Level 3 Certificate

Mathematics

H869/01: Core Maths B (MEI): Introduction to quantitative reasoning

OCR Level 3 Certificate Core Maths B (MEI)

Mark Scheme for June 2024

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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.

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.

8. 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.

9. A*ssistant 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.*

10. For answers marked by levels of response:
    a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
    b. **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	AO	Guidance
1	(a)	(i)	$102.6 \times 1000 \times 1000 \times 1000 \times 1000$	B1	2	Allow 102 600 000 000 000 **or** 102.6×10^{12} **or** 10.26×10^{13} **or** (1 or 1.026 or 1.03 or 1.02) $\times 10^{14}$ **or** 10^{14}
			$=1.0 \times 10^{14}$	B1	1	Correct answer only
				[2]		
1	(a)	(ii)	112.4	B1	1	
				[1]		

1	(b)					
			Cost of spamming 100 000 × 0.0005 = £50	**B1**	**3**	
			Number of books sold as result of spamming			
			× 0.001 oe (100)	**M1**	**2**	Seen or implied
			× 0.4 × 0.02 oe	**M1**	**2**	Seen or implied e.g. ×0.008
			× 100000 = 0.8	**A1**	**3**	
			This assumes that all visitors to the site buy a book, so only 0 or 1 books sold	**B1FT**	**3**	Allow 0.8 and so no click throughs and expectation from *their* 0.8 × 8 Must have stated assumption that each visit to the site results in a sale, or that only a given proportion results in a sale (usually because of a large erroneous their "0.8").
			Considering economic benefit of spamming set against its cost Not the best way: spending £50 compared with profit from 0 / 1 / books which is only £0 / £8 /	**B1FT**	**1**	Allow similar reason and conclusion based on *their* £50 advertising costs
				[6]		

				Alternative method (Comparing a particular cost/spend with profit generated)			
				Number visiting the homepage for, say, £1 spent on spamming £1 buys $\frac{1}{0.0005}$ = 2000 (spam emails)	**B1**	**3**	Allow any stated or implied value (e.g. £100)
				Number of sales generated for the £1 ×0.001 (= 2 spam emails in inbox)	**M1**	**2**	Seen or implied
				×0.4 (= 0.8 opened)	**M1**	**2**	Seen or implied
				2000 ×0.08 = 0.016 (through to homepage – a view)	**A1**	**3**	
				Assuming that a 0.016 view converts into a sale	**B1FT**	**3**	This mark may be gained at any point. Allow any conversion rate 100% or less oe for *their* 0.016 view rate
				Considering economic benefit of spamming set against its cost 0.016 × £8 = £0.128 profit for £1 spend so spamming not worth it	**B1FT**	**1**	Following through on *their* conversion and *their* starting cost but comparison must be between correctly stated money units.
					[6]		

Question			Answer	Marks	AO	Guidance
2	(a)		(VEI of) 5	B1 [1]	1	
2	(b)		(VEI from volume ejected) = 2	B1	1	
			(VEI from height of plume) $V = \frac{9+25}{9}$	M1	2	Or equivalent seen or 3.777 or 34/9 seen
			4	A1 [3]	2	4 implies M1 A1 Working and answers must be clearly attributable to the appropriate method.

2	**(c)**		1 for each – up to maximum of 2, for example:- • Bigger differences at lower numbers or for low values of VEI the plume heights are greater than those using the material ejected. • For higher values there is good agreement, or for values of 5 and above agreement is perfect • Specific comparisons – with numbers stated	**B2** **[2]**	**3**	Do not allow comments based on accuracy i.e. "the results get more accurate" or "results are similar" oe Comments should be different. e.g. "the plume height is always the same or bigger" can only get B1 (a general summary so rules out any additional credit for other comments) Condone reference to "tables" i.e. "in the third table there is agreement between the two (methods)" For example, "material ejected 1 is lower than plume height" and "material ejected 2 is lower than plume height" would be B1 B1

