



## **Level 3 Certificate**

## **Quantitative Reasoning (MEI)**

Unit **H866/02** Statistical problem solving

OCR Level 3 Certificate

## **Mark Schemes for June 2018**

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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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## Annotations and abbreviations

<b>Annotation in scoris</b>	<b>Meaning</b>
✓ 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	
<b>Other abbreviations in mark scheme</b>	<b>Meaning</b>
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

**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.

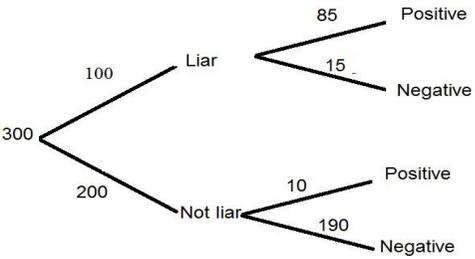
Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

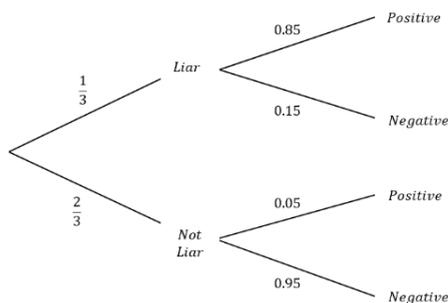
- i Anything in the mark scheme which is in square brackets [...] is not required for the mark to be earned, but if present it must be correct.

Question			Answer	Marks	Guidance	
1	(i)	(A)	Answer in range 31 to 35[%] inclusive	<b>B1</b>		
		(B)	Answer in range 65 to 69[%] inclusive	<b>B1</b> <b>[2]</b>	OR FT 100 – <i>their A</i>	
	(ii)		5[%]	<b>B1</b> <b>[1]</b>	Condone -5 [%] decrease Accept 0.05 but 0.05% is B0	
	(iii)		0.69 × 21.7 [million] oe 0.64 × 23.4 [million] oe 14.973 [million] 14.976 [million] No [there were not fewer in 2011] oe [3000] more in 2011	<b>M1</b> <b>A1</b> <b>A1</b> <b>B1 FT</b> <b>[4]</b>	For either percentage calculation (implied by correct answer) Allow M1 with place value slip in households 14 973 000 14.97m 14 976 000 14.98m Less in 2001 or [about] the same number FT conclusion must be consistent with <i>their</i> working. Qualitative work only: SC1 is possible eg ‘population has increased so lower % could still be a bigger number’	
		(iv)	[Each bar represents] <b>100%</b> oe	<b>B1</b> <b>[1]</b>	Allow comments that say it should not be 100% with a reason, e.g. does not include the homeless.	
2		(i)	(A)	4.4	<b>B1</b>	$\frac{7 + 4 + 4 + 5 + 2}{5}$
			(B)	2 and 7 eliminated 4.3[3333....]	<b>M1</b> <b>A1</b> <b>[3]</b>	<b>SC1</b> for 3½
	(ii)		Attempt to calculate BOTH combined scores for any new set of 5 scores Either correct combined score for that set Both scores correct for a set of scores 0 – 10 that demonstrates ‘eliminate extremes’ is higher	<b>M1</b> <b>A1</b> <b>A1</b> <b>[3]</b>	Implied by correct set of scores  Must include both combined scores or other justification eg for 0, 5, 5, 5, 9 average of middle three scores is more than average of highest and lowest Condone rounding or truncating if conclusion unaffected A wrong set of scores can earn M1A1A0	

