

# **Mathematics A**

General Certificate of Secondary Education

Unit **A501/02**: Mathematics A (Higher Tier)

## **Mark Scheme for November 2012**

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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

| Annotation                                                                          | Meaning                                                                                       |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
|    | Correct                                                                                       |
|    | Incorrect                                                                                     |
|    | Benefit of doubt                                                                              |
|    | Follow through                                                                                |
|    | Ignore subsequent working (after correct answer obtained), provided method has been completed |
|    | Method mark awarded 0                                                                         |
|    | Method mark awarded 1                                                                         |
|    | Method mark awarded 2                                                                         |
|    | Accuracy mark awarded 1                                                                       |
|    | Independent mark awarded 1                                                                    |
|    | Independent mark awarded 2                                                                    |
|  | Misread                                                                                       |
|  | Special case                                                                                  |
|  | Omission sign                                                                                 |

These should be used whenever appropriate during your marking.

The **M**, **A**, **B**, etc annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks.

It is vital that you annotate these scripts to show how the marks have been awarded.

It is not mandatory to use annotations for any other marking, though you may wish to use them in some circumstances.

**Subject-Specific Marking Instructions**

1. **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.
2. 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.

3. 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  $180 \times (\text{their '37'} + 16)$ , or FT  $300 - \sqrt{(\text{their '5'}^2 + 7^2)}$ . Answers to part questions which are being followed through are indicated by eg FT  $3 \times \text{their (a)}$ .

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.
  - **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 and applies as a default.
  - **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. In questions with no final answer line, make no deductions for wrong work after an acceptable answer (ie **isw**) unless the mark scheme says otherwise, indicated for example by the instruction 'mark final answer'.
7. In questions with a final answer line following working space,
  - (i) if the correct answer is seen in the body of working and the answer given on the answer line is a clear transcription error allow full marks unless the mark scheme says 'mark final answer'. Place the annotation ✓ next to the correct answer.
  - (ii) if the correct answer is seen in the body of working but the answer line is blank, allow full marks. Place the annotation ✓ next to the correct answer.
  - (iii) if the correct answer is seen in the body of working but a completely different answer is seen on the answer line, then accuracy marks for the answer are lost. Method marks could still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✕ next to the wrong answer.
8. 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).
9. 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.
10. 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.
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) | (i)  |                                                                    | 3     | B2 for two correct entries<br>Or B1 for one correct entry                                                            | If a space is blank, accept clear evidence in working space eg Joe White = 21 |    |
|          |     |      |                                                                    |       |                                                                                                                      |                                                                               | 21 |
|          |     |      | 37                                                                 |       |                                                                                                                      |                                                                               |    |
|          |     | 77   | 53                                                                 |       |                                                                                                                      |                                                                               |    |
|          |     | (ii) | 8 : 7                                                              | 1     | Accept 1 : 0.875 or 1.14[...] : 1                                                                                    |                                                                               |    |
|          | (b) |      | 12                                                                 | 3     | nfw<br><br>M2 for $\frac{60}{their (7 + 5 + 3)} \times 3$ oe<br>Or M1 for $60 \div their (7 + 5 + 3)$ oe<br>or for 4 |                                                                               |    |
| 2        | (a) |      | There are overlaps eg 5 comes in two boxes                         | 1     | Or needs responses with no overlaps eg 0-4, 5-9 etc                                                                  | See exemplars                                                                 |    |
|          |     |      | There is no box for over 20 CDs (accept a numerical example eg 30) | 1     | Or needs responses covering all eventualities eg extra box for “21 or more” or extra box for “other”                 |                                                                               |    |

