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# GCSE MATHEMATICS 8300/1H

Higher Tier Paper 1 Non-Calculator

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Mark scheme

June 2021

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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.

| Question | Answer   | Mark | Comments |
|----------|----------|------|----------|
| 1        | $a^{15}$ | B1   |          |

| Question | Answer          | Mark | Comments |
|----------|-----------------|------|----------|
| 2        | $\frac{26}{70}$ | B1   |          |

| Question | Answer                | Mark | Comments |
|----------|-----------------------|------|----------|
| 3        | hexagon-based pyramid | B1   |          |

| Question | Answer            | Mark | Comments |
|----------|-------------------|------|----------|
| 4        | $y = \frac{k}{x}$ | B1   |          |

| Question | Answer                                                                                                                                                     | Mark | Comments                                                                                                                                                                                                                                                                                       |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5        | 200 written as a product of factors where at least one factor is prime                                                                                     | M1   | eg<br>2 and 100 or $2 \times 10^2$ or $200 \div 5 = 40$<br>may be on a factor tree or repeated division<br>allow one strand to be incorrect if a previous value completes the product<br>eg $10 \times 20$ followed by<br>$5 \times 2 \times 5 \times 6$ implies $5 \times 2 \times 20$ for M1 |
|          | 2 and 2 and 2 and 5 and 5                                                                                                                                  | A1   | may be on a factor tree or repeated division                                                                                                                                                                                                                                                   |
|          | $2^3 \times 5^2$ or $5^2 \times 2^3$                                                                                                                       | A1   |                                                                                                                                                                                                                                                                                                |
|          | <b>Additional Guidance</b>                                                                                                                                 |      |                                                                                                                                                                                                                                                                                                |
|          | Allow any number of 1s included as factors up to M1A1 only                                                                                                 |      |                                                                                                                                                                                                                                                                                                |
|          | M1 may be awarded for correct work with no or incorrect answer, even if this is seen among multiple attempts                                               |      |                                                                                                                                                                                                                                                                                                |
|          | $1 \times 2^3 \times 5^2$                                                                                                                                  |      | M1A1A0                                                                                                                                                                                                                                                                                         |
|          | $2^3.5^2$ or $2^3.5^2$ or $2^35^2$ or $2^3,5^2$                                                                                                            |      | M1A1A1                                                                                                                                                                                                                                                                                         |
|          | $2 + 2 + 2 + 5 + 5$                                                                                                                                        |      | M1A1A0                                                                                                                                                                                                                                                                                         |
|          | $2^3 + 5^2$                                                                                                                                                |      | M1A1A0                                                                                                                                                                                                                                                                                         |
|          | $2 \times 2 \times 2 \times 5 \times 5$ and $2^3 \times 5^2$ on answer line<br>but $2 \times 2 \times 2 \times 5 \times 5 = 2^3 \times 5^2$ on answer line |      | M1A1A0<br>M1M1A1                                                                                                                                                                                                                                                                               |
|          | $2^3 \times 5^2 = 10^5$                                                                                                                                    |      | M1A1A0                                                                                                                                                                                                                                                                                         |
|          | $2^3 \times 5^2 = 200$                                                                                                                                     |      | M1A1A1                                                                                                                                                                                                                                                                                         |
|          | $8 \times 25$ with no prime factorisation                                                                                                                  |      | M0A0A0                                                                                                                                                                                                                                                                                         |

| Question | Answer                                                                                                                                                     | Mark | Comments                                                                                                                                                                                                                                                                                                                                                  |  |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 6        | $\frac{7}{5}$ or $1\frac{2}{5}$                                                                                                                            | B2   | B1<br>28 and 20<br>or<br>$2\frac{1}{3}$ and $1\frac{2}{3}$ oe mixed numbers or fractions with common denominator<br>or<br>correct unsimplified fraction or mixed number eg $\frac{14}{10}$ or $1\frac{8}{20}$<br>or<br>correct simplification of a fraction where at least one of the values is 28 or 20 and the other is not 12<br><br>SC1 $\frac{5}{7}$ |  |
|          | Additional Guidance                                                                                                                                        |      |                                                                                                                                                                                                                                                                                                                                                           |  |
|          | Allow a fractional numerator and/or denominator in a correct fraction<br><br>eg $\frac{2\frac{1}{3}}{\frac{8}{12}}$ or $\frac{\frac{28}{12}}{\frac{5}{3}}$ |      | B1                                                                                                                                                                                                                                                                                                                                                        |  |
|          | $\frac{2.4}{1.8}$ simplified to $\frac{4}{3}$                                                                                                              |      | B0                                                                                                                                                                                                                                                                                                                                                        |  |
|          | Ignore an attempt to convert $\frac{7}{5}$ to an improper fraction<br><br>eg $\frac{7}{5} = 1\frac{2}{7}$ on the answer line                               |      | B2                                                                                                                                                                                                                                                                                                                                                        |  |
|          | 7 : 5 with no working worthy of B1                                                                                                                         |      | B0                                                                                                                                                                                                                                                                                                                                                        |  |

