GCSE

Mathematics A

General Certificate of Secondary Education

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

Mark Scheme for January 2012

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

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PMT

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 <u>using a correct method</u> and are not lost for purely numerical errors.
     A marks are for an <u>accurate</u> answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
     B marks are <u>independent</u> of **M** (method) marks and are awarded for a correct final answer or a correct intermediate stage.
     SC marks are for <u>special cases</u> 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 <u>not from wrong working</u> **full marks** should be awarded.

     Do <u>not</u> award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen <u>and</u> 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 × (*their* '37' + 16), or FT 300 − √(*their* '$5^2 + 7^2$'). Answers to part questions which are being followed through are indicated by eg FT 3 × *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).
     -    **nfww** 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	Guidance	
1	(a)		2000 [g] or 0.75 [kg] seen Interim step in simplification of 2000 : 750 or 2 : 0.75 leading to 8 : 3	M1 M1 dep	May be implied by eg $\frac{1}{8}$ of blackberries = 250 [g] Or multiplier method eg 8/2 = 4 and 3 ÷ 4 = 0.75 Or 2000/8 = 250 and 750/3 = 250 Or 2000/250 = 8 and 750/250 = 3 Or 2000/750 = 8/3 [so 8 : 3] for **M1** (bod using fraction button on calc)	NB answer 8 : 3 given, mark the method Similarly allow **M1** for 2/0.75 = 8/3 Condone all reversed. leading to 3 : 8 Condone starting with 8 : 3 and getting to 2000 : 750 or 2 : 0.75
	(b)	(i)	1125 or 1.125 or $1\frac{1}{8}$ g or kg as appropriate	2 1	**M1** for 750 × 1.5 oe in kg or for figs 1125 Accept kg with answer < 100 Accept g with answer ≥ 100 isw wrong conversion after a correct answer 0 in qn for just 3000 g or 3 kg as answer Allow 3 for 1kg 125g	Or **M1** for 375 × 3 or 0.375 × 3 or $\frac{3}{8} \times 3$ Give one fewer marks than otherwise earned for answer left in ratio form eg give 1 for 3000 : 1125
		(ii)	9	1		

PMT

Question			Answer	Marks	Guidance	
2			2, 3, 17 as final answer	2	May be expressed as a product Allow **M1** for correct division or factor tree Or **M1** for two of 2, 3, 17 or for all 3 seen + one extra	Condone 2 + 3 + 17 etc for 2 marks If answer line blank, allow 2 marks for correct factor tree or division with 2, 3 and 17 clearly identified eg circled For **M1**, ignore one other factor or one repeat eg **M1** for 2, 3, 34 But **M0** for 1, 2, 3, 3, 34
3	(a)		Correct angle for bearing used; tol 2°	1	Accept line or evidence such as dot in correct direction from A	Use overlay; if in doubt, use protractor or ruler (accept obtuse angle NAC from 111-115 inclusive)
			Mark for C 7.2 cm from A, tol 2 mm	1	Or other evidence eg line from A 7.2 cm long	If just a dot, need to be convinced it is not just a fleck from scanning – may be implied by use in (b) If C not marked, allow 2nd mark for an arc centre A rad 7.2 cm drawn; tol 2 mm
	(b)		235 (accept 220 – 250 inclusive) FT	2FT	**FT** (5 × *their* BC in mm) calculated, tolerance 15 **B1** for answer up to and including 5 below or above acceptable range FT Or **M1** for 4.7 [cm] or 47 [mm] or FT *their* BC, tol. 3 mm	Use ruler with one end set on B eg for C correctly 4.7 cm from B, allow **B1** for 215 to 255 if B2 not earned eg allow **M1** for answer of 4.7 on answer line

