OCR
RECOGNISING ACHIEVEMENT

Friday 24 May 2013 – Morning

AS GCE MATHEMATICS (MEI)

4766/01 Statistics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4766/01
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found in the centre of the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book**. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

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- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Section A (36 marks)

1 The weights, x grams, of 100 potatoes are summarised as follows.

$$n = 100 \qquad \Sigma x = 24\,940 \qquad \Sigma x^2 = 6\,240\,780$$

(i) Calculate the mean and standard deviation of x. **[3]**

(ii) The weights, y grams, of the potatoes after they have been peeled are given by the formula $y = 0.9x - 15$. Deduce the mean and standard deviation of the weights of the potatoes after they have been peeled. **[3]**

2 Every evening, 5 men and 5 women are chosen to take part in a phone-in competition. Of these 10 people, exactly 3 will win a prize. These 3 prize-winners are chosen at random.

(i) Find the probability that, on a particular evening, 2 of the prize-winners are women and the other is a man. Give your answer as a fraction in its simplest form. **[4]**

(ii) Four evenings are selected at random. Find the probability that, on at least three of the four evenings, 2 of the prize-winners are women and the other is a man. **[4]**

3 The weights of bags of a particular brand of flour are quoted as 1.5 kg. In fact, on average 10% of bags are underweight.

(i) Find the probability that, in a random sample of 50 bags, there are exactly 5 bags which are underweight. **[3]**

(ii) Bags are randomly chosen and packed into boxes of 20. Find the probability that there is at least one underweight bag in a box. **[2]**

(iii) A crate contains 48 boxes. Find the expected number of boxes in the crate which contain at least one underweight bag. **[2]**

4 Martin has won a competition. For his prize he is given six sealed envelopes, of which he is allowed to open exactly three and keep their contents. Three of the envelopes each contain £5 and the other three each contain £1000. Since the envelopes are identical on the outside, he chooses three of them at random. Let £X be the total amount of money that he receives in prize money.

(i) Show that $\mathrm{P}(X = 15) = 0.05$. **[2]**

The probability distribution of X is given in the table below.

r	15	1010	2005	3000
$\mathrm{P}(X = r)$	0.05	0.45	0.45	0.05

(ii) Find $\mathrm{E}(X)$ and $\mathrm{Var}(X)$. **[5]**

5 A researcher is investigating whether people can identify whether a glass of water they are given is bottled water or tap water. She suspects that people do no better than they would by guessing. Twenty people are selected at random; thirteen make a correct identification. She carries out a hypothesis test.

(i) Explain why the null hypothesis should be $p = 0.5$, where p represents the probability that a randomly selected person makes a correct identification. **[2]**

(ii) Briefly explain why she uses an alternative hypothesis of $p > 0.5$. **[1]**

(iii) Complete the test at the 5% significance level. **[5]**

Section B (36 marks)

6 The birth weights in kilograms of 25 female babies are shown below, in ascending order.

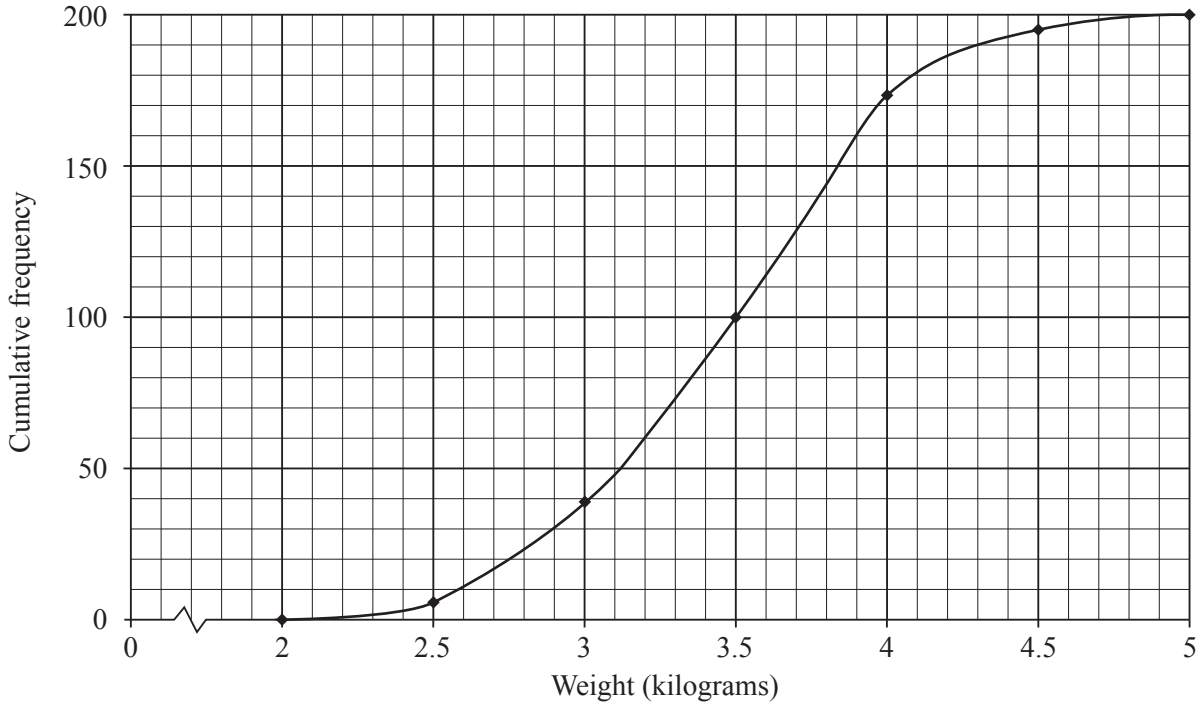
1.39	2.50	2.68	2.76	2.82	2.82	2.84	3.03	3.06	3.16	3.16	3.24	3.32
3.36	3.40	3.54	3.56	3.56	3.70	3.72	3.72	3.84	4.02	4.24	4.34	

(i) Find the median and interquartile range of these data. **[3]**

(ii) Draw a box and whisker plot to illustrate the data. **[3]**

(iii) Show that there is exactly one outlier. Discuss whether this outlier should be removed from the data. **[4]**

The cumulative frequency curve below illustrates the birth weights of 200 male babies.



