# GCSE
# MATHEMATICS
# 8300/2H

Higher Tier Paper 2 Calculator

**Mark scheme**

June 2022

Version: 1.0 Final

2 2 6 G 8 3 0 0 / 2 H / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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**Glossary for Mark Schemes**

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

| | |
|---|---|
| **M** | Method marks are awarded for a correct method which could lead to a correct answer. |
| **A** | Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied. |
| **B** | Marks awarded independent of method. |
| **ft** | Follow through marks. Marks awarded for correct working following a mistake in an earlier step. |
| **SC** | Special case. Marks awarded for a common misinterpretation which has some mathematical worth. |
| **M dep** | A method mark dependent on a previous method mark being awarded. |
| **B dep** | A mark that can only be awarded if a previous independent mark has been awarded. |
| **oe** | Or equivalent. Accept answers that are equivalent.<br>eg accept 0.5 as well as $\frac{1}{2}$ |
| **[a, b]** | Accept values between a and b inclusive. |
| **[a, b)** | Accept values a $\leqslant$ value $<$ b |
| **3.14…** | Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416 |
| **Use of brackets** | It is not necessary to see the bracketed work to award the marks. |

Examiners should consistently apply the following principles.

**Diagrams**

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

**Responses which appear to come from incorrect methods**

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

**Questions which ask students to show working**

Instructions on marking will be given but usually marks are not awarded to students who show no working.

**Questions which do not ask students to show working**

As a general principle, a correct response is awarded full marks.

**Misread or miscopy**

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

**Further work**

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

**Choice**

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

**Work not replaced**

Erased or crossed out work that is still legible should be marked.

**Work replaced**

Erased or crossed out work that has been replaced is not awarded marks.

**Premature approximation**

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

**Continental notation**

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **1** | $\frac{1}{80}$ | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **2** | P(A ∩ B') | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **3** | 15 | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **4** | $-5 < x \leqslant 1$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 5 | **Alternative method 1** | | |
| | $10x - 5$ | M1 | may be seen in a grid |
| | their $10x - 6x = 9$ + their 5<br>or<br>$4x = 14$<br>or<br>$14 \div 4$ or $7 \div 2$ | M1 | oe eg their $-5 - 9 = 6x -$ their $10x$<br>or $4x - 14 = 0$<br>collecting two terms in $x$ and two constant terms correctly |
| | $\frac{14}{4}$ or $3\frac{2}{4}$ or $\frac{7}{2}$ or $3\frac{1}{2}$ or 3.5 | A1ft | oe<br>ft M1M0 or M0M1 with exactly one error |
| | **Alternative method 2** | | |
| | $\frac{6x}{5} + \frac{9}{5}$ | M1 | oe two terms eg $1.2x + 1.8$ |
| | $2x -$ their $\frac{6x}{5}$ = their $\frac{9}{5} + 1$<br>or $\frac{4x}{5} = \frac{14}{5}$ | M1 | oe eg $-1 -$ their $\frac{9}{5}$ = their $\frac{6x}{5} - 2x$<br>or $\frac{4x}{5} - \frac{14}{5} = 0$<br>collecting two terms in $x$ and two constant terms correctly |
| | $\frac{14}{4}$ or $3\frac{2}{4}$ or $\frac{7}{2}$ or $3\frac{1}{2}$ or 3.5 | A1ft | oe<br>ft M1M0 or M0M1 with exactly one error |

**Additional Guidance is on the next page**

| | | |
|---|---|---|
| **5 cont** | **Additional Guidance** | |
| | Ignore simplification or conversion if correct answer seen | |
| | Correct answer from trial and improvement | M1M1A1 |
| | Correct equation with terms collected or division with no or incorrect answer | M1M1A0 |
| | Embedded 3.5 with no or incorrect answer | M1M1A0 |
| | $10x - 5 = 6x + 9$<br>$10x - 6x = 9 - 5$<br>$x = 1$ (exactly one error in line 2) | M1<br>M0<br>A1ft |
| | $7x - 5 = 6x + 9$<br>$7x - 6x = 9 + 5$<br>$x = 14$ (exactly one error in line 1) | M0<br>M1<br>A1ft |
| | $10x - 5 = 6x + 9$<br>$10x + 6x = 9 - 5$<br>$x = \frac{4}{16}$ (two errors in line 2) | M1<br>M0<br>A0ft |
| | $10x - 1 = 6x + 9$<br>$10x - 6x = 9 + 1$<br>$x = 3$ (exactly one error in line 1 but answer does not ft) | M0<br>M1<br>A0ft |
| | $7x - 6 = 6x + 9$<br>$7x - 6x = 9 + 6$<br>$x = 15$ (two errors in line 1) | M0<br>M1<br>A0ft |
| | $10x + 4 = 6x + 9$<br>$10x - 6x = 9 + 4$<br>$x = 3.25$ (neither M mark scored) | M0<br>M0<br>A0ft |
| | $10x - 5 = 30x + 45$ | M1M0A0ft |
| | Any ft answer must be rounded or truncated to 1 dp or better | |
| | The last two marks can be implied without the collection of terms seen<br>eg $10x - 1 = 6x + 9$ and $x = 2.5$ | M0M1A1ft |
| | Collecting terms before the bracket has been expanded | M0M0A0ft |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6 | 125 and 17<br>or $5^3$ and 17<br>or 5 and 5 and 5 and 17 | B2 | together in any order<br>eg $125 \times 17$ or $17 \times 5^3$ or 5, 5, 5, 17<br>or $2125 \div 17 = 125$ or $2125 \div 125 = 17$<br>B1 at least three of 8, 27, 64, 125, 216, 343, 512, 729, 1000, 1331, 1728, 2197 etc (allow $2^3$, $3^3$, $4^3$ etc)<br>or<br>all four of 11, 13, 17, 19 (ignore any numbers not between 10 and 20)<br>or<br>(cube number $>1$) $\times$ (prime number between 10 and 20)<br>or<br>$2125 \div$ (cube number $>1$)<br>or<br>$2125 \div$ (prime number between 10 and 20) |

