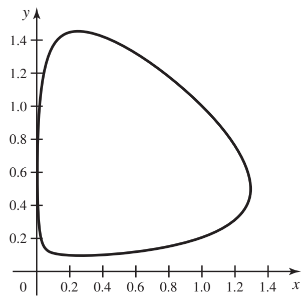
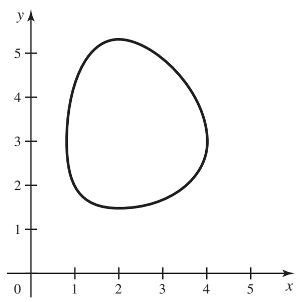
27. a. x is the predator population; y is the prey population.
b. $x' = 0$ on the lines $x = 0$ and $y = \frac{1}{2}$; $y' = 0$ on the lines $y = 0$ and $x = \frac{1}{4}$. **c.** $(0, 0)$, $\left(\frac{1}{4}, \frac{1}{2}\right)$
d. $x' > 0$ and $y' > 0$ for $0 < x < \frac{1}{4}$, $y > \frac{1}{2}$
$x' > 0$ and $y' < 0$ for $x > \frac{1}{4}$, $y > \frac{1}{2}$
$x' < 0$ and $y' < 0$ for $x > \frac{1}{4}$, $0 < y < \frac{1}{2}$
$x' < 0$ and $y' > 0$ for $0 < x < \frac{1}{4}$, $0 < y < \frac{1}{2}$
e. The solution evolves in the clockwise direction.



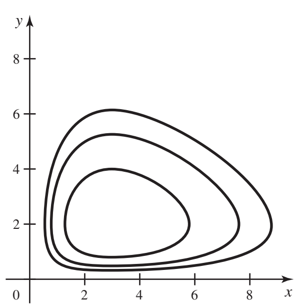
29. a. x is the predator population; y is the prey population.
b. $x' = 0$ on the lines $x = 0$ and $y = 3$; $y' = 0$ on the lines $y = 0$ and $x = 2$. **c.** $(0, 0)$, $(2, 3)$
d. $x' > 0$ and $y' > 0$ for $0 < x < 2$, $y > 3$
$x' > 0$ and $y' < 0$ for $x > 2$, $y > 3$
$x' < 0$ and $y' < 0$ for $x > 2$, $0 < y < 3$
$x' < 0$ and $y' > 0$ for $0 < x < 2$, $0 < y < 3$
e. The solution evolves in the clockwise direction.



31. a. True **b.** True **c.** True **35. c.** $\lim_{t\to\infty} m(t) = C_i V$, which is the amount of substance in the tank when the tank is filled with the inflow solution. **d.** Increasing R increases the rate at which the solution in the tank reaches the steady-state concentration.

37. a. $I = \frac{V}{R} e^{-t/(RC)}$ **b.** $Q = VC(1 - e^{-t/(RC)})$

39. a. $y'(x) = \dfrac{y(c - dx)}{x(-a + by)}$ **c.**

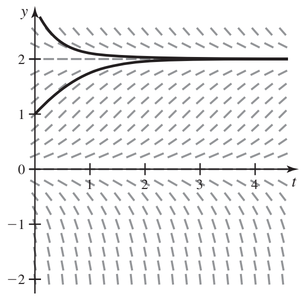


Chapter 9 Review Exercises, pp. 636–638

1. a. False **b.** False **c.** True **d.** True **e.** False
3. $y = Ce^{-2t} + 3$ **5.** $y = Ce^{t^2}$ **7.** $y = Ce^{\tan^{-1} t}$
9. $y = \tan(t^2 + t + C)$ **11.** $y = \sin t + t^2 + 1$
13. $Q = 8(1 - e^{t-1})$ **15.** $u = (3 + t^{2/3})^{3/2}$, $t > 0$

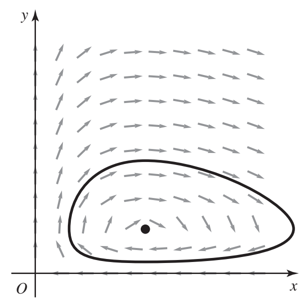
17. $s = \dfrac{t\sqrt{2}}{\sqrt{t^2 + 1}}$

19. a, b.



