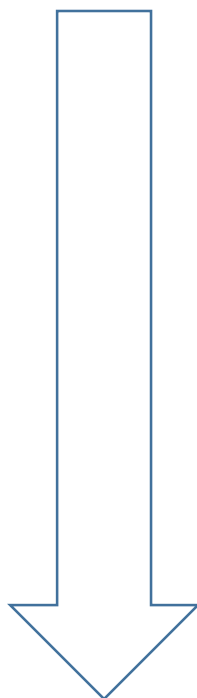


Start



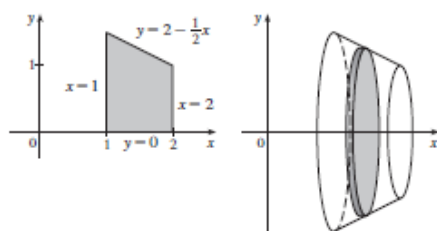
CHAPTER 5

EXERCISES 5.1 ■ PAGE 349

1.  $\frac{32}{3}$    3.  $\frac{4}{3}$    5. 19.5   7.  $\frac{9}{2}$    9.  $\frac{4}{3}$    11.  $\frac{8}{3}$    13. 72  
 15.  $6\sqrt{3}$    17.  $\frac{32}{3}$    19.  $2/\pi + \frac{2}{3}$    21.  $2 - \pi/2$    23.  $\frac{1}{2}$   
 25.  $\frac{59}{12}$    27.  $\frac{3}{4}$    29.  $\frac{5}{2}$    31.  $\frac{3}{2}\sqrt{3} - 1$    33. 0, 0.90; 0.04  
 35. -1.11, 1.25, 2.86; 8.38   37. 2.80123   39. 0.25142  
 41.  $12\sqrt{6} - 9$    43.  $117\frac{1}{3}$  ft   45. 4232 cm<sup>2</sup>  
 47. (a) Car A   (b) The distance by which A is ahead of B after 1 minute  
 (c) Car A   (d)  $t \approx 2.2$  min  
 49.  $\frac{24}{5}\sqrt{3}$    51.  $4^{2/3}$    53.  $\pm 6$    55.  $\ln 2 - \frac{1}{2}$   
 57.  $2 - 2 \ln 2$

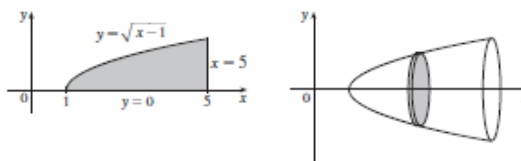
EXERCISES 5.2 ■ PAGE 360

1.  $19\pi/12$

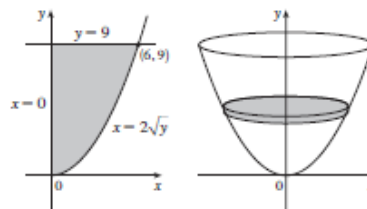


APPENDIX I ANSWERS TO ODD-NUMBERED EXERCISES A85

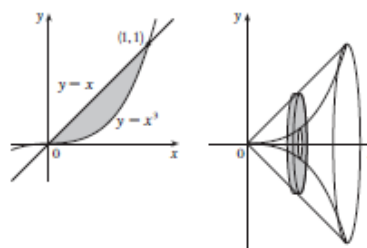
3.  $8\pi$



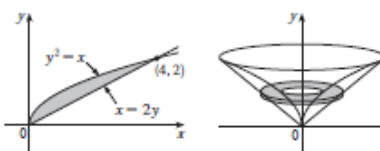
5.  $162\pi$



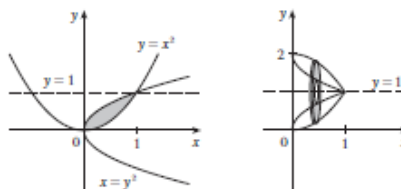
7.  $4\pi/21$



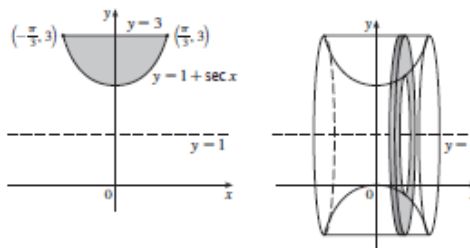
9.  $64\pi/15$



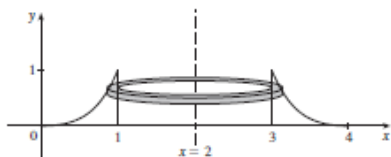
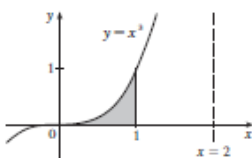
11.  $11\pi/30$



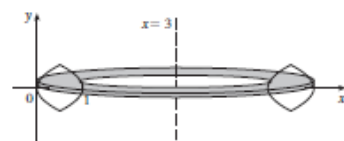
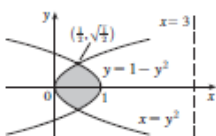
13.  $2\pi(\frac{4}{3}\pi - \sqrt{3})$



15.  $3\pi/5$



17.  $10\sqrt{2}\pi/3$



19.  $\pi/3$     21.  $\pi/3$     23.  $\pi/3$

25.  $13\pi/45$     27.  $\pi/3$     29.  $17\pi/45$

31. (a) 0.67419    (b) 2.85178

33. (a)  $2\pi \int_0^1 8\sqrt{1-x^2/4} dx \approx 78.95684$

(b)  $2\pi \int_0^1 8\sqrt{4-4y^2} dy \approx 78.95684$

35. -1.288, 0.884; 23.780    37.  $\frac{11}{9}\pi^2$

39. Solid obtained by rotating the region  $0 \leq x \leq \pi$ ,  $0 \leq y \leq \sqrt{\sin x}$  about the  $x$ -axis

41. Solid obtained by rotating the region above the  $x$ -axis bounded by  $x = y^2$  and  $x = y^4$  about the  $y$ -axis

43.  $1110 \text{ cm}^3$     45. (a) 196    (b) 838

47.  $\frac{1}{3}\pi r^2 h$     49.  $\pi r^2(r - \frac{1}{3}h)$     51.  $\frac{2}{3}b^2 h$

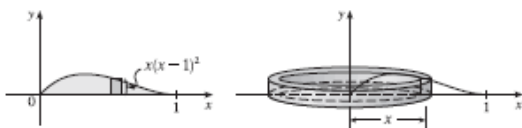
53.  $10 \text{ cm}^3$     55. 24    57.  $\frac{1}{3}$     59.  $\frac{8}{15}$

61. (a)  $8\pi R \int_0^R \sqrt{R^2 - y^2} dy$     (b)  $2\pi^2 r^2 R$

63. (b)  $\pi r^2 h$     65.  $\frac{5}{12}\pi r^3$     67.  $8 \int_0^R \sqrt{R^2 - y^2} \sqrt{R^2 - y^2} dy$

EXERCISES 5.3 ■ PAGE 366

1. Circumference =  $2\pi x$ , height =  $x(x-1)^2$ ;  $\pi/15$



3.  $6\pi/7$     5.  $8\pi$     7.  $8\pi$     9.  $4\pi$     11.  $768\pi/7$

13.  $16\pi/3$     15.  $7\pi/15$     17.  $8\pi/3$     19.  $5\pi/14$

21. (a)  $\int_{2\pi}^{3\pi} 2\pi x \sin x dx$     (b) 98.69604

23. (a)  $4\pi \int_{\pi/2}^{\pi} (\pi - x) \cos^4 x dx$     (b) 46.50942

25. (a)  $\int_0^{\pi} 2\pi(4 - y) \sqrt{\sin y} dy$     (b) 36.57476

27. 3.68

29. Solid obtained by rotating the region  $0 \leq y \leq x^4$ ,  $0 \leq x \leq 3$  about the  $y$ -axis

31. Solid obtained by rotating the region bounded by (i)  $x = 1 - y^2$ ,  $x = 0$ , and  $y = 0$ , or (ii)  $x = y^2$ ,  $x = 1$ , and  $y = 0$  about the line  $y = 3$

33. 0, 1.32; 4.05    35.  $\frac{1}{32}\pi^3$     37.  $8\pi$     39.  $4\sqrt{3}\pi$

41.  $4\pi/3$     43.  $117\pi/5$     45.  $\frac{4}{3}\pi r^3$     47.  $\frac{1}{3}\pi r^2 h$

EXERCISES 5.4 ■ PAGE 371

1. (a) 7200 ft-lb    (b) 7200 ft-lb

3. 4.5 ft-lb    5. 180 J    7.  $\frac{15}{4}$  ft-lb

9. (a)  $\frac{25}{24} \approx 1.04$  J    (b) 10.8 cm    11.  $W_2 = 3W_1$

13. (a) 625 ft-lb    (b)  $\frac{1875}{4}$  ft-lb    15. 650,000 ft-lb

17. 3857 J    19. 2450 J    21.  $\approx 1.06 \times 10^6$  J

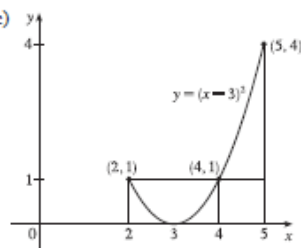
23.  $\approx 1.04 \times 10^5$  ft-lb    25. 2.0 m

29. (a)  $Gm_1m_2 \left( \frac{1}{a} - \frac{1}{b} \right)$     (b)  $\approx 8.50 \times 10^9$  J

EXERCISES 5.5 ■ PAGE 375

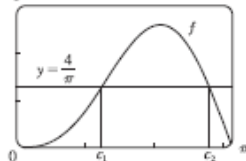
1.  $\frac{8}{3}$     3.  $\frac{45}{20}$     5. 29,524/15    7.  $2/(5\pi)$

9. (a) 1    (b) 2, 4    (c)



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

(c) 3



15.  $\frac{9}{8}$     17.  $(50 + 28/\pi)^\circ\text{F} \approx 59^\circ\text{F}$     19. 6 kg/m

21.  $5/(4\pi) \approx 0.4$  L

**CHAPTER 5 REVIEW ■ PAGE 378**
**Exercises**

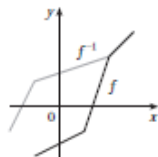
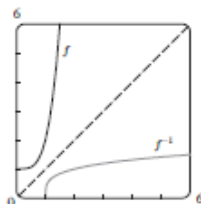
1.  $\frac{8}{3}$    3.  $\frac{7}{12}$    5.  $\frac{4}{3} + 4/\pi$    7.  $64\pi/15$    9.  $1656\pi/5$   
 11.  $\frac{4}{3}\pi(2ah + h^2)^{3/2}$    13.  $\int_{-\pi/3}^{\pi/3} 2\pi(\pi/2 - x)(\cos^2 x - \frac{1}{2}) dx$   
 15. (a)  $2\pi/15$    (b)  $\pi/6$    (c)  $8\pi/15$   
 17. (a) 0.38   (b)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

**PROBLEMS PLUS ■ PAGE 380**

1. (a)  $f(t) = 3t^2$    (b)  $f(x) = \sqrt{2x/\pi}$    3.  $\frac{32}{25}$   
 5. (b) 0.2261   (c) 0.6736 m  
 (d) (i)  $1/(105\pi) \approx 0.003 \text{ in/s}$    (ii)  $370\pi/3 \text{ s} \approx 6.5 \text{ min}$   
 9.  $y = \frac{32}{9}x^2$   
 11. (a)  $V = \int_0^b \pi[f(y)]^2 dy$   
 (c)  $f(y) = \sqrt{kA/(\pi C)} y^{1/4}$ . Advantage: the markings on the container are equally spaced.  
 13.  $b = 2a$

**CHAPTER 6**
**EXERCISES 6.1 ■ PAGE 390**

1. (a) See Definition 1.  
 (b) It must pass the Horizontal Line Test.  
 3. No   5. No   7. Yes   9. No   11. Yes   13. No  
 15. No   17. (a) 6   (b) 3   19. 4  
 21.  $F = \frac{9}{5}C + 32$ ; the Fahrenheit temperature as a function of the Celsius temperature;  $[-273.15, \infty)$   
 23.  $f^{-1}(x) = \frac{2}{3} - \frac{1}{3}x$    25.  $y = \frac{1}{3}(x-1)^2 - \frac{2}{3}$ ,  $x \geq 1$   
 27.  $y = \left(\frac{1-x}{1+x}\right)^2$ ,  $-1 < x \leq 1$   
 29.  $f^{-1}(x) = \sqrt[3]{x-1}$    31.

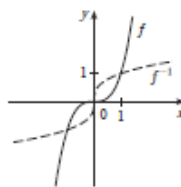


33. (a)  $f^{-1}(x) = \sqrt{1-x^2}$ ,  $0 \leq x \leq 1$ ;  $f^{-1}$  and  $f$  are the same function.   (b) Quarter-circle in the first quadrant

35. (b)  $\frac{1}{12}$

(c)  $f^{-1}(x) = \sqrt[3]{x}$ ,  
 domain =  $\mathbb{R}$  = range

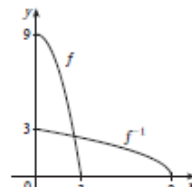
(e)



37. (b)  $-\frac{1}{2}$

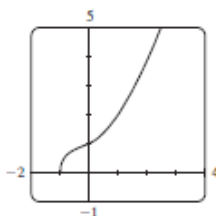
(c)  $f^{-1}(x) = \sqrt{9-x}$ ,  
 domain =  $[0, 9]$  range =  $[0, 3]$

(e)



39.  $\frac{1}{3}$

47.


