OCR
Oxford Cambridge and RSA

H

GCSE (9–1)

Mathematics

J560/04: Paper 4 (Higher tier)

General Certificate of Secondary Education

Mark Scheme for November 2021

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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.

1. 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

2. **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.

3. 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.

4. 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.

5. 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.

6. 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).

7. 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'.

8. 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.

9. 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.

10. 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.

11. 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.

12. 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.

13. Ranges of answers given in the mark scheme are always inclusive.

14. 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.

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

Question			Answer	Marks	Part marks and guidance	
1	(a)		68 921	1		
	(b)		2.86	3	**B2** for 2.85[7…] OR **B1** for 66.95 or 8.2 or 8.16[4…] and **B1** for *their* answer written to more than 3 figures correctly rounded to 3 sf	
2			71.4	2	**M1** for ½×(12.3 + 8.7) ×6.8 oe	
3			x^8	1		

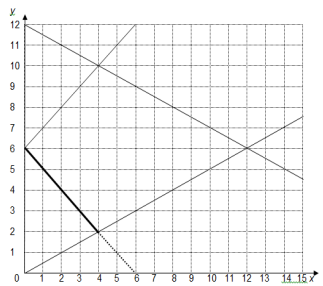
Question			Answer	Marks	Part marks and guidance	
4			$\frac{4}{16}$ oe nfww	4	**M2** for 16 correct outcomes shown or for [4 × 4 =] 16 [outcomes] or **M1** for table, list etc, with at least 10 correct outcomes to a maximum of 16 (ignoring repeats) AND **M2FT** for correctly indicating all the primes in *their* outcomes (at least 6) **and** gives the correct response for *their* outcomes or **M1FT** for writing *their* correct response from *their* outcomes **or** for indicating all the primes in *their* outcomes with maximum one error to a maximum of **3** marks if **0** scored then **SC3** for a correct response from adding 16 outcomes i.e. $\frac{9}{16}$ or **SC2** for a correct response from adding (at least 6 outcomes), primes must be indicated or **SC1** for correct response from adding (at least 6 outcomes), primes are not indicated Note : an alternative method is **M3** for [P(1 with 2,3 OR 2,3 with 1)=] $\frac{1}{4} \times \frac{2}{4} + \frac{2}{4} \times \frac{1}{4}$ or **M2** for the above method with one error or **M1** for a correct tree diagram drawn	<u>M marks are for products</u> The outcomes may be a list or table showing 16 outcomes which may have numbers or ticks and crosses to show primes etc, if just numbers with nothing above 8 assume addition By e.g. shading, underlining or ringing **M1** implied by a correct numerator and a correct denominator for *their* list Note that $\frac{2}{4} \times \frac{2}{4}$ is an incorrect method

Question			Answer	Marks	Part marks and guidance	
5	(a)		18 07 [pm] or 6 07 pm	4	**B3** for 18 07 am or 6 07 [am] OR **B2** for listing the next three correct times of both fountains, i.e. 15 43, 16 07, 16 31 and 16 01, 16 43, 17 25 OR **B1** for listing the next three correct times of one fountain, i.e. 15 43, 16 07, 16 31 or 16 01, 16 43, 17 25. <u>Alternative method</u> **B3** for 2[h] 48[m] OR **B2** for [LCM=] 168 OR **B1** for listing the next three multiples of 24 and 42, i.e. 48, 72, 96 and 84, 126, 168 OR **M1** for [24 =] 2 × 2 × 2 × 3 or [42 =] 2 × 3 × 7 allow in a factor tree or table or [LCM=] 168k ($k \neq 1$) and **M1** for correctly converting *their* time(mins) to hours and mins	Condone use of 12 hour clock e.g. [0]3 43 and 3 43 am for **B1** and **B2** *their* time must be over 60

