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 late

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

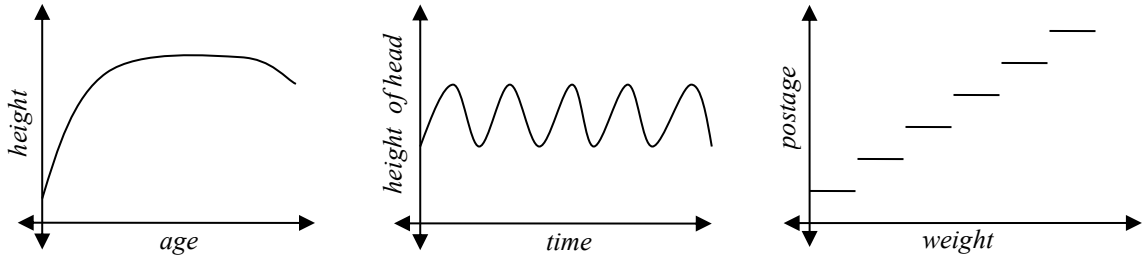
35. a. -6 b.-16 37. a. 5 b. $-\frac{5}{3}$

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: $2 < t \le 8$ R: $6 \le g(t) < 8$

5. D: [0,4] R: [-3, 0]

7. $[2,\infty)$

9. $(-\infty,3]$

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

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

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

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

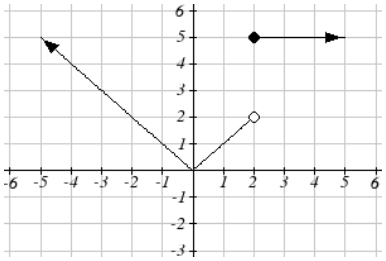
	$f(-1)$	$f(0)$	$f(2)$	$f(4)$
19.	-4	6	20	34
21.	-1	-2	7	5
23.	-5	3	3	16

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

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

29. $f(x)=\begin{cases} \dfrac{1}{x} & if \quad x < 0 \\ \sqrt{x} & if \quad x \ge 0 \end{cases}$

31.



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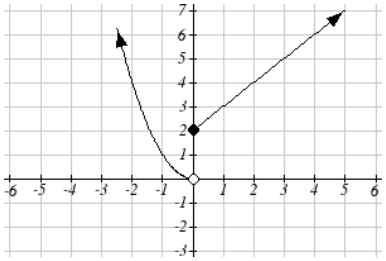

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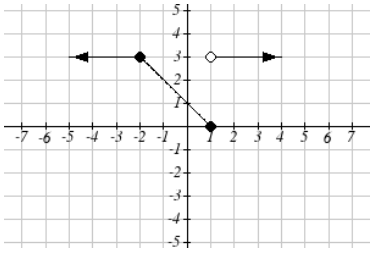


Section 1.3

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: $(1,3)\cup(4,\infty)$

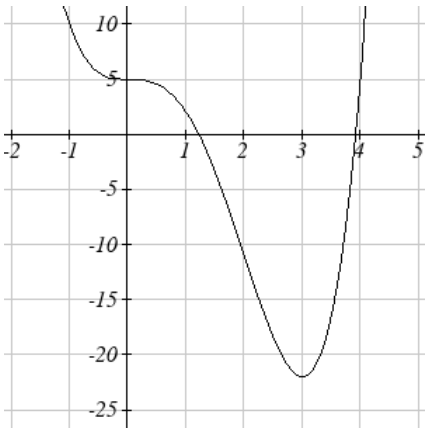
25. Increasing, concave up 27. Decreasing, concave down

29. Decreasing, concave up 31. Increasing, concave down

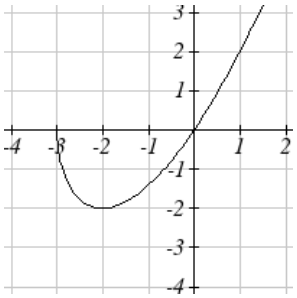
33. Concave up $(-\infty,1)$. Concave down $(1,\infty)$. Inflection point at (1, 2)

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

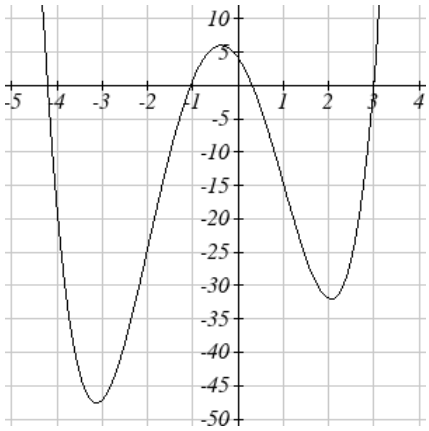
37. Local minimum at (3, -22).
Inflection points at (0,5) and (2, -11).
Increasing on $(3,\infty)$. Decreasing $(-\infty,3)$
Concave up $(-\infty,0)\cup(2,\infty)$. Concave down $(0,2)$



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

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

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

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

29. b 31a. $r\left(V\left(t\right)\right) = \sqrt[3]{\frac{3\left(10 + 20t\right)}{4\pi}}$ b. 4.609in

33. $\left(0, \infty\right)$ 35. $\left(-\infty, \frac{1}{3}\right) \cup \left(\frac{1}{3}, 1\right) \cup \left(1, \infty\right)$ 37. $\left[2,5\right) \cup \left(5, \infty\right)$

39. $g\left(x\right) = x + 2, f\left(x\right) = x^2$ 41. $f\left(x\right) = \frac{3}{x}, g\left(x\right) = x - 5$

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

45a. $f\left(f\left(x\right)\right) = a\left(ax + b\right) + b = \left(a^2\right)x + \left(ab + b\right)$

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

47a. $C\left(f\left(s\right)\right) = \frac{70\left(\frac{s}{60}\right)^2}{10 + \left(\frac{s}{60}\right)^2}$ b. $C\left(g\left(h\right)\right) = \frac{70\left(60h\right)^2}{10 + \left(60h\right)^2}$

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

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

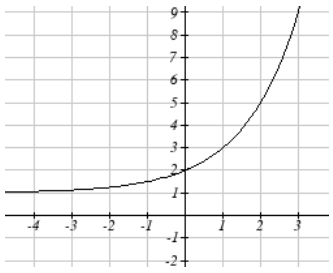
9. Horizontal shift right 2 units, Vertical shift up 3 units

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

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

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

17.



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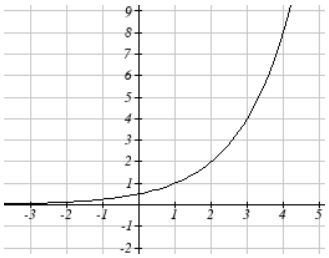

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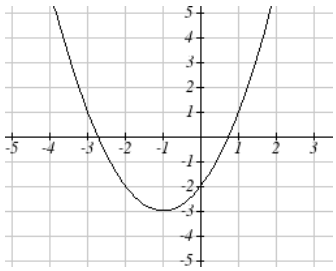

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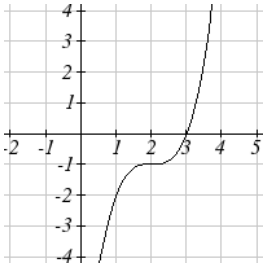
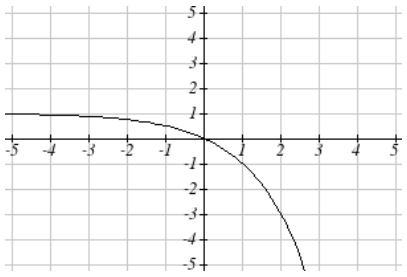


25. $y=|x-3|-2$

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*-axis

43. Vertically stretch *y* values by 4

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

47. Horizontally stretch *x* values by 3

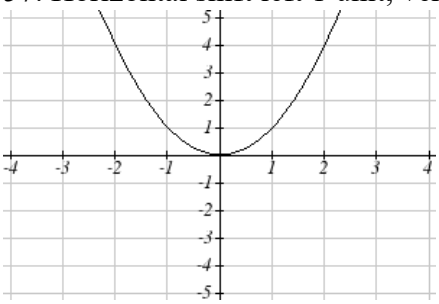
49. Reflect *f(x)* about the *y*-axis and vertically stretch *y* values by 3

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

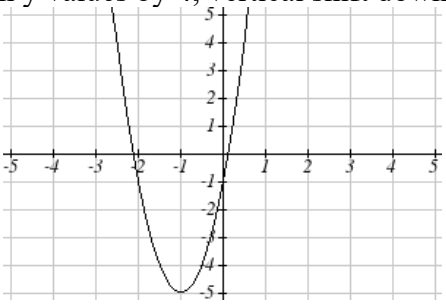
53. $\frac{1}{3} f(x+2) - 3 = \frac{1}{3(x+2)^2} - 3$

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

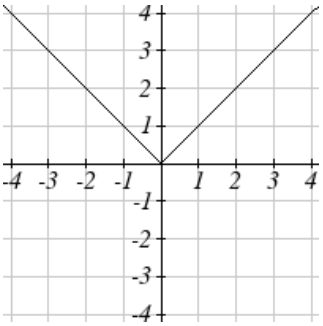
57. Horizontal shift left 1 unit, vertical stretch y values by 4, vertical shift down 5 units



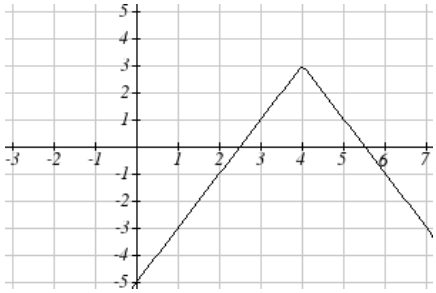
becomes



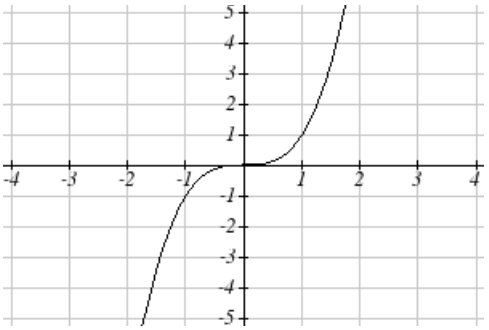
59. Horizontal shift right 4 units, vertical stretch y values by 2, reflect over x axis, vertically shift up 3 units.



