Question Number	Scheme	Marks
5(i)	$r = 0.25$	B1
	$S_\infty = \dfrac{1.5}{1-0.25} = 2$	M1 A1
		(3)
(ii)	(a) $\left(u_1 = 3,\right)\ u_2 = 0, u_3 = \dfrac{3}{2}, u_4 = 3, ...$	M1
	$\left(u_1 = 3\right), u_2 = 0, u_3 = \dfrac{3}{2}, u_4 = 3, ...$ and e.g. states that $u_4 = u_1$ so sequence will repeat (is periodic)	A1
		(2)
	(b) (Order) 3	A1
		(1)
	(c) $\displaystyle\sum_{n=1}^{70} u_n = 23 \times \left(3 + 0 + \frac{3}{2}\right) + 3 = 106.5$	M1, A1
		(2)
		(8 marks)

(i)

B1: States or uses $r = 0.25$ (may be implied by using $r = 0.25$ in the sum to infinity formula). 6×0.25 or any other term in the sequence is not sufficient evidence that this is a geometric sequence.
Alternatively, shows an understanding of the sigma notation by writing at least the first three terms in the sequence e.g. $6 \times \frac{1}{4} + 6 \times \left(\frac{1}{4}\right)^2 + 6 \times \left(\frac{1}{4}\right)^3 + ...$

Condone invisible brackets and may be written as a list.

M1: Attempts $S_\infty = \dfrac{a}{1-r}$ with $a = 1.5$ (or 6×0.25), $r = 0.25$ or $a = 6, r = 0.25$

You may also see $S_\infty = \dfrac{a}{1-r} - a$ with $a = 6, r = 0.25$ which is acceptable

Beware of other variants such as taking a factor of 6 out and using $a = 0.25, r = 0.25$

The values embedded in the expression is sufficient to score this mark.

A1: 2 cao **following evidence of the use of the sum to infinity formula**

Note $6 \times \frac{1}{4} + 6 \times \left(\frac{1}{4}\right)^2 + 6 \times \left(\frac{1}{4}\right)^3 + ... = 2$ is B1M0A0 (no evidence of using the sum to infinity formula)

(ii)(a)

M1: Uses the recurrence relation correctly at least once. If they do not achieve a correct $u_2 = 0$ then check e.g. their u_3 is a correct follow through for their u_2

A1: $\left(u_1 = 3\right), u_2 = 0, u_3 = \dfrac{3}{2}, u_4 = 3, ...$ with a statement or conclusion such as $u_4 = u_1$ /repeats/cycles (is periodic) As a minimum accept (3), 0, $\frac{3}{2}$, 3 (hence) periodic

(ii)(b) **This mark can only be scored following correct values in (ii)(a)** (or a restart in (ii)(b))

A1: (Order is) 3 (do not accept (repeats every) third). Cannot be for just listing the terms of the sequence.

(ii)(c)

M1: Establishes a correct method of finding $\sum_{n=1}^{70} u_n$ for their periodic sequence of order 3 found in (a).

If they did not have a periodic sequence of order 3 in (a) and they do not restart then this mark cannot be scored.

Seeing the values embedded in the expression is sufficient to score this mark.

Attempts to use the sum of a geometric or an arithmetic series is M0A0

A1: 106.5 or exact equivalent e.g. $\frac{213}{2}$ ignore any subsequent incorrect attempts to round.

Question Number	Scheme	Marks
6 (a)	$2\log_4\left(x+3\right)=\log_4\left(x+3\right)^2$ or $\frac{1}{2}=\log_4 2$ o.e	B1
	Combines two terms e.g. $2\log_4\left(x+3\right)+\log_4 x=\log_4 x\left(x+3\right)^2$	M1
	e.g. $x\left(x+3\right)^2=2\left(4x+2\right)$	A1
	e.g. $x\left(x^2+6x+9\right)=8x+4\Rightarrow x^3+6x^2+x-4=0$ *	A1*
		(4)
(b) (i)	$x^3+6x^2+x-4=\left(x+1\right)\left(x^2+5x-4\right)$	M1
	$x=\frac{-5\pm\sqrt{25+16}}{2}\Rightarrow x=\frac{-5\pm\sqrt{41}}{2}$	dM1 A1
		(3)
(ii)	$x=\frac{-5+\sqrt{41}}{2}$	B1
		(1)
		(8 marks)

(a) **Do not penalise the omission of base 4 in their working provided the terms and values are consistent with base 4.**

B1: Writes (or may be implied by further work)

- $2\log_4\left(x+3\right)$ as $\log_4\left(x+3\right)^2$ **or**
- $\frac{1}{2}$ as $=\log_4 2$

M1: Correctly combines (at least) **two of the original terms**. e.g.

- $2\log_4\left(x+3\right)+\log_4 x=\log_4 x\left(x+3\right)^2$ is M1 but $2\log_4\left(x+3\right)+\log_4 x=2\log_4 x\left(x+3\right)$ is M0
- $\log_4\left(4x+2\right)-\log_4 x=\log_4\left(\frac{4x+2}{x}\right)$ is M1
- $\log_4\left(4x+2\right)+\frac{1}{2}=\log_4\left(8x+4\right)$ is M1

Do not penalise if they subsequently make errors or apply laws incorrectly. May be implied if they proceed to an equation not involving logs e.g. $x\left(x+3\right)^2=2(4x+2)$ (but not the given answer)

Beware that $2\log(x+3)+\log x=2\log x(x+3)=\log x(x+3)^2$ is B1M0A0A0

A1: A correct intermediate equation not involving logs (but not the given answer).

Must follow correct log work. e.g. $\frac{\log_4 x(x+3)^2}{\log_4(4x+2)}=\frac{1}{2}\Rightarrow\frac{x(x+3)^2}{(4x+2)}=2$ is A0

A1*: Correct proof. Expect to see

- a correct equation not involving logs which is not the final answer
- the brackets multiplied out $(x+3)^2$ or $(x^2+3x)(x+3)$ before proceeding to the given answer.

Do not allow this mark for recovery from incorrect log work but allow invisible brackets to be "recovered" or implied if the intention is clear.