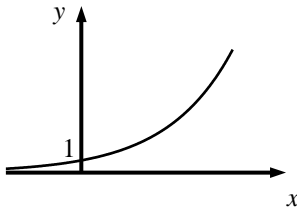


1	i	$\log_{10} P = \log_{10} a + \log_{10} 10^{bt}$ $\log_{10} 10^{bt} = bt$ intercept indicated as $\log_{10} a$	B1 B1 B1	condone omission of base	3	
	ii	3.9(0), 3.94, 4(.00), 4.05, 4.11 plots ft line of best fit ft	T1 P1 L1	to 3 sf or more; condone one error 1 mm ruled and reasonable	3	
	iii	(gradient =) 0.04 to 0.06 seen (intercept =) 3.83 to 3.86 seen (a =) 6760 to 7245 seen $P = 7000 \times 10^{0.05t}$ oe	M1 M1 A1 A1	7000×1.12^t SC $P = 10^{0.05t + 3.85}$ left A2	4	
	iv	17 000 to 18 500	B2	14 000 to 22 000 B1	2	12

2	(i)	1		
	(ii) -2	2	M1 for $1/9=3^{-2}$ or $\log(1) - \log(3^2)$	
	(iii) $\log x$	2	base not reqd; M1 for $5 \log x$ or $\log(x^5)$	5
3	Correct curve thro' y axis (0, 1) indicated on sketch or table	G1 G1	y, y' & y'' all positive independent	
	5.64	3	B2 for other versions of 5.64(3....) or B1 for other ans 5.6 to 5.7 or M1 for $x \log 2 = \log 50$ and M1 for $x = \log 50 \div \log 2$	5

4	i	81	1		1
	ii	$(1x)3^{n-1}$	1		1
	iii	(GP with) $a = 1$ and $r = 3$ clear correct use GP sum formula	M1 M1	or M1 for $= 1+3+9+ \dots +3^{n-1}$	2
	iv	(A) 6 www (B) B)	2 1	M1 for $364 = (3^n - 1)/2$	3
	v	their (ii) > 900 $(y - 1)\log 3 > \log 900 y$ $- 1 > \log 900 \div \log 3 y$ $= 8$ cao	M1ft M1ft M1 B1	-1 once for $=$ or $<$ seen: condone wrong letter / missing brackets / no base	4

5	(i)			M1 A1 [2]	for curve of correct shape in both quadrants through (0, 1) shown on graph or in commentary	SC1 for curve correct in 1 st quadrant and touching (0,1) or identified in commentary
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5	(ii)		$5x - 1 = \frac{\log_{10} 500\,000}{\log_{10} 3}$ $x = \left(\frac{\log_{10} 500\,000}{\log_{10} 3} + 1 \right) \div 5$ [x =] 2.588 to 2.59	M1 M1 A1 [3]	or $5x - 1 = \log_3 500\,000$ $x = (\log_3 500\,000 + 1) \div 5$ oe; or B3 www	condone omission of base 10 use of logs in other bases may earn full marks if unsupported, B3 for correct answer to 3 sf or more www
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6	(i)	$\log_{10}p = \log_{10}a + \log_{10}10^{kt}$ $\log_{10}p = \log_{10}a + kt$	M1 A1 [2]	condone omission of base;	if unsupported, B2 for correct equation
6	(ii)	2.02, 2.13, 2.23 plots correct ruled line of best fit	B1 B1 f.t. B1 [3]	allow given to more sig figs to nearest half square y-intercept between 1.65 and 1.7 and at least one point on or above the line and at least one point on or below the line	2.022304623..., 2.129657673, 2.229707433 fit their plots must cover range from $x = 9$ to 49
6	(iii)	0.0105 to 0.0125 for k 1.66 to 1.69 for $\log_{10}a$ or 45.7 to 49.0 for a	B1 B1		must be connected to k must be connected to a
		$\log_{10}p = \text{their } kt + \text{their } \log_{10}a$ $p = \text{their } "47.9 \times 10^{0.0115t}" \text{ or } 10^{1.6785 + 0.0115t}$	B1 B1 [4]	must be a correct form for equation of line and with their y-intercept and their gradient (may be found from graph or from table, must be correct method) as above, "47.9" and "0.0115" must follow from correct method	
6	(iv)	45.7 to 49.0 million	1 [1]	'million' needed, not just the value of p	
6	(v)	reading from graph at 2.301.. their 54 2014 cao	M1* M1dep* A1 [3]	or $\log_{10}200 = \log_{10}a + kt$ eg for their $t = \frac{\log 200 - 1.68}{0.0115}$ if unsupported, allow B3 only if consistent with graph	or $200 = "10^{\log a + kt}"$ oe or M1 for their $t = \frac{\log \frac{200}{47.9}}{0.0115}$