OCR
Oxford Cambridge and RSA

Wednesday 14 June 2017 – Morning

AS GCE MATHEMATICS (MEI)

4771/01 Decision Mathematics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4771/01
- 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 inside 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 barcodes.
- 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.

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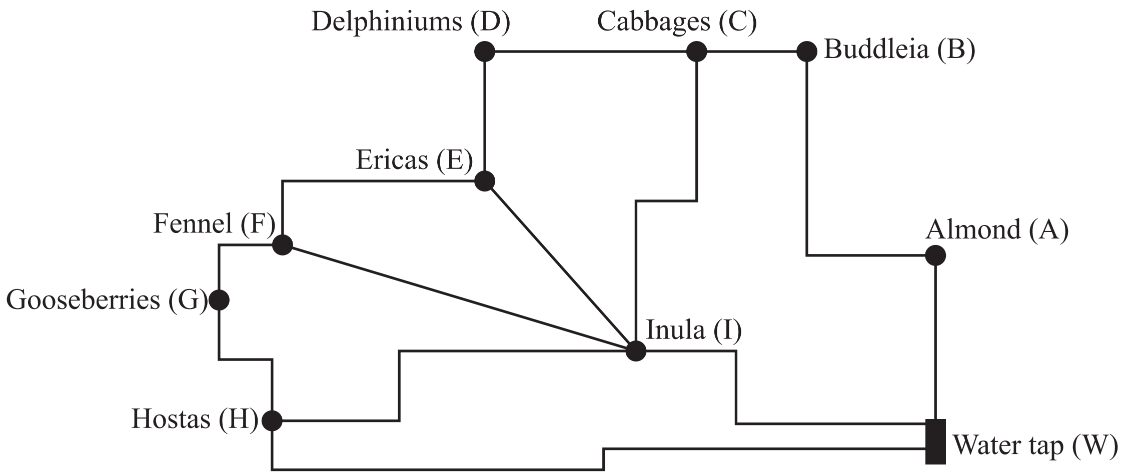
- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **8** pages. Any blank pages are indicated.

INSTRUCTIONS 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 (24 marks)

1 Pippa is planning an irrigation system for a new garden. The graph shows the water tap, the plants and trees which need to be watered, and possible routes for the irrigation pipes.



The lengths of possible pipe runs (m) are given in the table.

	W	A	B	C	D	E	F	G	H	I
W		10							40	20
A	10		17							
B		17		7						
C			7		12					18
D				12		8				
E					8		14			11
F						14		5		15
G							5		6	
H	40							6		18
I	20			18		11	15		18	

(i) Starting at W, use Prim's algorithm in tabular form to find the least length of pipe that is needed for the system. Give the length of pipe and draw the connections that are used in this solution. **[5]**

In fact, Pippa decides to connect the Inula directly to the water tap and then to use all of the direct connections from the Inula. The Almond, Buddleia, Delphiniums and Gooseberries she will subsequently connect in optimally.

(ii) Draw Pippa's connections. Give the minimum length of pipe she will need for this solution, and give a reason why she might choose it. **[3]**

2 The following is an algorithm for 'shop subtraction'. It applies to two whole numbers, each between 0 and 99

```
10   Let P be the smaller number
20   Let M be the larger number
30   Let C be 0
40   If P + C + 100 > M then goto 70
50   Let C = C + 100
60   Goto 40
70   If P + C + 10 > M then goto 100
80   Let C = C + 10
90   Goto 70
100  If P + C + 1 > M then goto 130
110  Let C = C + 1
120  Goto 100
130  Print 'The answer is' C
```

(i) Apply the algorithm to the numbers 112 and 250. Show the steps as you apply them and give the answer. **[4]**

(ii) Show how to modify the algorithm so that it can be applied to numbers between 0 and 9999. **[3]**

(iii) What is the connection between the algorithm and giving change for a purchase made in a shop? **[1]**

3 $K_{2,4}$ is the complete bipartite graph on sets of 2 and 4 elements, i.e. all possible ways of joining 2 elements in one set to 4 elements in another set.

(i) Draw $K_{2,4}$ with no lines crossing. **[1]**

(ii) Explain how $K_{2,n}$ can be drawn without any lines crossing for any positive integer n. **[1]**

(iii) The smallest value of n for which $K_{3,n}$ cannot be drawn without any lines crossing is $n = 3$. Start from a drawing of $K_{2,3}$ and explain why it is not possible to construct $K_{3,3}$ from this without having any lines crossing. **[3]**

It is claimed that the minimum number of line crossings needed to draw $K_{3,n}$ is given by $\frac{(n-1)^2}{4}$ if n is odd and $\frac{n(n-2)}{4}$ if n is even.

(iv) Draw $K_{3,5}$ with the number of line crossings given by the formula. **[2]**

(v) Explain the consequences of parts (i) to (iv) for circuit board design. **[1]**

Section B (48 marks)

4 A nursery has $9000\,\text{m}^2$ of land available for growing deciduous trees and evergreen trees from saplings (young trees). Each deciduous tree needs $8\,\text{m}^2$ of space, and each evergreen tree needs $6\,\text{m}^2$ of space.

The costs of purchasing saplings, labour, fertilisers, etc. are £16 for each deciduous tree and £16 for each evergreen tree, and £20 000 is available to invest.

The nursery can obtain at most 800 deciduous saplings for planting, and at most 1000 evergreen saplings.

When the saplings have grown into trees, the nursery sells the deciduous trees for £25 each, and the evergreen trees for £22 each.

(i) Calculate the profit which will be made from each deciduous tree and from each evergreen tree. **[1]**

The nursery manager wants to find how many trees of each type should be grown so as to maximise the profit.

(ii) Formulate the manager's problem as a linear program, ignoring the fact that the numbers of trees must be integers. **[5]**

(iii) Draw the feasible region for your problem in part (ii), and hence show that the solution to the LP is 800 deciduous trees and $433\frac{1}{3}$ evergreen trees. Give the maximum profit. **[7]**

(iv) How much extra profit would be made for an extra $100\,\text{m}^2$ of land, still allowing for non-integer solutions?

