

GCSE (9–1)

Mathematics

J560/06: Paper 6 (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
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 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 $3 \times \textit{their} (a)$.

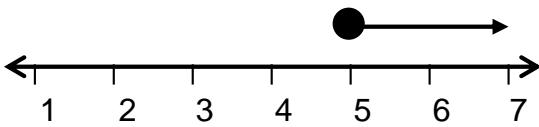
For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

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.
 - **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. 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.
9. 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.
10. Ranges of answers given in the mark scheme are always inclusive.
11. 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.
12. 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	<p>$x \geq 5$</p> <p>AND</p> 	4	<p>B2 for $x \geq 5$ as final answer or M1 for $3x \geq 10 + 5$ or better</p> <p>AND</p> <p>B2FT for $x \geq 5$, or <i>their</i> inequality, correctly shown or B1FT for $x \geq 5$, or <i>their</i> inequality, shown with a correct circle and wrong arrow or wrong circle and correct arrow</p> <p>Solution to inequality</p> <p>Allow M1 for this expression with other inequality symbols or equals sign or $[x =] 5$ as solution (can be implied by mark/circle on the diagram) or trials leading to selection of 5 or final correct trial using 5</p> <p>Displaying the solution Display must show an inequality that fits on the number line for FT Mark to candidate's advantage either $x \geq 5$ or <i>their</i> inequality Accept an arrow of any length or a line reaching 7</p> <p>If no solution to inequality seen: Filled circle at 5 arrow to right M1B2 Empty circle at 5 arrow to right M1B1 Filled circle at 5 arrow to left M1B1 Empty circle at 5 arrow to left M1B0 Mark at 5 no line or arrow M1B0 Circle and/or arrow at other than 5 M0B0</p>

Question	Answer	Marks	Part marks and guidance
2	31 218	5	<p>M4 for $54868 - \frac{54868}{2.32}$ oe</p> <p>or</p> <p>M3 for $\frac{54868}{2.32}$ soi by 23650 or 236.5</p> <p>or</p> <p>M2 for 2.32 or 232[%] soi</p> <p>or</p> <p>M1 for 1.32 or 132[%] soi</p> <p>If M1 only scored then also allow an</p> <p>SC1 for $\frac{54868}{1.32}$ soi by 41566 to 41567</p>
3	$\frac{1}{27}$	3	<p>M2 for $\frac{2}{6} \times \frac{2}{6} \times \frac{2}{6}$ soi by $\frac{8}{216}$ oe or 0.037[...] or 3.7[...]%</p> <p>or</p> <p>B1 for $\frac{2}{6}$ oe</p> <p>If 0 scored then SC1 for $(their \left(\frac{2}{6}\right))^3$ oe $0 < their \left(\frac{2}{6}\right) < 1$</p>

Question	Answer	Marks	Part marks and guidance
4	80 nfw	5	<p>B3 for height [of B =] 10</p> <p>OR</p> <p>M2 for $3x^2 = \textit{their}$ (12 × 25) or better</p> <p>or</p> <p>M1 for $3x \times x$ oe or 300 seen</p> <p>A1 for $x = 10$</p> <p>AND</p> <p>M1 for $(2 \times \textit{their} 10) + (2 \times 3 \times \textit{their} 10)$ oe or for $2a + 2b$ where $ab = 300$ but not with 25 and 12</p> <p>May be seen on diagram</p> <p>May be implied by arithmetic processing e.g. $\sqrt{\frac{\textit{their} (12 \times 25)}{3}}$ or at least two trials of $3 \times \text{number} \times \text{number}$ intending 300</p> <p>Allow <i>their</i> 10 if clearly intended as height e.g. “$h =$” or marked on diagram e.g. M1M1 for $2 \times 36 + 2 \times 8.3[3\dots]$ after 300 seen</p>

Question	Answer	Marks	Part marks and guidance
5	3.2 nfw	6	<p>M3 for 1500×1.03^5 or M2 for 1500×1.03^k where k is 2, 3 or 4 or M1 for 1.03 soi perhaps by 1545</p> <p>AND</p> <p>M2 for $\frac{\textit{their } 1738.91 - 1500}{5 \times 1500} [\times 100]$ oe or</p> <p>M1 for $(\textit{their } 1738.91 - 1500) \div 5$ or for $(\textit{their } 1738.91 - 1500) \div 1500$</p> <p><u>Alternative (not using a base amount)</u> M5 for $[r =] (1.03^5 - 1) \div 5$ or M4 for $1.03^5 - 1$ or M3 for 1.03^5 or M2 for 1.03^k (where k is 2, 3 or 4) or M1 for 1.03</p> <p>Condone 3.2% as final answer soi by 1738 to 1739</p> <p>soi by [2 yr =] 1591[.35], [3 yr =] 1639[.09..] or [4 yr =] 1688.[26...]</p> <p><i>their</i> 1738.91 must come from a valid attempt to find compound interest for at least 2 years M2 soi by 0.0317 to 0.032 or soi by 3.17 to 3.19</p> <p>M1 soi by 47.6[0] to 47.8[0] or soi by [0].1586 to 0.1594</p>

