

STEP II, 2006, Q3

- 3 (i) Show that $(5 + \sqrt{24})^4 + \frac{1}{(5 + \sqrt{24})^4}$ is an integer.

Show also that

$$0.1 < \frac{1}{5 + \sqrt{24}} < \frac{2}{19} < 0.11.$$

Hence determine, with clear reasoning, the value of $(5 + \sqrt{24})^4$ correct to four decimal places.

- (ii) If N is an integer greater than 1, show that $(N + \sqrt{N^2 - 1})^k$, where k is a positive integer, differs from the integer nearest to it by less than $(2N - \frac{1}{2})^{-k}$.



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