# 1.6 Approximation and estimation

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

## Markscheme

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

      ***(A1) (C1)***

**Note:** Accept   **OR**  width.

***[1 mark]***

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

## Markscheme

     ***(A1)*(ft) *(C1)***

**Note:** Follow through from their expression for the width from part (a).

***[1 mark]***

**1c.** *[2 marks]*

## Markscheme

 (or equivalent)     ***(M1)***

**Note:** Award ***(M1)*** for correctly removing the parentheses and collecting  terms. This may be seen in part (b).

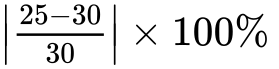
() 30      ***(A1)*(ft)*(C2)***

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

***[2 marks]***

**1d.** *[2 marks]*

## Markscheme

     ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into the percentage error formula. Accept a method in two steps where “×100” is implicit from their answer.

16.7 (%)  (16.6666…)      ***(A1)*(ft)*(C2)***

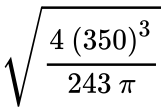
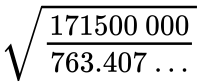
**Note:** Follow through from their answer in (c). Award at most ***(M1)(A0)*** for a final answer that is negative.

***[2 marks]***

**2a.** *[3 marks]*

## Markscheme

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

  ***OR***     ***(M1)***

**Note:** Award **(M1)** for substitution of 350 into volume formula.

= 473.973…    ***(A1)***

= 474 (cm)    ***(A1)*(ft)   *(C3)***

**Note:** The final **(A1)(ft)** is awarded for rounding **their** answer to 1 decimal place provided the unrounded answer is seen.

***[3 marks]***

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

## Markscheme

474 (cm)      ***(A1)*(ft) *(C1)***

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

***[1 mark]***

**3a.** *[2 marks]*

## Markscheme

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

24500 × 25   ***(M1)***

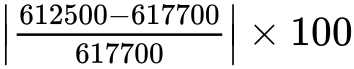
**Note:** Award ***(M1)*** for multiplying 24500 by 25.

= 613000  (612500)   ***(A1) (C2)***

***[2 marks]***

**3b.** *[2 marks]*

## Markscheme

    ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into the percentage error formula.

= 0.842  (0.841832)    **(A1)*(ft)* (C2)**

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

***[2 marks]***

**4a.** *[1 mark]*

## Markscheme

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

9 (cm)     ***(A1)***     ***(C1)***

***[1 mark]***

**4b.** *[1 mark]*

## Markscheme

40 (leaves)     ***(A1)***     ***(C1)***

***[1 mark]***

**4c.** *[2 marks]*

## Markscheme

 or equivalent     ***(M1)***

**Note:**     Award ***(M1)*** for a horizontal line drawn through the cumulative frequency value of 180 and meeting the curve (or the corresponding vertical line from 10.5 cm).

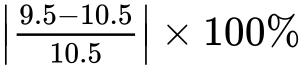
     ***(A1)***     ***(C2)***

**Note:**     Accept an error of ±0.1.

***[2 marks]***

**4d.** *[2 marks]*

## Markscheme

     ***(M1)***

**Notes:**     Award ***(M1)*** for their correct substitution into the percentage error formula.

     ***(A1)*(ft)**     ***(C2)***

**Notes:**     Follow through from their answer to part (c)(i).

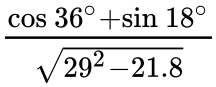
Award ***(A1)(A0)*** for an answer of  with or without working.

***[2 marks]***

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

## Markscheme

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

    ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into formula.

    ***(A1)     (C2)***

**Note:** Accept .

***[2 marks]***

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

## Markscheme

(i)     0.04     ***(A1)*(ft)**

(ii)     0.0391     ***(A1)*(ft)     *(C2)***

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

***[2 marks]***

**6a.** *[1 mark]*

## Markscheme

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

    ***(A1)     (C1)***

***[1 mark]***

**6b.** *[1 mark]*

## Markscheme

    ***(A1)     (C1)***

***[1 mark]***

**6c.** *[2 marks]*

## Markscheme

    ***(A1)*(ft)*(A1)*(ft)     *(C2)***

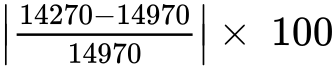
**Note:** Follow through from parts (a) and (b) irrespective of working seen, **but only** if both values are positive integers.

Award ***(M1)(A0)*** for a reasonable attempt to solve simultaneous equations algebraically, leading to at least one incorrect or missing value.

***[2 marks]***

**6d.** *[2 marks]*

## Markscheme

    ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into percentage error formula.

