# GCSE
# MATHEMATICS
# 8300/1H

Higher Tier Paper 1 Non-Calculator

**Mark scheme**

June 2023

Version: Final 1.0



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

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

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**Glossary for Mark Schemes**

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

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

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

Examiners should consistently apply the following principles.

**Diagrams**

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

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

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

**Questions which ask students to show working**

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

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

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

**Misread or miscopy**

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

**Further work**

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

**Choice**

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

**Work not replaced**

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

**Work replaced**

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

**Premature approximation**

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

**Continental notation**

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

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 1(a) | (0).35 | B1 | oe |
| | **Additional Guidance** | | |
| | Mark the answer line. If this is blank, mark the working | | |
| | If values are given in one or more forms, either on the answer line or in working with nothing on the answer line, all values must be correct | | |
| | eg1 $0.35 = \frac{7}{20}$ on answer line | | B1 |
| | eg2 $\frac{35}{100}$ and 3.5 in working with $\frac{35}{100}$ on answer line | | B1 |
| | eg3 $\frac{35}{100}$ and 3.5 in working with 3.5 on answer line | | B0 |
| | eg4 $\frac{35}{100}$ and 3.5 in working with answer line blank | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 1(b) | $\frac{5}{18}$ | B1 | oe eg $\frac{10}{36}$ |
| | **Additional Guidance** | | |
| | Mark the answer line. If this is blank, mark the working | | |
| | Allow 0.277… (minimum two 7s and two dots) or correct notation for recurring decimals | | |
| | If values are given in one or more forms, either on the answer line or in working with nothing on the answer line, all values must be correct | | |
| | eg1 $\frac{5}{18}$ = 0.277… on answer line | | B1 |
| | eg2 $\frac{5}{18}$ and 0.518 in working with answer line blank | | B0 |
| | $\frac{1\frac{2}{3}}{6}$ or $\frac{1.66...}{6}$ without answer in correct form | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 1(c) | 45 | B1 | |
| | **Additional Guidance** | | |
| | Mark the answer line. If this is blank, mark the working | | |
| | If values are given in one or more forms, either on the answer line or in working with nothing on the answer line, all values must be correct<br>eg1 $\frac{270}{6}$ = 45 on answer line | B1 | |
| | eg2 $\frac{270}{6}$ and $44\frac{5}{6}$ in working with answer line blank | B0 | |
| | Do not allow unprocessed answers<br>eg $\frac{270}{6}$ | B0 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 2 | $x < 13$ or $13 > x$ | B1 | |
| | **Additional Guidance** | | |
| | $x = 13$ in working with $x < 13$ on answer line | B1 | |
| | $x < 13$ and $(x =)\ 13$ on answer line | B0 | |
| | $x < 13$ in working with $x = 13$ or 13 on answer line | B0 | |
| | Ignore number lines drawn | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 3 | $2\frac{1}{4}$ | B1 | oe mixed number |
| | **Additional Guidance** | | |
| | $\frac{9}{4} = 2\frac{1}{4}$ or $2.25 = 2\frac{1}{4}$ on answer line | B1 | |
| | $2\frac{1}{4} = \frac{9}{4}$ or $2\frac{1}{4} = 2.25$ on answer line | B0 | |
| | Otherwise, $2\frac{1}{4}$ and $\frac{9}{4}$ or $2\frac{1}{4}$ and $2.25$ on answer line in either order (or in working with answer line blank and answer unclear) | B0 | |
| | $1\frac{5}{4}$ | B0 | |
| | $2\left(\frac{1}{4}\right)$ or $2 + \frac{1}{4}$ | B0 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 4 | **Alternative method 1 – numerical** | | |
| | 1 and 5 and 3 or 9 (parts)<br>or<br>numbers in the ratio 1 : 5 : 3<br>or<br>(angle sum on a straight line =) 180 | M1 | oe may be seen in a ratio<br>eg $\frac{1}{5} : 1 : \frac{3}{5}$ or $\frac{1}{3} : \frac{5}{3} : 1$<br>numbers can be in any order<br>eg 30, 10, 50 |
| | 180 ÷ (1 + 5 + 3) or 20<br>or 180 ÷ $\frac{9}{5}$ | M1dep | oe |
| | 100 | A1 | |
| | **Alternative method 2 – algebraic** | | |
| | $x$ and $5x$ and $3x$ or $9x$<br>or<br>(angle sum on a straight line =) 180 | M1 | oe correct terms with any angle as $x$<br>any letter, any order<br>may be seen on diagram |
| | Correct equation with correct method to solve for one angle | M1dep | eg $x + 5x + 3x = 180$<br>and 180 ÷ (1 + 5 + 3) |
| | 100 | A1 | |
| | **Additional Guidance** | | |
| | $x + 5x + 3x = 360$ or 360 ÷ 9 | | M1M0A0 |
| | $\frac{1}{5}x + x + \frac{3}{5}x = 180$ and $180 \div \left(\frac{1}{5} + 1 + \frac{3}{5}\right)$ | | M1M1 |
| | $\frac{1}{3}x + \frac{5}{3}x + x = 180$ and $180 \div \left(\frac{1}{3} + \frac{5}{3} + 1\right)$ | | M1M1 |
| | Angle *EBD* marked as 100 on the diagram with answer line blank | | M1M1A1 |
| | 20 and 100 in working with no or incorrect answer chosen | | M1M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 5 | All conditions met:<br>• first number is prime<br>• second number is prime<br>• correctly evaluated<br>• even answer<br>• answer in range | B3 | if their product is incorrectly evaluated or missing, then 'even answer' and 'answer in range' refer to the correct product for their multiplication<br><br>B2 4 conditions met<br>B1 3 conditions met |
| | **Additional Guidance** | | |
| | $2 \times 29 = 58$ (or $29 \times 2 = 58$) is the only fully correct solution | | B3 |
| | Allow 50 to 60 inclusive for 'answer in range' | | |
| | Award the best mark from boxes or in working for up to B2 | | |
| | The two prime numbers do not have to be different | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6 | $\frac{5}{6} \times 96$ or 80 | M1 | oe eg $96 \div 6 \times 5$<br>implied by 176 |
| | $\frac{1}{4} \times$ their 80 or 20 | M1dep | oe eg $80 \div 4$ |
| | $\frac{2}{3} \times 96$ or 64 | M1 | oe eg $96 \div 3 \times 2$<br>accept 0.66 or better for $\frac{2}{3}$ |
| | 84(.00) | A1 | SC2 100.8(0) or [77.32, 77.34]<br>condone incorrect money notation<br>eg 84.0 or 84.00p |
| | **Additional Guidance** | | |
| | SC2 for 100.8(0) is from misreading as Andrew gets £96 | | |
| | SC2 for [77.32, 77.34] is from $\frac{2}{3}$ of 80 plus $\frac{1}{4}$ of 96 | | |
| | Do not accept '$\frac{5}{6}$ of 96' or '$\frac{1}{4}$ of 80' or '$\frac{2}{3}$ of 96' for M marks unless accompanied by a correct method or value | | |

