

GCSE (9–1)

Mathematics

J560/05: Paper 5 (Higher tier)

General Certificate of Secondary Education

Mark Scheme for November 2019

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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
	Benefit of doubt
	Follow through
	Ignore subsequent working (after correct answer obtained), provided method has been completed
	Method mark awarded 0
	Method mark awarded 1
	Method mark awarded 2
	Accuracy mark awarded 1
	Independent mark awarded 1
	Independent mark awarded 2
	Misread
	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 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.

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 and applies as a default.
- **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. In questions with no final answer line, make no deductions for wrong work after an acceptable answer (ie **isw**) unless the mark scheme says otherwise, indicated by the instruction 'mark final answer'.
7. In questions with a final answer line following working space,
 - (i) if the correct answer is seen in the body of working and the answer given on the answer line 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) if the correct answer is seen in the body of working but the answer line is blank, allow full marks. Place the annotation ✓ next to the correct answer.
 - (iii) if the correct answer is seen in the body of working but a completely different answer is seen on the answer line, 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.
8. In questions with a final answer line:
 - (i) If one answer is provided on the answer line, mark the method that leads to that answer.
 - (ii) If more than one answer is provided on the answer line and there is a single method provided, award method marks only.
 - (iii) If more than one answer is provided on the answer line and there is more than one method provided, award zero marks for the question unless the candidate has clearly indicated which method is to be marked.
9. In questions with no final answer line:
 - (i) If a single response is provided, mark as usual.
 - (ii) If more than one response is provided, award zero marks for the question unless the candidate has clearly indicated which response is to be marked.
10. 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.

11. 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.
12. Ranges of answers given in the mark scheme are always inclusive.
13. 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.
14. 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)	$\frac{11}{12}$ final answer	2	M1 for $\frac{11k}{12k}$ or $\frac{9k}{12k} \left[+ \right] \frac{2k}{12k}$	$k =$ positive integer
1	(b)	$\frac{40 \times 20}{\sqrt{100}}$ $800 \div 10 = 80$	M1 A2	A1 for 800 or 10	For M1 allow 2 correct If more than one attempt, mark the better oe allow cancelling in fraction with 10 and 40 or 20
2		840	3	M2 for 168×5 oe or M1 for $30 = 2 \times 3 \times 5$ or for at least three multiples of 168 and three multiples of 30	For M1, accept 2, 3, 5 on a diagram and condone 1 included
3	(a)	She added the terms oe $2a^3$	1 1		In all 3 parts any incorrect statement treat as choice Allow correct descriptions of what Martina should have done in each part See AG
3	(b)	She divided the powers oe x^8	1 1		See AG
3	(c)	She squared ($\frac{1}{2} \times 6 \times 5$) oe 75	1 1		See AG
4		12	3	M2 for $\frac{250 - 220}{250} [\times 100]$ oe or $\frac{220}{250} \times 100$ oe or M1 for $\frac{220}{250}$ oe or $250 - 220$	M2 implied by 0.12 or 88[%] M1 implied by 0.88 or 30

Question		Answer	Marks	Part marks and guidance	
5		5.5 oe	3	<p>M1 for correct first step e.g. $6x - 4x - 10 = 1$</p> <p>M1 for $6x - 4x = 1 + 10$ FT <i>their</i> first step or FT <i>their</i> $ax = b$ to $x = \frac{b}{a}$</p>	<p>isw $\frac{11}{2}$ converted to decimal</p> <p>Embedded answer scores M2 max If not shown, M1 implied by $\pm 2x = b$ or $ax = \pm 11$</p> <p>e.g. M1 for $2x = -9$ leading to $x = -\frac{9}{2}$ oe</p>
6		<p>$(x + 4)(x + 5)$</p> <p>-5 and -4</p>	<p>M2</p> <p>B1</p>	<p>M2 for $(x + 4)$ and $(x + 5)$ or M1 for $(x + a)$ and $(x + b)$ where $ab = 20$ or $a + b = 9$ or $x(x + 4) + 5(x + 4)$ or $x(x + 5) + 4(x + 5)$</p> <p>If M0 scored SC1 for $x + 4 = 0$ and $x + 5 = 0$</p> <p>STRICT FT <i>their</i> factors dep on two brackets in factors.</p> <p>If 0 scored SC1 for answers ± 5 and ± 4</p>	<p>For M2 or M1 condone omission of final bracket</p>

