| Question number | Scheme | | Marks |
|---|---|---|---|
| 2. | (a) $u_2 = (-2)^2 = 4$ | | B1 |
| | $u_3 = 1,\ u_4 = 4$ | For $u_3$, ft $(u_2 - 3)^2$ | B1ft, B1 |
| | | | (3) |
| | (b) $u_{20} = 4$ | | B1ft |
| | | | (1) |
| | | | **Total 4 marks** |
| | (b) ft only if sequence is "oscillating".<br>Do <u>not</u> give marks if answers have clearly been obtained from wrong working,<br>e.g. $u_2 = (3-3)^2 = 0$<br>$u_3 = (4-3)^2 = 1$<br>$u_4 = (5-3)^2 = 4$ | | |

| Question number | Scheme | Marks |
|---|---|---|
| 4. (a) | $a_2 = 4$<br>$a_3 = 3\times a_2 - 5 = 7$ | B1<br>B1f.t.<br>(2) |
| (b) | $a_4 = 3a_3 - 5(=16)$ and $a_5 = 3a_4 - 5(=43)$<br><br>3 + 4 + 7 + 16 + 43<br><br>= 73 | M1<br><br>M1<br><br>A1c.a.o. (3)<br><br>**5** |
| (a) | 2nd B1f.t. — Follow through their $a_2$ but it must be a value. $3\times 4-5$ is B0<br>Give wherever it is first seen. | |
| (b) | 1st M1 — For two further attempts to use of $a_{n+1} = 3a_n - 5$, wherever seen.<br>Condone arithmetic slips<br><br>2nd M1 — For attempting to add 5 relevant terms (i.e. terms derived from an attempt to use the recurrence formula) or an expression.<br>Follow through their values for $a_2 - a_5$<br><br>Use of formulae for arithmetic series is M0A0 but could get 1st M1 if $a_4$ and $a_5$ are correctly attempted. | |

| Question number | Scheme | Marks | |
|---|---|---|---|
| 7. | (a) $1(p+1)$ or $p+1$ | B1 | (1) |
| | (b) $((a))(p+(a))$ [(a) must be a function of *p*]. $[(p+1)(p+p+1)]$ | M1 | |
| | $=1+3p+2p^2$ (*) | A1cso | (2) |
| | (c) $1+3p+2p^2=1$ | M1 | |
| | $p(2p+3)=0$ $p=\ldots$ | M1 | |
| | $p=-\frac{3}{2}$ (ignore $p$ = 0, if seen, even if 'chosen' as the answer) | A1 | (3) |
| | (d) Noting that even terms are the same. | M1 | |
| | This M mark can be implied by listing at least 4 terms, e.g. $1,\ -\frac{1}{2},\ 1,\ -\frac{1}{2},\ldots$ | | |
| | $x_{2008}=-\frac{1}{2}$ | A1 | (2) |
| | | | **8** |
| | (b) M: Valid attempt to use the given recurrence relation to find $x_3$.<br>Missing brackets, e.g. $p+1(p+p+1)$ Condone for the M1, then if all terms in the expansion are correct, with working fully shown, M1 A1 is still allowed.<br>Beware 'working back from the answer', e.g. $1+3p+2p^2=(1+p)(1+2p)$ scores no marks unless the recurrence relation is justified.<br>(c) 2nd M: Attempt to solve a quadratic equation in *p* (e.g. quadratic formula or completing the square).<br>The equation must be based on $x_3=1$.<br>The attempt must lead to a non-zero solution, so just stating the zero solution $p$ = 0 is M0.<br>A: The A mark is dependent on both M marks.<br>(d) M: Can be implied by a correct answer for their *p* (answer is $p$ + 1), and can also be implied if the working is 'obscure').<br>Trivialising, e.g. $p$ = 0, so every term = 1, is M0.<br>If the additional answer $x_{2008}=1$ (from $p$ = 0) is seen, ignore this (isw). | | |

| Question number | Scheme | Marks | |
|---|---|---|---|
| 5. (a) | $[x_2 =]\, a-3$ | B1 | (1) |
| (b) | $[x_3 =]\ ax_2 - 3$ or $a(a-3)-3$ | M1 | |
| | $= a(a-3)-3$ } both lines needed for A1 | | |
| | $= a^2 - 3a - 3$ (*) | A1cso | (2) |
| (c) | $a^2 - 3a - 3 = 7$ | | |
| | $a^2 - 3a - 10 = 0$ or $a^2 - 3a = 10$ | M1 | |
| | $(a-5)(a+2) = 0$ | dM1 | |
| | $\underline{a = 5 \text{ or } -2}$ | A1 | (3) |
| | | | **6** |
| (a) | B1 for $a \times 1 - 3$ or better. Give for $a-3$ in part (a) or if it appears in (b) they must state $x_2 = a-3$<br>This must be seen in (a) or before the $a(a-3)-3$ step. | | |
| (b) | M1 for clear show that. Usually for $a(a-3)-3$ but can follow through their $x_2$ and even allow $ax_2 - 3$<br>A1 for correct processing leading to printed answer. Both lines needed and no incorrect working seen. | | |
| (c) | 1st M1 for attempt to form a correct equation and start to collect terms. It must be a quadratic but need not lead to a 3TQ=0<br><br>2nd dM1 This mark is dependent upon the first M1.<br>for attempt to factorize their 3TQ=0 or to solve their 3TQ=0. The "=0"can be implied.<br>$(x \pm p)(x \pm q) = 0$, where $pq = 10$ or $(x \pm \frac{3}{2})^2 \pm \frac{9}{4} - 10 = 0$ or correct use of quadratic formula with $\underline{\pm}$<br>They must have a form that leads directly to 2 values for *a*.<br>Trial and Improvement that leads to only one answer gets M0 here.<br>A1 for both correct answers. Allow $x = \ldots$<br><br>Give 3/3 for correct answers with no working or trial and improvement that gives <u>both</u> values for *a* | | |

