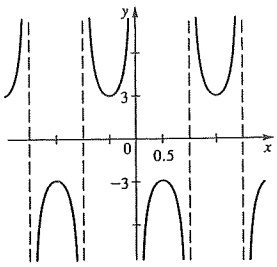
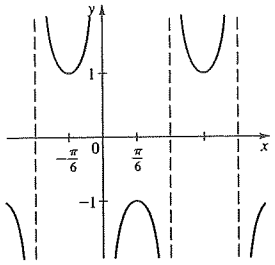
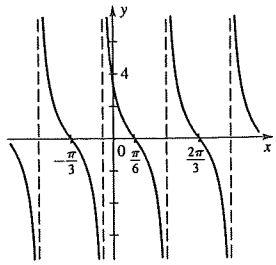
51. 2



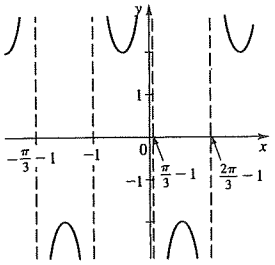
52. $2\pi/3$



53. $\pi/2$

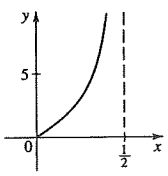


54. $2\pi/3$



57. **(a)** 1.53 mi, 3.00 mi, 18.94 mi

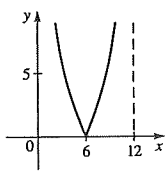
(b)



(c) $d(t)$ approaches ∞

58. **(a)** $S(2) = 10.39$ ft, $S(8) = 3.46$ ft, $S(11\frac{3}{4}) = 91.54$ ft, $S(12)$ is undefined

(b)



(c) 3, 9; 9:00 A.M., 3:00 P.M.

(d) The shadow gets increasingly longer.

SECTION 5.5 ■ PAGE 411

1. **(a)** $[-\pi/2, \pi/2]$, y, x, $\pi/6$, $\pi/6$, $\frac{1}{2}$ **(b)** $[0, \pi]$; y, x, $\pi/3$, $\pi/3$, $\frac{1}{2}$ **2.** $[-1, 1]$; (b) **3.** **(a)** $\pi/2$ **(b)** $\pi/3$ **(c)** Undefined **4.** **(a)** $-\pi/2$ **(b)** $\pi/4$ **(c)** Undefined **5.** **(a)** π **(b)** $\pi/3$ **(c)** $5\pi/6$ **6.** **(a)** $\pi/4$ **(b)** 0 **(c)** $3\pi/4$ **7.** **(a)** $-\pi/4$ **(b)** $\pi/3$ **(c)** $\pi/6$ **8.** **(a)** 0 **(b)** $-\pi/3$ **(c)** $-\pi/6$ **9.** **(a)** $2\pi/3$ **(b)** $-\pi/4$ **(c)** $\pi/4$ **10.** **(a)** $\pi/2$ **(b)** 0 **(c)** $-\pi/6$ **11.** 0.72973 **12.** -1.09491 **13.** 2.01371 **14.** 1.11024 **15.** 2.75876 **16.** 0.13889 **17.** 1.47113 **18.** -1.53235 **19.** 0.88998 **20.** Undefined **21.** -0.26005 **22.** -0.25168 **23.** $\frac{1}{4}$ **24.** $\frac{2}{3}$ **25.** 5 **26.** Undefined **27.** Undefined **28.** $\frac{3}{2}$ **29.** $5\pi/6$ **30.** $\pi/4$ **31.** $-\pi/6$ **32.** $-\pi/4$ **33.** $\pi/6$ **34.** $\pi/6$ **35.** $\pi/6$ · **36.** $\pi/3$ **37.** $-\pi/3$ **38.** $\pi/4$ **39.** $\sqrt{3}/3$ **40.** 1 **41.** $\frac{1}{2}$ **42.** 1 **43.** $-\sqrt{2}/2$ **44.** $-\sqrt{3}/2$

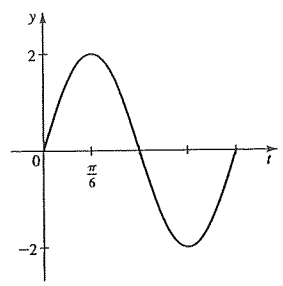
SECTION 5.6 ■ PAGE 420

1. **(a)** $a \sin \omega t$ **(b)** $a \cos \omega t$

2. **(a)** $ke^{-ct} \sin \omega t$ **(b)** $ke^{-ct} \cos \omega t$

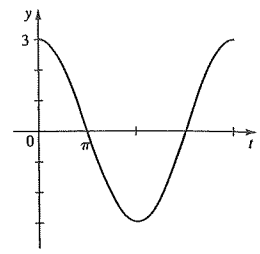
3. **(a)** $2, 2\pi/3, 3/(2\pi)$

(b)



