EXERCISES 6.5 ▪ PAGE 445

1. $\frac{8}{3}$ **3.** $\frac{45}{28}$ **5.** $\frac{1}{10}(1 - e^{-25})$ **7.** $2/(5\pi)$

9. (a) 1   (b) 2, 4   (c)

11. (a) $4/\pi$ (b) $\approx 1.24, 2.81$

(c)
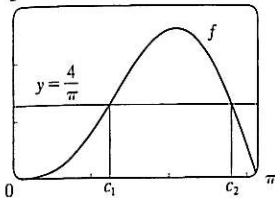
15. $38\frac{1}{3}$ **17.** $(50 + 28/\pi)°F \approx 59°F$ **19.** 6 kg/m
21. $5/(4\pi) \approx 0.4$ L

CHAPTER 6 REVIEW ▪ PAGE 446

Exercises

1. $\frac{8}{3}$ **3.** $\frac{7}{12}$ **5.** $\frac{4}{3} + 4/\pi$ **7.** $64\pi/15$ **9.** $1656\pi/5$
11. $\frac{4}{3}\pi(2ah + h^2)^{3/2}$ **13.** $\int_{-\pi/3}^{\pi/3} 2\pi(\pi/2 - x)(\cos^2 x - \frac{1}{4})\,dx$
15. (a) $2\pi/15$ (b) $\pi/6$ (c) $8\pi/15$
17. (a) 0.38   (b) 0.87
19. Solid obtained by rotating the region $0 \le y \le \cos x$,
$0 \le x \le \pi/2$ about the y-axis
21. Solid obtained by rotating the region $0 \le x \le \pi$,
$0 \le y \le 2 - \sin x$ about the x-axis
23. 36   **25.** $\frac{125}{3}\sqrt{3}$ m³   **27.** 3.2 J
29. (a) $8000\pi/3 \approx 8378$ ft-lb   (b) 2.1 ft   **31.** $f(x)$

PROBLEMS PLUS ▪ PAGE 448

1. (a) $f(t) = 3t^2$ (b) $f(x) = \sqrt{2x/\pi}$ **3.** $\frac{32}{27}$
5. (b) 0.2261   (c) 0.6736 m
(d) (i) $1/(105\pi) \approx 0.003$ in/s   (ii) $370\pi/3$ s ≈ 6.5 min
9. $y = \frac{32}{9}x^2$
11. (a) $V = \int_0^h \pi[f(y)]^2\,dy$ (c) $f(y) = \sqrt{kA/(\pi C)}\,y^{1/4}$
Advantage: the markings on the container are equally spaced.
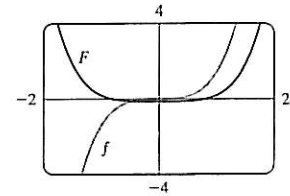**13.** $b = 2a$ **15.** $B = 16A$

CHAPTER 7

EXERCISES 7.1 ▪ PAGE 457

1. $\frac{1}{3}x^3 \ln x - \frac{1}{9}x^3 + C$ **3.** $\frac{1}{5}x \sin 5x + \frac{1}{25}\cos 5x + C$
5. $2(r - 2)e^{r/2} + C$

7. $-\frac{1}{\pi}x^2 \cos \pi x + \frac{2}{\pi^2}x \sin \pi x + \frac{2}{\pi^3}\cos \pi x + C$
9. $\frac{1}{2}(2x + 1)\ln(2x + 1) - x + C$
11. $t \arctan 4t - \frac{1}{8}\ln(1 + 16t^2) + C$
13. $\frac{1}{2}t \tan 2t - \frac{1}{4}\ln|\sec 2t| + C$
15. $x(\ln x)^2 - 2x \ln x + 2x + C$
17. $\frac{1}{13}e^{2\theta}(2 \sin 3\theta - 3 \cos 3\theta) + C$
19. $\pi/3$ **21.** $1 - 1/e$ **23.** $\frac{1}{2} - \frac{1}{2}\ln 2$ **25.** $\frac{1}{4} - \frac{3}{4}e^{-2}$
27. $\frac{1}{6}(\pi + 6 - 3\sqrt{3})$ **29.** $\sin x (\ln \sin x - 1) + C$
31. $\frac{32}{5}(\ln 2)^2 - \frac{64}{25}\ln 2 + \frac{62}{125}$
33. $2\sqrt{x} \sin \sqrt{x} + 2 \cos \sqrt{x} + C$ **35.** $-\frac{1}{2} - \pi/4$
37. $\frac{1}{2}(x^2 - 1)\ln(1 + x) - \frac{1}{4}x^2 + \frac{1}{2}x + \frac{3}{4} + C$
39. $(2x + 1)e^x + C$
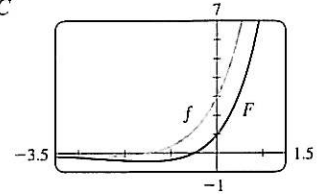
41. $\frac{1}{3}x^2(1 + x^2)^{3/2} - \frac{2}{15}(1 + x^2)^{5/2} + C$


