



Further Math with Ali Hashir

Summation of Series

Further Pure Mathematics 1 – Chapter 3 • Answers

Final answers only. Full step-by-step working, including every cancellation, is in the companion *Worked Solutions* booklet.

QUESTIONS 1–7 • Standard results

- 1 (a) $n(2n + 5)$ (b) $n(2n^2 + 3n - 1)$ (c) $n[n(n + 1)^2 + 1]$
 2 shown
 3 shown
 4 $n(n^2 + 4n + 1)$
 5 $\frac{1}{3}n(26n^2 + 12n + 1)$
 6 $-2n$
 7 166 650

QUESTIONS 8–14 • The method of differences

- 8 (a) shown (b) $\frac{n}{3(4n + 3)}$ (c) $\frac{1}{12}$
 9 (a) $\frac{1}{3} \left(\frac{1}{r} - \frac{1}{r + 3} \right)$ (b) $\frac{11}{18} - \frac{1}{3} \left(\frac{1}{n + 1} + \frac{1}{n + 2} + \frac{1}{n + 3} \right)$ (c) $\frac{11}{18}$
 10 (a) shown (b) shown
 11 $\frac{n}{(8n + 3)(4n + 3)}$
 12 (a) shown (b) shown
 13 (a) shown (b) $S_{2n+1} = -(n + 1)^2(4n + 1)$
 14 (a) $S_N = \frac{N}{5N + 1}$, $S = \frac{1}{5}$ (b) $N = 40$

QUESTIONS 15–20 • Examination-standard problems

- 15** (a) shown (b) $\frac{13}{36} - \frac{1}{3} \left(\frac{1}{n+2} + \frac{1}{n+3} + \frac{1}{n+4} \right)$ (c) $\frac{13}{36}$
- 16** (a) shown (b) $\frac{2}{15} - \frac{1}{4} \left(\frac{1}{2n+3} + \frac{1}{2n+5} \right)$ (c) $\frac{2}{15}$
- 17** (a) shown (b) the partial sums are $\ln \frac{(n+1)(n+2)}{2} \rightarrow \infty$, so the series diverges
- 18** (a) $u_r = r(r+3)$ (b) $\frac{1}{3}n(7n^2 + 18n + 5)$
- 19** (a) shown (b) shown (c) 2
- 20** (a) shown (b) shown (c) $S = \frac{1}{12}$ (d) $n = 25$

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Step-by-step working for every question is in the companion Worked Solutions booklet.

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