



STEP III, 2012 Q4 MS

4. Writing $\frac{n+1}{n!}$ as $\frac{n}{n!} + \frac{1}{n!}$ and then cancelling the first fraction, give exponential series. Similarly, $(n+1)^2$ can be written as $n(n-1) + 3n + 1$, and $(2n-1)^3$ as $8n(n-1)(n-2) + 12n(n-1) + 2n - 1$, the latter giving the result $21e + 1$. Using partial fractions, $\frac{n^2+1}{(n+1)(n+2)}$ can be written as $1 + \frac{2}{n+1} - \frac{5}{n+2}$, the first term giving a GP, and the other two, log series. The result for part (ii) is thus $12 - 16 \ln 2$.



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