43. (b) $-\frac{1}{4}\cos x \sin^3 x + \frac{3}{8}x - \frac{3}{16}\sin 2x + C$
45. (b) $\frac{2}{3}, \frac{8}{15}$ **51.** $x(\ln x)^3 - 3x(\ln x)^2 + 6x \ln x - 6x + C$
53. $\frac{25}{4} - \frac{75}{4}e^{-2}$ **55.** 1.0475, 2.8731; 2.1828   **57.** $4 - 8/\pi$
59. $2\pi e$ **61.** $\frac{9}{2}\ln 3 - \frac{13}{9}$ **63.** $2 - e^{-t}(t^2 + 2t + 2)$ m
65. 2

EXERCISES 7.2 ▪ PAGE 465

1. $\frac{1}{5}\cos^5 x - \frac{1}{3}\cos^3 x + C$ **3.** $-\frac{11}{384}$
5. $\frac{1}{3\pi}\sin^3(\pi x) - \frac{2}{5\pi}\sin^5(\pi x) + \frac{1}{7\pi}\sin^7(\pi x) + C$
7. $\pi/4$ **9.** $3\pi/8$ **11.** $\frac{3}{2}\theta + 2 \sin \theta + \frac{1}{4}\sin 2\theta + C$
13. $\pi/16$ **15.** $\frac{2}{45}\sqrt{\sin \alpha}\,(45 - 18 \sin^2\alpha + 15 \sin^4\alpha) + C$
17. $\frac{1}{2}\cos^2 x - \ln|\cos x| + C$ **19.** $\ln|\sin x| + 2 \sin x + C$
21. $\frac{1}{2}\tan^2 x + C$ **23.** $\tan x - x + C$
25. $\frac{1}{5}\tan^5 t + \frac{2}{3}\tan^3 t + \tan t + C$ **27.** $\frac{117}{8}$
29. $\frac{1}{3}\sec^3 x - \sec x + C$
31. $\frac{1}{4}\sec^4 x - \tan^2 x + \ln|\sec x| + C$
33. $\frac{1}{6}\tan^6\theta + \frac{1}{4}\tan^4\theta + C$
35. $x \sec x - \ln|\sec x + \tan x| + C$ **37.** $\sqrt{3} - \frac{1}{3}\pi$
39. $\frac{1}{3}\csc^3\alpha - \frac{1}{5}\csc^5\alpha + C$ **41.** $\ln|\csc x - \cot x| + C$
43. $-\frac{1}{6}\cos 3x - \frac{1}{26}\cos 13x + C$ **45.** $\frac{1}{8}\sin 4\theta - \frac{1}{12}\sin 6\theta + C$
47. $\frac{1}{2}\sin 2x + C$ **49.** $\frac{1}{10}\tan^5(t^2) + C$

51. $\frac{1}{4}x^2 - \frac{1}{4}\sin(x^2)\cos(x^2) + C$ **53.** $\frac{1}{6}\sin 3x - \frac{1}{18}\sin 9x + C$
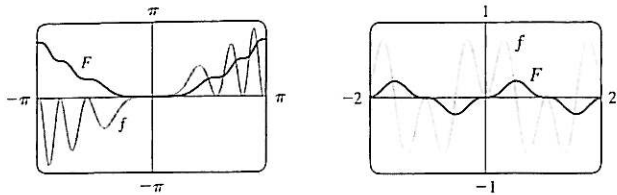
55. 0 **57.** 1 **59.** 0 **61.** $\pi^2/4$ **63.** $\pi(2\sqrt{2} - \frac{5}{2})$
65. $s = (1 - \cos^3\omega t)/(3\omega)$

EXERCISES 7.3 ▪ **PAGE 472**

1. $\sqrt{x^2 - 9}/(9x) + C$ **3.** $\frac{1}{3}(x^2 - 18)\sqrt{x^2 + 9} + C$
5. $\pi/24 + \sqrt{3}/8 - \frac{1}{4}$ **7.** $-\sqrt{25 - x^2}/(25x) + C$
9. $\ln(\sqrt{x^2 + 16} + x) + C$ **11.** $\frac{1}{4}\sin^{-1}(2x) + \frac{1}{2}x\sqrt{1 - 4x^2} + C$
13. $\frac{1}{6}\sec^{-1}(x/3) - \sqrt{x^2 - 9}/(2x^2) + C$
15. $\frac{1}{16}\pi a^4$ **17.** $\sqrt{x^2 - 7} + C$
19. $\ln\left|(\sqrt{1 + x^2} - 1)/x\right| + \sqrt{1 + x^2} + C$ **21.** $\frac{9}{500}\pi$
23. $\frac{9}{2}\sin^{-1}((x - 2)/3) + \frac{1}{2}(x - 2)\sqrt{5 + 4x - x^2} + C$
25. $\sqrt{x^2 + x + 1} - \frac{1}{2}\ln(\sqrt{x^2 + x + 1} + x + \frac{1}{2}) + C$
27. $\frac{1}{2}(x + 1)\sqrt{x^2 + 2x} - \frac{1}{2}\ln\left|x + 1 + \sqrt{x^2 + 2x}\right| + C$
29. $\frac{1}{4}\sin^{-1}(x^2) + \frac{1}{4}x^2\sqrt{1 - x^4} + C$
33. $\frac{1}{6}(\sqrt{48} - \sec^{-1}7)$ **37.** 0.81, 2; 2.10
41. $r\sqrt{R^2 - r^2} + \pi r^2/2 - R^2\arcsin(r/R)$ **43.** $2\pi^2Rr^2$

