Answers for Lesson 13-1 Exercises

1. $x = -2$ to $x = 3, x = 2$ to $x = 7; 5$

2. $x = 0$ to $x = 4, x = 5$ to $x = 9; 4$

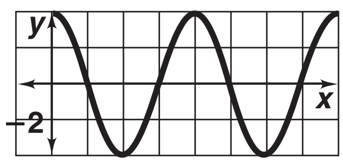
3. $x = 0$ to $x = 4, x = 2$ to $x = 6; 4$

4. not periodic **5.** periodic; 12 **6.** not periodic

7. not periodic **8.** periodic; 8 **9.** periodic; 7

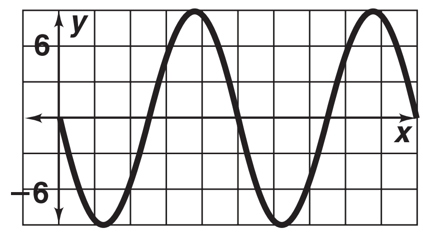
10. 4 **11.** 3 **12.** 1 **13.** 2

14.



1 unit on the *x*-axis is 0.005 s.

15.



1 unit on the *x*-axis is 0.001 s.

16. **a.** y

b. x

17. Answers may vary. Sample: Yes; average monthly temperatures for three years should be cyclical due to the variation of the seasons.

18. Answers may vary. Sample: No; population usually increases or decreases but is not cyclical.

19. Answers may vary. Sample: Yes; traffic that passes through an intersection should be at the same levels for the same times of day for two consecutive work days.

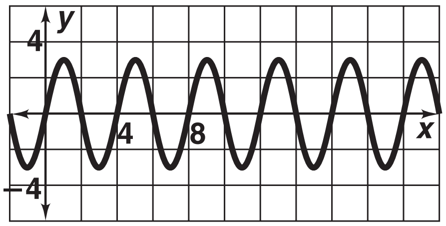
20. 60 beats per min

21. **a.** 1 s

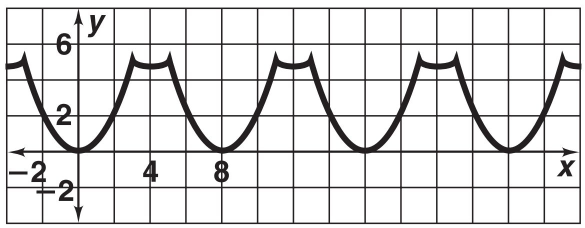
b. 1.5 mV

22. Check students' work.

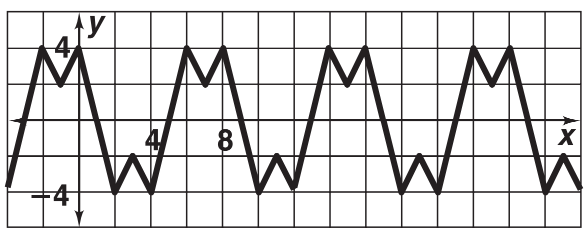
23. 3, −3, 4;



24. 5, 0, 8;



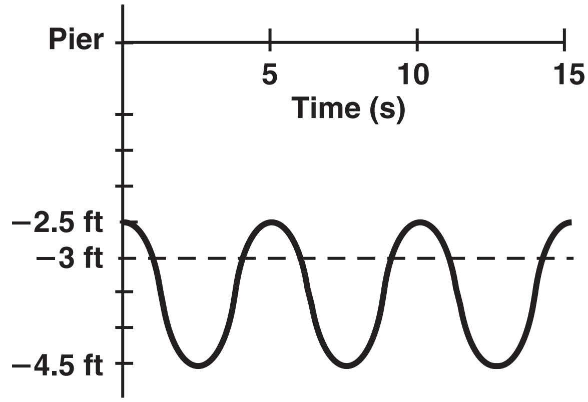
25. 4, −4, 8;



26. 1 yr
27. 2 weeks
28. 3 months
29. 1 hour
30. 1 day
31. 2, 2, 2

32. **a.** 67
b. 70
c. 70
d. 67

33. a.



b. 5 s, 1 ft

c. Answers may vary. Sample: about $1\frac{1}{3}$s

34. a. 24.22 days

b. 0.78 day

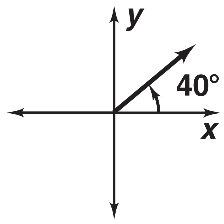
c. 0.22 day

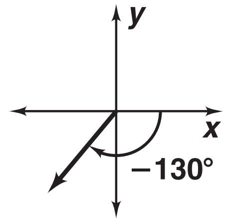
d. Answers may vary. Sample: The calendar year is meant to predict events in the solar year. Keeping the difference between the two minimal is necessary for the calendar year to be useful.

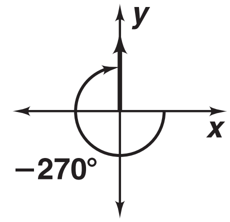
Answers for Lesson 13-2 Exercises

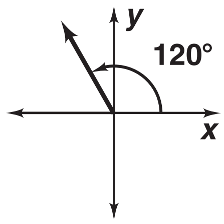
1. $-315°$ **2.** $-135°$ **3.** $240°$

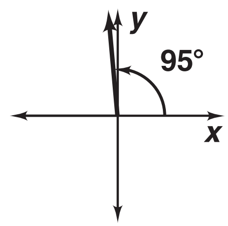
4. $115°$ **5.** $-110°$ **6.** $-340°$

7.


8.


9.


10.


11.


12. $25°$ **13.** $215°$ **14.** $315°$

15. $4°$ **16.** $140°$ **17.** $150°$

18. $55°$ **19.** $180°$

20. Answers may vary. Sample: $-135°, 585°$

21. $\frac{1}{2}, -\frac{\sqrt{3}}{2}$; 0.50, −0.87

22. $-\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}$; −0.71, −0.71

23. $\frac{\sqrt{3}}{2}, -\frac{1}{2}$; 0.87, −0.50

24. $-\frac{1}{2}, \frac{\sqrt{3}}{2}$; −0.50, 0.87

25. $\frac{\sqrt{3}}{2}, \frac{1}{2}$; 0.87, 0.50

26. $\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}$; 0.71, −0.71

27. $\frac{\sqrt{3}}{2}, -\frac{1}{2}$; 0.87, −0.50

28. $-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}$; −0.71, 0.71

29. 1.00, 0.00

30. 0.85, 0.53

31. 0.71, −0.71

32. −0.87, 0.50

33. −0.09, −1.00

34. 0.98, −0.17

35. −0.90, 0.44

36. 0.00, 1.00

37–44. Answers may vary. Samples:

37. $405°, -315°$

38. $235°, -485°$

39. $45°, -315°$

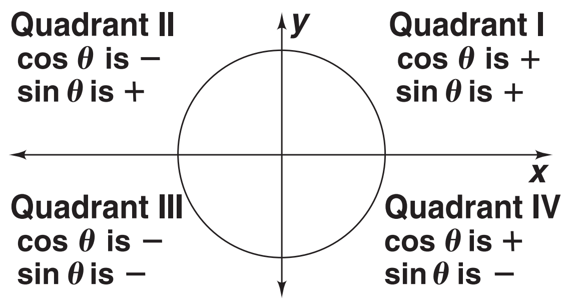
40. $40°, -320°$

41. 275°, −445° **42.** 295°, −65° **43.** 573°, −147°

44. 303°, −417° **45.** II **46.** III

47. negative x-axis **48.** IV **49.** positive x-axis

50. **a.**



b. II

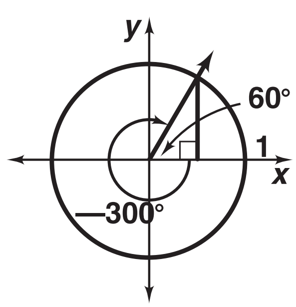
c. If the terminal side of an angle is in Quadrants I or II, then the sine of the angle is positive; otherwise it is not. If the terminal side of an angle is in Quadrants I or IV, then the cosine of the angle is positive; otherwise it is not.

51. **a.** 0.77, 0.77, 0.77

b. The cosines of the three angles are equal because the angles are coterminal.