| Additional Guidance | |
|---|---|
| B1 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts | |
| B2 responses may be seen on a factor tree | |
| B1 for three cube numbers given in index form – evaluations can be ignored<br>eg $4^3$ $5^3$ $6^3$ scores B1 with no evaluations or with incorrect evaluations | |
| B1 for multiplications or divisions – evaluation can be ignored<br>eg1 $2^3 \times 13$ scores B1 with no evaluation or evaluated incorrectly<br>eg2 $2125 \div 27$ scores B1 with no evaluation or evaluated incorrectly<br>eg3 $2125 \div 11$ scores B1 with no evaluation or evaluated incorrectly | |
| 125 and 17 seen in multiple attempts is B2 if 2125 included<br>eg $125 \times 17 = 2125$ or $2125 \div 17 = 125$ or $2125 \div 125 = 17$ seen amongst multiple attempts | B2 |
| 125 and 17 seen in multiple attempts is B1 if 2125 not included<br>eg $125 \times 17$ seen amongst multiple attempts | B1 |
| 11 13 15 17 19 does not score B1 unless 11 13 17 19 selected | |
| Incomplete list eg 11 13 19 does not score B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7 | **Alternative method 1** Words per minute or words per second | | |
| | 416 ÷ 8 or 52 | M1 | oe eg 416 ÷ (8 × 60) or 416 ÷ 480<br>or $\frac{13}{15}$ or [0.86, 0.87] or 0.9 |
| | 1534 ÷ their 52<br>or<br>(1534 – 416) ÷ their 52 + 8<br>or 29.5 | M1dep | oe eg 1534 ÷ their [0.86, 0.87]<br>or<br>(1534 – 416) ÷ their [0.86, 0.87] + 8 × 60<br>or 1770 |
| | 29 minutes 30 seconds | A1 | SC2 29 minutes 50 seconds<br>or 29 minutes 5 seconds |
| | **Alternative method 2** Minutes per word or seconds per word | | |
| | 8 ÷ 416 or $\frac{1}{52}$<br>or [0.019, 0.019 231] or 0.02 | M1 | oe eg 8 × 60 ÷ 416 or 480 ÷ 416<br>or $\frac{15}{13}$ or [1.15, 1.154] or 1.2 |
| | 1534 × their [0.019, 0.019 231]<br>or<br>(1534 – 416) ×<br>their [0.019, 0.019 231] + 8<br>or 29.5 | M1dep | oe eg 1534 × their [1.15, 1.154]<br>or<br>(1534 – 416) × their [1.15, 1.154]<br>+ 8 × 60<br>or 1770 |
| | 29 minutes 30 seconds | A1 | SC2 29 minutes 50 seconds<br>or 29 minutes 5 seconds |

**Mark scheme and Additional Guidance continue on the next page**

| | | | |
|---|---|---|---|
| **7 cont** | **Alternative method 3** Essay words ÷ report words | | |
| | 1534 ÷ 416 or $\frac{59}{16}$<br>or [3.68, 3.69] or 3.7<br>or<br>(1534 – 416) ÷ 416<br>or [2.68, 2.69] or 2.7 | M1 | oe |
| | 8 × their [3.68, 3.69]<br>or<br>8 × their [2.68, 2.69] + 8<br>or 29.5 | M1dep | oe eg 8 × 60 × their [3.68, 3.69]<br>or<br>8 × 60 × their [2.68, 2.69] + 8 × 60<br>or 1770 |
| | 29 minutes 30 seconds | A1 | SC2 29 minutes 50 seconds<br>or 29 minutes 5 seconds |
| | **Additional Guidance** | | |
| | M1 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Answer 29.5 minutes 1770 seconds | | M1M1A0 |
| | Build-up method must be a fully correct method that would lead to 29.5 | | |
| | If working with report words ÷ essay words apply the principles of Alt 3 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8 | **Alternative method 1** | | |
| | $90 \times 5$ or 450<br>or $\frac{72+83+88+97+x}{5}$<br>or $\frac{340+x}{5}$ | M1 | oe<br>any letter or symbol |
| | $90 \times 5 - 72 - 83 - 88 - 97$<br>or<br>$90 \times 5 - 340$<br>or<br>$72 + 83 + 88 + 97 + x = 90 \times 5$<br>or<br>$340 + x = 90 \times 5$ | M1dep | oe<br>any letter or symbol<br>equations must have fraction eliminated |
| | 110 | A1 | |
| | **Alternative method 2** | | |
| | Trial of any value with mean correctly evaluated | M1 | also allow if given to the next or previous integer<br>eg1 trial of 100<br>$\frac{72+83+88+97+100}{5} = 88$<br>eg2 trial of 78<br>$\frac{340+78}{5} = 83$ (or 84 or 83.6)<br>ignore trials with mean not evaluated or incorrectly evaluated |
| | Trial of 110 with mean evaluated to 90 | M1dep | eg $\frac{72+83+88+97+110}{5} = 90$<br>this mark implies M1M1 |
| | 110 | A1 | |

