2.889$

43.  $x \approx 6.873$  or  $x \approx -0.873$

45.  $x = \frac{12}{11} \approx 1.091$

47.  $x = 10$

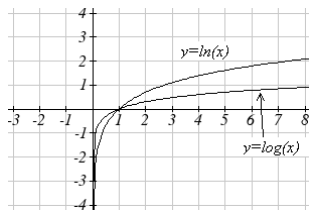
**Section 4.5**

1. Domain:  $x > 5$     V.A. @  $x = 5$

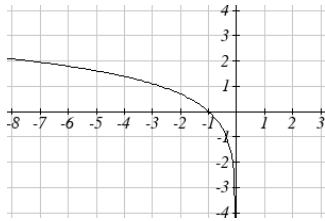
3. Domain:  $x < 3$     V.A. @  $x = 3$

5. Domain:  $x > -\frac{1}{3}$     V.A. @  $x = -\frac{1}{3}$

7. Domain:  $x < 0$     V.A. @  $x = 0$



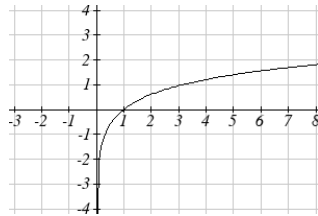
9.



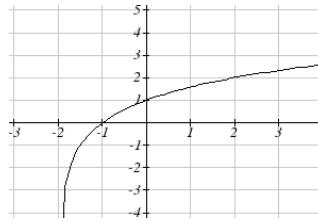
13.

$$17. y = \frac{1}{\log(2)} \log(-(x-1))$$

$$21. y = \frac{3}{\log(4)} \log(x+2)$$



11.



15.

$$19. y = -\frac{3}{\log(3)} \log(x+4)$$

$$23. y = -\frac{2}{\log(5)} \log(-(x-5))$$

## Section 4.6

1.  $f(t) = 13(0.9195)^t$ . 2 mg will remain after 22.3098 minutes

3.  $f(t) = 200(0.999564)^t$ .  $f(1000) = 129.3311$  mg

5.  $r = -0.06448$ . Initial mass: 9.9018 mg. After 3 days: 0.01648 mg

7.  $f(t) = 250(0.9909)^t$ . Half-life = 75.8653 minutes

9.  $f(t) = a(0.999879)^t$ . 60% ( $0.60a$ ) would remain after 4222.813 years

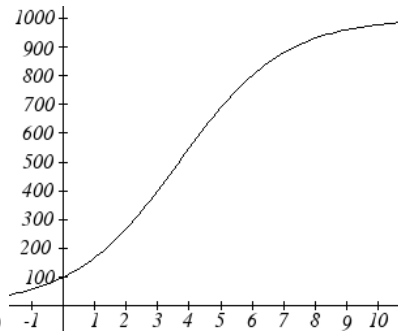
11.  $P(t) = 1500(1.02337)^t$  ( $t$  in minutes). After 2 hours = 24000. After 100 minutes = 15119

13. a) 610.5143 (about 611) b) 25.6427 minutes c) 10431.21 d) 106.9642 minutes

15. 23.1914 years

17. 53.319 hours

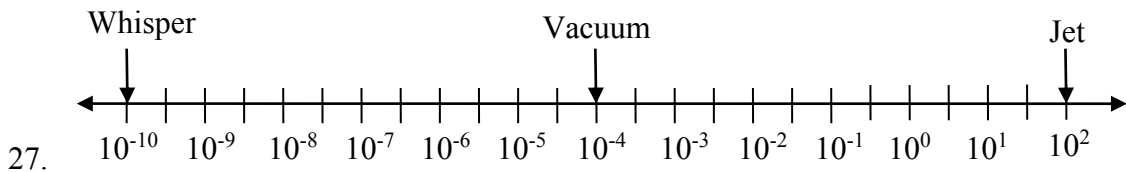
19.  $T(t) = 90(0.99166)^t + 75$ . a) 134.212 deg b) 112.743 minutes



21. a)  $-1$  |  $1$  |  $2$  |  $3$  |  $4$  |  $5$  |  $6$  |  $7$  |  $8$  |  $9$  |  $10$  b) 100 c) 269.487 d) 7.324 years

23.  $\log(x) = -0.5$ .  $x = 0.3162$

25.  $\log(x) = 1.5$ .  $x = 31.623$



27.

29. 63095.7 times more intense

31. MMS magnitude 5.817

33. a) about 1640671 b) 1.4 hours c) No, because  $(2.042727)^{0.693147} \approx e^{0.495105}$

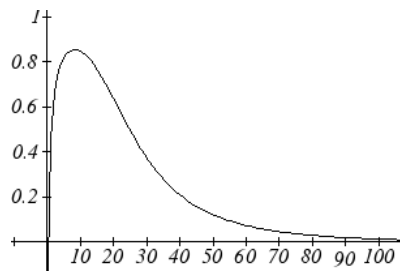
d) Anja's data predicts a continuous growth rate of 0.4116, which is much smaller than the rate 0.495105 you calculated. Our model would overestimate the number of cells.

35. a) The curve that increases rapidly at first is  $M(p)$

b)  $H(100) = 0.9775$

c) Myoglobin:  $M(20) = 0.9524$ . Hemoglobin:  $H(20) = 0.3242$

d) At 20 torrs: 0.6282. At 40 torrs: 0.2060. At 60 torrs: 0.0714



Efficiency seems to be maximized at about 8 torr

37. a)  $C(t) = 1.03526^t$ , or  $C(t) = e^{0.03466t}$

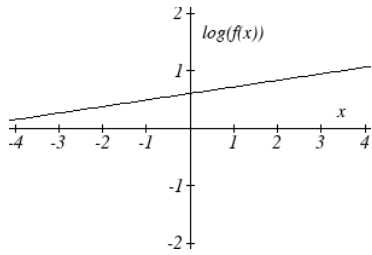
b) Volume of one cell:  $\frac{4}{3}\pi(50 \times 10^{-4})^3 \approx 5.236 \times 10^{-7} \text{ cm}^3$ , so will need about

$1.9099 \times 10^6$  cells for a volume of  $1 \text{ cm}^3$ .  $C(t) = 1.9099 \times 10^6$  after 417.3 hours