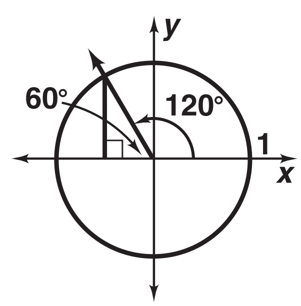
52. The x-coordinate of the point on the ray defined by angle θ is equal to $\cos\theta$; similarly for the y-coordinate and $\sin\theta$. The terminal sides of the angles 0°, 180°, and 360° lie on the x-axis, and thus their sines are all 0 and their cosines are ± 1. The angles 90° and 270° lie on the y-axis, so their cosines are 0 and their sines are 1 and −1 respectively.

53.



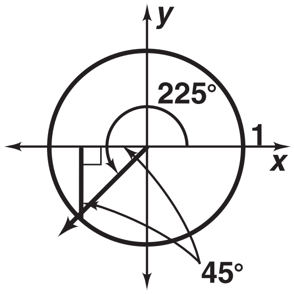
$\frac{1}{2}, \frac{\sqrt{3}}{2}$

54.



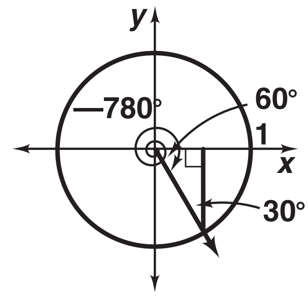
$-\frac{1}{2}, \frac{\sqrt{3}}{2}$

55.



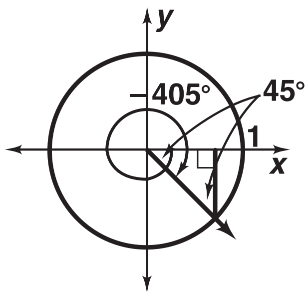
$-\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}$

56.



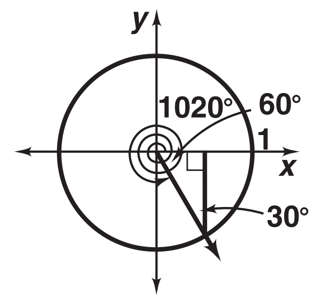
$\frac{1}{2}, -\frac{\sqrt{3}}{2}$

57.



$\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}$

58.

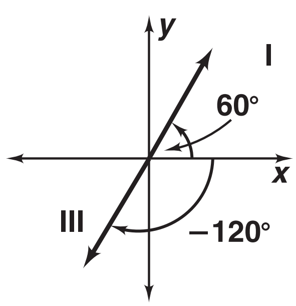


$\frac{1}{2}, -\frac{\sqrt{3}}{2}$

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

60. Answers may vary. Sample: 30°, 150°, −210°, 390°

61. No; yes; if the sin θ and cos θ are both negative, θ is in Quadrant III. −120° is in Quadrant III.

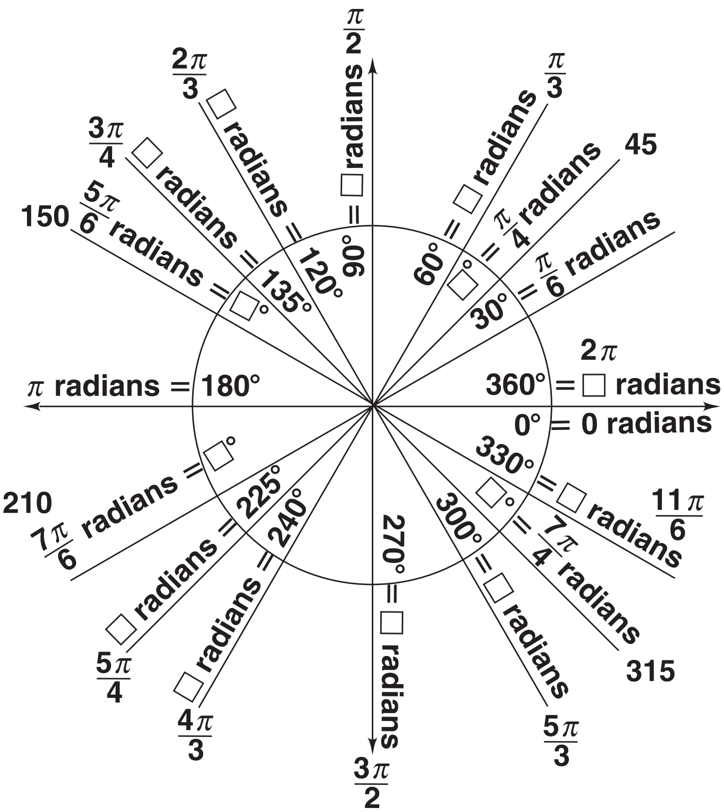


62. **a.** Check students' work.

b. −20°

Answers for Lesson 13-3 Exercises

1. $-\frac{5\pi}{3}, -5.24$
2. $\frac{5\pi}{6}, 2.62$
3. $-\frac{\pi}{2}, -1.57$
4. $-\frac{\pi}{3}, -1.05$
5. $\frac{8\pi}{9}, 2.79$
6. $\frac{\pi}{9}, 0.35$
7. $540°$
8. $198°$
9. $-120°$
10. $-172°$
11. $90°$
12. $270°$
13.



14. $\frac{\sqrt{3}}{2}, \frac{1}{2}$
15. $\frac{1}{2}, \frac{\sqrt{3}}{2}$
16. $0, 1$
17. $-\frac{1}{2}, \frac{\sqrt{3}}{2}$
18. $-\frac{\sqrt{3}}{2}, \frac{1}{2}$
19. $0, -1$
20. 3.1 cm
21. 10.5 m
22. 51.8 ft
23. 25.1 in.
24. 4.7 m
25. 43.2 cm
26. $\approx$107 in.
27. $\approx$32 ft

28. **a.** ≈11,048 km
b. ≈33,144 km
c. ≈27,620 km
d. ≈276,198 km
e. 18.1 h

29. ≈42.2 in.

30. **a.** 15°, $\frac{\pi}{12}$ radians
b. ≈1036.7 mi
c. ≈413.6 mi

31. III

32. II

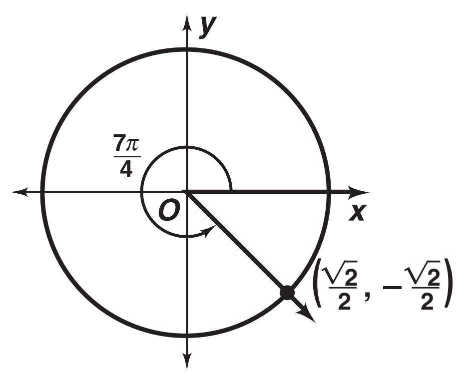
33. positive *y*-axis

34. II

35. negative *x*-axis

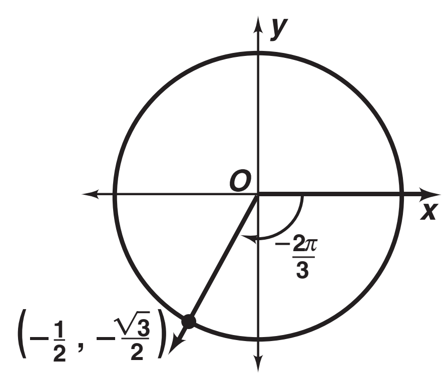
36. III

37.



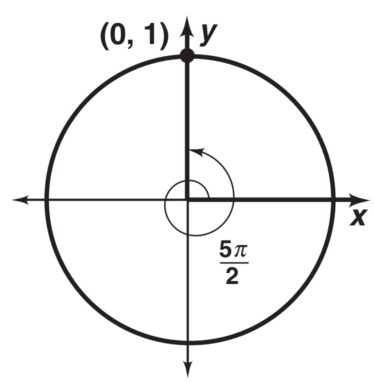
0.71, −0.71

38.



