Question Number	Scheme	Mark
7(a)	$\left\{\frac{\mathrm{d}y}{\mathrm{d}x}=\right\}-2+5\sin\left(\frac{1}{2}x\right)\cos\left(\frac{1}{2}x\right)$	M1A1
	$-2+5\sin\left(\frac{1}{2}x\right)\cos\left(\frac{1}{2}x\right)=0\Rightarrow\frac{5}{2}\sin x=2\Rightarrow x=...$	dM1
	$x=$ awrt 2.21	A1
		(4)
(b)	$\int 1-2x+5\sin^2\left(\frac{1}{2}x\right)\mathrm{d}x\Rightarrow\int\frac{7}{2}-2x-\frac{5}{2}\cos x\ \mathrm{d}x$	M1
	$\int\frac{7}{2}-2x-\frac{5}{2}\cos x\ \mathrm{d}x=\frac{7}{2}x-x^2-\frac{5}{2}\sin x\ \ (+c)$	A1ft
	$\left(\frac{7}{2}\left(\frac{\pi}{2}\right)-\left(\frac{\pi}{2}\right)^2-\frac{5}{2}\sin\left(\frac{\pi}{2}\right)\right)-\left(\frac{7}{2}\left(\frac{\pi}{6}\right)-\left(\frac{\pi}{6}\right)^2-\frac{5}{2}\sin\left(\frac{\pi}{6}\right)\right)$	dM1
	$=\frac{7\pi}{6}-\frac{2\pi^2}{9}-\frac{5}{4}$	A1
		(4)
		(8 marks)

(a) **Note:** If you just see $-2+\frac{5}{2}\sin x$ with no previous manipulation of the given expression, then send to review.

M1: Attempts to differentiate, achieving $A+B\sin\left(\frac{1}{2}x\right)\cos\left(\frac{1}{2}x\right)$ for A, B non-zero.

Alternatively, uses the identity $\pm\cos x=\pm1\pm2\sin^2\left(\frac{1}{2}x\right)$ to replace $\sin^2\left(\frac{1}{2}x\right)$ and differentiates to the form $\left\{\frac{\mathrm{d}y}{\mathrm{d}x}=\right\}\ \alpha+\beta\sin x$ for α, β non-zero. Note that they may rearrange $\pm\cos x=\pm1\pm2\sin^2\left(\frac{1}{2}x\right)$ incorrectly but allow if an acceptable identity is seen.

A1: $-2+5\sin\left(\frac{1}{2}x\right)\cos\left(\frac{1}{2}x\right)$ o.e. e.g. $-2+\frac{5}{2}\sin x$ There is no need to see a LHS e.g. $\frac{\mathrm{d}y}{\mathrm{d}x}$

May be unsimplified e.g. $-2+\frac{10}{2}\sin\left(\frac{1}{2}x\right)\cos\left(\frac{1}{2}x\right)$

Condone slips in their constant term for this mark and penalise in the final mark: see SC1.

dM1: Sets $A+B\sin\left(\frac{1}{2}x\right)\cos\left(\frac{1}{2}x\right)=0$, uses $\sin x=2\sin\left(\frac{x}{2}\right)\cos\left(\frac{x}{2}\right)$ and proceeds to solve $A+\frac{B}{2}\sin x=0$ with $\left|\frac{2A}{B}\right|\leqslant1$ **or** solves $\alpha+\beta\sin x=0$ with $\left|\frac{\alpha}{\beta}\right|\leqslant1$ to find a value for x.

There is no need to see e.g. $\sin x=\frac{4}{5}$

Some are incorrectly replacing $2\sin\left(\frac{x}{2}\right)\cos\left(\frac{x}{2}\right)$ with $\sin 2x$ and score dM0.

A1: awrt 2.21 following award of all previous marks. Correct answer only scores no marks.
If there is more than one answer, awrt 2.21 must be clearly selected or the others rejected.
Ignore any attempt to a y coordinate.

SC1: Note that if they use the alternative but make slips on the constant term e.g. a sign error e.g. $y=1-2x-\frac{5}{2}-\frac{5}{2}\cos x$ they may still achieve $\left\{\frac{\mathrm{d}y}{\mathrm{d}x}=\right\}-2+\frac{5}{2}\sin x$ and go on to find awrt 2.21. In such cases allow M1A1dM1A0 to be scored.

SC2: Similarly, a sign error on the cos$x$ term e.g. $y=1-2x+\frac{5}{2}+\frac{5}{2}\cos x$ followed by a second error when differentiating may fortuitously produce $\left\{\frac{\mathrm{d}y}{\mathrm{d}x}=\right\}-2+\frac{5}{2}\sin x$ and they may go on to find awrt 2.21. In such cases allow M1A0dM1A0 to be scored.

(b) Note: if you see work that does not show any algebraic integration but proceeds directly to e.g. $\frac{7\pi}{6}-\frac{2\pi^2}{9}-\frac{5}{4}$ or similar then send to review.

M1: Attempts to use the identity $\pm\cos x=\pm1\pm2\sin^2\left(\frac{1}{2}x\right)$ to achieve the integral $C+Dx+E\cos x$ where C, D and E are non-zero.
Note that the use of the identity may be seen in part (a) but must be seen again or used in part (b) to score this mark.

A1ft: Integrates to achieve $Cx+\frac{D}{2}x^2+E\sin x$ following through on their values for C, D and E.
This may be unsimplified, i.e., they may not have collected their x terms together or they may have e.g. $-\frac{2}{2}x^2$

dM1: Attempts to substitute in the correct limits and subtracts either way round into a changed expression from their $C+Dx+E\cos x$
It is dependent on the previous method mark.

A1: cao $\frac{7\pi}{6}-\frac{2\pi^2}{9}-\frac{5}{4}$ o.e. e.g. $\frac{42\pi-8\pi^2-45}{36}$ or $\frac{(4\pi-15)(3-2\pi)}{36}$ and apply ISW after a correct answer is seen. Allow equivalent fractions e.g. $\frac{14}{12}\pi$ for $\frac{7\pi}{6}$
All previous marks must be scored but note that the below is acceptable for full marks.

$$\int\frac{7}{2}-2x-\frac{5}{2}\cos x\ \{\mathrm{d}x\}=\left[\frac{7}{2}x-x^2-\frac{5}{2}\sin x\right]_{\frac{\pi}{6}}^{\frac{\pi}{2}}=\frac{7\pi}{6}-\frac{2\pi^2}{9}-\frac{5}{4}$$

SC3: Note that a sign error on the cos$x$ term followed by a second error when integrating may fortuitously produce the correct integrated expression. Scores maximum 1010 in this case.

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.