**Mark scheme and Additional Guidance continue on the next page**

| | | | |
|---|---|---|---|
| **8 cont** | **Alternative method 3** | | |
| | $\frac{72+83+88+97}{4}$ or $\frac{340}{4}$ or 85 | M1 | oe |
| | their 85 + 5 × (90 – their 85)<br>or their 85 + 5 × 5<br>or their 85 + 25 | M1dep | oe 90 + 4 × (90 – their 85) |
| | 110 | A1 | |
| | **Alternative method 4** | | |
| | $\frac{72+83+88+97}{5}$ or $\frac{340}{5}$ or 68 | M1 | oe |
| | 5 × (90 – their 68)<br>or 5 × 22 | M1dep | oe |
| | 110 | A1 | |
| | **Alternative method 5** | | |
| | (90 – 72) + (90 – 83) + (90 – 88) + (90 – 97)<br>or<br>18 + 7 + 2 – 7 or 20 | M1 | oe eg (72 – 90) + (83 – 90) + (88 – 90) + (97 – 90)<br>or 90 × 4 – 72 – 83 – 88 – 97<br>or –18 – 7 – 2 + 7 or –20 |
| | 90 + their 20 | M1dep | oe eg 90 – their –20 |
| | 110 | A1 | |
| | **Additional Guidance** | | |
| | M1 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Embedded 110 scores M1M1A0 using Alt 2 (even if a different answer is given) | | |
| | Condone eg Alt 3 72 + 83 + 88 + 97 ÷ 4<br>No further marks unless recovered | | M1 |
| | Alt 5 1st M1 Subtractions must be consistent | | |
| | Condone 110% for 110 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9(a) | $\frac{33}{120}$ or $\frac{11}{40}$ or 0.275 or 27.5% | B1 | oe fraction, decimal or percentage |
| | **Additional Guidance** | | |
| | Correct answer seen with an answer of 33 | | B0 |
| | Ignore simplification or conversion if correct answer seen<br>eg1 $\frac{33}{120}$ seen Answer $\frac{3}{10}$<br>eg2 0.275 seen Answer 0.28<br>eg3 $\frac{11}{40}$ seen Answer 27.5 | | <br>B1<br>B1<br>B1 |
| | Ignore words if correct answer seen<br>eg1 $\frac{33}{120}$ seen Answer 11 out of 40<br>eg2 $\frac{33}{120}$, unlikely | | <br>B1<br>B1 |
| | Answer given as ratio (even if correct answer also seen)<br>eg 33 : 120 | | <br>B0 |
| | Answer only in words eg 33 out of 120 | | B0 |
| | Only 27.5 (without %) | | B0 |
| | Only 27% or 28% | | B0 |
| | Only 0.27 or 0.28 | | B0 |
| | Only $\frac{1.1}{4}$ | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9(b) | $\frac{6}{120} \times 500$<br>or<br>[4.16, 4.17] × 6 or [24.96, 25.02]<br>or 4.2 × 6 or 25.2<br>or<br>25 : 500 or $\frac{25}{500}$ | M1 | oe eg 0.05 × 500 or 500 ÷ 20 |
| | 25 | A1 | |
| | **Additional Guidance** | | |
| | Working and value may be seen by table | | |
| | 24 + 1, Answer 25 | | M1A1 |
| | 480 = 24, Answer 25 | | M1A1 |
| | Embedded but not selected as answer eg 137.5 + 337.5 + 25 = 500 | | M1A0 |
| | Working for Not answered or Answered but sale not made is **not** choice eg ignore 137.5 and 337.5 seen | | |
| | 25 followed by answer 19 | | M1A0 |
| | If rounded or truncated values are used, the final answer must be exactly 25<br>eg1 500 ÷ 120 = 4.16, 4.16 × 6<br>Answer 25 (may have kept full value on calculator)<br>eg2 500 ÷ 120 = 4.16, 4.16 × 6 = 24.96<br>Answer 25 (comes from further rounding) | | <br><br>M1<br>A1<br><br>M1<br>A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 10 | 80 × 0.9 or 72<br>or<br>25 × 1.2 or 30<br>or<br>80 × 0.1 **and** 25 × 0.2<br>or<br>8 **and** 5<br>or<br>–8 **and** 5 | M1 | oe eg 80 × (1 – 0.1)<br>or 25 + 25 × 0.2<br>or 25 + 5<br>implied by 102 or 3 or –3 |
| | No and correct valid amount(s) | A1 | eg no and 105 and 102<br>or no and 3<br>or no and –3<br>or no and 8 and 5<br>or no and –8 and 5 |
| | **Additional Guidance** | | |
| | If neither box is ticked, No may be implied<br>eg neither box is ticked and Ellie paid 3 less | M1A1 | |
| | Working and values may be seen by the table | | |
| | No and 105 with M1 not seen | M0A0 | |
| | No and 8 with M1 not seen | M0A0 | |
| | No and 5 with M1 not seen | M0A0 | |
| | Condone No and 8 and 5 with arithmetic error(s) seen<br>eg 72 so 8 less 30 so 5 more<br>105 and 103 No (arithmetic error in calculating Ellie's total) | M1A1 | |
| | Do not condone No and 8 and 5 with process error(s) seen<br>eg 80 – 8 = 72 25 – 5 = 20 (process error, should be 25 + 5)<br>105 and 92 No | M1A0 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 11 | **Alternative method 1** | | |
| | $16^2$ or 256<br>and<br>$30^2$ or 900 | M1 | oe<br>implied by 1156 |
| | $\sqrt{16^2+30^2}$ or $\sqrt{256+900}$<br>or $\sqrt{1156}$ or 34 | M1dep | oe eg $\sqrt{16^2+30^2-2\times16\times30\times\cos 90}$ |
| | 52 × their 34 or 1768 | M1dep | oe<br>if M1M0 their 34 can be any value other than 16, 30 or 52<br>dep on 1st M |
| | 0.5 × 30 × 16 or 240 | M1 | oe eg 0.5 × 30 × 16 × sin 90 |
| | 2008 | A1 | SC3 2248 |
| | **Alternative method 2** | | |
| | $\tan^{-1}\frac{16}{30}$ or [28, 28.1]<br>or $\tan^{-1}\frac{30}{16}$ or [61.9, 62] | M1 | oe<br>may be on diagram |
| | $\frac{30}{\cos(\text{their [28, 28.1]})}$<br>or $\frac{16}{\cos(\text{their [61.9, 62]})}$ or 34 | M1dep | oe eg $\frac{16}{\sin(\text{their [28, 28.1]})}$<br>or $30\cos(\text{their [28, 28.1]}) + 16\cos(\text{their [61.9, 62]})$ |
| | 52 × their 34 or 1768 | M1dep | oe<br>if M1M0 their 34 can be any value other than 16, 30 or 52<br>dep on 1st M |
| | 0.5 × 30 × 16 or 240 | M1 | oe eg 0.5 × 30 × 16 × sin 90 |
| | 2008 | A1 | SC3 2248 |

