H

GCSE (9–1)

Mathematics

J560/05: Paper 5 (Higher tier)

General Certificate of Secondary Education

Mark Scheme for June 2019

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

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 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.

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 – √(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.

   - **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			8×10^7 final answer	2	**M1** for ans figs 8 or for ans $k \times 10^7$ where $0 < k < 10$	
2	(a)		$6a^{11}$	3	**B2** for answer ka^{11} or $\frac{6a^{13}}{a^2}$ or $6 \times a^6 \times a^5$ or $6 \times a^8 \times a^3$ shown in working OR **B1** for answer $6a^k$ or ka^{13} or for $3a^8 \times 2a^3$ or $3a^6 \times 2a^5$ shown in working	
	(b)		2.5 or $2\frac{1}{2}$ or $\frac{5}{2}$	3	**M1** for correct first step e.g. $6x - 10 = 5$ **M1** for $6x = 5 + 10$ FT their first step or for FT their $ax = b$ to $x = \frac{b}{a}$	Do not accept $\frac{15}{6}$ as final answer but allow to imply M1M1 Embedded answer scores M2 max where $\frac{b}{a}$ is a simplified fraction (improper or mixed number) or an integer e.g. M1 for $6x = 1$ leading to $x = \frac{1}{6}$
3	(a)		40	3	**M2** for $\frac{1.68 - 1.20}{1.20}$ [× 100] **oe** Or **M1** for $\frac{1.68}{1.20}$ **oe** or for 1.68 – 1.20 **oe**	eg $\frac{48}{1.20}$ or $\frac{48}{120}$ or 0.4 For M1 accept 168 – 120 oe eg 48 M1 implied by 1.4 or 140
	(b)		450	3	**M2** for 360 ÷ 0.8 **oe** or **B1** for 0.8[0] **oe** seen or for 360 associated with 80% **isw**	For B1 0.8 oe seen allow fraction but not just for 80%

Question			Answer	Marks	Part marks and guidance	
4	(a)		7	3	**B2** for 6.5 or $6\frac{1}{2}$ **oe** or **M1** for $\frac{\text{their } (106-80)}{4}$ **oe**	For M1 accept attempted repeated subtraction from 106 to 80 or from 26 to 0 or repeated addition of 4 from 80 to 106 or from 0 to 26 condone 1 error At least 4 correct additions or subtractions needed soi FT one error
	(b)		Fewer days **oe**	1		e.g. smaller, less, days would be shorter, would decrease, ignore reference to numbers of days if lower
5	(a)		Four points correctly plotted	2	**B1** for 2 or 3 correct plots	Mark in 70% zoom, use overlay, points inside or touching circles
	(b)		Negative Strong	1 1		Do not accept description of relationship Accept moderate, medium etc, but not weak
	(c)		Point at (4, 3.4) indicated only	1		
	(d)		Ruled line of best fit **and** answer FT their line ± 100	2	**B1** for ruled line of best fit or for answer FT their line with negative gradient	Use overlay for LOBF, ruled line should be as long as the zone and should not cross the longer sides of the zone Not for e.g. 6.4 thousand

Question			Answer	Marks	Part marks and guidance	
	(e)		Only have data on cars up to 12 years old **oe** **or** Equation of line of best fit would give a negative value or zero **oe**	**1**		e.g. the trend may not continue It would give a negative cost Outside range of data provided oe The price would be below zero The price would be zero oe See AG Do not accept 16 is not on the graph The graph does not go to 16 Ignore incorrect statements
6	**(a)**		$\frac{3}{7}, \frac{3}{7}, \frac{4}{7}, \frac{3}{7}$ correctly placed	**2**	**M1** for 2 or 3 probabilities correctly placed	Accept equivalent fractions, decimals or %s (3 figures needed for dec or %)
	(b)		$\frac{16}{49}$ **oe**	**2**	**M1** for $\frac{4}{7} \times \frac{4}{7}$ **oe**	isw cancelling/conversion to other forms

Question			Answer	Marks	Part marks and guidance	
7			173.4[0]	6	**M1** for evidence at some stage of intention to find the total ticket cost of 2 adults + 1 child (e.g. soi by 200 or 170) AND **M2** for complete method to reduce any valid ticket price or combination by 15% (eg full attempt at 85% or 100% – 15%) isw or **M1** for complete method to find 15% of a valid ticket price or combination isw AND **M2** for complete method to increase their ticket cost by 2% or **M1** for complete method to find 2% of their ticket cost	This may be at the start or later if calculating individual ticket prices and payments even if errors in the prices Working with just an individual ticket price will be M2M2max) Valid ticket price combinations are e.g. 40, 80, 120, 160, 200 "Complete method" means it would lead to a correct answer if not for arithmetic slips. M2 may be implied by e.g. 170, 34, 68, 102, 136 M1 may be implied by e.g. 30, 6, 12, 18, 24 May be from an original "valid ticket price or combination" or from a calculated sale price. The 2% increase and 15% decrease can be done in either order but if the15% decrease is done first with the original price the 2% increase must be done with their sale price and vice versa

