Question Number	Scheme	Notes	Marks
3(a)	**Note:** The question requires differentiation of the exponential form of $\operatorname{sech} x$. Responses using hyperbolic differentiation score no marks in part (a).		
	$\operatorname{sech} x = \dfrac{2}{e^x + e^{-x}} \quad \left\{= 2\left(e^x + e^{-x}\right)^{-1}\right\}$	States or uses a correct exponential definition for $\operatorname{sech} x$	M1
	$\dfrac{d}{dx}(\operatorname{sech} x) = -2\left(e^x + e^{-x}\right)^{-2}\left(e^x - e^{-x}\right)$	Attempts to differentiate an expression of the form $k\left(e^x \pm e^{-x}\right)^{-1}$ o.e. correctly using the product rule or quotient rule. Look for $\pm p\left(e^x \pm e^{-x}\right)^{-2}\left(e^x \mp e^{-x}\right)$ o.e.	M1
	$= -\dfrac{2}{e^x + e^{-x}} \times \dfrac{e^x - e^{-x}}{e^x + e^{-x}} = -\operatorname{sech} x \tanh x$*	Obtains given answer with intermediate line and no errors. Must split the expression into separate fractions for the exponential forms of $\operatorname{sech} x$ and $\tanh x$ before reaching final answer.	A1*
	Note: A "meet in the middle" approach is possible. First M1 as above. For second M1: any acceptable differentiation of $\operatorname{sech} x$ (see above). Then, award A1* if $-\operatorname{sech} x \tanh x$ is expanded using exponential definitions to reach an identical expression, AND a conclusion is made, e.g. $\ldots = \dfrac{d}{dx}(\operatorname{sech} x)$, or "=LHS", "QED", etc. If this approach is used, LHS and RHS can be written in any correct exponential form via correct algebra, e.g. $\dfrac{2e^{-x} - 2e^x}{e^{2x} + 2 + e^{-2x}}$		
			(3)
(b)	$y = k \arctan\left(e^x\right) + \operatorname{sech} 2x \Rightarrow$ $\dfrac{dy}{dx} = \dfrac{ke^x}{1 + \left(e^x\right)^2} - 2\operatorname{sech} 2x \tanh 2x$ o.e. (the second term may be in exponential form)	M1: Either term differentiated correctly A1: Fully correct differentiation. Note: it is possible to revert to the exponential form for $\operatorname{sech} x$ and differentiate the second term as in part (a).	M1 A1
	$x = \ln 3 \Rightarrow \dfrac{3k}{1+9} - 2 \times \dfrac{2}{9 + \frac{1}{9}} \times \dfrac{9 - \frac{1}{9}}{9 + \frac{1}{9}} = 0 \Rightarrow k = \ldots$	Makes some attempt to substitute $x = \ln 3$ into their $\dfrac{dy}{dx}$, sets = 0 and proceeds to a value for k	M1
	$\dfrac{3k}{10} = \dfrac{720}{1681} \Rightarrow k = \dfrac{2400}{1681}$ or $1\dfrac{719}{1681}$	Correct exact value in simplest form	A1
			(4)
			Total 7