**Additional Guidance is on the next page**

| | | |
|---|---|---|
| **11 cont** | **Additional Guidance** | |
| | Up to M4 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts | |
| | The 4th mark in Alts 1 and 2 is not dependent on any other marks | |
| | 34 or 1768 or 240 may be on the diagram | |
| | SC3 is for using $30 \times 16$ for the area of the triangle | |
| | Ignore units | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **12** | $y$ is 125% of $x$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 13(a) | $\frac{1}{3} \times \pi \times 24^2 \times 117$ or $\frac{2}{3} \times \pi \times 24^3$ | M1 | oe eg $\frac{1}{3}\pi \times 576 \times 117$ or $\frac{2}{3}\pi \times 13\,824$ |
| | $22\,464\pi$ or [70 536, 70 582] or $9216\pi$ or [28 938, 28 957] | A1 | may be seen in a sum<br>implied by final A1 |
| | $\frac{1}{3} \times \pi \times 24^2 \times 117 + \frac{2}{3} \times \pi \times 24^3$ or $22\,464\pi + 9216\pi$ or [70 536, 70 582] + [28 938, 28 957] | M1dep | oe |
| | $31\,680\pi$ or [99 474, 99 539] | A1 | |
| | **Additional Guidance** | | |
| | $\pi$ may be seen as any value in the interval [3.14, 3.142] | | |
| | Do not allow any misreads of formulae unless recovered<br>eg $\pi \times 24^2 \times 117$ and $\frac{2}{3} \times \pi \times 24^2$ | | M0 |
| | Allow dots for multiplication | | |
| | For A marks allow eg $22\,464 \times \pi$ or $\pi \times 31\,680$ | | |
| | $31\,680\pi$ followed by incorrect evaluation attempt | | M1A1M1A1 |
| | $31\,680\pi$ followed by further work | | M1A1M1A0 |
| | 31 680 only | | M0A0M0A0 |
| | $\frac{1}{3} \times \pi \times 24^2 \times 117 = 4725$ $\frac{2}{3} \times \pi \times 24^3 = 28\,952$<br>4725 + 28 952<br>(even though 4725 is wrong the method for $\frac{1}{3} \times \pi \times 24^2 \times 117$ is seen) | | M1A1<br>M1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 13(b) | **Alternative method 1** Uses volume scale factor | | |
| | 24 ÷ 2 or 12 | M1 | oe eg $12 \times 2 = 24$ |
| | (their 12)$^3$ | M1dep | oe eg $24^3 \div 2^3$ or $13\,824 \div 8$ |
| | 1728 | A1 | condone 1 : 1728 or 1728 : 1<br>SC2 $\frac{1}{1728}$ |
| | **Alternative method 2** Compares volumes of cornets (ie compares total volumes) | | |
| | 24 ÷ 2 or 12 | M1 | oe eg $12 \times 2 = 24$<br>may be implied eg (height of cone) 9.75<br>or (volume of cone) $13\pi$<br>or (volume of cone) [40.8, 40.85]<br>or (total volume) $\frac{55}{3}\pi$ or [57.4, 57.7] |
| | their (a) ÷ $(\frac{1}{3}\pi \times 2^2 \times \frac{117}{\text{their } 12} + \frac{2}{3}\pi \times 2^3)$ | M1dep | oe eg their (a) ÷ [57.4, 57.7] |
| | 1728 | A1 | condone 1 : 1728 or 1728 : 1<br>SC2 $\frac{1}{1728}$ |

**Mark scheme and Additional Guidance continue on the next two pages**

| | | | |
|---|---|---|---|
| **13(b) cont** | **Alternative method 3** Compares volumes of cones | | |
| | 24 ÷ 2 or 12 | M1 | oe eg 12 × 2 = 24<br>may be implied eg (height of cone) 9.75<br>or (volume of cone) $13\pi$<br>or (volume of cone) [40.8, 40.85]<br>or (total volume) $\frac{55}{3}\pi$ or [57.4, 57.7] |
| | their volume of cone from (a)<br>$\div (\frac{1}{3}\pi \times 2^2 \times \frac{117}{\text{their } 12})$ | M1dep | oe eg their volume of cone from (a)<br>÷ [40.8, 40.85] |
| | 1728 | A1 | condone 1 : 1728 or 1728 : 1<br>SC2 $\frac{1}{1728}$ |
| | **Alternative method 4** Compares volumes of hemispheres | | |
| | their volume of hemisphere from (a)<br>$\div (\frac{2}{3}\pi \times 2^3)$ | M2 | oe<br>eg their volume of hemisphere from (a)<br>÷ [16.7, 16.8] |
| | 1728 | A1 | condone 1 : 1728 or 1728 : 1<br>SC2 $\frac{1}{1728}$ |

**Additional Guidance is on the next page**

| | Additional Guidance | |
|---|---|---|
| **13(b) cont** | $\pi$ may be seen as any value in the interval [3.14, 3.142] | |
| | Answer $\times 1728$ or $1728\times$ | M1M1A1 |
| | Answer 12 | M1M0A0 |
| | Answer $12^3$ with 1728 seen | M1M1A1 |
| | Answer $12^3$ without 1728 seen | M1M1A0 |
| | Alts 2, 3 and 4<br>Allow if an incorrect volume formula from (a) is used in (b)<br>eg Alt 4 (a) $\frac{1}{2} \times \frac{2}{3} \times \pi \times 24^3 = 4608\pi$<br>(b) $\frac{1}{2} \times \frac{2}{3} \times \pi \times 2^3 = \frac{8}{3}\pi$<br>$4608\pi \div \frac{8}{3}\pi$<br>1728 | M2<br>A1 |
| | Alts 2 and 3 Allow $\frac{55}{3}$ rounded to 1dp or better eg allow 18.3 | |
| | Alt 4 Allow $\frac{16}{3}$ rounded to 1dp or better eg allow 5.3 | |
| | Alts 2 and 3 2nd M1 – allow consistent omission of $\pi$ | |
| | Alt 4 M2 – allow consistent omission of $\pi$ | |
| | Alts 2, 3 and 4<br>Answer 1728 is M1M1A1 unless it comes from rounding or truncating<br>eg1 Alt 2 $99\,525.655 \div 57.595 = 1728$<br>eg2 Alt 2 $99\,525.655 \div 57.595 = 1728.03$ Answer 1728 | M1M1A1<br>M1M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14(a) | **Alternative method 1** | | |
| | 375 + 400 + 1475 or 2250<br>or 13 seen or $\frac{59}{90}$ seen<br>or [0.65, 0.66] seen | M1 | oe<br>for 375 allow 350 or 370 or 380 or 400<br>for 1475 allow 1450 or 1470 or 1480 or 1500<br>eg 400 + 400 + 1500<br>any estimated values must be seen eg only seeing 2300 is M0 |
| | $\frac{1475}{375+400+1475} \times 29\,250$<br>or 1475 × 13<br>or [0.65, 0.66] × 29 250<br>or [19012.5, 19305] | M1dep | oe<br>for 375 allow 350 or 370 or 380 or 400<br>for 1475 allow 1450 or 1470 or 1480 or 1500<br>for 29 250 allow 29 000 or 29 200 or 29 300 or 29 500 or 30 000 |
| | 19 175 | A1 | |
| | **Alternative method 2** | | |
| | [234, 238] | M1 | may be on the diagram |
| | $\frac{\text{their [234, 238]}}{360} \times 29\,250$<br>or their [234, 238] × 81.25 | M1dep | oe<br>for 29 250 allow 29 000 or 29 200 or 29 300 or 29 500 or 30 000 |
| | 19 175 | A1 | |
| | **Additional Guidance** | | |
| | 375 + 400 + 1475 = 2250<br>If they subsequently estimate 2250 no further marks can be scored | | M1 |
| | Answer 19 175 is M1M1A1 unless it comes from rounding or truncating<br>eg1 Alt 1 0.65555 × 29 250 = 19 175<br>eg2 Alt 1 0.65555 × 29 250 = 19 174.8 Answer 19 175 | | M1M1A1<br>M1M1A0 |
| | Alt 2 if their angle is outside the range [234, 238] | | M0M0A0 |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 14(b) | It is lower than the answer to part (a) | B1 | |

