

**Level 3 Certificate**

**Quantitative Reasoning (MEI)**

Unit **H866/02** Critical Maths

OCR Level 3 Certificate

**Mark Schemes for June 2017**

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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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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

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.

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.

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.

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.

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.

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.

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.

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.

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	Grade	AOs
1	(i)	(A)	Lowest point in scatter diagram circled.	<b>B1</b> [1]		E	2
		(B)	65 (%)	<b>B1</b> [1]	$\pm 2$ FT from their circled point.	E	1
	(ii)		F T F T F	<b>B3</b>          <b>[3]</b>	Minus 1 for each one wrong (min mark zero)	E	3
2			Relative size: all small squares are equal oe OR large (square) is 4 times small (square) or vice versa oe  Total grey squares correct (=8)  (Whole design) has 4 times as much grey as white www	<b>B1</b>     <b>B1</b>  <b>B1</b>  <b>[3]</b>	May be on diagram or referred to as 10 small squares (implied by '8 shaded' and '2 clear') Accept white is quarter of grey 'square' or grey is 4 times (bigger than) white.  Must be referring to whole design (not just comparing a grey square to white)  <u>ALTs</u> Accept equivalent steps if lengths assigned to edges of squares Accept equivalent steps with fractions ie clear use of 1/10 is relative size point; 8/10 is correct for grey  <b>SC B2</b> for "4 times" with <u>no working</u>	E(3)	AO2(2) AO3(1)

Question			Answer	Marks	Guidance	Grade	AOs
3	(i)		$2066 \rightarrow 2000$ $812 \rightarrow 800$ $\frac{2000}{800} = 2.5$ or $800 \times 2.5 = 2000$ oe	<b>M1</b> <b>M1</b> <b>A1</b>  <b>[3]</b>	2066 rounded 812 rounded Completion to show result is close to 2.5(4) SC B2 for $\frac{20}{8} = 2.5$ if rounded figures not seen. NOTE: Candidates may work with unrounded values provided sufficient detail (eg multiplication or division processes shown), but calculator dependent methods score zero	E(3)	AO2 (2) AO1 (1)
	(ii)		1.33 or 2000 1.39 or 2005 1.24 or 2010	<b>B2</b> <b>[2]</b>	<b>B2</b> for all correct and no extras. Accept unambiguous statement of 'last 3 values' (in table). <b>OR B1</b> for at least one correct or all correct with up to two extras	C C	AO3 AO3
	(iii)		$\frac{1528}{1528 + 492}$ oe 75.6% or 76% w/w	<b>M1</b>  <b>A1</b> <b>[2]</b>	 Need not be rounded. 75.7 scores A0. SC B1 75% from rounded figures $\frac{1500}{2000}$	C(2)	AO1(2)
	(iv)		Approx 3500 men Approx 4500 women  $8000 \times \text{quarter million} = (\pounds)2000 \text{ million or 2billion}$	<b>M1</b> <b>M1</b>  <b>A1</b> <b>[3]</b>	 Approx total 8000 students implies both M1 marks  Answer which rounds to this to 1sf and is given to no more than 4 sf	C C C	AO1 AO2 AO3
4	(i)	(A)	$6 + 10$ 16 (%) as final answer	<b>M1</b> <b>A1</b> <b>[2]</b>	Accept $\frac{16}{96} = 16.7$ (%) or 16.6 (%) or 17 (%) Ignore subsequent rounding. SC B1 for 15.36 from 16% of 96	E E	AO3 AO1



Question		Answer	Marks	Guidance	Grade	AOs
	(B)	$6 + 10 + 17 + 30$ 63 (%) as final answer	<b>M1</b> <b>A1</b> <b>[2]</b>	Accept $\frac{63}{96} = 65.6$ (%) or 66 (%) Ignore subsequent rounding. SC B1 for 60.48 from 63% of 96	E E	AO3 AO1
	(ii)	Grade 4: $2 \times \frac{30}{3}$ = 20 Grade 5: $\frac{30}{3} + \frac{17}{3}$ = $15\frac{2}{3}$ or 15.6 or 15.7 Grade 6: $2 \times \frac{17}{3}$ $11\frac{1}{3}$ OR 11.3	<b>M1</b> <b>A1</b> <b>M1</b> <b>A1</b> <b>M1</b> <b>A1</b> <b>[6]</b>	Bottom $\frac{2}{3}$ of C grades as a calculation Top $\frac{1}{3}$ of C grades + Bottom $\frac{1}{3}$ of B grades as a calculation Accept 16 Top $\frac{2}{3}$ of B grades as a calculation Accept 11 (or 11.2 from $2 \times 5.6$ or 12 from $2 \times 6$ rounded) SC B1 for 3 values that sum to 47 if zero scored SC B3 for 11   16   20 with no working	C C C C A A	2xAO1 2xAO2 2xAO3
	(iii)	Description of suitable method is required Correct result for Hilary Correct result for Jay Correct result for Nadia First and second place stated	<b>B1</b> <b>B1</b> <b>B1</b> <b>B1</b> <b>B1</b> <b>[5]</b>	Some possible methods are listed below with results for the three students. <ul style="list-style-type: none"> <li>Total of grades: H51, N 37, J33</li> <li>Mean grade: N 6.2, H5.7, J4.7 (accept rounded or truncated eg N6.1 or H5.6)</li> <li>Total of best five grades: H36, N34, J28</li> </ul> Final B1 dependent on at least B2 earlier	E(3) C(2)	3xAO2 2xAO3

