# 1.2 arithmetic sequences and series\_P\_2

**1a.** *[4 marks]*

## Markscheme

\* This question is from an exam for a previous syllabus, and may contain minor differences in marking or structure.

attempt to find        ***(M1)***

eg   1.4 − 1.3 ,   ,  

 (may be seen in expression for )       ***(A1)***

correct equation       ***(A1)***

eg    ,  

       ***A1  N3***

***[4 marks]***

**1b.** *[2 marks]*

## Markscheme

correct substitution      ***(A1)***

*eg*    ,   ,  

        ***A1  N2***

***[2 marks]***

**1c.** *[5 marks]*

## Markscheme

recognizing need to find the sequence of multiples of 3 (seen anywhere)       ***(M1)***

*eg*  first term is  (= 1.5)   (accept notation ) ,

  (= 0.3) , 100 terms (accept ), last term is 31.2

(accept notation ) ,    (accept )

correct working for sum of sequence where n is a multiple of 3      ***A2***

 ,   ,  1635

valid approach (seen anywhere)       ***(M1)***

*eg*     ,   ,   (their sum for )

correct working (seen anywhere)       ***A1***

*eg*    , 4875 − 1635

       ***AG  N0***

***[5 marks]***

**2a.** *[1 mark]*

## Markscheme

(amount taken in the 7th day):      ***(A1)***

**Note:** Accept . The equations do not need to be simplified. They should be given in terms of  and  for the marks to be awarded.

***[1 mark]***

**2b.** *[1 mark]*

## Markscheme

(amount taken in the 11th day):      ***(A1)***

**Note:** Accept . The equations do not need to be simplified. They should be given in terms of  and  for the marks to be awarded.

***[1 mark]***

**2c.** *[2 marks]*

## Markscheme

( =) 9     ***(A1)*(ft)**

( =) 2     ***(A1)*(ft)**

**Note:** Follow through from part (a), but only if values are positive and  < 21.

***[2 marks]***

**2d.** *[3 marks]*

## Markscheme

      ***(M1)(A1)*(ft)**

**Note:** Award ***(M1)*** for substitution in the sum of an arithmetic sequence formula; ***(A1)*(ft)** for their correct substitution.

1140  (mg)       ***(A1)*(ft)*(G3)***

**Note:** Follow through from their  and  from part (b).

***[3 marks]***

**2e.** *[3 marks]*

## Markscheme

20 × (0.5)      ***(M1)(A1)***

**Note:** Award ***(M1)*** for substitution into the geometric sequence formula, ***(A1)*** for correct substitution.

1.25  (mg)       ***(A1)(G3)***

***[3 marks]***

**2f.** *[3 marks]*

## Markscheme

      ***(M1)(M1)***

**Note:** Award ***(M1)*** for correct substitution into the geometric sequence formula; ***(M1)*** for comparing their expression to 0.06. Accept an equation instead of inequality.

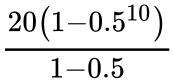
( =) 10  (10th day)       ***(A1)*(ft)*(G3)***

**Note:** Follow through from part (d)(i), if 0 <  < 1. Follow through answers must be rounded up for final mark.

***[3 marks]***

**2g.** *[3 marks]*

## Markscheme

     ***(M1)(A1)(ft)***

**Note:** Award ***(M1)*** for substitution into sum of a geometric sequence formula, ***(A1)(ft)*** for correct substitution.  
 Follow through from their  and  in part (d)(i), if 0 <  < 1. Follow through from their  in part (d)(ii) but only if  is a positive integer.

40.0  (39.9609…) (mg)       ***(A1)*(ft)*(G2)***

***[3 marks]***

**3a.** *[3 marks]*

## Markscheme

60 × 1.1     ***(M1)(A1)***

**Note:** Award ***(M1)*** for substituting the geometric progression *n*th term formula, ***(A1)*** for correct substitution.

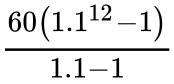
= ($) 156  (155.624…)     ***(A1)(G3)***

**Note:** Accept the answer if it rounds correctly to 3 sf, as per the accuracy instructions.

***[3 marks]***

**3b.** *[3 marks]*

## Markscheme

     ***(M1)(A1)*(ft)**

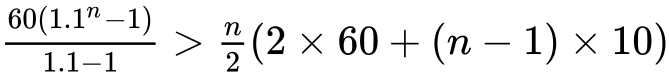
**Note:** Award ***(M1)*** for substituting the geometric series formula, ***(A1)*(ft)** for correct substitution. Follow through from part (c) for their first term and common ratio.