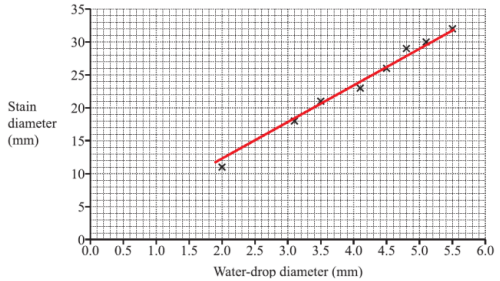
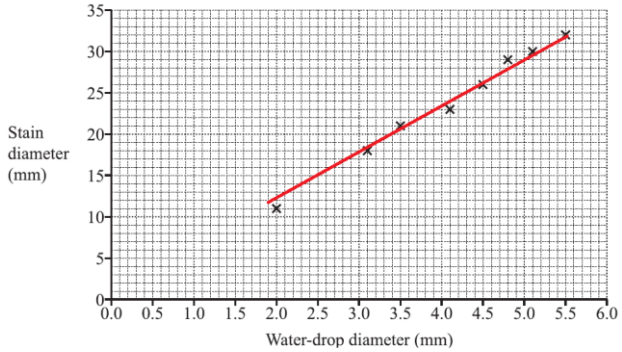
2	**(d)**	**(i)**	114 + 16 + 1 + 3 =134 (volcano eruptions with VEI of 4 or more)	**B1**	**2**	Full follow through on *their* 134 for the rest of the item.
			134 ÷50 = 2.68	**B1FT** **B1**	**2** **3**	*Their* 134 ÷ 50
			Alternative method			
			500 ÷10 = 50	**B1** **B1**	**2** **3**	
			Alternative method 500 ÷ 134 = 3.7 …	 **B1FT** **B1**	 **2** **3**	 500 ÷ *their* 134 ISW after 3.7 …
				[3]		
2	**(d)**	**(ii)**	(The distribution) is not bell shaped	**B1** **[1]**	**3**	Not symmetrical Skewed (negative) Condone any pair of (Mean. Mode or Median) stated as not having the same value.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>There are 69 stains</td><td>B1</td><td>1</td><td>Allow in range 64 to 74 then follow through on this value. Scrolling may be needed to find the “69”.</td></tr>
<tr><td></td><td></td><td></td><td>Area of filter paper
$= \pi \times 4.5^2 = 63.6172$ …. (cm^2) or
$= \pi \times 0.045^2 = 0.006361$…. ($m^2$)</td><td>B1</td><td>2</td><td>Allow 3 sf e.g. 63.6.
Allow these bands 63.585 to 63.6255 (cm^2) oe
(see table)
Estimating not acceptable at this point.
<table><tr><th>π</th><th colspan="2">Area</th><th>conversion factor</th><th>Drops in 10s</th></tr><tr><td></td><td>cm^2</td><td>m^2</td><td></td><td></td></tr><tr><td>3.14</td><td>63.585</td><td>0.006359</td><td>157.2698</td><td>65109.7</td></tr><tr><td>3.14159</td><td>63.6172</td><td>0.006362</td><td>157.1902</td><td>65076.74</td></tr><tr><td>3.142</td><td>63.6255</td><td>0.006363</td><td>157.1697</td><td>65068.25</td></tr></table></td></tr>
<tr><td></td><td></td><td></td><td>Area conversion to 1 square metre
$\frac{1}{0.006361} = 157.2.....$</td><td>B1FT</td><td>3</td><td>With appropriate bands based on the above.

