# GCSE
# MATHEMATICS
# 8300/3H

Higher Tier Paper 3 Calculator

**Mark scheme**

June 2024

Version: 1.1 Final

2 4 6 G 8 3 0 0 / 3 H / M S

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

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

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from aqa.org.uk

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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**

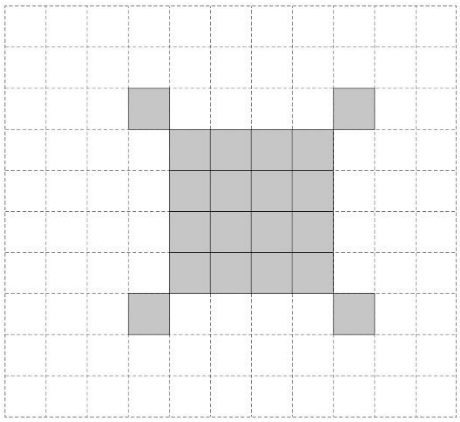
Erased or crossed out work that has been replaced is not awarded marks.

**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.

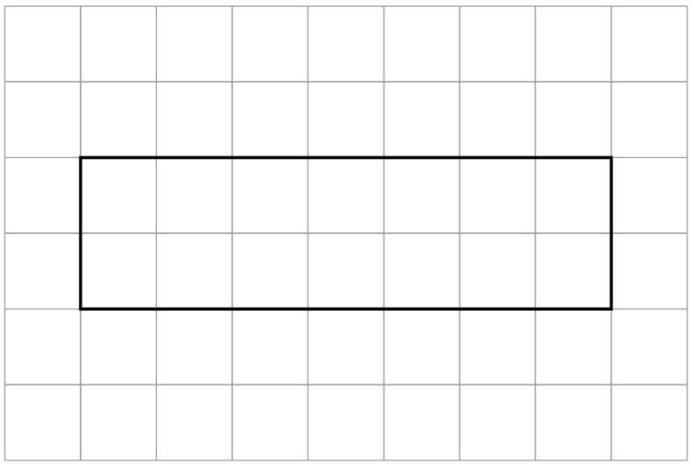
| Q | Answer | Mark | Comments |
|---|---|---|---|
| 1(a) |  | B1 | |
| | **Additional Guidance** | | |
| | Mark intention, condone missing interior lines | | |
| | Shading not required | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 1(b) | 23 | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 2 | $24^2$ or 576 **and** $31^2$ or 961<br>or<br>1537 | M1 | ignore units |
| | $\sqrt{24^2+31^2}$ or $\sqrt{576+961}$<br>or $\sqrt{1537}$ | M1dep | |
| | 39.2(…) | A1 | accept 39 with 1537 seen or M2 awarded |
| | **Additional Guidance** | | |
| | M1 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts | | |
| | $31^2 - 24^2$ | | M1M0A0 |
| | $\sqrt{385}$ without seeing $24^2$ or 576 **and** $31^2$ or 961 | | M0M0A0 |
| | Answer only 39.2 | | M2A1 |
| | Answer only 39 | | M0 |
| | 39.2 from only accurate drawing | | M0M0A0 |
| | 39.2 from only trigonometry | | M0M0A0 |
| | 39.2 from only cosine rule | | M1M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 3 | This is not representative of all flats<br>or<br>He didn't take into account flats on the other floors | B1 | oe |
| | **Additional Guidance** | | |
| | Ignore incorrect or irrelevant statements or incorrect values alongside a correct reason, unless contradictory | | |
| | Data is biased | | B1 |
| | Missing floor or Misses top 2 floors (ignore incorrect value) | | B1 |
| | There could be different results on the other 4 floors (ignore incorrect value) | | B1 |
| | Must have a flat from each floor, do another 27 (ignore irrelevant statement) | | B1 |
| | Only doing 5 out of the 8 floors | | B1 |
