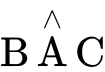
# 1.6 Approximation and estimation\_P\_2

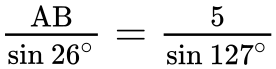
**1a.** *[5 marks]*

## Markscheme

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

180° − 27° − 26°      ***(M1)***

**Note:** Award ***(M1)*** for correct working to find angle  or 127 seen.

       ***(M1)(A1)***

**Note:** Award ***(M1)*** for substitution into sine rule formula and ***(A1)*** for correct substitution.

2.74450 (m)      ***(A1)***

( =) 2.745 (m)      ***(A1)*(ft)*(G4)***

**Note:** The final ***(A1)*(ft)** is for correctly rounding **their** unrounded  to 4 sf. If 2.745 is given as the final answer, the unrounded answer need not be seen, award ***(M1)(M1)(A1)(A2)***. For all other answers, the unrounded answer must be seen to an accuracy greater than 4 sf.

Award ***(G3)*** for a final answer of 2.74450…(m) with no working. If radians are used then award at most ***(M1)(M1)(A1)(A0)(A1)*(ft)** for an answer of 3.920 (m).

***[5 marks]***

**1b.** *[3 marks]*

## Markscheme

**Units are required in this question part.**

10 × 2.84 + 10 × 2.74450…       ***(M1)(M1)***

**Note:** Award ***(M1)*** for finding their area of each rectangle and ***(M1)*** for adding their areas.

**OR**

10 × (2.84 + 2.74450…)       ***(M1)(M1)***

**Note:** Award ***(M1)*** for adding  and their . Award ***(M1)*** for multiplying their total area by 10.

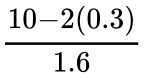
55.8 (55.8450…) m       ***(A1)*(ft)*(G3)***

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

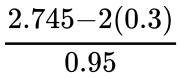
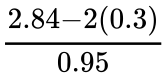
***[3 marks]***

**1c.** *[3 marks]*

## Markscheme

      ***(M1)***

**Note:** Award ***(M1)*** for correct calculation of the number of panels on the long side.

  **OR**       ***(M1)***

**Note:** Award ***(M1)*** for correct calculation of the number of panels on either short side with no further incorrect working.

20       ***(A1)*(ft)*(G2)***

**Note:** Follow through from part (a). Do not award ***(M0)(M1)(A1)*(ft)**.

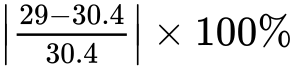
***[3 marks]***

**1d.** *[3 marks]*

## Markscheme

20 × 1.6 × 0.95  (= 30.4)       ***(M1)***

**Note:** Award ***(M1)*** for their 20 × 1.6 × 0.95 or 30.4 seen. Follow through from their 20 in part (c). Award ***(M0)*** if their 20 is not an integer.

      ***(M1)***

**Note:** Award ***(M1)*** for correct substitution of their 30.4 into the percentage error formula. Their 30.4 must be **exact**.

found. Accept a method in two steps where “×100” is implicit from their answer.

The second ***(M1)*** is contingent on the first ***(M1)*** being awarded, eg do **not** award ***(M0)(M1)(A0)***.

4.61 (%) (4.60526 (%))       ***(A1)*(ft)*(G3)***

**Note:** Follow through from their answer to part (c). Percentage sign is not required.

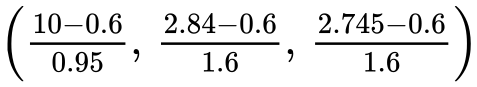
Award ***(G2)*** for an unsupported final answer of 4.61.

***[3 marks]***

**1e.** *[2 marks]*

## Markscheme

1 × 9 (array)  **OR** 18 (total panels)       ***(R1)*(ft)**

**Note:** Award ***(R1)*** for one correct array seen (1 × 9) or total number of panels (18). Working is not required, but award ***(R0)*** for incorrect working seen. Correct working is as follows.   
Reasoning may compare both sides of the roof or just one side; accept correct comparisons with part (c) values. Follow through from their treatment of tolerances in part (c) and maximum number of panels.  
Award ***(R0)*** for any approach with no clearance or for any method which includes further incorrect working.