| Question | Answer                                                                                                                                    | Mark | Comments                                         |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------------------|
| 7        | $(\sqrt{97} \Rightarrow) \sqrt{100}$ or 10<br>or<br>$(2.014^3 \Rightarrow) 2^3$ or 8<br>or<br>$(0.49 \Rightarrow) 0.5$ or $\frac{1}{2}$   | M1   |                                                  |
|          | $(\sqrt{97} \Rightarrow) \sqrt{100}$ or 10<br>and<br>$(2.014^3 \Rightarrow) 2^3$ or 8<br>and<br>$(0.49 \Rightarrow) 0.5$ or $\frac{1}{2}$ | M1   | $\frac{10+8}{0.5}$ or $\frac{18}{0.5}$ scores M2 |
|          | 36                                                                                                                                        | A1   |                                                  |

| Question | Answer                                                                                                                                                       | Mark | Comments                                                                                                                                                                                                                   |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8(a)     | $5x - 3x$ or $2x$<br>or $3x - 5x$ or $-2x$<br>or<br>$15 - 6$ or $9$<br>or $6 - 15$ or $-9$                                                                   | M1   | may be seen as an annotation to the given inequality<br>eg $-6$ written under $+15$                                                                                                                                        |
|          | $2x > 9$<br>or $-9 > -2x$<br>or<br>$4.5$ or $\frac{9}{2}$ or $4\frac{1}{2}$                                                                                  | A1   | implied by correct answer                                                                                                                                                                                                  |
|          | $x > 4.5$ or $x > \frac{9}{2}$ or $x > 4\frac{1}{2}$                                                                                                         | A1ft | ft solution of inequality of the form<br>$2x > k$ where $k$ is a number<br>or $m > -2x$ where $m$ is a number<br>or $ax > 9$ where $a$ is an integer not equal to 1<br>or $-9 > bx$ where $b$ is an integer not equal to 1 |
|          | <b>Additional Guidance</b>                                                                                                                                   |      |                                                                                                                                                                                                                            |
|          | In all cases accept the inequality written correctly in reverse order<br>For example, for $2x > 9$ accept $9 < 2x$                                           |      |                                                                                                                                                                                                                            |
|          | $4.5 < x$                                                                                                                                                    |      | M1A1A1                                                                                                                                                                                                                     |
|          | $2x > 21, x > 10.5$                                                                                                                                          |      | M1A0A1ft                                                                                                                                                                                                                   |
|          | $8x > 9, x > 1.125$                                                                                                                                          |      | M1A0A1ft                                                                                                                                                                                                                   |
|          | Do not allow a correct answer in working followed by an incorrect answer on the answer line<br>eg $x > \frac{9}{2}$ in working with $4.5$ on the answer line |      | M1A1A0                                                                                                                                                                                                                     |
|          | Do not allow the correct answer with another answer<br>eg $x > 4.5$ and $x = 4.5$ on the answer line                                                         |      | M1A1A0                                                                                                                                                                                                                     |

| Question | Answer                           | Mark | Comments                                                                                                         |
|----------|----------------------------------|------|------------------------------------------------------------------------------------------------------------------|
| 8(b)     | $2 \leq x < 5$ or $5 > x \geq 2$ | B2   | any letter<br>B1<br>$2 \leq x$ or $x \geq 2$<br>or $x < 5$ or $5 > x$<br>SC1<br>$2 < x \leq 5$ or $5 \geq x > 2$ |
|          | Additional Guidance              |      |                                                                                                                  |
|          | $2 \leq x$ and $x < 5$           |      | B1                                                                                                               |
|          | $2 \leq x$ and $x > 5$           |      | B1                                                                                                               |
|          | $2 \leq x > 5$                   |      | B1                                                                                                               |
|          | $2 \leq x \leq 5$                |      | B1                                                                                                               |
|          | $2 \leq x \leq 4$                |      | B1                                                                                                               |
|          | $2 < x < 5$                      |      | B1                                                                                                               |
|          | $2 \geq x > 5$                   |      | B0                                                                                                               |
|          | $2 \leq 5$                       |      | B0                                                                                                               |

| Question | Answer                                                                                                                                        | Mark | Comments                                                      |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------|
| 9        | (4, 16)                                                                                                                                       | B2   | may be on diagram<br>B1 one correct coordinate<br>SC1 (16, 4) |
|          | Additional Guidance                                                                                                                           |      |                                                               |
|          | B1 may be scored from 4 at the vertex vertically below Q or from 16 at the vertex vertically above <i>P</i> if not contradicted by the answer |      |                                                               |