Question		Answer	Marks	Part marks and guidance	
7		2700	4	<p>B3 for Emma's amount = 4500 or 4050 or old total = 7200 or new total = 6750 or M2 for $6k : 10k$ and $6k : 9k$ seen where k is a positive integer or for $\frac{5}{3} [-] \frac{3}{2}$ oe seen or for correct unsimplified equation to find Emma or Sundip or the total amount</p> <p>or M1 for $6k : 10k$ or $6k : 9k$ seen where k is a positive integer or for $\frac{5}{3}$ or $\frac{3}{2}$ or $\frac{5}{8}$ or $\frac{3}{8}$ or $\frac{3}{5}$ or $\frac{2}{3}$ oe seen or used</p>	<p>M2 implied by $\frac{1}{6}$ eg $\frac{3E}{5} = \frac{2}{3}(E - 450)$ where E is Emma's original share</p> <p>For M1 accept decimal versions of fractions</p>
8	(a)	Rhombus	1	<p>Allow kite, parallelogram or trapezium Do <i>not</i> allow quadrilateral or polygon</p>	
8	(b)	105	4	<p>M1 for $DEA = 60$ or $AFB = 60$ or any angle within either equilateral triangle identified as 60</p> <p>M2 for $DAE = 15$ or M1 for <i>their</i> $EAF \div 4$ soi B1FT $x = 180 - \textit{their} AED - \textit{their} DAE$</p>	<p>Angles may be identified in working or seen on the diagram</p> <p>May be implied by $15 : 60$</p> <p>If answer incorrect then max of 3 marks</p>
9	(a)	2500	1	<p>Ignore units</p>	

Question		Answer	Marks	Part marks and guidance	
9	(b)	Bisector of angle BCD accurate with pairs of correct arcs	M2	B1 for accurate bisector of angle BCD with no/incorrect arcs	Tol $\pm 2^\circ$ use overlay Condone solid/broken lines bisector
		Arc centre E radius 3 cm with length fit for purpose	M2	B1 for arc centre E	Tol ± 2 mm For B1 accept 5 correctly marked points in tolerance
		No oe with correct constructions	B1	Dep on at least B1M2	Accept the boat will travel within 75 m
10		300	5	M4 for $36 \div 0.12$ oe or M1 for 0.3×0.4 oe A1 for 0.12 oe OR M1 for $36 \div 0.3$ oe A1 for 120 M1 for <i>their</i> $120 \div \frac{2}{5}$ oe seen A1FT for <i>their</i> $120 \div \frac{2}{5}$ oe correctly evaluated to nearest integer or better seen	e.g. Answer 420 from $300 + 120$, gets M1A1M1A1
11		Select a pencil from the bag and record results and put it back in the bag oe	1	eg $\frac{\text{no of red pencils}}{\text{no of trials}}$ oe or no of red pencils recorded and no of trials recorded or number of greens recorded oe	Steps may be combined together
		Repeat trial at least 10 times	1		Accept many, a lot etc clearly implied
		Find rel frequency or probability	1		} oe eg if number of trials = 20 and then number of reds $\times 5$ or no of red pencils $\times \frac{100}{\text{no of trials}}$ oe then allow both marks
		Rel freq $\times 100$ oe	1		

Question			Answer	Marks	Part marks and guidance	
12	(a)		15	2	M1 for [UQ =] 64 and [LQ =] 49	Could be on diagram
12	(b)		Correct box plot	3	B2 for 4 or 5 correct markers OR B1 for 3 correct markers or 54 or 76 soi	Use overlay, condone freehand
12	(c)		Incorrect and Interquartile range is measure of spread not average oe or Incorrect and boys were less consistent because of the IQR oe	2	B1 for no/wrong decision and boys did better on average oe as median was larger or they had higher marks overall oe or boys were less consistent [and IQR not mentioned] oe	For 2 marks e.g. Incorrect and should have said the median is greater rather than IQR
13	(a)	(i)	[0].3̇	1		Condone e.g. [0].3̇
13		(ii)	[0].03̇	1		Condone e.g. [0].03̇
13	(b)		$4\sqrt{5}$	3	B2 for $\frac{20\sqrt{5}}{5}$ or M1 for $\frac{20}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$ or better	

