

Mathematics A

General Certificate of Secondary Education

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

Mark Scheme for November 2010

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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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Marking Instructions & Abbreviations**Marking instructions**

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Work crossed out but not replaced should be marked.
4. **M** (method) marks are not lost for purely numerical errors.
A (accuracy) marks depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
B marks are independent of **M** (method) marks and are awarded for a correct final answer or a correct intermediate stage.
5. Two additional situations may appear in the mark scheme allowing the award of **A** marks or independent (**B**) marks:
 - i. Correct answer with no working
 - ii. Follows correctly from a previous answer whether correct or not (“FT” on mark scheme).
6. 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).
7. 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.
8. 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. If the answer is missing, but the correct answer is seen in the body allow full marks. If the correct answer is seen in working but a completely different answer is seen in the answer space, then accuracy marks for the answer are lost. Method marks would normally be given.
9. For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work.

10. For answers scoring no marks, you must either award NR (no response) or 0, as follows:

Award NR (no response) if:

- Nothing is written at all in the answer space
- There is any comment which does not in any way relate to the question being asked (“can’t do”, “don’t know”, etc.)
- There is any sort of mark that is not an attempt at the question (a dash, a question mark, etc.)

Award 0 if:

- There is any attempt that earns no credit. This could, for example, include the candidate copying all or some of the question, or any working that does not earn any marks, whether crossed out or not.

11. Where a follow through mark is indicated on the mark scheme for a particular part question, you must ensure that you refer back to the answer of the previous part question.
12. Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures seen. E.g. answer on 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.
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.
14. Ranges of answers given in the mark scheme are always inclusive.
15. Annotating scripts. The following annotations are available:

✓ and ✗

BOD - Benefit of doubt

FT - Follow through

ISW - Ignore subsequent working

M0, M1, M2 - Method mark awarded 0, 1, 2

A1 - Accuracy mark awarded

B1, B2 - Workless mark awarded 1, 2

MR - Misread

SC - Special case

^ - Omission sign

These should be used whenever appropriate during your marking.

Abbreviations

The following abbreviations are commonly found in GCSE Mathematics mark schemes.

- Where you see **oe** in the mark scheme it means **or equivalent**.
- Where you see **isw** in the mark scheme it means **ignore subsequent working** (after correct answer obtained), provided the method has been completed.
- Where you see **cao** in the mark scheme it means **correct answer only**.
- Where you see **soi** in the mark scheme it means **seen or implied**.
- Where you see **www** in the mark scheme it means **without wrong working**.
- Where you see **rot** in the mark scheme it means **rounded or truncated**.
- Where you see **seen** in the mark scheme it 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.
- Figs: for example **figs 237** means any answer with just these digits with leading or trailing zeros disregarding any decimal point. E.g. 237000, 2.37, 2.370, 0.00237 but not 23070 or 2374.

1	(a)	5 : 6	2	Accept 1 : 1.2 or 0.83(3...) : 1 or better M1 for a correct simplification of 40 : 48 e.g. 10 : 12	
	(b)	Sonja 80 and Ben 60	2	M1 for $140 \div 7$ or 20 Or SC1 for S 60 B 80	
2	(a)	3×5^2 or $3 \times 5 \times 5$ oe	2	Must have product M1 for 3 and 5 identified as prime factors e.g. in factor tree	Condone 3.5^2 as product
	(b)	600 as final answer	3	M2 for $2^3 \times 3 \times 5^2$ or for 75×2^3 or for 120×5 Or M1 for list of at least 3 multiples of both 120 and 75 or list of at least 3 times from 2pm for both sets of lights or for correct decomposition of 120 into prime factors Or SC2 for 10 minutes or 2:10 as answer Or SC1 for other multiples of 600 as answer	
3	(a)	4, 7, 12	2	M1 for two correct (condone misplaced)	
	(b)	$5n - 2$ oe	2	Accept unsimplified M1 for $5n$ soi	Accept $5 \times n$, $n5$ etc; condone capitals or different letters used

