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# GCSE MATHEMATICS 8300/1H

Higher Tier Paper 1 Non-Calculator

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Mark scheme

November 2023

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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.

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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.

|                        |                                                                                                                                        |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>M</b>               | Method marks are awarded for a correct method which could lead to a correct answer.                                                    |
| <b>A</b>               | 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>B</b>               | Marks awarded independent of method.                                                                                                   |
| <b>ft</b>              | Follow through marks. Marks awarded for correct working following a mistake in an earlier step.                                        |
| <b>SC</b>              | Special case. Marks awarded for a common misinterpretation which has some mathematical worth.                                          |
| <b>M dep</b>           | A method mark dependent on a previous method mark being awarded.                                                                       |
| <b>B dep</b>           | A mark that can only be awarded if a previous independent mark has been awarded.                                                       |
| <b>oe</b>              | Or equivalent. Accept answers that are equivalent.<br>eg accept 0.5 as well as $\frac{1}{2}$                                           |
| <b>[a, b]</b>          | Accept values between a and b inclusive.                                                                                               |
| <b>[a, b)</b>          | Accept values $a \leq \text{value} < b$                                                                                                |
| <b>3.14 ...</b>        | Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416                                                                                 |
| <b>Use of brackets</b> | 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 | 100    | B1   |          |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| 2 | 60     | B1   |          |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| 3 | 1, -2  | B1   |          |

| Q | Answer             | Mark | Comments |
|---|--------------------|------|----------|
| 4 | $a + 3$ or $3 + a$ | B1   |          |

| Q | Answer                                                                                                                         | Mark  | Comment                                                                                                                                 |
|---|--------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 5 | $(8^2 \times 8 =) 8^3$ or $(8^9 \div 8^5 =) 8^4$<br>or<br>512 or 4096<br>or<br>$8^2 \times 8 \div 8^9 \times 8^5$              | M1    |                                                                                                                                         |
|   | $(8^3$ or $512) \div (8^4$ or $4096)$<br>or<br>$8^{(2+1-9+5)}$<br>or<br>$8^8 \times 8^{-9}$<br>or<br>$8^{-1}$ or $\frac{1}{8}$ | M1dep | oe in the form $8^n \div 8^{(n+1)}$<br><br>oe where index sums to $-1$<br><br>oe in the form $8^n \times 8^{(-n-1)}$<br><br>oe fraction |
|   | (0).125                                                                                                                        | A1    |                                                                                                                                         |
|   | <b>Additional Guidance</b>                                                                                                     |       |                                                                                                                                         |
|   | (0).125 and either $8^{-1}$ or $\frac{1}{8}$ on the answer line                                                                |       | M1M1A1                                                                                                                                  |
|   | (0).125 in working and $8^{-1}$ on the answer line                                                                             |       | M1M1A0                                                                                                                                  |
|   | If a student attempts numerical and index working award the higher mark                                                        |       |                                                                                                                                         |

| Q  | Answer                                                                                        | Mark | Comment                                                                                                                                                                                              |
|----|-----------------------------------------------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6a | Valid description                                                                             | B1   | eg<br>as downloads increase, so do CD sales<br>downloads are about $\left[1\frac{1}{3}, 2\right]$ times as many as CDs<br>CDs are about $\left[\frac{1}{2}, \frac{3}{4}\right]$ as many as downloads |
|    | <b>Additional Guidance</b>                                                                    |      |                                                                                                                                                                                                      |
|    | Ignore 'Positive correlation'                                                                 |      |                                                                                                                                                                                                      |
|    | Condone references to causality<br>eg an increase in downloads causes an increase in CDs sold |      | B1                                                                                                                                                                                                   |
|    | As one goes up the other goes up / Both go up at a similar rate                               |      | B1                                                                                                                                                                                                   |
|    | They both go up                                                                               |      | B0                                                                                                                                                                                                   |
|    | Downloads are always more than CDs                                                            |      | B0                                                                                                                                                                                                   |
|    | They are in direct proportion                                                                 |      | B0                                                                                                                                                                                                   |
|    | The relationship is linear                                                                    |      | B0                                                                                                                                                                                                   |

