# GCSE
# MATHEMATICS
# 8300/1H

Higher Tier Paper 1 Non-Calculator

**Mark scheme**

June 2019

Version: 1.0 Final

*196g8300IH/MS*

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 Assessment Writer.

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

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**Glossary for Mark Schemes**

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

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

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

Examiners should consistently apply the following principles

**Diagrams**

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

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

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

**Questions which ask students to show working**

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

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

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

**Misread or miscopy**

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

**Further work**

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

**Choice**

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

**Work not replaced**

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

**Work replaced**

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

**Premature approximation**

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

**Continental notation**

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

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **1** | 9 | B1 | |
| **2** | $2\frac{7}{9}$ | B1 | |
| **3** | $6\pi$ | B1 | |
| **4** | $\frac{37}{8}$ | B1 | |
| **5(a)** | $9.7 \times 10^{-4}$ | B1 | |
| | **Additional Guidance** | | |
| | Condone $9.7 . 10^{-4}$ or $9.7 \cdot 10^{-4}$ | | B1 |
| | Ignore zeroes before the '9'<br>eg $00009.7 \times 10^{-4}$ | | B1 |
| | $9.7 \times 10^{4-}$ | | B0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **5(b)** | 300 000 and 4000<br>or<br>$(10^5 \div 10^3 =)\ 10^2$<br>or $(10^5 \div 10^3 =)\ 100$<br>or $7.5 \times 10^{(1)}$ or $75 \times 10^0$<br>or<br>$\frac{3\times10^2}{4}$ or $\frac{300}{4}$ | M1 | |
| | 75 | A1 | |
| | **Additional Guidance** | | |
| | If the answer is given in standard form and as 75 the student must indicate that 75 is their chosen answer or it must be the final answer given<br>eg1 $7.5 \times 10^{(1)} = 75$ on the answer line<br>eg2 $75 = 7.5 \times 10^{(1)}$ on the answer line | | M1A1<br>M1A0 |
| | $\frac{300}{4}$ or 75 from incorrect working scores zero<br>eg1 $3 \times 10^5 = 30\,000$ and $4 \times 10^3 = 400$ and $30\,000 \div 400 = \frac{300}{4} = 75$<br>eg2 $\frac{30\,000}{400} = 75$ | | M0A0<br>M0A0 |
| | For the method mark, ignore incorrect work from a correct expression<br>eg $0.75 \times 10^2 = 7.5 \times 10^3$ | | M1A0 |
| | If the student attempts two methods (simplifying the powers and attempting to convert to ordinary numbers) mark both methods and award the higher mark | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 6(a) | $\frac{1}{6}$ on '1' and $\frac{1}{3}$ or $\frac{2}{6}$ on '2 or 3'<br>and<br>$\frac{1}{2}$ on each of 'Odd' and 'Even' | B2 | oe fraction, decimal or percentage<br>B1<br>$\frac{1}{6}$ on '1' and $\frac{1}{3}$ or $\frac{2}{6}$ on '2 or 3'<br>or<br>$\frac{1}{2}$ on each of 'Odd' and 'Even'<br>or<br>all correct unsimplified probabilities with one or more simplification errors<br>eg $\frac{3}{6}$ on 'Odd' simplified to $\frac{1}{3}$ |
| | **Additional Guidance** | | |
| | Accept decimals or percentages rounded or truncated correctly to at least 2 significant figures | | |
| | Only withhold a mark for simplification errors if B2 would otherwise be awarded | | |
| | Ignore extra branches added | | |
| | Ignore attempts to work out combined probabilities to the right of the tree diagram | | |
| | If an answer line is blank, the student may have written their answer elsewhere on the branch | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 6(b) | **Alternative method 1: P(1) + P(4, 5 or 6) × P(Odd)** | | |
| | $\frac{1}{2}$ × their $\frac{1}{2}$ or $\frac{1}{4}$ | M1 | oe |
| | their $\frac{1}{4}$ + their $\frac{1}{6}$ | M1dep | oe |
| | (P(win) =) $\frac{10}{24}$ or $\frac{5}{12}$ | A1ft | oe ft their tree diagram |
| | Lose (and P(Lose) = $\frac{14}{24}$ or $\frac{7}{12}$ oe) | A1ft | ft correct decision for their $\frac{5}{12}$ (and their $\frac{7}{12}$) with M2 scored |
| | **Alternative method 2: 1 – P(2 or 3) – P(4, 5 or 6) × P(Even)** | | |
| | $\frac{1}{2}$ × their $\frac{1}{2}$ or $\frac{1}{4}$ | M1 | oe |
| | their $\frac{1}{4}$ + their $\frac{1}{3}$<br>or P(lose) = $\frac{7}{12}$ | M1dep | oe<br>ft their tree diagram |
| | (P(win) =) $\frac{10}{24}$ or $\frac{5}{12}$ | A1ft | oe ft their tree diagram |
| | Lose (and P(Lose) = $\frac{14}{24}$ or $\frac{7}{12}$ oe) | A1ft | ft correct decision for their $\frac{5}{12}$ (and their $\frac{7}{12}$) with M2 scored |
| | **Additional Guidance is on the following page** | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|