| Question |     |  | Answer       | Marks | Part Marks and Guidance                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|-----|--|--------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | (b) |  | 260          | 4     | nfw<br><b>M1</b> for midpoints 50, 150, 250 etc (at least 3 correct) soi<br><br><b>M1</b> for <i>their</i> 'midpoints' $\times$ freq attempted soi by 10400 or 10420 or at least 3 products seen FT <i>their</i> 'midpoints'<br><br><b>M1</b> for <i>their</i> sum of $f \times x \div$ <i>their</i> sum of $f$<br><br>Or <b>SC3</b> for final answer 260.5<br>Or <b>SC2</b> for final answer 210 or 310 | eg may be seen by table<br>Condone 50.5, 150.5 etc<br><br>eg at least 3 of 100, 1500, 3750, 3150, 1350, 550 or total 10400<br>Working may be by table<br><br>If correct: $10400 \div 40$<br><br>eg allow 2 <sup>nd</sup> and 3 <sup>rd</sup> <b>M1</b> s for use of endpoints not midpoints<br><br>First two <b>M1</b> s may be earned for correct work seen even if not then used in the final answer |
| 3        | (a) |  | 47.52        | 1     |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                        |
|          | (b) |  | 15.2         | 1     |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                        |
| 4        | (a) |  | 96           | 2     | nfw<br><b>M1</b> for $[6 \times] 16$<br>Or <b>SC1</b> for answers of -96 or 576                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                        |
|          | (b) |  | 7, 11, 15    | 2     | <b>M1</b> for two terms in correct place<br>Or <b>SC1</b> for 3, 7, 11                                                                                                                                                                                                                                                                                                                                   | eg <b>M1</b> for 3, 11, 15                                                                                                                                                                                                                                                                                                                                                                             |
|          | (c) |  | $3y(2y + 3)$ | 2     | <b>M1</b> for $3y(\dots)$ or for $y(6y + 9)$ or for $3(2y^2 + 3y)$                                                                                                                                                                                                                                                                                                                                       | Condone missing final bracket                                                                                                                                                                                                                                                                                                                                                                          |

| Question |     |  | Answer                                          | Marks | Part Marks and Guidance                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                               |
|----------|-----|--|-------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | (d) |  | $\frac{15}{4}$ oe isw                           | 3     | <b>M2</b> for $15 = 4x$ oe<br>OR<br><b>M1</b> for $x$ s or numbers collected and simplified correctly<br><b>M1FT</b> for final answer FT <i>their</i> $ax = b$ with $a \neq 1$ or 0 or $b$ and $b \neq 0$<br><br>Allow <b>B3</b> for correct answer given embedded as final answer | Allow <b>M1</b> for eg $2x = 6x - 15$<br><br>eg $2 \times \frac{15}{4} + 7 = 6 \times \frac{15}{4} - 8$                                                                                                                                                                                                                       |
|          | (e) |  | $[x =] \frac{y-6}{4}$ or $\frac{y}{4} - 1.5$ oe | 2     | <b>M1</b> for a correct constructive first step, or for answer correct except for a sign error                                                                                                                                                                                     | eg <b>M1</b> for $\frac{6-y}{4}$ (sign error in denominator)                                                                                                                                                                                                                                                                  |
| 5        |     |  | Correct perpendicular line                      | 1     | Within tolerance 88 to 92° of AB and within 1mm of D; line to reach at least from D to within 2mm of AB                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                               |
|          |     |  | Arcs showing compasses used correctly           | 1     | As well as standard two pairs of two arcs, condone arc touching line drawn and radius drawn, condone 'kite construction'                                                                                                                                                           | 'Kite construction' arcs through D, centre A, above and below AB intersecting with similar arcs centre B<br><br>Also condone 'half kite' with just the intersecting arcs below AB but with radii AD and BD<br>Ignore perp. bisector if also drawn<br><br>NB <b>0</b> for spurious arcs drawn after the line – watch for these |
|          |     |  | 14.8 to 15.2                                    | 2     | <b>M1</b> for 7.4 to 7.6 [cm] or 1480 to 1520 [cm]                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                               |

