Question Number	Scheme	Notes	Marks
3	$y=\arcsin 2x \qquad \dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{2}{\sqrt{1-4x^2}}\left\{=2\left(1-4x^2\right)^{-\frac{1}{2}}\right\}$		
(a)	$\dfrac{\mathrm{d}^2y}{\mathrm{d}x^2}=-\left(1-4x^2\right)^{-\frac{3}{2}}\left(-8x\right) \quad \left\{=8x\left(1-4x^2\right)^{-\frac{3}{2}}\right\}$	Obtains correct form for $\dfrac{\mathrm{d}^2y}{\mathrm{d}x^2}$	**M1**
	$\dfrac{\mathrm{d}^3y}{\mathrm{d}x^3}=(8x)\left(-\dfrac{3}{2}\right)\left(1-4x^2\right)^{-\frac{5}{2}}\left(-8x\right)+8\left(1-4x^2\right)^{-\frac{3}{2}}$ or $\dfrac{8\left(1-4x^2\right)^{\frac{3}{2}}+96x^2\left(1-4x^2\right)^{\frac{1}{2}}}{\left(1-4x^2\right)^3}$	Uses product/quotient rule to obtain correct form for $\dfrac{\mathrm{d}^3y}{\mathrm{d}x^3}$	**dM1**
	$=\dfrac{96x^2+8\left(1-4x^2\right)}{\left(1-4x^2\right)^{\frac{5}{2}}}=\dfrac{64x^2+8}{\left(1-4x^2\right)^{\frac{5}{2}}}$	Correct answer in the correct form	**A1**
			(3)
Allow full access to the remaining marks with an incorrect value of *A*			
(b)	$y(0)=0,\ y'(0)=2,\ y''(0)=0,\ y'''(0)=8$ $\mathrm{f}(x)=\mathrm{f}(0)+\mathrm{f}'(0)x+\dfrac{\mathrm{f}''(0)}{2}x^2+\dfrac{\mathrm{f}'''(0)}{3!}x^3+\ldots$ $\left(\Rightarrow \arcsin 2x\right)\approx 2x+\dfrac{4}{3}x^3$	M1: Finds values for $y(0),\ y'(0),\ y''(0)$ and $y'''(0)$ and obtains a consistent Maclaurin expansion A1: Correct expression	**M1** **A1**
			(2)
(c)	$\mathrm{e}^{3x}\arcsin 2x=(1+3x+\ldots)\left("2x+\dfrac{4}{3}x^3+\ldots"\right)=\ldots$	Attempts to find the expansion of e^{3x} and multiplies by their expression for arcsin 2*x*	**M1**
	$=\left(\underline{1+3x+\dfrac{(3x)^2}{2}+\ldots}\right)\left("2x+\dfrac{4}{3}x^3+\ldots"\right)=\ldots$ $=2x+6x^2+9x^3+\dfrac{4}{3}x^3+\ldots$	For a **correct** expansion of e^{3x} up to the x^2 term multiplied by their expression for arcsin with at least one correct term obtained.	**A1**
	$\Rightarrow \mathrm{e}^{3x}\arcsin 2x\approx 2x+6x^2+\dfrac{31}{3}x^3$	Fully correct expression	**A1**
			(3)
			Total 8

Additional Notes:

(a)

M1: Attains the form $Kx\left(1-4x^2\right)^{-\frac{3}{2}}$, $K\neq 0$ or equivalent form, e.g. by quotient rule $\dfrac{0-Kx\left(1-4x^2\right)^{-\frac{1}{2}}}{1-4x^2}$

dM1: Differentiates again, any correct unsimplified form is fine (chain rule must have been applied).

A1: Reaches the correct simplified answer.

Note: Full marks are available in (b) and (c) if an incorrect *A* was found in part (a).

(b)

M1: Attempts all the values for the derivatives and finds the Maclaurin expansion. If the formula is quoted correctly allow any values appearing in the formula as their values if they are not separately stated. If no formula is given and values not stated, the denominators in their expansion must be seen to imply a correct attempt at the formula.

A1: The arcsin2x need not be stated, the A can be awarded for a correct expression. May have come from an incorrect A in (a).

(c)

M1: Attempts the series for e^{3x} and multiplies by their answer to part (b) – an attempt at the multiplication must be carried out but need not be complete or correct. Attempts via differentiation from scratch or expanding the series for $\left(e^{x}\right)^{3} = \left(1 + x + \frac{x^2}{2}\right)^{3} = \ldots$ will need to successfully obtain a correct unsimplified series up to the x term, ie $1+3x+\ldots$ oe.

A1: Must have a **correct expansion of** e^{3x} **up to the** x^2 **term** (ie $1+3x+\frac{(3x)^2}{2}$) and multiply by their expression for arcsin 2x with at least one correct term obtained for the final series attained.

A1: Correct series.