# GCSE
# MATHEMATICS
# 8300/2H

Higher Tier Paper 2 Calculator

**Mark scheme**

June 2021

Version: 1.0 Final

2 1 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 $a \leq$ 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.

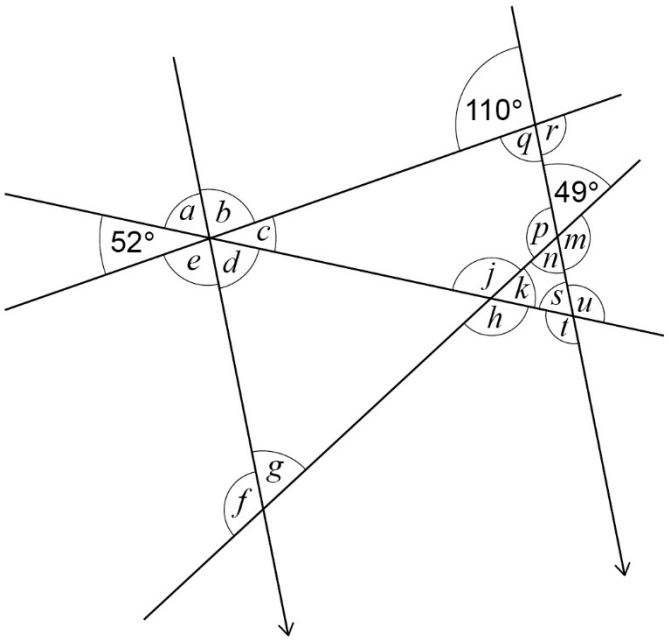
| Q | Answer | Mark | Comments |
|---|---|---|---|
| **1** | $x - 5$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **2** | 1 : 2 | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **3** | $\frac{16}{81}$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **4** | SSS | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **5** | $10x + 3x$ or $13x$<br>or<br>$-3x - 10x$ or $-13x$ | M1 | may be implied<br>eg 62.4 ÷ 13 or $-62.4 \div -13$ |
| | 4.8 or $4\frac{4}{5}$ or $\frac{24}{5}$ | A1 | oe eg $\frac{624}{130}$ |
| | **Additional Guidance** | | |
| | $\frac{-24}{-5}$ | | M1A0 |
| | Correct answer embedded eg 10 × 4.8 = 62.4 – 3 × 4.8 | | M1A0 |
| | Ignore conversion attempt after correct answer seen | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6 | Using these letters for the unknown angles<br><br> | | |
| | 73 | B3 | B2 $180 - 110 + 52 - 49$ oe calculation<br>or<br>$h = 107$ or $j = 107$ or $k = 73$<br>or<br>$g = 49$ and $d = 58$<br>or<br>$g = 49$ and $e = 70$<br>or<br>$f = 131$ and $d = 58$<br>B1 any angle correct (others may be incorrect) |
| | **Additional Guidance** | | |
| | Angles will usually be seen on the diagram | | |
| | Angles must be unambiguously linked to the correct position<br>eg 131 seen in working but not on the diagram or in wrong position | | B0 |
| | $a = 58$ $b = 70$ $c = 52$ $d = 58$ $e = 70$<br>$f = 131$ $g = 49$ $h = 107$ $j = 107$ $k = 73$<br>$m = 131$ $n = 49$ $p = 131$ $q = 70$ $r = 110$<br>$s = 58$ $t = 122$ $u = 122$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7 | **Alternative method 1** | | |
| | $102 \times 68.5$ or 6987<br>or<br>$85 \times 72.4$ or 6154<br>or<br>13 141 | M1 | values may be seen by the table |
| | $\frac{102 \times 68.5 + 85 \times 72.4}{102 + 85}$<br>or $\frac{13\,141}{187}$<br>or 70.2(7…) or 70.3 | M1dep | oe |
| | 70.2(7…) and Yes<br>or<br>70.3 and Yes | A1 | |
| | **Alternative method 2** | | |
| | $102 \times 68.5$ or 6987<br>or<br>$85 \times 72.4$ or 6154<br>or<br>13 141 | M1 | values may be seen by the table |
| | $(102 + 85) \times 70$<br>or $187 \times 70$<br>or 13 090 | M1 | oe |
