

**GCSE**

**Mathematics (9-1)**

Unit **J560H/04**: Paper 4 (Higher Tier)

General Certificate of Secondary Education

**Mark Scheme for June 2017**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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## Annotations used in the detailed Mark Scheme.

| Annotation | Meaning   |
|------------|---|
| ✓          | Correct   |
| ✗          | Incorrect   |
| BOD        | Benefit of doubt  |
| FT         | Follow through  |
| ISW        | Ignore subsequent working (after correct answer obtained), provided method has been completed |
| M0         | Method mark awarded 0   |
| M1         | Method mark awarded 1   |
| M2         | Method mark awarded 2   |
| A1         | Accuracy mark awarded 1   |
| B1         | Independent mark awarded 1  |
| B2         | Independent mark awarded 2  |
| MR         | Misread   |
| SC         | Special case  |
| ^          | Omission sign   |

## Subject-Specific Marking Instructions

- M** marks are for using a correct method and are not lost for purely numerical errors.  
**A** marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.  
**B** marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.  
**SC** marks are for special cases that are worthy of some credit.
- Unless the answer and marks columns of the mark scheme specify **M** and **A** marks etc, or the mark scheme is 'banded', then if the correct answer is clearly given and is not from wrong working **full marks** should be awarded.

Do not award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen and the correct answer clearly follows from it.
- Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct.

Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, eg FT  $180 \times (\textit{their} '37' + 16)$ , or FT  $300 - \sqrt{(\textit{their} '5^2 + 7^2')}$ . Answers to part questions which are being followed through are indicated by eg FT  $3 \times \textit{their}$  (a).

For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

4. Where dependent (**dep**) marks are indicated in the mark scheme, you must check that the candidate has met all the criteria specified for the mark to be awarded.
5. The following abbreviations are commonly found in GCSE Mathematics mark schemes.
  - **cao** means **correct answer only**.
  - **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point eg 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
  - **isw** means **ignore subsequent working** (after correct answer obtained).
  - **nfw** means **not from wrong working**.
  - **oe** means **or equivalent**.
  - **rot** means **rounded or truncated**.
  - **seen** means that you should award the mark if that number/expression is seen anywhere in the answer space, including the answer line, even if it is not in the method leading to the final answer.
  - **soi** means **seen or implied**.
6. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise, indicated for example by the instruction 'mark final answer'.
7. As a general principle, if two or more methods are offered, mark only the method that leads to the answer on the answer line. If two (or more) answers are offered, mark the poorer (poorest).
8. When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the **MR** annotation. **M** marks are not deducted for misreads.
9. Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.

10. If the correct answer is seen in the body and the answer given in the answer space is a clear transcription error allow full marks unless the mark scheme says 'mark final answer' or 'cao'. Place the annotation ✓ next to the correct answer.

If the answer space is blank but the correct answer is seen in the body allow full marks. Place the annotation ✓ next to the correct answer.

If the correct answer is seen in the working but a completely different answer is seen in the answer space, then accuracy marks for the answer are lost. Method marks would still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✗ next to the wrong answer.

11. Ranges of answers given in the mark scheme are always inclusive.

12. For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.

13. Anything in the mark scheme which is in square brackets [...] is not required for the mark to be earned, but if present it must be correct.

| Question |     | Answer  | Marks | Part marks and guidance  |  |
|----------|-----|---|-------|--|--|
| 1        | (a) | 3   | 2     | B1 for 36 or 9   | ignore $\pm$   |
|          | (b) | $4 \times 10^{-5}$ or [0].000 04  | 2     | B1 for $2.5 \times 10^4$ or 25 000   | Condone $\frac{1}{25\,000}$ for 2 marks  |
| 2        |     | 8.25    8.35  | 2     | B1 for either one correct or for both correct but reversed   |  |
| 3        | (a) | $2 \times 2 \times 2 \times 3 \times 3 \times 7$ or $2^3 \times 3^2 \times 7$<br>final answer | 3     | B2 for 2,2,2,3,3,7 or $2^3, 3^2, 7$ or for a correct expression one stage short of the correct answer e.g. $2^3 \times 9 \times 7$<br>or<br>B1 for two of 2,3,7 identified | allow "." for "x" and condone $2^3 3^2 7$ for 3 marks<br>for B1 and B2 allow factor tables and trees |
|          | (b) | 2520  | 2     | M1 for factors of $180 = 2,2,3,3,5$ oe or seen as factor tables and trees<br><br>If 0 scored<br>then SC1 for $2520n$ e.g. 90 720   | accept any correct method  |
| 4        |     | 128   | 2     | M1 for $12(4) + \frac{1}{2}(10)(4)^2$<br>or<br>B1 for 48 or 80   |  |
| 5        |     | 34.5  | 3     | M2 for $38.64 \div 1.12$ oe<br>or<br>B1 for 1.12 or 112  |  |