| | Additional Guidance | |
|---|---|---|
| **6(b) cont** | Check the tree diagram for working | |
| | Any 'their' or ft probability must be > 0 and < 1 for marks to be awarded | |
| | For the second A1ft, the ft can be from an incorrect tree (which may score 4 marks) or an arithmetic error (which scores 3 marks, M1M1A0A1ft) | |
| | Accept equivalent fractions or decimals within calculations and equivalent fractions, decimals or percentages for final probabilities | |
| | Accept decimals or percentages rounded or truncated correctly to at least 2 significant figures | |
| | Condone $\frac{1}{2} \times$ their $\frac{1}{2}$ as part of a longer, incorrect multiplication<br>eg $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{6}$ | M1M0A0A0 |
| | Condone decimals used within fractions<br>eg P(Win) = $\frac{2.5}{6}$ | at least M1M1A1 |
| | For the method marks, condone incorrect mathematical notation<br>eg $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4} + \frac{1}{6} =$ … | at least M1M1 (may go on to score 3 or 4 marks) |
| | For the second A1ft, if the student gives a value for P(Lose), their P(Win) + their P(Lose) must equal 1<br>However, allow a comparison to $\frac{1}{2}$ unless it is clearly an incorrect value for P(Lose) | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 7 | **Alternative method 1** | | |
| | $3 \div \frac{20}{100}$ or $3 \times 5$ or 15 or $3 \times 6$ | M1 | oe |
| | 18 | A1 | |
| | **Alternative method 2** | | |
| | $1.2x = x + 3$ | M1 | oe equation |
| | 18 | A1 | |
| | **Additional Guidance** | | |
| | Trial and improvement scores 0 or 2 unless M1 can be awarded for 15 | | |
| | 15 seen scores M1 | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **8** | $(3^{12} =)$ 531 441<br>or<br>$(3^5 =)$ 243<br>or<br>$(3^{12} \div 3^5 =) 3^7$ or $(3^{12} \div 3^5 =) 2187$<br>or<br>$(3^2 \times 3 =) 3^3$ or $(3^2 \times 3 =) 27$<br>or<br>$3^{12} \div 3^5 \div 3^2 \div 3$<br>or<br>$\frac{3^{12}}{3^5} \times \frac{1}{3^2 \times 3}$ | M1 | |
| | $3^7 \div 3^3$ or $3^7 \div 27$<br>or<br>$3^{(12-5-2-1)}$<br>or<br>$\frac{3^{12}}{3^8}$<br>or<br>$3^4$<br>or<br>$2187 \div 27$ | M1dep | oe in the form $3^n \div 3^{(n-4)}$ |
| | 81 | A1 | |
| | **Additional Guidance** | | |
| | $3^4$ and 81 on the answer line in either order | | M1M1A1 |
| | 81 in working and $3^4$ on the answer line | | M1M1A0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 9 | **Alternative method 1: areas** | | |
| | $\pi \times 10^2$ or $100\pi$ | M1 | implied by [314, 314.2] |
| | $\pi \times (8 \div 2)^2$ or $\pi \times 4^2$ or $16\pi$<br>or $\pi \times (8 \div 2)^2 \div 2$ or $\pi \times 4^2 \div 2$<br>or $16\pi \div 2$ or $8\pi$ | M1 | implied by [50.2, 50.3] or [25.12, 25.14]<br>$92\pi$ or $84\pi$ or 92 : 8 or 8 : 92<br>or 84 : 16 or 16 : 84 implies M1M1 |
| | (their 100($\pi$) – their 8($\pi$)) ÷ their 8($\pi$)<br>or 92($\pi$) ÷ 8($\pi$)<br>or<br>their 100($\pi$) ÷ their 8($\pi$) (– 1)<br>or $12\frac{1}{2}$ (– 1) or 12.5 (– 1) | M1dep | dep on M2<br>absence of $\pi$ must be consistent<br>condone 16($\pi$) as their 8($\pi$) in first calculation only, ie condone<br>(their 100($\pi$) – their 16($\pi$)) ÷ their 16($\pi$)<br>or 84($\pi$) ÷ 16($\pi$),<br>but not their 100($\pi$) ÷ their 16($\pi$) (– 1) |
| | $11\frac{1}{2}$ or 11.5 | A1 | condone $\frac{23}{2}$ |
| | **Alternative method 2: scale factor** | | |
| | $\frac{10}{8 \div 2}$ or $\frac{10}{4}$ or $\frac{5}{2}$<br>or $\frac{10 \times 2}{8}$ or $\frac{20}{8}$ or 2.5 | M1 | oe scale factor of lengths eg $\frac{2}{5}$ or 0.4<br>accept 2 : 5 or 5 : 2 oe ratio<br>$\pi$ may be present, but must be consistent in numerator and denominator |
| | (their $\frac{5}{2}$)$^2$ or $\frac{25}{4}$ | M1dep | oe scale factor of areas eg $\frac{4}{25}$<br>accept 4 : 25 or 25 : 4 oe ratio |
| | 2 × their $\frac{25}{4}$ (– 1) or $\frac{25}{2}$ (– 1)<br>or $12\frac{1}{2}$ (– 1) or 12.5 (– 1) | M1dep | oe eg 2 ÷ their $\frac{4}{25}$ (– 1) |
| | $11\frac{1}{2}$ or 11.5 | A1 | condone $\frac{23}{2}$ |
| | **Additional Guidance is on the following page** | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|