c. $0 < A < 2$
d. $A > 2$ or $A < 0$
e. $y = 0$ and $y = 2$

21. a. 1.05, 1.09762 **b.** 1.04939, 1.09651 **c.** 0.00217, 0.00106; the error in part (b) is smaller. **23.** $y = -3$ (unstable), $y = 0$ (stable), $y = 5$ (unstable) **25.** $y = -1$ (unstable), $y = 0$ (stable), $y = 2$ (unstable) **27. a.** 0.0713 **b.** $P = \dfrac{1600}{79e^{-0.0713t} + 1}$, $t \ge 0$
c. Approx. 61 hours **29. a.** $m = 2000(1 - e^{-0.005t})$
b. 2000 g **c.** Approx. 599 minutes **31. a.** x represents the predator. **b.** $x'(t) = 0$ when $x = 0$ and $y = 2$. $y'(t) = 0$ when $y = 0$ and $x = 5$. **c.** $(0, 0)$ and $(5, 2)$ **d.** $x' > 0$, $y' > 0$ when $0 < x < 5$ and $y > 2$; $x' > 0$, $y' < 0$ when $x > 5$ and $y > 2$; $x' < 0$, $y' < 0$ when $x > 5$ and $0 < y < 2$; $x' < 0$, $y' > 0$ when $0 < x < 5$ and $0 < y < 2$
e. Clockwise direction



33. a. $p_1 = 3$, $p_2 = -4$ **b.** $y(t) = t^3 - t^{-4}$, $t > 0$

CHAPTER 10

Section 10.1 Exercises, pp. 647–649

1. A sequence is an ordered list of numbers. Example: $1, \frac{1}{3}, \frac{1}{9}, \frac{1}{27}, \ldots$
3. 1, 1, 2, 6, 24 **5.** $a_n = (-1)^{n+1} n$, for $n = 1, 2, 3, \ldots$; $a_n = (-1)^n (n + 1)$, for $n = 0, 1, 2, \ldots$ (Answers may vary.)
7. e **9.** 1, 5, 14, 30 **11.** $\sum_{k=1}^{\infty} 10$ (Answer is not unique.)
13. $\frac{1}{10}, \frac{1}{100}, \frac{1}{1000}, \frac{1}{10{,}000}$ **15.** $-\frac{1}{2}, \frac{1}{4}, -\frac{1}{8}, \frac{1}{16}$ **17.** $\frac{4}{3}, \frac{8}{5}, \frac{16}{9}, \frac{32}{17}$
19. 2, 1, 0, 1 **21.** 2, 4, 8, 16 **23.** 10, 18, 42, 114 **25.** $1, \frac{1}{2}, \frac{2}{3}, \frac{3}{5}$
27. a. $\frac{1}{32}, \frac{1}{64}$ **b.** $a_1 = 1$, $a_{n+1} = \frac{1}{2} a_n$, for $n \ge 1$ **c.** $a_n = \frac{1}{2^{n-1}}$, for $n \ge 1$ **29. a.** 32, 64 **b.** $a_1 = 1$, $a_{n+1} = 2a_n$, for $n \ge 1$
c. $a_n = 2^{n-1}$, for $n \ge 1$ **31. a.** 243, 729 **b.** $a_1 = 1$, $a_{n+1} = 3a_n$, for $n \ge 1$ **c.** $a_n = 3^{n-1}$, for $n \ge 1$ **33. a.** $-5, 5$ **b.** $a_1 = -5$, $a_{n+1} = -a_n$, for $n \ge 1$ **c.** $a_n = (-1)^n \cdot 5$, for $n \ge 1$
35. 9, 99, 999, 9999; diverges **37.** $\frac{1}{10}, \frac{1}{100}, \frac{1}{1000}, \frac{1}{10{,}000}$; converges to 0 **39.** 2, 4, 2, 4; diverges **41.** 2, 2, 2, 2; converges to 2
43. 54.545, 54.959, 54.996, 55.000; converges to 55

45.

n	a_n
1	0.83333333
2	0.96153846
3	0.99206349
4	0.99840256
5	0.99968010
6	0.99993600
7	0.99998720
8	0.99999744
9	0.99999949
10	0.99999990

The limit appears to be 1.

47.

n	a_n
1	2
2	6
3	12
4	20
5	30
6	42
7	56
8	72
9	90
10	110

The sequence appears to diverge.