| Q  | Answer                                                                                                        | Mark  | Comment                                                  |
|----|---------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------|
| 6b | <b>Alternative method 1 – reading from the graph</b>                                                          |       |                                                          |
|    | $2.5(0) \times 9000$ or 22 500<br>or<br>[5300, 5500]                                                          | M1    | oe<br>$2.5(0)$ may be 2 or 3<br>[5300, 5500] may be 5000 |
|    | $2.5(0) \times 9000 + 3 \times [5300, 5500]$<br>or<br>$22\,500 + [15\,900, 16\,500]$                          | M1dep | oe<br>$2.5(0)$ may be 2 or 3<br>[5300, 5500] may be 5000 |
|    | [38 400, 39 000]                                                                                              | A1ft  | ft 2 or 3 for $2.5(0)$ and/or 5000 for [5300, 5500]      |
|    | <b>Alternative method 2 – using a multiplier</b>                                                              |       |                                                          |
|    | $2.5(0) \times 9000$ or 22 500<br>or<br>$9000 \times [0.5, 0.75]$                                             | M1    | oe<br>$2.5(0)$ may be 2 or 3                             |
|    | $2.5(0) \times 9000 + 3 \times 9000 \times [0.5, 0.75]$                                                       | M1dep | oe<br>$2.5(0)$ may be 2 or 3                             |
|    | [36 000, 42 750]<br>with $9000 \times [0.5, 0.75]$ seen                                                       | A1ft  | ft 2 or 3 for $2.5(0)$                                   |
|    | <b>Additional Guidance</b>                                                                                    |       |                                                          |
|    | Check graph for working                                                                                       |       |                                                          |
|    | Working may be in pence, units not required for up to M2<br>Final answer in pence must have units to award A1 |       |                                                          |



| Q | Answer                                                             | Mark  | Comment |
|---|--------------------------------------------------------------------|-------|---------|
| 7 | Correct method to find 1%, 2%, 5%, 10%, 100% or 840% of the number | M1    |         |
|   | Fully correct method                                               | M1dep |         |
|   | 600                                                                | A1    |         |
|   | <b>Additional Guidance</b>                                         |       |         |
|   | Up to M2 may be awarded for multiple attempts if no answer chosen  |       |         |

| Q | Answer                                                                                                                         | Mark  | Comments                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------|
| 8 | <b>Alternative method 1: using algebra</b>                                                                                     |       |                                                                                               |
|   | $\frac{1}{2} \times k \times 12$ or $6k$<br>or<br>$2 \times k + 3 \times m$ or $2k + 3m$                                       | M1    | oe correct expression for either area<br>eg $2(k - 3) + 3(m + 2)$<br>or $k(m + 2) - m(k - 3)$ |
|   | $\frac{1}{2} \times k \times 12 = 2 \times k + 3 \times m$<br>or<br>$4k = 3m$                                                  | M1dep | oe equation                                                                                   |
|   | 3 : 4                                                                                                                          | A1    | oe ratio                                                                                      |
|   | <b>Alternative method 2: substituting a value for <math>k</math></b>                                                           |       |                                                                                               |
|   | Substitutes a value for $k$<br>and gives<br>correct method or value for area of triangle<br>or correct area in $m$ for L-shape | M1    | eg<br>$k = 5$ and area of triangle is 30<br>or<br>$k = 5$ and area of L-shape is $10 + 3m$    |
|   | Correct equation connecting the two areas<br>or<br>correct value of $m$ for their $k$                                          | M1dep | eg<br>$k = 5$ and $30 = 10 + 3m$<br>or<br>$k = 6$ and $m = 8$                                 |
|   | 3 : 4                                                                                                                          | A1    | oe ratio                                                                                      |

| Q | Answer                                                              | Mark | Comment                                                                                                                                                                                                                                      |
|---|---------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9 | $(x =) [2.25, 2.75]$<br>and<br>$(x =) [9.25, 9.75]$                 | B2   | B1 $(x =) [2.25, 2.75]$ or $(x =) [9.25, 9.75]$<br>or<br>one or both values identified but not given in correct notation<br>eg $(2.5, 0)$ and/or $(9.5, 0)$<br>or $2.5 < x < 9.5$<br>or<br>2.5 and/or 9.5 written on the graph or in working |
|   | <b>Additional Guidance</b>                                          |      |                                                                                                                                                                                                                                              |
|   | $x =$ can be $x \approx$                                            |      |                                                                                                                                                                                                                                              |
|   | $[2.25, 2.75]$ and/or $[9.25, 9.75]$ with one extra value           |      | B1                                                                                                                                                                                                                                           |
|   | $[2.25, 2.75]$ and/or $[9.25, 9.75]$ with more than one extra value |      | B0                                                                                                                                                                                                                                           |
|   | Answer from use of formula or completing the square                 |      | B0                                                                                                                                                                                                                                           |