| | Additional Guidance | |
|---|---|---|
| **9 (cont)** | Accept, for example, $\pi 8$ or $\pi \times 8$ or $8 \times \pi$ for $8\pi$ | |
| | An answer of $11.5\pi$ with no incorrect working | M1M1M1A0 |
| | Consistent use of $\pi d^2$ for the area of a circle gives the area of the circle as $400\pi$, the area of the semicircle as $32\pi$ and the area of the shaded part as $368\pi$. This also gives the answer 11.5, but scores zero | M0M0M0A0 |
| | Irrespective of where their answer comes from and the presence of other measures such as circumference, students can gain the first two marks of alternative method 1 if it is clear that the methods or values given are for area<br>eg 1<br>Big area = $100\pi$, little area = $8\pi$, big circumference = $20\pi$, little circumference = $4\pi$, $20 \div 4 = 5$<br>eg 2<br>$100\pi$, $8\pi$, $20\pi$, $4\pi$ | M1M1M0A0<br><br>M0M0 |
| | Do not award the second mark if the value of $8\pi$ comes from $\pi d$<br>This is implied by, eg, 'Area of circle = $20\pi$, area of semi-circle = $8\pi$' | M?M0<br>M0M0 |
| | $\frac{100(\pi)-16(\pi)}{16(\pi)}$ (which may give an answer of 5.25) | M1M1M1A0 |
| | $\frac{100(\pi)}{16(\pi)}$ (which may give an answer of 6.25) | M1M1M0A0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 10(a) | Plots the points (1, 60), (2, 30), (3, 20) and (4, 15) | M1 | $\pm \frac{1}{2}$ small square |
| | Correct smooth curve through correct four points | A1 | $\pm \frac{1}{2}$ small square |
| | **Additional Guidance** | | |
| | Ignore any calculations and mark the graph only | | |
| | Points cannot be implied by a bar chart or vertical line graph, but condone crosses at the top of a vertical line graph for M1 and the correct curve superimposed for M1A1 | | |
| | For M1, ignore the curve outside the domain $1 \leqslant t \leqslant 4$<br>For A1, whether or not the curve extends outside the domain $1 \leqslant t \leqslant 4$ it must not have a positive gradient at any point | | |
| | If there is no curve, for M1 there must be no other points with $x$-coordinate 1, 2, 3 or 4 | | |
| | The curve should be a single line with no feathering | | |
| | Unless it affects the shape of the curve (in which case A1 cannot be awarded), ignore incorrect evaluations of 60 ÷ a non-integer value<br>eg 60 ÷ 1.5 = … | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 10(b) | Vertical line from $3\frac{1}{2}$ minutes to their graph | M1 | $\pm \frac{1}{2}$ small square<br>implied by mark at correct place on the graph or on the vertical axis (but not on the horizontal axis) or by correct reading from their graph |
| | Correct reading from their graph for $t = 3.5$ | A1ft | ft their graph $\pm \frac{1}{2}$ small square |
| | **Additional Guidance** | | |
| | Correct reading for their graph, with or without evidence of using graph | | M1A1 |
| | No graph in (a) | | M0A0 |
| | To score any marks, their graph must be decreasing in the domain $1 \leqslant t \leqslant 4$, but may be a straight line or series of connected straight lines | | |
| | Answer from 60 ÷ 3.5 with no graph, or which does not match graph | | M0A0 |
| | Reading from 3.3 | | M0A0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 11 | **Alternative method 1** | | |
| | 330 ÷ (7 + 4) or 30 | M1 | oe |
| | 7 × their 30 or 210<br>and<br>4 × their 30 or 120 | M1dep | oe |
| | 45 | A1 | |
| | **Alternative method 2** | | |
| | 330 ÷ (7 + 4) or 30 | M1 | oe |
| | (7 – 4) × their 30 or 90 | M1dep | oe |
| | 45 | A1 | |
| | **Alternative method 3** | | |
| | 330 ÷ (7 + 4) or 30 | M1 | oe |
| | 7 × their 30 or 210<br>or 4 × their 30 or 120<br>and<br>330 ÷ 2 or 165 | M1dep | oe |
| | 45 | A1 | |
| | **Alternative method 4** | | |
| | 330 ÷ (7 + 4) or 30 | M1 | oe |
| | their 30 × 1.5 | M1dep | oe |
| | 45 | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **12** | –9 2 –7 –5 –12 | B1 | |
| **13** | One of<br>(102 →) 100<br>(8.14 →) 8 | M1 | |
| | their 100 = 0.5 × $x^2$ × their 8<br>or<br>($x^2$ =) their 100 ÷ 8 × 2<br>or<br>($x^2$ =) 100 ÷ their 8 × 2<br>or<br>25<br>or<br>their 8 × 5 × 5 × 0.5 = 100<br>or<br>8 × 5 × 5 × 0.5 = their 100 | M1dep | oe<br>must have used at least one correct 1 sf value |
| | 5 with M2 seen | A1 | |
| | **Additional Guidance** | | |
| | If working is done with approximations and with the given values ignore the working with the given values and mark the working with approximations | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 14 | **Alternative method 1: work out the value of both angles** | | |
| | ($b$ =) 90 ÷ 5 × 3 or 54 | M1 | oe may be on diagram for $b$ or $x$ |
| | ($x$ =) $\frac{360 - 90 - \text{their } 54}{3+1}$ or $\frac{216}{4}$ | M1dep | oe |
| | ($b$ =) 54 and ($x$ =) 54<br>with M2 awarded | A1 | |
| | **Alternative method 2: assumes both angles are equal and uses sum of angles in a quadrilateral** | | |
