



GCSE

Mathematics (9-1)

Unit **J560/05**: Paper 5 (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
	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.
 - **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. 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)	$1\frac{9}{40}$	3	Mark final answer M2 for $\frac{24[k] + 25[k]}{40[k]}$ or better (k is positive integer) or M1 for two equivalent fractions with common denominator of $40[k]$ attempted with one numerator correct If 0 scored, SC1 for answer 1.225	Could be separate fractions M2 soi by $\frac{49[k]}{40[k]}$ oe Could be seen in 2 different fractions without addition
	(b)	4.84×10^4	3	M2 for figs 484 in final answer or B1 for 50 000 or 50×10^3 seen or for 1600 or 0.16×10^4 seen	Allow M2 if correct answer oe seen in working
2		Correct solution is $x > -2$ No and number line shows $x < -2$ oe or No and draws the correct inequality on number line or No [the circle is correctly placed but] the arrow points the wrong way oe	M2 A1	M1 for $3x > -5 - 1$ oe or evaluates $3x + 1$ correctly for $x = -3$ or $x = -4$, or $x = -5$ or $x = -6$ After 0 scored, allow SC1 for number line shows $x < -2$ oe isw or for [the circle is correctly placed but] the arrow points the wrong way oe	For M2 accept in words, x is greater than -2 , accept correctly drawn solution on a number line For M1 condone incorrect inequality sign or 'equals' e.g. $x = -2$ implies M1 M1 implied by -8 or -11 or -14 or -17 But for A1 or SC1 if just 'it points the wrong way' oe accept this provided there is no incorrect statement about where the circle should be placed and no incorrect working shown
3	(a)	$\begin{pmatrix} 2 \\ 9 \end{pmatrix}$	1		In (a) and (b) penalise first occurrence of fraction line in vector

Question		Answer	Marks	Part marks and guidance	
	(b)	$\begin{pmatrix} 1 \\ 10 \end{pmatrix}$	2	B1 for answer $\begin{pmatrix} 1 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 10 \end{pmatrix}$	
4		Correct attempt to find 90% or 10% of 110 99 or 11 and 10.6 [She is] correct oe	M1 A1 A1	or $\frac{99.4}{110}[\times 100]$ oe or $\frac{9.5+1.1}{110}[\times 100]$ oe or 90.36 to 90.4 or 9.6[4] and 10 Dep on M1A1 earned	M1 implied by 99 seen or 11 and 10.6 seen or 90.36 or 9.6[4] and 10 seen Be aware of 90.36 or 9.6[4] appearing without written evidence as possible calculator use Other methods are possible
5	(a)	[0].35 oe	2	M1 for $1 - (0.2 + 0.45)$ oe isw conversion to other forms M1 implied by answer 0.53	
	(b)	40	3	M2 for $10 \div (0.45 - 0.2)$ oe or M1 for $0.45 - 0.2$ soi e.g. 0.25 oe associated with 10 [games] then 4×10 soi Allow with algebra, eg for M1 $0.45x - 0.2x = 10$	
6		60	4	B3 for [Feb =] 400 or M2 for $460 \div \left(\frac{100+15}{100}\right)$ oe or M1 for 115% oe 400 as answer implies B3 e.g. 1.15, $\frac{23}{20}$	

Question		Answer	Marks	Part marks and guidance	
7		225[.00] nfw	6	<p>B3 for 54 [tiles] OR M1 3×4.5 oe or 300×450 oe or $4.5 \div 0.5$ or $450 \div 50$ oe soi and M1 0.5×0.5 oe or 50×50 oe or $3 \div 0.5$ or $300 \div 50$ oe soi</p> <p>AND</p> <p>M1 for <i>their</i> 6×20</p> <p>M1 for <i>their</i> 14×7.5</p>	<p>Could be on diagram</p> <p>Could be on diagram</p> <p><i>their</i> 6 is correct number of packs for <i>their</i> number of tiles – must be positive integer, implied by 120</p> <p><i>their</i> 14 is <i>their</i> answer to (3×4.5) rounded up to next integer, implied by 105</p>
8	(a)	Too many branches oe	1	<p>Accept e.g. Takes too long oe Tree would be too big oe Too complicated oe Too hard to draw oe Tree diagrams are better for fewer outcomes oe Do not accept e.g. Trees can only have two branches</p>	

