OCR
Oxford Cambridge and RSA

H

GCSE (9–1)

Mathematics

J560/06: Paper 6 (Higher tier)

General Certificate of Secondary Education

Mark Scheme for November 2021

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 available in RM Assessor. These **must** be used whenever appropriate during your marking.

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
BP	Blank page
SEEN	Seen

For a response awarded zero (or full) marks a single appropriate annotation (cross, tick, M0 or ^) is sufficient, but not required.
For responses that are not awarded either 0 or full marks, you must make it clear how you have arrived at the mark you have awarded and all responses must have enough annotation for a reviewer to decide if the mark awarded is correct without having to mark it independently.

It is vital that you annotate standardisation scripts fully 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. 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 e.g. 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**.
   - **soi** means **seen or implied**.
   - **dep** means that the marks are **dependent** on the marks indicated. You must check that the candidate has met all the criteria specified for the mark to be awarded.
   - **with correct working** means that full marks **must not** be awarded without some working. The required minimum amount of working will be defined in the guidance column and **SC** marks given for unsupported answers.

3. 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.

4. Unless the command word requires that working is shown and the working required is stated in the mark scheme, 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, i.e. incorrect working is seen and the correct answer clearly follows from it.

5. 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. 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.

   Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, e.g. FT 180 × (*their* '37' + 16), or FT 300 – √(*their* '52 + 72'). Answers to part questions which are being followed through are indicated by e.g. FT 3 × *their* (a).

6. In questions **with no final answer line**, make no deductions for wrong work after an acceptable answer (i.e. **isw**) unless the mark scheme says otherwise, indicated by the instruction 'mark final answer'.

7. In questions **with a final answer line and incorrect answer given**:

   (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 if there is no other method leading to the incorrect answer. 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. A correct step, value or statement that is not part of the method that leads to the given answer should be awarded **M0** and/or **B0**.

   (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 marks for the poorer response 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 marks for the poorer response 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. If a candidate corrects the misread in a later part, do not continue to follow through, but award **A** and **B** marks for the correct answer only.

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. If in any case the mark scheme operates with considerable unfairness consult your Team Leader.

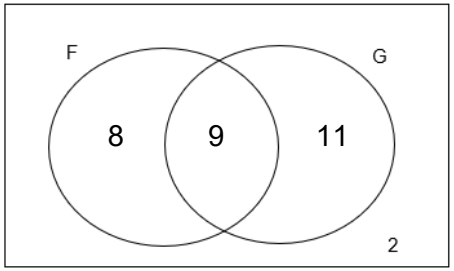
Question			Answer	Marks	Part marks and guidance	
1	(a)		5120	1		
	(b)		Topozero, Tana, Mweru, Ladoga, Victoria or 986, 3200, 5120, 18 100, 68 900 oe in standard form	2	**B1** for Topozero as smallest or Victoria as largest or all in correct reverse order	9.86×10^2, 3.20×10^3, 5.12×10^3, 1.81×10^4, 6.89×10^4 condoning superfluous zeros and slip in index
	(c)		1.5×10^4 nfww isw	4	**B3** for 15000 oe or $1.49[0..] \times 10^4$ or **B2** for 14900 oe or **M1** for figs 181 – figs 32 If **0** scored **SC1** for *their* value correctly rounded to 2 significant figures	eg 15000 may be 15×10^3 Subtraction may be implied by figs 15 or figs 149 *Their* unrounded value must be seen
2	(a)		285	2	**M1** for $760 \div (2 + 3 + 3)$ soi by 95	
	(b)		24	2	**M1** for $\frac{2}{3} \times 36$ oe	Allow $(0.66 \text{ or } 0.7) \times 36$ for **M1** only
3			$2x + 7$ as final answer	2	**B1** for each part or **M1** for $3x + 6$ or $-x + 1$	
4	(a)		Triangle at (-8, 6), (-8, 2), (0, 6)	2	**B1** for reflection in $x = k$ or in $y = 0$	Mark intention, condoning freehand

