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

A1: cso $x=\dfrac{-3+\sqrt{105}}{4}$ or awrt 1.81 ONLY. If $x=\dfrac{-3-\sqrt{105}}{4}$ or awrt -3.31 is also written down it must be rejected. ISW after a correct answer. There must be evidence of dM1 to award this mark

Question Number	Scheme	Marks
6. (a)	$\mathrm{f}(x)=\dfrac{5x-3}{x-4}\Rightarrow \mathrm{f}'(x)=\dfrac{5(x-4)-(5x-3)}{(x-4)^2}=\dfrac{k}{(x-4)^2}$	M1 dM1
	States that $\mathrm{f}'(x)=\dfrac{-17}{(x-4)^2}\Rightarrow \mathrm{f}'(x)<0$ hence decreasing * cso	A1*
		(3)
(b)	$y=\dfrac{5x-3}{x-4}\Rightarrow xy-4y=5x-3\Rightarrow xy-5x=4y-3$	M1
	$\Rightarrow x=\dfrac{4y-3}{y-5}$ So $\mathrm{f}^{-1}(x)=\dfrac{4x-3}{x-5}$	A1
	Domain $x>5$	B1
		(3)
(c) (i)	$\mathrm{ff}(x)=\dfrac{5\times\dfrac{5x-3}{x-4}-3}{\dfrac{5x-3}{x-4}-4}$	M1
	$\mathrm{ff}(x)=\dfrac{5\times(5x-3)-3(x-4)}{5x-3-4(x-4)}=\dfrac{22x-3}{x+13}$	dM1 A1
(ii)	$5<\mathrm{ff}(x)<22$	B1, B1
		(5)
		(11 marks)

(a)

M1: Attempts to use the quotient rule to achieve a form $\dfrac{p(x-4)-q(5x-3)}{(x-4)^2}$ with $p,q>0$ OR

attempts the product rule to achieve a form $p(x-4)^{-1}\pm(5x-3)(x-4)^{-2}$

Condone attempts in which terms such as $(x-4)^2$ may have been multiplied out incorrectly

dM1: Proceeds to $\mathrm{f}'(x)=\dfrac{k}{(x-4)^2}$ Allow the lhs to be $\dfrac{\mathrm{d}y}{\mathrm{d}x}$

A1*: Requires a correct $\mathrm{f}'(x)$, a correct statement such as "$\mathrm{f}'(x)<0$ " o.e (such as $\mathrm{f}'(x)$ is negative) and a minimal conclusion which could be ✓ or QED or □

It cannot be awarded from substituting in single values of *x*. It cannot be based on incorrect mathematics.

"There is a minus sign" or "$-17<0$ " is insufficient without the further statement $\mathrm{f}'(x)<0$ (o.e) followed by a minimal conclusion.

(b)

M1 Attempts to change the subject. Look for cross multiplication with an attempt to collect terms with *x*'s (or replaced *y*'s) on one side of the equation and non *x* terms on the other side

A1 $\mathrm{f}^{-1}(x)=\dfrac{4x-3}{x-5}$ o.e Condone the lhs as f^{-1} and even *y*. The notation $\mathrm{f}^{-1}:x\mapsto\dfrac{4x-3}{x-5}$ is fine