Question Number	Scheme	Notes	Marks
2	$f(x)=(1+4x)^2\ln(1+4x)$	$\frac{d^2y}{dx^2}+(3x-1)\frac{dy}{dx}+2y^2=5$	
(i)(a)	$f'(x)=2(1+4x)(4)\ln(1+4x)+\frac{4(1+4x)^2}{1+4x}$ $\{=8(1+4x)\ln(1+4x)+4(1+4x)\}$	Differentiates using product and chain rule to obtain an expression of the correct form	M1
	$f''(x)=32\ln(1+4x)+\frac{32(1+4x)}{1+4x}+16\Rightarrow\ldots$	Differentiates using product rule again to obtain $f''(x)=A\ln(1+4x)+B$	dM1
	$32\ln(1+4x)+48$	Correct expression (condone missing brackets)	A1
			(3)
(i)(b)	$f''(0)=48\rightarrow\frac{48}{2}=24$	24 or their $\frac{B}{2}$ Condone $24x^2$	B1ft
			(1)
(ii)	$x=1,\ \frac{dy}{dx}=-3,\ y=2\Rightarrow\frac{d^2y}{dx^2}-6+8=5\Rightarrow\frac{d^2y}{dx^2}=3$	Correct value for $\frac{d^2y}{dx^2}$	B1
	$\frac{d^3y}{dx^3}+3\frac{dy}{dx}+(3x-1)\frac{d^2y}{dx^2}+4y\frac{dy}{dx}=0$	M1: Differentiates to obtain an equation with at least 3 terms of the correct form. Condone "=5" for "=0" A1: Correct differentiation	M1 A1
	$\frac{d^3y}{dx^3}-9+6-24=0\Rightarrow\frac{d^3y}{dx^3}=\ldots\ \{27\}$	Substitutes $x=1,\ \frac{dy}{dx}=-3,\ y=2$ and their $\frac{d^2y}{dx^2}$ into their equation to find a value for $\frac{d^3y}{dx^3}$	M1
	$y=2-3(x-1)+\frac{3}{2}(x-1)^2+\frac{9}{2}(x-1)^3$	M1: Uses $x=1,\ \frac{dy}{dx}=-3,\ y=2$ and their $\frac{d^2y}{dx^2}$ & $\frac{d^3y}{dx^3}$ to form a correct series expansion (may be unsimplified)	dM1 A1
	A1: Correct expansion with simplified coefficients.		
			(6)
			Total 10

Further Notes

(i)

dM mark, must see evidence of the product rule having been used.

(b) Accept if seen as part of a written out series (ignore other terms). Allow if they make up a *B* if they don't have a derivative of correct form.

(ii)

2nd M mark accept any value following a suitable attempt at the derivative to imply the substitution if method is not seen (though if using the function from (i) it is M0).

Final dM mark, there must have been attempts at values for the correct derivatives in (ii). Use of the function in (i) will be dM0.

If they do not show a value for $\frac{d^3y}{dx^3}$ before substituing in the Taylor series then you may need to check if their value fits with the third derivative expression. If correct for their expression allow M1dM for the values, if incorrect score M1dM0 (bod).

Final A, the "$y=$" may be omitted and condone f(x) = …, but x = .. or f($x-1$) = … is A0. Must be from a correct third derivative equation.