Question	Scheme	Marks
3(a)	$2x\frac{d^2y}{dx^2}+y\frac{dy}{dx}-6xy=0$ and $\frac{dy}{dx}=3$, $y=\frac{1}{2}$ when $x=2$	
	$\frac{d^2y}{dx^2}=\frac{1}{2x}\left(6xy-y\frac{dy}{dx}\right)\Rightarrow\left.\frac{d^2y}{dx^2}\right\|_{x=2}=\frac{1}{4}\left(6-\frac{3}{2}\right)=\frac{9}{8}$	M1A1
	E.g. $2\frac{d^2y}{dx^2}+2x\frac{d^3y}{dx^3}+\underline{y\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^2}-6y-6x\frac{dy}{dx}=0$ Or $\frac{d^3y}{dx^3}=-\frac{1}{2x^2}\left(6xy-y\frac{dy}{dx}\right)+\frac{1}{2x}\left(6x\frac{dy}{dx}+6y-\underline{\left(\frac{dy}{dx}\right)^2-y\frac{d^2y}{dx^2}}\right)$ Or $2x\frac{d^2y}{dx^2}=-y\frac{dy}{dx}+6xy\Rightarrow 2\frac{d^2y}{dx^2}+2x\frac{d^3y}{dx^3}=-\underline{\left(\frac{dy}{dx}\right)^2-y\frac{d^2y}{dx^2}}+6y+6x\frac{dy}{dx}$	M1<u>A1</u> A1
	$\left.\frac{d^3y}{dx^3}\right\|_{x=2}=\frac{435}{64}$	A1
		(6)
(b)	$(y)=\frac{1}{2}+3(x-2)+\frac{9/8}{2}(x-2)^2+\frac{435/64}{3!}(x-2)^3$	M1
	$y=\frac{1}{2}+3(x-2)+\frac{9}{16}(x-2)^2+\frac{145}{128}(x-2)^3$	A1
		(2)
		(8 marks)

Notes:

(a)

M1: Attempts to find $\frac{d^2y}{dx^2}$ at $x = 2$ (May see after the 3rd derivative has been calculated)

A1: Correct value. Note if a method is used in (a) that does not find this value, score for the attempt at it in (b). A correct value for $\frac{d^2y}{dx^2}$ implies M1A1

M1: Attempts to differentiate the equation (may have been rearranged first) with **at least one** use of **product rule** in evidence (sign/coefficient errors only)

A1: For $y\frac{dy}{dx}\rightarrow y\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^2$

A1: Fully correct expression in the third derivative (can be implicit)

A1: Correct value for the third derivative following a correct expression

(b)

M1: Applies the series formula correctly with their values. Must have the correct factorials/implied factorials if not shown. If series is incorrect for their values and no formula shown then M0

A1: Correct answer with <u>simplified</u> coefficients. **Must be $y = \cdots$ so $f(x) = \cdots$ is A0**

(a) **Alt**

M1: Attempts to differentiate the equation (may have been rearranged first) with at least one use of product rule.

A1: For $y\frac{\mathrm{d}y}{\mathrm{d}x} \rightarrow y\frac{\mathrm{d}^2y}{\mathrm{d}x^2}+\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right)^2$

M1: Attempts to replace $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ in their expression to find $\frac{\mathrm{d}^3y}{\mathrm{d}x^3}$ in terms of $\frac{\mathrm{d}y}{\mathrm{d}x}$, x and y only.

A1: Correct replacement at least once

A1: Fully correct expression in the third derivative in terms of $\frac{\mathrm{d}y}{\mathrm{d}x}$, x and y only.

A1: Correct value for the third derivative at $x = 2$

Note: If in doubt about this method being used, please send to review