Question			Answer	Marks	Part marks and guidance	
	(b)		[size] 15 [number] 11	**4**	**B3** for 15 and 11 OR **B2** for [HCF or group size =] 15 or **M2** for [60] = 2× 2 × 3 × 5 and [105] = 3 × 5 × 7 or for listing complete factors of both numbers allow in a factor tree or table OR **M1** for one of 2 × 2 × 3 × 5 or 3 × 5 × 7 allow in a factor tree or table or for common factors 3 or 5 AND **B1** for [size] 3 [number] 55 or [size] 5 [number] 33	accept any correct method [60] 1,2,3,4,5,6,10,12,15,20,30,60 [105] 1,3,5,7,15,21,35,105
6	**(a)**		500 ml with three correct comparisons	**3**	Allow any correct comparison e.g.(converting all to 500 ml) **B2** for three correct figures to compare or **B1** for two correct figures OR **M1** for one correct appropriate calculation e.g. 1.96 ÷ 4 or 31 × 5 ÷ 3 oe	See appendix for other values e.g. 49[p] is sufficient for **B1** as it compares to 47[p]
	(b)		7 × 120 soi by 840 840 ÷ 300 soi by 2.8 or 3 and 3 × 31 = 93[p] 840 ÷ 500 soi by 1.68 or 2 and 2 × 47 = 94[p]	**M1** **B1** **B1**	accept any correct argument If **B0** then **SC1** for 3 [of 300 ml] and 2[of 500 ml]	Condone omitting one day so 6 × 120 soi by 720 for **M1** 3 × 31 = 93[p] is sufficient 2 × 47 = 94[p] is sufficient

Question			Answer	Marks	Part marks and guidance	
7	(a)	(i)	0.2 and 0.8 in all the correct places	2	**B1** for first branch correct or second branches correct	Accept equivalent fractions and percentages (need % sign)
	(a)	(ii)	0.64 or $\frac{16}{25}$ oe or 64%	2	**FT** *their* tree for **1** or **2** marks (*their* values < 1) **M1** for 0.8 × 0.8 oe	Allow long method : e.g. 1 – (0.04 + 0.16 + 0.16)
	(a)	(iii)	Suggestion of dependence between the trains or unexpected events or data may not be applicable	1		Accept any correct reason, e.g. if first train is late second train may be held up e.g. unexpected delays can occur e.g. changed schedule that day (implies data not applicable)
	(b)		0.73[4] or $\frac{734}{1000}$ oe or 73.4%	3	**M2** for 1 – 0.35 × 0.76 or 0.35 × 0.24 + 0.65 × 0.24 + 0.65 × 0.76 oe or **M1** for two correct products or 0.35 × 0.76	e.g. common equivalent $\frac{367}{500}$ products implied by 0.266, 0.084, 0.156, 0.494
8			3.25	4	**B3** for 0.0325 OR **M1** for 7170 – 6000 or $\frac{7170}{6000}$ **M1** for $\frac{their\ 1170}{6000}$ or $\frac{their\ 1170}{6}$ or 1.195 - 1 **M1** for *their* 0.195 ÷ 6 or *their* 195 ÷ 6000	Accept any correct method and condone extra % symbol implied by 1170 or 1.195 implied by 0.195 or 195 implied by 0.0325 watch out for $\sqrt[6]{1170}$ = 3.246…

Question			Answer	Marks	Part marks and guidance	
9			1240	3	**M2** for 1426 ÷ 1.15 oe or **B1** for 1.15 or 115	Accept $\frac{115}{100}$ but not 115%
10			87 253 278 with correct working	7	**B1** for 3*n* – 8 **B1** for 3*n* – 8 + 25 or better **M1** for writing a correct equation equal to 618 using *their* expressions e.g. *n* + 3*n* – 8 + 3*n* – 8 + 25 = 618 or better **M1** for simplifying *their* equation e.g. 7*n* + 9 = 618 **A1FT** for correctly solving *their* equation e.g. *n* = 87 **M1** for substituting *their* 87 into both expressions e.g.3×87 – 8 and 3×87 – 8 + 25 oe <u>Trials:</u> **B1** for one complete trial with *n* ≥ 3 **B1** for second complete trial *n* ≥ 3 If **0** or **1** scored **SC3** for 87, 253, 278 with **B1** only or **SC2** for 87, 253, 278 with no working	"Correct working" requires evidence of at least **B1 B1** Expressions could start from B or C. See appendix for a more complete set of trials