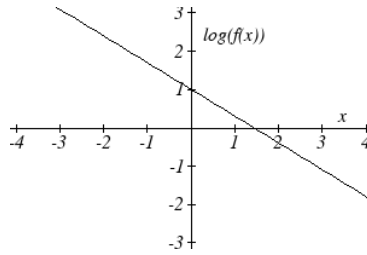
39. 31.699 days

**Section 4.7**

1.  $\log(f(x)) = \log(1.3)x + \log(4)$



3.  $\log(f(x)) = \log(0.2)x + 1$



5.  $y = e^{\frac{1}{2}x-1} = e^{-1}e^{\frac{1}{2}x} \approx 0.368(1.6487)^x$

7.  $y = 10^{-x-2} = 10^{-2}10^{-1x} = 0.01(0.1)^x$

9.  $y = 776.682(1.426)^x$

11.  $y = 731.92(0.738)^x$

13. Expenditures are approximately \$205

15.  $y = 7.599(1.016)^x$ ,  $r = 0.83064$ ,  $y = 0.1493x + 7.4893$ ,  $r = 0.81713$ . Using the

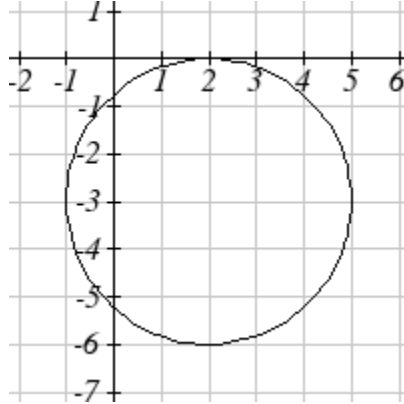
better function, we predict electricity will be 11.157 cents per kwh

## Chapter 5

### Section 5.1

1. 10

5.  $(x-7)^2 + (y+2)^2 = 293$



9.

11.  $(0, 3 + \sqrt{5})$  and  $(0, 3 - \sqrt{5})$

15.  $(-1.07335, 2.8533)$

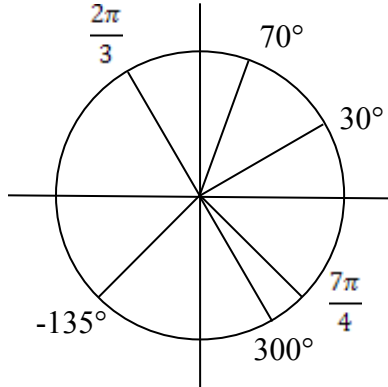
3.  $(x-8)^2 + (y+10)^2 = 8^2$

7.  $(x-5)^2 + (y-8)^2 = 13$

13.  $(1.3416407865, 7.683281573)$

17. 29.87 miles

### Section 5.2



1.

3.  $\pi$

9.  $54^\circ$

15. 35 miles

21.  $28.6479^\circ$

25. 3960 rad/min 630.254 RPM

27. 2.094 in/sec,  $\pi/12$  rad/sec, 2.5 RPM

29. 75,398.22 mm/min = 1.257 m/sec

31. Angular speed:  $\pi/12$  rad/hr. Linear speed: 1036.73 miles/hr

5.  $150^\circ$

11.  $\frac{8\pi}{9}$

17.  $8\pi$  cm

23.  $14.1372 \text{ cm}^2$

7.  $325^\circ$

13.  $\frac{\pi}{2}$

19. 5.7596 miles

## Section 5.3

1. a. III b. II

3.  $-\frac{4}{5}$

5.  $-\frac{4\sqrt{3}}{7}$

7.  $-\frac{\sqrt{55}}{8}$

9. a. reference:  $45^\circ$ . Quadrant III.  $\sin(225^\circ) = -\frac{\sqrt{2}}{2}$ .  $\cos(225^\circ) = -\frac{\sqrt{2}}{2}$

b. reference:  $60^\circ$ . Quadrant IV.  $\sin(300^\circ) = -\frac{\sqrt{3}}{2}$ .  $\cos(300^\circ) = \frac{1}{2}$

c. reference:  $45^\circ$ . Quadrant II.  $\sin(135^\circ) = \frac{\sqrt{2}}{2}$ .  $\cos(135^\circ) = -\frac{\sqrt{2}}{2}$

d. reference:  $30^\circ$ . Quadrant III.  $\sin(210^\circ) = -\frac{1}{2}$ .  $\cos(210^\circ) = -\frac{\sqrt{3}}{2}$

11. a. reference:  $\frac{\pi}{4}$ . Quadrant III.  $\sin\left(\frac{5\pi}{4}\right) = -\frac{\sqrt{2}}{2}$ .  $\cos\left(\frac{5\pi}{4}\right) = -\frac{\sqrt{2}}{2}$

b. reference:  $\frac{\pi}{6}$ . Quadrant III.  $\sin\left(\frac{7\pi}{6}\right) = -\frac{1}{2}$ .  $\cos\left(\frac{7\pi}{6}\right) = -\frac{\sqrt{3}}{2}$

c. reference:  $\frac{\pi}{3}$ . Quadrant IV.  $\sin\left(\frac{5\pi}{3}\right) = -\frac{\sqrt{3}}{2}$ .  $\cos\left(\frac{5\pi}{3}\right) = \frac{1}{2}$

d. reference:  $\frac{\pi}{4}$ . Quadrant II.  $\sin\left(\frac{3\pi}{4}\right) = \frac{\sqrt{2}}{2}$ .  $\cos\left(\frac{3\pi}{4}\right) = -\frac{\sqrt{2}}{2}$

13. a.  $\sin\left(-\frac{3\pi}{4}\right) = -\frac{\sqrt{2}}{2}$   $\cos\left(-\frac{3\pi}{4}\right) = -\frac{\sqrt{2}}{2}$

b.  $\sin\left(\frac{23\pi}{6}\right) = -\frac{1}{2}$   $\cos\left(\frac{23\pi}{6}\right) = \frac{\sqrt{3}}{2}$

c.  $\sin\left(-\frac{\pi}{2}\right) = -1$   $\cos\left(-\frac{\pi}{2}\right) = 0$

d.  $\sin(5\pi) = 0$   $\cos(5\pi) = -1$

15. a.  $\frac{2\pi}{3}$  b.  $100^\circ$  c.  $40^\circ$  d.  $\frac{5\pi}{3}$  e.  $235^\circ$