Question		Answer	Marks	Guidance
	(iii)	Attempt to calculate BOTH combined scores for any new set of 5 scores  Both scores correct for a set of scores 0 -10 that demonstrates combined scores are equal	<b>M1</b>  <b>A1</b>  [2]	Implied by correct set of scores  Must include both combined scores or other justification eg for 5, 5, 5, 5, 5 eg for 1, 2, 3, 4, 5 average of middle three scores is equal to average of highest and lowest  Must work exactly ie both scores correct with no rounding or truncation errors
	(iv) (A)	Uses all values oe	<b>B1</b>	Soi any reference to using all numbers [therefore fairer or true average] Do not accept 'easy to calculate'
	(iv) (B)	Removes outliers / anomalies / biased scoring oe	<b>B1</b> [2]	Soi reference to fairer because uses middle values or highest/lowest excluded
3	(i)	$10 \times 2.8$ oe  28	<b>M1</b>  <b>A1</b> [2]	Implied by correct answer or implied by 10% + 8%  If zero scored, <b>SC B1</b> for 18
	(ii)	<b>No</b> because can't reduce by over 100% oe	<b>B1 FT</b> [1]	Must have reason eg '% decrease is not the same as % increase' or 'reducing by 180% makes it negative' Allow good qualitative argument eg ref to proportions or % of different amounts  Justification could be example using numbers from <i>their</i> (i) e.g. reduction is $\frac{28-10}{28} \times 100 \approx 64\%$
	(iii)	25 [%]	<b>B1</b> [1]	
	(iv)	125 000 25% of 125 000 31 250 cao	<b>B1</b> <b>M1</b> <b>A1</b> [3]	FT <i>their</i> iii (eg may be 95%) and <i>their</i> 125 000 (or 250 000) for M1 May be rounded 37500 from 6250+31250 scores B1M1A0

Question		Answer	Marks	Guidance
	(v)	Negative correlation	<b>B1</b> [1]	Or description of this eg ‘higher internet use [corresponds] lower smoking’ Not a wrong description eg ‘households with more internet smoke less’ Ignore weak/strong
	(vi)	One relevant and correct comment	<b>B1</b> [1]	Eg ‘Correlation does not imply causation’ Eg ‘No obvious reason why her statement should be true’ Allow reasonable arguments such as ‘one addiction replaced by another’ or ‘improved (internet) access to information / health risks of smoking’ Accept ‘may be other factors [causing reduction]’
<b>4</b>	(i)	(A) Total UK population is 65 million	<b>B1</b>	Answer in range 60 to 70 million
		(B) Ages 0 to 80 Age 16+ is about 80% of the total  52 million $0.31 \times \textit{their}$ 52 million  $\approx$ 16 million	<b>M1</b> <b>M1</b> <b>A1</b> <b>M1</b> <b>A1 FT</b> [6]	Soi consideration of overall age with adults $\geq$ 50% Proportion of adults in range 70% to 85% If elderly specifically excluded allow proportion to be as low as 50% Adults in range 42 to 60 million (elderly excluded: allow 30 million) Calculation must be 31% or 30% or $\frac{1}{3}$ of either adults or whole population. M0 any other % adults. Expect final answer in range 12 million to 20 million if working correct Elderly excluded: accept 9 million M0M0A0M1A1FT is possible.
	(ii)	1.2 billion $\div$ <i>their</i> (i)[=75] Comparison with time  About once a week OR a bit more than once a week oe.	<b>M1</b> <b>M1</b> <b>A1 FT</b> [3]	Must be their final answer [for adults taking selfies] from i To give better than per year: eg 12 months, 52 weeks or 365 days. Can be awarded independently of first M1 FT from <i>their</i> i is dependent on M1M1. Do not accept “once a week” with no working
	(iii)	Zero oe	<b>B1</b> [1]	

