Question Number	Scheme	Marks
1	$y = \frac{5}{2}$ at point P	B1
	$y = \frac{3x-2}{(x-2)^2} \Rightarrow \frac{dy}{dx} = \frac{(x-2)^2 \times 3 - (3x-2)\times 2(x-2)}{(x-2)^4}$	M1A1
	Sub $x = 4$ into $\frac{dy}{dx} = \left(-\frac{7}{4}\right)$	M1
	$\frac{4}{7} = \frac{y-\frac{5}{2}}{x-4} \Rightarrow 8x - 14y + 3 = 0$	M1,A1
		(6 marks)

Notes

B1: Correct coordinate $y = \frac{5}{2}$ at P stated or used.

M1: Attempts to differentiate using the Quotient rule or Product rule to achieve an expression of the correct form.

Look for $\frac{(x-2)^2 \times A - (3x-2)\times B(x-2)}{\left((x-2)^2\right)^2}$ or $A(x-2)^{-2} + (3x-2)\times -B(x-2)^{-3}$ where $A,B > 0$

You may condone mising brackets for the M mark, but they must have been recovered (possibly implied by working) for the A mark.

Partial fractions may be used. Look for

$y = \frac{3x-2}{(x-2)^2} \Rightarrow y = \frac{P}{(x-2)} + \frac{Q}{(x-2)^2} (P = 3, Q = 4) \Rightarrow \frac{dy}{dx} = \pm \frac{R}{(x-2)^2} \pm \frac{S}{(x-2)^3}$ with appropriate signs for their P and Q.

A1: Any correct (unsimplified) form of the derivative. Accept from the product rule versions equivalent to $\frac{dy}{dx} = 3(x-2)^{-2} - 2(3x-2)(x-2)^{-3}$ or from partial fractions $\frac{dy}{dx} = -3(x-2)^{-2} - 8(x-2)^{-3}$

FYI: Correct simplified expressions are $\frac{dy}{dx} = \frac{-3x^2+4x+4}{(x-2)^4}$ or $\frac{-3x-2}{(x-2)^3}$

M1: Substitutes $x = 4$ into their derivative (any changed function) to find a numerical value of $\frac{dy}{dx}$.

M1: Uses $x = 4$ and their numerical value of y at $x = 4$ with their numerical $-\frac{dx}{dy}$ to form an equation of a normal. If the form $y = mx + c$ is used then it must be a full method reaching a value for c.

A1: Accept $\pm A(8x - 14y + 3) = 0$ where A is a non-zero integer coming from correct work. Terms may be in a different order but must be on one side and the "= 0" must be given. Watch for correct answers coming from incorrect versions of $\frac{dy}{dx}$ with eg. $(x-2)^2$ on the denominator, which will lose both A marks.

Question Number	Scheme	Marks
2. (a)	$0 < f(x) < \frac{4}{5}$	M1A1
		(2)
(b)	$y = \frac{4}{3x+5} \quad \Rightarrow (3x+5)y = 4 \Rightarrow x = h(y)$	M1
	$\Rightarrow x = \frac{4-5y}{3y}$ or $\Rightarrow y = \frac{4-5x}{3x}$ o.e.	A1
	$f^{-1}(x) = \frac{4-5x}{3x} \quad 0 < x < \frac{4}{5}$	A1ft
		(3)
(c)	$fg(x) = \frac{4}{\frac{3}{x}+5}$	B1
		(1)
(d)	$\frac{3x+5}{4} = \frac{4}{\frac{3}{x}+5} \rightarrow ax^2+bx+c=0$	M1
	$15x^2+18x+15=0$ or $5x^2 + 6x + 5 = 0$ oe	A1
	E.g. Uses $18^2-4\times15\times15$ or completing square, or applies formula.	dM1
	E.g. Discriminant < 0 hence there are no real solutions.	A1
		(4)
		(10 marks)

Notes

(a)

M1: One end correct, condoning $\leqslant$ instead of <. Accept alternative forms, e.g. interval notation. Condone use of x for this mark.

A1: Completely correct. Accept with f(x), f or y or Range, but A0 with x used. If interval notation is used, brackets must be correct for this mark, ie $\left(0, \frac{4}{5}\right)$.

(b)

M1: Sets y = f(x), multiplies both sides by denominator and reaches x as a function of y. Condone slips in expanding or in signs when rearranging after cross multiplying.
Alternatively swaps x any y and proceeds to y as a function of x.

A1: Correct expression for x in terms of y, or if swapping first, y in terms of x. E.g. $y = \frac{4-5x}{3x}$,

$y = \frac{4}{3x} - \frac{5}{3}$ or $x = \frac{\frac{4}{y}-5}{3}$

A1ft: A fully correct definition for f^{-1} with the correct rule and a correct domain or follow through domain for their (a). Must be in terms of x but accept with "y ="

E.g. $f^{-1}(x) = \frac{1}{3}\left(\frac{4}{x}-5\right) \quad 0 < x < \frac{4}{5}$ Accept equivalent forms for the rule as long as it is unambiguous e.g. $\frac{\frac{4}{x}-5}{3}$ is acceptable. You may isw after an acceptable answer has been seen.