17. a.  $\frac{5\pi}{3}$  b.  $280^\circ$  c.  $220^\circ$  d.  $\frac{2\pi}{3}$  e.  $55^\circ$

19.  $(-11.491, -9.642)$

**Section 5.4**

1.  $\sec(\theta) = \sqrt{2}$ ,  $\csc(\theta) = \sqrt{2}$ ,  $\tan(\theta) = 1$ ,  $\cot(\theta) = 1$
3.  $\sec(\theta) = -\frac{2\sqrt{3}}{3}$ ,  $\csc(\theta) = 2$ ,  $\tan(\theta) = -\frac{\sqrt{3}}{3}$ ,  $\cot(\theta) = -\sqrt{3}$
5.  $\sec(\theta) = -2$ ,  $\csc(\theta) = \frac{2\sqrt{3}}{3}$ ,  $\tan(\theta) = -\sqrt{3}$ ,  $\cot(\theta) = -\frac{\sqrt{3}}{3}$
7. a.  $\sec(135^\circ) = -\sqrt{2}$    b.  $\csc(210^\circ) = -2$    c.  $\tan(60^\circ) = \sqrt{3}$    d.  $\cot(225^\circ) = 1$
9.  $\cos(\theta) = -\frac{\sqrt{7}}{4}$ ,  $\sec(\theta) = -\frac{4\sqrt{7}}{7}$ ,  $\csc(\theta) = \frac{4}{3}$ ,  $\tan(\theta) = -\frac{3\sqrt{7}}{7}$ ,  $\cot(\theta) = -\frac{\sqrt{7}}{3}$
11.  $\sin(\theta) = -\frac{2\sqrt{2}}{3}$ ,  $\csc(\theta) = -\frac{3\sqrt{2}}{4}$ ,  $\sec(\theta) = -3$ ,  $\tan(\theta) = 2\sqrt{2}$ ,  $\cot(\theta) = \frac{\sqrt{2}}{4}$
13.  $\sin(\theta) = \frac{12}{13}$ ,  $\cos(\theta) = \frac{5}{13}$ ,  $\sec(\theta) = \frac{13}{5}$ ,  $\csc(\theta) = \frac{13}{12}$ ,  $\cot(\theta) = \frac{5}{12}$
15. a.  $\sin(0.15) = 0.1494$     $\cos(0.15) = 0.9888$     $\tan(0.15) = 0.1511$   
       b.  $\sin(4) = -0.7568$     $\cos(4) = -0.6536$     $\tan(4) = 1.1578$   
       c.  $\sin(70^\circ) = 0.9397$     $\cos(70^\circ) = 0.3420$     $\tan(70^\circ) = 2.7475$   
       d.  $\sin(283^\circ) = -0.9744$     $\cos(283^\circ) = 0.2250$     $\tan(283^\circ) = -4.3315$
17.  $\sec(t)$    19.  $\tan(t)$    21.  $\tan(t)$    23.  $\cot(t)$    25.  $(\sec(t))^2$

**Section 5.5**

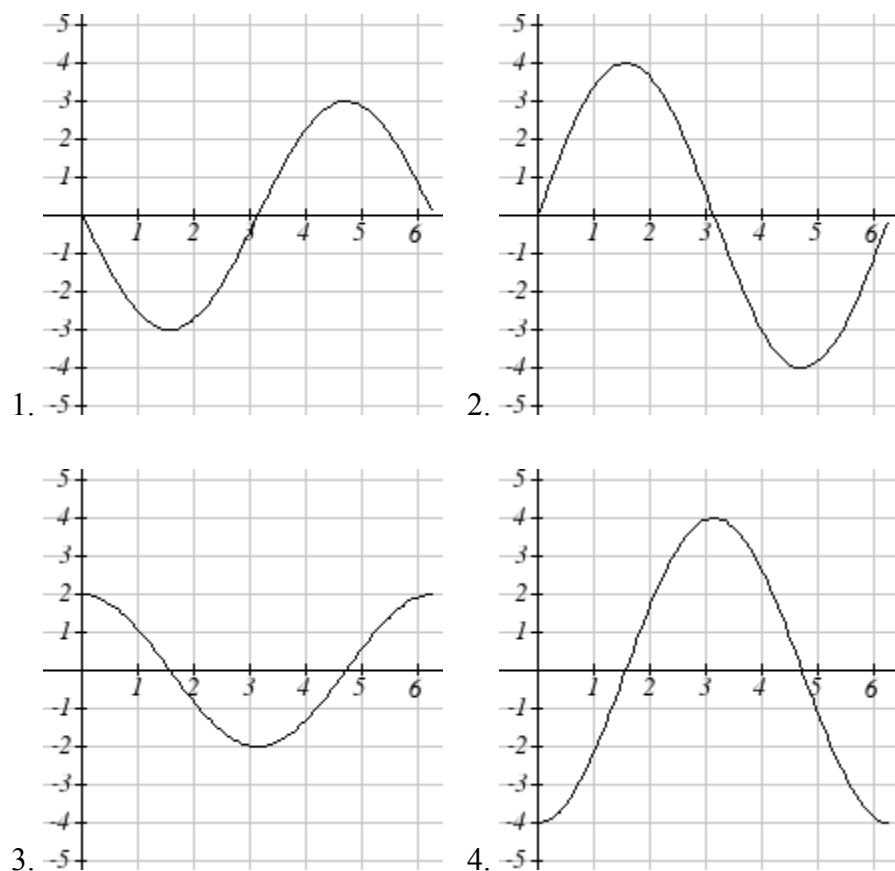
1.  $\sin(A) = \frac{5\sqrt{41}}{41}$ ,  $\cos(A) = \frac{4\sqrt{41}}{41}$ ,  $\tan(A) = \frac{5}{4}$

$$\sec(A) = \frac{\sqrt{41}}{5}, \csc(A) = \frac{\sqrt{41}}{4}, \cot(A) = \frac{4}{5}$$

