Question Number	Scheme	Marks
2(a)	$f(1)=\frac{2(1)^2+3(1)-4}{e^1}-\frac{1}{1^2}=\ldots$ **and** $f(2)=\frac{2(2)^2+3(2)-4}{e^2}-\frac{1}{(2)^2}=\ldots$	M1
	$f(1)=-0.6(321\ldots)[<0]$ **and** $f(2)=1.(103\ldots)[>0]$ $\Rightarrow$ There is a sign change and f(x) is continuous over the interval hence root (in the interval $[1,2]$)	A1
		(2)
(b)	$\frac{2x^2+3x-4}{e^x}-\frac{1}{x^2}=0\Rightarrow 2x^4+3x^3=e^x+4x^2$	M1
	$x^3(2x+3)=e^x+4x^2\Rightarrow x=\sqrt[3]{\frac{e^x+4x^2}{2x+3}}$ *	A1*
		(2)
(c) **(i)**	$x_2=\sqrt[3]{\frac{e^1+4(1)^2}{2(1)+3}}=\text{awrt}\,1.1035\Rightarrow x_3=\text{awrt}\,1.1484$	M1A1
(ii)	1.1813	A1
		(3)
		(7 marks)

(a)

M1: Attempts $f(1)$ and $f(2)$. Values embedded in the expression is sufficient (accept slips if the intention is clear), or if no substitution is seen accept one correct value (truncated or rounded to 1sf) with an attempt at both made.

A1: Both $f(1)$ and $f(2)$ correct (truncated or rounded to 1sf), reason (e.g. "sign change" or < 0, > 0 shown) and conclusion. Must refer to the function being continuous (over the interval) in some way, though be tolerant with language used.

Note: a narrower interval may be used but if so must contain the root 1.183… to score the M.

(b)

M1: Sets f(x) = 0 (may be implied), attempts to multiply both sides by x^2 and e^x and isolates the quartic and cubic terms on one side.

A1*: Factorises the left-hand side and proceeds to the given answer via an intermediate step with no errors seen.

Note: Working backwards is possible. For the M look for cubing and cross multiplying to reach a similar intermediate stage, and all correct for the A mark.

(c)

(i)

M1: Substitutes $x = 1$ into the iterative formula. May be implied by awrt 1.10 or awrt 1.15 if substitution not seen. Condone miscopies if the substitution is shown. NB Correct value for x_3 stated implies this mark.

A1: (x_3 =) awrt 1.1484. Must be x_3 and not another term (if labelled).

(ii)

A1: cao 1.1813 as the final answer (cannot be scored without M1 being scored in (c)(i))

Question Number	Scheme	Marks
3(a)	$m = \dfrac{2.25-2}{5}$ $\log_{10} V = 0.05t + 2$	M1 A1
		(2)
(b)	$\log_{10} V = 0.05t + 2 \Rightarrow V = 10^{0.05t+2}$ $a = 100$ or $b = 1.12$ $V = 100\times(1.12)^t$	M1 A1 A1
		(3)
(c)	$\dfrac{\mathrm{d}V}{\mathrm{d}t} = 100\times\ln 1.12\times(1.12)^t \quad \left(=11.33(1.12)^t\right)$ $100\times\ln 1.12\times(1.12)^T = 50 \Rightarrow (1.12)^T = \dfrac{50}{100\ln 1.12}$ $(T=)\ \log_{1.12}\left(\dfrac{50}{100\ln 1.12}\right) = \ldots$ $(T=)13$	B1ft M1 dM1 A1
		(4)
		(9 marks)

(a)

M1: Attempts to find the gradient of the line, must be change in "*y*"/change in "*x*". May be found via simultaneous equations – look for an attempt to solve the correct equations.

A1: $\log_{10} V = 0.05t + 2$ Accept log in place of $\log_{10}$ here and throughout but must be correct variables.

(b)

M1: Correct attempt to make *V* the subject, or alternatively takes log of $V = ab^t$ and finds an equation in just *a* or *b* ie either $2 = \log_{10} a$ or $\dfrac{1}{20} = \log_{10} b$. If there is no incorrect working allow for obtaining an expression for *a* or *b*, e.g. $a = 10^2$ or $b = 10^{0.05}$.

A1: $a = 100$ or $b = \text{awrt}\,1.12$ (may be stated or embedded in an equation of the correct form).

A1: $V = 100\times(\text{awrt } 1.12)^t$. The equation must be given not just values.
SC Award M1A1A0 for candidates who start with an incorrect step of $V = 10^{0.05t} + 10^2$ but recover to $V = 10^2\times 10^{0.05t} = 100(1.12)^t$ in subsequent work (and similar for variants).

(c)