CHAPTER 11

Section 11.1

Check Point Exercises

1. a. 7, 9, 11, 13 **b.** $-\frac{1}{3}, \frac{1}{5}, -\frac{1}{9}, \frac{1}{17}$ **2.** 3, 11, 27, 59 **3.** $10, \frac{10}{3}, \frac{5}{6}, \frac{1}{6}$ **4. a.** 91 **b.** n **5. a.** 182 **b.** 47 **c.** 20

6. a. $\sum_{i=1}^{9} i^2$ **b.** $\sum_{i=1}^{n} \frac{1}{2^{i-1}}$

Exercise Set 11.1

1. 5, 8, 11, 14 **2.** 3, 7, 11, 15 **3.** 3, 9, 27, 81 **4.** $\frac{1}{3}, \frac{1}{9}, \frac{1}{27}, \frac{1}{81}$ **5.** $-3, 9, -27, 81$ **6.** $-\frac{1}{3}, \frac{1}{9}, -\frac{1}{27}, \frac{1}{81}$ **7.** $-4, 5, -6, 7$ **8.** $5, -6, 7, -8$

9. $\frac{2}{5}, \frac{2}{3}, \frac{6}{7}, 1$ **10.** $\frac{1}{2}, \frac{6}{7}, \frac{9}{8}, \frac{4}{3}$ **11.** $1, -\frac{1}{3}, \frac{1}{7}, -\frac{1}{15}$ **12.** $\frac{1}{3}, -\frac{1}{5}, \frac{1}{9}, -\frac{1}{17}$ **13.** 7, 12, 17, 22 **14.** 12, 16, 20, 24 **15.** 3, 12, 48, 192

16. 2, 10, 50, 250 **17.** 4, 11, 25, 53 **18.** 5, 14, 41, 122 **19.** $1, 2, \frac{3}{2}, \frac{2}{3}$ **20.** $2, \frac{3}{2}, \frac{8}{3}, \frac{15}{2}$ **21.** 4, 12, 48, 240 **22.** $-2, -2, -4, -12$

23. 272 **24.** 306 **25.** 120 **26.** 190 **27.** $(n + 2)(n + 1)$ **28.** $2n + 1$ **29.** 105 **30.** 147 **31.** 60 **32.** 225 **33.** 115

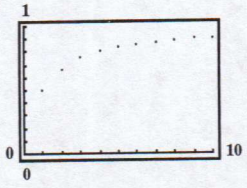
34. -4 **35.** $-\frac{5}{16}$ **36.** $\frac{7}{81}$ **37.** 55 **38.** 60 **39.** $\frac{3}{8}$ **40.** $-\frac{19}{30}$ **41.** 15 **42.** 110 **43.** $\sum_{i=1}^{15} i^2$ **44.** $\sum_{i=1}^{12} i^4$ **45.** $\sum_{i=1}^{11} 2^i$

46. $\sum_{i=1}^{12} 5^i$ **47.** $\sum_{i=1}^{30} i$ **48.** $\sum_{i=1}^{40} i$ **49.** $\sum_{i=1}^{14} \frac{i}{i+1}$ **50.** $\sum_{i=1}^{16} \frac{i}{i+2}$ **51.** $\sum_{i=1}^{n} \frac{4^i}{i}$ **52.** $\sum_{i=1}^{n} \frac{i}{9^i}$ **53.** $\sum_{i=1}^{n} (2i - 1)$ **54.** $\sum_{i=1}^{n} (ar^{i-1})$

55. $\sum_{k=1}^{14} (2k + 3)$ **56.** $\sum_{k=3}^{16} 2k$ **57.** $\sum_{k=0}^{12} ar^k$ **58.** $\sum_{k=0}^{14} ar^k$ **59.** $\sum_{k=0}^{n} (a + kd)$ **60.** $\sum_{k=1}^{n} (a + d^k)$ **61.** 45 **62.** 35 **63.** 0

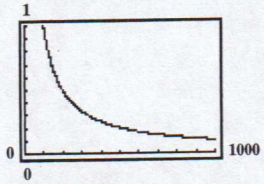
64. 0 **65.** 2 **66.** -2 **67.** 80 **68.** 20 **69. a.** 9.9; Online ad spending averaged \$9.9 billion per year from 2000 through 2006.
b. 12; overestimates by \$2.1 billion **70. a.** 4.28; Spending for consumer drug ads averaged \$4.28 billion per year from 2002 through 2006.
b. 4.25; This is a reasonable model. **71.** \$8081.13 **72.** \$16,084.37 **81.** 39,800 **82.** 1,307,674,368,000 **83.** 8.109673361 E15
84. 6840 **85.** 24,804 **88.** $a_{10} = 2.5937$; $a_{100} = 2.7048$; $a_{1000} = 2.7169$; $a_{10,000} = 2.7181$; $a_{100,000} = 2.7183$; As n gets larger, a_n gets closer to $e \approx 2.7183$.