3.  $c = 14$ ,  $b = 7\sqrt{3}$ ,  $B = 60^\circ$
5.  $a = 5.3171$ ,  $c = 11.3257$ ,  $A = 28^\circ$
7.  $a = 9.0631$ ,  $b = 4.2262$ ,  $B = 25^\circ$
9. 32.4987 ft
11. 836.2698 ft
13. 460.4069 ft
15. 660.35 feet
17. 28.025 ft
19. 143.0427
21. 86.6685

## Chapter 6

### Section 6.1



5. Amp: 3. Period= 2. Midline:  $y= -4$ .  $f(t) = 3\sin(\pi t) - 4$
6. Amp: 2. Period= 4. Midline:  $y= -3$ .  $f(t) = 2\sin\left(\frac{\pi}{2}t\right) - 3$
7. Amp: 2. Period=  $4\pi$ . Midline:  $y= 1$ .  $f(t) = 2\cos\left(\frac{1}{2}t\right) + 1$
8. Amp: 3. Period=  $\pi$ . Midline:  $y= -1$ .  $f(t) = 3\cos(2t) - 1$
9. Amp: 2. Period= 5. Midline:  $y= 3$ .  $f(t) = -2\cos\left(\frac{2\pi}{5}t\right) + 3$
10. Amp: 1. Period= 3. Midline:  $y= -1$ .  $f(t) = -\sin\left(\frac{2\pi}{3}t\right) - 1$
11. Amp: 3, Period =  $\frac{\pi}{4}$ , Shift: 4 left, Midline:  $y= 5$
12. Amp: 4, Period = 4, Shift: 3 right, Midline:  $y= 7$
13. Amp: 2, Period =  $\frac{2\pi}{3}$ , Shift: 7 right, Midline:  $y= 4$



14. Amp: 5, Period =  $\frac{2\pi}{5}$ , Shift: 4 left, Midline:  $y = -2$

15. Amp: 1, Period = 12, Shift: 6 left, Midline:  $y = -3$

16. Amp: 8, Period =  $\frac{12}{7}$ , Shift: 3 left, Midline:  $y = 6$

17.  $f(x) = 4 \sin\left(\frac{\pi}{5}(x+1)\right)$

18.  $f(x) = 3 \sin\left(\frac{\pi}{3}(x+1)\right)$

19.  $f(x) = \cos\left(\frac{\pi}{5}(x+2)\right)$

20.  $f(x) = -2 \cos\left(\frac{\pi}{3}(x-1)\right)$

21.  $D(t) = 50 - 7 \sin\left(\frac{\pi}{12}t\right)$

22.  $D(t) = 68 - 12 \sin\left(\frac{\pi}{12}t\right)$

23. a. Amp: 12.5. Midline:  $y = 13.5$ . Period: 10

b.  $h(t) = -12.5 \cos\left(\frac{\pi}{5}t\right) + 13.5$

c.  $h(5) = 26$  meters

24. a. Amp: 17.5. Midline:  $y = 20.5$ . Period: 8

b.  $h(t) = -17.5 \cos\left(\frac{\pi}{4}t\right) + 20.5$

c.  $h(4) = 38$  meters

## Section 6.2

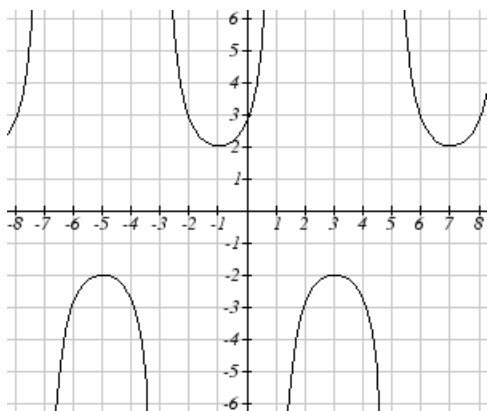
1. II

3. I

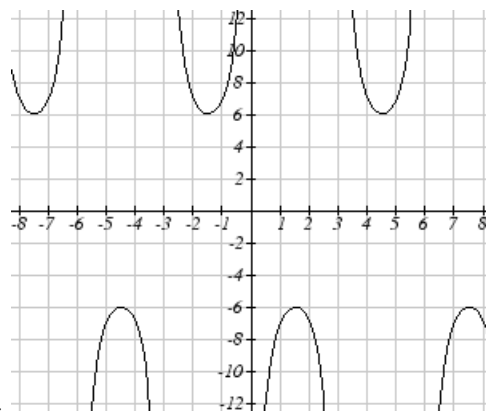
5. Period:  $\frac{\pi}{4}$ . Horizontal shift: 8 right

7. Period: 8. Horizontal shift: 1 left

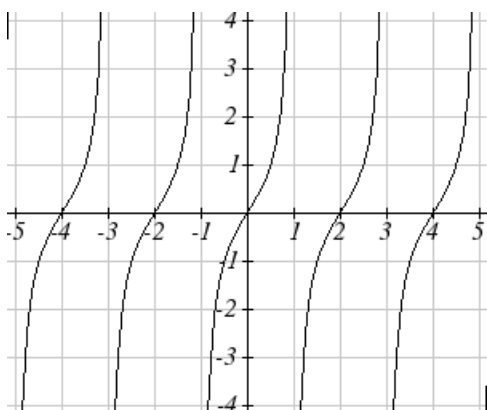
9. Period: 6. Horizontal shift: 3 left



11.



13.



15.