| Question | Answer                                                                                                                                           | Mark | Comments                                                                             |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------|
| 10(a)    | $2 \times 10^3$ or $7 \times 10^4$<br>or<br>140 000 000                                                                                          | M1   | oe correct value not in standard form<br>eg $14 \times 10^7$                         |
|          | $1.4 \times 10^8$                                                                                                                                | A1   | SC1 Correctly converts an ordinary number with at least four digits to standard form |
|          | <b>Additional Guidance</b>                                                                                                                       |      |                                                                                      |
|          | Condone extra zeros on 1.4 eg $1.40\,000\,000 \times 10^8$                                                                                       |      | M1A1                                                                                 |
|          | $1.4 \times 10^8$ from 1 400 000 000                                                                                                             |      | M0A0                                                                                 |
|          | $2 \times 10^3$ is implied by $(2 \times 7) \times (10^3 \times 10^0)$<br>$7 \times 10^4$ is implied by $(2 \times 7) \times (10^b \times 10^4)$ |      | M1                                                                                   |
|          | 1 400 000 000 converted to $1.4 \times 10^9$                                                                                                     |      | SC1                                                                                  |

| Question | Answer                                                                                                                                                                                      | Mark | Comments                                   |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------------|
| 10(b)    | 180 or 0.3<br>or<br>$(1.8 \div 3 =) 0.6$<br>or<br>$(10^2 \div 10^{-1} =) 10^3$<br>or<br>calculation which would have the outcome 600<br>or<br>correct value not given as an ordinary number | M1   | eg $1800 \div 3$<br><br>eg $6 \times 10^2$ |
|          | 600                                                                                                                                                                                         | A1   |                                            |
|          | <b>Additional Guidance</b>                                                                                                                                                                  |      |                                            |
|          | $1800 \div 0.3 = 600$ scores M1 only, as 600 comes from incorrect working                                                                                                                   |      | M1A0                                       |
|          | $1800 \div 30 = 600$ scores zero, as 600 comes from incorrect working                                                                                                                       |      | M0A0                                       |

| Question | Answer                                                     | Mark  | Comments                     |
|----------|------------------------------------------------------------|-------|------------------------------|
| 11       | $62 \div 2$ or $62 \times 0.5$ or 31                       | M1    | oe eg $62 \div 60 \times 30$ |
|          | their 31 – 25 or 6                                         | M1    | their 31 must be $> 25$      |
|          | their $6 \times 3$ or 18<br>or<br>their $6 \times 4$ or 24 | M1dep | dep on 2nd M1                |
|          | 49                                                         | A1    |                              |
|          | <b>Additional Guidance</b>                                 |       |                              |
|          | 49 from correct working, but a different answer given      |       | M3A0                         |

| Question | Answer                                                                                  | Mark  | Comments                                                         |
|----------|-----------------------------------------------------------------------------------------|-------|------------------------------------------------------------------|
| 12       | <b>Alternative method 1</b>                                                             |       |                                                                  |
|          | $\sin 30 = \frac{x}{10}$<br>or<br>( $x =$ ) $10 \sin 30$                                | M1    | oe eg $\frac{x}{\sin 30} = \frac{10}{\sin 90}$                   |
|          | $\sin 30 = 0.5$                                                                         | M1    | oe may be seen in a table<br>$0.5 = \frac{x}{10}$ oe scores M1M1 |
|          | 5                                                                                       | A1    |                                                                  |
|          | <b>Alternative method 2</b>                                                             |       |                                                                  |
|          | Correct trigonometric method to show that the length of the missing side is $5\sqrt{3}$ | M1    | oe                                                               |
|          | $\sqrt{(5\sqrt{3})^2 + x^2} = 10$                                                       | M1dep | oe                                                               |
|          | 5                                                                                       | A1    |                                                                  |
|          | <b>Additional Guidance</b>                                                              |       |                                                                  |
|          | Accept use of $\cos 60$ instead of $\sin 30$                                            |       |                                                                  |

| Question | Answer                                                                                                                                                                   | Mark | Comments                                                                                         |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------|
| 13       | $5 \div 6$ attempted with at least 0.8 shown and a carry of any integer from 1 to 7<br>or<br>$0.1\dot{6} \times 5$<br>or<br>$1.\dot{6} \div 2$<br>or<br>$1 - 0.1\dot{6}$ | M1   | oe calculation involving a correct recurring decimal which would give an outcome of $0.8\dot{3}$ |
|          | 0.83                                                                                                                                                                     | A1   | condone any number of 3s immediately before the recurring 3                                      |
|          | <b>Additional Guidance</b>                                                                                                                                               |      |                                                                                                  |
|          | Condone other recurring symbols or repeated dots<br>eg $0.83^r$ or $0.83\ldots$                                                                                          |      | M1A1                                                                                             |
| Question | Answer                                                                                                                                                                   | Mark | Comments                                                                                         |
| 14       | $\frac{7}{x}$                                                                                                                                                            | B1   |                                                                                                  |