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comment</th></tr>
<tr><td rowspan="8">15</td><td>
<table>
<tr><td>8</td><td>$\frac{1}{4}$</td><td>$\frac{1}{2}$</td></tr>
<tr><td>$\frac{1}{16}$</td><td>1</td><td>16</td></tr>
<tr><td>2</td><td>4</td><td>$\frac{1}{8}$</td></tr>
</table>
</td><td>B2</td><td>oe values eg 0.0625 for $\frac{1}{16}$<br><br>condone unprocessed values<br>eg for 8 allow $\frac{16}{2}$ or $\frac{8}{1}$<br><br>B1 at least three of the eight rows, columns and diagonals have a product of 1<br><br>do not count rows, columns or diagonals that only have ones<br><br>do not count incomplete rows, columns or diagonals</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">If decimal values are used they must be exact</td><td></td></tr>
<tr><td colspan="2">The given values in the grid cannot be changed</td><td></td></tr>
<tr><td colspan="2">B1 can be awarded with an incomplete grid eg
<table>
<tr><td>8</td><td>$\frac{1}{4}$</td><td></td></tr>
<tr><td>$\frac{1}{16}$</td><td>1</td><td></td></tr>
<tr><td>2</td><td>4</td><td>$\frac{1}{8}$</td></tr>
</table>
</td><td>B1</td></tr>
<tr><td colspan="2">
<table>
<tr><td>1</td><td>$\frac{1}{4}$</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>$\frac{1}{2}$</td></tr>
<tr><td>1</td><td>4</td><td>$\frac{1}{8}$</td></tr>
</table>
Three products of 1 but two are not counted as they only have ones
</td><td>B0</td></tr>
</table>

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16(a) | Valid criticism of method indicating or implying that 30 is incorrect | B1 | eg the shop was open for fewer than 30 days |
| | **Additional Guidance** | | |
| | Valid criticism with non-contradictory statements | | B1 |
| | Contradictory statements | | B0 |
| | 30 should be 26 | | B1 |
| | The answer is 115 (allow 116 or 115.4 or 115.38…) | | B1 |
| | 30 should be 25 | | B1 |
| | The answer is 120 | | B1 |
| | 30 should be 24 (condone) | | B1 |
| | The answer is 125 (condone) | | B1 |
| | The answer is more than 100 | | B1 |
| | The shop wasn't open for 30 days | | B1 |
| | He didn't work every day in June | | B1 |
| | The shop was shut on Sundays | | B1 |
| | He is open 6 days a week | | B1 |
| | The shop isn't open every day | | B1 |
| | He should divide by 31 | | B0 |
| | He doesn't work weekends | | B0 |
| | There aren't 30 days in June | | B0 |
| | Not every month has 30 days | | B0 |
| | 30 should be 27 | | B0 |
| | The answer is less than 100 | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16(b) | **Alternative method 1** | | |
| | 3000 ÷ (9 + 4 + 7) or 3000 ÷ 20<br>or<br>150 | M1 | oe<br>implied by 1350 or 600 or 1050<br>or 358.5(0) or 283.5(0) |
| | 9 × 2.39 or 21.51<br>or<br>4 × 1.89 or 7.56<br>or<br>29.07 | M1 | oe may be embedded or implied<br>eg 9 × 2.39 × their 150<br>or 4 × 1.89 × their 150<br>their 150 can be any number<br>3226.5(0) or 1134 or 4360.5(0) score M1M1 |
| | (6660 – 9 × 2.39 × their 150 – 4 × 1.89 × their 150) ÷ (7 × their 150)<br>or<br>(6660 – 3226.5(0) – 1134) ÷ 1050<br>or<br>(6660 – 4360.5(0)) ÷ 1050<br>or<br>2299.5(0) ÷ 1050 | M1dep | oe<br>eg (6660 – 9 × 2.39 × their 150 – 4 × 1.89 × their 150) ÷ (3000 – 9 × their 150 – 4 × their 150)<br>or $\frac{219}{100}$<br>dep on M1M1<br>their 150 must be from 1st M1 |
| | 2.19 | A1 | |