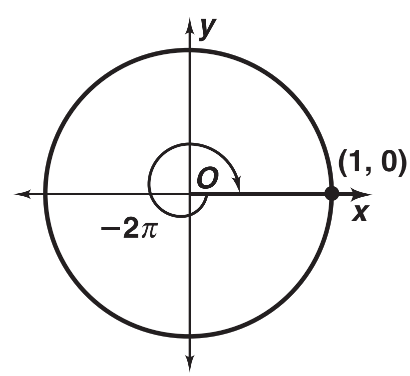
−0.50, −0.87

39.



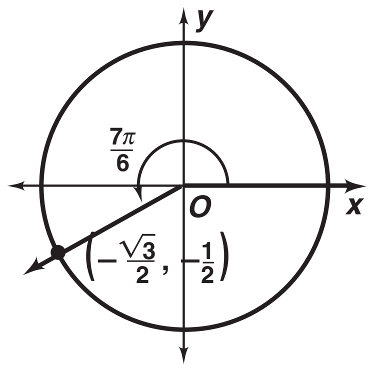
0.00, 1.00

40.



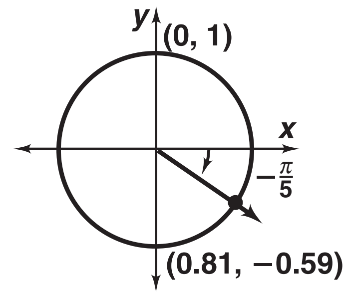
1.00, 0.00

41.



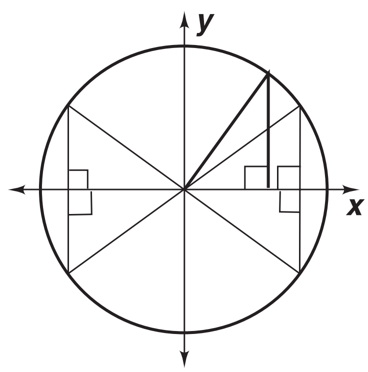
$-0.87, -0.50$

42.



$0.81, -0.59$

43. a–b.



c. All five triangles are congruent by SSS. All have a hypotenuse of 1 unit, a long leg of about 0.81 unit, and a short leg of 0.59 unit.
$\cos\frac{\pi}{5} \approx 0.81, \sin\frac{\pi}{5} \approx 0.59;$
$\sin\frac{3\pi}{10} \approx 0.81, \cos\frac{3\pi}{10} \approx 0.59;$
$\cos\frac{4\pi}{5} \approx -0.81, \sin\frac{4\pi}{5} \approx 0.59;$
$\cos\frac{6\pi}{5} \approx -0.81, \sin\frac{6\pi}{5} \approx -0.59;$
$\cos\frac{9\pi}{5} \approx 0.81, \sin\frac{9\pi}{5} \approx -0.59$

44. Check students' work.

45. ≈ 11 radians

46. The student forgot to include parentheses around $2*\pi$.

47. ≈ 798 ft; $55°, -665°$

48. ≈ 23.6 in.; Sample: $-\frac{7\pi}{6}, \frac{17\pi}{6}$

49. If two angles measured in radians are coterminal, the difference of their measures will be evenly divisible by 2π.

50. ≈ 6.3 cm

51. ≈ 4008.7 mi

52. $-\frac{3\pi}{2}$ radians

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

54. $\frac{4\pi}{3}$ radians

55. $\frac{35\pi}{6}$ radians

56.

$$\begin{aligned} \frac{\theta}{2\pi} &= \frac{s}{2\pi r} \\ \frac{\theta}{2\pi} \cdot 2\pi r &= \frac{s}{2\pi r} \cdot 2\pi r \\ \theta r &= s \\ s &= r\theta \end{aligned}$$

57. **a.** 0.5017962; 0.4999646; the first four terms

b. $1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} - \ \ldots$

c. ≈ 0.951; $18°$

Answers for Lesson 13-4 Exercises

1. $\frac{1}{2}$ **2.** ≈ 0.7 **3.** ≈ 0.9

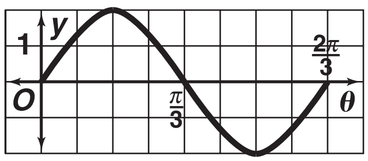
4. 0 **5.** ≈ -0.9 **6.** ≈ -0.9

7. 1 **8.** ≈ 0.1 **9.** ≈ -0.8

10. ≈ -1 **11.** -1 **12.** ≈ -0.7

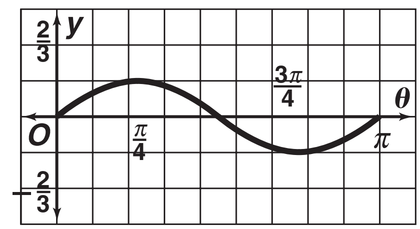
13. $3; 2, \frac{2\pi}{3}$ **14.** $\frac{1}{2}; 1, 4\pi$ **15.** $2; 3, \pi$

16.



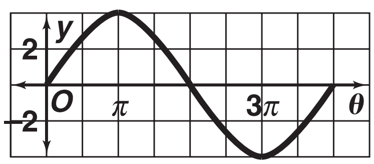
$y = 2 \sin 3\theta$

17.



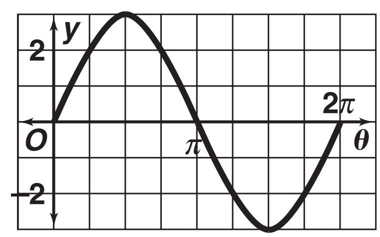
$y = \frac{1}{3} \sin 2\theta$

18.



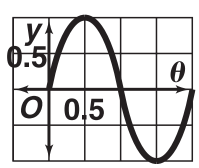
$y = 4 \sin \frac{1}{2}\theta$

19.



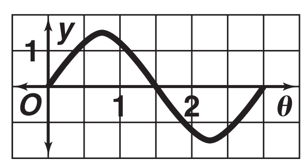
$y = 3 \sin \theta$

20.



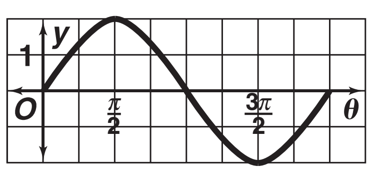
$y = \sin \pi\theta$

21.

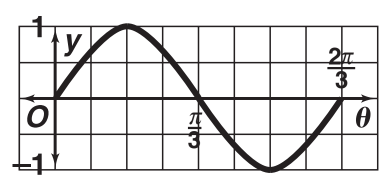


$y = 1.5 \sin \frac{2\pi}{3}\theta$

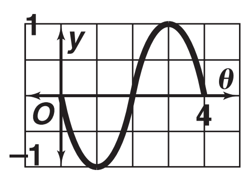
22.



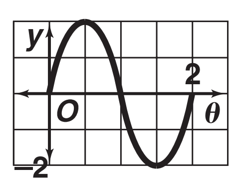
23.



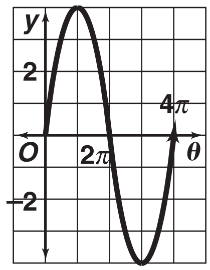
24.



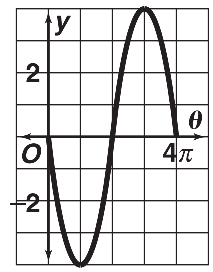
25.



26.



27.



28. $2\pi; y = 2 \sin \theta$

29. $2\pi; y = -3 \sin \theta$

30. $\pi; y = \frac{5}{2} \sin 2\theta$

31. $\frac{\pi}{3}; y = \frac{1}{2} \sin 6\theta$

32. $\pi; y = -\sin 2\theta$

33. $4; y = 3 \sin \frac{\pi}{2}\theta$

34. $1; 1, 2\pi$

35. $5; 1, \frac{2\pi}{5}$

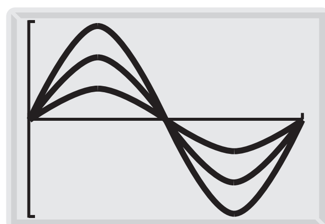
36. $\pi; 1, 2$

37. $1; 3, 2\pi$

38. $1; 5, 2\pi$

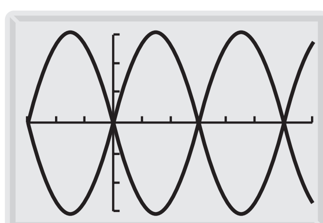
39. $2\pi; 5, 1$

40. a.



