Suppose that a car drives at 110 ft/s past a woman standing on the shoulder of a highway, blowing its horn, which has a frequency of 500 Hz. Assume that the speed of sound is 1130 ft/s. (This is the speed in dry air at 70°F.)

(a) What are the frequencies of the sounds that the woman hears as the car approaches her and as it moves away from her?

(b) Let A be the amplitude of the sound. Find functions of the form

$$y = A \sin \omega t$$

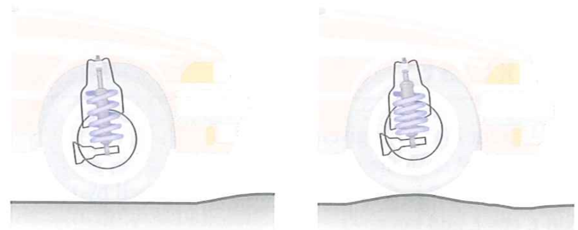
that model the perceived sound as the car approaches the woman and as it recedes.

45. Motion of a Building A strong gust of wind strikes a tall building, causing it to sway back and forth in damped harmonic motion. The frequency of the oscillation is 0.5 cycle per second, and the damping constant is $c = 0.9$. Find an equation that describes the motion of the building. (Assume that $k = 1$, and take $t = 0$ to be the instant when the gust of wind strikes the building.)

46. Shock Absorber When a car hits a certain bump on the road, a shock absorber on the car is compressed a distance of 6 in., then released (see the figure). The shock absorber vibrates in damped harmonic motion with a frequency of 2 cycles per second. The damping constant for this particular shock absorber is 2.8.

(a) Find an equation that describes the displacement of the shock absorber from its rest position as a function of time. Take $t = 0$ to be the instant that the shock absorber is released.

(b) How long does it take for the amplitude of the vibration to decrease to 0.5 in?



47. Tuning Fork A tuning fork is struck and oscillates in damped harmonic motion. The amplitude of the motion is measured, and 3 s later it is found that the amplitude has dropped to $\frac{1}{4}$ of this value. Find the damping constant c for this tuning fork.

48. Guitar String A guitar string is pulled at point P a distance of 3 cm above its rest position. It is then released and vibrates in damped harmonic motion with a frequency of 165 cycles per second. After 2 s, it is observed that the amplitude of the vibration at point P is 0.6 cm.

(a) Find the damping constant c.

(b) Find an equation that describes the position of point P above its rest position as a function of time. Take $t = 0$ to be the instant that the string is released.

CHAPTER 5 | REVIEW

CONCEPT CHECK

1. **(a)** What is the unit circle?
(b) Use a diagram to explain what is meant by the terminal point determined by a real number t.
(c) What is the reference number $\bar{t}$ associated with t?
(d) If t is a real number and $P(x, y)$ is the terminal point determined by t, write equations that define $\sin t$, $\cos t$, $\tan t$, $\cot t$, $\sec t$, and $\csc t$.
(e) What are the domains of the six functions that you defined in part (d)?
(f) Which trigonometric functions are positive in Quadrants I, II, III, and IV?

2. **(a)** What is an even function?
(b) Which trigonometric functions are even?
(c) What is an odd function?
(d) Which trigonometric functions are odd?

3. **(a)** State the reciprocal identities.
(b) State the Pythagorean identities.

4. **(a)** What is a periodic function?
(b) What are the periods of the six trigonometric functions?

5. Graph the sine and cosine functions. How is the graph of cosine related to the graph of sine?

6. Write expressions for the amplitude, period, and phase shift of the sine curve $y = a \sin k(x - b)$ and the cosine curve $y = a \cos k(x - b)$.

7. **(a)** Graph the tangent and cotangent functions.
(b) State the periods of the tangent curve $y = a \tan kx$ and the cotangent curve $y = a \cot kx$.

8. **(a)** Graph the secant and cosecant functions.
(b) State the periods of the secant curve $y = a \sec kx$ and the cosecant curve $y = a \csc kx$.

9. **(a)** Define the inverse sine function $\sin^{-1}$. What are its domain and range?
(b) For what values of x is the equation $\sin(\sin^{-1} x) = x$ true?
(c) For what values of x is the equation $\sin^{-1}(\sin x) = x$ true?

10. **(a)** Define the inverse cosine function $\cos^{-1}$. What are its domain and range?
(b) For what values of x is the equation $\cos(\cos^{-1} x) = x$ true?
(c) For what values of x is the equation $\cos^{-1}(\cos x) = x$ true?

11. **(a)** Define the inverse tangent function $\tan^{-1}$. What are its domain and range?
(b) For what values of x is the equation $\tan(\tan^{-1} x) = x$ true?
(c) For what values of x is the equation $\tan^{-1}(\tan x) = x$ true?