| Question |     |  | Answer            | Marks | Part Marks and Guidance                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                  |
|----------|-----|--|-------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6        | (a) |  | $2^3 \times 3$ oe | 2     | <b>M1</b> for factor tree or division of 24 with 2 and 3 found as factors                                                                                                                                                                                                                                                                   | Index form not required but product needed for <b>2</b> marks                                                                                                                    |
|          | (b) |  | 168 and 600       | 3     | <b>M1</b> for $4200 = 2^3 \times 3 \times 5^2 \times 7$ oe seen (need not be formally expressed as product)<br><b>M1</b> for correct Venn diagram oe seen<br>OR<br><b>M1</b> for $4200 \div 24$ or 175 seen<br><b>M1</b> for $7 \times 24$ or $25 \times 24$ oe<br><br>If <b>M0</b> , then <b>SC1</b> for 168 or 600 seen as a final answer | eg clear split of 52 and 7                                                                                                                                                       |
| 7        | (a) |  | 76.3 to 76.4[0]   | 3     | nfw<br><b>M2</b> for $85 \times \sin 64$ or $2 \times 42.5 \times \sin 64$<br>Or <b>M1</b> for $\sin 64$ used<br><br>Allow <b>A1</b> for 76 if correct method seen<br><br>Or <b>SC2</b> for 78.2 to 78.3 (radians) or 71.7 to 71.8 (grads)                                                                                                  | Allow <b>M2</b> for complete equivalent method involving $85 \times \cos 64$ [= 33.3...] followed by Pythagoras<br><br>From scale drawing, allow only <b>B1</b> for 76.3 to 76.4 |

| Question |     |  | Answer | Marks | Part Marks and Guidance                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                      |
|----------|-----|--|--------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | (b) |  | 68.3   | 3     | <p>nfw</p> <p><b>B2</b> for other rot version of 68.34...</p> <p>Or <b>M2</b> for <math>\sin^{-1}\left(\frac{79}{85}\right)</math> oe</p> <p>Or <b>M1</b> for use of inverse trig fn</p> <p>If <b>M0</b> scored, allow</p> <p><b>B1</b> for 68.2 or 68.4 following</p> <p><math>\sin x = \left(\frac{79}{85}\right)</math> oe seen</p> <p>Or <b>SC1</b> for 1.2 (radians) or 75.9 (grads)</p> | <p><b>0</b> from scale drawing</p> <p>Condone poor notation</p> <p>Allow even with wrong trig fn – will usually have already been penalised for this in part (a)</p> |

| Question |     |  | Answer                                                                                                                                                              | Marks | Part Marks and Guidance                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                         |
|----------|-----|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8        | (a) |  | Vert. dist = $449 - 170$ or 279                                                                                                                                     | M1    | <b>M1</b> for 279 seen                                                                                                                                                                             | <u>Alternative method using trig:</u><br><b>M1</b> for vert. dist as opposite<br><b>M1</b> for unit conversion as opposite<br><b>M1</b> for use of $\tan^{-1}$ to find an angle (note they could be finding either angle)<br><b>M1</b> for correct selection of a length and trig ratio consistent with the angle found<br><b>A1</b> for 2098.6 to 2100 |
|          |     |  | Unit conversion before Pythagoras/trig:<br>Either Horiz. dist. = $1.293 \times 1609$ or 2080[.437..]<br>Or Vert. dist. = <i>their</i> $279 \div 1609$ or 0.17[3...] | M1    | Allow <b>M1</b> for<br>$449 \div 1609$ or $170 \div 1609$<br>or clear indication that either<br>$449$ [metres] = 0.279[...] or 0.28 [miles]<br>or that $170$ [metres] = 0.105[...] or 0.11 [miles] |                                                                                                                                                                                                                                                                                                                                                         |
|          |     |  | <i>Their</i> $h^2 + \text{their } v^2$ [= 4406059 or 1.7019..]                                                                                                      | M1    | Allow even if units are not consistent                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                         |
|          |     |  | $\sqrt{\text{Their } h^2 \pm \text{their } v^2}$                                                                                                                    | M1    | Allow even if units are not consistent<br>Square root step may be implied                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                         |
|          |     |  | 2098.6 to 2100                                                                                                                                                      | A1    |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                         |
|          | (b) |  | Use at least two triangles/use interim point                                                                                                                        | 1     |                                                                                                                                                                                                    | See exemplars                                                                                                                                                                                                                                                                                                                                           |
| 9        |     |  | Frequency densities 1, 1.6, 2, 2.2, 1.6, 0.2 soi                                                                                                                    | B1    | Seen or plotted<br>Condone one error                                                                                                                                                               | <b>0</b> if labelled 'Freq' oe                                                                                                                                                                                                                                                                                                                          |
|          |     |  | Heights correct                                                                                                                                                     | B1    | No FT from wrong freq density                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                         |
|          |     |  | Widths correct                                                                                                                                                      | B1    |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                         |
|          |     |  | Sensible scale and fd axis labelled                                                                                                                                 | B1    | Accept 'Frequency density' or 'Fd'<br>and/or 'people per £10k' oe                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                         |

