OCR
Oxford Cambridge and RSA

Level 3 Certificate

Quantitative Problem Solving (MEI)

Unit **H867/01** Introduction to quantitative reasoning

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.

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

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 units. 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.

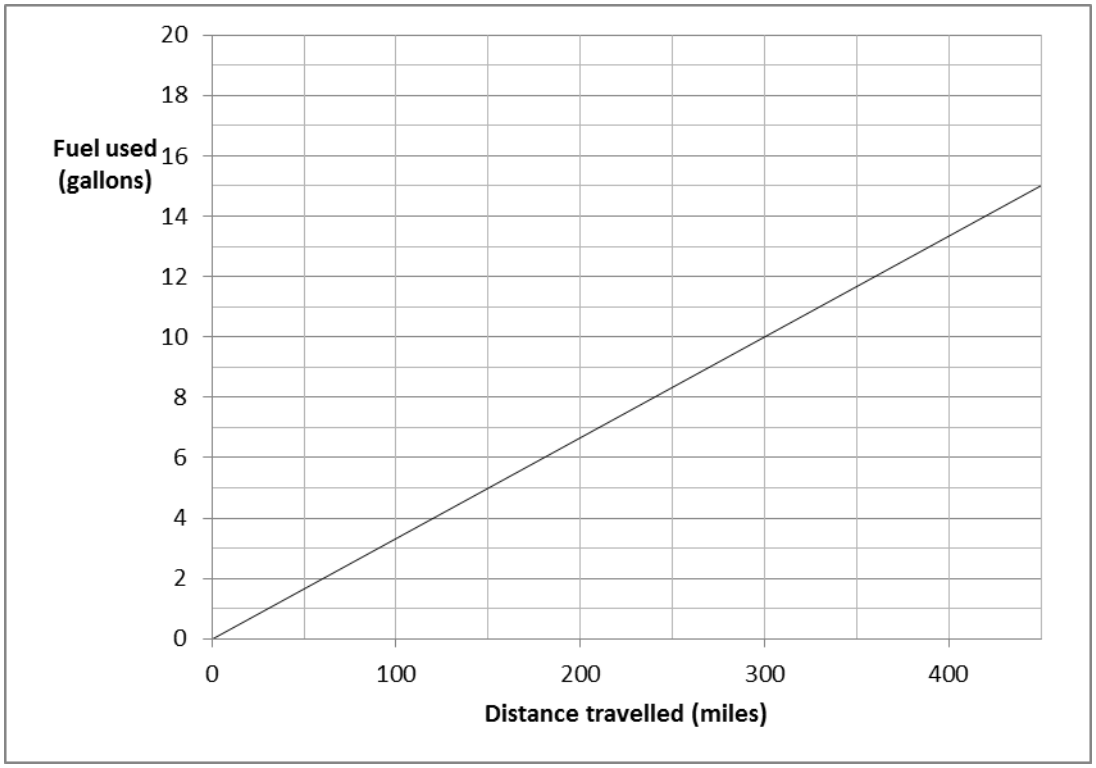
Question		Answer	Marks	Guidance	AO	Level
1	(i)	"2000000"/22000 $= 90.9$ *or* 91	**M1** **A1**	o.e. Also allow for $2\times10^{k} \div 22000$ for any value of k. accept awrt 91 isw 90 gets M1A0 www	**1** **1**	E E
			[2]			
1	(ii)	Annual interest $= 2000000 \times 0.032 (= 64000)$ Weekly interest $= 64000/52 (= 1230.769)$ Number of weeks $= \frac{22000}{"1230.769"} = (17.875)$ So 18 Complete weeks	**M1** **M1** **M1** **A1**	Finding interest paid by any method Finding interest for a shorter timespan Dividing by their weekly amount Cao. Must be rounded up.	**1** **2** **2** **3**	E E E C
			[4]			

Question		Answer	Marks	Guidance	AO	Level
1	(iii)	EITHER If probability of winning once is p, probability of winning twice is p^2 $p^2 = \frac{1}{253{,}000{,}000{,}000}$ $p = 0.00000198$ $(\approx \frac{1}{500{,}000})$	**M1** **M1** **A1**		2 2 1	A A A
			[3]			
		OR using given answer $\left(\frac{1}{500{,}000}\right)^2 = 4 \times 10^{-12}$ $\frac{1}{253billion} = 4.255 \times 10^{-12}$ Values close so 1 in 500,000 is correct	**M1** **M1** **A1**			
			[3]			
		OR Using integers $\sqrt{253billion} = 502991$ ≈ 500000 So 1 in 500,000 is correct	**M1** **M1** **A1**	Also allow for 253billion ÷ 500000 Use of rounding Must use 1 in… or probability notation		
			[3]			

Question		Answer	Marks	Guidance	AO	Level
		OR $500000^2 = 2.5 \times 10^{11}$ $\approx 253 billion$ So 1 in 500,000 is correct	**M1** **M1** **A1**	 Use of "approximately" Must use 1 in… or probability notation		
			[3]			
		OR Tree diagram with $\frac{1}{500000}$ or 0.000002 on suitable branches but not multiplied	**SC1**			