12. **(a)** What is simple harmonic motion?
(b) What is damped harmonic motion?
(c) Give three real-life examples of simple harmonic motion and of damped harmonic motion.

■ EXERCISES

1–2 ■ A point $P(x, y)$ is given.
(a) Show that P is on the unit circle.
(b) Suppose that P is the terminal point determined by t. Find $\sin t$, $\cos t$, and $\tan t$.

1. $P\left(-\dfrac{\sqrt{3}}{2}, \dfrac{1}{2}\right)$ **2.** $P\left(\dfrac{3}{5}, -\dfrac{4}{5}\right)$

3–6 ■ A real number t is given.
(a) Find the reference number for t.
(b) Find the terminal point $P(x, y)$ on the unit circle determined by t.
(c) Find the six trigonometric functions of t.

3. $t = \dfrac{2\pi}{3}$ **4.** $t = \dfrac{5\pi}{3}$

5. $t = -\dfrac{11\pi}{4}$ **6.** $t = -\dfrac{7\pi}{6}$

7–16 ■ Find the value of the trigonometric function. If possible, give the exact value; otherwise, use a calculator to find an approximate value correct to five decimal places.

7. **(a)** $\sin \dfrac{3\pi}{4}$ **(b)** $\cos \dfrac{3\pi}{4}$

8. **(a)** $\tan \dfrac{\pi}{3}$ **(b)** $\tan\left(-\dfrac{\pi}{3}\right)$

9. **(a)** $\sin 1.1$ **(b)** $\cos 1.1$

10. **(a)** $\cos \dfrac{\pi}{5}$ **(b)** $\cos\left(-\dfrac{\pi}{5}\right)$

11. **(a)** $\cos \dfrac{9\pi}{2}$ **(b)** $\sec \dfrac{9\pi}{2}$

12. **(a)** $\sin \dfrac{\pi}{7}$ **(b)** $\csc \dfrac{\pi}{7}$

13. **(a)** $\tan \dfrac{5\pi}{2}$ **(b)** $\cot \dfrac{5\pi}{2}$

14. **(a)** $\sin 2\pi$ **(b)** $\csc 2\pi$

15. **(a)** $\tan \dfrac{5\pi}{6}$ **(b)** $\cot \dfrac{5\pi}{6}$

16. **(a)** $\cos \dfrac{\pi}{3}$ **(b)** $\sin \dfrac{\pi}{6}$

17–20 ■ Use the fundamental identities to write the first expression in terms of the second.

17. $\dfrac{\tan t}{\cos t}$, $\sin t$ **18.** $\tan^2 t \sec t$, $\cos t$

19. $\tan t$, $\sin t$; t in Quadrant IV

20. $\sec t$, $\sin t$; t in Quadrant II

21–24 ■ Find the values of the remaining trigonometric functions at t from the given information.

21. $\sin t = \frac{5}{13}$, $\cos t = -\frac{12}{13}$

22. $\sin t = -\frac{1}{2}$, $\cos t > 0$

23. $\cot t = -\frac{1}{2}$, $\csc t = \sqrt{5}/2$

24. $\cos t = -\frac{3}{5}$, $\tan t < 0$

25. If $\tan t = \frac{1}{4}$ and the terminal point for t is in Quadrant III, find $\sec t + \cot t$.

26. If $\sin t = -\frac{8}{17}$ and the terminal point for t is in Quadrant IV, find $\csc t + \sec t$.

27. If $\cos t = \frac{3}{5}$ and the terminal point for t is in Quadrant I, find $\tan t + \sec t$.

28. If $\sec t = -5$ and the terminal point for t is in Quadrant II, find $\sin^2 t + \cos^2 t$.

29–36 ■ A trigonometric function is given.
(a) Find the amplitude, period, and phase shift of the function.
(b) Sketch the graph.

29. $y = 10 \cos \frac{1}{2}x$ **30.** $y = 4 \sin 2\pi x$

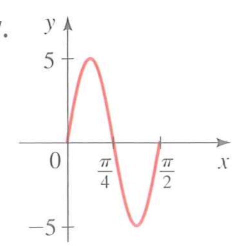
31. $y = -\sin \frac{1}{2}x$ **32.** $y = 2 \sin\left(x - \dfrac{\pi}{4}\right)$

33. $y = 3 \sin(2x - 2)$ **34.** $y = \cos 2\left(x - \dfrac{\pi}{2}\right)$

35. $y = -\cos\left(\dfrac{\pi}{2}x + \dfrac{\pi}{6}\right)$ **36.** $y = 10 \sin\left(2x - \dfrac{\pi}{2}\right)$

37–40 ■ The graph of one period of a function of the form $y = a \sin k(x - b)$ or $y = a \cos k(x - b)$ is shown. Determine the function.

37.



