Question	Scheme	Marks	AOs
9 (a)	$\{y = ab^t \ \Rightarrow\}\ \log_{10} y = \log_{10}(ab^t) \Rightarrow \log_{10} y = \log_{10} a + \log_{10} b^t$	M1	1.1b
	$\Rightarrow \log_{10} y = t\log_{10} b + \log_{10} a\,,\ \{\text{where } c = \log_{10} a\}$	A1	2.1
		(2)	
(b)	$c = \log_{10} a = 2.23,$ $m = \log_{10} b = -0.076$		
	$\Rightarrow a = 10^{2.23}\ \{= 169.8243652...\}$ $\Rightarrow b = 10^{-0.076}\ \{= 0.8394599865...\}$	M1	1.1b
	$a = 170$ (2 sf) and $b = 0.84$ (2 sf)	A1	1.1b
		(2)	
(c)	$y = (170)(0.84)^t$		
	(i) $\{a = "170" \Rightarrow\}$ e.g. • "170" milligrams of antibiotic were initially given to the patient • the initial dose of the antibiotic is estimated as "170" milligrams	B1ft	3.4
	(ii) $\{b = "0.84" \Rightarrow\}$ e.g. after the antibiotic is first given the amount of antibiotic in the patient's bloodstream reduces by approximately "16%" per hour	B1ft	3.4
		(2)	
(d)	$30 = (170)(0.84)^t \Rightarrow \dfrac{30}{170} = (0.84)^t \Rightarrow \ln\left(\dfrac{30}{170}\right) = \ln(0.84)^t$ $\Rightarrow \ln\left(\dfrac{30}{170}\right) = t\ln(0.84) \Rightarrow t = \dfrac{\ln\left(\dfrac{30}{170}\right)}{\ln(0.84)}$	M1	3.4
	$\{t = 9.948766031... \Rightarrow\}\ t = 9.9$ (hours) (1 dp)	A1	1.1b
		(2)	
(d) Alt 1	$\log_{10} 30 = -0.076t + 2.23 \Rightarrow t = \dfrac{2.23 - \log_{10} 30}{0.076}$	M1	3.4
	$\{t = 9.90629928... \Rightarrow\}\ t = 9.9$ (hours) (1 dp)	A1	1.1b
		(2)	
(e)	e.g. As $t = 9.9$ is outside of the experimental data $0 \leqslant t \leqslant 5$, we do not have enough evidence to deduce that the model $y = (170)(0.84)^t$ is still valid. So, the estimate in part (d) should be treated with caution.	B1	3.5b
		(1)	
			(9 marks)

Question 9 Notes:	
(a)	
M1:	Starting from $y = ab^t$, takes logs of both sides and uses the addition law of logarithms to progress as far as $\log_{10} y = \log_{10} a + \log_{10} b^t$
A1:	Starting from $y = ab^t$, correctly shows that $\log_{10} y = t\log_{10} b + \log_{10} a$ with no errors seen
Note:	M1 (special case) can be given in part (a) for stating $c = \log_{10} a$
(b)	
M1:	For either $a = 10^{2\ 23}$ or $b = 10^{-0\ 076}$
A1:	$a = 170$ and $b = 0.84$
(c)(i)	
B1ft:	Correct practical interpretation of their a, where their $a > 0$
(c)(ii)	
B1ft:	Correct practical interpretation of their b, where their b: $0 < b < 1$
(d)	
M1:	Substitutes $y = 2.5$ into the model $y = (\text{their } a)(\text{their } b)^t$ and rearranges their equation to give $t = ...$
A1:	9.9 (hours) (1 dp)
(d)	
Alt 1	
M1:	Substitutes $y = 30$, $m = -0.076$ and $c = 2.23$ into the model $\log_{10} y = mt + c$ and rearranges their equation to give $t = ...$
A1:	9.9 (hours) (1 dp)
(e)	
B1:	E.g. Estimate should be treated with caution because $t = 9.9$ is outside the range of times, i.e. $0 \leqslant t \leqslant 5$, for which the model $y = (170)(0.84)^t$ is valid