

Question Number	Scheme	Marks
8(a)	$x = -\frac{2}{3}$	B1 (1)
(b)	$\frac{dy}{dx} = \frac{6x(3x+2) - 3(3x^2 - 1)}{(3x+2)^2}$ $18x^2 + 12x - 9x^2 + 3 = 0 \quad \text{oe}$ $3x^2 + 4x + 1 = 0$ $(3x+1)(x+1) = 0 \quad x = -\frac{1}{3} \quad x = -1$ $\left(-\frac{1}{3}, -\frac{2}{3}\right) \quad (-1, -2)$	M1A1A1 M1 A1 M1A1 A1 (8)
(c)	A is $\left(0, -\frac{1}{2}\right)$	B1 (1)
(d)	<p>$x = -2/3$</p> <p>(Curve should not bend away from the asymptote.)</p> <p>(-1, -2) $(-1/3, -2/3)$ (0, -1/2)</p> <p>No diagonal asymptote need be shown or implied but each branch must have a turning point.</p>	B1 two branches with turning points B1 Asymptote parallel to y-axis B1 Required coords (3)
(e)	$\text{grad at A} = \frac{0 - 3(-1)}{2^2} = \frac{3}{4} \quad \text{grad normal} = -\frac{4}{3}$ $y + \frac{1}{2} = -\frac{4}{3}x \quad \text{oe}$	B1 M1A1 (3)
		[16]

8(a)	
B1	$x = -\frac{2}{3}$ oe eg $3x = -2$, $3x + 2 = 0$ Must be an equation
(b)	
M1	Attempt to differentiate using the quotient or product rule. For quotient rule, the numerator must be the difference of 2 terms and the denominator must be $(3x + 2)^2$ For the product rule the difference of 2 terms is required and both terms must contain $(3x + 2)^{-k}$, where $k = 1$ or 2
A1	For quotient rule, either term correct apart from sign For product rule, either term correct
A1	Completely correct derivative.
M1	Equate their numerator to 0. (For product rule use, equate their whole derivative to 0)
A1	Simplify to the correct 3 term quadratic. Terms can be in any order.
M1	Attempt the solution of their 3 term quadratic
A1	Two correct values for x
A1	Corresponding correct values for y . No need to write in coordinate brackets.
(c)	
B1	$\left(0, -\frac{1}{2}\right)$ or $x = 0, y = -\frac{1}{2}$
(d)	
B1	Two branches with turning points. One to be in all 4 quadrants, the other in the third quadrant only
B1	Vertical asymptote drawn and labelled either with its equation or by the point where it crosses the x -axis. At least one branch of the curve must be asymptotic to the line and neither branch should cross it.
B1	Show the required coordinates on their sketch beside their turning points or indicated by arrow(s).
(e)	
B1	Gradient of the normal seen explicitly or used.
M1	Any complete method for the equation of a line using their gradient of the normal at A and their coordinates of A
A1	Correct equation, any equivalent form.