(b)	**Mark (b) and (c) together**		
	$r^3 = -\frac{20.48}{320} \Rightarrow r = \sqrt[3]{-\frac{20.48}{320}}$	Correct strategy for *r*. Allow for dividing the 2 given terms **either way round** and attempting to cube root.	M1
	$= -0.4$	Correct value (and no others) but allow equivalents e.g. -2/5. Correct answer only scores both marks.	A1
	Note that some candidates take $ar^2 = -320$ and $ar^5 = \frac{512}{25}$ and use these correctly to give $r^3 = -\frac{20.48}{320} \Rightarrow r = \sqrt[3]{-\frac{20.48}{320}} = -0.4$ **In such cases you can allow full marks for (b) but see note * in (c)**		
			(2)

(c)	$r = -0.4 \Rightarrow a = \frac{-320}{-0.4}(= 800)$ or $r = -0.4 \Rightarrow a = \frac{512}{25} \div \left(-\frac{2}{5}\right)^4 (= 800)$	Correct attempt at the first term using ± **their *r*** and the –320 or the $\frac{512}{25}$. May be implied by their *a* but must be using e.g. $ar = -320$ or $ar^4 = \frac{512}{25}$ **not** $ar^2 = -320$ or $ar^5 = \frac{512}{25}$ *	M1
	$S_{13} = \frac{"800"\left(1-"-0.4"^{13}\right)}{1-"-0.4"}$ Correct attempt at the sum using their *a* and **their *r*** and *n* = 13 to find a value for S_{13}. **Must be a fully correct attempt at the sum here using *n* = 13, their *a* and their *r*.** Note that $\frac{800\left(1+0.4^{13}\right)}{1+0.4}$ is equivalent to $\frac{800\left(1-(-0.4)^{13}\right)}{1-(-0.4)}$ and is acceptable for this mark.		M1
	$= 571.43$	Correct value. Note that S_∞ is also 571.43 so working must be seen i.e. correct answer only scores no marks.	A1
			(3)
			Total 8

Proof by induction for part (a):

$$n=1 \Rightarrow S_1 = \frac{a\left(1-r^1\right)}{1-r} = a \quad \text{so true for } n = 1$$

Assume true for $n = k$ so $S_k = \frac{a\left(1-r^k\right)}{1-r}$

Add $(k+1)^{th}$ term $S_{k+1} = \frac{a\left(1-r^k\right)}{1-r} + ar^k = \frac{1-ar^k+ar^k-ar^{k+1}}{1-r}$

$$= \frac{a-ar^{k+1}}{1-r} = \frac{a\left(1-r^{k+1}\right)}{1-r}$$

So if true for $n = k$ it has been shown true for $n = k + 1$ and as it is true for $n = 1$ it is true for (for all n)

Mark as follows:

M1: Shows true for $n = 1$ and assumes true for $n = k$ and adds the $(k+1)^{th}$ term

A1(M1 on EPEN): Finds common denominator obtains $\frac{a-ar^{k+1}}{1-r}$ using correct algebra

A1: Fully correct proof reaching $\frac{a\left(1-r^{k+1}\right)}{1-r}$ with all steps shown and conclusion

If you are in any doubt about awarding marks in this case or any other cases that you think deserve credit, send to your Team Leader using Review