| Q | Answer | Mark | Comments | |
|---|---|---|---|---|
| 7 | **Alternative method 1 – evaluation and division** | | | |
| | $(5^2 =)$ 25 or $(3 \times 5^2 =)$ 75<br>or<br>600 ÷ 3 or 200<br>or<br>600 ÷ $5^2$ or 24 | M1 | oe<br><br>oe eg $3 \times 200 = 600$<br><br>oe eg $25 \times 24 = 600$ | |
| | 600 ÷ 3 ÷ $5^2$ or 8 | M1dep | oe eg $8 \times 75 = 600$ | |
| | 3 with M1 awarded and not from incorrect working | A1 | | |
| | **Alternative method 2 – product of prime factors** | | | |
| | 600 written as a product of factors where at least one factor is prime | M1 | eg 2 and 300 or 5 and 120<br>or 2 and 2 and 150<br>may be seen on a factor tree or in repeated division<br>allow one strand to be incorrect if a previous value completes the product<br>eg $20 \times 30$ followed by $2 \times 10 \times 5 \times 8$ implies $2 \times 10 \times 30$ for M1 | |
| | 2 and 2 and 2 and 3 and 5 and 5 | M1dep | may be seen on a factor tree or in repeated division | |
| | 3 with M1 awarded and not from incorrect working | A1 | | |
| | **Additional Guidance** | | | |
| | $8 \times 3 \times 25 = 600$ and answer 3 | | | M1M1A1 |
| | $2^3$ on answer line with M2 awarded | | | M1M1A0 |
| | Answer 3 on answer line with no working | | | M0M0A0 |
| | Do not allow 600 ÷ 3 × $5^2$ for M2 in alt 1 unless recovered, but do allow<br>$\frac{600}{3 \times 5^2}$ or 600 ÷ $(3 \times 5^2)$ | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8 | $13x + 22$ | B2 | B1 $15x + 20$ or $-2x + 2$<br>or $13x + a$ or $bx + 22$, where $a$ and $b$ can be any numbers |
| | **Additional Guidance** | | |
| | Do not ignore further working for B2<br>eg $13x + 22 = 35x$<br>eg $13x + 22$, $x = \frac{22}{13}$ | | B1<br>B1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9 | Any two from:<br>Reference to graph passing through point where $x = 0$<br>Reference to graph being incorrect for negative $x$ values<br>Reference to the graph stopping before the end of the axes/axis | B2 | B1 any one correct reference<br>eg the graph touches the $y$-axis<br>eg the graph to the left of the $y$-axis should be below the $x$-axis<br>eg the graph should go to the ends of the axes |
| | **Additional Guidance** | | |
| | Ignore non-contradictory, irrelevant responses alongside a correct response | | |
| | Draws correct graph | | B2 |
| | Draws graph with one section correct for positive values of $x$ or negative values of $x$ | | B1 for that section |
| | 'It isn't the graph of $y = \frac{1}{x}$' scores B0, but B1 may still be scored for the other criticism | | |
| | 'There are no numbers on the axes' scores B0, but B1 may still be scored for the other criticism | | |
| | **Mark for graph touching $y$-axis** | | |
| | You cannot have $x = 0$ | | B1 |
| | The line in the top right should be moved to the right | | B1 |
| | It says $x$ doesn't = 0 but it (the sketch) does | | B1 |
| | One line is touching the $y$-axis | | B1 |
| | The lines should be symmetrical | | B0 |
| | You cannot have $y = 0$ | | B0 |
| | One line is touching the $y$-axis but the other isn't | | B0 |