Question		Answer	Marks	Guidance	Grade	AOs
	(iv)	Relevant disadvantage stated	<b>B1</b> [1]	Disadvantage must relate to their chosen method E.g. <ul style="list-style-type: none"> <li>Does not use all scores (subjects)</li> <li>Does not use the same number of scores (subjects) for each student</li> <li>Not just a non-specific reference to outliers</li> <li>Not there would be lots of calculations to do</li> </ul>	C	AO3
5	(i)	Answer in range 2 (m) to 7 (m)	<b>B1</b> [1]		E	AO2
5	(ii)	<p>1 mile = 1600 (m)</p> <p><math>1600 \div \textit{their} 5 = (320)</math></p> <p><math>\textit{their} 320 \times 10</math> (miles) = (3200)</p> <p><math>3200 \times 2</math> (lanes) to obtain final answer in range 4000 to 12800</p>	<p><b>B1</b></p> <p><b>M1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> <p>[4]</p>	<p>FT <i>their</i> (i) or fresh start with car length 2 to 7m, with or without gaps between cars</p> <p>Mile converted to metres seen or implied</p> <p>Relevant distance (could still be in km) <math>\div</math> car length</p> <p>10 mile queue, single lane. Award first 3 marks in any order.</p> <p>Final answer must be a whole number www.</p> <p><b>SC B2</b> for answer in range 4000 to 12800 with no working</p>	E C C C	AO2 AO2 AO3 AO1

Question			Answer	Marks	Guidance	Grade	AOs
6	(i)	(A)	<p>OR</p>	<p><b>B1</b></p> <p><b>B1</b></p> <p><b>B1</b></p>	<p>Correct partial frequencies or probabilities within any branch:</p> <p>First set of branches</p> <p>Upper second set of branches</p> <p>Lower second set of branches</p> <p>Probabilities can be fractions, decimals or percentages</p> <p>Partial frequencies need not be whole numbers</p>	<p>C(2)</p> <p>A(3)</p>	<p>AO1 (2)</p> <p>AO2 (3)</p>
		(B)	$\frac{45 + 199}{10000} \quad \left( = \frac{244}{10000} \right)$ <p>or <math>0.005 \times 0.9 + 0.995 \times 0.02 \quad (= 0.0045 + 0.0199)</math></p> <p>2.44% oe</p>	<p><b>M1</b></p> <p><b>A1</b></p> <p><b>[5]</b></p>	<p>FT values from <i>their</i> tree for method, but partial frequencies and probabilities must now be consistent</p> <p>May be rounded (eg 2.4% or 2%) but do not accept 2% without working.</p> <p><u>Alternative method</u> Partial frequencies could be shown in a two way table</p>		

Question		Answer	Marks	Guidance	Grade	AOs
	(ii)	$\frac{199}{199 + 45} (= \frac{199}{244}) \text{ oe } \frac{0.995 \times 0.02}{0.0244} (= \frac{0.0199}{0.0244})$ 81.557....% oe $\approx$ <b>81.6% AG</b>	<b>M1</b>  <b>A1</b> <b>[2]</b>	Numerical values required. FT values from <i>their</i> tree in numerator and denominator for method Note AG; 81.6 unsupported scores zero	A(2)	AO2 AO3
	(iii)	Reasonable action e.g. <ul style="list-style-type: none"> <li>• Make further checks</li> <li>• Check with the customer or card-holder</li> <li>• Do not allow the purchase</li> </ul>	<b>B1</b> <b>[1]</b>	Accept: Perform a re-test or second test Block the card  Do not accept: police / legal / prosecute / courts	A	AO3
7	(i)	<b>Feature - Reason</b> Randomised - Eliminates effects of other factors  Controlled - Allows comparison  Impulsivity questionnaires – Measures change	<b>B1</b>  <b>B1</b>  <b>B1</b> <b>[3]</b>	Do not award mark for feature joined to more than one reason.	E E E	AO1 AO1 AO3
	(ii)	Avoids bias (due to wanting the trial to be successful)	<b>E1</b>  <b>[1]</b>	Accept a description of bias Accept: the person's views won't affect.. (questionnaires / outcomes) Not unspecific reference to judgements	C	AO3
	(iii) (A)	-60.1	<b>E1</b> <b>[1]</b>	Must be negative	E	AO1
	(B)	Numbers are lower oe Or refer to treatment effect being negative	<b>E1</b> <b>[1]</b>	Must use a comparator eg smaller / lower oe not just quote corresponding figures.	E	AO3

Question		Answer	Marks	Guidance	Grade	AOs
	(C)	Refer to 120 re-offences per 100 prisoners	<b>E1</b>  [1]	Explanation required as answer is given. Or refer to re-offences per 100 prisoners is greater than % reconvicted	C	AO2
(iv)	(A)	200 cao	<b>B1</b> [1]		E	AO1
	(B)	$\frac{\sqrt{400}}{2}$ 10	<b>M1</b>  <b>A1</b> [2]	Allow $\frac{200}{\sqrt{400}}$ or $\sqrt{\frac{200}{2}}$  www	C C	AO2 AO1
(v)		$\frac{239 - 200}{10}$ soi 3.9 standard deviations from mean An unusual result so probabilities unlikely to be equal	<b>M1</b>  <b>A1</b> <b>A1</b> [3]	M1 for an approximate number of <i>their</i> sd from the mean  Accept 'over 3 sd' for A1  Note: Comparison of group sizes by number or % scores zero	A A A	AO2 AO2 AO3

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