49. a. $\frac{5}{2}, \frac{9}{4}, \frac{17}{8}, \frac{33}{16}$ **b.** 2

51.

n	a_n
1	3.00000000
2	3.50000000
3	3.75000000
4	3.87500000
5	3.93750000
6	3.96875000
7	3.98437500
8	3.99218750
9	3.99609375
10	3.99804688

The limit appears to be 4.

53.

n	a_n
0	1
1	5
2	21
3	85
4	341
5	1365
6	5461
7	21,845
8	87,381
9	349,525

The sequence appears to diverge.

55.

n	a_n
1	8.00000000
2	4.41421356
3	4.05050150
4	4.00629289
5	4.00078630
6	4.00009828
7	4.00001229
8	4.00000154
9	4.00000019
10	4.00000002

The limit appears to be 4.

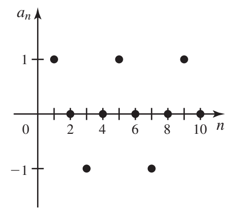
57. a. 20, 10, 5, $\frac{5}{2}$ **b.** $h_n = 20\left(\frac{1}{2}\right)^n$, for $n \geq 0$ **59. a.** 30, $\frac{15}{2}, \frac{15}{8}, \frac{15}{32}$ **b.** $h_n = 30\left(\frac{1}{4}\right)^n$, for $n \geq 0$ **61.** $S_1 = 0.3, S_2 = 0.33, S_3 = 0.333, S_4 = 0.3333; \frac{1}{3}$ **63.** $S_1 = 4, S_2 = 4.9, S_3 = 4.99, S_4 = 4.999$; 5 **65.** $S_1 = 0.6, S_2 = 0.66, S_3 = 0.666, S_4 = 0.6666; \frac{2}{3}$ **67. a.** $\frac{2}{3}, \frac{4}{5}, \frac{6}{7}, \frac{8}{9}$ **b.** $S_n = \frac{2n}{2n+1}$; $\frac{10}{11}, \frac{12}{13}, \frac{14}{15}, \frac{16}{17}$ **c.** 1

69. a. 9, 9.9, 9.99, 9.999 **b.** $S_n = 10 - (0.1)^{n-1}$; 9.9999, 9.99999, 9.999999, 9.9999999 **c.** 10 **71. a.** True **b.** False **c.** True **73. a.** 20, 10, 5, $\frac{5}{2}, \frac{5}{4}$ **b.** $M_n = 20\left(\frac{1}{2}\right)^n$, for $n \geq 0$ **c.** $M_0 = 20$, $M_{n+1} = \frac{1}{2}M_n$, for $n \geq 0$ **d.** $\lim_{n\to\infty} M_n = 0$ **75. a.** 200, 190, 180.5, 171.475, 162.90125 **b.** $d_n = 200(0.95)^n$, for $n \geq 0$ **c.** $d_0 = 200, d_{n+1} = (0.95)d_n$, for $n \geq 0$ **d.** $\lim_{n\to\infty} d_n = 0$ **77. a.** 40, 70, 92.5, 109.375 **b.** 160 **79.** 0.739

Section 10.2 Exercises, pp. 659–662

1. $a_n = \dfrac{1}{n}, n \geq 1$ **3.** $a_n = \dfrac{n}{n+1}, n \geq 1$ **5.** Converges for $-1 < r \leq 1$, diverges otherwise **7.** Diverges monotonically **9.** Converges, oscillates; 0 **11.** $\{e^{n/100}\}$ grows faster then $\{n^{100}\}$. **13.** 0 **15.** $\dfrac{3}{2}$ **17.** $\dfrac{\pi}{4}$ **19.** 2 **21.** 0 **23.** $\dfrac{1}{4}$ **25.** 2 **27.** 0 **29.** 0 **31.** 3 **33.** Diverges **35.** $\dfrac{\pi}{2}$ **37.** 0 **39.** e^2 **41.** e^3 **43.** $e^{1/4}$ **45.** 0 **47.** 1 **49.** 0 **51.** 6

53.