**Question 9 Additional Guidance continues on the next page**

| | | |
|---|---|---|
| **9 cont** | **Mark for negative values being in the wrong quadrant** | |
| | There shouldn't be anything in the top-left section | B1 |
| | There should be something in the bottom-left section | B1 |
| | It is the graph of $y = \frac{1}{x^2}$ | B1 |
| | It should have rotational symmetry | B1 |
| | It should be symmetrical about $y = x$ | B1 |
| | It should be symmetrical about $y = -x$ | B1 |
| | It should be symmetrical | B0 |
| | One should be negative | B0 |
| | The bit on the left is wrong | B0 |
| | The negative values are plotted incorrectly | B0 |
| | **Reference to the graph stopping before the end of the axes** | |
| | It stops before the end of the axes | B1 |
| | The lines don't go far enough | B1 |
| | The lines need to be higher up | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 10 | **Alternative method 1 – algebra based on Sunita's age** | | |
| | 5 × 3 or 15 | M1 | may be implied by their algebraic total of the three ages being divided by 3 |
| | $x - 1$ or $2x$<br>or $4x - 1$ | M1 | oe expressions<br>any letter throughout |
| | $x$ + their $(x - 1)$ + their $2x$ = their 15<br>or $4x - 1$ = their 15 | M1dep | oe equation eg $\frac{x + x - 1 + 2x}{3} = 5$<br>dep on M1M1 |
| | $(x =)$ 4 | M1dep | correct solution to their equation<br>if the solution has a decimal part allow truncation or rounding to the nearest whole number |
| | 8 | A1 | |
| | **Alternative method 2 – algebra based on Joel's age** | | |
| | 5 × 3 or 15 | M1 | may be implied by their algebraic total of the three ages being divided by 3 |
| | $\frac{y}{2}$ or $\frac{y}{2} - 1$<br>or $2y - 1$ | M1 | oe expressions<br>any letter throughout<br>$2y - 1$ must not come from $y + y - 1$ |
| | $y$ + their $\frac{y}{2}$ + their $(\frac{y}{2} - 1)$ = their 15 | M1dep | oe equation eg $\frac{y + \frac{y}{2} + \frac{y}{2} - 1}{3} = 5$<br>dep on M1M1 |
| | $2y$ + their $y$ + their $(y - 2) = 2 \times$ their 15<br>or $4y - 2 = 30$<br>or $2y - 1 = 15$ | M1dep | their equation with no denominator |
| | 8 | A1 | |

