# GCSE
# MATHEMATICS
# 8300/2H

Higher Tier Paper 2 Calculator

**Mark scheme**

June 2023

Version: 1.0 Final

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.

Further copies of this mark scheme are available from aqa.org.uk

**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 | Comments |
|---|---|---|---|
| 1 | $\frac{30}{12}$ or 2.5 | B1 | oe fraction, mixed number or decimal<br>eg $\frac{5}{2}$ or $2\frac{1}{2}$ |
| | **Additional Guidance** | | |
| | Ignore simplification or conversion attempt after correct answer seen<br>eg $\frac{30}{12}$ in working with 2.6 on answer line | B1 | |
| | 30 ÷ 12 with no further correct work | B0 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 2 | 28 | B1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 3 | $\frac{7}{4}$ or 1.75 | B1 | oe fraction, mixed number or decimal<br>eg $1\frac{3}{4}$ |
| | **Additional Guidance** | | |
| | Ignore conversion attempt after correct answer seen<br>eg $\frac{7}{4}$ = 1.8 | B1 | |
| | Condone answer $\frac{1}{4/7}$ | B1 | |
| | Condone answer $\left(\frac{4}{7}\right)^{-1}$ (without brackets B0) | B1 | |
| | Do not allow 1 ÷ $\frac{4}{7}$ | B0 | |
| | $\frac{-7}{-4}$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 4 | 112.5% or 1.125 or $\frac{9}{8}$<br>or<br>19.53 ÷ 112.5 (× 100)<br>or 0.1736 (× 100) | M1 | oe eg 1 + 0.125<br>or<br>19.53 ÷ 9 × 8 or 2.17 × 8 |
| | 17.36 | A1 | |
| | **Additional Guidance** | | |
| | M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | | |
| | M1 may be seen in a trial (the answer to the trial can be ignored)<br>eg 15 × 1.125 | | M1 |
| | 19.53 × 1.125 | | M1 |
| | Do not allow misreads for 12.5%<br>eg1 19.53 ÷ 1.0125<br>eg2 19.53 ÷ 112 | | M0<br>M0 |
| | 112.5 not recovered | | M0 |

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="6">5</td><td>45 × 8 or 360</td><td>M1</td><td>oe<br>number of 2p coins<br>may be embedded</td></tr>
<tr><td>45 × 8 × 2<br>or 360 × 2<br>or 720 or 7.2(0)</td><td>M1dep</td><td>oe<br>value of 2p coins<br>implied by 1170 or 11.7(0)</td></tr>
<tr><td>17.7(0) – their 7.2(0) – 45 × 0.1(0)<br>or<br>1770 – their 720 – 45 × 10<br>or<br>6(.00) or 600</td><td>M1dep</td><td>oe<br>value of 5p coins<br>implied by 7.2 : 6 oe ratio not in simplest form<br>or 6 : 7.2 oe ratio</td></tr>
<tr><td>6 : 5</td><td>A1</td><td>accept 1.2 : 1 or $\frac{6}{5}$ : 1 or $1\frac{1}{5}$ : 1<br>or 1 : 0.83(…) or 1 : $\frac{5}{6}$</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="3">Up to M3 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts</td></tr>
<tr><td colspan="3">Allow working in pence or pounds throughout</td></tr>
<tr><td colspan="3">Must work consistently in pence or pounds for the third mark (or recover)</td></tr>
<tr><td colspan="3">Ignore units in the ratio eg 6p : 5p or £1.20 : £1</td><td>M3A1</td></tr>
<tr><td colspan="3">720 may be seen in a ratio with the value of the 10p coins<br>eg 720 : 450 or 7.2 : 4.5</td><td>M2</td></tr>
<tr><td colspan="3">600 may be seen in a ratio with the value of the 10p coins<br>eg 600 : 450 or 6 : 4.5</td><td>M3</td></tr>
<tr><td colspan="4">For information:
<table>
<tr><td>Coin</td><td>10p</td><td>2p</td><td>5p</td></tr>
<tr><td>Number</td><td>45</td><td>360</td><td>120</td></tr>
<tr><td>Value</td><td>£4.50</td><td>£7.20</td><td>£6.00</td></tr>
</table></td></tr>
</table>

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6(a) | 360 ÷ 8<br>or<br>135 seen | M1 | oe eg 45 × 8 = 360<br>or $180 - \frac{(8-2)\times 180}{8}$<br>may be on diagram |
| | 45 | A1 | |
| | **Additional Guidance** | | |
| | M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | | |
| | 45 seen but not chosen as answer, even if linked to the wrong angle | | M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6(b) | It is less than the answer to part (a) | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7(a) | All values correct | B2 | B1 1 or 2 rows correct |
| | **Additional Guidance** | | |
| | | | B2 |

| | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| **2*x*** | 2 | 4 | 6 | 8 | 10 | 12 |
| **3*x*** | 3 | 6 | 9 | 12 | 15 | 18 |
| $x^2$ | 1 | 4 | 9 | 16 | 25 | 36 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7(b) | $\frac{8}{18}$ or $\frac{4}{9}$<br>or 0.44(4…) or 44(.4…)% | B1ft | oe fraction, decimal or percentage<br>ft their table with ⩾ 12 values<br>must be using 18 for the total number of possible scores |
| | **Additional Guidance** | | |
| | Ignore simplification or conversion attempt (not ratio) after correct probability seen | | |
| | Ratio answer eg 8 : 18, even alongside a correct probability is B0 | | |
| | ft decimals or percentages must be correct to the same accuracy as in the scheme<br>eg 10 winning values in their table<br>$\frac{10}{18}$ or 0.55(5…) or 0.56 or 0.556 or 55(.5…)% or 56% or 55.6% | B1ft | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7(c) | 711 × their $\frac{8}{18}$ | M1 | oe<br>ft their probability from (b)<br>or if no probability in (b), ft their table with $\geqslant$ 12 values<br>where 0 < their probability < 1<br>probabilities, if rounded in (c), must be truncated or rounded to at least 2 sf |
| | 316 | A1 | SC2 395 |
| | **Additional Guidance** | | |
| | Answer 316 | | M1A1 |
| | $\frac{316}{711}$ on answer line | | M1A0 |
| | Condone 316 out of 711 | | M1A1 |
| | Do not treat estimating by rounding as a misread<br>eg1 700 used instead of 711<br>eg2 (b) 0.44 (c) 0.4 × 711 (rounded to 1sf in (c) for the probability)<br>eg3 (b) 0.4 (c) 0.4 × 711 (follows through their (b)) | | <br>M0A0<br>M0A0<br>M1A0 |
| | Do not allow ft for a ratio from (b) but may ft their (a) instead | | |
| | For 0.44 × 711, accept 44% × 711 but do not accept 44% of 711 unless recovered | | |
| | The method mark may be implied by a ft answer (decimal or truncated to the nearest integer or rounded up to the nearest integer)<br>eg1 (b) $\frac{7}{18}$<br>(c) 276.5 or 276 or 277 (correct ft method implied using (b))<br>eg2 (a) completed table has 7 winning values (b) no probability shown<br>(c) 276.5 or 276 or 277 (correct ft method implied using (a)) | | <br><br>M1A0<br><br>M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8 | $a = 8$ and $b = 6$ | B2 | B1 $a - 3 = 5$ or $a = 3 + 5$ or $a = 8$<br>or<br>$2b = 12$ or $b = 12 \div 2$ or $b = 6$<br>SC1 $a = 6$ and $b = 8$ |
| | **Additional Guidance** | | |
| | Ignore working if B2 or B1 or SC1 seen | | |
| | $(a - 3)x^2 = 5x^2$ with no further correct work | | B0 |
| | For B1 do not allow embedded values eg $2 \times 6 = 12$ | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9 | Identifies (6, 3) or (7, 9)<br>or (–4, 3) or (–3, 9) | M1 | may be seen on the grid<br>mark intention on diagram<br>eg parallelogram drawn with one of the vertices at (6, 3) or (6, 3) plotted |
| | Identifies (6, 3) and (7, 9)<br>**or**<br>identifies (–4, 3) and (–3, 9) | M1dep | may be seen on the grid<br>mark intention on diagram<br>eg parallelogram drawn with two of the vertices at (6, 3) and (7, 9)<br>**or** (6, 3) and (7, 9) plotted |
| | Both diagonals drawn for one of the correct parallelograms<br>or<br>centre of one of the correct parallelograms identified<br>or<br>(4, 6) or (–1, 6) | M1dep | mark intention on diagram<br>M3 may be implied<br>eg $\left(\frac{1+7}{2}, \frac{9+3}{2}\right)$ or $\left(\frac{-4+2}{2}, \frac{9+3}{2}\right)$ |
| | (4, 6) and (–1, 6) | A1 | |

| Additional Guidance | |
|---|---|
| Up to M3 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | |
| Both answers correct (ignore working) | M3A1 |
| One answer correct (ignore working) | M3A0 |
| For first 2 marks condone correct points plotted even if labelled incorrectly | |
| Up to M2 can be awarded for coordinates given as answers | |
| Arc centre *A* radius 5 cm passing through (6, 3) and/or (–4 , 3) is not sufficient to award M1 etc | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 10 | $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ | B2 | B1 $\begin{pmatrix} 4 \\ ... \end{pmatrix}$ or $\begin{pmatrix} ... \\ -3 \end{pmatrix}$<br>SC1 $\begin{pmatrix} -4 \\ 3 \end{pmatrix}$ |
| | **Additional Guidance** | | |
| | (4, –3) or $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$ | | B0 |
| | Ignore words if a vector is also seen<br>eg1 Reflection $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$<br>eg2 4 right 3 up and $\begin{pmatrix} 4 \\ 3 \end{pmatrix}$<br>eg3 4 right 3 down<br>eg4 Rotate 4 left and 3 up and $\begin{pmatrix} -4 \\ 3 \end{pmatrix}$ | | B2<br>B1<br>B0<br>SC1 |
| | Condone any type of brackets | | |
| | Condone missing brackets for B2 or B1 or SC1 but must have two numbers in a column | | |
| | Condone 'fraction line' for B2 or B1 or SC1 but must have two numbers in a column | | |
| | $\begin{pmatrix} 4x \\ -3y \end{pmatrix}$ or $\begin{pmatrix} x4 \\ -y3 \end{pmatrix}$ or $\begin{pmatrix} x+4 \\ y-3 \end{pmatrix}$ or $\begin{pmatrix} 4 \text{ right} \\ 3 \text{ down} \end{pmatrix}$ or $\begin{pmatrix} 4 \text{ r} \\ 3 \text{ d} \end{pmatrix}$ or $\begin{pmatrix} 4 \rightarrow \\ 3 \downarrow \end{pmatrix}$ | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 11 | **Alternative method 1** Compares 70% of volume of hemisphere with volume of water | | |
| | $\frac{4}{3} \times \pi \times 12^3$ or $2304\pi$<br>or [7216, 7239.2]<br>or<br>$\frac{2}{3} \times \pi \times 12^3$ or $1152\pi$<br>or [3581, 3638] | M1 | oe eg $\frac{4}{3}\pi \times 1728$<br>allow without any multiplication signs<br>eg $\frac{4}{3}\pi 12^3$ |
| | 0.7 × their $1152\pi$ or $806.4\pi$<br>or [2506, 2547] | M1dep | oe<br>0.7 × their [3581, 3638] or $\frac{4032}{5}\pi$<br>must be using volume of hemisphere |
| | 325 × 8 or 2600 | M1 | oe |
| | [2506, 2547] and 2600 and Yes | A1 | oe |
| | **Alternative method 2** Works out volume of water as proportion of volume of hemisphere | | |
| | $\frac{4}{3} \times \pi \times 12^3$ or $2304\pi$<br>or [7216, 7239.2]<br>or<br>$\frac{2}{3} \times \pi \times 12^3$ or $1152\pi$<br>or [3581, 3638] | M1 | oe eg $\frac{4}{3}\pi \times 1728$<br>allow without any multiplication signs<br>eg $\frac{4}{3}\pi 12^3$ |
| | 325 × 8 or 2600 | M1 | oe |
| | their 2600 ÷ their $1152\pi$<br>or [0.71, 0.73] | M1dep | oe eg their 2600 ÷ their [3581, 3638]<br>or 72%<br>dep on M2<br>must be using volume of hemisphere |
| | [71, 73](%) and Yes | A1 | oe eg 0.72 and 0.7 and Yes |