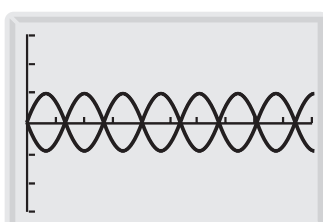
b. As *a* increases, the amplitude of the graph increases.

41. a.



They are reflections of each other in the *x*-axis.

b.



They are reflections of each other in the *x*-axis.

c. When either *a* or *b* is replaced by its opposite, the graph is a reflection of the original graph in the *x*-axis.

42. **a.** π

b. 4

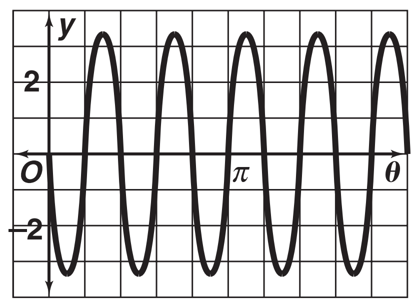
43. **a.** $\frac{1}{440}$

b. 0.001

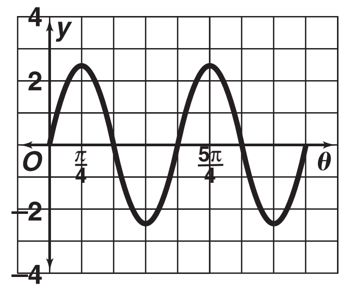
c. 880π

44.
- $|a|$ is the amplitude of the function.
- b is the number of cycles in the interval 0° to 360°.
- $\frac{360°}{b}$ is the period of the function. The properties relating to number of cycles and period are affected.

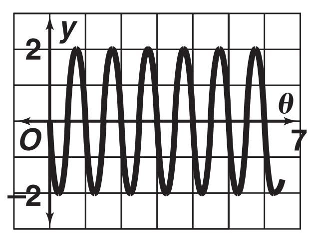
45. $\frac{2\pi}{5}$, 3.5



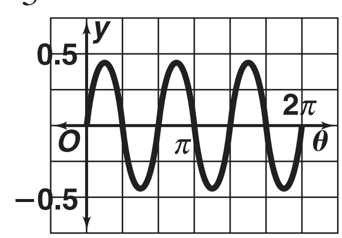
46. $\pi, \frac{5}{2}$



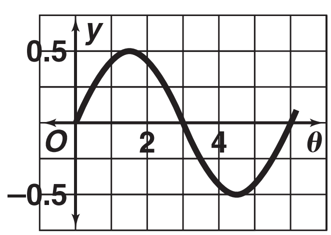
47. 1, 2



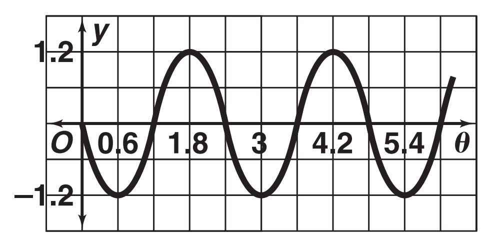
48. $\frac{2\pi}{3}$, 0.4



49. 6, 0.5



50. $\frac{12}{5}$, 1.2



51. Check students' work.

52. **a.** $4, 2\pi$

b. $y = 4 \sin \theta$

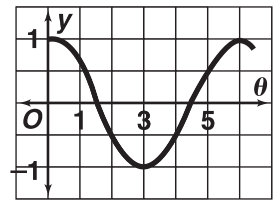
c. coil B

53. $y = \sin 60\pi\theta$

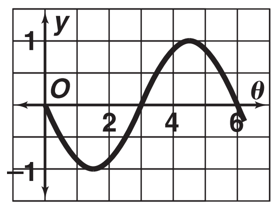
54. $y = \sin 30\pi\theta$

55. $y = \sin 240{,}000\pi\theta$

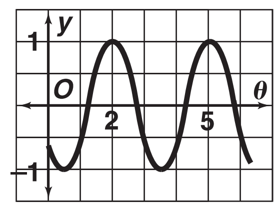
56. $2\pi, 1$



57. $2\pi, 1$



58. $\pi, 1$



59. **a.** days from spring equinox, hours of sunlight

b. $\frac{23}{12}$ h, about 365 days

c. $y = \frac{23}{12} \sin \frac{2\pi x}{365}$

d. 1.1 h

e. Check students' work.

Answers for Lesson 13-5 Exercises

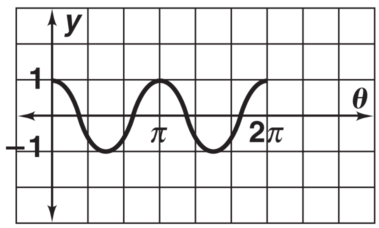
1. 2π, 3; max: 0, 2π; min: π; zeros: $\frac{\pi}{2}, \frac{3\pi}{2}$

2. $\frac{2\pi}{3}$, 1; max: 0, $\frac{2\pi}{3}, \frac{4\pi}{3}$, 2π; min: $\frac{\pi}{3}, \pi, \frac{5\pi}{3}$; zeros: $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{3\pi}{2}, \frac{11\pi}{6}$

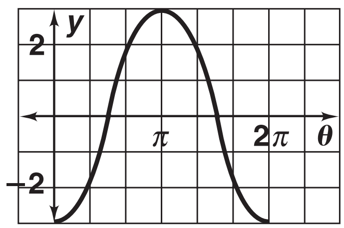
3. π, 1; max: 0, π, 2π; min: $\frac{\pi}{2}, \frac{3\pi}{2}$; zeros: $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$

4. 2π, 2; max: π; min: 0, 2π; zeros: $\frac{\pi}{2}, \frac{3\pi}{2}$

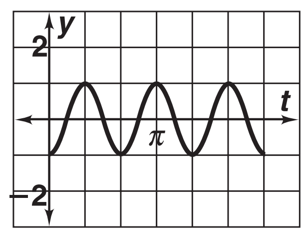
5.



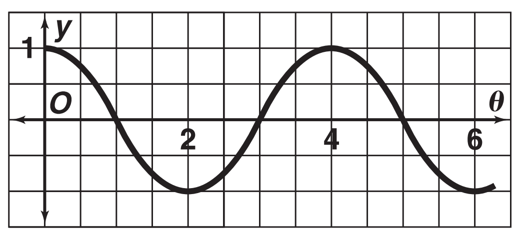
6.



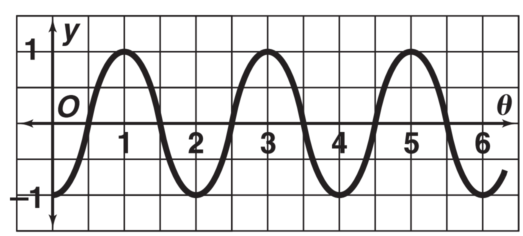
7.



8.



9.



10. $y = 2\cos 2\theta$

11. $y = \frac{\pi}{2}\cos\frac{2\pi}{3}\theta$

12. $y = \pi\cos\pi\theta$

13. $y = -3\cos 2\theta$

14. $y = 2\cos\frac{\pi}{4}\theta$

15. $y = 4\cos\frac{2\pi}{3}\theta$

16. 0.52, 2.62, 3.67, 5.76

17. 1.98, 4.30

18. 0.55, 1.45, 2.55, 3.45, 4.55, 5.45

19. 2.52

20. 0.00

21. 0.86, 5.14

22. $2\pi, -3 \le y \le 3, 3$

23. $\pi, -1 \le y \le 1, 1$

24. $4\pi, -2 \le y \le 2, 2$

25. $4\pi, -\frac{1}{3} \le y \le \frac{1}{3}, \frac{1}{3}$

26. $6\pi, -3 \le y \le 3, 3$

27. $\frac{2\pi}{3}, -\frac{1}{2} \le y \le \frac{1}{2}, \frac{1}{2}$

28. $\frac{4}{3}, -16 \le y \le 16, 16$

29. $2, -0.7 \le y \le 0.7, 0.7$

30. 0.64, 2.50

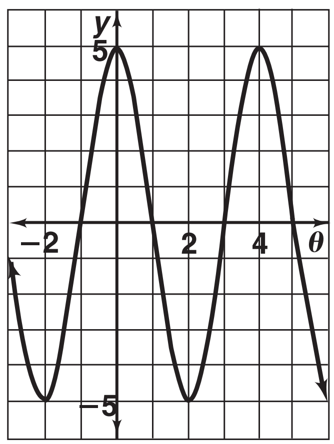
31. 1.83, 2.88, 4.97, 6.02

32. 0.50, 2.50, 4.50

33. **a.** 3.79, 5.64

b. 10.07, 11.92; these values are the sums of the values from part (a) and 2π.