**Question 10 continues on the next page**

| | | | |
|---|---|---|---|
| **10 cont** | **Alternative method 3 – trial and improvement** | | |
| | 5 × 3 or 15 | M1 | may be implied by their total of the three ages being divided by 3 |
| | Trial of three numbers which fit the criteria, with either their sum correctly evaluated or their sum divided by 3 | M1 | eg 2 + 1 + 4 = 7<br>or (2 + 1 + 4) ÷ 3<br>condone missing brackets |
| | Second trial of three numbers which fit the criteria, with either their sum correctly evaluated or their sum divided by 3 | M1dep | dep on previous M1<br>eg 3 + 2 + 6 = 11<br>or (3 + 2 + 6) ÷ 3<br>condone missing brackets |
| | 4, 3 and 8 selected as their final combination | M1dep | any order<br>implies M4 |
| | 8 | A1 | |
| | **Additional Guidance** | | |
| | Up to M4 may be awarded for correct work seen in multiple attempts even if not subsequently used | | |
| | Correct expressions, but the sum of the three ages is equated to 5<br>eg $4x - 1 = 5$ | | M0M1M0M0A0 |
| | In alt 1, the correct value of $x$ or the correct age for Joel for their two terms for Beth and Joel, with one correct, implies the first 4 marks<br>eg $x$ and $x + 1$ and $2x$, with $x = 3.5$ or answer 7 | | M1M1M1M1A0 |
| | In alt 2, the correct value of $y$ for their two terms for Sunita and Beth, with one correct, implies the first 4 marks<br>eg $y$ and $\frac{y}{2}$ and $(\frac{y}{2} + 1)$, with $y = 7$ or answer 7 | | M1M1M1M1A0 |
| | In alt 1 and alt 2, condone missing brackets in equations if not recovered for up to M1M1M1<br>eg $x + x - 1 + 2x \div 3 = 5$ not recovered | | M1M1M1M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **11(a)** | $\frac{13}{100}$ or 0.13 or 13% | B1 | oe fraction, decimal or percentage |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **11(b)** | $\frac{59}{100}$ or 0.59 or 59% | B1 | oe fraction, decimal or percentage<br>SC1<br>answers 13 in (a) and 59 in (b)<br>or $\frac{13}{x}$ in (a) and $\frac{59}{x}$ in (b)<br>where $x$ is an integer $\geqslant 59$ |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **11(c)** | $\frac{89}{100}$ or 0.89 or 89% | B1 | oe fraction, decimal or percentage<br>SC1<br>answers 13 in (a) and 89 in (c)<br>or $\frac{13}{x}$ in (a) and $\frac{89}{x}$ in (c), where $x$ is an integer $\geqslant 89$<br>or<br>answers 59 in (b) and 89 in (c)<br>or $\frac{59}{x}$ in (b) and $\frac{89}{x}$ in (c), where $x$ is an integer $\geqslant 89$ |
| | **Additional Guidance** | | |
| | 13 in (a) and 59 in (b) and 89 in (c) scores 0, SC1, SC1 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **12(a)** | $1 \leqslant a < 10$ | B1 | allow 1.0 etc |
| | **Additional Guidance** | | |
| | Accept $9.\dot{9}$ for 10 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 12(b) | 0.0072 | B2 | B1 $7.2 \times 10^{3}$<br>or $7.2 \times 10^{-3}$<br>ignore extra 0s which don't affect the value |
| | **Additional Guidance** | | |
| | 0.0072 in working with $7.2 \times 10^{-3}$ on the answer line | | B1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 13(a) | $(y =)\ ax + b$<br>and<br>$(y =)\ ax + 2a + b$ | B2 | any letter for $x$ other than $a$ or $b$ or $y$<br>B1<br>$(y =)\ ax + b$<br>or<br>$(y =)\ a(x + 2) + b$<br>or $(y =)\ ax + 2a + b$<br>or<br>substitution of two values for $x$ with a difference of 2 and correct working to show that the output increases by $2a$<br>eg substituting $x = 3$ and $x = 5$ to get $3a + b$ and $5a + b$ |
| | **Additional Guidance** | | |
| | Allow $xa$ for $ax$ throughout | | |
| | Do not allow $a \times x + b$ for $ax + b$ unless recovered | | |
| | Allow, eg $(x + 2) \times a + b$ for $a(x + 2) + b$ | | |
| | Do not allow missing brackets unless recovered<br>eg do not allow $x + 2 \times a$ for $a(x + 2)$ | | |
| | Do not accept written answers without the necessary algebra<br>eg The input has increased by 2 and will then be multiplied by $a$, so the output will increase by $2a$ | | B0 |
| | Ignore further non-contradictory work if B2 awarded | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 13(b) | **Alternative method 1 – using $k$** | | |
| | $\frac{f(6)}{f(2)}\left(=\frac{36k}{4k}\right) = 9$<br>or<br>$f(3) = 9k$ | M1 | condone eg $k36$ |
| | $\frac{f(6)}{f(2)} = 9$ and $f(3) = 9k$<br>and No | A1 | condone $k9$ |
| | **Alternative method 2 – substituting a value for $k$** | | |
| | Identifies a value of $k$ other than 1<br>and<br>correctly evaluates $\frac{f(6)}{f(2)}$ or $f(3)$ | M1 | eg $k = 2$<br>and<br>$\frac{f(6)}{f(2)} = 9$ or $f(3) = 18$ |
| | Identifies a value of $k$ other than 1<br>and<br>correctly evaluates $\frac{f(6)}{f(2)}$ and $f(3)$<br>and No | A1 | eg $k = 2$ and $\frac{f(6)}{f(2)} = 9$ and $f(3) = 18$<br>and No |
| | **Additional Guidance** | | |
| | $9k$ from $\frac{f(6)}{f(2)}$ is M0, but M1 can be awarded if accompanied by $f(3) = 9k$ | | |
| | Do not allow 9 from $\frac{36}{4}$ (unless $\frac{36}{4}$ is from $\frac{36k}{4k}$) | | |
| | Do not allow 9 from $\frac{36k^2}{4k^2}$ | | |
| | Students may correctly state that $\frac{f(6)}{f(2)}$ and $f(3)$ are (only) equal when $k = 1$<br>This may replace 'No' in their answer, but does not score without $9k$ and 9 | | |
| | Do not allow unprocessed values, eg $6^2$, $2^2$ or $3^2$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14 | 12 24 30 41 | B2 | B1<br>their median = 2 × their LQ with the first eight values in order and their UQ and their last number ⩾ their median<br>or<br>their UQ = 2.5 × their LQ with the first ten numbers in order and their last number ⩾ their UQ<br>or<br>their range = 2 × their interquartile range with all values in order |
| | **Additional Guidance** | | |
| | Take the boxes to be the LQ, median, UQ and highest value in that order | | |
| | Decimal values can score up to B1<br>eg 11.5 23 29 40 has median = 2 × LQ | | B1 |
| | Ignore blank boxes for B1 | | |
| | If all boxes are blank, mark the working lines | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 15 | True<br>Not true<br>Not true<br>True | B4 | B1 each correct answer |
| | **Additional Guidance** | | |
| | Allow a cross if it's the only answer in that row | | |
| | If one tick and one or two crosses are given in a row, mark the tick | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16 | **Alternative method 1 – equates coefficients and eliminates an unknown** | | |
| | $8x - 20y = 52$ and $15x + 20y = 40$<br>or<br>$6x - 15y = 39$ and $6x + 8y = 16$ | M1 | oe<br>equates coefficients of one unknown<br>allow one term error |
| | $8x + 15x = 52 + 40$ or $23x = 92$<br>or<br>$-15y - 8y = 39 - 16$ or $-23y = 23$ | M1dep | oe<br>eliminates an unknown<br>must be correct for their equations |
| | $x = 4$ and $y = -1$ | A2 | A1 $x = 4$ from correct method<br>or $y = -1$ from correct method |
| | **Alternative method 2 – substitutes for $x$** | | |
| | $x = 6.5 + 2.5y$<br>or<br>$x = \frac{8}{3} - \frac{4}{3}y$ | M1 | oe<br>makes $x$ the subject of one equation<br>allow one term error |
| | $3(6.5 + 2.5y) + 4y = 8$<br>or $11.5y = -11.5$<br>or<br>$2(\frac{8}{3} - \frac{4}{3}y) - 5y = 13$<br>or $-\frac{23}{3}y = \frac{23}{3}$ | M1dep | oe<br>eliminates $x$<br>must be correct for their rearrangement |
| | $x = 4$ and $y = -1$ | A2 | A1 $y = -1$ from this method |

