Question Number	Scheme	Marks
4(i)	E.g. $2=\log_3 9$ Eg $\log_3(4x)-\log_3(5x+7)=\log_3\dfrac{4x}{5x+7}$	M1
	E.g. $36x=5x+7$ $\dfrac{4x}{5x+7}=\dfrac{1}{9}$	A1
	$x=\dfrac{7}{31}$	A1
		(3)
(ii)	$\left(\sum_{r=1}^{2}\log_a y^r=\right)\log_a y+\log_a y^2$ or $\left(\sum_{r=1}^{2}(\log_a y)^r=\right)\log_a y+(\log_a y)^2$	B1
	$\log_a y+\log_a y^2=\log_a y+(\log_a y)^2\Rightarrow 2\log_a y-(\log_a y)^2=0$ $\Rightarrow \log_a y(2-\log_a y)=0\Rightarrow \log_a y=2$	M1
	$y=a^2$	A1
		(3)
		Total 6

(i) Answer on its own with no working score 0 marks.

M1 Demonstrates at least one correct law of logarithms.

e.g. $2=\log_3 9$ or $\log_3(4x)=\log_3 4+\log_3 x$ or $\log_3(4x)-\log_3(5x+7)=\log_3\dfrac{4x}{5x+7}$

$\log_3(5x+7)-\log_3(4x)=\log_3\dfrac{5x+7}{4x}$

(Do not be concerned with slips on the 2 if manipulating the equation

e.g. $\log_3(4x)+2=\log_3(5x+7)\Rightarrow\log_3\dfrac{4x}{5x+7}=2$ scores M1)

A1 For a correct equation in any form with no logs eg $4x=\dfrac{5x+7}{9}$. Must have come from correct log work.

A1 $\dfrac{7}{31}$ only and follows a correct equation with no logs.

Note $\dfrac{\log_3 5x+7}{\log_3 4x}=-2\Rightarrow x=\dfrac{7}{31}$ will only score a maximum of M1A0A0 if they are able to demonstrate at least one correct law of logarithms.

(ii) Answer on its own with no working score 0 marks.

B1 For either (or both) summation correct $\log_a y+\log_a y^2$ or $\log_a y+(\log_a y)^2$ or equivalent

Can also be awarded for a correct equation:

e.g. $\log_a y^2=(\log_a y)^2$ or $2\log_a y=(\log_a y)^2$ or $3\log_a y=\log_a y+(\log_a y)^2$

Sight of either expression or the equation scores even if they make subsequent errors.
Poor bracketing may be recovered or implied by later work. Do not penalise the absence of base *a* on some or all of the log terms for this mark.

M1 Proceeds from their quadratic equation in $\log_a y$, collects terms, factorises or cancels $\log_a y$ and obtains $\log_a y = k$. They may define $\log_a y$ in terms of another variable e.g. x such that $x + 2x = x + x^2 \Rightarrow x = k$ which is acceptable

Alternatively, they may change the base and obtain $\log_a y = k$

e.g. $\log_a y^2 = (\log_a y)^2 \Rightarrow \dfrac{\log_a y^2}{\log_a y} = \log_a y \Rightarrow \log_y y^2 = \log_a y \Rightarrow \log_a y = 2$

Question Number	Scheme	Marks
5(a)	$3^3+3^2(p+3)-3+q=0$	M1
	eg $\Rightarrow 27+9p+27-3+q=0 \Rightarrow 9p+q=-51$*	A1*
		(2)
(b)	$(-p)^3+(p+3)(-p)^2-(-p)+q=9$	M1
	eg $-p^3+p^3+3p^2+p+q=9 \Rightarrow 3p^2+p+q-9=0$*	A1*
		(2)
(c)	$3p^2+p+q-9=0$ $\Rightarrow 3p^2+p-51-9p-9=0$ $\Rightarrow 3p^2-8p-60=0$	M1
	$p=6$	A1
	$q=-51-9p=-105$	A1
		(3)
(d)	$\mathrm{f}(x)=x^3+9x^2-x-105$ $\mathrm{f}(x)=(x-3)(...x^2+...x+...)$	M1
	$\mathrm{g}(x)=x^2+12x+35$	A1
		(2)
		Total 9

(a)

M1 Attempts to use the factor theorem by setting $\mathrm{f}(\pm 3)=0$. Score for the values embedded in the expression leading to an equation in *p* and *q*. The = 0 may be implied by later work for this mark.
Alternatively, there may be other attempts eg to divide algebraically by $x-3$

$$
\begin{array}{r|l}
 & x^2+(p+6)x+3p+17 \\
\hline
x-3 & x^3+(p+3)x^2 \qquad\qquad -x \qquad +q \\
 & x^3 \qquad -3x^2 \\
 & \qquad (p+6)x^2 \qquad\qquad -x \\
 & \qquad (p+6)x^2+(-3p-18)x \\
 & \qquad\qquad\qquad (3p+17)x \qquad +q \\
 & \qquad\qquad\qquad (3p+17)x-9p-51
\end{array}
$$

$\Rightarrow -9p-51=q \Rightarrow 9p+q=-51$

To score the method mark they would need to proceed as far as equating *q* with their "$-9p-51$" to achieve an equation in *p* and *q*.
With alternative methods look for a correct method, condoning slips and invisible brackets leading to an equation in *p* and *q*.

A1* Correct proof with no errors including brackets. There must be at least one intermediate stage of working and $=0$ must be seen at some point in their solution via the factor theorem method.
e.g. $3^3+(p+3)\times 3^2-3+q=0 \Rightarrow 9p+q=-51$ scores M1A0 (no intermediate stage seen)
$27+(p+3)\times 9-3+q=0 \Rightarrow 51+9p+q=0 \Rightarrow 9p+q=-51$ scores M1A1