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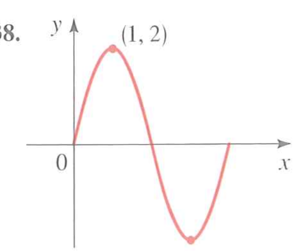

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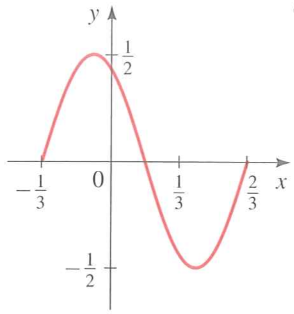

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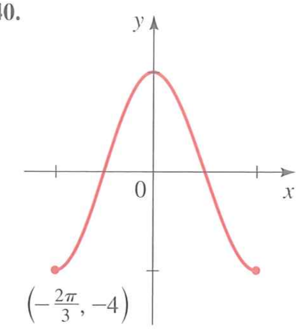


41–48 ■ Find the period, and sketch the graph.

41. $y = 3 \tan x$

42. $y = \tan \pi x$

43. $y = 2 \cot\left(x - \frac{\pi}{2}\right)$

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

45. $y = 4 \csc(2x + \pi)$

46. $y = \tan\left(x + \frac{\pi}{6}\right)$

47. $y = \tan\left(\frac{1}{2}x - \frac{\pi}{8}\right)$

48. $y = -4 \sec 4\pi x$

49–52 ■ Find the exact value of each expression, if it is defined.

49. $\sin^{-1} 1$

50. $\cos^{-1}\left(-\frac{1}{2}\right)$

51. $\sin^{-1}\left(\sin \frac{13\pi}{6}\right)$

52. $\tan\left(\cos^{-1}\left(\frac{1}{2}\right)\right)$

53–58 ■ A function is given.
(a) Use a graphing device to graph the function.
(b) Determine from the graph whether the function is periodic and, if so, determine the period.
(c) Determine from the graph whether the function is odd, even, or neither.

53. $y = |\cos x|$

54. $y = \sin(\cos x)$

55. $y = \cos(2^{0.1x})$

56. $y = 1 + 2^{\cos x}$

57. $y = |x| \cos 3x$

58. $y = \sqrt{x} \sin 3x \quad (x > 0)$

59–62 ■ Graph the three functions on a common screen. How are the graphs related?

59. $y = x, \quad y = -x, \quad y = x \sin x$

60. $y = 2^{-x}, \quad y = -2^{-x}, \quad y = 2^{-x} \cos 4\pi x$

61. $y = x, \quad y = \sin 4x, \quad y = x + \sin 4x$

62. $y = \sin^2 x, \quad y = \cos^2 x, \quad y = \sin^2 x + \cos^2 x$

63–64 ■ Find the maximum and minimum values of the function.

63. $y = \cos x + \sin 2x$

64. $y = \cos x + \sin^2 x$

65. Find the solutions of $\sin x = 0.3$ in the interval $[0, 2\pi]$.

66. Find the solutions of $\cos 3x = x$ in the interval $[0, \pi]$.

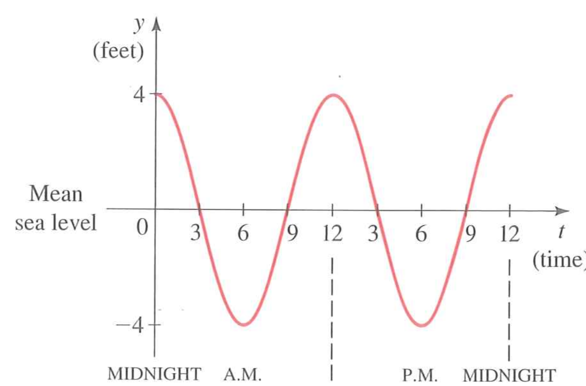
67. Let $f(x) = \dfrac{\sin^2 x}{x}$.
(a) Is the function f even, odd, or neither?
(b) Find the x-intercepts of the graph of f.
(c) Graph f in an appropriate viewing rectangle.
(d) Describe the behavior of the function as x becomes large.
(e) Notice that $f(x)$ is not defined when $x = 0$. What happens as x approaches 0?

68. Let $y_1 = \cos(\sin x)$ and $y_2 = \sin(\cos x)$.
(a) Graph y_1 and y_2 in the same viewing rectangle.
(b) Determine the period of each of these functions from its graph.
(c) Find an inequality between $\sin(\cos x)$ and $\cos(\sin x)$ that is valid for all x.

69. A point P moving in simple harmonic motion completes 8 cycles every second. If the amplitude of the motion is 50 cm, find an equation that describes the motion of P as a function of time. Assume that the point P is at its maximum displacement when $t = 0$.

