Question number	Scheme	Marks
7 (a)	$\dfrac{ar^6}{ar^3}=r^3=\dfrac{e^{\frac{2x+1}{2}}}{e^{x+2}}=\dfrac{e^x\times e^{\frac{1}{2}}}{e^x\times e^2}=e^{-\frac{3}{2}}\Rightarrow r=e^{-\frac{1}{2}}$ *	M1M1A1 cso [3]
	ALT $\dfrac{e^{x+2}}{r^3}r^6=e^{\frac{2x+1}{2}}\Rightarrow r^3=e^{x+\frac{1}{2}-x+2}\Rightarrow r^3=e^{-\frac{3}{2}}\Rightarrow r=e^{-\frac{1}{2}}$ *	{M1} {M1}{A1} cso [3]
(b)	$ar^3=ae^{-\frac{3}{2}}=e^{x+2}\Rightarrow a=\dfrac{e^{x+2}}{e^{-\frac{3}{2}}}=\dfrac{e^x\times e^2}{e^{-\frac{3}{2}}}=e^{x+\frac{7}{2}}$ oe	M1M1A1 [3]
	ALT $a=\dfrac{e^{x+2}}{e^{-\frac{3}{2}}}=e^{x+2+\frac{3}{2}}=e^{x+\frac{7}{2}}$ oe	{M1}{M1} {A1} [3]
(a)		
M1	Use of $\dfrac{ar^6}{ar^3}=r^3$	
M1	Using $e^{a+b}=e^a\times e^b$ to simplify leading to $r^3=e^c$ where c is a number	
A1 cso	Obtains the **given** answer with no errors in the working	
ALT		
M1	For rearranging to make a subject and substituting into the other equation	
M1	Using $e^{a-b}=e^a\div e^b$ to simplify leading to $r^3=e^c$ where c is a number	
A1 cso	Obtains the **given** answer with no errors in the working	
(b)		
M1	For $a=\dfrac{e^{x+2}}{e^{-\frac{3}{2}}}$	
M1	Using $e^{a+b}=e^a\times e^b$ to simplify to $a=\dfrac{e^x\times e^2}{e^{-\frac{3}{2}}}$	
A1	$e^{x+\frac{7}{2}}$ oe	
ALT		
M1	For $a=\dfrac{e^{x+2}}{e^{-\frac{3}{2}}}$	
M1	Using $e^{a+b}=e^a\times e^b$ to simplify to $e^{x+2+\frac{3}{2}}$	
A1	$e^{x+\frac{7}{2}}$ oe	

(c)	$S_\infty = \dfrac{e^{x+\frac{7}{2}}}{1-e^{-\frac{1}{2}}} = \dfrac{e^{x+\frac{7}{2}}}{\dfrac{e^{\frac{1}{2}}-1}{e^{\frac{1}{2}}}} = \dfrac{e^{x+4}}{e^{\frac{1}{2}}-1} \Rightarrow p = x+4$ **ALT 1** $S_\infty = \dfrac{e^{x+\frac{7}{2}}}{1-e^{-\frac{1}{2}}} = \dfrac{e^{x+\frac{7}{2}}}{1-e^{-\frac{1}{2}}} \times \dfrac{e^{\frac{1}{2}}}{e^{\frac{1}{2}}} = \dfrac{e^{x+4}}{e^{\frac{1}{2}}-1} \Rightarrow p = x+4$ **ALT 2** $S_\infty = \dfrac{e^{x+\frac{7}{2}}}{1-e^{-\frac{1}{2}}} = \dfrac{e^{p}}{e^{\frac{1}{2}}-1} \Rightarrow e^{x+\frac{7}{2}}\left(e^{\frac{1}{2}}-1\right) = e^{p}\left(1-e^{-\frac{1}{2}}\right)$ $\Rightarrow e^{x+4} - e^{x+\frac{7}{2}} = e^{p} - e^{p-\frac{1}{2}} \Rightarrow p = x+4$	M1M1A1 [3] {M1}{M1} {A1} [3] {M1}{M1} {A1} [3]
(c)		
M1	Use of $S_\infty = \dfrac{a}{1-r}$	
M1	$1-e^{-\frac{1}{2}} = \dfrac{e^{\frac{1}{2}}-1}{e^{\frac{1}{2}}}$	
A1	$p = x+4$	
ALT 1		
M1	Use of $S_\infty = \dfrac{a}{1-r}$	
M1	Multiplying S_∞ by $\dfrac{e^{\frac{1}{2}}}{e^{\frac{1}{2}}}$	
A1	$p = x+4$	
ALT 2		
M1	Use of $S_\infty = \dfrac{a}{1-r}$	
M1	For simplifying to $e^{x+4} - e^{x+\frac{7}{2}} = e^{p} - e^{p-\frac{1}{2}}$ oe	
A1	$p = x+4$	

(d)	$e^{x+\frac{7}{2}} \times \left(e^{-\frac{1}{2}}\right)^{17} > 1.6 \Rightarrow e^x \times e^{\left(\frac{7}{2}-\frac{17}{2}\right)} > 1.6 \Rightarrow e^x > \dfrac{1.6}{e^{-5}}$ $\Rightarrow e^x > 237.46105....$ $\Rightarrow x > \ln(237.46105) \Rightarrow x > 5.4700...$ $\Rightarrow x = 6$ **ALT** $e^{x+\frac{7}{2}} \times \left(e^{-\frac{1}{2}}\right)^{17} > 1.6 \Rightarrow e^{x-5} > 1.6$ $\Rightarrow x - 5 > \ln(1.6)$ $\Rightarrow x > \ln(1.6) + 5 \Rightarrow x > 5.4700...$ $\Rightarrow x = 6$	M1 M1 M1 A1 [4] {M1} {M1} {M1} {A1} [4]
		Total 13 marks
(d)	**NB** Allow use of = for M marks	
M1	Use of $ar^{17} > 1.6$	
M1	Simplifying to $e^x > \ldots$	
M1	Using logs to reach $x > \ln \ldots$	
A1	$x = 6$	
ALT		
M1	Use of $ar^{17} > 1.6$	
M1	Simplifying to $e^{x-5} > \ldots$ ft their a	
M1	Using logs to reach $x > \ln \ldots + 5$ ft their a	
A1	$x = 6$	