Question		Answer	Marks	Part marks and guidance	
14		3.5	3	<p>M2 for $\frac{7 \times \sqrt{25}}{\sqrt{100}}$ oe</p> <p>Or M1 for $\frac{y}{7} = \frac{\sqrt{25}}{\sqrt{100}}$ oe</p> <p>OR</p> <p>M1 for $y = \frac{k}{\sqrt{x}}$ oe</p> <p>B1 for $k = 35$</p>	<p>Accept $ky = \sqrt{x}$</p> <p>Accept $k = \frac{5}{7}$</p>
15	(a)	Translation $\begin{pmatrix} -4 \\ -3 \end{pmatrix}$ oe	2	<p>B1 for $\begin{pmatrix} -4 \\ -3 \end{pmatrix}$ oe or for translation $\begin{pmatrix} -4 \\ k \end{pmatrix}$ oe or translation $\begin{pmatrix} k \\ -3 \end{pmatrix}$ oe</p> <p>If 0 scored, SC1 for translation $(-4, -3)$ or for triangle drawn on grid at $(-1, 0)$, $(-1, -1)$, $(1, -1)$</p>	<p>Extra transformations spoil all marks but allow SC1 mark</p> <p>Extra properties treat as choice oe e.g. 4 left and 3 down</p> <p>Use overlay ignore other triangles</p>
15	(b)	Reflection $x - \text{axis}$ oe	3	<p>B2 for reflection</p> <p>B1 for $x - \text{axis}$ oe</p> <p>If 0 scored,</p> <p>SC2 for image drawn at $(3, -3)$, $(3, -2)$ and $(5, -2)$</p> <p>SC1 for image drawn at $(3, 3)$, $(2, 3)$ and $(2, 5)$</p>	<p>Extra transformations spoil all marks but allow SC marks</p> <p>Extra properties treat as choice</p> <p>Use overlay ignore other triangles</p>

Question		Answer	Marks	Part marks and guidance
16		$\frac{11}{40}$ oe	5	<p>B3 for walk [only] = 29, walk and sail = 11 or B2 for walk and sail = 11</p> <p>or M1 for $40 + 18 + 3 - 50$ oe</p> <p>M1 for answer $\frac{n}{40}$ or $\frac{11}{k}$</p> <p style="text-align: center;">OR</p> <p>M1 for $40 + 18 + 3 - 50$ oe</p> <p>B2FT for correctly completed Venn diagram with $40 - x$, x [<i>their</i> 11], $18 - x$, [3] correctly placed FT <i>their</i> x (can be algebraic or x is an integer ($0 < x < 18$)) or B1FT for attempt at Venn diagram with $40 - x$ or $18 - x$ or 3 correctly placed FT <i>their</i> x (can be algebraic or x is an integer ($0 < x < 18$))</p> <p>M1 for answer $\frac{n}{40}$ or $\frac{11}{k}$</p> <p>Accept dec or % equivalents (3 figures) 0.275 or 27.5 % isw cancelling, conversion to other forms For B3 and B2 11 must be identified for both walk and sail</p> <p>M1 implied by 11 seen</p> <p>where $0 < n < 40$ and $11 < k < 50$ Check previous working for signs of cancelling e.g. $\frac{18}{40} = \frac{9}{20}$ gets M1</p> <p>M1 implied by 11 seen</p> <p>For B2 or B1, condone omission of universal set rectangle</p> <p>where $0 < n < 40$ and $11 < k < 50$ Check previous working for signs of cancelling e.g. $\frac{18}{40} = \frac{9}{20}$ gets M1</p>

Question		Answer	Marks	Part marks and guidance	
17		$a^{\frac{4}{3}} \times a^{-1} = a^{\frac{4}{3}-1} = a^{\frac{1}{3}}$ or $a^{\frac{4}{3}} \div a = a^{\frac{4}{3}-1} = a^{\frac{1}{3}}$	3	B1 for $a^{\frac{4}{3}}$ B1 for $\left[\frac{1}{a}\right] a^{-1}$	e.g. $a^{\frac{4}{3}} \times a^{-1} = a^{1/3}$ scores B1B1 only but $a^{\frac{4}{3}} \times a^{-1} = a^{1/3}$ with $\frac{4}{3} - 1 = \frac{1}{3}$ or arrow connecting $\frac{4}{3}$ and -1 scores full marks.
18			6	B1 for $y = x - 2$ drawn B2 for $x = 3$ broken line or B1 $x = 3$ solid line AND B1 for R correct side of $3y + 6x = 13$ B1 for R correct side of <i>their</i> $y = x - 2$ B1 for R correct side of $x = 3$	Penalise one mark only for good freehand lines Additional lines treat as choice See marks on diagram for the final B3 marks provided all lines drawn correctly For region, FT <i>their</i> $y = x - 2$ provided line with positive gradient only but no FT for $x = 3$ if incorrect
19	(a)	$\frac{1}{\sqrt{2}}$ or $\frac{\sqrt{2}}{2}$ final answer	1		