How much extra profit (compared to your answer to part (iii)) would be made for an extra $1000\,\text{m}^2$ of land, still allowing for non-integer solutions? **[2]**

(v) Saplings have to be purchased in bundles of 50 at a time. For the original problem, with $9000\,\text{m}^2$ of land available, find the optimal number of each type of sapling to purchase. **[1]**

5 John wants to generate integers between 0 and 15, each being equally likely. He has a coin available. He constructs a table with headings as shown, and with as many rows as he needs.

8	**4**	**2**	**1**

…

To complete the first row he throws the coin four times, recording the results as a 1 for ‘heads’ or a 0 for ‘tails’ in the four columns of the first row, starting from the right and moving left. For example, if he gets two heads, then a tail and then another head, this will be recorded in the table as 1, 0, 1, 1 (remembering that the order is from the right). He then multiplies the entries in the row by the column headings to get a score. In the example the score is $8 + 2 + 1 = 11$.

So the example has the following result and score:

8	**4**	**2**	**1**	
1	0	1	1	11

…

(i) Explain why this method generates the scores 0 to 15, each with the same probability. **[3]**

John wants to repeat this experiment 64 times. His last 8 coin throws are as follows:

H T T T T H T H

(ii) Compute John’s final two scores. **[2]**

John is trying to simulate a fairground game in which 16 jars are arranged in a square formation, and a ball is repeatedly thrown until it lands in one of them.

00	01	02	03
04	05	06	07
08	09	10	11
12	13	14	15

(The jars have been numbered to help in the rest of this question.)

When John produces a score, that score corresponds to the number of a jar.

(iii) Explain why John’s simulation will not be a good model of reality. **[1]**

John decides instead to use two-digit random numbers to simulate the game. He decides that he will allocate a probability of $\frac{1}{36}$ for a ball to land in each of the corner jars (jars 00, 03, 12 and 15), a probability of $\frac{2}{36}$ for each of the other eight edge jars (jars 01, 02, 04, 07, 08, 11, 13 and 14), and a probability of $\frac{4}{36}$ for each of the other four jars.

(iv) Give a rule for John to use, i.e. specify which jar should be represented by each two-digit random number. **[8]**

(v) Use your rule together with the string of two-digit random numbers in the answer book to simulate two repetitions of the game. **[2]**

6 Pippa owns a garden construction company. She is preparing a quotation for constructing a garden on $1000\,\mathrm{m}^2$ site. Her quotation will need to include an estimate of how long the construction will take.

The tasks, together with limitations on their starting times and durations, are as follows:

A Produce a detailed survey of the site. This must be done before anything else, except that clearing the site can be started at the same time. The surveying will take 1 day.

B Clear the site. This will take 3 days.

C Put forward a plan, debate it and adjust it. This can't be done until the survey is complete. It involves meeting with the client, and will take 3 days.

D Build walls and other fixed features. This cannot be started until the site is cleared and the plan agreed. It will take 3 days.

E Have a specialist contractor install the pond. This cannot be started until the site is cleared and the plan agreed. It will take 5 days.

F Plant the trees. This cannot be started until the walls and other fixed features are completed. It will take 3 days.

G Plant the plants. This cannot be started until the walls and other fixed features are completed. It will take 2 days.

H Install the irrigation. This cannot be started until the trees are planted and the plants are planted. It will take 2 days.

(i) Draw an activity-on-arc precedence network for this project. **[4]**

(ii) Complete a forward pass and a backward pass to determine the minimum completion time and the critical activities, using the durations given above. **[6]**

Activities D and E will be contracted to specialist companies. Pippa plans to complete activities A, B, C, F, G and H herself, but she can employ her friend, Afzal, to do or to help with any of these tasks except for A and C. Each of B, F, G and H can be done by two people, with the total time taken by the two of them being the same as the activity duration.

(iii) The project is to be completed in the shortest time. Produce a schedule to achieve this whilst using as little of Afzal's time as possible. Show who does what and when. Give the minimum completion time and give the total time for which Afzal must be employed. **[5]**

(iv) How long will it take to complete the project if Pippa does not use Afzal at all? **[1]**

END OF QUESTION PAPER

OCR
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Wednesday 14 June 2017 – Morning

AS GCE MATHEMATICS (MEI)

4771/01 Decision Mathematics 1

PRINTED ANSWER BOOK

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- MEI Examination Formulae and Tables (MF2)

Other materials required:
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Duration: 1 hour 30 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

