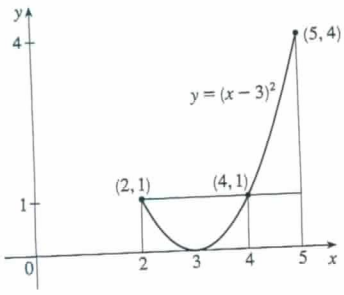
EXERCISES 6.5 ■ PAGE 445

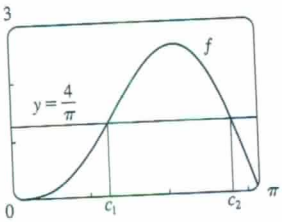
1. $\frac{8}{3}$ **3.** $\frac{45}{28}$ **5.** $\frac{1}{10}(1 - e^{-25})$ **7.** $2/(5\pi)$

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



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

(c)



15. $38\frac{1}{3}$ **17.** $(50 + 28/\pi)°\text{F} \approx 59°\text{F}$ **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 $0 \leqslant y \leqslant \cos x$, $0 \leqslant x \leqslant \pi/2$ about the y-axis

21. Solid obtained by rotating the region $0 \leqslant x \leqslant \pi$, $0 \leqslant y \leqslant 2 - \sin x$ about the x-axis

23. 36 **25.** $\frac{125}{3}\sqrt{3}\ \text{m}^3$ **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. $-\dfrac{1}{\pi}x^2 \cos \pi x + \dfrac{2}{\pi^2}x \sin \pi x + \dfrac{2}{\pi^3}\cos \pi x + C$

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.** $\frac{1}{4} - \frac{3}{4}e^{-2}$

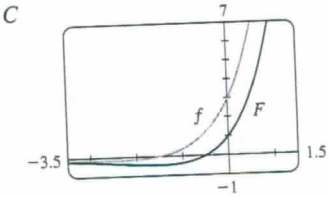
27. $\frac{1}{6}(\pi + 6 - 3\sqrt{3})$ **29.** $\sin x\,(\ln \sin x - 1) + C$

31. $\frac{32}{5}(\ln 2)^2 - \frac{64}{25}\ln 2 + \frac{62}{125}$

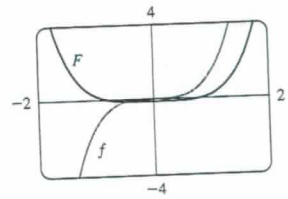
33. $2\sqrt{x} \sin \sqrt{x} + 2 \cos \sqrt{x} + C$ **35.** $-\frac{1}{2} - \pi/4$

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. $\dfrac{1}{3\pi}\sin^3(\pi x) - \dfrac{2}{5\pi}\sin^5(\pi x) + \dfrac{1}{7\pi}\sin^7(\pi x) + C$

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. $\frac{1}{6}\tan^6\theta + \frac{1}{4}\tan^4\theta + C$

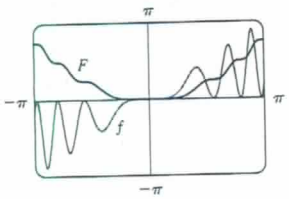
35. $x \sec x - \ln|\sec x + \tan x| + C$ **37.** $\sqrt{3} - \frac{1}{3}\pi$

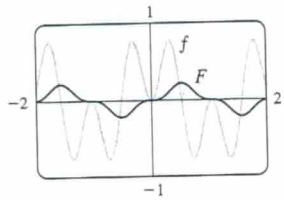
39. $\frac{1}{3}\csc^3\alpha - \frac{1}{5}\csc^5\alpha + C$ **41.** $\ln|\csc x - \cot x| + C$

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.** $\pi\left(2\sqrt{2} - \frac{5}{2}\right)$
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. $\ln\left(\sqrt{x^2 + 16} + x\right) + C$ **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. $\ln\left|\left(\sqrt{1 + x^2} - 1\right)/x\right| + \sqrt{1 + x^2} + C$ **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. $\sqrt{x^2 + x + 1} - \frac{1}{2}\ln\left(\sqrt{x^2 + x + 1} + x + \frac{1}{2}\right) + C$
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. $\frac{1}{6}\left(\sqrt{48} - \sec^{-1} 7\right)$ **37.** 0.81, 2; 2.10
41. $r\sqrt{R^2 - r^2} + \pi r^2/2 - R^2 \arcsin(r/R)$ **43.** $2\pi^2 R r^2$

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. $\frac{27}{5}\ln 2 - \frac{9}{5}\ln 3$ (or $\frac{9}{5}\ln\frac{8}{3}$)
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. $\frac{1}{2}\ln(x^2 + 1) + \left(1/\sqrt{2}\right)\tan^{-1}\left(x/\sqrt{2}\right) + C$
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. $\left(x - \frac{1}{2}\right)\ln(x^2 - x + 2) - 2x + \sqrt{7}\tan^{-1}\left(\dfrac{2x - 1}{\sqrt{7}}\right) + C$
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. $\frac{1}{8}\cos^8\theta - \frac{1}{6}\cos^6\theta + C$ (or $\frac{1}{4}\sin^4\theta - \frac{1}{3}\sin^6\theta + \frac{1}{8}\sin^8\theta + C$)
15. $x/\sqrt{1 - x^2} + C$
17. $\frac{1}{4}x^2 - \frac{1}{2}x\sin x\cos x + \frac{1}{4}\sin^2 x + C$
(or $\frac{1}{4}x^2 - \frac{1}{4}x\sin 2x - \frac{1}{8}\cos 2x + C$)
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. $\dfrac{1}{m}x^2\cosh(mx) - \dfrac{2}{m^2}x\sinh(mx) + \dfrac{2}{m^3}\cosh(mx) + C$