 The graph passes the  
 Horizontal Line Test.

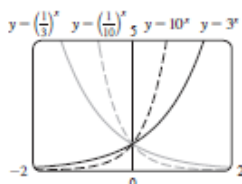
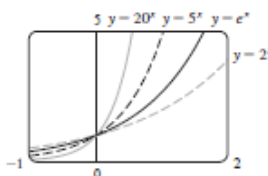
$$f^{-1}(x) = -\frac{1}{6}\sqrt[3]{4(\sqrt[3]{D-27x^2+20} - \sqrt[3]{D+27x^2-20} + \sqrt[3]{2})}$$

where  $D = 3\sqrt{3}\sqrt{27x^2 - 40x^2 + 16}$ ; two of the expressions are complex.

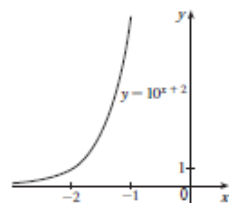
49. (a)  $g^{-1}(x) = f^{-1}(x) - c$    (b)  $h^{-1}(x) = (1/c)f^{-1}(x)$

**EXERCISES 6.2 ■ PAGE 401**

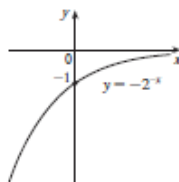
1. (a)  $f(x) = a^x$ ,  $a > 0$    (b)  $\mathbb{R}$    (c)  $(0, \infty)$   
 (d) See Figures 6(c), 6(b), and 6(a), respectively.  
 3.  $y = 20^x$   $y = 5^x$   $y = e^x$   $y = 2^x$   
 All approach 0 as  $x \rightarrow -\infty$ , all pass through  $(0, 1)$ , and all are increasing. The larger the base, the faster the rate of increase.  
 5.  $y = (\frac{1}{7})^x$   $y = (\frac{1}{10})^x$   $y = 10^x$   $y = 3^x$   
 The functions with base greater than 1 are increasing and those with base less than 1 are decreasing. The latter are reflections of the former about the  $y$ -axis.

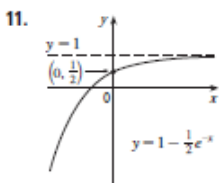


7.



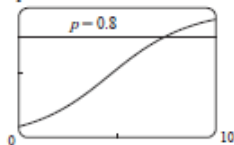
9.



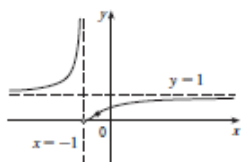


11. (a)  $y = e^x - 2$  (b)  $y = e^{x-2}$  (c)  $y = -e^x$   
 (d)  $y = e^{-x}$  (e)  $y = -e^{-x}$   
 15. (a)  $(-\infty, -1) \cup (-1, 1) \cup (1, \infty)$  (b)  $(-\infty, \infty)$   
 17.  $f(x) = 3 \cdot 2^x$  21. At  $x \approx 35.8$  23.  $\infty$  25. 1  
 27. 0 29. 0 31.  $f'(x) = 0$   
 33.  $f'(x) = e^x(x^3 + 3x^2 + 2x + 2)$  35.  $y' = 3ax^2e^{ax^3}$   
 37.  $y' = e^{-kx}(-kx + 1)$  39.  $f'(u) = (-1/u^2)e^{1/u}$   
 41.  $F'(t) = e^{t \sin 2t}(2t \cos 2t + \sin 2t)$  43.  $y' = \frac{3e^{3x}}{\sqrt{1 + 2e^{3x}}}$

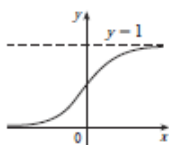
45.  $y' = e^x e^x$  47.  $y' = \frac{(ad - bc)e^x}{(ce^x + d)^2}$   
 49.  $y' = \frac{4e^{2x}}{(1 + e^{2x})^2} \sin \frac{1 - e^{2x}}{1 + e^{2x}}$  51.  $y = 2x + 1$   
 53.  $y' = \frac{y(y - e^{xy})}{y^2 - xe^{xy}}$  57.  $-4, -2$  59.  $f^{(n)}(x) = 2^n e^{2x}$   
 61. (b)  $-0.567143$   
 63. (a) 1 (b)  $kae^{-kt}/(1 + ae^{-kt})^2$   
 (c) 1  $t \approx 7.4$  h



65.  $-1$  67.  $f(2) = 2/\sqrt{e}$ ,  $f(-1) = -1/\sqrt[3]{e}$   
 69. (a) Inc. on  $(2, \infty)$ ; dec. on  $(-\infty, 2)$   
 (b) CU on  $(-\infty, 3)$ ; CD on  $(3, \infty)$  (c)  $(3, -2e^{-3})$   
 71. A.  $\{x | x \neq -1\}$   
 B.  $y$ -int.  $1/e$  C. None  
 D. HA  $y = 1$ ; VA  $x = -1$   
 E. Inc. on  $(-\infty, -1), (-1, \infty)$   
 F. None  
 G. CU on  $(-\infty, -1), (-1, -\frac{1}{2})$ ;  
 CD on  $(-\frac{1}{2}, \infty)$ ; IP  $(-\frac{1}{2}, 1/e^2)$   
 H. See graph at right.

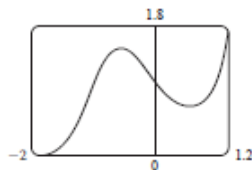


73. A.  $\mathbb{R}$  B.  $y$ -int.  $\frac{1}{2}$  C. None  
 D. HA  $y = 0, y = 1$   
 E. Inc on  $\mathbb{R}$  F. None  
 G. CU on  $(-\infty, 0)$ ; CD on  $(0, \infty)$ ;  
 IP  $(0, \frac{1}{2})$  H. See graph at right.



75. 28.57 min, when the rate of increase of drug level in the bloodstream is greatest; 85.71 min, when rate of decrease is greatest

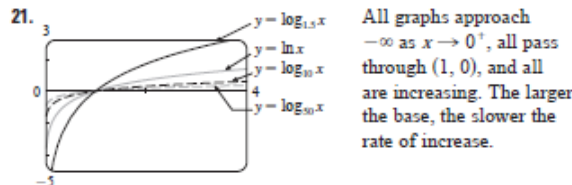
77. Loc. max.  $f(-1/\sqrt{3}) = e^{2\sqrt{3}/9} \approx 1.5$ ;  
 loc. min.  $f(1/\sqrt{3}) = e^{-2\sqrt{3}/9} \approx 0.7$ ;  
 IP  $(-0.15, 1.15), (-1.09, 0.82)$



79.  $\frac{1}{e+1} + e - 1$  81.  $\frac{1}{\pi}(1 - e^{-2\pi})$   
 83.  $\frac{2}{3}(1 + e^x)^{3/2} + C$  85.  $\frac{1}{2}e^{2x} + 2x - \frac{1}{2}e^{-2x} + C$   
 87.  $e^{\sin x} + C$  89.  $e - \sqrt{e}$  91. 4.644 93.  $\pi(e^2 - 1)/2$   
 97.  $\approx 4512$  L 99.  $\frac{1}{2}$

EXERCISES 6.3 ■ PAGE 408

1. (a) It's defined as the inverse of the exponential function with base  $a$ , that is,  $\log_a x = y \iff a^y = x$ .  
 (b)  $(0, \infty)$  (c)  $\mathbb{R}$  (d) See Figure 1.  
 3. (a) 3 (b)  $-3$  5. (a) 4.5 (b)  $-4$   
 7. (a) 3 (b)  $-2$   
 9.  $\frac{1}{2} \ln a + \frac{1}{2} \ln b$  11.  $2 \ln x - 3 \ln y - 4 \ln z$   
 13.  $\ln \frac{x^2 y^3}{z}$  15.  $\ln 1215$  17.  $\ln \frac{\sqrt{x}}{x+1}$   
 19. (a) 0.402430 (b) 1.454240 (c) 1.651496



23. (a)  $y = \log_{10}(x+5)$  (b)  $y = -\ln x$

25. (a)  $(0, \infty); (-\infty, \infty)$  (b)  $e^{-2}$  (c)  $f(x) = \ln x + 2$

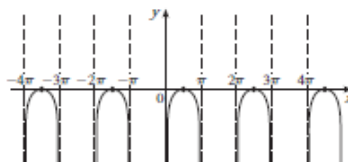
27. (a)  $\frac{1}{4}(7 - \ln 6)$  (b)  $\frac{1}{3}(e^2 + 10)$   
 29. (a)  $5 + \log_2 3$  or  $5 + (\ln 3)/\ln 2$  (b)  $\frac{1}{2}(1 + \sqrt{1 + 4e})$   
 31.  $-\frac{1}{2} \ln(e - 1)$  33.  $e^e$  35.  $\ln 3$   
 37. (a) 0.5210 (b) 3.0949  
 39. (a)  $0 < x < 1$  (b)  $x > \ln 5$

41. About 1,084,588 mi    43. 8.3  
 45. (a)  $f^{-1}(n) = (3/\ln 2) \ln(n/100)$ ; the time elapsed when there are  $n$  bacteria    (b) After about 26.9 hours  
 47.  $-\infty$     49. 0    51.  $\infty$     53.  $(-\infty, -3) \cup (3, \infty)$   
 55. (a)  $(-\infty, \frac{1}{2} \ln 3]$     (b)  $f^{-1}(x) = \frac{1}{2} \ln(3 - x^2)$ ,  $[0, \sqrt{3})$   
 57. (a)  $(\ln 3, \infty)$     (b)  $f^{-1}(x) = \ln(e^x + 3)$ ;  $\mathbb{R}$   
 59.  $y = e^x - 3$     61.  $f^{-1}(x) = \sqrt[3]{\ln x}$     63.  $y = \frac{1}{10^x - 1}$   
 65.  $(-\frac{1}{2} \ln 3, \infty)$   
 67. (b)  $f^{-1}(x) = \frac{1}{2}(e^x - e^{-x})$     69.  $f$  is a constant function  
 73.  $-1 \leq x < 1 - \sqrt{3}$  or  $1 + \sqrt{3} < x \leq 3$

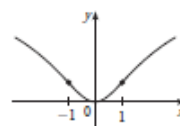
**EXERCISES 6.4 ■ PAGE 418**

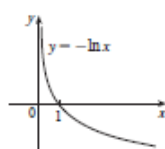
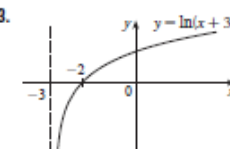
1. The differentiation formula is simplest.  
 3.  $f'(x) = \frac{\cos(\ln x)}{x}$     5.  $f'(x) = -\frac{1}{x}$   
 7.  $f'(x) = \frac{3x^2}{(x^3 + 1) \ln 10}$     9.  $f'(x) = \frac{\sin x}{x} + \cos x \ln(5x)$   
 11.  $C'(y) = \frac{10}{2y + 1} - \frac{y}{y^2 + 1}$     13.  $g'(x) = \frac{2x^2 - 1}{x(x^2 - 1)}$   
 15.  $f'(u) = \frac{1 + \ln 2}{u[1 + \ln(2u)]^2}$     17.  $f'(x) = 5x^4 + 5^x \ln 5$   
 19.  $y' = \sec^2(\ln(ax + b)) \frac{a}{ax + b}$     21.  $y' = \frac{-x}{1 + x}$   
 23.  $y' = \frac{1}{\ln 10} + \log_{10} x$     25.  $f'(t) = 10^{\sqrt{t}} \ln 10 / (2\sqrt{t})$   
 27.  $y' = x + 2x \ln(2x)$ ;  $y'' = 3 + 2 \ln(2x)$   
 29.  $y' = \frac{1}{\sqrt{1 + x^2}}$ ;  $y'' = \frac{-x}{(1 + x^2)^{3/2}}$   
 31.  $f'(x) = \frac{2x - 1 - (x - 1) \ln(x - 1)}{(x - 1)[1 - \ln(x - 1)]^2}$ ,  
 $(1, 1 + e) \cup (1 + e, \infty)$   
 33.  $f'(x) = \frac{2(x - 1)}{x(x - 2)}$ ;  $(-\infty, 0) \cup (2, \infty)$     35.  $\frac{1}{2}$   
 37.  $y = 3x - 9$     39.  $\cos x + 1/x$     41. 7  
 43.  $y' = (x^2 + 2)^2(x^4 + 4)^4 \left( \frac{4x}{x^2 + 2} + \frac{16x^3}{x^4 + 4} \right)$   
 45.  $y' = \sqrt{\frac{x - 1}{x^4 + 1}} \left( \frac{1}{2x - 2} - \frac{2x^3}{x^4 + 1} \right)$   
 47.  $y' = x^x(1 + \ln x)$   
 49.  $y' = x^{\sin x} \left( \frac{\sin x}{x} + \cos x \ln x \right)$   
 51.  $y' = (\cos x)^x(-x \tan x + \ln \cos x)$   
 53.  $y' = (\tan x)^{1/x} \left( \frac{\sec^2 x}{x \tan x} - \frac{\ln \tan x}{x^2} \right)$   
 55.  $y' = \frac{2x}{x^2 + y^2 - 2y}$     57.  $f^{(n)}(x) = \frac{(-1)^{n-1}(n-1)!}{(x-1)^n}$   
 59. 2.958516, 5.290718  
 61. CU on  $(e^{8/3}, \infty)$ , CD on  $(0, e^{8/3})$ , IP  $(e^{8/3}, \frac{8}{3}e^{-4/3})$

63. A. All  $x$  in  $(2n\pi, (2n + 1)\pi)$  ( $n$  an integer)  
 B.  $x$ -int  $\pi/2 + 2n\pi$     C. Period  $2\pi$     D. VA  $x = n\pi$   
 E. Inc on  $(2n\pi, \pi/2 + 2n\pi)$ ; dec on  $(\pi/2 + 2n\pi, (2n + 1)\pi)$   
 F. Loc max  $f(\pi/2 + 2n\pi) = 0$     G. CD on  $(2n\pi, (2n + 1)\pi)$   
 H.