**Question 11 continues on the next page**

| | | | |
|---|---|---|---|
| **11 cont** | **Alternative method 3** Works out time to fill 70% of volume of hemisphere | | |
| | $\frac{4}{3} \times \pi \times 12^3$ or $2304\pi$<br>or [7216, 7239.2]<br>or<br>$\frac{2}{3} \times \pi \times 12^3$ or $1152\pi$<br>or [3581, 3638] | M1 | oe eg $\frac{4}{3}\pi \times 1728$<br>allow without any multiplication signs<br>eg $\frac{4}{3}\pi 12^3$ |
| | 0.7 × their $1152\pi$ or $806.4\pi$<br>or [2506, 2547]<br>or<br>their $1152\pi \div 325$<br>or [11, 11.2] | M1dep | oe<br>0.7 × their [3581, 3638] or $\frac{4032}{5}\pi$<br>or<br>their [3581, 3638] ÷ 325<br>must be using volume of hemisphere |
| | 0.7 × their $1152\pi \div 325$<br>or 0.7 × their [3581, 3638] ÷ 325<br>or [7.7, 7.84] | M1dep | oe<br>their [2506, 2547] ÷ 325<br>or 0.7 × their [11, 11.2] |
| | [7.7, 7.84] and Yes | A1 | oe |

**Question 11 continues on the next page**

| | | |
|---|---|---|
| **11 cont** | **Additional Guidance** | |
| | Up to M3 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | |
| | Allow 1.33(…) for $\frac{4}{3}$ | |
| | Allow 0.66(…) or 0.67 for $\frac{2}{3}$ | |
| | $\pi$ may be seen as [3.14, 3.142] eg Alt 1 $\frac{2}{3} \times 3.14 \times 12^3$ | M1 |
| | If a number (or calculation) in terms of $\pi$ is seen but $\pi$ is subsequently omitted, treat as a miscopy for M marks<br>eg Alt 1<br>$1152\pi$<br>$0.7 \times 1152 = 806.4$<br>$325 \times 8 = 2600$ Yes | <br><br><br>M1<br>M1dep<br>M1A0 |
| | Yes cannot be implied by inequalities | |
| | Alts 1 and 2<br>$325\,\text{cm}^3 \times 8$ seen is M1 even if evaluated incorrectly<br>$325^3 \times 8$ seen is M0 unless recovered to 2600 | |
| | Do not allow misreads of the given formula unless recovered<br>eg1 using $12^2$ instead of $12^3$<br>eg2 using $\frac{3}{4}$ instead of $\frac{4}{3}$ | |
| | For $0.7 \times$ their $1152\pi$, do not accept $70\% \times$ their $1152\pi$ unless recovered | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 12 | $8 \div 5$ or $19.2 \div 12$<br>or $\frac{8}{5}$ or $\frac{19.2}{12}$ or 1.6<br>or<br>$12 \div 5$ or $19.2 \div 8$<br>or $\frac{12}{5}$ or $\frac{19.2}{8}$ or 2.4 | M1 | oe use of a valid pair of sides to make an appropriate calculation or value<br>eg $5 \div 8$ or 0.625<br>or<br>$5 \div 12$ or [0.416, 0.417] |
| | $8 \div 5 = 19.2 \div 12$ or $\frac{8}{5} = \frac{19.2}{12}$<br>or<br>$12 \div 5 = 19.2 \div 8$ or $\frac{12}{5} = \frac{19.2}{8}$ | A1 | oe showing sides are in proportion<br>eg $5 \div 8 = 12 \div 19.2$<br>or<br>$\frac{5}{12} = \frac{8}{19.2}$ |
| | **Additional Guidance** | | |
| | For A1 equating may be implied by two calculations or two fractions with correct evaluation<br>eg $8 \div 5 = 19.2 \div 12$ is implied by $8 = 5 \times 1.6$ and $19.2 = 12 \times 1.6$ | | M1A1 |
| | For A1 equating may be implied by calculations<br>eg1 $8 \div 5 = 19.2 \div 12$ is implied by $8 \div 5 = 1.6$ and $12 \times 1.6 = 19.2$<br>eg2 $8 \div 5 = 19.2 \div 12$ is implied by $\frac{8}{5} \times 12 = 19.2$ | | M1A1<br>M1A1 |
| | $5 \times 19.2 = 8 \times 12$ | | M1A1 |
| | $5 \times 19.2 = 96$ and $8 \times 12 = 96$ | | M1A1 |
| | Non-contradictory working can be ignored<br>eg correct response along with area calculations | | M1A1 |
| | Ignore words eg references to scale factors, enlargement, angles | | |
| | Working on diagrams may be seen<br>eg1 Arrows or lines from 5 to 8 and 12 to 19.2 with × 1.6 on them<br>eg2 Arrows or lines from 5 to 8 and 12 to 19.2 with 1.6 on them<br>Arrows or lines must unambiguously link relevant numbers | | M1A1<br>M1A0 |
| | For $8 \div 5$ or $\frac{8}{5}$ allow 8 : 5 etc | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 13 | $80 \times x$ or $80x$ or $x \times 80$ or $x80$<br>or<br>$x \div 60$ or $\frac{x}{60}$ or $\frac{1}{60}x$ or $x\frac{1}{60}$<br>or<br>$80 \div 60$ or $\frac{80}{60}$ | M1 | teabags per hour<br><br>boxes per minute |
| | $\frac{80x}{60}\left(=\frac{4x}{3}\right)$<br>or<br>$80 \div 60 \times x\left(=\frac{4x}{3}\right)$ | A1 | oe showing 80 and 60 and $x$<br>eg $\frac{80 \times x}{60}\left(=\frac{4x}{3}\right)$ or $x\frac{80}{60}\left(=\frac{4x}{3}\right)$<br>or $\frac{80}{60} \times x\left(=\frac{4x}{3}\right)$ or $80x \div 60\left(=\frac{4x}{3}\right)$ |

