

**GCSE**

**Mathematics (9-1)**

Unit **J560/04**: Paper 4 (Higher Tier)

General Certificate of Secondary Education

**Mark Scheme for June 2018**

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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 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.
- 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  $180 \times (\textit{their} \text{'37'} + 16)$ , or FT  $300 - \sqrt{(\textit{their} \text{'5}^2 + 7^2)}$ . 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.

- **cao** means **correct answer only**.
- **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 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'. Place the annotation ✓ next to the correct answer.
- If the answer space is blank but the correct answer is seen in the body allow full marks. Place the annotation ✓ next to the correct answer.
- If the correct answer is seen in the working but a completely different answer is seen in the answer space, then accuracy marks for the answer are lost. Method marks would 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)	250	2	<b>B1</b> for [2 :] 500 If <b>0</b> scored <b>SC1</b> for answer of figs 25	Ignore any units seen
	(b)	4500	2	<b>M1</b> for $\frac{7200}{1+2+5}$ [x5] soi by 900	
2		12	1		not $y^{12}$
3	(a) (i)	$2 \times 2 \times 2 \times 3 \times 5$ oe	3	<b>M2</b> for 2, 2, 2, 3, 5 which could be on a tree diagram or in a table or for an answer one step away from correct answer e.g. $2 \times 2 \times 2 \times 15$ or <b>M1</b> for correct complete method with one error or one step from correct method e.g tree or multiple division or <b>B1</b> for two of 2, 3 and 5 as factors	So $2^3 \times 3 \times 5$ scores <b>3</b> marks and $2^3, 3, 5$ scores <b>M2</b>  see additional guidance
	(ii)	9	2	<b>B1</b> for an answer of 18, 36, 45, 72, 90, 180 or 360.	
	(b)	168	2	<b>M1</b> for $2^3, 3$ and 7 selected	condone $2^3 \times 3 \times 7$ for <b>2</b> marks even if calculated incorrectly
4	(a)	accept any correct explanation e.g. sample size is small, no mention of subjects being randomly selected	1		If more than one choose the best one see list of exemplars
	(b)	two points accurately plotted	2	<b>B1</b> for each	tolerance $\pm \frac{1}{2}$ small square and use overlay as a guide
	(c)	positive	1		ignore any extras e.g. strong

Question		Answer	Marks	Part marks and guidance	
	(d)	a line or a mark between (35,9) and (35,15)  9 to 15	1  1		use overlay as a guide, a clear indication of method to find their answer
	(e)	9 soi  For putting <i>their 9</i> out of 12 into a percentage oe e.g. 9 in 12 or $\frac{9}{12}$ [=] 75[%]  A correct conclusion from <i>their 9</i> e.g. "No/she is wrong"	B1  M1        A1FT	Accept any correct reasoning e.g. M1 for $0.80 \times 12$ or 9.6    A1FT for a correct conclusion from <i>their 9</i> e.g. "No/she is wrong"  If no points plotted in (b) award M1 for 8 [out of 10] = 80[%] and A1 for "Yes"	9 can be implied by 75  Accept fractions, decimals or percentages providing the two figures can be compared  FT <i>their percentage or figure</i>
5	(a)	610.7 to 632.2	5	B2 for 1425 to 1475 or B1 for 11.4 to 11.8 or M1 for <i>their length</i> $\times 125$ AND B1 for $2\frac{1}{3}$ , 2[h] 20 or 2.33... or 140 and M1 for distance $\div$ time and A1FT ft for a correct answer for <i>their length</i>	See additional guidance  This calculation must be seen and distance must be <i>their</i> measurement or <i>their</i> measurement $\times 125$ . You must be convinced that it is a time as a divisor.