Question			Answer	Marks	Part marks and guidance	
	(b)		Enlargement $\frac{1}{4}$ or 0.25 (0, -6)	**3**	**B1** for each element	Marks spoilt if extra transformations Condone omission of brackets Accept centre as a vector
5	**(a)**		0.14, 0.09, (0.19), 0.2[0], 0.13, 0.25	**2**	**B1** for three or four correct relative frequencies in the correct place	Accept fractions
	(b)	**(i)**	[Unbiased dice] would have each [rf=] 0.16-0.17 or [Unbiased dice] would have each [f=] 50 or comment about very unequal [relative] frequencies and implied comparison	**1**		Accept “about 0.16” Accept “about 50” Not enough to say one number was rolled the most. Must say 6 [and 4] or some numbers are much higher or 2 or 5 or some numbers are much lower
		(ii)	need larger sample oe	**1**		

Question			Answer	Marks	Part marks and guidance	
6			5 : 6 nfww	4		Accept for all part marks *n* replaced by a consistent integer
					B3 for 5*kn* : 6*kn* *k*>0 or equivalent correct unsimplified ratio seen	Eg 2.5*n* : 3*n* or 5*n* : 6*n* or 10 : 12 etc
					OR	
					M1 for two ratios with a common number of mints implied by … : 10*k* **and** 10*k* : … seen, *k*>0 with one correct ratio or for 2.5*n* : 5 seen	May be seen as two separate ratios Eg 5*n* : 10 and 10 : 6*n* or 10 : 20 and 20 : 12 etc For **M1** the examples just require the common 10 or the common 20 etc
					A1 for 5*kn* : 10*k* : 6*kn*	
7	**(a)**		Ruled bisector of angle ABC to reach CD with construction arcs	2	**B1** for correct ruled bisector at least 2cm long by eye with no construction arcs or correct construction arcs with no/wrong bisector drawn	Tolerance ±2˚ Construction arcs on AB and on BC and two intersecting arcs from these
	(b)		Arc, centre C, radius 5 cm, intersecting *their* line twice or intersecting BC and CD or two points marked on *their* line that are 5 cm from C	2	**B1** for any arc, centre C, intersecting *their* line at least once or intersecting BC or CD or short arc (at least 1 cm), centre C, radius 5 cm	Tolerance 4.8 – 5.2 cm Max **B1** for freehand, all within template
			Locus of line within arc from C rad indicated	1dep	**Dep** on at least **B1** in (a) and **B1** in (b)	

Question			Answer	Marks	Part marks and guidance	
8	(a)		54 nfww	4	**B3** for 90 min and 144 min or for 0.9h or **B2** for 90 min or 144 min or for A: 1.5h and B 2.4h or **M1** for evidence of time = distance / speed	For **B3 and B2** accept 1 h 30 min and 2 h 24 min
	(b)		1000*x*/3600 oe isw	2	**B1** for 1000*x* [m/h] or *x*/3600 [km/s] or *x*1000/3600 oe	For **2** marks, final answer must not have any units within the expression isw wrong simplification after correct answer. Accept *x*/3.6 and (0.277 to 0.28)*x* For **B1** allow *x* × 1000 or *x* ÷ 3600 or these clearly implied in a longer calculation
9	(a)		59.5 60.5	2	**B1** for either one correct or both correct but reversed	

Question			Answer	Marks	Part marks and guidance	
	(b)	(i)	Accept any correctly matched wall and 6 × cupboard where values quoted satisfy: wall < 6 × cupboard where 362.5 ≤ wall < 363 and 362.5 < 6 × cupboard ≤ 363 OR wall ÷ 6 < cupboard where 362.5 ≤ wall < 363 and $60.41\dot{6}$ to 60.42 < cupboard ≤ 60.5 OR wall ÷ cupboard < 6 where 362.5 ≤ wall < 363 and $60.41\dot{6}$ to 60.42 < cupboard ≤ 60.5	3	**B1** for 362.5 ≤ wall value < 363 **B1** for 362.5 < 6 × cupboard value ≤ 363 or 60.416 to 60.42 < cupboard value ≤ 60.5 eg [lower bound of] wall is 362.5 [upper bound of] cupboard is 60.5 362.5 ÷ 60.5 = 5.9[9…] < 6	
		(ii)	6.5 cm	3	**M2** for 363.5 – 6 × *their* lower bound of cupboard or 363.5 – 357 or **M1** for [upper bound of wall =] 363.5 or for 6 × *their* lower bound of cupboard or [6 cupboards =] 357	