| Additional Guidance | |
|---|---|
| M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | |
| Do not allow M1 if only seen embedded in an incorrect expression or calculation eg $80x \times 4 = 320x$ | M0 |
| $60 \times \frac{4x}{3} = 80x$ (M1 allowed as $80x$ is not embedded in an incorrect expression or calculation, A0 because using the given answer) | M1A0 |
| Condone $x = 80 \div 60$ | M1A0 |
| $\frac{80x}{60}\left(=\frac{4x}{3}\right)$ | M1A1 |
| $\frac{80}{60} = \frac{4}{3}$ and $\frac{4}{3} \times x\left(=\frac{4x}{3}\right)$<br>$\frac{80}{60} = \frac{4}{3}$ and $\frac{4x}{3}$ | M1A1<br>M1A0 |
| No equivalents allowed for M1 | |
| Ignore units | |
| Condone 1.33(…) for $\frac{4}{3}$ | |
| Ignore non-contradictory working after M1A1 seen | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14(a) | **Alternative method 1** Works out best estimate of the percentage of employees with hourly rate more than £17 | | |
| | 32 ÷ 2 or 16 | M1 | oe<br>implied by 41 or 82 |
| | (15 + 10 + their 16) ÷ 123<br>or 41 ÷ 123<br>or $\frac{1}{3}$ or 0.33(...)<br>or<br>(66 + their 16) ÷ 123<br>or 82 ÷ 123<br>or $\frac{2}{3}$ or 0.66(…) or 0.67 | M1dep | oe eg (123 – 66 – their 16) ÷ 123<br>or<br>13(.0…)(%) + [12, 12.2](%) + 8(.1…)(%) |
| | 33(.3…)(%) | A1 | oe eg 0.33(3…) and 0.3<br>allow 33.2(%)<br>from 13(%) + 12.2(%) + 8(%)<br>SC3 37 (or 36.9) and explains that a minimum of 12 of 32 people earn more than £17 |
| | **Alternative method 2** Compares best estimate of the number of employees with hourly rate more than £17 with 30% of number of employees | | |
| | 32 ÷ 2 or 16 | M1 | oe<br>implied by 41 or 82 |
| | 0.3 × 123 or 36.9<br>or<br>0.7 × 123 or 86.1 | M1 | oe<br>accept 36 or 37 for 36.9<br>accept 86 or 87 for 86.1 |
| | 41 and 36.9<br>or<br>82 and 86.1 | A1 | accept 36 or 37 for 36.9<br>accept 86 or 87 for 86.1<br>SC3 37 (or 36.9) and explains that a minimum of 12 of 32 people earn more than £17 |

