



Oxford Cambridge and RSA

Level 3 Certificate

Mathematics

H868/02: Critical Maths

OCR Level 3 Certificate Core Maths A (MEI)

Mark Scheme for June 2023

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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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MARKING INSTRUCTIONS**PREPARATION FOR MARKING
RM ASSESSOR**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.
5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. (*The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.*)

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.
7. Award No Response (NR) if:
 - there is nothing written in the answer space

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

- The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.
- Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.
- For answers marked by levels of response:
 - To determine the level** – start at the highest level and work down until you reach the level that matches the answer
 - To determine the mark within the level**, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

11. Annotations

Annotation	Meaning
✓ and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	

Other abbreviations in mark scheme	Meaning
E1	Mark for explaining
U1	Mark for correct units
G1	Mark for a correct feature on a graph
M1 dep*	Method mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working

12. Subject Specific Marking Instructions

- a. Annotations must be used during your marking. 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.

Award NR (No Response)

- if there is nothing written at all in the answer space and no attempt elsewhere in the script
- OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
- OR if there is a mark (e.g. a dash, a question mark, a picture) which isn't an attempt at the question.

Note: Award 0 marks only for an attempt that earns no credit (including copying out the question).

If a candidate uses the answer space for one question to answer another, for example using the space for 8(b) to answer 8(a), then give benefit of doubt unless it is ambiguous for which part it is intended.

- b. An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct solutions leading to correct answers are awarded full marks but work must not always be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly. Correct but unfamiliar or unexpected methods are often signalled by a correct result following an apparently incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

If you are in any doubt whatsoever you should contact your Team Leader.

- c. The following types of marks are available.

M

A suitable method has been selected and applied in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using

some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A method mark may usually be implied by a correct answer unless the question includes the DR statement, the command words “Determine” or “Show that”, or some other indication that the method must be given explicitly.

A

Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B

Mark for a correct result or statement independent of Method marks.

Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

- d. When a part of a question has two or more ‘method’ steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation ‘dep*’ is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.
- e. The abbreviation FT implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only – differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, what is acceptable will be detailed in the mark scheme. If this is not the case please, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be ‘follow through’. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

- f. We are usually quite flexible about the accuracy to which the final answer is expressed; over-specification is usually only penalised where the scheme explicitly says so.
- When a value is given in the paper only accept an answer correct to at least as many significant figures as the given value.
 - When a value is not given in the paper accept any answer that agrees with the correct value to 3 s.f. unless a different level of accuracy has been asked for in the question, or the mark scheme specifies an acceptable range.
- NB for Specification B (MEI) the rubric is not specific about the level of accuracy required, so this statement reads “2 s.f”.

Follow through should be used so that only one mark in any question is lost for each distinct accuracy error.

Candidates using a value of 9.80, 9.81 or 10 for g should usually be penalised for any final accuracy marks which do not agree to the value found with 9.8 which is given in the rubric.

- g. Rules for replaced work and multiple attempts:
- If one attempt is clearly indicated as the one to mark, or only one is left uncrossed out, then mark that attempt and ignore the others.
 - If more than one attempt is left not crossed out, then mark the last attempt unless it only repeats part of the first attempt or is substantially less complete.
 - If a candidate crosses out all of their attempts, the assessor should attempt to mark the crossed out answer(s) as above and award marks appropriately.
- h. For a genuine misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate’s data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A or B mark in the question. Marks designated as cao may be awarded as long as there are no other errors.
- If a candidate corrects the misread in a later part, do not continue to follow through. Note that a miscopy of the candidate’s own working is not a misread but an accuracy error.
- i. If a calculator is used, some answers may be obtained with little or no working visible. Allow full marks for correct answers, provided that there is nothing in the wording of the question specifying that analytical methods are required such as the bold “In this question you must show detailed reasoning”, or the command words “Show” or “Determine”. Where an answer is wrong but there is some evidence of method, allow appropriate method marks. Wrong answers with no supporting method score zero. If in doubt, consult your Team Leader.
- j. If in any case the scheme operates with considerable unfairness consult your Team Leader.

