Level 3 Certificate

Quantitative Reasoning (MEI)

H868/02: Critical Maths

OCR Level 3 Certificate

Mark Scheme for November 2020

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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.

Annotations and abbreviations

Annotation in scoris	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

1. **Subject-specific Marking Instructions**

a Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

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 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, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) 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, eg 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
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.

E

A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg 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, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

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 Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

g Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

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 components. This is achieved by withholding one A mark in the question.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

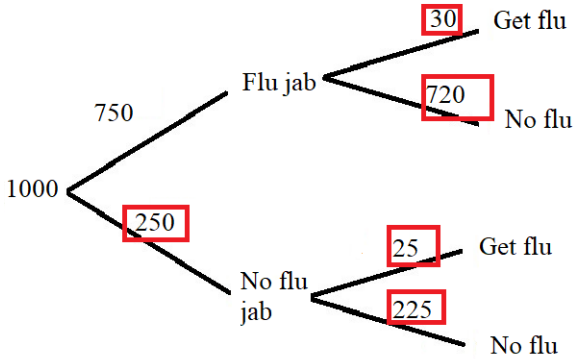
i Anything in the mark scheme which is in square brackets […] is not required for the mark to be earned, but if present it must be correct.

Question			Answer	Marks	Guidance	AOs
1	(i)		95[%]	B1 [1]	Answer in range 93 to 97	AO3
	(ii)		There are no points on the vertical axis	E1 [1]	OE eg 'Lowest handed in was 10%' Correct statement may be seen amongst other irrelevant points 'No dots or points at 0%' is not good enough as it doesn't specify which axis Reference to line of best fit not passing through the origin is not an appropriate explanation	AO2
1	(iii)		Possible reason e.g. • There were 10 assignments • The percentages have been rounded to the nearest 10	E1 [1]	OE eg 'assignments were each worth 10%' is sufficient Accept arguments that indicate % assignments truncated rather than rounded	AO2
1	(iv)		Suitable criticism e.g. • Only students who handed in 90% or 100% did better • It is only one test on one course • One person who handed in all assignments did worse than all those who handed in 90% • Correlation does not imply causation	E1 [1]	OE eg 'all those who handed in 20-80% of assignments got similar test results' Might indicate or compare specific students Ignore irrelevant statements such as knowing how well students did in their assignments	AO3

Question			Answer	Marks	Guidance	AOs
2	(i)		Each square in Fig. 2.1 is 9 cm^2	M1	9cm^2 soi by use of 3cm or 1.5cm	AO2
			Half a square is removed in total	M1	OR area of quarter square = 2.25 cm^2 OR area of half square = 4.5 cm^2 OR area of three quarter square is 6.75 cm^2	AO2
			Area = 13.5 [cm^2]	A1		AO1
			Alternative method			
			States removed portion of B is $\frac{1}{4}$ or $\frac{2}{8}$ of area A	M1	soi by use of $\frac{3}{4}$ or $\frac{6}{8}$	
			Calculates $\frac{1}{4} \times 18$ or $\frac{3}{4} \times 18$	M1		
			Area = 13.5 [cm^2]	A1		
				[3]		
2	(ii)		Each side is 3 cm	M1	Finding square root of *their* area of **one** square 3 may be seen on diagram	AO2
			8 equal sides	M1	OR attempt to find 4 × *their* 3 cm Second M1 can be earned by multiplying *their* side length by 4 or 8 (eg $\sqrt{18}$ ..leads to 33.94 M0M1A0)	AO3
			24 cm	A1 [3]		A01
2	(iii)		The two edges of the small square in Shape B are the same as the part of Shape A which is missing	M1	May draw in the missing quarter square and refer to this	AO2
			All the rest is the same	A1	Any justification that Jack is wrong is 0/2	AO3
			Alternative method		Note: consistent use of wrong side length can earn full credit here	
			The perimeter of each half of Shape B is formed from the sides of 8 little squares	M1	OE wording or calculations Or long sections are **4** x 3 = 12 cm Short sections are **8** x 1.5 = 12 cm	
			This is the same as for Shape A	A1	24 cm in all which is the same as A or Jack is correct	
				[2]		

Question			Answer	Marks	Guidance	AOs
3	(i)		125 kg	**B1** **B1**	Weight in range 122-128 Units correct	AO2 AO1
				[2]		
	(ii)		 103.77… 104 or 100 [kg]	**M1** **A1**	Substitution of 105 into formula soi Any level or accuracy OR $105^{2.65} = 227065..$ Accept 103.8, but 103.78 is A0	AO1 AO3
				[2]		
	(iii)		[The second estimate] is too low Reason	**B1** **B1**	 E.g. Weight must be between 115 kg and 135 kg FT ± 10 *their* (i)	AO3 AO2
				[2]		
	(iv)	(*A*)	$590 \div 5 = 118$ 100 [kg]	**M1** **A1**	OR the donkey weighs over 500 kg [so 100 kg will be lower than one fifth of weight] Draws the right conclusion	AO1 AO2
				[2]		
	(iv)	(*B*)	Reason in favour Either the new rule is simpler Or the extra rule about 100 kg maximum does not make much difference Reason against e.g. If there are a lot of big donkeys, the old rule is better.	**E1** **E1**	OR other sensible reason Note: new rule does not reduce the load for any donkey, therefore ignore spurious reasons E0 OR other sensible reason Note: reasons against the original rule scores E0	AO3 AO3
				[2]		