34. **a.**



b. Answers may vary. Sample: 0 s, 4 s, 8 s, 12 s

c. 2 s; 2 s

35. **a.** 5.5 ft; 1.5 ft

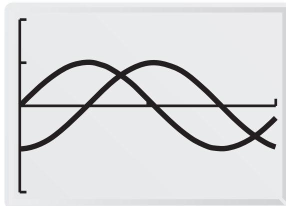
b. about 12 h 22 min

c. $y = 1.5 \cos \frac{2\pi t}{742}$

d. 12:17 A.M.–7:49 A.M., 12:39 P.M.–8:11 P.M.

36. a. Answers may vary. Sample: sine; The sine function gives vertical position with respect to the center of the wheel.

b.



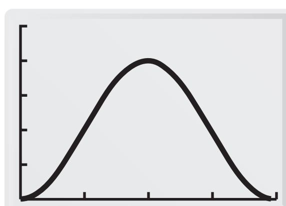
Answers may vary. Sample: Going from left to right, the graph of $Y2 = \sin\left(x - \frac{\pi}{2}\right)$ "trails" the graph of $Y1 = \sin x$ by $\frac{\pi}{2}$ units. If the "ride" for Y2 would start $\frac{\pi}{2}$ units of time sooner than the ride for Y1, the two graphs would be identical from the origin on out.

c. 20 times as great

d. The center of the Ferris wheel is 20 ft higher at (0, 20)

e. $f(x) = 20 \sin\left(x - \frac{\pi}{2}\right) + 20$

f.

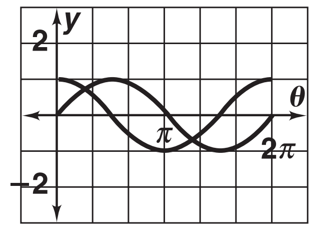


g. Allow for different values of 2 in $f(x) = 20 \sin b\left(x - \frac{\pi}{2}\right) = 20$. Model faster Ferris wheel speed by increasing the value of b. You can keep the starting point of the model at (0, 0) by letting b have value $4n - 3, n = 1, 2, \ldots$

h. In parametric mode, let $X_{1T} = T, Y_{1T} = 20 \sin\left(T - \frac{\pi}{2}\right) + 20$ and adjust Tstep values.

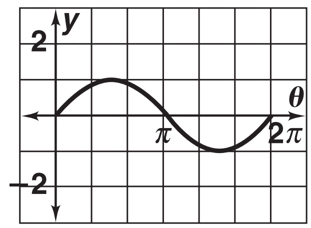
i. Answers may vary. Sample: You can use the cosine function to model horizontal position with respect to the center of the wheel.

37. a.



shift of $\frac{\pi}{2}$ units to the right

b.



They are the same.

c. To write a sine function as a cosine function, replace sin with cos and replace θ with $\theta - \frac{\pi}{2}$.

38. $y = \cos \frac{\pi}{12}x$ or $y = -\cos \frac{\pi}{12}x$

39. On the unit circle, the x-values of $-\theta$ are equal to the x-values of θ, so $\cos(-\theta) = \cos \theta$. $-\cos \theta$ is the opposite of $\cos \theta$, so these graphs are reflections of each other over the x-axis.

Answers for Lesson 13-6 Exercises

1. 0 **2.** 0 **3.** -1

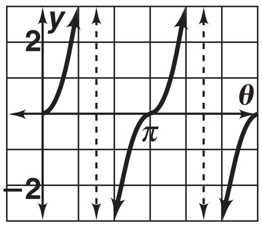
4. undefined **5.** 1 **6.** 0

7. 1 **8.** undefined **9.** π

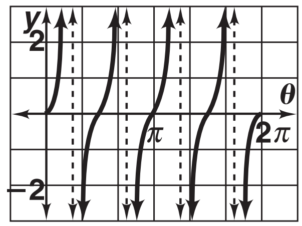
10. $\frac{\pi}{2}$ **11.** $\frac{\pi}{5}, \theta = -\frac{\pi}{10}, \frac{\pi}{10}$ **12.** $\frac{2\pi}{3}, \theta = -\frac{\pi}{3}, \frac{\pi}{3}$

13. $\frac{\pi}{4}, \theta = -\frac{\pi}{8}, \frac{\pi}{8}$ **14.** $\frac{3\pi^2}{2}, \theta = -\frac{3\pi^2}{4}, \frac{3\pi^2}{4}$

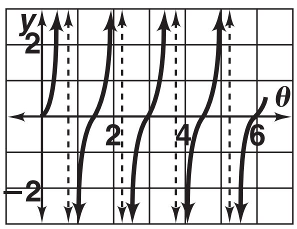
15.



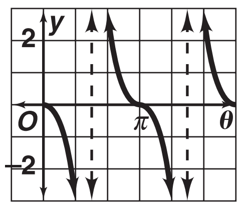
16.



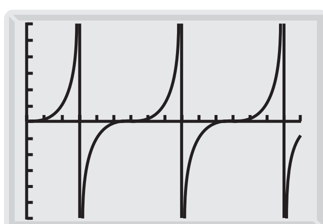
17.



18.

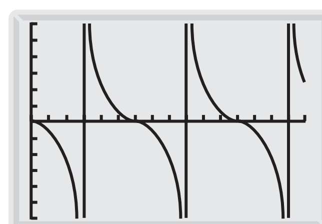


19.



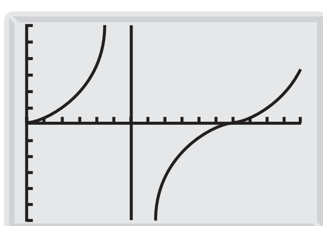
50, undefined, -50

20.



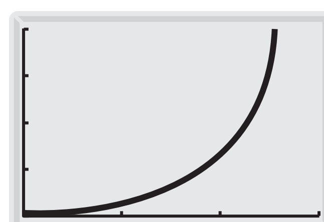
-100, undefined, 100

21.



≈ 51.8, 125, ≈ 301.8

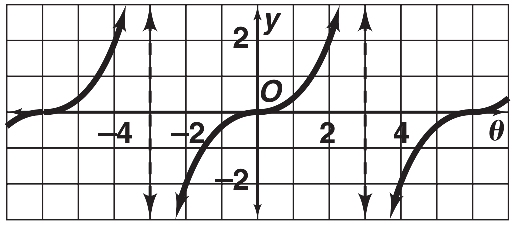
22. a.



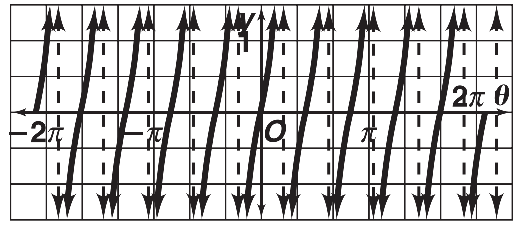
b. ≈ 14.3 ft

c. ≈ 20.2 ft

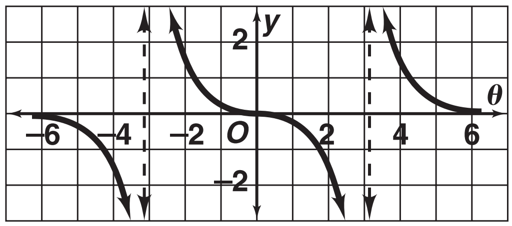
23. 6



24. $\frac{2\pi}{5}$



25. $\frac{2\pi^2}{3}$

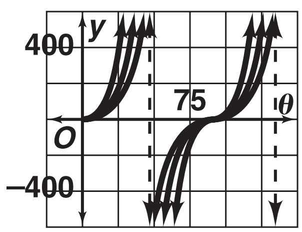


26. 1.11, 4.25

27. 2.03, 5.18

28. 0.08, 1.65, 3.22, 4.79

29. a.