Diverges

55. 0 **57.** Diverges **59.** Diverges **61.** 0 **63.** 0 **65.** 0 **67.** 0 **69.** 0 **71. a.** $d_{n+1} = \frac{1}{2}d_n + 80$, for $n \geq 1$ **b.** 160 mg

73. a. \$0, \$100, \$200.75, \$302.26, \$404.53 **b.** $B_{n+1} = 1.0075B_n + 100$, for $n \geq 0$ **c.** Approx. 43 months **75.** 0 **77.** Diverges **79.** 0 **81.** 1 **83. a.** True **b.** False **c.** True **d.** True **e.** False **f.** True **85. a.** Nondecreasing **b.** $\dfrac{1}{2}$ **87. a.** Nonincreasing **b.** 2 **89. a.** $d_{n+1} = 0.4d_n + 75$; $d_1 = 75$ **c.** 125; in the long run there will be approximately 125 mg of medication in the blood. **91.** 0.607 **93. b.** 9 **95. a.** $\sqrt{2}, \sqrt{2+\sqrt{2}}, \sqrt{2+\sqrt{2+\sqrt{2}}}, \sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2}}}}$, or 1.41421, 1.84776, 1.96157, 1.99037 **c.** 2 **97. a.** 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 **b.** No **99. b.** 1, 2, 1.5, 1.6667, 1.6 **c.** Approx. 1.618 **e.** $\dfrac{a+\sqrt{a^2+4b}}{2}$ **101.** Given a tolerance $\varepsilon > 0$, look beyond a_N, where $N > 1/\varepsilon$. **103.** Given a tolerance $\varepsilon > 0$, look beyond a_N, where $N > \dfrac{1}{4}\sqrt{3/\varepsilon}$, provided $\varepsilon < \dfrac{3}{4}$. **105.** Given a tolerance $\varepsilon > 0$, look beyond a_N, where $N > c/(\varepsilon b^2)$. **107.** $a < 1$ **109.** $\{n^2 + 2n - 17\}_{n=3}^{\infty}$ **111.** $n = 4, n = 6, n = 25$

Section 10.3 Exercises, pp. 668–671

1. The constant r in the series $\sum_{k=0}^{\infty} ar^k$ **3.** No **5. a.** $a = \dfrac{2}{3}; r = \dfrac{1}{5}$ **b.** $a = \dfrac{1}{27}; r = -\dfrac{1}{3}$ **7.** $S_n = \dfrac{1}{4} - \dfrac{1}{n+4}; S_{36} = \dfrac{9}{40}$ **9.** 9841 **11.** Approx. 1.1905 **13.** Approx. 0.5392 **15.** $\dfrac{1093}{2916}$ **17.** \$15,920.22 **19. a.** $\dfrac{7}{9}$ **21.** $\dfrac{4}{3}$ **23.** $\dfrac{10}{19}$ **25.** 10 **27.** Diverges **29.** $\dfrac{1}{e^2-1}$ **31.** $\dfrac{1}{7}$ **33.** $\dfrac{1}{500}$ **35.** $\dfrac{3\pi}{\pi+1}$ **37.** $\dfrac{\pi}{\pi-e}$ **39.** $\dfrac{9}{460}$ **41.** $\dfrac{4}{11}$ **43.** $A_5 = 266.406; A_{10} = 266.666; A_{30} = 266.667$; $\lim_{n\to\infty} A_n = 266\dfrac{2}{3}$ mg, which is the steady-state level. **45.** 400 mg **47.** $0.\overline{3} = \sum_{k=1}^{\infty} 3(0.1)^k = \dfrac{1}{3}$ **49.** $0.\overline{037} = \sum_{k=1}^{\infty} 37(0.001)^k = \dfrac{1}{27}$ **51.** $0.\overline{456} = \sum_{k=0}^{\infty} 0.456(0.001)^k = \dfrac{152}{333}$ **53.** $0.00\overline{952} = \sum_{k=0}^{\infty} 0.00952(0.001)^k = \dfrac{238}{24{,}975}$ **55.** $S_n = \dfrac{n}{2n+4}; \dfrac{1}{2}$ **57.** $S_n = \dfrac{1}{7} - \dfrac{1}{n+7}; \dfrac{1}{7}$ **59.** $S_n = \dfrac{1}{9} - \dfrac{1}{4n+9}; \dfrac{1}{9}$ **61.** $S_n = \ln(n+1)$; diverges

63. $S_n = \frac{1}{p+1} - \frac{1}{n+p+1}; \frac{1}{p+1}$

65. $S_n = \left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}}\right) - \left(\frac{1}{\sqrt{n+2}} + \frac{1}{\sqrt{n+3}}\right); \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}}$