| | ($b$ =) 90 ÷ 5 × 3 or 54 | M1 | oe may be on diagram for $b$ or $x$ |
| | 90 + their 54 + their 54 + 3 × their 54<br>or<br>360 – 90 – their 54 – their 54<br>and either<br>3 × their 54<br>or<br>their 162 ÷ 3 or their 162 ÷ 54 | M1dep | oe<br>addition of the four angles in the quadrilateral or subtraction of 90 and the two equal angles from 360<br>and<br>multiplication to work out the fourth angle or division of the fourth angle by 3 or 54 to act as a check |
| | 90 + 54 + 54 + 162 = 360<br>and 54 × 3 = 162<br>or<br>360 – 90 – 54 – 54 = 162<br>and 162 ÷ 3 = 54 or 162 ÷ 54 = 3 | A1 | oe |
| | **Alternative method 3: assumes both angles are equal and uses ratio to check 90°** | | |
| | 5 : 3 : 3 : 9 | M1 | |
| | 360 ÷ (5 + 3 + 3 + 9) × 5<br>or 360 ÷ 20 × 5 | M1dep | oe |
| | 360 ÷ 20 × 5 = 90<br>with M2 awarded | A1 | |
| | **Additional Guidance** | | |
| | Any correct method to work out 54 scores M1 on alt 1 or alt 2 | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **15(a)** | 20 48 88 108 120 | B1 | |
| **15(b)** | All 5 points plotted using upper class bounds and their cf values | M1 | $\pm \frac{1}{2}$ small square<br>must be increasing |
| | Smooth curve or polygon for their cf values | A1ft | $\pm \frac{1}{2}$ small square<br>must be increasing |
| | **Additional Guidance** | | |
| | If (a) is correct, points should be at (10, 20), (20, 48), (30, 88), (40, 108) and (50, 120) | | |
| | For A1, the graph should start at (0, 0) or (1, 0) or (10, 20) | | |
| | For A1, the graph should end at $m = 50$ unless it followed by a horizontal line adjoining (50, 120) | | |
| | Histogram only | | M0A0 |
| | Histogram and graph | | Mark curve |
| **15(c)** | Line from 15 marks to their graph | M1 | $\pm \frac{1}{2}$ small square<br>implied by mark at correct place on the graph or on the vertical axis (but not on the horizontal axis) or by correct reading from their graph |
| | Correct reading from their graph for 15 marks | A1ft | $\pm \frac{1}{2}$ small square |
| | **Additional Guidance** | | |
| | Correct reading for their graph, with or without evidence of using graph | | M1A1 |
| | No graph in (b) | | M0A0 |
| | For M1 and A1ft the domain of their graph must be at least $10 \leqslant m \leqslant 20$ and their graph must be increasing in the domain $10 \leqslant m \leqslant 50$ or from $m = 10$ if their graph does not extend to $m = 50$ | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **16** | Correct factorisation of numerator<br>$2(2x - 4x^2)$ or $4(x - 2x^2)$<br>or $x(4 - 8x)$ or $2x(2 - 4x)$<br>or $4x(1 - 2x)$<br>or<br>correct factorisation of denominator<br>$2(6x - 3)$ or $3(4x - 2)$ or $6(2x - 1)$<br>or<br>correct cancelling by 2 throughout<br>$\frac{2x - 4x^2}{6x - 3}$ | M1 | oe with negative coefficients |
| | Correct fraction with numerator<br>$4x(1 - 2x)$ or $-4x(2x - 1)$<br>and denominator<br>$6(2x - 1)$ or $-6(1 - 2x)$<br>or<br>$-\frac{4x}{6}$ or $\frac{-4x}{6}$ or $\frac{4x}{-6}$<br>or<br>$\frac{2x(2-4x)}{-3(2-4x)}$ or $\frac{2x(2-4x)}{3(4x-2)}$ | M1dep | oe with cancelling of 2 throughout<br>eg<br>$\frac{2x(1-2x)}{3(2x-1)}$ or $\frac{2x(1-2x)}{-3(1-2x)}$ |
| | $-\frac{2x}{3}$ or $-\frac{2}{3}x$ | A1 | allow $\frac{-2x}{3}$ or $\frac{2x}{-3}$ |
| | **Additional Guidance** | | |
| | Allow multiplication signs up to M1M1 | | |
| | Allow $-0.\dot{6}$ for $-\frac{2}{3}$ | | |
| | Do not allow $-0.66\ldots$ for $-\frac{2}{3}$ | | |
| | For the first M1 only, allow any correct factorisation seen within multiple attempts | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 17(a) | $y^2 = \frac{1}{2}y(y + 3)$ | B2 | oe equation<br>eg $2y^2 = y^2 + 3y$ or $y^2 = 3y$ or $y = 0$<br>or $y = 3$ or $y = 0$ or 3<br>B1<br>$\frac{1}{2}y(y + 3)$ oe expression<br>or an otherwise correct equation using a different unknown or combination of unknowns |
| | **Additional Guidance** | | |
| | Allow multiplication signs<br>eg $y \times y = \frac{y}{2} \times (y + 3)$ | | B2 |
| | $y^2 = \frac{1}{2}y(y + 3)$ followed by incorrect simplification or attempt to solve the equation | | B2 |
| | $y^2 = \frac{1}{2}y + y + 3$ | | B0 |
| | 3 only or 0 only or 0 and 3 only | | B0 |
| | Do not allow missing or partially missing brackets unless recovered<br>eg1 $y^2 = \frac{1}{2}y \times y + 3$ without correct equation seen<br>eg2 $y^2 = \frac{1}{2}y(y + 3$ without correct equation seen | | B0<br>B0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 17(b) | Correct comment<br>or<br>shows correct working | B1 | eg1 he hasn't square rooted (correctly)<br>eg2 it should be $\sqrt{8}\,x = 3$<br>eg3 he should have divided (by 8) before square rooting |
| | **Additional Guidance** | | |
| | $\sqrt{8}$ may be given as $2\sqrt{2}$ | | |
| | Comment that he shouldn't have a negative answer | | B0 |
| | Mathematically incorrect statement | | B0 |