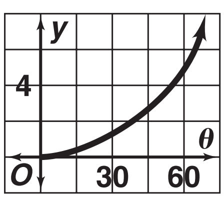


b. Check students' work; doubling the coefficient of the tangent function also doubles the output.

c. Answers may vary. Sample: the values of $y = 600 \tan x$ will be three times greater than the values of $y = 200 \tan x$.

30. a. 140.4 ft^2

b.



≈1.7 in., ≈5.2 in.

c. ≈5.2 $in.^2$, ≈15.6 $in.^2$

d. ≈3888 tiles, ≈1296 tiles

31. Check students' work.

32. The asymptotes occur at $x = -\frac{\pi}{2b}$ and $x = \frac{\pi}{2b}$; adding or subtracting multiples of their difference, b, will give other asymptote values.

33. 200

34. 0

35. 135

36. −162

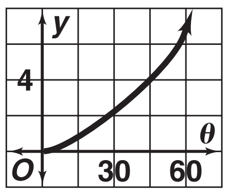
37. 70

38. $y = \tan\left(\frac{1}{2}x\right)$

39. $y = -\tan\left(\frac{1}{2}x\right)$

40. $y = -\tan x$ or $y = \tan(-x)$

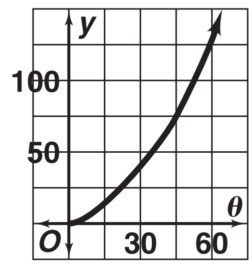
41. $y = \tan(2x)$

42. **a.** 

≈6.9 ft

b. ≈27.7 ft2

c. ≈166.3 ft^2

43. **a.** 

b. ≈130 ft

c. ≈61,500 ft2

44. **a.** Check students' work.

b. The new pattern is asymptote—(−a)—zero—(a)—asymptote.

45. Answers may vary. Sample: Triangles OAP and OBQ both share the angle θ and each triangle has a right angle, so they are similar by AA. $\frac{\sin\theta}{\cos\theta} = \frac{AP}{OA} = \frac{BQ}{OB} = \frac{\tan\theta}{1}$. Thus $\frac{\sin\theta}{\cos\theta} = \tan\theta$.

46. 2; for $0 \le x < 2\pi$, x is nonnegative, and there are only 2 branches of the graph of the tangent function above the x-axis.

Answers for Lesson 13-7 Exercises

1. -1; 1 unit to the left

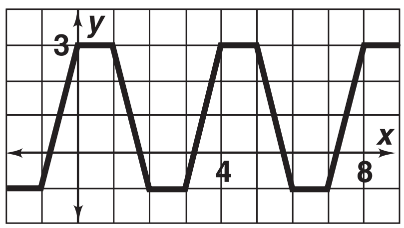
2. -2; 2 units to the left

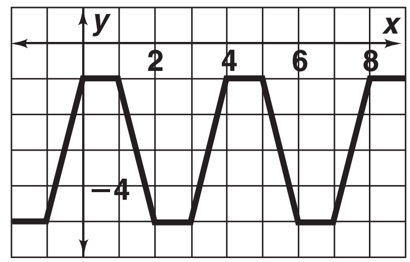
3. 1.6; 1.6 units to the right

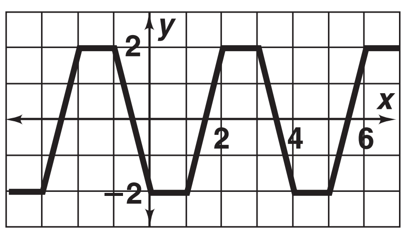
4. 3; 3 units to the right

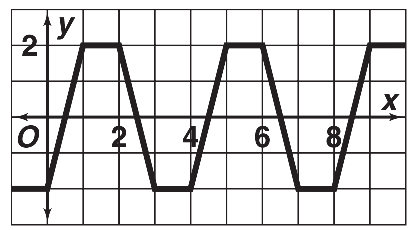
5. $-\pi$; π units to the left

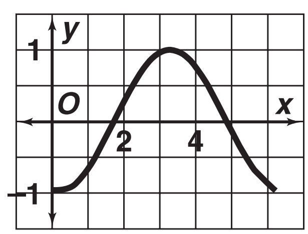
6. $\frac{5\pi}{7}$; $\frac{5\pi}{7}$ units to the right

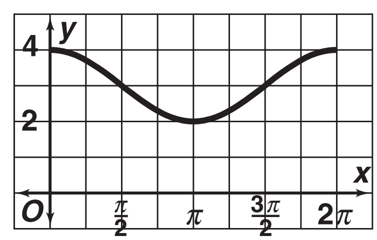
7. 

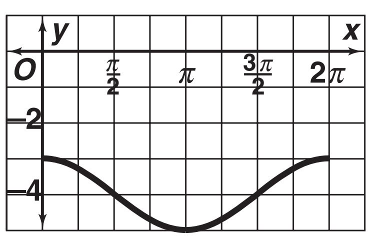
8. 

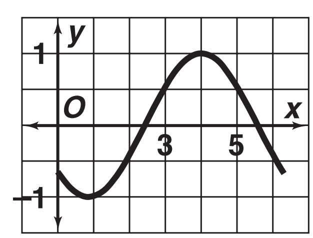
9. 

10. 

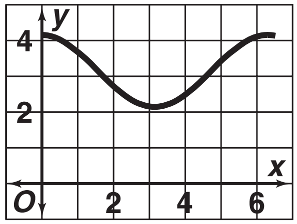
11. 

12. 

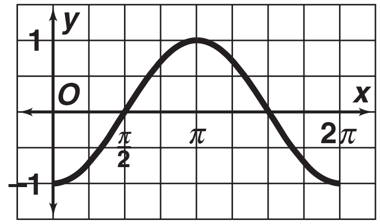
13. 

14. 

15.



16.



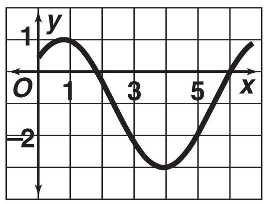
17. 3, 2π; 1 unit up

18. 4, π; 1 unit left and 2 units down

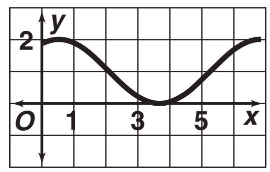
19. 1, 2π; $\frac{\pi}{2}$ units left and 2 units up

20. 1, 2; 3 units right and 2 units up

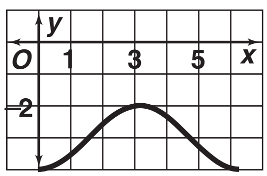
21.



22.



23.



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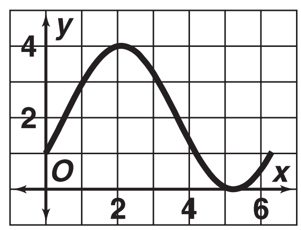

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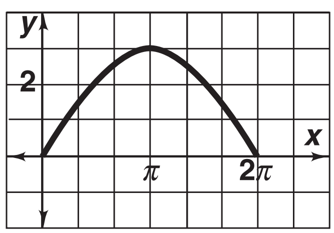
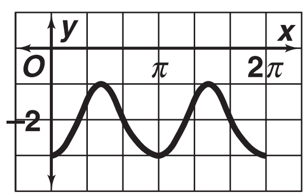
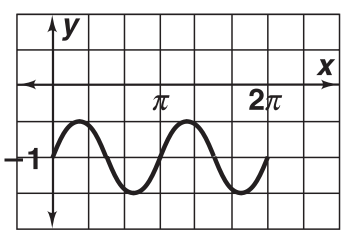


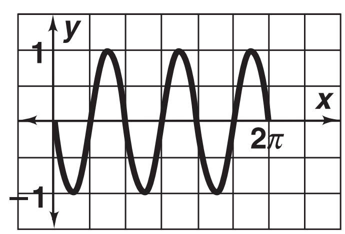
26.