EXERCISES 7.4 ▪ **PAGE 481**

1. (a) $\dfrac{A}{x + 3} + \dfrac{B}{3x + 1}$ (b) $\dfrac{A}{x} + \dfrac{B}{x + 1} + \dfrac{C}{(x + 1)^2}$

3. (a) $\dfrac{A}{x} + \dfrac{B}{x^2} + \dfrac{C}{x^3} + \dfrac{Dx + E}{x^2 + 4}$

(b) $\dfrac{A}{x + 3} + \dfrac{B}{(x + 3)^2} + \dfrac{C}{x - 3} + \dfrac{D}{(x - 3)^2}$

5. (a) $1 + \dfrac{A}{x - 1} + \dfrac{B}{x + 1} + \dfrac{Cx + D}{x^2 + 1}$

(b) $\dfrac{At + B}{t^2 + 1} + \dfrac{Ct + D}{t^2 + 4} + \dfrac{Et + F}{(t^2 + 4)^2}$

7. $x + 6\ln|x - 6| + C$
9. $2\ln|x + 5| - \ln|x - 2| + C$ **11.** $\frac{1}{2}\ln\frac{3}{2}$
13. $a\ln|x - b| + C$ **15.** $\frac{7}{6} + \ln\frac{2}{3}$
17. $\frac{27}{5}\ln 2 - \frac{9}{5}\ln 3$ $\left(\text{or } \frac{9}{5}\ln\frac{8}{3}\right)$
19. $-\dfrac{1}{36}\ln|x + 5| + \dfrac{1}{6}\dfrac{1}{x + 5} + \dfrac{1}{36}\ln|x - 1| + C$
21. $\frac{1}{2}x^2 - 2\ln(x^2 + 4) + 2\tan^{-1}(x/2) + C$
23. $2\ln|x| + (1/x) + 3\ln|x + 2| + C$
25. $\ln|x - 1| - \frac{1}{2}\ln(x^2 + 9) - \frac{1}{3}\tan^{-1}(x/3) + C$
27. $\frac{1}{2}\ln(x^2 + 1) + (1/\sqrt{2})\tan^{-1}(x/\sqrt{2}) + C$
29. $\frac{1}{2}\ln(x^2 + 2x + 5) + \frac{3}{2}\tan^{-1}\left(\dfrac{x + 1}{2}\right) + C$
31. $\frac{1}{3}\ln|x - 1| - \frac{1}{6}\ln(x^2 + x + 1) - \dfrac{1}{\sqrt{3}}\tan^{-1}\dfrac{2x + 1}{\sqrt{3}} + C$
33. $\frac{1}{4}\ln\frac{8}{3}$ **35.** $\frac{1}{16}\ln|x| - \frac{1}{32}\ln(x^2 + 4) + \dfrac{1}{8(x^2 + 4)} + C$

37. $\frac{7}{8}\sqrt{2}\tan^{-1}\left(\dfrac{x - 2}{\sqrt{2}}\right) + \dfrac{3x - 8}{4(x^2 - 4x + 6)} + C$

39. $\ln\left|\dfrac{\sqrt{x + 1} - 1}{\sqrt{x + 1} + 1}\right| + C$
41. $2 + \ln\frac{25}{9}$ **43.** $\frac{3}{10}(x^2 + 1)^{5/3} - \frac{3}{4}(x^2 + 1)^{2/3} + C$
45. $2\sqrt{x} + 3\sqrt[3]{x} + 6\sqrt[6]{x} + 6\ln\left|\sqrt[6]{x} - 1\right| + C$

47. $\ln\left[\dfrac{(e^x + 2)^2}{e^x + 1}\right] + C$

49. $\ln|\tan t + 1| - \ln|\tan t + 2| + C$

51. $(x - \frac{1}{2})\ln(x^2 - x + 2) - 2x + \sqrt{7}\tan^{-1}\left(\dfrac{2x - 1}{\sqrt{7}}\right) + C$
53. $-\frac{1}{2}\ln 3 \approx -0.55$

55. $\frac{1}{2}\ln\left|\dfrac{x - 2}{x}\right| + C$ **59.** $\frac{1}{5}\ln\left|\dfrac{2\tan(x/2) - 1}{\tan(x/2) + 2}\right| + C$

61. $4\ln\frac{2}{3} + 2$ **63.** $-1 + \frac{11}{3}\ln 2$
65. $t = -\ln P - \frac{1}{9}\ln(0.9P + 900) + C$, where $C \approx 10.23$