| Q  | Answer                                                                                                                  | Mark | Comment                                                                                                                                                                                                                                                                                               |
|----|-------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 | $(\pi \times) \left( \frac{\sqrt{17}}{2} \right)^2$                                                                     | M1   | oe<br>condone missing brackets                                                                                                                                                                                                                                                                        |
|    | $\frac{17}{4}(\pi)$ or $4\frac{1}{4}(\pi)$ or $4.25(\pi)$                                                               | A1   | oe fraction, mixed number or decimal                                                                                                                                                                                                                                                                  |
|    | $(\pi \times) 5^2$ or $(\pi \times) 25$<br>or<br>$\frac{60}{360}$ used                                                  | M1   | oe                                                                                                                                                                                                                                                                                                    |
|    | $\frac{25}{6}(\pi)$ or $4\frac{1}{6}(\pi)$<br>or $4.1(6\dots)(\pi)$ or $4.17(\pi)$                                      | A1   | oe fraction, mixed number or decimal                                                                                                                                                                                                                                                                  |
|    | A with values in comparable form<br>or<br>A by $\frac{1}{12}(\pi)$ or A by $0.08(3\dots)(\pi)$                          | A1   | eg values<br>$\frac{51}{12}(\pi)$ and $\frac{50}{12}(\pi)$<br>$4\frac{1}{4}(\pi)$ and $4\frac{1}{6}(\pi)$<br>$4.2(5)(\pi)$ and $4.1(6\dots)(\pi)$<br>$4.2(5)(\pi)$ and $4.17(\pi)$<br>accept 'circle' for A<br><br>allow comparison of fraction or decimal parts only if integer parts shown as equal |
|    | <b>Additional Guidance</b>                                                                                              |      |                                                                                                                                                                                                                                                                                                       |
|    | For the final mark, presence or absence of $\pi$ must be the same for both values                                       |      |                                                                                                                                                                                                                                                                                                       |
|    | Accept consistent use of a numerical value of $\pi$ throughout.<br>The value can be 3 or 3.1 or 3.14 or 3.142 or better |      |                                                                                                                                                                                                                                                                                                       |

| Q  | Answer                                             | Mark | Comment                                                                |
|----|----------------------------------------------------|------|------------------------------------------------------------------------|
| 11 | $(x + 6)(x - 4)$                                   | B2   | either order<br>B1 $(x + a)(x + b)$<br>where $ab = -24$ or $a + b = 2$ |
|    | <b>Additional Guidance</b>                         |      |                                                                        |
|    | Condone a multiplication sign between the brackets |      |                                                                        |
|    | Condone missing final bracket                      |      |                                                                        |
|    | Ignore an attempt to solve $(x + 6)(x - 4) = 0$    |      |                                                                        |

| Q     | Answer | Mark | Comment |
|-------|--------|------|---------|
| 12(a) | 2000   | B1   |         |

| Q     | Answer                                                                                                                                                         | Mark | Comment                              |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------|
| 12(b) | 0.5<br>or<br>$\frac{2 \times 10^3}{5 \times 10^{-1}}$ or $\frac{\text{their 2000}}{5 \times 10^{-1}}$<br>or<br>$0.4 \times 10^{3 - (-1)}$ or $0.4 \times 10^4$ | M1   | oe<br><br>their 2000 from part (a)   |
|       | 4000 or $4 \times 10^3$                                                                                                                                        | A1ft | ft $2 \times$ their 2000 in part (a) |

| Q  | Answer                                                      | Mark  | Comments |
|----|-------------------------------------------------------------|-------|----------|
| 13 | $10x + 5d$ or $10x = cx$ or $5d = 30$                       | M1    |          |
|    | $10x = cx$ and $5d = 30$<br>or<br>$c = 10$<br>or<br>$d = 6$ | M1dep |          |
|    | $c = 10$ $d = 6$                                            | A1    |          |

