Question Number	Scheme	Marks
1(a)	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right) 6\times 3(3x-2)^5 \quad (=18(3x-2)^5)$	M1A1
		(2)
(b)	$"18"(3\times\frac{1}{3}-2)^{"5"}=-18$ $-18\rightarrow\frac{1}{18}$ $y-1="\frac{1}{18}"\left(x-\frac{1}{3}\right)$ $3x-54y+53=0$	M1 M1 dM1 A1
		(4)
		(6 marks)

(a)

M1 Applies the chain rule to achieve a form of $A(3x-2)^5$ which may be unsimplified.
The index does not need to be processed for this mark.

Alternatively, multiplies out the brackets to achieve an expression of the form $Ax^6+Bx^5+Cx^4+Dx^3+Ex^2+Fx+G$ (where all coefficients do not need to be simplified) and reduces the power by 1 on at least one of the terms. You will need to check this carefully to make sure it is the relevant term where the power has decreased

eg $Bx^5\rightarrow\ldots\times Bx^4$

Condone slips in their expansion.

(The actual expansion is $64-576x+2160x^2-4320x^3+4860x^4-2916x^5+729x^6$)

A1 $\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)18(3x-2)^5$ or unsimplified equivalent eg $6\times 3(3x-2)^5$ but the index must be processed. If they have multiplied out then accept $-576+4320x-12960x^2+19440x^3-14580x^4+4374x^5$.

Accept x^1 for x

(b)

M1 Substitutes $x = \frac{1}{3}$ into their $\frac{dy}{dx}$ which must be of the form $A(3x-2)^5$ (or accept a polynomial of degree 5) and finds a value for $\frac{dy}{dx}$

M1 Finds the negative reciprocal of their gradient. May be implied by the equation of their line. It cannot be scored for setting $\frac{dy}{dx} = 0$, solving to find *x* and then taking the negative reciprocal of this.

dM1 Attempts to find the equation of the normal. Look for $y - 1 = "\frac{1}{18}"\left(x - \frac{1}{3}\right)$ (must be a changed gradient from their tangent gradient). It is dependent on the first method mark. If they use $y = mx + c$ they must proceed as far as $c = ...$ $\left("= \frac{53}{54}"\right)$

A1 $3x - 54y + 53 = 0$ or any integer multiple of this with all terms on one side of the equation eg $-6x + 108y - 106 = 0$ You must see the = 0

isw after a correct answer is seen. Eg if they proceed to state values for *a*, *b* and *c* which contradict their equation then take their equation as their final answer.

Question Number	Scheme	Marks
2(a)	$\text{fg}(5) = \text{f}(3) = \frac{5-"3"}{3\times"3"+2}, = \frac{2}{11}$	M1, A1
		(2)
(b)	$\text{f}^{-1}(x) = \frac{5-2x}{3x+1}$	M1A1
	$x \in \mathbb{R},\ x \neq -\frac{1}{3}$	B1
		(3)
(c)	$\frac{5-\frac{1}{a}}{3\times\frac{1}{a}+2} = 2(a+3)-7$	B1ft
	$\frac{5-\frac{1}{a}}{3\times\frac{1}{a}+2} = 2(a+3)-7 \Rightarrow 4a^2-a-2=0$	M1A1
	$(a=)\ \frac{1\pm\sqrt{33}}{8}$	A1
		(4)
		(9 marks)

(a)

M1 Correct order of operations applying g before f on 5

Allow an attempt to substitute $x=5$ into $\text{fg}(x) = \frac{5-(2x-7)}{3(2x-7)+2}$ condoning slips. They must proceed to find a value.

This may be completed in two steps so allow for an attempt at $\text{g}(5) = A \rightarrow \text{f}(A) = ...$

Condoning arithmetical slips and bracket errors/omissions.

A1 $\frac{2}{11}$ or exact equivalent. Accept $0.\dot{1}\dot{8}$ but not eg 0.18 or 0.18….

(b)

M1 Changes the subject of $y = \frac{5-x}{3x+2} \rightarrow x = \frac{...\pm 2y}{\pm 3y \pm ...}$ or $x = \frac{5-y}{3y+2} \rightarrow y = \frac{...\pm 2x}{\pm 3x \pm ...}$