

STEP II, 2010, Q8

- 8 The curves C_1 and C_2 are defined by

$$y = e^{-x} \quad (x > 0) \quad \text{and} \quad y = e^{-x} \sin x \quad (x > 0),$$

respectively. Sketch roughly C_1 and C_2 on the same diagram.

Let x_n denote the x -coordinate of the n th point of contact between the two curves, where $0 < x_1 < x_2 < \dots$, and let A_n denote the area of the region enclosed by the two curves between x_n and x_{n+1} . Show that

$$A_n = \frac{1}{2}(e^{2\pi} - 1)e^{-(4n+1)\pi/2}$$

and hence find $\sum_{n=1}^{\infty} A_n$.



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