| | 13 141 and 13 090 and Yes | A1 | |
| | **Additional Guidance** | | |
| | Yes may be implied eg $70.27 > 70$ | | M1M1A1 |
| | M1 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8 | Enlargement | B1 | |
| | $\frac{1}{4}$ | B1 | scale factor<br>oe eg 0.25 |
| | (3, 9) or *A* | B1 | centre<br>do not allow $\begin{pmatrix}3\\9\end{pmatrix}$ |
| | **Additional Guidance** | | |
| | Do not accept reduction or unenlargement or negative | | 1st B0 |
| | Do not accept ÷ 4 | | 2nd B0 |
| | A combination of transformations cannot score the first B1<br>eg1 Enlarge sf $\frac{1}{4}$ Translate $\begin{pmatrix}0\\6\end{pmatrix}$<br>eg2 Enlarge sf $\frac{1}{4}$ 1.5 right up 6 (3, 9) | | <br>B0B1B0<br>B0B1B1 |
| | Do not allow $\begin{pmatrix}3\\9\end{pmatrix}$ for (3, 9) but do not regard as implying a combination of transformations<br>eg Enlargement sf 0.25 $\begin{pmatrix}3\\9\end{pmatrix}$ | | <br>B1B1B0 |
| | Enlargement, sf 4 about (3, 9) | | B1B0B1 |
| | Enlarge(d) 0.25 *A* | | B1B1B1 |
| | Condone *ABC* is an enlargement of *ADE* | | 1st B1 |
| | Condone enlargement with other words unless referring to another transformation<br>eg1 Enlargement making shapes bigger<br>eg2 Enlarged then moved using a vector<br>eg3 Enlarged which means *B* moves to *D* and *C* moves to *E* | | <br>1st B1<br>1st B0<br>1st B1 |
| | If more than one point is listed it must be clear which point is their centre<br>eg (1, 1) (5, 1) (3, 9) (2, 7) | | <br>3rd B0 |
| | Reflected in the point (3, 9) | | B0B0B1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9 | **Alternative method 1** Working out time to fill the ball | | |
| | $4 \div 3 \times 15^3 \times \pi$ or $[4488, 4500]\pi$ or [14 092, 14 139] | M1 | oe<br>allow 1.33 or better |
| | their [14 092, 14 139] – 5000<br>or [9092, 9139]<br>or<br>their [14 092, 14 139] ÷ 160<br>or [88, 88.37] | M1dep | oe |
| | (their [14 092, 14 139] – 5000) ÷ 160<br>or [56, 57.12] | M1dep | oe eg their [9092, 9139] ÷ 160<br>or<br>their [88, 88.37] – 5000 ÷ 160 |
| | [56, 57.12] and Yes | A1 | |
| | **Alternative method 2** Comparing volume needed with volume that could be filled | | |
| | $4 \div 3 \times 15^3 \times \pi$ or $[4488, 4500]\pi$ or [14 092, 14 139] | M1 | oe<br>allow 1.33 or better |
| | their [14 092, 14 139] – 5000<br>or [9092, 9139] | M1dep | |
| | [58, 60] × 160 or [9280, 9600] | M1 | oe |
| | [9092, 9139] and [9280, 9600] and Yes | A1 | |