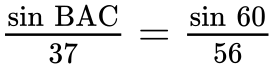
No    (new arrangement will mean fewer solar panels)         ***(A1)*(ft)**

**Note:** Follow through from their maximum number of panels in part (c). Do not award ***(R0)(A1)*(ft)**.

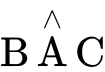
***[2 marks]***

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

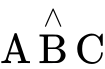
## Markscheme

    ***(M1)(A1)***

**Note:** Award ***(M1)*** for substituting the sine rule formula, ***(A1)*** for correct substitution.

angle  = 34.9034…°    ***(A1)***

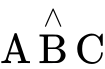
**Note:** Award ***(A0)*** if unrounded answer does not round to 35. Award ***(G2)*** if 34.9034… seen without working.

angle  = 180 − (34.9034… + 60)     ***(M1)***

Note: Award ***(M1)*** for subtracting their angle BAC + 60 from 180.

85.0965…°    ***(A1)***

85°     ***(AG)***

**Note:** Both the unrounded and rounded value must be seen for the final ***(A1)*** to be awarded. If the candidate rounds 34.9034...° to 35° while substituting to find angle , the final ***(A1)*** can be awarded but **only** if both 34.9034...° and 35° are seen.  
If 85 is used as part of the workings, award at most ***(M1)(A0)(A0)(M0)(A0)(AG)***. This is the reverse process and not accepted.

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

## Markscheme

sin 85… × 56     ***(M1)***

= 55.8 (55.7869…) (m)     ***(A1)(G2)***

**Note:** Award ***(M1)*** for correct substitution in trigonometric ratio.

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

## Markscheme

     ***(M1)***

**Note:** Award ***(M1)*** for correct substitution in the Pythagoras theorem formula. Follow through from part (a)(ii).

**OR**

cos(85) × 56     ***(M1)***

**Note:** Award ***(M1)*** for correct substitution in trigonometric ratio.

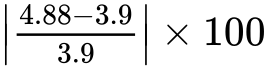
= 4.88 (4.88072…) (m)     ***(A1)*(ft)*(G2)***

**Note:** Accept 4.73 (4.72863…) (m) from using their 3 s.f answer. Accept equivalent methods.

***[2 marks]***

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

## Markscheme

     ***(M1)***

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

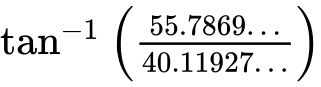
= 25.1  (25.1282) (%)     ***(A1)*(ft)*(G2)***

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

***[2 marks]***

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

## Markscheme

     ***(A1)*(ft)*(M1)***

**Note:** Award ***(A1)*(ft)** for their 40.11927… seen. Award ***(M1)*** for correct substitution into trigonometric ratio.

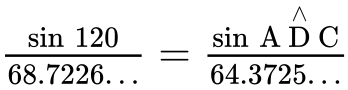
**OR**

(37 − 4.88072…) + 55.7869…

(AC =) 64.3725…

64.3726… + 8 − 2 × 8 × 64.3726… × cos120

(AD =) 68.7226…

    ***(A1)*(ft)*(M1)***

**Note:** Award ***(A1)*(ft)** for their correct values seen, ***(M1)*** for correct substitution into the sine formula.

= 54.3°  (54.2781…°)     ***(A1)*(ft)*(G2)***

**Note:** Follow through from part (a). Accept equivalent methods.

***[3 marks]***

**3a.** *[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 Pythagoras.

Accept correct substitution into cosine rule.

     ***(A1)***

     ***(AG)***

**Note:** Both the rounded and unrounded value must be seen for the ***(A1)*** to be awarded.

***[2 marks]***

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

## Markscheme

     ***(M1)(M1)(A1)*(ft)**

**Note:** Award ***(M1)*** for correct substitution into right-angle triangle area. Award ***(M1)*** for substitution into area of triangle formula and ***(A1)*(ft)** for correct substitution.