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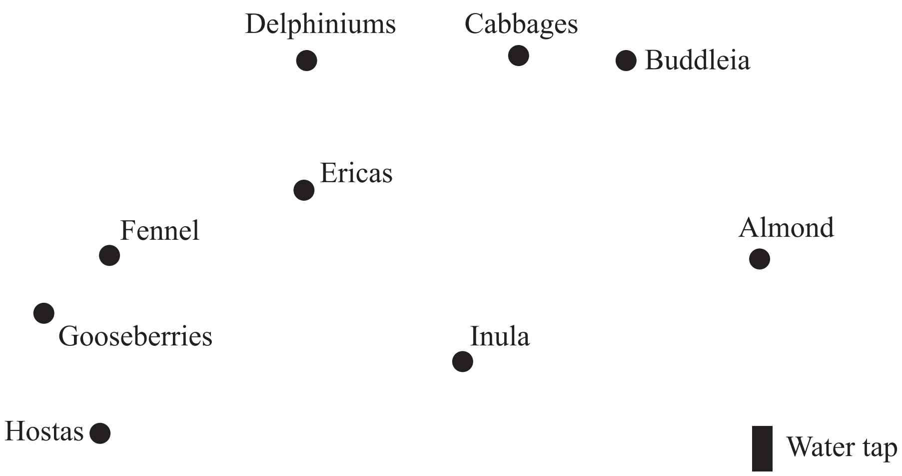
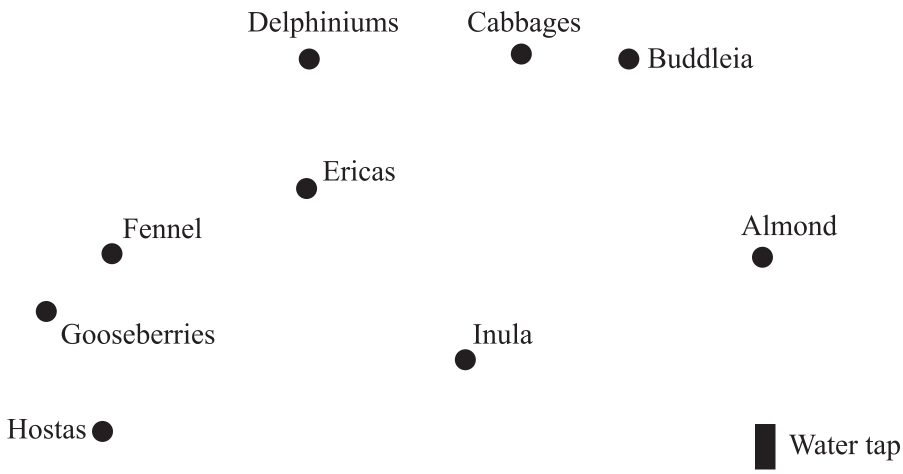
1 (i)

	W	A	B	C	D	E	F	G	H	I
W		10							40	20
A	10		17							
B		17		7						
C			7		12					18
D				12		8				
E					8		14			11
F						14		5		15
G							5		6	
H	40							6		18
I	20			18		11	15		18	

Length of pipe used =



1 (ii)

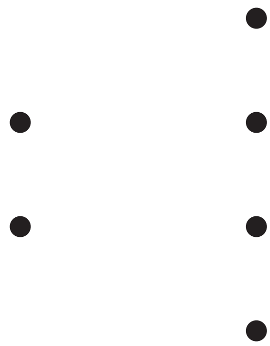


Minimum length of pipe:

Reason:

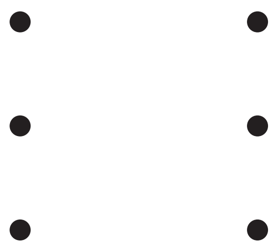
2 (i)	
2 (ii)	
2 (iii)	

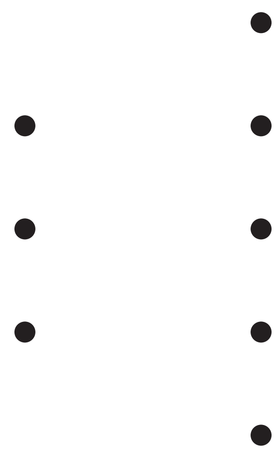
3 (i)



3 (ii)

3 (iii)



3 (iv)	
3 (v)	

Turn over

4 (i)	
4 (ii)	
4 (iii)	A spare copy of this graph can be found on page 11.

(answer space continued on next page)

4 (iii)	continued
4 (iv)	
4 (v)	

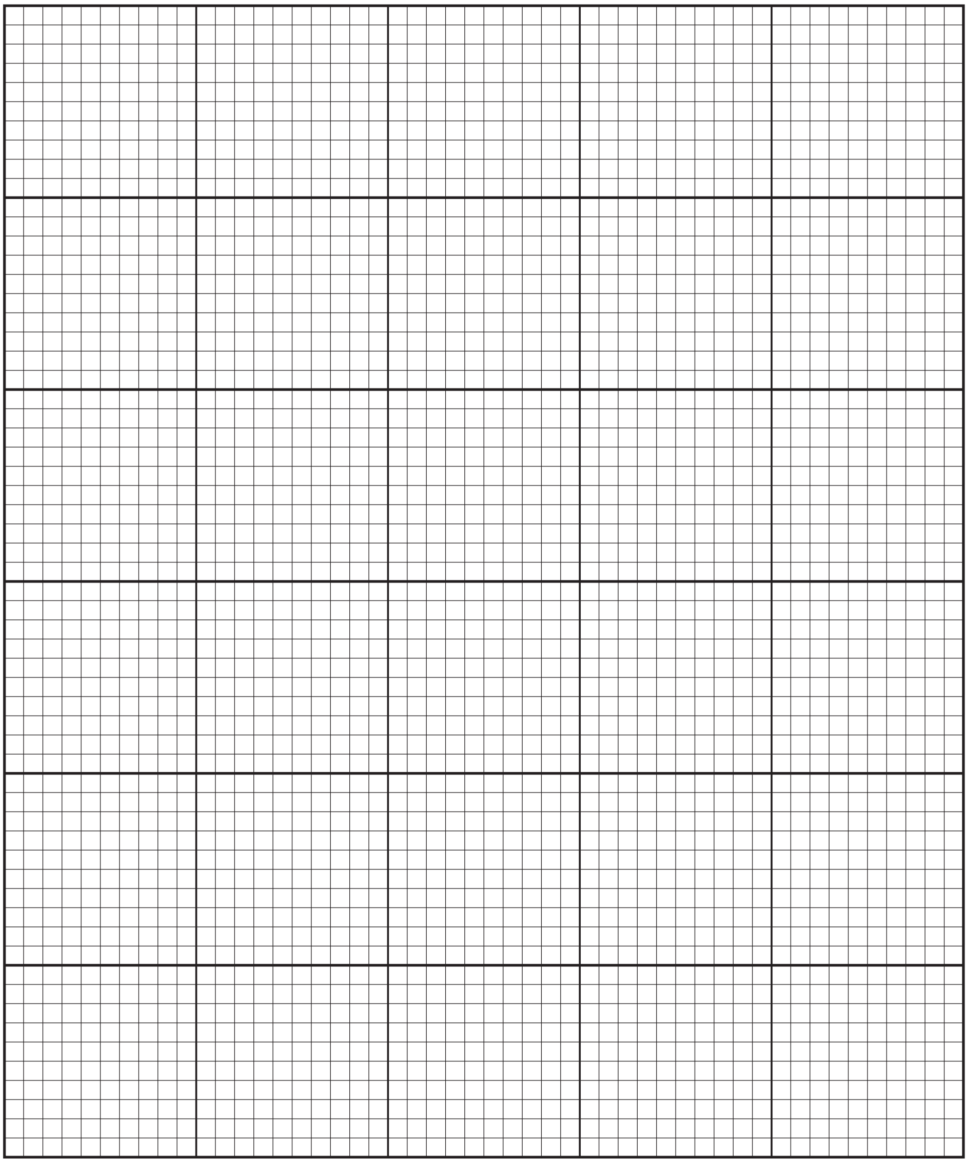
5 (i)	
5 (ii)	
5 (iii)	
5 (iv)	