Question Number	Scheme	Notes	Marks
9(i)	$4=\log_3 81$ or $4=\log_3 3^4$ May be implied by e.g. $\log_3\dfrac{x+5}{2x-1}=4\Rightarrow\dfrac{x+5}{2x-1}=3^4\left(\text{or }81\right)$		B1
	Examples: $\log_3(x+5)-\log_3 81=\log_3\dfrac{x+5}{81}$ or $\log_3(x+5)-\log_3(2x-1)=\log_3\dfrac{x+5}{2x-1}$ or $\log_3(2x-1)+\log_3 81=\log_3 81(2x-1)$ This mark is for combining 2 log terms correctly and can be awarded following an incorrect rearrangement e.g. $\log_3(x+5)-4=\log_3(2x-1)\Rightarrow\log_3(x+5)+\log_3(2x-1)=4$ $\Rightarrow\log_3(2x-1)(x+5)=...$		M1
	$\dfrac{x+5}{81}=2x-1$	Obtains this equation in any form e.g. $\dfrac{x+5}{2x-1}=3^4$	A1
	$x=\dfrac{86}{161}$	Cao	A1
	Condone the omission of the base throughout		
			(4)
	<u>Alternative for first 3 marks:</u> $\log_3(x+5)-4=\log_3(2x-1)\Rightarrow 3^{\log_3(x+5)-4}=3^{\log_3(2x-1)}$ $\Rightarrow 3^{\log_3(x+5)}\times 3^{-4}=2x-1\Rightarrow\dfrac{x+5}{81}=2x-1$ Score B1 for sight of 3^{-4} and M1 for applying $3^{a\pm b}=3^a\times 3^{\pm b}$ and A1 as above		
	<u>(a) Special Case</u> $\log_3(x+5)-\log_3(2x-1)=4\Rightarrow\dfrac{\log_3(x+5)}{\log_3(2x-1)}=4\Rightarrow\dfrac{x+5}{2x-1}=81\Rightarrow x=\dfrac{86}{161}$ Scores B1(implied) M0 A0 A1		
(ii)(a)	$3^{y+3}=3^y\times 3^3$ **or** $2^{1-2y}=2\times 2^{-2y}$ or $\dfrac{2}{2^{2y}}$ or 2×4^{-y} or $\dfrac{2}{4^y}$	One correct index law seen or implied anywhere in their working	B1
	$3^{y+3}\times 2^{1-2y}=27\times 3^y\times 2\times 2^{-2y}=...$	Applies both correct index laws to the lhs of the equation	M1**(B1 on EPEN)**
	$3^y\times 2^{-2y}=\dfrac{108}{27\times 2}$ or $\dfrac{3^y}{4^y}=\dfrac{108}{27\times 2}$ or $\dfrac{3^y}{2^{2y}}=\dfrac{108}{54}$ Isolates the terms in y (as powers of 3 and 2(or 4)) on the lhs and the constants on the rhs. There must be no incorrect work to combine terms e.g. $3^y\times 3^3=27^y$ etc.		M1
	$(0.75)^y=2*$	Cso. Reaches the given answer with no errors and all steps shown with 2^{2y} appearing as 4^y at some point.	A1*
			(4)

	Alternative 1 for (ii)(a) using logs:		
	$\log\left(3^{y+3}\times 2^{1-2y}\right)=\log 3^{y+3}+\log 2^{1-2y}$ Or $\log 3^{y+3}=(y+3)\log 3$ Or $\log 2^{1-2y}=(1-2y)\log 2$	One **correct** log law seen or implied anywhere in their working. **No bracketing errors allowed for <u>this mark</u>.**	B1
	$\log 3^{y+3}+\log 2^{1-2y}=(y+3)\log 3+(1-2y)\log 2$ Applies the correct log laws to the lhs. You can condone missing brackets around the $y + 3$ and/or $1 – 2y$		M1**(B1 on EPEN)**
	$(y+3)\log 3+(1-2y)\log 2=\log 108\Rightarrow \log 3^{y}-\log 2^{2y}=\log 108-3\log 3-\log 2$ $\Rightarrow \log\frac{3^{y}}{2^{2y}}=\log\frac{108}{3^{3}\times 2}$ Proceeds to isolate the terms in y on the lhs and combines the constants on the rhs or e.g. $(y+3)\log 3+(1-2y)\log 2=\log 108\Rightarrow y(\log 3-2\log 2)=\log\frac{108}{3^{3}\times 2}$ Proceeds to isolate the terms in y on the lhs and combines the constants on the rhs		M1
	$(0.75)^{y}=2*$	Cso. With e.g. 2log 2 seen as log 4 or log 2^2 or implied at some point.	A1*
	Alternative 2 for (ii)(a) using factors of 108:		
	$3^{y+3}\times 2^{1-2y}=108=2^{2}\times 3^{3}$ $\Rightarrow \frac{3^{y+3}\times 2^{1-2y}}{2^{2}\times 3^{3}}=\ldots$ $\Rightarrow 3^{y}\times 2^{-1-2y}=\ldots$	One correct index law seen or implied anywhere in their working e.g. $\frac{3^{y+3}}{3^{3}}=3^{y}$ or $\frac{2^{1-2y}}{2^{2}}=2^{-1-2y}$	B1
	$\Rightarrow 3^{y}\times 2^{-1-2y}=\ldots$	Applies both correct index laws to the lhs of the equation	M1**(B1 on EPEN)**
	$\Rightarrow 3^{y}\times 2^{-2y}=2$	Proceeds to isolate the terms in y (as powers of 3 and 2(or 4)) on the lhs and the constants on the rhs	M1
	$(0.75)^{y}=2*$	Cso. Reaches the given answer with no errors and all steps shown with 2^{2y} appearing as 4^{y} at some point.	A1*
(b)	$(0.75)^{y}=2\Rightarrow y=\frac{\log 2}{\log 0.75}$ or $(0.75)^{y}=2\Rightarrow y=\log_{0.75}2$	Correct processing to obtain a value for y May be implied by awrt – 2.4	M1
	$y=-2.409$	Awrt –2.409 A correct answer implies both marks	A1
			(2)
			Total 10