Question			Answer	Marks	Part marks and guidance	
10	(a)		Using interior angles: ((10 – 2) × 180) ÷ 10 or 1440 ÷ 10 seen [Int angle of triangle =] 60 in working 360 – (144 + 60) oe [= 156]	 **1** **1** **1**	Using exterior angles: 360 ÷ 10 seen [Ext angle of triangle =] 120 in working 36 + 120 [= 156] Alternative method: **1** for 360 ÷ 10 seen **1** for [Int angle of triangle =] 60 in working **1** for 180 – (60 – 36) [= 156] If **0** scored **SC1** for 24, 36, 60, 120 or 144 shown in correct place on diagram	Mark the working. Mark angles on diagram only if 0 scored. Working backwards from 156 to 144 [to 10 sides] scores 0
	(b)		15	**2**	**M1** for $[n =]\frac{360}{180-156}$ or $\frac{180(n-2)}{n} = 156$	
11	(a)			**3**	**B2** for 8, 9 or 11 correctly placed or **B1** for the total of F = 17 or for the total of G = 20 or for all 3 regions add up to 28 or for 17 – *x* , *x*, 20 – *x*	Do not accept a blank region to represent 0

Question			Answer	Marks	Part marks and guidance	
	(b)		88/435 oe or 0.202(…) with correct working	**5**	**B1** for $\frac{8}{30}$ oe soi or $\frac{11}{30}$ soi **M1** for P(F only, G only) [+] P(G only, F only) **M1** for P(F only, G only) = $\frac{their\ 8}{30} \times \frac{their\ 11}{29\ or\ 30}$ or $\frac{their\ 11}{30} \times \frac{their\ 8}{29\ or\ 30}$ **A1** for 88/870 or 44/435 or 0.101(…) If **0**, **1** or **2** scored, instead award **SC3** for answer 88/435 oe or 0.202(…) with no or insufficient working If **0** or **1** scored, instead award **SC2** for 88/870 or 44/435 or 0.101(…) with no or insufficient working If **0** scored **SC1** for 88/450, 44/225 or 0.195[5..] to 0.196 with no working	"Correct working" requires evidence of at least **M1M1** eg correct branches identified on tree or implied by *their* subsequent calculation FT *their* **(a)** *their* 8 and *their* 11 are FT *their* **(a)** Likely incorrect answers with working: **B1M1M1** for answer 88/450, 44/225 or 0.195[5..] to 0.196 **B1M0M1** for answer 88/900, 44/450, 22/225 or 0.097[7..] to 0.098

Question			Answer	Marks	Part marks and guidance	
12			answer with at least 4 sf rounding to 46.9 with correct working	6	**M1** for [vol =] 235 ÷ 7.78 [=30.2…] AND **M2** for $r^3 = \frac{their\,30.2... \times 3}{4 \times \pi}$ oe [=7.2…] or **M1** for *their* 30.2 = $\frac{4}{3}\pi r^3$ **A1** for r = 1.93… AND **M1** for [SA =] $4 \times \pi \times their\,1.93...^2$ If **0** scored **SC1** for [r =] 1.93… with no working	"Correct working" requires evidence of at least **M1** AND **M1** AND **M1** ie using formulas for density, volume and surface area After *their* 30.2 = $\frac{4}{3}\pi r^3$, r = 1.93… scores **M2A1** Condone working in reverse for a maximum of 2 marks: **M1** for 46.9 = $4\pi r^2$ **A1** for r = 1.93...
13			$y = -\frac{x}{4} + 3$ oe simplified form	4	**B3** for correct equation not in required form OR **B1** for gradient of perp line = -¼ oe soi **M1** for $y - 1 =$ *their grad* $\times (x - 8)$ or $1 =$ *their grad* $\times 8 + c$ **M1** for correct simplification to $y = mx + c$ form of *their* $y - 1 =$ *their grad* $\times (x - 8)$ or using *their* $c = 1 -$ *their* grad $\times 8$	*their* grad may be 4 ie they are finding the equation of the parallel line. Max **M1** if *their* grad is '*m*'