Question			Answer	Marks	Part marks and guidance	
8			10	5	**B4** for $\frac{120}{11}$ **oe** or for $\frac{110}{30}$ **oe and** $\frac{121}{30}$ **oe** or **B3** for $\frac{110}{30}$ **oe or** $\frac{121}{30}$ **oe** OR **B2** for $\frac{11}{30}$ **oe** or **M1** for $\frac{1}{6}+\frac{1}{5}$ or for $\frac{5}{30}$ **and** $\frac{6}{30}$ seen **M1** for 4 ÷ their $\left(\frac{1}{6}+\frac{1}{5}\right)$ **oe**	For B4 accept 10.9… or 3.66 to 3.67 and 4.03... For B3 accept 3.66 to 3.67 or 4.03... 0.366 to 0.367 or 36.6% to 36.7% For M1 intention to add the fractions eg use of 0.16 to 0.17 + 0.2 oe percentages e.g. $4 \div (0.16 \text{ to } 0.17 + 0.2)$ oe NB can score B2 M1 or M1M1
9	(a)		1 : 5	2	**B1** for [1]k : 5k with both values numeric	e.g. B1 for 0.2 : 1, 30: 150
	(b)		30 , 75 , 75 and 30, 30, 120	4	**B3** for 30, 75, 75 or 30, 30, 120 or **B2** for p = 30 or **M1** for 180 ÷ (1 + 5) FT their (a) If 0 scored, **SC2** for 150, 15, 15	Accept each set in any order Could be on diagram
10	(a)		$0.1\dot{6}$ final answer	2	**B1** for 0.16….	Accept unambiguous alternate notation for the recurring decimal e.g. B1 for 0.166, 0.168, $0.\dot{1}\dot{6}$

Question			Answer	Marks	Part marks and guidance	
	(b)		She is correct **oe** OR She is not correct **oe** AND 7 [and] 45 **and** 14 [and] 90 or 14 [and] 90 **and** 14k [and] 90k shown	**4**	**B3** for $\frac{7}{45}$ **and** $\frac{14}{90}$ or for $\frac{14}{90}$ **and** $\frac{14k}{90k}$ or **B2** for $\frac{14}{90}$ **oe** fraction or **M1** for 1.5... [× 10^n] **and** 15.5… [× 10^n] **seen**	For 4 marks there must be no incorrect fractions shown Accept yes for she is correct and no for she is not correct Where k is a positive integer For B2 and B3 accept as pairs of values instead of fractions Where n is an integer e.g. allow M1 for 0.15… and 1.5… or for 15.5.. and 155.5…
11	**(a)**		$10\sqrt{2}$ final answer	**2**	**B1** for $2\sqrt{50}$ or $5\sqrt{8}$ or for correct answer seen then spoiled	
	(b)		2	**1**		
12	**(a)**		$\frac{x+2}{3}$ or $\frac{x}{3}+\frac{2}{3}$ final answer	**2**	**M1** for y + 2 = 3x or x + 2 = 3y or for x = 3y – 2 or for $[x=]\frac{y+2}{3}$ If 0 scored, **SC1** for answer y = $\frac{x}{2}-7$	For 2 marks, condone answer $y=\frac{x+2}{3}$ Allow M1 for correct reverse flowchart with arrows reversed ← ÷ 3 ← + 2 ←

Question			Answer	Marks	Part marks and guidance	
	(b)		−5	**5**	**M3** for 2(3x – 2 + 7) = 4x **oe** or $\frac{2x-7+2}{3}=x$ **oe** or **M2** for 2(3x – 2 + 7) **oe seen or** $\frac{2x-7+2}{3}$ **oe seen** or **M1** for 3x – 2 or 3x + 5 **oe seen** or 2x – 7 or 2x – 5 **oe seen** **M1dep** for correct rearrangement of their eqn with at least 2 terms in x to ax + b = 0 or better	For method marks, condone inclusion of multiplication signs Method must be seen in working space for part (b) If brackets omitted then allow recovery for method For M3 eg 2x – 7 = 3x – 2 M1dep on at least M1 earned previously e.g. 2(3x – 2) + 7 [= 4x] scores M1 and then can earn M1 dep if they then correctly rearrange to ax = b
13			It should be a curve with increasing gradient oe It should go through (0, 1)	**1** **1**		Accept alternate forms e.g. correct sketch See AG Incorrect statements treat as choice. Incomplete statements ignore

