Proof By Induction (Series) Exam Questions (Edexcel)

Q1.
Prove by induction that for all positive integers n

$$\sum_{r=1}^{n} r^3 = \frac{1}{4}n^2(n+1)^2$$

(6)

(Total for question = 6 marks)

(Q06 8FM0/01, June 2025)

Q2.
Prove by induction that, for all positive integers n,

$$\sum_{r=1}^{n} (2r-1)^2 = \frac{1}{3}n\left(4n^2-1\right)$$

(6)

(Total for question = 6 marks)

(Q06 9FM0/01, June 2024)

Q3.

Prove by mathematical induction that, for $n \in \mathbb{N}$

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

(Total for question = 6 marks)

(Q03 8FM0/01, June 2019)

Q4.
Prove by induction that, for $n \in \mathbb{N}$,

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

(5)
(Total 5 marks)
(Q04 6667/01, Jan 2009)

Q5.
Prove by induction that, for

$n \in \mathbb{Z}^+$, $\sum_{r=1}^{n} (2r-1)^2 = \frac{1}{3}n(2n-1)(2n+1)$.

(5)
(Total 5 marks)

(Q10 6676/01, June 2007)

Q6.

(a) Prove by induction that

$$\sum_{r=1}^{n} r^2 = \frac{1}{6}n(n+1)(2n+1)$$

(6)

Using the standard results for $\sum_{r=1}^{n} r$ and $\sum_{r=1}^{n} r^2$,

(b) show that

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

where a and b are integers to be found.

(5)

(c) Hence show that

$$\sum_{r=n+1}^{2n}(r+2)(r+3) = \frac{1}{3}n(7n^2+27n+26)$$

(3)

(Total 14 marks)

(Q07 6667/01, June 2010)

Q7.

(a) Prove by induction that for all positive integers n,

$$\sum_{r=1}^{n} r^2 = \frac{1}{6}n(n+1)(2n+1)$$

(6)

(b) Use the standard results for $\sum_{r=1}^{n} r^3$ and $\sum_{r=1}^{n} r$ to show that for all positive integers n,

$$\sum_{r=1}^{n} r(r+6)(r-6) = \frac{1}{4}n(n+1)(n-8)(n+9)$$

(4)

(c) Hence find the value of n that satisfies

$$\sum_{r=1}^{n} r(r+6)(r-6) = 17\sum_{r=1}^{n} r^2$$

(5)

(Total for question = 15 marks)

(Q06 8FM0/01, Specimen papers)