

Mathematics A

General Certificate of Secondary Education

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

Mark Scheme for June 2012

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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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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

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 awarded for a correct final 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 $180 \times (\textit{their} '37' + 16)$, 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.
- **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 of working
 - i. and the answer given in the answer space 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. but the answer space is blank, allow full marks. Place the annotation ✓ next to the correct answer.
 - iii. but a completely different answer is seen in the answer space, 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.
- 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)	0.019	2	B1 for 0.0186... seen or rot to 2dp or more, except 0.019 SC1 for 4.612	Allow B1 for 0.02, whether from rounding calculated answer or from estimate
	(b)	$2 \times (2 + 6) \times 4 = 64$ $(2 \times 2 + 6) \times 4 = 40$	1 1	Allow superfluous pairs of brackets in one or both answers	
2	(a)	$2 \times 3^2 \times 5$ oe	2	For 2 marks must be product M1 for at least two of 2, 3 and 5 found as factors	
	(b)	4:30 pm oe	3	nfw M2 for $2 \times 3^2 \times 5^2$ oe or 450 [minutes] identified as interval (eg by lists stopping) or for 4:30 [pm] oe appearing in a list of times for both bell and buzzer Or M1 for lists of multiples of both 90 and 150 up to at least 450 condoning one error, FT in the lists or of times for bell and buzzer up to at least 16:30 oe, with one error (or to at least <i>their</i> first common time provided this is 2pm or later) or M1 for $150 = 2 \times 3 \times 5^2$ oe soi (eg by correct factor tree) If 0 scored then SC2 for 4:30 or 16:30 pm or other wrong time format Or SC1 for 900 [minutes] seen/used as interval or for midnight oe as answer	Condone 4.30 pm or 16.30 Allow M2 for answer of 16:50 or for 450s or 4h 50m seen/used as interval eg by answers of 1:50 pm

Question		Answer	Marks	Part Marks and Guidance		
3	(a)		[C=] $0.3n + 120$ oe	2	<p>Accept $0.3 \times n$, $n0.3$ etc Ignore £ or p</p> <p>M1 for $0.3n$ seen</p> <p>If 0 scored then SC1 for $[C=] 30n + 120$ or $30n + 12000$ oe</p>	<p>Condone m or x etc, except c, used instead of n</p>
	(b)	(i)	75	3	<p>nfw</p> <p>M1 for $110 = 0.4n + 80$</p> <p>M1 for $30 = 0.4n$</p> <p>If 75 found, allow full marks for greater answer including eg journey from bus depot</p>	<p>First M1 for substitution (may be earned after rearrangement)</p> <p>Second M1 for one correct constructive step in solution or initial rearrangement eg $B - 80 = 0.4n$)</p> <p>Just $30 = 0.4n$ seen implies both M1s</p> <p>If no algebra allow: M1 for $110 - 80$ or 30 seen, but not $30p$ M1 for $30/0.4$ or $(110 - 80)/0.4$ or for $0.4 \times 75 = 30$</p> <p>Allow B3 for correct solution arrived at after trial and improvement</p>

Question		Answer	Marks	Part Marks and Guidance	
	(ii)	Leading [question] oe	1	Or biased or 'it needs response categories'	Accept eg 'it's too vague – I don't know what good means' 0 for 'it can only be answered Yes or No'
		'Do you think that your bus hire was good value for money' or Suitable version with responses eg 'Yes/No' boxes or at least 3 'non-overlapping' categories covering all eventualities	1	Accept other 'Do you think that...' also trying to improve on other aspects of wording 0 for any 'Don't you think that...'	Condone improved question if additional question eg 'Why?' See appendix for exemplars