	Question		Answer	Marks	Guidance
1	(a)	(i)	1600	B1 [1]	Allow answer in range 1550 to 1650
1	(a)	(ii)	<i>their</i> 1600 = 80% and attempt to find 1%, 10%, 20% or 100% 400	M1 A1 [2]	Oe attempt eg <i>their</i> (i) $\div 0.8$ Note: 2000 = 100% CAO If M0 SC B1 max 1/2 for answer 320 following 1280 in (1ai) $\div 4$ Note: 20% of 1600 = 320 is M0 and not SC
1	(b)		Eg 400 = 40% \rightarrow 1000 = 100% Eg 400 = 40% \rightarrow 100 = 10% Eg 400 = 40% \rightarrow 200 = 20% 600	M1 A1 [2]	Use of 400 = 40% (from Figs 1.1 & 1.2) to get towards answer. M1 implied by their number from Fig.1.1 $\times 1.5$ or $\div 40 \times 60$ Note 400 $\times 0.6$ is M0 CAO Accept 600 without working
1	(c)		Either Yes, with appropriate justification: eg 1100 is nearly 2×600 (1.83×600) eg 600 is just over half of 1100 OR No, with appropriate justification: eg 1100 is not 2 times 600 (ratio is 1.83)	B1 [1]	Must see 1100 and 600 in the answer space, or reference to 100 more
1	(d)		20% (refunded by GabiAir) in 1 month No , with correct reason: eg another 80% will take 4 months (not 8 months) eg refunds will take 5 months (in total)	B1 B1 [2]	Correct reading from chart. Implied if second mark is awarded Note: If using numbers: 400 refunded in 1 month, remaining 1600 in further 4 months B1 Correct conclusion. Note: both marks available without working, or following wrong answers in (1ai) and (1aii) eg 320 as 20% and considers 80% is a valid argument Condone absence of “no the claim is not justified” if this is clearly evident from their calculations

	Question		Answer	Marks	Guidance
2	(a)	(i)	3°C	B1 [1]	Condone missing units
2	(a)	(ii)	6.5°C	B1 [1]	condone missing units. If max and min wrong way round then SC1
2	(b)	(i)	Rule A: No payment The temp on 6 Feb (day1) is above zero all day oe	B1 B1 [2]	Only from correct option chosen. Must refer to the first day (6 th) OR The average temp on 6 Feb is above zero OR Lowest temperature on 6 Feb is 3°C
		(ii)	Rule B: Payment The mean (noon temperature) is -0.09 (-0.08(6)°C) oe	B1 B1 [2]	Only from correct option chosen OR the total is -0.6°C (implies the mean is negative). But not from wrong mean stated, eg “mean = -0.6” or “mean = 0.08” Must see values to justify this choice
		(iii)	Rule C: No payment The temp on 6 Feb (day1) did not drop below zero oe	B1 B1 [2]	Only from correct option chosen Must refer to the first day (6 th)
2	(c)		-0.62 + 0.5 (= -0.12) OR Increasing each temp by 0.5 increases average by 0.5	M1	Working out new mean (soi by -0.12 or 1.12)
					(alternative method for mean: $\frac{7 \times 24 \times (-0.62) + 84}{7 \times 24}$) OR working out new total $7 \times 24 \times (-0.62) + 7 \times 24 \times 0.5$
			Alex is wrong / there is still a payment (because the average temperature is still below zero)	A1 [2]	Clear conclusion, following from correct working that includes -0.62 or -0.12 or negative total

