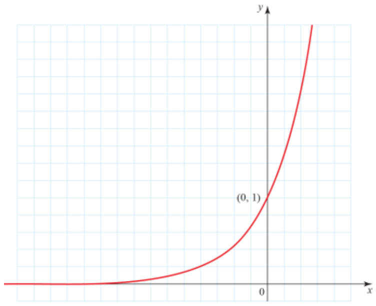
Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1a	Substitutes (2, 400) into the equation. $400 = ab^2$	M1	1.1b	6th Set up, use and critique exponential models of growth and decay.
	Substitutes (5, 50) into the equation. $50 = ab^5$	M1	1.1b	
	Makes an attempt to solve the expressions by division. For example, $b^3 = \frac{1}{8}$ (or equivalent) seen.	M1	1.1b	
	Solves for b. $b = 0.5$ or $b = \frac{1}{2}$	A1	1.1b	
	Solves for a. $a = 1600$	A1	1.1b	
		(5)		
1b	Divides by '1600' and takes logs of both sides. $\log\left(\frac{1}{2}\right)^x < \log\left(\frac{k}{1600}\right)$	M1ft	1.1b	5th Understand and use the three laws of logarithms.
	Uses the third law of logarithms to write $\log\left(\frac{1}{2}\right)^x = x\log\left(\frac{1}{2}\right)$ or $\log 2^x = x\log 2$ anywhere in solution.	B1	2.1	
	Uses the law(s) of logarithms to write $\log\left(\frac{1}{2}\right) = -\log 2$ anywhere in solution.	B1	2.1	
	Uses above to obtain $x > \frac{\log\left(\frac{1600}{k}\right)}{\log 2}$ *	A1*	2.1	
		(4)		
				(9 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2	Uses appropriate law of logarithms to write $\log_{11}(2x-1)(x+4)=1$	**M1**	3.1a	5th Solve simple logarithmic equations using the laws of logs.
	Inverse $\log_{11}$ (or 11 to the) both sides. $(2x-1)(x+4)=11$	**M1**	1.1b	
	Derives a 3 term quadratic equation. $2x^2+7x-15=0$	**M1**	1.1b	
	Correctly factorises $(2x-3)(x+5)=0$ or uses appropriate technique to solve their quadratic.	**M1**	1.1b	
	Solves to find $x=\frac{3}{2}$	**A1**	1.1b	
	Understands that $x\neq-5$ stating that this solution would require taking the log of a negative number, which is not possible.	**B1**	3.2	
				(6 marks)

Notes

Q	Scheme		Marks	AOs	Pearson Progression Step and Progress descriptor
3a	**Figure 1** 	Graph has correct shape and does not touch x-axis.	**M1**	3.1a	3rd Sketch the graph of $y = a^x$ (for $a > 1$)
		The point (0, 1) is given or labelled.	**A1**	3.1a	
			(2)		
3bi	Translation 1 unit right (or positive x direction) or by $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$		**B1**	2.2a	5th Transform the graphs of exponential functions using translations and stretches.
ii	Translation 5 units up (or positive y direction) or by $\begin{pmatrix} 0 \\ 5 \end{pmatrix}$		**B1**	2.2a	
			(2)		
					(4 marks)

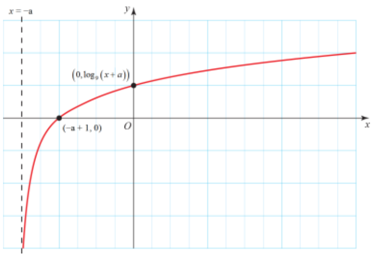
Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4	Correctly factorises. $\left(8^{x-1}-2\right)\left(8^{x-1}-16\right)=0$ (or for example, $(y-2)(y-16)=0$)	M1	1.1b	5th Solve exponential equations using logarithms.
	States that $8^{x-1}=2$, $8^{x-1}=16$ (or y = 2, y = 16).	A1	1.1b	
	Makes an attempt to solve either equation (e.g. uses laws of indices. For example, $\sqrt[3]{8}=2$ or $8^{\frac{1}{3}}=2$ or $\left(\sqrt[3]{8}\right)^4=16$ or $8^{\frac{4}{3}}=16$ (or correctly takes logs of both sides).	M1	2.2a	
	Solves to find $x=\frac{4}{3}$ o.e. or awrt 1.33	A1	1.1b	
	Solves to find $x=\frac{7}{3}$ o.e. or awrt 2.33	A1	1.1b	
		(5)		
				(5 marks)

