9.5 Q's

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9.5 Exercises

See CalcChat.com for tutorial help and worked-out solutions to odd-numbered exercises.

Numerical and Graphical Analysis In Exercises 1–4, explore the Alternating Series Remainder.

(a) Use a graphing utility to find the indicated partial sum S_n and complete the table.

n	1	2	3	4	5	6	7	8	9	10
S_n										

(b) Use a graphing utility to graph the first 10 terms of the sequence of partial sums and a horizontal line representing the sum.

(c) What pattern exists between the plot of the successive points in part (b) relative to the horizontal line representing the sum of the series? Do the distances between the successive points and the horizontal line increase or decrease?

(d) Discuss the relationship between the answers in part (c) and the Alternating Series Remainder as given in Theorem 9.15.

1. $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{2n-1} = \frac{\pi}{4}$
2. $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{(n-1)!} = \frac{1}{e}$
3. $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n^2} = \frac{\pi^2}{12}$
4. $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{(2n-1)!} = \sin 1$

Determining Convergence or Divergence In Exercises 5–26, determine the convergence or divergence of the series.

5. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n+1}$
6. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} n}{3n+2}$
7. $\sum_{n=1}^{\infty} \frac{(-1)^n}{3^n}$
8. $\sum_{n=1}^{\infty} \frac{(-1)^n}{e^n}$
9. $\sum_{n=1}^{\infty} \frac{(-1)^n(5n-1)}{4n+1}$
10. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} n}{n^2+5}$
11. $\sum_{n=1}^{\infty} \frac{(-1)^n n}{\ln(n+1)}$
12. $\sum_{n=1}^{\infty} \frac{(-1)^n}{\ln(n+1)}$
13. $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}}$
14. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} n^2}{n^2+4}$
15. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}(n+1)}{\ln(n+1)}$
16. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} \ln(n+1)}{n+1}$
17. $\sum_{n=1}^{\infty} \sin \frac{(2n-1)\pi}{2}$
18. $\sum_{n=1}^{\infty} \frac{1}{n} \cos n\pi$
19. $\sum_{n=0}^{\infty} \frac{(-1)^n}{n!}$
20. $\sum_{n=0}^{\infty} \frac{(-1)^n}{(2n+1)!}$
21. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}\sqrt{n}}{n+2}$
22. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}\sqrt{n}}{\sqrt[3]{n}}$
23. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} n!}{1 \cdot 3 \cdot 5 \cdot \cdots \cdot (2n-1)}$
24. $\sum_{n=1}^{\infty} (-1)^{n+1} \frac{1 \cdot 3 \cdot 5 \cdot \cdots \cdot (2n-1)}{1 \cdot 4 \cdot 7 \cdot \cdots \cdot (3n-2)}$
25. $\sum_{n=1}^{\infty} \frac{2(-1)^{n+1}}{e^n - e^{-n}} = \sum_{n=1}^{\infty} (-1)^{n+1} \operatorname{csch} n$
26. $\sum_{n=1}^{\infty} \frac{2(-1)^{n+1}}{e^n + e^{-n}} = \sum_{n=1}^{\infty} (-1)^{n+1} \operatorname{sech} n$

Approximating the Sum of an Alternating Series In Exercises 27–30, approximate the sum of the series by using the first six terms. (See Example 4.)

27. $\sum_{n=0}^{\infty} \frac{(-1)^n 5}{n!}$
28. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} 4}{\ln(n+1)}$
29. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} 2}{n^3}$
30. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} n}{3^n}$

Finding the Number of Terms In Exercises 31–36, use Theorem 9.15 to determine the number of terms required to approximate the sum of the series with an error of less than 0.001.

31. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^3}$
32. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^2}$
33. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{2n^3 - 1}$
34. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^5}$
35. $\sum_{n=0}^{\infty} \frac{(-1)^n}{n!}$
36. $\sum_{n=0}^{\infty} \frac{(-1)^n}{(2n)!}$

Determining Absolute and Conditional Convergence In Exercises 37–54, determine whether the series converges absolutely or conditionally, or diverges.

37. $\sum_{n=1}^{\infty} \frac{(-1)^n}{2^n}$
38. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^2}$
39. $\sum_{n=1}^{\infty} \frac{(-1)^n}{n!}$
40. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n+3}$
41. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{\sqrt{n}}$
42. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n\sqrt{n}}$
43. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} n^2}{(n+1)^2}$
44. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}(2n+3)}{n+10}$
45. $\sum_{n=2}^{\infty} \frac{(-1)^n}{n \ln n}$
46. $\sum_{n=0}^{\infty} (-1)^n e^{-n^2}$
47. $\sum_{n=2}^{\infty} \frac{(-1)^n n}{n^3 - 5}$
48. $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^{4/3}}$
49. $\sum_{n=0}^{\infty} \frac{(-1)^n}{(2n+1)!}$
50. $\sum_{n=0}^{\infty} \frac{(-1)^n}{\sqrt{n+4}}$
51. $\sum_{n=0}^{\infty} \frac{\cos n\pi}{n+1}$
52. $\sum_{n=1}^{\infty} (-1)^{n+1} \arctan n$
53. $\sum_{n=1}^{\infty} \frac{\cos n\pi}{n^2}$
54. $\sum_{n=1}^{\infty} \frac{\sin[(2n-1)\pi/2]}{n}$