= ($)1280  (1283.05…)     ***(A1)*(ft)*(G2)***

***[3 marks]***

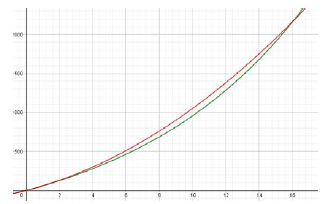
**3c.** *[4 marks]*

## Markscheme

    ***(M1)(M1)***

**Note:** Award ***(M1)*** for correctly substituted geometric and arithmetic series formula with *n* (accept other variable for “*n*”), ***(M1)*** for comparing their expressions consistent with their part (b) and part (d).

**OR**

     ***(M1)(M1)***

**Note:** Award ***(M1)*** for two curves with approximately correct shape drawn in the first quadrant, ***(M1)*** for one point of intersection with approximate correct position.

Accept alternative correct sketches, such as



Award ***(M1)*** for a curve with approximate correct shape drawn in the 1 (or 4) quadrant and all above (or below) the *x*-axis, ***(M1)*** for one point of intersection with the x-axis with approximate correct position.

17      ***(A2)*(ft)*(G3)***

**Note:** Follow through from parts (b) and (d).  
An answer of 16 is incorrect. Award at most ***(M1)(M1)(A0)(A0)*** with working seen. Award ***(G0)*** if final answer is 16 without working seen.

***[4 marks]***

**4a.** *[4 marks]*

## Markscheme

\* This question is from an exam for a previous syllabus, and may contain minor differences in marking or structure.

*u* + 2*d* = 1407,  *u* + 9*d* = 1183   ***(M1)(A1)***

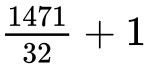
*u* = 1471, *d* = −32    ***A1A1***

***[4 marks]***

**4b.** *[3 marks]*

## Markscheme

1471 + (*n* − 1)(−32) > 0      ***(M1)***

⇒ *n* < 

*n* < 46.96…      ***(A1)***

so 46 positive terms      ***A1***

***[3 marks]***

**5a.** *[2 marks]*

## Markscheme

**OR**     ***(M1)(A1)***

**Note:** Award ***(M1)*** for substitution into arithmetic sequence formula, ***(A1)*** for correct substitution.

***[2 marks]***

**5b.** *[2 marks]*

## Markscheme

     ***(M1)***

**Notes:** Award ***(M1)*** for their correct inequality. Accept .

Accept  **OR** . Award ***(M0)*** for .

     ***(A1)*(ft)*(G2)***

**Note:** Follow through from part (a)(ii), but only if  is a positive integer.

***[2 marks]***

**5c.** *[4 marks]*

## Markscheme

     ***(M1)(A1)*(ft)**

**Note:** Award ***(M1)*** for substitution into sum of an arithmetic series formula, ***(A1)*(ft)** for correct substitution.

     ***(A1)***

**Note:** Award ***(A1)*** for their  seen.

     ***(A1)*(ft)*(G3)***

**Note:** Award ***(A1)*(ft)** for correctly converting their answer in metres to km; this can be awarded independently from previous marks.

***OR***

     ***(M1)(A1)*(ft)*(A1)***

**Note:** Award ***(M1)*** for substitution into sum of an arithmetic series formula, ***(A1)*(ft)** for correct substitution, ***(A1)*** for correctly converting 3000 m and 400 m into km.

     ***(A1)(G3)***

***[4 marks]***

**5d.** *[3 marks]*

## Markscheme

     ***(M1)(A1)***

**Note:** Award ***(M1)*** for substitution into geometric series formula, ***(A1)*** for correct substitutions.

     ***(A1)(G3)***

***OR***

     ***(M1)(A1)***

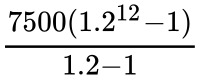
**Note:** Award ***(M1)*** for substitution into geometric series formula, ***(A1)*** for correct substitutions.

     ***(A1)(G3)***

***[3 marks]***

**5e.** *[3 marks]*

## Markscheme

     ***(M1)(A1)***

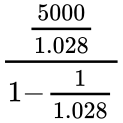
**Notes:** Award ***(M1)*** for substitution into sum of a geometric series formula, ***(A1)*** for correct substitutions. Follow through from their ratio () in part (d). If  (distance does not increase) or the final answer is unrealistic (*eg* ), do not award the final ***(A1)***.