(iv) Find the median and interquartile range of the birth weights of the male babies. **[3]**

(v) Compare the weights of the female and male babies. **[2]**

(vi) Two of these male babies are chosen at random. Calculate an estimate of the probability that both of these babies weigh more than any of the female babies. **[3]**

7 Jenny has six darts. She throws darts, one at a time, aiming each at the bull's-eye. The probability that she hits the bull's-eye with her first dart is 0.1. For any subsequent throw, the probability of hitting the bull's-eye is 0.2 if the previous dart hit the bull's-eye and 0.05 otherwise.

(i) Illustrate the possible outcomes for her first, second and third darts on a probability tree diagram. **[4]**

(ii) Find the probability that

(*A*) she hits the bull's-eye with at least one of her first three darts, **[3]**

(*B*) she hits the bull's-eye with exactly one of her first three darts. **[4]**

(iii) Given that she hits the bull's-eye with at least one of her first three darts, find the probability that she hits the bull's-eye with exactly one of them. **[3]**

Jenny decides that, if she hits the bull's-eye with any of her first three darts, she will stop after throwing three darts. Otherwise she will throw all six darts.

(iv) Find the probability that she hits the bull's-eye three times in total. **[4]**

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4766/01 Statistics 1

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Duration: 1 hour 30 minutes

* 4 7 6 6 0 1 *

* 4 7 1 5 8 4 0 6 1 3 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

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Section A (36 marks)

1 (i)	
1 (ii)	

2 (i)

2 (ii)

3 (i)	
3 (ii)	
3 (iii)	

4 (i)

4 (ii)

5 (i)	
5 (ii)	
5 (iii)	
	(answer space continued on next page)

5 (iii)	**(continued)**

Section B (36 marks)

6 (i)	
6 (ii)	
6 (iii)	

6 (iv)	
6 (v)	
6 (vi)	

7 (i)	

7 (ii) (*A*)

7 (ii) (*B*)

7 (iii)

7 (iv)	

OCR
RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4766:** Statistics 1

Mark Scheme for June 2013

Oxford Cambridge and RSA Examinations

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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 for GCE Mathematics (MEI) Statistics strand

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. 3 significant figures may often be the norm for this, but this always needs to be considered in the context of the problem in hand. For example, in quoting probabilities from Normal tables, we generally expect *some* evidence of interpolation and so quotation to 4 decimal places will often be appropriate. But even this does not always apply – quotations of the standard critical points for significance tests such as 1.96, 1.645, 2.576 (maybe even 2.58 – but not 2.57) will commonly suffice, especially if the calculated value of a test statistic is nowhere near any of these values. Sensible discretion *must* be exercised in such cases.

Discretion must also be exercised in the case of small variations in the degree of accuracy to which an answer is given. For example, if 3 significant figures are expected (either because of an explicit instruction or because the general context of a problem demands it) but only 2 are given, loss of an accuracy ("A") mark is likely to be appropriate; but if 4 significant figures are given, this should not normally be penalised. Likewise, answers which are slightly deviant from what is expected in a very minor manner (for example a Normal probability given, after an attempt at interpolation, as 0.6418 whereas 0.6417 was expected) should not be penalised. However, answers which are *grossly* over- or under-specified should normally result in the loss of a mark. This includes cases such as, for example, insistence that the value of a test statistic is (say) 2.128888446667 merely because that is the value that happened to come off the candidate's calculator. Note that this applies to answers that are given as final stages of calculations; intermediate working should usually be carried out, and quoted, to a greater degree of accuracy to avoid the danger of premature approximation.

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. Genuine misreading (of numbers or symbols, occasionally even of text) occurs. If this results in the object and/or difficulty of the question being considerably changed, it is likely that all the marks for that question, or section of the question, will be lost. However, misreads are often such that the object and/or difficulty remain substantially unaltered; these cases are considered below.

The simple rule is that *all* method ("M") marks [and of course all independent ("B") marks] remain accessible but at least some accuracy ("A") marks do not. It is difficult to legislate in an overall sense beyond this global statement because misreads, even when the object and/or difficulty remains unchanged, can vary greatly in their effects. For example, a misread of 1.02 as 10.2 (perhaps as a quoted value of a sample mean) may well be catastrophic; whereas a misread of 1.6748 as 1.6746 may have so slight an effect as to be almost unnoticeable in the candidate's work.

A misread should normally attract *some* penalty, though this would often be only 1 mark and should rarely if ever be more than 2. Commonly in sections of questions where there is a numerical answer either at the end of the section or to be obtained and commented on (eg the value of a test statistic), this answer will have an "A" mark that may actually be designated as "cao" [correct answer only]. This should be interpreted *strictly* – if the misread has led to failure to obtain this value, then this "A" mark must be withheld even if all method marks have been earned. It will also often be the case that such a mark is implicitly "cao" even if not explicitly designated as such.