65. A.  $\mathbb{R}$     B.  $y$ -int 0;  $x$ -int 0  
 C. About  $y$ -axis    D. None  
 E. Inc. on  $(0, \infty)$ ;  
 dec. on  $(-\infty, 0)$   
 F. Loc. min.  $f(0) = 0$   
 G. CU on  $(-1, 1)$ ; CD on  
 $(-\infty, -1), (1, \infty)$ ;  
 IP  $(\pm 1, \ln 2)$     H. See graph at right.  
 67. Inc. on  $(0, 2.7), (4.5, 8.2), (10.9, 14.3)$ ;  
 IP  $(3.8, 1.7), (5.7, 2.1), (10.0, 2.7), (12.0, 2.9)$   
 69. (a)  $Q = ab^m$  where  $a \approx 100.01244$  and  $b \approx 0.000045146$   
 (b)  $-670.63 \mu\text{A}$   
 71.  $3 \ln 2$     73.  $\frac{1}{2} \ln \frac{5}{2}$     75.  $\frac{1}{2}e^2 + e - \frac{1}{2}$   
 77.  $\frac{1}{3}(\ln x)^3 + C$     79.  $-\ln(1 + \cos^2 x) + C$     81.  $90/(\ln 10)$   
 85.  $\pi \ln 2$     87. 45,974 J    89.  $\frac{1}{3}$   
 91.  $0 < m < 1, m - 1 - \ln m$


**EXERCISES 6.2\* ■ PAGE 428**

1.  $\frac{1}{2} \ln a + \frac{1}{2} \ln b$     3.  $2 \ln x - 3 \ln y - 4 \ln z$   
 5.  $\ln \frac{x^2 y^3}{z}$     7.  $\ln 1215$     9.  $\ln \frac{\sqrt{x}}{x + 1}$   
 11.     13.   
 15.  $-\infty$     17.  $f'(x) = (2 + \ln x)/(2\sqrt{x})$   
 19.  $f'(x) = \frac{\cos(\ln x)}{x}$     21.  $f'(x) = -\frac{1}{x}$   
 23.  $f'(x) = \frac{\sin x}{x} + \cos x \ln(5x)$     25.  $g'(x) = -\frac{2a}{a^2 - x^2}$   
 27.  $C'(y) = \frac{10}{2y + 1} - \frac{y}{y^2 + 1}$     29.  $g'(x) = \frac{2x^2 - 1}{x(x^2 - 1)}$   
 31.  $f'(u) = \frac{1 + \ln 2}{u[1 + \ln(2u)]^2}$     33.  $y' = \frac{10x + 1}{5x^2 + x - 2}$   
 35.  $y' = \sec^2(\ln(ax + b)) \frac{a}{ax + b}$   
 37.  $y' = x + 2x \ln(2x)$ ;  $y'' = 3 + 2 \ln(2x)$

39.  $f'(x) = \frac{2x-1-(x-1)\ln(x-1)}{(x-1)[1-\ln(x-1)]^2}$ ,  
 $(1, 1+e) \cup (1+e, \infty)$

41.  $f'(x) = \frac{1}{2x\sqrt{1-\ln x}}$ ;  $(0, e]$     43.  $\frac{1}{2}$     45.  $\cos x + 1/x$

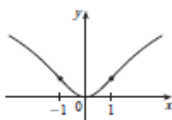
47.  $y = 2x - 2$     49.  $y' = \frac{2x}{x^2 + y^2 - 2y}$

51.  $f^{(n)}(x) = \frac{(-1)^{n-1}(n-1)!}{(x-1)^n}$     53. 2.958516, 5.290718

55. A. All  $x$  in  $(2n\pi, (2n+1)\pi)$  ( $n$  an integer)  
 B.  $x$ -int  $\pi/2 + 2n\pi$     C. Period  $2\pi$     D. VA  $x = m\pi$   
 E. Inc on  $(2m\pi, \pi/2 + 2m\pi)$ ; dec on  $(\pi/2 + 2m\pi, (2n+1)\pi)$   
 F. Loc max  $f(\pi/2 + 2m\pi) = 0$     G. CD on  $(2n\pi, (2n+1)\pi)$   
 H.



57. A.  $\mathbb{R}$     B.  $y$ -int 0;  $x$ -int 0  
 C. About  $y$ -axis    D. None  
 E. Inc. on  $(0, \infty)$ ;  
 dec. on  $(-\infty, 0)$   
 F. Loc. min.  $f(0) = 0$   
 G. CU on  $(-1, 1)$ ; CD on  
 $(-\infty, -1), (1, \infty)$ ;  
 IP  $(\pm 1, \ln 2)$     H. See graph at right.



59. Inc. on  $(0, 2.7), (4.5, 8.2), (10.9, 14.3)$ ;  
 IP  $(3.8, 1.7), (5.7, 2.1), (10.0, 2.7), (12.0, 2.9)$

61.  $y' = (x^2 + 2)^2(x^4 + 4)^4 \left( \frac{4x}{x^2 + 2} + \frac{16x^3}{x^4 + 4} \right)$

63.  $y' = \sqrt{\frac{x-1}{x^4+1}} \left( \frac{1}{2x-2} - \frac{2x^3}{x^4+1} \right)$

65.  $3 \ln 2$     67.  $\frac{1}{2} \ln \frac{5}{2}$     69.  $\frac{1}{2}e^2 + e - \frac{1}{2}$

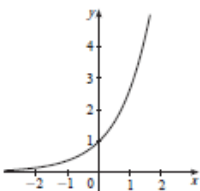
71.  $\frac{1}{3}(\ln x)^3 + C$     73.  $-\ln(1 + \cos^2 x) + C$

77.  $\pi \ln 2$     79. 45.974 J    81.  $\frac{1}{3}$     83. (b) 0.405

87.  $0 < m < 1, m - 1 - \ln m$

EXERCISES 6.3\* ■ PAGE 434

1. If  $f(x) = e^x$ , then  $f'(0) = 1$ .



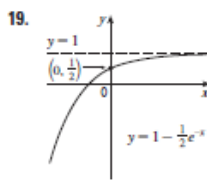
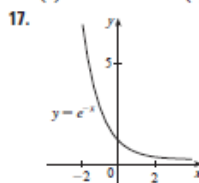
3. (a)  $\frac{1}{25}$     (b) 10  
 5. (a)  $\frac{1}{4}(7 - \ln 6)$     (b)  $\frac{1}{3}(e^2 + 10)$

7. (a)  $\frac{1}{3}(\ln k - 1)$     (b)  $\frac{1}{2}(1 + \sqrt{1+4e})$

9.  $-\frac{1}{2} \ln(e-1)$     11.  $\ln 3$

13. (a) 0.5210    (b) 3.0949

15. (a)  $0 < x < 1$     (b)  $x > \ln 5$



21. (a)  $(-\infty, \frac{1}{2} \ln 3]$     (b)  $f^{-1}(x) = \frac{1}{2} \ln(3 - x^2), [0, \sqrt{3})$

23.  $y = e^x - 3$     25.  $f^{-1}(x) = \sqrt[3]{\ln x}$     27. 1    29. 0

31. 0    33.  $f'(x) = 0$     35.  $f(x) = e^x(x^3 + 3x^2 + 2x + 2)$

37.  $y' = 3ax^2e^{ax^3}$     39.  $y' = e^{-kx}(-kx + 1)$

41.  $f'(t) = (-1/t^2)e^{1/t}$     43.  $F'(t) = e^{t \sin 2t}(2t \cos 2t + \sin 2t)$

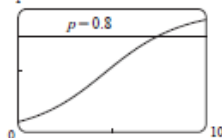
45.  $y' = \frac{3e^{3x}}{\sqrt{1+2e^{3x}}}$     47.  $y' = e^x e^x$     49.  $y' = \frac{(ad-bc)e^x}{(ce^x+d)^2}$

51.  $y' = \frac{4e^{2x}}{(1+e^{2x})^2} \sin \frac{1-e^{2x}}{1+e^{2x}}$     53.  $y = 2x + 1$

55.  $y' = \frac{y(y - e^{xy})}{y^2 - xe^{xy}}$     59. -4, -2    61.  $f^{(n)}(x) = 2^n e^{2x}$

63. (b) -0.567143

65. (a) 1    (b)  $kae^{-kt}/(1+ae^{-kt})^2$   
 (c) 1     $t \approx 7.4$  h



67. -1    69.  $f(2) = 2/\sqrt{e}, f(-1) = -1/\sqrt[3]{e}$

71. (a) Inc. on  $(2, \infty)$ ; dec. on  $(-\infty, 2)$

(b) CU on  $(-\infty, 3)$ ; CD on  $(3, \infty)$     (c)  $(3, -2e^{-3})$

73. A.  $\{x | x \neq -1\}$

B.  $y$ -int  $1/e$     C. None

D. HA  $y = 1$ ; VA  $x = -1$

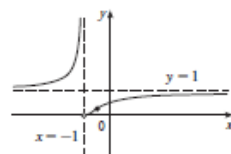
E. Inc. on  $(-\infty, -1), (-1, \infty)$

F. None

G. CU on  $(-\infty, -1), (-1, -\frac{1}{2})$ ;

CD on  $(-\frac{1}{2}, \infty)$ ; IP  $(-\frac{1}{2}, 1/e^2)$

H. See graph at right.



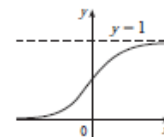
75. A.  $\mathbb{R}$     B.  $y$ -int  $\frac{1}{2}$     C. None

D. HA  $y = 0, y = 1$

E. Inc on  $\mathbb{R}$     F. None

G. CU on  $(-\infty, 0)$ ; CD on  $(0, \infty)$ ;

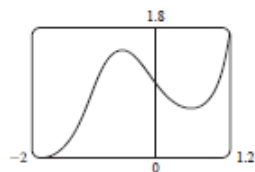
IP  $(0, \frac{1}{2})$     H. See graph at right.



77. 28.57 min, when the rate of increase of drug level in the blood-stream is greatest; 85.71 min, when rate of decrease is greatest



79. Loc. max.  $f(-1/\sqrt{3}) = e^{-\sqrt{3}/9} \approx 1.5$ ;  
 loc. min.  $f(1/\sqrt{3}) = e^{-2\sqrt{3}/9} \approx 0.7$ ;  
 IP  $(-0.15, 1.15), (-1.09, 0.82)$



81.  $\frac{1}{e+1} + e - 1$     83.  $\frac{1}{\pi}(1 - e^{-2\pi})$   
 85.  $\frac{2}{3}(1 + e^x)^{3/2} + C$     87.  $\frac{1}{2}e^{2x} + 2x - \frac{1}{2}e^{-2x} + C$   
 89.  $e^{\sin x} + C$     91.  $e - \sqrt{e}$     93. 4.644    95.  $\pi(e^2 - 1)/2$   
 99.  $\approx 4512$  L    101.  $\frac{1}{2}$

**EXERCISES 6.4\* ■ PAGE 444**

1. (a)
- $a^x = e^{x \ln a}$
- (b)
- $(-\infty, \infty)$
- (c)
- $(0, \infty)$
- 
- (d) See Figures 1, 3, and 2.

3.  $e^{-\pi \ln 4}$     5.  $e^{x^2 \ln 10}$

7. (a) 3    (b) -3    9. (a) 3    (b) -2

 11. 
 All approach 0 as  $x \rightarrow -\infty$ , all pass through  $(0, 1)$ , and all are increasing. The larger the base, the faster the rate of increase.

13. (a) 0.402430    (b) 1.454240    (c) 1.651496

 15. 
 All graphs approach  $-\infty$  as  $x \rightarrow 0^+$ , all pass through  $(1, 0)$ , and all are increasing. The larger the base, the slower the rate of increase.

