Question Number	Scheme		Marks
4(a)	$\frac{dy}{dx}=\sinh\frac{x}{3}$	Correct expression for dy/dx seen explicitly or used	B1
	$\int\sqrt{1+\left(\frac{dy}{dx}\right)^2}\,dx=\int\sqrt{1+\sinh^2\left(\frac{x}{3}\right)}dx=\int\cosh\left(\frac{x}{3}\right)dx$ Uses the correct formula for arc length and reaches: $k\int\pm\cosh\left(\frac{x}{3}\right)dx$		M1
	$=3\sinh\left(\frac{x}{3}\right)$	Correct integration	A1
	$\text{length}=\left[3\sinh\left(\frac{x}{3}\right)\right]_{-3a}^{3a}=3\left(\sinh a-\sinh(-a)\right)=...$ **or** $\text{length}=2\left[3\sinh\left(\frac{x}{3}\right)\right]_{0}^{3a}=2\times3\left(\sinh a-\sinh(0)\right)=...$ Correct use of limits – in the second case, the lower (0) limit does not have to been seen used		M1
	$=6\sinh a$	Correct expression	A1
	Do not be overly concerned if a "sinh" becomes "sin" or there is a missing "dx" along the way but the final answer must be correct.		
			(5)
(b)	$6\sinh a=12\Rightarrow\sinh a=2\Rightarrow x_Q=3a=3\text{arsinh}2$ Uses their arc length in terms of sinh a and the 12 to find a in terms of arsinh or ln and multiplies by 3		M1
	$=3\ln\left(2+\sqrt{5}\right)$	Correct answer **<u>including brackets</u>** and no other answers.	A1
			(2)
(c)	$y_Q=3\cosh a=3\sqrt{1+\sinh^2 a}=3\sqrt{1+"2"^2}$ or $y_Q=3\cosh a=3\cosh\left(\ln\left(2+\sqrt{5}\right)\right)=3\left(\frac{e^{\ln\left(2+\sqrt{5}\right)}+e^{-\ln\left(2+\sqrt{5}\right)}}{2}\right)=...$ Use the curve equation with $x=3a$ or $x=-3a$ and their value for a or sinh a to obtain a numerical **value** for y_Q i.e. no e's or ln's or cosh's etc.		M1
	$=3\sqrt{5}$	Cao	A1
			(2)
			[Total 9]