67. (a) $\dfrac{24{,}110}{4879}\dfrac{1}{5x + 2} - \dfrac{668}{323}\dfrac{1}{2x + 1} - \dfrac{9438}{80{,}155}\dfrac{1}{3x - 7} +$

$\dfrac{1}{260{,}015}\dfrac{22{,}098x + 48{,}935}{x^2 + x + 5}$

(b) $\dfrac{4822}{4879}\ln|5x + 2| - \dfrac{334}{323}\ln|2x + 1| - \dfrac{3146}{80{,}155}\ln|3x - 7| +$

$\dfrac{11{,}049}{260{,}015}\ln(x^2 + x + 5) + \dfrac{75{,}772}{260{,}015\sqrt{19}}\tan^{-1}\dfrac{2x + 1}{\sqrt{19}} + C$

The CAS omits the absolute value signs and the constant of integration.

EXERCISES 7.5 ▪ **PAGE 488**

1. $\sin x + \frac{1}{3}\sin^3 x + C$
3. $\sin x + \ln|\csc x - \cot x| + C$
5. $4 - \ln 9$ **7.** $e^{\pi/4} - e^{-\pi/4}$
9. $\frac{243}{5}\ln 3 - \frac{242}{25}$ **11.** $\frac{1}{2}\ln(x^2 - 4x + 5) + \tan^{-1}(x - 2) + C$
13. $\frac{1}{8}\cos^8\theta - \frac{1}{6}\cos^6\theta + C$ $\left(\text{or } \frac{1}{4}\sin^4\theta - \frac{1}{3}\sin^6\theta + \frac{1}{8}\sin^8\theta + C\right)$
15. $x/\sqrt{1 - x^2} + C$
17. $\frac{1}{4}x^2 - \frac{1}{2}x\sin x\cos x + \frac{1}{4}\sin^2 x + C$
$\left(\text{or } \frac{1}{4}x^2 - \frac{1}{4}x\sin 2x - \frac{1}{8}\cos 2x + C\right)$
19. $e^{e^x} + C$ **21.** $(x + 1)\arctan\sqrt{x} - \sqrt{x} + C$
23. $\frac{4097}{45}$ **25.** $3x + \frac{23}{3}\ln|x - 4| - \frac{5}{3}\ln|x + 2| + C$
27. $x - \ln(1 + e^x) + C$ **29.** $15 + 7\ln\frac{2}{7}$
31. $\sin^{-1}x - \sqrt{1 - x^2} + C$

33. $2\sin^{-1}\left(\dfrac{x + 1}{2}\right) + \dfrac{x + 1}{2}\sqrt{3 - 2x - x^2} + C$

35. 0 **37.** $\pi/8 - \frac{1}{4}$ **39.** $\ln|\sec\theta - 1| - \ln|\sec\theta| + C$
41. $\theta\tan\theta - \frac{1}{2}\theta^2 - \ln|\sec\theta| + C$ **43.** $\frac{2}{3}(1 + e^x)^{3/2} + C$
45. $-\frac{1}{3}(x^3 + 1)e^{-x^3} + C$
47. $\ln|x - 1| - 3(x - 1)^{-1} - \frac{3}{2}(x - 1)^{-2} - \frac{1}{3}(x - 1)^{-3} + C$

49. $\ln\left|\dfrac{\sqrt{4x + 1} - 1}{\sqrt{4x + 1} + 1}\right| + C$ **51.** $-\ln\left|\dfrac{\sqrt{4x^2 + 1} + 1}{2x}\right| + C$

**53.** $\dfrac{1}{m}x^2\cosh(mx) - \dfrac{2}{m^2}x\sinh(mx) + \dfrac{2}{m^3}\cosh(mx) + C$

55. $2 \ln \sqrt{x} - 2 \ln(1 + \sqrt{x}) + C$

57. $\frac{3}{7}(x + c)^{7/3} - \frac{3}{4}c(x + c)^{4/3} + C$

59. $\sin(\sin x) - \frac{1}{3}\sin^3(\sin x) + C$ **61.** $2(x - 2\sqrt{x} + 2)e^{\sqrt{x}} + C$

63. $-\tan^{-1}(\cos^2 x) + C$ **65.** $\frac{2}{3}[(x + 1)^{3/2} - x^{3/2}] + C$

67. $\sqrt{2} - 2/\sqrt{3} + \ln(2 + \sqrt{3}) - \ln(1 + \sqrt{2})$

69. $e^x - \ln(1 + e^x) + C$

71. $-\sqrt{1 - x^2} + \frac{1}{2}(\arcsin x)^2 + C$

73. $\frac{1}{8}\ln|x - 2| - \frac{1}{16}\ln(x^2 + 4) - \frac{1}{8}\tan^{-1}(x/2) + C$

75. $2(x - 2)\sqrt{1 + e^x} + 2 \ln \dfrac{\sqrt{1 + e^x} + 1}{\sqrt{1 + e^x} - 1} + C$