17.  $f(x) = 3 \cdot 2^x$     19. (b) About 1,084,588 mi

21.  $\infty$     23. 0    25.  $f'(x) = 5x^4 + 5^x \ln 5$

27.  $f'(t) = 10^{\sqrt{t}} \ln 10 / (2\sqrt{t})$     29.  $L'(v) = 2v \ln 4 \sec^2(4^v) \cdot 4^v$

31.  $f'(x) = \frac{3}{(3x-1) \ln 2}$     33.  $y' = \frac{1}{\ln 10} + \log_{10} x$

35.  $y' = x^x(1 + \ln x)$     37.  $y' = x^{\sin x} \left( \frac{\sin x}{x} + \cos x \ln x \right)$

39.  $y' = (\cos x)^x (-x \tan x + \ln \cos x)$

41.  $y' = (\tan x)^{1/x} \left( \frac{\sec^2 x}{x \tan x} - \frac{\ln \tan x}{x^2} \right)$

43.  $y = (10 \ln 10)x + 10(1 - \ln 10)$     45.  $90/(\ln 10)$

47.  $(\ln x)^2 / (2 \ln 10) + C$  [or  $\frac{1}{2}(\ln 10)(\log_{10} x)^2 + C$ ]

49.  $3^{\sin \theta} / \ln 3 + C$     51.  $16/(5 \ln 5) - 1/(2 \ln 2)$

53. 0.600967    55.  $y = \frac{1}{10^x - 1}$     57. 8.3

59.  $10^5 / \ln 10$  dB/(watt/m<sup>2</sup>)

61. (a)  $Q = ab^t$  where  $a \approx 100.01244$  and  $b \approx 0.000045146$   
 (b)  $-670.63 \mu\text{A}$

**EXERCISES 6.5 ■ PAGE 451**

1. About 235

3. (a)  $100(4.2)^t$     (b)  $\approx 7409$     (c)  $\approx 10,632$  bacteria/h

(d)  $(\ln 100)/(\ln 4.2) \approx 3.2$  h

5. (a) 1508 million, 1871 million    (b) 2161 million

(c) 3972 million; wars in the first half of century, increased life expectancy in second half

7. (a)  $Ce^{-0.0005t}$     (b)  $-2000 \ln 0.9 \approx 211$  s

9. (a)  $100 \times 2^{-t/30}$  mg    (b)  $\approx 9.92$  mg    (c)  $\approx 199.3$  years

11.  $\approx 2500$  years    13. (a)  $\approx 137^\circ\text{F}$     (b)  $\approx 116$  min

15. (a)  $13.3^\circ\text{C}$     (b)  $\approx 67.74$  min

17. (a)  $\approx 64.5$  kPa    (b)  $\approx 39.9$  kPa

19. (a) (i) \$3828.84    (ii) \$3840.25    (iii) \$3850.08

(iv) \$3851.61    (v) \$3852.01    (vi) \$3852.08

(b)  $dA/dt = 0.05A$ ,  $A(0) = 3000$

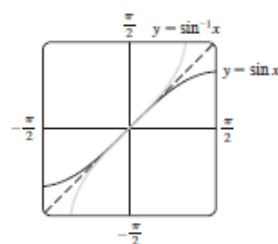
**EXERCISES 6.6 ■ PAGE 459**

1. (a)  $\pi/6$     (b)  $\pi$     3. (a)  $\pi/4$     (b)  $\pi/4$

5. (a) 10    (b)  $\pi/3$

7.  $2/\sqrt{5}$     9.  $\frac{2}{3}\sqrt{2}$     13.  $x/\sqrt{1+x^2}$

15.


 The second graph is the reflection of the first graph about the line  $y = x$ .

23.  $y' = \frac{2 \tan^{-1} x}{1+x^2}$     25.  $y' = \frac{1}{\sqrt{-x^2-x}}$     27.  $y' = \sin^{-1} x$

29.  $y' = -\frac{2e^{2x}}{\sqrt{1-e^{4x}}}$     31.  $y' = -\frac{\sin \theta}{1+\cos^2 \theta}$

33.  $h'(t) = 0$     35.  $y' = \frac{\sqrt{a^2-b^2}}{a+b \cos x}$

37.  $g'(x) = \frac{2}{\sqrt{1-(3-2x)^2}}$ ,  $[1, 2], (1, 2)$     39.  $\pi/6$

41.  $1 - \frac{x \arcsin x}{\sqrt{1-x^2}}$     43.  $-\pi/2$     45.  $\pi/2$

47. At a distance  $5 - 2\sqrt{5}$  from A    49.  $\frac{1}{2}$  rad/s

51. A.  $[-\frac{1}{2}, \infty)$

B.  $y$ -int. 0;  $x$ -int. 0

C. None

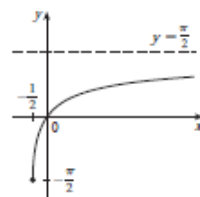
D. HA  $y = \pi/2$

E. Inc. on  $(-\frac{1}{2}, \infty)$

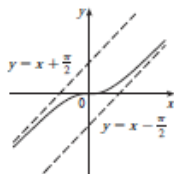
F. None

G. CD on  $(-\frac{1}{2}, \infty)$

H. See graph at right



53. A.  $\mathbb{R}$   
 B.  $y$ -int 0;  $x$ -int 0  
 C. About (0, 0)  
 D. SA  $y = x \pm \pi/2$   
 E. Inc. on  $\mathbb{R}$  F. None  
 G. CU on (0,  $\infty$ ); CD on  $(-\infty, 0)$ ;  
 IP (0, 0)  
 H. See graph at right.



55. Max at  $x = 0$ , min at  $x \approx \pm 0.87$ , IP at  $x \approx \pm 0.52$   
 57.  $F(x) = \tan^{-1}x + x + C$  59.  $4\pi/3$  61.  $\pi^2/72$   
 63.  $\tan^{-1}x + \frac{1}{2}\ln(1+x^2) + C$  65.  $\ln|\sin^{-1}x| + C$   
 67.  $\frac{1}{3}\sin^{-1}(t^3) + C$  69.  $2 \tan^{-1}\sqrt{x} + C$  73.  $\pi/2 - 1$

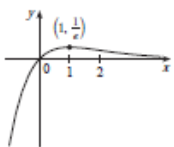
## EXERCISES 6.7 ■ PAGE 467

1. (a) 0 (b) 1 3. (a)  $\frac{3}{4}$  (b)  $\frac{1}{2}(e^2 - e^{-2}) \approx 3.62686$   
 5. (a) 1 (b) 0  
 21.  $\operatorname{sech} x = \frac{2}{e^x + e^{-x}}$ ,  $\sinh x = \frac{e^x - e^{-x}}{2}$ ,  $\operatorname{csch} x = \frac{2}{e^x - e^{-x}}$ ,  $\tanh x = \frac{e^x - e^{-x}}{e^x + e^{-x}}$ ,  $\coth x = \frac{e^x + e^{-x}}{e^x - e^{-x}}$   
 23. (a) 1 (b) -1 (c)  $\infty$  (d)  $-\infty$  (e) 0 (f) 1  
 (g)  $\infty$  (h)  $-\infty$  (i) 0  
 31.  $f'(x) = x \cosh x$  33.  $h'(x) = \tanh x$   
 35.  $y' = 3e^{\cosh 3x} \sinh 3x$  37.  $f'(t) = -2e^t \operatorname{sech}^2(e^t) \tanh(e^t)$   
 39.  $G'(x) = \frac{-2 \sinh x}{(1 + \cosh x)^2}$  41.  $y' = \frac{1}{2\sqrt{x(x-1)}}$   
 43.  $y' = \sinh^{-1}(x/3)$  45.  $y' = -\csc x$   
 51. (a) 0.3572 (b)  $70.34^\circ$   
 53. (a) 164.50 m (b) 120 m; 164.13 m  
 55. (b)  $y = 2 \sinh 3x - 4 \cosh 3x$   
 57.  $(\ln(1 + \sqrt{2}), \sqrt{2})$   
 59.  $\frac{1}{3} \cosh^3 x + C$  61.  $2 \cosh \sqrt{x} + C$  63.  $-\operatorname{csch} x + C$   
 65.  $\ln\left(\frac{6 + 3\sqrt{3}}{4 + \sqrt{7}}\right)$  67.  $\tanh^{-1}e^x + C$   
 69. (a) 0, 0.48 (b) 0.04

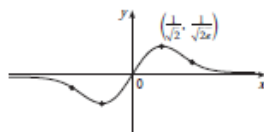
## EXERCISES 6.8 ■ PAGE 477

1. (a) Indeterminate (b) 0 (c) 0  
 (d)  $\infty$ ,  $-\infty$ , or does not exist (e) Indeterminate  
 3. (a)  $-\infty$  (b) Indeterminate (c)  $\infty$   
 5.  $\frac{3}{4}$  7. 2 9.  $-\frac{1}{3}$  11.  $-\infty$  13. 2 15.  $\frac{1}{4}$   
 17. 0 19.  $-\infty$  21.  $\frac{8}{7}$  23. 3 25.  $\frac{1}{2}$  27. 1  
 29. 1 31.  $1/\ln 3$  33. 0 35.  $-1/\pi^2$  37.  $\frac{1}{2}a(a-1)$   
 39.  $\frac{1}{24}$  41.  $\pi$  43. 3 45. 0 47.  $-2/\pi$  49.  $\frac{1}{2}$   
 51.  $\frac{1}{2}$  53.  $\infty$  55. 1 57.  $e^{-2}$  59.  $1/e$   
 61. 1 63.  $e^4$  65.  $1/\sqrt{e}$  67.  $e^2$  69.  $\frac{1}{4}$  73. 1

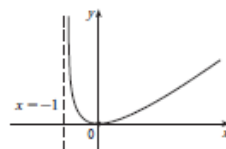
75. A.  $\mathbb{R}$  B.  $y$ -int 0;  $x$ -int 0  
 C. None D. HA  $y = 0$   
 E. Inc on  $(-\infty, 1)$ , dec on  $(1, \infty)$   
 F. Loc max  $f(1) = 1/e$   
 G. CU on  $(2, \infty)$ ; CD on  $(-\infty, 2)$   
 IP  $(2, 2/e^2)$   
 H. See graph at right.



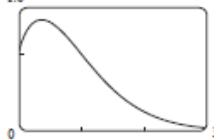
77. A.  $\mathbb{R}$  B.  $y$ -int 0;  $x$ -int 0 C. About (0, 0) D. HA  $y = 0$   
 E. Inc on  $(-1/\sqrt{2}, 1/\sqrt{2})$ ; dec on  $(-\infty, -1/\sqrt{2})$ ,  $(1/\sqrt{2}, \infty)$   
 F. Loc min  $f(-1/\sqrt{2}) = -1/\sqrt{2}e$ ; loc max  $f(1/\sqrt{2}) = 1/\sqrt{2}e$   
 G. CU on  $(-\sqrt{3}/2, 0)$ ,  $(\sqrt{3}/2, \infty)$ ; CD on  $(-\infty, -\sqrt{3}/2)$ ,  $(0, \sqrt{3}/2)$ ;  
 IP  $(\pm\sqrt{3}/2, \pm\sqrt{3}/2e^{-3/2})$ , (0, 0)  
 H.



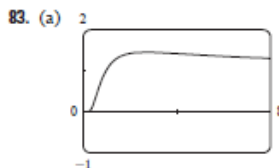
79. A.  $(-1, \infty)$  B.  $y$ -int 0;  $x$ -int 0  
 C. None D. VA  $x = -1$   
 E. Inc on  $(0, \infty)$ ; dec on  $(-1, 0)$   
 F. Loc min  $f(0) = 0$   
 G. CU on  $(-1, \infty)$   
 H. See graph at right.



81. (a) 1.6 (b)  $\lim_{x \rightarrow 0^+} x^{1/x} = 1$



- (c) Max value  $f(1/e) = e^{1/e} \approx 1.44$  (d) 1.0



- (b)  $\lim_{x \rightarrow 0^+} x^{1/x} = 0$ ,  $\lim_{x \rightarrow \infty} x^{1/x} = 1$   
 (c) Loc max  $f(e) = e^{1/e}$  (d) IP at  $x \approx 0.58, 4.37$

85.  $f$  has an absolute minimum for  $c > 0$ . As  $c$  increases, the minimum points get farther away from the origin.  
 91.  $\pi/6$  93.  $\frac{16}{9}a$  95.  $\frac{1}{2}$  97. 56 101. (a) 0

## CHAPTER 6 REVIEW ■ PAGE 481

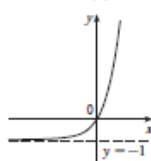
## True-False Quiz

1. True 3. False 5. True 7. True 9. False  
 11. False 13. False 15. True 17. True

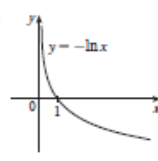
## Exercises

1. No 3. (a) 7 (b)  $\frac{1}{8}$

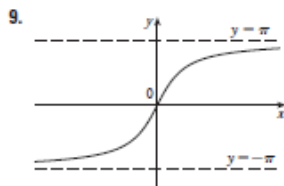
5.



7.







11. (a) 9 (b) 2

13.  $e^{1/3}$

15.  $\ln \ln 17$  17.  $\sqrt{1+e}$

19.  $\tan 1$  21.  $f(t) = t + 2t \ln t$

23.  $h'(\theta) = 2 \sec^2(2\theta)e^{\tan 2\theta}$  25.  $y' = 5 \sec 5x$

27.  $y' = \frac{4x}{1+16x^2} + \tan^{-1}(4x)$  29.  $y' = 2 \tan x$

31.  $y' = -\frac{e^{1/2}(1+2x)}{x^4}$  33.  $y' = 3^{x \ln 3}(\ln 3)(1 + \ln x)$

35.  $H'(v) = \frac{v}{1+v^2} + \tan^{-1}v$

37.  $y' = 2x^2 \cosh(x^2) + \sinh(x^2)$  39.  $y' = \cot x - \sin x \cos x$

41.  $y' = -(1/x)[1 + 1/(\ln x)^2]$

43.  $y' = 3 \tanh 3x$  45.  $y' = (\cosh x)/\sqrt{\sinh^2 x - 1}$

47.  $y' = \frac{-3 \sin(e^{\sqrt{\tan 3x}})e^{\sqrt{\tan 3x}} \sec^2(3x)}{2\sqrt{\tan 3x}}$  49.  $e^{g(x)}g'(x)$

51.  $g'(x)/g(x)$  53.  $2^x(\ln 2)^x$  57.  $y = -x + 2$  59.  $(-3, 0)$

61. (a)  $y = \frac{1}{2}x + \frac{1}{2}(\ln 4 + 1)$  (b)  $y = ex$

63. 0 65. 0 67.  $-\infty$  69.  $-1$

71. 1 73. 8 75. 0 77.  $\frac{1}{2}$

79. A.  $[-\pi, \pi]$  B.  $y$ -int 0;  $x$ -int  $-\pi, 0, \pi$

C. None D. None

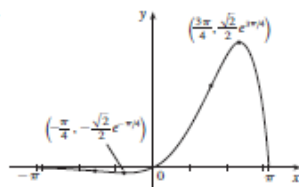
E. Inc on  $(-\pi/4, 3\pi/4)$ ; dec on  $(-\pi, -\pi/4), (3\pi/4, \pi)$

F. Loc max  $f(3\pi/4) = \frac{1}{2}\sqrt{2}e^{3\pi/4}$ , loc min  $f(-\pi/4) = -\frac{1}{2}\sqrt{2}e^{3\pi/4}$

G. CU on  $(-\pi/2, \pi/2)$ ; CD on  $(-\pi, -\pi/2), (\pi/2, \pi)$ ;

IP  $(-\pi/2, -e^{-\pi/2}), (\pi/2, e^{\pi/2})$

H.