becomes



61. Vertically compress y values by ½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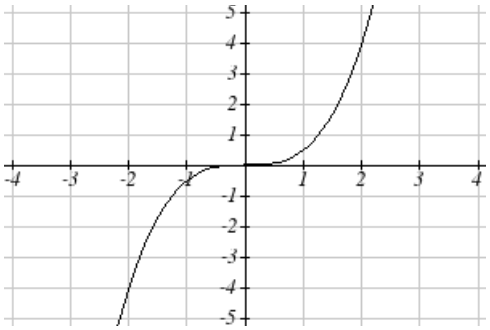
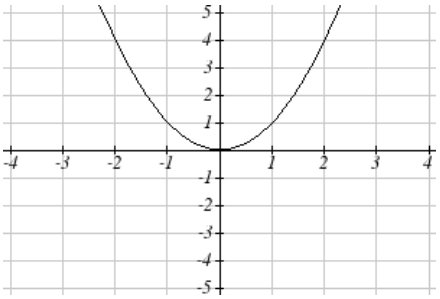


63. Horizontally stretch x values by 3, vertical shift down 3 units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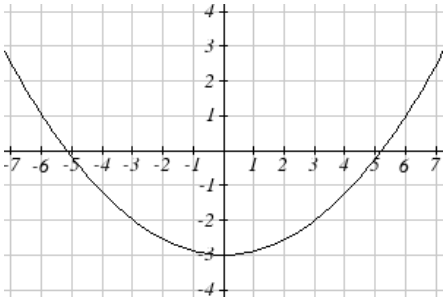
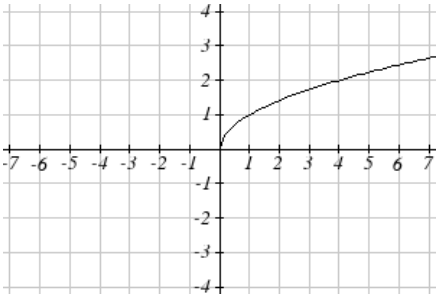


65. Reflected over the y axis, horizontally shift right 4 units $a(x)=\sqrt{-(x-4)}$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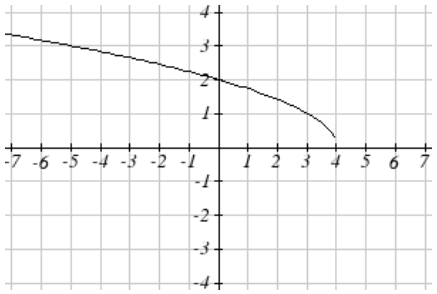


67. This function is increasing on $(-1,\infty)$ and decreasing on $(-\infty,-1)$

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

99. $f(x)=\begin{cases}(x+3)^2+1 & \text{if } x\le -2\\ \frac{1}{2}|x-2|+3 & \text{if } x>-2\end{cases}$

101. $f(x)=\begin{cases}1 & \text{if } x<-2\\ -2(x+1)^2+4 & \text{if } -2\le x\le 1\\ \sqrt[3]{x-2}+1 & \text{if } x>1\end{cases}$

103a. *Domain*: $3.5\le x\le 6$ d. *Range*: $-9\le y\le 7$

Section 1.6

1. 6 3. -4 5. ½

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 $x\ge -7, f^{-1}(x)=\sqrt{x}-7$

21. Restricted domain $x\ge 0$, $f^{-1}(x)=\sqrt{x+5}$

23a. $f(g(x))=\left(\sqrt[3]{x+5}\right)^3-5=x$ b. $g(f(x))=\sqrt[3]{x^3-5+5}=x$

c. This means that they are inverse functions (of each other)

Chapter 2

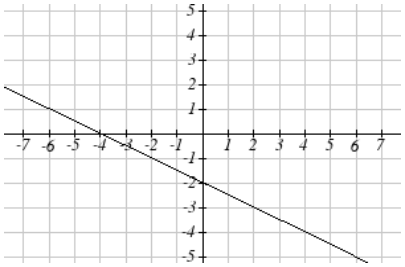
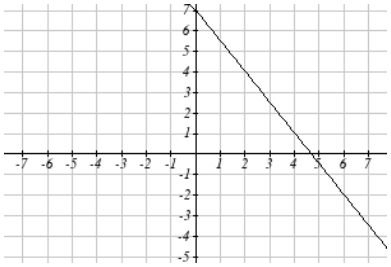
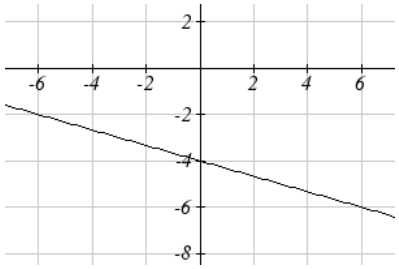
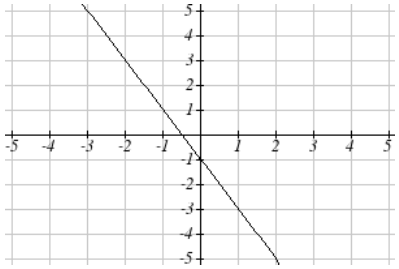
Section 2.1

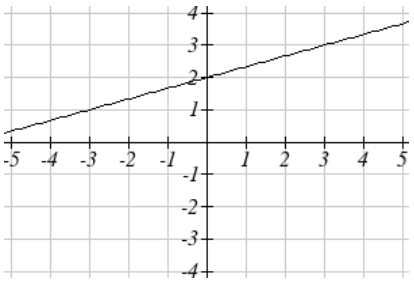
1. $P(t) = 1700t + 45000$
3. $D(t) = 10 + 2t$
5. $M(n) = 40 - 2n$
7. Increasing
9. Decreasing
11. Decreasing
13. Increasing
15. Decreasing
17. 3
19. $-\frac{1}{3}$
21. $\frac{4}{5}$
23. $\frac{2}{3}$
25. -0.05 mph (or 0.05 miles per hour toward her home)
27. Population is decreasing by 400 people per 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 1st ,3rd & 4th tables are linear: respectively

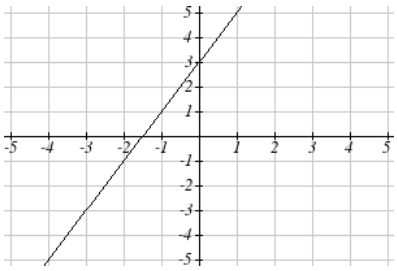
1. $g(x) = -3x + 5$
3. $f(x) = 5x - 5$
4. $k(x) = 3x - 2$

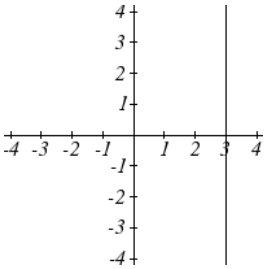
49a. $C = \frac{5}{9}F - \frac{160}{9}$
b. $F = \frac{9}{5}C + 32$
c. $-9.4°F$

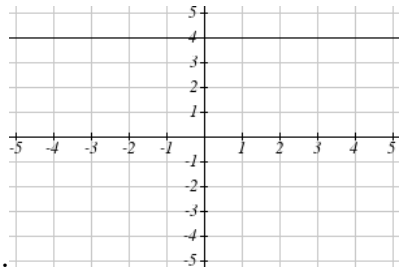
Section 2.2

1. E
3. D
5. B
7. 
9. 
11. 
13. 

15. 

17. 

19. 

21. 

23. a. $g(x)=\frac{3}{4}(x+2)-4$ b. ¾ c. -5/2

25. $y=3$

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 $>111\frac{1}{9}$

51. $f(x)=\begin{cases}2x+3 & if \quad -3\le x<-1\\ x-1 & if \quad -1\le x\le 2\\ -2 & if \quad 2<x\le 5\end{cases}$

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

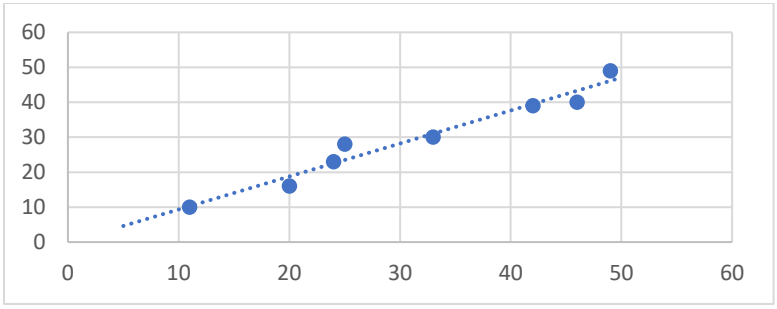
17. $A=-\dfrac{b^2}{2m}$

19a. Hawaii b. \$80,640 c. During the year 1933

21. 26.225 miles

Section 2.4

1.



3. $y=1.971x-3.519,\ r=0.967$ 5. $y=-0.901x+26.04,\ r=-0.968$

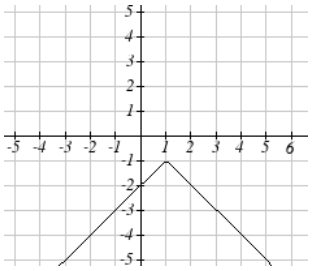
7. $17.483\approx 17$ *situps* 9. D 11. A

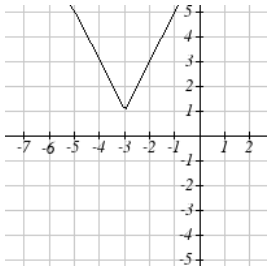
13. Yes, trend appears linear because r =0.994 and will exceed 35% near the end of the year 2019.

