

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

Question Number	Scheme	Marks
3(a)	$\log_{10} D = 1.04 + 0.38t \Rightarrow D = 10^{1.04 + 0.38t}$ or $a = 10^{1.04}$ or $b = 10^{0.38}$ $a = \text{awrt } 10.96$ or $b = \text{awrt } 2.399$ $D = 10.96 \times 2.399^t$	M1 A1 A1 (3)
(b)	$45\,000 = "10.96" \times "2.399"^T \Rightarrow T = \dots$ or $\log_{10} 45\,000 = 1.04 + 0.38T \Rightarrow T = \dots$ awrt 9.51	M1 A1 (2)
(c)	$D = "10.96" \times "2.399"^{12} \Rightarrow D = \dots$ or $\log_{10} D = 1.04 + 0.38 \times 12 \Rightarrow D = \dots$ or $350\,000 = "10.96" \times "2.399"^t \Rightarrow t = \dots$ or $\log_{10} 350\,000 = 1.04 + 0.38 \times t \Rightarrow t = \dots$ $D = \text{awrt } (\text{£})400\,000 \Rightarrow \text{yes}$ or $t = \text{awrt } 11.9 \Rightarrow \text{yes}$	M1 A1 (2)
(7 marks)		

8 (a)	52 b.p.m.	B1
		(1)
(b)	32 b.p.m.	B1
		(1)
(c)	$\frac{dH}{dt} = -8e^{-0.2t} + 18e^{-0.9t}$	M1, A1
	Sets $-8e^{-0.2t} + 18e^{-0.9t} = 0 \Rightarrow 4e^{0.7t} = 9$	dM1
	$\Rightarrow 0.7t = \ln \frac{9}{4} \Rightarrow t = \dots$	M1
	$T = 1.158$ (minutes)	A1
		(5)
(d)	$37 = 32 + 40e^{-0.2t} - 20e^{-0.9t} \Rightarrow e^{-0.2t} = \frac{1 + 4e^{-0.9t}}{8}$	M1
	$\Rightarrow e^{0.2t} = \frac{8}{1 + 4e^{-0.9t}} \Rightarrow t = 5 \ln \left(\frac{8}{1 + 4e^{-0.9t}} \right)$	A1*
		(2)
(e)	$t_2 = 5 \ln \left(\frac{8}{1 + 4e^{-0.9 \times 10}} \right) = \dots$	M1
	$(t_2) = \text{awrt } 10.3947$	A1
	$(M) = 10.3955$	A1
		(3)
		Total 12