Question Number	Scheme	Marks
4	$\log_{10} h = 2.4 - 0.25\log_{10} m$	
(a)	$\log_{10} h = 2.4 - 0.25\log_{10} 3 \Rightarrow h = 10^{2.4-0.25\log_{10} 3}$	M1
	$\Rightarrow h = 191$	A1
		(2)
(b)	Example: One correct law $\log_{10} h = 2.4 + \log_{10} m^{-0.25}$	M1
	Full method in forming an equation linking h and m, e.g. $h = 10^{2.4} \times m^{-0.25}$	dM1
	$\Rightarrow h = \dfrac{251}{m^{0.25}}$	A1
		(3)
(c)	The resting heart rate (in beats per minute) for (a mammal of mass) 1 kg	B1
		(1)
		(6 marks)

(a)

M1 Substitutes $m = 3$ into the given equation and uses the correct order of operations to find h. Can be implied by a correct value for h.

A1 awrt 191

(b)

M1 Makes a first step towards achieving an answer. Sight of a correct rule or law used. Will usually be awarded for one of:

- Application of a power rule e.g. $-0.25\log_{10} m \rightarrow \log_{10} m^{-0.25}$
- An attempt to make h the subject. E.g. $\log_{10} h = 2.4 - 0.25\log_{10} m \rightarrow h = 10^{2.4-0.25\log_{10} m}$
- Both of the above applied at once, e.g. $\log_{10} h = 2.4 - 0.25\log_{10} m \rightarrow h = \dfrac{10^{2.4}}{m^{0.25}}$ or $10^{2.4} \times m^{-0.25}$

In this case, M1 dM1 are scored together.

dM1 Dependent on the first M1. Full and complete method to make h the subject, with logs being correctly removed, e.g. $\log_{10} h = 2.4 + \log_{10} m^{-0.25} \Rightarrow h = 10^{2.4} \times m^{-0.25}$

A1 Achieves $h = \dfrac{251}{m^{0.25}}$ with at least one intermediate step (see M1) between the given equation and the final answer. Accept ¼ or 0.250 in place of 0.25 and allow awrt 251. Do not accept $p = 251, q = 0.25$ for this mark without seeing the full equation.

Note: It is possible to score 000 in (b) despite a numerator of 251 if an incorrect method is used.

Note: Allow full marks for part (b) if full working is shown correctly in (a).

SC: Award SC110 for use of $m = 3$ in part (a), and making h the subject, reaching $h = \dfrac{10^{2.4}}{3^{1/4}}$ and then writing down $p = 251, q = 0.25$ in part (b).

(c)

B1 "The (resting) heart rate (in beats per minute) for (a mammal of mass) 1 kg". Also accept "The beats per minute for (a mammal of mass) 1 kg."

Question Number	Scheme	Marks
5 (a)	$\text{ff}(x)=\dfrac{2\times\left(\dfrac{2x+16}{x-4}\right)+16}{\left(\dfrac{2x+16}{x-4}\right)-4}, \dfrac{2\times(2x+16)+16(x-4)}{(2x+16)-4(x-4)}, =\dfrac{10x-16}{-x+16}$	M1, dM1, A1 **(3)**
(b)	$\dfrac{2x+16}{x-4}=12\Rightarrow 10x=64\Rightarrow x=6.4$	M1 A1 **(2)**
(c)	$\dfrac{2\ln a+16}{\ln a-4}=\ln a\Rightarrow(\ln a)^2-6\ln a-16=0$ $\Rightarrow(\ln a-8)(\ln a+2)=0\Rightarrow \ln a=8,-2$ $\Rightarrow a=\text{e}^{-2},\text{e}^{8}$	M1 dM1 A1 **(3)** **8 marks**

(a)

M1 Attempts to fully substitute f(x) for x in $\dfrac{2x+16}{x-4}$. Condone **one** slip as long as the intention is clear and there are two substitutions of f(x) for x.

dM1 Dependent on the first M1. Correct attempt to form a single fraction (see scheme) by multiplying two terms in the numerator and two terms in the denominator by $(x-4)$

A1 $\dfrac{10x-16}{-x+16}$ or exact simplified equivalent

(b)

M1 Attempts to solve $\text{f}(x)=12$ using correct order of operations (multiplying by $x-4$ and grouping terms in x).

Alternatively, reaches $\text{f}^{-1}(x)=\dfrac{ax+b}{cx+d}$ using correct order of operations and attempts to substitute $x=12$. Note: $\text{f}^{-1}(x)=\dfrac{4x+16}{x-2}$

A1 6.4 o.e.

(c) **Note:** If correct answers appear without a 3TQ, send to review.

M1 Sets up a 3TQ in $\ln a$. Must have three terms, but not necessarily on one side of the equation. Condone a four term quadratic with all terms on one side if it is followed by a correct attempt to solve. Condone missing "=0".

dM1 Dependent on the first M1. Full attempt to solve a 3TQ in $\ln a$, using any valid method (including calculator), reaching two values, which do not necessarily have to be labelled $\ln a$. Allow a substitution, e.g. $x=\ln a$ or even $a=\ln a$.

A1 $a=\text{e}^{8},\text{e}^{-2}$ (or $\dfrac{1}{\text{e}^{2}}$) and no others. Accept answers labelled as x or unlabelled. Apply isw (e.g. if exact answers are followed by decimals). Must follow M1 dM1.