H

GCSE (9–1)

Mathematics

J560/04: Paper 4 (Higher tier)

General Certificate of Secondary Education

Mark Scheme for June 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 × (*their* '37' + 16), or FT 300 – $\sqrt{}$(*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.
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	Mark	Guidance
1			1.19	3	**B2** for 1.18[8…] or 1.189 or **B1** for 125 or 1.68 and **B1** for *their* answer seen to more than 3sf correctly rounded to 3sf (both rounded and unrounded values must be seen)
2			20	2	condone 1 : 20 for **2** marks **B1** for [50 :] 1000 oe or $\frac{1000}{50}$ ignoring units or answer with units e.g. 20g, 1g : 20g
3	(a)		$\frac{5}{36}$ or equivalent fraction	3	**M2** for $\frac{5}{3+4+5}\times\frac{1}{3}$ oe implied by e.g. [0].139, [0].1388…, 13.9%, 13.88..%, $\frac{1.\dot{6}}{12}$, $\frac{1.66[6.]}{12}$, $\frac{1.67}{12}$, $\frac{1.7}{12}$, $\frac{5/3}{12}$ or better OR **B1** for $\frac{5}{12}$ or equivalent fraction or $0.41\dot{6}$ or better OR **M1** for ($\frac{3}{3+4+5}$ or $\frac{4}{3+4+5}$) × $\frac{1}{3}$ or $\frac{1}{3}$ × 5 oe, implied by $1.\dot{6}$, 1.66[6…], 1.67 or 1.7 or better
3	(b)		4000	2	**M1** for 1600 ÷ 8 or (5+7+8) ÷ 8 implied by 200 or 2.5

Question			Answer	Mark	Guidance
4	(a)		11.37 [am]	4	**B3** for 11.37 pm or **B2** for listing the next 3 correct times of both buses. i.e.8.55, 9.13, 9.31 and 8.57, 9.17, 9.37 or **B1** for listing the next 3 correct times of one bus i.e. 8.55, 9.13, 9.31 or 8.57, 9.17, 9.37 Alternative method **B3** for 3 [h] (must be sure 3 is not minutes) or **B2** for [LCM=] 180 or answer 14 37 or 2 37 pm or **M1** for [18=] 2×3^2 or [20=] $2^2 \times 5$ allow in a tree diagram etc or [LCM=] $180k$ ($k \neq 1$) or **B1** for listing the next 3 multiples of 18 and 20 i.e. 36, 54, 72 and 40, 60, 80 See appendix for other methods **SC2** for answer 14 37 oe
4	(b)		accept any correct assumption e.g. buses keep to the timetable or there are no delays or there are no changes to the timetable or they do not cancel any buses	1	see the appendix for other comments, if there is more than one comment mark the best one providing there are no incorrect comments

Question	Answer	Mark	Guidance
5	9 16 32	**6**	allow any letter providing use is consistent this method assumes Ayesha's age = *a* **B4** for *a* + *a* + 7 + 2(*a* + 7) = 57 or better OR **B1** for [*b*=] *a* + 7 oe e.g. *a* = *b* – 7 **B1** for *c* = 2*b* oe e.g. $\frac{c}{2} = b$ or [*c* =] 2(*a* + 7) **B1** for *their'a'* + *their'b'* + *their'c'* = 57 e.g. *a* + *b* + *c* = 57 must be algebraic AND **M1FT** for correctly solving *their* linear equation in one variable e.g. 4*a* = 36 and *a* = 9 AND **M1** for substituting *their a* into *b*= *a* + 7 and *c* = 2*b* e.g. *a* = 8, *b* = 15 and *c* = 30 implied by *their* answer which must be integers see appendix for other methods mark working first, if **0** scored then **SC2** for 2 answers correct in the correct place or **SC1** for 1 answer correct in the correct place or if **1** scored then award the better of 1 or **SC2** for 2 answers correct in the correct place to a maximum of 5 marks

Question			Answer	Mark	Guidance
6			[Year 10] [left]17 and [total] 61 [Year 11] [left] 20 and [total] 59 **and** a comparison such as there are more Year 11 left-handers [than Y10] and there are fewer Year 11s [than Y10] in total or two comparable figures e.g. $[\frac{17}{61}=]$ .28 or .279 or .27[8…] or 28% or $\frac{1003}{3599}$ oe $[\frac{20}{59}=]$ .34 or .339 or .33[8…] or 34% or $\frac{1220}{3599}$ oe **and** conclusion e.g. Y11	6	**B5** for [Year 10] 17 with 61, and [Year 11] 20 with 59 (eg as fractions, or "out of") and **B1** for a comparison and conclusion e.g. two comparable figures or a statement such as "there are more Year 11 left-handers [than Y10] and there are fewer Year 11s [than Y10] in total ……." or the following marks may be seen in their working or in the table **B4** for [Year 10] 17 with 61 **and** [Year 11] 20 with 59 or **B3** for [Year 10] 17 with 61 **or** [Year 11] 20 with 59 or **B2** for 17 or both 37 and 59 or **B1** for 37 or 59 if percentages used we must see % sign or use "out of 100 people …"