This may well be subsumed in the working and not necessarily explicitly stated.</td></tr>
<tr><td></td><td></td><td></td><td>Number of drops falling in 1 minute is
$6 \times 69 \times 157$. ….
= 65 109.7 …..</td><td>B1FT</td><td>3</td><td>FT on the product their 157. … and their 69 × 6
The “× 6” may occur earlier but only gains credit here as part of their 157× their 69.</td></tr>
<tr><td></td><td></td><td></td><td>Which sensibly rounded would be 65 000 (drops per minute falling in a square metre)</td><td>B1FT

[5]</td><td>2</td><td>FT on their 65 080.8
(1, 2 or 3 sf the most likely but for some cases judgment needed), must be the result of a calculation,

Only award if rounding seen here or at other steps in the whole calculation.</td></tr>
</table>

3	**(b)**	**(i)**		**B1** **[1]**	**1**	Ruler drawn line.  By-eye – with a single straight line (condone poor erasing). Condone extrapolating and thick lines.
3	**(b)**	**(ii)**	2.5 to 2.8 (mm)	**B1FT** **[1]**	**1**	Followed through from *their* line.
3	**(b)**	**(iii)**	15 = 6d – 1 oe 16 = 6d oe giving d = 2.6(66) (mm) yes	**B1** **B1FT** **[2]**	**2** **2**	May be assumed from subsequent working Condone “yes” or “no” must be based on a calculation – allow “yes” for less than 0.2 difference or less **or** “close” oe for difference 0.1 or less but not zero.
			Alternative method			(Using *their* 3(b)(ii) to predict the stain diameter)
			6 × (2.5 to 2.8) – 1 = (14 to 15.8)	**B1**	**2**	6 × *their* response to **part (b)(ii) - 1**

			yes	**B1FT** **[2]**	**2**	Condone "no" if comparison made e.g. "too big" oe which fits *their* figures
3	**(c)**		$\pi \approx 3$ and $3.8 \approx 4$	**B1**	**2**	Any evidence of the two approximations i.e. $\sqrt[3]{\frac{6\times 4}{3}}$ or $\sqrt[3]{\frac{24}{3}}$
			2 (mm)	**B1** **[2]**	**1**	Dependent on first B1
			Alternative method			
			$\pi \approx 3$ and $7.6 \approx 8$	**B1**		
			so $d \approx \sqrt[3]{\frac{6\times 3.8}{3}} = \sqrt[3]{7.6} \approx 2$ (mm)	**B1** **[2]**		
3	**(d)**		460.75	**M1**	**1**	Showing sum of (Total of freq. × mid-interval) or answer
			÷ 319	**M1**	**1**	Showing sum of (Total number of raindrops) or answer
			1.4 (mm)	**B1** **[3]**	**1**	If zero so far for the item, follow through on rounding of their calculation (must be the result a calculation *their* 460.75 ÷ *their* 319) – with answer to 1 dp

Question			Answer	Marks	AO	Guidance
4	(a)	(i)	21.64 (seconds)	B1 [1]	1	Allow 21.63 to 21.65 (±1/2 a small square, must be 2 decimal places)
4	(a)	(ii)	2008	B1 [1]	1	
4	(a)	(iii)	Horizontal when existing record stands	E1	3	Allow equivalent relevant wording e.g. Horizontal shows how long a record lasted No change in record
			Vertical when a new record is set.	E1 [2]	3	Allow equivalent relevant wording e.g. Vertical show drop in record time

4	**(a)**	**(iv)**	Large drop in 2009 **or** Record broken twice in 2008 and in 2009 **or** Up the end of 2015 the record dropped by about between 0.7 and 0.8 seconds compared to 2005 **or** Between 2005 and 2015 the record dropped by 0.73 (seconds). **or** It went down from 21.64 (s) to 20.91 (s) **or** Record changed 4 times or there were 5 world records **or** Not changed since 2010 **or** In 2009 the time dropped from 21.41 to 20.91 **or** In 2009 the record fell by 0.5 (seconds)	**E1** **[1]**	**3**	Accept any correct sensible overall **detailed** observation(s): Do not accept: • specific items read from graph such as "in 2007 the World record was 21.41 seconds". • "They go down" oe Condone 0.74 (seconds) Condone 21.64 (s) to 20.9 (s) Condone 21.4 (s) to 20.9(s)