Question		Answer	Marks	Part marks and guidance	
	(b) (i)	Attempts sample space 36 correct outcomes	M1 A1	Presented in any clear form, including list or table Pairs shown or accept as totals in table	For M1, accept two by two table drawn with row and column labelled 1 to 6 [with no entries or with incorrect entries] For M1 accept as a list of at least 6 different pairs or totals with no others or no repeats If listing as pairs on table, condone e.g. (2, 1) listed as (1, 2) etc
	(ii)	$\frac{2}{36} = \frac{1}{18}$	2	M1 for (5, 6) and (6, 5) identified or for $2\left(\frac{1}{6} \times \frac{1}{6}\right)$ oe	Accept indicated on sample space
9	(a)	2	1		
	(b)	Fully correct graph	3	B2FT for 7 correctly plotted points or B1FT for 5 or 6 correctly plotted points	Mark in 70% zoom, use overlay, mark curve first For 3 marks, curve must pass through or touch circles on overlay Condone ruled sections for $-3 \leq x \leq -2$, $-1 \leq x \leq 1$ and $2 \leq x \leq 3$. No vertical section on curve of more than 5 small squares must have min and max Condone slight feathering If curve incorrect, mark the plots use the overlay, plots must lie inside or touch circles. If large blob for plot, check centre of blob
	(c)	2.5 to 2.7	1		

Question		Answer	Marks	Part marks and guidance	
10	(a)	440	3	<p>M2 for $165 \div 3 \times 8$ or M1 for 165 is $1 - \frac{5}{8}$ soi or for $165 \div 3$ soi If 0 scored, SC1 for answer 264</p>	M1 implied by 55 or 275 seen (from $165 \div 5 \times 8$)
	(b)	Correct comment	1	Any statement that implies the assumption that the rate of petrol consumption remains constant	e.g. Speed stays the same Same type of roads The car uses fuel at the same rate Does not get stuck in traffic Weather stays the same See AG
11		8 nfw	6	<p>B1 for $\cos 60 = 0.5$ oe soi M1 for $\frac{BD}{12} = \cos 60$ oe A1 for [BD =] 6 AND M2 for $\sqrt{10^2 - \text{their } BD^2}$ or M1 for $\text{their } BD^2 + AB^2 = 10^2$ oe or for $10^2 - \text{their } BD^2$</p>	<p>nfw - must check method before giving 6 marks must not come from wrong working</p> <p>e.g. $\sin 30 = 0.5$ e.g. $\frac{BD}{12} = \sin 30$</p> <p>For M2 or M1 $0 < \text{their } BD < 10$ and BD must be identified first on diagram or in working</p>

Question		Answer	Marks	Part marks and guidance	
12		She divided by 2 and did not square root oe $\frac{1}{8}$	B1 2	M1 for square root [8 seen in answer] M1 for reciprocal [implied by answer of form $\frac{1}{n}$, $n \neq 0$ or 32]	Must mention divide by 2 oe accept in symbols e.g. $\div 2$ and square rooting. Accept $\sqrt{\quad}$ or [square] root for square root Each step must be correctly evaluated but FT previous step Allow method marks in either order
13	(a)	0.416 ^{&}	2	B1 for answer 0.41...	For 2 marks accept e.g. 0.4166[6]... or 0.416r
	(b)	$\frac{76}{99}$	2	Mark final answer M1 for 76.76... seen or answer $\frac{k}{99}$	
14		3 nfw	5	B4 for $4r^3 = 108$ or better or B3 for $r^2h = 108$ or M3 for $\pi \times 2^2 \times 9 = \frac{1}{3}\pi r^2 4r$ oe or for $\pi \times 2^2 \times 9 = \frac{1}{3}\pi \left(\frac{h}{4}\right)^2 h$ oe or B2 for 36π or M1 for $\pi \times 2^2 \times 9$ or better or B1 for $4r$ or $\frac{h}{4}$ seen	nfw - must check method before giving 5 marks must not come from wrong working Condone use of other letter for r (or h) e.g. x For method marks allow use of 3.14, 3.142 or $\frac{22}{7}$ for π