4	(a)	Both perpendicular bisectors drawn with correct construction arcs and intersecting [at labelled P]	3	M2 for both correct but without arcs or for one correct with arcs or for bisectors both drawn but not intersecting Or M1 for one correct without arcs	Use tolerance on overlay For each perp bisector, allow two sets of arcs or one set + measured midpoint
	(b)	No, distance from D is different oe	1	Not dependent on (a), but comment should refer to distance from vertices not distance from sides, or should refer to fact that bisectors of DA and DC not drawn (and may conclude 'don't know') 0 if yes...	0 if their comment implies distance from A different as well, for instance
5	(a)	$(6 + 2) \times 4 = 32$	1		
	(b)	$6 + 2 \times (4 - 1) = 12$	1	Accept superfluous pairs of brackets in all 3 parts eg accept $6 + (2 \times (4 - 1)) = 12$ here	Brackets must be in pairs 0 for e.g. $6 + 2 \times (4 - 1 = 12$
	(c)	$6 + (2 \times 4)^2 = 70$	1		
6		Formula Identity	2	1 each	

7	(a)	(i) 221 to 224	1		
		<p>(ii) At least one side of AB, BC, CA measured accurately (11 cm, 9 cm, 8 cm with tolerance ± 1 mm)</p> <p>Total distance found e.g. 28 cm on map or 700 000 cm soi</p> <p>100 cm = 1 m and 1000 m = 1 km or 4 cm to 1 km soi</p> <p>7 [km] and appropriate comment</p>	<p>M1</p> <p>M1</p> <p>M1</p> <p>B1</p>	<p>May be implied by conversion to actual distances in cm, m or km (e.g. figs 275, 225, 2)</p> <p>FT <i>their</i> measurements; may be done after conversion</p> <p>May be earned earlier; need not be explicit M0 for e.g. 10 000 m = 1 km stated</p> <p>Accept 6.9 to 7.1 km and 'so OK', 'no, paths may be not straight so they have to go further' etc</p>	<p>Often seen by diagram; may be implied by 28 e.g. 2.75 [km] seen by diagram earns first and third M1s If only 8 seen must be clearly identified as AC</p> <p>Figs 7 imply this second M1</p> <p>May be implied by correct answer</p> <p>E.g. if measurements or 28 not seen, may earn M0 M1 M1 B1</p>
	(b)	<p>1.41(4...)</p> <p>Suitable comment e.g. '1.4 would be more accurate' or 'not too far out for a rough guide' or '1.5 is near and is easier for an estimate' or 'they have rounded wrongly it should be 1.4 not 1.5'</p>	<p>2</p> <p>1</p>	<p>M1 for $1^2 + 1^2$ or $\sqrt{2}$ oe soi Allow A1 for 1.4 if M1 earned</p> <p>Allow SC1 for $1.5^2 - 1^2 = 1.25$ followed by $\sqrt{1.25} = 1.1(18\dots)$ rot [can also earn comment mark following this]</p> <p>Dependent on answer 1.4 to 1.42 or Pythagoras attempted</p>	<p>Condone trigonometry used if correct answer obtained</p> <p>M0 for just $1 + 1 [= 2]$ with no evidence of squaring or square root</p> <p>Mark equivalently for other squares used e.g. M1 for $2^2 + 2^2$ and A1 for 2.82(8...) and B1 for comparison with 3</p>

	(c)	$\tan x = \frac{400}{600}$ Inverse trig function seen or used 33.6 to 33.823 and appropriate comment e.g. not as steep as Mike thought	M1 <u>Alternative method</u> M2 for vertical = $600 \times \tan 40$ M1 Or M1 for $\tan 40 = \frac{\text{vertical}}{600}$ or equivalents with horizontal distance AND A1 for vertical = 503(.45...) or horizontal = 476(.7...) and appropriate comment A1 Allow B3 for 33.6 to 33.823 or better and appropriate comment	Second M1 is independent of first – is earned for some indication that an inverse trig fn is needed to find an angle – even if done wrongly Comparison of $\tan 40$ with $\tan x$, both evaluated with appropriate comment earns full marks Allow A1 for any of the following oe: “Good estimate - only 6° out” “Not a good estimate as it is 6° out “ “Not far off, but 30° would have been closer“ Condone ‘so OK’ etc
8	(a)	(i) $\frac{8}{5}$ or 1.6 oe	3 M2 for $5x = 8$ Or M1 for one side of equation correct AND M1 for final answer FT from <i>their</i> $ax = b$, provided $a \neq \pm 1$ Allow B3 for correct answer given embedded as final answer	Allow M1 for e.g. $3x = 8 - 2x$ E.g. $3 \times 1.6 + 7 = 15 - 2 \times 1.6$
		(ii) 4	1	0 for embedded answer
		(iii) ± 5	3 B2 for one solution Or M1 for 25 or 5^2 seen or for $\sqrt{\frac{75}{3}}$ Or B1 each for embedded solutions e.g. $3 \times 5^2 = 75$ as final answer	