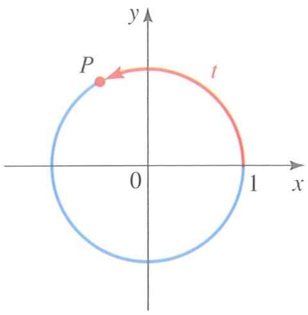
70. A mass suspended from a spring oscillates in simple harmonic motion at a frequency of 4 cycles per second. The distance from the highest to the lowest point of the oscillation is 100 cm. Find an equation that describes the distance of the mass from its rest position as a function of time. Assume that the mass is at its lowest point when $t = 0$.

71. The graph shows the variation of the water level relative to mean sea level in the Long Beach harbor for a particular 24-hour period. Assuming that this variation is simple harmonic, find an equation of the form $y = a \cos \omega t$ that describes the variation in water level as a function of the number of hours after midnight.



72. The top floor of a building undergoes damped harmonic motion after a sudden brief earthquake. At time $t = 0$ the displacement is at a maximum, 16 cm from the normal position. The damping constant is $c = 0.72$ and the building vibrates at 1.4 cycles per second.
(a) Find a function of the form $y = ke^{-ct} \cos \omega t$ to model the motion.
(b) Graph the function you found in part (a).
(c) What is the displacement at time $t = 10$ s?

CHAPTER 5 TEST



1. The point $P(x, y)$ is on the unit circle in Quadrant IV. If $x = \sqrt{11}/6$, find y.

2. The point P in the figure at the left has y-coordinate $\frac{4}{5}$. Find:
   (a) $\sin t$ (b) $\cos t$
   (c) $\tan t$ (d) $\sec t$

3. Find the exact value.
   (a) $\sin \dfrac{7\pi}{6}$ (b) $\cos \dfrac{13\pi}{4}$
   (c) $\tan\left(-\dfrac{5\pi}{3}\right)$ (d) $\csc \dfrac{3\pi}{2}$

4. Express $\tan t$ in terms of $\sin t$, if the terminal point determined by t is in Quadrant II.

5. If $\cos t = -\frac{8}{17}$ and if the terminal point determined by t is in Quadrant III, find $\tan t \cot t + \csc t$.

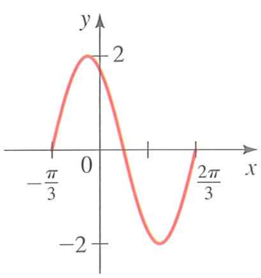
6–7 ■ A trigonometric function is given.
(a) Find the amplitude, period, and phase shift of the function.
(b) Sketch the graph.

6. $y = -5 \cos 4x$ 7. $y = 2 \sin\left(\dfrac{1}{2}x - \dfrac{\pi}{6}\right)$

8–9 ■ Find the period, and graph the function.

8. $y = -\csc 2x$ 9. $y = \tan\left(2x - \dfrac{\pi}{2}\right)$

10. Find the exact value of each expression, if it is defined.
    (a) $\tan^{-1} 1$ (b) $\cos^{-1}\left(-\dfrac{\sqrt{3}}{2}\right)$
    (c) $\tan^{-1}(\tan 3\pi)$ (d) $\cos(\tan^{-1}(-\sqrt{3}))$



11. The graph shown at left is one period of a function of the form $y = a \sin k(x - b)$. Determine the function.

12. Let $f(x) = \dfrac{\cos x}{1 + x^2}$.
    (a) Use a graphing device to graph f in an appropriate viewing rectangle.
    (b) Determine from the graph if f is even, odd, or neither.
    (c) Find the minimum and maximum values of f.

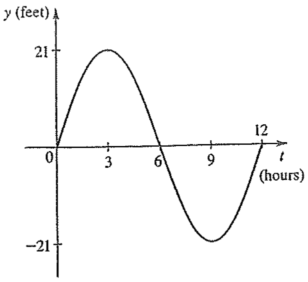
13. A mass suspended from a spring oscillates in simple harmonic motion. The mass completes 2 cycles every second, and the distance between the highest point and the lowest point of the oscillation is 10 cm. Find an equation of the form $y = a \sin \omega t$ that gives the distance of the mass from its rest position as a function of time.

14. An object is moving up and down in damped harmonic motion. Its displacement at time $t = 0$ is 16 in; this is its maximum displacement. The damping constant is $c = 0.1$, and the frequency is 12 Hz.
    (a) Find a function that models this motion.
    (b) Graph the function.

