Question Number	Scheme	Marks
3(a)	$\log_{10} D = 1.04 + 0.38t \Rightarrow D = 10^{1.04+0.38t}$ **or** $a = 10^{1.04}$ or $b = 10^{0.38}$	M1
	$a =$ awrt 10.96 **or** $b =$ awrt 2.399	A1
	$D = 10.96 \times 2.399^t$	A1
		(3)
(b)	$45000 = "10.96" \times "2.399"^T \Rightarrow T = ...$ or $\log_{10} 45000 = 1.04 + 0.38T \Rightarrow T = ...$	M1
	awrt 9.51	A1
		(2)
(c)	$D = "10.96" \times "2.399"^{12} \Rightarrow D = ...$ or $\log_{10} D = 1.04 + 0.38 \times 12 \Rightarrow D = ...$ or $350000 = "10.96" \times "2.399"^t \Rightarrow t = ...$ or $\log_{10} 350000 = 1.04 + 0.38 \times t \Rightarrow t = ...$	M1
	D = awrt (£)400 000 $\Rightarrow$ yes or t = awrt 11.9 $\Rightarrow$ yes	A1
		(2)
		(7 marks)

(a)

M1: A correct application of log laws to obtain $D = 10^{1.04+0.38t}$ or forms one correct equation for a or b e.g. $a = 10^{1.04}$ or $b = 10^{0.38}$. May be implied by a = awrt 11 or b = awrt 2.4

A1: One of $a =$ awrt 10.96, $b =$ awrt 2.399. May be seen embedded in their equation.

A1: Correct **equation** with correct awrt values e.g. $D = (awrt\,10.96) \times (awrt\,2.399)^t$

Do <u>not</u> allow recovery from incorrect work e.g.

$\log_{10} D = 1.04 + 0.38t \Rightarrow D = 10^{1.04} + 10^{0.38t} \Rightarrow a = 10.96,\ b = 2.399 \Rightarrow D = 10.96 \times 2.399^t$

Scores M1A1A0

Note that *a* and *b* may be found in other ways e.g.

$$t = 0 \Rightarrow a = D = 10^{1.04},\ t = 1 \Rightarrow b = \frac{D}{a} = \frac{10^{1.42}}{10^{1.04}} = 10^{0.38}$$

(b)

M1: This mark is awarded for proceeding to $T = \ldots$ or $t = \ldots$ where … may be a numerical expression e.g. ln(…) from one of:

- substituting $D = 45000$ into their $D = "10.96" \times "2.399"^{T}$ (Must be of this form)
- substituting $D = 45000$ into $\log_{10} D = 1.04 + 0.38T$ (Must be the given equation)

A1: awrt 9.51 (months) (Ignore labelling and just look for the value)
Units are **not** required but if any are given they must be correct.

Allow recovery from incorrect rounding in (a) e.g. 10.97 for *a*
Correct answer only scores both marks.
Note that part (b) can be done without having attempted part (a)

(c)

M1: This mark is awarded for one of:

- substituting $t = 12$ into their $D = "10.96" \times "2.399"^{12}$ and proceeding to a **value** for D
- substituting $t = 12$ into $\log_{10} D = 1.04 + 0.38t$ proceeding to a value for D
- substituting $D = 350000$ into their $D = "10.96" \times "2.399"^{t}$ and proceeding to a **value** for t
- substituting $D = 350000$ into $\log_{10} D = 1.04 + 0.38t$ and proceeding to a **value** for t

A1: This mark is awarded for one of:

- obtaining D = awrt (£)400 000 and making a (minimal) conclusion e.g. "yes"
- obtaining t = awrt 11.9 or truncated 11.8 and making a (minimal) conclusion e.g. "yes"

For reference the values of *D*/*t* which may be seen are:
D = 398 266.278 (from rounded values of a and b)
D = 398 107.1706 (from full values of a and b)
t = 11.85236… (from rounded values of a and b)
t = 11.85281… (from full values of a and b)

Allow recovery from incorrect rounding in (a) e.g. 10.97 for *a*
Note that part (c) can be done without having attempted part (a)

Acceptable alternative for (c):
$\log_{10} 350000 = 5.54...,\ 1.04 + 0.38 \times 12 = 5.6$ so "yes"
or e.g.
$\log_{10} 350000 = 1.04 + 0.38 \times 12,\ 5.544... < 5.6$ so "yes"
(Condone e.g. $5.54 \approx 5.6$ so "yes")
Score M1 for substituting D = 350 000 and t = 12 into the given equation and evaluating both sides and then A1 for a correct conclusion with lhs evaluated as awrt 5.54 or truncated 5.5 and rhs evaluated as 5.6

Allow obvious slips in the copying of 45 000 and/or 350 000 used as e.g. 4500 or 35000 for the M marks in (b) and (c)

Question Number	Scheme	Marks
4(a)	$\mathrm{f}(x)=\dfrac{2x^2-32}{(3x-5)(x+4)}+\dfrac{8}{3x-5}$	B1
	$=\dfrac{2x^2-32}{(3x-5)(x+4)}+\dfrac{8}{3x-5}=\dfrac{2x^2-32+8(x+4)}{(3x-5)(x+4)}$ or e.g. $=\dfrac{2(x-4)(x+4)}{(3x-5)(x+4)}+\dfrac{8}{3x-5}=\dfrac{2(x-4)+8}{(3x-5)}$	M1
	$=\dfrac{2x\cancel{(x+4)}}{(3x-5)\cancel{(x+4)}}=\dfrac{2x}{3x-5}$ *	A1*
		(3)
(b)	$\mathrm{f}'(x)=\dfrac{2(3x-5)-3\times 2x}{(3x-5)^2}$	M1A1
	$\mathrm{f}'(x)=\dfrac{-10}{(3x-5)^2}$ As $(3x-5)^2>0$ (for $x>2$) then $\mathrm{f}'(x)<0$ Hence f is a decreasing function *	A1cso*
		(3)
(c)	$\mathrm{g}^{-1}(x)=\mathrm{e}^{\frac{x-3}{2}}$	M1A1
	$x\geqslant 3$	B1
		(3)
(d)	$\mathrm{g}\left(\dfrac{2a}{3a-5}\right)=5\Rightarrow 3+2\ln\left(\dfrac{2a}{3a-5}\right)=5$	B1
	$\ln\left(\dfrac{2a}{3a-5}\right)=1\Rightarrow\dfrac{2a}{3a-5}=\mathrm{e}$	M1
	$\dfrac{2a}{3a-5}=\mathrm{e}\Rightarrow a=...$	**d**M1
	$a=\dfrac{5\mathrm{e}}{3\mathrm{e}-2}$	A1
		(4)
(d) Way 2	$\mathrm{gf}(a)=5\Rightarrow\dfrac{2a}{3a-5}=\mathrm{g}^{-1}(5)$	B1
	$\dfrac{2a}{3a-5}=\mathrm{g}^{-1}(5)\Rightarrow\dfrac{2a}{3a-5}=\mathrm{e}$	M1
	$\dfrac{2a}{3a-5}=\mathrm{e}\Rightarrow a=...$	**d**M1
	$a=\dfrac{5\mathrm{e}}{3\mathrm{e}-2}$	A1
		(13 marks)