4	**(b)**			**B1**	**2**	50/B7 oe seen (C=50/B7 gains just this mark) Condone for 1 mark =50÷B7
			=50/B7	**B1**	**1**	Fully correct spreadsheet notation, including "=" must be seen, allow =(50/B7) or = 50*B7^-1 or = SUM(50/B7) (on the basis that it works in Excel)
				[2]		
4	**(c)**	**(i)**	(Using full length of pool) 50 005 (mm) or 5 000.5 (cm) or 50.005 (m)	**B1**	**2**	
			Yes, (this is within the range)	**B1**	**3**	Dependent on first B1 with correct units showing at some point.
				[2]		
			Alternative Method (Using uncertainties in length)			
			10 mm or 0.005 m or 0.5 cm seen	**B1**		
			Yes, with valid explanation	**B1**		e.g. 10 mm is larger than 5 mm so its acceptable oe
				[2]		
			Alternative Method (Using estimation of speed)			
			Max. time, assuming speed of 2 m s^{-1} $=\frac{50.005}{2} = 25.0025$	**B1**	**2**	
			This is within the ±0.005 seconds acceptable	**B1**	**3**	A conclusion is needed here to gain credit
				[2]		

4	**(c)**	**(ii)**				Beware of "plausible" arguments deriving from, say, mixing and erroneously comparing time and distance
			Estimation of speed of a 50m swimmer in women's race = 2 (ms^{-1}) **or** Estimation of time = 24 (s)	**B1**	**3**	e.g. 2 (ms^{-1}) soi Condone 2.04 to 2.08 (ms^{-1}) Condone in range 24 to 24.5 (e.g. as above "time = 24.4 (s)) Condone, say, median = 24, treat "median=" as isw "estimates" / time / speed mean / 24.307 / 2.057 mode / #N/A / 2.05 median / 24.335 / 2.055
			Time taken to swim 0.8 cm at 2 ms^{-1} is $\frac{0.008}{2}$	**M1FT**	**2**	FT on *their* estimation of speed
			= 0.004 (seconds)	**B1FT**	**3**	FT on *their* estimation of speed
			The uncertainty in timing is ± 0.005 (seconds)	**B1FT**	**3**	Must be explicitly used
			Which is greater than 0.004 (seconds), so can record same time.	**B1FT** **[5]**	**3**	FT on *their* swim distance time 0.004, if this figure makes it impossible to explain award credit if candidate states this.
			SC1 if up till this point 1 or less marks have been gained for this item			
			Correct usage of any of the distance/time/speed relationships	**SC1**		

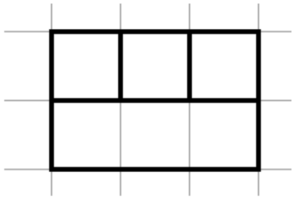
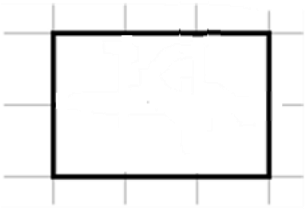
			Alternative method			
			Estimation of speed of a 50m swimmer in women's race = 2 (ms^{-1}) **or** Estimation of time = 24 (s)	**B1**	**3**	2 (ms^{-1}) soi Condone 2.04 to 2.08 (ms^{-1}) Condone in range 24 to 24.5 (e.g. as above "time = 24.4 (s)) and, say, median = 24, treat "median=" as isw "estimates" / time / speed mean / 24.307 / 2.057 mode / #N/A / 2.05 median / 24.335 / 2.055
			In an uncertainty in time of 0.005 seconds an international swimmer can travel about 2 × 0.005 (m)	**M1FT**	**3**	FT on *their* estimation of speed
			= 0.01 (m)	**B1FT**	**3**	FT on *their* estimation of speed
			Giving an uncertainty of 1 cm	**B1FT**	**3**	Must be explicitly stated
			0.8 cm is within this uncertainty in the distance so yes can record the same time.	**B1FT**	**3**	FT on *their* calculated uncertainty distance
				[5]		
			SC1 if up till this point 1 or less marks have been gained for this item			
			Correct usage of any of the distance/time/speed relationships	**SC1**		