On the other hand, we commonly allow "fresh starts" within a question or part of question. For example, a follow-through of the candidate's value of a test statistic is generally allowed (and often explicitly stated as such within the marking scheme), so that the candidate may exhibit knowledge of how to compare it with a critical value and draw conclusions. Such "fresh starts" are not affected by any earlier misreads.
A misread may be of a symbol rather than a number – for example, an algebraic symbol in a mathematical expression. Such misreads are more likely to bring about a considerable change in the object and/or difficulty of the question; but, if they do not, they should be treated as far as possible in the same way as numerical misreads, *mutatis mutandis*. This also applied to misreads of text, which are fairly rare but can cause major problems in fair marking.

The situation regarding any particular cases that arise while you are marking for which you feel you need detailed guidance should be discussed with your Team Leader.

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

Question			Answer	Marks	Guidance	
1	(i)		Mean $= \frac{24940}{100} = 249.4$g or 249g	B1	Ignore units	CAO NB 249.40 gets B0 for over-specification
			$Sxx = 6240780 - \frac{24940^2}{100} = 20744$	M1	For S*xx*	M1 for 6240780 - 100 × their mean^2 BUT NOTE M0 if their $S_{xx} < 0$
			$s = \sqrt{\frac{20744}{99}} = \sqrt{209.53} = 14.4751 = 14.5$g	A1	CAO ignore units	For s^2 of 210 (or better) allow M1A0 with or without working For RMSD of 14.4 (or better) allow M1A0 provided working seen For RMSD^2 of 207 (or better) allow M1A0 provided working seen Allow 14.48 but NOT 14.47
				[3]		
1	(ii)		New mean = (0.9 × 249.4) – 15 = 209.5g	B1	FT their mean provided answer is positive	If candidate 'starts again' only award marks for CAO Allow 209
			New sd = 0.9 × 14.48 = 13.03g	M1 A1	FT their sd FT Allow 13.0 to 13.1	Or for $0.9^2 \times 14.5^2$ Deduct at most 1 mark overall in whole question for over-specification of Mean and 1 mark overall for SD
				[3]		

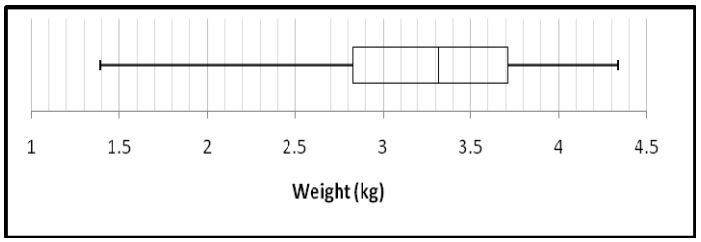
Question			Answer	Marks	Guidance	
2	(i)		$3\times\frac{5}{10}\times\frac{4}{9}\times\frac{5}{8}=\frac{300}{720}=\frac{5}{12}\ (=0.4167)$	M1	For 5/10 × 4/9	Correct working but then multiplied or divided by some factor scores M1M1M0A0
				M1	For × 5/8	Zero for binomial Allow M2 for equivalent triple such as $\frac{5}{10}\times\frac{5}{9}\times\frac{4}{8}$
				M1	For 3 × triple product	Or 3 separate equal triplets added
				A1	CAO (Fully simplified)	Answer must be a fraction
				[4]		
			Or	M1*	For $\binom{5}{2}\times\binom{5}{1}$	Seen
			$\frac{\binom{5}{2}\times\binom{5}{1}}{\binom{10}{3}}=\frac{10\times5}{120}=\frac{5}{12}$	M1*	For $\binom{10}{3}$	Seen
				M1* dep	For whole fraction	Correct working but then multiplied or divided by some factor scores M1M1M0A0
				A1	CAO (Fully simplified)	
2	(ii)		$4\times\frac{7}{12}\times\left(\frac{5}{12}\right)^3+\left(\frac{5}{12}\right)^4$	M1FT	For first probability	Allow ${}^4C_3$
				M1FT	For $(5/12)^4$	
				M1FT	For sum of both correct probabilities	Provided sum <1
			$=0.169+0.030=0.199$	A1	CAO	Alternative for 1- (P(0)+P(1)+P(2)) allow M1FT for two 'correct' probs, M1 for sum of three 'correct', M1 for 1 – answer, A1 CAO
			Or $=\frac{875}{5184}+\frac{625}{20736}=\frac{1375}{6912}$		Do not allow 0.2, unless fuller answer seen first	
				[4]		

Question			Answer	Marks	Guidance	
3	(i)		X ~ B(50, 0.1) P(5 underweight) = $\binom{50}{5} \times 0.1^5 \times 0.9^{45} = 0.1849$	M1 M1 A1 **[3]**	For $0.1^5 \times 0.9^{45}$ For $\binom{50}{5} \times p^5 \times q^{45}$ CAO	With $p + q = 1$ Also for $2118760 \times 8.73 \times 10^{-8}$ Allow 0.185 or better NB 0.18 gets A0
3	(ii)		X ~ B(20, 0.1) P($X \geq 1$) = 1 – P($X = 0$) = 1 – 0.1216 = 0.8784	M1 A1 **[2]**	For 0.1216 CAO	Allow M1 for 0.9^{20} Allow 0.878 or better See tables at the website http://www.mei.org.uk/files/pdf/formula_book_mf2.pdf
3	(iii)		E(X) = 48 × 0.8784 = 42.16 (= 42.2)	M1 A1 **[2]**	FT their probability from part (ii)	If any indication of rounding to 42 or 43 or to another integer on FT allow M1A0 SC1 for 48 × their p giving an integer answer. NB 0.6083 in (ii) leads to 29.20