Question			Answer	Marks	Part marks and guidance	
14						Allow any unambiguous labelling for angles e.g. ABC or ABE or B, but not E
			Angle BEA = angle CED and [vertically] opposite Angle DAB = angle ADC and alternate Angle ABC = angle DCB and alternate	**M2**	For **M2** only two of the three statements and reasons are required **M1** for one pair of angles with a reason	Accept 3rd angle in triangle oe for reason with final angle Condone spelling e.g. alternating but not alternative
			[Triangle ABE is similar to triangle CDE] [corresponding] angles are equal **oe**	**A1**	With no errors or incorrect statements seen If 0 scored, **SC1** for at least two correct pairs of angles identified with no / incorrect reasons	For oe allow e.g. AAA Condone identified on diagram for **SC1**

Question			Answer	Marks	Part marks and guidance	
15			$\frac{x}{360} \times \pi \times 6^2$ or $\frac{[\pi\times]6^2}{[\pi\times]6}$ or shows $\pi \times 6^2$ and $\frac{1}{6}$ oe	M1	Accept 36 for 6^2	x = angle AOX , condone any variable used For M1 may be seen in stages e.g. M1 for $36\pi \div 6$
			$\frac{x}{360}[\times\pi] \times 6^2 = 6[\pi]$ or 360 ÷ 6	M1dep	Dep on previous M1	
			[x =] 60	A1		Must earn M1M1 before awarding A1
			$\frac{AX}{6} = \sin$their 60 **oe**	M1	Dep on 0 < their 60 < 90 Accept use of cos 30 or cos 60 and Pythagoras' or sine rule with 90	Do not accept assumption that OX = 3 without any evidence
			AX = $6 \times \frac{\sqrt{3}}{2} = 3\sqrt{3}$ or $\frac{3\sqrt{3}}{6} = \frac{AX}{6}$, AX = $3\sqrt{3}$	M2	or **M1** for $\sin 60 = \frac{\sqrt{3}}{2}$ or $\cos 30 = \frac{\sqrt{3}}{2}$ To award 6 marks, there must be no errors seen	Beware circular methods using $3\sqrt{3}$ leading to 60, this can only score M1 maximum for $\sin 60 = \frac{\sqrt{3}}{2}$ but ignore circular methods if alongside a correct method

Question			Answer	Marks	Part marks and guidance	
16	(a)		[Angle DCB =] 180 – 112	M1	Must show the subtraction	Must not be associated with wrong angle
			[Opposite angles in a] cyclic quadrilateral [are supplementary] **oe**	M1		Do not accept any incorrect statement e.g. opposite angles in a cyclic quad are equal, angles of a cyclic quad = 180. Condone issues with spelling provided clear
			[Angle BCO =] 68 – 33 = 35	M1	Must show the subtraction	Must not be associated with wrong angle If [angle BCO =] 180 – 112 – 33 is shown this implies first M1 and third M1
			y = 35 and [triangle BOC =] isosceles with no incorrect statement	M1		For M1 must mention isosceles with y = 35 stated not just shown on the diagram
16	(b)		55	B1		
			Angles in triangle [BOC sum to 180] **oe**	M1	Accept [triangle BOC =] isosceles	Accept triangle and 180 without 'angle'
			Angle at circumference is half angle at centre **oe**	M1		Must use correct terminology, angle, circumference, half oe (or double oe), centre. Accept arc for circumference If more than 2 reasons given then treat each extra reason as choice
17	(a)		$(x + 4)^2 – 13$ final answer	3	**B1** for $(x + 4)^2$ **B2FT** for [+] 3 – their $(a)^2$ after $(x +$ their $a)^2$ correctly evaluated or **B1** for [+] 3 – their a^2 shown If 0 scored, **SC2** for final answer $(x + 4) – 13$	FT can be implied eg $(x + 2)^2 – 1$ gets B2FT