| | Correct comment and an incorrect comment | | B0 |
| | **Example responses** | | |
| | He has taken it as $(8x)^2$ | | B1 |
| | He has divided $8x^2$ by $x$ (instead of square rooting) and square rooted the 9 | | B1 |
| | He $\sqrt{}$ first when supposed to divide it by 8 | | B1 |
| | He didn't divide 9 by 8 to get $x^2$ | | B1 |
| | At the start he took the 8 over when you want $\sqrt{\frac{9}{8}}$ | | B1 |
| | Toby should have got $\pm\sqrt{\frac{9}{8}}$ | | B1 |
| | He should have divided by 8 | | B0 |
| | Toby didn't square root $8x$ | | B0 |
| | He hasn't square rooted the $8x^2$ to leave $x$ on its own | | B0 |
| | He hasn't square rooted the other side to just get $x$ | | B0 |
| | Didn't divide by 8 | | B0 |
| | He should have divided by $8x$ | | B0 |
| | He found the square root of 9 but didn't write $\sqrt{8x} = 9$ | | B0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 18(a) | (193 + 7)(193 – 7) or (200)(186) or 200 (×) 186 | M1 | either order |
| | (200)(186) = 37 200 or 200 (×) 186 = 37 200 | A1 | |
| | **Additional Guidance** | | |
| | 37 200 with correct method not seen | | M0A0 |
| | 37 200 from 37 249 – 49 only | | M0A0 |
| | 37 200 from (200)(186) or 200 (×) 186 and 37 249 – 49 also given | | M1A1 |
| | Do not award M1 for a 'misread' eg (193 + 2)(193 – 2) | | M0A0 |
| 18(b) | $(10a + 9b)(10a – 9b)$ or $(9b + 10a)(10a – 9b)$ | B1 | either order |
| | **Additional Guidance** | | |
| | Condone missing final bracket, eg $(10a + 9b)(10a – 9b$ | | B1 |
| | Condone a multiplication sign eg $(10a + 9b) \times (10a – 9b)$ | | B1 |
| 19 | $\frac{1}{9}$ | B1 | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 20(a) | **Alternative method 1: shows that *BAC* = *ACD* and alternate angles** | | |
| | *ACD* = *ABC* | M1 | accept both with same letter on diagram |
| | *ABC* = *BAC* | M1 | accept both with same letter on diagram |
| | *BAC* = *ACD*<br>and alternate segment (theorem)<br>with M2 awarded | M1dep | dep on M2 |
| | Other two correct reasons given with M3 awarded | A1 | eg<br>(base angles of) isosceles triangle<br>and alternate angles |
| | **Alternative method 2: shows that *ABC* + *BCD* = 180 and co-interior angles** | | |
| | *ACD* = *ABC* | M1 | accept both with same letter on diagram |
| | *ABC* = *BAC* | M1 | accept both with same letter on diagram |
| | *BCD* = 180 – (*BAC* + *ABC*) + *ACD*<br>and *ABC* + *BCD* = 180<br>and alternate segment (theorem)<br>with M2 awarded | M1dep | oe<br>dep on M2 |
| | Other two correct reasons given with M3 awarded | A1 | eg<br>(base angles of) isosceles triangle<br>and (co-)interior angles or allied angles |
| | **The mark scheme for question 20(a) continues on the next page** | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **20(a) (cont)** | **Alternative method 3: line from midpoint of *AB* to *C* is perpendicular to *AB* and *CD*** | | |
| | Let *M* be the midpoint of *AB*<br>and<br>*MC* is perpendicular to *AB* | M1 | any letter |
| | *MC* is perpendicular to *CD* | M1 | |
| | *AB* and *CD* are both perpendicular to *MC*<br>with M2 awarded | M1dep | oe<br>dep on M2 |
| | Three correct reasons given with M3 awarded | A1 | eg<br>(perpendicular bisector of) isosceles triangle<br>and *MC* goes through the centre of the circle<br>and tangent is perpendicular to radius |
| | **Additional Guidance** | | |
| | Other correct methods can be found by extending one or more of the lines. For example, by extending *BC* it is possible to use corresponding angles as a proof instead of alternating angles. This should be reflected in the reasons required for the last mark | | |
| | In the scheme, *ACD* (for example) means angle *ACD* and not triangle *ACD* | | |
| | Accept equality of angles indicated by labelling with the same letter, but not by arcs | | |
| | Accept (angle) *B* for angle *ABC*<br>Do not accept (angle) *A* for angle *BAC* or (angle) *C* for angle *ACB* unless intention is clear from annotation of the diagram | | |
| | For the third mark in alternative method 2, accept algebraic expressions for angles if clearly marked on the diagram | | |
| | Do not award marks for an argument based only on assumed values of angles, but ignore 60° marked on diagram, which is for (b) | | |
| | Ignore an angle marked at *ADC* | | |
| | Ignore incorrect statements that do not affect the proof<br>eg *ACD* is an isosceles triangle (but not used in proof) | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 20(b) | ✓ *AB* is parallel to *DC*<br>✓ *AC* bisects angle *BCD*<br>☐ *AC* bisects angle *BAD* | B1 | |
| | **Additional Guidance** | | |
| | | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 21 | **Alternative method 1: substitution of $2x + p$ for $y$** | | |
| | $2x + 3(2x + p) = 5p$ | M1 | oe equation<br>eg $2x + 6x + 3p = 5p$ |