| Q  | Answer                                                                                                                                        | Mark  | Comments                                                        |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------|
| 14 | $7x = 2x + 20$<br>or<br>$\frac{x-20}{x} = \frac{2}{7}$<br>or<br>$\frac{x+20}{x} = \frac{7}{2}$<br>or<br>$20 \div (7 - 2)$ or $20 \div 5$ or 4 | M1    | oe<br>any letter                                                |
|    | $7 \times 20 \div (7 - 2)$ or 28<br>or<br>$2 \times 20 \div (7 - 2)$ or 8<br>or<br>$(7 + 2) \times 20 \div (7 - 2)$                           | M1dep | oe hours for History<br><br>hours for French<br><br>total hours |
|    | 36                                                                                                                                            | A1    |                                                                 |
|    |                                                                                                                                               |       |                                                                 |

| Q     | Answer | Mark | Comments |
|-------|--------|------|----------|
| 15(a) | 16     | B1   |          |

| Q     | Answer                                                                                                                                               | Mark | Comments                                                                                                                                       |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------|
| 15(b) | <b>Average</b>                                                                                                                                       |      |                                                                                                                                                |
|       | Indicates that the statement is correct and uses the median to support their decision                                                                | B2   | eg Yes, as median is lower (in 2019)<br>B1 median is lower in 2019 with no or incorrect decision<br>or median (for 2019) is 22.5               |
|       | <b>Consistency</b>                                                                                                                                   |      |                                                                                                                                                |
|       | Indicates that the statement is correct and uses the IQR to support their decision<br>or<br>states that both quartiles were 1 minute greater in 2020 | B2   | eg IQRs are equal, so same consistency<br>B1 IQR is the same with no or incorrect decision<br>or IQR (for 2019) is 6<br>or IQR (for 2020) is 6 |
|       | <b>Additional Guidance</b>                                                                                                                           |      |                                                                                                                                                |
|       | <b>Average</b>                                                                                                                                       |      |                                                                                                                                                |
|       | For B2 or B1, ignore reference to the LQ or UQ                                                                                                       |      |                                                                                                                                                |
|       | Condone 22.30 for the median                                                                                                                         |      |                                                                                                                                                |
|       | For B2 or B1, if using 'average' for 'median' the value(s) must be given                                                                             |      |                                                                                                                                                |
|       | Incorrect value for the 2019 median can score B1 if lower than 24<br>eg It's correct, the 2019 median was 23.5                                       |      | B1                                                                                                                                             |
|       | Reference to IQR                                                                                                                                     |      | B1max                                                                                                                                          |
|       | Median is 22.5, so true                                                                                                                              |      | B2                                                                                                                                             |
|       | Correct, the median is 1.5 lower in 2019 / Yes, it was 1.5 seconds faster                                                                            |      | B2                                                                                                                                             |
|       | <b>Consistency</b>                                                                                                                                   |      |                                                                                                                                                |
|       | Allow calculation seen to imply IQR eg (2019) $26 - 20 = 6$                                                                                          |      |                                                                                                                                                |
|       | Ignore reference to the range in 2019                                                                                                                |      |                                                                                                                                                |
|       | Reference to median                                                                                                                                  |      | B1max                                                                                                                                          |
|       | $26 - 20 = 27 - 21$ so this is true                                                                                                                  |      | B2                                                                                                                                             |
|       | 6 not accompanied by a calculation or reference to IQR                                                                                               |      | B0                                                                                                                                             |
|       | 6 stated to be the range                                                                                                                             |      | B0                                                                                                                                             |

| Q     | Answer                                                                                                                       | Mark  | Comments                             |
|-------|------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------|
| 16(a) | $2x + x + 15 + 8 = 80$<br>or<br>$3x + 23 = 80$<br>or<br>$80 - 15 - 8$ or 57<br>or<br>$\frac{x+8}{80}$ or $\frac{x+8}{3x+23}$ | M1    | oe<br><br>implied by $\frac{57}{80}$ |
|       | $(x =) \frac{80-15-8}{3}$ or $\frac{57}{3}$ or 19<br>or<br>27                                                                | M1dep | oe implied by $\frac{19}{80}$        |
|       | $\frac{27}{80}$ or 0.3375 or 33.75%                                                                                          | A1    | oe fraction, decimal or percentage   |
|       | <b>Additional Guidance</b>                                                                                                   |       |                                      |
|       | Ignore incorrect conversion after correct answer seen                                                                        |       |                                      |

| Q     | Answer                                                        | Mark | Comments                           |
|-------|---------------------------------------------------------------|------|------------------------------------|
| 16(b) | $\frac{8}{23}$ or 0.3478... or 34.78...%<br>or 0.348 or 34.8% | B1   | oe fraction, decimal or percentage |
|       | <b>Additional Guidance</b>                                    |      |                                    |
|       | Ignore incorrect conversion after correct answer seen         |      |                                    |