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| Question Number | Scheme | Marks |
|---|---|---|
| Q7 (a) | $(a_2 =)2k-7$ | B1 (1) |
| (b) | $(a_3 =)2(2k-7)-7$ or $4k-14-7, = 4k-21$ (*) | M1, A1cso (2) |
| (c) | $\left(a_4 =\right)2(4k-21)-7 \quad (=8k-49)$ | M1 |
| | $\sum_{r=1}^{4} a_r = k+"(2k-7)"+(4k-21)+"(8k-49)"$ | M1 |
| | $k+(2k-7)+(4k-21)+(8k-49)=15k-77=43 \qquad k=8$ | M1 A1 (4) **[7]** |
| (b)<br><br><br><br>(c) | M1 must see 2(their $a_2$) - 7 or $2(2k-7)-7$ or $4k-14-7$. Their $a_2$ must be a function of *k*.<br>A1cso must see the $2(2k-7)-7$ or $4k-14-7$ expression and the $4k$ - 21 with no incorrect working<br>1st M1 for an attempt to find $a_4$ using the given rule. Can be awarded for $8k$ - 49 seen.<br>**Use of formulae for the sum of an arithmetic series scores M0M0A0 for the next 3 marks.**<br>2nd M1 for attempting the sum of the 1st 4 terms. Must have "+" not just , or clear attempt to sum.<br>Follow through their $a_2$ and $a_4$ provided they are linear functions of *k*.<br>Must lead to linear expression in *k*. Condone use of their linear $a_3 \neq 4k-21$ here too.<br>3rd M1 for forming a linear equation in *k* using their sum and the 43 and attempt to solve for *k* as far as $pk = q$<br>A1 for *k* = 8 only so $k=\frac{120}{15}$ is A0<br><br>Answer Only (e.g. trial improvement)<br>Accept *k* = 8 only if 8 + 9 + 11 + 15 = 43 is seen as well<br><br>Sum $\underline{a_2+a_3+a_4+a_5}$ or $\underline{a_2+a_3+a_4}$<br>Allow: M1 if $8k$ - 49 is seen, M0 for the sum (since they are not adding the 1st 4 terms) then M1<br>if they use their sum along with the 43 to form a linear equation and attempt to solve but A0 | |

| Question Number | Scheme | Marks |
|---|---|---|
| **5.** | | |
| **(a)** | $a_2 = \left(\sqrt{4+3}\right) = \sqrt{7}$ | B1 |
| | $a_3 = \sqrt{\text{"their 7"}+3} = \sqrt{10}$ | B1ft (2) |
| **(b)** | $a_4 = \sqrt{10+3}\left(=\sqrt{13}\right)$ | M1 |
| | $a_5 = \sqrt{13+3} = 4$ * | A1 cso (2) |
| | | **4** |
| | **Notes** | |
| **(a)** | 1st B1 for $\sqrt{7}$ only<br>2nd B1ft follow through their "7" in correct formula provided they have $\sqrt{n}$ ,where $n$ is an integer. | |
| **(b)** | M1 for an attempt to find $a_4$. Should see $\sqrt{\text{"their"}\left(a_3\right)^2+3}$. Must see evidence for M1.<br>$a_4 = \sqrt{13}$ provided this follows from their $a_3$ working or answer is sufficient<br><br>A1cso for a correct solution (M1 explicit) must include the = 4.<br>Ending at $\sqrt{16}$ only is A0 and ending with $\pm$ 4 is A0.<br>Ignore any incorrect statements that are not used e.g. common difference = $\sqrt{3}$<br><br><u>Listing</u>: A <u>full</u> list: 2 $\left(=\sqrt{4}\right)$, $\sqrt{7}$, $\sqrt{10}$, $\sqrt{13}$, $\sqrt{16} = 4$ is fine for M1A1 | |
| **ALT** | <u>Formula</u>: Some may state (or use) $a_n = \sqrt{3n+1}$ leading to $a_5 = \sqrt{3\times 5+1} = 4$.<br>This will get marks in (a) [if correct values are seen] and can score the M1 in (b) if $a_n = \sqrt{3n+1}$ or $a_4 = \sqrt{13}$ are seen. | |
| $\pm\sqrt{\ }$ | If $\pm\sqrt{\ }$ appear any where ignore in part (a) and withhold the final A mark only | |