**Question 16 continues on the next page**

| | | | |
|---|---|---|---|
| **16 cont** | **Alternative method 3 – substitutes for $y$** | | |
| | $y = 0.4x - 2.6$<br>or<br>$y = 2 - 0.75x$ | M1 | oe<br>makes $y$ the subject of one equation<br>allow one term error |
| | $3x + 4(0.4x - 2.6) = 8$<br>or $4.6x = 18.4$<br>or<br>$2x - 5(2 - 0.75x) = 13$<br>or $5.75x = 23$ | M1dep | oe<br>eliminates $y$<br>must be correct for their rearrangement |
| | $x = 4$ and $y = -1$ | A2 | A1 $x = 4$ from this method |
| | **Alternative method 4 – makes the same unknown the subject in both equations** | | |
| | $x = 6.5 + 2.5y$ or $x = \frac{8}{3} - \frac{4}{3}y$<br>or<br>$y = 0.4x - 2.6$ or $y = 2 - 0.75x$ | M1 | oe<br>makes $y$ or $x$ the subject of one equation<br>allow one term error |
| | $6.5 + 2.5y = \frac{8}{3} - \frac{4}{3}y$<br>or $\frac{23}{6}y = -\frac{23}{6}$<br>or<br>$0.4x - 2.6 = 2 - 0.75x$<br>or $1.15x = 4.6$ | M1dep | oe<br>makes $y$ or $x$ the subject of both equations (maximum one term error)<br>and<br>eliminates $y$ or $x$<br>must be correct for their rearrangements |
| | $x = 4$ and $y = -1$ | A2 | A1 $x = 4$ from correct method<br>or $y = -1$ from correct method |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work seen in multiple attempts, even if not subsequently used | | |
| | In alts 2, 3 and 4 allow rounding or truncating to 1dp or better for up to M1M1<br>eg (Alt 4) $6.5 + 2.5y = 2.7 - 1.3y$ | | M1M1 |
| | Answers from trial and improvement or with no working score 0 or 4 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 17 | **Alternative method 1 – expressions in $x$** | | |
| | $4\pi x^2 \div 2$ or $2\pi x^2$<br>or $\pi x^2$<br>or $\pi(3x)^2$ or $9\pi x^2$<br>or $2 \times \pi(3x)^2$ or $18\pi x^2$<br>or $2\pi x(3x)$ or $6\pi x^2$ | M1 | oe area of curved face of hemisphere<br>oe area of flat face of hemisphere<br>oe area of one flat face of cylinder<br>oe area of both flat faces of cylinder<br>oe area of curved face of cylinder |
| | $4\pi x^2 \div 2 + \pi x^2$ or $3\pi x^2$<br>or<br>$\pi(3x)^2 + \pi(3x)^2 + 2\pi x(3x)$<br>or $9\pi x^2 + 9\pi x^2 + 6\pi x^2$<br>or $24\pi x^2$ | M1dep | oe total surface area of the hemisphere<br>oe total surface area of the cylinder |
| | $3\pi x^2$ and $24\pi x^2$ and 1 : 8 | A1 | either order |
| | **Alternative method 2 – substituting a value for $x$** | | |
| | Substitutes a value for $x$ and works out the area of at least one of<br>area of curved face of hemisphere<br>area of flat face of hemisphere<br>area of one flat face of cylinder<br>area of both flat faces of cylinder<br>area of curved face of cylinder | M1 | eg using $x = 5$, at least one of<br>$50\pi$<br>$25\pi$<br>$225\pi$<br>$450\pi$<br>$150\pi$ |
| | Substitutes a value for $x$ and works out an expression for the total surface area of the hemisphere or the cylinder | M1dep | eg using $x = 5$<br>total surface area of hemisphere =<br>$25\pi + 50\pi$ or $75\pi$<br>or<br>total surface area of cylinder =<br>$225\pi + 225\pi + 150\pi$ or $600\pi$ |
| | Both correct total surface areas for their value of $x$ and 1 : 8 | A1 | either order |

