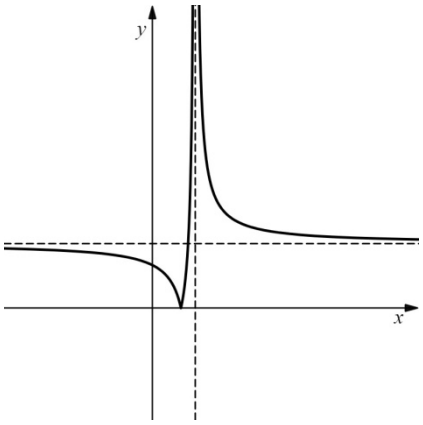
Question Number	Scheme	Marks
8. (a)	$g(2a) = \dfrac{3\times 2a - 2a}{2a - a} = 4$, $\quad f(4) = \ln(2\times 4 - 3) = \ln 5$	M1, A1 **(2)**
(b)	$y = \ln(2x-3) \Rightarrow e^{y} = 2x - 3 \Rightarrow x = \dfrac{e^{y}+3}{2}$	M1
	$f^{-1}(x) = \dfrac{e^{x}+3}{2}$ $\qquad x > 0$	A1, B1 **(3)**
(c)	 Shape of curve to right of $x = a$ Shape of curve to left of $x = a$ $y = 3$ marked at correct place on curve	B1 B1 B1 **(3)**
(d) (i)	$\dfrac{3\times 8 - 2a}{8 - a} = 10 \Rightarrow a = ...$	M1
	$\Rightarrow a = 7$	A1
(ii)	$\dfrac{3x - 2\times 7}{x - 7} = -10 \Rightarrow x = ...$	dM1
	$\Rightarrow x = \dfrac{84}{13}$	A1 **(4)**
		(12 marks)

(a)

M1: Complete method to find fg($2a$). E.g. Finds g($2a$) and substitutes into f.

Some may find fg(x) = $\ln\left(2\times\dfrac{3x-2a}{x-a} - 3\right)$ and substitute $x = 2a$ into this. Condone slips in signs

A1: $\ln 5$. ISW after a correct answer. Allow this to be written down for both marks.

(b)

M1: Complete method to find $f^{-1}(x)$. Score for the correct order of operations so award this mark for work proceeding to $x = \frac{e^y \pm 3}{2}$ or $y = \frac{e^x \pm 3}{2}$ o.e if they start with $x = \ln(2y - 3)$

A1: $f^{-1}(x) = \frac{e^x + 3}{2}$ o.e. BUT condone/allow $f^{-1} = \frac{e^x}{2} + \frac{3}{2}$ and $y = \frac{1}{2}\left(e^x + 3\right)$

B1: States a domain of $x > 0$. Do not accept $x > \ln 1$

(c) **Do not accept the curve drawn on Figure 3 unless you can clearly see all parts of the curve.**

Allow the B1 for the equation of the horizontal asymptote if correct

B1: Shape of curve to the right of the vertical asymptote (provided that the whole of the original curve is not copied out). Be tolerant of slips of the pen

B1: Shape of curve to the left of the vertical asymptote. It must be a cusp as opposed to a minimum turning point. Again, be tolerant of slips of the pen and a linear looking section from $x = \frac{2}{3}a$ to $x = a$

B1: For the horizontal asymptote marked as $y = 3$ and not just 3

(d)(i) **The following two marks are for a correct method and answer of finding the value of the constant *a***

If both equations are used then a correct choice must be made for both marks to be awarded

M1: Sets $\frac{3x - 2a}{x - a} = 10$ o.e., substitutes $x = 8$ and solves for *a.* Note that $3 + \frac{a}{x - a} = 10$ is the same equation

Don't be too worried about the method of solving this equation but the initial equation must be correct

A1: $a = 7$ only

(d)(ii) **Marks can only be scored in (ii) only following the award of M1 in (i)**

dM1: Sets $\frac{3x - 2a}{x - a} = -10$ o.e. and substitutes their *a* from (d)(i) and solves for *x*

Don't be too worried about the method of solving this equation

Their *a* must have been found from solving an equation equivalent to $\frac{3x - 2a}{x - a} = 10$ with $x = 8$

A1: $x = \frac{84}{13}$ only (exact answer but ISW after a correct answer).

If both solutions are found, $x = 8$ and $x = \frac{84}{13}$, the $\frac{84}{13}$ must be selected and identified as the only solution.

Question Number	Scheme	Marks
9.(a)	$x = 30\mathrm{e}^{-0.2\times 8} = 6.06\,(\mathrm{mg})$	M1, A1 **(2)**
(b)	$x = 30\mathrm{e}^{-0.2\times 10} + 20\mathrm{e}^{-0.2\times 2} = 17.5\,(\mathrm{mg})$ *	B1* **(1)**
(c)	$30\mathrm{e}^{-0.2\times(T+8)} + 20\mathrm{e}^{-0.2T} = 10$ $\left(3\mathrm{e}^{-1.6} + 2\right)\mathrm{e}^{-0.2T} = 1$ $\mathrm{e}^{-0.2T} = \dfrac{1}{3\mathrm{e}^{-1.6} + 2}$ $T = 5\ln\left(3\mathrm{e}^{-1.6} + 2\right) = 4.79$	M1 A1 dM1, A1 **(4)**
		(7 marks)

(a)

M1: Substitutes $D = 30$ and $t = 8$ into $x = D\mathrm{e}^{-0.2t}$ and proceeds to a value for x

A1: AWRT 6.06 Allow this to be written down for both marks. Units are not important

(b)

B1*: There are many ways to achieve this. Examples of correct expressions are

- $30\mathrm{e}^{-0.2\times 10} + 20\mathrm{e}^{-0.2\times 2}$
- $6.06\mathrm{e}^{-0.2\times 2} + 20\mathrm{e}^{-0.2\times 2}$ (allow with more accurate values than 6.06)
- $26.06\mathrm{e}^{-0.2\times 2}$ (allow with more accurate values than 26.06)

You need to see a correct expression followed by awrt 17.47 or 17.5 (Units not important)

Note that values other than 26.06 in $26.06\mathrm{e}^{-0.2\times 2}$ would still round to 17.5.

For instance, expressions such as $26.1\times\mathrm{e}^{-0.2\times 2}$ and $26.07\times\mathrm{e}^{-0.2\times 2}$ would round to an appropriate value **but will not score this mark**