**Question 14(a) continues on the next page**

| | | | |
|---|---|---|---|
| **14(a) cont** | **Alternative method 3** Shows that a value of $x$ gives a percentage > 30% | | |
| | $(15 + 10 + x) \div 123$<br>where $12 \leqslant x \leqslant 32$ | M2 | oe eg $(25 + x) \div 123$<br>must see 15 and 10 **or** 25 |
| | $(15 + 10 + x) \div 123$<br>where $12 \leqslant x \leqslant 32$<br>and<br>evaluates<br>$(15 + 10 + x) \div 123 \times 100$ correctly | A1 | evaluations rounded or truncated to nearest integer or better<br>SC3 37 (or 36.9) and explains that a minimum of 12 of 32 people earn more than £17 |
| | **Alternative method 4** Shows a number of employees that gives a percentage > 30% | | |
| | $0.3 \times 123$ or 36.9 | M1 | oe<br>accept 36 or 37 for 36.9 |
| | $15 + 10 + x$ or $25 + x$<br>where $12 \leqslant x \leqslant 32$ | M1dep | must see 15 and 10 **or** 25 |
| | 36.9 and<br>evaluates $15 + 10 + x$ correctly<br>where $12 \leqslant x \leqslant 32$ | A1 | accept 36 or 37 for 36.9<br>SC3 37 (or 36.9) and explains that a minimum of 12 of 32 people earn more than £17 |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | | |
| | 16 may be seen by the table | | |
| | Alt 1 67% needs further explanation to score A1 | | |
| | Ignore irrelevant working in an otherwise fully correct response | | |
| | For the SC3, minimum of 12 may be implied by an explanation that<br>$10 + 15 + x$ is at least 37 or $25 + x$ is at least 37 | | |
| | Responses involving interpolation should be escalated | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14(b) | Valid reason | B1 | eg all employees in the second interval may earn less than £17 |
| | **Additional Guidance** | | |
| | Fewer than 12 employees could earn more than £17 per hour | | B1 |
| | Only 10 might get more than £17 in second class interval<br>(10 could be replaced by any integer from 0 to 11 inclusive) | | B1 |
| | More than 12 in group 2 earn less than £17 | | B0 |
| | Everyone in second group may earn 14 or 15 or 16 | | B1 |
| | 21 people may earn between £14 and £17<br>(21 could be replaced by any integer from 22 to 32 inclusive) | | B1 |
| | More people may earn between £14 and £17 | | B0 |
| | People in the 14 to 20 group aren't evenly distributed | | B0 |
| | Not everyone in 14 – 20 earns more than £17 | | B0 |
| | Not many in second group may get more than £17 | | B0 |
| | Some of second group may get more than £17 | | B0 |
| | 14 to 20 includes people who get less than £17 | | B0 |
| | 2nd group includes some getting less than 17 and some getting more than 17 | | B0 |
| | We don't know what each person earns | | B1 |
| | We don't know how many of 2nd group earn less than £17 per hour | | B1 |
| | Under £17 isn't in the data | | B1 |
| | Grouped data or it is only an estimate or using midpoints or data is wrong | | B0 |
| | Ignore irrelevant working but do not ignore incorrect working | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14(c) | 12 × 66 or 792<br>and<br>17 × 32 or 544<br>and<br>30 × 15 or 450<br>and<br>70 × 10 or 700 | M1 | oe<br>implied by 2486<br>may be seen by the table<br>allow one product or $fx$ value to be incorrect |
| | (their 792 + their 544 + their 450 + their 700) ÷ 123<br>or<br>2486 ÷ 123 | M1dep | oe eg $\frac{792+544+450+700}{66+32+15+10}$<br>condone bracket error if working seen<br>eg 792 + 544 + 450 + 700 ÷ 123 |
| | 20.2(1…) | A1 | allow 20.20 if M2 seen and no errors |
| | **Additional Guidance** | | |
| | Four values with three correct from 792, 544, 450, 700 can score up to M2 if they add and divide by 123 | | |
| | Correct products or values seen but a different method used eg 123 ÷ 4 | | M0M0 |
| | 20.2(1…) in working with answer given as the interval $20 \leqslant p < 40$ | | M2A0 |
| | Ignore any references to statement B<br>eg £20.21 which makes B wrong | | M2A1 |
| | Condone $20.\dot{2}$, $20.\dot{2}\dot{1}$ etc for $20.\dot{2}1138\dot{}$ | | |
| | Do not allow rounding of any of their 4 values in the second mark<br>eg 792 544 450 700<br>(800 + 544 + 450 + 700) ÷ 123 | | M1<br>M0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14(d) | Valid reason referring to the distribution | B1 | eg 98 employees earned below £20 |
| | **Additional Guidance** | | |
| | Less than a half earned more than £20 | | B1 |
| | Over a half earned between £10 and £14 | | B1 |
| | Lots earned 10 to 14 | | B0 |
| | Only 25 people were over £20 | | B1 |
| | 25 people were over £20 | | B0 |
| | Not many earned more than the mean | | B0 |
| | Most earned less than £20 | | B1 |
| | Some earned less than the mean, some earned more | | B0 |
| | Mean is not a real amount of money | | B0 |
| | Median is between £10 and £14 | | B1 |
| | Median is better or mode is better | | B0 |
| | Modal class is $10 \leqslant p < 14$ | | B1 |
| | The mode is between £10 and £14 (condone mode as modal class) | | B1 |
| | We don't know what each person earns | | B0 |
| | Grouped data or it is only an estimate or using midpoints or data is wrong | | B0 |
| | The range is large | | B0 |
| | The data has extreme values or outliers or anomalous values | | B1 |
| | The data is (positively) skewed | | B1 |
| | The distribution is not symmetrical | | B1 |
| | The distribution is not evenly spread | | B1 |
| | Not representative | | B0 |
| | Lots of low values or high values can make the mean inaccurate | | B0 |
| | Ignore irrelevant working but do not ignore incorrect working | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 15 | $2x^3 - 18x^2y + 5x^2y - 45xy^2$ | M1 | exactly 4 terms with 3 correct terms in any order<br>may be seen in a grid<br>implied by $2x^3 - 13x^2y$ with one other term or $-13x^2y - 45xy^2$ with one other term |
| | $2x^3 - 18x^2y + 5x^2y - 45xy^2$<br>or<br>$2x^3 - 13x^2y - 45xy^2$ | A1 | terms in any order<br>do not allow if only seen in a grid |
| | **Additional Guidance** | | |
| | A correct term includes the sign (in a grid allow eg $5x^2y$ for $+ 5x^2y$) | | |
| | Condone four correct terms followed by incorrect simplification of $x^2y$ terms, otherwise do not allow further incorrect work<br>eg1 $2x^3 - 18x^2y + 5x^2y - 45xy^2 = 2x^3 + 13x^2y - 45xy^2$<br>eg2 $2x^3 - 18x^2y + 5x^2y - 45xy^2 = 36x^5y + 5x^2y - 45xy^2$ | | M1A1<br>M1A0 |
| | Allow equivalent fully simplified terms eg $5x^2y$ may be seen as $5yx^2$ | | |
| | For M1 allow coefficients to be incorrectly positioned<br>eg $x^32 - 18x^2y + y5x^2 - 45xy^2$ | | M1A0 |
| | $2x^3 + - 18x^2y + 5x^2y + - 45xy^2$ has 4 correct terms but needs further simplification to score A1 | | M1A0 |
| | Terms must be processed<br>eg do not allow $x^2 \times 2x$ for $2x^3$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16 | $13 = 7a - 1$<br>or $(a =)\ 2$ | M1 | oe eg $\frac{13 - -1}{7 - 0}$<br>may be implied eg $(y =)\ 2x - 1$ |
| | $(y =)\ \frac{3}{5}x \ldots$<br>or (gradient B =) $\frac{3}{5}$ | M1 | oe eg (gradient B =) 0.6<br>allow $(y =)\ \frac{3x + 4}{5}$ |
| | gradient A = 2<br>and gradient B = $\frac{3}{5}$ | A1 | oe eg $2 > \frac{3}{5}$<br>condone $2x > \frac{3}{5}x$ |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Condone incorrect $y$-intercept<br>eg $a = 2$ $\quad y = \frac{3}{5}x + 4$<br>gradient A = 2 $\quad$ gradient B = $\frac{3}{5}$ | | M1M1<br>A1 |
| | It must be clear that the values 2 and $\frac{3}{5}$ are being used to answer the question to award A1<br>eg1 gradient A = 2 and gradient B = $\frac{3}{5}$ (no statement needed)<br>eg2 $a = 2$ $\quad y = \frac{3}{5}x + \frac{4}{5}$<br>eg3 $y = 2x - 1$ and $y = \frac{3}{5}x + \frac{4}{5}$ $\quad$ 2 is greater than $\frac{3}{5}$<br>eg4 $y = 2x - 1$ and $y = \frac{3}{5}x + \frac{4}{5}$ $\quad$ gradient of A > gradient of B | | M2A1<br>M2A0<br>M2A1<br>M2A0 |
| | $13 = 7x - 1$ or $x = 2$ must be recovered to award 1st M1 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 17 | **Alternative method 1** Works out *AC* and uses it in triangle *ABC* | | |
| | $\cos 37 = \frac{AC}{4}$ | M1 | oe eg $\sin 53 = \frac{AC}{4}$<br>allow [0.798, 0.8] for cos 37 or sin 53 |
| | (*AC* =) 4 × cos 37<br>or (*AC* =) [3.19, 3.2] | M1dep | oe eg (*AC* =) 4 × sin 53<br>allow [0.798, 0.8] for cos 37 or sin 53<br>may be seen on diagram |
| | $\sin x = \frac{\text{their } [3.19, 3.2]}{9.3}$<br>or ($x$ =) $\sin^{-1}$[0.34, 0.3441] | M1dep | oe eg $\cos x = \frac{\sqrt{9.3^2 - \text{their } [3.19, 3.2]^2}}{9.3}$<br>or ($x$ =) 90 – $\cos^{-1}$[0.34, 0.3441] |
| | [19.87, 20.13] | A1 | |
| | **Alternative method 2** Works out angle *ADC* and uses it in triangle *ABD* | | |
| | (angle *ADC* =) 90 – 37<br>or (angle *ADC* =) 53 | M1 | oe eg (angle *ADC* =) 180 – 90 – 37<br>may be seen on diagram |
| | $\frac{\sin x}{4} = \frac{\sin(90-37)}{9.3}$ | M1dep | oe eg $\frac{4}{\sin x} = \frac{9.3}{\sin 53}$ |
| | (sin $x$ =) $\frac{\sin(90-37)}{9.3} \times 4$<br>or ($x$ =) $\sin^{-1}$[0.34, 0.3441] | M1dep | oe |
| | [19.87, 20.13] | A1 | |

