|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **1** | Recognises that two subsequent values will divide to give an equal ratio and sets up an appropriate equation. | **M1** | 2.2a | 4thUnderstand simple geometric sequences. |
| Makes an attempt to solve the equation. For example, or  | **M1** | 1.1b |
| Factorises to get  | **M1** | 1.1b |
| States the correct solution: *k* = 6.  or *k* = 0 is trivial may also be seen, but is not required. | **A1** | 1.1b |
| (4 marks) |
| Notes |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **2a** | Forms a pair of simultaneous equations, using the given values | **M1** | 2.2a | 4thUnderstand simple arithmetic sequences. |
| Correctly solves to find *d* = −6 | **A1** | 1.1b |
| Finds *a* = 116 | **A1** | 1.1b |
| Uses  to find  | **A1** | 1.1b |
|  | **(4)** |  |  |
| **2b** | Uses the sum of an arithmetic series to form the equation | **M1 ft** | 2.2a | 5thUnderstand simple arithmetic series. |
| Successfully multiplies out the brackets and simplifies. Fully simplified quadratic of  is seen or is seen. | **M1 ft** | 1.1b |
| Correctly factorises:  | **M1 ft** | 1.1b |
| States that *n* = 39 is the correct answer. | **A1** | 1.1b |
|  | **(4)** |  |  |
| (8 marks) |
| Notes**2a**Can use elimination or substitution to solve the simultaneous equations.**2b**Award method marks for a correct attempt to solve the equation using their incorrect values from part **a**. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **3a** | Writes out the first *n* terms of the arithmetic sequence in both ascending and descending form | **M1** | 2.4 | 5thUnderstand the proof of the *Sn* formula for arithmetic series. |
| Attempts to add these two sequences | **M1** | 2.4 |
| States  | **A1** | 1.1b |
|  | **(3)** |  |  |
| **3b** | Makes an attempt to find the sum. For example,  is seen. | **M1** | 2.2a | 4thUnderstand simple arithmetic series. |
| States correct final answer. *S* = 40 000 | **A1** | 1.1b |
|  | **(2)** |  |  |
| (5 marks) |
| Notes**3a**Do not award full marks for an incomplete proof.**3a**Do award second method mark if student indicates that (2*a + (n* − 1)*d* appears *n* times. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **4a** | States that  | **A1** | 1.1b | 5thWork with sequences defined by simple recurrence relations. |
| Attempts to substitute  into .  and simplifies to find  | **A1** | 1.1b |
|  | **(2)** |  |  |
| **5b** | States  or  | **M1** | 2.2a | 5thWork with sequences defined by simple recurrence relations. |
| Factorises to get  | **M1** | 1.1b |
| States *p* = 5. May also state that , but mark can be awarded without that being seen. | **A1** | 1.1b |
|  | **(3)** |  |  |
| **5c** |  | **A1 ft** | 1.1b | 5thWork with sequences defined by simple recurrence relations. |
|  | **(1)** |  |  |
| (6 marks) |
| Notes**5c**Award mark for a correct answer using their value of *p* from part **b**. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **5a** | States the recurrence relation. Choice of variable is not important. or  | **M1** | 3.1a | 5th Work with sequences defined by simple recurrence relations.  |
| Defines the first value. Accept either use of  or . or | **M1** | 3.1a |
|  | **(2)** |  |  |
| **5b** | Makes an attempt to find the height, for example  is seen. | **M1** | 3.1a | 5thWork with the *n*th term formula for geometric sequences. |
| States that the maximum height would be 13.445… cm. Accept awrt 13.4 | **A1** | 1.1b |
|  | **(2)** |  |  |
| **5c** | Attempts to make use of the sum to infinity. For example,  or is seen. | **M1** | 3.1a | 6thUse geometric sequences and series in context. |
| Understands that the ball travels upwards and then downwards, so multiplies by 2.  or  is seen. | **M1** | 3.1a |
| Recognises that when the ball is dropped, it initially only travels downwards. Either  or  is seen or implied. | **M1** | 3.1a |
| States a fully correct answer of cm. Accept awrt 453.3 cm. | **A1** | 1.1b |
|  | **(4)** |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **5d** | ‘It is very unlikely that the ball will not bounce vertically’ or ‘This model assumes the ball will continue to bounce forever’. | **B1** | 3.5 | 6thUnderstand convergent geometric series and the sum to infinity. |
|  | **(1)** |  |  |
| (9 marks) |
| Notes**6c**Award first method mark for an understanding that the sum to infinity formula is required.**6c**Award second method mark for an understanding that the sum to infinity formula will need adjusting, i.e. the ball goes down and then up.**6c**Award third method mark for an understanding that the ball only goes down initially as it is dropped. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **6a** | Recognises that it is a geometric series with a first term  and common ratio | **M1** | 3.1a | 6thUse geometric sequences and series in context. |
| Attempts to use the sum of a geometric series. For example,  or  is seen. | **M1\*** | 2.2a |
| Finds  | **A1** | 1.1b |
|  | **(3)** |  |  |
| **6b** | States  or  | **M1** | 3.1a | 5thUse arithmetic sequences and series in context. |
| Begins to simplify.  or  | **M1** | 1.1b |
| Applies law of logarithms correctly or  | **M1** | 2.2a |
| States  | **A1** | 1.1b |
|  | **(4)** |  |  |
| **6c** | Uses the sum of an arithmetic series to state | **M1** | 3.1a | 5thUse arithmetic sequences and series in context. |
| Solves for *d*. *d* = £11.21 | **A1** | 1.1b |
|  | **(2)** |  |  |
| (9 marks) |
| Notes**M1**Award mark if attempt to calculate the amount of money after 1, 2, 3,….,8 and 9 months is seen. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **7a** | Understands that for the series to be convergent  or states  | **M1** | 2.2a | 6thUnderstand convergent geometric series and the sum to infinity. |
| Correctly concludes that . Accept  | **A1** | 1.1b |
|  | **(2)** |  |  |
| **7b** | Understands to use the sum to infinity formula. For example, states  | **M1** | 2.2a | 5thUnderstand sigma notation. |
| Makes an attempt to solve for *x*. For example,  is seen. | **M1** | 1.1b |
| States  | **A1** | 1.1b |
|  | **(3)** |  |  |
| (5 marks) |
| Notes |