17.  $f(x) = 2 \sec\left(\frac{\pi}{2}x\right) - 1$

21.  $\tan(-x) = 1.5$

25.  $\csc(-x) = 5$

19.  $f(x) = 2 \csc\left(\frac{\pi}{4}x\right) + 1$

23.  $\sec(-x) = 2$

27.  $-\csc(x)$

### Section 6.3

1.  $\frac{\pi}{4}$

3.  $-\frac{\pi}{6}$

5.  $\frac{\pi}{3}$

7.  $\frac{3\pi}{4}$

9.  $\frac{\pi}{4}$

11.  $-\frac{\pi}{3}$

13. 1.9823

15. -0.9273

17. 44.427°

19.  $\frac{\pi}{4}$

21.  $-\frac{\pi}{6}$

23.  $\frac{2\sqrt{10}}{7}$

25.  $\frac{1}{\sqrt{17}}$

27.  $\frac{\sqrt{25-x^2}}{5}$

29.  $\frac{3x}{\sqrt{9x^2+1}}$

**Section 6.4**

$$1. \frac{5\pi}{4}, \frac{7\pi}{4} \qquad 3. \frac{\pi}{3}, \frac{5\pi}{3} \qquad 5. \frac{\pi}{2} \qquad 7. \frac{\pi}{2}, \frac{3\pi}{2}$$

$$9. \frac{\pi}{4} + 2\pi k, \frac{7\pi}{4} + 2\pi k, \text{ where } k \text{ is an integer}$$

$$11. \frac{7\pi}{6} + 2\pi k, \frac{11\pi}{6} + 2\pi k, \text{ where } k \text{ is an integer}$$

$$13. \frac{\pi}{18} + \frac{2\pi}{3}k, \frac{5\pi}{18} + \frac{2\pi}{3}k, \text{ where } k \text{ is an integer}$$

$$15. \frac{5\pi}{12} + \frac{2\pi}{3}k, \frac{7\pi}{12} + \frac{2\pi}{3}k, \text{ where } k \text{ is an integer}$$

$$17. \frac{\pi}{6} + \pi k, \frac{5\pi}{6} + \pi k, \text{ where } k \text{ is an integer}$$

$$19. \frac{\pi}{4} + \frac{2\pi}{3}k, \frac{5\pi}{12} + \frac{2\pi}{3}k, \text{ where } k \text{ is an integer}$$

$$21. 4 + 8k, \text{ where } k \text{ is an integer}$$

$$23. \frac{1}{6} + 2k, \frac{5}{6} + 2k, \text{ where } k \text{ is an integer}$$

$$25. 0.2734, 2.8682$$

$$27. 3.7603, 5.6645$$

$$29. 2.1532, 4.1300$$

$$31. 0.7813, 5.5019$$

$$33. 0.04829, 0.47531$$

$$35. 0.7381, 1.3563$$

$$37. 0.9291, 3.0709$$

$$39. 1.3077, 4.6923$$

**Section 6.5**

$$1. c = \sqrt{89}, A = 57.9946^\circ, B = 32.0054^\circ$$

$$3. b = \sqrt{176}, A = 27.8181^\circ, B = 62.1819^\circ$$

$$5. y(x) = 6 \sin\left(\frac{\pi}{2}(x-1)\right) + 4$$

$$7. D(t) = 50 - 13 \cos\left(\frac{\pi}{12}(t-5)\right)$$

$$9. \text{ a. } P(t) = 129 - 25 \cos\left(\frac{\pi}{6}t\right) \quad \text{ b. } P(t) = 129 - 25 \cos\left(\frac{\pi}{6}(t-3)\right)$$

$$11. 75 \text{ degrees}$$

$$13. 8$$

$$15. 2.80869431742$$

$$17. 5.035 \text{ months}$$

## Chapter 7

### Section 7.1

1.  $\frac{7\pi}{6}, \frac{11\pi}{6}$

3.  $\frac{\pi}{3}, \frac{5\pi}{3}$

5.  $\frac{2}{3} + 8k$ , and  $\frac{10}{3} + 8k$ , where  $k$  is an integer

7.  $\frac{5\pi}{12} + k\pi$  and  $\frac{7\pi}{12} + k\pi$ , where  $k$  is an integer

9.  $0.1339 + 10k$  and  $8.6614 + 10k$ , where  $k$  is an integer

11.  $1.1438 + \frac{2\pi}{3}k$  and  $1.9978 + \frac{2\pi}{3}k$ , where  $k$  is an integer

13.  $\frac{\pi}{2}, \frac{3\pi}{2}, 0.644, 2.498$

15. 0.056, 1.515, 3.197, 4.647

17.  $0, \pi, \frac{\pi}{3}, \frac{5\pi}{3}$

19.  $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$

21. 1.183, 1.958, 4.325, 5.100

23.  $\frac{3\pi}{2}, \frac{7\pi}{6}, \frac{11\pi}{6}$

25.  $\pi, \frac{\pi}{3}, \frac{5\pi}{3}$

27. 1.823, 4.460

29. 2.301, 3.983, 0.723, 5.560

31. 3.305, 6.120

33.  $0, \frac{\pi}{3}, \frac{2\pi}{3}, \pi, \frac{4\pi}{3}, \frac{5\pi}{3}$

35.  $0, \frac{\pi}{4}, \frac{3\pi}{4}, \pi, \frac{5\pi}{4}, \frac{7\pi}{4}$

37.  $\frac{\pi}{6}, \frac{2\pi}{3}, \frac{5\pi}{6}, \frac{4\pi}{3}$

39.  $0, \pi, 1.231, 5.052$

41.  $\frac{\pi}{3}, \frac{5\pi}{3}$

### Section 7.2

1.  $\frac{\sqrt{2} + \sqrt{6}}{4}$

3.  $\frac{-\sqrt{2} - \sqrt{6}}{4}$

5.  $\frac{\sqrt{2} - \sqrt{6}}{4}$

7.  $\frac{\sqrt{2} + \sqrt{6}}{4}$

9.  $\frac{\sqrt{3}}{2}\sin(x) - \frac{1}{2}\cos(x)$

11.  $-\frac{\sqrt{3}}{2}\cos(x) + \frac{1}{2}\sin(x)$

13.  $\sec(t)$

15.  $\tan(x)$

17.  $8(\cos(5x) - \cos(27x))$

19.  $\sin(8x) + \sin(2x)$

21.  $2\cos(5t)\cos(t)$

23.  $2\sin(5x)\cos(2x)$

25. a.  $\left(\frac{2}{3}\right)\left(-\frac{1}{4}\right) + \left(-\frac{\sqrt{5}}{3}\right)\left(\frac{\sqrt{15}}{4}\right) = \frac{-2-5\sqrt{3}}{12}$

b.  $\left(-\frac{\sqrt{5}}{3}\right)\left(-\frac{1}{4}\right) + \left(\frac{2}{3}\right)\left(\frac{\sqrt{15}}{4}\right) = \frac{\sqrt{5}+2\sqrt{15}}{12}$