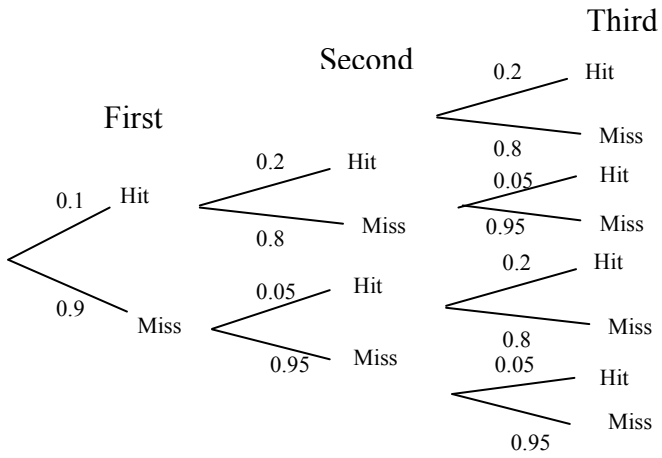
Question			Answer	Marks	Guidance	
4	(i)		$P(X = 15) = \frac{3}{6} \times \frac{2}{5} \times \frac{1}{4}$ $= = \frac{6}{120} = \frac{1}{20} = 0.05$ **Or** $\frac{1}{{}_6C_3} = \frac{1}{20} = 0.05$ **Or** $\frac{3! \times 3!}{6!} = \frac{1}{20} = 0.05$	M1 A1 **[2]**	For product of three correct fractions NB ANSWER GIVEN NB 1 – (0.45 + 0.45 + 0.05) = 0.05 scores M0A0	Full marks for $3! \times \frac{1}{6} \times \frac{1}{5} \times \frac{1}{4} = \frac{6}{120} = 0.05$ Allow 3 × 2 in place of 3! SC1 for $6 \times \frac{1}{6} \times \frac{1}{5} \times \frac{1}{4} = \frac{6}{120} = 0.05$
4	(ii)		$E(X) = (15 \times 0.05) + (1010 \times 0.45) + (2005 \times 0.45) + (3000 \times 0.05)$	M1	For Σrp (at least 3 terms correct)	
			= 1507.5 so 1508 (4sf)	A1	CAO	Allow 1507, 1510, 1507.5, 1507.50 or 3015/2
			$E(X^2) = (15^2 \times 0.05) + (1010^2 \times 0.45) + (2005^2 \times 0.45) + (3000^2 \times 0.05)$ = 2718067.5	M1	For $\Sigma r^2 p$ (at least 3 terms correct)	Use of $E(X-\mu)^2$ gets M1 for attempt at $(x-\mu)^2$ should see $(-1492.5)^2$, $(-497.5)^2$, 497.5^2, 1492.5^2, (if E(X) wrong FT their E(X)) (all 4 correct for M1), then M1 for $\Sigma p(x-\mu)^2$ (at least 3 terms correct with their probabilities) Division by 4 or other spurious value at end gives max M1A1M1M1A0, or M1A0M1M1A0 if E(X) also divided by 4. Unsupported correct answers get 5 marks
			Var $(X) = 2718067.5 - (1507.5)^2$	M1	dep for – their $E(X)^2$	
			= 445511.25 so 445500 (4sf)	A1	FT their E(X) provided Var(X) > 0 (and of course $E(X^2)$ is correct)	Allow 446000
				[5]		

Question			Answer	Marks	Guidance	
5	(i)		Because if people cannot make a correct identification, then the probability that they guess correctly will be 0.5 For 'equally likely to guess right or wrong' or 'two outcomes with equal probability' or '50:50 chance of success' or 'right one in two occasions on average' or 'two (equally likely) outcomes' etc	E1 E1 **[2]**	For idea of a guess or 'chosen at random' For idea of two outcomes	NB The question includes the sentence 'She suspects that people do no better than they would by guessing.', so this on its own does not get the mark for the idea of a guess
5	(ii)		'Because people may do better than they would by guessing' or similar	B1 **[1]**	For idea of selecting correctly /identifying /knowing	No marks if answer implies that it is because there are over half in the sample who make a correct identification
5	(iii)		$P(X \geq 13) = 1 - P(X \leq 12) = 1 - 0.8684 = 0.1316$ **NB PLEASE ANNOTATE THE TOP AND BOTTOM OF THE EXTRA PAGE IF NOT USED** $0.1316 > 0.05$ So not significant There is insufficient evidence to suggest that people can make a correct identification.	M1 B1* M1* dep A1* E1* dep	For notation $P(X \geq 13)$ or $P(X > 12)$ or $1 - P(X \leq 12)$ For 0.1316 For comparison with 5% NB Point probabilities score zero.	Notation $P(X = 13)$ scores M0. If they have the correct $P(X \geq 13)$ then give M1 and ignore any further incorrect notation. Or for 1 – 0.8684 indep of previous mark Allow 'accept H_0' or 'reject H_1' Must include 'insufficient evidence' or something similar such as 'to suggest that' ie an element of doubt either in the A or E mark. Must be in context to gain E1 mark. Do not allow 'sufficient evidence to suggest proportion making correct identification is 0.5' or similar

Question			Answer	Marks	Guidance	
			ALTERNATIVE METHOD – follow method above unless some mention of CR seen		Must see some reference to CR to gain any marks	
			Critical region method			Do not insist on correct notation as candidates have to work out two probabilities for full marks.
			UPPER TAIL $P(X \geq 14) = 1 - P(X \leq 13) = 1 - 0.9423 = 0.0577 > 5\%$	B1	For either probability	
			$P(X \geq 15) = 1 - P(X \leq 14) = 1 - 0.9793 = 0.0207 < 5\%$	M1*	For a correct comparison with 5%	Allow comparison in form of statement 'critical region at 5% level is …'
			So critical region is {15,16,17,18,19,20}	M1* dep	cao dep on the two correct probabilities	No marks if CR not justified Condone {15, … 20}, $X \geq 15$, oe but not $P(X \geq 15,)$ etc
			13 not in CR so not significant	A1*	Must include '13 not in CR'	Allow 'accept H_0' or 'reject H_1'
			There is insufficient evidence to indicate that people can make a correct identification.	E1* dep on A1	Ignore any work on lower critical region	NB If CR found correctly, **then P(X=13) subsequently found,** but cand says '13 not in CR' then allow up to all five marks. If do not say '13 not in CR' allow no marks
				[5]		