Question		Answer	Marks	Part marks and guidance	
15		$[13n + 3 +] 6n^2 + 9n - 10n - 15$ $6n^2 + 12n - 12$ $6(n^2 + 2n - 2)$ and is a multiple of 6 oe	M2 A1 A1	M1 for two or three of $6n^2 + 9n - 10n - 15$ Dep on M2 A1 and no errors seen Accept $(6n^2 + 12n - 12) \div 6 = n^2 + 2n - 2$ and is a multiple of 6 oe	For M2 accept $6n^2 + - [1]n - 15$ For M1, accept expansion on grid with negative signs shown For A1, condone $6n^2 + 12n - 12 = 0$ Do not accept each term is a multiple of 6 without showing the outcome $n^2 + 2n - 2$
16	(a)	72 and [angles in] alternate segment [are equal]	2	B1 for 72	For 2 marks. In reason, must mention alternate segment or opposite segment with no incorrect statement seen
	(b)	108 and [opposite angles of a] cyclic quadrilateral [are supplementary] oe	2FT	FT 180 – <i>their 72</i> with correct reason accept alt reason angles on a [straight] line [add up to 180] and [angles in] alternate segment [are equal] oe B1FT for 180 – <i>their 72</i> or for a correct reason given	In reason, must mention cyclic quadrilateral with no incorrect statement If part (a) blank allow 2FT 180 – x in (b) with a correct reason or B1FT for 180 – x

Question	Answer	Marks	Part marks and guidance	
17	$a = -4$ $b = 2$ $c = -1$ $d = -25$	4	<p>B4 for 4 correct values</p> <p>For 3 marks or less, FT $7 + 2 \times$ <i>their a</i> for c and FT $3 + 7 \times$ <i>their a</i> for d</p> <p>OR</p> <p>B3 for any 3 correct or FT</p> <p>OR</p> <p>B2 for any 2 correct or FT or for reaching $2x^3 + (7 + 2a)x^2 + (3 + 7a)x + 3a$ oe</p> <p>OR</p> <p>B1 for any one correct or FT or any correct product of two brackets</p>	<p>Mark answers first</p> <p>B2 for a fully correct 3-bracket expansion, could be unsimplified e.g. $2x^3 + 7x^2 + 2ax^2 + 3x + 7ax + 3a$</p> <p>For B1, $2x^2 + x + 6x + 3$ or better or $x^2 + ax + 3x + 3a$ or better or $2x^2 + 2ax + x + a$ or better For B1 accept terms on a grid</p>
18 (a)	$y = -\frac{1}{4}x + 6$	3	<p>Mark final answer</p> <p>B2 for correct equation seen</p> <p>or</p> <p>M1 for [grad=] $-\frac{1}{4}$ oe soi</p> <p>M1 for answer $y = kx + 6$ oe ($k \neq 0$)</p>	<p>For 3 marks accept $y = -0.25x + 6$</p> <p>Does not have to be in form $y = mx + c$ e.g. $y - 6 = -\frac{1}{4}(x - 0)$</p>

Question		Answer	Marks	Part marks and guidance	
	(b)	(6, 19) and (-2, -13)	6	<p>M2 for $x^2 - 4x - 12 [= 0]$ or M1 for $x^2 - 17 = 4x - 5$ or better</p> <p>M2 for $(x - 6)(x + 2) [= 0]$ oe or M1 for $(x + a)(x + b) [= 0]$ where $a + b = -4$ or $ab = -12$</p> <p>B1 for either pair of coordinates correct or for $x = 6$ and $x = -2$</p>	<p>FT <i>their</i> 3 term quadratic equation or expression. Accept correct use of quad formula or complete the square M2 if completely correct, M1 if one error in formula or complete the square</p> <p>See AG for alt method</p>
19	(a)	<p>Correct histogram with blocks of height 5.4, 5, 2.2 and 0.5</p> <p>Vertical axis labelled 'frequency density' and a correct linear scale shown</p>	<p>3</p> <p>If 0 scored, SC1 for 3 correct freq densities soi 5.4 oe, 5, 2.2 oe and 0.5 oe</p> <p>1</p>	<p>$\frac{1}{2}$ small square accuracy for heights, no gaps between blocks Condone good freehand if in tolerance Condone omission of vertical line at $t = 80$ Other correct histograms may be possible with different scales</p> <p>For SC1 oe accept e.g. $\frac{44}{20}$ isw for 2.2</p> <p>At least 2 numbers shown for linear scale (other than zero), A correct linear scale could use e.g. 2 cm to 1 unit or 2 cm for 2 units Accept FD for frequency density label</p>	