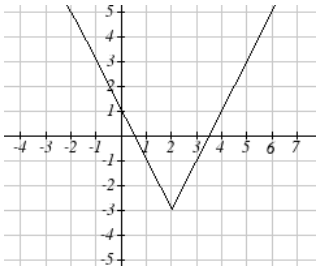
Section 2.5

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 $x \to \infty,\ f(x) \to \infty$ As $x \to -\infty,\ f(x) \to \infty$
3. As $x \to \infty,\ f(x) \to \infty$ As $x \to -\infty,\ f(x) \to -\infty$
5. As $x \to \infty,\ f(x) \to -\infty$ As $x \to -\infty,\ f(x) \to -\infty$
7. As $x \to \infty,\ f(x) \to -\infty$ As $x \to -\infty,\ f(x) \to \infty$
9. 7th Degree, Leading coefficient 4
11. 2nd Degree, Leading coefficient -1
13. 4th Degree, Leading coefficient -2
15. 3rd Degree, Leading coefficient 6
17. As $x \to \infty,\ f(x) \to -\infty$ As $x \to -\infty,\ f(x) \to -\infty$
19. As $x \to \infty,\ f(x) \to \infty$ As $x \to -\infty,\ f(x) \to \infty$
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. $f(x)=\frac{3}{5}(x-2)(x-5)$

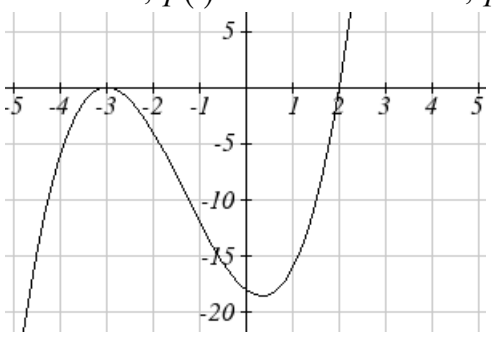
23. $f(x)=-\frac{1}{4}(x-4)^2$ 25. $f(x)=-\frac{1}{9}(x+3)^2+2$

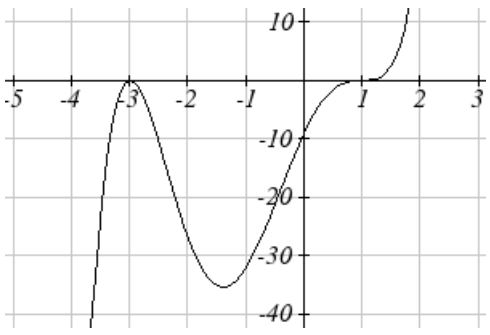
27a. 234m b. 2909.561 ft c. 47.735 seconds
29a. 3 ft b. 111 ft c. 72.497 ft
31. 24.91 in by 24.91 in
33. 125 *ft* by $83\frac{1}{3}$ *ft*
35. 24.6344 cm
37. $10.70

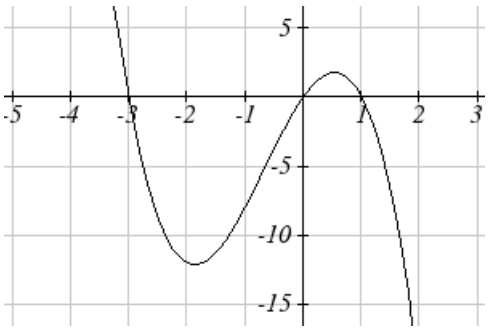
Section 3.3

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

13. 

15. 

17. 

19. $(3,\infty)$

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

23. $[3.5,6]$

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

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

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

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

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

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

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

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

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

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

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

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

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

51. Base 2.58, Height 3.336

Section 3.4

1. $4x^2+3x-1=(x-3)(4x+15)+44$

3. $5x^4-3x^3+2x^2-1=(x^2+4)(5x^2-3x-18)+(12x+71)$

5. $9x^3+5=(2x-3)\left(\frac{9}{2}x^2+\frac{27}{4}x+\frac{81}{8}\right)+\frac{283}{8}$

7. $(3x^2-2x+1)=(x-1)(3x+1)+2$

9. $(3-4x-2x^2)=(x+1)(-2x-2)+5$

11. $(x^3+8)=(x+2)(x^2-2x+4)+0$

13. $(18x^2-15x-25)=\left(x-\frac{5}{3}\right)(18x+15)+0$

15. $(2x^3+x^2+2x+1)=\left(x+\frac{1}{2}\right)(2x^2+2)+0$

17. $(2x^3-3x+1)=\left(x-\frac{1}{2}\right)\left(2x^2+x-\frac{5}{2}\right)-\frac{1}{4}$

19. $(x^4-6x^2+9)=(x-\sqrt{3})(x^3+\sqrt{3}x^2-3x-3\sqrt{3})+0$

21. $x^3 - 6x^2 + 11x - 6 = (x-1)(x-2)(x-3)$

23. $3x^3 + 4x^2 - x - 2 = 3\left(x - \frac{2}{3}\right)(x+1)^2$

25. $x^3 + 2x^2 - 3x - 6 = (x+2)(x+\sqrt{3})(x-\sqrt{3})$

27. $4x^4 - 28x^3 + 61x^2 - 42x + 9 = 4\left(x - \frac{1}{2}\right)^2 (x-3)^2$

Section 3.5

1. All of the real zeros lie in the interval $[-7,7]$

- Possible rational zeros are $\pm 1,\ \pm 2,\ \pm 3$

3. All of the real zeros lie in the interval $[-13,13]$

- Possible rational zeros are $\pm 1,\ \pm 2,\ \pm 3,\ \pm 4,\ \pm 6,\ \pm 12$

5. All of the real zeros lie in the interval $[-8,8]$

- Possible rational zeros are $\pm 1,\ \pm 7$

7. All of the real zeros lie in the interval $[-3,3]$

- Possible rational zeros are $\pm\frac{1}{17},\ \pm\frac{2}{17},\ \pm\frac{5}{17},\ \pm\frac{10}{17},\ \pm 1,\ \pm 2,\ \pm 5,\ \pm 10$

9. All of the real zeros lie in the interval $\left[-\frac{14}{3}, \frac{14}{3}\right]$

- Possible rational zeros are $\pm\frac{1}{3},\ \pm\frac{2}{3},\ \pm\frac{5}{3},\ \pm\frac{10}{3},\ \pm 1,\ \pm 2,\ \pm 5,\ \pm 10$

11. $x = -2,\ x = 1,\ x = 3$ (each has mult. 1)

13. $x = -2$ (mult. 2), $x = 1$ (mult. 1), $x = 3$ (mult. 1)

15. $x = 7$ (mult. 1)

17. $x = \frac{5}{17},\ x = \pm\sqrt{2}$ (each has mult. 1)

19. $x = -2,\ x = \frac{3 \pm \sqrt{69}}{6}$ (each has mult. 1)

21. $x = 0,\ x = \frac{5 \pm \sqrt{61}}{18}$ (each has mult. 1)

23. $x = \pm\sqrt{3}$ (each has mult. 1)

25. $x = \pm\sqrt{5}$ (each has mult. 1)

27. $x = \sqrt[3]{-2} = -\sqrt[3]{2},\ x = \sqrt[3]{5}$ (each has mult. 1)

29. $x = 2,\ x = \pm\sqrt{2}$ (each has mult. 1)

31. $x = -4$ (mult. 3), $x = 6$ (mult. 2)

Section 3.6

1. $3i$
3. -12
5. $1+\sqrt{3}i$
7. $8-i$
9. $-11+4i$
11. $-12+8i$
13. $30-10i$
15. $11+10i$
17. 20
19. $\frac{3}{2}+2i$
21. $\frac{3}{2}+\frac{5}{2}i$
23. $-\frac{1}{25}-\frac{18}{25}i$
25. $f(x)=x^2-4x+13=(x-(2+3i))(x-(2-3i))$. Zeros: $x=2\pm 3i$
27. $f(x)=3x^2+2x+10=3\left(x-\left(-\frac{1}{3}+\frac{\sqrt{29}}{3}i\right)\right)\left(x-\left(-\frac{1}{3}-\frac{\sqrt{29}}{3}i\right)\right)$. Zeros: $x=-\frac{1}{3}\pm\frac{\sqrt{29}}{3}i$
29. $f(x)=x^3+6x^2+6x+5=(x+5)(x^2+x+1)=(x+5)\left(x-\left(-\frac{1}{2}+\frac{\sqrt{3}}{2}i\right)\right)\left(x-\left(-\frac{1}{2}-\frac{\sqrt{3}}{2}i\right)\right)$

    Zeros: $x=-5, x=-\frac{1}{2}\pm\frac{\sqrt{3}}{2}i$
31. $f(x)=x^3+3x^2+4x+12=(x+3)\left(x^2+4\right)=(x+3)(x+2i)(x-2i)$. Zeros: $x=-3,\pm 2i$
33. $f(x)=x^3+7x^2+9x-2=(x+2)\left(x-\left(-\frac{5}{2}+\frac{\sqrt{29}}{2}\right)\right)\left(x-\left(-\frac{5}{2}-\frac{\sqrt{29}}{2}\right)\right)$

    Zeros: $x=-2, x=-\frac{5}{2}\pm\frac{\sqrt{29}}{2}$
35. $f(x)=4x^4-4x^3+13x^2-12x+3=\left(x-\frac{1}{2}\right)^2\left(4x^2+12\right)=4\left(x-\frac{1}{2}\right)^2(x+i\sqrt{3})(x-i\sqrt{3})$

    Zeros: $x=\frac{1}{2}, x=\pm\sqrt{3}i$
37. $f(x)=x^4+x^3+7x^2+9x-18=(x+2)(x-1)\left(x^2+9\right)=(x+2)(x-1)(x+3i)(x-3i)$

    Zeros: $x=-2,1,\pm 3i$
39. $f(x)=-3x^4-8x^3-12x^2-12x-5=(x+1)^2\left(-3x^2-2x-5\right)=-3(x+1)^2\left(x-\left(-\frac{1}{3}+\frac{\sqrt{14}}{3}i\right)\right)\left(x-\left(-\frac{1}{3}-\frac{\sqrt{14}}{3}i\right)\right)$

    Zeros: $x=-1, x=-\frac{1}{3}\pm\frac{\sqrt{14}}{3}i$
41. $f(x)=x^4+9x^2+20=\left(x^2+4\right)\left(x^2+5\right)=(x-2i)(x+2i)\left(x-i\sqrt{5}\right)\left(x+i\sqrt{5}\right)$

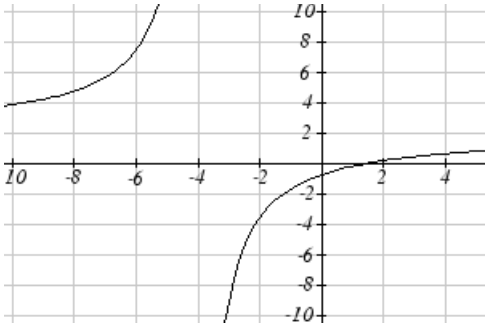
    Zeros: $x=\pm 2i,\pm i\sqrt{5}$

Section 3.7

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, ¼)	(-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)

5.