Question		Answer	Marks	Part marks and guidance	
	(b)	accept any correct reason e.g. it may not have flown in a straight line or it may have been diverted	1		If more than one choose the best one. Comment about distance only, see list of exemplars.
6	(a)	Reflection $y = x$ oe	1 1		Double transformation scores 0
	(b)	Rotation  [centre] (0,0)  [+]90 or 90 anti-clockwise or -270 or 270 clockwise	2  1  1	If 0 scored then award <b>B2</b> for correct position of the intermediary triangle	Double transformation scores 0 <u>unless</u> the second one is reflection in $x = 0$ or in the $x/y$ axis.  accept origin and O as centre  use overlay as a guide
7	(a)	Accurate angle bisector with 2 pairs of correct arcs	2	<b>B1</b> for correct bisector with no arcs or incorrect arcs	The bisector does not have to go through A but if extended it must go through A and it must lie within green lines in overlay. For <b>2</b> marks condone intersecting arcs of equal radius, one centre B and the other centre C for the construction with bisector drawn. For arc, measure radius using ruler.  tolerance $\pm 2$ mm and $\pm 2^\circ$ for both constructions
		Arc centre C radius 7cm	2	<b>B1</b> for arc centre C with incorrect radius	
		Correct region indicated	<b>1Dep</b>	Dependent on at least <b>B1</b> for bisector and <b>B2</b> for arc	



Question		Answer	Marks	Part marks and guidance	
	(b)	accept any correct assumption e.g. Road[s] is not/are not straight, road AB is busier than road AC, land is not suitable for construction	1		If more than one choose the best one see list of exemplars
8		145.2 to 146.2	5	<p><b>B1</b> for angle CBD = 28 soi or for angle BCD = 90 soi</p> <p>and</p> <p><b>M2</b> for <math>\frac{6.4}{\sin 28}</math> oe or 13.6[3...] nfw</p> <p>or <b>M1</b> for <math>\sin [28] = \frac{6.4}{[.]}</math> oe</p> <p>and</p> <p><b>M1</b> for <math>\pi \times (\text{their radius})^2</math></p>	<p><b>B1</b> implied by e.g. 28 or 62 correctly used in trigonometry or 28, 62 or 90 (or symbol) marked in the correct place in the diagram</p> <p>13.6... can imply <b>B1</b> however if it is marked on the wrong side, e.g. on AC, then it scores <b>0</b> marks</p>

Question		Answer	Marks	Part marks and guidance
9		15 9	6	<p><b>B5</b> for <math>[x=]</math> 4.5 or <math>4\frac{1}{2}</math> and <math>[y=]</math> -0.5 or <math>-\frac{1}{2}</math> even given as answers</p> <p>OR</p> <p><b>B2</b> for <math>5x - y - 8 = 3x + 5y + 4</math> or <math>3x + y - 4 = 2x - 6y - 3</math> and</p> <p><b>M1dep</b> for rearranging either equation correctly so that the x's, y's and numbers are combined in <u>one</u> of the equations</p> <p>and</p> <p><b>M1dep</b> for multiplying one equation to equate coefficients of one variable</p> <p>and</p> <p><b>M1dep</b> for the correct method to eliminate a variable</p> <p>If <b>0</b> scored <b>SC1</b> for equating two adjacent sides e.g. <math>5x - y - 8 = 2x - 6y - 3</math></p>

accept 15 or 9 either way round for **6** marks

The next **M1s** are dep on **B2** gained. For **M1** need an equation with one x term, one y term and one number term and allow one numerical error e.g.  $2x - 6y = 12$  oe or  $x + 7y - 1 = 0$  oe .