Question		Answer	Marks	Part marks and guidance	
19	(b)	10 nfw	6	<p>B3 for $BD = 10\sqrt{2}$ oe or M2 for $10\sqrt{6} \times \tan 30$ oe or M1 for $\frac{BD}{10\sqrt{6}} = \tan 30$ oe</p> <p>AND</p> <p>M2 for $BC = \sqrt{\frac{\text{their } BD^2}{2}}$ oe or <i>their</i> $BD \times \text{their } \sin 45$ oe or M1 for $BC^2 + CD^2 = (\text{their } BD)^2$ or for $\frac{BC}{\text{their } BD} = \text{their } \sin 45$</p>	<p>Allow use of other variables for BC and CD (possibly different)</p>
20	(a)	$(x - 3)^2 + 2$ final answer	3	<p>B1 for $(x - 3)^2$ B2 FT for 2</p> <p>or M1 for $11 - (\text{their } -3)^2$ If 0 scored, SC2 for final answer $(x - 3) + 2$</p>	<p>FT can be implied, check $11 - (\text{their } -3)^2$</p>

Question		Answer	Marks	Part marks and guidance	
20	(b)	U shaped parabola with minimum value indicated in 1st quadrant at (3, 2)	3	<p>FT U-shaped parabola with turning point at <i>their</i> $(-a, b)$ from part (a) dep on answer of form $(x + a)^2 - b$ where $a \neq -3$ and/or $b \neq 2$</p> <p>B1 for U shape curve</p> <p>B1 for turning point at $(3, k)$ or FT for turning point at $(-a, k)$ dep on answer of form $(x + a)^2 - b$ in part (a)</p> <p>B1 for turning point at $(k, 2)$ or FT for turning point at (k, b) dep on answer of form $(x + a)^2 - b$ in part (a)</p>	<p>Be generous for the U shape condone broken line</p> <p>Sketch takes priority when marking</p> <p>Do not allow all 3 marks if (3, 2) indicated on U shaped parabola but TP on sketch is in wrong quadrant</p> <p>Values must be shown but could be marked on axes. Mark intention</p> <p>Accept turning point = (3, 2) written in working provided no contradiction on sketch</p> <p>If point (3, 2) only plotted on graph and no sketch then B0B1B1</p>
21	(a)	6 (0, 0)	1 1		
21	(b)	10	4	<p>B3 for 5 and -5</p> <p>Or</p> <p>M2 for $x^2 = 25$</p> <p>Or</p> <p>M1 for $x^2 + (\sqrt{11})^2 = 36$</p>	Accept a or b for x

APPENDIX

Exemplar responses for Q3a

	Response	Mark
1	She did not multiply [the terms]	1
2	She added up all the a	1
3	She added [to] the 2a's	1BOD
4	She hasn't multiplied the a's	1
5	it is \times not +	1
6	she would be right if they were plus signs and not times	1
7	Not $2a + a + a$	1
8	a would equal $2a + a + a$. When you times you add them $2a \times a \times a = 2a^3$	1
9	She added a to the multiplication instead of using index laws	0
10	She has added the 2a's then times by the 2a	0
11	She added the a's to the 2 instead of multiplying them	0
12	She added the 2a to the $a \times a$	0
13	2a is different to a times a = a^2	0

Exemplar responses for Q3b

	Response	Mark
1	She divided the 10 and the 2/she divided the powers (must refer to 'numbers' or 'indices')	1
2	she done $10 \div 2 = 5$	1
3	She should have done $10 - 2$	1
4	She should take away the indices	1
5	She divided 10 by 2 instead of subtracting 2	1
6	Laws of indices it should be taken away	1
7	Divided the numbers	1
8	She divided instead of taking away ('indices' implied by referring to division and subtraction)	1
9	She has used division	0
10	She divided it when it should be timesd	0
11	She didn't use the laws of indices	0

Exemplar responses for Q3c

	Response	Mark
1	didn't do the power first	1
2	She did 5×6 and then $\times \frac{1}{2}$ but the 2 is near the 5^2 not all of it	1
3	She should have squared 5 first and then divide 6 by 2 and times them together	1
4	She didn't do the 5^2 bit first	1
5	She didn't square 5 and times 6 by 25	1
6	She hasn't squared the 5	1
7	Doing 15^2 she needs to do 5^2	1
8	She did 15^2	0
9	She halved 30 when she meant to halve 6 earlier in the equation	0
10	She didn't square the number 5 correctly nor did she times by 6 or halve it by half	0
11	She square after, when you square before	0
12	She halved 6 before multiplying by 5^2	0
13	Didn't use BODMAS	0
14	$6 \times 25 = 150$	0

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