7. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

$$I_n = \int_0^{\frac{\pi}{4}} e^{4x} \tan^n x \, dx$$

(a) Use integration to prove that, for $n \geqslant 1$

$$I_{n+1} = \frac{e^{\pi}}{n} - \frac{k}{n} I_n - I_{n-1}$$

where k is a constant to be determined.

(4)

(b) Determine the exact value of I_0

(2)

Given that $I_1 = 3.7002$ to 5 significant figures,

(c) use the answer to part (a) to determine the value of I_4 to 3 significant figures.

(3)

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Question 7 continued

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Question 7 continued

(Total for Question 7 is 9 marks)