1	**(i)**		0	**[1]**		
	(ii)		18	**[1]**		
	(iii)		$\frac{1}{2}$ or 0.5	1 **[1]**		

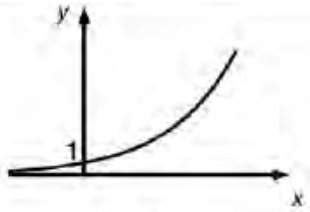
2			log235 + log5^x = log987 $[x =]\frac{\log 987 - \log 235}{\log 5}$ oe 0.892 cao	M1 M1 A1 **[3]**	$\log 5^x = \log\left(\frac{987}{235}\right)$ $[x =]\log_5\left(\frac{987}{235}\right)$	

3			$y - a = x^b$ $\log_{10}(y - a) = b \log_{10} x$ $[\log_{10} x =]\frac{\log_{10}(y-a)}{b}$	M1 M1 A1 **[3]**	 if M0 earned, allow SC1 for $b \log_{10} x$ term seen SC2 for correct answer without working	condone omission of base of log

4	(i) $17 \log_{10} x$ or $\log_{10} x^{17}$	**B2**	**M1** for $5\log_{10} x$ or $12 \log_{10} x$ or $\log_{10} x^{12}$ as part of the first step	condone omission of base
4	(ii) $-b$	**B2**	**M1** for $\log_a 1 = 0$ or $\log_a a = 1$ soi	allow $0 - b$

5	(i) 50% of 25 000 is 12 500 and population [in 2005] is 12 000 [so consistent]	**B1**	or 12 000 is 48% of 25 000 so less than 50%[so consistent]	
5	(ii) $\log_{10} P = \log_{10} a - kt$ or $\log_{10}\left(\frac{P}{a}\right) = -kt$ o.e. www	**B2**	condone omission of base; **M1** for $\log_{10} P = \log_{10} a + \log_{10} 10^{-kt}$ or better www	

5	(iii) 4.27, 4.21, 4.13, plots ruled line of best fit drawn	**B1** **B1** **B1**	accept 4.273…, 4.2108…, 4.130…, 4.079… rounded to 2 or more dp 1 mm tolerance ft their values if at least 4 correct values are correctly plotted	 f.t. if at least two calculated values correct must have at least one point on or above and at least one point on or below the line and must cover $0 \leq t \leq 25$
5	(iv) a = 25000 to 25400 $0.01 \leq k \leq 0.014$ $P = a \times 10^{-kt}$ or $P = 10^{\log a - kt}$ with values in acceptable ranges	**B1** **B2** **B1**	allow $10^{4.4..}$ **M1** for $-k = \frac{\Delta y}{\Delta x}$ using values from table or graph; condone $+k$ **B0** if left in logarithmic form	**M1** for a correct first step in solving a pair of valid equations in either form **A1** for k **A1** for a **A1** for $P = a \times 10^{-kt}$
5	(v) $P = a \times 10^{-35k}$ 8600 to 9000 comparing their value with 9375 o.e. and reaching the correct conclusion for their value	**M1** **A1** **A1**	T heir a and k f.t.	allow $\log P = \log a - 35k$

6	(i)		G1 DG1	for curve of correct shape in both quadrants must go through (0, 1) shown	
	(ii)	$2x + 1 = \frac{\log 10}{\log 3}$ o.e. [x =] 0.55	M1 A2	or M1 for $2x + 1 = \log_3 10$ A1 for other versions of 0.547…or 0.548	5

7	(i)	$\log P = \log a + bt$ www comparison with $y = mx + c$ s.o.i. intercept = $\log_{10} a$	1 1 1	 must be with correct equation dependent on correct equation	3
	(ii)	[2.12, 2.21], 2.32, 2.44, 2.57, 2.69 plots ft ruled line of best fit	1 1 1	 Between (10, 2.08) and (10, 2.12)	3

	(iii)	$0.0100 \leq m < 0.0125$	B2	M1 for $\frac{y-\text{step}}{x-\text{step}}$	
		$a = 10^c$ or $\log a = c$	B1	$1.96 \leq c \leq 2.02$	
		$P = 10^c \times 10^{mt}$ or 10^{mt+c}	B1	f.t. their m and a	4
	(iv)	use of $t = 105$ 1.0 – 2.0 billion approx unreliable since extrapolation o.e.	B1 B1 E1	 	3

8	(i) 1 (ii) (A) 3.5 $\log_a x$ (ii) (B) $-\log_a x$	1 2 1	M1 for correct use of 1st or 3rd law	 4