Question Number	Scheme	Marks
4	$A = \dfrac{80pe^{0.15t}}{pe^{0.15t}+4}$	
(a)	$30 = \dfrac{80p}{p+4}$	M1
	$30p+120 = 80p \Rightarrow p = \dfrac{120}{50} = 2.4$ *	A1* **(2)**
(b)	$50 = \dfrac{80\times 2.4e^{0.15T}}{2.4e^{0.15T}+4} \Rightarrow 72e^{0.15T} = 200$	M1 A1
	$\Rightarrow 0.15T = \ln\left(\dfrac{200}{72}\right) \Rightarrow T = 6.8$	dM1 A1 **(4)**
(c)	80 m^2	B1 **(1)**
		(7 marks)

(a)

M1: Sets $A = 30$ and $e^{0.15\times 0} = 1$ to set up an equation in p.

A1*: Achieves $p = 2.4$ with no significant (*) errors and with one correct **linear (non fractional)** equation in p. * Condone minor slips as long as they are recovered before reaching the given answer.

An example of this would be

$$p+4(30) = 80p \Rightarrow 30p+120 = 80p \Rightarrow 50p = 120 \Rightarrow p = 2.4$$

Alt method

M1: Sets $p = 2.4$, $e^{0.15\times 0} = 1$ and attempts the value of $(A) = \dfrac{80\times 2.4\times 1}{2.4\times 1+4}$

A1*: Achieves $A = 30$ with no errors and concludes that $p = 2.4$. Condone $30 = \dfrac{192}{6.4}$ ✓

(b) Allow $t \leftrightarrow T$ here

M1: Sets $A = 50$, $p = 2.4$ and proceeds to an equation of the form $ce^{0.15t} = d \quad c\times d > 0$

Condone slips, e.g. on the 0.15. You may see $de^{-0.15t} = c \quad c\times d > 0$

A1: Achieves $72e^{0.15t} = 200$ o.e.

dM1: Correct order of operations to find T/t

For example $0.15T = \ln\left(\dfrac{200}{72}\right) \Rightarrow T = ...$ or

$\ln 72 + 0.15T = \ln 200 \Rightarrow 0.15T = ... \Rightarrow T = ...$

A1: AWRT 6.8

(c)

B1: Requires units as well. 80 m^2

Students lacking work in part (b)

Example 1: $50 = \dfrac{80\times 2.4e^{0.15T}}{2.4e^{0.15T}+4} \Rightarrow T = awrt\ 6.8$ can be awarded SC 1000

Example 2: $50 = \dfrac{80 \times 2.4e^{0.15T}}{2.4e^{0.15T} + 4} \Rightarrow 72e^{0.15T} = 200 \Rightarrow T = awrt\ 6.8$ score M1 A1 via scheme and then SC 10

Question Number	Scheme	Marks
5 (a)	Attempts to find y at -1.25 and -1.2 with one correct to 1sf	M1
	Achieves $y(-1.25) = -0.9$ and $y(-1.2) = 0.2$	
	With reason (change of sign and continuous) and Conclusion	A1
		(2)
(b)	(i) Attempts $\sqrt{12\ln(15)+8}$	M1
	$x_2 =$ awrt 6.3637	A1
	(ii) $x = 6.4142$	B1
		(3)
(c)	$\dfrac{dy}{dx} = \dfrac{12}{2x+3} - x$	M1 A1
	Stationary point when $\dfrac{12}{2x+3} = x \Rightarrow 2x^2 + 3x - 12 = 0 \Rightarrow x =$	dM1
	$\Rightarrow x = \dfrac{-3+\sqrt{105}}{4}$ or awrt 1.81 ONLY	A1
		(4)
		(9 marks)

(a)

M1: Attempts to find y at -1.25 and -1.2 with one correct to at least 1sf.

FYI $y(-1.25) = -0.9$ and $y(-1.2) = 0.2$

A1: Achieves $y(-1.25) =$ awrt -0.9 and $y(-1.2) =$ awrt 0.2 with a reason and minimal conclusion.

Acceptable reasons are; " sign change and continuous", " $y(-1.25) \times y(-1.2) < 0$ and continuous" Minimal conclusions are; "hence proven", "hence root", "✓", "□"

Note: A smaller interval could be chosen but it must span -1.20998 and the final conclusion must refer to the given interval to score both marks.

(b)(i)

M1: Attempts to apply the iteration formula once. Accept $\sqrt{12\ln(15)+8} = ...$ or awrt 6.4

A1: $x_2 =$ awrt 6.3637

(b)(ii)

B1: CAO $x = 6.4142$ There must be some evidence of the M or continued iteration for this to be awarded. A minimum would be an attempt at x_2 (the M) or an attempt at any intermediate term.

(c)

M1: Attempts to differentiate with $\ln(2x+3) \rightarrow \dfrac{...}{2x+3}$

A1: $\dfrac{dy}{dx} = \dfrac{12}{2x+3} - x$ which may be left unsimplified . No requirement to see lhs

dM1: Sets their $\dfrac{...}{2x+3} \pm ...x = 0$ and proceeds to a value for x via a correct method of solving a 3TQ

There must be some evidence of working but allow candidates to use a calculator to write down the solution of 3TQ. If they do, it must be correct for their 3TQ