

8(a)

Attempts to use,

$$\log_a b = \frac{\log_c b}{\log_c a}$$

M1

$$y = \log_x 3 = \frac{\log_e 3}{\log_e x} = \frac{\ln 3}{\ln x}$$

M1

$$\frac{dy}{dx} = -1 \times (\ln 3) \times (\ln x)^{-2} \times \frac{1}{x} = -\frac{\ln 3}{x(\ln x)^2}$$

M1

Substitute $x = 3$

M1

$$-\frac{\ln 3}{3(\ln 3)^2} = -\frac{1}{3(\ln 3)} = -\frac{1}{\ln 27}$$

The normal has gradient $\ln 27$ and $P = (3,1)$

M1

8(a) cont.	Equation of normal is given by, $y - 1 = \ln 27 (x - 3)$ Begins process to solve simultaneously with curve, e.g. $\frac{\ln 3}{\ln x} - 1 = x \ln 27 - 3 \ln 27$ Begins process to rearrange for $\ln 3$ e.g. $\ln 3 - \ln x = x \ln x \ln 27 - 3 \ln x \ln 27$ Full process resulting in given form $\ln 3 = \ln x (1 + x \ln 27 - 3 \ln 27)$	M1 M1 M1 A1 [9]
8(b)	Finds iterative formula, $\ln x = \frac{\ln 3}{1 + x \ln 27 - 3 \ln 27}$ $x = e^{\frac{\ln 3}{1 + x \ln 27 - 3 \ln 27}}$ $x_{n+1} = e^{\left(\frac{\ln 3}{1 + x_n \ln 27 - 3 \ln 27}\right)}$ Identifies valid starting value, e.g. $x_0 = 0.5$ Uses iterative formula to find x-coordinate e.g. $x_1 = 0.8592 \dots$ $x_2 = 0.8341 \dots$ $\dots$ Critical values $x_3 = 0.8361$ and $x_4 = 0.8360$ must be seen Thus $x = 0.836$ $y = \frac{\ln 3}{\ln(0.836)} = -6.133$	M1 M1 A1 A1 [4] [13 marks]