

Sequences and Series: math practice, College – download the PDF

22 problems graded by difficulty (★ easy, ★★ medium, ★★★ hard). Try first, without looking at the solutions!

1 Limit of a rational sequence

★ ★ ★

Find $\lim_{n \rightarrow \infty} \frac{5n - 3}{2n + 7}$.

2 Sum of a geometric series

★ ★ ★

Find the sum of $3 + 1.5 + 0.75 + 0.375 + \dots$.

3 Use the divergence test

★ ★ ★

Show that $\sum_{n=1}^{\infty} \frac{n}{n+4}$ diverges.

4 Classify three p-series

★ ★ ★

Decide whether each series converges: (a) $\sum \frac{1}{n^3}$; (b) $\sum \frac{1}{\sqrt{n}}$; (c) $\sum n^{-2/3}$.

5 A repeating decimal



Write $0.272727\ldots$ as a geometric series and find the fraction it equals.

6 A telescoping partial sum



Let s_N be the partial sums of $\sum_{k=1}^{\infty} \frac{1}{k(k+1)}$. Use $\frac{1}{k(k+1)} = \frac{1}{k} - \frac{1}{k+1}$ to find s_4 and the sum of the series.

7 Radius of a simple power series



Find the radius of convergence of $\sum_{n=0}^{\infty} \frac{x^n}{2^n}$ and its sum at $x = 1$.

8 A bouncing ball



A ball is dropped from 10 feet (about 3.05 m). After each bounce it rises to 60% of its previous height. What total distance does it travel before coming to rest?

9 Ratio test with powers



Use the ratio test on $\sum_{n=1}^{\infty} \frac{n^2}{3^n}$.

10 Two comparisons



Decide whether each series converges: (a) $\sum \frac{1}{n^2 + 5}$; (b) $\sum \frac{1}{2n - 1}$.

11 Integral test with an exponential



Show that $\sum_{n=1}^{\infty} n e^{-n^2}$ converges by the integral test, and evaluate the integral you used.

12 How many terms are enough?



The series $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^2}$ converges. How many terms guarantee an error below 0.1? Give the resulting estimate s_N .

13 Absolute or conditional?



Classify $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{\sqrt{n}}$ as absolutely convergent, conditionally convergent or divergent.

14 A Maclaurin approximation



Write the first four terms of the Maclaurin series of e^{2x} and use them at $x = 0.1$ to approximate $e^{0.2}$.

15 True or false?



Decide whether each statement is true or false and justify. (a) If $a_n \rightarrow 0$, then $\sum a_n$ converges. (b) If $\sum a_n$ converges, then $a_n \rightarrow 0$. (c) If $\sum |a_n|$ converges, then $\sum a_n$ converges. (d) $\sum (-1)^n$ converges because it alternates.

16 Interval of convergence



Find the interval of convergence of $\sum_{n=1}^{\infty} \frac{x^n}{n 3^n}$, testing both endpoints.

17 A telescoping series with partial fractions

★★★

Find $\sum_{n=1}^{\infty} \frac{2}{n(n+2)}$.

18 When the ratio test fails

★★★

Show that the ratio test gives $L = 1$ for both $\sum \frac{1}{n}$ and $\sum \frac{1}{n^2}$, then decide each series another way. What does this prove about the case $L = 1$?

19 Root test

★★★

Does $\sum_{n=1}^{\infty} \left(\frac{2n+1}{3n+4} \right)^n$ converge?

20 Estimating a logarithm

★★★

Use the series $\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \dots$ to approximate $\ln 1.1$ with three terms, and bound the error.

21 Differentiating a power series

★★★

Starting from $\frac{1}{1-x} = \sum_{n=0}^{\infty} x^n$ for $|x| < 1$, show that $\sum_{n=1}^{\infty} nx^n = \frac{x}{(1-x)^2}$ and evaluate $\sum_{n=1}^{\infty} \frac{n}{2^n}$.

22 Factorial and power

★★★

Use the ratio test on $\sum_{n=1}^{\infty} \frac{n!}{n^n}$.



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