**Question 17 continues on the next page**

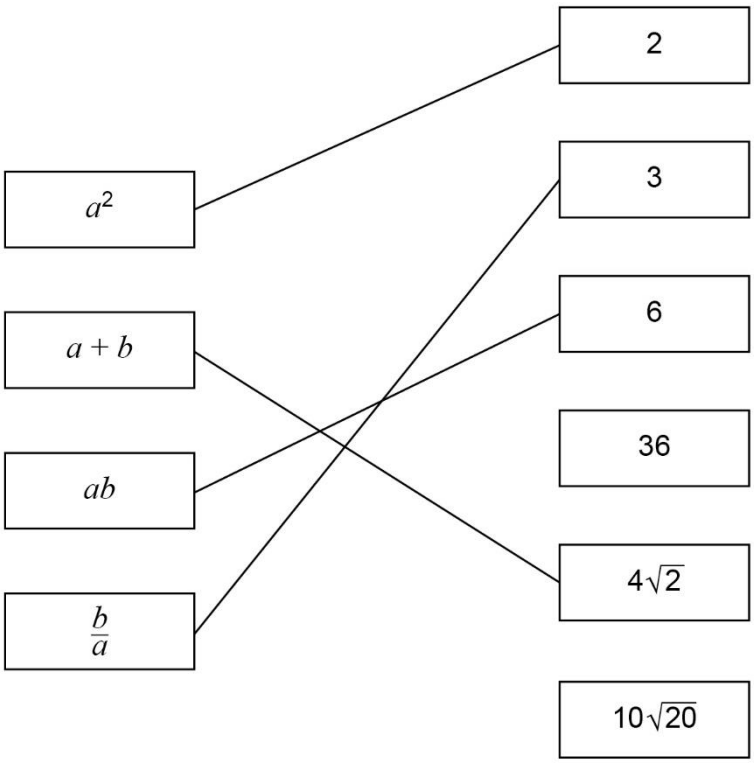
| | | |
|---|---|---|
| **17 cont** | **Additional Guidance** | |
| | 1 : 8 or 8 : 1 without correct working or values | M0M0A0 |
| | Condone π missing consistently for all marks | |
| | Allow 'correct' and consistent values of π throughout (eg 3, 3.14, $\frac{22}{7}$) | |
| | Condone use of $r$ for $x$ throughout | |
| | Do not allow $3\pi x^2$ from $3x \times \pi \times x$ oe | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **18** | 290 | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **19** | $4 \times 3 \times 2$ (× 1) × 2<br>or<br>$5 \times 4 \times 3 \times 2$ (× 1) × $\frac{2}{5}$<br>or 120 × $\frac{2}{5}$ | M1 | oe |
| | 48 | A1 | SC1 12 or 24 or 72 or 120 |
| | **Additional Guidance** | | |
| | 12 is the number of possible 5-digit numbers ending in two odd digits | | |
| | 24 is the number of possible 5-digit numbers ending in 7<br>or the number of possible 5-digit numbers ending in 9 | | |
| | 72 is the number of possible 5-digit even numbers | | |
| | 120 is the number of possible 5-digit numbers | | |
| | Ignore any listing of possible numbers | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 20 | **Alternative method 1 – finds K in terms of L and substitutes** | | |
| | $3K = 4L$<br>or<br>$K = L + 2M$ | M1 | oe correct equation<br>eg $K = \frac{4L}{3}$ or $L = \frac{3K}{4}$<br>may be implied by values on diagram |
| | $\frac{4L}{3} = L + 2M$ | M1dep | oe correct equation in L and M<br>eg $4L = 3L + 6M$ |
| | 6 | A1 | condone 6M (= L) |
| | **Alternative method 2 – finds two variables in terms of the other variable** | | |
| | Finds one variable in terms of one other<br>eg L is $\frac{3}{4}$ of K | M1 | oe fractions, decimals, percentages or ratio<br>eg $K : L = 1 : \frac{3}{4}$<br>may be implied by values on diagram |
| | Finds two variables in terms of the other<br>eg L is $\frac{3}{4}$ of K and M is $\frac{1}{8}$ of K | M1dep | oe fractions, decimals, percentages or ratio<br>eg $K : L : M = 1 : \frac{3}{4} : \frac{1}{8}$<br>may be implied by values on diagram |
| | 6 | A1 | condone 6M (= L) |
| | **Alternative method 3 – assumes a mass for one unknown** | | |
| | Assumes a mass for one unknown and works out the mass of one other | M1 | eg K = 2 kg and L = 1.5 kg |
| | Assumes a mass for one unknown and works out the masses of the other two | M1dep | eg<br>K = 2 kg and L = 1.5 kg and M = 0.25 kg |
| | 6 | A1 | condone 6M (= L) |
| | **Additional Guidance** | | |
| | Condone 1.33 or better for $\frac{4}{3}$, but 0.125 for $\frac{1}{8}$ must be correct | | |
| | 3K : 4L is not enough for M1 | | |
| | Ignore units | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 21 | $(x-3)^2-24$<br>or $a=3$ and $b=24$ | B2 | B1 $(x-3)^2$ … or $(x-3)(x-3)$ …<br>or<br>$a=3$ (implied by 3, –24)<br>or<br>$x^2-2ax+a^2-b$<br>or<br>$-2a=-6$ or $2a=6$<br>or<br>$a^2-b=-15$<br>or<br>correct $b$ for their $a$ |
| | **Additional Guidance** | | |
| | $(x+3)^2-24$ (24 is correct for $a=-3$) | | B1 |
| | $(x-6)^2-51$ (51 is correct for $a=6$) | | B1 |
| | $(x+6)^2-51$ (51 is correct for $a=-6$) | | B1 |

