Question	Scheme	Marks	AOs
2	Solves the quadratic equation for $cosh^2 x$ e.g. $$(8\,cosh^2 x - 9)(8\,cosh^2 + 1) = 0 \Rightarrow cosh^2 x = \ldots$$	M1	3.1a
	$$cosh^2 x = \frac{9}{8}\left\{-\frac{1}{8}\right\}$$	A1	1.1b
	$$cosh\,x = \frac{3}{4}\sqrt{2} \Rightarrow x = ln\left[\frac{3}{4}\sqrt{2} + \sqrt{\left(\frac{3}{4}\sqrt{2}\right)^2 - 1}\right]$$ **Alternatively** $$cosh\,x = \frac{3}{4}\sqrt{2} \Rightarrow \frac{1}{2}(e^x + e^{-x}) \Rightarrow e^{2x} - \frac{3}{2}\sqrt{2}e^x + 1 = 0$$ $$\Rightarrow e^x = \sqrt{2} \text{ or } \frac{\sqrt{2}}{2} \Rightarrow x = \ldots$$	M1	1.1b
	$$x = \pm\frac{1}{2}ln\,2$$	A1	2.2a
		(4)	
			(4 marks)

Notes:

M1: Solves the quadratic equation for $cosh^2 x$by any valid means. If by calculator accept for reaching the positive value for $cosh^2 x$ (negative may be omitted or incorrect) but do not allow for going directly to a value for $cosh\,x$ Alternatively score a correct process leading to a value for sinh 2*x* or its square (Alt 1) or use of correct exponential form for cosh *x* to form and expand to an equation in e^{4x} and e^{2x} (Alt 2)

A1: Correct value for $cosh^2 x$ (ignore negative or incorrect extra roots.). In Alt 1 score for a correct value for $\sinh^2 2x$ or sinh 2*x*. In Alt 2 score for a correct simplified equation in e^{4x}.

M1: For a correct method to achieve at least one value for *x* (from $\cosh^2 x$). In the main scheme or Alt 1, takes positive square root (if appropriate) and uses the correct formula for arcosh *x* or arsinh *x* to find a value for *x*. (No need to see negative square root rejected.) In Alt 2 it is for solving the quadratic in e^{4x} and proceeding to find a value for *x*.

Alternatively uses the exponential definition for cosh *x*, forms and solves a quadratic for e^x leading to a value for *x*

A1: Deduces (both) the correct values for *x* and no others. Must be in the form specified.

SC Allow M0A0M1A1 for cases where a calculator was used to get the value for cosh *x* with no evidence if a correct method for find both values is shown.

2 Alt 1	$64\cosh^2 x\left(\cosh^2 x-1\right)-9=0 \Rightarrow 64\cosh^2 x\sinh^2 x-9=0$ $\Rightarrow 16\sinh^2 2x=9 \Rightarrow \sinh^2 2x=\frac{9}{16}$ Or $(8\,sinh\,x\,cosh\,x-3)(8\,sinh\,x\,cosh\,x+3)=0 \Rightarrow sinh\,2x=\pm\frac{3}{4}$	M1 A1	3.1a 1.1b
	$sinh\,2x=\pm\frac{3}{4} \Rightarrow x=\frac{1}{2}ln\left[\pm\frac{3}{4}+\sqrt{\frac{9}{16}+1}\right]$ (or use exponentials, or proceed via cosh4x)	M1	1.1b
	$x=\pm\frac{1}{2}ln\,2$	A1	2.2a
		(4)	
2 Alt 2	$64\left(\frac{e^x+e^{-x}}{2}\right)^4-64\left(\frac{e^x+e^{-x}}{2}\right)^2-9=0 \Rightarrow$ $4(e^{4x}+4e^{2x}+6+4e^{-2x}+e^{-4x})-16(e^{2x}+2+e^{-2x})-9=0$	M1	3.1a
	$4e^{4x}-17+4e^{-4x}=0$	A1	1.1b
	$(4e^{4x}-1)(1-4e^{-4x})=0 \Rightarrow e^{4x}=\ldots \Rightarrow x=\ldots$	M1	1.1b
	$x=\pm\frac{1}{2}ln\,2$	A1	2.2a
		(4)	