89.



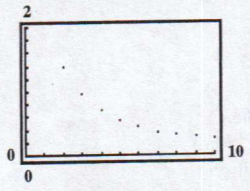
As n gets larger, a_n approaches 1.

90.



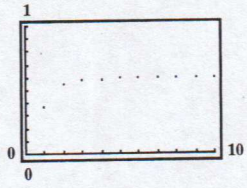
As n gets larger, a_n approaches 0.

91.



As n gets larger, a_n approaches 0.

92.



As n gets larger, a_n approaches $\frac{3}{5}$.

93. does not make sense **94.** does not make sense **95.** makes sense **96.** does not make sense **97.** false **98.** true
99. false **100.** false **101.** 9, 32, 16, 8, 4 **103.** -5; -5; -5; -5; The difference between consecutive terms is always -5.
104. 4; 4; 4; 4; The difference between consecutive terms is always 4. **105.** -45

Section 11.2

Check Point Exercises

1. 100, 70, 40, 10, -20, -50 **2.** -34 **3. a.** $a_n = 0.7n + 31.3$ **b.** 39 **4.** 360 **5.** 2460 **6.** \$740,300

Exercise Set 11.2

1. 200, 220, 240, 260, 280, 300 **2.** 300, 350, 400, 450, 500, 550 **3.** $-7, -3, 1, 5, 9, 13$ **4.** $-8, -3, 2, 7, 12, 17$

5. 300, 210, 120, 30, -60, -150 **6.** 200, 140, 80, 20, -40, -100 **7.** $\frac{5}{2}, 2, \frac{3}{2}, 1, \frac{1}{2}, 0$ **8.** $\frac{3}{4}, \frac{1}{2}, \frac{1}{4}, 0, -\frac{1}{4}, -\frac{1}{2}$ **9.** $-9, -3, 3, 9, 15, 21$

10. $-7, -3, 1, 5, 9, 13$ **11.** 30, 20, 10, 0, -10, -20 **12.** 50, 30, 10, -10, -30, -50 **13.** 1.6, 1.2, 0.8, 0.4, 0, -0.4
14. $-1.7, -2, -2.3, -2.6, -2.9, -3.2$ **15.** 33 **16.** 39 **17.** 252 **18.** 362 **19.** 955 **20.** 685 **21.** -142 **22.** 244
23. $a_n = 4n - 3$; $a_{20} = 77$ **24.** $a_n = 5n - 3$; $a_{20} = 97$ **25.** $a_n = 11 - 4n$; $a_{20} = -69$ **26.** $a_n = 11 - 5n$; $a_{20} = -89$
27. $a_n = 7 + 2n$; $a_{20} = 47$ **28.** $a_n = 3n + 3$; $a_{20} = 63$ **29.** $a_n = -16 - 4n$; $a_{20} = -96$ **30.** $a_n = -65 - 5n$; $a_{20} = -165$
31. $a_n = 1 + 3n$; $a_{20} = 61$ **32.** $a_n = 5n + 1$; $a_{20} = 101$ **33.** $a_n = 40 - 10n$; $a_{20} = -160$ **34.** $a_n = 36 - 12n$; $a_{20} = -204$
35. 1220 **36.** 3775 **37.** 4400 **38.** 6600 **39.** 5050 **40.** 10,100 **41.** 3660 **42.** 6480 **43.** 396 **44.** 504
45. $8 + 13 + 18 + \cdots + 88$; 816 **46.** $2 + 8 + 14 + \cdots + 116$; 1180 **47.** $2 - 1 - 4 - \cdots - 85$; -1245
48. $4 + 2 + 0 - \cdots - 74$; -1400 **49.** $4 + 8 + 12 + \cdots + 400$; 20,200 **50.** $-4 - 8 - 12 - \cdots - 200$; -5100 **51.** 7 **52.** 29

