Question Number	Scheme		Marks
2 (a)(i)	$2\cosh^2 x - 1 = 2\dfrac{\left(e^x + e^{-x}\right)^2}{4} - 1 = \dfrac{\left(e^{2x} + 2e^x \times e^{-x} + e^{-2x}\right)}{2} - 1$ Substitutes the correct definition for cosh$x$ into the rhs and squares - full expansion must be seen but allow 2 for $2e^x \times e^{-x}$		M1
	$= \dfrac{\left(e^{2x} + e^{-2x}\right)}{2} + 1 - 1 = \cosh 2x *$	Correct completion with no errors seen.	A1
	Working from left to right:		
	$\cosh 2x = \dfrac{\left(e^{2x} + e^{-2x}\right)}{2} = \dfrac{\left(e^x + e^{-x}\right)^2 - 2}{2}$ Uses the correct definition for cosh2x on lhs and expresses in terms of $\left(e^x + e^{-x}\right)^2$.		M1
	$2\cosh^2 x - 1 *$	Correct completion with no errors seen.	A1
(ii)	$2\sinh x \cosh x = 2\dfrac{\left(e^x - e^{-x}\right)}{2} \times \dfrac{\left(e^x + e^{-x}\right)}{2} = \ldots$ Use both correct definitions on rhs and attempts to multiply $2\sinh x \cosh x = \dfrac{1}{2}\left(e^x - e^{-x}\right)\left(e^x + e^{-x}\right) = \ldots$ scores M0 as the definitions for sinh$x$ and cosh$x$ have not been seen		M1
	$\dfrac{\left(e^{2x} - e^{-2x}\right)}{2} = \sinh 2x *$	Correct completion with no errors seen.	A1
	Working from left to right:		
	$\sinh 2x = \dfrac{\left(e^{2x} - e^{-2x}\right)}{2} = \dfrac{\left(e^x + e^{-x}\right)\left(e^x - e^{-x}\right)}{2}$ Uses the correct definition for sinh2x on lhs and uses the difference of 2 squares.		M1
	$2\sinh x \cosh x *$	Correct completion with no errors seen.	A1

If they work from both ends then a clear link must be established as a conclusion e.g. lhs = rhs, tick QED etc.

(b)	$2\cosh^2 x - 1 - 7\cosh x + 7 = 0$	Use the identity for cosh2x	M1
	$2\cosh^2 x - 7\cosh x + 6 = 0 \Rightarrow (2\cosh x - 3)(\cosh x - 2) = 0 \Rightarrow \cosh x = ...$ Solve their 3TQ in cosh x (the usual rules for solving can be applied if necessary)		M1
	$\cosh x = \frac{3}{2}$, 2	Correct answers, both needed	A1
	$\cosh x = \alpha \Rightarrow x = \ln\left(\alpha + \sqrt{\alpha^2 - 1}\right)$ **or** $\frac{e^x + e^{-x}}{2} = 2 \Rightarrow e^{2x} - 4e^x + 1 = 0$ or $\frac{e^x + e^{-x}}{2} = \frac{3}{2} \Rightarrow e^{2x} - 3e^x + 1 = 0$ $\Rightarrow e^x = \frac{4 \pm \sqrt{12}}{2}$ or $e^x = \frac{3 \pm \sqrt{5}}{2}$ $\Rightarrow x = \ln...$ Changes at least one arcosh to ln form either using the correct ln form of arcosh or by returning to the correct exponential form of cosh and solving a quadratic in e^x. (Note that returning to exponentials is more likely to give all 4 answers below)		M1
	$x = \ln\left(\frac{3}{2} + \sqrt{\frac{5}{4}}\right)$, $-\ln\left(\frac{3}{2} + \sqrt{\frac{5}{4}}\right)$ $\left(\text{or } \ln\left(\frac{3}{2} - \sqrt{\frac{5}{4}}\right)\right)$, $\ln\left(2 + \sqrt{3}\right), -\ln\left(2 + \sqrt{3}\right)$ $\left(\text{or } \ln\left(2 - \sqrt{3}\right)\right)$ All 4 correct, must be exact logarithms but can be any equivalent to those shown **with brackets**. Allow unsimplified if necessary and apply isw e.g. allow $\ln\left(\frac{3}{2} + \sqrt{\left(\frac{3}{2}\right)^2 - 1}\right)$ for $\ln\left(\frac{3}{2} + \sqrt{\frac{5}{4}}\right)$		A1
			(5)
			[Total 9]

	Alternative for 2(b) using exponentials:	
	$\cosh 2x - 7\cosh x = -7 \Rightarrow \frac{e^{2x}+e^{-2x}}{2} - 7\left(\frac{e^{x}+e^{-x}}{2}\right) = -7$ $\Rightarrow e^{4x} - 7e^{3x} + 14e^{2x} - 7e^{x} + 1 = 0$ Substitutes the correct exponential forms and forms quartic in e^x	M1
	$e^{4x} - 7e^{3x} + 14e^{2x} - 7e^{x} + 1 = 0 \Rightarrow \left(e^{2x} - 4e^{x} + 1\right)\left(e^{2x} - 3e^{x} + 1\right) = 0$ $\Rightarrow e^{x} = \frac{4 \pm \sqrt{12}}{2}$ or $e^{x} = \frac{3 \pm \sqrt{5}}{2}$ M1: Attempts to solve one of their quadratics in e^x which has come from their quartic in e^x to **obtain exact values** for e^x A1: For at least 2 **exact** values of e^x	M1A1
	$\Rightarrow e^{x} = \frac{4 \pm \sqrt{12}}{2}$ or $e^{x} = \frac{3 \pm \sqrt{5}}{2}$ $\Rightarrow x = \ln\ldots$ Change at least one exponential form to ln form	M1
	$\Rightarrow x = \ln\left(\frac{4 \pm \sqrt{12}}{2}\right)$ and $x = \ln\left(\frac{3 \pm \sqrt{5}}{2}\right)$ All 4 correct, must be exact logarithms but can be any equivalent to those shown with brackets if necessary but e.g. they would not be required in the above forms.	A1