| Question | Answer | Marks | Part marks and guidance  |
|----------|--------|-------|--|
| 6        | 214    | 5     | <p><b>B4</b> for 214.2 or 214.24 to 214.26</p> <p>OR</p> <p><b>B1</b> for 60 marked or used as width of the rectangle or distance from B to the corner</p> <p>AND</p> <p><b>M2</b> for <math>\frac{1}{4} \times \pi \times 120</math> soi by <math>30\pi</math>, 94.2 or 94.24 to 94.26<br/>or<br/><b>M1</b> for <math>\pi \times 120</math> soi by 376.8 to 377.1 or <math>\frac{1}{2}\pi \times 120</math> soi by 188.4 to 188.56</p> <p>AND</p> <p><b>M1</b> for <math>2 \times \textit{their} 60 + \textit{their} 30\pi</math></p> <p>AND</p> <p><b>B1</b> for their final answer written to more than 3 figs correctly rounded to 3 s.f.</p> <p><u>to a max. of 4 marks</u></p> |

| Question |     | Answer                      | Marks | Part marks and guidance  |  |
|----------|-----|-----------------------------|-------|--|--|
| 7        | (a) | 135                         | 2     | <b>B1</b> for <u>angle</u> 45  | e.g. 45 marked at ACB or ABC,<br>180 – 45, 90 + 45   |
|          | (b) | 209 to 209.1                | 4     | <b>M2</b> for $\tan^{-1}(45 \div 25)$ or $\tan^{-1}(25 \div 45)$<br>soi by 61, 60.94 to 60.95 or 29[.1] ,<br>29.05...<br><br>or<br><br><b>M1</b> for $\tan [=] 45 \div 25$ or $\tan [= ] 25 \div 45$<br><br>AND<br><br><b>M1</b> for $270 - \textit{their angle ABD}$<br>or $180 + \textit{their angle ADB}$ | Accept longer methods but they<br>must get to the equivalent point to<br>gain credit e.g. if they find the<br>hypotenuse, they score <b>M0</b> until<br>they start to use sin or cos.<br><br>Can be implied by <i>their</i> answer |
| 8        | (a) | 4 points accurately plotted | 2     | <b>B1</b> for 2 or 3 points accurately plotted   | condone missing or incorrect lines   |

| Question | Answer  | Marks | Part marks and guidance  |  |
|----------|---|-------|--------------------------|--|
| (b)      | <p>Here are 4 different categories ,</p> <ul style="list-style-type: none"> <li>• Compares the number of people in the whole of 2015 to the whole of 2016 (e.g. there were more people shopping in 2016)</li> <li>• Compares same seasons in 2015 with seasons in 2016 (e.g there were more in Jul–Sept 2016 than in 2015)</li> <li>• Compares seasons within the same year (e.g in 2016 there were more customers in the summer months)</li> <li>• Compares increases / decreases in the number of customers, referring to gradients (e.g the biggest change was between Jul–Sept and Oct-Dec)</li> </ul> <p>Do not allow comparisons that only refer to the shape of the graph ( e.g, it goes up and down again or it peaks in Jul–Sept)</p> <p>1 mark for each acceptable comment - for 2 marks they must come from different categories</p> | 2     | B1 for 1 correct comment | <p>If they make 3 comments mark the best 2.</p> <p>It is possible to cover 2 categories in one comment for 2 marks</p> |