67. $S_n = \frac{13}{12} - \frac{1}{n+2} - \frac{3}{n+3} - \frac{1}{n+4}; \frac{13}{12}$

69. $S_n = \tan^{-1}(n+1) - \tan^{-1}1; \frac{\pi}{4}$ **71. a, b.** $\frac{4}{3}$ **73.** $-\frac{1}{4}$

75. $\frac{2500}{19}$ **77.** $-\frac{2}{15}$ **79.** $\frac{1}{\ln 2}$ **81.** -2 **83.** $\frac{113}{30}$ **85.** $\frac{17}{10}$

87. a. True **b.** True **c.** False **d.** False **e.** True **f.** False **g.** True **89. a.** $\frac{1}{5}$ **b.** Approx. 0.19999695 **91.** Approx. 0.96

95. 462 months **99.** $\sum_{k=0}^{\infty}\left(\frac{1}{4}\right)^k A_1 = \frac{A_1}{1-1/4} = \frac{4}{3}A_1$

101. a. $L_n = 3\left(\frac{4}{3}\right)^n$, so $\lim_{n\to\infty} L_n = \infty$ **b.** $\lim_{n\to\infty} A_n = \frac{2\sqrt{3}}{5}$

103. $R_n = S - S_n = \frac{1}{1-r} - \left(\frac{1-r^n}{1-r}\right) = \frac{r^n}{1-r}$ **105. a.** 60 **b.** 9 **107. a.** 13 **b.** 15 **109. a.** $1, \frac{5}{6}, \frac{2}{3}$, undefined, undefined **b.** $(-1, 1)$ **111.** Converges for x in $(-\infty, -2)$ or $(0, \infty)$; $x = \frac{1}{2}$

Section 10.4 Exercises, pp. 680–683

1. The series diverges. **3.** $\lim_{k\to\infty} a_k = 0$ **5.** Converges for $p > 1$ and diverges for $p \le 1$ **7.** $R_n = S - S_n$ **9.** Diverges **11.** Inconclusive **13.** Diverges **15.** Diverges **17.** Diverges **19.** Diverges **21.** Converges **23.** Diverges **25.** Converges **27.** Diverges **29.** Converges **31.** Converges **33.** Converges **35.** Diverges **37.** Diverges **39. a.** $S \approx S_2 = 1.0078125$ **b.** $R_2 < 0.0026042$ **c.** $L_2 = 1.0080411$; $U_2 = 1.0104167$

41. a. $\frac{1}{5n^5}$ **b.** 3 **c.** $L_n = S_n + \frac{1}{5(n+1)^5}$; $U_n = S_n + \frac{1}{5n^5}$ **d.** $(1.017342754, 1.017343512)$ **43. a.** $\frac{3^{-n}}{\ln 3}$ **b.** 7 **c.** $L_n = S_n + \frac{3^{-n-1}}{\ln 3}$; $U_n = S_n + \frac{3^{-n}}{\ln 3}$ **d.** $(0.499996671, 0.500006947)$ **45.** 1.0083 **47. a.** False **b.** True **c.** False **d.** True **e.** False **f.** False **49.** Converges **51.** Converges **53.** Diverges **55.** Diverges **57.** Diverges **59.** Converges **61.** Converges **63.** Converges **65. a.** $p > 1$ **b.** $\sum_{k=2}^{\infty} \frac{1}{k(\ln k)^2}$ converges faster. **67.** $\zeta(3) \approx 1.202$, $\zeta(5) \approx 1.037$ **69.** $\frac{\pi^2}{8}$ **73. a.** $\frac{1}{2}, \frac{7}{12}, \frac{37}{60}$

Section 10.5 Exercises, pp. 687–688

1. Find an appropriate comparison series. Then take the limit of the ratio of the terms of the given series and the comparison series as $n \to \infty$. The value of the limit determines whether the series converges.