**Mark scheme and Additional Guidance continue on the next page**

| | | | |
|---|---|---|---|
| **16(b) cont** | **Alternative method 2** | | |
| | 3000 ÷ (9 + 4 + 7) or 3000 ÷ 20<br>or<br>150 | M1 | oe<br>implied by 1350 or 600 or 1050<br>or 358.5(0) or 283.5(0) |
| | 9 × 2.39 or 21.51<br>or<br>4 × 1.89 or 7.56<br>or<br>29.07 | M1 | oe may be embedded or implied<br>eg 9 × 2.39 × their 150<br>or 4 × 1.89 × their 150<br>their 150 can be any number<br>3226.5(0) or 1134 or 4360.5(0) score M1M1 |
| | $\left(\frac{6660}{\text{their } 150} - 9 \times 2.39 - 4 \times 1.89\right) \div 7$<br>or<br>(44.4(0) – 21.51 – 7.56) ÷ 7<br>or<br>15.33 ÷ 7 | M1dep | oe eg (44.4(0) – 29.07) ÷ 7<br>or $\frac{219}{100}$<br>dep on M1M1<br>their 150 must be from 1st M1 |
| | 2.19 | A1 | |
| | **Additional Guidance** | | |
| | Up to M1M1 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts | | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **17** | cylinder | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 18 | $\frac{-7 \pm \sqrt{7^2 - 4 \times 1 \times -11}}{2 \times 1}$ or $-\frac{7}{2} \pm \sqrt{\left(\frac{7}{2}\right)^2 + 11}$ | M1 | oe eg $\frac{-7 \pm \sqrt{49 + 44}}{2}$ or $\frac{-7 \pm \sqrt{93}}{2}$ or $-\frac{7}{2} \pm \sqrt{\frac{49}{4} + 11}$ or $-\frac{7}{2} \pm \sqrt{\frac{93}{4}}$ |
| | 1.3(2…) and –8.3(2…) | A1 | |
| | **Additional Guidance** | | |
| | $-3.5 \pm \sqrt{12.25 + 11}$ or $-3.5 \pm \sqrt{23.25}$ | | M1 |
| | For M1 allow solutions given separately eg $\frac{-7 + \sqrt{93}}{2}$ and $\frac{-7 - \sqrt{93}}{2}$ | | M1 |
| | Both solutions correct | | M1A1 |
| | One solution correct does not imply M1 | | |
| | Not using ± is M0 unless recovered<br>eg1 $\frac{-7 + \sqrt{7^2 - 4 \times 1 \times -11}}{2 \times 1}$ followed by 1.32<br>eg2 $\frac{-7 + \sqrt{7^2 - 4 \times 1 \times -11}}{2 \times 1}$ followed by 1.3 and –8.3 | | M0A0<br>M1A1 |
| | A short dividing line or a short square root symbol is M0 unless recovered eg by a correct solution | | |
| | Condone if their square root symbol is above any part of –11 | | |
| | $\sqrt{(7^2 - 4 \times 1 \times -11)}$ is correct for $\sqrt{7^2 - 4 \times 1 \times -11}$ | | |
| | Both decimal solutions seen in working but only one on answer line | | M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 19 | (32, 8) | B3 | B2 $E$ (32, …) or $E$ (…, 8)<br>B1 $C$ (17, 18) or $D$ (23, 14)<br>SC1 $C$ ($a$, $b$) and $D$ ($a + 6$, $b - 4$) |
| | **Additional Guidance** | | |
| | Mark the answer line for B3 and B2 (if blank check working lines and diagram) | | |
| | B1 or SC1 is likely to be seen in working lines or on the diagram | | |
| | Condone missing brackets eg $C$ 17, 18 | | B1 |
| | Coordinates can be implied eg $D$ $x = 23$ $y = 14$ | | B1 |
| | Condone answers given as vectors for B2, B1 or SC1<br>eg $C \begin{pmatrix} 17 \\ 18 \end{pmatrix}$ | | B1 |
| | SC1 C cannot be (5, 26) or (11, 22) and coordinates of $D$ must be evaluated<br>eg $C$ (15, 17) and $D$ (21, 13) | | SC1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 20 | **Alternative method 1** | | |
| | 5.88 ÷ 1.68 or 3.5<br>or<br>1.68 ÷ 5.88 or [0.285, 0.29]<br>or<br>5.88 ÷ 5.60 or 1.05 | M1 | oe eg $\frac{7}{2}$ or $\frac{2}{7}$ or $\frac{21}{20}$<br>or<br>5.6 × 1.05 = 5.88 |
| | 5.6(0) ÷ (5.88 ÷ 1.68)<br>or<br>5.6(0) × (1.68 ÷ 5.88)<br>or<br>1.68 ÷ (5.88 ÷ 5.60)<br>or<br>1.6 | M1dep | oe<br>eg 5.6(0) ÷ 3.5<br>or<br>5.6(0) × [0.285, 0.29]<br>or<br>1.68 ÷ 1.05 |
| | their 1.6 ÷ 1.68 or [0.952, 0.9524]<br>or 1 – their 1.6 ÷ 1.68<br>or 1 – [0.952, 0.9524]<br>or [0.0476, 0.048] | M1dep | oe eg $\frac{20}{21}$ or $1-\frac{20}{21}$ or $\frac{1}{21}$<br>5.6(0) ÷ 5.88 oe scores M3<br>1 – 5.6(0) ÷ 5.88 oe scores M3 |
| | 4.76 | A1 | |
| | **Alternative method 2** | | |
| | 5.88 ÷ 5.6(0) or 1.05 | M1 | oe eg $\frac{21}{20}$ |
| | 1 ÷ their 1.05 | M1dep | oe eg $1 \div \frac{21}{20}$ |
| | [0.952, 0.9524]<br>or 1 – [0.952, 0.9524]<br>or [0.0476, 0.048] | M1dep | oe eg $\frac{20}{21}$ or $1-\frac{20}{21}$ or $\frac{1}{21}$<br>5.6(0) ÷ 5.88 oe scores M3<br>1 – 5.6(0) ÷ 5.88 oe scores M3 |
| | 4.76 | A1 | |

**Additional Guidance is on the next page**

| | Additional Guidance | |
|---|---|---|
| **20 cont** | Up to M3 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts | |
| | $\frac{0.28}{5.60} = 0.05$ is M0 unless 1.05 subsequently used | |
| | $5.60 \div 1.68$ with no further correct working | M0 |
| | Note that 1.6 seen may be from an incorrect method<br>eg $1.68 \times 0.95 = 1.6$ does not score because $1.68 \times 0.95$ is an incorrect method and the actual value of $1.68 \times 0.95$ is 1.596 | |
| | Any single calculation or set of calculations that lead to $\frac{20}{21}$ or $\frac{1}{21}$ | M3 |
| | Some common oes for $1 - 5.6(0) \div 5.88$ are<br>$\frac{5.88 - 5.6(0)}{5.88}$ or $\frac{0.28}{5.88}$ and $\frac{1.68 - 1.6}{1.68}$ or $\frac{0.08}{1.68}$ | M3 |
| | 3rd M1 oes include<br>$[0.952, 0.9524] \times 100$ or $[95.2, 95.24]\%$<br>$100\% - [0.952, 0.9524] \times 100$<br>$[0.0476, 0.048] \times 100$ or $(4.76, 4.8]\%$ | |
| | Values that score marks may be seen in ratios<br>eg 5.88 : 1.68 (does not score at this stage)<br>3.50 : 1 | M1 |
| | Allow working in pence eg $588 \div 1.68$ or 350 | M1 |
| | Allow working in grams eg $5.88 \div 1680$ or 0.0035 | M1 |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **21** | $x^2 + y^2 = 6$ | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **22** | $8^{-5}$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **23** | $(3x + 2)(x - 6)$ | B2 | B1 $(3x + a)(x + b)$<br>where $ab = -12$ or $a + 3b = -16$<br>$a$ and $b$ must be integers<br>SC1 $(-3x - 2)(6 - x)$ |
| | **Additional Guidance** | | |
| | Brackets in either order for B2 and B1 and SC1 | | |
| | $(3x + 6)(x - 2)$ | | B1 |
| | $(3x + 4)(x - 3)$ or $(3x + 3)(x - 4)$ or $(3x - 3)(x + 4)$ or $(x + 3)(3x - 4)$ | | B1 |
| | $(3x + 12)(x - 1)$ or $(x - 12)(3x + 1)$ | | B1 |
| | Some B1 responses may be implied<br>eg $3(x + 4)(x - 1)$ implies $(3x + 12)(x - 1)$ | | B1 |
| | Do not allow answers involving fractions eg $3(x - 6)(x + \frac{2}{3})$ | | B0 |
| | Some examples of B1 with $a + 3b = -16$<br>$(3x + 5)(x - 7)$ $(3x + 8)(x - 8)$ $(3x - 1)(x - 5)$ $(3x - 7)(x - 3)$ | | |
| | $(2 + 3x)$ is equivalent to $(3x + 2)$ etc | | |
| | Condone use of multiplication signs in B2 or B1 responses<br>eg $(3x + 2) \times (x - 6)$ | | B2 |
| | Condone missing closing bracket in B2 or B1 responses<br>eg $(3x + 6)(x - 2$ | | B1 |
| | Ignore any attempt to 'solve' after B2 or B1 seen | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 24 | $\frac{15-8}{6-2}$ or $\frac{7}{4}$ | M1 | oe eg $\frac{8-15}{2-6}$ or 1.75<br>may be embedded in an attempt at equation of line<br>eg $y = \frac{7}{4}x\ldots$<br>may be implied |
| | $-1 \div$ their $\frac{7}{4}$ or $-\frac{4}{7}$<br>or<br>$\frac{17-9}{x-0} \times$ their $\frac{7}{4} = -1$ | M1 | oe<br>allow [–0.57143, –0.57]<br>may be embedded in an attempt at equation of a line<br>eg $y =$ their $-\frac{4}{7}x\ldots$ |
| | $17 - 9 =$ their $-\frac{4}{7}x$<br>or $-4x = 56$<br>or $56 \div -4$ | M1dep | oe<br>equation must be of the form $ax = b$ ($b$ can be unprocessed)<br>dep on 2nd M1 |
| | –14 | A1 | |