53. 22 **54.** 19 **55.** 847 **56.** 975 **57.** $f(x) = -4x + 5$ **58.** $g(x) = 5x - 2$ **59.** $a_n = 3n - 2$ **60.** $a_n = 2n + 1$
61. a. $a_n = 0.77n + 9.23$ **b.** 30.0% **62. a.** $a_n = 0.83n + 16.77$ **b.** 59.1% **63.** Company A will pay $1400 more in year 10.
64. Company A will pay $600 more in year 10. **65. a.** $21,153 **b.** $21,158; overestimates by $5 **66. a.** $83,245
b. $83,248; overestimates by $3 **68.** $442,500 **69.** Company A: $307,000; Company B: $324,000; Company B pays the greater total amount.
70. 1430 seats **71.** 2869 seats **78.** does not make sense **79.** makes sense **80.** makes sense **81.** makes sense **82.** the 200th term
83. 320 degree-days **84.** $S_n = \frac{n}{2}(1 + 2n - 1) = \frac{n}{2}(2n) = n^2$ **85.** $-2; -2; -2; -2$; The ratio of a term to the term that directly precedes it is always -2. **86.** 5; 5; 5; 5; The ratio of a term to the term that directly precedes it is always 5. **87.** 8019

Section 11.3

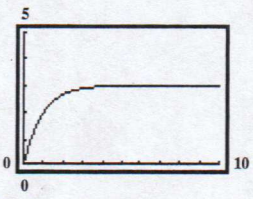
Check Point Exercises

1. $12, 6, 3, \frac{3}{2}, \frac{3}{4}, \frac{3}{8}$ **2.** 3645 **3.** $a_n = 3(2)^{n-1}; a_8 = 384$ **4.** 9842 **5.** 19,680 **6.** $2,371,746 **7. a.** $333,946 **b.** $291,946
8. 9 **9.** 1 **10.** $4000

Exercise Set 11.3

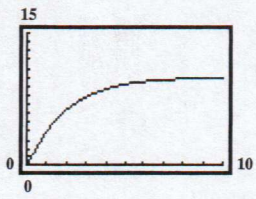
1. $5, 15, 45, 135, 405$ **2.** $4, 12, 36, 108, 324$ **3.** $20, 10, 5, \frac{5}{2}, \frac{5}{4}$ **4.** $24, 8, \frac{8}{3}, \frac{8}{9}, \frac{8}{27}$ **5.** $10, -40, 160, -640, 2560$ **6.** $10, -30, 90, -270, 810$
7. $-6, 30, -150, 750, -3750$ **8.** $-2, 12, -72, 432, -2592$ **9.** $a_8 = 768$ **10.** $a_8 = 10{,}935$ **11.** $a_{12} = -10{,}240$ **12.** $a_{12} = -8192$
13. $a_{40} \approx -0.000000002$ **14.** $a_{30} \approx -0.000014901$ **15.** $a_8 = 0.1$ **16.** $a_8 = 0.004$ **17.** $a_n = 3(4)^{n-1}; a_7 = 12{,}288$
18. $a_n = 3(5)^{n-1}; a_7 = 46{,}875$ **19.** $a_n = 18\left(\frac{1}{3}\right)^{n-1}; a_7 = \frac{2}{81}$ **20.** $a_n = 12\left(\frac{1}{2}\right)^{n-1}; a_7 = \frac{3}{16}$ **21.** $a_n = 1.5(-2)^{n-1}; a_7 = 96$
22. $a_n = 5\left(-\frac{1}{5}\right)^{n-1}; a_7 = \frac{1}{3125}$ **23.** $a_n = 0.0004(-10)^{n-1}; a_7 = 400$ **24.** $a_n = 0.0007(-10)^{n-1}; a_7 = 700$ **25.** 531,440 **26.** 12,285
27. 2049 **28.** 177,148 **29.** $\frac{16{,}383}{2}$ **30.** $\frac{5461}{24}$ **31.** 9840 **32.** 5460 **33.** 10,230 **34.** -6564 **35.** $\frac{63}{128}$ **36.** $\frac{364}{2187}$
37. $\frac{3}{2}$ **38.** $\frac{4}{3}$ **39.** 4 **40.** 6 **41.** $\frac{2}{3}$ **42.** $\frac{9}{4}$ **43.** $\frac{80}{13} \approx 6.15385$ **44.** $\frac{120}{17} \approx 7.05882$ **45.** $\frac{5}{9}$ **46.** $\frac{1}{9}$ **47.** $\frac{47}{99}$ **48.** $\frac{83}{99}$
49. $\frac{257}{999}$ **50.** $\frac{529}{999}$ **51.** arithmetic, $d = 1$ **52.** arithmetic, $d = 1$ **53.** geometric, $r = 2$ **54.** geometric, $r = \frac{1}{2}$ **55.** neither
56. neither **57.** 2435 **58.** -5260 **59.** 2280 **60.** -2700 **61.** -140 **62.** 1140 **63.** $a_2 = 12, a_3 = 18$
64. $a_2 = -6, a_3 = 18$ **65.** $16,384 **66.** $536,870,912 **67.** $3,795,957 **68.** $38,2811.45 **69. a.** approximately 1.01 for each division
b. $a_n = 35.48(1.01)^{n-1}$ **c.** approximately 38.04 million **70. a.** approximately 1.02 for each division **b.** $a_n = 22.12(1.02)^{n-1}$
c. approximately 25.41 million **71.** $32,767 **72.** $1,073,741,823 **73.** $793,583 **74.** Company B; $780 **75.** 130.26 in. **76.** 134.07 in.
77. a. $11,617 **b.** $1617 **78. a.** $14,163 **b.** $1663 **79. a.** $87,052 **b.** $63,052 **80. a.** $171,271 **b.** $135,271
81. a. $693,031 **b.** $293,031 **82. a.** $956,793 **b.** $356,793 **83.** $30,000 **84.** $98,888 **85.** $9 million **86.** $15 billion **87.** $\frac{1}{3}$