Question		Answer	Marks	Part Marks and Guidance	
4		5.39	5	<p>nfw B4 for other rot versions of 5.38516... nfw to at least 2dp</p> <p>OR</p> <p>M1 for 5 and 2 used or seen in right-angled triangle</p> <p>M1 for an attempt at Pythagoras</p> <p>M1 for square root of $(\textit{their } 5^2 \pm \textit{their } 2^2)$ (may be implied by answer)</p> <p>Allow A1 for 5.3 or 5.4 (dep on M3)</p> <p>Following attempt at Pythagoras, allow B1 for <i>their</i> answer correctly rounded to 2dp if answer with more dp seen</p>	<p>NB 0 for 5.4 without correct method seen – no marks for measuring</p> <p>eg 2 and 5 in relevant places on diagram or $\frac{1}{2} \times 5 \times 2$ or $5 + 2 = 7$ or 5 across, 2 up seen</p> <p>eg <i>their</i> 5^2 and <i>their</i> 2^2 seen; second and third M1s may be earned for an attempt at Pythag with a wrong triangle (possibly not right-angled)</p>

Question	Answer	Marks	Part Marks and Guidance	
5	<p>Circle centre R radius 3 cm</p> <p>Ruled line parallel to AB and 3 cm from it</p> <p>Perpendicular bisector of TW attempted</p> <p>Accurately drawn bisector with correct compass arcs</p> <p>Correct region shaded</p>	<p>1</p> <p>1</p> <p>M1</p> <p>A1</p> <p>1</p>	<p>Or arc of this circle extending through at least 3 of the six circles for this arc on the overlay</p> <p>Condone arc hand-drawn only if in tolerance for three consecutive circles on overlay</p> <p>Extending through at least 2 of the three circles for this line on the overlay</p> <p>M0 for arcs/circles centres T and W with no line</p> <p>Line must extend at least between the circles on the overlay</p> <p>Dependent on circle and two lines attempted for the above loci</p>	<p>Use overlay; tolerances 2 mm; if in doubt, use ruler</p> <p>For all boundaries, allow marks whether they are dashed or full</p> <p>Allow M1 for line through midpoint of TW but at 80 to 100° to TW eg M0 for line through centre of TW parallel to wall of house</p> <p>Allow A1 for touching circles and common tangent drawn if accurate</p> <p>Region must be bounded by the house wall, another two lines and the arc for the distance from R; ignore any shaded/non-shaded region to left of circle if FT from wrong bisector</p>

Question		Answer	Marks	Part Marks and Guidance	
6	(a)	18.2	4	nfw M1 for midpoints 12.5, 17.5 etc (at least 3 correct) soi M1 for <i>their</i> 'midpoints' × freq attempted soi sum seen or at least 3 products seen FT <i>their</i> 'midpoints' M1 for <i>their</i> sum of $f \times x \div 50$ Allow A1 for 18 after correct method seen Allow SC2 for 20.7 and 15.7 (correct answers from endpoints used)	eg may be seen by table eg at least 3 of 175, 350, 247.5, 137.5 or total 910 Working may be by table At least 3 midpoints must be in the correct group If correct: $910 \div 50$ eg allow 2 nd and 3 rd M1 s for use of endpoints not midpoints First two M1 s may be earned for correct work seen even if not then used in the final answer Following use of 5 as x throughout, allow MOMOM1 for reaching 250/50
	(b)	(i)	8	1	
		(ii)	21 to 21.5	1	
		(iii)	9.5 to 10.8	2	nfw M1 for [UQ] 26.5 to 27.3 or for [LQ] 16.5 to 17 eg 0 for $\frac{1}{4} \times 40 = 10$ eg M1 for answer of 27

Question		Answer	Marks	Part Marks and Guidance							
7	(a)	15 18	1+1								
	(b)	$2.5x + 2 = x - 1$ or $5x + 4 = 2x - 2$ $1.5x = -3$ or $3x = -6$ $[x =] -2$	M1 M1 M1	For correctly dealing with 2 in denominator and expanding brackets if necessary For correctly collecting x terms on one side and numbers on the other, FT <i>their</i> equation; must have a single term on each side For final answer FT <i>their</i> $ax = b$ or $ax - b = 0$, with $a \neq \pm 1$ and $b \neq 0$ Allow B3 for $[x =] -2$ as answer from trials	Allow M s for combined steps if next equation is correct FT If FT is not an integer answer, accept fractions and ignore subsequent conversions eg to decimals; for recurring decimals eg allow 0.16 to 0.17 for $1/6$ for the last M1FT if no fraction seen Common errors: M0M1M1 for <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>$5x + 4 = 2x - 1$</td> <td>$5x + 4 = x - 2$</td> </tr> <tr> <td>$3x = -5$</td> <td>$4x = -6$</td> </tr> <tr> <td>$x = -5/3$</td> <td>$x = -1.5$</td> </tr> </table> Combined steps: eg $5x + 4 = x - 2$ M0 $4x + 6 = 0$ M0 not far enough $x = -1.5$ M1M1FT	$5x + 4 = 2x - 1$	$5x + 4 = x - 2$	$3x = -5$	$4x = -6$	$x = -5/3$	$x = -1.5$
$5x + 4 = 2x - 1$	$5x + 4 = x - 2$										
$3x = -5$	$4x = -6$										
$x = -5/3$	$x = -1.5$										
	(c)	9 and -9	1+1	Condone embedded							

