

STEP II, 2006, Q5

5 The notation $\lfloor x \rfloor$ denotes the greatest integer less than or equal to the real number x . Thus, for example, $\lfloor \pi \rfloor = 3$, $\lfloor 18 \rfloor = 18$ and $\lfloor -4.2 \rfloor = -5$.

- (i) Two curves are given by $y = x^2 + 3x - 1$ and $y = x^2 + 3\lfloor x \rfloor - 1$. Sketch the curves, for $1 \leq x \leq 3$, on the same axes.

Find the area between the two curves for $1 \leq x \leq n$, where n is a positive integer.

- (ii) Two curves are given by $y = x^2 + 3x - 1$ and $y = \lfloor x \rfloor^2 + 3\lfloor x \rfloor - 1$. Sketch the curves, for $1 \leq x \leq 3$, on the same axes.

Show that the area between the two curves for $1 \leq x \leq n$, where n is a positive integer, is

$$\frac{1}{6}(n-1)(3n+11).$$



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