| Question | Answer                                                                                                                                                                                                | Mark | Comments                                                                                  |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------|
| 15       | $x^2 + 3ax + ax + 3a^2 (\equiv x^2 + bx + 75)$<br>or<br>$x^2 + 4ax + 3a^2 (\equiv x^2 + bx + 75)$<br>or<br>$3ax + ax + 3a^2 \equiv bx + 75$<br>or<br>$4ax + 3a^2 \equiv bx + 75$<br>or<br>$3a^2 = 75$ | M1   |                                                                                           |
|          | $a = 5$ and/or $a = -5$                                                                                                                                                                               | A1   | implied by $(x + 5)(x + 15)$<br>or $(x - 5)(x - 15)$<br>implied by answer 20 and/or $-20$ |
|          | 20 and $-20$                                                                                                                                                                                          | A1   | oe $\pm 20$                                                                               |

| Question | Answer                                     | Mark | Comments                                                     |
|----------|--------------------------------------------|------|--------------------------------------------------------------|
| 16(a)    | Vertical line from 21 to [15, 17]<br>or 16 | M1   | implied by correct point marked on curve<br>or vertical axis |
|          | 24                                         | A1   | SC1 23 or 25                                                 |

| Question | Answer                                                                                                                       | Mark | Comments                  |
|----------|------------------------------------------------------------------------------------------------------------------------------|------|---------------------------|
| 16(b)    | (Median =) 22                                                                                                                | B1   | in working or in box plot |
|          | (LQ =) 18 and (UQ =) 24                                                                                                      | B1   | in working or in box plot |
|          | Rectangular box with median line<br>and whiskers to 3 and 28                                                                 | B1   |                           |
|          | <b>Additional Guidance</b>                                                                                                   |      |                           |
|          | Median and quartiles may be seen on cumulative frequency diagram                                                             |      |                           |
|          | If the values for the median and/or the LQ and UQ are correct in<br>working but incorrect in the box plot award up to B1B1B0 |      |                           |

| Question | Answer                                  | Mark | Comments |
|----------|-----------------------------------------|------|----------|
| 17       | $\begin{pmatrix} 5 \\ -8 \end{pmatrix}$ | B1   |          |

| Question | Answer                             | Mark | Comments                     |
|----------|------------------------------------|------|------------------------------|
| 18(a)    | Correct explanation                | B1   | eg 35 is more than $17 + 13$ |
|          | <b>Additional Guidance</b>         |      |                              |
|          | It is more than 30                 |      | B1                           |
|          | $AB$ cannot be more than $AC + BC$ |      | B1                           |
|          | $AC + BC$ only add up to 30        |      | B1                           |
|          | The triangle inequality            |      | B1                           |
|          | $17 + 13$ is only 30               |      | B1                           |
|          | $17 + 13$ is 30                    |      | B0                           |
|          | It would be too long               |      | B0                           |

| Question | Answer                                                               | Mark | Comments                              |
|----------|----------------------------------------------------------------------|------|---------------------------------------|
| 18(b)    | Correct explanation                                                  | B1   | eg (it should be) $\frac{31}{\sin x}$ |
|          | <b>Additional Guidance</b>                                           |      |                                       |
|          | $x$ and 31 should be swapped                                         |      | B1                                    |
|          | She has used 31 as an angle                                          |      | B1                                    |
|          | She has used $x$ as a length                                         |      | B1                                    |
|          | It should be $\frac{\sin x}{31} \left( = \frac{\sin 72}{54} \right)$ |      | B1                                    |

| Question | Answer                                                  | Mark | Comments                           |
|----------|---------------------------------------------------------|------|------------------------------------|
| 19(a)    | 0.1 on Fail<br>for First check                          | B1   | oe fraction, decimal or percentage |
|          | 0.01 on Fail<br>and<br>0.99 on Pass<br>for Second check | B1   | oe fraction, decimal or percentage |
|          | <b>Additional Guidance</b>                              |      |                                    |
|          | Ignore any extra branches drawn                         |      |                                    |

| Question | Answer                                            | Mark  | Comments                                                                                             |
|----------|---------------------------------------------------|-------|------------------------------------------------------------------------------------------------------|
| 19(b)    | <b>Alternative method 1</b>                       |       |                                                                                                      |
|          | $0.9 \times \text{their } 0.01 \text{ or } 0.009$ | M1    | oe eg $\frac{9}{10} \times \frac{1}{100} = \frac{9}{1000}$                                           |
|          | their $0.009 + \text{their } 0.1$                 | M1dep | oe<br>their 0.1 must be $> 0$ and $< 1$                                                              |
|          | 0.109                                             | A1ft  | oe fraction, decimal or percentage<br>ft their tree diagram if all probabilities are $> 0$ and $< 1$ |
|          | <b>Alternative method 2</b>                       |       |                                                                                                      |
|          | $0.9 \times \text{their } 0.99 \text{ or } 0.891$ | M1    | oe eg $\frac{9}{10} \times \frac{99}{100} = \frac{891}{1000}$                                        |
|          | $1 - \text{their } 0.891$                         | M1dep | oe                                                                                                   |
|          | 0.109                                             | A1ft  | oe fraction, decimal or percentage<br>ft their tree diagram if all probabilities are $> 0$ and $< 1$ |
|          | <b>Additional Guidance</b>                        |       |                                                                                                      |
|          | Answer 0.109%                                     |       | M2A0                                                                                                 |