Question			Answer	Mark	Guidance
7			109 or 108.8 to 108.9	6	*figures and working may be on diagram* **B1** for [radius of circle =] 9 **B1** for [AB or ED =] 32 soi by 41 – *their* 9 **M1** for $\frac{1}{4}$ × 2 × π × *their* 9 soi by $\frac{9\pi}{2}$,14.1 or 14.13 to 14.14 **M2** for $\sqrt{(their\,9)^2 + (their\,9)^2}$ soi by $9\sqrt{2}$, 12.7[2…] or 12.73 or **M1** for (*their* 9)^2 + (*their* 9)^2 soi by 162 **M1** for *their* 12.72… + *their* 14.1 + 2 × *their* 32 + 18 seen to a maximum of **5** marks
8	**(a)**		Rotation or enlargement [centre] (¯1, 0) 180° [centre] (¯1, 0) [sf] -1	**1** **1** **1**	double transformation scores **0, 0, 0** must be coordinates, condone missing final bracket ignore direction
8	**(b)**		Reflection *x* = 5	**1** **2**	double transformation may only score **B1** below **B1** for drawing line *x* = 5 or for a correct mirror line of *their final image*, not *x* = 3, drawn or written or for a correct final image or a correct follow through translation of the reflection of *their object* or the correct reflection of *their object*
9	**(a)**		*a*, A, [angle] BAC or [angle] CAB corresponding	**1** **1**	not numbers Condone misspellings e.g. correspondent but not F angles. Any longer reasons must be correct and complete.
9	**(b)**		angle BCD = *b* or ABC or CBA alternate angle[s] [on a] line [add to 180]	**1** **1** **1**	allow written on the diagram not Z angles condone ‘straight line’

Question			Answer	Mark	Guidance
10			2 602.02 cao	**4**	**B3** for 27 602.02 soi by 2 602[.02…] as final answer or **M2** for 25 000 × $(1.02)^5$ oe implied by 27 602[.02…] see appendix or **M1** for 25 000 × $(1.02)^k$ oe implied by 26 010 ($k \neq 5$ and $k \geq 2$) see appendix
11			[55.5 ÷ 9.25 or 9.24$\dot{9}$ =] 6	**4**	6 must not come from a rounded answer **B1** for 55.5 **B1** for 9.25 condone 9.2499 or better **M1** for *their* 55.5 ÷ *their* 9.25 (55.5 ≤ *their* 55.5 ≤ 56.5 and 9.15 ≤ *their* 9.25 ≤ 9.25)
12	**(a)**		$5n - 6$ or $-1 + 5(n - 1)$ oe	**2**	condone + −6 etc for **2** marks **B1** for $5n + c$
12	**(b)**		[a =] 6 [b =] −15	**5**	**B1** for $3^2a + 3b = 9$ or better **B1** for $6^2a + 6b = 126$ or better **M1** for equating the coefficients of a variable, e.g. $18a + 6b = 18$, allow one numerical error **M1** for correctly eliminating one variable, e.g. $18a = 108$, allow one numerical error allow any correct method

Question			Answer	Mark	Guidance
13	(a)	(i)	172	1	
13	(a)	(ii)	16 to 17	2	**B1** for 160 or 176 to 177 (may be written or indicated on graph, not just a line through it)
13	(a)	(iii)	16.6 to 16.7 or 17	3	**B2** for [0].83[3…] or 83[.3…]% or [0].166… or [0].167 or [0].17 OR **B1** for 100 (from graph) or 20 **M1** for $\frac{their100}{120}$ [× 100] or $\frac{their20}{120}$ [× 100]
13	(b)		76.5 or 77 and 102 or both 28 (or 14+14) and 74 Swimming club has a median in group 160 to 170 oe [Rowing club has median *their* 172] So rowing club [has higher median] oe **FT** *their* **(a)(i)** for conclusion	5	**B1** for 76.5 or 77 **M2** for 20 × 1.4 and 10 × 7.4 soi by 102 or both 28 (or 14+14) and 74 or **M1** for 20 × 1.4 or 10 × 7.4 soi by 28 (or 14+14) or 74 Accept any correct alternative methods (e.g. 5 squares = 1 person) **B1** for [swimming club has a median in group] 160 to 170 oe e.g. "≤ 170" (if they use a proportional calculation answer 166 to 167) **A1dep** on previous 4 marks for "rowing club [has higher median"] oe **FT** *their* **(a)(i)** for conclusion
14	(a)		12	1	condone "greater than 12" or "> 12"
14	(b)		Acceleration is constant oe	1	see appendix for acceptable answers
14	(c)		15.8[3…] or 16 if no evidence of incorrect working	5	**M1** for attempt to find an area under the graph (eg $\frac{1}{2}$ × 15 × 20) soi by e.g. 150, 700, 100 or 950 **M2** for $\frac{1}{2}$ [(50 – 15) + 60] × 20 oe or 950 or **M1** for a total area attempt with one error **M1dep** for *their* 950 ÷ 60, dep. on attempt at total area under graph
Question			Answer	Mark	Guidance