Question		Answer	Marks	Guidance																
5	(i)	Length for one medal in range 50 cm to 120cm oe Multiply by 30 Ans 30 times value for 1 medal	M1 M1 A1 FT [3]	20-48 inches  Dep on 2 <sup>nd</sup> M mark only (M0M1A1 possible); need units for A1 SC2 for answer in range 15m to 36m with no working.																
5	(ii)	12 – 7 and 6 – 1 Same number of turns [each roll] but each turn has longer length on 12 cm roll oe Roll A has more ribbon from correct working	M1 M1  A1 [3]	<u>Widths method:</u> Soi 'same width' of ribbon. M1M0A1 possible if not fully explained.  <u>Alternative method: cross-sectional areas</u> M1 $\pi \times (6^2 - 3.5^2) [= 23.75\pi] [=74.6]$ oe M1 $\pi \times (3^2 - 0.5^2) [= 8.75\pi] [27.5]$ oe condone $-1^2$ A1 Roll A has more from correct working																
6	(i)	100–2 or 100 – 47 53% oe [to] 98% oe	M1 A1 A1 [3]	For subtracting either from 100 Allow 0.53 Allow 0.98																
	(ii)			Working can be shown in a two way table instead of a tree diagram  <table border="1" data-bbox="1131 986 1608 1173"> <thead> <tr> <th></th> <th>+ve</th> <th>-ve</th> <th>total</th> </tr> </thead> <tbody> <tr> <th>Liar</th> <td>85</td> <td>15</td> <td>100</td> </tr> <tr> <th>Not liar</th> <td>10</td> <td>190</td> <td>200</td> </tr> <tr> <th>total</th> <td>95</td> <td>205</td> <td>300</td> </tr> </tbody> </table>		+ve	-ve	total	Liar	85	15	100	Not liar	10	190	200	total	95	205	300
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			M1	Tree diagram with appropriate labelling or table with labels or equivalent numbers clearly shown																
			A1	Correct partial frequencies or probabilities on ONE set of branches																

Question		Answer	Marks	Guidance
			<b>A1</b>	<p>Correct partial frequencies or probabilities on ALL branches</p> <p>Probabilities can be fractions/decimals/percentages</p> <p><u>Calculations with no tree or table:</u> Allow M1A1 once two outcomes have been identified in calculation. Final A1 requires all 4 outcomes.</p>
	(A)	<p>Adding the 2 relevant outcomes</p> <p><math>\frac{10}{95}</math> oe <math>\frac{2}{19}</math> 10.5% cao no FT</p>	<p><b>M1</b></p> <p><b>A1</b></p>	<p><u>Frequencies:</u> their 85 + their 10 [=95]</p> <p><u>Probabilities:</u> their <math>(\frac{1}{3} \times 0.85 = \frac{17}{60})</math> + their <math>(\frac{2}{3} \times 0.05 = \frac{2}{60})</math> [= <math>\frac{19}{60} = 0.31\bar{6}</math>]</p> <p>From <math>\frac{1}{30} \div \frac{19}{60}</math></p>
	(B)	<p>Adding the 2 relevant outcomes</p> <p><math>\frac{15}{205}</math> oe <math>\frac{3}{41}</math> 7.3% cao no FT</p>	<p><b>M1</b></p> <p><b>A1</b></p> <p>[7]</p>	<p><u>Frequencies:</u> their 15 + their 190 [=205]</p> <p><u>Probabilities:</u> their <math>(\frac{1}{3} \times 0.15 = \frac{1}{20})</math> + their <math>(\frac{2}{3} \times 0.95 = \frac{37}{20})</math> [= <math>\frac{41}{20} = 0.68\bar{3}</math>]</p> <p>From <math>\frac{1}{20} \div \frac{41}{60}</math></p>
(iii)	(A)	200	<b>B1</b> [1]	
	(B)	$\frac{\sqrt{400}}{2}$ 10	<b>M1</b> <b>A1</b> [2]	
	(C)	<p>their 200 at axis of symmetry</p> <p>Scale going up in their sd soi</p>	<b>B1 FT</b> <b>B1 FT</b> [2]	<p>FT their (A)</p> <p>FT their (B)</p>

Question		Answer	Marks	Guidance
	(iv)	<p>Polygraph seems to be doing better than 50% detection oe</p> <p>Over 2 or over 3 sd from mean oe</p>	<p><b>B1</b></p> <p><b>B1</b></p> <p><b>[2]</b></p>	<p>Correct conclusion oe: eg the [50%] assumption was not right / he was incorrect</p> <p>Reason oe: eg 5.7 sd above mean or 'very unlikely result' FT reasoning here from <i>their sd in B</i></p>

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