| Question |     | Answer   | Marks  | Part marks and guidance  |  |
|----------|-----|--|--|--|--|
| 9        | (a) | 24<br>31   | 5  | <p><b>M1</b> for <math>3X + 2Y = 134</math> oe<br/><b>M1</b> for <math>2X + 5Y = 203</math> oe</p> <p><b>M1</b> for multiplying both equations by scalars to equate coefficients of one variable (allow one arithmetic error)</p> <p><b>M1</b> for correct method to eliminate one variable (allow one arithmetic error)</p> <p>if <b>M4</b> not scored award <b>B3</b> for one correct answer</p> | <p>allow any correct method e.g. substitution</p> <p><b>M1</b> for rearranging one equation to make X or Y the subject,<br/><math display="block">X = \frac{134 - 2Y}{3}</math></p> <p><b>M1</b> for substitution of <i>their</i> expression in the other equation</p> |
|          | (b) | Any correct comment relating to distance   | 1  |  | See appendix   |
| 10       | (a) | 4200   | 1  |  |  |
|          | (b) | <p><math>3948 = 4200r</math> oe<br/><math>3948 \div 4200 = 0.94</math></p>   | <p><b>B1</b><br/><b>B1</b></p>               |  | Can be implied by e.g. second statement  |
|          | (c) | <p><math>[0].4[0] \times 4200</math> or 1680<br/><math>4200 \times ([0].94)^{15}</math> or 1660[. ...]<br/>1660[. ...] and 1680 oe</p> | <p><b>M1</b><br/><b>M1</b><br/><b>A1</b></p> | <p>accept any correct method e.g.<br/><b>M1</b> for <math>4200 \times 0.94^{15}</math> or 1660[. ...]</p> <p><b>M1</b> for <math>1660[. ...] \div 4200</math> [<math>\times 100</math>] implied by .395[...] or 39.5 to 39.6</p> <p><b>A1</b> for 60.4 to 60.5[...] or 39.5 to 39.6 with a suitable comment</p>  | <p>Alternatives:<br/><b>M2</b> for <math>0.94^{15} = .395[...]</math><br/><b>A1</b> for 60.4 to 60.5[...]</p>  |

| Question |         | Answer   | Marks  | Part marks and guidance   |   |
|----------|---------|--|--|---|---|
| 11       | (a)     | Correct translation  | 2  | <b>B1</b> for a correct horizontal translation or a correct vertical translation  | Condone freehand, points must be joined for <b>2</b> marks, <b>B1</b> if all correct and not joined   |
|          | (b) (i) | rotation (0,0) oe<br><br>90° [anticlockwise] oe  | 1<br><br>1   | if <b>0</b> scored <b>M1</b> for the triangle/dots on the grid correctly rotated twice<br><br>for centre allow origin and O and for angle allow e.g. -270°, 270° clockwise  | Double transformation can only score <b>M1</b>  |
|          | (ii)    | Rotation<br><br>(0,0) oe<br><br>180°   | 1<br><br>1<br><br>1  | if <b>0</b> scored <b>M1</b> for the triangle /dots on the grid correctly reflected twice<br><br>or<br><br><b>SC2</b> for "rotation (0,0) oe, 90°" written twice<br><br>for centre allow origin and O                             | Allow enlargement (0,0) [sf=] -1 for <b>3</b> marks<br><br>Other double transformations can only score <b>M1</b>  |
| 12       |         | 55 soi by 25<br><br>80 – <i>their</i> 55 soi 25<br><br>[0].3[0] × 80 soi 24<br><br>25 and 24 so yes oe | <b>B1</b><br><br><b>M1</b><br><br><b>M1</b><br><br><b>A1</b> | condone if written on graph<br><br>or <i>their</i> 25 ÷ 80 or 31[%] or 31.2 to 31.3[%]<br><br>31[%] or 31.2 to 31.3[%][and 30] so yes<br><br><b>A1dep</b> on both <b>M1</b> s and <b>A1FT</b> follow through from <i>their</i> 55 | accept any correct method e.g<br><b>B1</b> for 55<br><br><b>M2</b> for [0].7 × 80 soi 56<br>or<br><b>M1</b> for [0].3 × 80 soi 24<br><br><b>A1</b> for 55 and 56 so yes |