| Q  | Answer                                                                                                                                        | Mark  | Comments                                                                                             |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------|
| 17 | $2 \leq x \leq 5$ or $6 \leq 3x \leq 15$<br>or<br>$x = 5$ or $3x = 15$                                                                        | M1    | may be in two parts<br>implied by ( $y =$ ) 27 or ( $x =$ ) 2, 3, 4, 5<br>or ( $3x =$ ) 6, 9, 12, 15 |
|    | $y - 3 \times 5 < 12$ or $y < 12 + 3 \times 5$<br>or $y < 27$<br>or<br>$y - 3 \times 5 \leq 11$ or $y \leq 11 + 3 \times 5$<br>or $y \leq 26$ | M1dep | oe<br>may be seen in a double-sided inequality<br>eg condone $18 < y < 27$<br>using $\leq$ or $=$    |
|    | 26                                                                                                                                            | A1    | SC1 17                                                                                               |
|    | <b>Additional Guidance</b>                                                                                                                    |       |                                                                                                      |
|    | SC1 is for the use of 2 instead of 5                                                                                                          |       |                                                                                                      |
|    | All inequalities may be reversed, eg $2 \leq x \leq 5$ may be $5 \geq x \geq 2$                                                               |       |                                                                                                      |
|    |                                                                                                                                               |       |                                                                                                      |

| Q     | Answer                                                  | Mark | Comments                                                                                                                     |
|-------|---------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------|
| 18(a) | <b>Rotation about (1, 0)</b>                            |      |                                                                                                                              |
|       | $90^\circ$ anticlockwise<br>or<br>$270^\circ$ clockwise | B1   | oe description of rotation<br>condone $90^\circ$ counter-clockwise<br>eg quarter turn anticlockwise                          |
|       | <b>Translation</b>                                      |      |                                                                                                                              |
|       | $\begin{pmatrix} -2 \\ -6 \end{pmatrix}$                | B1   | oe description of translation<br>eg 2 left and 6 down<br>condone missing brackets<br>SC1 B0B0 and point $(-1, 4)$ identified |
|       | <b>Additional Guidance</b>                              |      |                                                                                                                              |
|       | Condone missing degrees sign                            |      |                                                                                                                              |
|       | $(-2, -6)$                                              |      | B0                                                                                                                           |
|       | Compound transformation                                 |      | B0 for that part                                                                                                             |
|       |                                                         |      |                                                                                                                              |

| Q     | Answer                                       | Mark | Comments                                    |
|-------|----------------------------------------------|------|---------------------------------------------|
| 18(b) | (4, 4) and (7, 7)<br>or<br>(1, 1) and (6, 6) | B1   | condone (5, 5) and (10, 10)<br>either order |

|    |                                                                                                                                                      |       |                                                                                             |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------|
| 19 | <b>Alternative method 1</b>                                                                                                                          |       |                                                                                             |
|    | $(0.\dot{4}) = \frac{4}{9}$<br>or<br>$10x - x = 4$ or $9x = 4$                                                                                       | M1    | oe eg $100x - x = 44$ or $99x = 44$<br>or $100x - 10x = 40$ or $90x = 40$<br>any letter     |
|    | $\frac{7}{9} \div 10$ or $\frac{7}{90}$<br>or<br>$10y - y = 0.7$ or $9y = 0.7$                                                                       | M1    | oe eg $100y - y = 7.7$ or $99y = 7.7$<br>or $100y - 10y = 7$ or $90y = 7$<br>any letter     |
|    | $\frac{47}{90}$                                                                                                                                      | A1    | oe single fraction                                                                          |
|    | <b>Alternative method 2</b>                                                                                                                          |       |                                                                                             |
|    | $0.5\dot{2}$                                                                                                                                         | M1    | oe                                                                                          |
|    | $10x - x = 4.7$ or $9x = 4.7$                                                                                                                        | M1dep | oe eg $100x - x = 51.7$ or $99x = 51.7$<br>or $100x - 10x = 47$ or $90x = 47$<br>any letter |
|    | $\frac{47}{90}$                                                                                                                                      | A1    | oe single fraction                                                                          |
|    | <b>Additional Guidance</b>                                                                                                                           |       |                                                                                             |
|    | For M marks, allow fractions with decimal numerator or denominator<br>eg in alt 1, $\frac{0.7}{9}$ scores M1 and in alt 2, $\frac{4.7}{9}$ scores M2 |       |                                                                                             |