allow one numerical error e.g.  $2x - 6y = 12$  and  $2x + 14y = 2$

allow one numerical error e.g.  $20y = -10$

Question		Answer	Marks	Part marks and guidance																	
10		24	5	accept any correct method e.g. <b>M1</b> for $1 - [0].6$ soi by $[0].4$ or 40  <b>M1</b> for $[0].6 \times [0].2$ or $[0].12$ or 12 soi by $[0].096(9.6)$  <b>M1</b> for $[0].216 - [0].12$ or $[0].096(9.6)$  <b>M1</b> for <i>their</i> $[0].096 \div [0].4$ or $[0].24$	Working may be in decimals (or %) e.g. table based on 100 :  <table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>L</td> <td>L<sup>1</sup></td> <td></td> </tr> <tr> <td>M</td> <td>12</td> <td>48</td> <td>60</td> </tr> <tr> <td>M<sup>1</sup></td> <td>9.6</td> <td>30.4</td> <td>40</td> </tr> <tr> <td></td> <td>21.6</td> <td>78.4</td> <td>100</td> </tr> </table>		L	L <sup>1</sup>		M	12	48	60	M <sup>1</sup>	9.6	30.4	40		21.6	78.4	100
	L	L <sup>1</sup>																			
M	12	48	60																		
M <sup>1</sup>	9.6	30.4	40																		
	21.6	78.4	100																		
11		32.25	4	accept any correct method e.g. <b>B1</b> for 1.15  <b>M1</b> for $y = k(1.15 \times x)^2$  <b>M1</b> for $(1.15^2 - 1) [\times 100]$ or $[0].3225$  OR  <b>B2</b> for $1.15^2$ or 1.3225 or <b>B1</b> for 1.15  <b>M1</b> for $(1.15^2 - 1) [\times 100]$ or $[0].3225$  If <b>0</b> scored award <b>B1</b> for $y = kx^2$	accept if $k$ replace by a numerical value																
12	(a)	16 500	1																		
	(b)	18	1																		
	(c)	7460 and 8250 oe or $[0].452\dots$ and $[0].5$ oe	2	<b>M1</b> for $[16\ 500 \times] .82^4$ or 7460 or $[0].452$	accept 7460.01 or 7460.009...  accept any correct argument for 2 marks e.g. $7460 \times 2$ and 16 500 or better																

Question		Answer	Marks	Part marks and guidance	
13	(a)	420	2	M1 for $6 \times 10 \times 7$	
	(b)	$6 \times 10 + 6 \times 7 + 10 \times 7$ or $60 + 42 + 70$ [=172]	3	M2 for two correct products shown or M1 for one correct product shown	
14	(a)	27	1		
	(b)	$\frac{27}{45}$ or $\frac{3}{5}$ or [0].6 or $\frac{their(a)}{45}$ oe	2	B1 for $\frac{27}{n}$ or $\frac{their(a)}{n}$ or $\frac{k}{45}$ ( $n, k$ are positive integers and fractions are proper)	Any fraction or percentage equivalent to $\frac{27}{45}$ for 2 marks, the fractions must be proper and isw if conversion or cancelling after an acceptable answer
15	(a)	$(x - 4)^2 + 9$	3	B1 for $(x - 4)^2$ B2 FT for 9	FT $their(x - 4)^2$
	(b)	(4, 9)	2	B1FT for each part	FT $their(x - 4)^2 + 9$
	(c)	Translation $\begin{pmatrix} 4 \\ 9 \end{pmatrix}$	2	B1 for translation B1FT for $\begin{pmatrix} 4 \\ 9 \end{pmatrix}$	award B1 if it FT from either (a) or (b) and condone e.g. 4 right 9 up
16		$(3x - 4)(x + 5)$ and $\frac{4}{3}$ oe and -5	3	B2 for $(3x - 4)(x + 5)$ or B1 for two factors giving two correct terms and B1FT for two answers correct from <i>their</i> factors  If 0 scored then B1 for two correct answers	For $\frac{4}{3}$ accept 1. $\frac{4}{3}$ , 1.33[3...] and $1\frac{1}{3}$