5 (v)	Two-digit random numbers: 01 99 52 67 23 62 85

6 (i) & (ii)

6 (iii)

6 (iv)

4 (iii)	**Spare copy of graph for question 4(iii)** 

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OCR
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GCE

Mathematics (MEI)

Unit **4771**: Decision Mathematics 1

Advanced Subsidiary GCE

Mark Scheme 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.

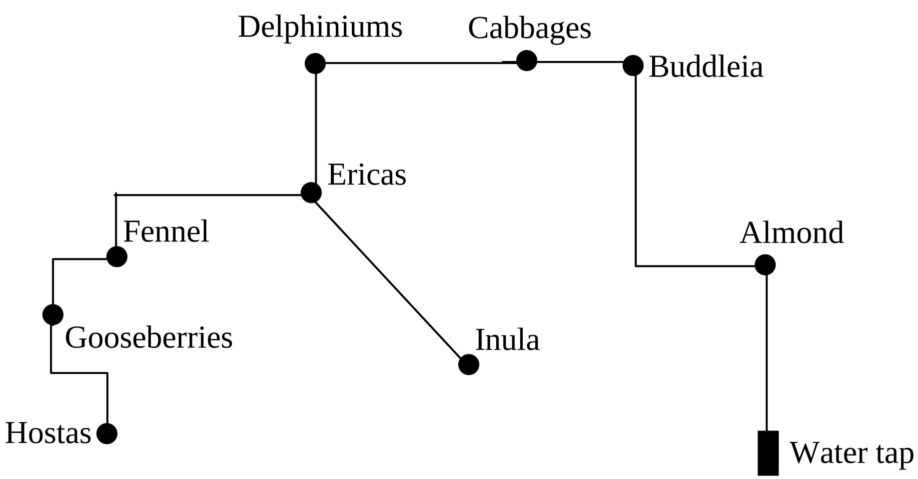
Annotations and abbreviations

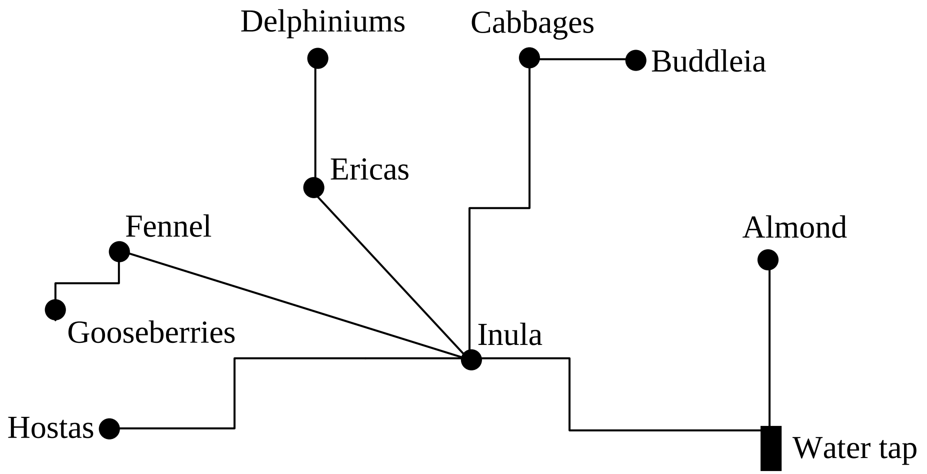
Annotation in scoris	Meaning
✓and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	
Other abbreviations in mark scheme	**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

Question		Answer	Marks	Guidance
1	(i)	(see matrix below)	B1	indicating selections
			B1	deleting in rows
			B1	numbering columns
		Length of pipe used = 90m	B1cao	
		(see diagram below)	B1cao	

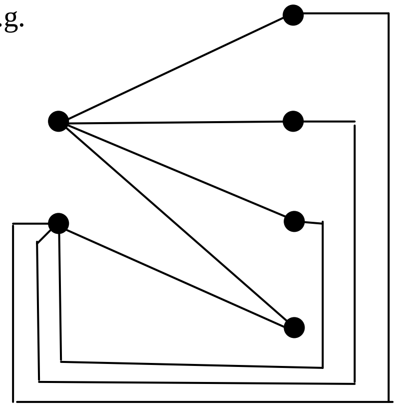
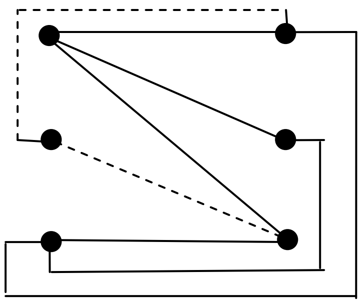
	W1	A2	B3	C4	D5	E6	F8	G9	H	I7
W		10							40	20
A	10		17							
B		17		7						
C			7		12					18
D				12		8				
E					8		14			11
F						14		5		15
G							5		6	
H	40							6		18
I	20			18		11	15		18	