Question	Answer	Marks	Part marks and guidance
6	43.75 or 43.8	4	<p>M3 for $\frac{7}{16}$ [$\times 100$]</p> <p>OR</p> <p>M1 for 16 correct combinations shown or for 4×4 [combinations] M1 for AA, AC, AG, AS, BA, EA, PA only or 7 [combinations involving Alice] identified</p> <p><u>Alternative method</u> M3 for $\frac{7}{16}$ [$\times 100$] or M2 for $1 - \frac{3}{4} \times \frac{3}{4}$ or $\frac{1}{4} + \frac{3}{4} \times \frac{1}{4}$ or $\frac{1}{4} \times \frac{1}{4} + \frac{1}{4} \times \frac{3}{4} + \frac{3}{4} \times \frac{1}{4}$ or M1 for $\frac{3}{4} \times \frac{3}{4}$ or $\frac{3}{4} \times \frac{1}{4}$ or $\frac{1}{4} \times \frac{1}{4}$</p>

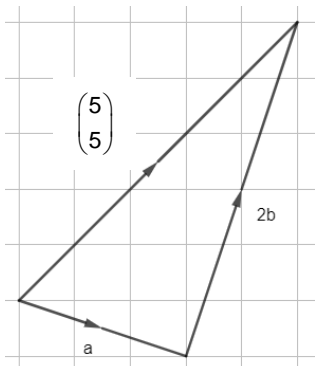
Accept 44 after correct method seen

Implied by 16 or a denominator of 16

Allow [0].75 and [0].25 throughout

soi by 9/16, 3/16 or 1/16

Question		Answer	Marks	Part marks and guidance																	
7	a	Completes table with <table border="1" style="margin-left: 20px;"> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>6</td><td></td><td>-2</td><td>-3</td><td></td><td>1</td><td></td><td></td> </tr> </table>									6		-2	-3		1			2	B1 for at least 2 correct values	
6		-2	-3		1																
	b	Correct curve	3	B2 for 6 or 7 points correctly plotted FT <i>their</i> table or B1 for 4 or 5 points correctly plotted FT <i>their</i> table Tolerance ± 2 mm for plotting and curve through the correct points. Strict marking of 'smooth curve' – must not be ruled or 'feathered'																	
	c	Straight line passing through (0, -6) and (3, 0)	3	M2 for a correct unruled line or a straight line of gradient 2 or a straight line passing through (0, -6) or two correct points correctly stated or plotted or M1 for one correct point stated or plotted <table border="1" style="margin-left: 20px;"> <tr> <td>x</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td> </tr> <tr> <td>y</td><td>-8</td><td>-6</td><td>-4</td><td>-2</td><td>0</td><td>2</td><td>4</td> </tr> </table>		x	-1	0	1	2	3	4	5	y	-8	-6	-4	-2	0	2	4
x	-1	0	1	2	3	4	5														
y	-8	-6	-4	-2	0	2	4														
	d	1.6 and 4.4	2FT	B1 for each or both answers as decimals to a greater accuracy Correct answer or FT <i>their</i> straight line Tolerance ± 1 mm. Do not allow exact answers $3 + \sqrt{2}$ and $3 - \sqrt{2}$																	

Question		Answer	Marks	Part marks and guidance	
8		7.2 oe nfww	4	<p>M2 for $\frac{1}{3} \times 5 \times 5 \times \frac{h}{2} = 30$ oe or $\frac{1}{3} \times 5 \times 5 \times h = 60$ oe or $\frac{1}{3} \times 5 \times 5 \times h = 30$ oe</p> <p>or M1 for $\frac{1}{3} \times 5 \times 5 [\times \frac{h}{2} \text{ or } \times h]$</p> <p>AND</p> <p>A1dep for $[h \text{ or } \frac{h}{2} =] 3.6 \text{ or } 7.2$</p>	<p>Condone use of h or other letter as height of pyramid</p> <p>M2 implied by $\frac{30}{\frac{1}{3} \times 5 \times 5}$ or $\frac{60}{\frac{1}{3} \times 5 \times 5}$, perhaps in stages</p> <p>soi 8.3[3...] or $\frac{25}{3}$</p> <p>A1 dep on <i>their</i> M2</p> <p>Note: using $V = 60$ should lead to final answer 7.2, and score 4 marks. If spoilt (e.g final answer 14.4, then M2A1)</p>
9	a	2.5 5	3	<p>B2 for $[k =] 2.5$ or B1 for $\binom{4}{2}$ B1 for $[n =] 5$</p>	
9	b		<p>1</p> <p>1</p> <p>1</p>	<p>Correct arrow and label $\binom{5}{5}$ or $a + 2b$</p> <p>Correct arrows on a and 2b</p> <p>Correct labels on a and 2b</p>	<p>Accept single arrowhead</p>