Question			Answer	Marks	Part marks and guidance	
11			AED or DEA and corresponding common oe correct reason e.g. AAA or both triangles have the same angles oe	1 1 1		accept CED, DEC accept "same as angle DAE" oe ignore any reasons
12	(a)		≥ ≤ ≤	2	**B1** for two correct or "> < <"	i.e correct but no equals
	(b)		$x + y \geq 6$ or $y \geq 6 - x$ oe	3	**B1** for the correct straight line drawn  **B1** for correct equation for *their* line e.g. $x + y = 6$ oe	implied by e.g. $x + y = 6$ oe and accept a ruled or good freehand line bold line shows minimum length implied by e.g. answer of $x + y \leq 6$ oe
13			First bar($170 \leq h < 180$) at 'height' 2.4 Second bar($180 \leq h < 200$) at height 0.5	6	**M2** for $\frac{3.2 \times 3 \times 10}{4 \times 10}$ oe or **M1** for 3.2×10 **B1** for *their* bar correctly drawn at $\frac{their 24}{10}$ AND **M2** for $\frac{their\ 80 - their\ 24 - 32 - their\ 0.7 \times 20}{20}$ oe or **M1** for *their* 80 – *their* 24 – 32 – *their* 0.7 × 20 oe AND **B1** for *their* bar correctly drawn at $\frac{their\ 10}{20}$	**M2** implied by 'first bar height' 2.4 **M1** implied by 24, 32 or 80 **M2** implied by 'second bar' height 0.5 **M1** implied by 10

Question			Answer	Marks	Part marks and guidance	
14			−3, 8	**4**	**B1** for $(x + 3)^2$ or $-6 \div 2$ **B2FT** for +8, correct or ft *their* $(x + 3)^2$ or **M1** for (*their* −3)^2 + 6 × (*their* −3) + 17 **B1FT** for (−*a*, *b*) **FT** *their*{$(x + a)^2 + b$} to a maximum of **3** marks If no working **B2** for either ordinate correct	accept any correct method(see appendix) **B3** implied by $(x + 3)^2 + 8$
15			[a=] 3 [b=] -5 [c=] 1	**4**	**B2** for a = 3 or **M1** for second differences = 6 **M1** for revised terms of -4 -9 -14 -19 or **B1** for either *b* = -5 or *c* = 1	Condone e.g. $3n^2$ at least two terms See appendix for alternative methods
16	**(a)**		6800	**1**		
	(b)		4.5	**1**		condone extra %
	(c)	**(i)**	11500 or 11530 or 11532	**2**	**M1** for 6800×1.045^{12} oe	allow 11531 and 11531.9[9…]
		(ii)	Any correct reason e.g. the rate may not continue	**1**		see appendix

Question			Answer	Marks	Part marks and guidance	
17			105 or 104.7 to 104.82	6	**M2** for $\frac{48\times\sin 53}{85}$ oe implied by 26.8… or **M1** for $\frac{\sin 53}{85}=\frac{\sin[B]}{48}$ oe **M1** for [C=] 180 − 53 − their 26.807… or 100.19[…] **M2** for $\frac{85\times\sin theirC}{\sin 53}$ oe or **M1** for $\frac{[AB]}{\sin theirC}=\frac{85}{\sin 53}$ oe <u>Alternative method</u> cosine rule (AB = x) **M3** for quadratic with coefficients evaluated or **M2** for $x^2 + (-2 \times 48 \times \cos 53)x + (48^2 - 85^2)$ [=0] oe or **M1** for $85^2 = x^2 + 48^2 - 2 \times x \times 48\cos 53$ AND **M2** for correct use of quadratic formula or **M1** for quadratic formula with at most one error If **0** scored **SC2** for 105 or 104.7 to 104.82 with no working or **SC1** for 26.8… with no working	"Correct working" requires evidence of at least **M2** or **M1M1** i.e. $x^2 - 57.77\ldots x - 4921$ [= 0] oe

Question			Answer	Marks	Part marks and guidance	
18	(a)	(i)	tan *x*	1		
		(ii)	3^x	1		
	(b)	(i)	Graph of $y = -x^3$	1		Mark intent
		(ii)	$y = x^3$ translated vertically 8 down *y*-intercept -8 *x*-intercept 2	1 1 1		Intercepts must be marked on graph and accept given as coordinates
19	(a)		complete correct argument e.g. angle ABC = 40° [BO =] e.g. $\frac{6}{sin20}$ 17.542… or 17.543	 B1 M2 A1dep	 **M1** for e.g sin 20 = $\frac{6}{[BO]}$ **dep.** on at least **M1**	accept any correct method not using 17.54 could be on diagram and also accept ABO = 20°, BO'T' = 70° i.e BO as subject for **M2** and condone sine rule with sin 90° for **M2**
	(b)		202 or 201.5 to 201.8 with correct working	5	Accept any correct method e.g. **M1** for [height=] 17.54 + 6 or 23.54… **M2** for [half base =] $\frac{6}{\tan 35}$ or $\frac{23.54}{\tan 70}$ or **M1** for tan 35 = $\frac{6}{half\ base}$ or tan 70 = $\frac{23.54}{half\ base}$ **M1** for ½ × *their* base × *their* height oe If **0** scored **SC2** for 202 or 201.6 to 201.8 with no working or **SC1** for 8.56 to 8.57 or 17.1 to 17.2 with no working	"Correct working" requires evidence of at least **M2** or **M1M1** Condone use of 8.6 leading to an answer of 202.4… **M2** implied by e.g. 8.56 to 8.57 or 17.1 to 17.2 e.g. ½ × (2 × 8.568…) × 23.54…