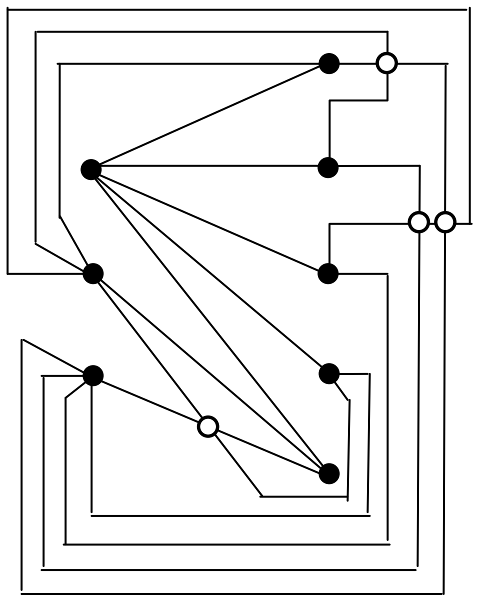
Length of pipe used = 90m

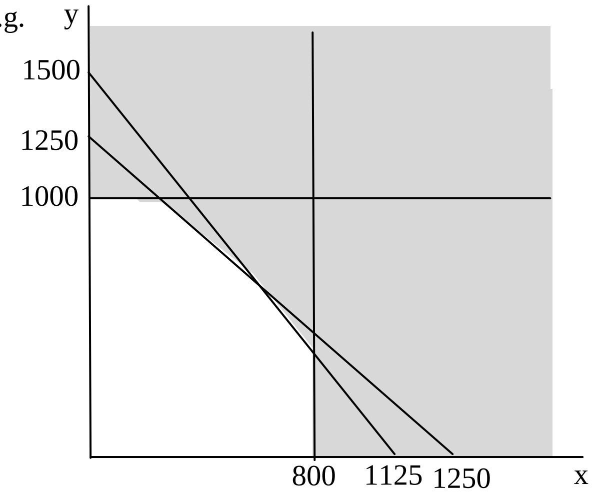


	(ii)			M1	3 out of 4 connections for A, B, D and G correct
			112m Shorter runs, or less exposure to risk.	A1 B1	cao

Question			Answer	Marks	Guidance
2	(i)		P 112 M 250 C (0) 100 110 120 130 131 132 133 134 135 136 137 138 The answer is 138	 B1 M1 A1 B1	 correct to statement 100 (i.e. 130)
	(ii)		e.g. add 34 If P + C + 1000 > M then goto 40 35 Let C = C + 1000 36 Goto 34	 B1 B1 B1	 (ignore "34" and "40") (ignore "35") logic all OK
	(iii)		e.g. P = price, M = money tendered, C = change	B1	No need to consider note denominations instead of powers of 10.

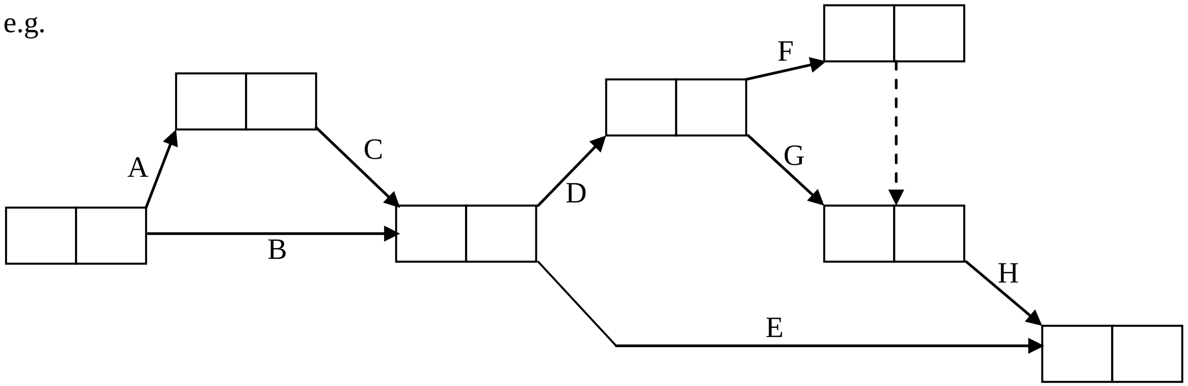
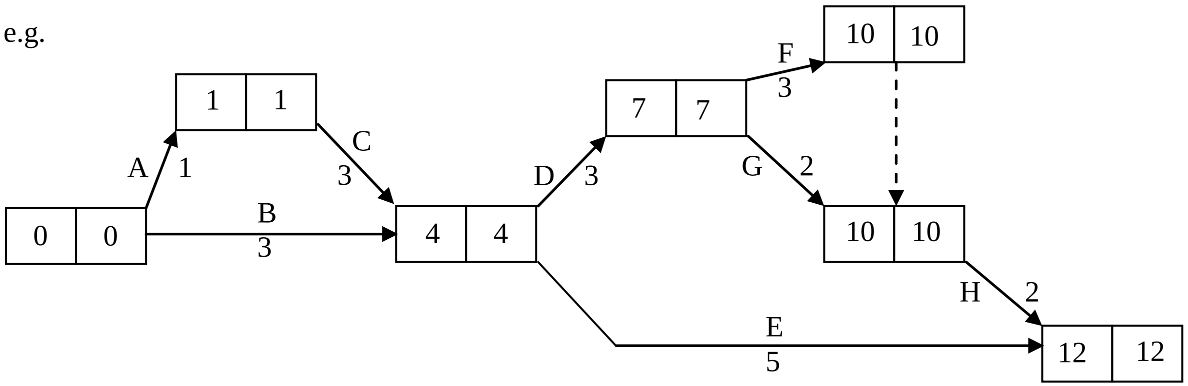
Question			Answer	Marks	Guidance
3	(i)		e.g. 	B1	
	(ii)		e.g. as per the above, with top left connected directly and bottom left connected around the back.	B1	
	(iii)		e.g. 	B1	$K_{2,3}$ seen
			e.g. (Dotted connections not needed.) The middle left cannot access the middle right.	M1 E1	choice of just two points that cannot be connected on the candidate's graph. dependent on the M1

