

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

Suggested time: 45 minutes. Out of 20 points. Calculator allowed only when the problem says so.

1 Arithmetic sequence

/ 3 pts

An arithmetic sequence satisfies $a_3 = 11$ and $a_8 = 31$. (a) Find the common difference. (b) Find a_1 and a formula for a_n . (c) Find S_{25} .

2 Geometric sequence

/ 3 pts

A geometric sequence has $a_2 = 12$ and $a_5 = 324$. Find the ratio r , the first term a_1 , and the sum of the first 7 terms.

3 Infinite series

/ 3 pts

(a) Find the sum of $20 - 10 + 5 - \frac{5}{2} + \dots$. (b) Write $0.272727\dots$ as a fraction in lowest terms.

4 Sigma notation and recursion

/ 3 pts

- (a) Expand and evaluate $\sum_{k=1}^6 2^k$. (b) A sequence has $b_1 = 2$ and $b_n = b_{n-1} + 2n$ for $n \geq 2$. Compute b_2, b_3, b_4 and conjecture a formula for b_n .

5 Proof by induction

/ 4 pts

Prove by induction that $1 + 3 + 9 + \dots + 3^{n-1} = \frac{3^n - 1}{2}$ for every integer $n \geq 1$.

6 Binomial Theorem

/ 4 pts

- (a) Expand $(x - 2)^5$. (b) Find the coefficient of x^3 in $(1 + 2x)^7$.



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