| Question | Answer          | Mark | Comments |
|----------|-----------------|------|----------|
| 20       | $\text{g/cm}^3$ | B1   |          |

| Question | Answer                                                                                               | Mark  | Comments                                                 |
|----------|------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------|
| 21       | <b>Alternative method 1: using the left hand values</b>                                              |       |                                                          |
|          | $(a =) 6 \div 2$<br>or $(a =) 3$                                                                     | M1    | implied by $3n^2 \dots$                                  |
|          | $3 \times \text{their } 3 + b = 7$<br>or $b = -2$                                                    | M1dep | oe<br>$3n^2 - 2n \dots$ implies M1M1                     |
|          | $3 + \text{their } -2 + c = 10$<br>or $c = 9$                                                        | M1dep | oe                                                       |
|          | $3n^2 - 2n + 9$                                                                                      | A1    | SC1 30 and 49 as the next two terms                      |
|          | <b>Alternative method 2: subtracting <math>3n^2</math> to get a linear sequence</b>                  |       |                                                          |
|          | $(a =) 6 \div 2$<br>or $(a =) 3$                                                                     | M1    | implied by $3n^2 \dots$                                  |
|          | $10 - \text{their } 3 \times 1^2$ or 7<br>and $17 - \text{their } 3 \times 2^2$ or 5<br>or $b = -2$  | M1dep | oe using any two terms<br>$3n^2 - 2n \dots$ implies M1M1 |
|          | $(\text{their } 5 - \text{their } 7) (\times 1) + c = 7$<br>or $-2 (\times 1) + c = 7$<br>or $c = 9$ | M1dep | oe equation using any term                               |
|          | $3n^2 - 2n + 9$                                                                                      | A1    | SC1 30 and 49 as the next two terms                      |

Mark scheme and Additional Guidance continues on the next page

|            |                                                                                                                              |       |                                                                                                                                                                                                         |
|------------|------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21<br>cont | <b>Alternative method 3: simultaneous equations</b>                                                                          |       |                                                                                                                                                                                                         |
|            | Simultaneous equations leading to a fully correct method to work out $a$ or $b$<br>or<br>$a = 3$<br>or<br>$b = -2$           | M1    | eg $a + b + c = 10$<br>and $4a + 2b + c = 17$<br>and $9a + 3b + c = 30$<br>and<br>$3a + b = 7$<br>and $5a + b = 13$<br>and<br>$2a = 6$<br>and $(a =) 3$<br>implied by $3n^2 \dots$ or $\dots -2n \dots$ |
|            | Substitutes for $a$ or $b$ in one or two of the simultaneous equations with fully correct method to work out the other value | M1dep | eg $3 \times \text{their } 3 + b = 7$<br>or $b = -2$<br>$3n^2 - 2n \dots$ implies M1M1                                                                                                                  |
|            | Substitutes for $a$ & $b$ to work out $c$<br>or $c = 9$                                                                      | M1dep | any term<br>eg $3 - 2 + c = 10$                                                                                                                                                                         |
|            | $3n^2 - 2n + 9$                                                                                                              | A1    | SC1 30 and 49 as the next two terms                                                                                                                                                                     |
|            | <b>Alternative method 4: Using the '0th' term to get <math>c</math></b>                                                      |       |                                                                                                                                                                                                         |
|            | $(a =) 6 \div 2$<br>or $(a =) 3$                                                                                             | M1    | implied by $3n^2 \dots$                                                                                                                                                                                 |
|            | $0n^2 + 0n + c = 9$<br>or $c = 9$                                                                                            | M1    |                                                                                                                                                                                                         |
|            | their $3 + b$ + their $9 = 10$<br>or $b = -2$                                                                                | M1dep | oe<br>dep on M2                                                                                                                                                                                         |
|            | $3n^2 - 2n + 9$                                                                                                              | A1    | SC1 30 and 49 as the next two terms                                                                                                                                                                     |
|            | <b>Additional Guidance</b>                                                                                                   |       |                                                                                                                                                                                                         |
|            | In all cases $a$ , $b$ and $c$ refer to the general expression for the $n$ th term of a quadratic sequence $an^2 + bn + c$   |       |                                                                                                                                                                                                         |
|            | Condone $n = 3n^2 - 2n + 9$ and accept any letter for $n$                                                                    |       |                                                                                                                                                                                                         |
|            | Note that $b = -2$ does not imply a specific number of marks                                                                 |       |                                                                                                                                                                                                         |