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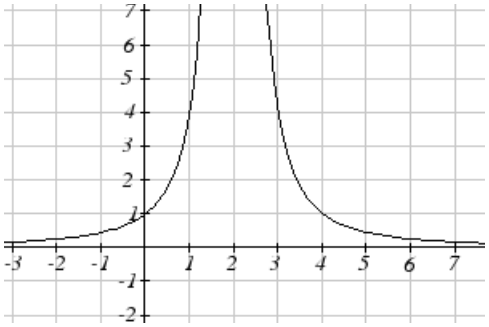

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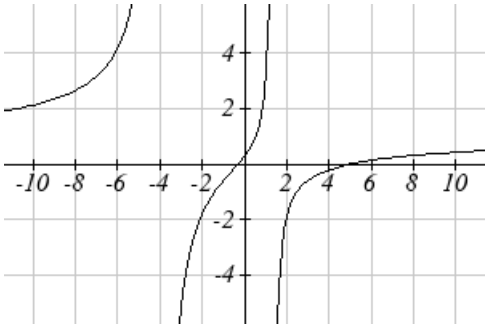

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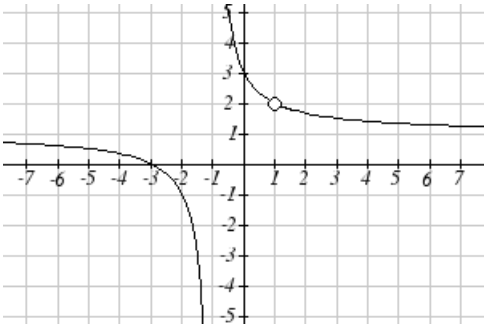

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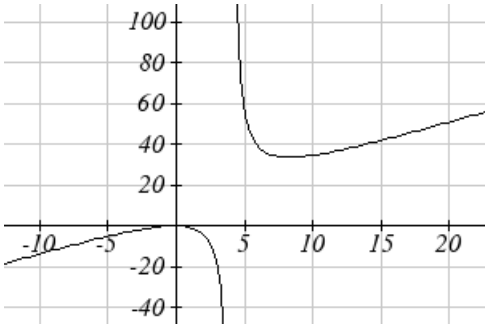

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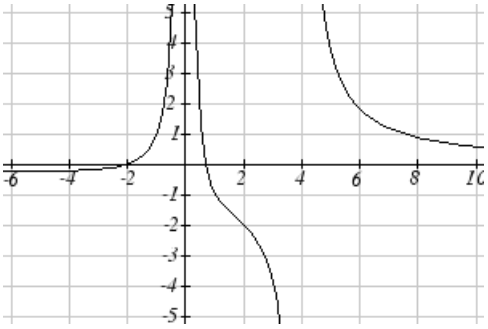
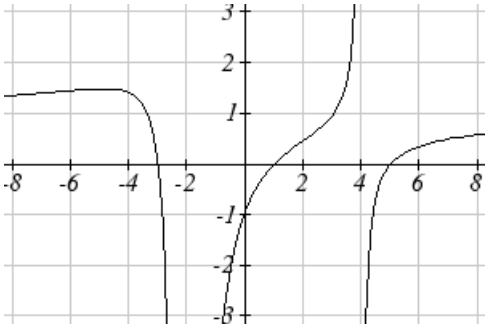


17. 

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

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

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

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

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

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

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

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

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

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

39. $y=3x-2$

41. $y=\dfrac{1}{2}x+1$

43. $y=-2x+1$

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

Section 3.8

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 $f^{-1}(x)=\sqrt[3]{\dfrac{x-1}{3}}$

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

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

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

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

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

17. 65.574 mph

19. 34.073 mph

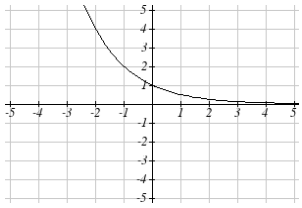
21. 14.142 feet

Chapter 4

Section 4.1

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

Section 4.2

1. B
3. A
5. E
7. D
9. C
11.

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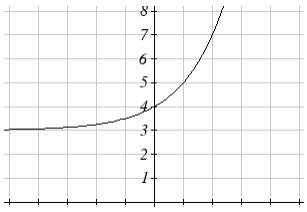
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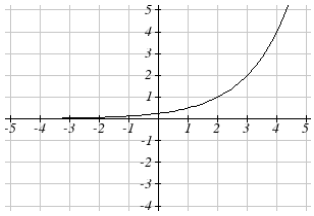

17. $y=4^x+4$
19. $y=4^{x+2}$
21. $y=-4^x$
23. As $x\to\infty$ $f(x)\to-\infty$. As $x\to-\infty$ $f(x)\to-1$
25. As $x\to\infty$ $f(x)\to-2$ As $x\to-\infty$ $f(x)\to\infty$
27. As $x\to\infty$ $f(x)\to 2$ As $x\to-\infty$ $f(x)\to\infty$
29. $y=-2^{x+2}+1=-4(2)^x+1$
31. $y=-2(2)^{-x}+3$
33. $y=-2(3)^x+7$
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. ½

31. 4
33. -3
35. -2
37. -1.398
39. 2.708
41. $\frac{\log(14)}{\log(5)} \approx 1.6397$
43. $\frac{\log\left(\frac{1}{15}\right)}{\log(7)} \approx -1.392$
45. $\frac{\ln(17)}{5} \approx 0.567$
47. $\frac{\frac{\log(38)}{\log(3)}+5}{4} \approx 2.078$
49. $\frac{\log(5)}{\log(1.03)} \approx 54.449$
51. $\frac{\log\left(\frac{8}{3}\right)}{3\log(1.04)} \approx 8.335$
53. $\frac{\ln\left(\frac{1}{5}\right)}{-0.12} \approx 13.412$
55. $\frac{\log\left(\frac{5}{8}\right)}{\log\left(\frac{1}{2}\right)} \approx 0.678$
57. $f(t) = 300e^{-0.0943t}$
59. $f(t) = 10e^{0.03922t}$
61. $f(t) = 150(1.0618)^t$
63. $f(t) = 50(0.98807)^t$
65. During the year 2013
67. During the year 2074
69. ≈ 34 *hours*
71. 13.532 years

Section 4.4

1. $\log_3(4)$
3. $\log_3(7)$
5. $\log_3(5)$
7. $\log_7(2)$
9. $\log\left(6x^9\right)$
11. $\ln\left(2x^7\right)$
13. $\log\left(x^2(x+1)^3\right)$
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. $x = 10$

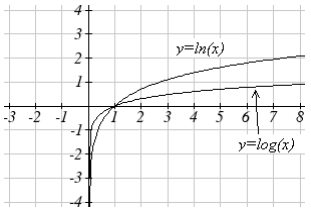
Section 4.5

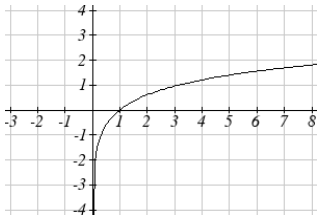
1. Domain: $: x > 5$ V. A. @ $x = 5$

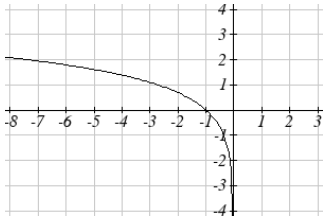
3. Domain: $x < 3$ V.A. @ $x = 3$

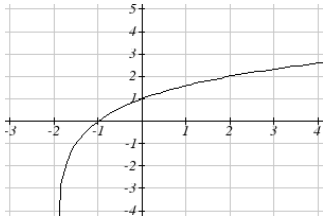
5. Domain: $x > -\frac{1}{3}$ V.A. @ $x = -\frac{1}{3}$

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

9. 

11. 

13. 

15. 

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

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

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

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.

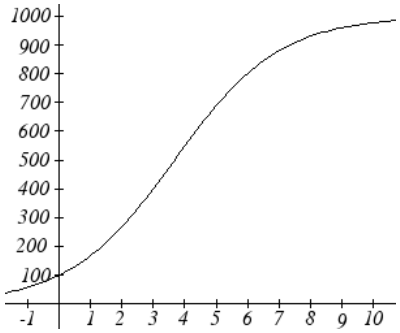
After 100 minutes = 15119

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

15. 23.1914 years

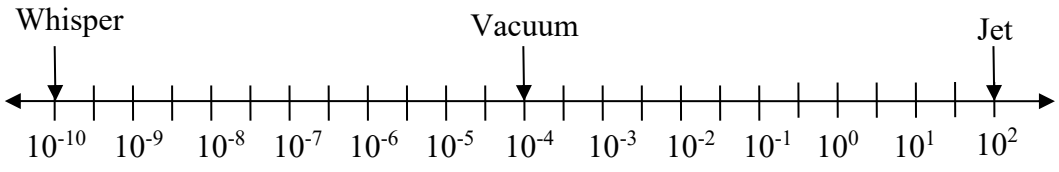
17. 53.319 hours

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

21. a) 

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 $(2.042727)^{0.693147} \approx e^{0.495105}$

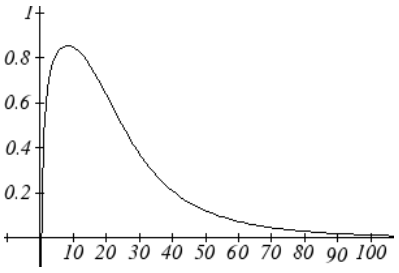
d) Anja's data predicts a continuous growth rate of 0.4116, which is much smaller than the rate 0.495105 you calculated. Our model would overestimate the number of cells.