	(b) $8x^2 - 28x$ as final answer	2	M1 for one term correct or for correct answer seen then spoiled by further 'simplification' or for $4(2x^2 - 7x)$	Condone $8x^2 + - 28x$ for 2 marks M0 for $x(8x - 28)$
	(c) $2(3 + 4x)$	1		Condone missing final bracket
	(d) $x - bx = 2a - 3$ oe $x(1 - b) = 2a - 3$ oe $[x =] \frac{2a - 3}{1 - b}$ or $\frac{3 - 2a}{b - 1}$	M2 M1 M1	M1 for one correct step in collection of terms For factorising, FT For division, FT <i>their</i> factored form; condone written with a division symbol (even without brackets) rather than as a fraction for final step	E.g. M1 for $x = 2a - 3 + bx$ or for terms in x or $x^2 = 2a - 3$ or, at worst, e.g. $-b = 2a - 3$ For last two marks, no FT from too simple 'formulae' after their errors Mark best attempt, not a mixture

9	(a)	<p>Median at 170.5 - 172</p> <p>Box with LQ at 155 - 156 and UQ at 178 - 178.5</p> <p>Whiskers with lower end at 140 - 141 and upper end at 184.5 - 185</p>	<p>1</p> <p>1</p> <p>1</p>	<p>Accept full or dashed</p> <p>Allow BOD if UQ possibly slightly greater than 178.5 but it must clearly be less than 179</p>	<p>Allow median mark BOD if no box just line in correct position</p>															
	(b)	<p>40-44 took longer on average oe</p> <p>And correct medians (or differences)</p> <p>Range used in appropriate comment (and similarly for IQR)</p> <p>Correct times for <i>their</i> choice</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p>	<p>For both comment marks to be earned, at least one comment must mention time/length of time</p> <p>Allow mention of median or figures for median to imply 'on average'</p> <p>B0 if average associated with spread or with mean</p> <p>Allow this B1 if values for median correct even if called 'mean'</p> <p>B0 for just 'spread' without evidence of which measurement used from words or times</p>	<p>Accept these values (may be seen by diagrams):</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>18-39</th> <th>40-44</th> <th>diff</th> </tr> </thead> <tbody> <tr> <td>median</td> <td>170-172.5</td> <td>191.5-192.5</td> <td>19-22.5</td> </tr> <tr> <td>range</td> <td>43-45.5</td> <td>49.5-50.5</td> <td>4-7.5</td> </tr> <tr> <td>IQR</td> <td>21.5-24</td> <td>9.5-10.5</td> <td>11-15</td> </tr> </tbody> </table> <p>Allow comment re: differences</p> <p>No FT from wrong box plot for second B1 for median, etc</p> <p>Comments may be in either order – comment 1 does not have to be about average</p>		18-39	40-44	diff	median	170-172.5	191.5-192.5	19-22.5	range	43-45.5	49.5-50.5	4-7.5	IQR	21.5-24	9.5-10.5
	18-39	40-44	diff																	
median	170-172.5	191.5-192.5	19-22.5																	
range	43-45.5	49.5-50.5	4-7.5																	
IQR	21.5-24	9.5-10.5	11-15																	

10	(a)	<p>Frequencies in each group soi: [5], 10, 17, 33, 35 Correct boundaries to groups</p> <p>Frequencies \times midpoints attempted: 5×25, 10×75, 17×150, 33×350, 35×750</p> <p><i>Their</i> total of midpoints \times freq \div 100</p> <p>412.25 [so over 400 h]</p>	<p>M1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>A1</p>	<p>Allow this M1 for two or more correct</p> <p>Condone poor notation such as 200-500, 500-1000 if endpoints correct</p> <p>At least 3 correct or FT correct: may be 125, 750, 2550, 11550, 26250 [total = 41 225]</p> <p>May be implied by correct answer or by FT answer if <i>their</i> total seen</p> <p>Or allow final M1 A1 for comparison of 41225 with 400×100</p>	<p>Condone 24.5, 74.5, 149.5 etc</p> <p>No FT from endpoints used</p>
	(b)	<p>Estimate of mean uses midpoints, but actual values may have been towards lower end of groups oe</p>	<p>1</p>		<p>Comment should indicate values might have been towards low end of groups, not just that they are grouped and we do not know actual values</p>