| | $6x + 2x = 5p - 3p$ or $8x = 2p$ | M1dep | oe equation with terms collected<br>condone incorrect expansion before rearrangement |
| | Correct simplified terms<br>$(x =) \frac{p}{4}$ or $\frac{1}{4}p$ or $0.25p$<br>and<br>$(y =) \frac{3p}{2}$ or $\frac{3}{2}p$ or $1\frac{1}{2}p$ or $1.5p$ | A2 | A1<br>one correct simplified term<br>or<br>otherwise correct terms for both with '$p$' omitted<br>eg $x = 0.25$ and $y = 1.5$<br>or<br>correct unsimplified terms for both<br>eg $x = \frac{2p}{8}$ and $y = \frac{6p}{4}$ |
| | **Alternative method 2: substitution of $y - p$ for $2x$** | | |
| | $y - p + 3y = 5p$ | M1 | oe equation |
| | $y + 3y = 5p + p$ or $4y = 6p$ | M1dep | oe equation with terms collected |
| | Correct simplified terms<br>$(x =) \frac{p}{4}$ or $\frac{1}{4}p$ or $0.25p$<br>and<br>$(y =) \frac{3p}{2}$ or $\frac{3}{2}p$ or $1\frac{1}{2}p$ or $1.5p$ | A2 | A1<br>one correct simplified term<br>or<br>otherwise correct terms for both with '$p$' omitted<br>eg $x = 0.25$ and $y = 1.5$<br>or<br>correct unsimplified terms for both<br>eg $x = \frac{2p}{8}$ and $y = \frac{6p}{4}$ |
| | **The mark scheme for question 21 continues on the next page** | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **21 (cont)** | **Alternative method 3: elimination of $x$** | | |
| | $y - 2x = p$ | M1 | oe with multiplication of both equations |
| | $y + 3y = 5p + p$ or $4y = 6p$ | M1dep | oe<br>addition must be seen if result is incorrect |
| | Correct simplified terms<br>$(x =) \frac{p}{4}$ or $\frac{1}{4}p$ or $0.25p$<br>and<br>$(y =) \frac{3p}{2}$ or $\frac{3}{2}p$ or $1\frac{1}{2}p$ or $1.5p$ | A2 | A1<br>one correct simplified term<br>or<br>otherwise correct terms for both with '$p$' omitted<br>eg $x = 0.25$ and $y = 1.5$<br>or<br>correct unsimplified terms for both<br>eg $x = \frac{2p}{8}$ and $y = \frac{6p}{4}$ |
| | **Alternative method 4: elimination of $y$** | | |
| | $3y - 6x = 3p$ | M1 | oe with multiplication of both equations |
| | $2x - (-6x) = 5p - 3p$ or $8x = 2p$ | M1dep | oe<br>subtraction must be seen if result is incorrect |
| | Correct simplified terms<br>$(x =) \frac{p}{4}$ or $\frac{1}{4}p$ or $0.25p$<br>and<br>$(y =) \frac{3p}{2}$ or $\frac{3}{2}p$ or $1\frac{1}{2}p$ or $1.5p$ | A2 | A1<br>one correct simplified term<br>or<br>otherwise correct terms for both with '$p$' omitted<br>eg $x = 0.25$ and $y = 1.5$<br>or<br>correct unsimplified terms for both<br>eg $x = \frac{2p}{8}$ and $y = \frac{6p}{4}$ |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 22(a) | – 3**b** + 6**a** + 7.5**b** (= 6**a** + 4.5**b**)<br>or 6**a** + 7.5**b** – 3**b** (= 6**a** + 4.5**b**)<br>or<br>6**a** + 7.5**b** – (6**a** + 4.5**b**) = 3**b** | B1 | oe rearranged equation using all 5 terms |
| | **Additional Guidance** | | |
| | 3**b** + 6**a** + 4.5**b** = 6**a** + 7.5**b** | | B1 |
| | 6**a** + 4.5**b** + 3**b** = 6**a** + 7.5**b** | | B1 |
| | 7.5**b** – 3**b** = 4.5**b**, so 6**a** + 4.5**b** | | B0 |
| | 6**a** + 7.5**b** – 3**b** = 4.5**b** | | B0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 22(b) | **Alternative method 1: equal ratios from *k*a + 3b and 6a + 4.5b** | | |
| | (*BC =) k***a** + 3**b**<br>or $k : 6 = 3 : 4.5$<br>or $k : 3 = 6 : 4.5$ | M1 | oe ratio |
| | $3 \times 6 \div 4.5$<br>or 4**a** + 3**b** | M1dep | oe |
| | 4 | A1 | |
| | **Alternative method 2: scale factor from *k*a + 3b and 6a + 4.5b** | | |
| | (*BC =) k***a** + 3**b**<br>or $4.5 \div 3$ or $\frac{3}{2}$<br>or $3 \div 4.5$ or $\frac{2}{3}$<br>or $4.5 \div 6$ or $\frac{3}{4}$<br>or $6 \div 4.5$ or $\frac{4}{3}$ | M1 | oe fractions or decimals |
| | 6 ÷ their $\frac{3}{2}$<br>or 6 × their $\frac{2}{3}$<br>or 3 ÷ their $\frac{3}{4}$<br>or 3 × their $\frac{4}{3}$<br>or 4**a** + 3**b** | M1dep | oe |
| | 4 | A1 | |
| | **The mark scheme for question 22(b) continues on the next page** | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **22(b) (cont)** | **Alternative method 3: equal ratios from ($k$ + 6)a + 7.5b and 6a + 4.5b** | | |
| | ($BD$ =) $k$**a** + 6**a** + 7.5**b**<br>or ($BD$ =) ($k$ + 6)**a** + 7.5**b**<br>or ($k$ + 6) : 6 = 7.5 : 4.5<br>or ($k$ + 6) : 7.5 = 6 : 4.5 | M1 | oe ratio |
| | 6 × 7.5 ÷ 4.5 – 6<br>or 4**a** + 3**b** | M1dep | oe |
| | 4 | A1 | |
| | **Alternative method 4: scale factor from ($k$ + 6)a + 7.5b and 6a + 4.5b** | | |
| | ($BD$ =) $k$**a** + 6**a** + 7.5**b**<br>or ($BD$ =) ($k$ + 6)**a** + 7.5**b**<br>or 7.5 ÷ 4.5 or $\frac{5}{3}$<br>or 4.5 ÷ 7.5 or $\frac{3}{5}$<br>or 4.5 ÷ 6 or $\frac{3}{4}$<br>or 6 ÷ 4.5 or $\frac{4}{3}$ | M1 | oe fractions or decimals |
| | 6 × their $\frac{5}{3}$ – 6<br>or 6 ÷ their $\frac{3}{5}$ – 6<br>or 7.5 ÷ their $\frac{3}{4}$ – 6<br>or 7.5 × their $\frac{4}{3}$ – 6<br>or 4**a** + 3**b** | M1dep | oe |
| | 4 | A1 | |
| | **Additional Guidance for question 22(b) is on the next page** | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|