81. A.  $(0, \infty)$  B.  $x$ -int 1

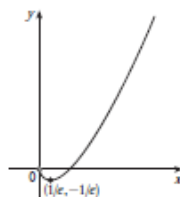
C. None D. None

E. Inc on  $(1/e, \infty)$ ; dec on  $(0, 1/e)$

F. Loc min  $f(1/e) = -1/e$

G. CU on  $(0, \infty)$

H. See graph at right.



83. A. R

B.  $y$ -int  $-2$ ;  $x$ -int 2

C. None D. HA  $y = 0$

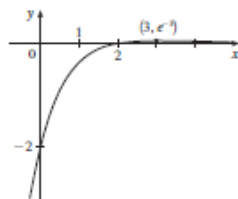
E. Inc on  $(-\infty, 3)$ ; dec on  $(3, \infty)$

F. Loc max  $f(3) = e^{-3}$

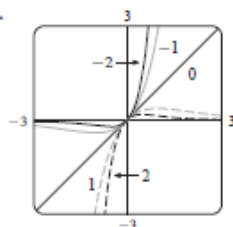
G. CU on  $(4, \infty)$ ; CD on  $(-\infty, 4)$ ;

IP  $(4, 2e^{-4})$

H. See graph at right.



85.



For  $c > 0$ ,  $\lim_{x \rightarrow \infty} f(x) = 0$  and  $\lim_{x \rightarrow -\infty} f(x) = -\infty$ .

For  $c < 0$ ,  $\lim_{x \rightarrow \infty} f(x) = \infty$  and  $\lim_{x \rightarrow -\infty} f(x) = 0$ .

As  $|c|$  increases, the max and min points and the IPs get closer to the origin.

87.  $v(t) = -Ae^{-ct}[c \cos(\omega t + \delta) + \omega \sin(\omega t + \delta)]$

$a(t) = Ae^{-ct}[(c^2 - \omega^2) \cos(\omega t + \delta) + 2c\omega \sin(\omega t + \delta)]$

89. (a)  $200(3.24)^t$  (b)  $\approx 22,040$

(c)  $\approx 25,910$  bacteria/h (d)  $(\ln 50)/(\ln 3.24) \approx 3.33$  h

91. 4.32 days 93.  $\frac{1}{4}(1 - e^{-2})$  95.  $\arctan e - \pi/4$

97.  $2e^{\sqrt{x}} + C$  99.  $\frac{1}{2} \ln|x^2 + 2x| + C$

101.  $-\frac{1}{2}[\ln(\cos x)]^2 + C$  103.  $2^{\ln 2}/\ln 2 + C$

105.  $-(1/x) - 2 \ln|x| + x + C$  109.  $e^{\sqrt{x}}/(2x)$

111.  $\frac{1}{2} \ln 4$  113.  $\pi^2/4$  115.  $\frac{2}{3}$  117.  $2/e$

121.  $e^{2x}(1 + 2x)/(1 - e^{-x})$

### PROBLEMS PLUS ■ PAGE 486

3. Abs max  $f(-5) = e^{45}$ , no abs min 9.  $1/\sqrt{2}$  11.  $a = \frac{1}{2}$

15.  $2\sqrt{e}$  17.  $a \leq e^{1/e}$

### CHAPTER 7

#### EXERCISES 7.1 ■ PAGE 492

1.  $\frac{1}{2}x^3 \ln x - \frac{1}{8}x^3 + C$  3.  $\frac{1}{2}x \sin 5x + \frac{1}{25} \cos 5x + C$

5.  $-\frac{1}{7}te^{-3t} - \frac{1}{9}e^{-3t} + C$

7.  $(x^2 + 2x) \sin x + (2x + 2) \cos x - 2 \sin x + C$

9.  $x \ln \sqrt{x} - \frac{1}{2}x + C$  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.  $\frac{1}{15}e^{2\theta}(2 \sin 3\theta - 3 \cos 3\theta) + C$

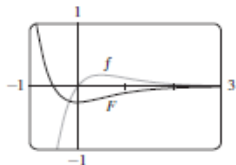
19.  $z^3 e^z - 3z^2 e^z + 6z e^z - 6e^z + C$

21.  $\frac{e^{2x}}{4(2x+1)} + C$  23.  $\frac{\pi-2}{2\pi^2}$

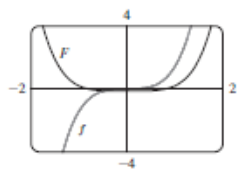
25.  $1 - 1/e$  27.  $\frac{81}{4} \ln 3 - 5$  29.  $\frac{1}{4} - \frac{3}{4}e^{-2}$

31.  $\frac{1}{8}(\pi + 6 - 3\sqrt{3})$  33.  $\sin x (\ln \sin x - 1) + C$

35.  $\frac{32}{5}(\ln 2)^2 - \frac{64}{25} \ln 2 + \frac{62}{125}$   
 37.  $2\sqrt{x} \sin \sqrt{x} + 2 \cos \sqrt{x} + C$  39.  $-\frac{1}{2} - \pi/4$   
 41.  $\frac{1}{2}(x^2 - 1) \ln(1 + x) - \frac{1}{4}x^2 + \frac{1}{2}x + \frac{3}{4} + C$   
 43.  $-\frac{1}{2}xe^{-2x} - \frac{1}{4}e^{-2x} + C$



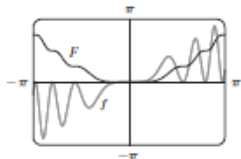
45.  $\frac{1}{3}x^2(1 + x^2)^{3/2} - \frac{2}{15}(1 + x^2)^{5/2} + C$



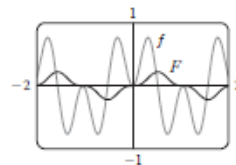
47. (b)  $-\frac{1}{2} \cos x \sin^3 x + \frac{3}{8}x - \frac{3}{16} \sin 2x + C$   
 49. (b)  $\frac{2}{3}, \frac{8}{15}$   
 55.  $x[(\ln x)^3 - 3(\ln x)^2 + 6 \ln x - 6] + C$   
 57.  $\frac{16}{3} \ln 2 - \frac{29}{9}$  59. -1.75119, 1.17210, 3.99926  
 61.  $4 - 8/\pi$  63.  $2\pi e$  65.  $1 - (2/\pi) \ln 2$   
 67.  $2 - e^{-1}(t^2 + 2t + 2) \ln$  69. 2

EXERCISES 7.2 ■ PAGE 500

1.  $\frac{1}{3} \sin^3 x - \frac{1}{5} \sin^5 x + C$  3.  $\frac{1}{120}$   
 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.  $\pi/16$   
 13.  $\frac{1}{4}t^2 - \frac{1}{4}t \sin 2t - \frac{1}{8} \cos 2t + C$   
 15.  $\frac{25}{45} \sqrt{\sin \alpha} (45 - 18 \sin^2 \alpha + 5 \sin^4 \alpha) + C$   
 17.  $\frac{1}{2} \cos^3 x - \ln |\cos x| + C$  19.  $\ln |\sin x| + 2 \sin x + C$   
 21.  $\frac{1}{3} \sec^3 x + C$  23.  $\tan x - x + C$   
 25.  $\frac{1}{9} \tan^9 x + \frac{2}{7} \tan^7 x + \frac{1}{5} \tan^5 x + C$  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.  $x \sec x - \ln |\sec x + \tan x| + C$  35.  $\sqrt{3} - \frac{1}{3}\pi$   
 37.  $\frac{23}{105} \sqrt{2} - \frac{8}{105}$  39.  $\ln |\csc x - \cot x| + C$   
 41.  $-\frac{1}{5} \cos 3x - \frac{1}{20} \cos 13x + C$  43.  $\frac{1}{8} \sin 4\theta - \frac{1}{12} \sin 6\theta + C$   
 45.  $\frac{1}{2}\sqrt{2}$  47.  $\frac{1}{2} \sin 2x + C$   
 49.  $x \tan x - \ln |\sec x| - \frac{1}{2}x^2 + C$   
 51.  $\frac{1}{4}x^2 - \frac{1}{4} \sin(x^2) \cos(x^2) + C$



53.  $\frac{1}{8} \sin 3x - \frac{1}{18} \sin 9x + C$



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 507

1.  $-\frac{\sqrt{4-x^2}}{4x} + C$  3.  $\sqrt{x^2-4} - 2 \sec^{-1}\left(\frac{x}{2}\right) + C$   
 5.  $\frac{\pi}{24} + \frac{\sqrt{3}}{8} - \frac{1}{4}$  7.  $\frac{1}{\sqrt{2}a^2}$   
 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.  $\frac{1}{10}\pi a^4$  17.  $\sqrt{x^2-7} + C$   
 19.  $\ln |(\sqrt{1+x^2}-1)/x| + \sqrt{1+x^2} + C$  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.  $\frac{1}{2}(x+1)\sqrt{x^2+2x} - \frac{1}{2} \ln|x+1+\sqrt{x^2+2x}| + C$   
 29.  $\frac{1}{4} \sin^{-1}(x^2) + \frac{1}{4}x^2\sqrt{1-x^4} + C$   
 33.  $\frac{1}{8}(\sqrt{48} - \sec^{-1} 7)$  37.  $\frac{3}{8}\pi^2 + \frac{3}{2}\pi$   
 41.  $2\pi^2 R^2$  43.  $r\sqrt{R^2-r^2} + \pi r^2/2 - R^2 \arcsin(r/R)$

EXERCISES 7.4 ■ PAGE 516

1. (a)  $\frac{A}{4x-3} + \frac{B}{2x+5}$  (b)  $\frac{A}{x} + \frac{B}{x^2} + \frac{C}{5-2x}$   
 3. (a)  $\frac{A}{x} + \frac{B}{x^2} + \frac{C}{x^3} + \frac{Dx+E}{x^2+4}$   
 (b)  $\frac{A}{x+3} + \frac{B}{(x+3)^2} + \frac{C}{x-3} + \frac{D}{(x-3)^2}$   
 5. (a)  $x^4 + 4x^2 + 16 + \frac{A}{x+2} + \frac{B}{x-2}$   
 (b)  $\frac{Ax+B}{x^2-x+1} + \frac{Cx+D}{x^2+2} + \frac{Ex+F}{(x^2+2)^2}$   
 7.  $\frac{1}{4}x^4 + \frac{1}{3}x^3 + \frac{1}{2}x^2 + x + \ln|x-1| + C$   
 9.  $\frac{1}{2} \ln|2x+1| + 2 \ln|x-1| + C$  11.  $2 \ln \frac{3}{2}$   
 13.  $a \ln|x-b| + C$  15.  $\frac{2}{5} + \ln \frac{2}{3}$   
 17.  $\frac{22}{5} \ln 2 - \frac{9}{5} \ln 3$  (or  $\frac{9}{5} \ln \frac{8}{3}$ )  
 19.  $10 \ln|x-3| - 9 \ln|x-2| + \frac{5}{x-2} + C$   
 21.  $\frac{1}{2}x^2 - 2 \ln(x^2+4) + 2 \tan^{-1}(x/2) + C$   
 23.  $\ln|x-1| - \frac{1}{2} \ln(x^2+9) - \frac{1}{3} \tan^{-1}(x/3) + C$   
 25.  $-2 \ln|x+1| + \ln(x^2+1) + 2 \tan^{-1}x + C$   
 27.  $\frac{1}{2} \ln(x^2+1) + (1/\sqrt{2}) \tan^{-1}(x/\sqrt{2}) + C$   
 29.  $\frac{1}{2} \ln(x^2+2x+5) + \frac{3}{2} \tan^{-1}\left(\frac{x+1}{2}\right) + C$   
 31.  $\frac{1}{3} \ln|x-1| - \frac{1}{6} \ln(x^2+x+1) - \frac{1}{\sqrt{3}} \tan^{-1} \frac{2x+1}{\sqrt{3}} + C$

$$33. \frac{1}{4} \ln \frac{8}{3} \quad 35. \frac{1}{16} \ln |x| - \frac{1}{32} \ln(x^2 + 4) + \frac{1}{8(x^2 + 4)} + C$$