| Q  | Answer                                                                     | Mark  | Comments                                                                      |
|----|----------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------|
| 20 | $(x =) 60$ or $(3x =) 180$<br>or<br>$(y =) 45$ or $(2y =) 90$              | M1    | implied by $\sin 60$ or $\tan 45$<br>must be selected and not just in a table |
|    | $3 \times 60 - 2 \times 45$<br>or $180 - 90$<br>or $(w =) 90$ or $\cos 90$ | M1dep |                                                                               |
|    | 0 with M2 awarded                                                          | A1    |                                                                               |
|    | <b>Additional Guidance</b>                                                 |       |                                                                               |
|    | 0 with no working                                                          |       | M0M0A0                                                                        |
|    | Condone degrees sign on answer with correct working                        |       | M1M1A1                                                                        |

| Q  | Answer                                                                    | Mark  | Comments                                                                                                         |
|----|---------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------|
| 21 | $2(4x)^2 + 9$                                                             | M1    | oe                                                                                                               |
|    | $32x^2 + 9$                                                               | M1dep | dep on 2nd M1<br>may be implied by 4th mark                                                                      |
|    | $8x + 9$                                                                  | M1    | may be implied by 4th mark                                                                                       |
|    | $32x^2 - 8x = 0$ or $32x^2 = 8x$                                          | M1    | oe equation with brackets expanded<br>rearranges their $f^{-1}(x)$ = their $gh(x)$ to<br>correctly collect terms |
|    | 0 and $\frac{1}{4}$                                                       | A1    | oe eg 0 and $\frac{8}{32}$                                                                                       |
|    | <b>Additional Guidance</b>                                                |       |                                                                                                                  |
|    | With no terms to collect in their equation the 4th mark cannot be awarded |       |                                                                                                                  |
|    | $8x + 9 = 8x^2 + 36$<br>$0 = 8x^2 - 8x + 27$                              |       | M0M0M1<br>M1A0                                                                                                   |
|    | $8x - 9 = 8x^2 + 36$<br>$0 = 8x^2 - 8x + 45$                              |       | M0M0M0<br>M1A0                                                                                                   |
|    | $8x + 9 = 2(4x)^2 + 9$<br>$8x + 9 = 16x^2 + 9$<br>$8x = 16x^2$            |       | M1M0M1<br><br>M1A0                                                                                               |
|    | $8x + 9 = 4x(2x^2 + 9)$<br>$0 = 8x^3 + 28x - 9$                           |       | M0M0M1<br>M1A0                                                                                                   |

| Q  | Answer                                                                                                                                              | Mark  | Comments                                                                                           |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------|
| 22 | <b>Alternative method 1</b>                                                                                                                         |       |                                                                                                    |
|    | $\frac{180}{9+3}$ or 15<br>or<br>$3 \times \frac{180}{9+3}$ or 45<br>or<br>$9 \times \frac{180}{9+3}$ or 135                                        | M1    | oe eg $180 \times \frac{1}{3+1}$ or $180 \div 4$<br><br>size of angle $c$<br><br>size of angle $a$ |
|    | $5 \times \frac{180}{9+3}$ or or $5 \times 15$ or 75<br>or<br>$7 \times \frac{180}{9+3}$<br>or<br>$(3+5+9) \times \frac{180}{9+3}$ or 255           | M1dep | oe<br>size of angle $b$                                                                            |
|    | 105                                                                                                                                                 | A1    |                                                                                                    |
|    | <b>Alternative method 2</b>                                                                                                                         |       |                                                                                                    |
|    | $a : b : c : d = 9 : 5 : 3 : 7$<br>or<br>$b : d = 5 : 7$                                                                                            | M1    | oe<br>implied by $d = 7$                                                                           |
|    | $\frac{7}{9+5+3+7} \times 360$ or $\frac{7}{24} \times 360$<br>or<br>$\frac{7}{5+7} \times 180$ or $\frac{7}{12} \times 180$<br>or<br>$7 \times 15$ | M1dep | oe<br>allow numerator to be 5                                                                      |
|    | 105                                                                                                                                                 | A1    |                                                                                                    |