Question		Answer	Marks	Part marks and guidance	
10	a	$4 + 11 + 8 = 23$ seen	1		Accept written as a sum in a column
	b	e.g. First column: $n + (n + 7) + (n + 6) = 3n + 13$ Second column: $(n + 1) + (n + 8) + (n + 5) = 3n + 14$ $(3n + 14) - (3n + 13) = 1$	5	B2 for consistent algebraic terms for at least first two columns of the grid or B1 for at least 3 algebraic terms for consecutive numbers seen AND M1 for algebraic sum of first or second column shown M1 for algebraic sum of first and second columns shown and correctly simplified A1 for sum of second column – sum of first column = 1 calculated or explained from correct working or M1 for difference of one pair of algebraic terms from first and second column shown M1 for differences of two further pairs of algebraic terms from first and second column, with all three pairs correctly simplified A1 for each difference found as +1 or -1 oe and summed/explained to a difference of +1. Correct algebra and reasoning throughout If 0 scored, allow SC1 for a correct numerical or descriptive example using either method and stating an overall difference of 1	e.g. $n, (n + 7), (n + 6)$ and $(n + 1), (n + 8), (n + 5)$ e.g. $n, (n + 1), (n + 2)$ e.g. $n + (n + 7) + (n + 6)$ or in column e.g. $n + (n + 7) + (n + 6) = 3n + 13$ A1 for e.g. $3n + 14$ and $3n + 13$ and “second column is 1 more than the first” but A0 for e.g. $3n + 14$ and $3n + 13$ and “difference of 1” or for $(3n + 14) - 3n + 13 = 1$ e.g. “the difference between $n + 1$ and n is 1” e.g. “ $n + 1$ is 1 more than n ” Condone poor use of brackets for both M marks

Question			Answer	Marks	Part marks and guidance
11	a	i	60	3	B2 for $[u_4 =] 15$ or M1 for $5 \times 6 - 15$
		ii	4.2 oe	3	M2 for $(6 + 15) \div 5$ or M1 for $6 = 5u_2 - 15$ or $u_2 = \frac{u_3 + 15}{5}$ Allow $6 = 5k - 15$ or $u_n = \frac{u_{n+1} + 15}{5}$
	b		$[u_2 =] 5 \times 3.75 - 15 = 3.75$ Since $u_1 = u_2$, all terms are equal	1 1dep	Must see calculation and answer Accept "every term is 3.75"

Question		Answer	Marks	Part marks and guidance	
12	a	37 minutes 52 seconds to 37 minutes 53 seconds	4	<p>B1 for 5000 or 0.0022 seen and</p> <p>M1 for figs 5 ÷ figs 22 oe soi by figs 2272 to 2273 and</p> <p>M1 for figs (2272 to 2273) ÷ 60 soi by figs 37[....]</p>	
	b	19.09 20.19	6	<p>B5 for 19.09 to 19.1 and 20.18 to 20.2 as final answers</p> <p>OR</p> <p>B2 for 53.5, 52.5, 2.65 and 2.75 all seen or B1 for two of 53.5, 52.5, 2.65 or 2.75 seen</p> <p>and</p> <p>M2 for both 53.5 ÷ 2.65 and 52.5 ÷ 2.75 or M1 for (52.5 to 53.5) ÷ (2.65 to 2.75)</p> <p>and</p> <p>A1dep for 19.09 to 19.1 and 20.18 to 20.2</p> <p>If 0 scored, allow SC3 for one answer either 19.09 to 19.1 or 20.18 to 20.2</p>	<p>Allow 2.749[9...] for 2.75 or 53.49[9...] for 53.5</p> <p>For M2 ignore other unnecessary divisions e.g. 53.5 ÷ 2.75 and 52.5 ÷ 2.65</p> <p>Dep on M2</p>