**Question 17 continues on the next page**

| | | |
|---|---|---|
| **17 cont** | **Additional Guidance** | |
| | Up to M3 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | |
| | Allow any unambiguous notation for angles eg allow *B* for $x$ | |
| | Alt 1 Allow any unambiguous notation for *AC* eg $y$<br>(condone $x$ if clearly referring to *AC*) | |
| | Alt 1 1st M1 must be an equation where *AC* is the only variable<br>eg $AC^2 + (4\sin 37)^2 = 4^2$ | M1 |
| | Alt 1 A calculation that leads to *AC* scores M1M1<br>eg $\sqrt{4^2 - (4\sin 37)^2}$ | M1M1 |
| | Alt 1 3rd M1 must have sin $x$ (or cos $x$) as the subject or be a calculation that leads to $x$ | |
| | Alt 2 53 only marked at angle *BAC* on diagram | M0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 18 | $xy = x + 8$<br>or<br>$y = 1 + \frac{8}{x}$ | M1 | oe equation with fraction eliminated<br>or<br>oe equation with single fraction split into two terms<br>eg $y \times x = x + 8$ or $y = \frac{x}{x} + \frac{8}{x}$ |
| | $xy - x = 8$ or $x(y - 1) = 8$ | M1dep | oe equation with $x$ terms collected<br>eg $x - xy = -8$ |
| | $x = \frac{8}{y-1}$ or $x = \frac{-8}{1-y}$ | A1 | oe equation with $x$ the subject<br>eg $-\frac{8}{1-y} = x$ |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Correct answer in working with answer repeated on answer line without $x =$<br>eg $x = \frac{8}{y-1}$ seen in working with answer $\frac{8}{y-1}$ | | M1M1A1 |
| | Do not allow incorrect simplification after correct answer seen<br>eg $x = \frac{8}{y-1}$ $x = \frac{8}{y} - 8$ | | M2A0 |
| | $xy - x - 8 = 0$ with no further correct working | | M1M0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 19 | **Alternative method 1** $n$th term = $an^2 + bn + c$ | | |
| | (second differences =) 10<br>or $a = 5$ or $5n^2$ | M1 | second difference seen at least once and not contradicted by a different value unless recovered<br>may be seen by the sequence |
| | $3 - 5 \times 1^2$ and $20 - 5 \times 2^2$<br>**or** $-2$ and $0$<br>**or** $b = 2$ **or** $2n$ | M1dep | oe subtraction of $5n^2$ from any two consecutive terms<br>eg $47 - 5 \times 3^2$ and $84 - 5 \times 4^2$<br>**or** 2 and 4<br>implied by $5n^2 + 2n$ … |
| | $5 \times 1^2 + 2 \times 1 + c = 3$<br>or $5 + 2 + c = 3$<br>or<br>($2n + c$ and) $2 \times 1 + c = -2$ | M1dep | oe substitution of $a = 5$ and $b = 2$<br>eg $5 \times 2^2 + 2 \times 2 + c = 20$<br>or<br>oe use of $2n + c$ and another term<br>eg ($2n + c$ and) $2 \times 2 + c = 0$ |
| | $5n^2 + 2n - 4$ | A1 | terms in any order<br>SC2 $a = 5$ and $c = -4$<br>SC1 $c = -4$ |
| | **Alternative method 2** $n$th term = $an^2 + bn + c$ | | |
| | (second differences =) 10<br>or $a = 5$ or $5n^2$ | M1 | second difference seen at least once and not contradicted by a different value unless recovered<br>may be seen by the sequence |
| | $3 \times 5 + b = 17$<br>or<br>$b = 2$ or $2n$ | M1dep | oe substitution of $a = 5$<br>eg $5 \times 5 + b = 27$<br>implied by $5n^2 + 2n$ … |
| | $5 \times 1^2 + 2 \times 1 + c = 3$<br>or $5 + 2 + c = 3$ | M1dep | oe substitution of $a = 5$ and $b = 2$<br>eg $5 \times 2^2 + 2 \times 2 + c = 20$ |
| | $5n^2 + 2n - 4$ | A1 | terms in any order<br>SC2 $a = 5$ and $c = -4$<br>SC1 $c = -4$ |