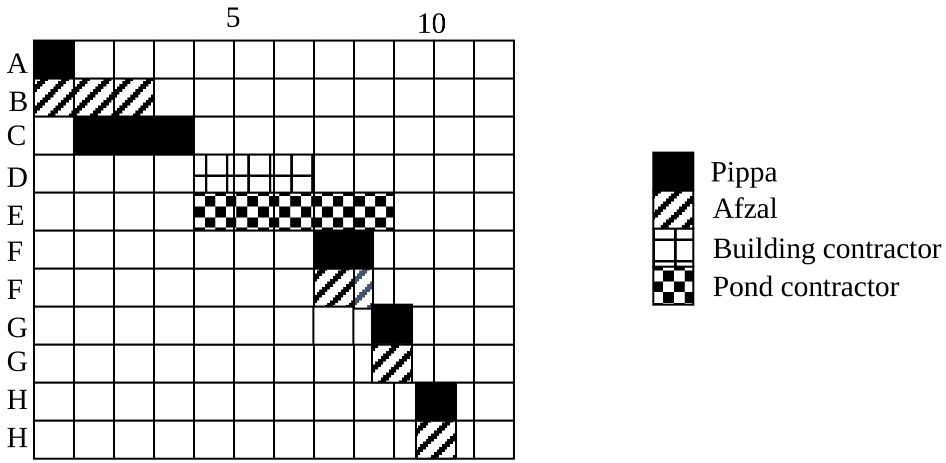
	(iv)		(5-1)×(5-1)/4 = 4 crossings e.g. 	B1 B1	can be implied
	(v)		e.g. They inform about how many layers will be needed.	B1	

Question			Answer	Marks	Guidance
4	(i)		£9 and £6 respectively	B1	
	(ii)		Let x be the number of deciduous trees and y the number of evergreens. Max $9x+6y$ st $8x+6y<9000$ $16x+16y<20000$ $x<800$ $y<1000$	B1 B1 B1 B1 B1	
	(iii)		e.g.  $(800,\ 433\frac{1}{3}) \to 9800$ $\left((800, 0) \to 7200\right)$ $(750, 500) \to 9750$ Profit is £9800	B1 B1 B1 B1 B1 B1 B1	labelling and scaling axes line for space constraint line for finance constraint lines for availability constraints feasible region indicated (with 6 or 5 lines correct) for profit at $(800,\ 433\frac{1}{3})$ and (750, 500) or gradient method with gradient -1.5 9800 indicated
	(iv)		£100 (at (800, 450)) £100 (also at (800, 450))	B1 B1	
	(v)		(750, 500) or 15 and 10 bundles (giving £9750 - but this not required)	B1	

Question			Answer	Marks	Guidance
5	(i)		stating 0000 gives a score of 0 stating 1111 gives a score of 15 all equally likely	B1 B1 B1	or 16 (B1) distinct numbers generated (B1)
	(ii)		1 10	B1 B1	penultimate last SC1 … 8, 5
	(iii)		The ball will not have an equal probability of landing in each jar	B1	
	(iv)		e.g. 00, 01 $\rightarrow$ 00 02, 03 $\rightarrow$ 03 04, 05 $\rightarrow$ 12 06, 07 $\rightarrow$ 15 08 – 11 $\rightarrow$ 01 12 – 15 $\rightarrow$ 02 16 – 19 $\rightarrow$ 04 20 – 23 $\rightarrow$ 07 24 – 27 $\rightarrow$ 08 28 – 31 $\rightarrow$ 11 32 – 35 $\rightarrow$ 13 36 – 39 $\rightarrow$ 14 40 – 47 $\rightarrow$ 05 48 – 55 $\rightarrow$ 06 56 – 63 $\rightarrow$ 09 64 – 71 $\rightarrow$ 10 72 – 99 $\rightarrow$ reject and repeat e.g. corner 00 00-01 2 edge 01 02-05 4 edge 02 06-09 4 corner 03 10-11 2 edge 04 12-15 4 inside 05 16-23 8 inside 06 24-31 8 edge 07 32-35 4 edge 08 36-39 4 inside 09 40-47 8 inside 10 48-55 8 edge 11 56-59 4 corner 12 60-61 2 edge 13 62-65 4 edge 14 66-69 4 corner 15 70-71 2 reject 72-99 28	M1 A1 M1 A1 M1 A1 M1 A1	reject some efficient – numbers stated rule for corner jars rule for edge jars rule for inside jars

	(v)		e.g. Using the above rule(s), the first ball lands in jar 00 (00) and the second in jar 06 (10).	B1 B1	√ subject to last 3 M marks

Question			Answer	Marks	Guidance
6	(i)		e.g.  	M1 A1 A1 A1	activity-on-arc A, B, C D, E Rest
6	(ii)		e.g.  minimum completion time – 12 days critical activities – A, C, D, F, H.	M1 A1 M1 A1 B1 B1	forward pass backward pass

6	(iii)		e.g.  Minimum completion time = 10.5 days Afzal needs to be employed for 6.5 days.	B1 B1 B1 B1 B1	A, B, C D, E F, G, H
6	(iv)		17 days	B1	

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4771 Decision Mathematics 1

General Comments:

There were a number of candidates for this paper who exhibited very poor communication skills. Candidates who did not take the time to read the questions carefully, and who did not express their answers clearly, could not do well on this paper.

Many of the general comments from last year's report resonate with this year's scripts.

There were very significant difficulties with respect to accurate and concise communication which are affecting the quality of the mathematics presented by some candidates.