2	**(i)**	People with a higher deprivation score tend to smoke more.	**E1**	Must make a link with deprivation.	3	E
			[1]			
2	**(ii)**	30	**B1**	Allow 28 to 32	3	E
			[1]			
2	**(iii)**	IQR = 35 – 23 =12	**M1** **A1**	Award for UQ-LQ clear Allow (32 to 36) – (21.5 to 24) if not labelled Allow 10 – 14 www	2 1	E E
			[2]			

2	**(iv)**	Upper quartile is 35 35 + 1.5 ×"12" = 53	**B1** **M1** **A1ft**	Must be (34 to 36) Allow their UQ and IQR from (iii) Ft their UQ and IQR from (iii)	1 1 1	E E E
			[3]			
2	**(v)**	Boxes tend to get wider (or whiskers tend to get wider) as deprivation scores increase.	**E1**	Accept that the range or IQR increases Accept more spread out or more variation	3	C
			[1]			

3	**(i)**	411 (miles)	**B1**		3	E
			[1]			
3	**(ii)**	Ford Focus	**B1**		2	E
			[1]			
3	**(iii)**		**G1** **G1**	Straight line starting from 0. Correct gradient (for example, ends at (450, 15) or through (300, 10)). Allow ± a small division SC1 At least four correct points not joined – ignore errors	2 3	E E
			[2]			

3	**(iv)**	Amount of fuel from graph or from distance ÷ 30 Rounded answer 14 Using cost £5 per gallon 14 × 5 = (£) 70	**M1** **A1** **B1** **M1** **A1**	Allow 13 or 14 Soi FT their 14 Must be to 1 or 2 significant figures	2 2 2 2 3	E E E E E
			[5]			
4	**(i)**	Two distinct comments about **prices not changes** for example: Prices went down and then they went up (with no dates given) Prices going down until February 2009 Until February 2009, the prices fall by different amounts in each month. (Do not allow for prices fluctuate)	**E1** **E1**	Allow "initially" and "first 13 months" or similar Allow for last six months – allow without time reference if implied by another comment. Ignore incorrect comments	3 3	C C
			[2]			
4	**(ii)**	$\frac{6}{20} \times 100$ $= 30\%$	**M1** **A1**	Allow for fraction oe	2 2	C C
			[2]			

4	**(iii)**	EITHER 245000 × 0.983 × 0.982 oe (£)236 499.97 ≈(£)236500	**M1** **M1** **A1** **A1**	Attempt at one factor Both correct factors or × 0.965306 seen May be implied by correct rounded answer Ft their answer dep on at least 1 method mark.	2 1 1 1	E E C E
			[4]			
		OR 245000× 0.983 oe 240835 × 0.982 oe (£)236 499.97 ≈(£)236500	 **M1** **M1** **A1** **A1**	 Allow for 2 stage calculation Ft their answer dep on at least 1 method mark. Allow for changes in reverse order (240590 seen)		
			[4]			

4	**(iv)**	Two distinct comments for example: The area where the house is might not have had the same growth as the national trend. She might have paid too much for the house initially. Hanna might have improved her home.	**E1** **E1**	Any two distinct sensible answers Ignore incorrect comments	3 3	C A
			[2]			
5	**(i)**	Biased sample College students aren't representative of all potential customers / tend to buy cheaper sandwiches / don't tend to use sandwich shops	**E1**		3	C
			[1]			
5	**(ii)**	'Over £50'	**B1**		3	E
		For example: They didn't take the survey seriously. They misunderstood They thought it was 50p	**E1**		3	C
			[2]			

5	(iii)	$(0.50 \times 30) + (1.50 \times 15) + (2.50 \times 35) + (4 \times 15) + (7.50 \times 5)$ = 15 + 22.50 + 87.50 + 60 + 37.50 = 222.5 **OR** 223 Total frequency = 100 $\frac{222.5}{100}$ = (£) 2.225 **OR** 2.23 **OR** 223p	**M1** **A1** **B1** **B1**	Attempt at midpoint × frequency including at least two correct midpoints or resulting products. Midpoints can be either 1.5 or 1.495 etc. can be implied SC1 for using maximum (289.05 or 290) or minimum (155) in each class award if seen Also allow £2.22 oe FT their 222.5	1 1 1 1	C C C C
			[4]			
5	(iv)	Data was grouped / midpoints used instead of true values He used a sample (which will not always give the true population value). He included £5 - £10 which might also not be sensible values He excluded the outliers	**E1** **E1**	Allow sensible comment. Must be a different point Ignore incorrect comments	3 3	C A
			[2]			