Question			Answer	Marks	AO	Guidance
5	(a)	(i)	14 (days) oe	B1 [1]	2	
5	(a)	(ii)	111.80 (for £100) 111.80 × 3 = £335.40	B1 B1 [2]	2 2	Condone 111.8 (their working) Proper money notation – £335.40 needed Award full credit for correct use of formula giving £335.40, but only B1 total for (£)335.404…..
5	(b)	(i)	72 ÷ 6 = 12 (days)	B1 [1]	2	
5	(b)	(ii)	It's the same oe	B1FT [1]	2	Strict follow through on *their* 5(b)(i) Allow "quite close" or "similar" oe

5	**(c)**		$T=100\times\left(1+\frac{r}{100}\right)^n$	**B2** **[2]**	**2**	Fully correct (omission of the "×" quite acceptable) Accept $T=100\times\left(\frac{100+r}{100}\right)^n$ Condone $100\times\left(1+\frac{r}{100}\right)^n=T$ **B1** for responses with just one error or omission e.g. $T=100*\left(1+\frac{r}{100}\right)^n$ or $T=100\times\left(1+\frac{r}{100}\right)^{\wedge n}$ $£T=100\times\left(1+\frac{r}{100}\right)^n$ or $T=100\times\left(1+\frac{r\%}{100}\right)^n$ $100\times\left(1+\frac{r}{100}\right)^n$ or $T=100\times(1+r)^n$
5	**(d)**		The *y*-axis (or total amount owed axis) is logarithmic (or exponential)	**E1** **[1]**	**3**	1 for vertical axes is "uneven" oe (e.g. distances between 200 to 400 different to 600 to 800). Must, for example, have *y*-axis oe and "non-linear" oe Condone "the graph/scale is exponential/logarithmic" without specific reference to *y*-axes or total amount owed.

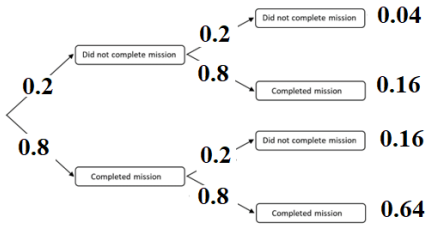
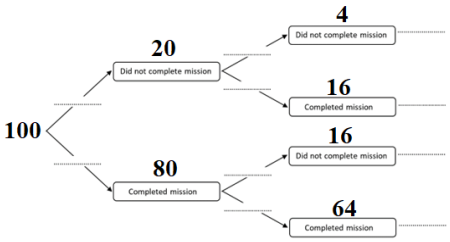
5	**(e)**					The legal limit is 0.8% compound per day – beware of simple interest being used to compare
			Using the table, the total owed for borrowing £250 for 7 days at 0.8% daily compound interest is 2.5 × 105.74	**M1**	**3**	Condone use of formula rather than table (as requested in the question) If £100 using formula and answer kept then 2.5×105.7362 ….. which gives (£)264.34 – see below.
			=(£)264.35	**B1FT**	**2**	Follow through on *their* (£)105.74 × 2.5 (or (£)264.34 see above)
			Brisk Bread charge a total of (£)250 + (£)15 = (£)265 which is illegal.	**B1FT** **[3]**	**3**	Follow through on *their* calculated (£)264.35 Explicitly stating "*Brisk Bread* loans are illegal" oe
			Alternative method (Using the formula) Not all steps may be shown (calculator use) condone this providing final step is clear. In some cases, the equation is solved using trial and improvement.			
			$250x^7 = 265$	**M1**	**3**	
			$x^7 = 1.06$	**B1**	**2**	
			$X = 1.06^{1/7}$ = 1.0083 … or 1.0084 so 0.83 (%) or 0.84(%) interest by *Brisk Bread* and illegal.	**B1** **[3]**	**3**	Need "So *Brisk Bread* is illegal" oe