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

| | | | |
|---|---|---|---|
| **9 cont** | **Alternative method 3** Volume of ball compared with volume that could be filled + 5000 | | |
| | $4 \div 3 \times 15^3 \times \pi$ or [4488, 4500]$\pi$ or [14 092, 14 139] | M1 | oe<br>allow 1.33 or better |
| | [58, 60] × 160 or [9280, 9600] | M1 | oe |
| | their [9280, 9600] + 5000<br>or [14 280, 14 600] | M1dep | dep on 2nd M1 |
| | [14 092, 14 139]<br>and [14 280, 14 600] and Yes | A1 | |
| | **Additional Guidance** | | |
| | Accept $\frac{4}{3}\pi 15^3$ without multiplication signs | | |
| | Condone use of 1.3 for up to M3 if 1.3 shown | | |
| | Up to M3 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Using an incorrect power eg $15^2$, $15\pi^3$, $(15\pi)^3$ or omitting $\pi$ unless recovered | | 1st M0 |
| | NB 56.(59…) or 56.6 or 57 coming from 5000 ÷ 88.35… | | M1M1M0 |
| | Yes can be implied eg Alt 1 $57 < 60$ | | M3A1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 10 | Sometimes true<br>Always true<br>Always true<br>Never true | B4 | B1 for each |
| | **Additional Guidance** | | |
| | Allow any unambiguous indication<br>eg all 4 correct boxes contain a cross with all other boxes blank | | B4 |
| | A row with one tick and some crosses – mark the tick | | |
| | A row with more than one tick is B0 for that row | | |
| | Mark the boxes not the working lines | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 11(a) | Any one of<br>0.24 or 0.19 or 0.22<br>in the correct cell | M1 | oe fraction, decimal or percentage<br>eg $\frac{36}{150}$ or $\frac{38}{200}$ or $\frac{55}{250}$<br>implied by any correct point for these three values |
| | At least two of their relative frequencies plotted accurately | M1dep | $\pm \frac{1}{2}$ square |
| | (150, 0.24), (200, 0.19)<br>and (250, 0.22) plotted<br>and graph completed with straight lines | A1 | $\pm \frac{1}{2}$ square<br>allow dotted or solid lines |
| | **Additional Guidance** | | |
| | Mark intention for straightness of lines | | |
| | Ignore any continuation of line after the last point or any other lines drawn on the graph, for example a line of best fit | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 11(b) | 0.22 | B1ft | oe fraction, decimal or percentage<br>eg $\frac{55}{250}$<br>ft their relative frequency for 250 trains ($> 0$ and $< 1$) given in table or plotted on graph |
| | **Additional Guidance** | | |
| | The mark may be awarded for a correct restart or a follow through from their table or a follow through from their graph | | |
| | Ignore attempts to convert a correct relative frequency once seen in (b) | | |
| | NB $\frac{166}{750} = 0.2213\ldots$ is incorrect (unless it is given as their relative frequency for 250 trains) | | B0ft |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 12 | **Alternative method 1** Shows algebraically that the angles are equal | | |
| | $4x + 40$ | M1 | may be embedded or on the diagram |
| | $x + 2(2x + 20)$ or $x + 4x + 40$ | M1 | |
| | $x + 4x + 40 = 5x + 40$<br>and Yes | A1 | |
| | **Alternative method 2** Derives and solves an equation for angles at a point and substitutes into $5x + 40$ or $x + 2(2x + 20)$ | | |
| | $4x + 40$ | M1 | may be embedded or on the diagram or implied<br>eg implied by $10x + 80 = 360$ |
| | $x + 2(2x + 20) + 5x + 40 = 360$<br>or<br>$x + 4x + 40 + 5x + 40 = 360$<br>or $(x =) 28$ | M1 | oe equation eg $10x + 80 = 360$<br>$(x =)$ 28 may be on the diagram |
| | $140 + 40 = 180$ and Yes<br>or<br>$28 + 152 = 180$ and Yes | A1 | oe<br>must obtain $(x =)$ 28 from one expression and substitute $(x =)$ 28 into a different expression |
| | **Alternative method 3** Assumes line is a diameter. Derives and solves an equation for angles on a line using $5x + 40$ and substitutes into $x + 2(2x + 20)$ or $x + 2(2x + 20) + 5x + 40$ | | |
| | $5x + 40 = 180$ | M1 | |
| | $(x =) (180 - 40) \div 5$<br>or $(x =) 28$ | M1dep | oe<br>$(x =)$ 28 may be on the diagram |
| | $28 + 152 = 180$ and Yes<br>or<br>$28 + 152 + 140 + 40 = 360$ and Yes | A1 | oe<br>must obtain $(x =)$ 28 from one expression and substitute $(x =)$ 28 into a different expression |