77. $\frac{2}{3}\tan^{-1}(x^{3/2}) + C$

79. $\frac{1}{3}x \sin^3 x + \frac{1}{3}\cos x - \frac{1}{9}\cos^3 x + C$ **81.** $xe^{x^2} + C$

EXERCISES 7.6 ▪ PAGE 493

1. $(-1/x)\sqrt{7 - 2x^2} - \sqrt{2}\sin^{-1}(\sqrt{2}x/\sqrt{7}) + C$

3. $\dfrac{1}{2\pi}\sec(\pi x)\tan(\pi x) + \dfrac{1}{2\pi}\ln|\sec(\pi x) + \tan(\pi x)| + C$

5. $\pi/4$ **7.** $\dfrac{1}{2\pi}\tan^2(\pi x) + \dfrac{1}{\pi}\ln|\cos(\pi x)| + C$

9. $-\sqrt{4x^2 + 9}/(9x) + C$ **11.** $e - 2$

13. $-\frac{1}{2}\tan^2(1/z) - \ln|\cos(1/z)| + C$

15. $\frac{1}{2}(e^{2x} + 1)\arctan(e^x) - \frac{1}{2}e^x + C$

17. $\dfrac{2y - 1}{8}\sqrt{6 + 4y - 4y^2} + \frac{7}{8}\sin^{-1}\left(\dfrac{2y - 1}{\sqrt{7}}\right)$
  $- \frac{1}{12}(6 + 4y - 4y^2)^{3/2} + C$

19. $\frac{1}{9}\sin^3 x [3 \ln(\sin x) - 1] + C$

21. $\dfrac{1}{2\sqrt{3}}\ln\left|\dfrac{e^x + \sqrt{3}}{e^x - \sqrt{3}}\right| + C$

23. $\frac{1}{4}\tan x \sec^3 x + \frac{3}{8}\tan x \sec x + \frac{3}{8}\ln|\sec x + \tan x| + C$

25. $\frac{1}{2}(\ln x)\sqrt{4 + (\ln x)^2} + 2\ln[\ln x + \sqrt{4 + (\ln x)^2}] + C$

27. $\sqrt{e^{2x} - 1} - \cos^{-1}(e^{-x}) + C$

29. $\frac{1}{5}\ln|x^5 + \sqrt{x^{10} - 2}| + C$ **31.** $2\pi^2$

35. $\frac{1}{3}\tan x \sec^2 x + \frac{2}{3}\tan x + C$

37. $\frac{1}{4}x(x^2 + 2)\sqrt{x^2 + 4} - 2\ln(\sqrt{x^2 + 4} + x) + C$

39. $\frac{1}{10}(1 + 2x)^{5/2} - \frac{1}{6}(1 + 2x)^{3/2} + C$

41. $-\ln|\cos x| - \frac{1}{2}\tan^2 x + \frac{1}{4}\tan^4 x + C$

43. (a) $-\ln\left|\dfrac{1 + \sqrt{1 - x^2}}{x}\right| + C$;

both have domain $(-1, 0) \cup (0, 1)$

45. $F(x) = \frac{1}{2}\ln(x^2 - x + 1) - \frac{1}{2}\ln(x^2 + x + 1)$;

max. at -1, min. at 1; IP at -1.7, 0, and 1.7
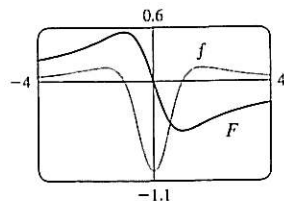
47. $F(x) = -\frac{1}{10}\sin^3 x \cos^7 x - \frac{3}{80}\sin x \cos^7 x + \frac{1}{160}\sin x \cos^5 x$
  $+ \frac{1}{128}\sin x \cos^3 x + \frac{3}{256}\sin x \cos x + \frac{3}{256}x$;

max. at π, min. at 0; IP at 0.7, $\pi/2$, and 2.5
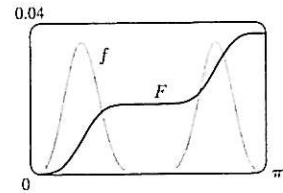
EXERCISES 7.7 ▪ PAGE 505

1. (a) $L_2 = 6, R_2 = 12, M_2 \approx 9.6$
(b) L_2 is an underestimate, R_2 and M_2 are overestimates.
(c) $T_2 = 9 < I$ (d) $L_n < T_n < I < M_n < R_n$

3. (a) $T_4 \approx 0.895759$ (underestimate)
(b) $M_4 \approx 0.908907$ (overestimate)
$T_4 < I < M_4$

5. (a) 5.932957, $E_M \approx -0.063353$
(b) 5.869247, $E_S \approx 0.000357$

7. (a) 2.413790 (b) 2.411453 (c) 2.412232

9. (a) 0.146879 (b) 0.147391 (c) 0.147219

11. (a) 0.451948 (b) 0.451991 (c) 0.451976

13. (a) 4.513618 (b) 4.748256 (c) 4.675111

15. (a) -0.495333 (b) -0.543321 (c) -0.526123

17. (a) 1.064275 (b) 1.067416 (c) 1.074915

19. (a) $T_8 \approx 0.902333, M_8 \approx 0.905620$
(b) $|E_T| \leq 0.0078, |E_M| \leq 0.0039$
(c) $n = 71$ for T_n, $n = 50$ for M_n

