OCR
Oxford Cambridge and RSA

Level 3 Certificate

Quantitative reasoning (MEI)

Unit **H866/02** Critical Maths

OCR Level 3 Certificate

Mark Schemes for June 2016

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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.

Annotations and abbreviations

Annotation in scoris	Meaning
	
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
	Highlight

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

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.

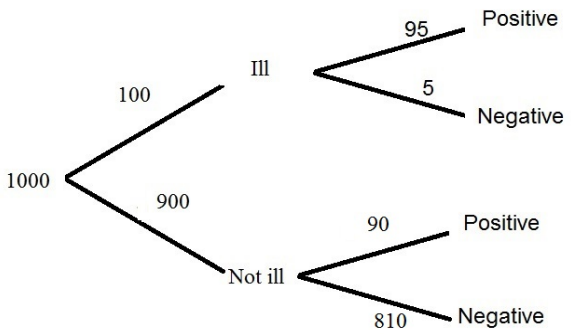
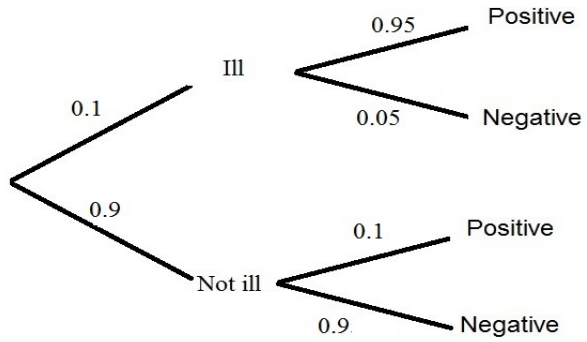
Question			Answer	Marks	Guidance	
1	(i)		20	**B1** **[1]**		
	(ii)		Three percentages which add to 100 and round to 54, 37 and 10	**B2** **[2]**	**B1** for three unrounded % which add to 100 and two of them round to correct values Or **B1** for three unrounded % which round to correct values but do not add to 100	Eg 53.5, 36.5, 10 Eg 54.4, 36.6, 9 Eg 54.1, 36.9, 10.2
	(iii)		$\frac{54}{54+37}$ oe 0.59[34...] **cao AG**	**M1** **M1** **A1** **[3]**	**Numerator** **Denominator** (accept 90) Or changing fraction to percentage	Alternative method "54+5" with explanation: splitting the *10% don't knows* equally **M1** (5+5), 54+5 **M1 A1** **SC B1** for "54+5" without explanation
	(iv)		60.8…oe $\frac{56}{56+36}$, 0.608... 61 cao 100 – *ans* ... [39]	**B1** **B1** **B1**√ **[3]**	Percentage fraction or decimal	Alternative method **B1** Either "56+4" or "36+4" oe **B1** 60 **nfww** **B1** 40 **nfww**
2	(i)		Each shaded region is a circle [same size] minus the centre region [common/overlapping]	**E1** **[1]**	Condone lack of conclusion that they are the same as this is given in the question.	Alternative method "Vertical" line of symmetry identified (may be drawn on diagram) with correct comment
	(ii)		Centre region smaller Each shaded region is more than half a circle oe	**B1** **E1** **[2]**	Or shaded region bigger OR The centre region is less than half a circle oe	OR other proportions if clear

Question			Answer	Marks	Guidance	
3	(i)		Correct reason Different correct reason Fig 3.2 is better	**M1** **M1** **A1** **[3]**	Dep on either M1	Correct reasons include • Second graph allows numbers to be read off • Second graph has smaller scale (in 2's rather than 5's) • Second [2D] graph makes comparison easier • First graph makes it look as though minimum wage is lower than it is • 3D charts [pyramids] can be confusing / distracting / misleading
	(ii)		Hourly increase £0.70 soi oe Uses hours per week in range 30 to 50 oe Uses weeks per year in range 40 to 52 oe Annual increase in range £800 to £2000	**M1** **M1** **M1** **A1** **[4]**	Increase may be inferred from calculation of new wage and old wage Must be a wage [not %] increase	If at least one method mark gained and estimate in correct range given all method marks can be assumed. If 0/4 **SC B1** for 10.7[69]% increase
	(iii)		Reads off from 50% on vertical axis Answer in range £11.50 - £12	**M1** **A1** **[2]**	May be seen as lines on graph	Correct answer implies correct method Allow **M1A0** for median from 45%
	(iv)		Method for estimate Answer in range 2[%] to 10[%]	**M1** **A1** **[2]**	May be seen as continuation of line on graph or reading off wage for 10% Accept "less than 10%" oe	From 6.5 not 7 Answer in range implies correct method