| | Not tested any on floor 7 or 8 | | B1 |
| | Missing most of the other floors (ignore 'most of' as irrelevant) | | B1 |
| | Some floors might be different to others | | B1 |
| | Sample all floors, sample size too small (ignore incorrect statement) | | B1 |
| | Needs to sample them all (all may refer to all flats not floors) | | B0 |
| | Sample too small | | B0 |
| | Some flats might be different to others | | B0 |
| | Didn't test a third of the flats | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 4 | It is true for **all** values of $x$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 5 | 42 ÷ (2 × 3) or 7<br>or<br>rectangle with height 2 cm | M1 | oe<br>implied by rectangle with one side 7 cm |
| | Rectangle with height 2 cm and width 7 cm | A1 | any position on the grid |
| | **Additional Guidance** | | |
| | Mark intention, condone interior lines | | |
| | Accept unruled lines | | |
| | **Side elevation**<br> | | M1A1 |
| | Cuboid with rectangle height 2 cm and / or width 7 cm | | M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6(a) | **Alternative method 1: working in metres per second or kilometres per second** | | |
| | 1500 (metres) or 0.05 (km) | B1 | implied by 30 or 1200 |
| | their 1500 ÷ 50 × 40<br>or<br>1.5 ÷ their 0.05 × 40<br>or<br>1200 | M2 | oe<br>M1 their 1500 ÷ 50 or 30 oe<br>or 50 ÷ 40 or 1.25 oe<br>or 1.5 ÷ their 0.05 oe<br>their 1500 must be using digits 15 (and zeros)<br>their 0.05 must be using single digit 5 (and zeros) |
| | their 1200 ÷ 60 | M1dep | oe<br>dep on M2 |
| | 20 | A1ft | ft their 1500 or their 0.05 |
| | **Alternative method 2: working in metres per minute or kilometres per minute** | | |
| | 1500 (metres) or 0.05 (km) | B1 | implied by 0.075 |
| | 40 ÷ 60 or $\frac{2}{3}$ | M1 | oe<br>accept [0.66, 0.67] |
| | 50 ÷ (40 ÷ 60) or 75<br>or<br>$\frac{\text{their } 0.05}{(40 \div 60)}$ or 0.075<br>or<br>their 1500 × (40 ÷ 60) | M1dep | oe calculation<br>their 1500 must be using digits 15 (and zeros)<br>their 0.05 must be using single digit 5 (and zeros) |
| | their 1500 ÷ their 75<br>or<br>1.5 ÷ their 0.075<br>or<br>their 1500 × (40 ÷ 60) ÷ 50 | M1dep | oe |
| | 20 | A1ft | ft their 1500 or their 0.05 |