Question			Answer	Marks	Guidance	AOs
4	(i)		Group 3	B1		AO1
				[1]		
4	(ii)		Allows a comparison to be made	E1	OR Allows for effects of other factors	AO1
				[1]		
4	(iii)		The participants need to know what they are doing and so which group they belong to.	E1		AO3
				[1]		
4	(iv)		Valid improvement e.g • increase number of participants • encourage participants to keep going • exclude very fit participants from the trial	B1	NOT longer trial or shorter trial	AO3
				[1]		
5	(i)	(*A*)	Total UK population is 65 million	B1	Answer in range 60 to 70 million	AO1
				[1]		
5	(i)	(*B*)	80 years	B1	Answer in range 65 to 95 years	AO3
				[1]		
5	(ii)		$70 \times 12 [= 840]$ $840 \times 24 [= 20160]$ $20160 \times 365 = 7358400$ Population would be replaced in 10 years; this is not realistic so cannot be true	M1 M1 A1 A1	Children per hour Children per day Children per year (may use 350 or 360 or 366 days) Correct conclusion from completely correct working	AO2 AO2 AO2 AO3

Question			Answer	Marks	Guidance	AOs
			Alternative method 65 million people with lifespan approx 80 About 800 000 people born a year $800000/365 \approx 2192$ $2192 \div 24 = 91$ $91/12 = 7.6$ This is nowhere near 70 so cannot be true	 **M1** **M1** **A1** **A1**	 *Their* **(i)** (*A*) ÷ *their* **(i)** (*B*) Children born a day (may use 350 or 360 or 366 days) Children born per hour (need not be rounded) Children per 5 minutes (need not be rounded) Correct conclusion from completely correct working	
				[4]		
6			About 49% lost in 13 years	**M1**	Readings from graph to find a rate of change	AO2
			3.76% loss per year; 43.8 ÷ 3.76	**M1**	Finding and using *their* rate for the remaining years	AO2
			= 11.6 so 2028	**A1**	Or 2029	AO3
				[3]		
7	**(i)**		$10 - 4 = 6$ $\frac{6}{10} = 0.6$ Correct completion to 60%	**M1** **A1**	May use representative frequencies AG	AO2 A03
				[2]		
7	**(ii)**	**(*A*)**		**B1** **B1** **B1** **[3]**	250 correct Correct frequencies on one pair of final branches Correct frequencies throughout tree	AO1 AO2 AO3

Question			Answer	Marks	Guidance	AOs
		(*B*)	5.5[%]	**M1** **A1**	Adding *their* 30 and 25 **OR M1** $0.75 \times 0.04 + 0.25 \times 0.1$	A02 AO1
				[2]		
		(C)	$\frac{30}{55}$ oe	**M1** **A1**	*Their* 55 as denominator **OR M1** $\frac{0.75\times0.04}{0.75\times0.04+0.25\times0.1}$ 54.5%	AO2 AO3
				[2]		
7	**(iii)**		Argument in favour related to information in question. E.g. • Reduces the risk of flu so worth doing • Flu can be serious and the jab is free so worth doing.	**E1**	OE eg 'only a very small proportion of those vaccinated catch the flu	AO3
			Argument against related to information in question. E.g. • Can still catch flu so not worth doing • Most will not catch flu anyway so not worth doing.	**E1**	OE eg 'it may be a new strain of flu against which the vaccine doesn't provide immunity'	AO3
				[2]		
8	**(i)**	**(*A*)**	7000	**B1**	Answer in range 6800 to 7100	AO1
		(*B*)	4300	**B1**	Answer in range 4100 to 4400	AO1
				[2]		

Question			Answer	Marks	Guidance	AOs
8	(ii)		Suggestion to improve charts, e.g. • Make the vertical axes the same • Put all the information on one bar chart	B1	OE eg Allow 'use the same scales' eg 'have the M/F groups next to each other'	AO3
				[1]		
8	(iii)		average driving is 8471 miles So 847 100 miles	M1	*Their* number × 8471	AO1
			847 100 ÷ 89	M1	$\frac{8471}{0.89}$ earns M1 M1	AO1
			9518 miles each	A1		AO1
				[3]		
8	(iv)		For every 100 females, average driving is 3582 miles so 358 200 miles	M1	*Their* number × 3582 M1 can be earned for method consistent with their attempt in (iii)	AO2
			Driven by 74 females so 4840 miles each	A1	$\frac{3582}{0.74} = 4840$ earns M1 A1	AO2
			9518 miles is about double 4840 miles	E1	Justification of about half from *their* consistent working	AO3
				[3]		
8	(v)	A	50	B1		AO1
				[1]		
		B	$\frac{\sqrt{100}}{2}$	M1		AO2
			5	A1		AO1
				[2]		
8	(vi)		59 is less than 2 sd from the mean	M1	Comparison of 59 with *their* mean and *their* sd	AO2
			This is not unusual so the assistant is wrong	A1	CAO must be with reason SC1 for 'it's very unlikely you would get exactly equal numbers of male and female drivers in the sample' OE	AO3
				[2]		

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