    ***(A1) (C2)***

***[2 marks]***

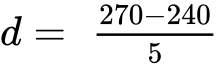
**7a.** *[2 marks]*

## Markscheme

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

        ***(M1)***

**OR**

       ***(M1)***

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

       ***(A1) (C2)***

**7b.** *[2 marks]*

## Markscheme

       ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into sum of an arithmetic sequence.

**OR**



      ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into sum of an arithmetic sequence.

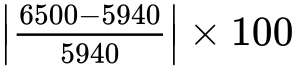
**OR**  
adding  terms consistent with their        ***(M1)***

       ***(A1)*(ft) *(C2)***

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

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

## Markscheme

       ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into percentage error formula.

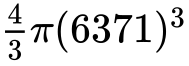
       ***(A1)*(ft) *(C2)***

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

**8a.** *[3 marks]*

## Markscheme

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

     ***(M1)***

**Note:** Award ***(M1)*** for correct substitution into volume formula.

     ***(A2)     (C3)***

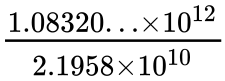
**Notes:** Award ***(A1)(A0)*** for correct mantissa between 1 and 10, with incorrect index.

Award ***(A1)(A0)*** for 

Award ***(A0)(A0)*** for answers of the type: .

**8b.** *[3 marks]*

## Markscheme

     ***(M1)***

**Note:** Award ***(M1)*** for dividing their answer to part (a) by .

     ***(A1)*(ft)**

**Note:**Accept  from use of 3 sf answer to part (a).

     ***(A1)     (C3)***

**Notes:** Follow through from part (a).

The final ***(A1)*** is awarded for their unrounded non-integer answer seen and given correct to the nearest integer.

Do not award the final ***(A1)*** for a rounded answer of 0 or if it is incorrect by a large order of magnitude.

**9a.** *[1 mark]*

## Markscheme

     ***(A1)*(ft)     *(C1)***

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

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

## Markscheme

     ***(A1)*(ft)*(A1)*(ft)     *(C2)***

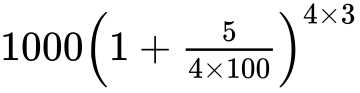
**Notes:** Award ***(A1)(A0)*** for  and an incorrect index value.

Award ***(A0)(A0)*** for answers such as .

**10a.** *[3 marks]*

## Markscheme

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

     ***(M1)(A1)***

**Note:** Award ***(M1)*** for substitution into compound interest formula, ***(A1)*** for correct substitution.

**OR**









     ***(A1)(M1)***

**Note:** Award ***(A1)*** for  seen, ***(M1)*** for other correct entries.

**OR**









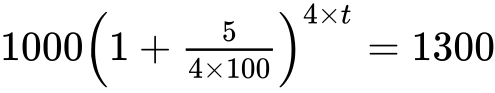
     ***(A1)(M1)***

**Note:** Award ***(A1)*** for  seen, ***(M1)*** for other correct entries.

 (€)    ***(A1)     (C3)***

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

## Markscheme

     ***(M1)(A1)***

**Note:**Award ***(M1)*** for using the compound interest formula with a variable for time, ***(A1)*** for substituting correct values and equating to .

**OR**









     ***(A1)(M1)***

**Note:** Award ***(A1)*** for 1300 seen, ***(M1)*** for the other correct entries.

**OR**







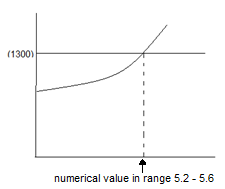


     ***(A1)(M1)***

**Note:** Award ***(A1)*** for 1300 seen, ***(M1)*** for the other correct entries.

**OR**

Sketch drawn of two appropriate lines which intersect at a point



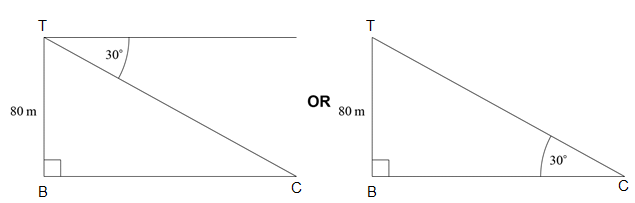
**Note:** Award ***(M1)*** for a sketch with a straight line intercepted by appropriate curve, ***(A1)*** for a numerical answer in the range .

     ***(A1) (C3)***

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

## Markscheme

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

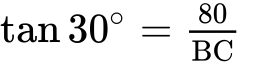
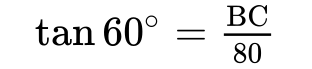
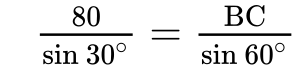
     ***(A1)(A1)     (C2)***

**Notes:**Award ***(A1)*** for 80 m in the correct position on diagram.

Award ***(A1)*** for 30° in a correct position on diagram.

