

1	$3.5 \log_a x$ or $k = 3.5$	2	B1 for $3 \log_a x$ or $\frac{1}{2} \log_a x$ or $\log_a x^{3\frac{1}{2}}$ seen
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2	$\log 18 = \log a + n \log 3$ <u>and</u> $\log 6 = \log a + n \log 2$ $\log 18 - \log 6 = n (\log 3 - \log 2)$ $n = 2.71$ to 2 d.p. c.a.o. $\log 6 = \log a + 2.70951 \dots \log 2$ o.e. $a = 0.92$ to 2 d.p. c.a.o.	M1* DM1 A1 M1 A1	or $18 = a \times 3^n$ <u>and</u> $6 = a \times 2^n$ $3 = \left(\frac{3}{2}\right)^n$ $n = \frac{\log 3}{\log 1.5} = 2.71$ c.a.o. $6 = a \times 2^{2.70951}$ o.e. $= 0.92$ c.a.o.
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3	(i) (A)	1024	2	M1 for number of buds = 2^{10} s.o.i.
	(i) (B)	2047	2	M1 for $1+2+4+\dots+2^{10}$ or for $2^{11} - 1$ or (their 1024) + 512 + 256 + ... + 1
	(ii) (A)	no. of nodes = $1 + 2 + \dots + 2^{n-1}$ s.o.i. $\frac{7 \times (2^n - 1)}{2 - 1}$	1 1	no. of leaves = $7 + 14 + \dots + 7 \times 2^{n-1}$
	(ii) (B)	$7(2^n - 1) > 200\,000$ $2^n > \frac{200\,000}{7} + 1$ or $\frac{200\,007}{7}$ $n \log 2 > \log \left(\frac{200\,007}{7}\right)$ and completion to given ans $[n =] 15$ c.a.o.	M1 M1 M1 B1	or $\log 7 + \log 2^n > \log 200\,007$

4	(i) 7	1		
	(ii) 5.5 o.e.	2	M1 for at least one of $5 \log_{10} a$ or $\frac{1}{2} \log_{10} a$ or $\log_{10} a^{5.5}$ o.e.	3

5	i	0.6(0..), 0.8(45..), [1], 1.1(76..) 1.3(0..), 1.6(0.) points plotted correctly f.t. ruled line of best fit	T 1 P1 L1	Correct to 2 d.p. Allow 0.6, 1.3 and 1.6 tol. 1 mm	3
	ii	$b =$ their intercept $a =$ their gradient $-11 \leq b \leq -8$ and $21 \leq a \leq 23.5$	M1 M1 A1		
	iii	34 to 35 m	1		1
	iv	$29 = "22" \log t - "9"$ $t = 10^{1.727..}$ 55 [years] approx	M1 M1 A1	accept 53 to 59	3
	v	For small t the model predicts a negative height (or $h = 0$ at approx 2.75) Hence model is unsuitable	1 D1		2

6	$x \log 5 = \log 235$ or $x = \frac{\log 235}{\log 5}$ 3.39	M1	or $x = \log_5 235$	3
		A2	A1 for 3.4 or versions of 3.392...	

7	(i) $\log_a 1 = 0, \log_a a = 1$	1+1	NB, if not identified, accept only in this order	5
	(ii) show both sides equivalent	3	M1 for correct use of 3 rd law and M1 for correct use of 1 st or 2 nd law. Completion www A1. Condone omission of a .	
8	(i) curve with increasing gradient any curve through (0, 1) marked	G1 G1	correct shape in both quadrants	5
	(ii)	3	M1 for $x \log 3 = \log 20$ (or $x = \log_3 20$) and M1 for $x = \log 20 \div \log 3$ or B2 for other versions of 2.726833.. or B1 for other answer 2.7 to 2.8	

9	1, 3	1,1		2	
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10	$3x \log 5 = \log 100$ $3x = \log 100 / \log 5$ $x = 0.954$	M1 M1 A2	allow any or no base or $3x = \log_5 100$ dep't A1 for other rot versions of 0.9537... SC B2/4 for 0.954 with <u>no</u> log wkg SC B1 r.o.t. 0.9537...	4	
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