Question			Answer	Marks	Guidance	
6	(i)		Median = 3.32 kg Q1 (= 6.5th value) = 2.83 Q3 (= 19.5th value) = 3.71 Inter-quartile range = 3.71 – 2.83 = 0.88	B1 B1 B1 [3]	 For Q1 or Q3 For IQR dep on both quartiles correct	 For Q1 allow 2.82 to 2.84 For Q3 allow 3.70 to 3.72 If no quartiles given allow B0B1 for IQR in range 0.86 to 0.90
	(ii)			G1 G1 G1 [3]	For reasonably linear scale shown. For boxes in approximately correct positions, with median just to right of centre For whiskers in approximately correct positions in proportion to the box FT their median and quartiles if sensible – guidance above is only for correct values	Dep on attempt at box and whisker plot with at least a box and one whisker. Condone lack of label. Do not award unless RH whisker significantly shorter than LH whisker Allow LH whisker going to 2.5 and outlier marked at 1.39
6	(iii)		Lower limit 2.83 – (1.5 × 0.88) = 1.51 Upper limit 3.71 + (1.5 × 0.88) = 5.03 Exactly one baby weighs less than 1.51 kg and none weigh over 5.03 kg so there is exactly one outlier.	B1 B1 E1*	For 1.51 FT For 5.03 FT Dep on their 1.51 and 5.03	Any use of <u>median</u> ± 1.5 × IQR scores B0 B0 E0 No marks for ± 2 or 3 × IQR In this part FT their values from (i)or (ii) if sensibly obtained but not from location ie 6.5, 19.5 Do not penalise over-specification as not the final answer Do not allow unless FT leads to upper limit above 4.34 and lower limit between 1.39 and 2.50

Question			Answer	Marks	Guidance	
			'Nothing to suggest that this baby is not a genuine data value so she should not be excluded' or 'This baby is premature and therefore should be excluded'.	E1* Dep **[4]**	Any sensible comment in context	For use of mean ± 2sd allow B1 For $3.27 + 2 \times 0.62 = 4.51$ B1 For $3.27 - 2 \times 0.62 = 2.03$ Then E1E1 as per scheme
6	**(iv)**		Median = 3.5 kg Q1 = 50th value = 3.12 Q3 = 150th value = 3.84 Inter-quartile range = 3.84 – 3.12 = 0.72	B1 B1 B1 **[3]**	 For Q1 or Q3 For IQR FT their quartiles	 For Q1 allow 3.11 to 3.13 For Q3 allow 3.83 to 3.85 Dep on both quartiles correct If no quartiles given allow B0B1 for IQR in range 0.70 to 0.74
6	**(v)**		Female babies have lower weight than male babies on the whole Female babies have higher weight variation than male babies	E1 FT E1 FT **[2]**	Allow 'on average' or similar in place of 'on the whole' Allow 'more spread' or similar but not 'higher range' Condone less consistent	Do not allow lower median Do not allow higher IQR, but SC1 for both lower median and higher IQR, making clear which is which
6	**(vi)**		Male babies must weigh more than 4.34 kg			
			Approx 10 male babies weigh more than this.	M1*	For 10 or 9 or 8	Or 200 – 190, 200 –191 or 200 –192
			Probability = $\frac{10}{200}\times\frac{9}{199}=\frac{90}{39800}=\frac{9}{3980}=0.00226$ or $\frac{9}{200}\times\frac{8}{199}=\frac{72}{39800}=0.00181$ or $\frac{8}{200}\times\frac{7}{199}=\frac{56}{39800}=\frac{7}{4975}=0.00141$	M1* dep A1	For first fraction multiplied by any other different fraction (Not a binomial probability) CAO Allow their answer to min of 2 sf	Allow any of these answers For spurious factors, eg 2 × correct answer allow M1M1A0 SC1 for $n/200 \times (n-1)/199$
				[3]		

Question			Answer	Marks	Guidance	
7	(i)			G1 G1 G1 G1 **[4]**	For first set of branches For second set of branches (indep) For third set of branches (indep) For labels	All probabilities correct All probabilities correct All probabilities correct All correct labels for 'Hit' and 'Miss', 'H' and 'M' etc. Condone omission of First, Second, Third. Do not allow misreads here as all FT
7	(ii)	*A*	P(Hits with at least one) = 1 – P(misses with all) = 1 – (0.9 × 0.95 × 0.95) = 1 – 0.81225 = 0.18775 ALTERNATIVE METHOD only if there is an attempt to add 7 probabilities At least three correct triple products Attempt to add 7 triple products FURTHER ALTERNATIVE METHOD 0.1 + 0.9 × 0.05 Above probability + 0.9 × 0.95 × 0.05	M1* M1* dep A1 M1 M1 A1 M1 M1 A1 **[3]**	For 0.9 × 0.95 × 0.95 For 1 – ans CAO CAO	FT their tree for both M marks, provided three terms 0.188 or better. Condone 0.1877 Allow 751/4000 (not necessarily correct triple products)