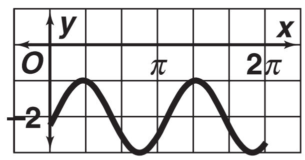


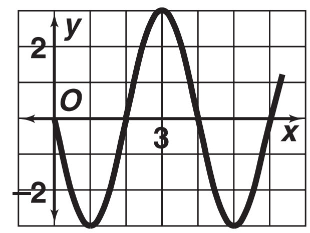
27.



28.



29. 

30. 

31. $y = \sin(x + \pi)$

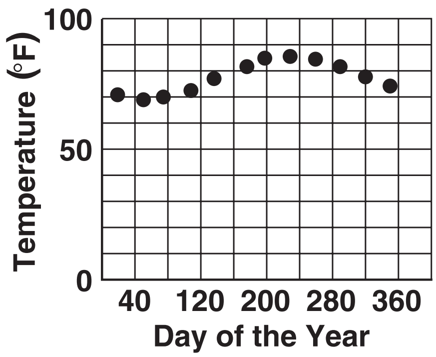
32. $y = \cos x - \frac{\pi}{2}$

33. $y = \sin x + 3$

34. $y = \cos(x - 1.5)$

35. $y = \cos\left(x + \frac{3}{2\pi}\right)$

36. $y = \sin x - 3\pi$

37. a. 

b. $y = 8.5 \cos \frac{2\pi}{365}(x - 228) + 77.5$

38. $y = \sin(x - 2) - 4$

39. $y = \cos(x + 3) + \pi$

40. $y = \sin\left(x - \frac{\pi}{2}\right) + 3.5$

41. $y = 2\cos\left(x - \frac{\pi}{3}\right) - 1; y = 2\sin\left(x + \frac{\pi}{6}\right) - 1$

42. $y = -10\cos \frac{\pi}{10}x; y = 10\sin\left(\frac{\pi}{10}x - \frac{\pi}{2}\right)$

43. a. $\frac{\pi}{2}$; $\sin x = \cos\left(x - \frac{\pi}{2}\right)$

b. $-\frac{\pi}{2}$; $\cos x = \sin\left(x + \frac{\pi}{2}\right)$

44. a. $14.5 \sin\left(\frac{2\pi}{365}(x - 105.75)\right) + 76.5$

b. The difference between the two models is the sine function is a horizontal shift of the cosine function.

c. about 66°F

d. March 20 (day 79)

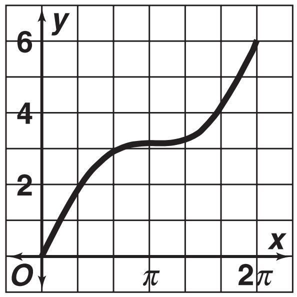
45. **a.** Check students' work.

b. $g(x) = f(x + 4) - 3$

46. **a.** $y = 3 \sin 2(x - 2) + 1$

b. $3, \pi$; 2 units right and 1 unit up

47.



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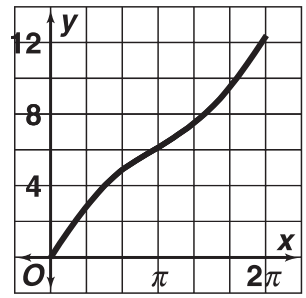

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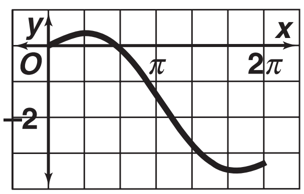

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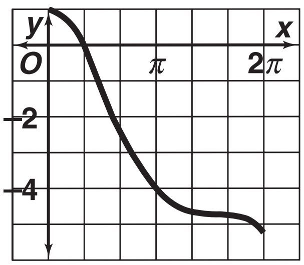

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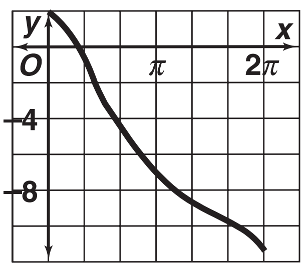

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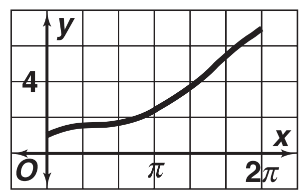

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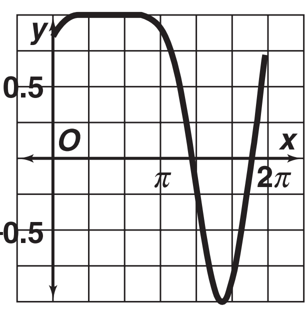

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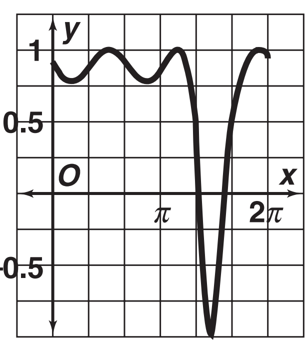
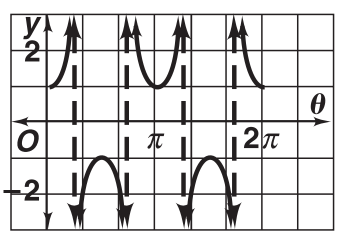


1. 1.02	**2.** 1.02	**3.** -0.70
4. -1.06	**5.** $\frac{3}{4}$	**6.** $\frac{18}{13}$
7. $-\frac{5}{3}$	**8.** $-\frac{3}{4}$	**9.** $\sqrt{2}$
10. $\frac{\sqrt{3}}{3}$	**11.** 0	**12.** -1
13. undefined	**14.** $\frac{2\sqrt{3}}{3}$	**15.** undefined
16. $\sqrt{3}$	**17.** undefined	**18.** 2
19. 2	**20.** $\sqrt{2}$	**21.** -7.02
22. -1	**23.** 1	**24.** -1
25. -1.25	**26.** 17.13	**27.** 1.73
28. 1.02		

29.



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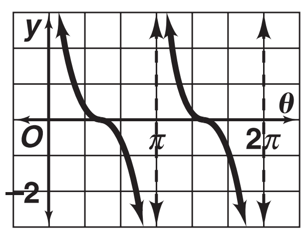

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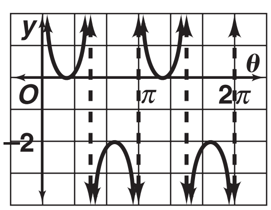

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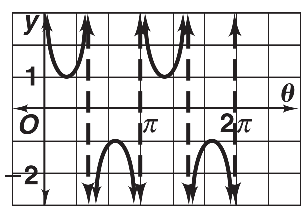
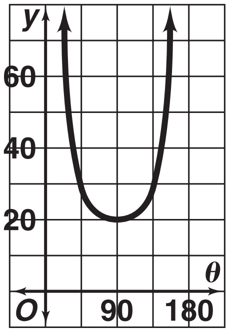


33. 1.1547	**34.** 5.7588	**35.** -2.9238
36. 2	**37.** 1.0642	**38.** 1.3054
39. 1.7321	**40.** 0.5774	

41. a.



Note that the units on the horizontal axis are degrees.

b. ≈28.3 ft

c. ≈23.1 ft

d. ≈20.7 ft

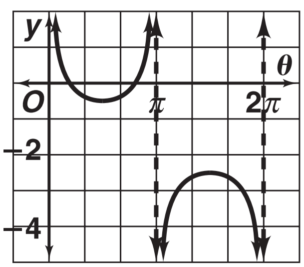
42. −1

43. $\frac{2\sqrt{3}}{3}$; 1.15

44. −1

45. −1

46.



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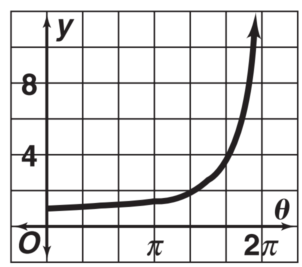

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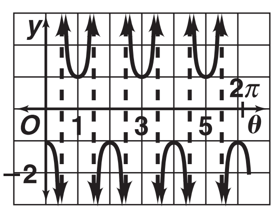

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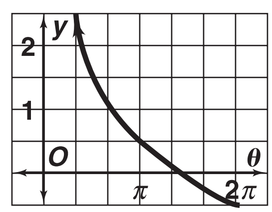


50. B

51. C

52. A

53. D

54. a. domain: all real numbers except multiples of π; range: all real numbers ≥ 1 or ≤ -1; period 2π

b. 1

c. −1

55. a. Reciprocals have the same sign.

