

Mathematics A

General Certificate of Secondary Education

Component **J512/03**: Paper 3

Mark Scheme for January 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 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

- 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)	- 3 3 4 - - 4 5 4 5 5 6 4 5 5 6	2	B1 for 6 correct	
	(b)	$\frac{5}{16}$ or 0.3125 or 31.25% isw	2	B1 for $\frac{5}{x}$ or $\frac{x}{16}$ seen	In (b) and (c), if no correct answer seen, -1 once for poor notation eg 5 to 16, 5 in 16, 5 : 16 etc
	(c)	$\frac{5}{16}$ or $\frac{5}{\text{their}16}$ isw oe	FT1	FT <i>their</i> denominator in (b)	
2	(a)	450	1		
	(b)	4.5 or 4½ isw	1	Ignore any units	
	(c)	10	2	B1 for 1000 ÷ 400 soi by 2.5 oe or 400, 400, 200 oe or 1 litre = 1000 and 1person = 100	ie 'chunking' to 1000

Question		Answer	Marks	Part Marks and Guidance	
3	(a)	114 (Co-)interior angles (add to 180) Or Alternate angles <u>AND</u> angles on a straight line Or Corresponding angles <u>AND</u> angles on a straight line	B1 B1	<u>Reason indep. but NOT $x = 66$</u> Allow 'allied angles' Or any correct reasons supported by work which may be on the diagram.	Throughout, condone 'U angles', 'C angles' 'F angles' or 'Z angles' Condone reason(s) not on answer line.
	(b)	32 or 146 – <i>their</i> (a) Corresponding angles Or Alternate angles Or angles on a straight line <u>AND</u> interior angles Or angles on a straight line <u>AND</u> angles in a triangle <u>AND</u> alternate angles Or Alternate angles <u>AND</u> opposite angles in a parallelogram	FT1 B1	<u>Dep. on a correct/ correct FT answer</u> Or any correct reasons supported by work which may be on the diagram.	Condone reason(s) not on answer line.
4		104.55	6	M3 for $205 - (205 \div 5 \times 2)$ oe soi by 123 Or M2 for $205 \div 5 \times 2$ oe soi by 82 Or M1 for $205 \div 5$ oe soi by 41 And M2 for $their123 - 0.15 \times their123$ oe Or M1 for $0.15 \times their123$ oe soi by 18.45 Or allow SC3 for answer of 92.25 Or SC2 for answer of 112.75	<i>their</i> 123 NOT 82 or 205 eg $10\% = 12.3$ and $5\% = 6.15$ and $80\% = 12.3 \times 8$ eg $10\% = 12.3$ and $5\% = 6.15$

Question			Answer	Marks	Part Marks and Guidance
5	(a)	(i)	2 nfw	3	<p>B1 for $6x + 14 (= 26)$ or $(3x + 7 =) 13$ And B1 FT for correct next step in <i>their</i> equation And B1 FT for <i>their</i> 'correct' solution, evaluated Or M1 for correct reverse flow And M1 for three calculations in flow starting with 26 and with no more than one error Or allow SC1 for correct embedded answer seen anywhere or use of $x = 2$</p> <p>Allow top heavy fraction if non-integer answer, isw ie $\div 3 \leftarrow -7 \leftarrow \div 2 \leftarrow$</p>
		(ii)	4.5, $4\frac{1}{2}$, $\frac{9}{2}$	3	<p>M2 for correctly collecting x AND correctly collecting numbers Or M1 for EITHER correctly collecting x OR correctly collecting numbers Or allow SC1 for correct embedded answer seen anywhere or use of $x = 4.5$ oe</p>
	(b)	(i)	$x \geq -2$	2	<p>M1 for $2x \geq -5 + 1$ or better Or allow SC1 for answer $(x =) -2$ or $x > -2$ or $(x =) \geq -2$ or $x \geq -3$</p>
		(ii)	$\begin{array}{ccccccc} & & & & \bullet & & \text{-----}> \\ & & & & & & \\ -2 & -1 & 0 & 1 & & & \end{array}$	FT1	<p>Correct answer or follow through from <i>their inequality</i> in part (i) Condone open, closed or no circle at -2</p> <p>Condone any clear alternative diagram e.g. $\begin{array}{ccccccc} & & & & \text{-----} & & \\ & & & & & & \\ -2 & -1 & 0 & 1 & & & \end{array}$ as a minimum Or shorter line with arrow</p>

Question		Answer	Marks	Part Marks and Guidance	
6	(a)	4 points correctly plotted	2	B1 for 2 points correctly plotted	Centre of point within ± 1 small sq. Ignore any extra points Use circles on overlay as a guide to position of points
	(b)	Positive	1	Ignore 'strong', 'weak' etc	
	(c)	Single ruled line on or within overlay boundaries	1	Any length which will stay within overlay if extended	
	(d)	63 to 67	1	Indep. of <i>their</i> line	
	(e)	Inappropriate to extrapolate Or Outside range of data used (oe)	1	Or 'data only goes to 18' oe Or 'weight may differ after a certain length' Or 'correlation may change after 18'	NOT 'graph only goes to 18' oe <i>Mark best part</i>
7	(a)	10	3	B2 for 1000 – 900 or better Or B1 for 1000 <u>or</u> 900 seen	± 10 implies B2 1000 must come from 10^3 900 must come from 4×15^2
	(b)	$\frac{6}{7}$	2	M1 for $\frac{3}{4} \times \frac{8}{7}$ or equivalent fraction or $\frac{24}{28}$ or equivalent fraction	
8	(a)	25	1		
	(b)	-12	1		
	(c)	9	1		