27.  $0.373 + \frac{2\pi}{3}k$  and  $0.674 + \frac{2\pi}{3}k$ , where  $k$  is an integer

29.  $2\pi k$ , where  $k$  is an integer

31.  $\frac{\pi}{7} + \frac{4\pi}{7}k$ ,  $\frac{3\pi}{7} + \frac{4\pi}{7}k$ ,  $\frac{\pi}{3} + \frac{4\pi}{3}k$ , and  $\pi + \frac{4\pi}{3}k$ , where  $k$  is an integer

33.  $\frac{7\pi}{12} + \pi k$ ,  $\frac{11\pi}{12} + \pi k$ , and  $\frac{\pi}{4}k$ , where  $k$  is an integer

35.  $2\sqrt{13}\sin(x+5.3004)$  or  $2\sqrt{13}\sin(x-0.9828)$

37.  $\sqrt{29}\sin(3x+0.3805)$

39. 0.3681, 3.8544

41. 0.7854, 1.8158

43.  $\tan(6t)$

**Section 7.3**

1. a.  $\frac{3\sqrt{7}}{32}$  b.  $\frac{31}{32}$  c.  $\frac{3\sqrt{7}}{31}$

3.  $\cos(56^\circ)$

5.  $\cos(34^\circ)$

7.  $\cos(18x)$

9.  $2\sin(16x)$

11.  $0, \pi, 2.4189, 3.8643$

13. 0.7297, 2.4119, 3.8713, 5.5535

15.  $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{3\pi}{2}$

17. a.  $\frac{2\pi}{9}, \frac{4\pi}{9}, \frac{8\pi}{9}, \frac{10\pi}{9}, \frac{14\pi}{9}, \frac{16\pi}{9}, 0, \frac{2\pi}{3}, \frac{4\pi}{3}$

19.  $\frac{1 + \cos(10x)}{2}$

21.  $\frac{3}{8} - \frac{1}{2} \cos(16x) + \frac{1}{8} \cos(32x)$

23.  $\frac{1}{16} - \frac{1}{16} \cos(2x) + \frac{1}{16} \cos(4x) - \frac{1}{16} \cos(2x) \cos(4x)$

25. a.  $\sqrt{\frac{1}{2} + \frac{2\sqrt{3}}{7}}$  b.  $\sqrt{\frac{1}{2} - \frac{2\sqrt{3}}{7}}$  c.  $\frac{1}{7 - 4\sqrt{3}}$

**Section 7.4**

1.  $y = 3 \sin\left(\frac{\pi}{6}(x-3)\right) - 1$

3. Amplitude: 8, Period:  $\frac{1}{3}$  second, Frequency: 3 Hz (cycles per second)

5.  $P(t) = -19 \cos\left(\frac{\pi}{6}t\right) + \frac{40}{3}t + 650$

7.  $P(t) = -33 \cos\left(\frac{\pi}{6}t\right) + 900(1.07)^t$

9.  $D(t) = 10(0.85)^t \cos(36\pi t)$

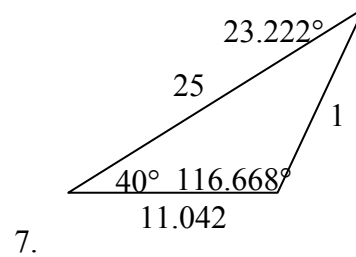
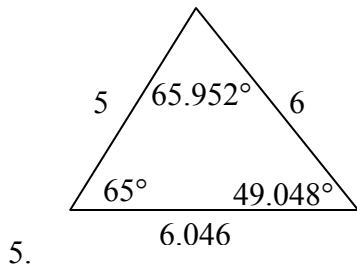
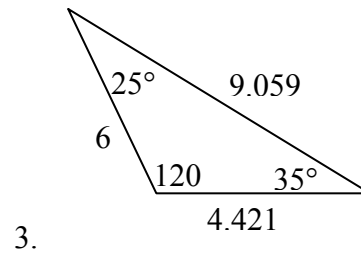
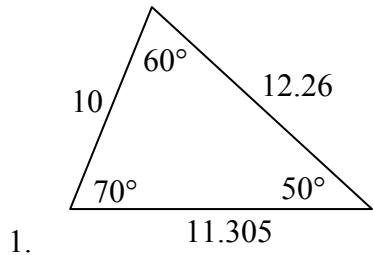
11.  $D(t) = 17(0.9145)^t \cos(28\pi t)$

13. a. IV b. III

15.  $y = 6(4)^x + 5 \sin\left(\frac{\pi}{2}x\right)$

17.  $y = -3 \sin\left(\frac{\pi}{2}\right) + 2x + 7$

19.  $y = 8\left(\frac{1}{2}\right)^x \cos\left(\frac{\pi}{2}x\right) + 3$

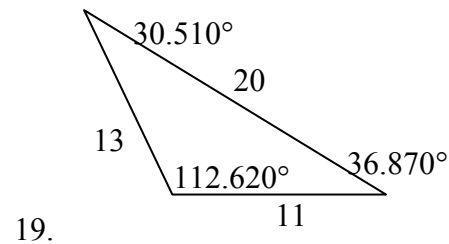
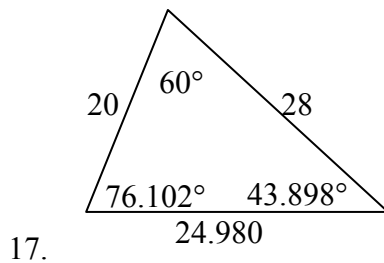
**Chapter 8****Section 8.1**

9.  $\beta = 68^\circ$ ,  $a = 14.711$ ,  $c = 20.138$

11.  $\beta = 28.096^\circ$ ,  $\gamma = 32.904^\circ$ ,  $c = 16.149$

13. Not possible.

15.  $\beta = 64.243^\circ$ ,  $\gamma = 72.657^\circ$ ,  $c = 257.328$  OR  $\beta = 115.757^\circ$ ,  $\gamma = 21.143^\circ$ ,  $c = 97.238$



