Question number	Scheme	Marks
4	$u_1 = (1+1)\ln 4 = 2\ln 4$ and $d = \ln 4$	M1
	$S_n = \dfrac{n}{2}\left(2\times '2\ln 4' + (n-1)'\ln 4'\right)$ or $S_n = \dfrac{n}{2}\left('2\ln 4' + (n+1)'\ln 4'\right)$	M1
	ln 4 to either 2ln 2 or ln 2^2 at any stage.	M1
	$S_n = \dfrac{n}{2}(2n+6)\ln 2$ or $S_n = \dfrac{n}{2}(n+3)\ln 4$ or $S_n = \dfrac{n}{2}\left(\ln 2^6 + \ln 2^{2n}\right)$ or $S_n = \dfrac{n}{2}\left(\ln 4^3 + \ln 4^n\right)$	M1
	$S_n = \ln 2^{n^2+3n}$	A1 cso
		Total 5 marks

Note: You may see the use of $\ln 4\sum_1^n (r+1)$

<u>Solution</u>

$$S_n = \ln 4\sum_1^n (r+1)$$
$$= \ln 4\left(\sum_1^n r + \sum_1^n 1\right)$$
$$= \ln 4\left(\frac{n}{2}(n+1) + n\right)$$
$$= 2\ln 2\left(\frac{n^2}{2} + \frac{3n}{2}\right)$$
$$= (n^2+3n)\ln 2$$
$$S_n = \ln 2^{n^2+3n}$$

If this is a full and correct solution (no errors) as shown – award full marks – otherwise, please send to Review.

<table>
<tr><th>Mark</th><th>Notes</th></tr>
<tr><td>M1</td><td>Finds the first term and the common difference.
$u_1 = (1+1)\ln 4 = 2\ln 4$ and $d = \ln 4$
Both must be correct for this mark.</td></tr>
<tr><td colspan="2">The general principle of marking this question is as follows:
Note: Their a and d must be in terms of ln 4 or 2ln 2

Second M1 for a correct substitution of their a and their d into either $\frac{n}{2}(2a+(n-1)d)$ or $\frac{n}{2}(a+L)$
Third M1 is for dealing correctly with all terms in ln 4 at any stage $(\ln 4 = 2\ln 2 \text{ or } \ln 2^2)$ seen anywhere in the solution.
Fourth M1 for attempting to simplify the sum to the required form using their a and d
Final mark is for obtaining the given answer with no errors seen.
</td></tr>
<tr><td>M1</td><td>Uses either form of the summation formula for an arithmetic series with their a and d provided both are in terms of ln 4 or 2ln 2
There must be no errors in the use of and substitution of their values into the formula for this question – it is given on page 2.
$S_n = \frac{n}{2}(2\times\text{'}2\ln 4\text{'}+(n-1)\text{'}\ln 4\text{'})$ or $S_n = \frac{n}{2}(\text{'}2\ln 4\text{'}+(n+1)\text{'}\ln 4\text{'})$</td></tr>
<tr><td>M1</td><td>For correctly changing all terms in ln 4 to either 2ln 2 or $\ln 2^2$ at any stage.

You may see this step at the end of the solution.</td></tr>
<tr><td>M1</td><td>Simplifies their expression in either ln 2 or ln 4 to obtain one of the following.
$S_n = \frac{n}{2}(2n+6)\ln 2$
or
$S_n = \frac{n}{2}(n+3)\ln 4$
or
$S_n = \frac{n}{2}(\ln 2^6 + \ln 2^{2n})$
or
$S_n = \frac{n}{2}(\ln 4^3 + \ln 4^n)$</td></tr>
<tr><td>A1cso*</td><td>For obtaining the given answer in full with no errors.
$S_n = \ln 2^{n^2+3n}$</td></tr>
</table>