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 <u>using a correct method</u> and are not lost for purely numerical errors.
    A marks are for an <u>accurate</u> answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
    B marks are <u>independent</u> of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
    SC marks are for <u>special cases</u> 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 <u>not from wrong working</u> **full marks** should be awarded.

    Do <u>not</u> award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen <u>and</u> 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 × (*their* '37' + 16), or FT 300 − √(*their* '5^2 + 7^2'). Answers to part questions which are being followed through are indicated by eg FT 3 × *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.
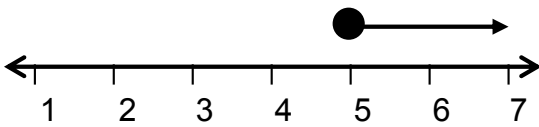
    -   **cao** means **correct answer only**.
    -   **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point eg 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
    -   **isw** means **ignore subsequent working** (after correct answer obtained).
    -   **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.   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			$x \geq 5$ AND 	4	**B2** for $x \geq 5$ as final answer or **M1** for $3x \geq 10 + 5$ or better AND **B2FT** for $x \geq 5$, or *their* inequality, correctly shown or **B1FT** for $x \geq 5$, or *their* inequality, shown with a correct circle and wrong arrow or wrong circle and correct arrow	Solution to inequality 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 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 *their* inequality Accept an arrow of any length or a line reaching 7 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**

Question			Answer	Marks	Part marks and guidance	
2			31 218	5	**M4** for $54868 - \frac{54868}{2.32}$ oe or **M3** for $\frac{54868}{2.32}$ soi by 23650 or 236.5 or **M2** for 2.32 or 232[%] soi or **M1** for 1.32 or 132[%] soi If **M1** only scored then also allow an **SC1** for $\frac{54868}{1.32}$ soi by 41566 to 41567	May be seen as $54868 \times \frac{132}{232}$ or 236.5×132 Examples of implied: 2.32 implied by [A =] 0.32B + 2B oe but not by 32[%] × B + 2B oe 1.32 implied by 0.32 + 1 but not by 32[%] + 1 nor 0.32 + 100[%]
3			$\frac{1}{27}$	3	**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[…]% or **B1** for $\frac{2}{6}$ oe If **0** scored then **SC1** for $(their\left(\frac{2}{6}\right))^3$ oe	$0 < their \left(\frac{2}{6}\right) < 1$
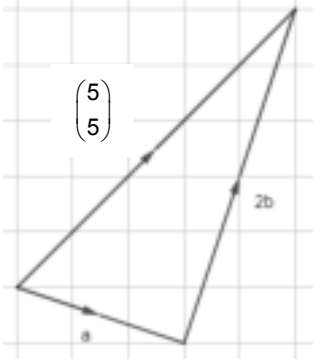
Question			Answer	Marks	Part marks and guidance	
4			80 nfww	5	**B3** for height [of B =] 10 OR **M2** for $3x^2$ = *their* (12 × 25) or better or **M1** for $3x × x$ oe or 300 seen **A1** for x = 10 AND **M1** for (2 × *their* 10) + (2 × 3 × *their* 10) oe or for $2a + 2b$ where ab = 300 but not with 25 and 12	May be seen on diagram May be implied by arithmetic processing e.g. $\sqrt{\dfrac{their\ (12 \times 25)}{3}}$ or at least two trials of 3 × number × number intending 300 Allow *their* 10 if clearly intended as height e.g. "h =" or marked on diagram e.g. **M1M1** for 2 × 36 + 2 × 8.3[3…] after 300 seen

Question	Answer	Marks	Part marks and guidance	

5	3.2 nfww	6	**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
			
			 AND
			
			 M2 for $\frac{their\ 1738.91 - 1500}{5 \times 1500}$ [× 100] oe
			
			 or
			
			 M1 for (*their* 1738.91 − 1500) ÷ 5
			 or for (*their* 1738.91 − 1500) ÷ 1500
			
			 Alternative (not using a base amount)
			 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
				Condone 3.2% as final answer
				 soi by 1738 to 1739
				
				 soi by [2 yr =] 1591[.35],
				            [3 yr =] 1639[.09..] or
				            [4 yr =] 1688.[26…]
				