	Question	Answer	Marks	Guidance
3	(a)	Suitable reason: eg gyms closed in some areas in July eg more people on holidays in summer eg membership take-up wasn't at same rate	B1 [1]	Oe eg It is (now) out of a larger number of people / more employees eg a sensible comment about time/habits of head office employees versus other employees
3	(b)	Members smallest 54.0% (not 54) Members largest 54.9%	B1 B1 [2]	Condone missing % sign throughout
3	(c)	(Multiplier is) $\times 0.58$ (Multiplier is) $\times 1.455$ (Overall multiplier is) $\times 0.84(39)$ 15.6% reduction	M1 M1 A1 A1 [4]	soi by 58% (or working out 58% of any starting amount) eg: £100 sales \rightarrow £58 sales soi by 145.5% (or increasing any amount by 45.5%) eg: £100 sales \rightarrow £145.50 sales 0.84(39) seen implies earlier M1M1. (2sf sufficient here) oe: £100 sales \rightarrow £84(.39) sales (any starting amount) CAO to 1dp. Condone missing % sign here. Condone -15.6 reduction.

	Question	Answer	Marks	Guidance
4	(a)	<p>20 million \div 50 = (400 000 trees per hectare)</p> <p>\div 10000 \rightarrow 40 trees per square metre</p> <p>This is too close so not possible</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>[3]</p>	<p>Working to find trees per unit of area OR calculating $50 \div 20 \text{ million} = 0.0000025$</p> <p>Consideration of tree density per square metre OR area per tree $0.0000025 \times 10000 = 0.025$ or $\left(\frac{1}{40}\right)$</p> <p>Conclusion with reason related to their working Conclusion must be justified by a correct calculation Must have dealt with hectares to obtain full marks</p>
		<p>Alternative method eg Each tree needs 2 m^2 $500\,000 \div 2 = 250\,000$ OR calculates $20\,000\,000 \times \text{their } 2 = 40\,000\,000 \text{ m}^2$</p> <p>This is nowhere near 20 million – you could not get that many trees in. OR $40\,000\,000 \text{ m}^2 > 500\,000 \text{ m}^2$</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>[3]</p>	<p>Space for each tree up to 25 m^2</p> <p>Working out no of trees which can be fitted in Note: ($1 \text{ m}^2 \rightarrow 500\,000$ trees, $10 \text{ m}^2 \rightarrow 50\,000$ trees)</p> <p>Conclusion with reason related to their working Conclusion must be justified by a correct calculation Must have dealt with hectares to obtain full marks</p>

4	(b)	<p>One dimension of house (plot) in range 5 to 15 m</p> <p>Other dimension of house (plot) in range 8 m to 25 m</p> <p>Area of land = 500 000 m²</p> <p><i>their</i> Area of land ÷ <i>their</i> area of house (plot)</p> <p>OR completion of alternative correct method to find how many plots could be fitted into land</p> <p>Reduction of space available by approx. one third to allow for roads / space between houses</p> <p>Number of houses in range 1 000 to 10 000</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>[6]</p>	<p>Estimate of one dimension of house plot</p> <p>Estimate of other dimension of house plot B2 implied by range 40m² to 375m². B1B0 for 20m² to 500m²</p> <p>soi</p> <p>Must be an area, 3D calculation of volume is M0</p> <p>May be stated, or in drawings, or embedded in calculations Reduction of space/number of houses by 20% to 50% OR increasing plot size by a factor of 1.25 to 2.0</p> <p>Note: might have occurred earlier by reducing their 500000 m² If not clear, check houses before reduction and houses after</p> <p>Dep on first M1. Must be whole number.</p>
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	Question	Answer	Marks	Guidance
5	(a)	Lowest point circled	B1 [1]	
5	(b)	Positive correlation	B1 [1]	Indicated clearly
5	(c)	Reason eg <ul style="list-style-type: none"> • Correlation does not imply causation • Only a small sample • Some of the 0-1 hour phone people slept for longer than the 1-2 hour people. 	B1 [1]	eg correctly describing any instance eg there could be other factors affecting sleep eg the correlation is weak, or the points are quite scattered
5	(d)	A complete method described eg <ul style="list-style-type: none"> • Assign a random number to each person and put the 200 with the lowest numbers in group A • Assign 0 or 1 at random to each person; those with 0 are in group A 	B1 [1]	Method must give equal probability of being in each group (but need not give equal group sizes). Method must say specifically how each person is assigned to a group Allow alternating selections from alphabetical order, but not “first 200” as this could create family groupings Examples of B0: <ul style="list-style-type: none"> • Split them in half, half go to A and half to B. • Randomise names from a hat so anyone could be picked
5	(e)	To prevent influence of other factors OR referring specifically to another relevant factor	B1 [1]	OE eg eliminates bias or a description of bias eg make sure test is fair

