Question Number	Scheme	Marks
4(i)	$\dfrac{16}{\log_4 r} = \log_4 r \Rightarrow 16 = (\log_4 r)^2 \Rightarrow \log_4 r = \pm 4$	M1
	$r = 4^4 = 256 \quad \text{or } r = 4^{-4} = \dfrac{1}{256}$	A1 (2)
(ii)	$\log_5 9 + \log_5 12 + \log_5 15 + \log_5 18 = \log_5 (9\times12\times15\times18) = \log_5 29160$	M1
	$1 + \log_5 x + \log_5 x^2 = \log_5 5 + \log_5 x + \log_5 x^2 = \log_5 5x^3$	M1A1
	$5x^3 = 29160$	dM1
	$x = 18$	A1 (5) [7]
ALT 1		
	$\text{LHS} = \log_5 29160$	M1
	$\text{RHS} = 1 + \log_5 x^3$	M1
	$\left(\dfrac{\log_{10} 29160}{\log_{10} 5}\right) = 6.387... \left(= \log_5 x^3 + 1\right)$	A1
	$5.387... = 3\log_5 x$	dM1
	$\log_5 x = 1.795...$	
	$x = 18$	A1
ALT 2	$\text{LHS} = \log_5 29160$	M1
	$\text{RHS} = \log_5 5 + \log_5 x^3$	M1A1
	$\log_5 29160 = \log_5 5 + \log_5 5832$	
	$5832 = x^3$	dM1
	$x = 18$	A1
ALT 3	$\text{LHS} = \log_5 5832 + \log_5 5$	M1
	$\text{RHS} = 1 + \log_5 x^3$	M1
	$\text{LHS} = \log_5 5832 + 1$	A1
	$\log_5 5832 = \log_5 x^3$	
	$5832 = x^3$	dM1
	$x = 18$	A1
ALT 4	$\log_5 29160 - \log_5 x^3 = 1$	M1M1
	$\log_5 \dfrac{29160}{x^3} = 1$	A1
	$\dfrac{29160}{x^3} = 5 \Rightarrow x^3 = 5832$	dM1
	$x = 18$	A1

(i)	
M1	Change base (can have base 4 or base r provided the same for both logs), multiply to remove the fraction and solve to $\log_4 r = ...$ (or $\log_r 4 = ...$) (One answer only is sufficient)
A1	Complete to the correct answers, **both** needed
(ii)	
M1	Combine the LHS logs to a single log. Numbers should be multiplied – if added award M0
M1	Change 1 to $\log_5 5$ and obtain a single log for the RHS
A1	Correct single log for RHS (Requires second M mark, not first)
dM1	Use LHS = RHS to obtain an equation without logs Depends on both previous M marks
A1	Correct answer
ALT 1	
M1	Combine the LHS logs to a single log. Numbers should be multiplied – if added award M0
M1	Combine the two logs on RHS
A1	Correct numerical value for **LHS**. This will need a calculator so change of base need not be seen. Equation need not be formed yet. Correct final answer implies correct value here. Otherwise min 3 sf needed
dM1	This mark requires the **first** M mark to have been given – the second M mark can be M0 Use LHS = RHS to obtain a value for $3\log_5 x$ or $\log_5 x$ Depends on both previous M marks
A1	Correct answer. This will be exact if all numbers stored on the calculator so accept 18 only.
ALT 2	
M1	Combine the LHS logs to a single log. Numbers should be multiplied – if added award M0 **Alternatively** we may see $\text{LHS} = \log_5 5 + \log_5 5832$ without ever seeing $\text{LHS} = \log_5 29160$
M1	Combine the 2 logs on RHS and change 1 to $\log_5 5$
A1	Correct RHS (Requires second M mark, not first)
dM1	Use LHS = RHS to obtain a value for x^3 Depends on both previous M marks
A1	Correct answer
ALT 3	
M1	Split $\log_5 15$ and combine all logs apart from $\log_5 5$ to a single log
M1	Combine the two logs on RHS
A1	Change $\log_5 5$ to 1 and have the correct log on LHS
dM1	This mark requires the **first** M mark to have been given – the second M mark can be M0 Use LHS = RHS to obtain a value for x^3 Depends on both previous M marks
A1	Correct answer
ALT 4	
M1	Combine the LHS logs to a single log. Numbers should be multiplied – if added award M0
M1	Combine the two logs from the RHS
A1	Obtain the equation shown
dM1	Obtain a value for x^3 Depends on both previous M marks
A1	Correct answer