Question			Answer	Marks	Part marks and guidance	
14	(a)		$y = \frac{30}{\sqrt{x}}$ oe	3	**M1** for $y = \frac{k}{\sqrt{x}}$ oe **B1** for [k =] 30	eg condone $y = \frac{k}{\sqrt{36}}$ for **M1**
	(b)		2.25 oe	3	**B2** for $\sqrt{x} = \frac{3}{2}$ oe or **M1** for $20 = \frac{\textit{their}\ 30}{\sqrt{x}}$ or $\frac{20}{5} = \frac{\sqrt{36}}{\sqrt{x}}$	

Question			Answer	Marks	Part marks and guidance	
15	(a)		$2^3 - 5 \times 2 - 1 = -3$ $3^3 - 5 \times 3 - 1 = 11$ Sign change so solution between $x = 2$ and $x = 3$	3	**M2** for $2^3 - 5 \times 2 - 1 = -3$ and $3^3 - 5 \times 3 - 1 = 11$ or **M1** for $2^3 - 5 \times 2 - 1$ or $3^3 - 5 \times 3 - 1$ soi by -3 or 11 <u>Alternative method</u> After $x^3 - 5x = 1$ seen **M2** for $2^3 - 5 \times 2 = -2$ and $3^3 - 5 \times 3 = 12$ **A1** for $-2 < 1$ and $12 > 1$ so solution between $x = 2$ and $x = 3$ OR **M1** for $2^3 - 5 \times 2$ or $3^3 - 5 \times 3$ soi by -2 or 12 <u>Alternative method</u> **SC3** for using an iterative equation that converges to a value in the range 2.25 to 2.35 **and** concluding statement that $2 < 2.25$ to $2.35 < 3$ oe or **SC2** for using an iterative equation that converges to a value in the range 2.25 to 2.35	Accept other values of x used between 2 and 3 (see table in part (b)). For full marks, the two values need to produce a sign change. Examples just sufficient for third mark include: change of sign $-3 < 0 < 11$ $x = 2$ gives an answer < 0 and $x = 3$ gives an > 0 Examples insufficient for third mark: so x lies between 2 and 3 If within part **(a)** candidates <u>refer to</u> their working in part **(b)**, award marks for this final alternative method.

Question	Answer	Marks	Part marks and guidance	
(b)	Two correct evaluations in the range 2.25 to 2.35, one which gives a positive value and the other giving a negative value	**M3**	**M2** for two correct evaluations between 2 and 3, one which gives a positive value and the other giving a negative value or and **M1** for one correct evaluation between 2 and 3	Likely values: accept rot to 2+sf
	2.3	**A1dep**	Dependent on achieving at least **M2**	
			Alternative method **M1** rearranges to a correct iterative formula (converging or diverging) **M1** attempts first iteration (either substitution seen or found to at least 2dp (rot) **M1** continues iteration(s) to reach x in the range 2.25 to 2.35 **A1** for 2.3 If **0** scored **SC1** for answer 2.3 with no worthwhile working	Condone missing subscripts If within part **(b)** candidates refer to their working in part **(a)**, award up to full marks for part **(b)**.

x	$x^3 - 5x - 1$	x	$x^3 - 5x - 1$
2.1	-2.239	2.25	-0.859
2.2	-1.352	2.26	-0,757
2.25	-0.859	2.27	-0.653
2.3	-0.333	2.28	-0.548
2.4	0.824	2.29	-0.441
2.5	2.125	2.30	-0.333
2.6	3.576	2.31	-0.224
2.7	5.183	2.32	-0.113
2.75	6.047	2.33	-0.001
2.8	6.952	2.34	0.113
2.9	8.889	2.35	0.228