30. (a) 8900 (b) about 3.14 yr

31. $d(t) = 5\sin(5\pi t)$ **32.** $y = -6\sin\left(\frac{\pi}{6}t\right)$

33. $y = 21\sin\left(\frac{\pi}{6}t\right)$



34. $y = -2\cos 2\pi t$ **35.** $y = 5\cos(2\pi t)$

36. (a) $f(t) = 5\cos\left(\sqrt{\frac{3}{10}}t\right)$ (b) $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$

(c) The frequency decreases; slower

(d) The frequency increases; faster

37. $y = 11 + 10\sin\left(\frac{\pi t}{10}\right)$ **38.** $f(t) = 10\sin \pi t$

39. $y = 3.8 + 0.2\sin\left(\frac{\pi}{5}t\right)$

40. $R(t) = 20 + 1.5\sin\left(\frac{2\pi}{5.4}t\right)$, where R is measured in millions of miles and t is measured in days

41. $f(t) = 10\sin\left(\frac{\pi}{12}(t - 8)\right) + 90$

42. $E(t) = 310\cos(200\pi t)$, 219.2 V

43. (a) 45 V (b) 40 (c) 40 (d) $E(t) = 45\cos(80\pi t)$

44. (a) 553.9 Hz; 455.6 Hz (b) $y = A\sin(1107.8\pi t)$, $y = A\sin(911.2\pi t)$

45. $f(t) = e^{-0.9t}\sin \pi t$ **46.** (a) $f(t) = 6e^{-2.8t}\cos 4\pi t$

(b) $\frac{\ln 12}{2.8} \approx 0.88$ s **47.** $e = \frac{1}{3}\ln 4 \approx 0.46$

48. (a) $c = \frac{1}{2}\ln 5 \approx 0.80$ (b) $f(t) = 3e^{-0.8t}\cos 330\pi t$

CHAPTER 5 REVIEW ■ PAGE 424

1. (b) $\frac{1}{2}, -\sqrt{3}/2, -\sqrt{3}/3$ **2.** (b) $-\frac{4}{5}, \frac{3}{5}, -\frac{4}{3}$

3. (a) $\pi/3$ (b) $(-\frac{1}{2}, \sqrt{3}/2)$

(c) $\sin t = \sqrt{3}/2$, $\cos t = -\frac{1}{2}$, $\tan t = -\sqrt{3}$, $\csc t = 2\sqrt{3}/3$, $\sec t = -2$, $\cot t = -\sqrt{3}/3$

4. (a) $\pi/3$ (b) $(\frac{1}{2}, -\sqrt{3}/2)$ (c) $\sin t = -\sqrt{3}/2$, $\cos t = \frac{1}{2}$, $\tan t = -\sqrt{3}$, $\csc t = -2\sqrt{3}/3$, $\sec t = 2$, $\cot t = -\sqrt{3}/3$

5. (a) $\pi/4$ (b) $(-\sqrt{2}/2, -\sqrt{2}/2)$

(c) $\sin t = -\sqrt{2}/2$, $\cos t = -\sqrt{2}/2$, $\tan t = 1$, $\csc t = -\sqrt{2}$, $\sec t = -\sqrt{2}$, $\cot t = 1$

6. (a) $\pi/6$ (b) $(-\sqrt{3}/2, \frac{1}{2})$

(c) $\sin t = \frac{1}{2}$, $\cos t = -\sqrt{3}/2$, $\tan t = -\sqrt{3}/3$, $\csc t = 2$, $\sec t = -2\sqrt{3}/3$, $\cot t = -\sqrt{3}$

7. (a) $\sqrt{2}/2$ (b) $-\sqrt{2}/2$ **8.** (a) $\sqrt{3}$ (b) $-\sqrt{3}$

9. (a) 0.89121 (b) 0.45360 **10.** (a) 0.80902 (b) 0.80902

11. (a) 0 (b) Undefined **12.** (a) 0.43388 (b) 2.30476

13. (a) Undefined (b) 0 **14.** (a) 0 (b) Undefined

15. (a) $-\sqrt{3}/3$ (b) $-\sqrt{3}$ **16.** (a) $\frac{1}{2}$ (b) $\frac{1}{2}$

17. $(\sin t)/(1 - \sin^2 t)$ **18.** $\frac{1 - \cos^2 t}{\cos^3 t}$

19. $(\sin t)/\sqrt{1 - \sin^2 t}$ **20.** $\frac{1}{-\sqrt{1 - \sin^2 t}}$

21. $\tan t = -\frac{5}{12}$, $\csc t = \frac{13}{5}$, $\sec t = -\frac{13}{12}$, $\cot t = -\frac{12}{5}$

22. $\cos t = \sqrt{3}/2$, $\tan t = -\sqrt{3}/3$, $\csc t = -2$, $\sec t = 2\sqrt{3}/3$, $\cot t = -\sqrt{3}$

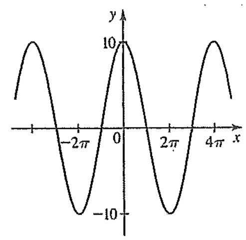
23. $\sin t = 2\sqrt{5}/5$, $\cos t = -\sqrt{5}/5$, $\tan t = -2$, $\sec t = -\sqrt{5}$

24. $\sin t = \frac{4}{5}$, $\tan t = -\frac{4}{3}$, $\csc t = \frac{5}{4}$, $\sec t = -\frac{5}{3}$, $\cot t = -\frac{3}{4}$