21.  $c = 2.066$ ,  $\alpha = 52.545^\circ$ ,  $\beta = 86.255^\circ$

23.  $a = 11.269$ ,  $\beta = 27.457^\circ$ ,  $\gamma = 32.543^\circ$

25. 177.562

27. 978.515 ft

29. Distance to A: 565.258 ft. Distance to shore: 531.169 ft

31. 529.014 m

33. 173.877 feet

35. 4.642 km, 2.794 km

37. 757.963 ft

39. 2371.129 miles

41. 65.375 cm<sup>2</sup>

43. 7.72

## Section 8.2

1.  $\left(-\frac{7\sqrt{3}}{2}, -\frac{7}{2}\right)$

5.  $(3\sqrt{2}, -3\sqrt{2})$

9.  $\left(-\frac{3\sqrt{3}}{2}, -\frac{3}{2}\right)$

13.  $(2\sqrt{5}, 0.464)$

17.  $(\sqrt{34}, 5.253)$

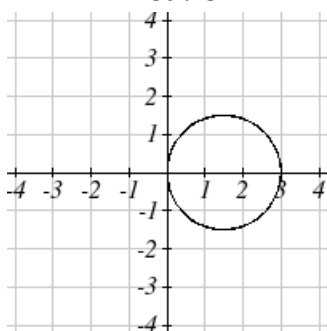
21.  $r = 3\sec(\theta)$

25.  $r = 4\sin(\theta)$

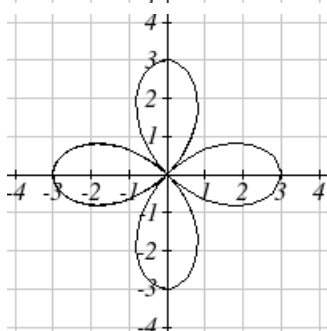
29.  $x^2 + y^2 = 3y$

33.  $x = 2$

37. A

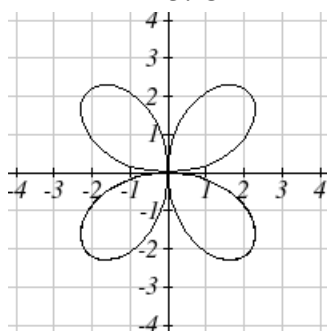


49.

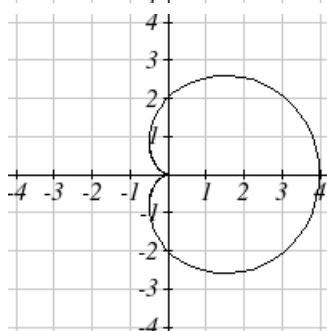


55.

41. E



51.



57.

3.  $(2\sqrt{2}, -2\sqrt{2})$

7.  $(0, 3)$

11.  $(-1.248, 2.728)$

15.  $(2\sqrt{13}, 2.159)$

19.  $(\sqrt{269}, 4.057)$

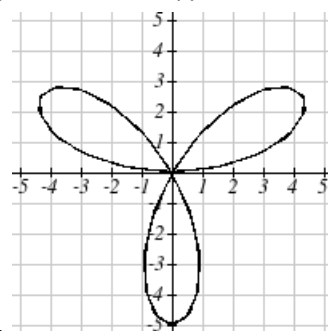
23.  $r = \frac{\sin(\theta)}{4\cos^2(\theta)}$

27.  $r = \frac{\cos(\theta)}{(\cos^2(\theta) - \sin^2(\theta))}$

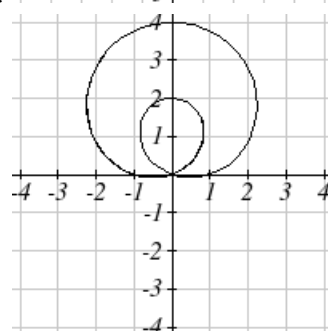
31.  $y + 7x = 4$

35.  $x^2 + y^2 = x + 2$

45. D

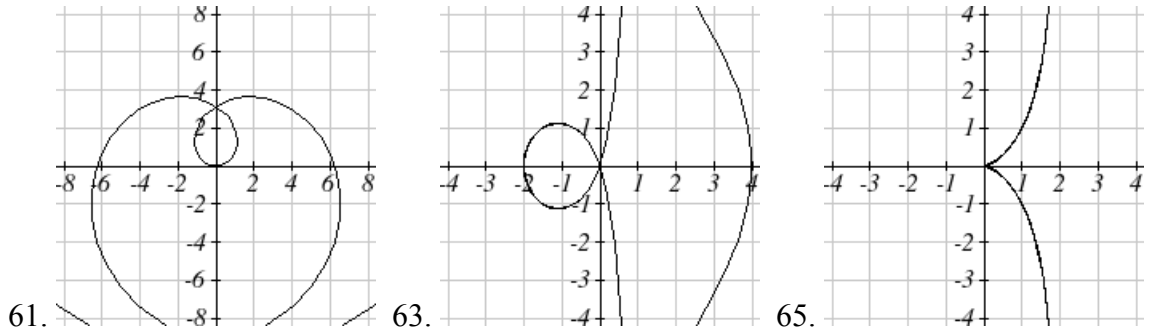


53.



59.





### Section 8.3

1.  $3i$

5.  $1 + \sqrt{3}i$

9.  $-11 + 4i$

13.  $30 - 10i$

17. 20

21.  $\frac{3}{2} + \frac{5}{2}i$

25.  $-1$

29.  $3 \cos(2) + 3 \sin(2)i = -1.248 + 2.728i$

31.  $3\sqrt{3} + 3i$

35.  $6e^{0i}$

39.  $2\sqrt{2}e^{\frac{\pi}{4}i}$

43.  $\sqrt{34}e^{0.540i}$

47.  $\sqrt{17}e^{4.467i}$

51.  $6e^{\frac{5\pi}{12}i}$

55.  $1024e^{\frac{5\pi}{2}i}$

59. 4096

63.  $1.771 + 0.322i$

65.  $\sqrt[5]{2} \approx 1.149, 0.355 + 1.092i, -0.929 + 0.675i, -0.929 - 0.675i, 0.355 - 1.092i$

67.  $1, \frac{1}{2} + \frac{\sqrt{3}}{2}i, -\frac{1}{2} + \frac{\sqrt{3}}{2}i, -1, -\frac{1}{2} - \frac{\sqrt{3}}{2}i, \frac{1}{2} - \frac{\sqrt{3}}{2}i$

