

Question	Scheme	Marks	AOs	
14(a)	$\log_{10} P = mt + c$	M1	1.1b	
	$\log_{10} P = \frac{1}{200}t + 5$	A1	1.1b	
		(2)		
(b)	<p>Way 1: As $P = ab^t$ then $\log_{10} P = t \log_{10} b + \log_{10} a$</p>	<p>Way 2: As $\log_{10} P = \frac{t}{200} + 5$ then $P = 10^{\left(\frac{t}{200} + 5\right)} = 10^5 10^{\left(\frac{t}{200}\right)}$</p>	M1	2.1
	$\log_{10} b = \frac{1}{200}$ or $\log_{10} a = 5$	$a = 10^5$ or $b = 10^{\left(\frac{1}{200}\right)}$	M1	1.1b
	So $a = 100\,000$ or $b = 1.0116$		A1	1.1b
	Both $a = 100\,000$ and $b = 1.0116$ (awrt 1.01)		A1	1.1b
			(4)	
(c)(i)	The initial population	B1	3.4	
(c)(ii)	The proportional increase of population each year	B1	3.4	
		(2)		
(d)(i)	300000 to nearest hundred thousand	B1	3.4	
(d)(ii)	Uses $200000 = ab^t$ with their values of a and b or $\log_{10} 200000 = \frac{1}{200}t + 5$ and rearranges to give $t =$	M1	3.4	
	60.2 years to 3sf	A1ft	1.1b	
		(3)		
(e)	Any two valid reasons- e.g. <ul style="list-style-type: none"> 100 years is a long time and population may be affected by wars and disease Inaccuracies in measuring gradient may result in widely different estimates Population growth may not be proportional to population size The model predicts unlimited growth 	B2	3.5b	
		(2)		

Question 14 continued**Notes:****(a)****M1:** Uses a linear equation to relate $\log P$ and t **A1:** Correct use of gradient and intercept to give a correct line equation**(b)****M1:** **Way 1:** Uses logs correctly to give log equation; **Way 2:** Uses powers correctly to “undo” log equation and expresses as product of two powers**M1:** **Way 1:** Identifies $\log b$ or $\log a$ or both; **Way 2:** Identifies a or b as powers of 10**A1:** Correct value for a or b **A1:** Correct values for both**(c)(i)****B1:** Accept equivalent answers e.g. The population at $t = 0$ **(c)(ii)****B1:** So accept rate at which the population is increasing each year or scale factor 1.01 or increase of 1% per year**(d)(i)****B1:** cao**(d)(ii)****M1:** As in the scheme**A1ft:** On their values of a and b with correct log work**(e)****B2:** As given in the scheme – any two valid reasons