25. $(16 - \sqrt{17})/4$ **26.** $-\frac{119}{120}$ **27.** 3 **28.** 1

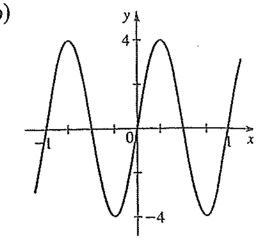
29. (a) $10, 4\pi, 0$

(b)



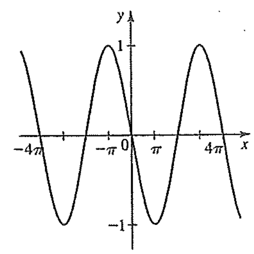
30. (a) $4, 1, 0$

(b)



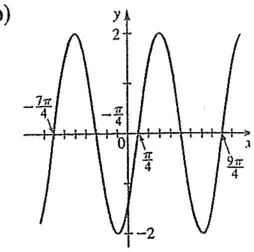
31. (a) $1, 4\pi, 0$

(b)



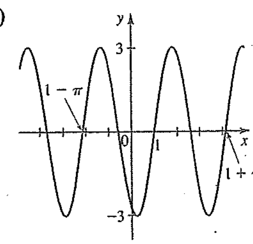
32. (a) $2, 2\pi, \pi/4$

(b)



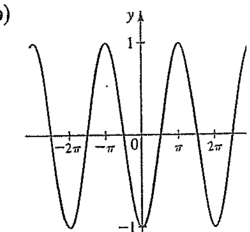
33. (a) $3, \pi, 1$

(b)



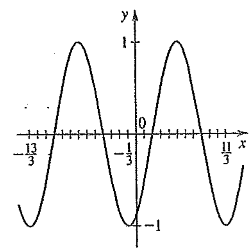
34. (a) $1, \pi, \pi/2$

(b)



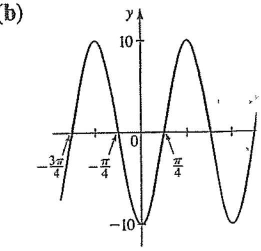
35. (a) $1, 4, -\frac{1}{3}$

(b)



36. (a) $10, \pi, \pi/4$

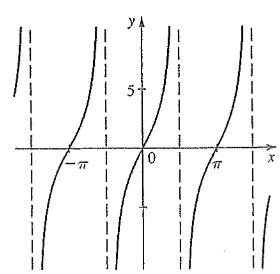
(b)



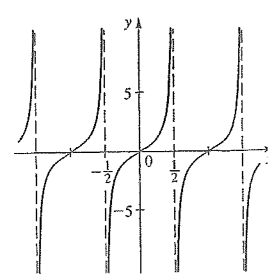
37. $y = 5\sin 4x$ **38.** $y = 2\sin(\frac{\pi}{2}x)$

39. $y = \frac{1}{2}\sin 2\pi(x + \frac{1}{3})$ **40.** $y = 4\sin\frac{3}{2}(x + \pi/3)$

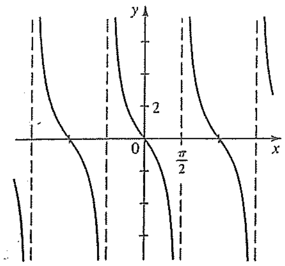
41. π



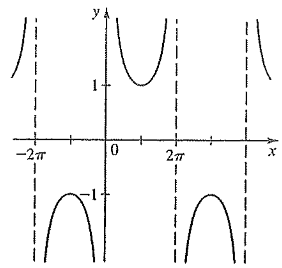
42. 1



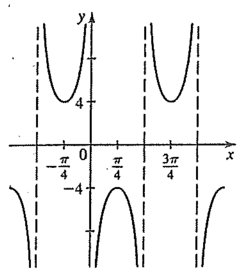
43. π



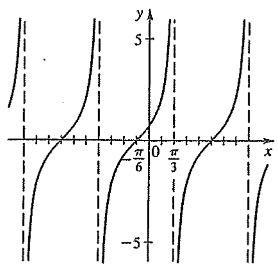
44. 4π



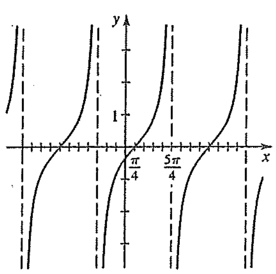
45. π



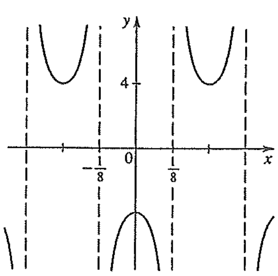
46. π



47. 2π

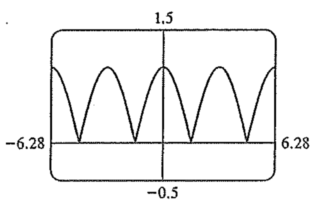


48. $\frac{1}{2}$



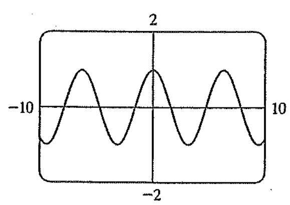
49. $\frac{\pi}{2}$ **50.** $\frac{2\pi}{3}$ **51.** $\frac{\pi}{6}$ **52.** $\sqrt{3}$