15			Accept any correct justification e.g. two of OC = **a** + 2**b** OD = 2**a** + 4**b** CD = **a** + 2**b** and correct conclusion e.g. OD = 2(**a** + 2**b**) = 2OC or OD is a multiple of OC or OC = CD (must be consistent with vectors found)	**5**	**B1** for [AB =] 3**b** – 3**a** oe **M1** for each of e.g. OC = 3**a** + $\frac{2}{3}$ (3**b** – 3**a**) oe soi by **a** + 2**b** OD = 3**b** + 2**a** + **b** oe soi by 2**a** + 4**b** CD = $\frac{1}{3}$(3**b** – 3**a**) + 2**a** + **b** oe soi by **a** + 2**b** to a maximum of **M2** and may be on diagram and condone notation OCD for OD only **M1** for [OD =] 2(**a** + 2**b**) or 2OC = OD or OC = CD and must be consistent with vectors found If **0** scored **M1** for any correct route leading to OC, CD or OD e.g. OC = OB + BC
16	**(a)**		any correct method e.g. two of [$y \times \sqrt{x}$ =] 6 × $\sqrt{4}$ = 12, 3 × $\sqrt{16}$ = 12, 2 × $\sqrt{36}$ = 12 oe or use one pair to find $y = \frac{12}{\sqrt{x}}$ and check with another pair	**2**	accept 6 for $\sqrt{36}$ etc **M1** for correct method with one error or omission or uses $y = \frac{k}{\sqrt{x}}$ to find k = 12 or one of [$y \times \sqrt{x}$ =] 6 × $\sqrt{4}$ = 12, 3 × $\sqrt{16}$ = 12, 2 × $\sqrt{36}$ = 12 alternative method : show x is × 4 and × 9 and y is ÷ 2 and ÷ 3.
16	**(b)**		$a = \frac{60}{b^2}$ oe	**3**	condone answer of $a \propto \frac{60}{b^2}$ for **2** marks or **M1** for $a = \frac{k}{b^2}$ oe implied by $3.75 = \frac{k}{4^2}$ **B1** for [k =] 60
17			[$(a^3)^{-\frac{1}{3}}$ =] a^{-1} or $\frac{1}{a}$ [$(a^2)^{\frac{1}{2}}$ =] $a^{[1]}$ or $\frac{a^{[1]}}{1}$ $\frac{1}{a}$ × a or a^0 or $\frac{a}{a}$ [= 1]	**1** **1** **1dep**	condone x etc instead of a but not numbers only **dep** on both previous marks
Question			**Answer**	**Mark**	**Guidance**

18			Three correct lines and region R correctly labelled with an 'R' or unambiguous wording or shading	**6**	**B1** for line $y = 3$ and **B1dep** indicates correct side **B1** for line $y = x$ and **B1dep** indicates correct side **B1** for line $x + y = 9$ and **B1dep** indicates correct side to a maximum of 5 marks Condone good freehand lines, which can be dashed or solid. Mark the region which is labelled, but if no labelling mark the single region which is shaded (or unshaded). Condone regions that are just in the first quadrant. Region mark depends on the line being a close attempt. Note : lines need only be one square long for line mark but they must be fit for purpose to define their region up to the intersections and the *y*-axis.
19			−3.19 [0].52 with some correct algebraic working	**4**	**M2** for correct substitution into the formula, allow one error e.g. $\frac{-8 \pm \sqrt{8^2 - 4 \times 3 \times -5}}{2 \times 3}$ or for e.g. $3[(x + \frac{8}{6})^2 - (\frac{8}{6})^2] - 5 = 0$ oe and $x = \sqrt{\frac{5}{3} + (\frac{8}{6})^2} - \frac{8}{6}$ oe or better or **M1** for correct substitution into the formula, allow two errors or for e.g. $3[(x + \frac{8}{6})^2 - (\frac{8}{6})^2] - 5 = 0$ oe or better and **A1** for −3.19 or [0].52 or for both solutions correct but to more than 2dp. e.g. −3.189254… or 0.522588….. If **0** scored allow **SC1** for two correct answers with no correct algebraic working.