21. (a) $T_{10} \approx 1.983524, E_T \approx 0.016476$;
$M_{10} \approx 2.008248, E_M \approx -0.008248$;
$S_{10} \approx 2.000110, E_S \approx -0.000110$
(b) $|E_T| \leq 0.025839, |E_M| \leq 0.012919, |E_S| \leq 0.000170$
(c) $n = 509$ for T_n, $n = 360$ for M_n, $n = 22$ for S_n

23. (a) 2.8 (b) 7.954926518 (c) 0.2894
(d) 7.954926521 (e) The actual error is much smaller.
(f) 10.9 (g) 7.953789422 (h) 0.0593
(i) The actual error is smaller.   (j) $n \geq 50$

25.

n	L_n	R_n	T_n	M_n
5	0.742943	1.286599	1.014771	0.992621
10	0.867782	1.139610	1.003696	0.998152
20	0.932967	1.068881	1.000924	0.999538

| n	E_L	E_R	E_T	E_M
5	0.257057	-0.286599	-0.014771	0.007379
10	0.132218	-0.139610	-0.003696	0.001848
20	0.067033	-0.068881	-0.000924	0.000462

Observations are the same as after Example 1.

27.

n	T_n	M_n	S_n
6	6.695473	6.252572	6.403292
12	6.474023	6.363008	6.400206

n	E_T	E_M	E_S
6	-0.295473	0.147428	-0.003292
12	-0.074023	0.036992	-0.000206

Observations are the same as after Example 1.

29. (a) 19.8   (b) 20.6   (c) $20.5\bar{3}$

31. (a) 23.44   (b) $0.341\bar{3}$ **33.** $37.7\bar{3}$ ft/s

35. 10,177 megawatt-hours   **37.** 828   **39.** 6.0   **41.** 59.4
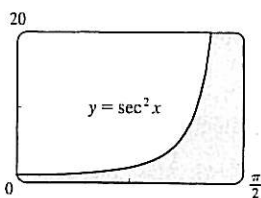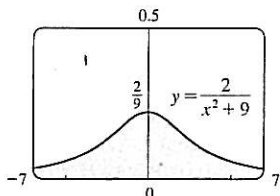
43.
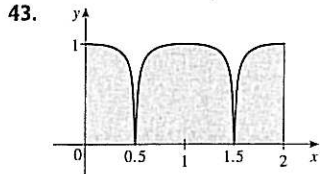
EXERCISES 7.8 ▪ **PAGE 515**

Abbreviations: C, convergent; D, divergent

1. (a) Infinite interval   (b) Infinite discontinuity
(c) Infinite discontinuity   (d) Infinite interval

3. $\frac{1}{2} - 1/(2t^2)$; 0.495, 0.49995, 0.4999995; 0.5

5. $\frac{1}{12}$ **7.** D   **9.** $2e^{-2}$ **11.** D   **13.** 0   **15.** D

17. D   **19.** $\frac{1}{25}$ **21.** D   **23.** $\pi/9$

25. $\frac{1}{2}$ **27.** D   **29.** $\frac{32}{3}$ **31.** D   **33.** $\frac{75}{4}$

35. D   **37.** $-2/e$ **39.** $\frac{8}{3}\ln 2 - \frac{8}{9}$

41. e **43.** $2\pi/3$
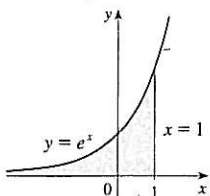
45. Infinite area

47. (a)

t	$\int_1^t [(\sin^2 x)/x^2]\, dx$
2	0.447453
5	0.577101
10	0.621306
100	0.668479
1,000	0.672957
10,000	0.673407

It appears that the integral is convergent.

(c)
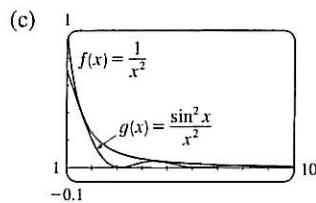
49. C   **51.** D   **53.** D   **55.** π **57.** $p < 1, 1/(1 - p)$

59. $p > -1, -1/(p + 1)^2$ **65.** $\sqrt{2GM/R}$

67. (a)
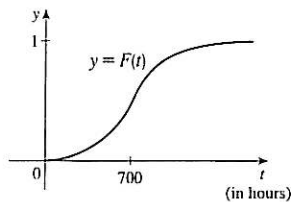
(b) The rate at which the fraction $F(t)$ increases as t increases
(c) 1; all bulbs burn out eventually

69. 1000

71. (a) $F(s) = 1/s, s > 0$ (b) $F(s) = 1/(s - 1), s > 1$
(c) $F(s) = 1/s^2, s > 0$

