Question	Scheme	Marks
8 (a)	$a+ar=400$ or $\dfrac{a(1-r^2)}{1-r}=400$, $ar+ar^2=100$ oe	B1B1
	Common methods	
	1) $r\left(a+ar\right)=100 \Rightarrow r\left(400\right)=100$	M1
	$r=\dfrac{1}{4}$ *	A1cso
	2) $a=\dfrac{400}{1+r} \Rightarrow \left(\dfrac{400}{1+r}\right)r+\left(\dfrac{400}{1+r}\right)r^2=100$	M1
	$\Rightarrow 400r+400r^2=100+100r \Rightarrow 4r^2+3r-1=0 \Rightarrow (4r-1)(r+1)\left(=0\right)$	A1cso
	$r=\dfrac{1}{4}$ *	
	3) $r=\dfrac{400-a}{a} \Rightarrow a\left(\dfrac{400-a}{a}\right)+a\left(\dfrac{400-a}{a}\right)^2=100 \Rightarrow$	M1
	$\Rightarrow 400-a+\dfrac{\left(400-a\right)^2}{a}=100 \Rightarrow$	
	$400-a^2+160000-800a+a^2=100a \Rightarrow a=320 \Rightarrow 320+320r=400$	A1cso
	$r=\dfrac{1}{4}$ *	[4]
ALT	$\left(\text{Let } G_1, G_2, G_3 \text{ be the first 3 terms}\right)$	
	$G_2+G_3=100$	B1
	$\left(G_1+G_2=400\right) \Rightarrow rG_1+rG_2=100$	B1
	$rG_1+rG_2=100 \Rightarrow \left(r\left(G_1+G_2\right)=100\right) \Rightarrow r(400)=100$	M1
	$r=\dfrac{1}{4}$ *	A1*cso [4]
(b)	$\left(a=\right)\dfrac{300}{1-\left(\frac{1}{4}\right)^2}$ or $\dfrac{400}{1+\frac{1}{4}}$ or $\dfrac{100}{\frac{1}{4}+\left(\frac{1}{4}\right)^2}$ $=320$ *	M1A1 cso [2]
(c)	$S_\infty=\dfrac{320}{1-\frac{1}{4}}=\dfrac{1280}{3}$	M1A1 [2]
		Total 12 marks

Part	Mark	Notes
(a)	B1	For either equation shown correct a and r can be any letters throughout.
	B1	For both equations shown correct a and r can be any letters throughout.
	M1	For forming an equation eliminating a or r Allow one error in processing **such as a sign or arithmetical error, but not a 'cancellation'/simplification error**. Must be working with 2 correct equations. This mark can be awarded as soon as a or r are eliminated. Doesn't need simplification at this stage.
	A1 cso	For correctly solving and attaining $r = \frac{1}{4}$ minimum steps shown, no errors/omissions, ignore $r = -1$
ALT	B1	For either equation shown correct
	B1	For both equations shown correct
	M1	For multiplication of the first equation by r and formation of an equation in r Allow one error in processing. Must be working with 2 correct equations.
	A1	For $r = \frac{1}{4}$ minimum steps shown, no errors or omissions. Ignore work on any negative values
There are a number of different methods to do this, the four most commonly anticipated are shown. Mark to the following principles to gain the method mark: • One processing error only in any method **(M mark only, not A mark).** • Rearrange for r or a and correctly substitute into the other equation or such as method 1 to reach an equation in one variable only. • Rearrange the resulting equation so that an equation of the form ***br = c*** is reached. Note for the quadratic option, a factorisation will suffice. Note, if eliminating r, a must be found and the value of a then substituted into an appropriate equation. Methods where these principles can't be applied and thought worthy of credit **– send to review please**.		
(b)	M1	For using their expression for a with the correct r, to find a value for a Note, **for this question only**, work in (a) may be credited for this mark – **only if they eliminated *r* in their solution for part (a) and this is then used.**
	A1cso	For 320, no errors.
(c)	M1	For using the correct formula for the sum to infinity of a convergent series with the given values of a and r to find a value.
	A1	For the exact value of $\frac{1280}{3}$ oe or 426.67 or better (ie correctly rounded to more decimal places) or 426.6… (minimum 3 dots) or 426.66^{r} or $426.\dot{6}$
(d)	M1	Uses the correct formula for the sum of a geometric series, to set up **an inequality or equation,** allow < or > or = using the given values of r and a. Condone $\frac{1}{4}^{n}$
	dM1	For simplifying (allow errors in simplification) their **inequality or equation** in n to the form $\left(\frac{1}{4}\right)^{n} < d \quad d \neq 0$ or $4^{n} < d$ Allow < or > or =. Dependent on the 1st method mark. Condone poor bracketing with powers again.
	ddM1	For the correct use of logs and correct use of an inequality sign throughout, including the reversal at the appropriate point. Dependent on both previous method marks. This mark may not be awarded if 'd' is negative. If candidates give a final answer of (n =) 7 – this mark can be implied even if the inequality sign is not correctly reversed.
	A1	For (n =) 7 Note although n = 7 can imply ddM1 as described, it is unlikely to imply the first 2 marks as there must be some logs work (directed by the question).

(d)	$426.6 < \dfrac{320\left(1-\left(\frac{1}{4}\right)^n\right)}{1-\frac{1}{4}} \Rightarrow \left(\frac{1}{4}\right)^n < \frac{1}{6400}$ or $4^n < 6400$	M1dM1
	$\Rightarrow n > \dfrac{\log\left(\frac{1}{6400}\right)}{\log\left(\frac{1}{4}\right)}$ or $n > \log_{\frac{1}{4}}\left(\frac{1}{6400}\right)$ oe	ddM1
	$\Rightarrow n > 6.32... \Rightarrow n = 7$	A1 [4]
		Total 12 marks