99.



horizontal asymptote: $y = 3$; sum of series: 3

100.



horizontal asymptote: $y = 10$; sum of series: 10

101. makes sense **102.** makes sense **103.** makes sense **104.** does not make sense **105.** false **106.** false **107.** false **108.** true
109. Release 2000 flies each day. **110.** $442 **112.** $6 = 6$ **113.** $15 = 15$ **114.** $\frac{(k+1)(k+2)(2k+3)}{6}$

Mid-Chapter 11 Check Point

1. $1, -2, \frac{3}{2}, -\frac{2}{3}, \frac{5}{24}$ **2.** $5, 2, -1, -4, -7$ **3.** $5, -15, 45, -135, 405$ **4.** $3, 1, 3, 1, 3$ **5.** $a_n = 4n - 2; a_{20} = 78$
6. $a_n = 3(2)^{n-1}; a_{10} = 1536$ **7.** $a_n = -\frac{1}{2}n + 2; a_{30} = -13$ **8.** 5115 **9.** 2350 **10.** 6820 **11.** $-29{,}300$ **12.** 44 **13.** 3725
14. $\frac{1995}{64}$ **15.** $\frac{5}{7}$ **16.** $\frac{5}{11}$ **17.** Answers will vary. An example is $\sum_{i=1}^{18} \frac{i}{i+2}$. **18.** 464 ft; 3600 ft **19.** $311,249

Section 11.4

Check Point Exercises

1. a. $S_1: 2 = 1(1 + 1); S_k: 2 + 4 + 6 + \cdots + 2k = k(k + 1); S_{k+1}: 2 + 4 + 6 + \cdots + 2(k + 1) = (k + 1)(k + 2)$
b. $S_1: 1^3 = \frac{1^2(1+1)^2}{4}; S_k: 1^3 + 2^3 + 3^3 + \cdots + k^3 = \frac{k^2(k+1)^2}{4}; S_{k+1}: 1^3 + 2^3 + 3^3 + \cdots + (k + 1)^3 = \frac{(k+1)^2(k+2)^2}{4}$

2. $S_1: 2 = 1(1 + 1); S_k: 2 + 4 + 6 + \cdots + 2k = k(k + 1); S_{k+1}: 2 + 4 + 6 + \cdots + 2k + 2(k + 1) = (k + 1)(k + 2)$; S_{k+1} can be obtained by adding $2k + 2$ to both sides of S_k.