77. $C = 1$; $\ln 2$ **79.** No

CHAPTER 7 REVIEW ▪ **PAGE 518**

True-False Quiz

1. False   **3.** False   **5.** False   **7.** False
9. (a) True   (b) False   **11.** False   **13.** False

Exercises

1. $5 + 10\ln\frac{2}{3}$ **3.** $\ln 2$ **5.** $\frac{2}{15}$

7. $-\cos(\ln t) + C$ **9.** $\frac{64}{5}\ln 4 - \frac{124}{25}$

11. $\sqrt{3} - \frac{1}{3}\pi$ **13.** $3e^{\sqrt[3]{x}}(\sqrt[3]{x^2} - 2\sqrt[3]{x} + 2) + C$

15. $-\frac{1}{2}\ln|x| + \frac{3}{2}\ln|x + 2| + C$

17. $x \sec x - \ln|\sec x + \tan x| + C$

19. $\frac{1}{18}\ln(9x^2 + 6x + 5) + \frac{1}{9}\tan^{-1}[\frac{1}{2}(3x + 1)] + C$

21. $\ln|x - 2 + \sqrt{x^2 - 4x}| + C$

23. $\ln\left|\dfrac{\sqrt{x^2 + 1} - 1}{x}\right| + C$

25. $\frac{3}{2}\ln(x^2 + 1) - 3\tan^{-1}x + \sqrt{2}\tan^{-1}(x/\sqrt{2}) + C$

27. $\frac{2}{5}$ **29.** 0   **31.** $6 - \frac{3}{2}\pi$

33. $\dfrac{x}{\sqrt{4 - x^2}} - \sin^{-1}\left(\dfrac{x}{2}\right) + C$

35. $4\sqrt{1 + \sqrt{x}} + C$ **37.** $\frac{1}{2}\sin 2x - \frac{1}{8}\cos 4x + C$

39. $\frac{1}{8}e - \frac{1}{4}$ **41.** $\frac{1}{36}$ **43.** D

45. $4\ln 4 - 8$ **47.** $-\frac{4}{3}$ **49.** $\pi/4$

51. $(x + 1)\ln(x^2 + 2x + 2) + 2\arctan(x + 1) - 2x + C$

53. 0

55. $\frac{1}{4}(2x - 1)\sqrt{4x^2 - 4x - 3} -$
$\ln|2x - 1 + \sqrt{4x^2 - 4x - 3}| + C$

57. $\frac{1}{2}\sin x\sqrt{4 + \sin^2x} + 2\ln(\sin x + \sqrt{4 + \sin^2x}) + C$

61. No

63. (a) 1.925444   (b) 1.920915   (c) 1.922470

65. (a) $0.01348, n \geq 368$ (b) $0.00674, n \geq 260$

67. 8.6 mi

69. (a) 3.8   (b) 1.7867, 0.000646   (c) $n \geq 30$

71. C   **73.** 2   **75.** $\frac{3}{16}\pi^2$

PROBLEMS PLUS ◻ PAGE 521

1. About 1.85 inches from the center   **3.** 0

7. $f(\pi) = -\pi/2$ **11.** $(b^b a^{-a})^{1/(b-a)}e^{-1}$

13. $2 - \sin^{-1}(2/\sqrt{5})$

CHAPTER 8

EXERCISES 8.1 ◻ PAGE 530

1. $4\sqrt{5}$ **3.** $\int_0^{2\pi}\sqrt{1 + \sin^2x}\,dx$ **5.** $\int_1^4\sqrt{9y^4 + 6y^2 + 2}\,dy$

7. $\frac{2}{243}(82\sqrt{82} - 1)$ **9.** $\frac{1261}{240}$ **11.** $\frac{32}{3}$

13. $\ln(\sqrt{2} + 1)$ **15.** $\ln 3 - \frac{1}{2}$

17. $\sqrt{1 + e^2} - \sqrt{2} + \ln(\sqrt{1 + e^2} - 1) - 1 - \ln(\sqrt{2} - 1)$

19. $\sqrt{2} + \ln(1 + \sqrt{2})$ **21.** $\frac{46}{3}$ **23.** 5.115840
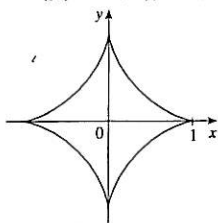
25. 1.569619

27. (a), (b)
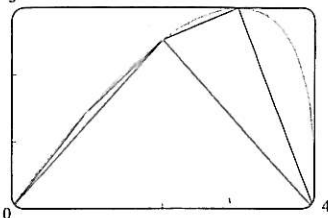
$L_1 = 4,$
$L_2 \approx 6.43,$
$L_4 \approx 7.50$

(c) $\int_0^4\sqrt{1 + [4(3 - x)/(3(4 - x)^{2/3})]^2}\,dx$ (d) 7.7988

29. $\sqrt{5} - \ln(\frac{1}{2}(1 + \sqrt{5})) - \sqrt{2} + \ln(1 + \sqrt{2})$

31. 6

33. $s(x) = \frac{2}{27}[(1 + 9x)^{3/2} - 10\sqrt{10}]$ **35.** $2\sqrt{2}(\sqrt{1 + x} - 1)$