| Question | Answer                                                                             | Mark | Comments                                                                                                                                                                                                                                                |
|----------|------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22       | $1\frac{24}{25}$                                                                   | B3   | oe mixed number<br>B2 $\frac{49}{25}$<br>B1 $\left(\frac{7}{5}\right)^2$ or $\frac{1}{\left(\frac{5}{7}\right)^2}$ or $\left(\frac{1}{5/7}\right)^2$<br>or $\frac{1}{25/49}$ or $\left(\frac{25}{49}\right)^{-1}$ or $\frac{1}{5^2} \div \frac{1}{7^2}$ |
|          | <b>Additional Guidance</b>                                                         |      |                                                                                                                                                                                                                                                         |
|          | For B2 or B1 allow equivalent fractions or decimals<br>eg 1.96 for $\frac{49}{25}$ |      | B2                                                                                                                                                                                                                                                      |

| Question | Answer                                                                                                                                            | Mark  | Comments             |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------|
| 23       | $y\sqrt{x+1} = 1$<br>or<br>$\sqrt{x+1} = \frac{1}{y}$<br>or<br>$y^2 = \frac{1}{x+1}$                                                              | M1    |                      |
|          | $y^2(x+1) = 1$ or $y^2x + y^2 = 1$<br>or<br>$y^2x = 1 - y^2$<br>or<br>$x + 1 = \frac{1}{y^2}$<br>or<br>$\frac{1}{y^2} - 1$ or $\frac{1-y^2}{y^2}$ | M1dep |                      |
|          | $x = \frac{1}{y^2} - 1$<br>or<br>$x = \frac{1-y^2}{y^2}$                                                                                          | A1    | oe in the form $x =$ |
|          | <b>Additional Guidance</b>                                                                                                                        |       |                      |
|          | Correct answer in working repeated on answer line without $x =$<br>eg $x = \frac{1}{y^2} - 1$ seen in working with answer $\frac{1}{y^2} - 1$     |       | M1M1A1               |
|          | Allow $\left(\frac{1}{y}\right)^2$ for $\frac{1}{y^2}$ throughout                                                                                 |       |                      |
|          | Allow $1^2$ for 1 throughout                                                                                                                      |       |                      |

| Question | Answer                                                                                                   | Mark  | Comments                                                                     |
|----------|----------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------|
| 24(a)    | <b>Alternative method 1: eliminates <math>d</math></b>                                                   |       |                                                                              |
|          | $4c + d = 7$<br>and<br>$10c + d = 22$                                                                    | M1    | oe equations                                                                 |
|          | $(10 - 4)c = 22 - 7$<br>or<br>$6c = 15$ or $c = 2.5$                                                     | M1dep | oe correct equation in $c$<br>eg $10c + 7 - 4c = 22$                         |
|          | $c = 2.5$ and $d = -3$                                                                                   | A1    | oe fraction or mixed number for $c$                                          |
|          | <b>Alternative method 2: eliminates <math>c</math></b>                                                   |       |                                                                              |
|          | $4c + d = 7$<br>and<br>$10c + d = 22$                                                                    | M1    |                                                                              |
|          | $(10 - 4)d = 70 - 88$<br>or $6d = -18$ or $d = -3$                                                       | M1dep | oe correct equation in $d$<br>eg $4\left(\frac{22 - d}{10}\right) + d = 7$   |
|          | $c = 2.5$ and $d = -3$                                                                                   | A1    | oe fraction or mixed number for $c$                                          |
|          | <b>Alternative method 3: works out the difference or the equation of the function through the points</b> |       |                                                                              |
|          | (difference $\Rightarrow$ ) $\frac{22 - 7}{10 - 4}$ or 2.5                                               | M1    | (gradient $\Rightarrow$ ) $\frac{22 - 7}{10 - 4}$ or ( $m \Rightarrow$ ) 2.5 |
|          | $c = 2.5$                                                                                                | M1dep | oe fraction or mixed number                                                  |
|          | $c = 2.5$ and $d = -3$                                                                                   | A1    | oe fraction or mixed number for $c$                                          |

| Question | Answer             | Mark | Comments |
|----------|--------------------|------|----------|
| 24(b)    | $\frac{2x - 1}{2}$ | B1   |          |