| Question |     | Answer  | Marks | Part marks and guidance   |   |
|----------|-----|---|-------|---|---|
| 13       | (a) | [0].4, [0].3 and [0].8 oe in the correct places | 1     |   | Accept equivalent fractions or percentages with % sign in each part and <b>FT their tree diagram only if (a) scores 0 marks</b>   |
|          | (b) | [0].4 or $\frac{2}{5}$ oe                       | 1     | <b>FT their tree diagram</b>  | accept 40%: condone $\frac{4}{1}$ , penalise wrong form once eg 4 : 10, 4 in 10   |
|          | (c) | [0].7 or $\frac{7}{10}$ oe                      | 1     |   | accept 70%  |
|          | (d) | [0].08 or $\frac{2}{25}$ oe                     | 2     | FT <i>their</i> tree diagram for <b>2</b> marks<br><b>M1</b> for <i>their</i> [0].4 × [0].2   | accept 8% and working may be in the tree  |
|          | (e) | [0].82 or $\frac{41}{50}$ oe                    | 3     | FT <i>their</i> tree diagram for <b>3</b> marks<br><br><b>M2</b> for $1 - [0].6 \times \textit{their} [0].3$<br>or $[0].6 \times [0].7 + \textit{their} [0].4 \times \textit{their} [0].8$<br>+ <i>their</i> [0].4 × [0].2 oe soi<br><br>or<br><br><b>M1</b> for $[0].6 \times \textit{their} [0].3$ or<br>two of $[0].6 \times [0].7$ , <i>their</i> [0].4 × <i>their</i> [0].8, <i>their</i> [0].4 × [0].2 oe soi | accept any correct method and working may be in tree<br><br>implied by $1 - [0].18$<br>implied by $[0].42 + [0].32 + [0].08$<br><br>implied by [0].18<br>implied by two of [0].42, [0].32, [0].08 |

| Question | Answer              | Marks | Part marks and guidance   |
|----------|---------------------|-------|---|
| 14       | 92 or 92.28 to 92.6 | 6     | <p><b>M3</b> for correct explicit cos rule to find angle A in ADE with cos as subject.<br/> <math display="block">[\cos A =] \frac{28^2 + 41^2 - 22^2}{2 \times 28 \times 41}</math> oe soi<br/>                     or<br/> <b>M2</b> for correct implicit form of the cos rule to find angle A<br/> <math display="block">22^2 = 28^2 + 41^2 - 2 \times 28 \times 41 \times \cos A</math><br/>                     or<br/> <b>M1</b> for either of the above forms with only one error</p> <p>AND</p> <p><b>M2</b> for correct sine rule e.g.<br/> <math display="block">\frac{64 \times \sin 72}{\sin \text{their} A}</math> oe soi<br/>                     or<br/> <b>M1</b> for <math>\frac{64}{\sin \text{their} A} = \frac{[\dots]}{\sin 72}</math> oe</p> <p>if 0 scored <b>SC1</b> for explicit form of cos rule to find angle D or E in ADE e.g.<br/> <math display="block">[\cos D =] \frac{28^2 + 22^2 - 41^2}{2 \times 28 \times 22}</math></p> |

| Question |     | Answer   | Marks   | Part marks and guidance  |   |
|----------|-----|--|---|--|---|
| 15       | (a) | 14 – 15  | 1   |  |   |
|          | (b) | 30 from graph<br><br>Starting with <i>their</i> 30 (using mph)<br><i>These method marks could be awarded in any order</i><br><br>$\times 60^2$ soi<br>$\div 1000$ soi<br>$\div 1.6$ soi<br><br>67.5 so yes | <b>B1</b><br><br><b>M1</b><br><b>M1</b><br><b>M1</b><br><b>A1</b> | Starting with 60 (using m/s)<br><i>These method marks could be awarded in any order</i><br><br><b>M1</b> $\times 1.6$ soi by 96<br><b>M1</b> $\times 1000$ soi<br><b>M1</b> $\div 60^2$ soi<br><b>B1</b> for 30 from graph<br><b>A1</b> for 26.6 to 26.7 and 30 so yes | accept any correct method e.g. (using km/hr)<br><b>M1</b> for $60 \times 1.6$ soi by 96<br><b>B1</b> for 30 from graph<br>Starting with <i>their</i> 30<br><i>These method marks could be awarded in any order</i><br><b>M1</b> $\times 60^2$ soi<br><b>M1</b> $\div 1000$ soi<br><b>A1</b> for 96 and 108 so yes |
|          | (c) | Attempt at a tangent drawn at $t = 7$<br><br>4.0 to 4.5 oe   | <b>B1</b><br><br><b>B2</b>  | <b>M1</b> for an attempt at speed $\div$ time, could be on the graph<br>e.g. $30 \div 10$ or <i>their</i> (a) $\div 7$ soi 2.07... or 2.14..   | Accept answer as a fraction and tolerance on reading from graph $\pm \frac{1}{2}$ small square<br>Gradient for M1 could be from a chord. Ignore any negative sign   |
|          | (d) | $v = kt^2$ where $0.25 \leq k \leq 0.33$   | 3   | <b>SC2</b> for $v \propto kt^2$ where $0.25 \leq k \leq 0.33$<br>or<br><b>B1</b> for $v = kt^2$<br>AND<br><b>M1</b> for $30 = k(10)^2$ or FT <i>their</i> reading from the graph for values of $v$ and $t$<br>or<br><b>B1</b> for $0.25 \leq k \leq 0.33$              | Condone use of other letters especially s for speed<br>Can be implied by eg $30 = k(10)^2$<br><br>$k$ could be a fraction e.g. $\frac{15}{49}$  |
|          | (e) | any correct comment e.g. graph only valid/information only available up to 10 secs or car will eventually reach max. speed   | 1   |  | See appendix  |