3. $\sum_{k=1}^{\infty}\frac{1}{k^2}$ **5.** $\sum_{k=1}^{\infty}\left(\frac{2}{3}\right)^k$ **7.** $\sum_{k=1}^{\infty}\frac{1}{k}$ **9.** Converges **11.** Diverges **13.** Converges **15.** Converges **17.** Converges **19.** Diverges **21.** Diverges **23.** Converges **25.** Diverges **27.** Converges **29.** Diverges **31.** Diverges **33.** Diverges **35.** Converges **37. a.** False **b.** True **c.** True **d.** True **39.** Converges **41.** Diverges **43.** Diverges **45.** Diverges **47.** Converges **49.** Diverges **51.** Converges **53.** Converges **55.** Diverges **57.** Converges **59.** Diverges **61.** Converges

Section 10.6 Exercises, pp. 694–696

1. Because $S_{n+1} - S_n = (-1)^n a_{n+1}$ alternates sign **3.** Because the remainder $R_n = S - S_n$ alternates sign **5.** $|R_n| = |S - S_n| \le |S_{n+1} - S_n| = a_{n+1}$ **7.** No; if a series of positive terms converges, it does so absolutely and not conditionally. **9.** Yes, $\sum_{k=1}^{\infty}\frac{(-1)^k}{k^2}$ has this property. **11.** Converges **13.** Diverges **15.** Converges **17.** Converges **19.** Diverges **21.** Diverges **23.** Diverges **25.** Diverges **27.** Converges **29.** $S_4 = -0.945939$; $|S - S_4| \le 0.0016$ **31.** $S_5 = 0.70696$; $|S - S_5| \le 0.001536$ **33.** 10,000 **35.** 5000 **37.** 10 **39.** -0.973 **41.** -0.269 **43.** -0.783 **45.** Converges conditionally **47.** Converges absolutely **49.** Converges absolutely **51.** Converges absolutely **53.** Diverges **55.** Converges conditionally **57.** Diverges **59.** Converges absolutely **61.** Converges conditionally **63.** Converges absolutely **65. a.** False **b.** True **c.** True **d.** True **e.** False **f.** True **g.** True **69.** x and y are divergent series.

71. b. $S_{2n} = \sum_{k=1}^{n}\left(\frac{1}{k^2} - \frac{1}{k}\right)$

Section 10.7 Exercises, pp. 699–700

1. Take the limit of the magnitude of the ratio of consecutive terms of the series as $k \to \infty$. The value of the limit determines whether the series converges absolutely or diverges. **3.** 999,000

5. $\frac{1}{(k+2)(k+1)}$ **7.** Ratio Test **9.** Converges absolutely **11.** Diverges **13.** Converges absolutely **15.** Converges absolutely **17.** Diverges **19.** Diverges **21.** Converges absolutely **23.** Converges absolutely **25.** Diverges **27.** Converges absolutely **29.** Diverges **31. a.** False **b.** True **c.** True **d.** True **33.** Converges absolutely **35.** Diverges **37.** Converges absolutely **39.** Converges conditionally **41.** Converges absolutely **43.** Converges absolutely **45.** Converges conditionally **47.** Converges absolutely **49.** Converges conditionally **51.** $p > 1$ **53.** $p > 1$ **55.** $p < 1$ **57.** Diverges for all p **59.** $-1 < x < 1$ **61.** $-1 \le x \le 1$ **63.** $-2 < x < 2$

Section 10.8 Exercises, pp. 703–704

1. Root Test **3.** Divergence Test **5.** p-series Test or Limit Comparison Test **7.** Comparison Test or Limit Comparison Test **9.** Alternating Series Test **11.** Diverges **13.** Diverges **15.** Converges **17.** Diverges **19.** Converges **21.** Converges **23.** Converges **25.** Converges **27.** Converges **29.** Diverges **31.** Converges **33.** Diverges **35.** Converges **37.** Diverges **39.** Diverges **41.** Converges **43.** Diverges **45.** Converges **47.** Diverges **49.** Converges **51.** Diverges **53.** Converges **55.** Diverges **57.** Converges **59.** Converges **61.** Diverges **63.** Diverges **65.** Converges **67.** Converges **69.** Diverges **71.** Converges **73.** Converges **75.** Converges **77.** Diverges **79.** Diverges **81.** Converges **83.** Converges **85.** Converges **87. a.** False **b.** True **c.** True **d.** False **89.** Diverges **91.** Diverges **93.** Diverges

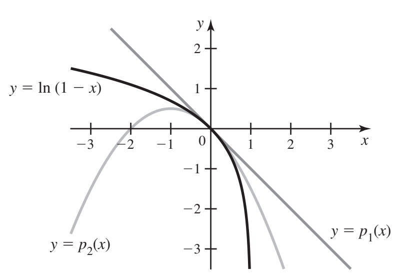
Chapter 10 Review Exercises, pp. 704–707