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="4">22</td><td>$a + b \rightarrow 4\sqrt{2}$<br>$ab \rightarrow 6$<br>$\frac{b}{a} \rightarrow 3$</td><td>B3</td><td>B1 each correct match</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">
</td><td>B3</td></tr>
<tr><td colspan="2">Two lines from a left-hand box is choice</td><td>B0</td></tr>
</table>

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 23 | **Alternative method 1 – subtracting powers of 10 algebraically** | | |
| | Denotes the given recurring decimal by a letter and multiplies by one of 10, 100, etc | M1 | eg<br>$10x = 1.33\ldots$<br>or $100x = 13.3\ldots$ |
| | Denotes the given recurring decimal by a letter<br>and<br>multiplies by one or two of 10, 100, etc and subtracts accordingly | M1dep | eg<br>$10x - x = 1.333\ldots - 0.1333\ldots$<br>or $9x = 1.2$ or $\frac{1.2}{9}$<br>or<br>$100x - x = 13.333\ldots - 0.1333\ldots$<br>or $99x = 13.2$ or $\frac{13.2}{99}$<br>or<br>$100x - 10x = 13.333\ldots - 1.333\ldots$<br>or $90x = 12$ or $\frac{12}{90}$ |
| | $\frac{2}{15}$ | A1 | |
| | **Alternative method 2 – subtracting powers of 10 numerically** | | |
| | Multiplies the given decimal by one of 10, 100, etc | M1 | eg $0.1\dot{3} \times 10 = 1.\dot{3}$ |
| | Multiplies the given decimal by one or two of 10, 100, etc and subtracts appropriately in fraction form | M1dep | eg<br>$0.1\dot{3} \times 100 = 13.\dot{3}$<br>and $0.1\dot{3} \times 10 = 1.\dot{3}$<br>and $\frac{13.3 - 1.3}{100 - 10}$ or $\frac{12}{90}$ |
| | $\frac{2}{15}$ | A1 | |

**Question 23 continues on the next page**

| | | | |
|---|---|---|---|
| **23 cont** | **Alternative method 3 – splitting into a known fraction and a recurring decimal** | | |
| | Splits into 0.1 and $0.0\dot{3}$ and uses a correct first step from alt 1 or alt 2 with $0.0\dot{3}$ | M1 | eg $10x = 0.33\ldots$<br>or $0.0\dot{3} \times 100 = 3.33\ldots$<br>0.1 does not need to be seen separately at this stage |
| | Correct method to evaluate $0.0\dot{3}$ as a fraction<br>and addition to $\frac{1}{10}$<br>or $\frac{1}{30} + \frac{1}{10}$<br>or $\frac{4}{30}$ | M1dep | oe fraction |
| | $\frac{2}{15}$ | A1 | |
| | **Additional Guidance** | | |
| | Condone decimals within fractions up to M2 eg $\frac{1.2}{9}$ | | M2 |
| | Equals signs may be implied throughout | | |
| | Subtraction signs must be seen or the results correct | | |
| | Recurring decimals should be denoted by correct notation or at least two of the recurring digits followed by at least two dots. However, condone missing dots if the result is, or would be, correct<br>eg condone $13.3 - 1.3 = 100x - 10x$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 24 | **Alternative method 1 – using the equations of the lines** | | |
| | $\frac{22-y}{8-0} = 2$<br>or $22 = 2 \times 8 + c$<br>or $(c =)\ 22 - 2 \times 8$<br>or $c = 6$<br>or $P$ is at (0, 6)<br>or $(PR =)\ y = 2x + 6$<br>or $y$-coordinate of $P$ is 6<br>or $y$-coordinate of $Q$ is 6 | M1 | oe equation using any letter<br>$y$ is the $y$-coordinate of $P$<br><br><br><br>ignore missing brackets<br><br>may be seen on diagram<br>may be seen on diagram |
| | $2m = -1$<br>or $(m =) -\frac{1}{2}$ | M1 | oe<br>gradient of $RQ$ |
| | 22 = their $-\frac{1}{2} \times 8 + c$<br>or<br>$22 = -4 + c$<br>or $c = 26$<br>or<br>$(RQ =)\ y = -\frac{1}{2}x + 26$ | M1dep | oe equation in $c$<br>dep on previous mark<br><br><br><br><br>oe equation of $RQ$ |
| | their $(-\frac{1}{2}x + 26)$ = their 6<br>or<br>$x$-coordinate of $Q$ is 40 | M1dep | oe equation in $x$ where $x$ is the $x$-coordinate of $Q$<br>dep on M3<br>$-\frac{1}{2} = \frac{22 - \text{their } 6}{8-x}$ implies M4 if their 6 is correct or from correct working |
| | (40, 6) | A1 | |