**Additional Guidance is on the next page**

| | | |
|---|---|---|
| **6(a) cont** | **Additional Guidance** | |
| | 1500 ÷ 1.25 | B1M2 |
| | 1.5 ÷ 50 × 40 their 1500 must be using digits 15 (and zeros) | B0M2 |
| | 1.5 ÷ 0.5 × 40 their 0.05 must be using single digit 5 (and zeros) | B0M2 |
| | 150 ÷ 50 their 1500 must be using digits 15 (and zeros) | B0M1 |
| | 150 ÷ 1.25 = 120, 120 ÷ 60 = 2 | B0M2M1A1ft |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **6(b)** | It is greater than the answer to part (a) | B1 | |

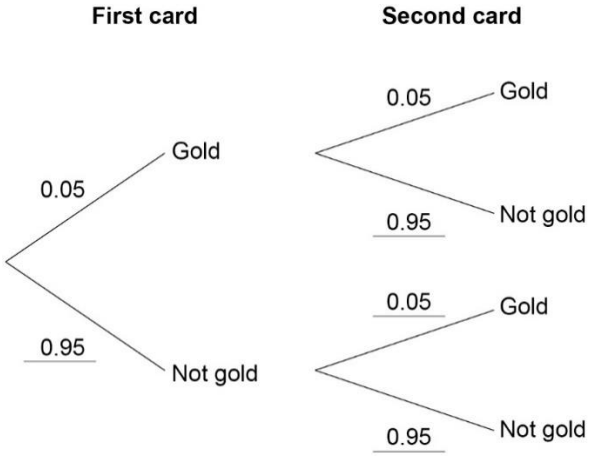
| Q | Answer | Mark | Comments |
|---|---|---|---|
| **7** | Any two of<br>(–2, 2) $\left(-1, 1\frac{1}{2}\right)$ (0, 1) $\left(1, \frac{1}{2}\right)$<br>(2, 0) $\left(3, -\frac{1}{2}\right)$ (4, –1)<br>or other correct points | M1 | may be seen in a table with values assigned to $x$ and $y$<br>implied by points plotted |
| | At least two of their points plotted | M1 | $\pm\frac{1}{2}$ square<br>implied by a line passing through two of their points |
| | Single straight line from (–2, 2) to (4, –1) | A1 | $\pm\frac{1}{2}$ square<br>ignore line beyond (–2, 2) and (4, –1) |
| | **Additional Guidance** | | |
| | Ignore extra points listed or plotted if required line is drawn | | |
| | M marks can be awarded even if incorrect line drawn | | |
| | Correct line from (–2, 2) to (4, –1) within tolerance with no points plotted | | M1M1A1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8 | (8 + 9 + 9 + 6 + 9 + 10) ÷ 6<br>or 51 ÷ 6<br>or 8.5 | M1 | oe<br>implied by 34 |
| | 162 ÷ 360 × 100<br>or 45 | M1 | oe |
| | 4 × their 8.5 + their 45<br>or 34 + 45 | M1dep | oe<br>dep on M2 |
| | 79 | A1 | SC2 53.5 or 57.5 |
| | **Additional Guidance** | | |
| | Check table and pie chart for working | | |
| | 34 + 45% | | M1M1M1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9 | **Alternative method 1: population density of Town A** | | |
| | 84 000 ÷ (7 × 2.6)<br>or [4615, 4616] | M2 | oe<br>M1 84 000 ÷ 7 or 12 000 oe<br>or 7 × 2.6 or 18.2 oe |
| | Town B and [4615, 4616] | A1 | |
| | **Alternative method 2: comparing one square mile of population** | | |
| | 84 000 ÷ 7 or 12 000 | M1 | oe |
| | 4695 × 2.6 or 12 207 | M1 | oe |
| | Town B and 12 000 and 12 207 | A1 | |
| | **Alternative method 3: comparing seven square miles of population** | | |
| | 4695 × 2.6 × 7<br>or 85 449 | M2 | oe<br>M1 4695 × 2.6 or 12 207 oe<br>or 7 × 2.6 or 18.2 oe |
| | Town B and 85 449 | A1 | |
| | **Alternative method 4: comparing areas with equal populations** | | |
| | 7 × 2.6 or 18.2 | M1 | oe |
| | 84 000 ÷ 4695<br>or [17.89, 17.9] or 18 | M1 | oe |
| | Town B **and** 18.2<br>**and** [17.89, 17.9] or 18 | A1 | |

| Q | Answer | Mark | Comments | |
|---|---|---|---|---|
| 10 | **Alternative method 1** | | | |
| | $1 - 0.38$ or $0.62$ | M1 | oe | |
| | their $0.62 \times 150$ | M1dep | oe implied by $\frac{93}{150}$ | |
| | 93 | A1 | | |
| | **Alternative method 2** | | | |
| | $0.38 \times 150$ or $57$ | M1 | oe | |
| | $150 -$ their $57$ | M1dep | oe implied by $\frac{93}{150}$ | |
| | 93 | A1 | | |
| | **Additional Guidance** | | | |
| | '93 out of 150' on answer line | | | M1M1A1 |
| | Ignore attempt to simplify $\frac{93}{150}$ | | | M1M1A0 |
| | $\frac{93}{150}$ and 93 both on answer line | | | M1M1A0 |
| | $\frac{57}{150}$ | | | M1M0A0 |
| | Do not allow a misread of any probability | | | |