Question			Answer	Marks	Guidance	
4	(a)		Correct expansion of brackets to $6x - 3$ [$= 6$]	M1	Need not be in equation, but if in eqn, rhs must be correct; or **M1** for correct division to $2x - 1 = 2$	
			$6x = 9$ or $6x - 9 = 0$ or FT	M1	For correct collection of terms, FT	
			$x = \dfrac{9}{6}$ or $\dfrac{3}{2}$ or 1.5 oe or FT	M1	isw for wrong conversion or embedded answer after acceptable answer seen FT *their ax = b* or *their ax + b* = 0 for $a \neq 1$ or 0, $b \neq 0$ Allow **B3** for $\dfrac{9}{6}$ or $\dfrac{3}{2}$ or 1.5 oe as answer nfww Or **SC2** for embedded answer eg 6 × 1.5 − 3 = 6	If their error leads to possible rounding, FT only for answer correctly rounded to 1 dp or rot to 2 dp or more Flow diagram: Allow **M2** for complete, correct, reversed flow diagram from start Or **M1** for $6x - 3 = 6$ and **M1** for complete, correct, reversed flow diagram from that stage
	(b)	(i)	25.28	1	Allow $\dfrac{632}{25}$ oe	
		(ii)	53	1		
5	(a)		9	2	**M1** for sensible strategy such as 40, 80, 160 etc seen (must be at least 3 terms of correct / FT correct doubling, condoning only one error)	Or similarly working backwards from 1280: 640, 320, 160 etc NB working may be by given terms of sequence
	(b)	(i)	11, 18 as final answer	1		

Question			Answer	Marks	Guidance	
		(ii)	$7n - 3$ oe	2	Accept unsimplified **M1** for $7n$ oe soi	Condone poor notation such as $n7$ etc or $n = 7n - 3$
6			3.2(.....)	3	nfww **M1** for $2.57^2 + 1.93^2$ or 10.3(298) **M1** for $\sqrt{2.57^2 \pm 1.93^2}$ oe	Or 6.6049 + 3.7249 Or **M2** for equivalent complete method using trig (condone poor notation) 3.2 from scale drawing scores 0
7	(a)		7×65.4 [= 457.8] + 85 = 542 to 543 [kg] and 'no' oe	M1 M1 B1	2nd **M1** dep on attempt at total of other 7 people isw further comment	Or **M1 dep** for 550 − (457 to 458) And **B1** for '92 to 93 so no' or for '7 to 8 [kg] spare so no' Or **M1** for 65.4 +(85/7 or 12.1(4...)) or 77.5(4...) And **M1 dep** for *their* 77.5(4...) × 7 or for 550 ÷ 7 And **B1** for corresponding correct result and no NB If no method shown, relevant correct answer gets **B1** only; **B0** for just 'no'
	(b)		67.7 to 67.9	2	**M1FT** for *their* sum of all eight people ÷ 8 or for restart with correct method or for correct (542 to 543) ÷ 8 Allow **SC1** for 150.4 ÷ 8 or 18.8	Beware 68.75 from 550 ÷ 8 gets 0

Question			Answer	Marks	Guidance	
8	(a)		7.84	2	**M1** for 481.89... seen (eg may be under root symbol) or for 2.8 seen	
	(b)		2.31 as final answer	2	**B1** for other rot versions of 2.30596... to at least 1 dp or for figs 231 Or **SC1** for 17.54 or 223.28 or 203.18	
	(c)		0.8 or $\dfrac{4}{5}$	1		
9	(a)		Median line correct Ends of box correct and box drawn Endpoints and whiskers correct, and no box except from LQ to UQ	1 1 1	Accept full or dashed The lines at 5.1 and 10.1 must be within the correct square and showing 'daylight' between it and the boundaries; others to be touching the gridlines	Use overlay Ignore boxplot for opponents also drawn Ignore line at 6 – may have been used for (b)(ii) 5 crosses drawn – award 0; 5 verticals drawn – can just get 1 for the median if correct
	(b)	(i)	2	1		