| | Additional Guidance | |
|---|---|---|
| **22(b) (cont)** | Check the diagram for working | |
| | If working is not seen, only accept exact decimal values in place of fractions for method marks | |
| | Answer 4 with no working or no incorrect working | M1M1A1 |
| | Assumes that *BC* is $3a + 2.25b$ (half the length of *CD*)<br>or that *BC* is $2a + 1.5b$ (one third of the length of *CD*) | M0M0A0<br>M0M0A0 |
| | 4a on the answer line does not get the A mark, but may have scored the method marks | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **23** | **Alternative method 1** | | |
| | $(8^4 =)\ (2^3)^4$ or $2^{12}$ or $(32^{\frac{2}{5}} =)\ (2^5)^{\frac{2}{5}}$ or $2^2$ | M1 | |
| | $2^{12}$ and $2^2$ | M1dep | or calculation in the form<br>$2^a \div 2^b$ where $a - b = 10$<br>$2^c \times 2^d$ where $c + d = 10$ |
| | $2^{10}$ | A1 | Accept $m = 10$ |
| | **Alternative method 2** | | |
| | $(8^4 =)\ 4096$ or $(32^{\frac{2}{5}} =)\ 4$ | M1 | |
| | 1024 | M1dep | |
| | $2^{10}$ | A1 | Accept $m = 10$ |
| | **Additional Guidance** | | |
| | Note that 1024 from 32 × 32 scores 2 marks if 1024 is their final numerical answer<br>However, if they then try to find $\sqrt[5]{1024}$ they are clearly processing $(32^{\frac{2}{5}} =)$, so this would only score 0 marks without further work | | |
| | If a numerical method and an index method are both attempted and an incorrect answer is given, award up to M1M1 from the better method | | |
| **24** | –1 | B1 | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 25(a) | (gradient of $OP$ =) $\frac{8-0}{4-0}$ | M1 | oe eg (gradient of $OP$ =) $\frac{8}{4}$ |
| | (gradient of $OP$ =) 2 or $\frac{2}{1}$<br>and<br>$-1 \div 2 = -\frac{1}{2}$ or $2 \times -\frac{1}{2} = -1$<br>with M1 seen | A1 | oe<br>accept 'negative reciprocal, so $-\frac{1}{2}$'<br>or 'product of gradients is –1, so $-\frac{1}{2}$'<br>oe comment |
| | **Additional Guidance** | | |
| | $4 \div 8 = \frac{1}{2}$ but slope is negative, so $-\frac{1}{2}$ | | M0A0 |
| | Do not accept a gradient including $x$<br>eg $\frac{8}{4} = 2$, so gradient of $OP = 2x$, product of gradients is –1, so $-\frac{1}{2}x$ | | M1A0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 25(b) | **Alternative method 1: $y = -\frac{1}{2}x + c$ and substitutes 8 and 4** | | |
| | $8 = -\frac{1}{2} \times 4 + c$ or $(c =)$ 10 | M1 | oe implied by $y = -\frac{1}{2}x + 10$ |
| | $0 = -\frac{1}{2}x +$ their 10 or $(x =)$ 20 | M1dep | oe |
| | their $20^2$ + their $10^2$ or 500<br>or $\sqrt{500}$ | M1dep | oe eg $2\sqrt{125}$<br>dep on M2 |
| | $10\sqrt{5}$ | A1 | accept $a = 10$ with $\sqrt{500}$ seen |
| | **Alternative method 2: uses the formula for a line and substitutes $x = 0$ and $y = 0$** | | |
| | $y - 8 = -\frac{1}{2}(x - 4)$<br>and substitutes $x = 0$ or $y = 0$<br>or $(x =)$ 20 or $(y =)$ 10 | M1 | oe equation<br>eg $x + 2y = 20$ |
| | $y - 8 = -\frac{1}{2}(x - 4)$<br>and substitutes $x = 0$<br>and substitutes $y = 0$<br>or $(x =)$ 20 and $(y =)$ 10 | M1 | oe equation<br>eg $x + 2y = 20$ |
| | their $20^2$ + their $10^2$ or 500<br>or $\sqrt{500}$ | M1dep | oe eg $2\sqrt{125}$<br>dep on M2 |
| | $10\sqrt{5}$ | A1 | accept $a = 10$ with $\sqrt{500}$ seen |
| | **The mark scheme for question 25(b) continues on the next page** | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **25(b) (cont)** | **Alternative method 3: uses formula for gradient with points *A* and *B*** | | |
| | $\frac{8-0}{4-x} = -\frac{1}{2}$ or $(x =)$ 20 | M1 | oe correct method to work out the $x$-coordinate of point $A$ |
| | $\frac{y-8}{0-4} = -\frac{1}{2}$ or $(y =)$ 10 | M1 | oe correct method to work out the $y$-coordinate of point $B$ |
| | their $20^2$ + their $10^2$ or 500<br>or $\sqrt{500}$ | M1dep | oe eg $2\sqrt{125}$<br>dep on M2 |
| | $10\sqrt{5}$ | A1 | accept $a = 10$ with $\sqrt{500}$ seen |
| | **Additional Guidance** | | |
| | Check the diagram and 25(a) for possible correct working or values<br>eg 1 20 marked on axis at A<br>eg 2 10 marked on axis at *B* | | M1<br>M1 |
| | On alternative method 2, if using $y - 8 = -\frac{1}{2}(x - 4)$, they must substitute $x = 0$ or $y = 0$ for M1 and both separately for M1M1 | | |
| | On alternative method 2, incorrect rearrangement of $y - 8 = -\frac{1}{2}(x - 4)$ can score up to 3 marks<br>eg $y - 8 = -\frac{1}{2}(x - 4)$, $2y - 8 = -x - 4$,<br>when $y = 0$, $x = 4$, when $x = 0$, $y = 2$, $\sqrt{4^2 + 2^2} = \sqrt{20}$ | | M1M1M1 |

