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3. (a) Express $\frac{2}{r^2-1}$ in partial fractions.

(1)

(b) Hence, using the method of differences, show that, for $n \in \mathbb{Z}$, $n > 2$

$$\sum_{r=2}^{n} \frac{2}{r^2-1} = \frac{(3n+2)(n-1)}{2n(n+1)}$$

(5)

(c) Hence show that, for $n > 1$

$$\sum_{r=n}^{3n} \frac{2}{r^2-1} = \frac{2(an-1)(bn+1)}{3n(cn+1)(n-1)}$$

where a, b and c are integers to be found.

(4)

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Q3