**Additional Guidance is on the next page**

| | Additional Guidance | |
|---|---|---|
| **24 cont** | The second mark is not dependent on the first – see examples below | |
| | (gradient of line through given points =) $\frac{6-2}{15-8} = \frac{4}{7}$<br>(gradient of perpendicular line =) $-\frac{7}{4}$<br>$17 - 9 = -\frac{7}{4}x$ | M0<br>M1<br>M1 |
| | (gradient of line through given points =) $-\frac{7}{4}$<br>$\frac{17-9}{x} \times -\frac{7}{4} = -1$<br>$-56 = -4x$ | M0<br>M1<br>M1 |
| | (gradient of line through given points =) $\frac{7}{4}$<br>(gradient of perpendicular line =) $\frac{4}{7}$ | M1<br>M0M0 |
| | Condone use of letters for gradients eg $x = 1.75$ | M1 |
| | For the first two marks, condone inclusion of $x$ in their gradients | |
| | Answer –14 that comes from rounding or truncating cannot score A1<br>eg1 (perp grad =) –0.57 8 = –0.57$x$ Answer –14<br>eg2 (perp grad =) –0.57 8 = –0.57$x$ = –14.03 Answer –14 | M3A1<br>M3A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 25 | $x = 2y + 5$ or $x - 5 = 2y$<br>or $y - 5 = 2x$ or $\frac{y-5}{2}$ | M1 | oe eg $x = 2f^{-1} + 5$<br>or $f(x) - 5 = 2x$ |
| | $\frac{x-5}{2}$ | A1 | oe eg $\frac{x}{2} - \frac{5}{2}$<br>may be implied eg by $12f^{-1}(x) = 6(x - 5)$<br>implied by $\frac{y-5}{2}$ if $\frac{x-5}{2}$ used in subsequent working |
| | Correctly expands<br>$3(2x + 5) - 12 \times$ their $\frac{x-5}{2}$<br>to a linear expression | M1 | $6x + 15 - 6x + 30$ if M1A1<br>their $\frac{x-5}{2}$ must be a function of $x$<br>their $\frac{x-5}{2}$ cannot be $2x + 5$<br>implied by a correct linear expression or value for<br>$3(2x + 5) - 12 \times$ their $\frac{x-5}{2}$ |
| | $\frac{x-5}{2}$ and 45 | A1 | |
| | **Additional Guidance** | | |
| | 45 with no working | | Zero |
| | 45 from wrong working does not score 4 marks – mark the working seen | | |
| | First A1 Condone $y = \frac{x-5}{2}$ or $f = \frac{x-5}{2}$ or $f(x) = \frac{x-5}{2}$ or $x = \frac{x-5}{2}$ | | |
| | For $6x + 15 - 6x + 30$ allow $\frac{12x+30-12x+60}{2}$ but not $6x + 15 - \frac{12x-60}{2}$ | | |
| | $x = 2y + 5$ $\frac{x+5}{2}$ | | M1A0 |
| | $6x + 15 - \frac{12x}{2} - \frac{60}{2}$ (implied by –15) | | M1A0 |
| | $-2x - 5$ | | M0A0 |
| | $6x + 15 + 24x + 60$ (implied by $30x + 75$) | | M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 26 | 18.9 ÷ 0.45 or 42 | M1 | oe |
| | their 42 ÷ 7 × 8 or 48 | M1dep | oe eg $\frac{8}{7}$ × their 42<br>or [1.14, 1.143] × their 42 |
| | 0.45 ÷ 9 × 5 or 0.25 | M1 | oe eg $\frac{5}{9}$ × 0.45 or [0.55, 0.56] × 0.45<br>$\frac{8}{7} \times \frac{5}{9}$ × 18.9 oe scores M3 |
| | 12 | A1 | |
| | **Additional Guidance** | | |
| | Up to M3 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Any single calculation or set of calculations that are a correct method and lead to 12 | | M3 |
| | Note that the single calculation $\frac{8}{7} \times \frac{5}{9} \times 18.9$ does not use 0.45 | | M3 |
| | An oe for $\frac{8}{7} \times \frac{5}{9} \times 18.9$ is $\frac{8}{7} \times \frac{18.9}{0.45} \times \frac{5}{9} \times 0.45$ | | M3 |
| | Values may be seen in ratios eg 42 : 48 | | M1M1 |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 27 | **Alternative method 1** | | |
| | Sight of at least one of<br>2.35 or 2.45 or 2.85 or 2.95 | M1 | allow $2.44\dot{9}$ for 2.45 and $2.94\dot{9}$ for 2.95 |
| | their 2.35 × their 2.85 | M1 | $2.3 \leqslant$ their 2.35 $< 2.4$<br>$2.8 \leqslant$ their 2.85 $< 2.9$ |
| | 2.35 × 2.85 selected<br>and 6.6(975) | A1 | accept 6.7(0) or 6.698<br>with 2.35 × 2.85 selected |
| | **Alternative method 2** | | |
| | Sight of at least one of<br>2.35 or 2.45 or 2.85 or 2.95 | M1 | allow $2.44\dot{9}$ for 2.45 and $2.94\dot{9}$ for 2.95 |
| | 6.51 ÷ their 2.35<br>or<br>6.51 ÷ their 2.85 | M1 | $2.3 \leqslant$ their 2.35 $< 2.4$<br>$2.8 \leqslant$ their 2.85 $< 2.9$ |
| | 6.51 ÷ 2.35<br>and 2.7(7…) and 2.85<br>or<br>6.51 ÷ 2.85<br>and 2.2(8…) and 2.35 | A1 | |
| | **Additional Guidance** | | |
| | Alt 1 2.35 × 2.85 amongst other calculations eg 2.45 × 2.95 and/or 2.35 × 2.95 can still score the second M1 but it must be clear that they are considering 2.35 × 2.85 = 6.6(975) to show that the bedroom can be rented<br>eg1 2.35 × 2.85 = 6.6975 2.45 × 2.95 = 7.2275<br>eg2 2.35 × 2.85 = 6.6975 2.45 × 2.95 = 7.2275<br>2.35 × 2.95 = 6.9325 The lower bounds show it can be rented | | M1M1A0<br><br>M1M1A1 |
| | Ignore the calculation 2.4 × 2.9 throughout | | |
| | Alt 1 6.6(975) or 6.7 or 6.698 without 2.35 × 2.85 selected | | A0 |
| | 6.6975 only | | M0M0A0 |
| | Alt 2 2.7(7…) without 6.51 ÷ 2.35 and 2.85 seen | | A0 |
| | Alt 2 2.2(8…) without 6.51 ÷ 2.85 and 2.35 seen | | A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **28** | interior angle = 150<br>or exterior angle = 30<br>or angle *BCN* = 120 | B1 | method not required<br>may be seen on diagram |
| | interior angle = 150 with a valid method shown<br>or exterior angle = 30 with a valid method shown<br>or angle *BCN* = 120 with a valid method shown | B1dep | angles may be seen on diagram but methods will be in working lines<br>eg $180 - \frac{360}{12} = 150$ or $\frac{1800}{12} = 150$<br>or $360 - 120 - 90 = 150$<br>or $\frac{360}{12} = 30$ or $\frac{180-120}{2} = 30$<br>or $180 - 150 = 30$<br>or $360 - 150 - 90 = 120$<br>or $360 - 240 = 120$<br>or $180 - 2 \times 30 = 120$ |
| | interior angle = 150 with a valid method shown<br>**and** exterior angle = 30 with a valid method shown<br>**and** angle *BCN* = 120 with a valid method shown | B1dep | angles may be seen on diagram but methods will be in working lines<br>eg $\frac{1800}{12} = 150$<br>**and** $\frac{180-120}{2} = 30$<br>**and** $360 - 240 = 120$<br>angles worked out in any order |
| | Fully correct working that must show correct progression and show all valid methods<br>Valid methods shown must be appropriate for the approach used<br>A reason must be included in the final step | B1dep | examples of the final step are<br>(i) angle *ABC* + angle *CBN* = 180<br>(ii) interior angle = 150 in two different ways<br>(iii) exterior angle = 30 in two different ways<br>(iv) angle *BCN* = 120 in two different ways<br>(v) sum of three angles at *C* = 360<br>(vi) sum of angles of triangle *BCN* = 180 |