53. **(a)**



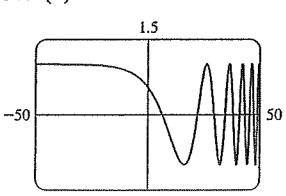
(b) Period π
(c) Even

54. **(a)**



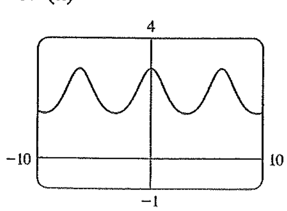
(b) Period 2π
(c) Even

55. **(a)**



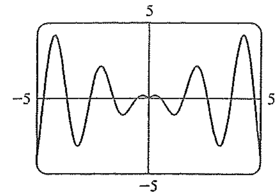
(b) Not periodic
(c) Neither

56. **(a)**



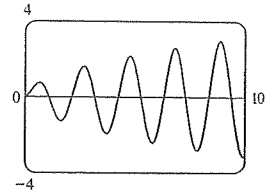
(b) Period 2π
(c) Even

57. **(a)**



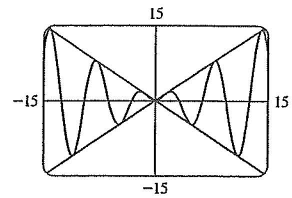
(b) Not periodic
(c) Even

58. **(a)**



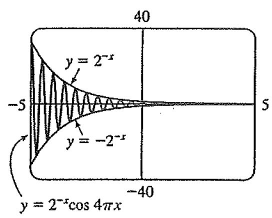
(b) Not periodic
(c) Neither

59.



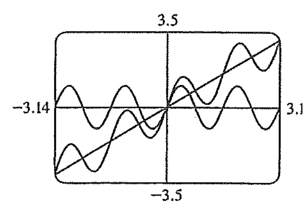
$y = x \sin x$ is a sine function whose graph lies between those of $y = x$ and $y = -x$

60.



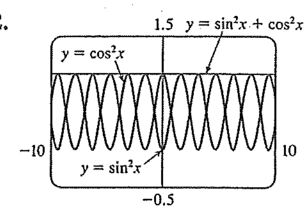
$y = 2^{-x} \cos 4\pi x$ is a cosine function whose graph lies between the graphs of $y = 2^{-x}$ and $y = -2^{-x}$

61.



The graphs are related by graphical addition.

62.

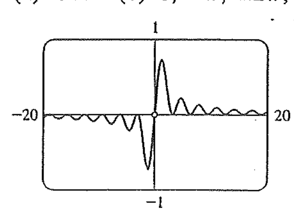


The graphs are related by graphical addition.

63. 1.76, -1.76 **64.** 1.25, -1 **65.** 0.30, 2.84 **66.** 0.390

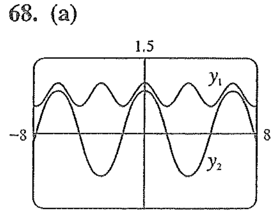
67. **(a)** Odd **(b)** $0, \pm\pi, \pm 2\pi, \ldots$

(c)



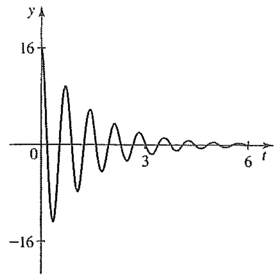
(d) $f(x)$ approaches 0
(e) $f(x)$ approaches 0

68. **(a)**



(b) y_1 has period π, y_2 has period 2π
(c) $\sin(\cos x) < \cos(\sin x)$, for all x

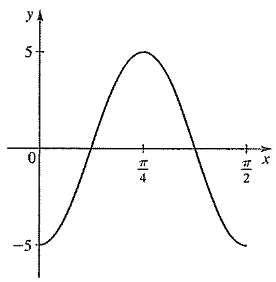
69. $y = 50\cos(16\pi t)$
70. $y = -50\cos(9\pi t)$ **71.** $y = 4\cos(\frac{\pi}{6}t)$
72. (a) $y = 16e^{-0.72t}\cos 2.8\pi t$
(b)