Having said that, there were cases in which candidates moved from very poor communication in, for instance, the explanation required in 3(ii), to excellent answers to subsequent algorithmic work. Candidates would benefit from more emphasis on the "explain" element, an emphasis which should not be restricted to preparing for examinations in decision mathematics.

Comments on Individual Questions:

Question No.1

Many candidates had difficulties with applying the algorithm in part (i). It was very common to see FI selected at the end instead of FE. This proved to be expensive in terms of marks lost, in considering the context of the question it should be obvious when drawing the network that it is better to connect in F directly to E rather than to I.

A minor mistake, often seen, was to fail to number the columns following the inclusion of nodes.

There were many cases where candidates who made a good attempt at part (i) struggled with part (ii). A common minor error was to connect A to B instead of to W.

The last mark was more difficult. We have been trying to discourage fanciful answers to these interpretational parts, but we still see them. It may well be the case, for instance, that a rare spider is nesting on the direct route from A to C, diverting both arachnophiles and arachnophobes, but no marks will be awarded for supposing thus. The mark is for interpretational work on the maths, and not for creative thinking. In this case the preferred answer was to increase the resilience of the system to pipe bursts.

> [For the probabilists, and certainly not required, if we assume a constant risk of breakage along the entire length of pipe, then the expected number of plants downstream from a burst is $5\frac{1}{15}$ in the answer to (i) and $2\frac{9}{14}$ in the answer to (ii).]

Many candidates offered "shorter pipe runs", and this was accepted as a proxy for the above. Others offered answers rooted in physics such as higher pressures or faster delivery of water, which were ultra vires.

Question 2

Candidates were very good indeed in following this algorithm, but not so good in the mechanics of answering the question. Many answers to part (i) were very long indeed, with much writing, often on several continuation sheets. A table of values does the job quickly and efficiently.

Most candidates scored 2 out of 3 in part (ii) because they did not know the convention of labelling in tens so that other statements can be inserted. Some resorted to writing out a whole new algorithm, incorporating their insertions and still labelling in tens.

A large proportion of candidates were not awarded the mark for part (iii) because they did not answer the question. Some wrote mini essays about proffering money to pay the price and collecting change, but failed to link P to price, M to money and C to change.

Question No. 3

There were many very good answers to this question, except for part (v), and except for candidates who had forgotten about bipartite graphs. In part (iii) the instruction to start from $K_{2,3}$ was helpful, and most candidates who did that were able to put together a convincing argument, which was pleasing.

The drawing required in part (iv) was intricate, and it was pleasing to see so many good attempts.

In contrast very few creditable answers were seen to part (v). This question did not require an extensive knowledge of electronics, there was enough in the question to deduce what was needed. If it can't be done in the plane then either go into 3-D (layers) or insulate your crossings – which is the same thing really. Instead most candidates accepted planarity as a constraint, and wrote about what could not be connected together on a (printed) circuit board.

Question No. 4

The LP was really well done, particularly the graph. Candidates did well in extracting the information from the text, although there were one or two "pinch points".

Part (i) was meant as a helpful hint, but in the event there were many candidates who correctly computed £9 and £6 for the profits in part (i) and then proceeded to use a profit function of 25x + 22y in the rest of the question.

Some candidates failed to label their axes. A few used non-uniform scales and a few used poor scales, e.g. 2cm representing 300. A few did not include the origin, using instead a false origin - but they invariably incorrectly used their lower and left boundary lines as if they were axes. A few failed accurately to compute $6 \times 433\frac{1}{3}$. However, in general, the graphical work was done with great competence.

The interpretational work in (iv) and (v) was challenging, and it was pleasing to see some good answers.

Question No. 5

The quality of answers to part (i) was mixed. We looked for 0000 and for 1111, and for a recognition that the equal probabilities for a head and a tail on the coin tossing leads, via the binary count, to an equal probability for each possible number. For instance, identifying 2^4 outcomes and 16 numbers earned the mark.
Despite the range of 0 to 15 being given in the question, quite a few candidates started counting at 1, often referring to probabilities of 1/15 in their explanations.

The modelling question in part (iii) prompted some essays and some misdirected consideration of the differences between game participants. All that was needed was the observation that the probability of a ball ending in a bottle depends on the bottle.

Some candidates failed to read "repeatedly thrown until …" in the question, including "miss" as a possibility in their modelling.

Many candidates seemed to think that “50-50” is a synonym for “of equal probability” in all contexts.

Most candidates handled part (iv) with aplomb, which was very pleasing. A small but significant number tried to answer a more interesting but more difficult question, to simulate whether a ball ends up in a corner bottle, an edge bottle or an inner bottle. It is more difficult because the probabilities have to be computed first from the information in the question. They are 1, 4 and 4 ninths respectively. Credit was allowed for those that did that.

Question No. 6

CPA modelling revolves around producing an activity graph, and that was tested in this question. That necessarily means that there have to be descriptions of the activities, and how they relate to each other. To compensate for this reading burden, the question was arranged so that the resulting graph was as simple as possible, within the constraints of testing the need for dummy activities, et al.

Candidates handled this well in parts (i) and (ii) of the question although, as always, some failed to give the duration and/or critical activities in part (ii).

The following stem, together with parts (iii) and (iv) proved to be a step too far for most candidates. Scheduling is always difficult but very many candidates struggled to demonstrate that they understood what was needed or how to present it. The mark scheme has a row for each task, with shading showing when and who attends to it. It is just as acceptable to have a row for each person, showing when and what they do.

Of course, the problem is that this is not tackled algorithmically, but rather by finding those combinations which use resources most efficiently, and that is not an easy task.