Question		Answer	Marks	Part marks and guidance	
17	(a)	$y = \frac{1}{x}$	1		
	(b)	$y = \sin x$	1		
	(c)	$y = 2^x$	1		
18		11.1 or 11.14 or 11.13[6...] or accept 11 with supporting working.	6	<p><b>M3</b> for correct cos rule with cos as subject e.g. <math>[\cos = ] \frac{6.4^2 + 5.8^2 - 3.9^2}{2 \times 6.4 \times 5.8}</math></p> <p>or <b>M2</b> for the above (M3) formula with one error or for <math>3.9^2 = 6.4^2 + 5.8^2 - 2 \times 6.4 \times 5.8 \times \cos[.]</math></p> <p>or <b>M1</b> for this (M2) formula with one error</p> <p style="text-align: center;">AND</p> <p><b>M2</b> for <math>\frac{1}{2} \times 6.4 \times 5.8 \times \sin(\text{their } 36.87\dots)</math></p> <p>or <b>M1</b> for the use of this formula with one error</p>	<p>accept any correct method and they can find any angle, see additional guidance for the other angles</p> <p>this angle (opposite 3.9) is 36.87... which implies <b>M3</b></p>
19		[a = ] 2 [b = ] 3 [c = ] -5	4	<p><b>B2</b> for [a =] 2 or <b>M1</b> for second differences = 4</p> <p>and</p> <p><b>M1</b> for revised differences of -2 1 4 7</p> <p>or <b>B1</b> for b or c correct</p>	

Question		Answer	Marks	Part marks and guidance	
20		-0.3    5.3	6	<p><b>B1</b> for <math>(x + 2)(x - 3)</math> oe seen</p> <p><b>M1</b> for <math>5(x - 3) + 3(x + 2)</math> oe or better</p> <p><b>M1FT</b> for <math>2x^2 - 10x - 3 [= 0]</math> or FT <i>their</i> correct attempt to form a quadratic equation with at most two errors</p> <p><b>M1FT</b> for <math display="block">\frac{-(-10) \pm \sqrt{(-10)^2 - 4 \times 2 \times -3}}{2 \times 2}</math> oe</p> <p>condoning at most two errors or better <b>FT</b> <i>their</i> 'quadratic equation'</p> <p><b>A1</b> for each of -0.3 or 5.3 or for both answers correct but to more than 1dp. or <b>A1FT</b> for two answers correct to 1 d.p. FT from <i>their</i> 'quadratic equation'</p>	<p>likely seen in <math>2(x + 2)(x - 3)</math> implied by <math>x^2 - x - 6</math> implied by <math>5x - 15 + 3x + 6</math> or <math>8x - 9</math></p> <p><math>2x^2 - 10x - 3 [= 0]</math> seen scores <b>3</b> marks, condone e.g. <math>2x^2 - 10x = 3</math> for <b>3</b> marks</p> <p>for completing the square see additional guidance</p> <p>For <b>A1</b> the correct answers are - 0.28388... and 5.28388... and can be rounded or truncated. Note: for <b>A1FT</b> they must get <b>M1</b> first.</p>

## APPENDIX

Exemplar responses for Q4(a)

<b>Response</b>	<b>Mark</b>
sample size is small	1
no mention of subjects being randomly selected(e.g. could be her friends)	1
in the same room so they could watch each other solve it	1
Some people may be experience at solving puzzles	1
Need people of different ages	1
We don't know their gender	0

Exemplar responses for Q5(b)

<b>Response</b>	<b>Mark</b>
it may not have flown in a straight line	1
It may not have taken a direct route	1
it may have been diverted	1
it flies up [and down]	1
I might have measured wrong	1
I am human, humans make errors	1
Because I rounded to the nearest one/ not exact	1
Not precise measurements	1
I might have worked out the distance from P to Q wrong	1
The distance could have been different	1BOD
We do not know the route the pilot took	1 BOD
The plane wouldn't be travelling at that speed the whole journey	0
The pilot make have taken a break	0
The jet stream may have got them there faster	0
There may be a delay	0
Assumes plane travelled at the same speed the whole time/it may have been faster or slower at some points	0
Scale is not accurate	0

Exemplar responses for Q7(b)

<b>Response</b>	<b>Mark</b>
Road[s] are/are not straight	1
Land is not suitable for construction [ e.g. it may be a lake]	1
The land may flood	1
Site is too small for centre	1
Site is too steep for construction	1
Land lies in a AONB/National Park	1
Too far from the towns (A/B/C)	1
The roads may not be able to cope with the increased traffic	1
There may be buildings there	1
It isn't built on a road	0
Its in the middle of two roads	0
Too close to the roads	0



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