| Question | Answer                                                                                                                               | Mark  | Comments                                                                          |
|----------|--------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------|
| 25       | <b>Alternative method 1</b>                                                                                                          |       |                                                                                   |
|          | $(\sqrt{150} \Rightarrow) \sqrt{25} \sqrt{6} \text{ or } 5\sqrt{6}$<br>or<br>$(\sqrt{2} \times \sqrt{3} \Rightarrow) \sqrt{6}$       | M1    | numerator allow $\sqrt{2}\sqrt{3}$ for $\sqrt{6}$<br><br>denominator              |
|          | $\frac{\sqrt{25}\sqrt{6} - \sqrt{6}}{\sqrt{6}} \text{ or } \frac{5\sqrt{6} - \sqrt{6}}{\sqrt{6}}$<br>or $\frac{4\sqrt{6}}{\sqrt{6}}$ | M1dep | allow consistent use of $\sqrt{2}\sqrt{3}$ for $\sqrt{6}$                         |
|          | 4 with M1M1 awarded                                                                                                                  | A1    |                                                                                   |
|          | <b>Alternative method 2</b>                                                                                                          |       |                                                                                   |
|          | $\sqrt{6}(\sqrt{25} - 1) \text{ or } \sqrt{6}(5 - 1)$<br>or $4\sqrt{6}$<br>or<br>$(\sqrt{2} \times \sqrt{3} \Rightarrow) \sqrt{6}$   | M1    | numerator allow $\sqrt{2}\sqrt{3}$ for $\sqrt{6}$<br><br>denominator              |
|          | $\frac{\sqrt{6}(\sqrt{25} - 1)}{\sqrt{6}} \text{ or } \frac{\sqrt{6}(5 - 1)}{\sqrt{6}}$                                              | M1dep | allow consistent use of $\sqrt{2}\sqrt{3}$ for $\sqrt{6}$                         |
|          | 4 with M1M1 awarded                                                                                                                  | A1    |                                                                                   |
|          | <b>Alternative method 3</b>                                                                                                          |       |                                                                                   |
|          | $\frac{\sqrt{150} - \sqrt{6}}{\sqrt{2} \times \sqrt{3}} \times \frac{\sqrt{6}}{\sqrt{6}}$                                            | M1    | allow $\frac{\sqrt{2}\sqrt{3}}{\sqrt{2}\sqrt{3}}$ for $\frac{\sqrt{6}}{\sqrt{6}}$ |
|          | $\frac{\sqrt{900} - 6}{6}$                                                                                                           | M1dep | oe rationalised                                                                   |
|          | 4 with M1M1 awarded                                                                                                                  | A1    |                                                                                   |
|          | <b>Additional Guidance</b>                                                                                                           |       |                                                                                   |
|          | Condone answer 4 and –6 from use of $\sqrt{25} = \pm 5$                                                                              |       | M1M1A1                                                                            |

| Question | Answer                                                                                                       | Mark  | Comments                                                                                                                   |
|----------|--------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------|
| 26       | <b>Alternative method 1: substitutes <math>2f</math> for <math>d</math></b>                                  |       |                                                                                                                            |
|          | $\frac{e-f}{2f-e} = \frac{1}{4}$ or $2f-e = 4(e-f)$                                                          | M1    | oe equation in $e$ and $f$                                                                                                 |
|          | $6f = 5e$<br>or<br>$\frac{e}{f} = \frac{6}{5}$                                                               | M1dep | oe with variables collected<br>eg $1.5f = 1.25e$<br>oe with single fractions eg $\frac{f}{5} = \frac{e}{6}$                |
|          | 6 : 5                                                                                                        | A1    | oe ratio                                                                                                                   |
|          | <b>Alternative method 2: substitutes <math>\frac{d}{2}</math> for <math>f</math></b>                         |       |                                                                                                                            |
|          | $d-e = 4(e - \frac{d}{2})$ or $3d = 5e$                                                                      | M1    | oe equation in $d$ and $e$                                                                                                 |
|          | $6f = 5e$<br>or<br>$\frac{e}{f} = \frac{6}{5}$                                                               | M1dep | oe with variables collected<br>eg $1.5f = 1.25e$<br>oe with single fractions eg $\frac{f}{5} = \frac{e}{6}$                |
|          | 6 : 5                                                                                                        | A1    | oe ratio                                                                                                                   |
|          | <b>Alternative method 3: substitutes <math>2f</math> for <math>d</math> and forms simultaneous equations</b> |       |                                                                                                                            |
|          | $e-f = 1$<br>and<br>$2f-e = 4$                                                                               | M1    | oe with rhs in the ratio 1 : 4<br>eg $e-f = 2$<br>and<br>$2f-e = 8$                                                        |
|          | $f = 5$<br>or<br>$e = 6$                                                                                     | M1dep | correct solution for one unknown from their correct simultaneous equations<br>eg $f = 10$ or $e = 12$ from above equations |
|          | 6 : 5                                                                                                        | A1    | oe ratio                                                                                                                   |
|          | <b>Additional Guidance</b>                                                                                   |       |                                                                                                                            |
|          | 5 : 6 with no method marks awarded                                                                           |       | M0M0A0                                                                                                                     |