| Q  | Answer                                                           | Mark  | Comments                                                                                       |
|----|------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------|
| 23 | <b>Alternative method 1</b>                                      |       |                                                                                                |
|    | $\frac{7\sqrt{3}}{\sqrt{20}} \times \frac{\sqrt{20}}{\sqrt{20}}$ | M1    | oe eg $\frac{7\sqrt{3}}{\sqrt{2}\sqrt{10}} \times \frac{\sqrt{2}\sqrt{10}}{\sqrt{2}\sqrt{10}}$ |
|    | $\frac{7\sqrt{60}}{20}$                                          | M1dep | oe single rationalised fraction                                                                |
|    | $\frac{7\sqrt{15}}{10}$ or $\frac{14\sqrt{15}}{20}$              | A1    | oe in the form $\frac{x\sqrt{15}}{y}$ where $x$ and $y$ are integers                           |
|    | <b>Alternative method 2</b>                                      |       |                                                                                                |
|    | $\frac{7\sqrt{3}}{2\sqrt{5}}$                                    | M1    |                                                                                                |
|    | $\frac{7\sqrt{3}}{2\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$   | M1dep | oe rationalisation<br>eg $\frac{7\sqrt{3}}{2\sqrt{5}} \times \frac{2\sqrt{5}}{2\sqrt{5}}$      |
|    | $\frac{7\sqrt{15}}{10}$ or $\frac{14\sqrt{15}}{20}$              | A1    | oe in the form $\frac{x\sqrt{15}}{y}$ where $x$ and $y$ are integers                           |

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

| Q          | Answer                                                                                                                                                                                          | Mark  | Comments                                                             |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------|
| 23<br>cont | <b>Alternative method 3</b>                                                                                                                                                                     |       |                                                                      |
|            | $\frac{7}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} \text{ or } \frac{7\sqrt{2}}{2}$<br>or<br>$\frac{\sqrt{3}}{\sqrt{10}} \times \frac{\sqrt{10}}{\sqrt{10}} \text{ or } \frac{\sqrt{30}}{10}$ | M1    | oe                                                                   |
|            | $\frac{7\sqrt{2}}{2} \times \frac{\sqrt{30}}{10} \text{ or } \frac{7\sqrt{60}}{20}$                                                                                                             | M1dep | oe rationalised                                                      |
|            | $\frac{7\sqrt{15}}{10} \text{ or } \frac{14\sqrt{15}}{20}$                                                                                                                                      | A1    | oe in the form $\frac{x\sqrt{15}}{y}$ where $x$ and $y$ are integers |
|            | <b>Alternative method 4</b>                                                                                                                                                                     |       |                                                                      |
|            | $\frac{7}{\sqrt{2}} \times \frac{\sqrt{3}}{\sqrt{10}} \times \frac{\sqrt{5}}{\sqrt{5}}$                                                                                                         | M1    | oe                                                                   |
|            | $\frac{7\sqrt{5}}{\sqrt{10}} \times \frac{\sqrt{3}}{\sqrt{10}}$<br>or<br>$\frac{7}{\sqrt{2}} \times \frac{\sqrt{15}}{\sqrt{50}}$<br>or<br>$\frac{7\sqrt{15}}{\sqrt{100}}$                       | M1dep | oe one term or product of two terms with numerator $7\sqrt{15}$      |
|            | $\frac{7\sqrt{15}}{10} \text{ or } \frac{14\sqrt{15}}{20}$                                                                                                                                      | A1    | oe in the form $\frac{x\sqrt{15}}{y}$ where $x$ and $y$ are integers |

| Q  | Answer        | Mark | Comments |
|----|---------------|------|----------|
| 24 | $\frac{1}{2}$ | B1   | oe       |

| Q  | Answer                                                                                                                                                                                                 | Mark | Comments                                                                            |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------|
| 25 | $r^2 = \frac{8}{9}$<br>or<br>$\sqrt{\frac{8}{9}}$ or $\frac{2\sqrt{2}}{\sqrt{9}}$ or $\frac{\sqrt{8}}{3}$ or $\frac{2\sqrt{2}}{3}$<br>or $\left(\sqrt{\frac{8}{9}}\right)^3$ or $\frac{8\sqrt{8}}{27}$ | M1   | oe eg $\left(\frac{8}{9}\right)^{\frac{1}{2}}$<br>allow $\pm\sqrt{\frac{8}{9}}$ etc |
|    | $\frac{16\sqrt{2}}{27}$                                                                                                                                                                                | A1   | oe in the form $\frac{c\sqrt{2}}{d}$ where $c$ and $d$ are integers                 |