Question			Answer	Marks	Guidance	
		(ii)	Opponents scored more [runs on average] oe	1	Accept 'opponents had larger median' oe Accept 'medians for A and opponents are similar' oe No mark for comment for average if spread is clearly associated with average as well, but allow reference to UQ and LQ values in addition to median	No FT for 'team A average was greater' from wrong median(s) Condone 'medium' Condone 'box is higher' if median also referred to
			Medians 7.6 and 8 to 8.1 shown in either comment	1 Indep	Or team A median 0.4 to 0.5 smaller oe	
			Ranges 5.9 for A and estimate of 6 to 7 for opponents shown in either comment	1 Indep	Or IQR 3.3 for A and 1.9 to 2.2 for opponents shown in either comment	
			'Spread about the same' or 'more spread out for opponents' (with some evidence of attempt at range)	1	Or results for A are more spread out (with some evidence of attempt at IQR) After acceptable comment and/or correct pair of values about range or IQR, ignore extra comments/values about spread but do not ignore about median	For spread need to see evidence of whether they are looking at range or IQR before the comment mark can be awarded Condone 'lower spread' as meaning 'smaller spread' Do not award any marks for a comparison of just one class or 'end' See appendix for exemplars

Question			Answer	Marks	Guidance	
10			Correct line	1	Within tolerance 88 to 92° of AB and within 1mm of P; line to reach at least from P to within 2mm of AB	Set up the protractor tool with one arm along AB and the other going through P, set at 90
			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 P centre A above and below AB intersecting with similar arcs centre B Also condone 'half kite' with just the intersecting arcs below AB but with radii AP and BP Ignore perp bisector if also drawn NB **0** for spurious arcs drawn after the line – watch for these
11	(a)		$r = [\pm]\sqrt{\dfrac{S}{4\pi}}$ oe as final answer	3	nfww For all 3 marks, '$r =$ 'must be stated; allow **SC2** if rhs is correct OR **M1** for $\dfrac{S}{4\pi} = r^2$ or $\sqrt{S} = \sqrt{4\pi}\, r$ oe **M1** for taking square root correctly FT *their* $r^2 = ...$ or $4r^2 = ...$ oe or for $\dfrac{\sqrt{S}}{k}$ oe ft *their* $\sqrt{S} = kr$ If **M0**, allow **B1** for $[r] = \dfrac{\sqrt{S}}{4\pi}$ Or allow **B1** for correctly finding r as the subject FT a wrong first step	Allow 'triple decker' fractions for Ms but not for 3 marks eg 2 for $r = \sqrt{\dfrac{S \div 4}{\pi}}$ (square root symbol must extend below fraction line) **M0** if r is on both sides Allow **M1** for complete correct reverse flowchart

Question			Answer	Marks	Guidance	
	(b)	(i)	$\dfrac{3}{10}$ oe	1		
		(ii)	0 found as denominator without further wrong working/comment	1	Accept denominator = 0 oe or 'cannot calculate 3/0' or '3/0 = error'	0 for 3/0 = 0 or for 3/0 = 3 etc or 'you can't divide 0 by 3'
12	(a)		$a = 8$ $b = 3$	1 1	If 0, allow **SC1** for LHS = $8x + 3$ soi	0 for 8 if it comes from eg $8x^2$
	(b)		Any pair of values satisfying the relationship $2c + d = 19$	2	nfww **M1** for $2c + d = 19$ soi or LHS = 19	eg **2** for <table><tr><td>c</td><td>5</td><td>6</td><td>10</td><td>9.5</td><td>8</td></tr><tr><td>d</td><td>9</td><td>7</td><td>−1</td><td>0</td><td>3</td></tr></table>
13			Attempt to find BD first	M1	For strategy eg implied by use of 6.5 and cos35 Allow for stating/implying that they need to find BD if they can't do so	Allow for finding AD if go on to find BD next
			$[BD =]\dfrac{6.5}{\cos 35}$ [= 7.9...] oe	M2	**M1** for $\cos 35 = \dfrac{6.5}{BD}$ oe	**M2** for other correct explicit expressions for BD eg using sine or **M1** for implicit ones Or **M2** for complete correct method using tan to find AD then Pythag to find BD
			$[CD=] \dfrac{theirBD}{\sin 35}$ oe	M2	**M1** for $\sin 35 = \dfrac{theirBD}{CD}$ oe	Condone poor notation throughout eg 35cos
			13.7 to 13.9	A1	If **M** marks for triangle BCD not earned, allow **A1** for [BD =] 7.9 to 7.95	Allow letters used for sides, not numerical values, for M marks and similarly for correct angle notation