Question			Answer	Marks	Part marks and guidance	
17	(b)		U shaped parabola with minimum value indicated in 3rd quadrant at (–4, –13) and intercepts positive y – axis at 3	4	**FT** U-shaped parabola with turning point at their (– a, – b) from part (a) dep on answer of form $(x + a)^2 – b$ where $a \neq 4$ and/or $b \neq 13$	Be generous for the U shape condone broken line TP values must be shown but could be marked on axes. Mark intention Sketch takes priority when marking Accept turning point = (– 4, –13) written in working or in table provided no contradiction on sketch
					B1 for U shape curve	
					B1 for their curve or line intercepts positive y – axis at 3	Must be stated on graph, 3 or (0, 3) Do not accept just in a table
					B1 for turning point at (– 4, k) or FT for turning point at (–a, k) dep on answer of form $(x + a)^2 – b$ in part (a)	If point (– 4, –13) only plotted on graph and no sketch then can score these final 2 marks
					B1 for turning point at (k, –13) or FT for turning point at (k, –b) dep on answer of form $(x + a)^2 – b$ in part (a)	
						If more than one graph drawn treat as choice

Question			Answer	Marks	Part marks and guidance	
18			$\frac{12}{132}$ **oe**	6		Accept dec or % equivalents (3 figures) 0.0909… or 9.09… % isw cancelling, conversion to other forms
					M5 for $\frac{4}{12} \times \frac{3}{11}$	
					or **B4** for $\frac{4}{12}$ **seen**	Do not accept $\frac{2}{6}$ alone For B4 accept $\frac{1}{3}$ provided it does not come from $\frac{2}{6}$ alone
					or **B3** for train [only] = 8**,** train and car = 4	
					or **B2** for train and car = 4	
					or **M1** for 12 + 6 + 7 – 21 **oe**	
					OR	
					B2FT for correctly completed Venn diagram with 12 – x, x [their 4], 6 – x, 7 correctly placed FT their x (can be algebraic or x is an integer $0 < x \leq 14$) or **B1FT** for attempt at Venn diagram with 12 – x or 6– x or 7 correctly placed FT their x (can be algebraic or x is an integer $0 < x \leq 14$)	For B2 and B1, condone no rectangle around Venn diagram
					M1 for $\frac{k}{n} \times \frac{k-1}{n-1}$	where k < n and n < 21
					If 0 scored, **SC1** for $\frac{k}{n} \times \frac{k}{n}$ **soi**	where k < n and n < 21

Question			Answer	Marks	Part marks and guidance	
19	(a)		1.7 **cao**	**1**		Mark at most accurate i.e. do not allow 1.65 = 1.7
	(b)	**(i)**	[a =] –5 [b =] 4	**2**	**B1** for each or for –5x + 4 seen	
		(ii)	Correct line ruled on grid	**M2**	**Strict FT** y = their ax + their b **M1** for correct y–intercept (**FT** their b) or correct gradient (**FT** their a) or for freehand or broken 'correct' line **FT** y = their ax + their b or for at least 3 correct plots and no incorrect plots **FT** y = their ax + their b	For M2 line must cross curve For M2 or M1, accuracy ± 1 small square at y – intercept (extend line if necessary provided it fits on the grid) and gradient ± 1 small square vertically for a run of 1 unit horizontally Do not follow through if a = 0 and/or b = 0
			1.1 or 1.2	**A1**		Only award if M2 scored previously

APPENDIX

Exemplar responses for Q5e

	Response	Mark
1	The line of best fit would hit zero before 16 years old and a car is always worth something	**1**
2	16 years is off the scale so the estimate would be inaccurate as the correlation may change (Ignore insufficient first part – this gets it for the final part underlined)	**1**
3	No data for a car 16 years old	**1**
4	The equation will give a negative value	**1**
5	Data is only provided for cars up to 12 years old, so we don't know beyond that	**1**
6	Should not extrapolate beyond 12 years	**1**
7	Car prices will never be zero BOD	**1**
8	Rate of value loss may not be constant (BOD trend does not continue)	**1**
9	16 years is not on the graph	**0**
10	Worth is not decreasing at a standard rate, it is fluctuating	**0**
11	Graph only goes to 12 years and it is less likely cars will be 16 years old	**0**
12	Starts to curve off which is not shown on the graph	**0**
13	Just an average, depends on the condition, mileage etc	**0**
14	Extrapolated	**0**
15	Line of best fit won't reach	**0**

Exemplar responses for Q13

	Response	Mark
1	It should be a curve It should start at 1 not 0	0 0
2	It should start at 1 on the y – axis It should be an exponential curve	1 0
3	Correct sketch shown of curve passing through 1 on y – axis	2
4	It should not start at 0 It should curve up	0 1
5	5^0 = 1 not 0 so y -values should increase by 1 Line should curve sharply upward	1 1
6	Put numbers on axes Make gradient steeper	0 0
7	Graph should be steeper not directly proportional	0
8	As increases, y increases even more The graph should start above 0 and $5^0 = 1$ BOD above implies starts at y = 1 on y axis	0 1

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553