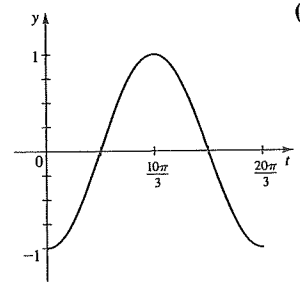
4. **(a)** $3, 4\pi, 1/(4\pi)$

(b)



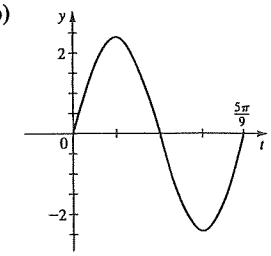
5. **(a)** $1, 20\pi/3, 3/(20\pi)$

(b)

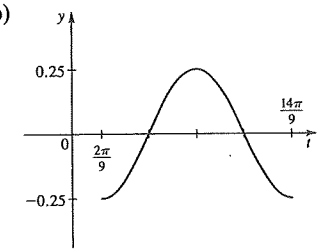


6. **(a)** $2.4, 5\pi/9, 9/(5\pi)$

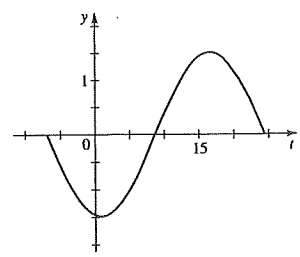
(b)



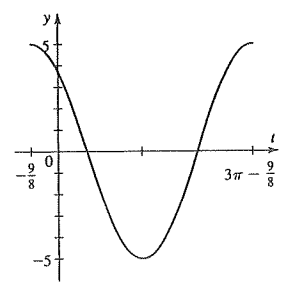
7. **(a)** $\frac{1}{4}, 4\pi/3, 3/(4\pi)$ **(b)**



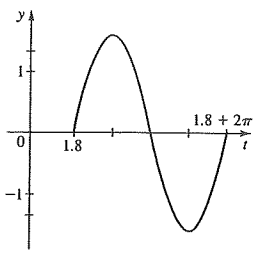
8. **(a)** $\frac{3}{2}, 10\pi, 1/(10\pi)$ **(b)**



9. **(a)** $5, 3\pi, 1/(3\pi)$ **(b)**



10. (a) $1.6,\ 2\pi,\ 1/(2\pi)$ (b)



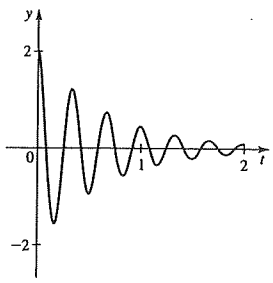
11. $y = 10\sin\left(\dfrac{2\pi}{3}t\right)$ **12.** $y = 24\sin(\pi t)$

13. $y = 6\sin(10t)$ **14.** $y = 1.2\sin(\pi t)$

15. $y = 60\cos(4\pi t)$ **16.** $y = 35\cos(\frac{1}{4}\pi t)$

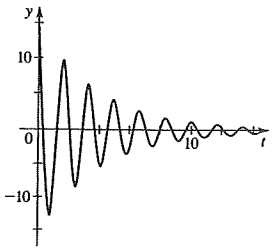
17. $y = 2.4\cos(1500\pi t)$ **18.** $y = 6.25\cos(120\pi t)$

19. (a) $y = 2e^{-1.5t}\cos 6\pi t$ (b)



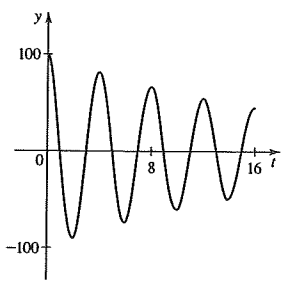
20. (a) $y = 15e^{-0.25t}\cos(1.2\pi t)$

(b)



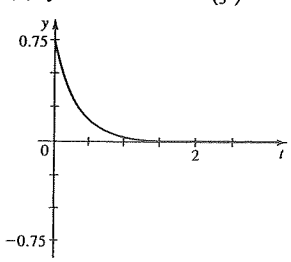
21. (a) $y = 100e^{-0.05t}\cos\dfrac{\pi}{2}t$

(b)

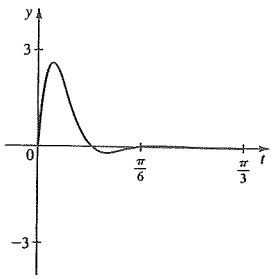


22. (a) $y = 0.75e^{-3t}\cos(\frac{2}{3}t)$

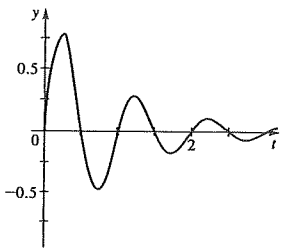
(b)



