Question	Scheme	Marks	AOs
3(a)	$100m^2+60m+13=0 \Rightarrow m=-0.3\pm 0.2\mathrm{i}$	M1	1.1b
	$x=\mathrm{e}^{-0.3t}\left(A\cos 0.2t+B\sin 0.2t\right)$	A1	1.1b
	PI: $x=2$	B1	1.1b
	$x=\mathrm{e}^{-0.3t}\left(A\cos 0.2t+B\sin 0.2t\right)+2$	A1ft	2.2a
		(4)	
(b)	$t=0,\ \ x=0 \Rightarrow A=-2$	M1	3.4
	$\frac{\mathrm{d}x}{\mathrm{d}t}=-0.3\mathrm{e}^{-0.3t}\left(-2\cos 0.2t+B\sin 0.2t\right)+\mathrm{e}^{-0.3t}\left(0.4\sin 0.2t+0.2B\cos 0.2t\right)$ $t=0,\ \frac{\mathrm{d}x}{\mathrm{d}t}=10 \Rightarrow B=\ldots(\text{NB } B=47)$	M1	3.4
	$x=\mathrm{e}^{-0.3t}\left(47\sin 0.2t-2\cos 0.2t\right)+2$	A1	1.1b
	$-0.3\mathrm{e}^{-0.3t}\left(47\sin 0.2t-2\cos 0.2t\right)+\mathrm{e}^{-0.3t}\left(9.4\cos 0.2t+0.4\sin 0.2t\right)=0$ $\Rightarrow t=\ldots$ or $x=\sqrt{2213}\mathrm{e}^{-0.3t}\sin\left(0.2t-0.0425\right)+2$ $\Rightarrow \frac{\mathrm{d}x}{\mathrm{d}t}=-0.3\sqrt{2213}\mathrm{e}^{-0.3t}\sin\left(0.2t-0.0425\right)$ $+0.2\sqrt{2213}\mathrm{e}^{-0.3t}\cos\left(0.2t-0.0425\right)$ $\Rightarrow t=\ldots$	M1	3.1b
	$\tan 0.2t=\frac{100}{137} \Rightarrow 0.2t=0.630\ldots$ or $\tan\left(0.2t-0.0425\right)=\frac{2}{3} \Rightarrow 0.2t=0.630$	M1	2.1
	$t=3.15\ldots$ weeks	A1	1.1b
	$x=\mathrm{e}^{-0.3\times\text{"}3.15\text{"}}\left(47\sin\left(0.2\times\text{"}3.15\ldots\text{"}\right)-2\cos\left(0.2\times\text{"}3.15\ldots\text{"}\right)\right)+2$	M1	3.4
	$=$ awrt 12.1 $\{\mu\text{g/ml}\}$	A1	3.2a
		(8)	
(c)	$t=10 \Rightarrow x=\mathrm{e}^{-3}\left(47\sin(2)-2\cos(2)\right)+2=4.16\ldots$	M1	3.4
	The model suggests that it would be safe to give the second dose	A1ft	2.2a
		(2)	
			(14 marks)

Notes

(a)
M1: Uses the model to form and solve the auxiliary equation
A1: Correct CF, does not need $x=$
B1: Correct PI
A1ft: Deduces the correct GS (follow through their CF + PI). Must have $x=\mathrm{f}(t)$ and PI not 0

(b)
M1: Uses the model and the initial conditions to establish the value of "A"
M1: Differentiates their model using the product rule and uses the initial conditions to establish the value of "B". Must be using $x=0$ and $\frac{\mathrm{d}x}{\mathrm{d}t}=10$
A1: Correct particular solution. This can be implied by the correct constants found following a correct answer to part (a).

M1: Uses their solution to the model with a correct strategy to obtain the required value of t e.g. differentiates, sets equal to zero and solves for t

M1: Uses a correct trigonometric approach that leads to a value for t

A1: Correct value for t

M1: Uses the model and their value for t to find the maximum concentration.

A1: Correct value

(c)

M1: Uses the model to find the concentration when $t = 10$

A1ft: Makes a suitable comment that is consistent with their calculated value

Special case: If the candidate's maximum value is less than 5 then

M1: never reaches 5 as maximum is…. or max is less than 5

A1: yes, it is safe