| Q | Answer | Mark | Comments | |
|---|---|---|---|---|
| 11 | $-1$ | B1 | | |
| | $4\pi$ | B1 | | |
| | **Additional Guidance** | | | |
| | Do not allow use of a numerical value for $\pi$ | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 12(a) | Fully correct diagram | B2 | oe<br>B1 0.95 seen once in correct position |
| | **Additional Guidance** | | |
| |  | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 12(b) | $0.05 \times 0.05$ or 0.0025<br>or<br>$0.05 \times 0.95$ or $0.95 \times 0.05$<br>or 0.0475<br>or<br>$0.95 \times 0.95$ or 0.9025 | M1 | oe<br>ft their tree diagram in (a) if all probabilities are between 0 and 1 |
| | $1 - 0.95 \times 0.95$ or $1 - 0.9025$<br>or<br>$0.05 \times 0.05 + 2 \times 0.05 \times 0.95$<br>or<br>$0.0025 + 2 \times 0.0475$<br>or<br>$0.0025 + 0.095$ | M1dep | oe<br>ft their tree diagram in (a) if all probabilities are between 0 and 1 |
| | 0.0975 or 0.098 | A1ft | oe eg $\frac{39}{400}$ or 9.75% |
| | **Additional Guidance** | | |
| | Calculations or probabilities for part (b) may be seen on diagram in part (a) | | |
| | If part (a) is incorrect full marks may be scored in part (b) | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 13 | ($x$ =) –2.2, 1.5 | B2 | B1 at least one of –2.2 and 1.5 with at most one incorrect value<br>or<br>(–2.2, 0) and (1.5, 0)<br>or<br>(–2.2, 1.5) |
| | **Additional Guidance** | | |
| | (1.5, –2.2) | | B0 |
| | (0, –2.2) and (0, 1.5) | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14 | **Alternative method 1** | | |
| | ($a$ =) 45 ÷ 3 × 7 or 105 | M1 | oe may be on diagram |
| | ($y$ =) $\frac{360 - 45 - \text{their}105}{4+1}$<br>or $\frac{210}{5}$ or 42 | M1dep | oe may be on diagram |
| | ($a$ =) 105 and ($y$ =) 42 or 105 : 42<br>and<br>($a$ : $y$ =) 5 : 2 with M2 awarded | A1 | |
| | **Alternative method 2** | | |
| | ($a$ =) 45 ÷ 3 × 7 or 105 | M1 | oe may be on diagram |
| | ($y$ =) their 105 ÷ 5 × 2 or 42 | M1dep | oe may be on diagram |
| | 45 + 105 + 42 + 168 = 360<br>and 42 × 4 = 168<br>or<br>360 – 45 – 105 – 42 = 168<br>and 168 ÷ 4 = 42 | A1 | |
| | **Additional Guidance** | | |
| | 105 : 42 | | M1M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **15(a)** | Correct method for finding the difference between the $x$ or $y$ coordinates for line $AC$ | M1 | may be on diagram<br>eg $9 - -7$ or 16<br>or<br>$3 - -5$ or 8 |
| | Correct method for finding the difference between the $x$ or $y$ coordinates for line $AB$ or line $BC$ | M1dep | may be on diagram<br>eg $16 \div (1 + 3)$ or 4<br>or $8 \div (1 + 3)$ or 2<br>or<br>$16 \times \frac{3}{(1+3)}$ or 12<br>or $8 \times \frac{3}{(1+3)}$ or 6 |
| | $(-3, 5)$ | A1 | |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Condone any missing minus signs if absolute values for the differences are correct | | |