Question		Answer	Marks	Part Marks and Guidance	
	(d)	-21	2	M1 for -7×3 Or allow SC1 for any answer from 0 to -20 inclusive	
9	(a)	300	3	M1 for $5 \times 6 \div 2$ soi by 15 And M1 for <i>their</i> (area of triangle) $\times 20$	eg $(6 \times 5) \times 20$ soi by 600
	(b)	2.5 or $2\frac{1}{2}$ g/cm ³ or gcm ⁻³	2 1	M1 for $750 \div \textit{their} (a)$	
10	(a)	41	1		
	(b)	75	3	M2 for $5 \times (60 \div 4)$ oe Or M1 for $60 \div 4$ soi by 15	
11	(a)	18 (Angle in a) semi-circle or Diameter is 180 AND angle at centre is twice angle at circumf.	1 1	Indep. of answer Condone 'Angle from a diameter at the circumference' oe	Condone omission of 'angles in a triangle' reason
	(b)	26	3	B1 for 128 soi as angle at centre And M1 for $(180 - \textit{their}128) \div 2$ soi	For M1 <i>their</i> 128 must NOT be 64
12	(a)	(i)	76	1	
		(ii)	29	2	B1 for 89 and 60 seen
	(b)	(Vehicles) faster at night oe More variable speeds during day oe or larger range of speeds during day oe	1 1	Condone 'Median <u>speed</u> at night is bigger' oe	Interpreting. Not just quoting values

Question		Answer	Marks	Part Marks and Guidance	
13	(a)	$x^2 = (x - 2)^2 + (x - 1)^2$ oe $x^2 - 2x - 2x + 4$ or better $x^2 - 1x - 1x + 1$ or better	M2 B1 B1	M1 for <u>any</u> attempt at Pythagoras	ie Equation involving 3 squares each in x soi
	(b)	$(x - 5)(x - 1)$ or $\frac{6 \pm \sqrt{(-6)^2 - 4 \times 1 \times 5}}{2 \times 1}$ oe or $(x - 3)^2 - 9 + 5$ oe (x =) 5 and 1 5, 4, 3	M2 A1 B1	M1 for $(x + a)(x + b)$ where $a + b = -6$ or $ab = +5$ or for formula with no more than 2 errors or for $(x - 3)^2$ seen Correct answers, with no wrong work, imply M2A1	Solution may occur in (a) but if re-start in (b) <u>do not</u> look back A1 dep. on M2 scored.
14	(a)	Complete, correct diagram	2	B1 for 0.8 correctly placed once	
	(b)	0.36 oe isw nfw	3	M2 for $1 - 0.8 \times 0.8$ or $0.2 \times 0.2 + 0.2 \times 0.8 + 0.8 \times 0.2$ or $0.2 (\times 1) + 0.8 \times 0.2$ Or M1 for <u>any</u> one of the 4 product pairs seen	For M marks FT from <i>their</i> tree. May be on diagram.
15	(a)	$(x) - 2$	2	B1 for $(x)2$ Or allow SC1 for $(x) - 1/2$	
	(b)	(0, 1)	2	M1 for connecting <u>two</u> pairs of corresponding corners with straight lines Or for one part of coordinate correct	Condone omission of brackets for 1 or 2 marks. Condone $x = 0, y = 1$ for 2 marks eg (0, n) or (n, 1)

Question			Answer	Marks	Part Marks and Guidance	
16	(a)		$F = \frac{200}{R^2}$ oe	3	<p>B1 for $F = \frac{k}{R^2}$ oe, k any letter or any number</p> <p>And M1 for substituting $F = 8$ and $R = 5$ into <i>their</i> formula</p> <p>Or allow</p> <p>SC1 for $F = 40/R$ oe</p>	M1 unavailable if no k letter in formula
	(b)		800	2	M1 for substituting $R = \frac{1}{2}$ into <i>their</i> formula	Whatever their formula might look like
17	(a)	(i)	$3\sqrt{2}$	1		
		(ii)	6	2	M1 for $\sqrt{36}$ or $2\sqrt{9}$ or $3\sqrt{4}$ seen	
	(b)	(i)	5	1		
		(ii)	$\frac{1}{5}$ or 0.2	2	M1 for $1/25^{1/2}$ or $\frac{1}{\sqrt{25}}$ or 5^{-1}	
18			$(x + 4)^2 - 17$	3	<p>Condone $(x + 4)^2 + - 17$</p> <p>M2 for $(x + 4)^2 - 16$ seen</p> <p>Or B1 for $(x + 4)^2$ seen or for $c = (+)4$</p>	

Question			Answer	Marks	Part Marks and Guidance	
19	(a)	(i)	$-2a + 2b$ oe	1		
		(ii)	$-1\frac{1}{2}a + 1\frac{1}{2}b$ oe	2	Coeffs. <u>must</u> be single value for 2 marks B1 for $-pa + pb$ oe seen, where $0 < p < 2$ <u>Or allow</u> SC1 for (OX =) $1\frac{1}{2}a$ oe or (OY =) $1\frac{1}{2}b$ oe	p may not be a single value, eg $\frac{3}{4} \times 2$ Coeff. <u>must</u> be single value for SC1
	(b)		Parallel XY is $\frac{3}{4}$ of AB oe	1 1	Or AB is $\frac{4}{3}$ of XY oe Or $4XY=3AB$ oe Or $AB:XY = 4:3$ oe	

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