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

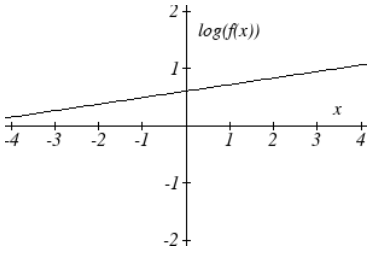
37. a) $C(t) = 1.03526^t$, or $C(t) = e^{0.03466t}$

b) Volume of one cell: $\frac{4}{3}\pi\left(50\times10^{-4}\right)^3 \approx 5.236\times10^{-7}$ cm^3, so will need about 1.9099×10^6 cells for a volume of 1cm^3. $C(t) = 1.9099\times10^6$ after 417.3 hours

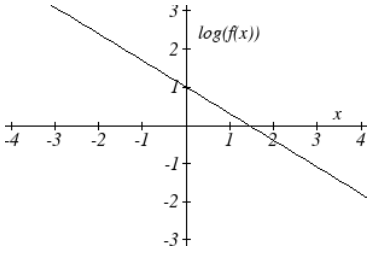
39. 31.699 days

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

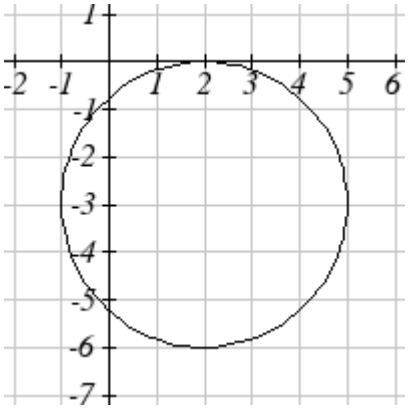
Section 5.1

1. 10

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

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

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

9. 

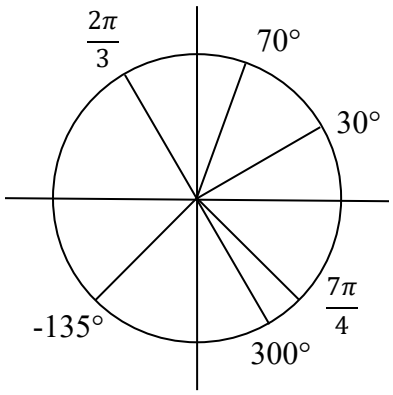
11. $(0,3+\sqrt{5})$ and $(0,3-\sqrt{5})$

13. (1.3416407865, 7.683281573)

15. (-1.07335, 2.8533)

17. 29.87 miles

Section 5.2

1. 

3. π

5. 150°

7. 325°

9. 54°

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

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

15. 35 miles

17. 8π cm

19. 5.7596 miles

21. 28.6479°

23. 14.1372 cm^2

25. 3960 rad/min 630.254 RPM

27. 2.094 in/sec, π/12 rad/sec, 2.5 RPM

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

31. Angular speed: π/12 rad/hr. Linear speed: 1036.73 miles/hr

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°. Quadrant III. $\sin(225°)=-\frac{\sqrt{2}}{2}$. $\cos(225°)=-\frac{\sqrt{2}}{2}$

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

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

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

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° c. 40° d. $\frac{5\pi}{3}$ e. 235°

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

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. $\sec(135°)=-\sqrt{2}$ b. $\csc(210°)=-2$ c. $\tan(60°)=\sqrt{3}$. d. $\cot(225°)=1$

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°) = 0.9397 cos(70°) = 0.3420 tan(70°) = 2.7475
    d. sin(283°) = -0.9744 cos(283°) = 0.2250 tan(283°) = -4.3315

17. $\sec(t)$ 19. $\tan(t)$ 21. $\tan(t)$ 23. $\cot(t)$ 25. $(\sec(t))^2$

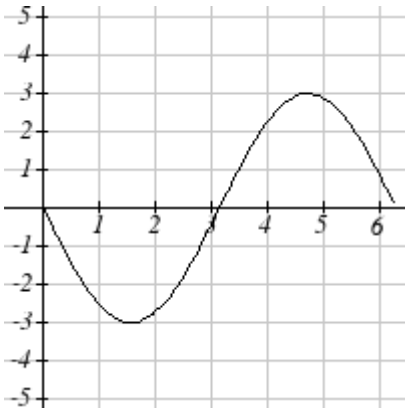
Section 5.5

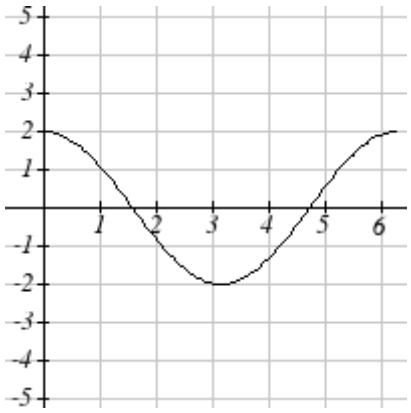
1. $\sin(A)=\frac{5\sqrt{41}}{41}, \cos(A)=\frac{4\sqrt{41}}{41}, \tan(A)=\frac{5}{4}$
   $\sec(A)=\frac{\sqrt{41}}{4}, \csc(A)=\frac{\sqrt{41}}{5}, \cot(A)=\frac{4}{5}$

3. $c=14,\ b=7\sqrt{3},\ B=60°$
5. $a=5.3171,\ c=11.3257,\ A=28°$
7. $a=9.0631,\ b=4.2262,\ B=25°$
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

1. 

3. 

5. Amp: 3. Period= 2. Midline: y= -4. $f(t) = 3\sin(\pi t) - 4$

7. Amp: 2. Period= 4π. Midline: y= 1. $f(t) = 2\cos\left(\frac{1}{2}t\right) + 1$

9. Amp: 2. Period= 5. Midline: y= 3. $f(t) = -2\cos\left(\frac{2\pi}{5}t\right) + 3$

11. Amp: 3, Period = $\frac{\pi}{4}$, Shift: 4 left, Midline: $y = 5$

13. Amp: 2, Period = $\frac{2\pi}{3}$, Shift: 7 right, Midline: $y = 4$

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

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

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

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

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

Section 6.2

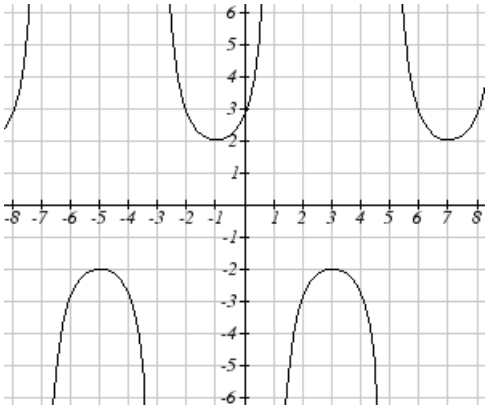
1. II

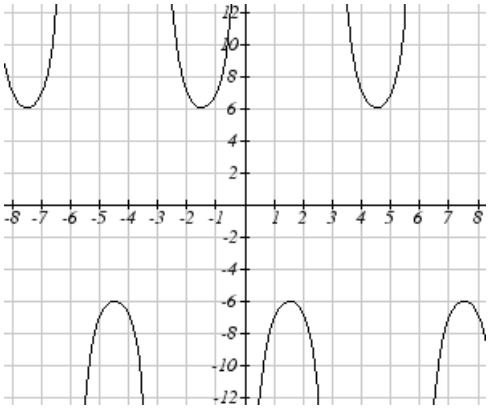
3. I

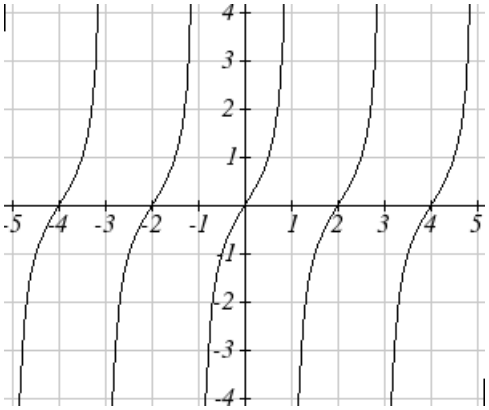
5. Period: $\frac{\pi}{4}$. Horizontal shift: 8 right

7. Period: 8. Horizontal shift: 1 left

9. Period: 6. Horizontal shift: 3 left

11. 

13. 

15. 

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

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

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

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

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

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

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

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

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

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

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

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

21. $4+8k$, where k is an integer

23. $\frac{1}{6}+2k, \frac{5}{6}+2k$, where k 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. $c = \sqrt{89}$, $A = 57.9946°$, $B = 32.0054°$

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

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

11. 75 degrees

13. 8

15. 2.80869431742

17. 5.035 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. $0.1386 + 10k$ and $8.6614 + 10k$, where k is an integer

11. $-0.0966 + \frac{2\pi}{3}k$ and $1.1438 + \frac{2\pi}{3}k$, 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. $8\left(\cos(5x)-\cos(27x)\right)$

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. $\cos(56°)$

5. $\cos(34°)$

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

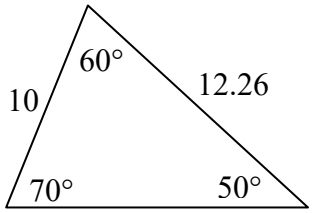
17. $y = -3\sin\left(\frac{\pi}{2}\right) + 2x + 7$

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

Chapter 8

Section 8.1

1.



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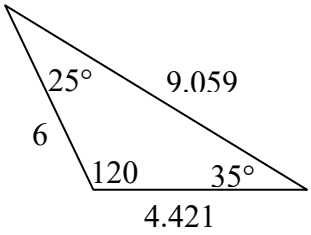

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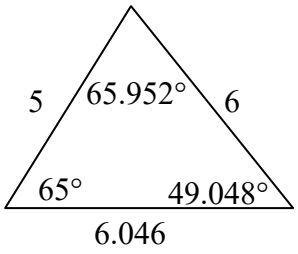
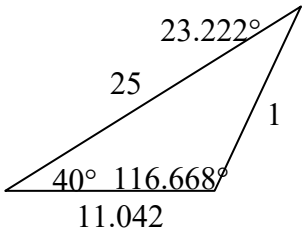


7.