| | $(-3, \ldots)$ or $(\ldots, 5)$ | | M1M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 15(b) | $(m_1=)\frac{-7-9}{3--5}$ or $(m_1=)\frac{9--7}{-5-3}$ or $-2$ | M1 | gradient of $AC$ |
| | $-1 \div$ their $-2$ or $\frac{1}{2}$ | M1 | gradient of line perpendicular to $AC$<br>their $-2$ must be identified as a gradient<br>$\frac{1}{2}$ implies M1M1 |
| | $-7 =$ their $\frac{1}{2} \times 3 + c$ or $(c=) -8.5$<br>or<br>$y - -7 =$ their $\frac{1}{2}(x - 3)$ | M1dep | oe<br>condone any letter for $c$<br>dep on 2nd M1 |
| | $y = \frac{1}{2}x - 8.5$ | A1 | oe eg $2y = x - 17$ |
| | **Additional Guidance** | | |
| | Check part (a) for working for part (b) | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16 | $\frac{1}{6}$ or 0.16(6…) or 0.167 or 0.17 | M1 | oe<br>theoretical probability |
| | $\frac{14}{72}$ or 0.19(4…) | M1 | oe<br>relative frequency |
| | Yes and both values in comparable formats | A1 | eg $\frac{12}{72}$ and $\frac{14}{72}$<br>or<br>$\frac{6}{36}$ and $\frac{7}{36}$<br>or<br>0.16(6…) or 0.167 or 0.17 **and** 0.19(4…)<br>SC1 Yes and 12 seen |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 17(a) | 80 | B3 | B2 (200 =) $2^3 \times 5^2$<br>or $2^4 \times 5$ oe<br>or $16 \times 5$<br>or $200 \times 2 \div 5$<br>B1 $a = 2$ and $b = 5$<br>or 2, 2, 2, 5, 5 seen on a factor tree<br>or 25<br>or 8 |
| | **Additional Guidance** | | |
| | For B1, 25 or 8 must be chosen from any lists of square or cube numbers | | |
| | $2 \times 2 \times 2 \times 5 \times 5$ | | B2 |
| | $5^3 \times 2^2$ | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 17(b) | $e = c^2d$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 18(a) | $\frac{\sin x}{11} = \frac{\sin 35}{7}$ or $\frac{11}{\sin x} = \frac{7}{\sin 35}$ | M1 | oe equation |
| | $\sin x = \frac{11\sin 35}{7}$ or $\sin x = 0.901...$ or $\sin^{-1}\frac{11\sin 35}{7}$ or $\sin^{-1} 0.901\ldots$ | M1dep | oe equation with $\sin x$ as the subject |
| | [64.2, 64.4] with correct working seen | A1 | |
| | **Additional Guidance** | | |
| | 0.901… may be seen as 0.9 for M marks | | |
| | Only using $x = 64$ in sine rule | | M0 |
| | [64.2, 64.4] with no appropriate working | | M0M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 18(b) | No and correct reason indicating that 35° is a different angle<br>or<br>No and correct reason indicating that 7 cm is a different side | B1 | oe<br>eg correct reasons<br>35 is between 7 and 11 this time<br>35 is not opposite 7<br>A is SSA but B is SAS |
| | **Additional Guidance** | | |
| | Ignore irrelevant reasons with a correct reason | | |
| | 'Yes' ticked | | B0 |
| | **'No' ticked and states:** | | |
| | (A and B are) not congruent | | B1 |
| | This triangle is SAS but the other one is not | | B1 |
| | The sides are not opposite the same angles | | B1 |
| | 35 is in a different position compared to the sides | | B1 |