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

| | | | |
|---|---|---|---|
| **12 cont** | **Alternative method 4** Assumes line is a diameter. Derives and solves an equation for angles on a line using $x + 2(2x + 20)$ and substitutes into $5x + 40$ or $x + 2(2x + 20) + 5x + 40$ | | |
| | $x + 2(2x + 20) = 180$<br>or<br>$x + 4x + 40 = 180$ | M1 | |
| | $(x =)\ (180 - 40) \div 5$<br>or $(x =)\ 28$ | M1dep | oe<br>$(x =)\ 28$ may be on the diagram |
| | $140 + 40 = 180$ and Yes<br>or<br>$28 + 152 + 140 + 40 = 360$ and Yes | A1 | oe<br>must obtain $(x =)\ 28$ from one expression and substitute $(x =)\ 28$ into a different expression |
| | **Alternative method 5** Assumes line is a diameter. Derives and solves two equations for angles on a line/angles at a point | | |
| | $5x + 40 = 180$<br>or<br>$x + 2(2x + 20) = 180$<br>or<br>$x + 4x + 40 = 180$<br>or<br>$x + 2(2x + 20) + 5x + 40 = 360$<br>or<br>$x + 4x + 40 + 5x + 40 = 360$ | M1 | |
| | $(x =)\ (180 - 40) \div 5$<br>or $(x =)\ 28$ | M1dep | oe<br>$(x =)\ 28$ may be on the diagram |
| | Obtains $(x =)\ 28$ from two equations for angles on a line/ angles at a point and Yes | A1 | |

**Additional Guidance is on the next page**

| | Additional Guidance | |
|---|---|---|
| **12 cont** | Choose the scheme that favours the student | |
| | Up to M2 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts | |
| | Correct response with other incorrect work | M1M1A0 |
| | Alt 1 $2(2x + 20) = 4x + 20$ followed by $x + 4x + 20$<br>Alt 1 $x + 4x + 20$ with $2(2x + 20) = 4x + 20$ not seen<br>Apply marks in a similar way in alts 2, 4 and 5 | M0M1<br>M0M0 |
| | $(x =)$ 28 | M1M1 |
| | Allow $(x =)$ 28 to be embedded | M1M1 |
| | No method marks scored with a value of $x$ ($\neq$ 28) substituted into $5x + 40$ and $x + 2(2x + 20)$ giving the same value | M0M0A0 |
| | Yes can be implied eg Alt 1 $x + 4x + 40 = 5x + 40$ and It is a diameter | M1M1A1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 13 | **Alternative method 1** | | |
| | $6 \times 3 + c = 19$ | M1 | oe eg $18 + c = 19$ |
| | $(c =)\ 19 - 6 \times 3$<br>or<br>$(c =)\ 1$ | M1dep | oe<br>implied by (0, 1) |
| | $y = 6x + 1$ | A1 | SC1 $y = 6x + c \quad c \neq 1$ |
| | **Alternative method 2** | | |
| | $y - 19 = 6(x - 3)$ | M1 | oe |
| | $y - 19 = 6x - 18$ | M1dep | oe correct equation with brackets expanded |
| | $y = 6x + 1$ | A1 | SC1 $y = 6x + c \quad c \neq 1$ |
| | **Additional Guidance** | | |
| | Allow $y = 6 \times x + 1$ | | |
| | $6x + 1$ on answer line, $y = 6x + 1$ seen in working | | M1M1A1 |
| | $6x + 1$ on answer line, $y = 6x + 1$ not seen in working | | M1M1A0 |
| | $m = 6$, $c = 1$ on answer line, $y = 6x + 1$ seen in working | | M1M1A1 |
| | $m = 6$, $c = 1$ | | M1M1A0 |
| | $y = mx + 1$ | | M1M1A0 |
| | Allow embedded value for $c$ eg $19 = 6 \times 3 + 1$ | | M1M1A0 |
| | $y = 6x + c$ | | SC1 |
| | $y = 6x$ | | SC1 |
| | $6x + c$ on answer line with $c \neq 1$, $y = 6x + c$ seen in working | | SC1 |
| | $6x + c$ on answer line with $c \neq 1$, $y = 6x + c$ not seen in working | | M0M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14(a) | $4200 \times 1.12^{20}$ | M1 | oe<br>allow $4200 \times [9.64, 9.65]$ |
| | 40 514(…) or 40 515<br>or 40 500 or 40 510<br>or 40 489 or 40 509 or 40 548 | A1 | |
| | **Additional Guidance** | | |
| | Year on year calculations<br>Consistently rounding down to nearest integer leads to 40 489<br>Consistently rounding to nearest integer leads to 40 509<br>Consistently rounding up to nearest integer leads to 40 548 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14(b) | $4200 \times 1.13^{19} \times 0.92$<br>or [39 402, 39 403]<br>or 39 400 or 39 372 or 39 407<br>or 39 435 | M1 | oe<br>allow $4200 \times [10.19, 10.2] \times 0.92$ |
| | No and [39 402, 39 403]<br>or No and 39 400<br>or No and 39 372<br>or No and 39 407<br>or No and 39 435 | A1 | |
| | **Additional Guidance** | | |
| | Year on year calculations<br>Consistently rounding down to nearest integer leads to 39 372<br>Consistently rounding to nearest integer leads to 39 407<br>Consistently rounding up to nearest integer leads to 39 435 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14(c) | 0.4 × 700 or 280<br>or<br>(1 – 0.4) × 900 or 0.6 × 900<br>or 540<br>or<br>30 × 0.4 or 12<br>or<br>30 × (1 – 0.4) or 30 × 0.6 or 18 | M1 | oe<br>implied by 820 |
| | 30 × 0.4 × 700 or 8400<br>or<br>30 × (1 – 0.4) × 900 or 16 200 | M1dep | oe<br>implied by 820 × 30 |
| | 24 600 | A1 | |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts | | |

| Q | Answer | Mark | Comments | |
|---|---|---|---|---|
| 15(a) | **Alternative method 1** | | | |
| | $L = kD^2$ | M1 | oe equation | |
| | $85 = 10^2k$ or $85 = 100k$<br>or $(k =)$ 0.85 | M1dep | oe<br>implies M2 | |
| | $L = 0.85D^2$ | A1 | oe equation | |
| | **Alternative method 2** | | | |
| | $cL = D^2$ | M1 | oe equation | |
| | $85c = 10^2$ or $85c = 100$<br>or $(c =) \frac{100}{85}$ | M1dep | oe<br>allow $(c =)$ [1.176, 1.18]<br>implies M2 | |
| | $\frac{100}{85}L = D^2$ | A1 | oe equation<br>allow [1.176, 1.18]$L = D^2$ | |
| | **Additional Guidance** | | | |
| | Condone use of α for up to M1M1A0<br>eg Alt 1<br>$L$ α $kD^2$<br>85 α $100k$<br>$L$ α $0.85D^2$ | | | M1<br>M1<br>A0 |
| | $L = 0.85D^2$ oe | | | M1M1A1 |
| | $L$ α $D^2$ is M0 with no further correct working | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 15(b) | **Alternative method 1** If using alt 1 in (a) | | |
| | their $k \times 5^2$ | M1 | oe<br>their $k$ from (a) |
| | 21.25 | A1ft | oe<br>correct or ft their $k \times 5^2$ |
| | **Alternative method 2** If using alt 2 in (a) | | |
| | $5^2 \div$ their $c$ | M1 | oe<br>their $c$ from (a) |
| | 21.25 | A1ft | oe<br>correct or ft $5^2 \div$ their $c$<br>do not follow through an approximated value for $\frac{100}{85}$ |
| | **Additional Guidance** | | |
| | $L$ α 21.25 on answer line | | M1A0 |
| | Alt 2 (a) $1.18L = D^2$ (scores 3 marks in (a))<br>(b) $25 \div 1.18 = 21.19$ | | M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16(a) | $\sqrt{3}\,x$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16(b) | $x$ might be a whole number | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 17(a) | **Alternative method 1** | | |
| | $\frac{2}{11} \times \frac{5}{9}$ or $\frac{10}{99}$<br>or<br>$\frac{9}{11} \times \frac{4}{9}$ or $\frac{36}{99}$ | M1 | oe fractions, decimals or percentages |
| | $\frac{2}{11} \times \frac{5}{9} + \frac{9}{11} \times \frac{4}{9}$<br>or $\frac{10}{99} + \frac{36}{99}$ | M1dep | oe fractions, decimals or percentages |
| | $\frac{46}{99}$ | A1 | oe fraction, decimal or percentage<br>allow 0.465 or better<br>allow 46.5% or better<br>SC2 $\frac{54}{99}$ oe |

