

Sequences, Series, and Induction: math practice, Grade 12 – download the PDF

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

1 Terms of an arithmetic sequence

★ ★ ★

An arithmetic sequence has $a_1 = 4$ and common difference $d = 6$. List the first five terms and find a_{12} .

2 Arithmetic, geometric, or neither?

★ ★ ★

Classify each sequence and justify: (a) 3, 9, 27, 81, ... (b) 50, 43, 36, 29, ... (c) 2, 5, 10, 17, ...

3 Expand a sum

★ ★ ★

Write out and evaluate $\sum_{k=1}^5 (3k - 2)$.

4 Fifth term of a geometric sequence

★ ★ ★

A geometric sequence has $a_1 = 2$ and $r = 5$. Find a_5 .

5 Does the series have a sum?



True or false, with justification: (a) $3 + 6 + 12 + 24 + \cdots$ has a finite sum. (b) $5 + 1 + 0.2 + 0.04 + \cdots$ has a finite sum. If it does, find it.

6 Recursive to explicit



A sequence is defined by $a_1 = 5$ and $a_n = a_{n-1} + 8$ for $n \geq 2$. Write the first four terms and give an explicit formula for a_n .

7 Expand with Pascal's triangle



Use row 5 of Pascal's triangle to expand $(x + 1)^5$.

8 Stadium seating



The first row of a small stadium section has 22 seats, and each row behind it has 3 more seats than the previous one. There are 18 rows. How many seats are in the last row, and how many seats are in the section?

9 Weekly savings



You save 50 dollars in week 1 and increase your deposit by 5 dollars every week. What do you deposit in week 26, and how much have you saved in total after 26 weeks?

10 A spreading rumor



On day 1, 6 students hear a rumor. Each following day, twice as many students newly hear it as on the previous day. How many students have heard it in total after 10 days?

11 How many terms?



The geometric sequence 3, 12, 48, ... ends with the term 3072. (a) Find the number of terms. (b) Find the sum of all the terms.

12 Repeating decimal as a fraction



Write $0.454545 \dots$ (repeating 45) as an infinite geometric series and find the fraction it equals.

13 Using the sum rules



Use the formulas for $\sum k$ and $\sum k^2$ to evaluate: (a) $\sum_{k=1}^{40} (3k + 2)$; (b) $\sum_{k=1}^{12} k^2$.

14 A Fibonacci-style sequence



Let $f_1 = 1$, $f_2 = 3$, and $f_n = f_{n-1} + f_{n-2}$ for $n \geq 3$. Find f_9 and the first index n for which $f_n > 50$.

15 Two coefficients in a binomial expansion



(a) Find the coefficient of x^3 in the expansion of $(2x - 1)^6$. (b) Find the constant term in the expansion of $\left(x^2 + \frac{1}{x}\right)^6$.

16 Induction: a sum of products



Prove by induction that $1 \cdot 2 + 2 \cdot 3 + 3 \cdot 4 + \dots + n(n+1) = \frac{n(n+1)(n+2)}{3}$ for all $n \geq 1$.

17 Induction: divisibility

★★★

Prove by induction that $4^n - 1$ is divisible by 3 for every integer $n \geq 1$.

18 Find the formula, then prove it

★★★

A sequence satisfies $a_1 = 2$ and $a_n = 2a_{n-1} + 3$ for $n \geq 2$. (a) Compute a_2, a_3, a_4 . (b) Show that $a_n = 5 \cdot 2^{n-1} - 3$ by induction.

19 The bouncing ball

★★★

A ball is dropped from a height of 10 feet. After each impact it rebounds to 60% of the height it fell from. Find the total distance the ball travels before coming to rest. Give the answer in feet, then convert to meters (1 ft = 0.3048 m).

20 Finding a_1 and d

★★★

In an arithmetic sequence, $a_4 = 17$ and $a_9 = 42$. Find a_1 , d , and S_{30} .

21 An unknown ratio

★★★

A geometric sequence has $a_1 = 81$ and $a_5 = 16$. Find every possible ratio r , then compute S_5 for each one.



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