     ***(A1)(G2)***

***[3 marks]***

**6.** *[3 marks]*

## Markscheme

sum to infinity is      ***(M1)(A1)***



so minimum amount is $178572     ***A1***

**Note:**     Accept answers which round to 178572.

***[3 Marks]***

**7a.** *[3 marks]*

## Markscheme

\* This question is from an exam for a previous syllabus, and may contain minor differences in marking or structure.

i)            ***(A1)***

ii)           ***(M1)***

**Note:** Award ***(M1)*** for   **OR** 

       ***(A1)(G3)***

**7b.** *[4 marks]*

## Markscheme

i)             ***(M1)(A1)***

**Note:** Award ***(M1)*** for substitution in arithmetic sequence formula; ***(A1)*** for correct substitutions.

ii)            ***(M1)(A1)***

**Note:** Award ***(M1)*** for substitution in arithmetic sequence formula; ***(A1)*** for correct substitutions.

**7c.** *[2 marks]*

## Markscheme

        ***(M1)***

**Note:** Award ***(M1)*** for setting a correct inequality using their expressions for (b)(i) and (b)(ii). Accept an equation.

**OR**

list of at least 4 correct terms of each sequence        ***(M1)***

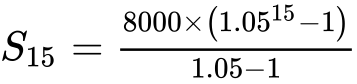
**Note:** Award ***(M1)*** for correct lists corresponding to their answers for parts (b)(i) and (b)(ii).

        ***(A1)*(ft)*(G2)***

**Note:** Value must be an integer for the final ***(A1)*** to be awarded. Follow through from parts (b)(i) and (b)(ii). Award ***(G1)*** for a final answer of  seen without working.

**7d.** *[7 marks]*

## Markscheme

i)              ***(M1)(A1)*(ft)**

**Note:** Award ***(M1)*** for substitution into geometric series formula and ***(A1)*** for correct substitution of  and their  from part (b)(ii). Follow through from part (b)(ii).

**OR**

        ***(M1)(A1)*(ft)**

**Note:** Follow through from part (b)(ii).

         ***(A1)*(ft)*(G2)***

ii)             ***(M1)(A1)*(ft)**

**Note:** Award ***(M1)*** for substitution into arithmetic series formula and ***(A1***) for correct substitution, using their first term and their last term from part (b)(i), or their  and . Follow through from part (b)(i).

**OR**

          ***(M1)(A1)*(ft)**

**Note:** Follow through from part (b)(i).

         ***(A1)*(ft)*(G2)***

Antonio does not earn more than Barbara

(his total salary will be less than Barbara’s)         ***(A1)*(ft)**

**Note:** Award ***(A1)*(ft)** for a final answer that is consistent with their part (d)(i) and (d)(ii). Accept “Barbara earns more”. The final ***(A1)*** can only be awarded if two total salaries are seen.

**8a.** *[2 marks]*

## Markscheme

\* This question is from an exam for a previous syllabus, and may contain minor differences in marking or structure.

valid approach     ***(M1)***

*eg*

    ***A1     N2***

***[2 marks]***

**8b.** *[2 marks]*

## Markscheme

correct substitution into term formula     ***(A1)***

*eg*

    ***A1     N2***

***[2 marks]***

**8c.** *[2 marks]*

## Markscheme

correct substitution into sum formula     ***(A1)***

*eg*

    ***A1     N2***

***[2 marks]***

**9a.** *[2 marks]*

## Markscheme

\* This question is from an exam for a previous syllabus, and may contain minor differences in marking or structure.

(i)              ***(A1)***

(ii)             ***(A1)*(ft)**

**Note:** Follow through from part (a)(i).

**9b.** *[2 marks]*

## Markscheme

        ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into arithmetic sequence formula. A list of **their**  correct terms (excluding those given in question and the  from part (a)(ii)) must be seen for the ***(M1)*** to be awarded.

         ***(A1)*(ft)*(G2)***

**Note:** Follow through from their value for .

If a list is used, award ***(A1)*** for their  term.

**9c.** *[3 marks]*

## Markscheme

 **OR**          ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into arithmetic series formula. Follow through from their part (a)(i). Accept a list added together until the  term.

          ***(A1)*(ft)**

**Note:** Follow through from parts (a) and (b).

          ***(A1)*(ft)*(G2)***

**Note:** Award ***(A1)*(ft)** for correctly converting **their** metres to kilometres, irrespective of method used. To award the last ***(A1)*(ft)** in follow through, the candidate’s answer in metres must be seen.

**9d.** *[3 marks]*

## Markscheme

           ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into arithmetic series formula equated to . Follow through from their part (a)(i). Accept a list of terms that shows clearly the  second and  second distances.  
Correct use of kinematics equations is a valid method.