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

| | | | |
|---|---|---|---|
| **17(a) cont** | **Alternative method 2** | | |
| | $\frac{2}{11} \times \frac{4}{9}$ or $\frac{8}{99}$<br>or<br>$\frac{9}{11} \times \frac{5}{9}$ or $\frac{45}{99}$ | M1 | oe fractions, decimals or percentages |
| | $1 - \frac{2}{11} \times \frac{4}{9} - \frac{9}{11} \times \frac{5}{9}$<br>or $1 - \frac{8}{99} - \frac{45}{99}$<br>or $1 - \frac{53}{99}$ | M1dep | oe fractions, decimals or percentages |
| | $\frac{46}{99}$ | A1 | oe fraction, decimal or percentage<br>allow 0.465 or better<br>allow 46.5% or better<br>SC2 $\frac{54}{99}$ oe |
| | **Additional Guidance** | | |
| | For M marks, accept values given as recurring decimals or correctly rounded to 2 dp or better<br>eg Alt 1 $0.18 \times 0.56 + 0.818 \times 0.44$ | | M1M1 |
| | M1 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Ignore conversion attempt if correct answer seen | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 17(b) | $\frac{9}{11} \times \frac{8}{10}$ | M1 | oe fractions, decimals or percentages |
| | $\frac{72}{110}$ or $\frac{36}{55}$ | A1 | oe fraction, decimal or percentage<br>allow [0.65, 0.655]<br>allow [65%, 65.5%] |
| | **Additional Guidance** | | |
| | For M1, accept $\frac{9}{11}$ given as a recurring decimal or correctly rounded to 2 dp or better<br>eg 0.82 × 0.8 | | M1 |
| | Ignore conversion attempt after correct answer seen | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 18 | $x = 5$ and $y = 4$ drawn as solid lines<br>and<br>$x + y = 6$ drawn as dashed line<br>and<br>correct region identified | B3 | B2 $x = 5$ and $y = 4$ drawn as solid lines<br>and<br>$x + y = 6$ drawn as dashed line<br>and<br>correct region not identified<br>or<br>$x = 5$ and $y = 4$ and $x + y = 6$ drawn as solid or dashed lines<br>and<br>correct region identified<br>B1 $x = 5$ and $y = 4$ drawn as solid or dashed lines<br>or<br>$x + y = 6$ drawn as solid or dashed line |
| | **Additional Guidance** | | |
| | Allow any unambiguous identification of the correct region<br>eg Labelled R or shaded in or shaded out | | |
| | Mark intention for straight lines | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **19(a)** | 6 seconds | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **19(b)** | Correct tangent drawn at 6 seconds | B1 | |
| | Correct gradient for their tangent | B1ft | ft their tangent, which must be an increasing straight line |
| | m/s | B1 | oe eg metres per second or mps |
| | **Additional Guidance** | | |
| | If no tangent is drawn the maximum mark possible is B0B0B1 | | |
| | Allow the units to be given in working lines if no units on the answer line | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **20** | 50 cm | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 21 | $9x^2 + 3x + 3x + 1$<br>or<br>$9x^2 + 6x + 1$<br>or<br>$-(8x^2 - 6x)$ or $-8x^2 + 6x$ | M1 | |
| | $35 + 9x^2 + 3x + 3x + 1 - 8x^2 + 6x$<br>or<br>$35 + 9x^2 + 6x + 1 - 8x^2 + 6x$ | M1dep | |
| | $x^2 + 12x + 36$ | A1 | |
| | $(x + 6)^2$ | A1 | allow $(x + 6)(x + 6)$ |
| | **Additional Guidance** | | |
| | Condone inclusion of $= 0$ in all working | | |
| | Ignore any solution attempt for $(x + 6)^2 = 0$ | | |
| | Ignore substitution of values | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 22 | **Alternative method 1** | | |
| | All three of<br>1, 8 and 1, 2, 4, 8 and 1, 3, 5, 7, 9<br>or<br>all three of 2, 4 and 5 | B2 | B1 any two correct<br><br><br>do not allow 2, 4 or 5 from an incorrect list of numbers |
| | their 2 × their 4 × their 5<br>or 40 | M1 | working out the number of possible codes<br>ft their non-zero number of options for each digit<br>implied by $\frac{1}{\text{their 2}} \times \frac{1}{\text{their 4}} \times \frac{1}{\text{their 5}}$ |
| | $\frac{1}{40}$ | A1ft | oe fraction, decimal or percentage<br>ft their non-zero number of options for each digit |
| | **Alternative method 2** | | |
| | All three of<br>$\frac{1}{2}$ and $\frac{1}{4}$ and $\frac{1}{5}$ | B2 | B1 any two correct<br>oe fractions, decimals or percentages<br>do not allow $\frac{1}{2}$, $\frac{1}{4}$ or $\frac{1}{5}$ from an incorrect list of numbers |
| | their $\frac{1}{2}$ × their $\frac{1}{4}$ × their $\frac{1}{5}$ | M1 | oe fractions, decimals or percentages<br>allow their $\frac{1}{2}$ to be 1<br>their $\frac{1}{4}$ must be $< 1$<br>their $\frac{1}{5}$ must be $< 1$ |
| | $\frac{1}{40}$ | A1ft | oe fraction, decimal or percentage<br>ft their probabilities |