**Question 19 continues on the next page**

| | | | |
|---|---|---|---|
| **19 cont** | **Alternative method 3** $n$th term = $an^2 + bn + c$ | | |
| | Any 3 of<br>$a + b + c = 3$<br>$4a + 2b + c = 20$<br>$9a + 3b + c = 47$<br>$16a + 4b + c = 84$ | M1 | oe 3 equations |
| | $3a + b = 17$ and $5a + b = 27$<br>**or** $a = 5$ and $b = 2$ | M1dep | oe pair of equations in $a$ and $b$<br>eg $8a + 2b = 44$ and $15a + 3b = 81$<br>implied by $5n^2 + 2n$ … |
| | $5 \times 1^2 + 2 \times 1 + c = 3$<br>or $5 + 2 + c = 3$ | M1dep | oe substitution of $a = 5$ and $b = 2$<br>eg $5 \times 2^2 + 2 \times 2 + c = 20$ |
| | $5n^2 + 2n - 4$ | A1 | terms in any order<br>SC2 $a = 5$ and $c = -4$<br>SC1 $c = -4$ |
| | **Additional Guidance** | | |
| | Up to M3 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Second differences = 10 scores M1 even if used incorrectly eg $10n$ …. | | |
| | Condone $n = 5n^2 + 2n - 4$ or $5n^2 + 2n - 4 = 0$ | | M3A1 |
| | Condone working in a different variable eg $5x^2 + 2x - 4$ | | M3A1 |
| | The 3rd method mark cannot be implied<br>ie $c = -4$ is only awarded M3 if the previous two method marks are seen | | |
| | Alt 1 2nd M1 cannot be awarded for subtracting in the wrong order unless recovered | | |
| | SC2 or SC1 can be awarded from work seen in the working lines | | |
| | SC2 or SC1 can be implied by a quadratic answer<br>eg1 answer $5n^2 + 6n - 4$<br>eg2 answer $10n^2 + 3n - 4$ | | SC2<br>SC1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 20(a) | 65 | B1 | |
| | **Additional Guidance** | | |
| | 65 unambiguously linked to $x$ on diagram with answer line blank | | B1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 20(b) | It is greater than the answer to part (a) | B1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 20(c) | No and valid statement | B1 | eg no it is angle *ACD* that is 70° |
| | **Additional Guidance** | | |
| | Angles may be seen on the diagram | | |
| | No may be implied<br>eg1 angle *ADC* is not 70<br>eg2 angle *y* is 55 | | <br>B1<br>B1 |
| | Allow unambiguous indication of angles<br>eg *y* and *D* are both 55 so he is wrong | | <br>B1 |
| | No and angle *ADC* = 55° | | B1 |
| | *y* is not 70 so no | | B1 |
| | No, neither angle is correct | | B1 |
| | No, he thinks *AB* and *DC* are parallel | | B1 |
| | No, he's used alternate angles | | B1 |
| | It should say alternate angles (no implied) | | B1 |
| | He has made mistakes | | B0 |
| | He used the alternate segment theorem incorrectly | | B1 |
| | Ignore irrelevant working but do not ignore incorrect working<br>eg No it is angle *ACD* that is 70° and angle *y* is 65 | | <br>B0 |
| | Responses saying he is correct | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 21 | **Alternative method 1** | | |
| | 560 ÷ 500 or 1.12 | M1 | oe |
| | $\sqrt[3]{\text{their } 1.12}$ or [1.038, 1.0385]<br>or<br>[3.8, 3.85] | M1dep | may be implied<br>eg $\frac{r}{100}$ = [0.038, 0.0385] |
| | 3.9 | A1 | |
| | **Alternative method 2** | | |
| | Trial of the form $500 \times x^3$ with $1 < x \leqslant 1.1$<br>and<br>correct evaluation | M1 | allow correct evaluation truncated or rounded to nearest integer or better<br>allow working year by year<br>value of $x$ used must be seen |
| | Two trials of the form $500 \times x^3$ each with $1 < x \leqslant 1.1$<br>and<br>correct evaluations, one with answer $< 560$ and one with answer $> 560$ | M1dep | allow correct evaluations truncated or rounded to nearest integer or better<br>allow working year by year<br>values of $x$ used must be seen |
| | 3.9 | A1 | |

**Question 21 continues on the next page**

**21 cont**

**Additional Guidance**

Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts

| | |
|---|---|
| 1.01 | 515.1505 |
| 1.02 | 530.604 |
| 1.03 | 546.3635 |
| 1.038 | 559.193436 |

| | |
|---|---|
| 1.0385 | 560.0019083 |
| 1.039 | 560.8111595 |
| 1.04 | 562.432 |
| 1.05 | 578.8125 |
| 1.06 | 595.508 |
| 1.07 | 612.5215 |
| 1.08 | 629.856 |
| 1.09 | 647.5145 |
| 1.1 | 665.5 |

eg of accepted values

For 578.8125 allow 578, 579, 578.8, 578.81, 578.812, 578.813

Alt 2 example of working year by year

(allow intermediate values to be truncated or rounded to the nearest penny, also allow if given to the next penny)

$500 \times 1.035 = 517.5$

$517.5 \times 1.035 = 535.6125$ (allow 535.61 or 535.62)