| Q     | Answer                                                                                                                                                                                                          | Mark | Comments                                                    |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------|
| 26(a) | $\sqrt[4]{5\frac{1}{16}}$<br>or $\left(5\frac{1}{16}\right)^{\frac{1}{4}}$ or $\frac{81^{\frac{1}{4}}}{16^{\frac{1}{4}}}$<br>or<br>$\left(81^{\frac{1}{4}} = \right) 3$ or $\left(16^{\frac{1}{4}} = \right) 2$ | M1   | oe eg $\sqrt[4]{\frac{81}{16}}$<br>condone missing brackets |
|       | $\frac{3}{2}$ or $1\frac{1}{2}$ or 1.5                                                                                                                                                                          | A1   |                                                             |

| Q     | Answer                                            | Mark | Comments                                          |
|-------|---------------------------------------------------|------|---------------------------------------------------|
| 26(b) | $(7^{2m})^{2.5}$ or $49^{2.5m}$ or $(7^2)^{2.5m}$ | M1   | oe with base changed to 7 and/or brackets removed |
|       | $7^{5m}$                                          | A1   |                                                   |

| Q  | Answer                       | Mark | Comments                                                       |
|----|------------------------------|------|----------------------------------------------------------------|
| 27 | $-4 < x < 4$ or $4 > x > -4$ | B1   | condone the inequality in two parts<br>eg $x > -4$ and $x < 4$ |



| Q  | Answer                                                                                                                                                                                                                                                                                                                      | Mark  | Comments                                                                                                                                                                                                                        |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28 | $(\overrightarrow{XR}) = \frac{3}{2}(2\mathbf{a} + 4\mathbf{b})$ or $3\mathbf{a} + 6\mathbf{b}$<br>or<br>$(\overrightarrow{QR}) = \frac{5}{2}(2\mathbf{a} + 4\mathbf{b})$ or $5\mathbf{a} + 10\mathbf{b}$                                                                                                                   | M1    | oe<br>may be on diagram                                                                                                                                                                                                         |
|    | $(\overrightarrow{PS}) = -5\mathbf{a} + 2\mathbf{a} + 4\mathbf{b}$<br>$+ \frac{3}{2}(2\mathbf{a} + 4\mathbf{b}) + \mathbf{a} - 8\mathbf{b}$<br>or<br>$(\overrightarrow{PS}) = -5\mathbf{a} + \frac{5}{2}(2\mathbf{a} + 4\mathbf{b}) + \mathbf{a} - 8\mathbf{b}$<br>or<br>$(\overrightarrow{PS}) = \mathbf{a} + 2\mathbf{b}$ | M1dep | oe<br>may be on diagram                                                                                                                                                                                                         |
|    | $(\overrightarrow{PS}) = \mathbf{a} + 2\mathbf{b}$<br>and<br>indication why $PS$ is parallel to $QR$                                                                                                                                                                                                                        | A1    | eg $2(\mathbf{a} + 2\mathbf{b}) = 2\mathbf{a} + 4\mathbf{b}$<br>or $5\mathbf{a} + 10\mathbf{b} = 5(\mathbf{a} + 2\mathbf{b})$<br>or $\mathbf{a} + 2\mathbf{b}$ and $\overrightarrow{QR}$ is a multiple of $\overrightarrow{PS}$ |
|    | <b>Additional Guidance</b>                                                                                                                                                                                                                                                                                                  |       |                                                                                                                                                                                                                                 |
|    | Some or all vectors may be reversed and the final mark can be from using a negative constant<br>eg $\overrightarrow{RX} = -3\mathbf{a} - 6\mathbf{b}$<br>$\overrightarrow{PS} = \mathbf{a} + 2\mathbf{b}$<br>$-3(\mathbf{a} + 2\mathbf{b}) = -3\mathbf{a} - 6\mathbf{b}$                                                    |       | M1<br>M1<br>A1                                                                                                                                                                                                                  |

| Q     | Answer                                           | Mark | Comments |
|-------|--------------------------------------------------|------|----------|
| 29(a) | $y = \cos x$ passes through<br>$(180^\circ, -1)$ | B1   |          |

| Q     | Answer                                              | Mark | Comments |
|-------|-----------------------------------------------------|------|----------|
| 29(b) | None of the graphs pass through<br>$(270^\circ, 1)$ | B1   |          |