**11b.** *[2 marks]*

## Markscheme

**OR****OR**     ***(M1)***

**Note:**Award ***(M1)*** for a correct trigonometric or Pythagorean equation for BC with correctly substituted values.

     ***(A1)*(ft)     *(C2)***

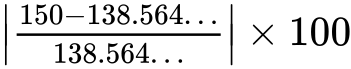
**Notes:** Accept an answer of  which is the exact answer.

Follow through from part (a).

Do not penalize use of radians unless it leads to a negative answer.

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

## Markscheme

     ***(M1)***

**Notes:**Award ***(M1)*** for their correct substitution into the percentage error formula.

     ***(A1)*(ft)     *(C2)***

**Notes:** Accept  ( if  is used.

Accept  ( if  is used.

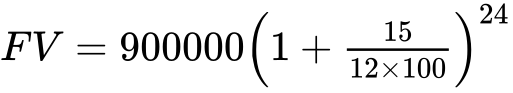
Follow through from their answer to part (b).

If answer to part (b) is , answer to part (c) is , award ***(M1)(A1)*(ft)** with or without working seen. If answer to part (b) is negative, award at most ***(M1)(A0)***.

**12a.** *[4 marks]*

## Markscheme

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

     ***(M1)(A1)***

**Note:** Award ***(M1)*** for substitution in the compound interest formula (either or interest), do not penalize if  not seen.

Award ***(A1)*** for correct substitution.

**OR**









     ***(A1)(M1)***

**Note:** Award ***(A1)*** for  seen, ***(M1)*** for other correct entries.

**OR**









     ***(A1)(M1)***

**Note:**Award ***(A1)*** for  seen, ***(M1)*** for other correct entries.

     ***(A1)***

     ***(A1)*(ft)     *(C4)***

**Notes:** Award the final ***(A1)*** for the correct rounding of their unrounded answer.

If final amount is  and working is shown award ***(M1)(A1)(A0)(A1)*(ft)***.*

Award ***(A2)*** for  if no working is seen.

**12b.** *[2 marks]*

## Markscheme

     ***(A1)*(ft)*(A1)*(ft)     *(C2)***

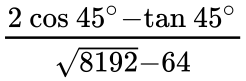
**Notes:** Award ***(A1)*(ft)** for their  , ***(A1)*(ft)** for .

Follow through from part (a).

**13a.** *[2 marks]*

## Markscheme

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

     ***(M1)***

     ***(A1)     (C2)***

**Notes:**     Accept  and also .

***[2 marks]***

**13b.** *[4 marks]*

## Markscheme

(i)     0.02     ***(A1)*(ft)**

(ii)     0.01563     ***(A1)*(ft)**

**Notes:**     For parts (i) and (ii), accept equivalent standard form representations.

(iii)          ***(A2)*(ft)     *(C4)***

**Notes:**     Award ***(A1)(A0)*** for correct mantissa, between 1 and 10, with incorrect index.

     Follow through from their answer to part (a).

     Where the candidate has correctly rounded their mantissa from part (a) and has the correct exponent, award ***(A0)(A1)***

     Award ***(A0)(A0)*** for answers of the type: .

***[4 marks]***

**14a.** *[1 mark]*

## Markscheme

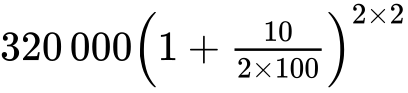
\* This question is from an exam for a previous syllabus, and may contain minor differences in marking or structure.

4     ***(A1)     (C1)***

***[1 mark]***

**14b.** *[3 marks]*

## Markscheme

     ***(M1)(A1)***

**Note:**Award ***(M1)*** for substituted compound interest formula, ***(A1)*** for correct substitutions.

**OR**









     ***(A1)(M1)***

**Note:**Award ***(A1)*** for  seen, ***(M1)*** for correctly substituted values from the question into the finance application.

**OR**









     ***(A1)(M1)***

**Note:**Award ***(A1)*** for  seen, ***(M1)*** for correctly substituted values from the question into the finance application.

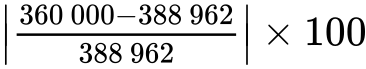
amount to repay      ***(A1)     (C3)***

**Note:**Award ***(C2)*** for final answer  if  not seen previously.

***[3 marks]***

**14c.** *[2 marks]*

## Markscheme

     ***(M1)***

**Note:**Award ***(M1)*** for correctly substituted percentage error formula.

     ***(A1)*(ft)     *(C2)***

**Notes:**Follow through from their answer to part (b).

***[2 marks]***

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