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

$$39. 2\sqrt{x+1} - \ln(\sqrt{x+1} + 1) + \ln|\sqrt{x+1} - 1| + C$$

$$41. -2 \ln \sqrt{x} - \frac{2}{\sqrt{x}} + 2 \ln(\sqrt{x} + 1) + C$$

$$43. \frac{3}{10}(x^2 + 1)^{5/3} - \frac{3}{2}(x^2 + 1)^{2/3} + C$$

$$45. 2\sqrt{x} + 3\sqrt[3]{x} + 6\sqrt[4]{x} + 6 \ln|\sqrt[4]{x} - 1| + C$$

$$47. \ln \frac{(e^x + 2)^2}{e^x + 1} + C$$

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

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

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

$$55. -\frac{1}{2} \ln 3 \approx -0.55$$

$$57. \frac{1}{2} \ln \left| \frac{x-2}{x} \right| + C \quad 61. \frac{1}{5} \ln \left| \frac{2 \tan(x/2) - 1}{\tan(x/2) + 2} \right| + C$$

$$63. 4 \ln \frac{2}{3} + 2 \quad 65. -1 + \frac{11}{12} \ln 2$$

$$67. t = -\ln P - \frac{1}{9} \ln(0.9P + 900) + C, \text{ where } C \approx 10.23$$

$$69. \text{(a)} \frac{24,110}{4879} \frac{1}{5x+2} - \frac{668}{323} \frac{1}{2x+1} - \frac{9438}{80,155} \frac{1}{3x-7} + \frac{1}{22,098x + 48,935}$$

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

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

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

$$73. \frac{1}{a^n(x-a)} - \frac{1}{a^n x} - \frac{1}{a^{n-1}x^2} - \dots - \frac{1}{ax^n}$$

#### EXERCISES 7.5 ■ PAGE 523

$$1. \sin x + \frac{1}{3} \sin^3 x + C$$

$$3. \sin x + \ln |\csc x - \cot x| + C$$

$$5. \frac{1}{2\sqrt{2}} \tan^{-1} \left( \frac{t^2}{\sqrt{2}} \right) + C \quad 7. e^{n/4} - e^{-n/4}$$

$$9. \frac{243}{25} \ln 3 - \frac{243}{25} \quad 11. \frac{1}{2} \ln(x^2 - 4x + 5) + \tan^{-1}(x-2) + C$$

$$13. -\frac{1}{5} \cos^5 t + \frac{2}{3} \cos^3 t - \frac{1}{5} \cos t + C \quad 15. x/\sqrt{1-x^2} + C$$

$$17. \frac{1}{4} \pi^2 \quad 19. e^{e^x} + C \quad 21. (x+1) \arctan \sqrt{x} - \sqrt{x} + C$$

$$23. \frac{4097}{25} \quad 25. 3x + \frac{23}{3} \ln|x-4| - \frac{5}{2} \ln|x+2| + C$$

$$27. x - \ln(1 + e^x) + C$$

$$29. x \ln(x + \sqrt{x^2 - 1}) - \sqrt{x^2 - 1} + C$$

$$31. \sin^{-1} x - \sqrt{1-x^2} + C$$

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

$$35. \frac{1}{8} \sin 4x + \frac{1}{16} \sin 8x + C \quad 37. \frac{1}{4}$$

$$39. \ln |\sec \theta - 1| - \ln |\sec \theta| + C$$

$$41. \theta \tan \theta - \frac{1}{2} \theta^2 - \ln |\sec \theta| + C \quad 43. \frac{2}{3} \tan^{-1}(x^{3/2}) + C$$

$$45. -\frac{1}{2}(x^3 + 1)e^{-x^3} + C$$

$$47. \ln|x-1| - 3(x-1)^{-1} - \frac{3}{2}(x-1)^{-2} - \frac{1}{3}(x-1)^{-3} + C$$

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

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

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

$$57. \frac{2}{3}(x+c)^{7/3} - \frac{2}{3}c(x+c)^{4/3} + C$$

$$59. \sin(\sin x) - \frac{1}{3} \sin^3(\sin x) + C$$

$$61. \csc \theta - \cot \theta + C \text{ or } \tan(\theta/2) + C$$

$$63. 2(x - 2\sqrt{x} + 2)e^{\sqrt{x}} + C$$

$$65. -\tan^{-1}(\cos^2 x) + C \quad 67. \frac{2}{3}[(x+1)^{3/2} - x^{3/2}] + C$$

$$69. \sqrt{2} - 2/\sqrt{3} + \ln(2 + \sqrt{3}) - \ln(1 + \sqrt{2})$$

$$71. e^x - \ln(1 + e^x) + C$$

$$73. -\sqrt{1-x^2} + \frac{1}{2}(\arcsin x)^2 + C$$

$$75. \frac{1}{8} \ln|x-2| - \frac{1}{16} \ln(x^2 + 4) - \frac{1}{8} \tan^{-1}(x/2) + C$$

$$77. 2(x-2)\sqrt{1+e^x} + 2 \ln \frac{\sqrt{1+e^x}+1}{\sqrt{1+e^x}-1} + C$$

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

$$81. 2\sqrt{1+\sin x} + C \quad 83. xe^{x^2} + C$$

#### EXERCISES 7.6 ■ PAGE 528

$$1. -\frac{5}{21} \quad 3. \sqrt{13} - \frac{3}{4} \ln(4 + \sqrt{13}) - \frac{1}{2} + \frac{1}{4} \ln 3$$

$$5. \frac{\pi}{8} - \frac{1}{4} \ln(1 + \frac{1}{16}\pi^2) \quad 7. \frac{1}{6} \ln \left| \frac{\sin x - 3}{\sin x + 3} \right| + C$$

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

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

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

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

$$19. \frac{1}{9} \sin^3 x [3 \ln(\sin x) - 1] + C \quad 21. \frac{1}{2\sqrt{3}} \ln \left| \frac{e^x + \sqrt{3}}{e^x - \sqrt{3}} \right| + C$$

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

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

$$27. -\frac{1}{2}x^{-2} \cos^{-1}(x^{-2}) + \frac{1}{2}\sqrt{1-x^{-4}} + C$$

$$29. \sqrt{e^{2x}-1} - \cos^{-1}(e^{-x}) + C$$

$$31. \frac{1}{5} \ln|x^5 + \sqrt{x^{10}-2}| + C \quad 33. \frac{3}{8}\pi^2$$

$$37. \frac{1}{3} \tan x \sec^2 x + \frac{2}{3} \tan x + C$$

$$39. \frac{1}{4}x(x^2+2)\sqrt{x^2+4} - 2 \ln(\sqrt{x^2+4} + x) + C$$

$$41. \frac{1}{4} \cos^3 x \sin x + \frac{3}{8}x + \frac{3}{8} \sin x \cos x + C$$

$$43. \frac{1}{4} \tan^4 x - \frac{1}{2} \tan^2 x - \ln |\cos x| + C$$

$$45. \text{(a)} -\ln \left| \frac{1 + \sqrt{1-x^2}}{x} \right| + C;$$

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

EXERCISES 7.7 ■ PAGE 540

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)  $M_{10} \approx 0.806598, E_M \approx -0.001879$   
 (b)  $S_{10} \approx 0.804779, E_S \approx -0.000060$
7. (a) 1.506361 (b) 1.518362 (c) 1.511519
9. (a) 2.660833 (b) 2.664377 (c) 2.663244
11. (a) 2.591334 (b) 2.681046 (c) 2.631976
13. (a) 4.513618 (b) 4.748256 (c) 4.675111
15. (a)  $-0.495333$  (b)  $-0.543321$  (c)  $-0.526123$
17. (a) 8.363853 (b) 8.163298 (c) 8.235114
19. (a)  $T_8 \approx 0.902333, M_8 \approx 0.905620$   
 (b)  $|E_T| \approx 0.0078, |E_M| \approx 0.0039$   
 (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)  $|E_T| \approx 0.025839, |E_M| \approx 0.012919, |E_S| \approx 0.000170$   
 (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)  $n \approx 50$

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.

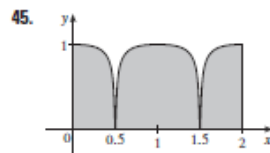
$n$	$T_n$	$M_n$	$S_n$
6	6.695473	6.252572	6.403292
12	6.474023	6.363008	6.400206

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

Observations are the same as after Example 1.

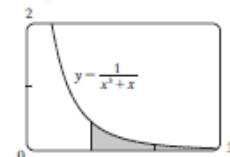
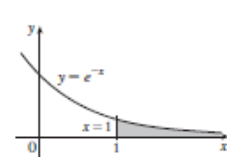
29. (a) 19.8 (b) 20.6 (c) 20.53
31. (a) 14.4 (b)  $\frac{1}{2}$
33. 64.4°F 35. 37.73 ft/s 37. 10,177 megawatt-hours
39. (a) 190 (b) 828
41. 6.0 43. 59.4



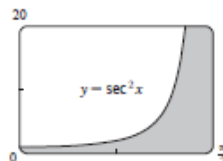
EXERCISES 7.8 ■ PAGE 551

Abbreviations: C, convergent; D, divergent

1. (a), (d) Infinite discontinuity (b), (c) Infinite interval
3.  $\frac{1}{2} - 1/(2r^2)$ ; 0.495, 0.49995, 0.4999995; 0.5
5. 2 7. D 9.  $\frac{1}{5}e^{-10}$  11. D 13. 0 15. D
17.  $\ln 2$  19.  $-\frac{1}{4}$  21. D 23.  $\pi/9$  25.  $\frac{1}{2}$  27. D
29.  $\frac{32}{3}$  31. D 33.  $\frac{9}{2}$  35. D 37.  $-2/e$
39.  $\frac{8}{3} \ln 2 - \frac{8}{9}$
41.  $1/e$  43.  $\frac{1}{2} \ln 2$



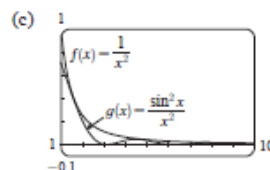
45. Infinite area



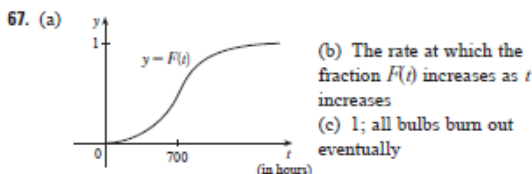
47. (a)

$t$	$\int_1^t [(\sin^2 x)/x^2] dx$
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.



49. C 51. D 53. D 55.  $\pi$  57.  $p < 1, 1/(1-p)$
59.  $p > -1, -1/(p+1)^2$  65.  $\sqrt{2CM/R}$



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 554

True-False Quiz

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

Exercises

1.  $\frac{7}{2} + \ln 2$  3.  $e - 1$  5.  $\ln|2t + 1| - \ln|t + 1| + C$   
 7.  $\frac{2}{15}$  9.  $-\cos(\ln t) + C$  11.  $\sqrt{3} - \frac{1}{3}\pi$   
 13.  $3e^{3/2}(x^{2/3} - 2x^{1/3} + 2) + C$   
 15.  $-\frac{1}{2} \ln|x| + \frac{3}{2} \ln|x + 2| + C$   
 17.  $x \sec x - \ln|\sec x + \tan x| + C$   
 19.  $\frac{1}{18} \ln(9x^2 + 6x + 5) + \frac{1}{9} \tan^{-1}\left[\frac{1}{3}(3x + 1)\right] + C$   
 21.  $\ln|x - 2 + \sqrt{x^2 - 4x}| + C$   
 23.  $\ln \left| \frac{\sqrt{x^2 + 1} - 1}{x} \right| + C$   
 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.  $\frac{x}{\sqrt{4-x^2}} - \sin^{-1}\left(\frac{x}{2}\right) + C$   
 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.  $\frac{1}{2} \sin x \sqrt{4 + \sin^2 x} + 2 \ln(\sin x + \sqrt{4 + \sin^2 x}) + C$   
 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. (a) D (b) C  
 73. 2 75.  $\frac{1}{16}\pi^2$

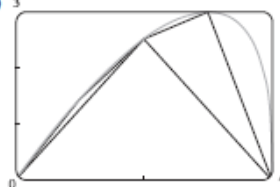
PROBLEMS PLUS ■ PAGE 558

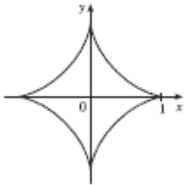
1. About 1.85 inches from the center 3. 0  
 7.  $f(\pi) = -\pi/2$  11.  $(b^b a^{-a})^{1/(b-a)} e^{-1}$  13.  $\frac{1}{4}\pi - \frac{1}{2}$   
 15.  $2 - \sin^{-1}(2/\sqrt{5})$

CHAPTER 8

EXERCISES 8.1 ■ PAGE 567

1.  $4\sqrt{5}$  3. 3.8202 5. 3.6095  
 7.  $\frac{2}{243}(82\sqrt{82} - 1)$  9.  $\frac{20}{24}$  11.  $\frac{32}{3}$   
 13.  $\ln(\sqrt{2} + 1)$  15.  $\frac{3}{4} + \frac{1}{2} \ln 2$  17.  $\ln 3 - \frac{1}{2}$   
 19.  $\sqrt{2} + \ln(1 + \sqrt{2})$  21. 10.0556  
 23. 15.374568 25. 7.118819  
 27. (a), (b)  $\int_0^4 \sqrt{1 + [4(3-x)/(3(4-x)^{2/3})]^2} dx$  (d) 7.7988  
 $L_1 = 4,$   
 $L_2 \approx 6.43,$   
 $L_4 \approx 7.50$



29.  $\sqrt{5} - \ln\left(\frac{1}{2}(1 + \sqrt{5})\right) - \sqrt{2} + \ln(1 + \sqrt{2})$   
 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 574