	Question	Answer	Marks	Guidance
5	(f)	eg Participants need to know whether or not they can use their phones eg Group B have to use their phones	B1 [1]	oe eg “participants need to follow instructions ..” Response must refer to the participants rather than the researchers
5	(g)	Advantage e.g. <ul style="list-style-type: none"> • Ensures accuracy / avoids human error • No need to follow instructions • Prevents people saying what they think the researcher wants to hear 	B1 [1]	Oe eg “People might forget and then make up some results” Not “it’s easier” unless justified Not “it saves time” unless justified

	Question	Answer	Marks	Guidance
6	(a)		B1 B1 B1 [3]	100 and zero 9702 198 SC if neither of the two previous marks are awarded then SC B1 if answers add up to 9900
6	(b)	<i>their</i> 198 + 100 2.98% or 3% or 0.0298 or 0.03	M1 A1FT [2]	Adding their 198 and 100 OR M1 $0.99 \times 0.02 + 0.01$ Or $\frac{298}{10000}$ oe. Allow 1 in 33(.55). Not 2.98 or 0.0298%
6	(c)	Their 298 as denominator soi 66(.44)% or 0.66(44) or $\frac{198}{298}$ oe	M1 A1FT [2]	OR M1 $\frac{0.99 \times 0.02}{0.99 \times 0.02 + 0.1}$ Allow “about two thirds” without workings
6	(d)	eg Yes/The claim is true, as more scam emails get through to people with security apps eg Yes 99% of scams go to people with the app eg Yes, by referring to their 2/3 or 66% from (6c)	B1 [1]	Oe eg Yes, because 198 is much more than 100 eg Yes, twice as many get the scams with the app
6	(e)	Yes as it blocks most (98%) scam emails Yes only 2% get through	B1 [1]	Oe Eg Yes 100% get through without the app

	Question		Answer	Marks	Guidance
7	(a)		Avoids bias from (eg) <ul style="list-style-type: none"> • Doing better second time due to practice • Doing worse second time due to being tired 	B1 [1]	An appropriate reason in context eg “to remove effect of the order of listening on results” Do not allow introduction of unrelated factors
7	(b)	(i)	6	B1 [1]	
7	(b)	(ii)	4	B1 [1]	
7	(b)	(iii)	No with reason eg <ul style="list-style-type: none"> • The sample size is too small • It could have happened by chance • You can’t prove anything for sure with a sample 	B1 [1]	eg No, “4 out of 8 did better which is only half” No “because 2 did the same” is not sufficient Note: Do not accept any justifications for yes, eg 4 out of 6 did better
7	(c)	(i)	98	B1 [1]	Accept without working
7	(c)	(ii)	$\frac{\sqrt{196}}{2}$ 7	M1 A1 [2]	Oe but not a wrong calculation Accept without working

	Question		Answer	Marks	Guidance
7	(c)	(iii)	$98 + 21 = 119$ or $98 - 21 = 77$ 119, 77 Between 78 and 118 (inclusive)	M1 A1FT A1FT [3]	Adding or subtracting 3sd to/from mean FT <i>their</i> mean and sd throughout; M1 if either of <i>their</i> 119 or 77 seen Both. Might be seen on a sketch. SC B1FT for a single tail test following M1A0: Upper tail and concludes ≤ 118 or < 119 max 2/3 Lower tail and concludes ≥ 78 or > 77 max 2/3

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