1. a. False **b.** False **c.** True **d.** False **e.** True **f.** False **g.** False **h.** True **3.** Approx. 1.25; approx. 0.05 **5.** $\lim_{k\to\infty} a_k = 0$, $\lim_{n\to\infty} S_n = 8$ **7.** $a_k = \dfrac{1}{k}$ **9. a.** 0 **b.** $\dfrac{5}{9}$ **11. a.** Yes; $\lim_{k\to\infty} a_k = 1$ **b.** No; $\lim_{k\to\infty} a_k \neq 0$ **13.** Diverges **15.** 5 **17.** 0 **19.** 0 **21.** $1/e$ **23.** Diverges **25. a.** 80, 48, 32, 24, 20 **b.** 16 **27.** Diverges **29.** Diverges **31.** Diverges **33.** $\dfrac{3\pi}{4}$ **35.** 3 **37.** $2/9$ **39.** $\dfrac{311}{990}$ **41.** 200 mg **43.** Diverges **45.** Diverges **47.** Converges **49.** Converges **51.** Converges **53.** Converges **55.** Converges **57.** Diverges **59.** Converges **61.** Converges **63.** Converges **65.** Converges **67.** Converges **69.** Converges **71.** Converges **73.** Diverges **75.** Diverges **77.** Converges conditionally **79.** Converges absolutely **81.** Diverges **83.** Converges absolutely **85.** Converges absolutely **87.** Diverges **89. a.** Approx. 1.03666 **b.** 0.0004 **c.** $L_5 = 1.03685$; $U_5 = 1.03706$ **91.** 0.0067 **93.** 100 **95. a.** 803 m, 1283 m, $2000(1 - 0.95^N)$ m **b.** 2000 m **97. a.** $\dfrac{\pi}{2^{n-1}}$ **b.** 2π **99. a.** $T_1 = \dfrac{\sqrt{3}}{16}$, $T_2 = \dfrac{7\sqrt{3}}{64}$ **b.** $T_n = \dfrac{\sqrt{3}}{4}\left(1 - \left(\dfrac{3}{4}\right)^n\right)$ **c.** $\lim_{n\to\infty} T_n = \dfrac{\sqrt{3}}{4}$ **d.** 0 **101.** $\sqrt{\dfrac{20}{g}}\left(\dfrac{1 + \sqrt{p}}{1 - \sqrt{p}}\right)$ s

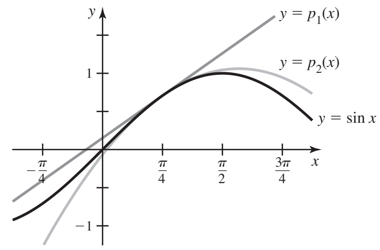
CHAPTER 11

Section 11.1 Exercises, pp. 718–721

1. $f(0) = p_2(0)$, $f'(0) = p_2'(0)$, and $f''(0) = p_2''(0)$
3. 1, 1.05, 1.04875 **5.** $p_3(x) = 1 + x^2 + x^3$; 1.048
7. $p_3(x) = 1 + (x - 2) + 2(x - 2)^3$; 0.898
9. a. $p_1(x) = 8 + 12(x - 1)$
b. $p_2(x) = 8 + 12(x - 1) + 3(x - 1)^2$ **c.** 9.2; 9.23
11. a. $p_1(x) = 1 - 2x$ **b.** $p_2(x) = 1 - 2x + 2x^2$ **c.** 0.8, 0.82
13. a. $p_1(x) = 1 - x$ **b.** $p_2(x) = 1 - x + x^2$ **c.** 0.95, 0.9525
15. a. $p_1(x) = 2 + \frac{1}{12}(x - 8)$
b. $p_2(x) = 2 + \frac{1}{12}(x - 8) - \frac{1}{288}(x - 8)^2$ **c.** $1.958\overline{3}$, 1.95747
17. $p_1(x) = 1$, $p_2(x) = p_3(x) = 1 - 18x^2$, $p_4(x) = 1 - 18x^2 + 54x^4$
19. $p_3(x) = 1 - 3x + 6x^2 - 10x^3$, $p_4(x) = 1 - 3x + 6x^2 - 10x^3 + 15x^4$
21. $p_1(x) = 1 + 3(x - 1)$, $p_2(x) = 1 + 3(x - 1) + 3(x - 1)^2$, $p_3(x) = 1 + 3(x - 1) + 3(x - 1)^2 + (x - 1)^3$
23. $p_3(x) = 1 + \dfrac{1}{e}(x - e) - \dfrac{1}{2e^2}(x - e)^2 + \dfrac{1}{3e^3}(x - e)^3$
25. a. $p_1(x) = -x$, $p_2(x) = -x - \dfrac{x^2}{2}$
b.