Question			Answer	Marks	Guidance	
3	(v)	*A*	No change All those who earned more due to the national living wage were below the median	**B1** **E1**		Correct reasons include • Median not affected by outliers / extreme values • Same numbers [earning wages] below and above the median • Wages near the median / middle have not changed • Only those below 50% were affected
		B	Increase The total wage went up	**B1** **E1** **[4]**		Correct reasons include • Mean is affected by outliers / extreme values • All wages are used when calculating [adding up and dividing] the mean • Relevant calculations

Question			Answer	Marks	Guidance	
4	(i)		£45, £38, £25, £19 soi Method A 45 + ½(38) + 25 + ½(19) oe £98.50 Method B 45 + ½(19) + 38 + ½(25) oe £105	**M1** **M1** **A1** **M1** **A1** **[5]**	Prices ordered highest to lowest, implied by at least one correct answer	
	(ii)		In each case, the higher priced item is full price and the lower priced one is half price	**E1** **[1]**	OE	
	(iii)		Four prices with the second and third highest equal	**B1** **[1]**		E.g. Four equal prices
	(iv)		Possible method explained fully Method applied to 5 prices to get final price	**E2** **B1** **[3]**	OR **E1** for possible method which is not clearly explained or incomplete, can be implied by calculation	E.g. As for Method A but the fifth item is paid for in full. E.g. As for Method B but the middle item is paid for in full. Method need not be based on Method A or Method B **SC B1** for BOGOF explained and used correctly

Question			Answer	Marks	Guidance	
5	(i)		Other possible cause	**B1** **[1]**		Possible causes include the following. • Trying harder • Better teaching • Regression to the mean • Placebo effect • Learned from mistakes • 2nd test was easier Not just "one year older.."
	(ii)		Have more than 10 children oe	**B1** **[1]**	OR continue experiment for longer	Improvements include • Male / female groups • Matching of groups by some criteria
	(iii)	(*A*)	2	**B1**		In each part, if more numbers circled than asked for, award zero
		(*B*)	4	**B1**		
		(*C*)	5, 6	**B1, B1** **[4]**		
	(iv)	(*A*)	Eliminates bias oe	**E1**	Eg Makes the groups comparable	
		(*B*)	Allows for effects of other factors oe	**E1**	Eg time Eg cause and effect Eg other variables are controlled	OR Allows a comparison to be made between the two groups
		(*C*)	Eliminates effect of expecting to improve	**E1** **[3]**	Sufficient detail to explain why	Must refer to both teachers and students either explicitly or by implication

Question			Answer	Marks	Guidance	
6	(i)		 OR 	**B1** **B1** **B1** **[3]**	Appropriate tree diagram with all branches labelled correctly Correct partial frequencies or probabilities on one pair of branches Correct partial frequencies or probabilities on all branches	Probabilities can be fractions, decimals or percentages For second B1 allow FT partial frequencies on second branch from incorrect first branch
	(ii)		$\frac{95+90}{1000}$ oe $(0.1\times0.95)+(0.9\times0.1)$ oe 18.5[%] cao	**M1** **A1** **[2]**		Complete method for either partial frequencies or probabilities **SC B1** for 9.5% or 9% nfww
	(iii)		$\frac{95}{185}$ oe Conversion to percentage **51.4cao AG**	**M1** **A1** **[2]**	Eg 0.5135... $\frac{19}{37}$	<u>Alternative method</u> Evaluates 51.4% of 18.5% **M1**[=9.5%] and draws correct conclusion **A1**

Question			Answer	Marks	Guidance	
	(iv)		Otherwise **nearly half** [49%] of those treated do not actually have the disease oe	**E1** **[1]**	Or refer to the **10%** of those who do not have illness who test positive	Needs to refer to relevant figures or % Not just "test is not accurate"
7	(i)		7 billion oe	**B1** **[1]**	Accept 6 billion to 8 billion	7 000 000 000
	(ii)		Method 1 About 3 billion internet users	**B1**	Some indication that not all people use the internet	
			50 000 × 60 × 60 × 24 = 4320 million searches per day	**M2**	**Scaling up** from searches per second to per hour or per day (could be 12 hours instead of 24)	**M1** for scaling up to per minute
			Just over one search per person per day	**M1**	Comparison of number of searches with number of people	
			Reasonable estimate	**A1** **[5]**	Or too high / low (not dep on B1)	Conclusion must follow **clearly** from *their* working
	(ii)		Method 2 About 3 billion internet users	**B1**	Some indication that not all people use the internet	
			Each user might do 5 searches a day on average	**M1**	Estimate of number of searches per user in a given time	Searches per person per day between 1 and 10
			15 billion searches a day 15 billion ÷ 24 ÷ 60 ÷ 60 ≈ 174 000 per second	**M2**	**Scaling down** from searches per day to per second (could be 12 hours instead of 24)	**M1** for scaling down to per hour
			50 000 is fairly close to this	**A1** **[5]**	Or 50 000 is a bit low (not dep on B1)	Conclusion must follow **clearly** from *their* working

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