

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

Test solutions with the detailed point scale. Add up your points and spot what to review.

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

1 Arithmetic sequence

/ 3 pts

(a) $5d = 31 - 11 = 20$, so $d = 4$. (1 pt)

(b) $a_1 = 11 - 2 \times 4 = 3$ and $a_n = 3 + 4(n - 1) = 4n - 1$. (1 pt)

(c) $a_{25} = 99$, so $S_{25} = \frac{25(3 + 99)}{2} = 25 \times 51 = 1275$. (1 pt)

2 Geometric sequence

/ 3 pts

$a_5/a_2 = r^3 = 27$, so $r = 3$. (1 pt)

$a_1 = 12/3 = 4$. (1 pt)

$S_7 = 4 \cdot \frac{3^7 - 1}{3 - 1} = 2 \times 2186 = 4372$. (1 pt)

3 Infinite series

/ 3 pts

(a) $a_1 = 20, r = -\frac{1}{2}, |r| < 1. S = \frac{20}{3/2} = \frac{40}{3}$. (2 pts)

(b) $0.27 + 0.0027 + \dots: a_1 = 0.27, r = 0.01$, so $S = \frac{0.27}{0.99} = \frac{27}{99} = \frac{3}{11}$. (1 pt)

4 Sigma notation and recursion

/ 3 pts

(a) $2 + 4 + 8 + 16 + 32 + 64 = 126$. (1 pt)

(b) $b_2 = 2 + 4 = 6, b_3 = 6 + 6 = 12, b_4 = 12 + 8 = 20$. (1 pt)

The terms 2, 6, 12, 20 equal $1 \cdot 2, 2 \cdot 3, 3 \cdot 4, 4 \cdot 5$, so $b_n = n(n+1)$. (1 pt)

5 Proof by induction

/ 4 pts

Base case. $n = 1$: left side 1, right side $\frac{3-1}{2} = 1$. (1 pt)

Inductive hypothesis. Assume $1 + 3 + \dots + 3^{k-1} = \frac{3^k - 1}{2}$. (1 pt)

Inductive step. Adding 3^k : $\frac{3^k - 1}{2} + 3^k = \frac{3^k - 1 + 2 \cdot 3^k}{2} = \frac{3^{k+1} - 1}{2}$. (1 pt)

Conclusion. By induction the formula is true for all $n \geq 1$. (1 pt)

6 Binomial Theorem

/ 4 pts

(a) The coefficients are 1, 5, 10, 10, 5, 1 and the powers of -2 are 1, -2 , 4, -8 , 16, -32 :

$(x - 2)^5 = x^5 - 10x^4 + 40x^3 - 80x^2 + 80x - 32$. (3 pts)

(b) $\binom{7}{3} \cdot 2^3 = 35 \times 8 = 280$. (1 pt)



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