APPENDIX

Question 4(a)

Alternative method :
B1 for $18x = 20y$
B1 for $x = 10$ $y = 9$
M1 for [8 37 +] $\frac{10\times18}{60}$

Exemplar responses for Q4(b)

Response	Mark
buses keep to the timetable	**1**
buses arrive/leave on time	**1BOD**
there are no delays	**1**
there are no unexpected stops	**1**
they follow the same routes each time	**1**
there are no changes to the timetable/ they keep to the timetable	**1**
they do not cancel any buses	**1**
no buses break down	**1**
there is no bad/heavy traffic	**1**
there is no traffic	**0 not enough**
buses are travelling at constant speed	**0**
buses stop to recharge/ refuel or collect passengers	**0**

Question 5 alternatives

e.g. assumes Bennie's age = *b*
B4 for *b* – 7 + *b* + 2*b* = 57 or better
OR
B1 for [*a* =] *b* – 7 oe e.g. *b*= *a* + 7

B1 for [*c* =] 2*b* oe e.g. $\frac{c}{2} = b$ or *c* = 2(*a* + 7)

B1 for *their'a'* + *their'b'* + *their'c'* = 57 e.g. *a* + *b* + *c* = 57 must be algebraic

AND

M1FT for correctly solving *their* linear equation in one variable e.g. 4*b* = 64 and *b* = 16
AND

M1 for substituting *their b* into *a* = *b* − 7 and $\frac{c}{2} = b$ e.g. *a* = 8, *b* = 15 and *c* = 30 implied by *their* answer which must be integers

e.g. assumes Chloe's age = *c*

B4 for $\frac{c}{2}$ − 7 + $\frac{c}{2}$ + *c* = 57 or better

OR

B1 for [*a*=] $\frac{c}{2}$ − 7 oe e.g. *c* = 2(*a* + 7)

B1 for [*b*=] $\frac{c}{2}$ oe e.g. *c* = 2*b* or *b* = (*a* + 7)

B1 for *their'a'* + *their'b'* + *their'c'* = 57 e.g. *a* + *b* + *c* = 57 must be algebraic

AND

M1FT for correctly solving *their* linear equation in one variable e.g. 2*c* = 64 and *c* = 32
AND

M1 for substituting *their c* into *b* = $\frac{c}{2}$ and *a* = $\frac{c}{2}$ − 7 e.g. *a* = 8, *b* = 15 and *c* = 30 implied by *their* answer which must be integers

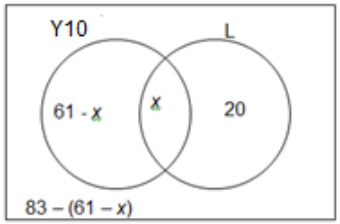
Question 6 alternatives

e.g. use of table

	L	R	
Y10	17		61
Y11	20		59
	37	83	120

or

e.g. use of Venn diagram



61 – x + x + 20 + 83 – (61- x) = 120 oe

x = 17

M1 for Venn Diagram with elements as shown oe

A1 for *their* x = 17

Question 10

Year on year method

working	total	interest	year
25000 × 1.02	25500	500	year 1
25500 × 1.02	26010	510	year 2
26010 × 1.02	26530.2	520.2	year 3
26530.2 × 1.02	27060.804	530.604	year 4
27060.806 × 1.02	27602.020085	541.216	year 5

values without working correct to 3 sf imply method

Exemplar responses for Q14(b)

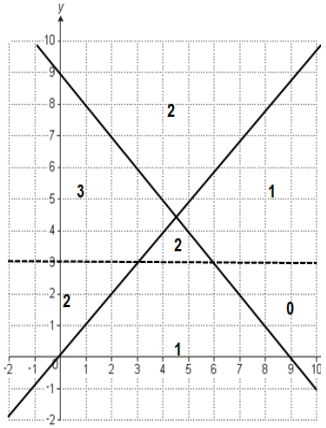
Response	Mark
Acceleration is constant	**1**
[Speed] increases by the same amount each time	**1**
It accelerates most over the first 15 seconds	**1 BOD**
Increasing [its speed]	**1 BOD**
steadily increasing pace	**1**
It is steady	**0**
[Speed] is constant	**0**
Increasing acceleration	**0**

Question 14(c)

950 scores **3** marks.

Question 18

Marks for regions if all lines are correctly drawn.
The line x + y = 9 must go very close to one of the points (0,9) or (9,0) to score its region mark after awarding B0 for that line.



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