1. (a) (i)  $\int_0^{\pi/3} 2\pi \tan x \sqrt{1 + \sec^4 x} dx$   
 (ii)  $\int_0^{\pi/3} 2\pi x \sqrt{1 + \sec^4 x} dx$  (b) (i) 10.5017 (ii) 7.9353  
 3. (a) (i)  $\int_{-1}^1 2\pi e^{-x} \sqrt{1 + 4x^2 e^{-2x}} dx$   
 (ii)  $\int_0^1 2\pi x \sqrt{1 + 4x^2 e^{-2x}} dx$  (b) (i) 11.0753 (ii) 3.9603  
 5.  $\frac{1}{27}\pi(145\sqrt{145} - 1)$  7.  $\frac{28}{9}\pi$   
 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.  $\pi a^2$   
 17. 1,230,507 19. 24.144251  
 21.  $\frac{1}{2}\pi[4 \ln(\sqrt{17} + 4) - 4 \ln(\sqrt{2} + 1) - \sqrt{17} + 4\sqrt{2}]$   
 23.  $\frac{1}{6}\pi[\ln(\sqrt{10} + 3) + 3\sqrt{10}]$   
 27. (a)  $\frac{1}{3}\pi a^2$  (b)  $\frac{26}{25}\pi\sqrt{3} a^2$

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

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

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

## EXERCISES 8.3 ■ PAGE 584

1. (a) 187.5 lb/ft<sup>2</sup>    (b) 1875 lb    (c) 562.5 lb

3. 6000 lb    5.  $6.7 \times 10^4$  N    7.  $9.8 \times 10^3$  N

9.  $1.2 \times 10^4$  lb    11.  $\frac{2}{3}\delta ab^2$

13.  $5.27 \times 10^3$  N    15. (a) 314 N    (b) 353 N

17. (a)  $5.63 \times 10^3$  lb    (b)  $5.06 \times 10^4$  lb

(c)  $4.88 \times 10^4$  lb    (d)  $3.03 \times 10^5$  lb

19. 4148 lb    21. 330; 22    23. 10; 14; (1.4, 1)    25.  $(\frac{2}{3}, \frac{2}{3})$

27.  $(\frac{1}{e-1}, \frac{e+1}{4})$     29.  $(\frac{9}{20}, \frac{9}{20})$

31.  $(\frac{\pi\sqrt{2}-4}{4(\sqrt{2}-1)}, \frac{1}{4(\sqrt{2}-1)})$     33.  $(\frac{8}{3}, -\frac{1}{2})$

35. 60; 160;  $(\frac{8}{3}, 1)$     37.  $(-\frac{1}{35}, -\frac{12}{35})$     41.  $(0, \frac{1}{12})$     45.  $\frac{1}{3}\pi r^2 h$

## EXERCISES 8.4 ■ PAGE 590

1. \$21,104    3. \$140,000; \$60,000    5. \$407.25

7. \$12,000    9. 3727; \$37,753

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

15.  $1.19 \times 10^{-4}$  cm<sup>3</sup>/s    17. 6.60 L/min    19. 5.77 L/min

## EXERCISES 8.5 ■ PAGE 597

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)  $\frac{17}{81}$

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.  $\approx 0.9545$

19. (b) 0;  $a_0$     (c)  $1 \times 10^{30}$



(d)  $1 - 41e^{-8} \approx 0.986$     (e)  $\frac{3}{2}a_0$

## CHAPTER 8 REVIEW ■ PAGE 599

## Exercises

1.  $\frac{15}{2}$     3. (a)  $\frac{21}{16}$     (b)  $\frac{41}{10}\pi$

5. 3.8202    7.  $\frac{124}{5}$     9.  $\approx 458$  lb    11.  $(\frac{8}{3}, 1)$

13.  $(2, \frac{2}{3})$     15.  $2\pi^2$     17. \$7166.67

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

(b)  $\approx 0.3455$     (c) 5, yes

21. (a)  $1 - e^{-3/8} \approx 0.31$     (b)  $e^{-5/4} \approx 0.29$

(c)  $8 \ln 2 \approx 5.55$  min

## PROBLEMS PLUS ■ PAGE 601

1.  $\frac{2}{3}\pi - \frac{1}{2}\sqrt{3}$

3. (a)  $2\pi r(r \pm d)$     (b)  $\approx 3.36 \times 10^6$  mi<sup>2</sup>

(d)  $\approx 7.84 \times 10^7$  mi<sup>2</sup>

5. (a)  $P(z) = P_0 + g \int_0^z \rho(x) dx$

(b)  $(P_0 - \rho_0 g H)(\pi r^2) + \rho_0 g H e^{k/H} \int_r^z e^{-k/H} \cdot 2\sqrt{r^2 - x^2} dx$

7. Height  $\sqrt{2} b$ , volume  $(\frac{20}{27}\sqrt{6} - 2)\pi b^3$     9. 0.14 m

11.  $2/\pi, 1/\pi$     13. (0, -1)



## CHAPTER 11

## EXERCISES 11.1 ■ PAGE 724

Abbreviations: C, convergent; D, divergent

1. (a) A sequence is an ordered list of numbers. It can also be defined as a function whose domain is the set of positive integers.

(b) The terms  $a_n$  approach 8 as  $n$  becomes large.

(c) The terms  $a_n$  become large as  $n$  becomes large.

3.  $1, \frac{4}{5}, \frac{3}{5}, \frac{8}{17}, \frac{5}{13}$     5.  $\frac{1}{5}, -\frac{1}{25}, \frac{1}{125}, -\frac{1}{625}, \frac{1}{3125}$     7.  $\frac{1}{2}, \frac{1}{6}, \frac{1}{24}, \frac{1}{120}, \frac{1}{720}$

9. 1, 2, 7, 32, 157    11.  $2, \frac{2}{3}, \frac{2}{3}, \frac{2}{3}, \frac{2}{3}$     13.  $a_n = 1/(2n - 1)$

15.  $a_n = -3\left(-\frac{2}{3}\right)^{n-1}$     17.  $a_n = (-1)^{n+1} \frac{n^2}{n+1}$

19. 0.4286, 0.4615, 0.4737, 0.4800, 0.4839, 0.4865, 0.4884, 0.4898, 0.4909, 0.4918; yes;  $\frac{1}{2}$

21. 0.5000, 1.2500, 0.8750, 1.0625, 0.9688, 1.0156, 0.9922, 1.0039, 0.9980, 1.0010; yes; 1

23. 1    25. 5    27. 1    29. 1    31. D    33. 0

35. D    37. 0    39. 0    41. 0    43. 0    45. 1

47.  $e^2$     49.  $\ln 2$     51.  $\pi/2$     53. D    55. D

57. 1    59.  $\frac{1}{2}$     61. D    63. 0

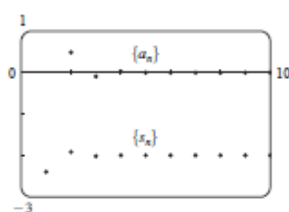
65. (a) 1060, 1123.60, 1191.02, 1262.48, 1338.23    (b) D

67. (a)  $P_n = 1.08P_{n-1} - 300$  (b) 5734  
 69.  $-1 < r < 1$   
 71. Convergent by the Monotonic Sequence Theorem;  $5 \leq L < 8$   
 73. Decreasing; yes    75. Not monotonic; no  
 77. Decreasing; yes  
 79. 2    81.  $\frac{1}{2}(3 + \sqrt{5})$     83. (b)  $\frac{1}{2}(1 + \sqrt{5})$   
 85. (a) 0    (b) 9, 11

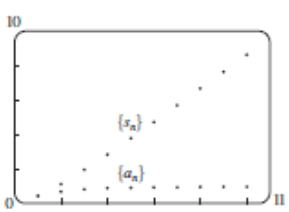
**EXERCISES 11.2 ■ PAGE 735**

1. (a) A sequence is an ordered list of numbers whereas a series is the sum of a list of numbers.  
 (b) A series is convergent if the sequence of partial sums is a convergent sequence. A series is divergent if it is not convergent.  
 3. 2  
 5. 1, 1.125, 1.1620, 1.1777, 1.1857, 1.1903, 1.1932, 1.1952; C  
 7. 0.5, 1.3284, 2.4265, 3.7598, 5.3049, 7.0443, 8.9644, 11.0540; D

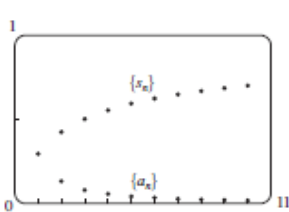
9. -2.40000, -1.92000,  
 -2.01600, -1.99680,  
 -2.00064, -1.99987,  
 -2.00003, -1.99999,  
 -2.00000, -2.00000;  
 convergent, sum = -2



11. 0.44721, 1.15432,  
 1.98637, 2.88080,  
 3.80927, 4.75796,  
 5.71948, 6.68962,  
 7.66581, 8.64639;  
 divergent



13. 0.29289, 0.42265,  
 0.50000, 0.55279,  
 0.59175, 0.62204,  
 0.64645, 0.66667,  
 0.68377, 0.69849;  
 convergent, sum = 1



15. (a) C    (b) D    17. D    19.  $\frac{25}{3}$     21. 60    23.  $\frac{1}{7}$   
 25. D    27. D    29. D    31.  $\frac{5}{2}$     33. D    35. D  
 37. D    39. D    41.  $e/(e-1)$     43.  $\frac{3}{2}$     45.  $\frac{11}{6}$     47.  $e-1$   
 49. (b) 1    (c) 2    (d) All rational numbers with a terminating decimal representation, except 0.  
 51.  $\frac{8}{9}$     53.  $\frac{838}{333}$     55. 5063/3300  
 57.  $-\frac{1}{5} < x < \frac{1}{5}$ ,  $\frac{-5x}{1+5x}$     59.  $-1 < x < 5$ ;  $\frac{3}{5-x}$   
 61.  $x > 2$  or  $x < -2$ ;  $\frac{x}{x-2}$     63.  $x < 0$ ;  $\frac{1}{1-e^x}$   
 65. 1    67.  $a_1 = 0$ ,  $a_n = \frac{2}{n(n+1)}$  for  $n > 1$ , sum = 1

69. (a) 157.875 mg;  $\frac{3000}{19}(1 - 0.05^n)$     (b) 157.895 mg

71. (a)  $S_n = \frac{D(1 - c^n)}{1 - c}$     (b) 5    73.  $\frac{1}{2}(\sqrt{3} - 1)$

77.  $\frac{1}{n(n+1)}$     79. The series is divergent.

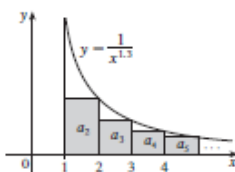
85.  $\{s_n\}$  is bounded and increasing.

87. (a)  $0, \frac{1}{9}, \frac{2}{9}, \frac{1}{3}, \frac{2}{9}, \frac{7}{9}, \frac{8}{9}, 1$

89. (a)  $\frac{1}{2}, \frac{5}{6}, \frac{23}{24}, \frac{119}{120}, \frac{(n+1)! - 1}{(n+1)!}$     (c) 1

**EXERCISES 11.3 ■ PAGE 744**

1. C



3. D    5. C    7. D    9. C    11. C    13. D  
 15. C    17. C    19. C    21. D    23. C    25. C  
 27.  $f$  is neither positive nor decreasing.  
 29.  $p > 1$     31.  $p < -1$     33.  $(1, \infty)$   
 35. (a)  $\frac{9}{10}\pi^4$     (b)  $\frac{1}{10}\pi^4 - \frac{17}{16}$   
 37. (a) 1.54977, error  $\leq 0.1$     (b) 1.64522, error  $\leq 0.005$   
 (c) 1.64522 compared to 1.64493    (d)  $n > 1000$   
 39. 0.00145    45.  $b < 1/e$

**EXERCISES 11.4 ■ PAGE 750**

1. (a) Nothing    (b) C    3. C    5. D    7. C    9. D  
 11. C    13. C    15. D    17. D    19. D    21. C  
 23. C    25. D    27. C    29. C    31. D  
 33. 1.249, error  $< 0.1$     35. 0.0739, error  $< 6.4 \times 10^{-8}$   
 45. Yes

**EXERCISES 11.5 ■ PAGE 755**

1. (a) A series whose terms are alternately positive and negative    (b)  $0 < b_{n+1} \leq b_n$  and  $\lim_{n \rightarrow \infty} b_n = 0$ , where  $b_n = |a_n|$     (c)  $|R_n| \leq b_{n+1}$   
 3. C    5. C    7. D    9. C    11. C    13. D    15. C  
 17. C    19. D    21. -0.5507    23. 5    25. 4  
 27. -0.4597    29. 0.0676    31. An underestimate  
 33.  $p$  is not a negative integer    35.  $\{b_n\}$  is not decreasing

**EXERCISES 11.6 ■ PAGE 761**

Abbreviations: AC, absolutely convergent;  
 CC, conditionally convergent

1. (a) D    (b) C    (c) May converge or diverge  
 3. AC    5. CC    7. AC    9. D    11. AC    13. AC  
 15. AC    17. CC    19. AC    21. AC    23. D    25. AC  
 27. AC    29. D    31. D    33. AC

35. (a) and (d)  
 39. (a)  $\frac{661}{900} \approx 0.68854$ , error  $< 0.00521$   
 (b)  $n \geq 11$ , 0.693109  
 45. (b)  $\sum_{n=2}^{\infty} \frac{(-1)^n}{n \ln n}$ ;  $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n}$

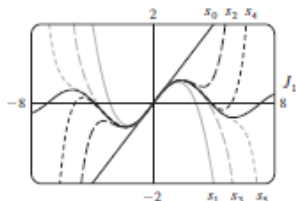
EXERCISES 11.7 ■ PAGE 764

1. C    3. D    5. C    7. D    9. C    11. C  
 13. C    15. C    17. C    19. C    21. D    23. D  
 25. C    27. C    29. C    31. D  
 33. C    35. D    37. C