**Question 24 continues on the next page**

| | | | |
|---|---|---|---|
| **24 cont** | **Alternative method 2 – using similar triangles** | | |
| | Drops a perpendicular from $R$ to point $S$ on $PQ$<br>and<br>uses $RS = 2PS = 16$ to work out that $P$ is at (0, 6) | M1 | any or no letter<br><br>eg $22 - 2 \times 8$ |
| | $2m = -1$<br>or $(m =) -\frac{1}{2}$<br>or<br>$\frac{RS}{SQ} = \frac{1}{2}$ | M1 | oe<br>gradient of $RQ$ |
| | $16 \times 2$ or 32 | M1dep | length of $SQ$<br>may be seen on diagram<br>dep on previous mark |
| | 8 + their 32<br>or<br>$x$-coordinate of $Q$ is 40 | M1dep | |
| | (40, 6) | A1 | |
| | **Additional Guidance** | | |
| | Note that 40 (for the $x$-coordinate of $Q$) implies M3 (on alt 2) and implies M4 if 6 is also seen (on alt 1) | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 25 | sin 30 = $\frac{1}{2}$<br>or<br>tan 45 = 1<br>or<br>cos 30 = $\frac{\sqrt{3}}{2}$ | M1 | oe eg tan 45 = $\frac{\sqrt{2}}{\sqrt{2}}$ or 4 sin 30 = 2<br>or 2 cos 30 = $\sqrt{3}$<br>implied by position in the expression<br>may be seen in a table |
| | substitution of all three correct values | M1dep | eg<br>$\frac{4\times\frac{1}{2}-1}{2\times\frac{\sqrt{3}}{2}}$ or $\frac{2-1}{2\times\frac{\sqrt{3}}{2}}$ or $\frac{2-1}{\sqrt{3}}$ |
| | $\frac{1}{\sqrt{3}}$ or $\frac{\sqrt{3}}{3}$ | M1dep | |
| | ($\frac{1}{\sqrt{3}}$ or $\frac{\sqrt{3}}{3}$ =) tan 30<br>or $x$ = 30<br>with full working seen for M3 | A1 | |
| | **Additional Guidance** | | |
| | Allow $\sqrt{1}$ for 1 throughout | | |
| | Reference to 30° being an acute angle is not required | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 26 | **Alternative method 1** | | |
| | $20\pi \div 2\pi$ or 10 | M1 | oe<br>may be seen on diagram<br>implied by diameter = 20 |
| | $x^2 + x^2 = (\text{their } 10)^2$<br>or $2x^2 = 100$<br>or $x^2 = 50$<br>or their 10 × sin 45<br>or their 10 × cos 45<br>or their 10 × $\frac{1}{\sqrt{2}}$ | M1 | oe any letter (condone $a$)<br>their 10 is their length $OQ$ (the radius of the circle) |
| | $\sqrt{\text{their } 10^2 \div 2}$<br>or $\sqrt{50}$ or $5\sqrt{2}$<br>or $4 \times \sqrt{50}$<br>or<br>4 × their 10 × sin 45<br>or 4 × their 10 × cos 45<br>or $40 \times \frac{1}{\sqrt{2}}$ or $\frac{40\sqrt{2}}{2}$<br>or<br>$20\sqrt{2}$ | M1dep | oe value for the length of one side of the square or the perimeter of the square<br>eg $\frac{10}{\sqrt{2}}$<br>dep on previous mark |
| | 2 with full working seen for M3 | A1 | |

**Question 26 continues on the next page**

| | | | |
|---|---|---|---|
| **26 cont** | **Alternative method 2** | | |
| | $20\pi \div 2\pi$ or 10<br>or<br>side length of square = $5\sqrt{a}$ | M1 | oe<br>may be seen on diagram<br>implied by diameter = 20 |
| | (Perimeter of square = $20\sqrt{a}$ and)<br>side length of square = $5\sqrt{a}$<br>and<br>$\left(5\sqrt{a}\right)^2 + \left(5\sqrt{a}\right)^2$ = (their 10)$^2$ | M1 | oe<br>their 10 is their length *OQ* (the radius of the circle)<br>condone missing brackets if recovered |
| | $25a + 25a$ = (their 10)$^2$<br>or $50a = 100$ | M1dep | dep on M1M1 |
| | 2 with full working seen for M3 | A1 | |
| | **Additional Guidance** | | |
| | 2 with no working | | M0M0M0A0 |
| | $\sqrt{2}$ on answer line (may score method marks) | | A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 27 | (Total time =) $\frac{30}{a} + \frac{30}{b}$ | M1 | oe eg $\frac{30b}{ab} + \frac{30a}{ab}$ or $\frac{30(b+a)}{ab}$ |
| | correct expression for total distance ÷ total time | M1dep | eg $(30 + 30) \div \left(\frac{30}{a} + \frac{30}{b}\right)$<br>or $60 \div \frac{30(b+a)}{ab}$ or $60 \times \frac{ab}{30(b+a)}$ |
| | $60 \times \frac{ab}{30(a+b)} = \frac{2ab}{a+b}$ | A1 | condone $b + a$ for $a + b$<br>condone $30a + 30b$ for $30(a + b)$ |
| | **Additional Guidance** | | |
| | Students can gain M1M1 if they incorrectly simplify a correct expression for total time before forming the division<br>eg $\frac{30}{a} + \frac{30}{b} = \frac{60}{a+b}$ followed by $60 \div \frac{60}{a+b}$ | | M1M1A0 |
| | Allow correct cancellation of 60 and 30 at any stage of the working | | |