$535.61 \times 1.035 = 554.35635$

Incorrect trials and evaluations can be ignored

3.9 from incorrect working

eg $560 - 500 = 60$ $\quad \sqrt[3]{60} = 3.9$ — M0M0A0

Wrong answer (eg 4) with no correct method seen — M0M0A0

Apply the scheme that favours the student

eg $500 \times 1.038^3$ scores M1M1 using Alt 1

$\frac{560-500}{500}$ with no further correct work — M0M0

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 22(a) | ($x_2$ =) 4.1(0…) | B1 | |
| | ($x_3$ =) [4.176, 4.178] or 4.18 | B1ft | ft their 4.1(0…) rounded to at least 2 dp<br>SC1 $x_2$ = [4.176, 4.178] or 4.18 |
| | **Additional Guidance** | | |
| | Allow second B1 for $x_3$ = 4.2 with acceptable answer seen in working | | |
| | $x_2$ = 7.8<br>$x_3$ = 6.59 | | B0<br>B1ft |
| | SC1 is for using $x_0$ = 4 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 22(b) | 4.25 < value ⩽ 4.39 | B1 | ignore any iteration number |
| | **Additional Guidance** | | |
| | Ignore other values if B1 response seen | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 23 | $\frac{3}{8}$ (×) $\frac{2}{7}$ or $\frac{6}{56}$ or $\frac{3}{28}$ | M1 | oe fraction, decimal or percentage<br>allow $\frac{2}{7}$ to be [0.285, 0.286]<br>or [28.5, 28.6]%<br>allow $\frac{6}{56}$ to be [0.107, 0.107143]<br>or [10.7, 10.7143]%<br>may be seen on a tree diagram<br>allow 6 out of 56 |
| | $\frac{1}{7}$ (×) $\frac{1}{4}$ (× 2)<br>or $\frac{1}{28}$ (× 2) or $\frac{2}{28}$ or $\frac{1}{14}$ | M1 | oe fraction, decimal or percentage<br>allow $\frac{1}{7}$ to be [0.142, 0.143]<br>or [14.2, 14.3]%<br>allow $\frac{1}{28}$ to be [0.035, 0.036]<br>or [3.5, 3.6]%<br>allow $\frac{2}{28}$ to be [0.071, 0.07143]<br>or [7.1, 7.143]%<br>may be seen on a tree diagram<br>allow 1 out of 28 or 2 out of 28 |
| | $\frac{6}{56}$ and $\frac{2}{28}$ | A1 | oe fractions, decimals or percentages<br>allow 6 out of 56 and 2 out of 28 |
| | Probabilities in comparable form<br>and<br>Option 1 | A1ft | ft their $\frac{6}{56}$ and their $\frac{2}{28}$ with M2A0<br>correct comparisons include<br>$\frac{3}{28}$ and $\frac{2}{28}$ $\frac{6}{56}$ and $\frac{4}{56}$<br>0.107 and 0.071 10.7% and 7.1%<br>6 out of 56 and 4 out of 56 |

**Question 23 continues on the next page**

| | | |
|---|---|---|
| **23 cont** | **Additional Guidance** | |
| | Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | |
| | 3 ways to win in Option 1 and 2 ways to win in Option 2 so Option 1 | M0M0A0A0 |
| | $\frac{3}{8} \times \frac{2}{7} = \frac{6}{56}$ $\quad$ $\frac{1}{7} \times \frac{1}{4} = \frac{1}{28}$ | M1M1 |
| | $\frac{6}{56}$ and $\frac{2}{56}$ and Option 1 | A0A1ft |
| | Assuming replacement can score a maximum of M0M1A0A0 | |
| | Choosing Option 1 cannot be implied by inequalities | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 24 | 64.5 or 65.5<br>or<br>25 or 35 | M1 | allow $65.4\dot{9}$ or $34.\dot{9}$<br>implied by 4160.25 or 4290.25<br>or 8320.5 or 8580.5<br>or 625 or 1225 |
| | $2 \times$ their $65.5^2 -$ their $25^2$<br>or $2 \times 4290.25 - 625$<br>or $8580.5 - 625$ | M1 | their 65.5 must be (65, 66]<br>their 25 must be [20, 30) |
| | 65.5 and 25 and 7955.5 | A1 | |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts | | |
| | If multiple attempts are seen and one is fully correct, the correct one must be unambiguously selected (eg ticked or circled) to award A1 if the answer line is blank | | |
| | Note that M0M1A0 is possible<br>eg $2 \times 66^2 - 21^2$ | | M0M1A0 |
| | Condone eg 65.50 for 65.5 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 25 | $\frac{(x-5)(x+2)}{(x-2)(x+2)}$ and $\frac{(x+5)(x-2)}{(x+2)(x-2)}$ | M1 | $(x-2)(x+2)$ or $x^2-2x+2x-4$ must be seen (expansion may be seen in a grid)<br>brackets in any order<br>if the brackets are not shown for the numerators, expansions must be correct<br>may be seen as a single fraction |
| | $x^2-5x+2x-10$ or $x^2-3x-10$<br>or<br>$x^2+5x-2x-10$ or $x^2+3x-10$ | M1 | correct expansion of $(x-5)(x+2)$<br>or $(x+5)(x-2)$<br>ignore denominators<br>may be seen in a grid<br>implied by $2x^2-20$ if no errors seen in expansions |
| | M2 seen with no errors<br>and $\frac{2x^2-20}{x^2-4}$ | A1 | allow M2 seen with no errors<br>and $a=2$ $b=20$ |

**Additional Guidance**

| | |
|---|---|
| Missing brackets must be recovered but condone missing closing bracket at the end of a numerator or denominator<br>eg $\frac{(x-5)(x+2)}{(x-2)(x+2)} + \frac{(x+5)(x-2)}{(x+2)(x-2}$ | 1st M1 |
| 2nd M1 is awarded for four correct terms even if subsequently simplified incorrectly | |
| For terms seen in a grid, signs must be correct (allow eg $2x$ for $+2x$) | |
| For 1st M1 allow multiplication signs | |
| After M2A1 ignore incorrect values stated eg $a=2$ $b=-20$ | |
| $\frac{2x^2-20}{x^2-4}$ may come from wrong working or incomplete working<br>eg $\frac{(x-5)(x+2)}{(x-2)(x+2)} + \frac{(x+5)(x-2)}{(x+2)(x-2)}$<br>$\frac{x^2-10+x^2-10}{x^2-4} = \frac{2x^2-20}{x^2-4}$ | M1<br>M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 26(a) | (0, 2) | B1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 26(b) | $y = -x^2$ | B1 | oe equation eg $x^2 = -y$ |
| | **Additional Guidance** | | |
| | $y = -1x^2 + 0$ | B1 | |
| | $y = -(x^2)$ | B1 | |
| | $-x^2$ | B0 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 26(c) | Translation | B1 | allow eg translate(d) |
| | $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ | B1 | |
| | **Additional Guidance** | | |
| | Do not accept a vector given as coordinates or with missing brackets or with 'fraction line' | | |
| | Translation from (0, 0) | | B1B0 |
| | Translation horizontally by 3 | | B1B0 |
| | Translate 3 to the left and 3 down | | B1B0 |
| | Reflect by $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ | | B0B1 |
| | Giving a combined transformation is B0B0<br>Rotate by $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ and reflect in the $x$-axis | | B0B0 |
| | Ignore references to movement if vector is correct<br>eg Move to the right by $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ | | B0B1 |