Question Number	Scheme	Mark
8(a)	-35	B1
		(1)
(b)	$"-35"+40e^{0.2\times3}=37.88...$ 37 900	M1 A1
		(2)
(c)	$\left\{\frac{dE}{dt}=\right\}\ 40\times0.2\times e^{0.2\times5}=$ awrt 21.7 thousand {cars} per year	M1A1
		(2)
(d)	$150+450e^{-0.2X}="-35"+40e^{0.2X}\Rightarrow 40e^{0.4X}-185e^{0.2X}-450=0$ $40e^{0.4X}-185e^{0.2X}-450=0\Rightarrow e^{0.2X}=6.386522...$ $\Rightarrow 0.2X=\ln(6.3865...)\Rightarrow X=...$ awrt 9.3	M1 dM1 ddM1 A1
		(4)
		(9 marks)

(a)

B1: $\{A=\}\ -35$ only. There is no need to see the complete model.

(b)

M1: Substitutes $t = 3$ into the model using their "–35" and proceeds to find a value.
May be implied by their answer correct to 2sf which may need to be checked if A is incorrect.

A1: 37 900 or 37.9 thousand(s) only. Correct answer implies both marks.
37,900 or 37,9 thousand are both also correct.

(c)

M1: Differentiates to the form $pe^{0.2t}$, $p \neq 40$, substitutes in $t = 5$ and proceeds to find a value.
Allow 8e to imply this mark.
Sight of 21.7 or 21700 alone scores M0 with no evidence of differentiation.

A1: awrt 21.7 thousand(s) {cars} per year or awrt 21700 {cars} per year including units.
21,700 {cars} per year or 21,7 thousand {cars} per year are both also correct.
Must follow a correct derivative in some form, so allow it to follow e.g. $40\times0.2\times e^{0.2\times5}$ or 8e or $8e^{0.2\times5}$ or $40\times0.2\times e^{0.2t}$
Correct answer only scores no marks.

(d) **Note that they may work in a variable other than X throughout this part for full marks.**

M1: Sets the two expressions equal to each other using their A, multiplies by $e^{\pm 0.2X}$ and proceeds to a 3TQ with terms collected. All terms do not need to be on the same side (so they may not even realise that they have a 3TQ).

Condone incorrect notation when squaring $e^{\pm 0.2X}$ i.e. $e^{(\pm 0.2X)^2}$ provided it is recovered (for all the marks).

dM1: Attempts to solve their 3TQ in $e^{\pm 0.2X}$ using the usual rules but they may use a calculator, in which case you may need to check their values to 2sf.

For reference, if their quadratic is correct, look for $e^{0.2X} = \text{awrt } 6.4$ **or** $\text{awrt } -1.8$

$\left(= \dfrac{37 \pm \sqrt{4249}}{16}\right)$ or $e^{-0.2X} = \text{awrt } 0.16$ **or** $\text{awrt } -0.57$ $\left(= \dfrac{-37 \pm \sqrt{4249}}{180}\right)$

Note that they must achieve $e^{\pm 0.2X} = ...$ so if they substitute for $e^{\pm 0.2X}$ then they must revert back but it may be implied by later work.

Dependent on the previous method mark.

ddM1: Uses logs correctly to proceed from $e^{\pm 0.2X} = q$ where $q > 0$ to $X = ...$

May be implied by a correct value for X from their $e^{\pm 0.2X} = q$

Dependent on both previous method marks.

A1: awrt 9.3 following award of all three previous marks. Correct answer only scores no marks.

Question Number	Scheme	Mark
9(a)	$\left(\frac{k}{2}, 3\right)$	B1B1
		(2)
(b)	$-2x+k+3=\frac{1}{2}x+\frac{k+7}{2}$ **or** $2x-k+3=\frac{1}{2}x+\frac{k+7}{2}$	M1
	$x=\frac{k-1}{5}$ **or** $x=\frac{3k+1}{3}$	A1
	$-2x+k+3=\frac{1}{2}x+\frac{k+7}{2}$ **and** $2x-k+3=\frac{1}{2}x+\frac{k+7}{2}$	dM1
	M: $x=\frac{k-1}{5}$ **and** N: $x=\frac{3k+1}{3}$	A1
		(4)
(c)	y coordinate of R is $k+3$	B1
	$\frac{1}{2}\times"(k+3)"\times"\frac{(k-1)}{5}"=\frac{33}{40}\Rightarrow ...k^2\pm...k\pm...=0$	M1
	$4k^2+8k-45=0 \Rightarrow k=...\{2.5\} \Rightarrow \frac{1}{2}\times("2.5+3")\times\left(\frac{3\times2.5+1}{3}\right)=\frac{187}{24}$	dM1A1
		(4)
		(10 marks)

Mark all parts together.

(a) **Note: May be seen on their diagram if they have drawn one.**

B1: One coordinate correct. Allow e.g. $x=0.5k$ or $y=3$

B1: Both coordinates correct. Allow e.g. $x=\frac{1}{2}k$, $y=3$

If they write their answer as a vector $\begin{pmatrix}\frac{1}{2}k\\3\end{pmatrix}$ then score B1B0

(b) **Ignore any attempt to find *y* coordinates in this part.**

M1: Attempts to form an equation with modulus brackets removed.

They must deal with the modulus brackets correctly (so $|2x-k|$ must be replaced with either $2x-k$ or $-2x+k$ o.e.) but condone a slip e.g. in multiplying by 2 when they first set up the equation.

So allow e.g. $|2x-k|+3=\frac{1}{2}x+\frac{k+7}{2} \rightarrow 2|2x-k|+3=x+k+7 \rightarrow 4x-2k+3=x+k+7$

or e.g. $|2x-k|+3=\frac{1}{2}x+\frac{k+7}{2} \rightarrow |2x-k|+6=x+k+7 \rightarrow -(2x-k)+6=x+k+7$

A1: $x=\frac{k-1}{5}$ or $x=\frac{3k+1}{3}$ o.e. Do not be concerned by labelling.

Ignore incorrect simplification after a correct expression for x in terms of k is seen.