APPENDIX 1

Exemplar responses for question 4b

Response	Mark awarded
No. D is 10 cm away but C is 4.5 cm away [no need to check measurements] / D is about twice as far away	1
No/I don't know [because] I haven't used D in constructing P	1
No because if you measure from each angle to the place where the bisectors cross you get different lengths	1 BOD
[DA has not been bisected so] the point is further away from D	1
No because its closer to angle ABC than to angle ADC	1
No [because] I haven't drawn the bisectors of DA and DC	1
No because it isn't a square	0
No because D and A aren't the same distance away as B and C	0
No because all the sides are different lengths	0
No because P is not right in the middle	0

Exemplar responses for question 7b

Response	Mark awarded
The magazine's estimate is 7% too high	1
They are only 100m out so quite good / they are 100 m out so wrong	1
Accuracy good as roughly right (after correct calculation)	1
"So not correct " after correct calculation	1
Magazine not accurate – rounds to 1.4 not 1.5	1
It should be 1.4 [or FT if M1 earned]	1
The magazine's information is fairly accurate [because they are only 4mm out] [Ignore justification]	1

Exemplar responses for question 9b

Response	Mark awarded
1 The average time of the under 40s (171 mins) was less than the average time of the over 40s (192 mins) [condone over 40s]	B1B1
2 The range of the under 40s (43) is less than the range of the over 40s (50) [accept comment re comparison]	B1B1
1 it took the older ages longer to run the marathon [if they had 'longer on average' it would get first B1]	0
1 The older women had an average of 192 minutes whereas the younger women had 171, so their average is lower	B1BOD B1
The older women had an average of 192 minutes whereas the younger women had 171 [no comparison]	B0B1
1 The 50 women aged 18 – 39 have a shorter average of 171 minutes	B1B0
1 The 50 women aged 18 – 39 have a shorter average of 171 minutes 2 The 50 women ages 40 – 44 have a higher average of 192 minutes. [count as two parts of comment about average]	B1B1 B0B0
1 Women aged 18 – 39 were quicker than women aged between 40 – 44 because the IQR was 19.5 and women 40 – 44 was 10 [would be B0B1 if the 19.5 was say 21.5]	B0B0
40-44 had larger range	B1
40-44 was more skewed	B0
40-44 had more slower runners	B0
18-39 faster runners more spread out	B0
18-39 middle group more spread out [accept as implying IQR or middle 50%]	B1B0
18-39 has larger IQR	B1B0
Younger....finished quicker. They all finished by 185 mins whereas Older finished by 195 mins	B0
All 18-39 finished by the time the 40-44 started finishing as 18-39 finished at 185mins and 40-44 started finishing then	B0
40-44 average 21 mins higher than younger women	B2
18-39 had quickest time of 143 mins (correct FT) compared to 40-44 lowest in 148 mins	B0
18-39 range smaller ... 42 (FT) and 40-44 range 50 [no FT from wrong boxplot]	B1B0
18-39 finished within 156-171 mins, 40-44 finished within 185 to 192	B0
18-39 average....171 40-44 average between 185 and 195 showing they are slower [true but we want more precise median]	B1BOD B0
Time taken for first 50 40-44 was 192 min; time taken for 18-39 took 179 (FT) so 18-39 13 min faster [use of correct median implies 'on average']	B1B0

A smaller IQR of 10 for 40-44 while 18-39 were more spread .. with IQR of 23	B1B1
More 40-44 finished before 192 mins	B0
Shorter range for 18-39 compared to Older, but bigger IQR	B1B0
40-44 took longer ...as box is further towards higher end of graph	B0
More of a variety of times for 18-39 as box is bigger [allow as referring to IQR]	B1B0
IQR of 40-44 less spread out	B1B0

Exemplar responses for question 10b

Response	Mark awarded
Because they individually might only be just in that category so the answers would be more precise [BOD 'just in' implies lower end]	1
Each has different value and may be towards the lower end of the range	1
Because it's a histogram and actual measurements are unknown	0
Because most bulbs last between 200 & 500, which doesn't mean they will definitely last over 400 hours – it could be less	0
Because we take time in groups so we don't know what the exact times are, so we do it as an estimate and take the middle of the group	0
It would give a more accurate result ...	0
The 500 to 1000 group is large and the real values might all be nearer the lower end	1

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