APPENDIX 1

Exemplar responses for question 9(b)(ii) Average

Response	Mark awarded
Opponents on average score more runs per over than team a. exactly 0.8 better	1 bod comment + 0 wrong value for difference between medians
Opponents on average score more runs per over than team A because their UQ is 0.8 better	0 median not used + 0
Team A's median is 7.6 whereas their opponents was 8	0 need more + 1
Average number most runs scored was higher for the opponents with 10.8 runs where as team A's highest was only 10.1	0 have used maxs + 0
They both have a similar median of 8 and 7.6	1 just + 1
The average was higher on Team A's opponents than on Team A because Team A only 7.6 whereas team A's opponents were just below 8 runs per over	1 + 0
The average is larger for opponents A they had 8 and team A getting 7.5	1 + 0
The average score for team A was 7.5 and their opponents was 8 which shows they have a better average score	0 unclear which team + 0
The median for the opponents was 8 but for A it was only 7.6	0 not enough 1
The box for team As opponents (the middle 50%) is higher than team A so the opponents scored more on average	0 median not used + 0
Opponents on average score more runs per over than team a. exactly 0.4 better	1 + 1 bod medians
Median for team A is 7.6 whereas Median for opponents is 8. They score more on average.	0 unclear which team + 1
Team A's opponents have a higher medium of 15 while Team A only has 7.6	1 condone medium + 0
Team A did worse because they scored 7.6 on average. Team A's opponents scored 8.	1 + 1
Team A had a better average with 7.6 as the median number of runs. The opponents median was 7.4 which overall meant an average of less runs.	0 no FT from wrong median
On average the A teams opponents have scored 8 and the A team also is 8	0 + 0
On average of median, lower and upper quartile the opponents scored higher than team A so more likely to win as medians were of team A 7.6 but their opponents has a median of 8.	1 + 1 condone UQ and LQ also mentioned

Exemplar responses for question 9(b)(ii) Spread

Response	Mark awarded
The spread of data from team a is higher on average than opponents this makes the less consistent exactly 1.3 better	0 + 0 - no clear ref to range or IQR with comment
Team A spread was 5.9 however their opponents was 6.8	1 bod range; + 0 needs more than 'however'
The median range for team A's was much larger than opponents with 7.6 (team A's) to only 5.4	0 + 0
Team A have a smaller spread so were more consistent in their matches	0 + 0 - no ref to range or IQR
The minimum of the opponents was 4 and for Team A it was 4.1 so team A is better there. And the max for opponents was 10.8 and team A was 10.1 so the opponents did better there	0 + 0
The opponents had a bigger range of 6.8 rather than team A who's range was 5.9	1 + 1
The spread between the two teams was very similar although team A's opponents maximum was a little higher. The range was bigger on Team A's opponents	0 + 1
Team A has an IQR of 3.3 and their opponents IQR is 2. Therefore Team A were more consistent	1 + 0 contradiction
The spread of team A was bigger than opponent because A was 3.3 and opponent 2........	1 + 1 bod comparing IQRs
Their opponents had a better spread because their lower quartile was 6.8 and higher was 9.5 which was closer and more consistent compared to team A which has 5 and 8.5	0 + 1 actually comparing IQR
The opponents graph is skewed towards the upper end, but team A had a more even spread	0 + 0 not sufft
Team A's opponents have a bigger range in score from 11 at the top and 4 at the bottom while team A's highest score is 10.1 and lowest is 4.2	0 + 1
The spread on team A's box plot shows they were consistent when scoring runs per over.	0 range or IQR??
Team A had more evenly spread results with their range being 5.9 runs. However the opponents team range was 6 runs making it less even.	1 + 0
The A teams graph will be more spread out because of the average being larger and the opposition will have a tighter spread due to the smaller average.	0 + 0 medians not spread
The spread for the opponents is 6.8 whilst the A team have 7.9 as their average meaning they are ahead again.	0 + 0
The minimum for team A was 4.2 whereas that for their opponents was 4. The maximum for team A was 10.1 whereas for their opponents it was 10.8. The spread from their opponents was much higher.	0 + 1 bod range
The spread of team A is much closer than of its opponents therefore making the batters more consistent of team A as the opponents scored between 4 and 10.8 and team A scored between 4.2 and 10.1	0 + 1 bod range

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