Question	Scheme	Marks	AOs
15(a)	$S_n = a + ar + ar^2 + ... + ar^{n-1}$	B1	1.2
	$rS_n = ar + ar^2 + ar^3 + ... + ar^n \Rightarrow S_n - rS_n = ...$	M1	2.1
	$S_n - rS_n = a - ar^n$	A1	1.1b

	$S_n(1-r)=a(1-r^n)\Rightarrow S_n=\dfrac{a(1-r^n)}{(1-r)}$*	A1*	2.1
		(4)	
(b)	$\dfrac{a(1-r^{10})}{1-r}=4\times\dfrac{a(1-r^5)}{1-r}$ or $4\times\dfrac{a(1-r^{10})}{1-r}=\dfrac{a(1-r^5)}{1-r}$ Equation in r^{10} and r^5 (and possibly $1-r$)	M1	3.1a
	$1-r^{10}=4(1-r^5)$	A1	1.1b
	$r^{10}-4r^5+3=0\Rightarrow(r^5-1)(r^5-3)=0\Rightarrow r^5=...$ or e.g. $1-r^{10}=4(1-r^5)\Rightarrow(1-r^5)(1+r^5)=4(1-r^5)\Rightarrow r^5=...$	dM1	2.1
	$r=\sqrt[5]{3}$ oe only	A1	1.1b
		(4)	
			(8 marks)

Notes:

(a)

B1: Writes out the sum or lists terms. Condone the omission of *S*.
The sum must include the first and last terms and (at least) two other correct terms and no incorrect terms e.g. ar^n
Note that the sum may be seen embedded within their working.

M1: For the key step in attempting to multiply the first series by *r* and subtracting.

A1: $S_n-rS_n=a-ar^n$ either way around but condone one side being prematurely factorised (but not both) **following correct work but this could follow B0 if insufficient terms were shown.**

A1*: Depends on all previous marks. Proceeds to given result showing all steps including seeing both sides unfactorised at some point in their working.
Note: If terms are listed rather than added then allow the first 3 marks if otherwise correct but withhold the final mark.

(b)

M1: For the correct strategy of producing an equation in just r^{10} and r^5 (and possibly $(1-r)$) with the "4" on either side using the result from part (a) and makes progress to at least cancel through by *a*
Some candidates retain the "$1-r$" and start multiplying out e.g. $(1-r)(1-r^{10})$ and this mark is still available as long as there is progress in cancelling the "*a*".

A1: Correct equation with the *a* and the $1-r$ cancelled. Allow any correct equation in just r^5 and r^{10}

dM1: Depends on the first M. Solves as far as $r^5=...$ by solving a 3 term quadratic in r^5 by a valid method – see general guidance or by difference of 2 squares – see above

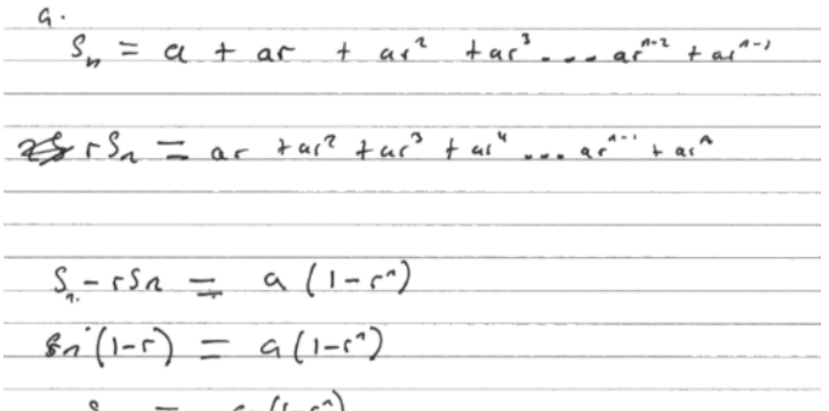
A1: $r=\sqrt[5]{3}$ oe only. The solution $r=1$ if found must be rejected here.

(b) Note: For candidates who use $S_5=4S_{10}$ expect to see:

$$4\times\frac{a(1-r^{10})}{1-r}=\frac{a(1-r^5)}{1-r}\Rightarrow 4(1-r^{10})=(1-r^5)\ \text{M1A0}$$

$4r^{10}-r^5-3=0\Rightarrow(4r^5+3)(r^5-1)=0\Rightarrow r^5=...$ or $4(1-r^5)(1+r^5)=(1-r^5)\Rightarrow r^5=...$ dM1A0

Example for (a):



This scores B1M1A1A0:

B1: Writes down the sum including first and last terms and at least 2 other correct terms and no incorrect terms

M1: Multiplies by *r* and subtracts

A1: Correct equation (we allow one side to be prematurely factorised)

A0: One side was prematurely factorised