27. a. $p_1(x) = \dfrac{\sqrt{2}}{2} + \dfrac{\sqrt{2}}{2}\left(x - \dfrac{\pi}{4}\right)$,
$p_2(x) = \dfrac{\sqrt{2}}{2} + \dfrac{\sqrt{2}}{2}\left(x - \dfrac{\pi}{4}\right) - \dfrac{\sqrt{2}}{4}\left(x - \dfrac{\pi}{4}\right)^2$
b.



29. a. 1.0247 **b.** 7.6×10^{-6} **31. a.** 0.8613 **b.** 5.4×10^{-4} **33. a.** 1.1274988 **b.** Approx. 8.85×10^{-6} (Answers may vary if intermediate calculations are rounded.) **35. a.** Approx. -0.10033333 **b.** Approx. 1.34×10^{-6} (Answers may vary if intermediate calculations are rounded.) **37. a.** 1.0295635 **b.** Approx. 4.86×10^{-7} (Answers may vary if intermediate calculations are rounded.) **39. a.** Approx. 0.52083333 **b.** Approx. 2.62×10^{-4} (Answers may vary if intermediate calculations are rounded.)
41. $R_n(x) = \dfrac{\sin^{(n+1)}(c)}{(n + 1)!}x^{n+1}$, for c between x and 0
43. $R_n(x) = \dfrac{(-1)^{n+1}e^{-c}}{(n + 1)!}x^{n+1}$, for c between x and 0
45. $R_n(x) = \dfrac{\sin^{(n+1)}(c)}{(n + 1)!}\left(x - \dfrac{\pi}{2}\right)^{n+1}$, for c between x and $\dfrac{\pi}{2}$
47. 2.0×10^{-5} **49.** 1.6×10^{-5} $(e^{0.25} < 2)$ **51.** 2.6×10^{-4}
53. With $n = 4$, $|\text{error}| \leq 2.5 \times 10^{-3}$
55. With $n = 2$, $|\text{error}| \leq 4.2 \times 10^{-2}$ $(e^{0.5} < 2)$
57. With $n = 2$, $|\text{error}| \leq 5.4 \times 10^{-3}$ **59.** 4 **61.** 3 **63.** 1
65. a. False **b.** True **c.** True **d.** True **67. a.** C **b.** E **c.** A **d.** D **e.** B **f.** F **69. a.** 0.1; 1.7×10^{-4} **b.** 0.2; 1.3×10^{-3} **71. a.** 0.995; 4.2×10^{-6} **b.** 0.98; 6.7×10^{-5} **73. a.** 1.05; 1.3×10^{-3} **b.** 1.1; 5×10^{-3} **75. a.** 1.1; 10^{-2} **b.** 1.2; 4×10^{-2}
77. a.

x	$\lvert \sec x - p_2(x) \rvert$	$\lvert \sec x - p_4(x) \rvert$
-0.2	3.39×10^{-4}	5.51×10^{-6}
-0.1	2.09×10^{-5}	8.51×10^{-8}
0.0	0	0
0.1	2.09×10^{-5}	8.51×10^{-8}
0.2	3.39×10^{-4}	5.51×10^{-6}

b. The errors decrease as $|x|$ decreases.

79. a.

x	$\lvert e^{-x} - p_1(x) \rvert$	$\lvert e^{-x} - p_2(x) \rvert$
-0.2	2.14×10^{-2}	1.40×10^{-3}
-0.1	5.17×10^{-3}	1.71×10^{-4}
0.0	0	0
0.1	4.84×10^{-3}	1.63×10^{-4}
0.2	1.87×10^{-2}	1.27×10^{-3}

b. The errors decrease as $|x|$ decreases.

81. Centered at $x = 0$, for all n