| Question |     |  | Answer                                                                                                             | Marks                  | Part Marks and Guidance                                                                                                                                                         |                                             |
|----------|-----|--|--------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| 10       | (a) |  | $p = 12$<br>$r = 9$                                                                                                | 2                      | B1 each                                                                                                                                                                         |                                             |
|          | (b) |  | $5c - cn = 9d - 6d$ [or $= 3d$ ]<br><br>$c(5 - n) = 9d - 6d$ [or $= 3d$ ] or FT<br><br>$[c =] \frac{3d}{5 - n}$ oe | M1<br><br>M1<br><br>A1 | For collecting $c$ terms on one side, non- $c$ terms on the other; condone one error<br><br>For factorising; may be implied by final answer<br><br>Numerator must be simplified |                                             |
| 11       | (a) |  | 19                                                                                                                 | 1                      |                                                                                                                                                                                 |                                             |
|          | (b) |  | $15t + 3$                                                                                                          | 3                      | nfw<br>Condone $3 + 15t$<br><b>M1</b> for $5(2 + 3t) - 7$<br><b>M1</b> for $10 + 15t - 7$                                                                                       | Allow $x$ instead of $t$ for <b>M</b> marks |

## APPENDIX 1

Exemplar responses for question 2(a)

| Response                                                                               | Mark awarded |
|----------------------------------------------------------------------------------------|--------------|
| She has included the last number from the previous category.                           | 1            |
| She has one same option in each of the boxes.                                          | 1            |
| It is not suitable for all possible responses.                                         | 0            |
| Not a true representation of population, age groups stop at 20 years old.              | 0            |
| How many CDs a person has is too specific – needs a more general question to be asked. | 0            |

Exemplar responses for question 8(b)

| Response                                                                                                            | Mark awarded           |
|---------------------------------------------------------------------------------------------------------------------|------------------------|
| Work out separate sections of the graph and not just use the line of best fit.                                      | 1                      |
| He could have used multiple smaller triangles.                                                                      | 1                      |
| It is just working it out as a whole, they should work out for every 0.2 miles then add together.                   | 1                      |
| Split into smaller sections on the graph.                                                                           | 1 relates to the graph |
| Include the changes in steepness he climbed.                                                                        | 0 how?                 |
| Use a smaller triangle.                                                                                             | 0                      |
| Use a bigger more precise triangle.                                                                                 | 0                      |
| By following the graph more closely instead of putting it in a triangle.                                            | 0                      |
| He could use a pedometer.                                                                                           | 0                      |
| Have all the lengths in the same units.                                                                             | 0                      |
| Calculate how far he climbed in 1m and multiply that by 2080.                                                       | 0                      |
| Start at 0m altitude and walk a whole number of miles.                                                              | 0                      |
| He could have taken the readings himself as the Sat Nav may have had no signal in some areas and not been accurate. | 0                      |

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