         ***(A1)*(ft)**

 (seconds)         ***(A1)*(ft)*(G2)***

**Note:** Award ***(A1)*(ft)** for correct unrounded value for . The second ***(A1)*(ft)** is awarded for the correct rounding off of their value for  to the nearest second if their unrounded value is seen.  
Award ***(M1)(A2)*(ft)** for their  if method is shown. Unrounded value for  may not be seen. Follow through from their  and  only if workings are shown.

**OR**

           ***(M1)***

**Note:** Award ***(M1)*** for adding the terms until reaching .

            ***(A2)*(ft)**

**Note:** In this method, follow through from their  from part (a) and their  from part (c).

**9e.** *[2 marks]*

## Markscheme

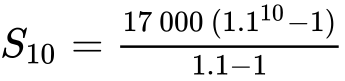
 (or equivalent)          ***(M1)***

**Note:** Award ***(M1)*** for multiplying  by  or equivalent.

                   ***(A1)(G2)***

**9f.** *[3 marks]*

## Markscheme

           ***(M1)(A1)*(ft)**

**Note:** Award ***(M1)*** for substitution into the geometric series formula, ***(A1)*(ft)** for correct substitution. Award ***(A1)*(ft)** for a list of their correct  terms, ***(M1)*** for adding their  terms.

           ***(A1)*(ft)(G2)**

**Note:** Follow through from their  in part (e).

**10a.** *[1 mark]*

## Markscheme

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     ***A1     N1***

***[1 mark]***

**10b.** *[3 marks]*

## Markscheme

**METHOD 1**

valid approach     ***(M1)***

*eg*

correct working     ***(A1)***

*eg*

     ***A1     N2***

**METHOD 2**

attempt to list 3 or more terms in either direction     ***(M1)***

*eg*

correct list of 4 or more terms in **correct** direction     ***(A1)***

*eg*

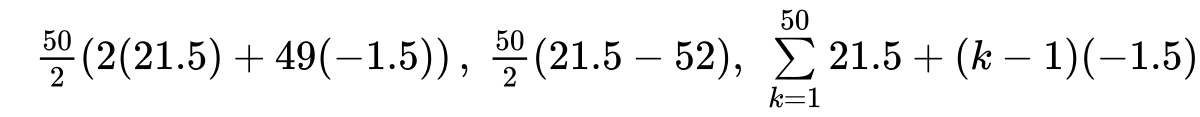
     ***A1     N2***

***[3 marks]***

**10c.** *[2 marks]*

## Markscheme

correct expression     ***(A1)***

*eg*

     ***A1     N2***

***[2 marks]***

***Total [6 marks]***

**11a.** *[2 marks]*

## Markscheme

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(i)          ***(A1)***

(ii)          ***(A1)***

**11b.** *[1 mark]*

## Markscheme

     ***(M1)(AG)***

**Note:** Award ***(M1)*** for subtracting 7 from 16. The 9 must be seen.

**OR**



     ***(M1)(AG)***

**Note:** Award ***(M1)*** for subtracting twice  from  and for correct substitution in correct arithmetic sequence formula.

The  must be seen.

Do not accept: .

**11c.** *[2 marks]*

## Markscheme

     ***(A1)*(ft)**

     ***(A1)*(ft)*(G2)***

**Notes:** Follow through from their  in part (a)(i).

**11d.** *[2 marks]*

## Markscheme

     ***(M1)***

**Note:** Award ***(M1)*** for correct substitution in the correct arithmetic sequence formula. Follow through from **their** parts (a)(i) and (c).

     ***(A1)*(ft)*(G2)***

**Note:**Award ***(A1)*(ft)** for their correct tenth term.

**11e.** *[3 marks]*

## Markscheme

     ***(A1)*(ft)*(M1)***

**Note:** Award ***(A1)*(ft)** for their correct expression for the  term, ***(M1)*** for comparing their expression to . Accept an equation. Follow through from their parts (a)(i) and (c).

     ***(A1)*(ft)*(G2)***

**Notes:** Answer must be a natural number.

**11f.** *[2 marks]*

## Markscheme

**OR****OR**

**OR**     ***(M1)***

**Notes:** Award ***(M1)*** for equating the sum of the first  terms to . Accept a sum of at least the first 7 correct terms.

     ***(A1)(G2)***

**Note:** If  is seen without working, award ***(G2)***. Award a maximum of ***(M1)(A0)*** if  is also given as a solution.

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