Question		Answer	Marks	Part Marks and Guidance	
	(d)	$H^2 = 10p + c$ $H^2 - c = 10p$ oe or FT $\frac{H^2 - c}{10} [= p]$ oe or FT as final answer	M1 M1 M1	Allow SC1 or first M1 for $c = H^2 - 10p$ as final answer or $\frac{H^2}{10} = p + \frac{c}{10}$ oe Allow M3 for correct final answer nfw Allow M2 for correct answer seen and then spoiled	
8	(a)	26	2	M1 for $325 \div (23 + 2)$ oe or for 13	Condone 299 : 26 for two marks
	(b)	Use of tan (Height at end of first stage) = 8.6(08...) 12.7 – <i>their</i> 8.6(08...) or 4.09 to 4.2 or FT $[x =]\tan^{-1}\left(\frac{\text{their } 4.09\dots}{35}\right)$ 6.6 to 6.843 or 7	M1 A1 M1 M1 B1	Even if used wrongly Accept 8.5 to 8.61 even if then used in wrong position on diagram; if not seen, may be implied by further correct working Dep on 2 nd M1 ; condone poor notation This final mark may still be gained if eg \sin^{-1} used or scale drawing	Allow M1 for use of tan (or \tan^{-1} oe) anywhere in the question Throughout question allow complete equivalent methods using Pythagoras and sin and cos M0 for just $\tan[x] = \left(\frac{\text{their } 4.09\dots}{35}\right)$ but M1 if their answer following this implies they have used invtan

Question		Answer	Marks	Part Marks and Guidance	
9	(a)	Freq densities: 3.5, 6, 9, 13.5, 2.5	1	Seen or plotted; condone one error	eg allow if points plotted at correct heights
		Bars all correct height	1	No FT from wrong freq density	Use overlay
		Bars all correct width	1	Last mark may be earned for bars without tops	Condone unruled and without vertical lines to bars
	(b)	Two valid worthwhile comparisons, with at least one mentioning context (cars or parking) and at least one comparing the whole distributions eg range or total number of cars or 'average'/comparing modal group	2	<p>1 for one valid worthwhile comparison (not necessarily mentioning context)</p> <p>Allow 1 mark for two acceptable statements in context which combine to form an acceptable comparison</p> <p>No FT from wrong graph in (a) leading to a wrong comparison</p>	<p>See appendix for examples</p> <p>0 if wrong comments / wrong reasons / wrong values</p> <p>Condone 'people' instead of 'cars' in a comment but parking must also be mentioned to be eligible for context</p>
10		$\sqrt{220^2 + 180^2 + 200^2} \left[= \sqrt{120800} \right]$ <p>347.56..</p> <p>= 3.47 to 3.48 m or 3.5 m so yes</p>	<p>M2</p> <p>A1</p> <p>A1</p>	<p>M1 for $220^2 + 180^2 + 200^2$ or for the diagonal of one face found rot to 3 sf or more [284.25..., 269.07..., 297.32...]</p> <p>Allow A1 for 347 to 348</p> <p>Allow B1FT for correct conversion of <i>their</i> answer cm to m or of 3 m to 300 cm – may be earned at start by conversion of a length to metres eg 2.2, 1.8, 2 seen on diagram</p>	<p>NB 0 for scale drawing, except that B1 may still be earned</p> <p>B0 for just stating 100 cm = 1 m</p>