| | 35 is in a different position | | B0 |
| | 7 is in a different position compared to the angles | | B1 |
| | 7 is in a different position | | B0 |
| | 7 was opposite 35 and is now adjacent | | B1 |
| | 7 was opposite and is now adjacent | | B0 |
| | Sides and angles are in different places | | B0 |
| | Sides are in different places | | B0 |
| | There is no value opposite the 35 | | B0 |
| | The angle is in a different position compared to the sides | | B0 |
| | It is a different size | | B0 |
| | It is a different shape | | B0 |
| | $w$ is 72(.3…) or use of sine rule (question says 'without further calculation') | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 19(a) | **Alternative method 1** | | |
| | $4 \times 6 - 7$ or $24 - 7$ or $17$ | M1 | |
| | $14$ | A1 | |
| | **Alternative method 2** | | |
| | $4x - 7 - 3$ or $4x - 10$ | M1 | |
| | $14$ | A1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 19(b) | $(x-3)^2 = 4x - 7$<br>or<br>$x^2 - 6x + 9 = 4x - 7$ | M1 | oe equation |
| | $x^2 - 10x + 16 \ (= 0)$ | M1dep | oe their 3-term quadratic equation with terms collected correctly |
| | $(x-2)(x-8)$<br>or<br>$\frac{--10 \pm \sqrt{(-10)^2 - 4 \times 1 \times 16}}{2 \times 1}$<br>or $5 \pm \sqrt{9}$ | M1 | oe<br>correct for their 3-term quadratic |
| | $x = 2$ and $x = 8$ | A1 | |
| | **Additional Guidance** | | |
| | $(x-3)^2 = 4x - 7 \quad x^2 + 9 = 4x - 7 \quad x^2 - 4x + 16 \ (= 0)$ | | M1M1 |
| | $(x-3)^2 = 4x - 7 \quad x^2 + 9 = 4x - 7 \quad x^2 - 4x + 2 \ (= 0) \quad x = 2 \pm \sqrt{2}$<br>correct answers imply 3rd M | | M1M0M1A0 |
| | $(x-3)^2 = 4x - 7 \quad x^2 + 9 = 4x - 7 \quad x^2 - 4x + 2 \ (= 0)$ | | M1M0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 20 | $P \propto Q$ or $P = kQ$ or $8 = k \times 2$<br>or<br>$R \propto \frac{1}{Q^2}$ or $R = \frac{c}{Q^2}$ or $10 = \frac{c}{3^2}$ | M1 | oe |
| | $k = \frac{8}{2}$ or $k = 4$<br>or<br>$c = 10 \times 3^2$ or $c = 90$ | M1dep | oe<br>implied by $P = 4Q$<br>implied by $R = \frac{90}{Q^2}$ |
| | $P = 4Q$ and $R = \frac{90}{Q^2}$<br>or<br>$k = 4$ and $c = 90$ | A1 | oe |
| | $Q = \frac{0.5}{\text{their } 4}$ and $R = \frac{\text{their } 90}{\left(\text{their } \frac{0.5}{4}\right)^2}$<br>or<br>$R = \frac{\text{their } 90}{0.125^2}$ | M1 | oe eg $R = \frac{1440}{0.25}$<br>ft their equations of the form $P = kQ$<br>and $R = \frac{c}{Q^2}$<br>their 90 must not be 4 |
| | 5760 | A1ft | ft their equations of the form $P = kQ$<br>and $R = \frac{c}{Q^2}$ with 3rd M1 scored |
| | **Additional Guidance** | | |
| | Allow $k$ and $c$ to be any letters, including using both as $k$ | | |
| | Correctly using constants on the left side of their equations – follow the spirit of the mark scheme | | |
| | 5760 with no errors in working | | 5 marks |
| | $P \propto kQ$ or $R \propto \frac{c}{Q^2}$ is M0 unless recovered | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 21(a) | **Alternative method 1** | | |