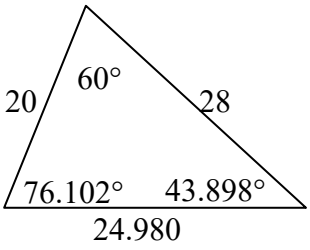
9. $\beta = 68°$, $a = 14.711$, $c = 20.138$

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

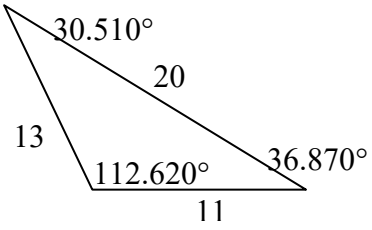
13. Not possible.

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

17.



19.



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

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

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^2

43. 7.72

Section 8.2

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

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

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

7. $(0,3)$

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

11. $(-1.248, 2.728)$

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

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

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

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

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

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

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

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

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

31. $y + 7x = 4$

33. $x = 2$

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

37. A

39. C

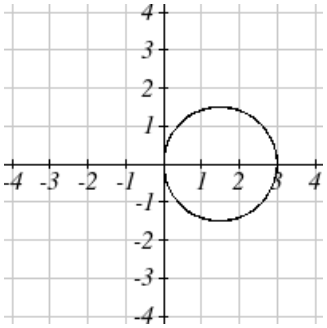
41. E

43. C

45. D

47. F

49.



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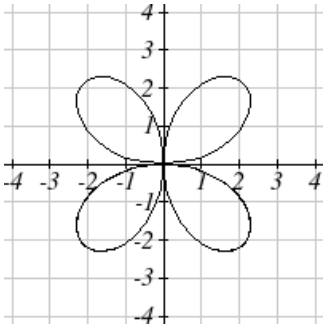

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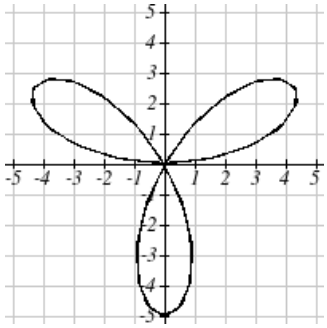
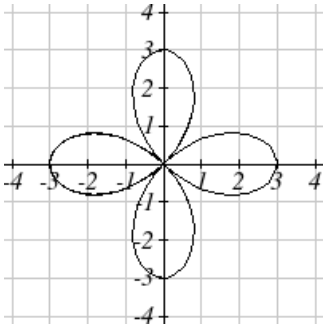
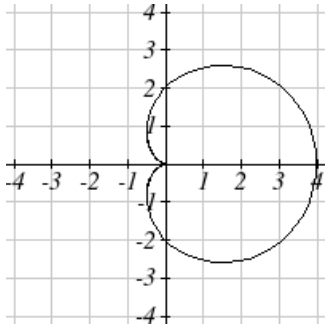
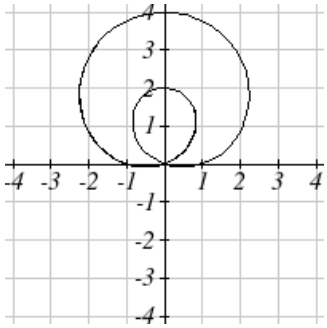
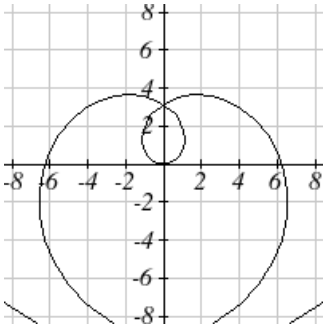
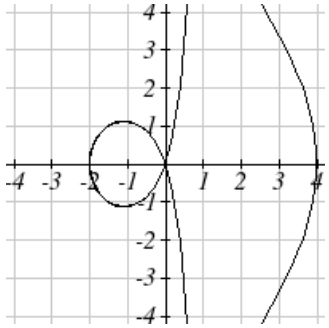


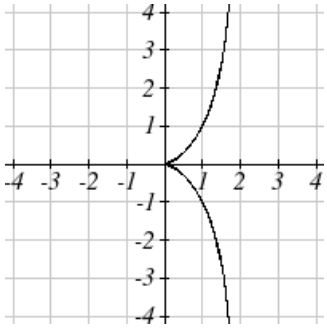
55. 

57. 

59. 

61. 

63. 

65. 

Section 8.3

1. $3i$

3. -12

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

7. $8-i$

9. $-11+4i$

11. $-12+8i$

13. $30-10i$

15. $11+10i$

17. 20

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

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

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

25. -1

27. i

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

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

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

35. $6e^{0i}$

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

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

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

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

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

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

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

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

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

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

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

59. 4096

61. $0.788+1.903i$

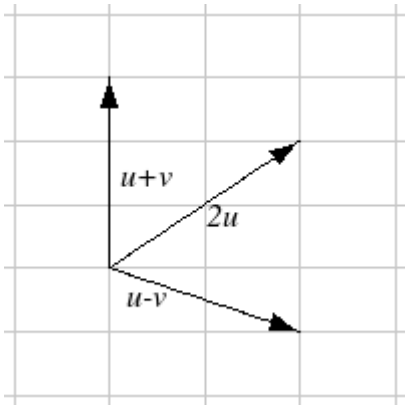
63. $1.771+0.322i$

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

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

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°

13. Magnitude: 7.810, Direction: 39.806°

15. Magnitude: 2.236, Direction: 153.435°

17. Magnitude: 5.385, Direction: 291.801°

19. Magnitude: 7.211, Direction: 236.310°

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. $\overrightarrow{F_{net}} = -4, -11$

29. Distance: 2.868. Direction: 86.474° North of West, or 3.526° 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. $6 \cdot 10 \cdot \cos(75°) = 15.529$ 3. $(0)(-3) + (4)(0) = 0$ 5. $(-2)(-10) + (1)(13) = 33$

7. $\cos^{-1}\left(\dfrac{0}{\sqrt{4}\sqrt{3}}\right) = 90°$ 9. $\cos^{-1}\left(\dfrac{(2)(1) + (4)(-3)}{\sqrt{2^2 + 4^2}\sqrt{1^2 + (-3)^2}}\right) = 135°$

11. $\cos^{-1}\left(\dfrac{(4)(8) + (2)(4)}{\sqrt{4^2 + 8^2}\sqrt{2^2 + 4^2}}\right) = 0°$ 13. $(2)(k) + (7)(4) = 0$, $k = -14$

15. $\dfrac{(8)(1) + (-4)(-3)}{\sqrt{1^2 + (-3)^2}} = 6.325$ 17. $\left(\dfrac{(-6)(1) + (10)(-3)}{\sqrt{1^2 + (-3)^2}^2}\right)\langle 1,-3\rangle = \langle -3.6,10.8\rangle$

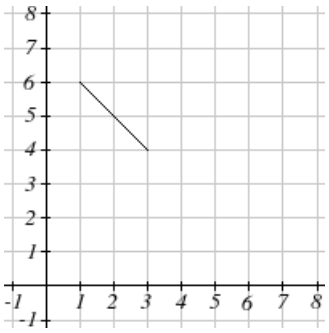
19. The vectors are $\langle 2,3\rangle$ and $\langle -5,-2\rangle$. The acute angle between the vectors is 34.509°

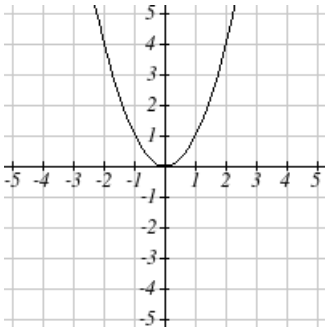
21. 14.142 pounds 23. $\langle 10\cos(10°),10\sin(10°)\rangle \cdot \langle 0,-20\rangle$, so 34.7296 ft-lbs

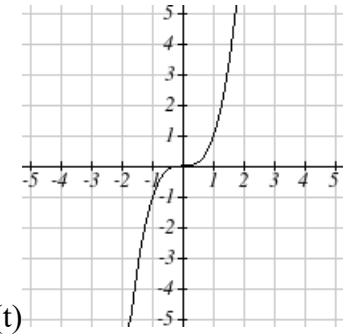
25. $40 \cdot 120 \cdot \cos(25°) = 4350.277$ ft-lbs

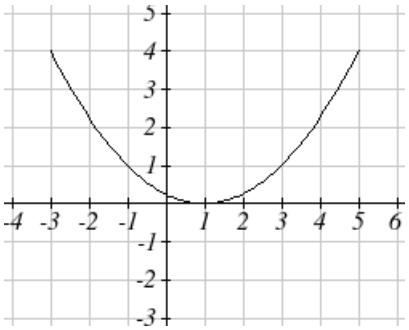
Section 8.6

1. C 3. E 5. F

7. 

9. x(t) 

y(t) 

11. 