Notes

4

2nd M mark can be implied by either $x-1=\frac{1}{3}$ or $x-1=\frac{4}{3}$

Q	Scheme		Marks	AOs	Pearson Progression Step and Progress descriptor
5a	**Figure 2** 	Attempt to find intersection with *x*-axis. For example, $\log_9(x+a)=0$	**M1**	1.1b	4th Sketch the graph $y = \log(x)$.
		Solving $\log_9(x+a)=0$ to find $x = -a + 1$, so coordinates of *x*-intercept are $(-a + 1, 0)$ oe	**A1**	1.1b	
		Substituting $x = 0$ to derive $y=\log_9(x+a)$, so coordinates of *y*-intercept are $(0,\log_9(x+a))$	**B1**	3.1a	
		Asymptote shown at $x = -a$ stated or shown on graph.	**B1**	3.1a	
		Increasing log graph shown with asymptotic behaviour and single *x*-intercept.	**M1**	3.1a	
		Fully correct graph with correct asymptote, all points labelled and correct shape.	**A1**	2.2a	
			(6)		
5b	$\log_9(x+a)^2=2\log_9(x+a)$ seen.		**M1**	2.1	5th Understand and use the three laws of logarithms.
	The graph of $y=\log_9(x+a)^2$ is a stretch, parallel to the *y*-axis, scale factor 2, of the graph of $y=\log_9(x+a)$.		**A1**	2.2a	
			(2)		
					(8 marks)

Notes

5a

Award all 5 points for a fully correct graph with asymptote and all points labelled, even if all working is not present

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6a	Makes an attempt to subsitute 7 into the equation, for example, $P = 100e^{0.4\times7}$ seen.	M1	1.1b	4th Understand the properties of functions of the form a^x.
	1644 or 1640 only (do not accept non-integeric final answer).	A1	3.4	
		(2)		
6b	It is the initial bacteria population.	B1	2.2a	4th Understand the properties of functions of the form a^x.
		(1)		
6c	States that $100e^{0.4t} > 1000000$ or that $e^{0.4t} > 10000$	M1	3.4	6th Set up, use and critique exponential models of growth and decay.
	Solves to find $t > \frac{\ln(10000)}{0.4}$	M1	1.1b	
	24 (hours) cao (do not accept e.g. 24.0).	A1	3.5	
		(3)		
				(6 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
7a	Uses the equation of a straight line in the form $\log_4 V = mt + c$ or $\log_4 V - k = m(t - t_0)$ o.e.	M1	1.1b	6th Set up, use and critique exponential models of growth and decay.
	Makes correct substitution. $\log_4 V = -\frac{1}{10}t + \log_4 40000$ o.e.	A1	1.1b	
		(2)		
7b	Either correctly rearranges their equation by exponentiation For example, $V = 4^{-\frac{1}{10}t + \log_4 40000}$ or takes the log of both sides of the equation $V = ab^t$. For example, $\log_4 V = \log_4(ab^t)$.	M1	1.1b	6th Set up, use and critique exponential models of growth and decay.
	Completes rearrangement so that both equations are in directly comparable form $V = 40000 \times \left(4^{-\frac{1}{10}}\right)^t$ and $V = ab^t$ or $\log_4 V = -\frac{1}{10}t + \log_4 40000$ and $\log_4 V = \log_4 a + t\log_4 b$.	M1	1.1b	
	States that $a = 40\,000$	A1	1.1b	
	States that $b = 4^{-\frac{1}{10}}$	A1	1.1b	
		(4)		
7c	*a* is the initial value of the car o.e.	B1	2.2a	6th Set up, use and critique exponential models of growth and decay.
	b is the annual proportional decrease in the value of the car o.e. (allow if explained in figures using their *b*. For example, (since *b* is ≈0.87) the car loses 13% of its value each year.)	B1	2.2a	
		(2)		

7d	Substitutes 7 into their formula from part b. Correct answer is £15 157, accept awrt £15 000	**B1ft**	3.4	4th Understand the properties of functions of the form a^x.
		(1)		
7e	Uses $10000 = ab^t$ with their values of *a* and *b* or writes $\log_4 10000 = -\frac{1}{10}t + \log_4 40000$ (could be inequality).	**M1**	3.4	5th Solve exponential equations using logarithms.
	Solves to find *t* = 10 years.	**A1ft**	1.1b	
		(2)		
7f	Acceptable answers include. The model is not necessarily valid for larger values of *t*. Value of the car is not necessarily just related to age. Mileage (or other factors) will affect the value of the car.	**B1**	3.5b	6th Set up, use and critique exponential models of growth and decay.
		(1)		
				(12 marks)

Notes

7b

2nd M mark can be implied by correct values of *a* and *b*.

7c

Accept answers that are the equivalent mathematically. For example, for *b*. the value of the car in 87% of the value the previous year.