Question		Answer	Marks	Part marks and guidance	
	(b)	We don't know oe and correct reason	1	e.g. Not sure, as exact data not given.	Accept No with correct reason but do not accept 'yes' with any reason e.g. No, all we know is that the longest time is in the group from 40 to 80 See AG
	(c) (i)	$20 + 44 \div 2 = 42$ 42 is 25% of [total] 168 oe	M1 A1	or $168 - 54 - 50 - 44 \div 2$ with no errors seen	Accept 22 for $44 \div 2$ Accept e.g. $\frac{1}{4}$ of 168 = 42, $168 \div 4 = 42$ $\frac{42}{168} = \frac{1}{4}$ etc oe These two steps may be done in reverse order
	(ii)	Correct statement on assumption made	B1		e.g. Sample is representative oe Distribution of students in the school is the same as the sample Data is distributed uniformly across the times/ the interval $20 < t \leq 40$ oe Half of the students in $20 < t \leq 40$ took longer than 30 minutes 22 of the students took between 30 and 40
20	(a) (i)	8	2	M1 for $\left[(\sqrt{2})^7 = \right] 2^3 \times \sqrt{2}$	For M1 accept $2 \times 2 \times 2$ for 2^3 Final answer $8\sqrt{2}$ scores M1
	(ii)	13	2	B1 for 2 correct trials with $n > 3$ correctly evaluated or M1 for $(\sqrt{2})^{12} = 2^6$ oe or for $\frac{n-1}{2} = 6$ oe	e.g. $(\sqrt{2})^6 = 8$ and $(\sqrt{2})^9 = 16\sqrt{2}$

Question	Answer	Marks	Part marks and guidance
(b)	$\frac{14}{3-\sqrt{2}} \times \frac{3+\sqrt{2}}{3+\sqrt{2}} \text{ or better}$ $\frac{14(3+\sqrt{2})}{7}$ $2(3+\sqrt{2}) \text{ or } 6 + 2\sqrt{2}$	<p>M1</p> <p>B3</p> <p>A1</p>	<p>If written in a single fraction, must have brackets</p> <p>or M2 for $\frac{14(3+\sqrt{2})}{9+3\sqrt{2}-3\sqrt{2}-(\sqrt{2})^2}$ or better</p> <p>or M1 for numerator or denominator correct</p> <p>Dep on M1B3 earned</p> <p>For B marks or method marks, allow numerator brackets expanded</p> <p>For M1, allow denominator unsimplified but not $9 - 2$ or 7 if from wrong working</p> <p>Allow M1 for either numerator or denominator even if not in fraction</p>

APPENDIX

Exemplar responses for Q10b

Response	Mark
Travelled at same speed	1
Car burns fuel same as for first 165 miles	1
Same amount of fuel is used for each bar	1
She travels constantly and does not stop BOD (speed is constant)	BOD 1
The roads are similar without having to stop and start in traffic	1
When the arrow reaches each point, she has travelled the same distance	1
The roads were similar for the rest of the journey	1
The tank empties at a consistent rate	1
Fuel gauge reading is accurate/correct	1
She did not have a fuel leak	1
She did not stop (not enough)	0
How efficiently she drove the car	0
The speed of the car	0
Car uses same amount of fuel each time	0
Every 4 bars would travel 165 miles (4 is incorrect – OK is 3 bars mentioned)	0
There are no diversions to her route	0
The fuel is used solely on covering distance (vague)	0
There are no hills (not enough as there may have been on the first part of the journey)	0

Exemplar responses for Q19b

Response	Mark
No all we know is that it lies between 40 and 80	1
They may have taken 80 minutes but we don't know that for sure – they may have all been less than 60	1
No [because the time section says $40 < t \leq 80$,] they may have been less than 80	1
No there is a range of values for the time so not definitely 80	1
No as the time is given as a range	1
No we are not give the accurate values	1
It might be but we would need to know the exact values to find out	1
Yes 80 is the highest value	0
Yes with any comment	0

Q18b alt algebraic method

(b)	(6, 19) and (-2, -13)	6	<p>M2 for $y^2 - 6y - 247 [= 0]$ or M1 for $y = \left(\frac{y+5}{4}\right)^2 - 17$ or better</p> <p>M2 for $(y + 13)(y - 19) [= 0]$ oe or M1 for $(y + a)(y + b) [= 0]$ where $a + b = -6$ or $ab = -247$</p> <p>B1 for either pair of coordinates correct or for $y = 19$ and $y = -13$</p>	<p>FT <i>their</i> 3 term quadratic equation or expression. Accept correct use of quad formula or complete the square M2 if completely correct, M1 if one error in formula or complete the square</p> <p>See AG</p>
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