37. 209.1 m   **39.** 29.36 in.   **41.** 12.4

EXERCISES 8.2 ◻ PAGE 537

1. (a) $\int_0^1 2\pi x^4\sqrt{1 + 16x^6}\,dx$ (b) $\int_0^1 2\pi x\sqrt{1 + 16x^6}\,dx$

3. (a) $\int_0^1 2\pi\tan^{-1}x\sqrt{1 + \dfrac{1}{(1 + x^2)^2}}\,dx$

(b) $\int_0^1 2\pi x\sqrt{1 + \dfrac{1}{(1 + x^2)^2}}\,dx$

5. $\frac{1}{27}\pi(145\sqrt{145} - 1)$ **7.** $\frac{98}{3}\pi$

9. $2\sqrt{1 + \pi^2} + (2/\pi)\ln(\pi + \sqrt{1 + \pi^2})$ **11.** $\frac{21}{2}\pi$

13. $\frac{1}{27}\pi(145\sqrt{145} - 10\sqrt{10})$ **15.** πa^2

17. 9.023754   **19.** 13.527296

21. $\frac{1}{4}\pi[4\ln(\sqrt{17} + 4) - 4\ln(\sqrt{2} + 1) - \sqrt{17} + 4\sqrt{2}]$

23. $\frac{1}{6}\pi[\ln(\sqrt{10} + 3) + 3\sqrt{10}]$

27. (a) $\frac{1}{3}\pi a^2$ (b) $\frac{56}{45}\pi\sqrt{3}a^2$

29. (a) $2\pi\left[b^2 + \dfrac{a^2b\sin^{-1}(\sqrt{a^2 - b^2}/a)}{\sqrt{a^2 - b^2}}\right]$

(b) $2\pi\left[a^2 + \dfrac{ab^2\sin^{-1}(\sqrt{b^2 - a^2}/b)}{\sqrt{b^2 - a^2}}\right]$

31. $\int_a^b 2\pi[c - f(x)]\sqrt{1 + [f'(x)]^2}\,dx$ **33.** $4\pi^2r^2$

EXERCISES 8.3 ◻ PAGE 547

1. (a) 187.5 lb/ft^2 (b) 1875 lb   (c) 562.5 lb

3. 6000 lb   **5.** 6.7×10^4 N   **7.** 9.8×10^3 N

9. 1.2×10^4 lb   **11.** $\frac{2}{3}\delta ah$ **13.** 5.27×10^5 N

15. (a) 314 N   (b) 353 N

17. (a) 5.63×10^3 lb   (b) 5.06×10^4 lb

(c) 4.88×10^4 lb   (d) 3.03×10^5 lb

19. 2.5×10^5 N   **21.** $230; \frac{23}{7}$ **23.** $10; 1; (\frac{1}{21}, \frac{10}{21})$

25. $(0, 1.6)$ **27.** $\left(\dfrac{1}{e - 1}, \dfrac{e + 1}{4}\right)$ **29.** $(\frac{9}{20}, \frac{9}{20})$

31. $\left(\dfrac{\pi\sqrt{2} - 4}{4(\sqrt{2} - 1)}, \dfrac{1}{4(\sqrt{2} - 1)}\right)$ **33.** $(2, 0)$

35. $60; 160; (\frac{8}{3}, 1)$ **37.** $(0.781, 1.330)$ **41.** $(0, \frac{1}{12})$

45. $\frac{1}{3}\pi r^2h$

EXERCISES 8.4 ◻ PAGE 553

1. \$38,000   **3.** \$43,866,933.33   **5.** \$407.25

7. \$12,000   **9.** 3727; \$37,753

11. $\frac{2}{3}(16\sqrt{2} - 8) \approx \$9.75$ million   **13.** $\dfrac{(1 - k)(b^{2-k} - a^{2-k})}{(2 - k)(b^{1-k} - a^{1-k})}$

15. 1.19×10^{-4} cm^3/s

17. 6.60 L/min   **19.** 5.77 L/min

EXERCISES 8.5 ◻ PAGE 560

1. (a) The probability that a randomly chosen tire will have a lifetime between 30,000 and 40,000 miles

(b) The probability that a randomly chosen tire will have a lifetime of at least 25,000 miles

3. (a) $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x)\,dx = 1$

(b) $1 - \frac{3}{8}\sqrt{3} \approx 0.35$

5. (a) $1/\pi$ (b) $\frac{1}{2}$

7. (a) $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x)\,dx = 1$ (b) 5

11. (a) $e^{-4/2.5} \approx 0.20$ (b) $1 - e^{-2/2.5} \approx 0.55$ (c) If you aren't served within 10 minutes, you get a free hamburger.

13. $\approx 44\%$

15. (a) 0.0668   (b) $\approx 5.21\%$

17. ≈ 0.9545