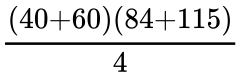
     ***(A1)*(ft)*(G3)***

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

***[4 marks]***

**3c.** *[2 marks]*

## Markscheme

     ***(M1)***

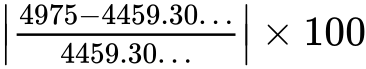
**Note:** Award ***(M1)*** for correct substitution in the area formula used by ‘Ancient Egyptians’.

     ***(A1)(G2)***

***[2 marks]***

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

## Markscheme

     ***(M1)***

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

     ***(A1)*(ft)*(G2)***

**Notes:** Follow through from parts (c) and (d)(i).

***[2 marks]***

**4a.** *[6 marks]*

## Markscheme

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

(i)          ***(M1)***

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

Accept correct alternative method using trigonometric ratios.

     ***(A1)***

     ***(AG)***

**Note:** The unrounded and rounded answer must be seen for the ***(A1)*** to be awarded.

**OR**

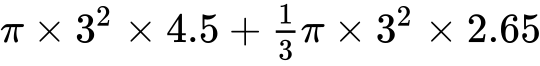
     ***(M1)***

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

     ***(A1)***

     ***(AG)***

**Note:** The exact answer must be seen for the final ***(A1)*** to be awarded.

(ii)          ***(M1)(M1)(M1)***

**Note:** Award ***(M1)*** for correct substitution into the volume of a cylinder formula, ***(M1)*** for correct substitution into the volume of a cone formula, ***(M1)*** for adding both of their volumes.

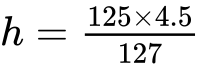
     ***(A1)(G3)***

**4b.** *[2 marks]*

## Markscheme

     ***(M1)***

**Note:**Award ***(M1)*** for correct substitution into the volume of a cylinder formula.

Accept alternative methods. Accept  () from using rounded answers in .

     ***(A1)(G2)***

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

## Markscheme

     ***(M1)(M1)(M1)***

**Note:** Award ***(M1)*** for correct substitution into curved surface area of a cylinder formula, ***(M1)*** for correct substitution into the curved surface area of a cone formula, ***(M1)*** for adding the area of the base of the cylinder to the other two areas.