5	**(v)**		700	560	140	**M1** **M1** **M1** **A1** **A1**	At least one correct bold number in each column 1st column entirely correct. 2nd and 3rd column entirely correct. .	2 2 2 2 2	E E C E C
			625	**500**	**437.5**				
			550	**440**	**660**				
			475	**380**	**807.5**				
			400	**320**	**880**				
			325	**260**	**877.5**				
			250	**200**	**800**				
			175	**140**	**647.5**				
			100	80	420				
						[5]			
5	**(vi)**	*If C2 attempted* = 0.8 * B2 oe				**B1**	0.8 * B2 seen isw	1	E
						B1	Fully correct – correct brackets and use of $B acceptable (B$2 not acceptable)	1	E
						[2]			
		If "number sold per day" attempted, providing a formula for B2 = 850 – 150 * A2 Or = 700 – 150 * (A2 – 1)					SC1 for (850 or 700) minus function of A2 SC2 for = (850 or 700) minus function of A2		
						[2]			
		If the candidate provides a formula that completes column B for the number sold per day by providing formula for cell B3 = B2 - 75				**B1** **B1**	B2- 75 oe = B2- 75 oe		
						[2]			

		If candidate indicates that C2 is not the number sold oe Allow two marks for indicating that C2 is not the number sold per day.	**[2]**	Ignore any formula given		
		If response contains confusion with cell references and number sold per day Refer unexpected responses to the Principal Examiner	**[2]**			
5	**(vii)**	= A2 * B2 – C2	**B1** **B1**	A2 * B2 Fully correct	2 1	E E
			[2]			
5	**(viii)**	£3	**A1**	FT from their table	3	C
			[1]			
5	**(ix)**	Monthly profit: (880 x 20) – 8000 = (£)9600 OR annual profit £115200 OR 134 sandwiches at £3 needed to break even Yes, as he would make a profit.	**B1** **E1**	Allow for 9600 seen FT their 880 from table FT their profit. Must be based on a relevant calculation	2 3	C C
			[2]			

6	**(i)**	$2 \times 10^9 \times 1000$ ml or cm^3 ($= 2 \times 10^{12}$) Using 1,000,000 $cm^3 = 1m^3$ $2{,}000{,}000{,}000 \times 1000 \div 1{,}000{,}000$ 2×10^6 (m^3)	**B1** **M1** **A1**	Soi FT their 2×10^{12} Cao. Must be in standard form. www	1 2 1	C C A
			[3]			
6	**(ii)**	EITHER Area of lake = $\pi \times 2000^2$ ($= 1.2566\ldots \times 10^{11}$ m^2) $V = \pi \times 2000^2 \times h$ $h = \frac{2 \times 10^6}{4000000\pi}$ = 0.159 m or 15.9 cm = 16cm (to nearest cm)	 **B1** **M1** **M1** **A1**	 Any units Consistent units Must rearrange. Their 2×10^6 must be used Must claim given answer with correct units **AG**	 2 2 2 3	 A A A A
			[4]			

		OR using given answer h = 15.5 cm, V = 1.945×10^6 – too small h = 16.5 cm, V = 2.073×10^6 – too big So h = 16 cm to the nearest cm	**M1** **A1** **M1** **A1**	Substituting one value $15.5 \leq h \leq 16.5$ One correct value for V (h = 16 cm, V = 2.0106×10^6) Using another value that establishes range for h that rounds to 16. Correct conclusion including a phrase "to the nearest cm" or "which is about 16cm" oe		
			[4]			
6	**(iii)**	0.96 × 0.90 × 0.92	**M1**	Alternative: 96 less 10% = 86.4, 86.4 less 8% = 79.5 Allow if seen as part of a volume calculation	2	C
		= 0.795	**A1**	or 79.5	2	C
		So 20.5% reduction.	**A1**	Allow 20 or 21without "% reduction"	2	A
			[3]			
6	**(iv)**	A	**B1**		3	C
			[1]			

<table>
<tr><td>6</td><td>(v)</td><td>$100 \times 0.93^n = 50$ or $0.93^n = 0.5$</td><td>M1</td><td>Can be implied.</td><td>2</td><td>A</td></tr>
<tr><td></td><td></td><td>Not all values need to be shown
<table><tr><td>n</td><td>100×0.93^n (1dp)</td></tr><tr><td>1</td><td>93</td></tr><tr><td>2</td><td>86.5</td></tr><tr><td>3</td><td>80.4</td></tr><tr><td>4</td><td>74.8</td></tr><tr><td>5</td><td>69.6</td></tr><tr><td>6</td><td>64.7</td></tr><tr><td>7</td><td>60.2</td></tr><tr><td>8</td><td>56.0</td></tr><tr><td>9</td><td>52.0</td></tr><tr><td>10</td><td>48.4</td></tr></table></td><td>M1</td><td>Value for 100×0.93^n or 0.93^n for any $n > 1$

Also allow for attempt to solve their indicial equation using logs or BC</td><td>2</td><td>A</td></tr>
<tr><td></td><td></td><td>10 years</td><td>A1</td><td>Needs evidence either by solving the equation to 1dp and rounding, or by establishing that $n = 9$ is not enough and that $n = 10$ is needed</td><td>3</td><td>A</td></tr>
<tr><td></td><td></td><td></td><td>[3]</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>(vi)</td><td>e.g. Measured at the same place / same time of year/day / used same equipment</td><td>E1</td><td></td><td>3</td><td>E</td></tr>
<tr><td></td><td></td><td></td><td>[1]</td><td></td><td></td><td></td></tr>
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