Question			Answer	Marks	Guidance	
7	(ii)	*B*	P(Hits with exactly one) $= (0.1 \times 0.8 \times 0.95) + (0.9 \times 0.05 \times 0.8) + (0.9 \times 0.95 \times 0.05)$ $= 0.076 + 0.036 + 0.04275 = \frac{19}{250} + \frac{9}{250} + \frac{171}{4000}$ $= \frac{619}{4000} = 0.15475$	M1 M1 M1 A1 **[4]**	For two correct products For all three correct products For sum of all three correct products CAO	FT their tree for all three M marks, provided three terms Allow 0.155 or better
7	(iii)		P(Hits with exactly one given hits with at least one) $= \frac{\text{P(Hits with exactly one and hits with at least one)}}{\text{P(Hits with at least one)}}$ $= \frac{0.15475}{0.18775}$ $= 0.8242$	 M1 M1 A1 **[3]**	 For numerator FT For denominator FT CAO	If answer to (*B*) > than answer to (*A*) then max M1M0A0 Both must be part of a fraction Allow 0.824 or better or 619/751
7	(iv)		P(Hits three times overall) = $(0.1 \times 0.2 \times 0.2) + (0.9 \times 0.95 \times 0.95 \times 0.05 \times 0.2 \times 0.2)$ $= 0.004 + 0.0016245$ $= 0.0056245$	M1 M1 M1* Dep on both prev M1's A1 **[4]**	For $0.1 \times 0.2 \times 0.2$ or 0.004 or 1/250 For $0.9 \times 0.95 \times 0.95 \times 0.05 \times 0.2 \times 0.2$ For sum of both CAO	FT their tree for all three M marks provided three terms in first product and six in second product. Last three probs must be $0.05 \times 0.2 \times 0.2$ unless they extend their tree With no extras Allow 0.00562 or 0.00563 or 0.0056

NOTE RE OVER-SPECIFICATION OF ANSWERS

If answers are grossly over-specified, deduct the final answer mark in every case. Probabilities should also be rounded to a sensible degree of accuracy. In general final non probability answers should not be given to more than 4 significant figures. Allow probabilities given to 5 sig fig.

PLEASE HIGHLIGHT ANY OVER-SPECIFICATION

Please note that there are no G or E marks in scoris, so use B instead

NB PLEASE ANNOTATE EVERY ADDITIONAL ANSWER SHEET EVEN IF FULL MARKS AWARDED OR THE PAGE IS BLANK

Additional notes re Q5 part iii

Comparison with 95% method
If 95% seen anywhere then
M1 for P($X \leq 12$)
B1 for 0.8684
M1* for comparison with 95% dep on second B1
A1* for not significant oe
E1*

Comparison with 95% CR method
If 95% seen anywhere then
B1 for 0.9423 or 0.9793
M1 for correct comparison with 95%
M1dep for correct CR provided both probs correct
then follow mark scheme for CR method

Smallest critical region method:
Smallest critical region that 13 could fall into is {13, 14, 15, 16, 17, 18, 19, 20} **gets B1 and has size 0.1316 gets B1, This is > 5% gets M1*, A1*, E1* as per scheme**
NB These marks only awarded if 13 used, not other values.

Use of *k* method with no probabilities quoted:
This gets zero marks.

Use of *k* method with one probability quoted:
Mark as per scheme

Line diagram method and Bar chart method
No marks unless correct probabilities shown on diagram, then mark as per scheme..

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RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced GCE **A2 7895-8**

Advanced Subsidiary GCE **AS 3895-8**

OCR Report to Centres

June 2013

4766 Statistics 1

General Comments

On the whole candidates coped well with this paper. A good number of candidates scored 60 marks or more out of 72. A considerable number of candidates scored the majority of their marks on topics which overlap with Higher Tier GCSE; however, Question 3 on the binomial distribution was well answered. Most candidates supported their numerical answers with appropriate working. However, when written explanations were required, the poor handwriting and use of English of some candidates made it difficult to determine what they were trying to say.

There was no evidence of candidates being unable to complete the paper in the allocated time. As last year only a small minority of candidates attempted parts of questions in answer sections intended for a different question/part and most candidates had adequate space in the answer booklet without having to use additional sheets. Those candidates who overwrote pencil working in ink, even if they made an attempt to rub out the pencil, made the work very difficult to read. Candidates should be advised to refrain from doing this.

Unfortunately, as in recent series, most candidates lost marks due to over specification of some of their answers, despite recent examiners' reports warning against this. The worst cases of this were in both parts of Question 1 and in Question 4(ii), where the vast majority of candidates gave the variance to 8 significant figures. It is possible that they thought that as it was a sum of money it should be exact, but of course the units of the variance would be pounds^2.

Comments on Individual Questions

1)(i) The vast majority of candidates answered this part correctly, though many lost marks for over-specification of the standard deviation (often given as 14.475). A small minority managed to over-specify the mean, giving it as 249.40. Only a few candidates found the root mean standard deviation instead of the standard deviation.

1)(ii) The mean was usually tackled correctly, but then the mark sometimes lost was for over-specification. Calculating the standard deviation seemed to cause more problems, with attempts made to 'start again' or comments such as 'it remains the same'. Candidates were not penalised a second time if they over-specified again – many in fact gave 6 or 7 significant figures in their (correct) answer.

2)(i) Candidates using the ${}^nC_r$ method tended to be more successful, as when using the product of 3 fractions method many did not realise that they needed to multiply the final product by 3. A small minority of candidates did not follow instructions and either left a fraction in unsimplified form (usually 15/36) or gave the answer as a decimal.