     ***(A1)(G3)***

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

## Markscheme

     ***(M1)***

**Note:**Award ***(M1)*** for substitution of  into their regression line equation from part (b).

     ***(A1)*(ft)*(G2)***

     ***(A1)*(ft)**

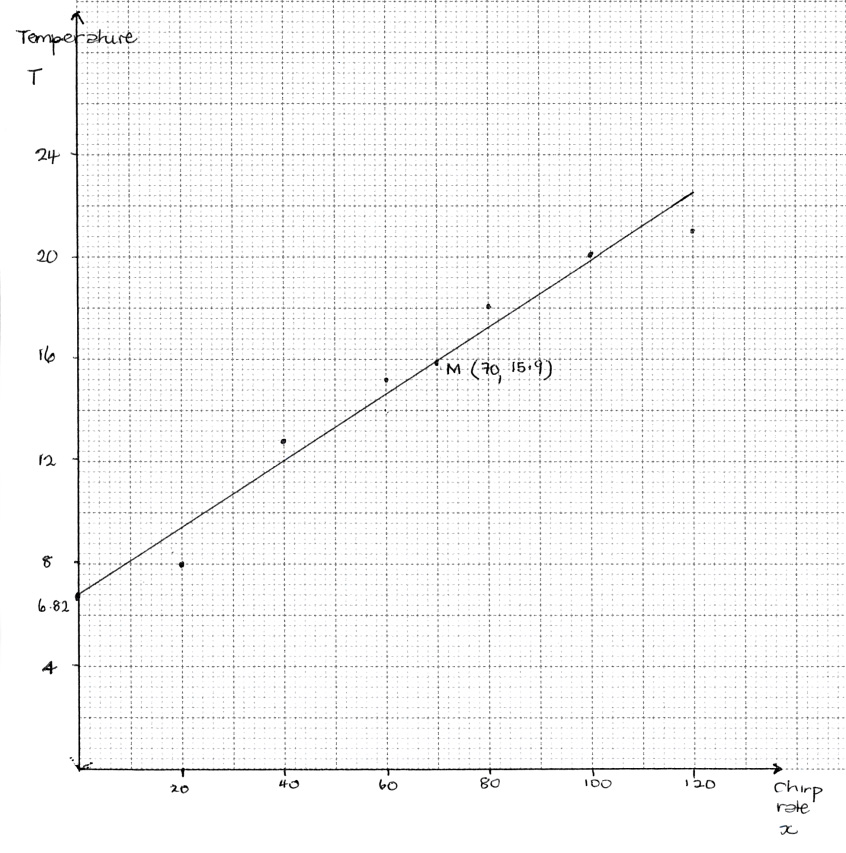
**Notes:** Follow through from their answer to part (b). If rounded values from part (b) used, answer is . Award the final ***(A1)*(ft)** for a correct rounding to the nearest USD of their answer. The unrounded answer may not be seen.

If answer is  and no working is seen, award ***(G2)***.

**6a.** *[4 marks]*

## Markscheme

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



***(A4)***

**Notes:**Award ***(A1)*** for correct scales and labels.

Award ***(A3)*** for all six points correctly plotted,

***(A2)*** for four or five points correctly plotted,

***(A1)*** for two or three points correctly plotted.

Award at most ***(A0)(A3)*** if axes reversed.

Accept tolerance for -axis.

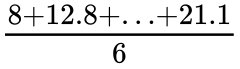
**6b.** *[2 marks]*

## Markscheme

     ***(M1)***

**Note:**Award ***(M1)*** for substitution of 70 into their equation of regression line.

**OR**

     ***(M1)***

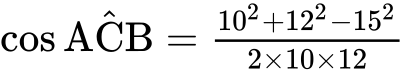
     ***(A1)*(ft)*(G2)***

**Note:**Follow through from part (d) without working.

**7a.** *[4 marks]*

## Markscheme

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

(i)          ***(M1)(A1)***

**Note:** Award ***(M1)*** for substituted cosine rule,

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

     ***(A1)(G2)***

(ii)          ***(A1)***

**OR**

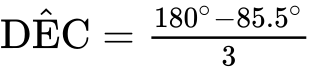
     ***(A1)***

**Notes:** Both reasons must be seen for the ***(A1)*** to be awarded.

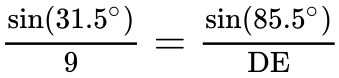
     ***(AG)***

**7b.** *[5 marks]*

## Markscheme

(i)          ***(M1)***

     ***(A1)(G2)***

(ii)          ***(M1)(A1)*(ft)**

**Note:** Award ***(M1)*** for substituted sine rule, ***(A1)*** for correct substitution.

.     ***(A1)*(ft)*(G2)***

**7c.** *[4 marks]*

## Markscheme

     ***(A1)*(ft)*(M1)(A1)*(ft)**

**Note:** Award ***(A1)*(ft)** for  seen, ***(M1)*** for substituted triangle area formula, ***(A1)*(ft)** for .

**OR**

     ***(A1)*(ft)*(A1)*(ft)**

     ***(M1)***

**Note:**Award ***(A1)*(ft)** for  seen, ***(A1)*(ft)** for correct triangle height with their angle , ***(M1)*** for .

     ***(A1)*(ft)*(G3)***

**Notes:** Units are required for the last ***(A1)*(ft)** mark to be awarded.

Follow through from parts (b)(i) and (b)(ii).

Follow through from their angle  **within this part of the question**.

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