				 their 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
				
				 M1 soi by 47.6[0] to 47.8[0] or
				       soi by [0].1586 to 0.1594

Question			Answer	Marks	Part marks and guidance	
6			43.75 or 43.8	**4**	**M3** for $\frac{7}{16}$ [× 100] OR **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 <u>Alternative method</u> **M3** for $\frac{7}{16}$ [× 100] or **M2** for 1 − ¾ × ¾ or ¼ + ¾ × ¼ or ¼ × ¼ + ¼ × ¾ + ¾ × ¼ or **M1** for ¾ x ¾ or ¾ × ¼ or ¼ × ¼	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 	6		-2	-3		1			2	**B1** for at least 2 correct values	
	b		Correct curve	3	**B2** for 6 or 7 points correctly plotted FT *their* table or **B1** for 4 or 5 points correctly plotted FT *their* 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><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>
	d		1.6 and 4.4	2FT	**B1** for each or both answers as decimals to a greater accuracy Correct answer or FT *their* 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		Condone use of h or other letter as height of pyramid
					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 or **M1** for $\frac{1}{3} \times 5 \times 5$ [$\times \frac{h}{2}$ or $\times h$] AND **A1dep** for [h or $\frac{h}{2}$ =] 3.6 or 7.2	**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 soi 8.3[3…] or $\frac{25}{3}$ **A1** dep on *their* **M2** 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**)
9	a		2.5 5	3	**B2** for [k =] 2.5 or **B1** for $\binom{4}{2}$ **B1** for [n =] 5	
9	b			1 1 1	Correct arrow and label $\binom{5}{5}$ or **a** + 2**b** Correct arrows on **a** and 2**b** Correct labels on **a** and 2**b**	Accept single arrowhead

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 × 6 − 15	
		ii	4.2 oe	3	**M2** for (6 + 15) ÷ 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 × 3.75 − 15 = 3.75	1		Must see calculation and answer
			Since $u_1 = u_2$, all terms are equal	1dep		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	**B1** for 5000 or 0.0022 seen and **M1** for figs 5 ÷ figs 22 oe soi by figs 2272 to 2273 and **M1** for figs (2272 to 2273) ÷ 60 soi by figs 37[….]	
	b		19.09 20.19	6	**B5** for 19.09 to 19.1 and 20.18 to 20.2 as final answers OR **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 and **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) and **A1dep** for 19.09 to 19.1 and 20.18 to 20.2 If **0** scored, allow **SC3** for one answer either 19.09 to 19.1 or 20.18 to 20.2	Allow 2.749[9…] for 2.75 or 53.49[9…] for 53.5 For **M2** ignore other unnecessary divisions e.g. 53.5 ÷ 2.75 and 52.5 ÷ 2.65 Dep on **M2**

Question			Answer	Marks	Part marks and guidance	
13			$\frac{29}{66}$ oe	**5**	**M4** for $\frac{2}{3} \times \frac{29}{44}$ OR **B1** for [p(black) =] $\frac{2}{3}$ oe soi and **B2** for $\frac{29}{44}$ or **B1** for $\frac{n}{44}$ with 0< n < 44 or **B1** for $\frac{29}{45}$ and **M1** for $\frac{2}{3} \times their \frac{n}{44}$ or $\frac{2}{3} \times \frac{29}{45}$	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**	**B2** for 2^{15} or $2^{¾}$ or $(2^3)^{5/4}$ or $3 \times \frac{1}{4} \times 5$ seen or **B1** for [8 =] 2^3 or $8^{\frac{5}{4}}$ or $8^{1.25}$ seen	Accept equivalences of 15/4

Question			Answer	Marks	Part marks and guidance	
15	a		e.g. 300-450: 150 × 70 = 10 500 [parcels] 450-700: 250 × 50 = 12 500 [parcels] [Zoe is] not correct oe	4	**M2** for 150 × 70 and 250 × 50 or **M1** for 150 × 70 or 250 × 50 AND **A1** for 10 500 or 12 500 AND **A1** 10 500 and 12 500 and conclusion Alternative method, for example: **M1** for 150 x 70 soi by 10 500 **A1** for 10 500 AND **M1** for *their* 10 500 ÷ 250 **A1** for height of 450-700 bar is more than 42 so Zoe is not correct 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	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 ÷ 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 nfww	**4**	**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
					
					If **0** scored, **SC1** for
					AOC = 2 × *[their]* ABC stated or applied
					or for 360 − *their* AOB − *their* COB applied
					
					Alternative method to find AOC = *x*
					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 = $\frac{x}{2}$
					
					Alternative method to find AOC = *x*
					M3 for 360 − x + 10 + 15 + $\frac{x}{2}$ = 360
					OR
					M1 for [reflex] AOC = 360 − *x*
					and
					M1 for ABC = $\frac{x}{2}$
						Throughout, angles could be on diagram
						
						SC0 for angle at centre = 2 × angle at circumference

Question			Answer	Marks	Part marks and guidance	
	b		e.g. DEF = 180 – (43 + 55) = 82 angles in a triangle HDF = DEF = 82 alternate segment theorem OR GDE = 55 alternate segment theorem HDF = 180 – (43+55) = 82 angles on a straight line	4	**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 AND **M2** for HDF = DEF [= 82] and alternate segment theorem or **M1** for HDF = DEF [= 82] <u>Alternative method</u> **M2** for GDE = 55 and alternate segment theorem or **M1** for GDE = 55 AND **M2** for [HDF =] 180 – (43 + 55) [= 82] and angles on a straight line or **M1** for [HDF =] 180 – (43 + 55) [= 82]	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) Note: 180 – (43 + 55) with no other creditable working or reasoning scores **M1**
17	a		(10, 11)	2	**B1** for a ray drawn through either point A and (6, 7) or point B and (2, 9)	
	b		−2	2	**B1** for 2	
	c		(4, 1)	2	**B1** for (4, k) or (k, 1)	

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