2)(ii) Most candidates made a reasonable start in this part, using their answer from part (i). However, many only calculated one probability, or missed the coefficient of 4 when calculating the probability of 3 evenings, not realising this was a binomial situation. Some candidates calculated the probability of 3, rather than *at least* 3, and thus only gained 1 mark. A small minority of candidates used statistical functions on graphical calculators to just write down an answer – this was a risky strategy, as a slip in copying the answer was heavily penalised, since no method was shown.

3)(i) This question was very well answered, with most candidates scoring all 3 marks. However, a few candidates seemed to have no idea about the binomial distribution.

3)(ii) Again another well answered question, although occasionally candidates did not read the question carefully and continued to use $n = 50$ in their calculation.

3)(iii) Full marks were available here for a correct follow through from part (ii), so many candidates managed to recover from an incorrect answer. However a large proportion of candidates rounded their answer to the nearest whole number, thus losing a mark. Others over-specified their final answer, again losing a mark. Other common errors were to use $p = 0.1$, rather than their answer to part (ii), or to use $n = 48 \times 20$.

4)(i) This was well answered by the majority of candidates with most of them using the product of 3 fractions method. A few successfully used $1/({}^{20}C_3)$. There were a few candidates who used the probabilities in the table to give 1-(0.45+0.45+0.05), for which of course no credit was available.

4)(ii) This was very well answered, with nearly all candidates picking up 4 marks out of 5. Very few candidates gained the final mark, due to over-specification of the variance, usually giving an answer of 445511.25. A minority of candidates made the usual errors in this type of question such as: squaring the probabilities when finding $E(X^2)$, subtracting $E(X)$ rather than $[E(X)]^2$ or introducing spurious multipliers or dividers. Candidates should be advised to check carefully the figures which they enter into their calculator, as although the written down calculation was usually correct, sometimes the answer written was not.

5) The wording of the researcher's theory appeared to cause confusion for some of the candidates throughout the question. This was translated into some poorly worded explanations and conclusions in all three parts of the question. Good comprehension skills are required in this type of question and, unfortunately, these skills were not always in evidence.

5)(i) Many candidates scored both marks. Unfortunately a good proportion lost either the first or the second mark by not mentioning 'guess' or only including it when they quoted the question or not mentioning, in any form, the idea of the two possible outcomes. Some candidates simply just re-stated the null hypothesis in words.

5)(ii) This was not as well answered as part (i). There was a failure to distinguish between guessing and being able to identify between the two types of water. A lot of candidates lost the mark because they gave the reason for the alternative hypothesis as '13 people out of 20 in the researcher's sample identified correctly' which of course is not a valid reason.

5)(iii) The most successful way of approaching this hypothesis test was to compare P($X \geq 13$) with the significance level. Several of the candidates, who used this method failed to gain the final mark due to not putting the explanation in the context of the question. Other candidates used incorrect probabilities, usually P($X \geq 12$) or P($X \geq 14$). Candidates who used the critical region method normally gained the first two marks but then many of them failed to gain any more marks – usually because they had included 14 in the critical region. Unfortunately some candidates started looking at the two probabilities necessary for the critical region but made no mention of the critical region, or critical value, so did not gain any marks.
It is pleasing to report, on the other hand, that very few candidates tried to use point probabilities. However, although full marks could be obtained by comparing 0.8684 with 95%, many candidates either compared with 5% or made no explicit comparison at all - such candidates were unable to gain any credit.

6)(i) Most candidates successfully found the median, although instead of the 13th value some found average of the 12^{th} and 13^{th} values. However, candidates were less successful in finding the interquartile range. The lower quartile was usually found correctly, but the upper quartile was more frequently wrong, with an answer of 3.665 being the most common error. Occasionally candidates did not subtract to find the interquartile range, but instead some found the midpoint of their quartiles.

6)(ii) The response to this question was very disappointing. Perhaps because they were faced with a blank space rather than graph paper, most candidates thought that accuracy was not required. Very few had a scale and some of those that did failed to make it linear. Some candidates simply sketched a box and whisker plot and then labelled the diagram with the relevant values. This did not gain marks as the question clearly instructs candidates to 'Draw a box and whisker plot…'. It seems likely that many candidates either did not have, or did not think to use a ruler. Far too many freehand diagrams were seen, with the sizes of the box and whiskers and the position of the median not in proportion.

6)(iii) Many candidates correctly found the upper and lower limits for the outliers. The most common misconception was that outliers were calculated using median ± 1.5×IQR, although many other errors were also seen. A few candidates attempted to use the mean and standard deviation, and if they got both of these correct, full marks were available, but unfortunately one or other of the two statistics was usually incorrect.
It was necessary to check both limits to show that there was only one outlier, but some candidates ignored the upper limit. Many candidates failed to give an explanation in context regarding the outlier, though those that did often made a valid point about premature babies.

6)(iv) As in part (i), the median was usually found correctly, but some candidates lost a mark due to inaccurate reading of the scales in finding the quartiles.

6)(v) Only about one third of candidates scored both marks. Credit was given to those candidates who could only compare medians and interquartile ranges without an explanation of what they meant. Candidates who just said 'boys are heavier' failed to get credit without a comment such as 'generally' or 'on average' or 'tend to be'. Similarly 'more consistent' or 'vary less' or 'less spread' gained credit for interquartile range – 'smaller range' was not awarded credit.

6)(vi) This part discriminated very well between the higher-scoring candidates. Many candidates realised that approximately 10 male babies weighed more than 4.34 kg. Unfortunately many then did not know how to proceed, often squaring 0.05 (10/200) rather than multiplying by 9/199. Those candidates who misread the scale but knew how to proceed could gain a Special Case mark. A significant number of candidates missed out this part altogether.

