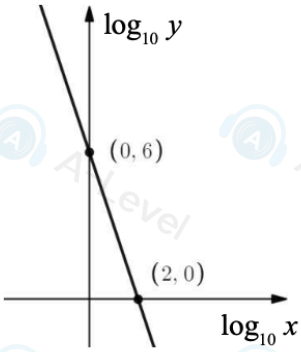
4(a)	$A = 93$	B1
		(1)
(b)	$100 = 125 - "93"e^{-0.109T} \Rightarrow Ae^{-0.109T} = ...$	M1
	$Ae^{kT} = B \Rightarrow T = \dfrac{\ln\left(\dfrac{B}{A}\right)}{k}$	dM1
	$T = 12.05$	A1
		(3)
(c)	$\dfrac{dN}{dt} = 0.109 \times "93"e^{-0.109 \times 7}$	M1
	4 730 (total sales per month)	A1
		(2)
(d)	The limit is 125 000 / the model has a limit below 150 000	B1
		(1)
		(7 marks)

Question Number	Scheme	Marks
3(a)	$m = \dfrac{2.25 - 2}{5}$ $\log_{10} V = 0.05t + 2$	M1 A1
		(2)
(b)	$\log_{10} V = 0.05t + 2 \Rightarrow V = 10^{0.05t+2}$ $a = 100$ or $b = 1.12$ $V = 100 \times (1.12)^t$	M1 A1 A1
		(3)
(c)	$\dfrac{dV}{dt} = 100 \times \ln 1.12 \times (1.12)^t \quad \left(= 11.33(1.12)^t\right)$ $100 \times \ln 1.12 \times (1.12)^T = 50 \Rightarrow (1.12)^T = \dfrac{50}{100 \ln 1.12}$ $(T =) \log_{1.12}\left(\dfrac{50}{100 \ln 1.12}\right) = ...$ $(T =) 13$	B1ft M1 dM1 A1
		(4)
		(9 marks)

Question Number	Scheme	Marks
5(a)	$(A=)8$	B1
		(1)
(b)	$16=10+"8"\mathrm{e}^{-Bt}\Rightarrow \mathrm{e}^{-Bt}=\ldots$	M1
	$\mathrm{e}^{-45B}="\frac{3}{4}"\Rightarrow -45B=\ln"\frac{3}{4}"\Rightarrow B=\ldots$	**d**M1
	$B=$ awrt 0.00639	A1
		(3)
(c)	$\frac{\mathrm{d}T}{\mathrm{d}t}=-"8"\times\frac{1}{45}\ln\left(\frac{4}{3}\right)\times\mathrm{e}^{-\frac{1}{45}\ln\left(\frac{4}{3}\right)\times 2}=\ldots$	M1
	$=-0.0505$	A1
		(2)
(d)	The temperature has a (lower) limit of 10 °C **or** $5=10+"8"\mathrm{e}^{-Bt}\Rightarrow \mathrm{e}^{-Bt}=-\frac{5}{"8"}$ e.g. which is not possible or cannot be solved or you cannot find the log of a negative number	B1
		(1)
		(7 marks)

7.(a)	States or implies that $A=2\,500$	B1
	$10000=2500\mathrm{e}^{k\times 8}\Rightarrow 8k=\ln 4\Rightarrow k=\ldots$	M1
	$\Rightarrow k=\frac{1}{8}\ln 4$ or awrt 0.1733	A1
		(3)
(b)	$\frac{\mathrm{d}N}{\mathrm{d}t}=60\,000\times -0.6\mathrm{e}^{-0.6\times 5}=-1792$ So decrease is 1790	M1, A1
		(2)
(c)	$60000\mathrm{e}^{-0.6t}=2500\mathrm{e}^{0.1733t}$	M1
	$24=\mathrm{e}^{0.1733t+0.6t}\Rightarrow 0.1733t+0.6t=\ln 24\Rightarrow t=\ldots$	dM1
	$T=4.11$	A1
		(3)
		8 marks

3 (i)	$y = \dfrac{10^6}{x^3} \Rightarrow \log_{10} y = \log_{10} 10^6 - \log_{10} x^3 \Rightarrow \log_{10} y = 6 - 3\log_{10} x$	
		B1 B1 B1 **(3)**
(ii)	States $\log_3 N = 2t + 4$ **or** $\log_3 N = \log_3 a + t\log_3 b$	B1
	$N = 3^{2t+4} = 3^{2t} \times 3^4$ **or** $\log_3 a = 4 \Rightarrow a = \ldots$ **or** $\log_3 b = 2 \Rightarrow b = \ldots$	M1
	$N = 81 \times 9^t$	A1cso **(3)** **(6 marks)**

8 (a)	52 b.p.m.	B1 **(1)**
(b)	32 b.p.m.	B1 **(1)**
(c)	$\dfrac{dH}{dt} = -8\,e^{-0.2t} + 18\,e^{-0.9t}$	M1, A1
	Sets $-8\,e^{-0.2t} + 18\,e^{-0.9t} = 0 \Rightarrow 4e^{0.7t} = 9$	dM1
	$\Rightarrow 0.7t = \ln\dfrac{9}{4} \Rightarrow t = \ldots$	M1
	$T = 1.158$ (minutes)	A1
		(5)
(d)	$37 = 32 + 40\,e^{-0.2t} - 20\,e^{-0.9t} \Rightarrow e^{-0.2t} = \dfrac{1 + 4\,e^{-0.9t}}{8}$	M1
	$\Rightarrow e^{0.2t} = \dfrac{8}{1 + 4\,e^{-0.9t}} \Rightarrow t = 5\ln\left(\dfrac{8}{1 + 4\,e^{-0.9t}}\right)$	A1*
		(2)
(e)	$t_2 = 5\ln\left(\dfrac{8}{1 + 4e^{-0.9\times10}}\right) = \ldots.$	M1
	$(t_2) =$ awrt 10.3947	A1
	$(M) = 10.3955$	A 1
		(3)
		Total 12

Question Number	Scheme	Marks
4(a)	$R=\sqrt{12}$ or $2\sqrt{3}$	B1
	$\alpha=\tan^{-1}\left(\frac{3}{\sqrt{3}}\right)=\ldots$	M1
	$(f(x)=)\sqrt{12}\sin\left(2x-\frac{\pi}{3}\right)$	A1
		(3)
(b)(i)	Minimum value $=\frac{18}{\sqrt{12}+4\sqrt{3}}(=\sqrt{3})$	B1
(ii)	$\sin\left(6x-\frac{\pi}{3}\right)=1\Rightarrow x=\frac{5}{36}\pi$	M1A1
		(3)
		(6 marks)

Question Number	Scheme	Marks
2 (a) (i)	$\log_6 T=4-2\log_6 x$	B1
(ii)	E.g. $\log_6 T=4-2\log_6 216\Rightarrow \log_6 T=4-2\times 3=-2\Rightarrow T=\ldots$	M1
	$\Rightarrow T=6^{-2}=\frac{1}{36}$	A1
		(3)
(b)	$\log_6 T=4-2\log_6 x\Rightarrow T=6^{4-2\log_6 x}$	M1
	$\Rightarrow T=6^4\times 6^{\log_6 x^{-2}}$	dM1
	$\Rightarrow T=\frac{1296}{x^2}$	A1
		(3)
		(6 marks)