| Question | Answer                                                                                                                                                                                  | Mark | Comments                                                                                                                                                    |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27       | $5^2 \times \pi (\div 6)$ or $25\pi (\div 6)$                                                                                                                                           | M1   | oe<br>allow 3.14 or better for $\pi$ throughout                                                                                                             |
|          | $\frac{1}{2} \times 5 \times 5 \times \sin 60$<br>or $\frac{1}{2} \times 5 \times 2.5 \tan 60$<br>or $\frac{25}{2} \times \frac{\sqrt{3}}{2}$                                           | M1   | oe correct method to work out the area of the triangle or the area of the hexagon implied by $75 \sin 60$ or $37.5 \tan 60$<br>or $\frac{75\sqrt{3}}{2}$ oe |
|          | $\frac{25\pi}{6} - \frac{25\sqrt{3}}{4}$                                                                                                                                                | A1   | oe eg $\frac{1}{6} \left( 25\pi - \frac{75\sqrt{3}}{2} \right)$<br>implied by correct answer                                                                |
|          | $\frac{50\pi - 75\sqrt{3}}{12}$                                                                                                                                                         | A1   | oe in correct form<br>eg $\frac{50\pi - 15\sqrt{75}}{12}$                                                                                                   |
|          | <b>Additional Guidance</b>                                                                                                                                                              |      |                                                                                                                                                             |
|          | Using Pythagoras to work out the perpendicular height of the triangle may lead to an area of $\frac{5\sqrt{18.75}}{2}$ for the triangle or $15\sqrt{18.75}$ for the area of the hexagon |      | 2nd M1                                                                                                                                                      |

| Question | Answer                                                  | Mark | Comments       |
|----------|---------------------------------------------------------|------|----------------|
| 28(a)    | Correct graph (translated $90^\circ$ to the right)      | B1   | mark intention |
|          | <b>Additional Guidance</b>                              |      |                |
|          | Condone the graph starting at (90, 1)                   |      |                |
|          | Ignore the curve outside the domain $0 \leq x \leq 360$ |      |                |

| Question | Answer                                                  | Mark | Comments       |
|----------|---------------------------------------------------------|------|----------------|
| 28(b)    | Correct graph (translated 1 up)                         | B1   | mark intention |
|          | <b>Additional Guidance</b>                              |      |                |
|          | Ignore the curve outside the domain $0 \leq x \leq 360$ |      |                |

| Question | Answer                                                            | Mark | Comments                                                                                          |
|----------|-------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------|
| 28(c)    | Correct statement                                                 | B1   | eg this is $y = -\cos x$<br>$\cos 0 = 1$<br>it's upside down<br>it should be the same as $\cos x$ |
|          | <b>Additional Guidance</b>                                        |      |                                                                                                   |
|          | It has been reflected in the $x$ -axis instead of the $y$ -axis   |      | B1                                                                                                |
|          | It should have been reflected in the $y$ -axis                    |      | B1                                                                                                |
|          | It starts at $-1$ (instead of $1$ )                               |      | B1                                                                                                |
|          | $180$ is above the $x$ -axis                                      |      | B1                                                                                                |
|          | Correct curve drawn                                               |      | B1                                                                                                |
|          | $\cos(-180) = -1$                                                 |      | B1                                                                                                |
|          | She has done $-y$ instead of $-x$                                 |      | B1                                                                                                |
|          | It can't start as a negative                                      |      | B1                                                                                                |
|          | It should go down not up                                          |      | B0                                                                                                |
|          | She shouldn't have flipped it                                     |      | B0                                                                                                |
|          | Ignore non-contradictory statements alongside a correct statement |      | B1                                                                                                |

| Question | Answer                                                 | Mark | Comments                                                                                                                                                                                  |
|----------|--------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29       | <b>Alternative method 1</b>                            |      |                                                                                                                                                                                           |
|          | Rotation, $180^\circ$ , (about) $(-1, 1)$              | B3   | B2<br>rotation, $180^\circ$<br>or<br>rotation (about) $(-1, 1)$<br>or<br>turn, $180^\circ$ (about) $(-1, 1)$<br>B1<br>rotation<br>or<br>turn, $180^\circ$<br>or<br>turn (about) $(-1, 1)$ |
|          | <b>Alternative method 2</b>                            |      |                                                                                                                                                                                           |
|          | Enlargement, scale factor $-1$ (with centre) $(-1, 1)$ | B3   | B2<br>enlargement, scale factor $-1$<br>B1<br>enlargement (with centre) $(-1, 1)$                                                                                                         |
|          | <b>Alternative method 3</b>                            |      |                                                                                                                                                                                           |
|          | Reflection in $(-1, 1)$                                | B3   | there are no part marks in this method                                                                                                                                                    |
|          | <b>Additional Guidance</b>                             |      |                                                                                                                                                                                           |
|          | Allow $B$ instead of $(-1, 1)$ throughout              |      |                                                                                                                                                                                           |
|          | Compound transformation                                |      | B0                                                                                                                                                                                        |