| Question |     | Answer                             | Marks | Part marks and guidance  |  |
|----------|-----|------------------------------------|-------|--|--|
| 16       |     | $(x - 5)^2$ final answer           | 1     |  |  |
|          |     | -9 final answer                    | 2     | FT <i>their</i> $(x - 5)^2$ final answer   |  |
| 17       |     | circle                             | 1     | condone circular   |  |
|          |     | centre (0, 0) oe and radius 3      | 1     | accept origin or O for (0,0)   |  |
| 18       | (a) | $(2x - 3)(x + 4)$ oe               | 2     | M1 for any two factors that give two correct terms when expanded   | If they use another method then award B1 for both answers correct.   |
|          |     | 1.5 oe and -4                      | 1     | Correct or FT <i>their</i> two factors   |  |
|          | (b) | [0].72<br>-1.39                    | 3     | M2 for one correct answer or<br>$\frac{-2 \pm \sqrt{2^2 - 4 \times 3 \times -3}}{2 \times 3}$ or better<br>or<br>M1 for this formula with at most two errors<br>if 0 scored allow SC1 for answers [0].720... or [0].721 and -1.38..... | for completing the square<br>M1 for $(x + \frac{1}{3})^2 - \frac{10}{9}$<br>M1 for $\sqrt{\frac{10}{9}} - \frac{1}{3}$ |
| 19       | (a) | $\frac{n^2}{n+1}$                  | 2     | B1 for $n^2$ or $n + 1$  |  |
|          | (b) | [a = ] 3<br>[b = ] 1<br>[c = ] - 2 | 4     | B2 for [a = ] 3<br>or<br>M1 for second differences = 6<br>and<br>M1 for revised differences of -1 0 1 2<br>or<br>B1 for b or c correct   | accept any correct method see notes  |

| Question |  | Answer   | Marks                      | Part marks and guidance  |                             |
|----------|--|--|----------------------------|--|-----------------------------|
| 20       |  | evidence of finding the area under the graph<br><br>15 to 22 | <b>M1</b><br><br><b>B1</b> | <b>M1</b> for evidence of any correct method to find the area under the graph e.g. counting squares (numbers or dots in squares) or use of triangles, trapeziums or rectangles | accept answer as a fraction |

## APPENDIX

Exemplar responses for Q9(b)

| <b>Response</b>  | <b>Mark</b> |
|--|-------------|
| He does no other driving other than routes X and Y in the week                           | 1           |
| There are no diversions or detours   | 1           |
| He sets off from the same place each time  | 1           |
| That he only drives these two routes   | 1           |
| They are the same 2 routes and never change  | 1           |
| He could of gone to other routes as well as X & Y routes. He didn't drive anywhere else. | 1           |
| That Dan isn't driving anywhere else during the week                                     | 1           |
| The routes are correctly measured  | 1           |
| He takes exactly the same route each time.   | 1           |
| He hasn't taken any breaks   | 0           |
| There are no stops   | 0           |
| There is no traffic jams   | 0           |
| He does not cancel his drive   | 0           |
| That no stops in petrol stations were made   | 0           |
| Y has a longer route than X  | 0           |
| Dan prefers to drive route Y as he has driven it more than route X                       | 0           |
| He didn't drive route X or Y there and back  | 0           |
| That there is no traffic or road works   | 0           |

Exemplar responses for Q15(e)

| <b>Response</b>   | <b>Mark</b> |
|---|-------------|
| graph only valid/information only available up to 10 secs | 1           |
| car will eventually reach max. speed                      | 1           |
| It could stay at a constant speed                         | 1BOD        |
| It gains enough acceleration its speed becomes constant   | 0           |
| He drove the whole route                                  | 0           |

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