**Additional Guidance is on the next page**

| | | |
|---|---|---|
| **22 cont** | **Additional Guidance** | |
| | If 0 is taken to be a cube number, $\frac{1}{3} \times \frac{1}{4} \times \frac{1}{5} = \frac{1}{60}$ | B1M1A1ft |
| | If they only have one cube number, $1 \times \frac{1}{4} \times \frac{1}{5} = \frac{1}{20}$ | B1M1A1ft |
| | 8, 9 and 1, 2, 4, 8 and 1, 3, 5, 7, 9<br>$\frac{1}{2} \times \frac{1}{4} \times \frac{1}{5} = \frac{1}{40}$ | B1<br>M1A1ft |
| | Ignore conversion attempt after correct answer seen | |
| | Allow $1^3$, $2^3$ for 1, 8 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **23** | 105 | B1 | may be seen on the diagram |
| | $12^2 + 28^2 - 2 \times 12 \times 28 \times \cos$ their 105<br>or<br>[1101, 1102] | M1 | oe eg $144 + 784 - 672 \cos$ their 105<br>or $928 - 672 \cos$ their 105<br>their 105 cannot be 0 or 90<br>their 105 must be $< 180$ |
| | $\sqrt{\text{their } [1101, 1102]}$ | M1dep | |
| | [33.19, 33.2] or 33 | A1ft | ft B0M2 |
| | **Additional Guidance** | | |
| | Follow through answers must be rounded to 2 sf or better | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 24 | $\frac{731}{x} + \frac{287}{x-24} = 2$ | M1 | oe equation |
| | $731(x-24) + 287x$<br>or<br>$731x - 17\,544 + 287x$ | M1dep | oe<br>allow with denominator $x(x-24)$ oe |
| | $2x^2 - 1066x + 17\,544\ (= 0)$<br>or<br>$x^2 - 533x + 8772\ (= 0)$ | A1 | oe eg $x^2 - 533x = -8772$ |
| | $\frac{-(-1066) \pm \sqrt{(-1066)^2 - 4 \times 2 \times 17\,544}}{2 \times 2}$<br>or $\frac{1066 \pm \sqrt{1\,136\,356 - 140\,352}}{2 \times 2}$<br>or $\frac{1066 \pm \sqrt{996\,004}}{2 \times 2}$<br>or $\frac{1066 \pm 998}{2 \times 2}$<br>or $(2x-34)(x-516)$<br>or<br>17 and 516 | M1 | ft their 3-term quadratic<br>oe eg<br>$\frac{-(-533) \pm \sqrt{(-533)^2 - 4 \times 1 \times 8772}}{2 \times 1}$<br>or $\frac{533 \pm \sqrt{284\,089 - 35\,088}}{2 \times 1}$<br>or $\frac{533 \pm \sqrt{249\,001}}{2 \times 1}$<br>or $\frac{533 \pm 499}{2}$<br>or $(x-17)(x-516)$ |
| | 516 | A1 | must discard 17 |
| | **Additional Guidance** | | |
| | First M1 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts | | |
| | 3rd M1 Allow ft of their 3-term quadratic even if discriminant is $\leqslant 0$ | | |
| | In quadratic formula, allow eg $1066^2$ for $(-1066)^2$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 25 | $(x+7)^2$ … | M1 | |
| | $(x+7)^2-7^2+52$<br>or<br>$(x+7)^2-49+52$<br>or<br>$(x+7)^2+3$ | M1dep | |
| | M2 seen<br>and<br>$(-7, 3)$ | A1 | |
| | **Additional Guidance** | | |
| | Answer from other methods or with no method seen | | M0M0A0 |
| | Allow $(x+7)(x+7)$ for $(x+7)^2$ throughout | | |
| | Condone inclusion of $=0$ in all working | | |
| | Ignore any solution attempt for $(x+7)^2+3=0$ | | |