13. $y=-2+2x$

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

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

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

21. $y=x^3$

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

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

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

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

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

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

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

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

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

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

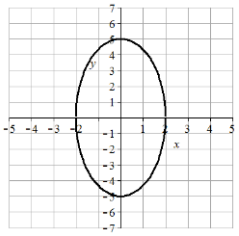
43. $\begin{cases}x(t)=20\sin\left(\dfrac{2\pi}{5}t\right)+8\sin(\pi t)\\ y(t)=35-20\cos\left(\dfrac{2\pi}{5}t\right)-8\cos(\pi t)\end{cases}$

Chapter 9

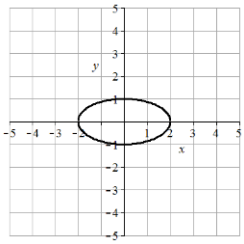
Section 9.1

1. D 3. B

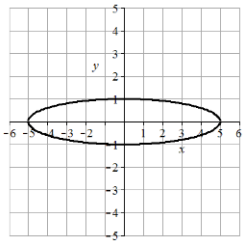
5. Vertices (0,±5), minor axis endpoints (±2,0), major length = 10, minor length = 4



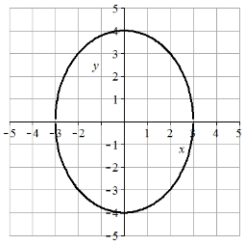
7. Vertices (±2,0), minor axis endpoints (0,±1), major length = 4, minor length = 2



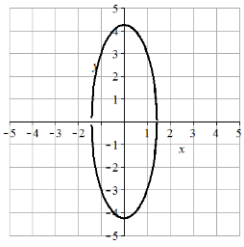
9. Vertices (±5,0), minor axis endpoints (0,±1), major length = 10, minor length = 2



11. Vertices (0,±4), minor axis endpoints (±3,0), major length = 8, minor length = 6



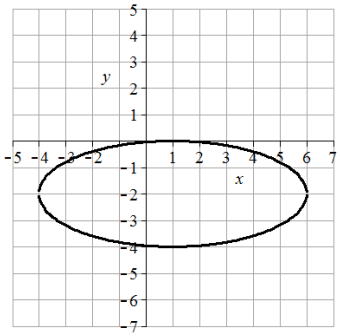
13. Vertices $\left(0,\pm 3\sqrt{2}\right)$, minor axis endpoints $\left(\pm\sqrt{2},0\right)$, major length = $6\sqrt{2}$, minor length = $2\sqrt{2}$



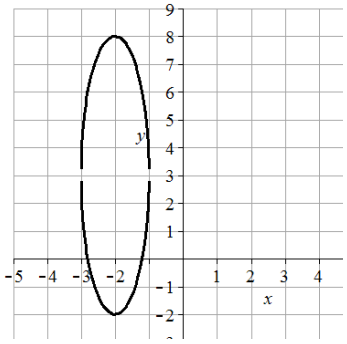
15. $\frac{x^2}{16}+\frac{y^2}{4}=1$ 17. $\frac{x^2}{1024}+\frac{y^2}{49}=1$ 19. $\frac{x^2}{4}+\frac{y^2}{9}=1$

21. B 23. C 25. F 27. G

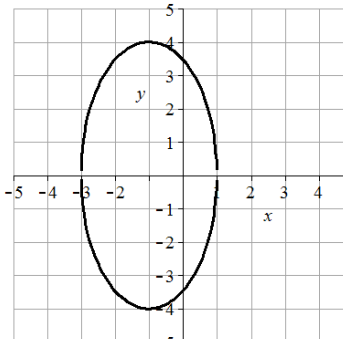
29. Center (1,-2), vertices (6,-2) and (-4,-2), minor axis endpoints (1,0) and (1,-4), major length= 10, minor length = 4



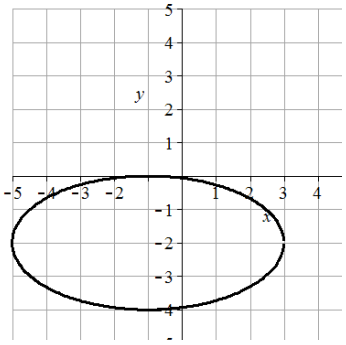
31. Center (-2,3), vertices (-2,8) and (-2,-2), minor axis endpoints (-1,3) and (-3,3), major length = 10, minor length = 2



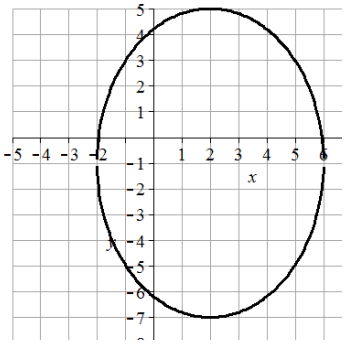
33. Center (-1,0), vertices (-1,4) and (-1,-4), minor axis endpoints (-1,0) and (3,0), major length = 8, minor length = 4



35. Center (-1,-2), vertices (3,-2) and (-5,-2), minor axis endpoints (-1,0) and (-1,-4), major length = 8, minor length = 4



37. Center (2,-1), vertices (2,5) and (2,-7), minor axis endpoints (6,-1) and (-2,-1), major length = 12, minor length = 8



39. $(x-3)^2+\frac{(y+1)^2}{16}=1$ 41. $\frac{(x+4)^2}{16}+\frac{(y-3)^2}{25}=1$

43. 2.211083 feet 45. 17 feet 47. 64 feet 49. (±4,0) 51. (-6,6) and (-6,-4)

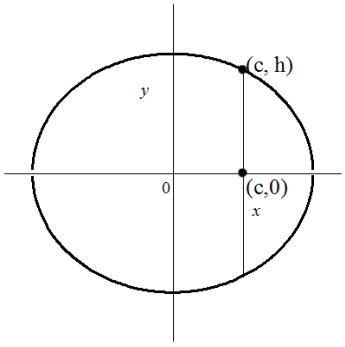
53. $\frac{x^2}{9}+\frac{y^2}{5}=1$ 55. $\frac{x^2}{11}+\frac{y^2}{36}=1$ 57. $\frac{x^2}{49}+\frac{y^2}{24}=1$ 59. $\frac{x^2}{4}+\frac{y^2}{20}=1$

61. $\frac{x^2}{16}+\frac{y^2}{8}=1$ 63. $\frac{(x+2)^2}{12}+\frac{(y-1)^2}{16}=1$ 65. $\frac{(x-3)^2}{36}+\frac{(y-2)^2}{11}=1$

67. $\frac{(x-3)^2}{21}+\frac{(y+1)^2}{25}=1$ 69. $\frac{(x-1)^2}{4}+\frac{(y-3)^2}{5}=1$ 71. $\frac{(x+2)^2}{289}+\frac{(y+1)^2}{120}=1$

73. 31.22 feet 75. $\frac{x^2}{8640.632025}+\frac{y^2}{8638.214}=1$ 77. $\frac{x^2}{25}+\frac{y^2}{9}=1$

79. The center is at (0,0). Since $a > b$, the ellipse is horizontal. Let (c,0) be the focus on the positive x-axis. Let (c, h) be the endpoint in Quadrant 1 of the latus rectum passing through (c,0).

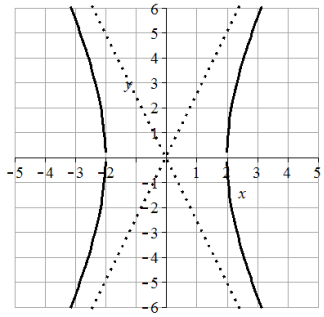


The distance between the focus and latus rectum endpoint can be found by substituting (c,0) and (c,h) into the distance formula $h=\sqrt{\left(x_1-x_2\right)^2+\left(y_1-y_2\right)^2}$ which yields $h=\sqrt{\left(c-c\right)^2+\left(h-0\right)^2}=h$. So h is half the latus rectum distance. Substituting (c,h) into the ellipse equation to find h gives $\frac{c^2}{a^2}+\frac{h^2}{b^2}=1$. Solve for h yields $h^2=b^2\left(1-\frac{c^2}{a^2}\right)=b^2\left(\frac{a^2}{a^2}-\frac{c^2}{a^2}\right)=b^2\left(\frac{a^2-c^2}{a^2}\right)=b^2\left(\frac{b^2}{a^2}\right)=\frac{b^4}{a^2}$. so $h=\sqrt{\frac{b^4}{a^2}}=\frac{b^2}{a}$. The distance of the latus rectum is $2h=\frac{2b^2}{a}$.

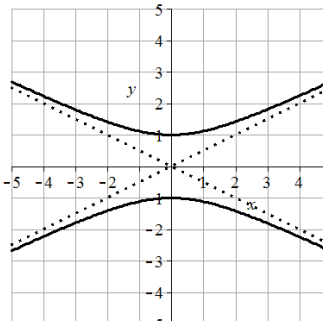
Section 9.2

1. B 3. D

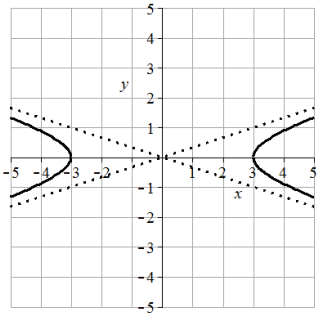
5. Vertices (±2,0), transverse length = 4, asymptotes y = ±5/2x,



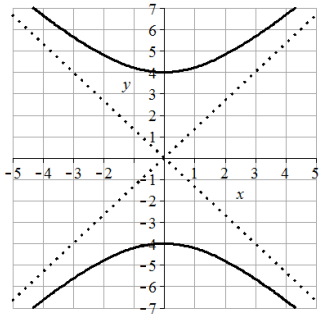
7. Vertices (0, ±1), transverse length = 2, asymptotes y = ±1/2x,



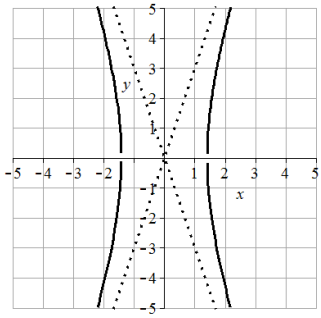
9. Vertices (±3,0), transverse length = 6, asymptotes y =±1/3x,



11. Vertices (0, ±4), transverse length = 8, asymptotes y =±4/3x



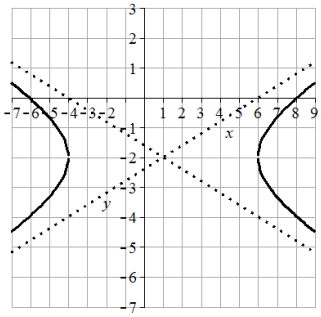
13. Vertices ($\pm\sqrt{2}$,0), transverse length = $2\sqrt{2}$, asymptotes y =±3x,



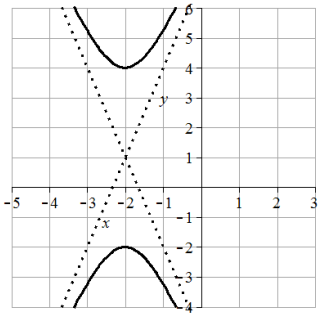
15. $\frac{y^2}{4}-\frac{x^2}{9}=1$ 17. $\frac{y^2}{16}-\frac{x^2}{64}=1$ 19. $\frac{x^2}{9}-\frac{y^2}{36}=1$ 21. $\frac{x^2}{16}-\frac{y^2}{16}=1$

