Question Number	Scheme	Marks
	There is no credit for attempts that do not use exponential definitions	
1(a) Working from LHS to RHS	$(2\cosh 5x\cosh x) = 2\dfrac{e^{5x}+e^{-5x}}{2}\times\dfrac{e^{x}+e^{-x}}{2} = \dfrac{e^{6x}+e^{4x}+e^{-4x}+e^{-6x}}{2}$	M1
	$= \dfrac{e^{6x}+e^{-6x}}{2} + \dfrac{e^{4x}+e^{-4x}}{2} = \cosh 6x + \cosh 4x$ *	A1*
		(2)
ALT Working from RHS to LHS	$\cosh 6x + \cosh 4x = \dfrac{e^{6x}+e^{-6x}}{2} + \dfrac{e^{4x}+e^{-4x}}{2} = \dfrac{e^{6x}+e^{4x}+e^{-4x}+e^{-6x}}{2} = 2\dfrac{e^{5x}+e^{-5x}}{2}\times\dfrac{e^{x}+e^{-x}}{2}$	M1
	$= 2\dfrac{e^{5x}+e^{-5x}}{2}\times\dfrac{e^{x}+e^{-x}}{2} = 2\cosh 5x\cosh x$	A1*
(b)	$\cosh 6x+\cosh 4x = 8\cosh x \Rightarrow 2\cosh 5x\cosh x = 8\cosh x$ $\Rightarrow 2\cosh x(\cosh 5x-4)=0 \Rightarrow \cosh 5x = \ldots$ or $2\cosh 5x = \ldots$	M1
	$\cosh 5x = 4$ or $2\cosh 5x = 8$	A1
	$\cosh 5x = 4 \Rightarrow 5x = \ln\left(4+\sqrt{4^2-1}\right)$ or $\cosh 5x = 4 \Rightarrow \dfrac{e^{5x}+e^{-5x}}{2} = 4 \Rightarrow e^{10x} - 8e^{5x} + 1 = 0 \Rightarrow e^{5x} = \dfrac{8\pm\sqrt{60}}{2}$	M1
	$x = \pm\dfrac{1}{5}\ln\left(4+\sqrt{15}\right)$ or $x = \dfrac{1}{5}\ln\left(4\pm\sqrt{15}\right)$	A1
		(4)
		Total 6

Notes:

(a)

M1: Expresses $\cosh 5x$ and $\cosh x$ correctly in terms of exponentials and attempts to multiply to obtain an expression involving four terms of the form $e^{\pm 6x}$ and $e^{\pm 4x}$ only.

A1*: Separates terms correctly from a correct expansion and achieves the required result with no errors. Must see one further line isolating the correct terms in exponential form before the stated result. Must clearly link the two exponential expressions to cosh 6*x* and cosh 4*x* so e.g. $= \frac{e^{6x}+e^{-6x}}{2} + \frac{e^{4x}+e^{-4x}}{2}$ and then stop is insufficient unless cosh 6*x* and cosh 4*x* have been correctly defined elsewhere in the work, or e.g. "=RHS" is seen

Note: One of the two's may be shown cancelled, but the correct exponential forms must be seen before any cancellation so e.g. $2\cosh 5x \cosh x = e^{5x} + e^{-5x} \times \frac{e^{x}+e^{-x}}{2} = \frac{e^{6x}+e^{4x}+e^{-4x}+e^{-6x}}{2}$ is M0A0

Missing '*h*' is A0

ALT

M1: Substitutes the correct exponential definitions of cosh 5*x* and cosh *x* into the RHS, combines over a common denominator and re-writes as "2 x a product involving $e^{\pm 5x}$ and $e^{\pm x}$ terms only

A1* Re-writes the expression in the correct form and achieves the required result with no errors. Must clearly link the two exponential expressions to cosh 6*x* and cosh 4*x* so e.g. $= 2\frac{e^{5x}+e^{-5x}}{2} \times \frac{e^{x}+e^{-x}}{2}$ and then stop is insufficient unless cosh 5*x* and cosh *x* have been correctly defined elsewhere in the work, or e.g. "=LHS" is seen

Note: One of the two's may be shown cancelled, but the correct exponential forms must be seen before any cancellation so e.g. $\frac{e^{6x}+e^{4x}+e^{-4x}+e^{-6x}}{2} = e^{5x} + e^{-5x} \times \frac{e^{x}+e^{-x}}{2} = 2\cosh 5x \cosh x$ is M0A0

Missing '*h*' is A0

(b)

M1: Uses the result from part (a) to obtain a value for $\cosh 5x$ or $2\cosh 5x$

A1: For $\cosh 5x = 4$ or $2\cosh 5x = 8$ (No need to discount $\cosh x = 0$)

M1: Uses the correct logarithmic form for arcosh *x* to find a value for 5*x* (which could be implied by a correct value of *x*) or uses the correct exponential form for $\cosh 5x$ then forms and solves (usual rules) a 3TQ in e^{5x} (may be implied by a correct value for e^{5x})

A1: Both correct values in either correct form and no extras. Condone modulus signs instead of brackets around the $4 \pm \sqrt{15}$. Condone equivalent duplicate solutions.