7)(i) The majority of tree diagrams were well constructed with correct labelling. Weaker candidates sometimes became confused and made errors in the 2nd and/or 3rd branch.

7)(ii)*A* Many candidates employed the 1 – P(misses with all) method, usually successfully, but a significant number used the protracted method of listing all 7 triplets associated with at least one hit. Usually errors were made using such an approach.

7)(ii)*B* Most candidates found the correct three products and calculated them correctly. A small number failed to find all three. For those who got the tree diagram wrong, follow through marks were available.

7)(iii) Many of those who reached this part were successful. However, there was considerable confusion in finding the conditional probability, often with a correct denominator but a wrong numerator of P(at least one)×P(exactly one). Some candidates inverted the fraction.

7)(iv) Approximately one third of candidates were successful in this part. However many were confused. Many candidates successfully found the first product but then failed to find the second, or found additional products. Those who attempted the second product often made errors. The last three probabilities were often 0.1×0.2×0.2 rather than 0.05×0.2×0.2.

For a description of how UMS marks are calculated see:
www.ocr.org.uk/learners/ums_results.html

Unit level raw mark and UMS grade boundaries June 2013 series
AS GCE / Advanced GCE / AS GCE Double Award / Advanced GCE Double Award

GCE Mathematics (MEI)

			Max Mark	a	b	c	d	e	u
4751/01	(C1) MEI Introduction to Advanced Mathematics	Raw	72	62	56	51	46	41	0
		UMS	100	80	70	60	50	40	0
4752/01	(C2) MEI Concepts for Advanced Mathematics	Raw	72	54	48	43	38	33	0
		UMS	100	80	70	60	50	40	0
4753/01	(C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	58	52	46	40	33	0
4753/02	(C3) MEI Methods for Advanced Mathematics with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4753/82	(C3) MEI Methods for Advanced Mathematics with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
4753	(C3) MEI Methods for Advanced Mathematics with Coursework	UMS	100	80	70	60	50	40	0
4754/01	(C4) MEI Applications of Advanced Mathematics	Raw	90	66	59	53	47	41	0
		UMS	100	80	70	60	50	40	0
4755/01	(FP1) MEI Further Concepts for Advanced Mathematics	Raw	72	63	57	51	45	40	0
		UMS	100	80	70	60	50	40	0
4756/01	(FP2) MEI Further Methods for Advanced Mathematics	Raw	72	61	54	48	42	36	0
		UMS	100	80	70	60	50	40	0
4757/01	(FP3) MEI Further Applications of Advanced Mathematics	Raw	72	60	52	44	36	28	0
		UMS	100	80	70	60	50	40	0
4758/01	(DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	62	56	51	46	40	0
4758/02	(DE) MEI Differential Equations with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4758/82	(DE) MEI Differential Equations with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
4758	(DE) MEI Differential Equations with Coursework	UMS	100	80	70	60	50	40	0
4761/01	(M1) MEI Mechanics 1	Raw	72	57	49	41	33	25	0
		UMS	100	80	70	60	50	40	0
4762/01	(M2) MEI Mechanics 2	Raw	72	50	43	36	29	22	0
		UMS	100	80	70	60	50	40	0
4763/01	(M3) MEI Mechanics 3	Raw	72	64	56	48	41	34	0
		UMS	100	80	70	60	50	40	0
4764/01	(M4) MEI Mechanics 4	Raw	72	56	49	42	35	29	0
		UMS	100	80	70	60	50	40	0
4766/01	(S1) MEI Statistics 1	Raw	72	55	48	41	35	29	0
		UMS	100	80	70	60	50	40	0
4767/01	(S2) MEI Statistics 2	Raw	72	58	52	46	41	36	0
		UMS	100	80	70	60	50	40	0
4768/01	(S3) MEI Statistics 3	Raw	72	61	55	49	44	39	0
		UMS	100	80	70	60	50	40	0
4769/01	(S4) MEI Statistics 4	Raw	72	56	49	42	35	28	0
		UMS	100	80	70	60	50	40	0
4771/01	(D1) MEI Decision Mathematics 1	Raw	72	58	52	46	40	35	0
		UMS	100	80	70	60	50	40	0
4772/01	(D2) MEI Decision Mathematics 2	Raw	72	58	52	46	41	36	0
		UMS	100	80	70	60	50	40	0
4773/01	(DC) MEI Decision Mathematics Computation	Raw	72	46	40	34	29	24	0
		UMS	100	80	70	60	50	40	0
4776/01	(NM) MEI Numerical Methods with Coursework: Written Paper	Raw	72	56	50	44	38	31	0
4776/02	(NM) MEI Numerical Methods with Coursework: Coursework	Raw	18	14	12	10	8	7	0
4776/82	(NM) MEI Numerical Methods with Coursework: Carried Forward Coursework Mark	Raw	18	14	12	10	8	7	0
4776	(NM) MEI Numerical Methods with Coursework	UMS	100	80	70	60	50	40	0
4777/01	(NC) MEI Numerical Computation	Raw	72	55	47	39	32	25	0
		UMS	100	80	70	60	50	40	0
4798/01	(FPT) Further Pure Mathematics with Technology	Raw	72	57	49	41	33	26	0
		UMS	100	80	70	60	50	40	0

GCE Statistics (MEI)

			Max Mark	a	b	c	d	e	u
G241/01	(Z1) Statistics 1	Raw	72	55	48	41	35	29	0
		UMS	100	80	70	60	50	40	0
G242/01	(Z2) Statistics 2	Raw	72	55	48	41	34	27	0
		UMS	100	80	70	60	50	40	0
G243/01	(Z3) Statistics 3	Raw	72	56	48	41	34	27	0
		UMS	100	80	70	60	50	40	0