23. C 25. H 27. B 29. A

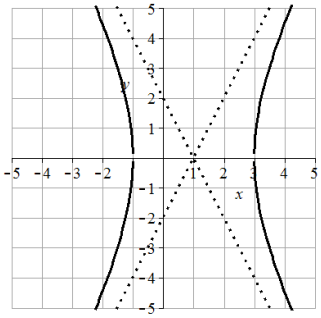
31. Center (1,-2), vertices (6,-2) and (-4,-2), transverse length = 10, asymptotes y =±2/5(x-1)-2



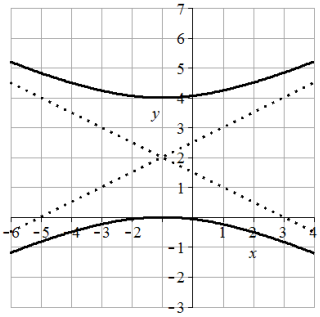
33. Center (-2,1), vertices (-2,4) and (-2,-2), transverse length = 6, asymptotes y =±3(x+2)+1



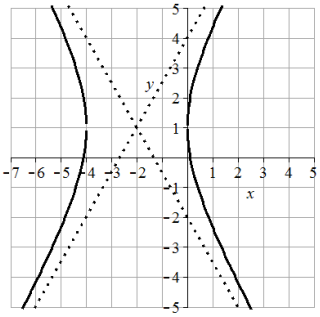
35. Center (1,0), vertices (3,0) and (-1,0), transverse length = 4, asymptotes y =±2(x-1)



37. Center (-1,2), vertices (-1,4) and (-1,0), transverse length = 4, asymptotes y =±1/2(x+1)+2

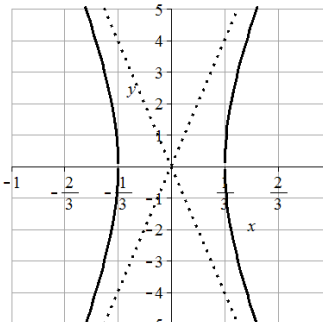


39. Center (-2,1), vertices (0,1) and (-4,1), transverse length = 4, asymptotes y =±3/2(x+2)+1

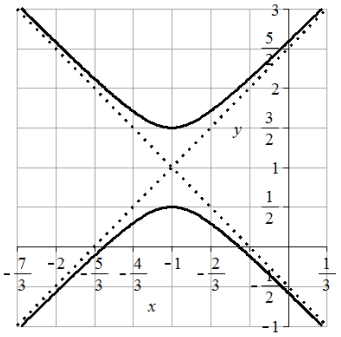


41. $\frac{(y+1)^2}{9}-\frac{(x-4)^2}{4}=1$ 43. $\frac{(y-2)^2}{16}-\frac{(x+1)^2}{4}=1$

45. Center (0,0), vertices (±1/3,0), transverse length = 2/3, asymptotes y = ±12x



47. Center (-1,1), vertices (-1,3/2) and (-1,1/2), transverse length = 1, asymptotes y = ± 3/2 (x + 1) +1



49. Foci (0,±5) 51. Foci (5,6) and (-3,6) 53. Foci (-4,6) and (-4,-4)

55. $\frac{x^2}{16}-\frac{y^2}{9}=1$ 57. $\frac{y^2}{144}-\frac{x^2}{25}=1$ 59. $\frac{x^2}{225}-\frac{y^2}{64}=1$ 61. $\frac{x^2}{64}-\frac{y^2}{36}=1$

63. $\frac{(y-2)^2}{16}-\frac{(x-1)^2}{9}=1$ 65. $\frac{(x+1)^2}{25}-\frac{(y-3)^2}{144}=1$ 67. $\frac{x^2}{900}-\frac{y^2}{1600}=1$

69. $\frac{x^2}{900}-\frac{y^2}{14400.3636}=1$

71. $\frac{x^2}{3025}-\frac{y^2}{6975}=1$

73. $5y^2-x^2+25=0$ can be put in the form $\frac{y^2}{5}-\frac{x^2}{25}=-1$. $x^2-5y^2+25=0$ can be put in the form $\frac{y^2}{5}-\frac{x^2}{25}=1$ showing they are conjugate.

75. $\sqrt{2}$ 77. No matter the value of k, the foci are at $\left(\pm\sqrt{6},0\right)$

Section 9.3

1. C 3. A

5. Vertex: (0,0). Axis of symmetry: $y = 0$. Directrix: $x = -4$. Focus: (4,0)

7. Vertex: (0,0). Axis of symmetry: $x = 0$. Directrix: $y = -1/8$. Focus: (0,1/8)

9. Vertex: (0,0). Axis of symmetry: $y = 0$. Directrix: $x = 1/16$. Focus: (-1/16,0)

11. Vertex: (2,-1). Axis of symmetry: $x = 2$. Directrix: $y = -3$. Focus: (2,1)

13. Vertex: (-1,4). Axis of symmetry: $x = -1$. Directrix: $y = 3$. Focus: (-1,5)

15. $(y-1)^2=-(x-3)$ 17. $(y-3)^2=12(x-2)$ 19. $x^2=4(y-3)$

21. At the focus, (0,1) 23. 2.25 feet above the vertex. 25. 0.25 ft

27. $\left(\frac{1}{\sqrt{3}},\frac{2}{\sqrt{3}}\right),\left(\frac{-1}{\sqrt{3}},\frac{-2}{\sqrt{3}}\right)$ 29. $\left(3,\sqrt{2}\right),\left(3,-\sqrt{2}\right),\left(-3,\sqrt{2}\right),\left(-3,-\sqrt{2}\right)$

31. $\left(2\sqrt{2},8\right),\left(-2\sqrt{2},8\right)$

33. $\left(\sqrt{\frac{5}{3}},\sqrt{\frac{2}{3}}\right),\left(-\sqrt{\frac{5}{3}},\sqrt{\frac{2}{3}}\right),\left(\sqrt{\frac{5}{3}},-\sqrt{\frac{2}{3}}\right),\left(-\sqrt{\frac{5}{3}},-\sqrt{\frac{2}{3}}\right)$

35. (-64.50476622, 93.37848007) ≈ (-64.50, 93.38)

Section 9.4

1. $e = 3$. Directrix: $x = 4$. Hyperbola.

3. $e = 3/4$. Directrix: $y = -2/3$. Ellipse.

5. $e = 1$. Directrix: $x = -1/5$. Parabola.

7. $e = 2/7$. Directrix: $x = 2$. Ellipse.

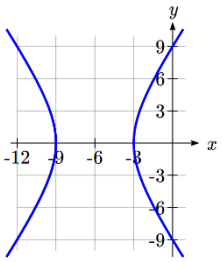
9. $r = \dfrac{20}{1 - 5\cos(\theta)}$

11. $r = \dfrac{1}{1 + \frac{1}{3}\sin(\theta)}$, or $r = \dfrac{3}{3 + \sin(\theta)}$

13. $r = \dfrac{2}{1 - \sin(\theta)}$

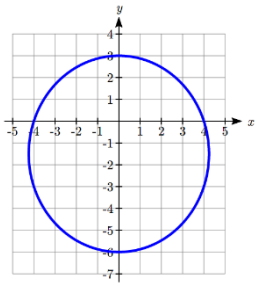
15. Hyperbola. Vertices at (-9,0) and (-3,0)
Center at (-6,0). $a = 3$. $c = 6$, so $b = \sqrt{27}$

$$\frac{(x+6)^2}{9} - \frac{y^2}{27} = 1$$



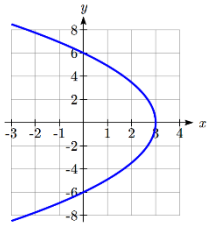
17. Ellipse. Vertices at (0,3) and (0,-6)
Center at (0,-1.5). $a = 4.5$, $c = 1.5$, $b = \sqrt{18}$

$$\frac{x^2}{18} + \frac{(y+1.5)^2}{20.25} = 1$$

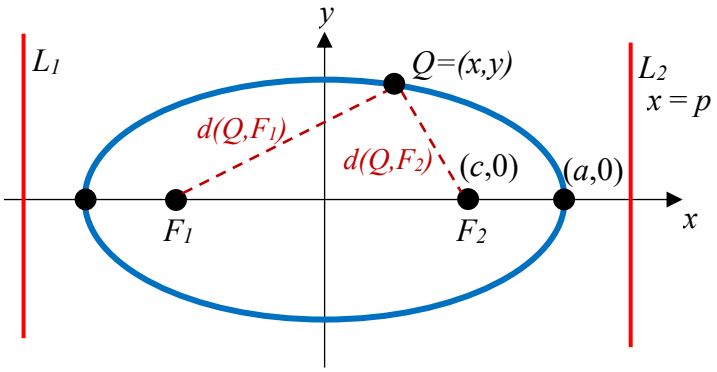


19. Parabola. Vertex at (3,0). $p = 3$.

$$y^2 = -12(x-3)$$



21. a)



b) $d(Q,L_1)=x-(-p)=x+p$, $d(Q,L_2)=p-x$

c) $d(Q,F_1)=ed(Q,L_1)=e(x+p)$. $d(Q,F_2)=ed(Q,L_2)=e(p-x)$

d) $d(Q,F_1)+d(Q,F_2)=e(x+p)+e(p-x)=2ep$, a constant.

e) At $Q = (a, 0)$, $d(Q,F_1)=a-(-c)=a+c$, and $d(Q,F_2)=a-c$, so
$d(Q,F_1)+d(Q,F_2)=(a+c)+(a-c)=2a$

Combining with the result above, $2ep=2a$, so $p=\frac{a}{e}$.

f) $d(Q,F_2)=a-c$, and $d(Q,L_2)=p-a$

$\frac{d(Q,F_2)}{d(Q,L_2)}=e$, so $\frac{a-c}{p-a}=e$.

$a-c=e(p-a)$. Using the result from (e),

$a-c=e\left(\frac{a}{e}-a\right)$

$a-c=a-ea$

$e=\frac{c}{a}$