Question Number	Scheme	Marks
6.(a)	$(2, -10)$	B1 B1 **(2)**
(b)	$\text{ff}(0) = \text{f}(-4) = ...$	M1
	= 8	A1cso **(2)**
(c)	Attempts to solve $-3(x-2)-10 = 5x+10 \Rightarrow x = ...$	M1
	$x > -\frac{7}{4}$ only	A1 **(2)**
(d)	$x\left(\text{or } \lvert x\rvert\right) = \frac{16}{3}$	B1
	Attempts $3(\lvert x\rvert -2)-10 = 0 \Rightarrow \lvert x\rvert = k,\ k > 0$	
	or $3(-x-2)-10 = 0 \Rightarrow x = -k$	M1
	or $3(x-2)-10 = 0 \Rightarrow x = k \Rightarrow x = -k$	
	$x = \left(\frac{16}{3} \text{ and }\right) -\frac{16}{3}$ with no other values	A1 **(3)**
		(9 marks)

Notes

(a)

B1 For one correct coordinate

B1 For $(2, -10)$. Allow $x = ..., y = ...$ Do not accept e.g. 6/3 unless 2 has been seen/identified with this.

(b)

M1 For a full attempt at f f (0) . Can be scored for f (-4). Allow for use of their f(0) even if incorrect as long as the process is clear, e.g. f(0) = .. stated or calculated first then used. May be scored by first attempting ff(x) before substituting. This mark is for showing the correct process of composites, so may be scored if there are slips or errors with modulus if the intent is clear.

A1cso $\text{ff}(0) = 8$ only. A0 if other values given.

(c)

M1 Attempts to solve $-3(x-2)-10 = 5x+10 \Rightarrow x = ...$ Allow with equality or any inequality for the M mark.

Alternatively, rearranges to $\lvert x-2\rvert = ax+b$, squares both sides and solves the quadratic.

A1 $x > -\frac{7}{4}$ (oe) only. If another inequality or value is given and not rejected withhold this mark.

(d)

Work for (d) must be seen or referred to in (d). Do not accept for work attempted in earlier parts but not used in (d).

B1 For $x = \frac{16}{3}$. Allow when seen even from incorrect working as it could be verified. May be seen on sketch as long as referred to in (d). Allow also for $\lvert x\rvert = \frac{16}{3}$

M1 Correct method to find the root on the negative *x*-axis. E.g. attempts to solve $3\left(|x|-2\right)-10=0$ to achieve a value for |*x*|, or $3\left(-x-2\right)-10=0$ to achieve a value for *x*, or for reflecting in the *y*-axis (making negative) their $\frac{16}{3}$ from an attempt at $3\left(x-2\right)-10=0$. May be part of longer winded attempts. Allow missing brackets for the M.

Note it is possible to arrive at an equation leading to $x=\pm\frac{16}{3}$ from incorrect starting points, and such methods will score M0.

A1 For $x=-\frac{16}{3}$ with no other values (aside their $x=\frac{16}{3}$) . Must give the negative value, not just $|x|=\frac{16}{3}$. May be stated on a sketch as long as work seen in (d). Do not isw if they clearly reject this value later or if they try to form an inequality from the values, which is A0 as other values are included.

Question Number	Scheme	Marks
7.(a)	States or implies that $A = 2\,500$	B1
	$10\,000 = 2500\mathrm{e}^{k\times 8} \Rightarrow 8k = \ln 4 \Rightarrow k = ...$	M1
	$\Rightarrow k = \frac{1}{8}\ln 4$ or awrt 0.1733	A1
		(3)
(b)	$\frac{\mathrm{d}N}{\mathrm{d}t} = 60\,000 \times -0.6\mathrm{e}^{-0.6\times 5} = -1792$ So decrease is 1790	M1, A1
		(2)
(c)	$60\,000\mathrm{e}^{-0.6t} = 2500\mathrm{e}^{0.1733t}$	M1
	$24 = \mathrm{e}^{0.1733t+0.6t} \Rightarrow 0.1733t + 0.6t = \ln 24 \Rightarrow t = ...$	dM1
	$T = 4.11$	A1
		(3)
		8 marks

Notes

(a)

B1 States or implies that $A = 2\,500$. E.g award for $N = 2500\mathrm{e}^{kt}$

M1 Attempts to use $N = A\mathrm{e}^{kt}$ with $t = 8, N = 10\,000$ and their A to set up and solve an equation in k. Correct ln work must be used to solve their equation.
Allow this mark for attempts to find k first by solving simultaneously if they use $t = 1$ for the start of the study: $2500 = A\mathrm{e}^{k}, 10000 = A\mathrm{e}^{8k} \Rightarrow \mathrm{e}^{7k} = 4 \Rightarrow 7k = \ln 4 \Rightarrow k = ...$ but the index and ln work must be correct.

A1 $k =$ awrt 0.1733. Accept the exact value $\frac{1}{8}\ln 4$ and isw after seen.

(b)

M1 $\frac{\mathrm{d}N}{\mathrm{d}t} = C\mathrm{e}^{-0.6\times 5} = ...$ where C is a constant. Condone $60\,000\mathrm{e}^{-0.6t} \rightarrow 60\,000\mathrm{e}^{-0.6t}$ as long as it is clear they think they have found $\frac{\mathrm{d}N}{\mathrm{d}t}$. Must be correct index (not kt).

A1 Awrt 1790 from a correct derivative. Condone awrt -1790

(c)

M1 Sets $60\,000\mathrm{e}^{-0.6t} =$ their $2500\mathrm{e}^{\text{"0.1733"}t}$ May use T or another variable instead. Allow a slip on e.g. the 60000 as 6000. Allow with k in place of their "0.1733" as long as they have a value for k in (a).

dM1 Proceeds to rearrange to $e^{mt} = D$ $(D > 0)$ and applies ln to find t. The ln work must be correct, though there may be slips in the coefficients or index work reaching $e^{mt} = D$ $(D > 0)$. May be implied by a correct answer for their $e^{mt} = D$
Alternatively, takes ln of both sides first and applies correct ln laws to proceed to make t the subject: $\ln\left(60\,000\mathrm{e}^{-0.6t}\right) = \ln\left(2500\mathrm{e}^{0.1733t}\right) \Rightarrow \ln 60000 - 0.6t = \ln 2500 + 0.1733t \Rightarrow t = ...$

A1 awrt 4.11 Must be a value, not an expression in ln terms for this mark.

Note Answer only scores no marks, method must be shown and the dM1 must be achieved in order to access the A mark.