3.  $-12$

7.  $8 - i$

11.  $-12 + 8i$

15.  $11 + 10i$

19.  $\frac{3}{2} + 2i$

23.  $-\frac{1}{25} - \frac{18}{25}i$

27.  $i$

33.  $-\frac{3\sqrt{2}}{2} - \frac{3\sqrt{2}}{2}i$

37.  $4e^{\frac{3\pi}{2}i}$

41.  $3\sqrt{2}e^{\frac{3\pi}{4}i}$

45.  $\sqrt{10}e^{2.820i}$

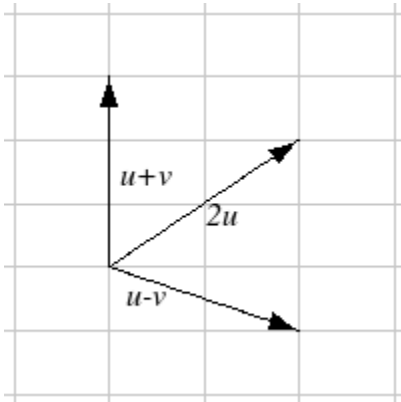
49.  $\sqrt{26}e^{6.086i}$

53.  $2e^{\frac{7\pi}{12}i}$

57.  $4e^{\frac{\pi}{3}i}$

61.  $0.788 + 1.903i$

## Section 8.4

1.  $-4, 2$ 

3. The vectors do not need to start at the same point

5.  $3\vec{v} - \vec{u}$ 7.  $3\sqrt{2}, 3\sqrt{2}$ 9.  $-6.128, -5.142$ 11. Magnitude: 4, Direction:  $90^\circ$ 13. Magnitude: 7.810, Direction:  $39.806^\circ$ 15. Magnitude: 2.236, Direction:  $153.435^\circ$ 17. Magnitude: 5.385, Direction:  $291.801^\circ$ 19. Magnitude: 7.211, Direction:  $236.310^\circ$ 21.  $\vec{u} + \vec{v} = \langle 3, 2 \rangle$ ,  $\vec{u} - \vec{v} = \langle 1, -8 \rangle$ ,  $2\vec{u} - 3\vec{v} = \langle 1, -21 \rangle$ 

23. 4.635 miles, 17.764 deg N of E

25. 17 miles. 10.318 miles

27.  $\vec{F}_{net} = -4, -11$ 29. Distance: 2.868. Direction:  $86.474^\circ$  North of West, or  $3.526^\circ$  West of North

31. 4.924 degrees. 659 km/hr

33. 4.424 degrees

35. (0.081, 8.602)

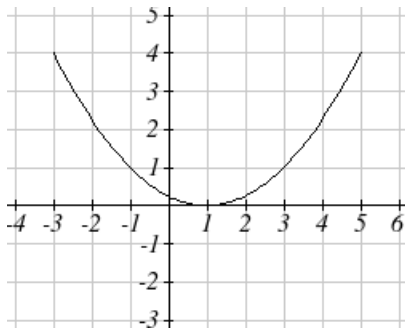
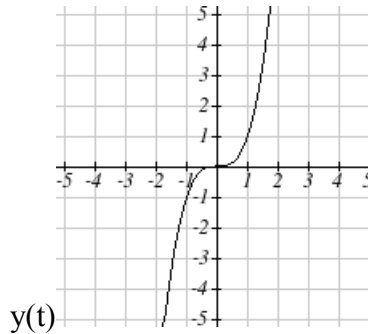
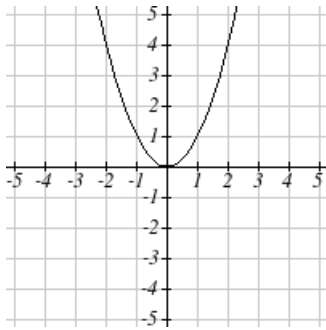
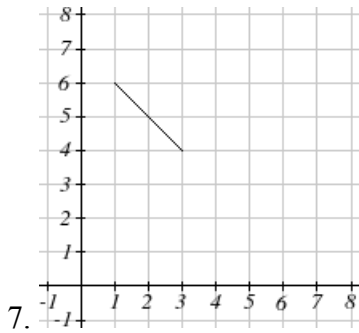
37. 21.801 degrees, relative to the car's forward direction

## Section 8.5

1. C

3. E

5. F



13.  $y = -2 + 2x$

17.  $x = 2e^{\frac{1-y}{5}}$  or  $y = 1 - 5 \ln\left(\frac{x}{2}\right)$

21.  $y = x^3$

25. 
$$\begin{cases} x(t) = t \\ y(t) = 3t^2 + 3 \end{cases}$$

15.  $y = 3\sqrt{\frac{x-1}{2}}$

19.  $x = \left(\frac{y}{2}\right)^3 - \frac{y}{2}$

23.  $\left(\frac{x}{4}\right)^2 + \left(\frac{y}{5}\right)^2 = 1$

27. 
$$\begin{cases} x(t) = 3 \log(t) + t \\ y(t) = t \end{cases}$$

29. 
$$\begin{cases} x(t) = 2 \cos(t) \\ y(t) = 3 \sin(t) \end{cases}$$

33. 
$$\begin{cases} x(t) = t - 1 \\ y(t) = -t^2 \end{cases}$$

37. 
$$\begin{cases} x(t) = 4 \cos(3t) \\ y(t) = 6 \sin(t) \end{cases}$$

41. 
$$y(x) = -16 \left( \frac{x}{15} \right)^2 + 20 \left( \frac{x}{15} \right)$$

31. 
$$\begin{cases} x(t) = t^3 \\ y(t) = t + 2 \end{cases}$$

35. 
$$\begin{cases} x(t) = -1 + 3t \\ y(t) = 5 - 2t \end{cases}$$

39. 
$$\begin{cases} x(t) = 4 \cos(2t) \\ y(t) = 3 \sin(3t) \end{cases}$$

43. 
$$\begin{cases} x(t) = 20 \sin\left(\frac{2\pi}{5}t\right) + 8 \sin(\pi t) \\ y(t) = 35 - 20 \cos\left(\frac{2\pi}{5}t\right) - 8 \cos(\pi t) \end{cases}$$