APPENDIX 1

Exemplar responses for question 3b(ii)

Response	Mark awarded
They may not know what amount bus hire usually is.	1
'Don't you think' makes it seem as if there is only one answer.	1
It isn't well-worded. 'Don't you think' makes it hard to answer.	1
The question doesn't take into account the distance travelled.	0
Don't you think that your bus hire was good value per mile of your journey?	0
It may have been good for the distance they travelled but not for all distances.	0
How does your bus hire compare to other bus services you have used, relating to the cost?	1
It starts off with 'Don't'.	1
Do you think that your bus hire was good value for money?	1
Very general; not giving specific answers, only Yes or No. You can't improve from answer given.	0
Compared to other bus hires, was your hire with us of a good price?	1
The person receiving the questionnaire might get confused because of the double negative if the answer is No.	1
Do you think that your bus hire was good value for money?	1
It could not be good value for money because other people may have different thoughts.	0
Do you think the service we provided was up to the standards we supply?	1
The customer can only answer yes or no.	0
Do you think Why?	1 (condone two qns)
Good value for money is too open a question.	1
Do you think your bus hire was too expensive?	1
It's asking the customer if they agree.	1
You can't put the results in a graph or table.	0
On a scale of 1 to 10, how good was the value for money?	1
It is a rhetorical question.	0
It is biased.	1
What do you think about the value for money?	1

Exemplar responses for question 9b

	Context OK?	Mark awarded
On average, cars parked for shorter time at B.	Y	1
Range for B is smaller than range for A.	N	1 so 2 overall
Fewer cars parked at B [124 at A, 97 at B].	Y	1
Cars stayed longer at A because it goes from 0-18 hours whereas B only goes up to 15 hours.	Y	1 so 2 overall
In Ayton people have spent up to 18 hours but at Beeton people have spent a maximum of 15 hours.	N	1
Ayton had a higher mean time.	N	1 so only 1 overall
More cars stayed in Ayton car park because the frequency density went up higher than Beeton.	Y	0 wrong reason
The frequency density is higher in B than in A.	N	0
For A the peak time was 8 to 12 hours but for B it was 4 to 8 hours.	N	1
No cars stayed up to 18 hours at Beeton whereas between 15 cars did at Ayton.	Y	1
At Beeton the most common class interval was 4–8 hours whereas it was 8–12 at Ayton.	N	1
Ayton is more popular in the later hours than Beeton.	N	0 graphs do not show time of day
Ayton has the highest number of cars at any time.	Y	0 not true for 2-4 hrs
Both sets of times show higher frequencies in the middle of the day.	N	0 graphs do not show time of day
People spend more time parked at Ayton.	Y parking mentioned	1 bod average
They both have a high amount of cars from 4–12 hours.	Y	1

Exemplar responses for question 9b continued

	Context OK?	Mark awarded
The majority of car stayed at both parks between 4 and 12 hours.	Y	1
Ayton had a higher maximum time.	N	1
The median is greater for the Ayton park.	Y bod	1 bod
Less people stayed in Beeton CP for 2 hours or less.	Y CP mentioned	1 so 2 overall
Overall the stays were longer at Beeton.	N	0
More cars stay longer in A.	Y	1
Nobody stayed any longer than 15 hrs in B whereas they did in A.	N	1
Bs most popular distribution was $4 < h \leq 8$ whereas As was $8 < h \leq 12$.	N	1 but no context so 1 overall
1 Cars were parked for shorter periods at B on average. 2 Both histograms follow same shape pattern, positive skew. 3 Lower modal group at B, lower median time.	Y N N	1 0 wrong 0 repeat of 1 st comment
More people stopped at Ayton for 8 to 12 hours than at Beeton.	N	1
Between 8 and 12 hours more stopped at Ayton than at Beeton.	N	1 bod length of time
There was no one at Beeton between 15 and 18 hours whereas there were 7.5 people at Ayton.	N	0
In Ayton more people stopped for a shorter period of time.	N	0 (vague definition of 'shorter')
The frequency density is lowest in both after 12 hours.	N	1

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