Question	Scheme	Marks	AOs
9(a)	$m^2+2m+1=0 \Rightarrow m=...(-1)$	M1	1.1b
	$CF: y=(At+B)\mathrm{e}^{-t}$	M1	2.2a
	PI : Try $y=kt^2\mathrm{e}^{-t}+c$	B1	2.2a
	$\frac{\mathrm{d}y}{\mathrm{d}t}=2kt\mathrm{e}^{-t}-kt^2\mathrm{e}^{-t}$, $\frac{\mathrm{d}^2y}{\mathrm{d}t^2}=2k\mathrm{e}^{-t}-2kt\mathrm{e}^{-t}+kt^2\mathrm{e}^{-t}-2kt\mathrm{e}^{-t}$ $2k\mathrm{e}^{-t}-4kt\mathrm{e}^{-t}+kt^2\mathrm{e}^{-t}+2\left(2kt\mathrm{e}^{-t}-kt^2\mathrm{e}^{-t}\right)+kt^2\mathrm{e}^{-t}+1=\mathrm{e}^{-t}+1\Rightarrow k=...$	M1	1.1b
	$k=\frac{1}{2}\Rightarrow PI: y=\frac{1}{2}t^2\mathrm{e}^{-t}+1$	A1	1.1b
	$y=CF+PI=(At+B)\mathrm{e}^{-t}+\frac{1}{2}t^2\mathrm{e}^{-t}+1$	A1	1.1a
		(6)	
(b)	$t=0,\ y=1\Rightarrow B=0$	M1	3.4
	$y=\left(At+0.5t^2\right)\mathrm{e}^{-t}+1\Rightarrow \frac{\mathrm{d}y}{\mathrm{d}t}=\left(A+t-At-0.5t^2\right)\mathrm{e}^{-t}$ $t=0,\ \frac{\mathrm{d}y}{\mathrm{d}t}=9\Rightarrow A=9$	M1	3.4
	$y=\left(0.5t^2+9t\right)\mathrm{e}^{-t}+1$	A1	1.1b
		(3)	
(c)	$\frac{\mathrm{d}y}{\mathrm{d}t}=0\Rightarrow 0.5t^2+8t-9=0\Rightarrow t=...$	M1	3.1a
	$t>0\Rightarrow t=1.0553...\Rightarrow y=...$	M1	3.4
	$y=4.50\text{mg/l}$	A1	1.1b
		(3)	
(d)	$t=8\Rightarrow y=\left(0.5\times8^2+9\times8\right)\mathrm{e}^{-8}+1=1.03488...$ • This is close to 1 so the model supports the suggestion that the concentration returns to its initial value after around 8 hours	M1 A1ft	3.4 3.2b
		(2)	
			(14 marks)

Notes

(a)

M1: Forms and solves the auxiliary equation

A1: Deduces the correct complementary function

B1: Deduces the correct form of the PI given the outcome for the CF

M1: Complete method to establish the value of k

A1: Correct PI

A1: Correct GS

(b)

M1: Uses the model and the initial conditions to find the value of B

M1: Uses the model by differentiating and using the other initial condition to find a value for A

A1: Correct PS

(c)

M1: Solves $\frac{\mathrm{d}y}{\mathrm{d}t} = 0$ to find t when the concentration is a maximum

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

A1: Correct value

(d)

M1: Uses their model to finds the concentration when $t = 8$ in order to test the claim

A1ft: Follow through their solution but the comment must be consistent with their values.