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Unit level raw mark and UMS grade boundaries June 2017 series

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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 (AS)	Raw	72	63	58	53	49	45	0
			UMS	100	80	70	60	50	40	0
4752	01	C2 – MEI Concepts for advanced mathematics (AS)	Raw	72	55	49	44	39	34	0
			UMS	100	80	70	60	50	40	0
4753	01	(C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	54	49	45	41	36	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
			UMS	100	80	70	60	50	40	0
4754	01	C4 – MEI Applications of advanced mathematics (A2)	Raw	90	67	61	55	49	43	0
			UMS	100	80	70	60	50	40	0
4755	01	FP1 – MEI Further concepts for advanced mathematics (AS)	Raw	72	57	52	47	42	38	0
			UMS	100	80	70	60	50	40	0
4756	01	FP2 – MEI Further methods for advanced mathematics (A2)	Raw	72	65	58	52	46	40	0
			UMS	100	80	70	60	50	40	0
4757	01	FP3 – MEI Further applications of advanced mathematics (A2)	Raw	72	64	56	48	41	34	0
			UMS	100	80	70	60	50	40	0
4758	01	(DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	63	56	50	44	37	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
			UMS	100	80	70	60	50	40	0
4761	01	M1 – MEI Mechanics 1 (AS)	Raw	72	57	49	41	34	27	0
			UMS	100	80	70	60	50	40	0
4762	01	M2 – MEI Mechanics 2 (A2)	Raw	72	56	48	41	34	27	0
			UMS	100	80	70	60	50	40	0
4763	01	M3 – MEI Mechanics 3 (A2)	Raw	72	58	50	43	36	29	0
			UMS	100	80	70	60	50	40	0
4764	01	M4 – MEI Mechanics 4 (A2)	Raw	72	53	45	38	31	24	0
			UMS	100	80	70	60	50	40	0
4766	01	S1 – MEI Statistics 1 (AS)	Raw	72	61	55	49	43	37	0
			UMS	100	80	70	60	50	40	0
4767	01	S2 – MEI Statistics 2 (A2)	Raw	72	56	50	45	40	35	0
			UMS	100	80	70	60	50	40	0
4768	01	S3 – MEI Statistics 3 (A2)	Raw	72	63	57	51	46	41	0
			UMS	100	80	70	60	50	40	0
4769	01	S4 – MEI Statistics 4 (A2)	Raw	72	56	49	42	35	28	0
			UMS	100	80	70	60	50	40	0
4771	01	D1 – MEI Decision mathematics 1 (AS)	Raw	72	52	46	41	36	31	0
			UMS	100	80	70	60	50	40	0
4772	01	D2 – MEI Decision mathematics 2 (A2)	Raw	72	53	48	43	39	35	0
			UMS	100	80	70	60	50	40	0
4773	01	DC – MEI Decision mathematics computation (A2)	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	58	53	48	43	37	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
			UMS	100	80	70	60	50	40	0
4777	01	NC – MEI Numerical computation (A2)	Raw	72	55	48	41	34	27	0

		UMS	100	80	70	60	50	[illegible]	[illegible]
4798	01 FPT - Further pure mathematics with technology (A2)	Raw	72	57	49	41	33	26	[illegible]
		UMS	100	80	70	60	50	40	[illegible]

GCE Statistics (MEI)

			Max Mark	a	b	c	d	e	u
G241	01 Statistics 1 MEI (Z1)	Raw	72	61	55	49	43	37	0
		UMS	100	80	70	60	50	40	0
G242	01 Statistics 2 MEI (Z2)	Raw	72	55	48	41	34	27	0
		UMS	100	80	70	60	50	40	0
G243	01 Statistics 3 MEI (Z3)	Raw	72	56	48	41	34	27	0
		UMS	100	80	70	60	50	40	0

GCE Quantitative Methods (MEI)

			Max Mark	a	b	c	d	e	u
G244	01 Introduction to Quantitative Methods MEI	Raw	72	58	50	43	36	28	0
G244	02 Introduction to Quantitative Methods MEI	Raw	18	14	12	10	8	7	0
		UMS	100	80	70	60	50	40	0
G245	01 Statistics 1 MEI	Raw	72	61	55	49	43	37	0
		UMS	100	80	70	60	50	40	0
G246	01 Decision 1 MEI	Raw	72	52	46	41	36	31	0
		UMS	100	80	70	60	50	40	0

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Level 3 Certificate and FSMQ raw mark grade boundaries June 2017 series

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Level 3 Certificate Mathematics for Engineering

			Max Mark	a*	a	b	c	d	e	u
H860	01 Mathematics for Engineering		This unit has no entries in June 2017							
H860	02 Mathematics for Engineering									

Level 3 Certificate Mathematical Techniques and Applications for Engineers

			Max Mark	a*	a	b	c	d	e	u
H865	01 Component 1	Raw	60	48	42	36	30	24	18	0

Level 3 Certificate Mathematics - Quantitative Reasoning (MEI) (GQ Reform)

			Max Mark	a	b	c	d	e	u
H866	01 Introduction to quantitative reasoning	Raw	72	54	47	40	34	28	0
H866	02 Critical maths	Raw	60*	48	42	36	30	24	0
	*Component 02 is weighted to give marks out of 72	Overall	144	112	97	83	70	57	0

Level 3 Certificate Mathematics - Quantitive Problem Solving (MEI) (GQ Reform)

			Max Mark	a	b	c	d	e	u
H867	01 Introduction to quantitative reasoning	Raw	72	54	47	40	34	28	0
H867	02 Statistical problem solving	Raw	60*	41	36	31	27	23	0
	*Component 02 is weighted to give marks out of 72	Overall	144	103	90	77	66	56	0

Advanced Free Standing Mathematics Qualification (FSMQ)

			Max Mark	a	b	c	d	e	u
6993	01 Additional Mathematics	Raw	100	72	63	55	47	39	0

Intermediate Free Standing Mathematics Qualification (FSMQ)

			Max Mark	a	b	c	d	e	u
6989	01 Foundations of Advanced Mathematics (MEI)	Raw	40	35	30	25	20	16	0