23. (a) $y = 7e^{-10t}\sin 12t$ (b)

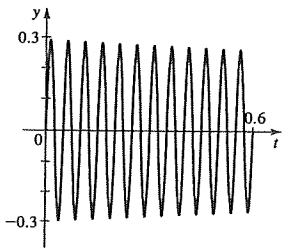


24. (a) $y = e^{-t}\sin(2\pi t)$ (b)



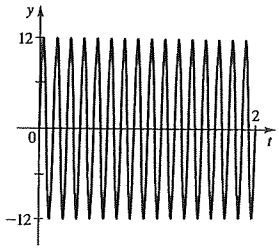
25. (a) $y = 0.3e^{-0.2t}\sin(40\pi t)$

(b)



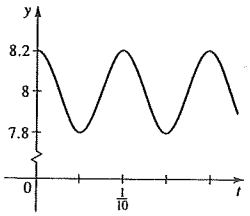
26. (a) $y = 12e^{-0.01t}\sin(16\pi t)$

(b)



27. (a) 10 cycles per minute

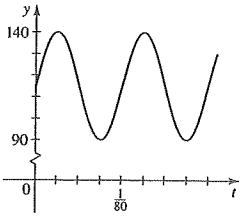
(b)



(c) 0.4 m

28. $1.09 \times 10^{-8},\ 9.15 \times 10^{7}$

29. (a) 25, 0.0125, 80 (b)

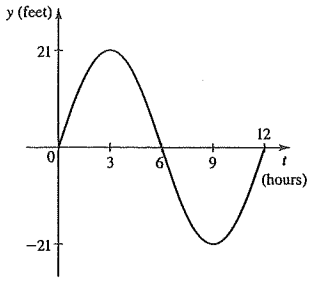


(c) The period decreases and the frequency increases.

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

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

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

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

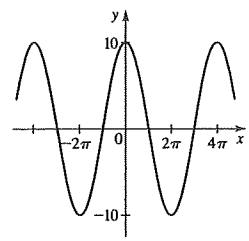
23. $\sin t = 2\sqrt{5}/5$, $\cos t = -\sqrt{5}/5$, $\tan t = -2$, $\sec t = -\sqrt{5}$

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

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

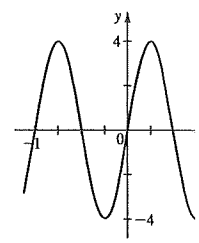
29. (a) $10, 4\pi, 0$

(b)



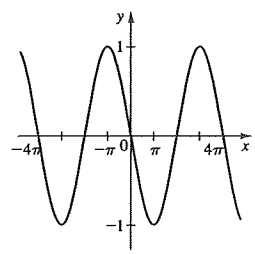
30. (a) $4, 1, 0$

(b)



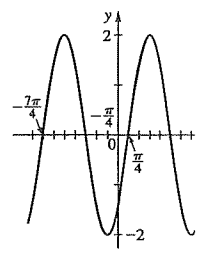
31. (a) $1, 4\pi, 0$

(b)



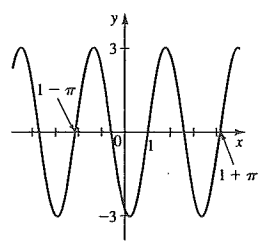
32. (a) $2, 2\pi, \pi/4$

(b)



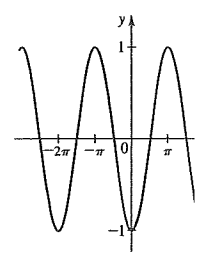
33. (a) $3, \pi, 1$

(b)



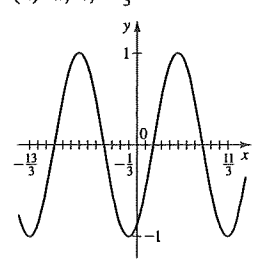
34. (a) $1, \pi, \pi/2$

(b)



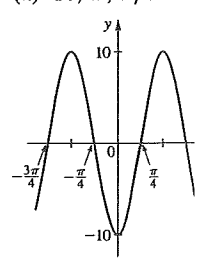
35. (a) $1, 4, -\frac{1}{3}$

(b)



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

(b)



37. $y = 5\sin 4x$

38. $y = 2\sin\left(\frac{\pi}{2}x\right)$

39. $y = \frac{1}{2}\sin 2\pi\left(x + \frac{1}{3}\right)$

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

41. π

42. 1