			Alternative method			
			Using the table, the total owed for borrowing £250 for 7 days at 0.8% daily compound interest is 2.5 × 105.74	**M1**	**3**	Condone use of formula rather than table (as requested in the question).
			= (£)264.35	**B1FT**	**2**	Follow through on *their* (£)105.74 × 2.5
			Interest charge by *Brisk Bread* is (£)15 Maximum interest allowed = (£)264.35 – (£)250 = (£)14.35 So *Brisk Bread* is illegal	**B1FT**	**3**	Follow through on *their* calculated (£)14.35 Need explicit "So *Brisk Bread* is illegal"
				[3]		

Question			Answer	Marks	AO	Guidance
6	(a)			**B 1**	**1**	Condone free hand drawing with sensibly straight lines. Correct perimeter irrespective of any internal structure e.g.  Must be in correct orientation, but condone isometric clearly showing correct view for B1 B0
				B1	**1**	Fully correct
				[2]		

6	**(b)**		Photocell area (in squares) for one side = 11 squares which is $11 \times 4 = 44$ cm^2	**B1**	**3**	
			Total photocell area = 3×44 Which is 132 (cm^2)	**B1FT**	**2**	FT on *their* 44 cm^2
			Giving $132 \times 0.019 = 2.508$ (watts) so is sufficient	**B1FT**	**2**	FT on *their* 132 cm^2 Condone the correct implied comparison
				[3]		The various parts are sometimes blended, the question involves $11 \times 4 \times 3 \times 0.019$ (=2.508), should the above steps not be clear award full credit for correct answer **or** award B1 B0 for three of the products seen in the same calculation set – the final B1FT is available for the comparison of *their* final answer with 2.508.

6	**(c)**	**(i)**	0.6067 …. or 0.6 or 0.61 oe rot	**B1**	**2**	Allow % equivalents and fractions $\frac{108}{178}$ or $\frac{54}{89}$ And 0.6 or 60% or $\frac{110}{180}$ as the question says "estimate" isw if errors in simplifying fraction
				[1]		

6	**(c)**	**(ii)**	 (Column 1 Column 2 Column 3) Or equivalent with a starting number of say 100 CubeSats. 	**B1** **B1** **[2]**	**1** **1**	Allow fractions or percentages Last column would be $\frac{1}{25}$ $\frac{4}{25}$ $\frac{4}{25}$ and $\frac{16}{25}$ Correct probabilities or numbers leaving 3 nodes. Accept the correct fractions. Condone if second column is in fact the correct third column but mark *their* third column against the correct third column. Fully correct
6	**(c)**	**(iii)**	0.64	**B1FT** **[1]**	**1**	Allow 64% or any fractional equivalent i.e. $\frac{16}{25}$ oe Allow FT from *their* probability tree if less than 1, and the result of *their* P(complete) × *their* P(complete)

6	**(d)**	**(i)**	370 (km)	**B1** **[1]**	**1**	Allow 368km to 372km
6	**(d)**	**(ii)**	Tangent drawn at (720,310) Attempt to find gradient of the tangent by drawing a triangle and measuring sides Gradient about -0.30 to -0.50 so will be falling at a rate of 0.30 to 0.50 km/day	**M1** **M1** **A1** **[3]**	**2** **2** **3**	Condone clear intent to draw relevant tangent – including line not quite rouching the curve by a mm or so Condone attempt to find gradient with measurements at the wrong part of the curve. If measurements given fit the ends of the tangent line condone lack of triangle. Units are km/day are needed as well as value – negative not needed. Dependent on M1 M1
6	**(d)**	**(iii)**	The student is wrong. For example, a 5 kg CubeSat orbit height 400 km has a lifetime of 1000 days This is not double that for 200 km which is 1.9 days.	**B1** **[1]**	**3**	Only one correct example is needed to disprove. Need “false” or “no” and a numerical argument e.g. specific comparison: - For example, a 5 kg CubeSat orbit height 400 km has a lifetime of 1000 days. This is not double that for 200 km which is 1.9 days. General comparison: across the whole table there is no consistent scale factor between numbers in columns.
				[72]		

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