Question			Answer	Marks	Part marks and guidance	
16	(a)		Subst into correct formula (may be implied) and partial simplification	2	**B2** for $25 = 20t - \frac{1}{2} \times 8 \times t^2$ oe or $25 = 20t + (-4)t^2$ or **B1** for subst eg $25 = 20t + \frac{1}{2}(-8)t^2$	Only accept $25 = 20t - 4t^2$ if subst seen For **B1**, condone ambiguity caused by missing brackets
			$25 = 20t - 4t^2$ seen and correct completion to $4t^2 - 20t + 25 = 0$	1dep	Dep on previous 2 marks	
	(b)		2.5 oe	3	**M2** for $(2t - 5)(2t - 5)$ or **M1** for any two factors that give two correct terms when expanded or for partial factorisation $2t(2t - 5) - 5(2t - 5)$ OR **M2** for $[t =] \frac{20 \pm \sqrt{400 - 400}}{8}$ or better **M1** for $[t =] \frac{-(-20) \pm \sqrt{(-20)^2 - 4 \times 4 \times 25}}{2 \times 4}$ with at most one error	eg a sign error, short fraction line, short root but condone missing brackets

Question			Answer	Marks	Part marks and guidance	
	(c)		Shows $v = 0$ and concludes "stationary"	3	**M1** for $[v^2 =] 20^2 + 2(-8)25$ or $[v =] 20 + (-8)\times$*their* (b) **A1** $v = 0$ If **0** scored, instead award **SC2** for $v = 0$ and other values substituted into a relevant equation as a correct check or **SC1** for $v = 0$	

Question			Answer	Marks	Part marks and guidance	
17			113 to 114 with correct working	5	Check diagram for incorrect triangle. Correct triangle or no triangle indicated: **M2** for $\sqrt{6.8^2 + 2.8^2}$ [= 7.35…] or for full alternative method or **M1** for $6.8^2 + 2.8^2$ [= 54.08 or 54.1] AND **M2** for $5.6 \times 5.6 + 4 \times \frac{1}{2} \times 5.6 \times$ *their* 7.35... or **M1** for $\frac{1}{2}$ × 5.6 × *their* 7.35… Incorrect triangle indicated: **M1** for complete Pythagoras to find hypotenuse with a maximum of one incorrect dimension If **0** or **M1** scored, instead award **SC2** for answer 113 to 114 with no or insufficient working If **0** scored **SC1** for 7.35 either correctly placed on diagram or with no working	"Correct working" requires evidence of at least **M2** AND **M1** ie correct triangle with Pythagoras and area of a triangle eg Finding AC, AO, AE then the height (AC = 7.919…, AE = 7.868…) eg EB found as $\sqrt{6.8^2 + 2.8^2}$ is using an incorrect dimension for OB

Question			Answer	Marks	Part marks and guidance	
18			$y = \frac{4}{3t-17}$ or $y = \frac{-4}{17-3t}$	5	**B4** for $\frac{4}{3t-17}$ or $y = \frac{2}{1.5t-8.5}$ as final answer OR **M2** for $10y + 4 = 3ty - 7y$ or $5 + \frac{2}{y} = 1.5t - 3.5$ or **M1** for $\frac{2(5y+2)}{y} = 3t - 7$ or $5y + 2 = \frac{y(3t-7)}{2}$ or $10y + 4$ or $3ty - 7y$ seen or $5 + \frac{2}{y} = \frac{3t-7}{2}$ or $\frac{5y+2}{y} = 1.5t - 3.5$ **M1ft** for correctly collecting y terms on one side and non-y terms on the other (need not be simplified at this stage) **M1ft** for factorising *their* 2 or 3 terms	To award full marks, solution must be correct eg $4 = 3ty - 7y - 10y$ or $\frac{2}{y} = 1.5t - 3.5 - 5$ ft for formulae of equal difficulty (eg must include a ty term oe) eg $4 = y(3t - 17)$ or $\frac{y}{2} = \frac{1}{1.5t-8.5}$

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