EXERCISES 11.8 ■ PAGE 769

1. A series of the form  $\sum_{n=0}^{\infty} c_n(x-a)^n$ , where  $x$  is a variable and  $a$  and the  $c_n$ 's are constants  
 3. 1,  $(-1, 1)$     5. 1,  $[-1, 1]$   
 7.  $\infty$ ,  $(-\infty, \infty)$     9. 2,  $(-2, 2)$     11.  $\frac{1}{3}$ ,  $[-\frac{1}{3}, \frac{1}{3}]$   
 13. 4,  $(-4, 4]$     15. 1,  $[1, 3]$     17.  $\frac{1}{5}$ ,  $[-\frac{13}{5}, -\frac{11}{5}]$   
 19.  $\infty$ ,  $(-\infty, \infty)$     21.  $b$ ,  $(a-b, a+b)$     23. 0,  $\{\frac{1}{2}\}$   
 25.  $\frac{1}{5}$ ,  $[\frac{1}{5}, 1]$     27.  $\infty$ ,  $(-\infty, \infty)$     29. (a) Yes    (b) No  
 31.  $k^k$     33. No  
 35. (a)  $(-\infty, \infty)$

(b), (c)



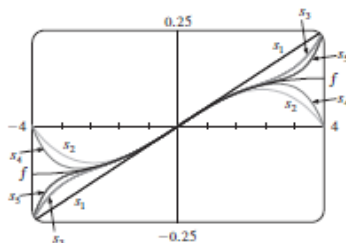
37.  $(-1, 1)$ ,  $f(x) = (1+2x)/(1-x^2)$     41. 2

EXERCISES 11.9 ■ PAGE 775

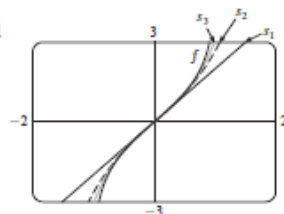
1. 10    3.  $\sum_{n=0}^{\infty} (-1)^n x^n$ ,  $(-1, 1)$     5.  $2 \sum_{n=0}^{\infty} \frac{1}{3^{n+1}} x^n$ ,  $(-3, 3)$   
 7.  $\sum_{n=0}^{\infty} (-1)^n \frac{1}{9^{n+1}} x^{2n+1}$ ,  $(-3, 3)$     9.  $1 + 2 \sum_{n=1}^{\infty} x^n$ ,  $(-1, 1)$   
 11.  $\sum_{n=0}^{\infty} \left[ (-1)^{n+1} - \frac{1}{2^{n+1}} \right] x^n$ ,  $(-1, 1)$   
 13. (a)  $\sum_{n=0}^{\infty} (-1)^n (n+1) x^n$ ,  $R=1$   
 (b)  $\frac{1}{2} \sum_{n=0}^{\infty} (-1)^n (n+2)(n+1) x^n$ ,  $R=1$   
 (c)  $\frac{1}{2} \sum_{n=2}^{\infty} (-1)^n n(n-1) x^n$ ,  $R=1$   
 15.  $\ln 5 - \sum_{n=1}^{\infty} \frac{x^n}{n5^n}$ ,  $R=5$   
 17.  $\sum_{n=0}^{\infty} (-1)^n 4^n (n+1) x^{n+1}$ ,  $R=\frac{1}{4}$

19.  $\sum_{n=0}^{\infty} (2n+1)x^n$ ,  $R=1$

21.  $\sum_{n=0}^{\infty} (-1)^n \frac{1}{16^{n+1}} x^{2n+1}$ ,  $R=4$



23.  $\sum_{n=0}^{\infty} \frac{2x^{2n+1}}{2n+1}$ ,  $R=1$



25.  $C + \sum_{n=0}^{\infty} \frac{t^{8n+2}}{8n+2}$ ,  $R=1$

27.  $C + \sum_{n=1}^{\infty} (-1)^n \frac{x^{n+3}}{n(n+3)}$ ,  $R=1$

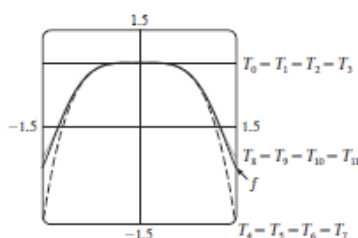
29. 0.199989    31. 0.000983    33. 0.19740

35. (b) 0.920    39.  $[-1, 1]$ ,  $[-1, 1)$ ,  $(-1, 1)$

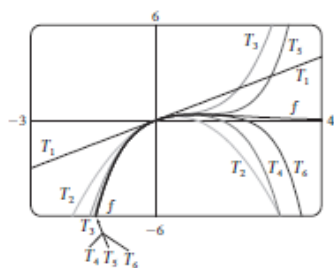
EXERCISES 11.10 ■ PAGE 789

1.  $b_8 = f^{(8)}(5)/8!$     3.  $\sum_{n=0}^{\infty} (n+1)x^n$ ,  $R=1$   
 5.  $\sum_{n=0}^{\infty} (n+1)x^n$ ,  $R=1$   
 7.  $\sum_{n=0}^{\infty} (-1)^n \frac{\pi^{-2n+1}}{(2n+1)!} x^{2n+1}$ ,  $R=\infty$   
 9.  $\sum_{n=0}^{\infty} \frac{(\ln 2)^n}{n!} x^n$ ,  $R=\infty$     11.  $\sum_{n=0}^{\infty} \frac{x^{2n+1}}{(2n+1)!}$ ,  $R=\infty$   
 13.  $-1 - 2(x-1) + 3(x-1)^2 + 4(x-1)^3 + (x-1)^4$ ,  $R=\infty$   
 15.  $\ln 2 + \sum_{n=1}^{\infty} (-1)^{n+1} \frac{1}{n2^n} (x-2)^n$ ,  $R=2$   
 17.  $\sum_{n=0}^{\infty} \frac{2^n e^n}{n!} (x-3)^n$ ,  $R=\infty$   
 19.  $\sum_{n=0}^{\infty} (-1)^{n+1} \frac{1}{(2n)!} (x-\pi)^{2n}$ ,  $R=\infty$   
 25.  $1 - \frac{1}{4}x - \sum_{n=2}^{\infty} \frac{3 \cdot 7 \cdot \dots \cdot (4n-5)}{4^n \cdot n!} x^n$ ,  $R=1$   
 27.  $\sum_{n=0}^{\infty} (-1)^n \frac{(n+1)(n+2)}{2^{n+4}} x^n$ ,  $R=2$

29.  $\sum_{n=0}^{\infty} (-1)^n \frac{\pi^{2n+1}}{(2n+1)!} x^{2n+1}, R = \infty$
31.  $\sum_{n=0}^{\infty} \frac{2^n + 1}{n!} x^n, R = \infty$
33.  $\sum_{n=0}^{\infty} (-1)^n \frac{1}{2^{2n}(2n)!} x^{4n+1}, R = \infty$
35.  $\frac{1}{2}x + \sum_{n=1}^{\infty} (-1)^n \frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{n! 2^{3n+1}} x^{2n+1}, R = 2$
37.  $\sum_{n=1}^{\infty} (-1)^{n+1} \frac{2^{2n-1}}{(2n)!} x^{2n}, R = \infty$
39.  $\sum_{n=0}^{\infty} (-1)^n \frac{1}{(2n)!} x^{4n}, R = \infty$



41.  $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{(n-1)!} x^n, R = \infty$



43. 0.99619

45. (a)  $1 + \sum_{n=1}^{\infty} \frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{2^n n!} x^{2n}$

(b)  $x + \sum_{n=1}^{\infty} \frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{(2n+1)2^n n!} x^{2n+1}$

47.  $C + \sum_{n=0}^{\infty} (-1)^n \frac{x^{6n+2}}{(6n+2)(2n)!}, R = \infty$

49.  $C + \sum_{n=1}^{\infty} (-1)^n \frac{1}{2n(2n)!} x^{2n}, R = \infty$

51. 0.0059    53. 0.40102    55.  $\frac{1}{2}$     57.  $\frac{1}{120}$

59.  $1 - \frac{3}{2}x^2 + \frac{25}{24}x^4$     61.  $1 + \frac{1}{6}x^2 + \frac{7}{360}x^4$     63.  $e^{-x^4}$

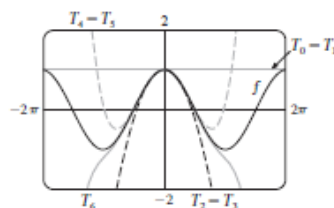
65.  $\ln \frac{8}{3}$     67.  $1/\sqrt{2}$     69.  $e^3 - 1$

**EXERCISES 11.11 ■ PAGE 798**

1. (a)  $T_0(x) = 1 = T_1(x)$ ,  $T_2(x) = 1 - \frac{1}{2}x^2 = T_3(x)$ ,

$T_4(x) = 1 - \frac{1}{2}x^2 + \frac{1}{24}x^4 = T_5(x)$ ,

$T_6(x) = 1 - \frac{1}{2}x^2 + \frac{1}{24}x^4 - \frac{1}{720}x^6$

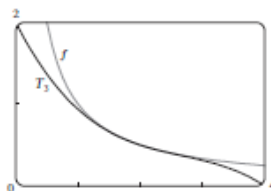


(b)

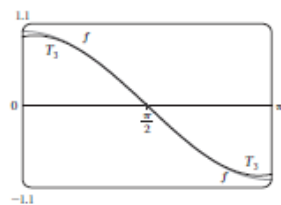
$x$	$f$	$T_0 = T_1$	$T_2 = T_3$	$T_4 = T_5$	$T_6$
$\frac{\pi}{4}$	0.7071	1	0.6916	0.7074	0.7071
$\frac{\pi}{2}$	0	1	-0.2337	0.0200	-0.0009
$\pi$	-1	1	-3.9348	0.1239	-1.2114

(c) As  $n$  increases,  $T_n(x)$  is a good approximation to  $f(x)$  on a larger and larger interval.

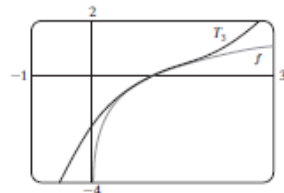
3.  $\frac{1}{2} - \frac{1}{4}(x-2) + \frac{1}{8}(x-2)^2 - \frac{1}{16}(x-2)^3$



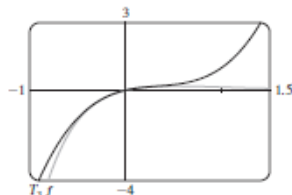
5.  $-\left(x - \frac{\pi}{2}\right) + \frac{1}{6}\left(x - \frac{\pi}{2}\right)^3$



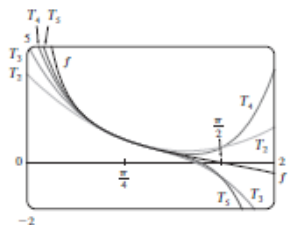
7.  $(x-1) - \frac{1}{2}(x-1)^2 + \frac{1}{3}(x-1)^3$



9.  $x - 2x^2 + 2x^3$



11.  $T_5(x) = 1 - 2\left(x - \frac{\pi}{4}\right) + 2\left(x - \frac{\pi}{4}\right)^2 - \frac{8}{3}\left(x - \frac{\pi}{4}\right)^3 + \frac{10}{3}\left(x - \frac{\pi}{4}\right)^4 - \frac{64}{15}\left(x - \frac{\pi}{4}\right)^5$



13. (a)  $2 + \frac{1}{4}(x - 4) - \frac{1}{24}(x - 4)^2$  (b)  $1.5625 \times 10^{-5}$

15. (a)  $1 + \frac{2}{3}(x - 1) - \frac{1}{9}(x - 1)^2 + \frac{4}{81}(x - 1)^3$  (b) 0.000097

17. (a)  $1 + \frac{1}{2}x^2$  (b) 0.0014

19. (a)  $1 + x^2$  (b) 0.00006 21. (a)  $x^2 - \frac{1}{2}x^4$  (b) 0.042

23. 0.17365 25. Four 27.  $-1.037 < x < 1.037$

29.  $-0.86 < x < 0.86$  31. 21 m, no

37. (c) They differ by about  $8 \times 10^{-9}$  km.

53.  $\frac{1}{2} + \sum_{n=1}^{\infty} \frac{1 \cdot 5 \cdot 9 \cdot \dots \cdot (4n - 3)}{n! 2^{6n+1}} x^n, R = 16$

55.  $C + \ln|x| + \sum_{n=1}^{\infty} \frac{x^n}{n \cdot n!}$

57. (a)  $1 + \frac{1}{2}(x - 1) - \frac{1}{8}(x - 1)^2 + \frac{1}{16}(x - 1)^3$

(b) 1.5 (c) 0.000006



59.  $-\frac{1}{8}$

PROBLEMS PLUS ■ PAGE 805

1.  $15!/5! = 10,897,286,400$

3. (b) 0 if  $x = 0$ ,  $(1/x) - \cot x$  if  $x \neq k\pi$ ,  $k$  an integer

5. (a)  $s_n = 3 \cdot 4^n$ ,  $l_n = 1/3^n$ ,  $p_n = 4^n/3^{n-1}$  (c)  $\frac{2}{5}\sqrt{3}$

9.  $(-1, 1), \frac{x^3 + 4x^2 + x}{(1 - x)^4}$

11.  $\ln \frac{1}{2}$  13. (a)  $\frac{250}{101}\pi(e^{-(n-1)/5} - e^{-nn/5})$  (b)  $\frac{250}{101}\pi$

19.  $\frac{\pi}{2\sqrt{3}} - 1$

21.  $-\left(\frac{\pi}{2} - \pi k\right)^2$  where  $k$  is a positive integer