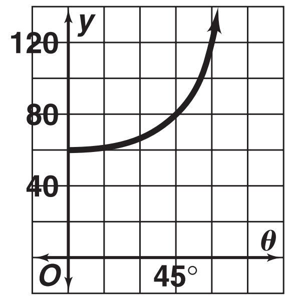
b. The reciprocal of −1 is −1.

56. csc 180° is undefined because sin 180° is 0 and $\csc\theta = \frac{1}{\sin\theta}$.

57. sec 90° is undefined because cos 90° is 0 and $\sec\theta = \frac{1}{\cos\theta}$.

58. cot 0° is undefined because tan 0° is 0 and $\cot\theta = \frac{1}{\tan\theta}$.

59. **a.**

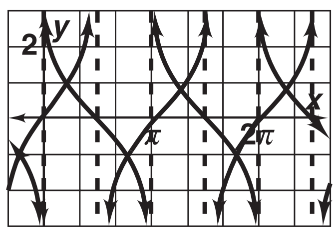


b. 63.9 ft

c. 69.3 ft

d. ≈41.4°; 60.9 ft

60. **a.**

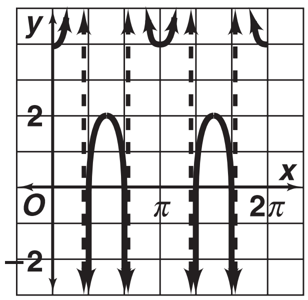


b. The domain of $y = \tan x$ is all real numbers except odd multiples of $\frac{\pi}{2}$, which are its asymptotes. The domain of $y = \cot x$ is all real numbers except multiples of π, which are its asymptotes. The range of both functions is all real numbers.

c. The graphs have the same period and range. Their asymptotes are shifted by $\frac{\pi}{2}$.

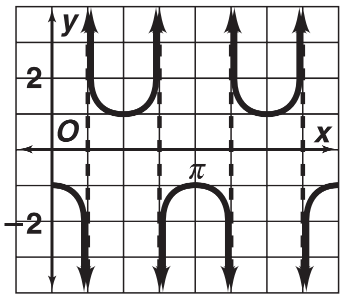
d. Answers may vary. Sample: $x = \frac{\pi}{4}, x = \frac{3\pi}{4}$

61.



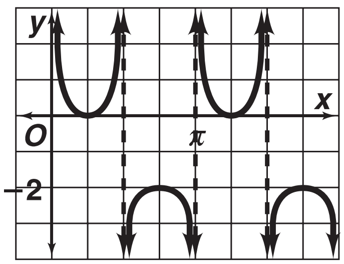
3 units up

62.



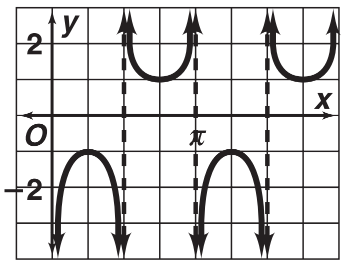
$\frac{\pi}{2}$ units left

63.



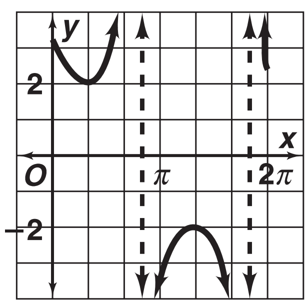
1 unit down

64.



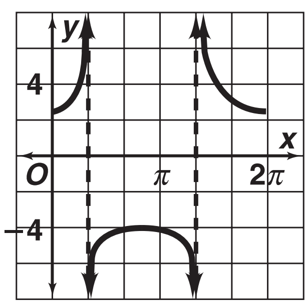
$\frac{\pi}{2}$ units right

65.



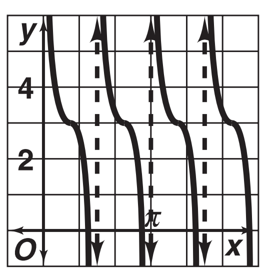
4 units right

66.



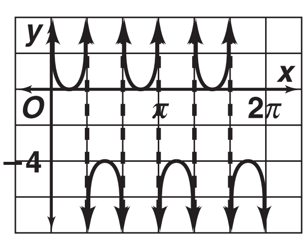
2 units left, 1 unit down

67.



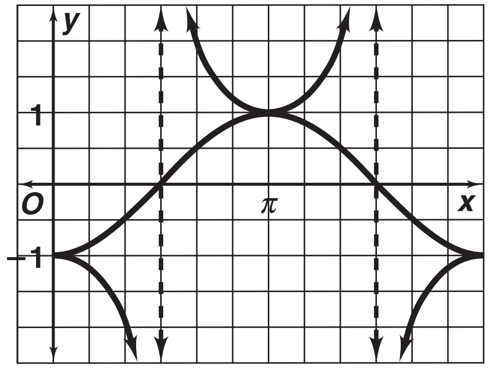
π units left, 3 units up

68.



$\frac{\pi}{6}$ units right, 2 units down

69. a.



b. $y = -\cos x$—domain: all real numbers; range: all real numbers between -1 and 1, inclusive; period: 2π; $y = -\sec x$—domain: all real numbers except odd multiples of $\frac{\pi}{2}$; range: all real numbers except those between -1 and 1; period: 2π

c. Multiples of π. By definition, $\sec x = \frac{1}{\cos x}$, so $-\cos x = -\sec x$ is equivalent to $-\cos x = -\frac{1}{\cos x}$, or $(\cos x)^2 = 1$. The solutions of $(\cos x)^2 = 1$ are the values of x for which $\cos x = 1$ or $\cos x = -1$. These values are the multiples of π.

d. Answers may vary. Sample: The graphs have the same period and their signs are always the same. However, they have no range values in common except 1 and -1.

e. The signs of $-\sec x$ and $-\cos x$ are the same because reciprocals have the same sign.

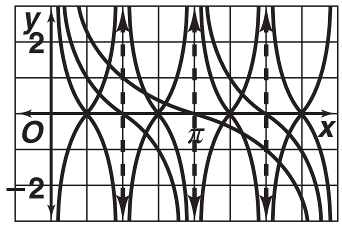
70. a. II

b. I

71. $y = \sec x$ and $y = \csc x$ are not parabolas because parabolas are not restricted by asymptotes, whereas the branches of $y = \sec x$ and $y = \csc x$ are between asymptotes.

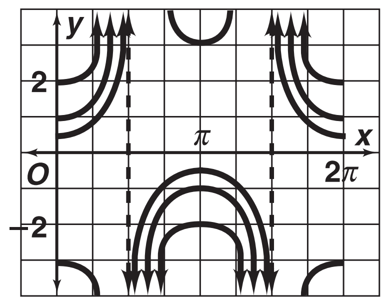
72. $y = \cos 3x$ has 3 cycles for each cycle of $y = \cos x$. Thus, for each cycle of $y = \sec x$, $y = \sec 3x$ has 3 cycles. Each cycle of $y = \sec 3x$ is $\frac{1}{3}$ as wide as one cycle of $y = \sec x$.

73. a.



b. Answers may vary. Sample: Given $y = \cot bx$, as $|b|$ decreases, the period increases; as $|b|$ increases, the period decreases. If $b < 0$, $y = \cot bx$ begins each branch with negative y-values and ends with positive y-values; the opposite is true for $b > 0$.

74. a.



b. Answers may vary. Sample: As $|b| > 1$ increases, the graph of $y = b \sec x$ stretches vertically away from the x-axis. As $|b|$ decreases from 1 to 0, the graph shrinks vertically toward the x-axis. For $b < 0$, the graph of $y = b \sec x$ is a reflection of $y = |b| \sec x$ across the x-axis. The asymptotes remain the same for all values of b.