Question			Answer	Marks	Part marks and guidance	
20			[x=] −4 [y=] −1 [x=] 4 [y=] 7 with correct algebraic working	**5**	accept any correct method **M1** for correct substitution e.g. $(x - 3)^2 + (x + 3)^2$ [= 50] **M1** for expanding both brackets correctly e.g. $x^2 - 3x - 3x + 9 + x^2 + 3x + 3x + 9$ [=50] **M1** for simplifying *their* equation e.g. $2x^2 = 32$ or $2x^2 - 32$ [= 0] **A1FT** for x = −4, 4 If **0** scored **SC2** for [x=] −4 [y=] −1 [x=] 4 [y=] 7 with no working or **SC1** for both x values with no working or a correct pair of x and y values with no working	"Correct algebraic working" requires evidence of at least **M1M1** implied by $2x^2 + 18$ [= 50] condoning one error or better to $ax^2 = b$ or to $ax^2 + bx + c$ [= 0] **FT** *their* quadratic equation See appendix for alternative methods

APPENDIX

Question 4

e.g.

	1	2	3	4
1	1	2	3	4
2	2	4	6	8
3	3	6	9	12
4	4	8	12	16

or

1×1 2×1 3×1 4×1
1×2 2×2 3×2 4×2
1×3 2×3 3×3 4×3
1×4 2×4 3×4 4×4

Question 6a

Numbers should be given to sufficient accuracy to enable a decision to be made, usually 2 figures and can be **truncated or rounded.**
These figures are in pence or ml and act as a guide. If they convert to, say 2 litres, they only need to work out two figures as one is given.

Converting all to 100 ml :10.333…, 9.4, 9.8
Converting all to 500 ml : 51.666…, 47, 49
Converting all to 1 litre : 103.333…, 94, 98
Amount for 10p : 96.774…, 106.3829…, 102.0408…

Question 10

n	3n-8	3n-8+25	Total
10	22	47	79
20	52	77	149
30	82	107	219
40	112	137	289
50	142	167	359
60	172	197	429
70	202	227	499
80	232	257	569
90	262	287	639
100	292	317	709

increments	+1	+3	+3	+7
e.g.	add 4	add 12	add 12	add 28
	24	64	89	177

Question 14

The curve does not cross the x-axis so solving $y = 0$ does not help.

Alternative method : find the line of symmetry
Find the two points where e.g. $y = 17$
$x^2 + 6x + 17 = 17$ …..**M1**
$x(x + 6) = 0$ so $x = 0$ or -6 …**A1**
So line of symmetry is $x = -3$ and by substitution $y = 8$ …**B1** each to maximum of **3** marks

Question 15

Using simultaneous equations : e.g.
$a + b + c = -1$
$4a + 2b + c = 3$
$9a + 3b + c = 13$ ……**M1**
subtracting
$3a + b = 4$
$5a + b = 10$ …….. **M1**

gives a = 3 ……..**A1**

Exemplar responses for Q16(c)(ii)

Response	**Mark**
the rate may not continue	**1**
there may not be enough housing on the island	**1**
they may run out of space	**1**
there may be a famine	**1**
people may move	**1**
there may be disease	**1**
the answer is a decimal	**0**
people will die	**0**

Question 20

M1 for correct substitution
e.g. $(y – 3 – 3)^2 + y^2$ [= 50]
M1 for expanding the bracket correctly
e.g. $y^2 – 6y – 6y + 36 + y^2$ [=50]
M1 for simplifying *their* equation
e.g. $2y^2 – 12y – 14$ [= 0] or better e.g. $y^2 – 6y – 7$ [= 0]
A1FT for $y = -1, 7$

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