Question Number	Scheme	Marks
1(a)	$\mathrm{f}(x) \geqslant \ln 3$	B1
		(1)
(b)	$\mathrm{g}^{-1}(x) = \dfrac{3-2x}{x-5}$ or $-2-\dfrac{7}{x-5}$ oe $x<5$	M1A1 B1
		(3)
(c)	$\mathrm{g}(0) = \dfrac{3}{2} \Rightarrow \mathrm{f}\left(\dfrac{3}{2}\right) = \ln\left(\dfrac{21}{4}\right)$	M1A1
		(2)
(d)	$\dfrac{3+5\mathrm{e}^{2a}}{\mathrm{e}^{2a}+2} = 4 \Rightarrow 5\mathrm{e}^{2a}+3 = 4\mathrm{e}^{2a}+8 \Rightarrow \mathrm{e}^{2a} = \ldots$ $\mathrm{e}^{2a} = 5 \Rightarrow 2a = \ln 5 \Rightarrow a = \ldots$ $a = \dfrac{1}{2}\ln 5$	M1 dM1 A1
		(3)
		(9 marks)

(a)

B1: $\mathrm{f}(x) \geqslant \ln 3$ o.e. Accept with *y* in place of f(*x*).

(b)

M1: Attempts to rearrange to find the inverse. Score for achieving the form $y = \dfrac{\pm 3 \pm 2x}{\pm x \pm 5}$ or $x = \dfrac{\pm 3 \pm 2y}{\pm y \pm 5}$. If they use $y = 5 - \dfrac{7}{\mathrm{x}+2}$ score for reaching $x = \dfrac{\pm 7}{\pm 5 \pm y} \pm 2$ oe for *y* =….

A1: $\mathrm{g}^{-1}(x) = \dfrac{3-2x}{x-5}$ o.e. (e.g. see scheme). Allow with just g^{-1} or *y* or even f^{-1}

B1: $x<5$

(c)

M1: Attempts to find $\mathrm{fg}(0)$. May find the function $\mathrm{fg}(x)$ and substitute 0 into this. Condone slips. May be implied by awrt 1.7 if no substitution is shown.

A1: $\ln\left(\dfrac{21}{4}\right)$ or exact simplified equivalent and isw.

(d)

M1: Sets $\dfrac{3+5\mathrm{e}^{2a}}{\mathrm{e}^{2a}+2} = 4$ and proceeds to make e^{2a} (or condone $A\mathrm{e}^{2a}$) the subject. They must achieve the 4 although this may appear later in working.

Alternatively, sets $\mathrm{g}^{-1}\mathrm{g}(\mathrm{e}^{2a}) = \mathrm{g}^{-1}\mathrm{f}\left(\sqrt{\mathrm{e}^4-3}\right) \Rightarrow \mathrm{e}^{2a} = \mathrm{g}^{-1}(4) = \dfrac{-5}{-1} = 5$

dM1: Takes valid lns of both sides (must be lns of positive numbers) and proceeds to find a value for *a*. It is dependent on the previous method mark.

A1: $(a=)\ \frac{1}{2}\ln 5$ or exact equivalent and isw

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.