3. (a) Starting with the definition of $\operatorname{sech} x$ in terms of exponentials, show that

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\operatorname{sech} x\right) = -\operatorname{sech} x \tanh x$$

(3)

The curve with equation

$$y = k \arctan\left(\mathrm{e}^{x}\right) + \operatorname{sech} 2x$$

where k is a constant, has a turning point when $x = \ln 3$

(b) Determine, in simplest form, the exact value of k

(*Solutions relying entirely on calculator technology are not acceptable.*)

(4)

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Question 3 continued

(Total for Question 3 is 7 marks)