| | | | |
|---|---|---|---|
| **26** | $(x - -2)^2$ or $(x + 2)^2$ or $a = 2$ | M1 | oe implied by $x^2 + 2x + 2x + 4$ (+ $b$)<br>or $x^2 + 4x + 4$ (+ $b$) |
| | $1 = (3 + 2)^2 + b$ | M1dep | oe |
| | –24 | A1 | accept (–2, –24) |
| | **Additional Guidance** | | |
| | $(x - 2)^2$<br>$1 = (3 - 2)^2 + b$ | | M0<br>M0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **27** | $\sin 60° = \frac{\sqrt{3}}{2}$<br>or $\tan 30° = \frac{\sqrt{3}}{3}$ or $\frac{1}{\sqrt{3}}$<br>or $\tan 30° \left(= \frac{\sin 30}{\cos 30}\right) = \frac{1/2}{\sqrt{3}/2}$ | M1 | oe<br>may be in a table<br>may be implied by position in multiplication |
| | $\frac{\sqrt{3}}{2} \times \frac{1}{\sqrt{3}} = \frac{1}{2}$<br>or $\cos x = \frac{1}{2}$<br>or $(x =) \cos^{-1}\frac{1}{2}$ | M1dep | oe works out the value of cos $x$ as a fraction or decimal with no surd values |
| | 60 with M2 awarded | A1 | |
| | **Additional Guidance** | | |
| | cos $x$ = 60 does not score the final mark | | |
| | | | |