Question Number	Scheme	Notes	Marks
1(a)	$y=\ln(5+3x)\Rightarrow \dfrac{dy}{dx}=\dfrac{3}{5+3x}$	Correct first derivative	B1
	$\dfrac{dy}{dx}=\dfrac{3}{5+3x}\Rightarrow \dfrac{d^2y}{dx^2}=-\dfrac{9}{(5+3x)^2}\Rightarrow \dfrac{d^3y}{dx^3}=\dfrac{54}{(5+3x)^3}$ **M1**: Continues the process of differentiating and reaches $\dfrac{d^3y}{dx^3}=\dfrac{k}{(5+3x)^3}$ oe Note this may be achieved via the quotient rule e.g. $\dfrac{d^3y}{dx^3}=\dfrac{-9\times-2\times3(5+3x)}{(5+3x)^4}$ **A1**: Correct **simplified** third derivative. Allow e.g. $\dfrac{54}{(5+3x)^3}$ or $54(5+3x)^{-3}$.		M1 A1
			(3)
(b)	$y_0=\ln 5, y_0'=\dfrac{3}{5}, y_0''=-\dfrac{9}{25}, y_0'''=\dfrac{54}{125}$ $\Rightarrow \ln(5+3x)\approx \ln 5+\dfrac{3}{5}x-\dfrac{9}{25}\dfrac{x^2}{2!}+\dfrac{54}{125}\dfrac{x^3}{3!}+...$ Attempts all values at $x = 0$ and applies Maclaurin's theorem. Evidence for attempting the values can be taken from at least 2 terms. The form of the expansion must be correct including the factorials or their values. Note that this is "Hence" and so do not allow other methods e.g. Formula Book.		M1
	$\ln(5+3x)\approx \ln 5+\dfrac{3}{5}x-\dfrac{9}{50}x^2+\dfrac{9}{125}x^3+...$ Correct expansion. The "ln(5 + 3x) =" is not required.		A1
			(2)
(c)	$\ln(5-3x)\approx \ln 5-\dfrac{3}{5}x-\dfrac{9}{50}x^2-\dfrac{9}{125}x^3+...$ Correct expansion even if obtained "from scratch" **OR** for a correct follow through with signs changed on the coefficients of the odd powers of x only in an expansion of the correct form e.g. a polynomial in ascending powers of x.		B1ft
			(1)
(d)	$\ln\dfrac{(5+3x)}{(5-3x)}=\ln(5+3x)-\ln(5-3x)$ $\ln 5+\dfrac{3}{5}x-\dfrac{9}{50}x^2+\dfrac{9}{125}x^3+...-\left(\ln 5-\dfrac{3}{5}x-\dfrac{9}{50}x^2-\dfrac{9}{125}x^3+...\right)$ Subtracts **<u>their</u>** 2 **different** series to obtain at least 2 non-zero terms in ascending powers of x.		M1
	$=\dfrac{6}{5}x+\dfrac{18}{125}x^3+...$ Correct terms. Allow e.g. $0+\dfrac{6}{5}x+0x^2+\dfrac{18}{125}x^3+...$		A1

	Allow both marks to score in (d) provided the **correct** series have been obtained in (b) and (c) by **any** means.	
		(2)
		Total 8