**Additional Guidance is on the next page**

| | | |
|---|---|---|
| **28 cont** | **Additional Guidance** | |
| | Condone incorrect use of equals signs throughout<br>eg interior angle = 12 – 2 = 10 × 180 = 1800 ÷ 12 = 150 | B1B1 |
| | interior angle may be seen as angle *ABC* or angle *BCD*<br>exterior angle may be seen as angle *CBN* | |
| | It must be clear which angle they are working out<br>eg1 Do not accept 150 if it is not correctly identified or not in the correct position on diagram<br>eg2 Do accept 150 if it is identified as an interior angle or angle *ABC* or is in the correct position on the diagram | |
| | Do not accept incorrect statements<br>eg1 exterior angle = 150 (even if 150 in correct position on the diagram)<br>eg2 angle *ACB* = 150 (even if 150 in correct position on the diagram) | |
| | Ignore reasons for the first three marks | |
| | Angles on the diagram with no valid methods can score a maximum of B1B0B0B0 | |
| | For the 2nd and 3rd marks the methods shown do not have to show progression | |
| | Example of fully correct working for (i)<br>interior angle = $\frac{1800}{12} = 150$<br>angle *BCN* = 360 – 150 – 90 = 120<br>angle *CBN* = $\frac{180-120}{2} = 30$<br>150 + 30 = 180 angles on a (straight) line | B1B1<br>B1<br>B1 |
| | Example of fully correct working for (ii)<br>exterior angle = $\frac{360}{12} = 30$<br>angle *BCN* = 180 – 2 × 30 = 120<br>interior angle = 360 – 120 – 90 = 150<br>interior angle = $\frac{1800}{12} = 150$ (interior) angle of polygon | B1B1<br>B1<br>B1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 29 | $(x-9)^2$… | M1 | allow $\left(x-\frac{18}{2}\right)^2$ …<br>may be implied by a grid for $(x-9)^2$ |
| | $(x-9)^2-9^2+70$<br>or $(x-9)^2-81+70$<br>or $(x-9)^2-11$ | M1dep | oe completing the square<br>eg $\left(x-\frac{18}{2}\right)^2-\left(\frac{18}{2}\right)^2+70$ |
| | (9, –11) with correct completing the square seen | A1 | eg (9, –11) with $(x-9)^2-9^2+70$ seen<br>SC1 (9, –11) with correct completing the square not seen |
| | **Additional Guidance** | | |
| | Allow $(x-9)^2$ to be $(9-x)^2$ throughout | | |
| | Allow $(x-9)^2$ to be $(x-9)(x-9)$ throughout | | |
| | Condone expression = 0 throughout | | |
| | $(x-9)^2=11$ with $(x-9)^2-11$ (= 0) also seen scores M1M1<br>Also scores A1 if answer correct | | |
| | $(x-9)^2=11$ without $(x-9)^2-11$ (= 0) also seen<br>Answer correct would still mean M1M0 (or SC1) | | M1M0 |
| | Allow as a slip if completing the square seen but the squared is omitted in a subsequent line<br>eg $(x-9)^2-81+70=(x-9)-11$<br>Answer (9, –11) | | M1M1<br>A1 |
| | $(x-9)-11$ and answer (9, –11) | | SC1 |
| | $(x-9)-11$ and answer not (9, –11) | | M0M0A0 |
| | (9, –11) with no method or from a different method eg calculus | | SC1 |
| | <table><tr><td></td><td>$x$</td><td>–9</td></tr><tr><td>$x$</td><td>$x^2$</td><td>$-9x$</td></tr><tr><td>–9</td><td>$-9x$</td><td>81</td></tr></table> Condone one of the products missing or incorrect | | M1 |