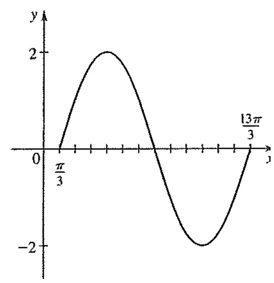
(c) 0.012 cm

CHAPTER 5 TEST ■ PAGE 426

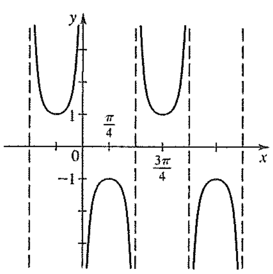
1. $y = -\frac{5}{6}$ **2. (a)** $\frac{4}{5}$ **(b)** $-\frac{3}{5}$ **(c)** $-\frac{4}{3}$ **(d)** $-\frac{5}{3}$
3. (a) $-\frac{1}{2}$ **(b)** $-\sqrt{2}/2$ **(c)** $\sqrt{3}$ **(d)** -1
4. $\tan t = -(\sin t)/\sqrt{1 - \sin^2 t}$ **5.** $-\frac{2}{15}$
6. (a) $5, \pi/2, 0$
(b)



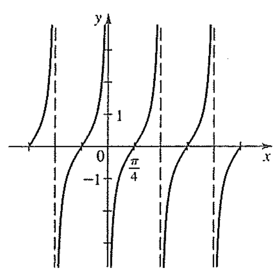
7. (a) $2, 4\pi, \pi/3$
(b)



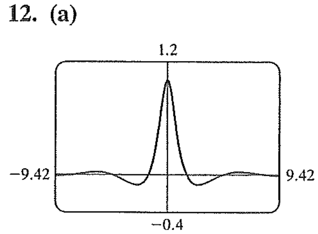
8. π



9. $\pi/2$

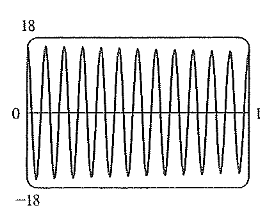


10. (a) $\pi/4$ **(b)** $5\pi/6$ **(c)** 0 **(d)** 1/2
11. $y = 2\sin 2(x + \pi/3)$
12. (a)



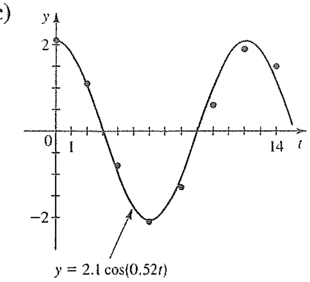
(b) Even
(c) Minimum value -0.11 when $x \approx \pm 2.54$, maximum value 1 when $x = 0$

13. $y = 5\sin(4\pi t)$
14. $y = 16e^{-0.1t}\cos 24\pi t$



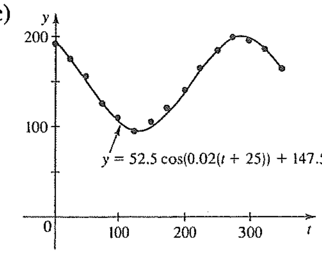
FOCUS ON MODELING ■ PAGE 430

1. (a) and (c)



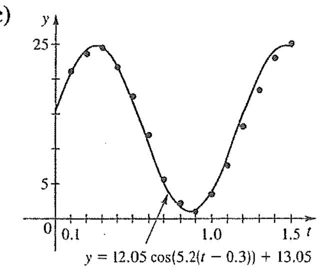
(b) $y = 2.1\cos(0.52t)$
(d) $y = 2.05\sin(0.50t + 1.55) - 0.01$ **(e)** The formula (reduces to $y = 2.05\cos(0.50t - 0.02) - 0.01$. Same as (b) rounded to one decimal.

2. (a) and (c)



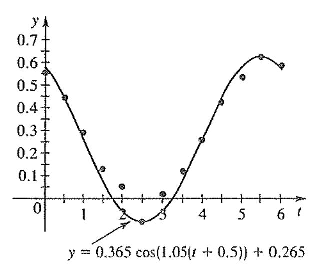
(b) $y = 52.5\cos(0.02(t + 25)) + 147.5$
(d) $y = 49.70\sin(0.02t + 2.09) + 149.13$ **(e)** The form (d) reduces to $y = 49.70\cos(0.02t + 0.52) + 149.13$. Clos not identical, to (b).

3. (a) and (c)



(b) $y = 12.05\cos(5.2(t - 0.3)) + 13.05$
(d) $y = 11.72\sin(5.05t + 0.24) + 12.96$ **(e)** The formul (d) reduces to $y = 11.72\cos(5.05(t - 0.26)) + 12.96$. Clos not identical, to (b).

4. (a) and (c)



(b) $y = 0.365\cos(1.05(t + 0.5)) + 0.265$
(d) $y = 0.33\sin(1.02t + 2.12) + 0.29$ **(e)** The formula (reduces to $y = 0.33\cos(1.02(t + 0.52)) + 0.29$. Same as (l rounded to one decimal.