| | $\frac{4}{3}\pi r^3 = \pi r^2 h$ | M1 | |
| | $\frac{4}{3}r = h$<br>or<br>$4r = 3h$ | M1dep | oe equation with $\pi$ and $r^2$ cancelled |
| | 3 : 4 with M2 awarded | A1 | oe ratio eg $\frac{3}{4}$ : 1 or 1 : $\frac{4}{3}$<br>accept 1.33 or better for $\frac{4}{3}$ |
| | **Alternative method 2** | | |
| | $\frac{4}{3}\pi r^3 = \pi r^2 h$<br>or<br>substitution of the same value of $r$<br>into $\frac{4}{3}\pi r^3$ and $\pi r^2 h$ | M1 | the substitution must be shown |
| | Substitution of the same value of $r$<br>into $\frac{4}{3}\pi r^3$ and $\pi r^2 h$<br>and<br>correct value of $h$ for their value of $r$ | A1 | the substitution must be shown<br>their $h$ should be exactly $\frac{4}{3}\times$ their $r$<br>eg $r = 2$ and $h = \frac{8}{3}$ (oe fraction)<br>do not allow rounded values |
| | 3 : 4 with M1A1 awarded | A1 | oe ratio eg $\frac{3}{4}$ : 1 or 1 : $\frac{4}{3}$<br>accept 1.33 or better for $\frac{4}{3}$ |
| | **Additional Guidance** | | |
| | Accept $h$ : $r$ = 4 : 3 for final mark with M2 or M1A1 awarded | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 21(b) | $(\pi)(3r)^2(2h)$<br>or<br>$3^2 \times 2$ | M1 | oe<br>ft their formula for a cylinder from part (a) in the form $k\pi r^2 h$ with $k$ as a positive constant |
| | 18 | A1 | |
| | **Additional Guidance** | | |
| | Answer 18 from choosing values for $r$ and $h$<br>eg $\pi \times 3^2 \times 4 = 36\pi$ and $\pi \times 9^2 \times 8 = 648\pi$ and $648\pi \div 36\pi = 18$ | | M1A1 |
| | Answer 18 from rounding a decimal | | M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 22 | 5 (×) 4 (×) 3 (×) 2 | M1 | oe |
| | 120 with no errors in working | A1 | SC1 625 (allowing repeated digits) |
| | **Additional Guidance** | | |
| | Ignore any listing of possible codes | | |
| | Condone further working after 120 seen and M1 awarded<br>eg answer as a probability $\frac{1}{120}$ | | M1A1 |
| | 5, 4, 3, 2 | | M1A0 |
| | 5, 4, 3, 2, 1 or $5 \times 4 \times 3 \times 2 \times 1 = 120$ | | M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 23 | 2 | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 24 | **Alternative method 1** | | |
| | $dx^2$ or $2dex$ or $de^2$ | M1 | |
| | $dx^2 + 2dex + de^2 + f$ | M1dep | |
| | $2(x-3)^2 - 11$<br>or<br>$d = 2,\ e = -3,\ f = -11$ | A1 | SC2 $2(x-6)^2 - 29$<br>SC1 $2(x-6)^2 + k \quad k \neq -29$<br>SC1 $2(x+6)^2 - 29$<br>SC1 $2(x+3)^2 + k$<br>SC1 $(x-3)^2 - 2$ |
| | **Alternative method 2** | | |
| | $2(x^2 \ldots)$<br>or<br>$d = 2$ | M1 | |
| | $2(x^2 - 6x + \frac{7}{2})$<br>or<br>$2(x^2 - 6x) + 7$<br>or<br>$2(x-3)^2 + k$ | M1dep | $k \neq -11$ |
| | $2(x-3)^2 - 11$<br>or<br>$d = 2,\ e = -3,\ f = -11$ | A1 | SC2 $2(x-6)^2 - 29$<br>SC1 $2(x-6)^2 + k \quad k \neq -29$<br>SC1 $2(x+6)^2 - 29$<br>SC1 $2(x+3)^2 + k$<br>SC1 $(x-3)^2 - 2$ |