Question	Answer	Marks	Part marks and guidance	
13	$\frac{29}{66}$ oe	5	<p>M4 for $\frac{2}{3} \times \frac{29}{44}$</p> <p>OR</p> <p>B1 for [p(black) =] $\frac{2}{3}$ oe soi</p> <p>and</p> <p>B2 for $\frac{29}{44}$</p> <p>or B1 for $\frac{n}{44}$ with $0 < n < 44$</p> <p>or B1 for $\frac{29}{45}$</p> <p>and</p> <p>M1 for $\frac{2}{3} \times$ <i>their</i> $\frac{n}{44}$ or $\frac{2}{3} \times \frac{29}{45}$</p>	oe e.g. $\frac{870}{1980}$ or 0.439... or 0.44 after correct working
14	$2^{\frac{15}{4}}$ or $2^{3.75}$	3	<p>B2 for 2^{15} or $2^{\frac{3}{4}}$ or $(2^3)^{5/4}$ or $3 \times \frac{1}{4} \times 5$ seen</p> <p>or</p> <p>B1 for [8 =] 2^3 or $8^{\frac{5}{4}}$ or $8^{1.25}$ seen</p>	Accept equivalences of $15/4$

Question		Answer	Marks	Part marks and guidance	
15	a	<p>e.g.</p> <p>300-450: $150 \times 70 = 10\,500$ [parcels]</p> <p>450-700: $250 \times 50 = 12\,500$ [parcels]</p> <p>[Zoe is] not correct oe</p>	4	<p>M2 for 150×70 and 250×50 or M1 for 150×70 or 250×50</p> <p>AND</p> <p>A1 for 10 500 or 12 500</p> <p>AND</p> <p>A1 10 500 and 12 500 and conclusion</p> <p><u>Alternative method. for example:</u> M1 for 150×70 soi by 10 500 A1 for 10 500</p> <p>AND</p> <p>M1 for <i>their</i> $10\,500 \div 250$ A1 for height of 450-700 bar is more than 42 so Zoe is not correct</p> <p>If 0 scored then SC2 for 10 500 and 12 500 with no method shown or SC3 for 10 500 and 12 500 with no method shown and correct conclusion</p>	For full marks, calculations must be shown, together with a conclusion. Allow other equivalent methods involving consistent area calculations.
	b	Bar of height 130 drawn for 50-100g	2	M1 for $6500 \div 50$ soi by 130	
	c	The weights of parcels may not be evenly distributed [between 200g and 300g] oe	1		e.g. uneven distribution of weights

Question		Answer	Marks	Part marks and guidance
16	a	50 nfw	4	<p>M3 for $ABC = 25$ or $B = 25$ or for $AOB = 150$ and $COB = 160$ or M2 for $ABO = 15$ and $CBO = 10$ or for $AOB = 150$ or for $COB = 160$ or M1 for $ABO = 15$ or $CBO = 10$</p> <p>If 0 scored, SC1 for $AOC = 2 \times [their] ABC$ stated or applied or for $360 - their\ AOB - their\ COB$ applied</p> <p><u>Alternative method to find $AOC = x$</u> M3 for $\frac{x}{2} + 2\left(\frac{180-x}{2}\right) + 15 + 10 = 180$ oe OR M1 for $OAC = OCA = \frac{180-x}{2}$ and M1 for $ABC = \frac{x}{2}$</p> <p><u>Alternative method to find $AOC = x$</u> M3 for $360 - x + 10 + 15 + \frac{x}{2} = 360$ OR M1 for [reflex] $AOC = 360 - x$ and M1 for $ABC = \frac{x}{2}$</p>

Throughout, angles could be on diagram

SC0 for angle at centre = $2 \times$ angle at circumference

Question	Answer	Marks	Part marks and guidance
	<p>e.g. $DEF = 180 - (43 + 55) = 82$ angles in a triangle $HDF = DEF = 82$ alternate segment theorem</p> <p>OR</p> <p>$GDE = 55$ alternate segment theorem $HDF = 180 - (43+55) = 82$ angles on a straight line</p>	4	<p>M2 for $[DEF =] 180 - (43 + 55)$ soi by $DEF = 82$ and angles in a triangle or M1 for $[DEF =] 180 - (43 + 55)$ soi by $DEF = 82$</p> <p>AND</p> <p>M2 for $HDF = DEF [= 82]$ and alternate segment theorem or M1 for $HDF = DEF [= 82]$</p> <p><u>Alternative method</u> M2 for $GDE = 55$ and alternate segment theorem or M1 for $GDE = 55$</p> <p>AND</p> <p>M2 for $[HDF =] 180 - (43 + 55) [= 82]$ and angles on a straight line or M1 for $[HDF =] 180 - (43 + 55) [= 82]$</p> <p>Allow full marks if 3 letter angle notation not used provided their angles are unambiguously defined (eg. labelled on the diagram and referred to in working using their labels)</p> <p>Note: $180 - (43 + 55)$ with no other creditable working or reasoning scores M1</p>
17	a	2	<p>B1 for a ray drawn through either point A and (6, 7) or point B and (2, 9)</p>
	b	2	<p>B1 for 2</p>
	c	2	<p>B1 for (4, k) or (k, 1)</p>

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